# Texas Commission on Environmental Quality

## Permit or Registration Application for Municipal Solid Waste Facility

### Part I

**A. General Information**

| | | | | |
|---|---|---|---|---|
| Facility Name: | McCombs Municipal Landfill | | | |
| Physical or Street Address (if available): | 13660 McCombs | | | |
| (City) (County)( State)( Zip Code): | El Paso | El Paso | TX | 79924 |
| (Area Code) Telephone Number: | 915-621-6700 | | | |
| Charter Number: | | | | |

If the application is submitted on behalf of a corporation, provide the Charter Number as recorded with the Office of the Secretary of State for Texas.

| | | | | |
|---|---|---|---|---|
| Operator Name[1]: | City of El Paso | | | |
| Mailing Address: | 7968 San Paulo Dr. | | | |
| (City) (County)( State)( Zip Code): | El Paso | El Paso | TX | 79907 |
| (Area Code) Telephone Number: | 915-621-6700 | | | |
| (Area Code) FAX Number: | 915-621-6711 | | | |
| Charter Number: | | | | |

If the permittee is the same as the operator, type "Same as Operator".

| | | | | |
|---|---|---|---|---|
| Permittee Name: | Same as Operator | | | |
| Physical or Street Address (if available): | | | | |
| (City) (County)( State)( Zip Code): | | | TX | |
| (Area Code) Telephone Number: | | | | |
| Charter Number: | | | | |

If the application is submitted by a corporation or by a person residing out of state, the applicant must register an Agent in Service or Agent of Service with the Texas Secretary of State's office and provide a complete mailing address for the agent. The agent must be a Texas resident.

| | | | | |
|---|---|---|---|---|
| Agent Name: | | | | |
| Mailing Address: | | | | |
| (City) (County)( State)( Zip Code): | | | | |
| (Area Code) Telephone Number: | | | | |
| (Area Code) FAX Number: | | | | |

Application Type:

| | | | | | |
|---|---|---|---|---|---|
| ☐ | Permit | ☒ | Major Amendment | ☐ | Minor Amendment |
| ☐ | Registration | ☐ | Modification | ☐ | Temporary Authorization |
| | | ☒ | w/Public Notice | | |
| | | ☐ | w/out Public Notice | ☐ | Notice of Deficiency Response |

[1] The operator has the duty to submit an application if the facility is owned by one person and operated by another [30 TAC 305.43(b)]. The permit will specify the operator and the owner who is listed on this application [Section 361.087 Texas Health and Safety Code].

Facility Classification:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ☒ | Type I | ☐ | Type IV | ☐ | Type V | ☐ | Type IX |
| ☐ | Type I AE | ☐ | Type IV AE | ☐ | Type VI | | |

Activities covered by this application (check all that apply):

| | | | | | |
|---|---|---|---|---|---|
| ☐ | Storage | ☐ | Processing | ☒ | Disposal |

Waste management units covered by this application (check all that apply):

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ☐ | Containers | ☐ | Tanks | ☐ | Surface Impoundments | ☒ | Landfills |
| ☐ | Incinerators | ☐ | Composting | ☐ | Type IV Demonstration Unit | ☐ | Type IX Energy/Material Recovery |
| ☐ | Other (Specify) | | | ☐ | Other (Specify) | | |
| ☐ | Other (Specify) | | | ☐ | Other (Specify) | | |

Is this submittal part of a Consolidated Permit Processing request, in accordance with 30 TAC Chapter 33?

☐ Yes ☒ No

**If yes**, state the other TCEQ program authorizations requested.

Provide a brief description of the portion of the facility covered by this application. For amendments, modifications, and temporary authorizations, provide a brief description of the exact changes to the permit or registration conditions and supporting documents referenced by the permit or registration. Also, provide an explanation of why the amendment, modification, or temporary authorization is requested.

This Major Permit Amendment application is for a vertical expansion to the existing McCombs Landfill owned and operated by the City of El Paso as well as a property size increase to 347-acres to account for the site entrance facilities. It should be noted that there is not an increase to the waste boundary. This amendment is requested to allow the City of El Paso to have adequate capacity for future solid waste disposal needs.

Does the application contain confidential Material? ☐ Yes ☒ No

If yes, cross-reference the confidential material *throughout the application* and submit as a separate document or binder conspicuously marked "CONFIDENTIAL."

Alternative Language Notice Instructions

For certain permit applications, public notice in an alternate language is required. If an elementary school or middle school nearest to the facility offers a bilingual program, notice may be required to be published in an alternative language. The Texas Education Code, upon which the TCEQ alternative language notice requirements are based, trigger a bilingual education program to apply to an entire school district should the requisite alternative language speaking student population exist. However, there may not exist any bilingual students at a particular school within a district which is required to offer the bilingual education program. For this reason, the requirement to publish notice in an alternative language is triggered if the nearest elementary or middle school, as a part of a larger school district, is required to make a bilingual education program available to qualifying students and either the school has students enrolled at such a program on-site, or has students who attend such a program at another location in satisfaction of the school's obligation to provide such a program as a member of a triggered district.

If it is determined that an alternative language notice is required, the applicant is responsible for ensuring that the publication in the alternate language is complete and accurate in that language. Electronic versions of the Spanish template examples are available from the TCEQ to help the applicant complete

the publication in the alternative language.

Alternative Language Notice Application Form:

Alternative language notice confirmation for this application:

1. Is a bilingual program required by the Texas Education Code in the school district where the facility is located? ☒ YES ☐ NO

   (If NO, alternative language notice publication not required)

2. If YES to question 1, are students enrolled in a bilingual education program at either the elementary school or the middle school nearest to the facility? ☒ YES ☐ NO

(IF YES to questions 1 and 2, alternative language publication is required; If NO to question 2, then consider the next question)

3. If YES to question 1, are there students enrolled at either the elementary school or the middle school nearest to the facility who attend a bilingual education program at another location? ☐ YES ☐ NO

(If Yes to questions 1 and 3, alternative language publication is required; If NO to question 3, then consider the next question)

4. If YES to question 1, would either the elementary school or the middle school nearest to the facility be required to provide a bilingual education program but for the fact that it secured a waiver from this requirement, as available under 19 TAC '89.1205(g)?
   ☐ YES ☐ NO

(If Yes to questions 1 and 4, alternative language publication is required; If NO to question 4, alternative language notice publication not required)

If a bilingual education program(s) is provided by either the elementary school or the middle school nearest to the facility, which language(s) is required by the bilingual program?

Note: Applicants for new permits and major amendments must make a copy of the administratively complete application available at a public place in the county where the facility is, or will be, located for review and copying by the public.

| Public place where administratively complete permit application will be located. | | | | |
|---|---|---|---|---|
| Public Place (e.g., public library, county court house, city hall, etc.): | El Paso Municipal Service Center (MSC) | | | |
| Mailing Address: | 7968 San Paulo Dr. | | | |
| (City) (County)( State)( Zip Code): | El Paso | El Paso | TX | 79907 |
| (Area Code) Telephone Number: | 915-621-6700 | | | |

## B. Facility Location

| Except for Type I AE and Type IV AE landfill facilities, for permits, registrations, amendments, and modifications requiring public notice, provide the URL address of a publicly accessible internet web site where the application and all revisions to that application will be posted. |
|---|
| http://home.elpasotexas.gov/environmental-services/landfill.php |

| | |
|---|---|
| Local Government Jurisdiction: | City of El Paso |
| Within City Limits of: | City of El Paso |
| Within Extraterritorial Jurisdiction of City of: | |
| Is the proposed municipal or industrial solid waste disposal or processing facility located in an area in which the governing body of the municipality or county has prohibited the disposal or processing of municipal or industrial solid waste? (If YES, provide a copy of the ordinance or order): | |
| ☐ YES ☒ NO | |

| Provide a description of the location of the facility with respect to known or easily identifiable landmarks. |
|---|
| Northeast of the intersection of McCombs Road and Stan Roberts Road (FM 2529) in El Paso, Texas. |

| Detail the access routes from the nearest United States or state highway to the facility. |
|---|
| 4.4 miles west on McCombs Road from US 54 North |

Provide the latitudinal and longitudinal geographic coordinates of the facility.

| | |
|---|---|
| Latitude | **N 31 deg. 59' 15"** |
| Longitude | **W 106 deg. 24' 19"** |
| Elevation (above msl) | Approximately 4070' near existing entrance |

| | |
|---|---|
| Is the facility within the Coastal Management Program boundary? | ☐ Yes ☒ No |

Texas Department of Transportation District Location:

| | | | | |
|---|---|---|---|---|
| TXDOT District Name & Number: | El Paso | | | |
| District Engineer's Name: | Robert Bielek, DPA, P.E. | | | |
| Street or P. O. Box: | 13301 Gateway West | | | |
| (City) (County)( State)( Zip Code): | El Paso | El Paso | TX | 79928 |
| (Area Code) Telephone Number: | 915-790-4203 | | | |
| (Area Code) FAX Number: | 915-790-4311 | | | |

The local governmental authority or agency responsible for road maintenance:

| | | | | |
|---|---|---|---|---|
| Agency Name | Department of Transportation, City of El Paso | | | |
| Contact Person's Name: | Ted Marquez (Interim Engineer) | | | |
| Street or P. O. Box: | 7968 San Paulo Drive | | | |
| (City) (County)( State)( Zip Code): | El Paso | El Paso | TX | 79907 |
| (Area Code) Telephone Number: | 915-621-6750 | | | |
| (Area Code) FAX Number: | 915-621-6772 | | | |

State Representative:

| | | | | |
|---|---|---|---|---|
| District Number: | 79 | | | |
| State Representative's Name: | Representative Joe C. Pickett | | | |
| District Office Address: | 1790 Lee Trevino #307 | | | |
| (City) (County)( State)( Zip Code): | El Paso | El Paso | TX | 79936 |
| (Area Code) Telephone Number: | 915-590-4349 | | | |
| (Area Code) FAX Number: | 915-590-4726 | | | |

State Senator:

| | | | | |
|---|---|---|---|---|
| District Number: | 29 | | | |
| State Senator's Name: | Senator José Rodríguez | | | |
| District Office Address: | 100 N. Ochoa, Suite A | | | |
| (City) (County)( State)( Zip Code): | El Paso | El Paso | TX | 79901 |
| (Area Code) Telephone Number: | 915-351-3500 | | | |
| (Area Code) FAX Number: | 915-351-3579 | | | |

Council of Government (COG) Information:

| | | | | |
|---|---|---|---|---|
| COG Name: | Rio Grande Council of Governments | | | |
| COG Representative's Name: | Annette Gutierrez | | | |
| COG Representative's Title: | Executive Director | | | |
| Street or P. O. Box: | 1100 N. Stanton Street, Suite 610 | | | |
| (City) (County)( State)( Zip Code): | El Paso | El Paso | TX | 79902 |
| (Area Code) Telephone Number: | 915-533-0998 | | | |
| (Area Code) FAX Number: | 915-532-9385 | | | |

River Basin Information:

| | | | | |
|---|---|---|---|---|
| River Authority: | International Boundary Water Commission | | | |
| Contact Person's Name: | Commissioner Edward Drusina | | | |
| Watershed Sub-Basin Name: | Rio Grande | | | |
| Street or P. O. Box: | 4171 N. Mesa Street, Suite C-100 | | | |
| (City) (County)( State)( Zip Code): | El Paso | El Paso | TX | 79902 |
| (Area Code) Telephone Number: | 915-832-4101 | | | |
| (Area Code) FAX Number: | 915-832-4166 | | | |

| This site is located in the following District of the U.S. Army Corps of Engineers: | | | |
|---|---|---|---|
| ☒ Albuquerque, NM | ☐ Ft. Worth, TX | ☐ Galveston, TX | ☐ Tulsa, OK |

## C. Maps

General **(See Part I – Section 1.3)**

For permits, registrations, and amendments only, submit a topographic map, ownership map, county highway map, or a map prepared by a registered professional engineer or a registered surveyor which shows the facility and each of its intake and discharge structures and any other structure or location regarding the regulated facility and associated activities. Maps must be of material suitable for a permanent record, and shall be on sheets 8-1/2 inches by 14 inches or folded to that size, and shall be on a scale of not less than one inch equals one mile. The map shall depict the approximate boundaries of the tract of land owned or to be used by the applicant and shall extend at least one mile beyond the tract boundaries sufficient to show the following:

each well, spring, and surface water body or other water in the state within the map area;

the general character of the areas adjacent to the facility, including public roads, towns and the nature of development of adjacent lands such as residential, commercial, agricultural, recreational, undeveloped, etc;

the location of any waste disposal activities conducted on the tract not included in the application; and

the ownership of tracts of land adjacent to the facility and within a reasonable distance from the proposed point or points of discharge, deposit, injection, or other place of disposal or activity.

General location maps **(See Part I – Section 1.3)**

For permits, registrations, and amendments only, submit at least one general location map at a scale of one-half inch equals one mile. This map shall be all or a portion of a county map prepared by Texas Department of Transportation (TxDOT). If TxDOT publishes more detailed maps of the proposed facility area, the more detailed maps shall also be included in Part I. Use the latest revision of all maps.

Land ownership map **(See Part I – Section 1.3)**

Provide a map that locates the property owned by adjacent and potentially affected landowners. The maps should show all property ownership within 1/4 mile of the facility, on-site facility easement holders, and all mineral interest ownership under the facility.

Landowners list **(See Part I – Section 1.3)**

Provide the adjacent and potentially affected landowners' list, keyed to the land ownership map with each property owner's name and mailing address. The list shall include all property owners within 1/4 mile of the facility, easement holders, and all mineral interest ownership under the facility. Provide the property, easement holders', and mineral interest owners' names and mailing addresses derived from the real property appraisal records as listed on the date that the application is filed. Provide the list in electronic form, as well.

## D. Property owner information

For permits, registrations, amendments, and modifications that change the legal description, a change in owner, or a change in operator only, provide the following:

(1) the legal description of the facility; **(See Part I – Section 1.4)**

- (A) the abstract number as maintained by the Texas General Land Office for the surveyed tract of land;
- (B) the legal description of the property and the county, book, and page number or other generally accepted identifying reference of the current ownership record;
- (C) for property that is platted, the county, book, and page number or other generally accepted identifying reference of the final plat record that includes the acreage encompassed in the application and a copy of the final plat, in addition to a written legal description;
- (D) a boundary metes and bounds description of the facility signed and sealed by a registered professional land surveyor;
- (E) on-site easements at the facility, and
- (F) drawings of the boundary metes and bounds description; and

(2) a property owner affidavit signed by the owner. **(See Part 9 of Part 1 Form 0650)**

## E. Legal authority

Provide verification of the legal status of the owner and operator, such as a one-page certificate of incorporation issued by the secretary of state. List all persons having over a 20% ownership in the proposed facility. **(See Part I – Section 1.5)**

| Indicate Ownership status of the facility: | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ☐ | Private | ☐ | Corporation | ☐ | Partnership | ☐ | Proprietorship | ☐ | Non-Profit Organization |
| ☐ | Public | ☐ | Federal | ☐ | Military | ☐ | State | ☐ | Regional |
| ☐ | County | ☒ | Municipal | ☐ | Other (Specify) | | | | |

| Does the operator own the facility units and the facility property? | ☒ Yes ☐ No |
|---|---|

| If "No," for permits, registrations, amendments, and modifications that changes the legal description, a change in owner, or a change in operators submit a copy of the lease for the use of or the option to buy the facility units or facility property, as appropriate, and identify: | |
|---|---|
| Owner Name: | |
| Street or P. O. Box: | |
| (City) (County)( State)( Zip Code): | |
| (Area Code) Telephone Number: | |
| (Area Code) FAX Number: | |
| Charter Number: | |

## F. Evidence of competency

| For permits, registrations, amendments, and modifications that change the legal description, a change in owner, or a change in operators submit a list of all Texas solid waste sites that the owner and operator have owned or operated within the last ten years. | | | | |
|---|---|---|---|---|
| Site Name | Site Type | Permit/Reg. No. | County | Dates of Operation |
| **See Part I – Section 1.6** | | | | |

| Submit a list of all solid waste sites in all states, territories, or countries in which the owner and operator have a direct financial interest. | | | |
|---|---|---|---|
| Site Name | Location | Dates of Operation | Regulatory Agency (Name & Address) |
| **See Part I – Section 1.6** | | | |

A licensed solid waste facility supervisor, as defined in 30 TAC Chapter 30, Occupational Licenses and Registrations will be employed before commencing facility operation.

| Provide the names of the principals and supervisors of the owner's and operator's organization, together with previous affiliations with other organizations engaged in solid waste activities. | | |
|---|---|---|
| Name | Previous Affiliation | Other Organization |
| **See Part I – Section 1.6** | | |

For landfill permit applications only, evidence of competency to operate the facility shall also include landfilling and earthmoving experience if applicable, and other pertinent experience, or licenses as described in 30 TAC Chapter 30 possessed by key personnel. The number and size of each type of equipment to be dedicated to facility operation will be specified in greater detail on Part IV of the application within the site operating plan.

| Landfilling/Earthmoving Equipment Types | Personnel Experience or Licenses |
|---|---|
| **See Part I – Section 1.6** | |
| | |
| | |

For mobile liquid waste processing units, submit a list of all solid waste, liquid waste, or mobile waste units that the owner and operator have owned or operated within the past five years. Submit a list of any final enforcement orders, court judgments, consent decrees, and criminal convictions of this state and the federal government within the last five years relating to compliance with applicable legal requirements relating to the handling of solid or liquid waste under the jurisdiction of the commission or the United States Environmental Protection Agency. Applicable legal requirement means an environmental law, regulation, permit, order, consent decree, or other requirement.

| Solid waste, liquid waste, or mobile waste units owned or operated within past 5 years | Texas and federal final enforcement orders, court judgments, consent decrees, and criminal convictions |
|---|---|
| **Not Applicable** | |
| | |
| | |

## G. Appointments

Provide documentation that the person signing the application meets the requirements of 30 TAC §305.44, Signatories to Applications. If the authority has been delegated, provide a copy of the document issued by the governing body of the owner or operator authorizing the person that signed the application to act as agent for the owner or operator. **(See Part I – Section 1.7)**

## H. Application Fees

For a new permit, registration, amendment, modification, or temporary authorization, submit a $150 application fee. **(See Part I – Section 1.8)**

For authorization to construct an enclosed structure over an old, closed municipal solid waste landfill in accordance with 30 TAC 330 Subchapter T, submit a $2,500 application fee.

If paying by check, send payment to:

Texas Commission on Environmental Quality
Financial Administration Division, MC 214
P. O. Box 13087
Austin, Texas 78711-3087

| Payment maybe made online using TCEQ e-pay at www.tceq.state.tx.us/e-services/ | |
|---|---|
| E-pay confirmation number | 582EA000111781 |

**PROPERTY OWNER AFFIDAVIT**

"I, KURT FENSTERMACHER,
(property owner)
acknowledge that the State of Texas may hold me either jointly or severally responsible for the operation, maintenance, and closure and post-closure care of the facility. For a facility where waste will remain after closure, I acknowledge that I have a responsibility to file with the county deed records an affidavit to the public advising that the land will be used for a solid waste facility prior to the time that the facility actually begins operating as a municipal solid waste landfill facility, and to file a final recording upon completion of disposal operations and closure of the landfill units in accordance with Title 30 Texas Administrative Code §330.19, Deed Recordation. I further acknowledge that I or the operator and the State of Texas shall have access to the property during the active life and post-closure care period, if required, after closure for the purpose of inspection and maintenance."

(Owner signature) 5/29/13 (Date)

**Signature Page**

I, KURT FENSTERMACHER (Operator), INTERIM DIRECTOR (Title),

certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature: Kurt Fenstermacher Date: 5/29/13

---

TO BE COMPLETED BY THE OPERATOR IF THE APPLICATION IS SIGNED BY AN AUTHORIZED REPRESENTATIVE FOR THE OPERATOR

I, _____ (Print or Type Operator Name), hereby designate _____ (Print or Type Representative Name)

as my representative and hereby authorize said representative to sign any application, submit additional information as may be requested by the Commission; and/or appear for me at any hearing or before the Texas Commission on Environmental Quality in conjunction with this request for a Texas Water Code or Texas Solid Waste Disposal Act permit. I further understand that I am responsible for the contents of this application, for oral statements given by my authorized representative in support of the application, and for compliance with the terms and conditions of any permit which might be issued based upon this application.

_____
Printed or Typed Name of Operator or Principal Executive Officer

_____
Signature

---

SUBSCRIBED AND SWORN to before me by the said Kurt Fenstermacher

On this 29th day of May, 2013

My commission expires on the 14th day of August, 2013

ASTRID L BUNNER
NOTARY PUBLIC
State of Texas
Comm. Exp. 08-14-2013

Astrid L Bunner
Notary Public in and for

El Paso County, Texas

(Note: Application Must Bear Signature & Seal of Notary Public)

## PROPERTY OWNER AFFIDAVIT

"I, Kurt Fenstermacher,
(property owner)
acknowledge that the State of Texas may hold me either jointly or severally responsible for the operation, maintenance, and closure and post-closure care of the facility. For a facility where waste will remain after closure, I acknowledge that I have a responsibility to file with the county deed records an affidavit to the public advising that the land will be used for a solid waste facility prior to the time that the facility actually begins operating as a municipal solid waste landfill facility, and to file a final recording upon completion of disposal operations and closure of the landfill units in accordance with Title 30 Texas Administrative Code §330.19, Deed Recordation. I further acknowledge that I or the operator and the State of Texas shall have access to the property during the active life and post-closure care period, if required, after closure for the purpose of inspection and maintenance."

Kurt Fenstermacher
(Owner signature)

3/13/13
(Date)

**Signature Page**

I, Kurt Fenstermacher (Operator), Interim Director (Title),

certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature: Kurt Fenstermacher Date: 3/13/13

---

TO BE COMPLETED BY THE OPERATOR IF THE APPLICATION IS SIGNED BY AN AUTHORIZED REPRESENTATIVE FOR THE OPERATOR

I, _____ (Print or Type Operator Name), hereby designate _____ (Print or Type Representative Name)

as my representative and hereby authorize said representative to sign any application, submit additional information as may be requested by the Commission; and/or appear for me at any hearing or before the Texas Commission on Environmental Quality in conjunction with this request for a Texas Water Code or Texas Solid Waste Disposal Act permit. I further understand that I am responsible for the contents of this application, for oral statements given by my authorized representative in support of the application, and for compliance with the terms and conditions of any permit which might be issued based upon this application.

_____
Printed or Typed Name of Operator or Principal Executive Officer

_____
Signature

---

SUBSCRIBED AND SWORN to before me by the said Kurt Fenstermacher

On this 13th day of March, 2013

My commission expires on the 16th day of October, 2014

GLORIA E. DURAN
NOTARY PUBLIC
In and for the State of Texas
My commission expires
10-16-2014

_____
Notary Public in and for
EL PASO County, Texas

(Note: Application Must Bear Signature & Seal of Notary Public)

Report

# Major Permit Amendment – Part I
# McCombs Municipal Landfill
# El Paso County, Texas
# TCEQ MSW Permit No. 729B

Prepared for: City of El Paso

Revised July 2013, Revision 6

SAIC

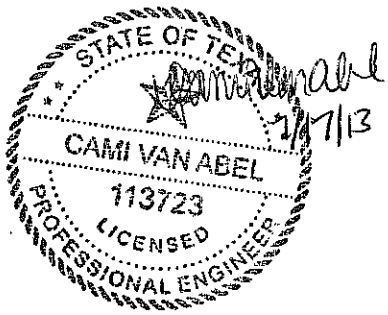
# McCombs Municipal Landfill
# El Paso County, Texas
# TCEQ MSW Permit No. 729B

# Major Permit Amendment Application
# Part I

Prepared for

**City of El Paso**

Updated July 2013, Revision 6




Prepared by

**SAIC**
5806 Mesa Drive, Suite 310 ♦ Austin, Texas 78731 ♦ 512.450.0991

Texas Board of Professional Engineers
Firm Registration No. 3823

# Major Permit Amendment – Part I
# McCombs Municipal Landfill Permit No. 729B
## City of El Paso

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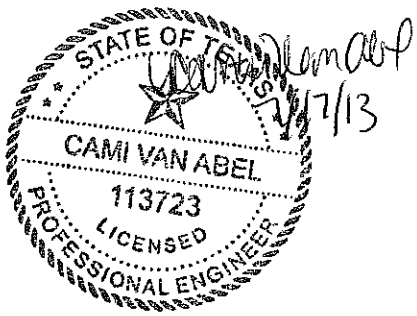


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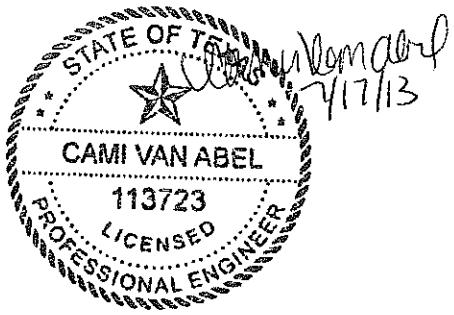

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CAM VAN ABEL
113723
REGISTERED PROFESSIONAL ENGINEER
STATE OF TEXAS
3/15/13

DESIGNED TLK
DRAWN CAD
VERIFY SCALE
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| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
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| 3 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

THE CITY OF EL PASO TEXAS

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MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

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PROJECT NUMBER: 9631500115
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## LEGEND

| EXISTING | FUTURE | DESCRIPTION |
|---|---|---|
| MW-3 | MW-5 | MONITORING WELL |
| GMP-8, GRP-1 | | GAS MONITORING PROBE, GAS RECOVERY PROBE |
| △ | | PIEZOMETER |
| PV-7 | | VERTICAL GAS WELL |
| 1* | | SOIL BORING – LOCATION AND NUMBER PER DRA CONSULTANTS (MAY 1983) |
| 1RI | | SOIL BORING – LOCATION AND NUMBER PER DRA CONSULTANTS (NOVEMBER 1983) |
| 1 | | SOIL BORING – LOCATION AND NUMBER PER DICKINSON LABORATORIES (JUNE 1976) |
| △4 | | SURVEY CONTROL POINT |
| Ⓦ | | WATER WELL |
| | | LEACHATE COLLECTION PIPING CLEANOUT |
| | | BUILDING/STRUCTURE |
| 1500 | 1500 | ELEVATION CONTOURS |
| X X X | | CHAIN LINK OR OTHER FENCE |
| UGE UGE | | UNDERGROUND ELECTRIC |
| OHE OHE | | OVERHEAD ELECTRIC UTILITY |
| UGC UGC | | UNDERGROUND COMMUNICATIONS |
| GCCS | GCCS | GAS COLLECTION AND CONTROL SYSTEM |
| GMCS | | GAS MIGRATION CONTROL SYSTEM |
| | | FACILITY/PROPERTY BOUNDARY |
| | | 125' BUFFER ZONE |
| W W | | WATER LINE |
| | | STORMWATER RETENTION POND BOUNDARY |
| | | HIGHWAY |
| | | LANDFILL ACCESS ROAD |
| | | SECTION LINE |
| | | STORMWATER DRAINAGE DITCH AND FLOW DIRECTION |
| | | SECTOR BOUNDARIES |
| | A | SECTOR DENOMINATION AND FILL DIRECTION |
| | | LEACHATE SUMP AND EXTRACTION PIPE |
| L L | | LEACHATE COLLECTION PIPING |
| | | DRAINAGE AREA BOUNDARY |
| | | FLOW DIRECTION |
| | | CLOSURE EXTENTS |

| EXISTING | FUTURE | DESCRIPTION |
|---|---|---|
| | | COMPACTED NATIVE SOIL |
| | | CALICHE SOIL |
| | | PROTECTIVE SOIL DRAINAGE MATERIAL OR BUFFER MATERIAL |
| | | COMMON BACKFILL/GENERAL FILL |
| | | PEA GRAVEL BACKFILL |
| | | TOPSOIL |
| | | DAILY/INTERMEDIATE COVER |
| | | EROSION LAYER |
| | | INFILTRATION LAYER |
| | | REFUSE |
| | | CONCRETE |
| | | AGGREGATE BACKFILL |
| | | AGGREGATE BASE COURSE |
| | | CLASS 5, AGGREGATE |
| | | SUBGRADE |
| | | BENTONITE |
| | | STEEL |
| | | 100 YEAR FLOOD PLAIN |
| | | PREPARED SUBGRADE |
| | | 60 MIL HDPE OR 40 MIL LLDPE GEOMEMBRANE LINER |
| | | GEOTEXTILE (CUSHION AND FILTER) |
| | | GEOGRID |
| | | GEOSYNTHETIC CLAY LINER (GCL) |
| | | EROSION CONTROL MATTING AND SEEDING |
| | | 6" DIA ROCK (UNLESS OTHERWISE SPECIFIED) OR RIPRAP |
| | | BURIED CULVERT |
| | | TREE LINE |

## ABBREVIATIONS

| | |
|---|---|
| & | AND |
| APPROX | APPROXIMATE |
| AZ | ARIZONA |
| BLDG | BUILDING |
| BOT | BOTTOM |
| C&D | CONSTRUCTION AND DEMOLITION DEBRIS |
| CB | CATCH BASIN |
| CFS | CUBIC FEET PER SECOND |
| ℄ | CENTERLINE |
| CLR | CLEAR |
| CM | CENTIMETERS |
| CMP | CORRUGATED METAL PIPE |
| CO | COMPANY, COUNTY |
| COEF | COEFFICIENT |
| CONC | CONCRETE |
| CONT | CONTINUOUS |
| CP | CONTROL POINT |
| CPE | CORRUGATED POLYETHYLENE |
| DEG | DEGREES |
| DEMO | DEMOLITION |
| DET | DETAIL |
| DIA | DIAMETER |
| DWG | DRAWING |
| E | EAST, EASTING |
| EL OR ELEV | ELEVATION |
| EQ | EQUAL |
| EW | EACH WAY |
| EX | EXISTING |
| GALV | GALVANIZED |
| GB | GRANULAR BED |
| GCCS | GAS COLLECTION AND CONTROL SYSTEM |
| GCL | GEOSYNTHETIC CLAY LINER |
| GMCS | GAS MIGRATION CONTROL SYSTEM |
| GMP | GAS MONITORING PROBE |
| GRP | GAS RECOVERY PROBE |
| GW | GAS WELL |
| GV | VERTICAL GAS WELL |
| HDPE | HIGH DENSITY POLYETHYLENE |
| ID | INSIDE DIAMETER |
| IE | INVERT ELEVATION |
| INC | INCORPORATED |
| L | LYSIMETER |
| LCO | LEACHATE CLEANOUT |
| LF | LANDFILL |
| LFG | LANDFILL GAS |
| LLDPE | LINEAR LOW DENSITY POLYETHYLENE |
| MAX | MAXIMUM |
| MFR | MANUFACTURER |
| MIN | MINIMUM |
| MSW | MUNICIPAL SOLID WASTE |
| MW | MONITORING WELL |
| N | NORTH, NORTHING |
| NAD | NORTH AMERICAN DATUM |
| NAVD | NORTH AMERICAN VERTICAL DATUM |
| NO | NUMBER |
| NPDES | NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM |
| NPT | NOMINAL PIPE THICKNESS |
| NSPS | STANDARD OF PERFORMANCE FOR NEW STATIONARY SOURCES |
| NTS | NOT TO SCALE |
| OC | ON CENTER |
| OPNG | OPENING |
| OSHA | OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION |
| P OR PZ | PIEZOMETER |
| PE | POLYETHYLENE |
| PERF | PERFORATED |
| PERM | PERMEABLE |
| POC | POINT OF CLOSURE |
| PSB | PUBLIC SERVICE BOARD |
| PT | POINT |
| PVC | POLYVINYL CHLORIDE |
| PV | VERTICAL GAS WELL |
| REINF | REINFORCED |
| REQD | REQUIRED |
| ROW | RIGHT-OF-WAY |
| S | STATION |
| SCH | SCHEDULE |
| SDR | STANDARD DIMENSION RATIO |
| SE | SOUTHEAST |
| SEC | SECOND |
| SHT | SHEET |
| SP | SPACING |
| SPEC | SPECIFICATION |
| SS OR SST | STAINLESS STEEL |
| SSR | SIDESLOPE RISER |
| SW | SOLID WASTE OR SOUTHWEST |
| TAC | TEXAS ADMINISTRATIVE CODE |
| TCEQ | TEXAS COMMISSION ON ENVIRONMENTAL QUALITY |
| TYP | TYPICAL |
| TX | TEXAS |
| UNO | UNLESS NOTED OTHERWISE |
| VERT | VERITCAL |
| W/ | WITH |
| W | WEST |

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STATE OF TEXAS
FREDRIC J. DORAN
111226
REGISTERED PROFESSIONAL ENGINEER
11/2/12

| | |
|---|---|
| DESIGNED | TLK |
| DRAWN | CAD |
| VERIFY SCALE | BAR IS ONE INCH ON ANSI "D" DRAWING |
| 0 | 1" |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
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| 1 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

THE CITY OF EL PASO TEXAS

SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve
Suite 305
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MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

ABBREVIATIONS AND LEGEND

PROJECT NUMBER: 9631500115
SHT. 2 OF: 78
DRAWING NUMBER: P0-2

Koller, Tonya L. 10/15/2012 10:26:49 AM – P:\00218000 El Paso TX\9631500115\Data Analytical\CADD\P0-2 ABBREVIATIONS AND LEGEND.dwg

## 1.1.1 General

SAIC Energy, Environment and Infrastructure, LLC (SAIC) is pleased to submit this Major Permit Amendment (MPA) application on behalf of the City of El Paso (City) to the Texas Commission on Environmental Quality (TCEQ).

This MPA application is organized into four parts as per the requirements set forth in 30 TAC Chapter 330 Subchapter B. The following describes the contents of the four parts.

- **Part I.** This portion of the MPA application includes information from 30 TAC §281.5, 30 TAC §305.45 and 30 TAC §330.59 relating to the McCombs Landfill (Landfill) and the City, the facility's owner and operator.
- **Part II.** This section contains information regarding the existing conditions at the Landfill to fulfill the requirements of 30 TAC §330.61.
- **Part III.** Part III contains the design data and specifications, analytical reports, and engineering drawings required by 30 TAC §330.63.
- **Part IV.** Part IV includes the Site Operating Plan (SOP) which describes the daily operations at the Landfill as per 30 TAC 30 TAC §330.65.

## 1.1.2 Supplementary Technical Report

The City owns and operates the Type I municipal solid waste disposal facility which is managed under Municipal Solid Waste (MSW) permit 729B. The Landfill is located in El Paso County within the El Paso city limits and serves the waste needs of the City and the surrounding area.

In 2005, the City ceased regular solid waste disposal activities, and the majority of the City's MSW was diverted to the City's Clint Landfill as well as private facilities. During this period, the Landfill was primarily used for the disposal of storm debris and material generated from street cleanings. The City estimates that the Clint Landfill will undergo final closure activities in 2030, and wishes to return the Landfill to full activities to meet immediate and future solid waste disposal needs.

The vertical expansion will increase the height of the Landfill from the previous permitted elevation of 4,125 feet mean sea level (MSL) to 4,305 feet MSL. This corresponds to an increase in capacity of 47,084,981 cubic yards (CY) from a previously permitted volume of 22,348,549 CY to a new permitted volume of 69,433,530 CY.

As described in the site life projections provided in Appendix 3H, the McCombs Landfill is anticipated to receive 3,000 tons per year from 2011 through 2013 (storm debris) and 497,300 tons per year in 2014 increasing at a 2% growth rate throughout

the life of the Landfill. Also, it is assumed that in 2030, the Clint Landfill will reach capacity and the McCombs Landfill will receive all incoming waste (or 1,517,100 tons in 2030). Based on these assumptions, and a 0.60 tons per cubic yard airspace utilization factor, the site capacity is estimated to be consumed in 2059 (when utilizing the prescriptive final cover) or 2060 (when utilizing the alternative final cover). The maximum rate of disposal is estimated to be approximately 2,748,029 tons per year (2060). The Landfill will be utilized following the Sector classifications in that Sector B will follow Sector A, Sector C will follow Sector B, etc.

Also included within this MPA is the disposal of C&D waste on top of the existing unlined landfill, which will act as a surcharge on the waste to enhance settlement prior to piggybacking over the waste with MSW. The C&D waste will be limited to 30-feet of fill, with the remainder of fill needed to reach the MSW base grades be obtained with uncontaminated soil. The C&D waste used for fill within the piggyback liner area will consist of (Class 3 like) inert wastes including (but not limited to) rock/stone, concrete, uncontaminated soil, masonry (brick, stucco and plaster), ceramic items, conduit and pipes, glass, inert plastics, molded fiberglass, and incidental amounts (no more than 5% per load) of metals (including aluminum). Any voids in all inert plastic materials accepted will be removed upon waste compaction. A complete list is provided in Section 2.2.1. It is estimated that based on a 60,000 tons per year disposal rate (2013), 2% growth, and 0.90 tons per cubic yard airspace utilization factor, that the C&D area will reach capacity in 2036.

As per 30 TAC §330.15, the Landfill will not accept hazardous wastes for disposal. These hazardous wastes include lead acid storage batteries, do-it-yourself motor vehicle oil, used oil filters, whole used or scrap tires, refrigerators, freezers, air conditioners, and other items containing chlorinated fluorocarbons (CFCs), bulk or non-containerized liquid waste, regulated hazardous waste as defined in 30 TAC §330.3, polychlorinated biphenyl (PCB) wastes, and radioactive materials. This list is further defined in Section 4.7.1.

The Landfill will accept MSW as defined by 30 TAC §330.3 and some special waste. Special wastes include Class II industrial wastes and municipal commercial waste such as treated medical waste, processed grease/grit trap waste, dead animals, slaughterhouse wastes, and petroleum-product and crude oil contaminated soil. The acceptance of special wastes is further defined in Appendix 4D. Special waste also includes RACM as described below.

The Landfill intends to dispose of regulated asbestos containing material (RACM) as defined in 40 Code of Federal Regulations Part 61 in accordance with 30 TAC §330.171(c)(3). This permit amendment will serve as the notification to the TCEQ of the intent to accept RACM. The procedures for accepting, disposing and recordkeeping are described in further detail in Section 4.9.22. Sector K will be utilized for the disposal of RACM.

This MPA also increases the property/facility area from 327.292 acres to 346.74 acres within Section 6, Block 80, Township 1, Texas and Pacific Railway Survey. An updated metes and bounds is provided in Appendix 1C. It should be noted that the increase is only for the property/facility boundary and the permitted waste footprint size is not increasing.

## 1.2.1 Facility Location and Description

The Landfill is an existing Type 1 MSW disposal facility owned and operated by the City. The Landfill is located at the northeast corner of the intersection of McCombs Road and Stan Roberts Road (FM 2529) in El Paso, Texas. The address of the Landfill is 13660 McCombs Road.

## 1.2.2 Access Routes

The Landfill is accessible through the entrance located on McCombs Road approximately 4.4 miles west of the intersection of McCombs Road with US 54 North. More specific transportation information can be found in Appendix 2C – Transportation Study. Greater detail regarding the location of the Landfill in relation to major thoroughfares can be found in Appendix 1A – General Location Maps.

## 1.2.3 Geographic Coordinates

The latitudinal and longitudinal geographic coordinates of the Landfill are:

- Latitude: N 32° 59’ 15”
- Longitude: W 106° 24’ 19”
- Elevation (above MSL): Approximately 4070’ near existing entrance.

## 1.3.1 General Location Maps

As per the requirements of 30 TAC §330.59(c)(1)-(2) and 30 TAC §305.45 the following maps are included as part of Appendix 1A – General Location Maps:

- General Highway Map for El Paso County;
- Detailed Highway Map for El Paso County; and
- General Topographic Map for the Landfill and Surrounding Area.

All maps updated in the application were completed with the latest information available at the time of development.

## 1.3.2 Land Owner Map and Land Owners List

To meet the requirements of 30 TAC §305.45(a) and 30 TAC §330.59(c)(3), a Land Owner Map and Land Owners List describing parcel ownership within one quarter mile of the Landfill are included in Appendix 1B – Land Ownership Map and Land Owners List.

## 1.4.1 Legal Description

To meet the requirements of 30 TAC §330.59(d)(1), a metes and bounds survey for the Landfill permit boundary is included as Appendix 1C – Legal Description.

## 1.4.2 Property Owner Affidavit

The property owner affidavit has been included in Page 9 of the Part 1 Form 0650 submitted as part of this MPA application.

# Section 1.5
# LEGAL AUTHORITY
30 TAC 330.59(e)

The Landfill is owned and operated by the City of El Paso. No other persons or entities have greater than 20 percent ownership in the Landfill. As per the requirements of 30 TAC §330.59(e), the legal authority of the City has been verified and a copy of the charter filed with the State of Texas is available upon request.

The following evidence of competency has been prepared on behalf of the City to meet the requirements of 30 TAC §330.59(f).

## 1.6.1 Solid Waste Sites

The City has owned/operated several municipal solid waste processing and disposal facilities within the State of Texas. The following is a list of MSW processing and disposal facilities owned/operated by the City.

| Facility Name | Facility Type | Permit Number | County |
|---|---|---|---|
| McCombs Landfill | Type I MSW Landfill | 729A | El Paso |
| Clint Landfill | Type I MSW Landfill | 1482, 2284 | El Paso |
| Delta Transfer Facility | MSW Transfer Station | 728 | El Paso |
| Doniphan HHW Site | HHW Collection and Processing Site | 120017 | El Paso |
| Escobar CCS | Citizens' Collection Station | 120022 | El Paso |
| Harrison CCS | Citizens' Collection Station | 120024 | El Paso |
| Hondo Pass CCS | Citizens' Collection Station | 120018 | El Paso |

The City does not own, operate or have a financial interest in any solid waste sites outside of the State of Texas.

## 1.6.2 Management and Personnel

The management and personnel dedicated to the Landfill are described in Part IV – Site Operating Plan, Section 4.4, Table 4.4-1 (Personnel Types and Descriptions) of this Major Permit Amendment application. A copy of this table has been included in Appendix 1D – Landfill Personnel and Equipment.

## 1.6.3 Equipment Dedicated to McCombs Landfill

The equipment dedicated to the Landfill is described in Part IV – Site Operating Plan, Section 4.4, Table 4.4-2 (Landfill Facility Equipment List) of this Major Permit Amendment application. A copy of this table has been included in Appendix 1D – Landfill Personnel and Equipment.

# Section 1.7
# APPOINTMENTS
30 TAC §330.59(g)

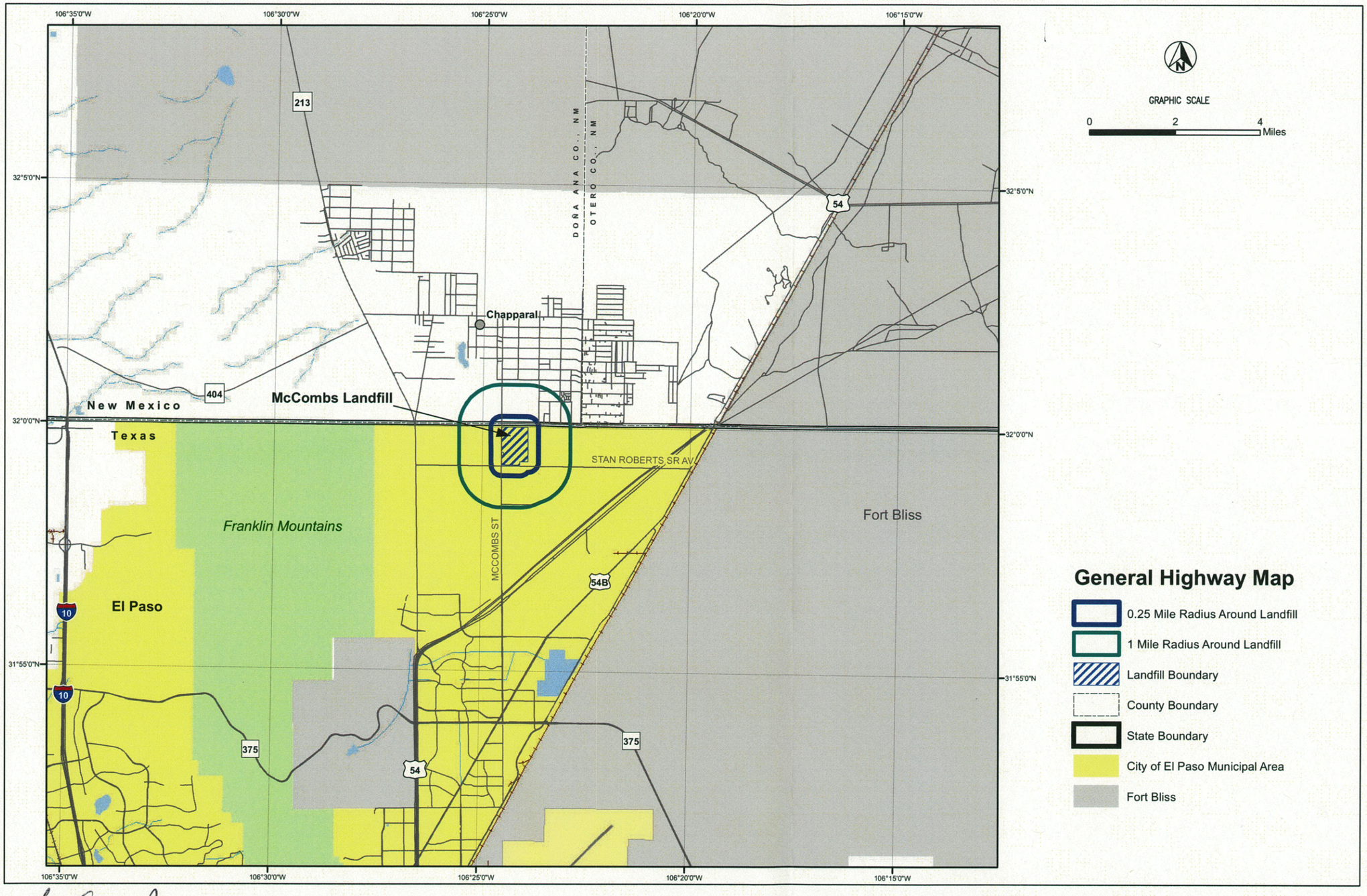
The appointments for this Major Permit Amendment application have been prepared as per the requirements set forth in 30 TAC §330.59(g) and 30 TAC §305.44. Ellen A. Smyth, P.E., Director of Environmental Services for the City of El Paso will act as the designated signatory on behalf of the City. Documentation of SAIC's appointment as the project engineer is provided in Appendix 1E – Engineer's Appointment.

# Section 1.8
# APPLICATION FEES
30 TAC §330.59(h)(1-2)

As per the requirements set forth in TCEQ Part 1 Form 0650, a payment for the amount of $150 has been submitted by the City to the TCEQ Financial Administration division. A receipt of this payment has been included as part of Appendix 1F – Application Fee Documentation.

# Appendix 1A
# General Location Maps

SAIC®




GRAPHIC SCALE

0 2 4 Miles

## General Highway Map

- 0.25 Mile Radius Around Landfill
- 1 Mile Radius Around Landfill
- Landfill Boundary
- County Boundary
- State Boundary
- City of El Paso Municipal Area
- Fort Bliss

## NOTES

1. HIGHWAY DATA OBTAINED FROM THE DONA ANA COUNTY ASSESSOR'S OFFICE IN NEW MEXICO AND BY THE CITY OF EL PASO'S GEOGRAPHIC INFORMATION SYSTEMS DIVISION IN TEXAS.
2. MAP CREATED USING ARCGIS SOFTWARE VERSION 9.2, ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE (ESRI) STREETMAP DATA, 2005 AND PASO DEL NORTE MAPA GIS DATASETS, 2008.

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STATE OF TEXAS
FREDRIC J. DORAN
111226
REGISTERED
PROFESSIONAL ENGINEER
11/2/12

DESIGNED TLK
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VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
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THE CITY OF EL PASO TEXAS

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MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

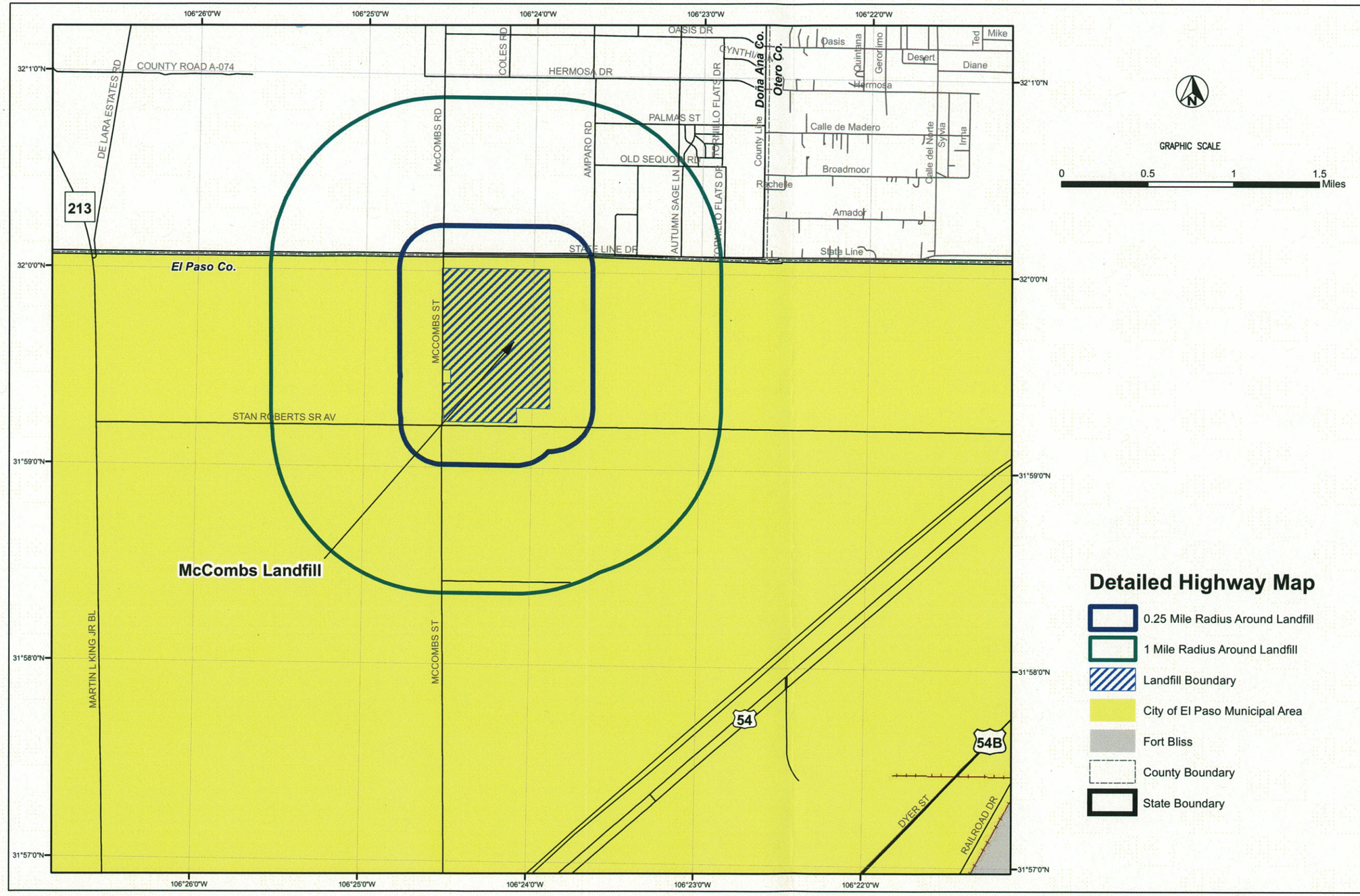
GENERAL HIGHWAY MAP

PROJECT NUMBER: 9631500115
SHT. 3 OF: 78
DRAWING NUMBER: P1-1

Keller, Tonya L. 10/29/2012 9:11:30 AM – P:\0021800 El Paso TX\9631500115\Data Analytical\CADD\P1-1 GENERAL HIGHWAY MAP.dwg

## NOTES

1. HIGHWAY DATA OBTAINED FROM THE DONA ANA COUNTY ASSESSOR'S OFFICE IN NEW MEXICO AND BY THE CITY OF EL PASO'S GEOGRAPHIC INFORMATION SYSTEMS DIVISION IN TEXAS.
2. MAP CREATED USING ARCGIS SOFTWARE VERSION 9.2, ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE (ESRI) STREETMAP DATA, 2005 AND PASO DEL NORTE MAPA GIS DATASETS, 2008.

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STATE OF TEXAS
FREDRIC J. DORAN
111226
REGISTERED
PROFESSIONAL ENGINEER
11/2/12

DESIGNED: TLK
DRAWN: CAD
VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 1/13/12 | FJD | CGL | ADMINISTRATIVE NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

THE CITY OF EL PASO TEXAS

SAIC®

SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve
Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

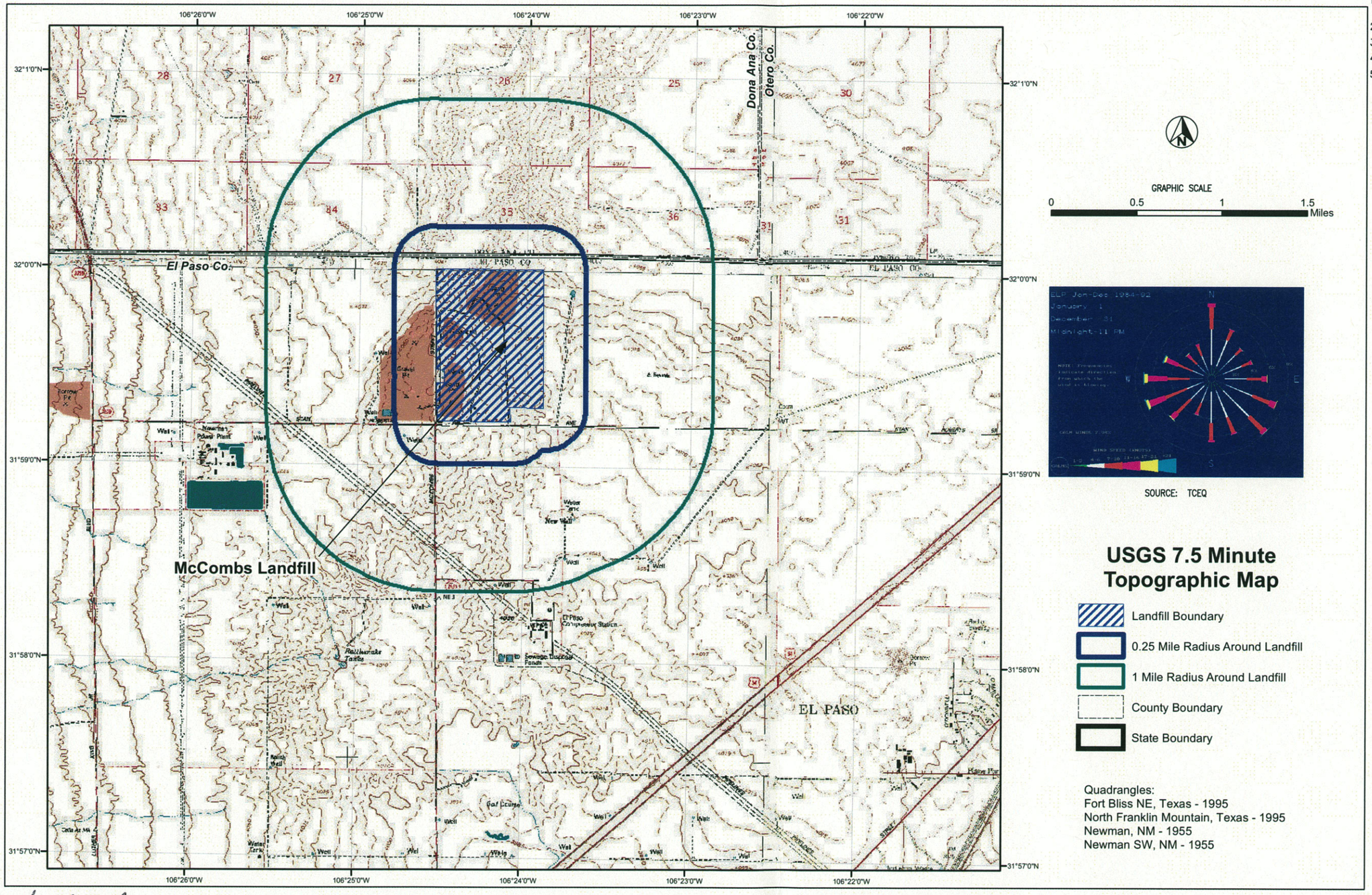
DETAILED HIGHWAY MAP

PROJECT NUMBER: 9631500115
SHT. 4 OF: 78
DRAWING NUMBER: P1-2

Keller, Tonya L. 10/29/2012 9:14:43 AM – P:\00218000 el paso tx\9631500115\data analytical\CADD\P1-2 DETAILED HIGHWAY MAP.dwg

## NOTES

1. TOPOGRAPHIC DATA OBTAINED FROM USGS 7.5 MINUTE MAP.
2. CONTOUR INTERVAL IS FIVE FEET.
3. MAP CREATED USING ARCGIS SOFTWARE VERSION 9.2.
4. WIND ROSE PERIOD OF RECORD: 1984 TO 1992.
5. WIND ROSE FREQUENCY OF OCCURENCE OF WINDS PLOTTED IN THE SIXTEEN POINTS OF THE COMPASS, WITH A MAXIMUM OF SIX WIND SPEED CLASSES FOR EACH DIRECTION.




GRAPHIC SCALE

0 0.5 1 1.5 Miles




SOURCE: TCEQ

## USGS 7.5 Minute Topographic Map

- Landfill Boundary
- 0.25 Mile Radius Around Landfill
- 1 Mile Radius Around Landfill
- County Boundary
- State Boundary

Quadrangles:
Fort Bliss NE, Texas - 1995
North Franklin Mountain, Texas - 1995
Newman, NM - 1955
Newman SW, NM - 1955

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STATE OF TEXAS
FREDRIC J. DORAN
111226
REGISTERED
PROFESSIONAL ENGINEER
11/2/12

DESIGNED TLK
DRAWN CAD
VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 1/13/12 | FJD | CGL | ADMINISTRATIVE NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

GENERAL TOPOGRAPHIC MAP

PROJECT NUMBER: 9631500115
SHT. 5 OF: 78
DRAWING NUMBER: P1-3

Keller, Tonya L. 10/29/2012 9:17:03 AM – P:\00218000 el paso tx\9631500115\data analytical\CADD\P1-3 GENERAL TOPOGRAPHIC MAP.dwg

# Appendix 1B
# Land Owner Map and Land Owners List

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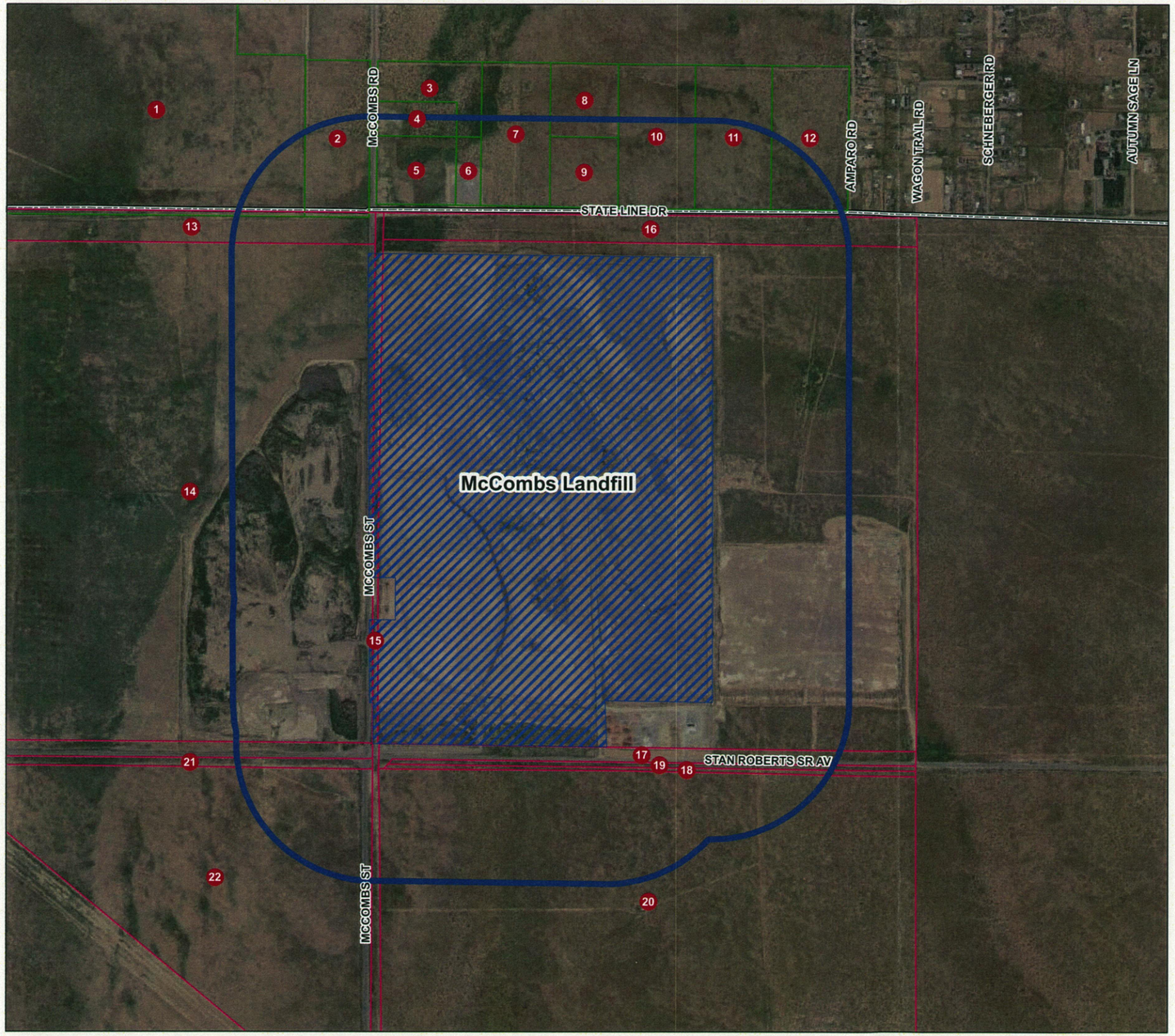
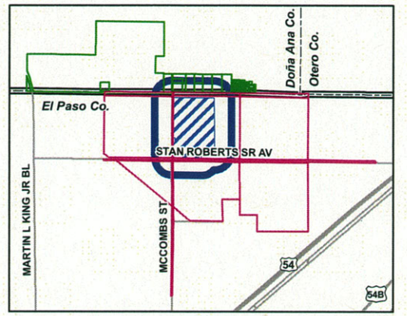



GRAPHIC SCALE

0 1,000 2,000 3,000 Feet

## Overview




## Land Owner Map

- El Paso County Parcels*
- Dona Ana County Parcels*
- Landfill Boundary
- 0.25 Mile radius Around Landfill
- County Boundary
- State Boundary

*Labels correspond to numbers on Land Owner List.

## NOTES

1. REFER TO LAND OWNERS LIST LOCATED IN APPENDIX 1B FOR LIST OF OWNERS CORRESPONDING WITH NUMBERED LOCATIONS.
2. MAP CREATED USING ARCGIS SOFTWARE VERSION 9.2.
3. LAND OWNERS HAVE BEEN IDENTIFIED ADJACENT TO AND WITHIN 0.25 MILES OF THE FACILITY BOUNDARY.
4. ADJACENT LAND OWNERS IDENTIFIED BASED ON DONA ANA COUNTY ASSESSOR'S OFFICE AND EL PASO CENTRAL APPRAISAL DISTRICT LISTINGS.
5. NO PERSONS HAVING A MINERAL INTEREST BELOW THE FACILITY WERE IDENTIFIED.

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STATE OF TEXAS
FREDRIC J. DORAN
111226
REGISTERED
PROFESSIONAL ENGINEER
11/2/12

DESIGNED TLK
DRAWN CAD
VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 1/13/12 | FJD | CGL | ADMINISTRATIVE NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

ADJACENT LAND OWNER MAP

PROJECT NUMBER: 9631500115
SHT. 6 OF: 78
DRAWING NUMBER: P1-4

Keller, Tonya L. 10/29/2012 9:32:35 AM – P:\00218000 el paso tx\9631500115\data analytical\CADD\P1-4 ADJACENT LAND OWNER MAP.dwg

**McCombs Landfill Land Owners**
**El Paso County parcel data, 11/2/2007; and Dona Ana County parcel data, 11/12/2010**

**Dona Ana County**

1 BOWEN JAMES N TRUST
112 CASITAS DEL ESTE
EL PASO, TX 79935-4116
ID/PID: 17-10473

2 HUGHES MARY ELIZABETH
4125 RANCHO GUSTO NW
ALBUQUERQUE, NM 87120-5809
ID/PID: 17-09128

3 LEWIS TONY & ANGIE
9473 E B TAULBEE
EL PASO, TX 79924
ID/PID: 17-14745

4 WILDMAN WAYNE
PO BOX 114
SOMERSET, TX 78069-0114
ID/PID: 17-14744

5 HUGHES EDWARD C & MARY ELIZABETH
4125 RANCHO GUSTO NW
ALBUQUERQUE, NM 87120-5809
ID/PID: 17-12864

6 EL PASO ELECTRIC CO
PO BOX 982
El Paso, TX 79960
ID/PID: 17-12590

7 COX SANFORD C JR TRUSTEE
112 VISTA DEL REY
EL PASO, TX 79912-4821
ID/PID: 17-17905

8 NAVARRO JOSE LUIS
3730 TRUMAN
EL PASO, TX 79930
ID/PID: 17-15035

9 SQUIRES ROBERT ET AL
2158 BRENTWOOD
HOUSTON, TX 77019
ID/PID: 17-17904

10 BELL PLESENE
3334 SHIELD LN
Garland, TX 75042
ID/PID: 17-16998

11 SCHNITZ VANETTE & REUBEN V VALDEZ JR
2819 FORT SILVER DR
BULL HEAD CITY, AZ 86429
ID/PID: 17-17000

12 SCHNITZ PLES E JR & SHERRY L AYCOCK
369 PRIVATE RD 7908
HAWKINS, TX 75765-4073
ID/PID: 17-16999

**McCombs Landfill Land Owners**
**El Paso County parcel data, 11/2/2007; and Dona Ana County parcel data, 11/12/2010**

**El Paso County**

13 EL PASO ELECTRIC CO
PO BOX 982
EL PASO , TX 79960
ID/PID: X58199910100105

14 CITY OF EL PASO
2 CIVIC CENTER PLZ
EL PASO , TX 79901-1153
ID/PID: X58199910100101

15

EL PASO, TX
ID/PID: MC COMBS RD

16 EL PASO ELECTRIC CO
PO BOX 982
EL PASO , TX 79960
ID/PID: X58099910600100

17 PEOPLE OF THE STATE OF TEXAS

EL PASO, TX
ID/PID: x58099910600020

18 CITY OF EL PASO
2 CIVIC CENTER PLZ
EL PASO , TX 79901-1153
ID/PID: X58099910600200

19 EL PASO ELECTRIC CO
PO BOX 982
EL PASO, TX 79960-0000
ID/PID: X58099910600010

20 CITY OF EL PASO
2 CIVIC CENTER PLZ
EL PASO, TX 79901-1153
ID/PID: X58099910700100

21 EL PASO ELECTRIC CO
PO BOX 982
EL PASO , TX 79960
ID/PID: X58199910100201

22 CITY OF EL PASO
2 CIVIC CENTER PLZ
EL PASO , TX 79901-1153
ID/PID: X58199911200350

# Appendix 1C
# Legal Description

SAIC®

Prepared for: City of El Paso
(McCombs Landfill)
October 16, 2012

METES AND BOUNDS

Description of a parcel of land being a portion of Section 6, Block 80, Township 1, Texas and Pacific Railway Company Surveys, City of El Paso, El Paso County, Texas and being more particularly described by metes and bounds as follows:

Commencing for reference at a point marking the common corner of Sections 6 and 7, Block 80 and Sections 1 and 12, Block 81, Township 1, Texas and Pacific Railway Company Surveys from which a point marking the common northerly corner of Section 1, Block 81 and Section 6, Block 80, bears North 02°06'50" East a distance of 5357.59 Feet; Thence along the line between Section 1, Block 81 and Section 6, Block 80, North 02°06'50" East a distance of 620.00 feet to The "TRUE POINT OF BEGINNING"

Thence along said common line, North 02°06'50" East a distance of a distance of 800.00 feet to a point;

Thence leaving said line South 86°43'10" East a distance of 250.00 feet to a point;

Thence, North 02°06'50" East a distance of 406.85 feet to a point;

Thence North 86°43'10" West a distance of 250.00 feet to a point on the common line between Section 1, Block 81, Township 1 and Section 6, Block 80,.Township 1, Texas and Pacific Railway Company Surveys;

Thence along said line, North 02°06'50" East a distance of 3133.27 feet to a point;

Thence leaving said line, South 86°58'10" East a distance of 3312.66 feet to a point;

Thence, South 02°17'50" West a distance of 4299.15 feet to a point;

Thence, North 86°43'13" West a distance of 1028.44 feet to a point;

Thence, South 00°14'23" West a distance of 449.69 feet to a point;

Thence, North 86°52'09" West a distance of 2258.08 feet to a point;

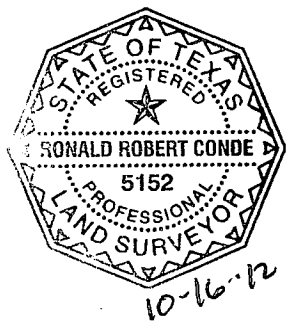
Thence, North 02°33'30" East a distance of 399.85 feet to a point;

Thence, North 86°43'10" West a distance of 30.33 feet to the TRUE POINT OF BEGINNING and containing 14,256,826.83 Square Feet or 327.29 Acres of land more or less.

Note: Not a ground survey, bearings based on survey of 19.442 Acre portion of Section 6, Block 80, Township 1, Texas and Pacific Railway Company Surveys prepared by Robert Seipel Associates, Inc., dated May 4, 2011.

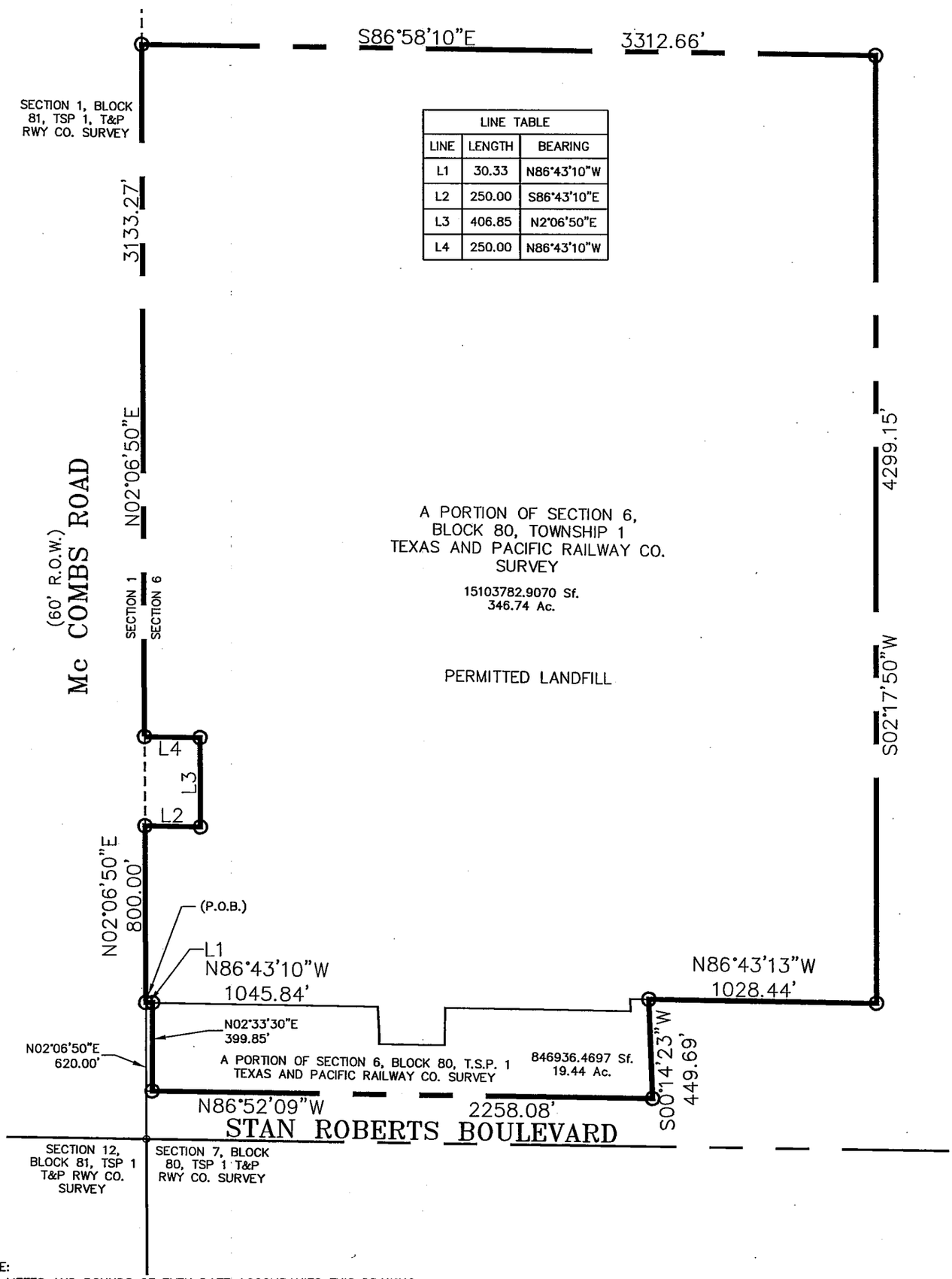
A drawing of even date accompanies this description.

Ron R. Conde
R.P.L.S. No. 5152




10-16-12

CONDE INC
ENGINEERING / LAND SURVEYING / PLANNING
6080 SURETY DRIVE / SUITE 100 / EL PASO, TEXAS 79905
(915) 592-0283 FAX (915) 592-0286




| LINE TABLE | | |
|---|---|---|
| LINE | LENGTH | BEARING |
| L1 | 30.33 | N86°43'10"W |
| L2 | 250.00 | S86°43'10"E |
| L3 | 406.85 | N2°06'50"E |
| L4 | 250.00 | N86°43'10"W |

NOTE:
1. A METES AND BOUNDS OF EVEN DATE ACCOMPANIES THIS DRAWING.
2. NOT A GROUND SURVEY, BEARINGS AND DESCRIPTION BASED ON SURVEY OF 19.442 ACRES PORTION OF SECTION 6, BLOCK 80, TOWNSHIP 1, TEXAS AND PACIFIC RAILWAY COMPANY SURVEYS PREPARED BY ROBERT SEIPEL ASSOCIATES, INC. DATED MAY 4, 2011.

SCALE: 1"=600'

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| JOB # 512-17 | DATE: MAY 10, 2012 | OFFICE: F.R. |
|---|---|---|
| | REVISED: OCTOBER 16, 2012 | |
| | A PORTION OF SECTION 6, BLOCK 80, TOWNSHIP 1 TEXAS AND PACIFIC RAILWAY COMPANY SURVEY CITY OF EL PASO, EL PASO COUNTY, TEXAS | |
| | CONDE INC. 6080 SURETY DR. SUITE 100 EL PASO, TEXAS 79905 | |

# Appendix 1D
# Landfill Personnel and Equipment

SAIC®

Table 4.4-1
Personnel Types and Descriptions

| Position | Number of Employees | Minimum Qualifications | Position Function |
|---|---|---|---|
| Director of Environmental Services | 1 | Must hold and maintain Landfill Operator license Class A. Minimum 1 year landfill operation. | Serves in landfill manager capacity when landfill manager is unavailable. |
| Solid Waste Operations Manager | 1 | Must hold and maintain Landfill Operator license Class A. Minimum 1 year landfill operation. | Manages all landfill activities. |
| Solid Waste Division Supervisor | 1 | Must hold and maintain Landfill Operator license Class B.<br>Minimum 1 year landfill operation experience.<br>Training by the Solid Waste Operations Manager in the SOP requirements. | Responsible for managing work face and daily fill and cover placement operations, landfill equipment maintenance and repair, and personnel safety during waste and cover construction. |
| Equipment Operator | 4 (0 tpd – 1500 tpd)<br>5 (1501 tpd – 2500 tpd)<br>6 (2501 tpd – 3500 tpd) | 6 months minimum experience in equipment operation or on the job training by experienced equipment operators and training by Landfill Manager in SOP requirements for daily cover and unauthorized waste. | Grading and excavating, necessary equipment maintenance, waste leveling and compaction, application of daily cover, and general site road maintenance. Operators are also responsible for keeping the working face in the smallest area practical and screening for unauthorized waste. |
| Senior Cashier/Accounting Payroll Specialist | 1 | Training by Solid Waste Operations Manager in the SOP rules and waste screening training course (e.g., I.I.E.D.) | Providing oversight for and filling in for the landfill cashiers as needed. |
| Cashiers | 2 or more | Training by Solid Waste Operations Manager in the SOP rules, and waste screening training course (e.g., I.I.E.D.) | Levies fees on landfill customers. Operates the scale, keeps appropriate records, controls site access screens for unauthorized waste, and provides general customer direction and information. |

Table 4.4-1
Personnel Types and Descriptions

| Position | Number of Employees | Minimum Qualifications | Position Function |
|---|---|---|---|
| Maintenance Personnel | 2 (0 tpd – 1500 tpd)<br>3 (1501 tpd – 3500 tpd) | Internal safety training and personal protective equipment training | General facility maintenance. Picks up windblown litter as directed. Directs traffic at disposal area. |

Table 4.4-2
Landfill Facility Equipment List

| Equipment Type | Number (Minimum) | Typical Size | Function |
|---|---|---|---|
| Dozers (tractor) | 1 (0 tpd–1500 tpd)<br>2 (1501 tpd–3500 tpd) | 240 HP or greater | Waste and soil spreading and compaction |
| Scraper | 1 or more (0 tpd–1500 tpd)<br>2 or more (1501 tpd–3500 tpd) | Greater than 20 cubic yards (cy) | Transportation of daily cover, fire fighting support |
| Compactor | 1 or more (0 tpd–1500 tpd)<br>2 or more (1501 tpd–3500 tpd | Greater than 80,000 lbs | Waste spreading and compaction |
| Water Truck | 1 | At least 5,000 gallons | Dust control, fire fighting support |
| Diesel Fuel Tank | 1 | 10,500 gallons | Vehicle fueling |
| Street Sweeper or sweeper attachment brush for loader | 1 | 5 foot broom | Cleaning of paved on-site roads |
| Portable Litter Screens | 4 or more | 10 feet by 10 feet | Active face litter control |
| Road Grader or Maintainer | 1 | Size varies | Grading of access roads, soil spreading |
| Bucket Loader | 1 | 25 cubic yards | Earth moving |
| Submersible Leachate Pumps | 1 per sump | | Transfer of leachate from sumps |
| Electronic liquid level indicators | 1 per sump | | Monitor leachate level in sumps |

# Appendix 1E
# Engineer's Appointment

SAIC®

## Memorandum

SAIC®

To: TCEQ

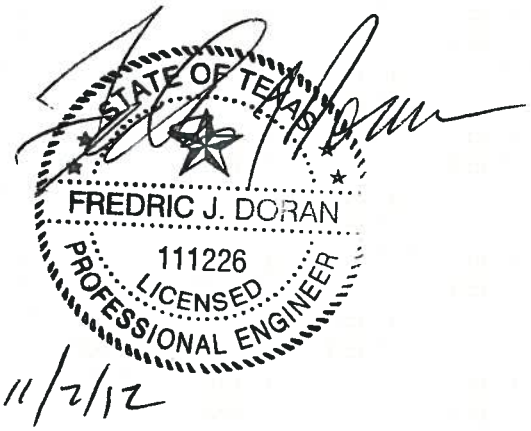
From: Fred J. Doran, SAIC

Subject: Appendix 1E – Engineer's Appointment

Date: November 2, 2012

The attached Engineer's Appointment dated November 21, 2011 references MSW Permit No. 729A. It should be noted that the letter is applicable to MSW Permit No. 729B and should be referenced as stating MSW Permit No. 729B.

TLK






SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI

*Dedicated to Outstanding Customer Service for a Better Community*

SERVICE SOLUTIONS SUCCESS

November 21, 2011

Mark R. Vickery, P.G.
Executive Director
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, TX 78711-3087

Subject: **Notice of Engineer's Appointment**

Dear Mr. Vickery:

This letter is provided to inform you that the City of El Paso has appointed SAIC as the consulting and design engineers responsible for the Major Permit Amendment for the McCombs Landfill (MSW Permit No. 729A).

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Sincerely,

**Ellen A. Smyth, P.E.**

Director of Environmental Services
City of El Paso

SWORN AND SUBSCRIBED BEFORE ME on this 21st day of November, 2011, which witness my hand and seal of office.

Notary Public in the State of Texas

GLORIA E. DURAN
NOTARY PUBLIC
In and for the State of Texas
My commission expires
10-16-2014

Gloria E. Duran
Printed Name

My Commission Expires: 10-16-2014


Mayor
John F. Cook

City Council

*District 1*
Ann Morgan Lilly

*District 2*
Susie Byrd

*District 3*
Emma Acosta

*District 4*
Carl L. Robinson

*District 5*
Dr. Michiel R. Noe

*District 6*
Eddie Holguin Jr.

*District 7*
Steve Ortega

*District 8*
Cortney Carlisle Niland

City Manager
Joyce A. Wilson



**Environmental Services Department**
7968 San Paulo Drive, El Paso, TX 79907 ◦ (915) 621-6700 ◦ Fax (915) 621-6711
www.elpasotexas.gov


El Paso All-America City 2010

# Appendix 1F
# Application Fee Documentation

SAIC®

## Parra, Miguel

**From:** steers@tceq.texas.gov
**Sent:** Monday, November 21, 2011 1:30 PM
**To:** Parra, Miguel
**Subject:** TCEQ ePay Receipt for 582EA000111781

This is an automated message from the TCEQ ePay system. Please do not reply.
Trace Number: 582EA000111781
Date: 11/21/2011 02:30 PM
Payment Method: CC - Authorization 0000002259 Amount Paid: $150.00

Actor: Miguel Parra
Email: parramx@elpasotexas.gov

Payment Contact: Miguel Parra P E
Phone: 915-599-6235
Company: City Of El Paso
Address: 7968 San Paulo, El Paso, TX 79907

Fees Paid:
Fee Description AR Number Amount
NONHAZARDOUS WASTE PERMIT - NEW, AMENDMENTS & MODIFICATIONS $100.00
30 TAC 305.53B HWP NOTIFICATION FEE $50.00
---
Total Fees For Transaction: $150.00

==========
Voucher: 144046
Trace Number: 582EA000111781
Date: 11/21/2011 02:30 PM
Payment Method: CC - Authorization 0000002259 Amount Paid: $100.00 Fee Paid: NONHAZARDOUS WASTE PERMIT - NEW, AMENDMENTS & MODIFICATIONS RN Number: RN100215599 Site Name: MCCOMBS MUNICIPAL LANDFILL Site Address: 13660 MCCOMBS, EL PASO, TX 79924 Site Location:
CN Number: CN601410244
Customer Name: CITY OF EL PASO
Customer Address: 7968 SAN PAULO, EL PASO, TX 79907 Billing Name: MIGUEL PARRA P E Billing Address: 7968 SAN PAULO, EL PASO, TX 79907
---
Voucher: 144047
Trace Number: 582EA000111781
Date: 11/21/2011 02:30 PM
Payment Method: CC - Authorization 0000002259 Amount Paid: $50.00 Fee Paid: 30 TAC 305.53B HWP NOTIFICATION FEE
---
==========
To print out a copy of the receipt and vouchers for this transaction either click on or copy and paste the following url into your browser:
https://www6.tceq.state.tx.us/epay/index.cfm?fuseaction=cor.search&trace_num_txt=582EA000111781.

This e-mail transmission and any attachments are believed to have been sent free of any virus or other defect that might affect any computer system into which it is received and opened. It is, however, the recipient's responsibility to ensure that the e-mail transmission and any attachments are virus free, and the sender accepts no responsibility for any damage that may in any way arise from their use.

EPAY
TEXAS COMMISSION ON ENVIRONMENTAL QUALITY



**Print this voucher for your records. If you are sending the TCEQ hardcopy documents related to this payment, include a copy of this voucher.**

**Transaction Information**

| | |
|---|---|
| **Voucher Number:** | 144046 |
| **Trace Number:** | 582EA000111781 |
| **Date:** | 11/21/2011 02:30 PM |
| **Payment Method:** | CC - Authorization 0000002259 |
| **Amount:** | $100.00 |
| **Fee Type:** | Hazardous Waste Permit Application Fee |
| **ePay Actor:** | Miguel Parra |
| **Actor Email:** | parramx@elpasotexas.gov |
| **IP:** | 209.194.208.124 |

**Payment Contact Information**

| | |
|---|---|
| **Name:** | Miguel Parra P E |
| **Company:** | City Of El Paso |
| **Address:** | 7968 San Paulo, El Paso, TX 79907 |
| **Phone:** | 915-599-6235 |

**Site Information**

| | |
|---|---|
| **RN:** | RN100215599 |
| **Site Name:** | MCCOMBS MUNICIPAL LANDFILL |
| **Site Address:** | 13660 MCCOMBS, EL PASO, TX 79924 |

**Customer Information**

| | |
|---|---|
| **CN:** | CN601410244 |
| **Customer Name:** | CITY OF EL PASO |
| **Customer Address:** | 7968 SAN PAULO, EL PASO, TX 79907 |

**Billing Information**

| | |
|---|---|
| **Site Name:** | MIGUEL PARRA P E |
| **Site Address:** | 7968 SAN PAULO, EL PASO, TX 79907 |

Close



Last Modified 12/4/08
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EPAY
TEXAS COMMISSION ON ENVIRONMENTAL QUALITY



**Print this voucher for your records. If you are sending the TCEQ hardcopy documents related to this payment, include a copy of this voucher.**

**Transaction Information**

| | |
|---|---|
| **Voucher Number:** | 144047 |
| **Trace Number:** | 582EA000111781 |
| **Date:** | 11/21/2011 02:30 PM |
| **Payment Method:** | CC - Authorization 0000002259 |
| **Amount:** | $50.00 |
| **Fee Type:** | POSTAGE-HWP-HAZ WASTE PERMIT |
| **ePay Actor:** | Miguel Parra |
| **Actor Email:** | parramx@elpasotexas.gov |
| **IP:** | 209.194.208.124 |

**Payment Contact Information**

| | |
|---|---|
| **Name:** | Miguel Parra P E |
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Report

# Major Permit Amendment – Part II
# McCombs Municipal Landfill
# El Paso County, Texas
# TCEQ MSW Permit No. 729B

Prepared for: City of El Paso

Revised June 2013, Revision 5

SAIC

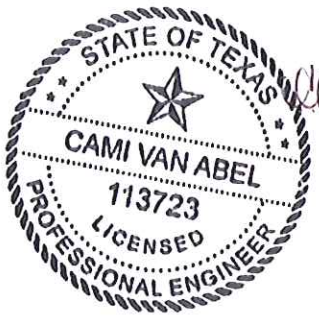
# McCombs Municipal Landfill
# El Paso County, Texas
# TCEQ MSW Permit No. 729B

# Major Permit Amendment Application
# Part II

Prepared for

**City of El Paso**

Updated June 2013, Revision 5

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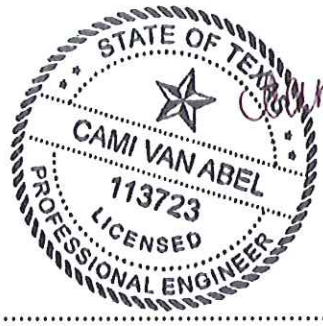


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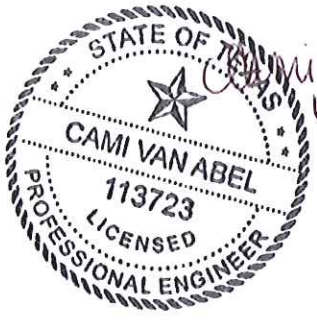

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| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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MCCOMBS LANDFILL
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## LEGEND

| EXISTING | FUTURE | DESCRIPTION |
|---|---|---|
| MW-3 | MW-5 | MONITORING WELL |
| GMP-8, GRP-1 | | GAS MONITORING PROBE, GAS RECOVERY PROBE |
| △ | | PIEZOMETER |
| PV-7 | | VERTICAL GAS WELL |
| 1* | | SOIL BORING – LOCATION AND NUMBER PER DRA CONSULTANTS (MAY 1983) |
| 1RI | | SOIL BORING – LOCATION AND NUMBER PER DRA CONSULTANTS (NOVEMBER 1983) |
| 1 | | SOIL BORING – LOCATION AND NUMBER PER DICKINSON LABORATORIES (JUNE 1976) |
| △4 | | SURVEY CONTROL POINT |
| Ⓦ | | WATER WELL |
| | ◒ | LEACHATE COLLECTION PIPING CLEANOUT |
| | | BUILDING/STRUCTURE |
| 1500 | 1500 | ELEVATION CONTOURS |
| X X X | | CHAIN LINK OR OTHER FENCE |
| UGE UGE | | UNDERGROUND ELECTRIC |
| OHE OHE | | OVERHEAD ELECTRIC UTILITY |
| UGC UGC | | UNDERGROUND COMMUNICATIONS |
| GCCS | GCCS | GAS COLLECTION AND CONTROL SYSTEM |
| GMCS | | GAS MIGRATION CONTROL SYSTEM |
| | | FACILITY/PROPERTY BOUNDARY |
| | | 125' BUFFER ZONE |
| W W | | WATER LINE |
| | | STORMWATER RETENTION POND BOUNDARY |
| | | HIGHWAY |
| | | LANDFILL ACCESS ROAD |
| | | SECTION LINE |
| | | STORMWATER DRAINAGE DITCH AND FLOW DIRECTION |
| | | SECTOR BOUNDARIES |
| | Ⓐ | SECTOR DENOMINATION AND FILL DIRECTION |
| | | LEACHATE SUMP AND EXTRACTION PIPE |
| L L | | LEACHATE COLLECTION PIPING |
| | | DRAINAGE AREA BOUNDARY |
| | | FLOW DIRECTION |
| | | CLOSURE EXTENTS |

| EXISTING | FUTURE | DESCRIPTION |
|---|---|---|
| | | COMPACTED NATIVE SOIL |
| | | CALICHE SOIL |
| | | PROTECTIVE SOIL DRAINAGE MATERIAL OR BUFFER MATERIAL |
| | | COMMON BACKFILL/GENERAL FILL |
| | | PEA GRAVEL BACKFILL |
| | | TOPSOIL |
| | | DAILY/INTERMEDIATE COVER |
| | | EROSION LAYER |
| | | INFILTRATION LAYER |
| | | REFUSE |
| | | CONCRETE |
| | | AGGREGATE BACKFILL |
| | | AGGREGATE BASE COURSE |
| | | CLASS 5, AGGREGATE |
| | | SUBGRADE |
| | | BENTONITE |
| | | STEEL |
| | | 100 YEAR FLOOD PLAIN |
| | | PREPARED SUBGRADE |
| | | 60 MIL HDPE OR 40 MIL LLDPE GEOMEMBRANE LINER |
| | | GEOTEXTILE (CUSHION AND FILTER) |
| | | GEOGRID |
| | | GEOSYNTHETIC CLAY LINER (GCL) |
| | | EROSION CONTROL MATTING AND SEEDING |
| | | 6" DIA ROCK (UNLESS OTHERWISE SPECIFIED) OR RIPRAP |
| | | BURIED CULVERT |
| | | TREE LINE |

## ABBREVIATIONS

| | |
|---|---|
| & | AND |
| APPROX | APPROXIMATE |
| AZ | ARIZONA |
| BLDG | BUILDING |
| BOT | BOTTOM |
| C&D | CONSTRUCTION AND DEMOLITION DEBRIS |
| CB | CATCH BASIN |
| CFS | CUBIC FEET PER SECOND |
| ℄ | CENTERLINE |
| CLR | CLEAR |
| CM | CENTIMETERS |
| CMP | CORRUGATED METAL PIPE |
| CO | COMPANY, COUNTY |
| COEF | COEFFICIENT |
| CONC | CONCRETE |
| CONT | CONTINUOUS |
| CP | CONTROL POINT |
| CPE | CORRUGATED POLYETHYLENE |
| DEG | DEGREES |
| DEMO | DEMOLITION |
| DET | DETAIL |
| DIA | DIAMETER |
| DWG | DRAWING |
| E | EAST, EASTING |
| EL OR ELEV | ELEVATION |
| EQ | EQUAL |
| EW | EACH WAY |
| EX | EXISTING |
| GALV | GALVANIZED |
| GB | GRANULAR BED |
| GCCS | GAS COLLECTION AND CONTROL SYSTEM |
| GCL | GEOSYNTHETIC CLAY LINER |
| GMCS | GAS MIGRATION CONTROL SYSTEM |
| GMP | GAS MONITORING PROBE |
| GRP | GAS RECOVERY PROBE |
| GW | GAS WELL |
| GV | VERTICAL GAS WELL |
| HDPE | HIGH DENSITY POLYETHYLENE |
| ID | INSIDE DIAMETER |
| IE | INVERT ELEVATION |
| INC | INCORPORATED |
| L | LYSIMETER |
| LCO | LEACHATE CLEANOUT |
| LF | LANDFILL |
| LFG | LANDFILL GAS |
| LLDPE | LINEAR LOW DENSITY POLYETHYLENE |
| MAX | MAXIMUM |
| MFR | MANUFACTURER |
| MIN | MINIMUM |
| MSW | MUNICIPAL SOLID WASTE |
| MW | MONITORING WELL |
| N | NORTH, NORTHING |
| NAD | NORTH AMERICAN DATUM |
| NAVD | NORTH AMERICAN VERTICAL DATUM |
| NO | NUMBER |
| NPDES | NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM |
| NPT | NOMINAL PIPE THICKNESS |
| NSPS | STANDARD OF PERFORMANCE FOR NEW STATIONARY SOURCES |
| NTS | NOT TO SCALE |
| OC | ON CENTER |
| OPNG | OPENING |
| OSHA | OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION |
| P OR PZ | PIEZOMETER |
| PE | POLYETHYLENE |
| PERF | PERFORATED |
| PERM | PERMEABLE |
| POC | POINT OF CLOSURE |
| PSB | PUBLIC SERVICE BOARD |
| PT | POINT |
| PVC | POLYVINYL CHLORIDE |
| PV | VERTICAL GAS WELL |
| REINF | REINFORCED |
| REQD | REQUIRED |
| ROW | RIGHT-OF-WAY |
| S | STATION |
| SCH | SCHEDULE |
| SDR | STANDARD DIMENSION RATIO |
| SE | SOUTHEAST |
| SEC | SECOND |
| SHT | SHEET |
| SP | SPACING |
| SPEC | SPECIFICATION |
| SS OR SST | STAINLESS STEEL |
| SSR | SIDESLOPE RISER |
| SW | SOLID WASTE OR SOUTHWEST |
| TAC | TEXAS ADMINISTRATIVE CODE |
| TCEQ | TEXAS COMMISSION ON ENVIRONMENTAL QUALITY |
| TYP | TYPICAL |
| TX | TEXAS |
| UNO | UNLESS NOTED OTHERWISE |
| VERT | VERITCAL |
| W/ | WITH |
| W | WEST |

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STATE OF TEXAS
FREDRIC J. DORAN
111226
REGISTERED PROFESSIONAL ENGINEER
11/2/12

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| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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ABBREVIATIONS AND LEGEND

PROJECT NUMBER: 963150D115
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DRAWING NUMBER: P0-2

Keller, Tonya L. 10/15/2012 11:13:17 AM – P:\00218000 El Paso TX\963150D115\Data Analytical\CAD\P0-2 ABBREVIATIONS AND LEGEND.dwg

## 2.1.1 Existing Conditions Overview

The Landfill is located on approximately 347 acres in rural El Paso County, Texas and serves the greater City of El Paso area. The Landfill was originally permitted in 1976, with subsequent permitting to 327 acres in 1984. This MPA includes the addition of 19.4 acres to include the site entrance facilities within the permitted boundary. The development of the Landfill generally followed the progression of a sand and gravel quarry in that location.

The following summarizes the Landfill's permitting timeline from the TCEQ and its predecessors: Texas Natural Resource Conservation Commission (TNRCC) and the Texas Department of Health (TDH).

- **1976:** Original MSW Permit 729 issued by TDH.
- **1984:** Permit amendment completed to expand acreage from 25 acres to 327 acres. MSW Permit 729A was issued by TDH.
- **1995:** Alternative liner design approved.
- **2002:** Site Development Plan (SDP) permit modification completed.
- **2004:** Closure and post-closure care cost estimates updated.
- **2006:** Site Operating Plan (SOP) updated to comply with current regulations.
- **2009:** Landfill Gas Collection and Control System (GCCS) permit modification completed.
- **2009:** Groundwater Sampling and Analysis Plan permit modification completed.

The Landfill serves the MSW disposal needs of the City of El Paso area. This represents a metropolitan population of 620,456, according to 2009 projections from the United States Census Bureau. The Landfill also accepts waste from neighboring communities in El Paso County, Texas and from Doña Ana County, New Mexico.

As discussed in Section 1.1.2 – Supplementary Technical Report, in 2005, the City ceased regular solid waste disposal activities, and the majority of the City's MSW was diverted to the City's Clint Landfill as well as private facilities. During this period, the Landfill was primarily used for the disposal of storm debris and material generated from street cleanings. The City estimates that the Clint Landfill will undergo final closure activities in 2030, and wishes to return the Landfill to full activities to meet immediate and future solid waste disposal needs. To account for the expected increase in waste, the City developed a vertical expansion of the existing Landfill from 4,125 feet MSL to 4,305 feet MSL to meet their solid waste disposal needs.

## 2.1.2 Permits and Authorizations

The following Table 2.1-1 summarizes the existing permits and authorizations for the Landfill.

Table 2.1-1
Current McCombs Landfill Permits and Authorizations

| Permit Type | Permit Number |
|---|---|
| TCEQ Texas Pollutant Discharge Elimination System (TPDES) Stormwater Permit | TXR05L795 |
| TCEQ Air New Source Permit | 81742 |
| TCEQ Subchapter U: Standard Air Permit | 1749 |
| TCEQ Wastewater General Permit | 2E0000049 |

## 2.1.3 Site-Specific Conditions

In accordance with 30 TAC §330.61(a), a detailed discussion of the site-specific special conditions at the Landfill is included throughout Part II of this MPA application. Items discussed in Section 2.4 through Section 2.10 include the impact on the surrounding area, transportation, general geology and soils, groundwater and surface water, abandoned oil and water wells, floodplains and wetlands, and endangered or threatened species.

There are no existing site-specific conditions that require special design considerations or possible mitigation of conditions.

## 2.2.1 Sources and Characteristics of Waste

The majority of the waste that will be accepted by the Landfill will be classified as MSW (defined in 30 TAC §330.3(88)). MSW accepted in the lined portion of the Landfill will be typically generated from household, residential, commercial, institutional, municipal, manufacturing, industrial, recreational, and construction-demolition sources.

The Landfill also intends to accept construction and demolition (C&D) waste on top of the existing unlined landfill that will consist of (Class 3 like) inert wastes. More specifically, C&D waste will consist of (but is not limited to):

- Rock/stone;
- Concrete;
- Uncontaminated soil;
- Masonry (brick, stucco and plaster);
- Aluminum[1];
- Ceramic items;
- Conduit and pipes (free of asbestos);
- Glass;
- Inert Plastics (any voids in materials accepted will be removed upon waste compaction);
- Molded fiberglass; and
- Metal.[1];

The Landfill will also accept several types of special wastes as described in the Special Waste Acceptance Plan included in Part IV – Site Operating Plan. Acceptable special wastes include Class II industrial waste and municipal commercial waste such as treated medical waste, processed grease/grit trap waste, dead animals, slaughterhouse wastes, and petroleum-product or crude oil contaminated soil. The Landfill also intends to accept regulated asbestos containing material (RACM) as described in Section 4.9.22.

As per 30 TAC §330.15, the Landfill will not accept hazardous wastes for disposal. These hazardous wastes include lead acid storage batteries, do-it-yourself motor vehicle oil, used oil filters, whole used or scrap tires, refrigerators, freezers, air

[1] For C&D material to be used within the area of the piggyback liner profile (referred throughout as Scenario 3), metals (including aluminum) shall be limited to incidental amounts (no more than 5% per load).

conditioners, and other items containing chlorinated fluorocarbons (CFCs), bulk or non-containerized liquid waste, regulated hazardous waste as defined in 30 TAC §330.3, polychlorinated biphenyl (PCB) wastes, and radioactive materials.

Specific information regarding the movement of these wastes through the Landfill is discussed in Section 3.2.2.

## 2.2.2 Projected Waste Acceptance Rates

The Landfill will serve the communities, businesses and institutions in and around the City of El Paso, Texas. The facility ceased regular solid waste disposal activities in 2005 and has only received minimal waste from storm events and street cleanings in the past 5 years. This amounted to approximately 3,785 tons in FY 2010.

The Landfill will continue accepting only minimal waste from 2011 through 2013. Based on research of the current waste stream and conversations with City staff, SAIC estimates that the Landfill may receive approximately 497,309 tons per year (TPY) starting in 2014. In general, this acceptance rate will likely increase over the life of the Landfill due to an expected increase in the population served, but may vary due to conditions in the solid waste market.

The estimated maximum annual waste acceptance rate for the Landfill projected for five years is summarized in Table 2.2-1.

Table 2.2-1
Estimated Maximum Annual Waste Acceptance
(FY 2011 to FY 2015)

| FY | Estimated Maximum Waste Acceptance Rate (Tons) |
|---|---|
| 2011 | 3,000 |
| 2012 | 3,000 |
| 2013 | 3,000 |
| 2014 | 497,309 |
| 2015 | 507,255 |

Once the vertical expansion is approved, the Landfill will have a remaining disposal capacity of approximately 69,433,530 cubic yards (CY) of soil and waste. This will allow the Landfill to have adequate capacity through approximately 2059 or 2060, depending on final cover, assuming that the City's Clint Landfill undergoes closure in the year 2030 and all of the City's MSW disposal needs are met by the McCombs Landfill.

## 2.2.3 Population Equivalent

According to 30 TAC §330.3, the population equivalent is defined as the hypothetical population that would generate an amount of solid waste equivalent to that actually being managed based on a generation rate of five pounds per capita per day and applied to situations involving solid waste not necessarily generated by individuals. It is assumed, for the purpose of this section, that the average volume per ton of waste

entering a municipal solid waste disposal facility is three cubic yards. The projected population equivalent for the Landfill is calculated in Table 2.2-2.

Table 2.2-2
Projected Population Equivalent for McCombs Landfill

| | 2012 | 2020 | 2030 | 2040 |
|---|---|---|---|---|
| Waste Accepted (ton/yr) | 3,000 | 560,050 | 1,517,107 | 1,849,345 |
| Waste Accepted (ton/day)[1] | 8.219 | 1,534 | 4,156 | 5,067 |
| Waste Accepted (lb/day)[2] | 16,438 | 3,068,767 | 8,312,915 | 10,133,397 |
| Population Equivalent[3] | 3,288 | 613,753 | 1,662,583 | 2,026,679 |

1. Assumes waste generation 365 days per year.
2. Assumes 2,000 lb per ton.
3. Assumes per capita generation rate of 5 pounds as per 30 TAC §330.3.

## 2.3.1 General Location Maps

As required by 30 TAC §330.61(c), general location maps have been provided in Appendix 2A - Maps. These maps have been provided in addition to those required by 30 TAC §330.59(c) relating to contents in Part I of the application and present information on the general character of the surrounding land. The required information per 30 TAC §330.61(c) and the information location within the report is summarized below:

> *"1) the prevailing wind direction with a wind rose;"*

The wind rose provided from TCEQ is shown on Drawing P1-3 (Appendix 1A). The wind rose period of record is from 1984 to 1992. The wind rose frequency of occurrence of winds is plotted in the sixteen points of the compass, with a maximum of six wind speed classes for each direction.

> *"2) all known water wells within 500 feet of the proposed permit boundary with the state well numbering system designation for Water Development Board "located wells";"*

Known water wells within 500-feet are provided in Section 2.4.2.

> *"3) all structures and inhabitable buildings within 500 feet of the proposed facility;"*

Three buildings were identified within 500-feet of the facility boundary. These buildings include the CEMEX Quarry office and scale house and site trailers.

> *"4) schools, licensed day-care facilities, churches, hospitals, cemeteries, ponds, lakes, and residential, commercial, and recreational areas within one mile of the facility;"*

Drawing P2-3 provides a land use map for the Landfill within one mile of the facility. Residential, commercial, and recreational areas are shown within this boundary. Table 2.4B-1 also provides a breakdown of the areas within the one mile radius by land use. Additionally, as stated, there are no schools, licensed day-care facilities, churches, hospitals, cemeteries or lakes within one mile of the Landfill. One man-made pond was identified approximately 1,800-feet east of the facility. The pond is part of the CEMEX quarry area for stormwater control and is dry most of the year. It should also be noted that due to ongoing quarry operations, the size, number, and location of man-made ponds may vary at different times during mining operations.

> *"5) the location and surface type of all roads within one mile of the facility that will normally be used by the owner or operator for entering or leaving the facility;"*

The three main roads to be used by the facility (McCombs St, Stan Roberts Sr. Ave, and State Line Drive; locations shown on P2-1) are two-lane asphalt paved roads.

*" 6) latitudes and longitudes;"*

The latitudes and longitudes of the facility are provided on Drawings P2-1 and P2-2.

*"7) area streams;"*

There were not any streams identified within a 1-mile radius of the facility.

*"8) airports within six miles of the facility;"*

Airport locations within the vicinity of the facility are provided in Drawing P2-4.

*"9) the property boundary of the facility;"*

The property boundary is shown on several drawings included in Appendix 2A.

*"10) drainage, pipeline, and utility easements within or adjacent to the facility;"*

Facility easements are provided on Drawing P2-7 and are also discussed in Section 4.9.6.

*"11) facility access control features; and"*

Access to the Landfill is restricted by an existing barbed wire fence located along the perimeter of the facility as well as a locking gate at the facility entrance as depicted on Drawing P2-7.0 and as described in Section 3.2.1.

*"12) archaeological sites, historical sites, and sites with exceptional aesthetic qualities adjacent to the facility."*

As stated in Appendix 2B – Land Use Analysis, Page 2B-3, no archaeologically significant sites, historical sites, or locations of exceptional aesthetic quality were located within one-mile of the Landfill.

## 2.3.2 Facility Layout Maps

Facility layout maps have been provided in Appendix 2A - Maps, as per the requirements set forth in 30 TAC §330.61(d). These maps have been prepared to show the outline of the landfill units, general locations of the main interior facility roadways, locations of monitoring wells, locations of buildings, fencing, natural windbreaks, site entrance roads, and a delineation of the landfill sectors including sequencing of excavation and filling activities.

Existing earthen berms along the western and northern boundaries of the Landfill provide a method of visual screening for the facility.

## 2.3.3 General Topographic Map

Consistent with the regulations set forth in 30 TAC §330.61(e), United States Geologic Survey (USGS) 7 ½ minute quadrangle sheets for El Paso County have been provided to show the topography of the site. This general topographic map is

provided in Appendix 2A – Maps and is shown at a scale of one inch equals 2,000 feet.

## 2.3.4 Aerial Photograph

A series of aerial photographs have been provided in Appendix 2A – Maps as Drawings P2-5 and P2-6. Drawing P2-5 is from an aerial survey completed in February 2011 by Cooper Aerial Surveys Company. This aerial survey was utilized to determine the existing topography at the site. Drawing P2-6 has been provided from Google Earth to meet the requirements set forth in 30 TAC §330.61(f). This aerial photograph has a scale of approximately 1,050 feet equals one inch and shows the area within a one mile radius of the Landfill. This Google Earth image is based on source data from the Texas Ortho Imagery Program and the United States Department of Agriculture (USDA) from April 1, 2008 to June 13, 2010.

## 2.3.5 Land Use Map

As per the requirements in 30 TAC §330.61(g), a land use map has been provided in Appendix 2A – Maps. This map has been prepared using county-provided parcel data from El Paso County, Texas and Doña Ana County, New Mexico to depict land uses within one mile of the Landfill. A detailed written examination of this parcel data can be found in Appendix 2B – Land Use Analysis.

## 2.4.1 Impact on Surrounding Area

As per the requirements set forth in 30 TAC §330.61(h), an evaluation of the impact on the surrounding area was completed for the Landfill. A detailed land-use analysis is included as Appendix 2B – Land Use Analysis. This analysis includes information on zoning for the area within two miles of the property, the character of the surrounding land within one mile of the property, growth trends within five miles of the property, and the proximity of residences and other places of interest within one mile of the facility.

## 2.4.2 Wells Within 500 Feet of Landfill

Consistent with 30 TAC §330.61(c)(2), Drawing P2-23 - Land Use Map of Appendix 2B includes all known water wells within 500 feet of the Landfill. The location, identification and use of each of the water wells is summarized below in Table 2.4-1. As can be seen in this table, four wells are located within the specified radius, none of which are used for domestic supply.

Table 2.4-1
Known Water Wells within 500 Feet of Landfill

| Well Number[1] | Well Use | Latitude | Longitude |
|---|---|---|---|
| 4905309 | Unused | 32.00083 | -106.410 |
| 4905314 | Industrial Use | 31.99028 | -106.408 |
| 4905315 | Industrial Use | 31.99055 | -106.408 |
| 4905325 | Not Classified | 31.99972 | -106.409 |

1. Well number is designated by the Texas Water Development Board state numbering system.

To comply with the regulations in 30 TAC §330.61(h)(5), a search of the Texas Railroad Commission (TRRC) oil and gas well database was conducted in February 2011. This search did not identify any oil and gas wells within the property boundary or within 500 feet of the Landfill.

## 2.5.1 Overview

Consistent with the requirements set forth in 30 TAC §330.61(i), a Traffic Impact Analysis (TIA) was conducted by the City's Department of Transportation for the area immediately surrounding the Landfill. This TIA is included as Appendix 2C – Transportation Study and provides data on:

- The availability and adequacy of access roads for the site;
- Volume of vehicular traffic on access roads within one mile of the facility, both existing and expected, during the life of the facility; and
- The expected traffic volume to be generated by the facility on the access roads within one mile of the facility.

Documentation of coordination between the City and Edgar E. Fino from the Texas Department of Transportation (TxDOT) concerning the future roadway improvements and traffic and location restrictions is provided in Appendix 2C – Transportation Report.

## 2.5.2 Airport Safety

Pursuant to 30 TAC §330.61(i)(5), an evaluation of the facility was completed in accordance with 30 TAC §330.545(a). The identified airports within the general vicinity of the Landfill are provided in Appendix 2A – Maps. The Biggs Army Airfield was identified as being located approximately 9 miles from the Landfill and the El Paso International Airport was identified as being located approximately 11 miles from the Landfill. Additionally, correspondence was submitted to the Federal Aviation Administration to ensure that the Landfill is not:

1. Located within 10,000 feet of any airport runway end used by turbojet aircraft;
2. Within 5,000 feet of any airport runway end used by only piston-type aircraft;
3. Within a six mile radius of any small general service airport runway end used by turbojet or piston-type aircraft; or
4. Within a five mile radius of any large general public commercial airport runway end used by turbojet or piston-type aircraft.

Documentation of this correspondence is also provided in Appendix 2C.

Consistent with §330.61(j)(1)-(4), a general discussion of the geology and soils of the site has been prepared. Detailed discussion of the geology of the site can be found in Section 3.5 of this application. This statement was prepared based on documents submitted for the McCombs Landfill in previous permit modifications with referenced documents provided in the appendices of this major permit amendment.

## 2.6.1 Topography

The original topography of the site was likely hilly. Subsequent quarrying and landfilling operations have significantly modified the natural conditions of the site. The present topography is dominated by large depressions; remnants of the quarrying operations that may range up to 30 feet deep. The landfill areas are currently built-up to elevations over 40 feet above land surface.

## 2.6.2 General Geology[1]

The McCombs Landfill is located within the Rio Grande Rift portion of the Mexican Highlands section of the Basin and Range Physiographic Province (Fnneman, 1931 and Thornbury, 1965). The Mexican Highlands Section is an area of variable geologic structure characterized by high desert valleys and mountain ranges and is subdivided into the Bolson and Rio Grande subsections (Hawley, 1975). The Bolson Subsections cover a large area of southwestern New Mexico, portions of Texas, Chihuahua, Mexico and Arizona. This region is characterized by broad intermontane basins with internal drainage, called bolsons, that are bounded by fault-block mountain ranges.

The mountain ranges on the eastern side of the Bolson subsection trend in a general north-to-northwest direction and typically flank sizeable basins, including the Hueco Bolson in which the site is located (Thornbury, 1965). The Rio Grande Valley in incised into thick deposits of basin fill at the southern end of the Hueco Bolson typically ranging in age from Pliocene to Holocene. A broad alluvial plain with gently sloping terraces characterize the valley of the Rio Grande River.

Tectonic basin formation began in the region in the early Miocene. With basin development, erosion and subsequent deposition of the Santa Fe Group sediments occurred (Gile, et al, 1981; Strain, 1966). Renewed faulting in Late Miocene and Pliocene time, coupled with uplift, produced a series of en echelon grabens, such as the Mesilla and Hueco Bolson that characterize this section of the Rio Grande Rift Valley. These bolsons received several thousands of feet of sediment during the Late Cenozoic (Strain, 1966). The ancestral Rio Grande River flowed into the closed

[1] Site Characterization and Monitoring Plan, McCombs Municipal Landfill, El Paso, Texas, SHB-AGRA, October 1993 (Appendix 3K, Attachment 1)

basins in the area during the Pliestocene depositing thick sequences of sediment and forming an ephemeral lake (Strain, 1969).

The Hueco Bolson deposits were divided into two rock stratigraphic units, the Fort Hancock Formation and the Camp Rice Formation (Strain, 1969). The older Fort Hancock Formation is a massive unit composed of poorly consolidated clays, silt and fine-grained sands. In the early Pleistocene time, adjacent basins aggraded to levels sufficient to coalesce with the Hueco Bolson. Periods of high precipitation resulted in the formation of a large ephemeral lake system, Lake Cabeza de Vaca (Strain, 1966). Deposits of fine-grained sediments in the Hueco Bolson continued until an outlet to the southeast formed in the early Pliestocene. This outlet breached Lake Cabeza de Vaca and changed the depositional environment from predominantly lacustrine to fluvial (Strain, 1980).

The Camp Rice Formation unconformably overlies the Fort Hancock Formation and is primarily composed of gravel, sand, silt and occasional discontinuous lenses of volcanic ash. The Camp Rice Formation is composed of two basic subdivisions, a fluvial and a piedmont facies (Gile, et al, 1981). The fluvial facies is chiefly sand to pebbly river-channel deposits with subordinate fine-grained overbank units. This facies thickens toward the bolson axes and commonly wedges out against the piedmont facies. The permitted landfill area is probably underlain by fluvial deposits of the Camp Rice Formation.

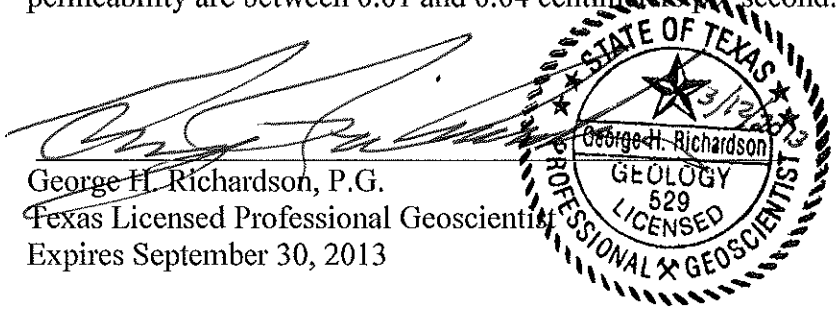
## 2.6.3 General Soils

The McCombs Landfill is located on deposits of the Hueco Bolson, probably Camp Rice Formation. These deposits primarily consist of clay, sand, and gravel, with some caliche. The landfill site is underlain by Tertiary and Quaternary basin (bolson) deposits, overlain by areas of gravel and caliche rimrock. Recent Quaternary alluvial deposits are also present in the landfill vicinity in topographically low areas.

Boring logs for wells drilled on site to depths greater than 500 feet generally indicate deposits of:

- 0 – 50 feet Sand, and sand and gravel;
- 50-250 feet Sand, with some clay;
- 250-470 feet Sand and fine gravel mix; and
- 470-560 feet Sandy clay.

In general, the relatively clean sands are non-plastic, while sandy clay ranges from low to high plasticity. Permeability tests were not considered necessary based on the soil types encountered during the site characterization. Estimated coefficients of permeability are between 0.01 and 0.04 centimeters per second.

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## 2.6.4 Fault Areas[2]

The fault area restriction states that no new landfill units or lateral expansions can be placed within 200 feet of a fault that has experienced Holocene displacement. This restriction provides for minimal setbacks from actual fault traces since faults can result in damage to the landfill's integrity through:

- Movement along the fault causing displacement;
- Seismic activity associated with faulting resulting in seismic shaking of facility structures; and
- Seismic shaking resulting in slope failures.

The original permit states that "...an Eastern Boundary Fault Zone exists between the Franklin Mountains and the Hueco Bolson deposits" and "...assuming continuous movement this (movement of the fault) would equate to approximately 0.005 inches per year" (DRA, 1984).

Since several Quaternary faults have been identified within and at the margins of the Hueco Bolson, SHB reviewed recent published geologic mapping and literature to evaluate the proximity and age of known faults in the vicinity of the McCombs Landfill.

Numerous fault scarps of Quaternary age are preset in the Hueco Bolson near the Landfill. One inferred scarp apparently traverses the northeastern quadrant of the Landfill permit area (SHB, 1993). This fault was not identified on the geologic map prepared by Harbour (1972). Insufficient information is available to confirm or refute the presence of the fault. This fault is more than 200 feet from any existing or proposed Landfill units. Other north-south trending scarps are also apparent in the area.

The age of faulting in Hueco Bolson has been dated as less than 0.5 million years (m.y.), based on offset in the Camp Rice Formation and in soils formed on the Camp Rice formation (Seager 1980). A report by Collins and Raney (1991), indicates that those faults near the site displace deposits of middle Pliestocene age (approximately 200,000 to 900,000 years old). Evidence of displacement of younger deposits have not been documented either because younger sediments do not exist along the fault traces or have been covered by windblown sand. Collins and Raney (1991) point out that movement on the basin bounding the East Franklin Mountains located a few miles to the west of the landfill may be as young as Holocene. Other basin bounding faults and some of the intragraben faults (such as those near the Landfill) most recently experienced rupture during the middle to late Pliestocene. More precise dating of the faults has not been performed, however, it is apparent that the faults have recurrence intervals of more than 10,000 years; otherwise the fault traces would be more clearly defined.

[2] Evaluation of Location Restrictions, McCombs Landfill, El Paso, Texas, SHB-AGRA June 1994 (Appendix 3K, Attachment 4)

## 2.6.5 Seismic Impact Zones[2]

The seismic impact zone restrictions (30 TAC §330.557) states that "New municipal solid waste landfill (MSWLF) units and lateral expansions shall not located in seismic impact zones, unless the owner or operator demonstrates to the Director that all containment structures, including liners, leachate collection systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth materials for the site."

Under this regulation, a seismic risk zone is considered to be an area that has a 10 percent or more probability that the maximum horizontal acceleration in lithified material, expressed as a percentage of the earth's gravitational pull (g), will not exceed 0.10g in 250 years.

This regulation pertains to new MSWLF units and lateral expansions. This permit modification is a vertical expansion of the existing permitted Landfill and no new horizontal area will be opened under this permit modification. Based on the work completed by SHB-AGRA (1994) a review of USGS Miscellaneous Field Study Map MF-2121, "Probabilistic Earthquake Acceleration and Velocity Maps for the United States and Puerto Rico", (Algermissen, et. al, 1991) was conducted. El Paso County (and the Landfill) fall outside of any designated seismic impact zone.

The map on Figure 2-1 is from the USGS website:

http://earthquake.usgs.gov/hazards/apps/map/

Based on 2008 revised data, this map demonstrates the facility is located within a seismic impact zone and exceeds the 30 TAC §330.557 standard of 10 percent or more probability. The seismic impact zone restrictions only apply to new MSWLF units and lateral expansions. The permit modification for the Landfill is for a vertical expansion and no previously-undisturbed earth will be added to the Landfill boundary.

The acreage within the proposed facility boundary was increased for this permit amendment from 327.29 to 346.74 acres at the request of the TCEQ to reflect the existing Landfill buildings and retention ponds that were submitted and approved by the TCEQ under Permit Amendment 729A. These features included existing buildings associated with the landfill operations on property previously leased and now owned by the City of El Paso. Retention ponds within this area were designed by Moreno Cardenas, Inc. to handle runoff from existing buildings and infrastructure (Permit Amendment 729-A, December 2010) in accordance with the applicable codes in place at that time.

## 2.6.6 Unstable Areas

Consistent with 330.61(j)(4) and 330.559, unstable areas documentation was prepared and part of the application to demonstrate that the Landfill meets the location restriction for unstable area.

TCEQ regulations require the owner or operators of new MSWLF units, existing MSWLF units and lateral expansions located in an unstable area shall demonstrate that engineering measures have been incorporated into the MSWLF unit's design to

ensure that the integrity of the structural components of the MSWLF unit will not be disrupted.

An unstable area is defined by TCEQ as a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity of some or all of the landfill's structural components responsible for preventing releases from a landfill. An unstable area can exhibit poor foundation conditions, area susceptible to mass movement, and karst terrains.

### 2.6.6.1 Unstable Slopes

No landslide deposits in the vicinity of the Landfill are shown on any published geologic information and none have been identified during site visits (SHB-AGRA, 1994).

### 2.6.6.2 Karst

Several thousand feet of basin filling sediments occur beneath the Landfill. No limestone or other soluble units subject to karst formation exists in the vicinity (SHB-AGRA, 1994).

### 2.6.6.3 Subsidence

Subsidence has been documented in the El Paso metropolitan area as a result of groundwater withdrawal and subsequent decline in groundwater levels, especially in area having thick accumulations of clay in the subsurface. The Landfill is located in an area of documented groundwater withdrawal resulting in groundwater declines up to 40 feet (Ashworth 1990). No land surface subsidence has been documented in the vicinity of the Landfill (Land and Armstrong, 1985). Due to depth to groundwater, formation of large scale subsidence features is not anticipated, but cannot be precluded (SHB-AGRA, 1994)

### 2.6.6.4 Liquefaction

Since groundwater occurs at depths of 300-400 feet below land surface, no liquefaction concerns exist (SHB-AGRA, 1994).

## NOTES

1. BASE MAP FROM USGS
   http://earthquake.usgs.gov/hazards/apps/map/

2. PEAK GROUND ACCELERATION (%g) WITH 2% PROBABILITY OF EXCEEDANCE IN 50 YEARS. WHICH IS EQUIVALENT TO 10% PROBABILITY OF EXCEEDANCE IN 250 YEARS.

Figure 2-1
US SEISMIC HAZARD 2008
McCombs Landfill, El Paso, Texas

SAIC

## 2.7.1 Groundwater Conditions

Consistent with §330.61(k)(1), a discussion of groundwater conditions at and near the facility was prepared. Data pertaining to the hydrogeology of the area and groundwater beneath the Landfill are provided in the reports *Site Characterization and Monitoring Plan, McCombs Municipal Landfill, El Paso, Texas* included in Appendix 3K, Attachment 1 and *Groundwater Monitoring System Installation, City of El Paso McCombs Landfill* included in Appendix 3L, Attachment 1.

The regional groundwater system in the area primarily consists of the Hueco Bolson aquifers. The Hueco Bolson is divided into the City Artesian area, the Mesa area and the Lower Valley (Leggart, 1962). The Mesa area extends north of the City Artesian area into New Mexico and east to the Hueco Mountains. The Landfill is located within the Mesa area.

Two aquifers occur in these areas: an upper aquifer in the Rio Grande alluvium and a lower aquifer in the Hueco Bolson deposits. Since no known impermeable zone of regional extent separates these aquifers, the Rio Grande alluvium and the Hueco Bolson are considered to be, at least in part, hydrologically connected in the City Artesian and Lower Valley areas (Alvared and Buckner, 1980). The Mesa area primarily consists of Hueco Bolson deposits. Historic withdrawals of groundwater since 1906 for public water supply and irrigation have caused major declines in the water levels. The average water level decline in the Hueco Bolson from 1903 to 1980 is approximately 53 feet (White, 1987).

Locally, recharge to the aquifer occurs due to mountain front infiltration of precipitation from the surface and from the injection of treated sewage into the aquifer from the Hueco Bolson Recharge Project (White and Sladek, 1990). Numerous injection wells were constructed northeast of El Paso and water from the Fred Hervey Water Treatment Plant has been injected into the aquifer by El Paso Water Utilities (EPWU) since the mid-1980s. Since 1991, EPWU has been selling water to El Paso Electric Company for use as cooling water at the Newman Plant, thus less water has been injected into the aquifer (Sperka, 1993).

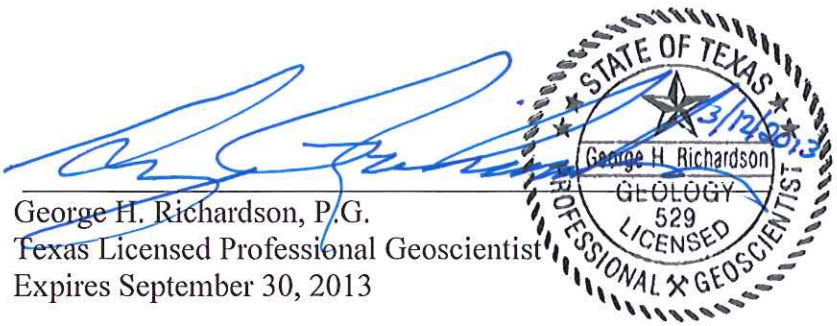
Based on available information, regional groundwater flow direction in the McCombs Landfill area is to the south-southeast. Groundwater movement in the area is generally less than 1.0 feet per day (White, 1987). EPWU groundwater data indicate that the static groundwater elevation in the area is between 3,670 and 3,675 feet MSL or approximately 370 to 390 feet below ground surface (EPWU, 1993).

Groundwater conditions at the site were determined using data from three groundwater monitoring wells constructed in 2003 around the landfill as part of the approved Subtitle D groundwater monitoring system. Water levels data from December 6, 2010

indicates ground water beneath the site occur approximately 390 to 398 feet below land surface, with corresponding elevations of 3,677 to 3,686 feet AMSI. Based on groundwater level measurements at the site, groundwater flow direction is S70° East or to the east-southeast.

Parkhill, Smith & Copper (PSC) completing an additional hydrogeologic evaluation for the Landfill that included the installation of two additional monitoring wells PZ-4 and PZ-5. Data collected from August 2011 through July 2012 indicate groundwater flow direction is predominately to the east/southeast, likely influenced by the drawdown from the Cemex well located near the southeast corner of the landfill and just north of Stan Roberts Road. The PSC report also notes a northwest component of groundwater flow in the southwest portion of the site.

The site-specific groundwater flow direction correlates with regional groundwater flow direction within the Hueco Bolson aquifer.

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## 2.7.2 Surface Water Conditions

Surface water conditions for the development of the site was designed to be consistent with 30 TAC 330.61(k). The surface water drainage report and design is included in Section 3.3 – Facility Surface Water Drainage Report.

The Landfill is located in the city limits of El Paso and encompasses a total of 347 acres. The surrounding areas are generally unpopulated and are predominantly undeveloped, agricultural or industrial.

Currently, stormwater on site is directed away from active portions of the landfill by ditches designed for the 25-year storm event. The ditches direct water to the three onsite stormwater retention ponds. These ponds are designed to hold the 100-year storm event as well as contingency storage for sediment. Stormwater runoff is collected in a v-ditch around the perimeter of the landfill units and is directed into an existing stormwater pond on the southeastern corner. Runoff from north of the existing landfill is currently captured within the mined pit area. Some of the runoff in the northwest corner continues to the site of existing Retention Pond A. Runoff generated to the east is captured in the mined pit area. Runoff generated in the existing landfill areas is conveyed into existing Retention Pond D, west of the existing fee house, and existing Retention Pond E, in the southeastern corner of the developed landfill area. These exiting stormwater patterns are shown on Drawing P3-4, Existing Drainage Conditions, in Appendix 3C.

Four ponds will exist in the final cover condition. The final contours include four ponds to break up drainage areas (the existing Retention Ponds A and E, and Ponds B and C), and in effect reduce sheet flow and minimize erosion. Existing Pond D is no longer needed as that area is filled to grade and flow is conveyed in a v-ditch to Pond E. Perimeter ditches will be constructed as the landfill final contours are approached. These ditches will direct water to the retention ponds where they will retain the 100-year event and sediment. The landfill will provide care and management, both during construction and long term, of soil erosion and control of sediment due to surface water.

The care and management of soil erosion and sedimentation is outlined in Part III – Erosion and Sedimentation Control Plan. The facility will prevent discharge of pollutants to waters of the state. There are no waters of the United States or Corps of Engineers' jurisdictional waters of the state on site, therefore, no Section 404 permit is required. The Landfill submitted a notice of intent (NOI) to comply with the Texas Pollutant Discharge Elimination System (TPDES) Stormwater Permit relating to stormwater discharge and received Permit No. TX05L795 from the TCEQ on October 28, 2011. A copy of this permit is included in Appendix 2D – TPDES Multi-Sector General Permit.

## 2.8.1 Abandoned Water Wells

No known abandoned water wells exist within the permit boundary of the Landfill. Existing water wells are identified on the Land Use Map located in Appendix 2A – Maps and a description of each well is noted in Section 2.4.2.

If an abandoned water well is indentified, the City shall provide the executive director with a written certification that all such wells have been capped, plugged, and closed in accordance with all applicable rules and regulations of the commission or other state agency. This certification will be provided to the TCEQ within 30 days after the well has been properly plugged. If necessary, a permit modification will be submitted to the executive director if the identification of an abandoned water well affects the liner installation plan.

## 2.8.2 Abandoned Oil Wells

No abandoned crude oil or natural gas wells, or other wells associated with the mineral recover that are under the jurisdiction of the TRRC were found within the permit boundary at the Landfill. As noted in Section 2.4.2, a search of the TRRC oil and gas well database conducted in February of 2011 did not identify any existing oil or gas wells within the Landfill boundary or within 500 feet of the Landfill.

If an abandoned oil well is identified, the City shall provide the executive director with a written certification that all such wells have been properly capped, plugged, and closed in accordance with all applicable rules and regulations of the TRRC. This certification will be provided to the TCEQ within 30 days after the well has been properly plugged.

# Section 2.9
# FLOODPLAINS AND WETLANDS STATEMENT
30 TAC §330.61(m)

A floodplain restrictions and wetlands restrictions report was completed in June of 1994 by SHB AGRA Earth and Environmental (SHB) and is provided for reference in Appendix 3K, Attachment 4. Information from that report has been included in this statement to meet the requirements of 30 TAC §330.61(m).

## 2.9.1 Floodplains

According to 40 CFR §258.11**,** 30 TAC §330.307 and §330.547, "owners or operators of new MSWLF units, existing MSWLF units, and lateral expansions located in 100-year floodplains must demonstrate that the unit will not restrict the flow of the 100-year flood, reduce the temporary water storage capacity of the floodplain, or results in washout of solid waste so as to pose a hazard to human health and the environment."

As shown in the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) provided in Appendix 2E – Floodplains and Wetlands Documentation, a portion of the landfill is located within the 100-year floodplain. No waste disposal activities will occur in the section of the property lying within the 100-year floodplain. Instead, existing Retention Pond A has been designed to cover the area affected by the 100-year floodplain. Refer to Section 3.3 – Facility Surface Water Drainage Report for further details concerning the effects of the 100-year floodplain and the design of the stormwater detention ponds.

## 2.9.2 Wetlands

According to 30 TAC §330.553, new MSW landfill units, lateral expansions, and material recovery operations from a landfill shall not be located in wetlands, unless the owner or operator makes specific demonstrations to show that the landfill will not cause environmental harm.

Based on a 1982 map prepared by T.E. Dohl, the Landfill is not located in area designated as a wetland. This map is included in Appendix 2E – Floodplains and Wetlands Documentation.

# Section 2.10
# ENDANGERED SPECIES STATEMENT
30 TAC §330.61(n)

To meet the requirements of 30 TAC §330.61(n) and 30 TAC §330.551, a letter dated August 13, 1982 from the United States Fish and Wildlife Service (USFWS) has been included in Appendix 2F – Endangered Species Documentation. This letter was previously included in both the 1984 and 2002 permit amendment application submittals. Additionally, current correspondence between the Texas Parks and Wildlife Department (TPWD) and the U.S. Fish and Wildlife Service is also provided in Appendix 2F.

According to the 1982 USFWS letter, the American Peregrine Falcon may use the project site as a feeding area or pass through the area during migration. According to the information provided on the USFWS website, the American Peregrine Falcon was delisted from the federal endangered species list on August 25, 1999. However, the American Peregrine Falcon remains a State of Texas protected species. A copy of the USFWS species profile is also provided in Appendix 2F – Endangered Species Documentation.

As indicated in the USFWS letter, it is unlikely that the Landfill will have any effect on this species. However, if the American Peregrine Falcon were to be observed within the permitted landfill area, the employees will be instructed to follow the steps listed below:

1. Avoid contact with the bird;
2. Temporarily halt or move site operations to an area away from the bird's location to prevent disrupting the bird's activities while feeding or passing by the site;
3. Wait until the bird abandons the site on its own will; and
4. Resume normal site operations once the bird has taken flight.

In addition, Landfill personnel will be trained regarding the bird's physical characteristics and appearance in order to be able to identify it at once and with certainty during operations. This training will prevent unnecessary and unwarranted disruptions of site activities due to the presence of birds that may look similar to the American Peregrine Falcon.

According to the 2012 TPWD response letter, the following species have been listed as threatened or endangered under the Endangered Species Act (ESA) and have the potential to occur in El Paso County:

- Least Tern – Listed 08/28/1985
- Northern Aplomado Falcon – Listed 02/25/1986
- Mexican Spotted Owl – Listed 03/16/1993
- Southwestern Willow Flycatcher – Listed 02/27/1995

The following are state-listed threatened species that could potentially occur in the area:

- Texas Horned Lizard
- Mountain Short-Horned Lizard

The following are state-listed species of concern that could potentially occur in the area:

- Western Burrowing Owl
- Desert Night-Blooming Cereus

Further information regarding these species, their suitable habitats, and avoidance procedures are included in Appendix 2F.

# Section 2.11
# TEXAS HISTORICAL COMMISSION REVIEW
30 TAC §330.61(o)

As required by 30 TAC §330.61(o), a letter was submitted to the Texas Historical Commission to document compliance with the Natural Resources Code, Chapter 191, Texas Antiquities Code. This letter and the Texas Historical Commission response can be found in Appendix 2G – Texas Historical Commission Documentation.

# Appendix 2A
# Maps

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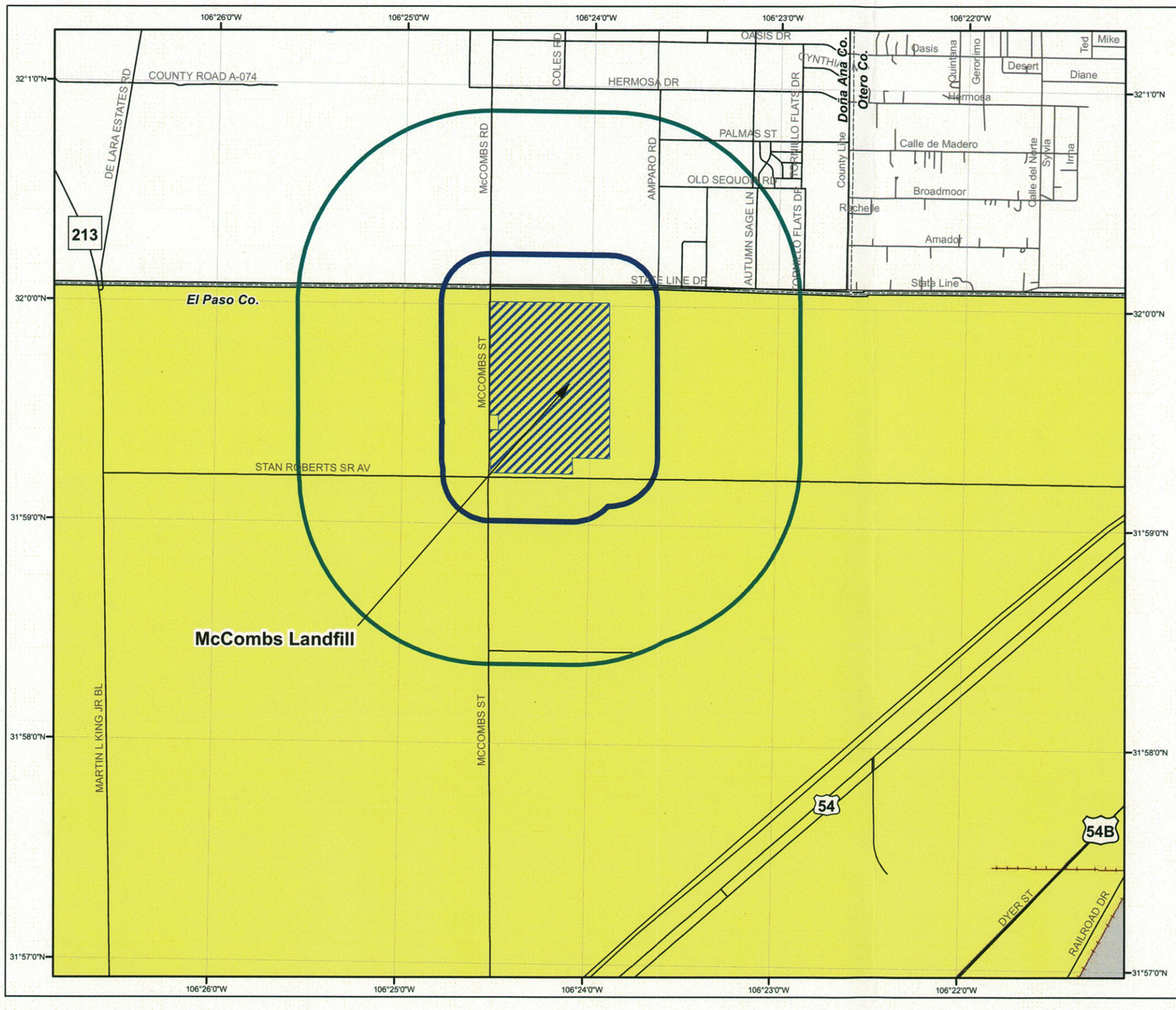


GRAPHIC SCALE

0 0.5 1 1.5 Miles

## Detailed Highway Map

- 0.25 Mile Radius Around Landfill
- 1 Mile Radius Around Landfill
- Landfill Boundary
- City of El Paso Municipal Area
- Fort Bliss
- County Boundary
- State Boundary

## NOTES

1. HIGHWAY DATA OBTAINED FROM THE DONA ANA COUNTY ASSESSOR'S OFFICE IN NEW MEXICO AND BY THE CITY OF EL PASO'S GEOGRAPHIC INFORMATION SYSTEMS DIVISION IN TEXAS.
2. MAP CREATED USING ARCGIS SOFTWARE VERSION 9.2, ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE (ESRI) STREETMAP DATA, 2005 AND PASO DEL NORTE MAPA GIS DATASETS, 2008.

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STATE OF TEXAS
FREDRIC J. DORAN
111226
REGISTERED
PROFESSIONAL ENGINEER
11/2/12

DESIGNED TLK
DRAWN CAD
VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 1/13/12 | FJD | CGL | ADMINISTRATIVE NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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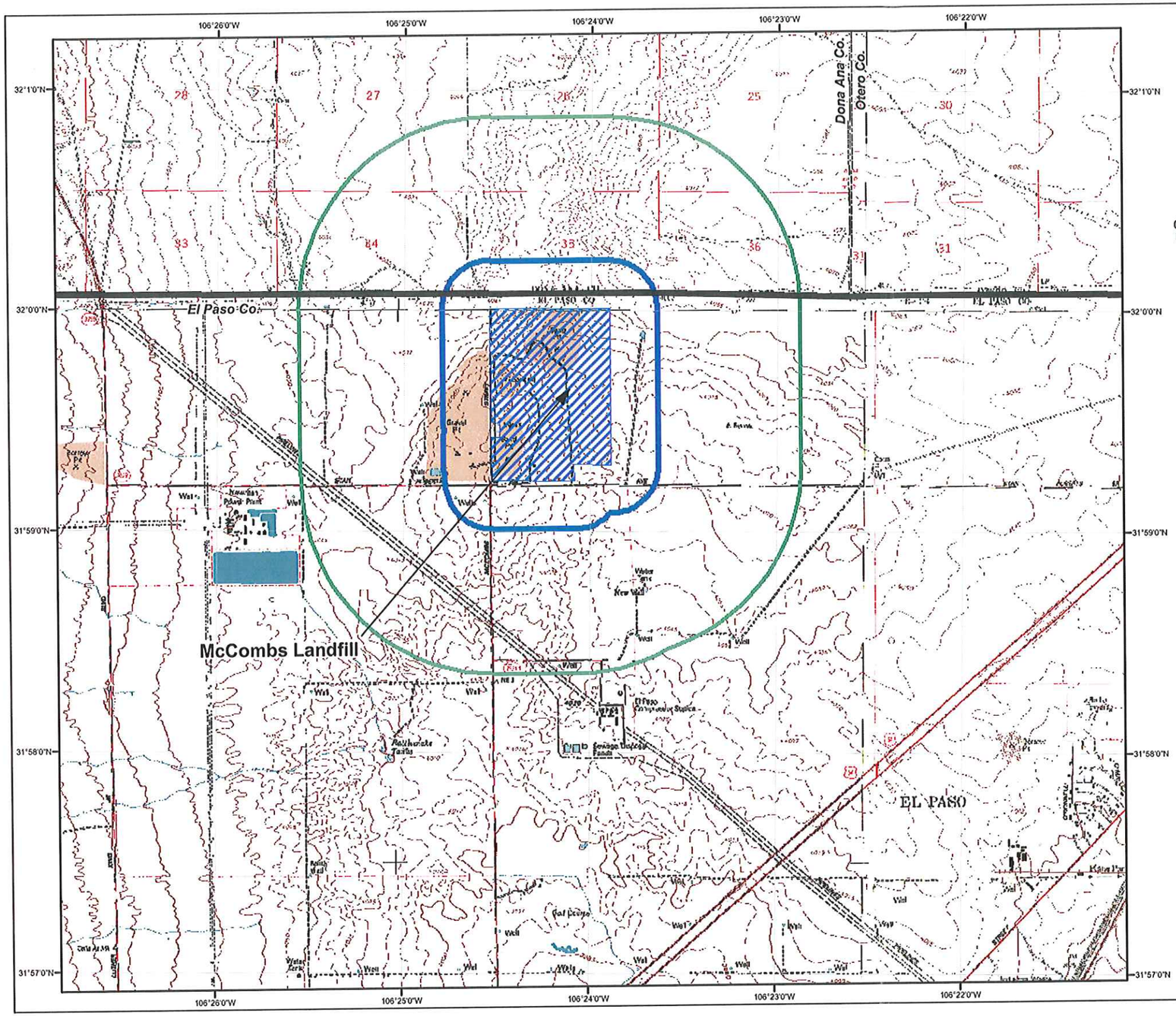
DETAILED HIGHWAY MAP

PROJECT NUMBER: 9631500115
SHT. 7 OF: 78
DRAWING NUMBER: P2-1

Keller, Tonya L. 10/29/2012 9:51:27 AM – P:\00218000 el paso tx\9631500115\data analytical\CADD\P2-1 DETAILED HIGHWAY MAP.dwg




GRAPHIC SCALE

0 0.5 1 1.5 Miles

## USGS 7.5 Minute Topographic Map

- Landfill Boundary
- 0.25 Mile Radius Around Landfill
- 1 Mile Radius Around Landfill
- County Boundary
- State Boundary

Quadrangles:
Fort Bliss NE, Texas - 1995
North Franklin Mountain, Texas - 1995
Newman, NM - 1955
Newman SW, NM - 1955

## NOTES

1. TOPOGRAPHIC DATA OBTAINED FROM USGS 7.5 MINUTE MAP.
2. CONTOUR INTERVAL IS FIVE FEET.
3. MAP CREATED USING ARCGIS SOFTWARE VERSION 9.2.
4. REFER TO DRAWING P1-3 FOR WIND ROSE.

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VERIFY SCALE BAR IS ONE INCH ON ANSI "D" DRAWING 0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 3 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 1/13/12 | FJD | CGL | ADMINISTRATIVE NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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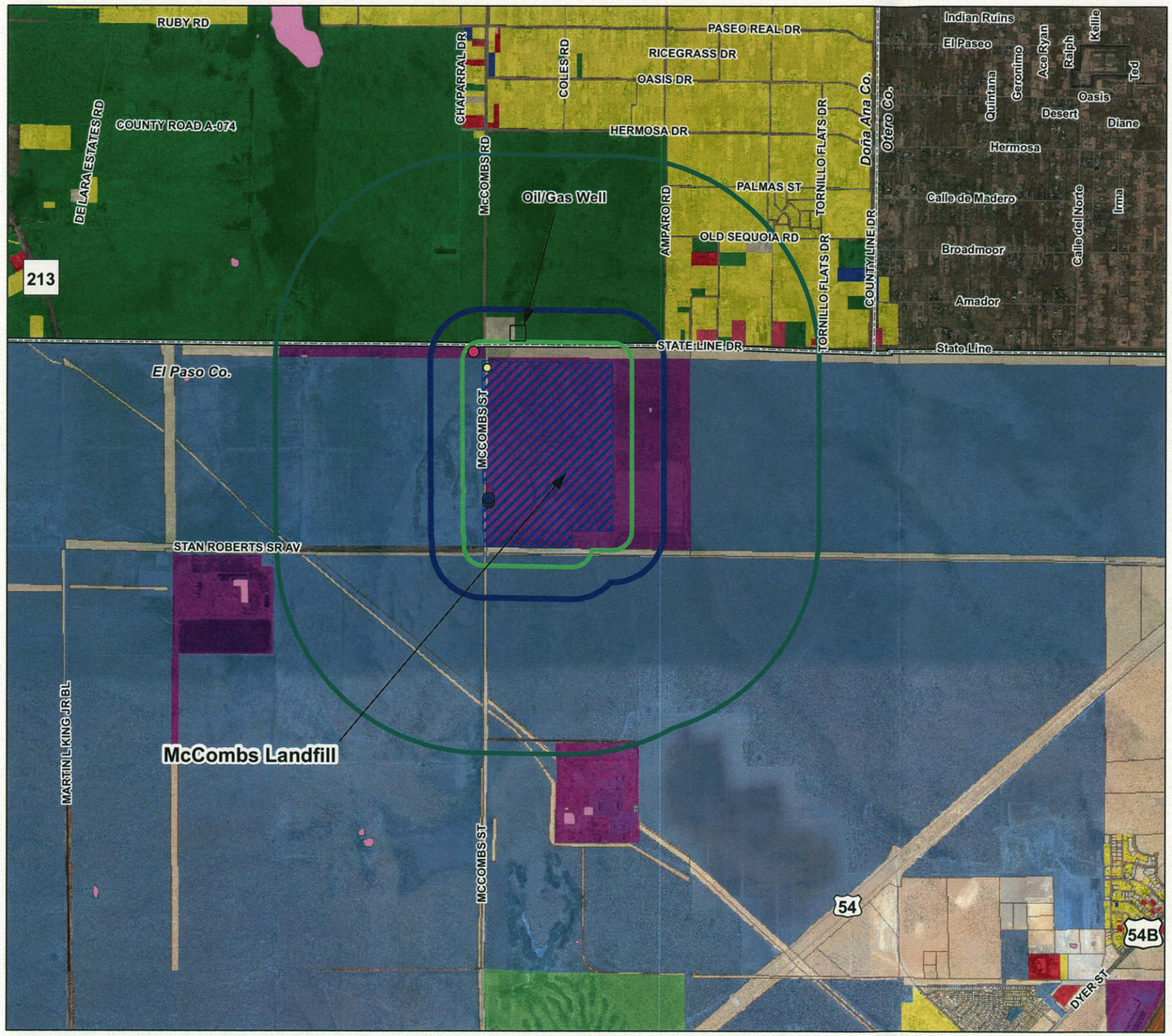
GENERAL TOPOGRAPHIC MAP

PROJECT NUMBER 9631500115
SHT. 8 OF: 78
DRAWING NUMBER P2-2

Von Abel, Cami A. 3/13/2013 10:05:47 AM – P:\00216000 El Paso TX\9631500115 – McCombs\Data Analysis\CAD\P2-2 GENERAL TOPOGRAPHIC MAP.dwg




GRAPHIC SCALE
0 0.5 1 1.5 Miles

## Land Use Map

### Water Wells (From TWDB Database)

- Industrial Use
- Unused
- Not Classified

### Existing Land Use

- City of El Paso
- Residential
- Mixed Use
- Commercial
- Industrial
- Public/Institutional
- Undeveloped
- Military
- ROW/Utility
- Parks and Open Space
- No Classified Activity
- 500 Foot Radius Around Landfill
- 0.25 mile radius Around Landfill
- 1 Mile Around Landfill
- Landfill Boundary
- County Boundary
- State Boundary

## NOTES

1. LAND USE MAP CREATED USING PARCEL DATA PROVIDED BY EL PASO COUNTY, TEXAS AND DOÑA ANA COUNTY, NEW MEXICO.
2. MAP CREATED USING ARCGIS SOFTWARE VERSION 9.2.
3. REFER TO APPENDIX 2B–LAND USE ANALYSIS FOR DETAILED INFORMATION ON THE LAND USE IN THE AREA.
4. NO ARCHAEOLOGICALLY SIGNIFICANT OR HISTORICAL SITES, LOCATIONS OF EXCEPTIONAL AESTHETIC QUALITY, SCHOOLS, LICENSED DAY–CARE FACILITIES, CHURCHES, CEMETERIES, HOSPITALS, LAKES OR STREAMS WERE IDENTIFIED WITHIN ONE MILE OF THE FACILITY BOUNDARY. ONE POND LOCATED APPROXIMATELY 1,800 FEET EAST OF THE FACILITY WAS IDENTIFIED. THE POND IS PART OF THE CEMEX QUARRY AREA FOR STORMWATER CONTROL AND IS DRY MOST OF THE YEAR.
5. REFER TO SECTION 2.4 FOR INFORMATION ON OIL, GAS AND WATER WELLS.

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VERIFY SCALE
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0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 3 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 2 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 1 | 1/13/12 | FJD | CGL | ADMINISTRATIVE NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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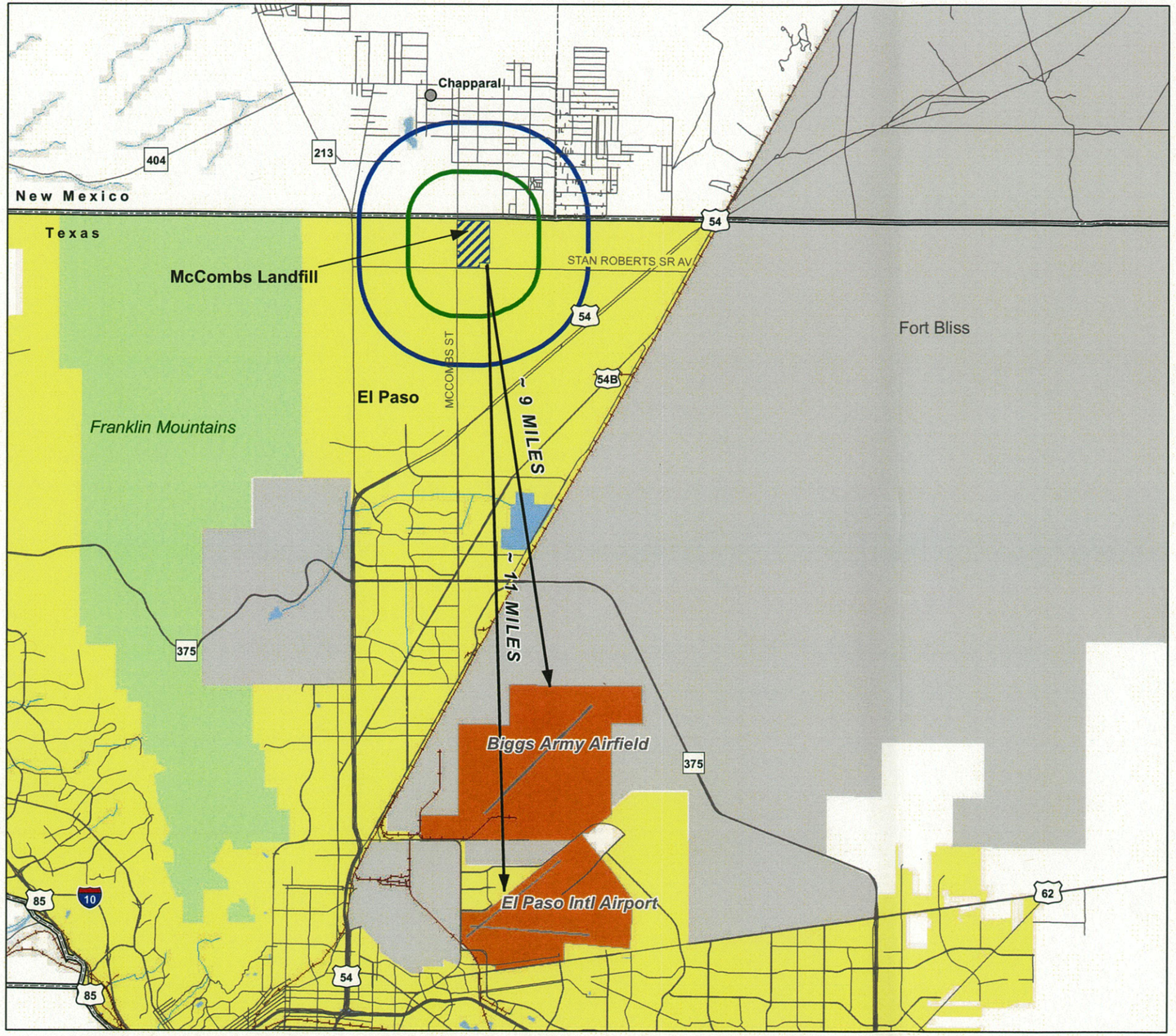
LAND USE MAP

PROJECT NUMBER: 9631500115
SHT. 9 OF: 78
DRAWING NUMBER: P2–3

Keller, Tonya L 10/29/2012 10:11:12 AM – P:\00218000 el paso tx\9631500115\data analytical\CADD\P2–3 LAND USE MAP.dwg




GRAPHIC SCALE
0 2 4 Miles

## Airport Location Map

- 5,000 Foot Radius Around Landfill
- 10,000 Foot Radius Around Landfill
- Airport/Airfield Area
- Landfill Boundary
- City of El Paso Municipal Area
- Fort Bliss
- County Boundary
- State Boundary

No airports are located within 10,000 feet of landfill.

**NOTES**

1. MAP CREATED USING ARCGIS SOFTWARE VERSION 9.2, ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE (ESRI) STREETMAP DATA, 2005 AND PASO DEL NORTE MAPA GIS DATASETS, 2008.

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11/2/12

| DESIGNED | DRAWN | VERIFY SCALE |
|---|---|---|
| TLK | CAD | BAR IS ONE INCH ON ANSI "D" DRAWING (0 – 1") |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 1/13/12 | FJD | CGL | ADMINISTRATIVE NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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AIRPORT MAP

PROJECT NUMBER: 9631500115
SHT. 10 OF: 78
DRAWING NUMBER: P2-4

Keller, Tonya L. 10/29/2012 10:13:06 AM – P:\00218000 el paso tx\9631500115\data analytical\CADD\P2-4 AIRPORT MAP.dwg

## NOTES

1. AERIAL PHOTOGRAPH FROM SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, ARIZONA.

## LEGEND

| | |
|---|---|
| MW–3 | MONITORING WELL |
| GMP–8 | GAS MONITORING PROBE |
| △ | PIEZOMETER |
| — — — | FACILITY/PROPERTY BOUNDARY |
| - - - - - | SECTOR BOUNDARIES |
| ═══ | STORMWATER RETENTION POND BOUNDARY |

GRAPHIC SCALE
1"=250'–0"
250 0 250 500
Scale Feet

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11/2/12

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 1 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

DESIGNED TLK
DRAWN CAD
VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
0 1"

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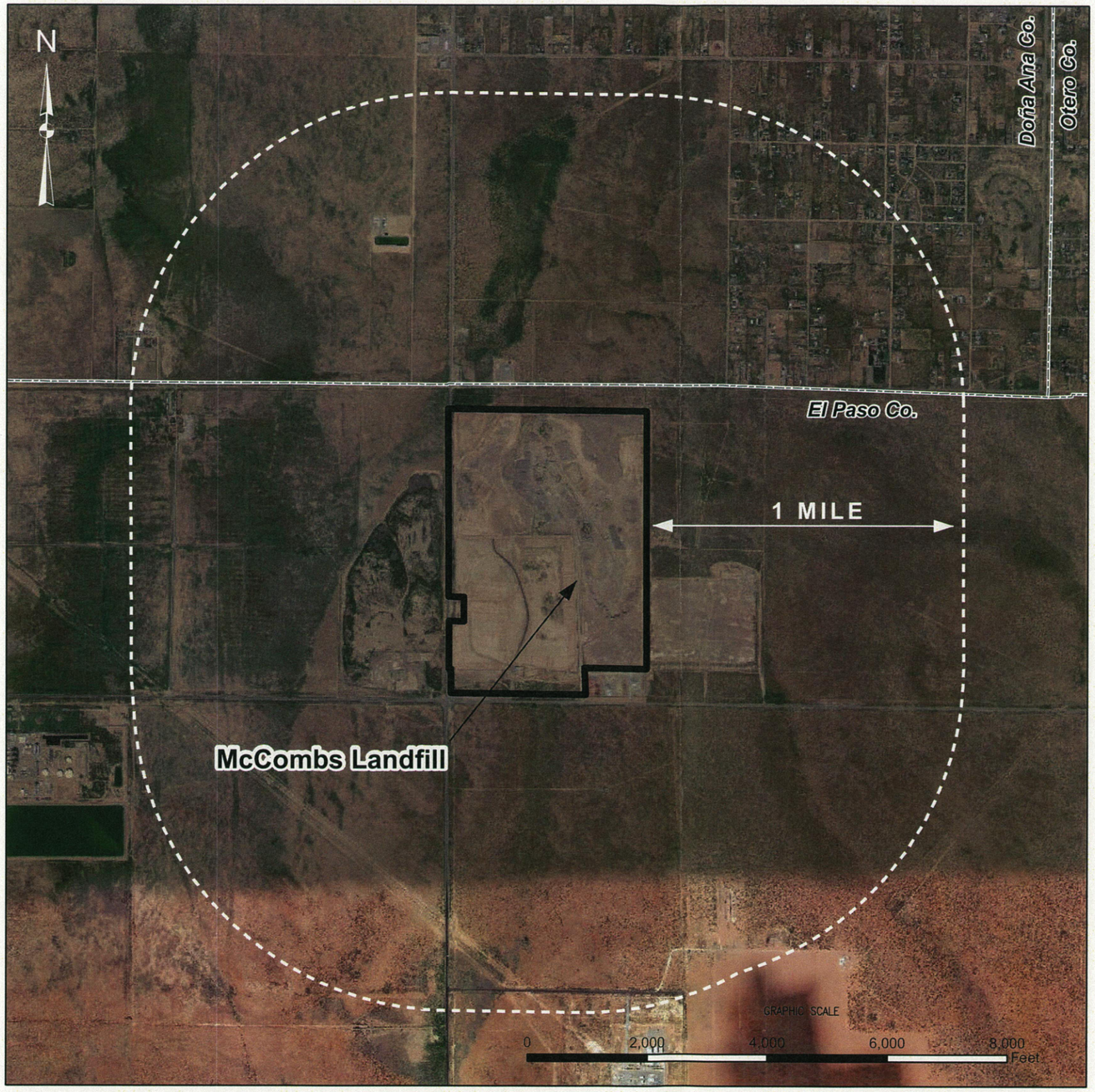
AERIAL PHOTOGRAPH

PROJECT NUMBER: 9631500115
SHT. 11 OF: 78
DRAWING NUMBER: P2–5

Keller, Tonya L. 10/16/2012 11:26:11 AM – P:\00218000 el paso tx\9631500115\data analysis\CADD\P2–5 AERIAL PHOTOGRAPH.dwg

## NOTES

1. MAP CREATED USING ARCGIS SOFTWARE VERSION 9.2.

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PROFESSIONAL ENGINEER
11/2/12

| DESIGNED | TLK |
|---|---|
| DRAWN | CAD |
| VERIFY SCALE | BAR IS ONE INCH ON ANSI "D" DRAWING |
| 0 | 1" |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 1 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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AERIAL PHOTOGRAPH – ONE MILE RADIUS

PROJECT NUMBER: 9631500115
SHT. 12 OF: 78
DRAWING NUMBER: P2–6

Keller, Tonya L. 10/29/2012 2:58:27 PM – P:\00218000 el paso tx\9631500115\data analytical\CADD\P2-6 AERIAL PHOTOGRAPH – ONE MILE RADIUS.dwg

## NOTES

1. DIGITIZED TOPOGRAPHY FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS.
2. COORDINATES ARE BASED ON THE TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NAD 83. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM. NAVD 88 DATUM TO NGVD 29 DATUM, SUBTRACT 1.99–FEET. NGVD 29 DATUM TO CITY OF EL PASO DATUM, ADD 27.65–FEET.
3. EXISTING CONTOUR INTERVAL IS TWO FEET.
4. SITE TOPOGRAPHY MAY VARY DUE TO OWNER'S OPERATIONS.

## LEGEND

| | |
|---|---|
| MW–3 | MONITORING WELL |
| GMP–8 | GAS MONITORING PROBE |
| GRP | GAS RECOVERY PROBE |
| △ | PIEZOMETER |
| PV–7 | VERTICAL GAS WELL |
| 1*, 1RI, 1 | SOIL BORING, TYPICAL |
| △4 | SURVEY CONTROL POINT |
| Ⓦ | WATER WELL |
| | BUILDING/STRUCTURE |
| 1500 | ELEVATION CONTOURS |
| —X—X—X— | CHAIN LINK OR OTHER FENCE |
| UGE | UNDERGROUND ELECTRIC |
| OHE | OVERHEAD ELECTRIC UTILITY |
| UGC | UNDERGROUND COMMUNICATIONS |
| GMCS | GAS MIGRATION CONTROL SYSTEM |
| | FACILITY/PROPERTY BOUNDARY |
| | SECTOR BOUNDARIES |
| | STORMWATER RETENTION POND BOUNDARY |
| W W | WATER LINE |
| | HIGHWAY |
| | LANDFILL ACCESS ROAD |
| | SECTION LINE |

GRAPHIC SCALE
1"=250'-0"
250 0 250 500
Scale Feet

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FREDRIC J. DORAN
111226
REGISTERED PROFESSIONAL ENGINEER
11/2/12

| DESIGNED | DRAWN | VERIFY SCALE |
|---|---|---|
| TLK | CAD | BAR IS ONE INCH ON ANSI "D" DRAWING (0 — 1") |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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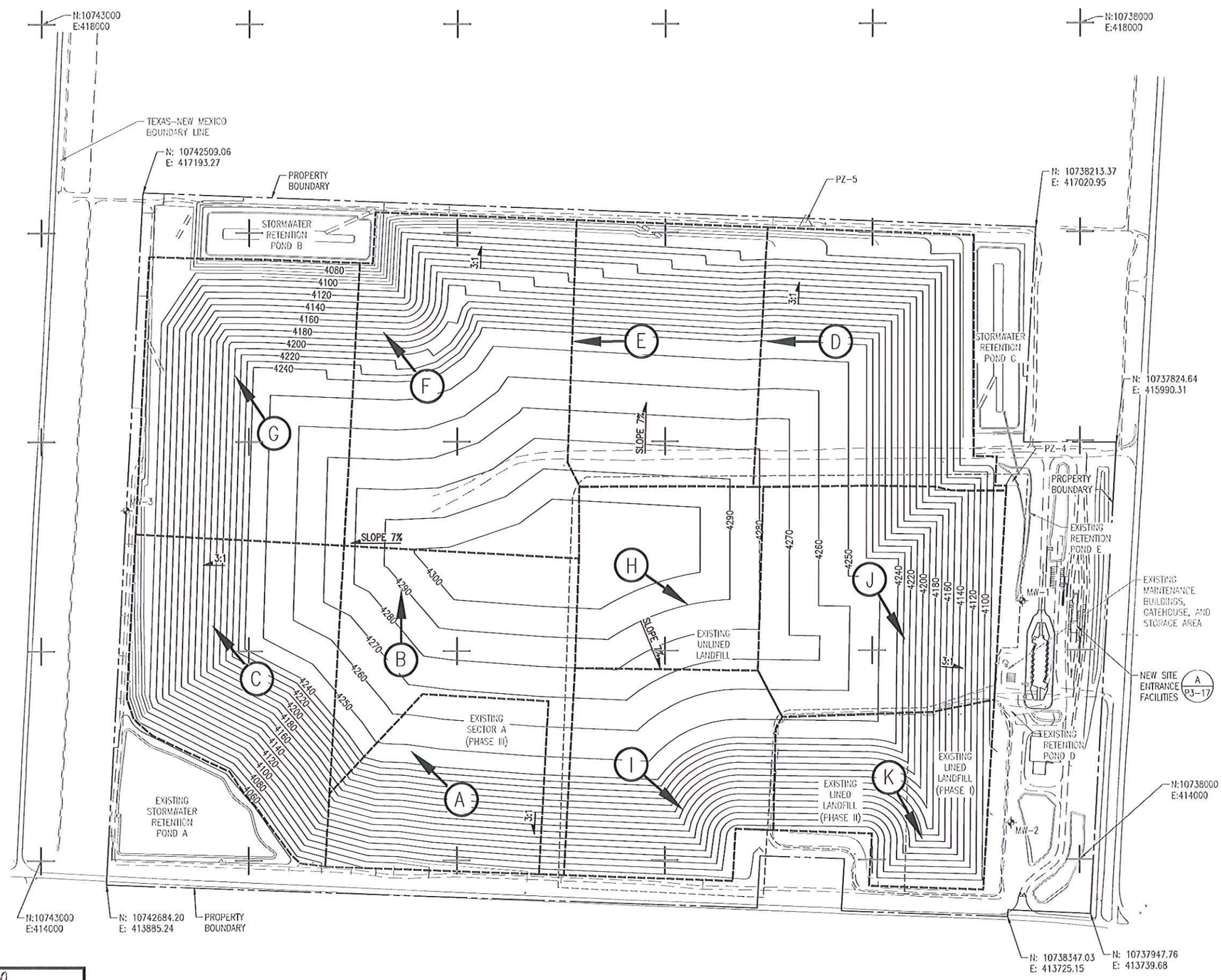
SITE LAYOUT PLAN – CURRENT CONDITIONS

PROJECT NUMBER: 9631500115
SHT. 13 OF: 78
DRAWING NUMBER: P2–7

Koller, Tonya L. 10/16/2012 11:19:00 AM – p:\00218000 el paso tx\9631500115\data analysis\CADD\P2–7 SITE LAYOUT PLAN – CURRENT CONDITIONS.dwg




## NOTES

1. DIGITIZED TOPOGRAPHY FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS.
2. COORDINATES ARE BASED ON THE TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NAD 83. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM. NAVD 88 DATUM TO NGVD 29 DATUM, SUBTRACT 1.99–FEET. NGVD 29 DATUM TO CITY OF EL PASO DATUM, ADD 27.65–FEET.
3. SITE TOPOGRAPHY MAY VARY DUE TO OWNER'S OPERATIONS.
4. FINAL COVER CONTOURS SHOWN ARE DESIGN CONTOURS.
5. FINAL COVER CONTOUR INTERVAL IS TEN FEET.
6. SECTORS WILL BE EXCAVATED AND FILLED BASED ON THE SEQUENCING LETTERS PROVIDED (I.E., A, B, C, ETC.)

## LEGEND

- MW-3 — MONITORING WELL
- △ — PIEZOMETER
- BUILDING/STRUCTURE
- 4050 — FUTURE ELEVATION CONTOURS
- FACILITY/PROPERTY BOUNDARY
- FUTURE SECTOR BOUNDARIES
- EXISTING SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- LANDFILL ACCESS ROAD
- A — SECTOR DENOMINATION AND FILL DIRECTION

GRAPHIC SCALE
1"=250'-0"
250 0 250 500
Scale Feet

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Ravi Jacob S. 5/30/2013 4:31:41 PM – R:\00218000 – El Paso TX\9631500115 – McCombs\Data Analysis\CAD\P2-8 SITE FACILITY LAYOUT.dwg

CAMI VAN ASEL
113723
REGISTERED PROFESSIONAL ENGINEER
STATE OF TEXAS
6/3/13

DESIGNED TLK
DRAWN CAD
VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 3 | 6/3/13 | JSR | CAV | FOURTH TECHNICAL NOD |
| 2 | 11/2/12 | TLK | CAV | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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SITE FACILITY LAYOUT

PROJECT NUMBER: 9631500115
SHT. 14 OF: 78
DRAWING NUMBER: P2-8

## NOTES

1. CONTOURS SHOWN REPRESENT DESIGN PHASING CONTOURS FOR SECTOR B DEVELOPMENT AND SUBSEQUENT SECTOR A INTERMEDIATE/FINAL COVER.
2. CONTOUR INTERVAL IS FIVE FEET. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM.
3. SECTOR B CONTOURS WILL BE TIED INTO EXISTING CONTOURS WITH A MAXIMUM 3:1 SLOPE.
4. SECTORS A THROUGH J WILL BE UTILIZED FOR MUNICIPAL SOLID WASTE PLACEMENT. SECTOR K WILL BE UTILIZED FOR CONTINUED MSW/ASBESTOS PLACEMENT DURING OTHER FILLING OPERATIONS.
5. ACTUAL LOCATION OF INTERIOR FACILITY ACCESS ROAD MAY VARY DEPENDENT ON SITE DEVELOPMENT AND OPERATOR DISCRETION.

## LEGEND

- MW-3 — MONITORING WELL
- PIEZOMETER
- BUILDING/STRUCTURE
- 4050 — FUTURE ELEVATION CONTOURS
- FACILITY/PROPERTY BOUNDARY
- FUTURE SECTOR BOUNDARIES
- EXISTING SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- FUTURE LANDFILL ACCESS ROAD
- EXISTING LANDFILL ACCESS ROAD
- STORMWATER FLOW DIRECTION

GRAPHIC SCALE

1"=200'-0" (200 0 200 400 Scale Feet)

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5/13/13

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DRAWN CAD
VERIFY SCALE BAR IS ONE INCH ON ANSI "D" DRAWING (0 — 1")

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 3 | 6/3/13 | JSR | CAV | FOURTH TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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CELL DEVELOPMENT PLAN – SECTOR B

PROJECT NUMBER: 9631500115
SHT. 15 OF: 78
DRAWING NUMBER: P2-9

Ron, Jacob S. 5/30/2013 4:33:08 PM – R:\0021800 – El Paso TX\9631500115 – McCombs\Data Analysis\CAD\P2-9 CELL DEVELOPMENT PLAN – SECTOR B.dwg

N: 10742509.06
E: 417193.27

N:10742000
E:417000

PROPERTY BOUNDARY

STORMWATER RETENTION POND B

PZ-5

N: 10738213.37
E: 417020.95

N:10738000
E:417000

SECTOR E

SECTOR D

SECTOR F

STORMWATER RETENTION POND C

SECTOR G

N: 10737824.64
E: 415990.31

POTENTIAL LOCATION OF INTERIOR ROADWAY, SEE NOTE 5

MW-3

1006'

PZ-4

EXISTING RETENTION POND E

PROPERTY BOUNDARY

4035

SECTOR DELINEATION BERM, TYP.

4
P3-29

SECTOR H

SECTOR J

MW-1

785'

SECTOR C

SECTOR B

EXISTING MAINTENANCE BUILDINGS, GATEHOUSE, AND STORAGE AREA

EXISTING UNLINED LANDFILL

4030

1534'

EXISTING SECTOR A (PHASE III)

4200
4180
4160
4140
4120

100'
125'
407'

SECTOR A

4240
4220
4200
4180
4160
4140
4120
4100

SECTOR I

SECTOR K
EXISTING LINED LANDFILL (PHASE II)

EXISTING LINED LANDFILL (PHASE I)

NEW SITE ENTRANCE FACILITIES

A
P3-17

EXISTING STORMWATER RETENTION POND A

556'

MW-2

POTENTIAL FINAL COVER EXTENTS (CLOSURE AREA = 6.6 ACRES)

121'

N:10738000
E:414000

N: 10742684.20
E: 413885.24

PROPERTY BOUNDARY

N:10742000
E:414000

N: 10738347.03
E: 413725.15

N: 10737947.76
E: 413739.68

GRAPHIC SCALE

1"=200'-0"

200 0 200 400

Scale Feet

## NOTES

1. CONTOURS SHOWN REPRESENT DESIGN PHASING CONTOURS FOR SECTOR C DEVELOPMENT AND SUBSEQUENT SECTOR B INTERMEDIATE/FINAL COVER.
2. CONTOUR INTERVAL IS FIVE FEET. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM.
3. SECTOR C CONTOURS WILL BE TIED INTO EXISTING CONTOURS WITH A MAXIMUM 3:1 SLOPE.
4. SECTORS A THROUGH J WILL BE UTILIZED FOR MUNICIPAL SOLID WASTE PLACEMENT. SECTOR K WILL BE UTILIZED FOR CONTINUED MSW/ASBESTOS PLACEMENT DURING OTHER FILLING OPERATIONS.
5. ACTUAL LOCATION OF INTERIOR FACILITY ACCESS ROAD MAY VARY DEPENDENT ON SITE DEVELOPMENT AND OPERATOR DISCRETION.

## LEGEND

- MW-3 — MONITORING WELL
- △ — PIEZOMETER
- BUILDING/STRUCTURE
- 4050 — FUTURE ELEVATION CONTOURS
- FACILITY/PROPERTY BOUNDARY
- FUTURE SECTOR BOUNDARIES
- EXISTING SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- FUTURE LANDFILL ACCESS ROAD
- EXISTING LANDFILL ACCESS ROAD
- STORMWATER FLOW DIRECTION

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Rec. Jacob S. 5/30/2013 4:34:04 PM - R:\00218000 - El Paso, TX\9631500115 - McCombs\Data Analytical\CADD\P2-10 CELL DEVELOPMENT PLAN - SECTOR C.dwg

CAMI VAN ABEL
STATE OF TEXAS
113723
REGISTERED PROFESSIONAL ENGINEER
5/31/13

DESIGNED TLK
DRAWN CAD
VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 3 | 6/3/13 | JSR | CAV | FOURTH TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

CELL DEVELOPMENT PLAN – SECTOR C

PROJECT NUMBER: 9631500115

SHT. 16 OF: 78

DRAWING NUMBER: P2-10

N: 10742509.06
E: 417193.27

N:10742000
E:417000

PROPERTY BOUNDARY

STORMWATER RETENTION POND B

POTENTIAL LOCATION OF INTERIOR ROADWAY, SEE NOTE 5

PZ-5

994'

SECTOR DELINEATION BERM, TYP.

4
P3-29

N: 10738213.37
E: 417020.95

N:10738000
E:417000

SECTOR E

SECTOR F

SECTOR G

SECTOR D

1244'

925'

4040

4050

4060

4030

1058'

STORMWATER RETENTION POND C

N: 10737824.64
E: 415990.31

MW-3

111'

139'

24'

PZ-4

879'

77'

264'

55'

PROPERTY BOUNDARY

EXISTING RETENTION POND E

SECTOR H

SECTOR J

MW-1

EXISTING MAINTENANCE BUILDINGS, GATEHOUSE, AND STORAGE AREA

SECTOR C

SECTOR B

EXISTING UNLINED LANDFILL

EXISTING SECTOR A (PHASE III)

4260
4200
4180
4160
4140
4120

SECTOR A

4240
4220
4200
4180
4160
4140
4120
4100

SECTOR I

POTENTIAL FINAL COVER EXTENTS (CLOSURE AREA = 32.0 ACRES)

SECTOR K
EXISTING LINED LANDFILL (PHASE II)

EXISTING LINED LANDFILL (PHASE I)

NEW SITE ENTRANCE FACILITIES

A
P3-17

MW-2

N:10738000
E:414000

EXISTING STORMWATER RETENTION POND A

N: 10742684.20
E: 413885.24

PROPERTY BOUNDARY

N:10742000
E:414000

N: 10738347.03
E: 413725.15

N: 10737947.76
E: 413739.68

GRAPHIC SCALE

1"=200'-0"

200 0 200 400

Scale Feet

## NOTES

1. CONTOURS SHOWN REPRESENT DESIGN PHASING CONTOURS FOR SECTOR D DEVELOPMENT AND SUBSEQUENT SECTOR C INTERMEDIATE/FINAL COVER.
2. CONTOUR INTERVAL IS FIVE FEET. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM.
3. SECTOR D CONTOURS WILL BE TIED INTO EXISTING CONTOURS WITH A MAXIMUM 3:1 SLOPE.
4. SECTORS A THROUGH J WILL BE UTILIZED FOR MUNICIPAL SOLID WASTE PLACEMENT. SECTOR K WILL BE UTILIZED FOR CONTINUED MSW/ASBESTOS PLACEMENT DURING OTHER FILLING OPERATIONS.
5. ACTUAL LOCATION OF INTERIOR FACILITY ACCESS ROAD MAY VARY DEPENDENT ON SITE DEVELOPMENT AND OPERATOR DISCRETION.

## LEGEND

- MW-3 — MONITORING WELL
- PIEZOMETER
- BUILDING/STRUCTURE
- 4050 — FUTURE ELEVATION CONTOURS
- FACILITY/PROPERTY BOUNDARY
- FUTURE SECTOR BOUNDARIES
- EXISTING SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- FUTURE LANDFILL ACCESS ROAD
- EXISTING LANDFILL ACCESS ROAD
- STORMWATER FLOW DIRECTION

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Cami Vanabel 6/3/13

STATE OF TEXAS
CAMI VAN ABEL
113723
REGISTERED PROFESSIONAL ENGINEER

| | |
|---|---|
| DESIGNED | TLK |
| DRAWN | CAD |
| VERIFY SCALE | BAR IS ONE INCH ON ANSI "D" DRAWING |
| | 0 — 1" |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 3 | 6/3/13 | JSR | CAV | FOURTH TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SBK | MAJOR PERMIT AMENDMENT |

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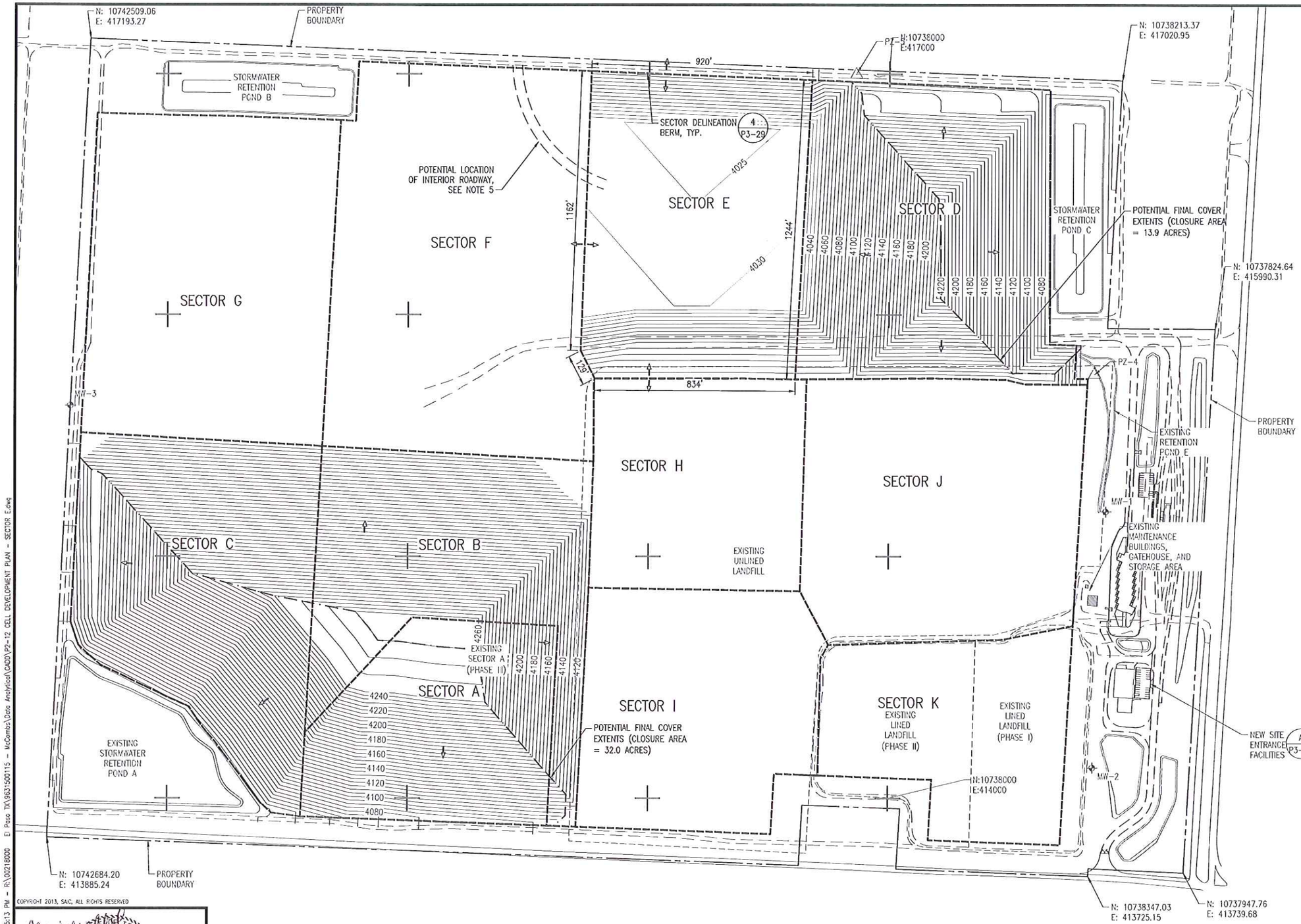
CELL DEVELOPMENT PLAN – SECTOR D

PROJECT NUMBER 9631500115

SHT. 17 OF: 78

DRAWING NUMBER P2-11

Roc, Jacob S, 5/30/2013 4:34:51 PM – R:\00218000 El Paso TX\9631500115 – McCombs\Data Analytical\CADD\P2-11 CELL DEVELOPMENT PLAN – SECTOR D.dwg




## NOTES

1. CONTOURS SHOWN REPRESENT PHASING DESIGN CONTOURS FOR SECTOR E DEVELOPMENT AND SUBSEQUENT SECTOR D INTERMEDIATE/FINAL COVER.
2. CONTOUR INTERVAL IS FIVE FEET. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM.
3. SECTOR E CONTOURS WILL BE TIED INTO EXISTING CONTOURS WITH A MAXIMUM 3:1 SLOPE.
4. SECTOR A THROUGH J WILL BE UTILIZED FOR MUNICIPAL SOLID WASTE PLACEMENT. SECTOR K WILL BE UTILIZED FOR CONTINUED MSW/ASBESTOS PLACEMENT DURING OTHER FILLING OPERATIONS.
5. ACTUAL LOCATION OF INTERIOR FACILITY ACCESS ROAD MAY VARY DEPENDENT ON SITE DEVELOPMENT AND OPERATOR DISCRETION.

## LEGEND

- MW-3 — MONITORING WELL
- PIEZOVETER
- BUILDING/STRUCTURE
- 4050 — FUTURE ELEVATION CONTOURS
- FACILITY/PROPERTY BOUNDARY
- FUTURE SECTOR BOUNDARIES
- EXISTING SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- FUTURE LANDFILL ACCESS ROAD
- EXISTING LANDFILL ACCESS ROAD
- STORMWATER FLOW DIRECTION

GRAPHIC SCALE

1"=200'-0" 200 0 200 400 Scale Feet

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Cami Van Abel 6/3/13
STATE OF TEXAS
CAMI VAN ABEL
113723
REGISTERED PROFESSIONAL ENGINEER

DESIGNED TLK
DRAWN CAD
VERIFY SCALE BAR IS ONE INCH ON ANSI "D" DRAWING 0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 3 | 6/3/13 | JSR | CAV | FOURTH TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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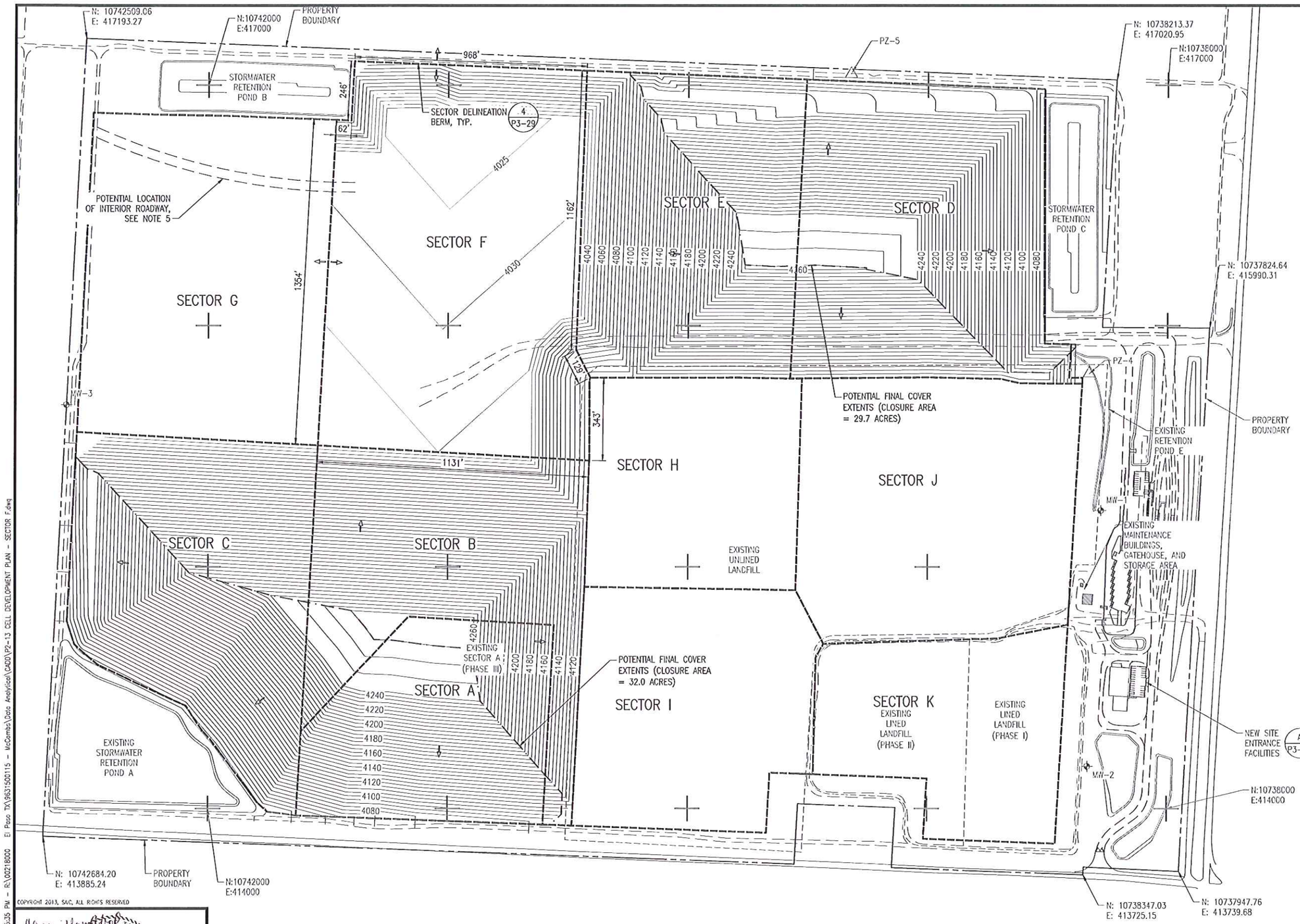
CELL DEVELOPMENT PLAN – SECTOR E

PROJECT NUMBER: 9631500115
SHT. 18 OF: 78
DRAWING NUMBER: P2-12

Ron, Jacob S. 5/30/2013 4:35:13 PM – R:\00218000 El Paso TX\9631500115 – McCombs\Data Analytical\CADD\P2-12 CELL DEVELOPMENT PLAN – SECTOR E.dwg




## NOTES

1. CONTOURS SHOWN REPRESENT DESIGN PHASING CONTOURS FOR SECTOR F DEVELOPMENT AND SUBSEQUENT SECTOR E INTERMEDIATE/FINAL COVER.
2. CONTOUR INTERVAL IS FIVE FEET. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM.
3. SECTOR F CONTOURS WILL BE TIED INTO EXISTING CONTOURS WITH A MAXIMUM 3:1 SLOPE.
4. SECTOR A THROUGH J WILL BE UTILIZED FOR MUNICIPAL SOLID WASTE PLACEMENT. SECTOR K WILL BE UTILIZED FOR CONTINUED MSW/ASBESTOS PLACEMENT DURING OTHER FILLING OPERATIONS.
5. ACTUAL LOCATION OF INTERIOR FACILITY ACCESS ROAD MAY VARY DEPENDENT ON SITE DEVELOPMENT AND OPERATOR DISCRETION.

## LEGEND

- MW-3 — MONITORING WELL
- PIEZOMETER
- BUILDING/STRUCTURE
- 4050 — FUTURE ELEVATION CONTOURS
- FACILITY/PROPERTY BOUNDARY
- FUTURE SECTOR BOUNDARIES
- EXISTING SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- FUTURE LANDFILL ACCESS ROAD
- EXISTING LANDFILL ACCESS ROAD
- STORMWATER FLOW DIRECTION

GRAPHIC SCALE

1"=200'-0" — 200 0 200 400 — Scale Feet

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Ron, Jacob S. 5/30/2013 4:35:35 PM – R:\00218000 El Paso TX\9631500115 – McCombs\Data Analysis\CAD\P2-13 CELL DEVELOPMENT PLAN – SECTOR F.dwg

Cami Van Abel 6/13/13

STATE OF TEXAS — CAMI VAN ABEL — 113723 — REGISTERED PROFESSIONAL ENGINEER

| | |
|---|---|
| DESIGNED | TLK |
| DRAWN | CAD |
| VERIFY SCALE | BAR IS ONE INCH ON ANSI "D" DRAWING |
| 0 | 1" |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 3 | 6/3/13 | JSR | CAV | FOURTH TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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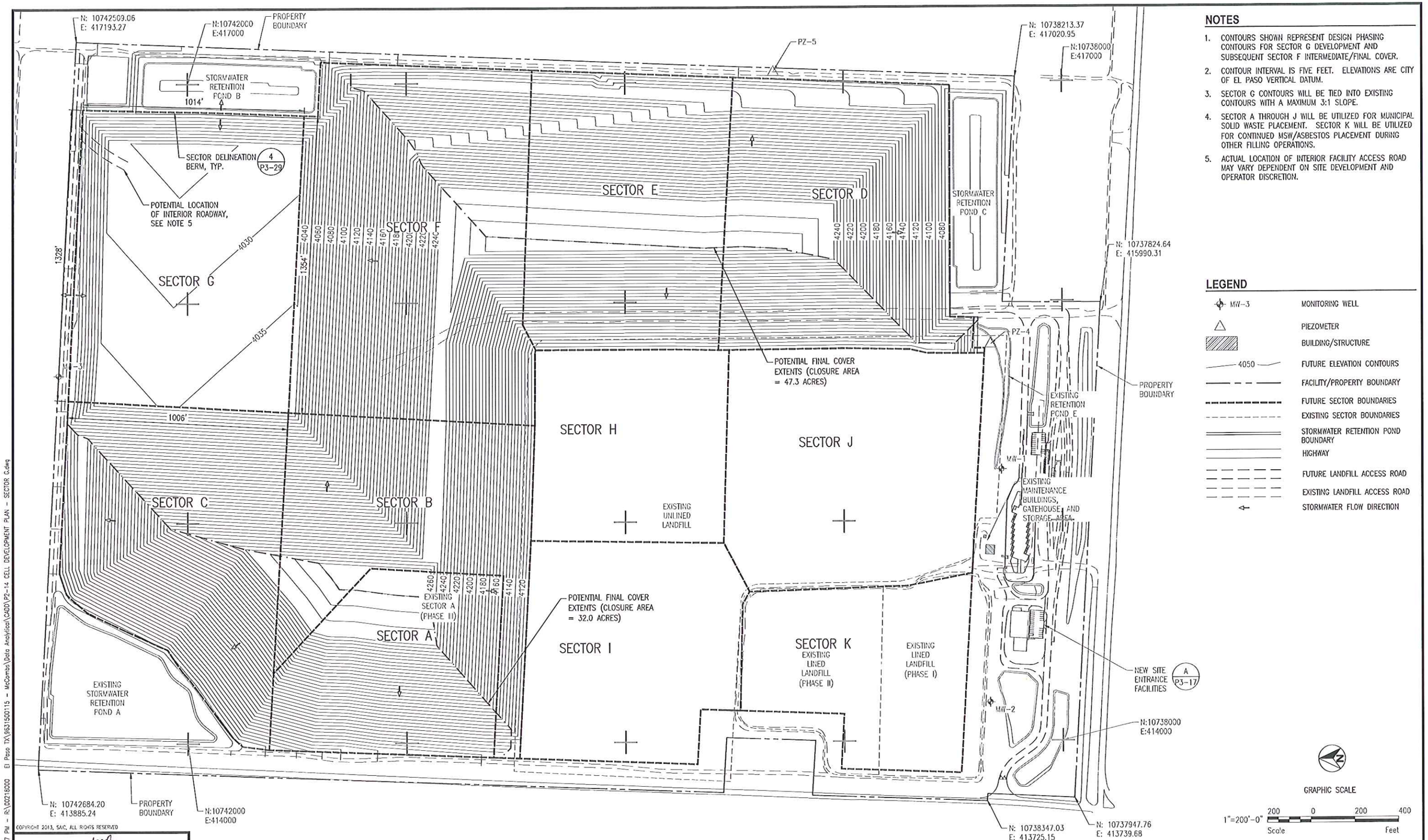
MAJOR PERMIT AMENDMENT

# CELL DEVELOPMENT PLAN – SECTOR F

PROJECT NUMBER: 9631500115
SHT. 19 OF: 78
DRAWING NUMBER: P2-13




## NOTES

1. CONTOURS SHOWN REPRESENT DESIGN PHASING CONTOURS FOR SECTOR G DEVELOPMENT AND SUBSEQUENT SECTOR F INTERMEDIATE/FINAL COVER.
2. CONTOUR INTERVAL IS FIVE FEET. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM.
3. SECTOR G CONTOURS WILL BE TIED INTO EXISTING CONTOURS WITH A MAXIMUM 3:1 SLOPE.
4. SECTOR A THROUGH J WILL BE UTILIZED FOR MUNICIPAL SOLID WASTE PLACEMENT. SECTOR K WILL BE UTILIZED FOR CONTINUED MSW/ASBESTOS PLACEMENT DURING OTHER FILLING OPERATIONS.
5. ACTUAL LOCATION OF INTERIOR FACILITY ACCESS ROAD MAY VARY DEPENDENT ON SITE DEVELOPMENT AND OPERATOR DISCRETION.

## LEGEND

- MW-3 — MONITORING WELL
- PIEZOMETER
- BUILDING/STRUCTURE
- 4050 — FUTURE ELEVATION CONTOURS
- FACILITY/PROPERTY BOUNDARY
- FUTURE SECTOR BOUNDARIES
- EXISTING SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- FUTURE LANDFILL ACCESS ROAD
- EXISTING LANDFILL ACCESS ROAD
- STORMWATER FLOW DIRECTION

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Rev. Jocep S. 5/30/2013 4:35:57 PM - R:\00218000 El Paso TX\9631500115 - McCombs\Data Analytical\CAD\P2-14 CELL DEVELOPMENT PLAN - SECTOR G.dwg

STATE OF TEXAS
CAMI VAN ABEL
113723
REGISTERED PROFESSIONAL ENGINEER
4/3/13

DESIGNED TLK
DRAWN CAD
VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 3 | 6/3/13 | JSR | CAV | FOURTH TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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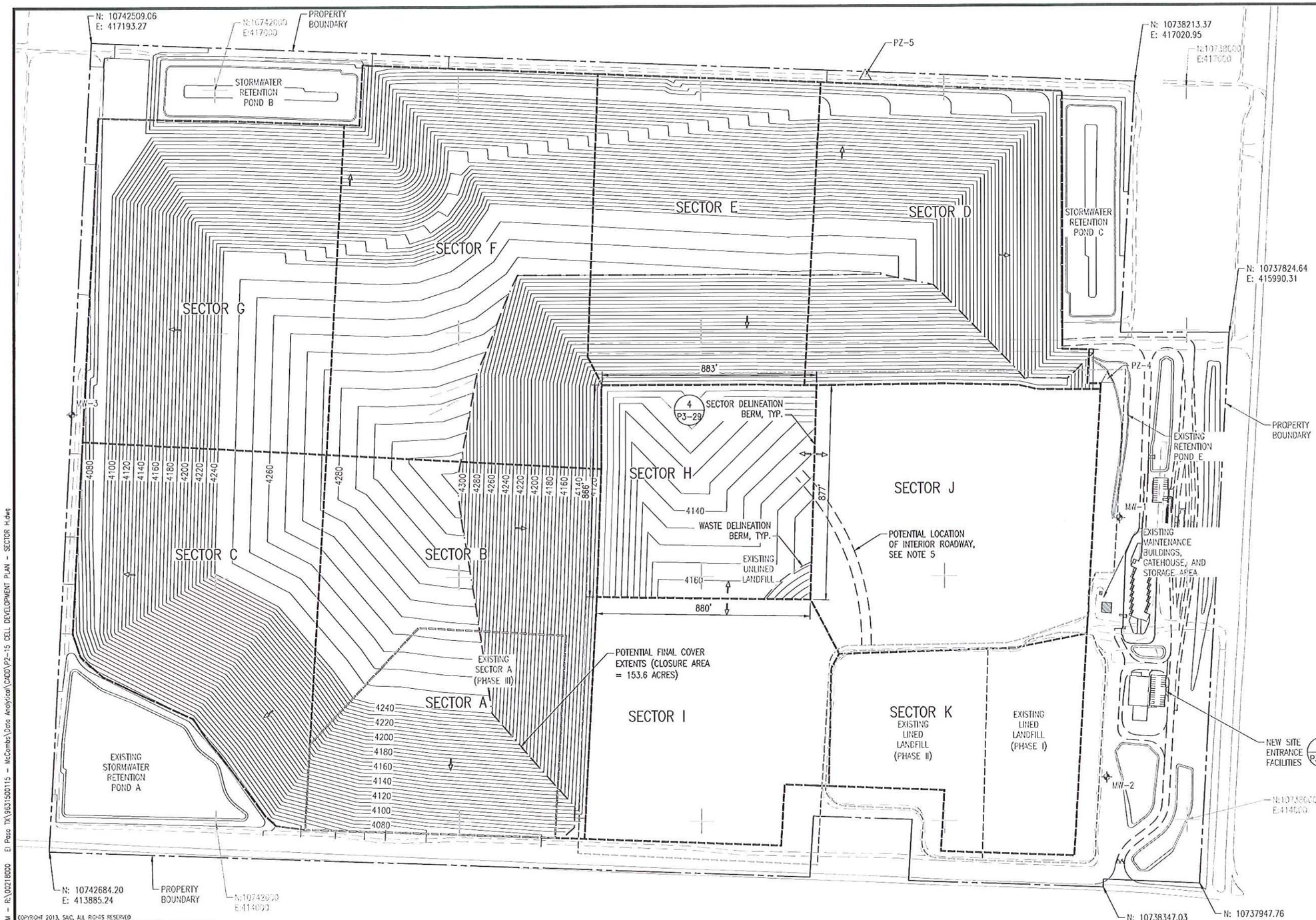
CELL DEVELOPMENT PLAN – SECTOR G

PROJECT NUMBER: 9631500115
SHT. 20 OF: 78
DRAWING NUMBER: P2-14




## NOTES

1. CONTOURS SHOWN REPRESENT DESIGN PHASING CONTOURS FOR SECTOR H DEVELOPMENT AND SUBSEQUENT SECTOR G INTERMEDIATE/FINAL COVER.
2. CONTOUR INTERVAL IS FIVE FEET. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM.
3. SECTOR H CONTOURS WILL BE TIED INTO EXISTING CONTOURS WITH A MAXIMUM 3:1 SLOPE.
4. SECTOR A THROUGH J WILL BE UTILIZED FOR MUNICIPAL SOLID WASTE PLACEMENT. SECTOR K WILL BE UTILIZED FOR CONTINUED MSW/ASBESTOS PLACEMENT DURING OTHER FILLING OPERATIONS.
5. ACTUAL LOCATION OF INTERIOR FACILITY ACCESS ROAD MAY VARY DEPENDENT ON SITE DEVELOPMENT AND OPERATOR DISCRETION.

## LEGEND

- MW-3 — MONITORING WELL
- PIEZOMETER
- BUILDING/STRUCTURE
- 4050 — FUTURE ELEVATION CONTOURS
- FACILITY/PROPERTY BOUNDARY
- EXISTING SECTOR BOUNDARIES
- FUTURE SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- FUTURE LANDFILL ACCESS ROAD
- EXISTING LANDFILL ACCESS ROAD
- STORMWATER FLOW DIRECTION

GRAPHIC SCALE

1"=200'-0" 200 0 200 400 Scale Feet

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CAMI VAN ABEL
113723
REGISTERED PROFESSIONAL ENGINEER
STATE OF TEXAS
4/13/13

DESIGNED TLK
DRAWN CAD
VERIFY SCALE BAR IS ONE INCH ON ANSI "D" DRAWING 0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 4 | 6/3/13 | JSR | CAV | FOURTH TECHNICAL NOD |
| 3 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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CELL DEVELOPMENT PLAN – SECTOR H

PROJECT NUMBER: 9631500115
SHT. 21 OF: 78
DRAWING NUMBER: P2-15

Rev. Jacob S. 5/30/2013 4:36:45 PM – R:\00218000 El Paso TX\9631500115 – McCombs\Data Analysis\CADD\P2-15 CELL DEVELOPMENT PLAN – SECTOR H.dwg

N: 10742509.06
E: 417193.27

N:10742000
E:417000

PROPERTY BOUNDARY

STORMWATER RETENTION POND B

PZ-5

N: 10738213.37
E: 417020.95

N:10739000
E:417000

STORMWATER RETENTION POND C

SECTOR E

SECTOR D

SECTOR F

SECTOR G

SECTOR H

SECTOR J

SECTOR C

SECTOR B

SECTOR A

SECTOR I

SECTOR K
EXISTING LINED LANDFILL (PHASE II)

EXISTING LINED LANDFILL (PHASE I)

4080 4100 4120 4140 4160 4180 4200 4220 4240

4260 4280

MW-3

POTENTIAL FINAL COVER EXTENTS (CLOSURE AREA = 168.1 ACRES)

4 / P3-29 SECTOR DELINEATION BERM, TYP.

EXISTING UNLINED LANDFILL

880'

POTENTIAL LOCATION OF INTERIOR ROADWAY, SEE NOTE 5

251'

166'

WASTE DELINEATION BERM, TYP.

EXISTING SECTOR A (PHASE III)

990'

482'

182'

250'

813'

PZ-4

EXISTING RETENTION POND E

PROPERTY BOUNDARY

MW-1

EXISTING MAINTENANCE BUILDINGS, GATEHOUSE, AND STORAGE AREA

NEW SITE ENTRANCE FACILITIES A / P3-17

MW-2

N:10738200
E:414000

EXISTING STORMWATER RETENTION POND A

N: 10742684.20
E: 413885.24

PROPERTY BOUNDARY

N:10742000
E:414000

N: 10738347.03
E: 413725.15

N: 10737947.76
E: 413739.68

N: 10737824.64
E: 415990.31

## NOTES

1. CONTOURS SHOWN REPRESENT DESIGN PHASING CONTOURS FOR SECTOR I DEVELOPMENT AND SUBSEQUENT SECTOR H INTERMEDIATE/FINAL COVER.
2. CONTOUR INTERVAL IS FIVE FEET. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM.
3. SECTOR I CONTOURS WILL BE TIED INTO EXISTING CONTOURS WITH A MAXIMUM 3:1 SLOPE.
4. SECTOR A THROUGH J WILL BE UTILIZED FOR MUNICIPAL SOLID WASTE PLACEMENT. SECTOR K WILL BE UTILIZED FOR CONTINUED MSW/ASBESTOS PLACEMENT DURING OTHER FILLING OPERATIONS.
5. ACTUAL LOCATION OF INTERIOR FACILITY ACCESS ROAD MAY VARY DEPENDENT ON SITE DEVELOPMENT AND OPERATOR DISCRETION.

## LEGEND

- MW-3 — MONITORING WELL
- PIEZOMETER
- BUILDING/STRUCTURE
- 4050 — FUTURE ELEVATION CONTOURS
- FACILITY/PROPERTY BOUNDARY
- FUTURE SECTOR BOUNDARIES
- EXISTING SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- FUTURE LANDFILL ACCESS ROAD
- EXISTING LANDFILL ACCESS ROAD
- STORMWATER FLOW DIRECTION

GRAPHIC SCALE

1"=200'-0" 200 0 200 400
Scale Feet

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STATE OF TEXAS
CAMI VAN ABEL
113723
REGISTERED PROFESSIONAL ENGINEER
6/3/13

| | |
|---|---|
| DESIGNED | TLK |
| DRAWN | CAD |
| VERIFY SCALE | BAR IS ONE INCH ON ANSI "D" DRAWING |
| 0 | 1" |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 4 | 6/3/13 | JSR | CAV | FOURTH TECHNICAL NOD |
| 3 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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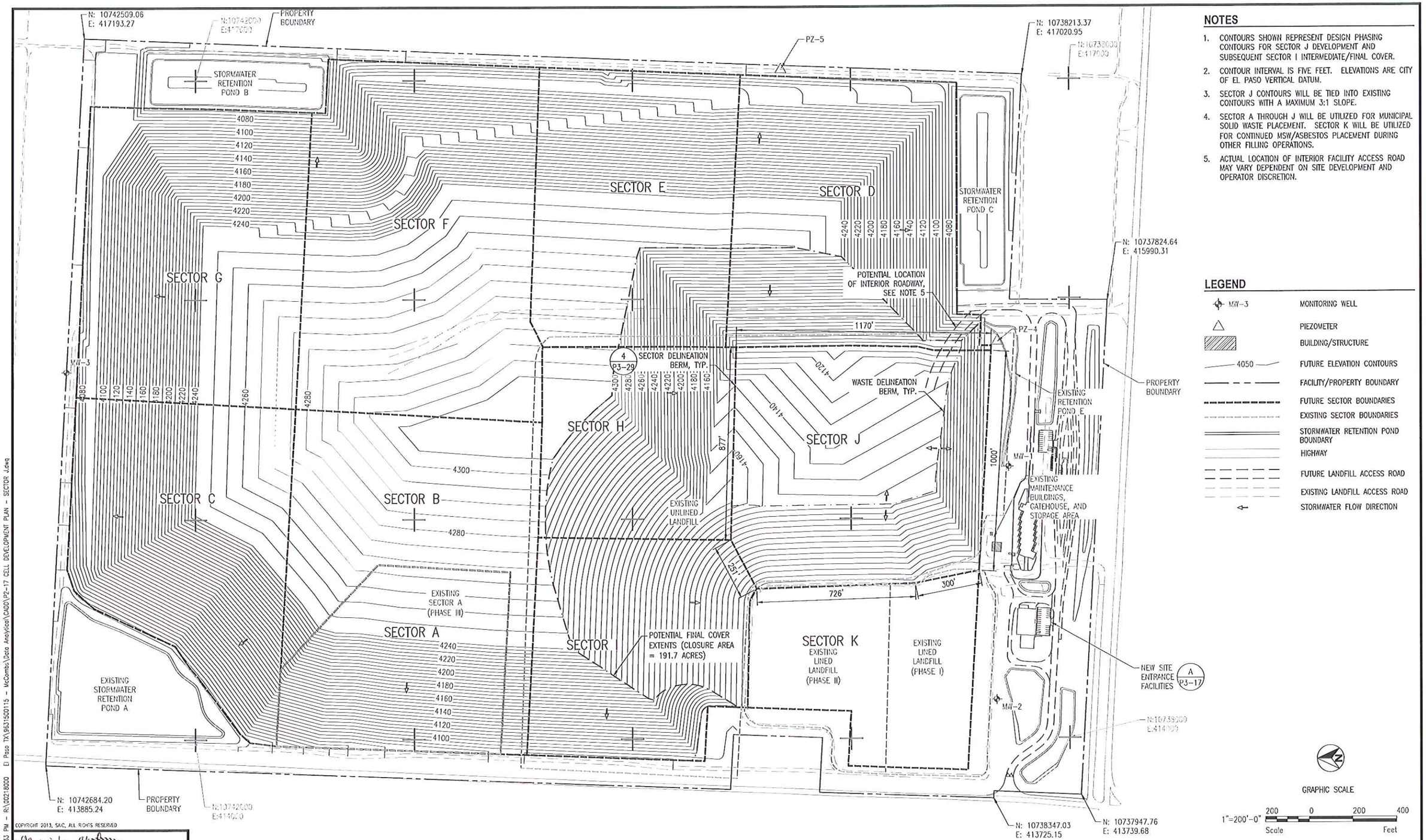
MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

CELL DEVELOPMENT PLAN – SECTOR I

PROJECT NUMBER: 9631500115
SHT. 22 OF: 78
DRAWING NUMBER: P2-16

Rev. Jacob S. 5/30/2013 4:37:07 PM - R:\0021800 - El Paso TX\9631500115 - McCombs\Data Analysis\CADD\P2-16 CELL DEVELOPMENT PLAN - SECTOR I.dwg




## NOTES

1. CONTOURS SHOWN REPRESENT DESIGN PHASING CONTOURS FOR SECTOR J DEVELOPMENT AND SUBSEQUENT SECTOR I INTERMEDIATE/FINAL COVER.
2. CONTOUR INTERVAL IS FIVE FEET. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM.
3. SECTOR J CONTOURS WILL BE TIED INTO EXISTING CONTOURS WITH A MAXIMUM 3:1 SLOPE.
4. SECTOR A THROUGH J WILL BE UTILIZED FOR MUNICIPAL SOLID WASTE PLACEMENT. SECTOR K WILL BE UTILIZED FOR CONTINUED MSW/ASBESTOS PLACEMENT DURING OTHER FILLING OPERATIONS.
5. ACTUAL LOCATION OF INTERIOR FACILITY ACCESS ROAD MAY VARY DEPENDENT ON SITE DEVELOPMENT AND OPERATOR DISCRETION.

## LEGEND

- MW-3 — MONITORING WELL
- PIEZOMETER
- BUILDING/STRUCTURE
- 4050 — FUTURE ELEVATION CONTOURS
- FACILITY/PROPERTY BOUNDARY
- FUTURE SECTOR BOUNDARIES
- EXISTING SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- FUTURE LANDFILL ACCESS ROAD
- EXISTING LANDFILL ACCESS ROAD
- STORMWATER FLOW DIRECTION

GRAPHIC SCALE

1"=200'-0" (200 0 200 400 Scale Feet)

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STATE OF TEXAS
CAMI VAN ABEL
113723
REGISTERED PROFESSIONAL ENGINEER
11/3/13

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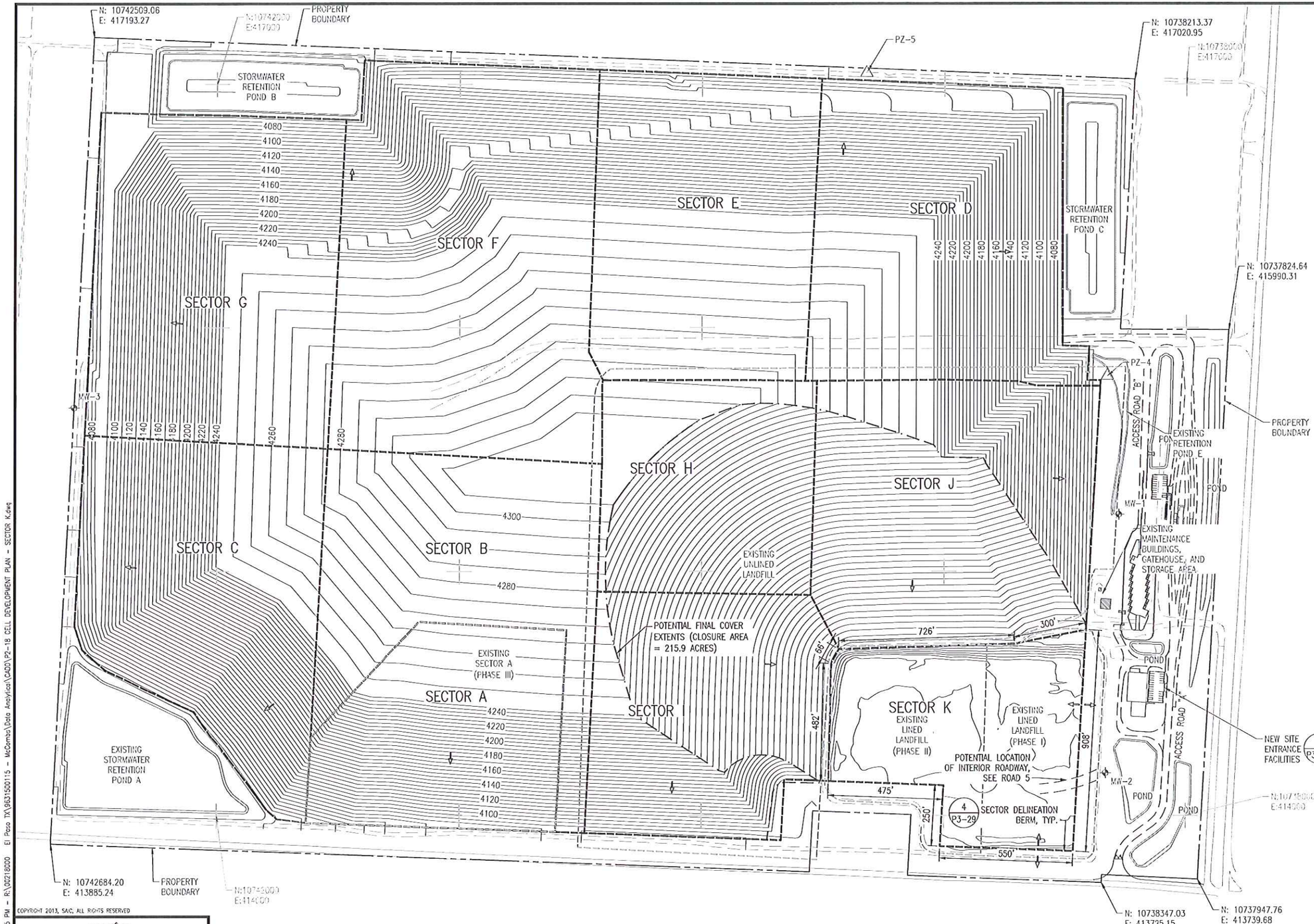
CELL DEVELOPMENT PLAN – SECTOR J

PROJECT NUMBER: 9631500115
SHT. 23 OF: 78
DRAWING NUMBER: P2-17

Rev. Jacob S. 5/30/2013 4:37:33 PM – R:\0021B000 El Paso TX\9631500115 – McCombs\Data Analysis\CAD\P2-17 CELL DEVELOPMENT PLAN – SECTOR J.dwg




## NOTES

1. CONTOURS SHOWN REPRESENT DESIGN PHASING CONTOURS FOR SECTOR K DEVELOPMENT AND SUBSEQUENT SECTOR J INTERMEDIATE/FINAL COVER.
2. CONTOUR INTERVAL IS FIVE FEET. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM.
3. SECTOR K CONTOURS WILL BE TIED INTO EXISTING CONTOURS WITH A MAXIMUM 3:1 SLOPE.
4. SECTOR A THROUGH J WILL BE UTILIZED FOR MUNICIPAL SOLID WASTE PLACEMENT. SECTOR K WILL BE UTILIZED FOR CONTINUED MSW/ASBESTOS PLACEMENT DURING OTHER FILLING OPERATIONS.
5. CONTOURS IN SECTOR K WILL VARY WITH CONTINUED MSW/ASBESTOS FILL.
6. ACTUAL LOCATION OF INTERIOR FACILITY ACCESS ROAD MAY VARY DEPENDENT ON SITE DEVELOPMENT AND OPERATOR DISCRETION.

## LEGEND

- MW-3 — MONITORING WELL
- PIEZOMETER
- BUILDING/STRUCTURE
- 4050 — FUTURE ELEVATION CONTOURS
- FACILITY/PROPERTY BOUNDARY
- FUTURE SECTOR BOUNDARIES
- EXISTING SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- FUTURE LANDFILL ACCESS ROAD
- EXISTING LANDFILL ACCESS ROAD
- STORMWATER FLOW DIRECTION

GRAPHIC SCALE

1"=200'-0" 200 0 200 400 Scale Feet

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CELL DEVELOPMENT PLAN – SECTOR K

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SHT. 24 OF: 78
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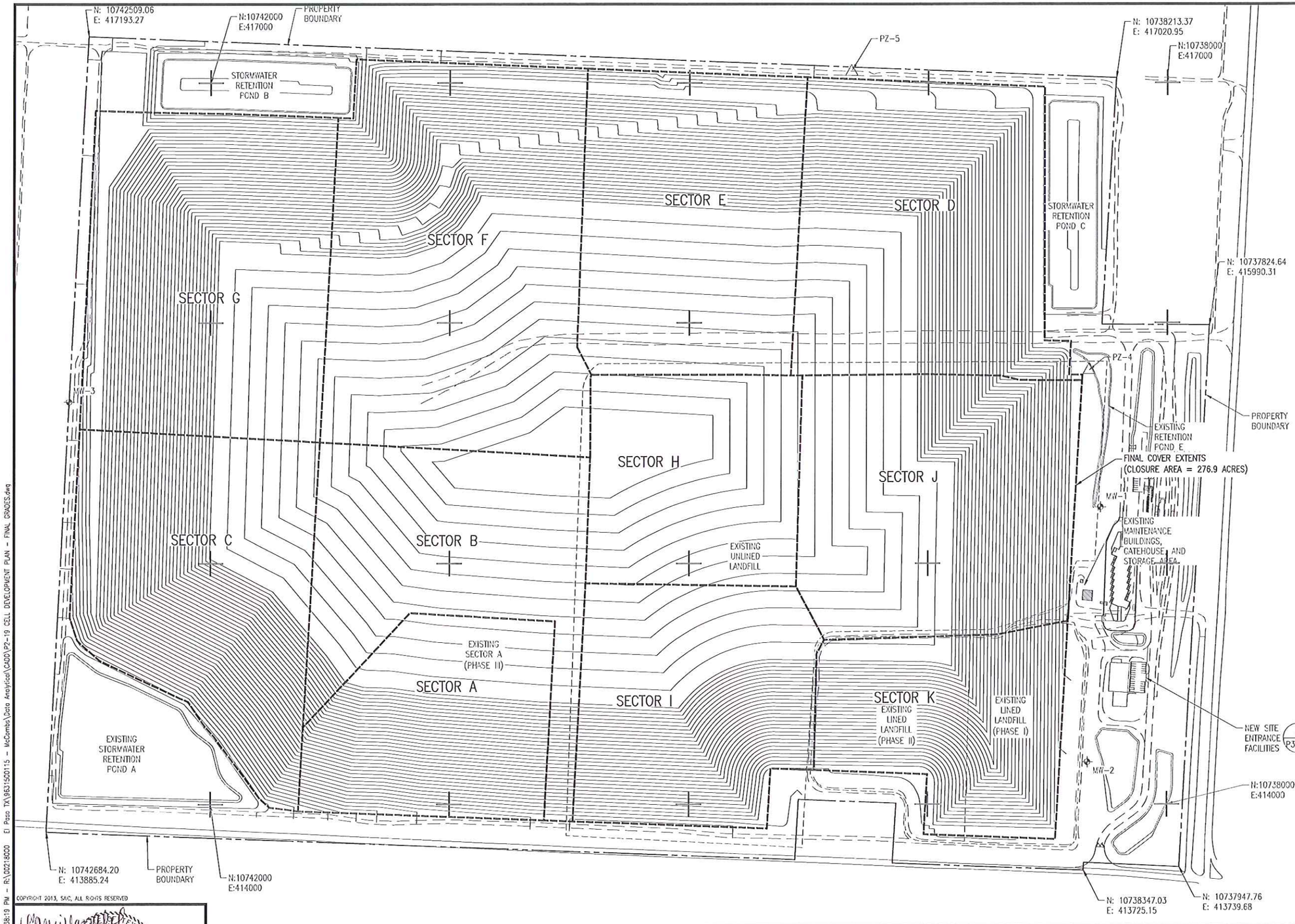


## NOTES

1. CONTOURS SHOWN REPRESENT TOP OF FINAL DESIGN CONTOURS FOR SITE DEVELOPMENT.
2. CONTOUR INTERVAL IS FIVE FEET. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM.

## LEGEND

- MW-3 — MONITORING WELL
- PIEZOMETER
- BUILDING/STRUCTURE
- 4050 — FUTURE ELEVATION CONTOURS
- FACILITY/PROPERTY BOUNDARY
- FUTURE SECTOR BOUNDARIES
- EXISTING SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- LANDFILL ACCESS ROAD

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# CELL DEVELOPMENT PLAN – FINAL GRADES

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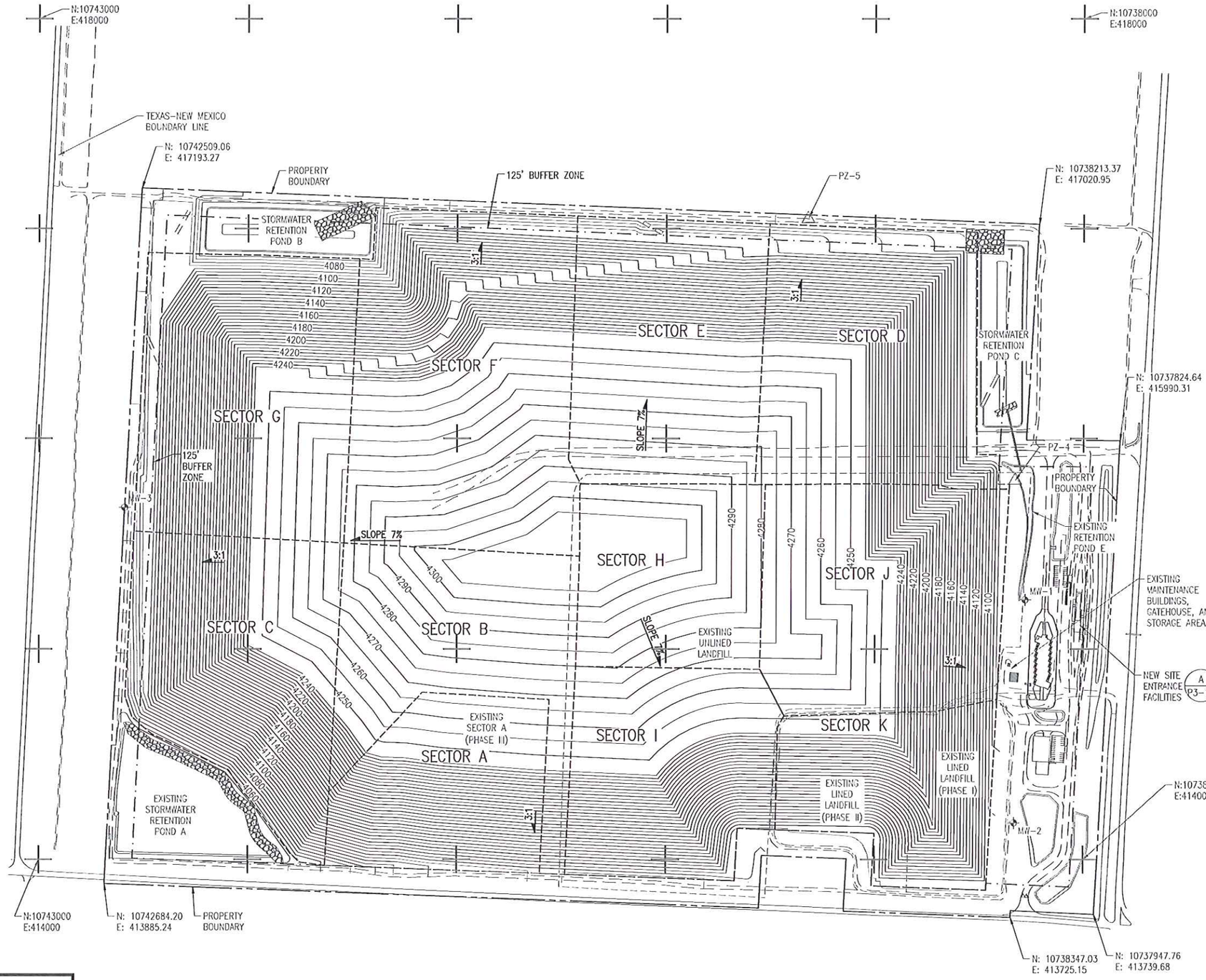
SHT. 25 OF: 78
DRAWING NUMBER: P2-19




## NOTES

1. DIGITIZED TOPOGRAPHY FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS.
2. COORDINATES ARE BASED ON THE TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NAD 83. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM. NAVD 88 DATUM TO NGVD 29 DATUM, SUBTRACT 1.99–FEET. NGVD 29 DATUM TO CITY OF EL PASO DATUM, ADD 27.65–FEET.
3. EXISTING CONTOUR INTERVAL IS TWO FEET.
4. SITE TOPOGRAPHY MAY VARY DUE TO OWNER'S OPERATIONS.
5. FINAL COVER CONTOURS SHOWN ARE DESIGN CONTOURS.
6. FINAL COVER CONTOUR INTERVAL IS FIVE FEET.

## LEGEND

- MW-3 — MONITORING WELL
- △ — PIEZOMETER
- BUILDING/STRUCTURE
- RIPRAP
- 4050 — ELEVATION CONTOURS
- FACILITY/PROPERTY BOUNDARY
- 125' BUFFER ZONE
- FUTURE SECTOR BOUNDARIES
- EXISTING SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- LANDFILL ACCESS ROAD

GRAPHIC SCALE

1"=250'-0" — 250 0 250 500 — Scale Feet

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LANDFILL COMPLETION PLAN

PROJECT NUMBER 9631500115
SHT. 26 OF: 78
DRAWING NUMBER: P2–20

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# Appendix 2B
# Land Use Analysis

SAIC®

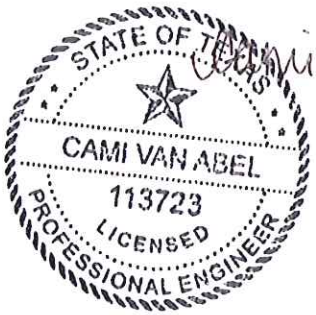
# McCombs Municipal Landfill
# El Paso County, Texas
# TCEQ MSW Permit No. 729B

## Part II
## Appendix 2B
## Land Use Analysis

Prepared for

**City of El Paso**

Updated June 2013, Revision 3




Cami Vanabel
6/3/13

Prepared by

**SAIC**
5806 Mesa Drive, Suite 310 ♦ Austin, Texas 78731 ♦ 512.450.0991

Texas Board of Professional Engineers
Firm Registration No. 3823

# Part II

# Appendix 2B – Land Use Analysis

## City of El Paso

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2B.2 Zoning ..... 2B-1
2B.3 Character of Surrounding Land ..... 2B-1
2B.4 Growth Trends ..... 2B-2
2B.5 Proximity to Residences, Commercial Establishments and Other Uses ..... 2B-3
2B.6 Conclusions ..... 2B-4

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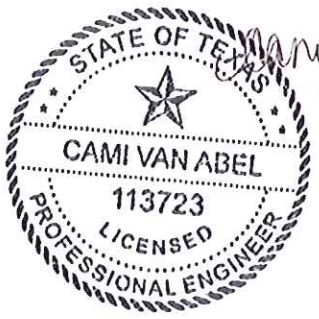
Table 2B-2 Growth Trends Within Five Miles of McCombs Landfill ..... 2B-3



## 2B.1 Introduction

The following land use analysis was prepared to evaluate the area surrounding the Landfill property. This study examines the zoning within two miles of the property, the character of the surrounding land within one mile of the property, growth trends within five miles of the property, and the proximity of residences, commercial establishments and other places of interest within one mile of the property. The results are summarized in the following sections.

## 2B.2 Zoning

The Landfill is located within the City limits approximately 10 miles northwest of downtown, and lies within 500 feet of the Texas-New Mexico border as shown in Drawing P2-24 – Zoning Map. The City and the adjacent Doña Ana County, New Mexico provide zoning ordinances that control the land use within the area.

In Texas, the land surrounding the Landfill is predominately zoned for light or heavy industrial use or as a ranch or farm district. In New Mexico, the surrounding land is zoned as a Performance District (PD) in Doña Ana County. According to the Doña Ana County Land Use Regulations and Zoning Ordinance, the purpose of zoning a region as a PD is to allow flexibility for land use activities in the rural areas of the County by acting as a mixed use zone.

## 2B.3 Character of Surrounding Land

The land surrounding the Landfill is predominately owned by the City within the State of Texas, and is undeveloped or for rural residential use within the State of New Mexico, as shown in Drawing P2-21 through Drawing P2-23. The following Table 2.4B-1 provides a detailed breakdown of the land use within a one-mile radius of the Landfill.

Table 2.4B-1
Land Use Within One Mile of McCombs Landfill

| Land Use | Area (Acres) | Area (Percent of Total) |
|---|---|---|
| City of El Paso | 2,133.01 | 51.57% |
| Undeveloped | 973.10 | 23.53% |
| Industrial | 617.02 | 14.92% |
| Residential | 233.78 | 5.65% |
| No Classified Activity | 100.03 | 2.42% |
| Right-of-Way/Utility | 58.89 | 1.42% |
| Mixed Use | 14.55 | 0.35% |
| Commercial | 5.86 | 0.14% |
| Total | 4,136.24 | 100.00% |

As shown in Table 2.4B-1, 51.57 percent of the land within a one-mile radius of the Landfill is owned by the City of El Paso and 23.53 percent of land is undeveloped. Residential housing accounts for approximately 5.65 percent of the land within a one-mile radius of the Landfill.

No schools, licensed day-care facilities, churches, hospitals, cemeteries, or lakes were identified through visual survey or parcel records within one mile of the Landfill. One man-made pond was identified approximately 1,800-feet east of the facility. The pond is part of the CEMEX quarry area for stormwater control and is dry most of the year. It should also be noted that due to ongoing quarry operations, the size, number, and location of man-made ponds may vary at different times during mining operations.

## 2B.4 Growth Trends

Visual comparison of the two sets of Census tracts revealed that three of the 2000 Census have been divided for the 2010 Census. To make a valid comparison between each 2000 tract and the corresponding area of the 2010 tracts, Table 2.4B-2 was created. Table 2.4B-2 shows the tracts and population from the 2000 and 2010 Censuses. Some 2000 Census tracts in the five mile radius surrounding the Landfill were divided for the 2010 Census. In these cases, population totals for the 2010 tracts were summed to reflect an area equivalent to the 2000 Census tract.

Table 2.4B-2
Growth Trends Within Five Miles of McCombs Landfill

| 2000 Census | | 2010 Census | | Total 2010 Population | Percent Change |
|---|---|---|---|---|---|
| Tract | Population | Tract | Population | | |
| 1.06 | 5,266 | 1.06 | 6,081 | 6,081 | 15.47 |
| 1.07 | 6,033 | 1.07 | 5,087 | 5,087 | -3.75 |
| 1.08 | 2,844 | 1.08 | 2,505 | 2,505 | -13.14 |
| 2.03 | 7,122 | 2.07 | 4,761 | 8,190 | 14.99 |
| | | 2.08 | 3,429 | | |
| 9.00 | 8,705 | 9.01 | 3,167 | 13,108 | 50.58 |
| | | 9.02 | 9,941 | | |
| 18.02 | 5,807 | 18.02 | 6,354 | 6,354 | 9.42 |
| 18.04 | 6,117 | 18.04 | 6,965 | 6,965 | 13.86 |
| 101.01 | 1,384 | 101.01 | 3,673 | 3,673 | 165.39 |
| 102.06 | 7,795 | 102.1 | 5,902 | 14,445 | 85.31 |
| | | 102.11 | 2,930 | | |
| | | 102.12 | 5,613 | | |
| 102.07 | 2,266 | 102.07 | 4,803 | 4,803 | 111.96 |

As can be seen from Table 2.4B-2, several tracts had significant growth from 2000 to 2010. These high-growth tracts are located southeast of the landfill and are mostly owned by the City of El Paso or zoned for mixed use as shown on the Land Use Map included as Drawing P2-23. The high growth for these tracts can be attributed to the construction of two neighborhoods approximately 2.5 to 3 miles away, respectively.

According to the United States Census Bureau, El Paso County experienced a growth rate of approximately 10.5 percent between 2000 and 2009[1] and Dona Ana County experienced a growth rate of approximately 18.2 percent between 2000 and 2009. A majority of the population growth rates summarized in Table 2.4B-2 follow these trends.

## 2B.5 Proximity to Residences, Commercial Establishments and Other Uses

Based on the visual survey conducted on November 10th, 2010, and from parcel data received from Doña Ana County, New Mexico, there are approximately 185 single family residences and mobile homes within a one-mile radius of the Landfill. The residence closest to filling activities is estimated to be 1,500 feet from the property boundary, and 1,550 feet from the waste limit.

SAIC identified 8 parcels of mixed use/commercial establishments within one mile of the facility (refer to Drawing P2-3 in Appendix 2B). The area immediately to the east of the Landfill is a quarry operated by Cemex, to the south approximately one mile is El Paso Natural Gas Company (private), and immediately to the west is an

[1] Most recent data available from the United States Census Bureau is for 2009.

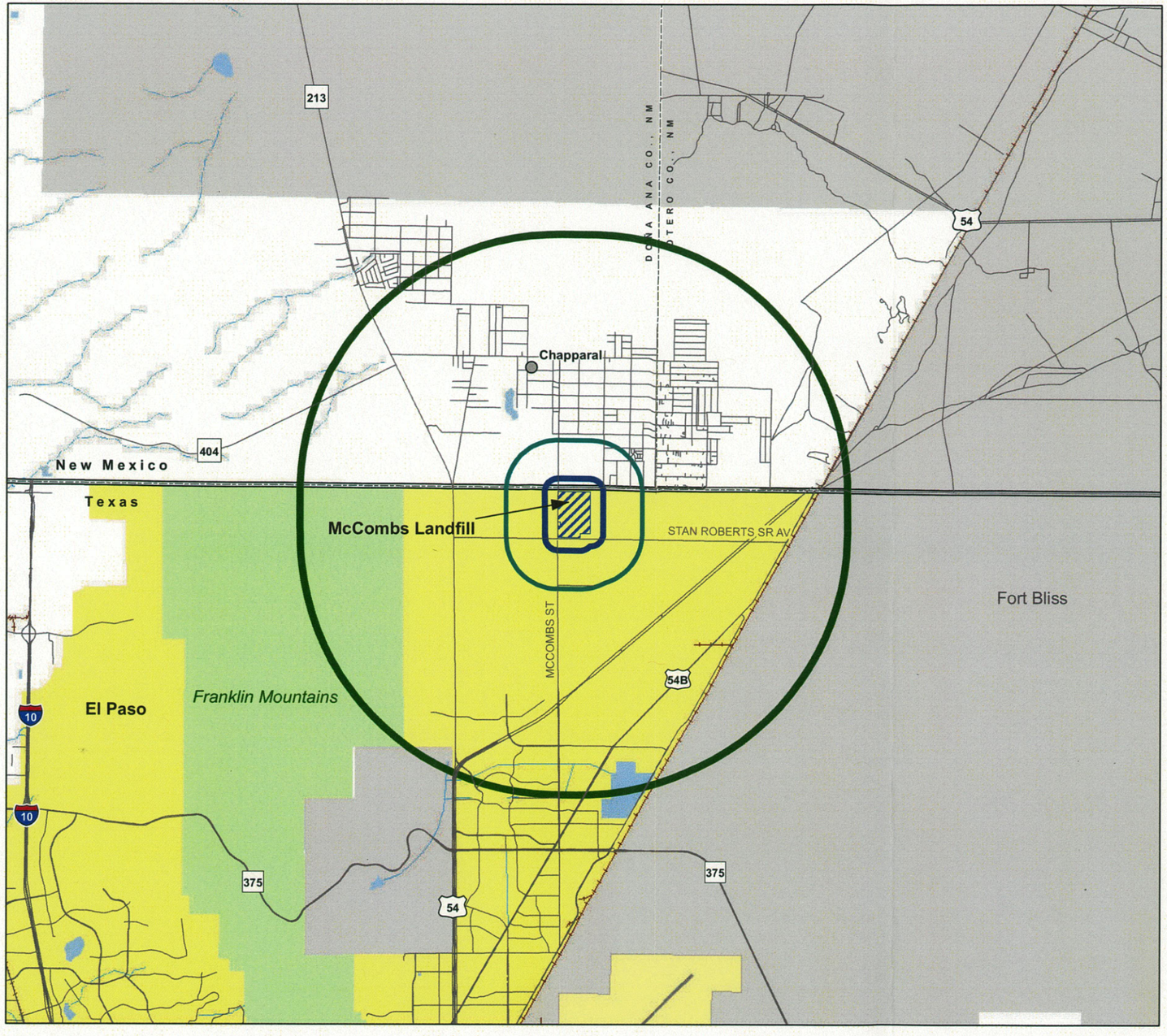
undeveloped area owned by El Paso Electric (private). To the northeast of the Landfill, within New Mexico (0.25 to 1-mile away), are 5 identified small businesses within the residential neighborhood.

SAIC did not identify any schools, licensed day care centers, churches, hospitals, cemeteries, lakes, streams, archaeologically significant sites, historic sites, or locations of exceptional aesthetic quality within one-mile of the Landfill based on the visual survey and parcel records. One man-made pond was identified approximately 1,800-feet east of the facility. The pond is part of the CEMEX quarry area for stormwater control and is dry most of the year. It should also be noted that due to ongoing quarry operations, the size, number, and location of man-made ponds may vary at different times during mining operations.

## 2B.6 Conclusions

As can be seen from Table 2.4B-1, approximately 90 percent of the land surrounding the Landfill is either owned by the City, undeveloped or used for industrial purposes. Less than 6 percent of the land within one mile is used for residential use.

Most of the area surrounding the landfill experienced growth similar to the El Paso County and Dona Ana County growth rates. Some areas experienced higher population growth rates due to the construction of neighborhoods within 3 miles of the Landfill. However, it is unlikely that these same growth rates will continue in the future.




GRAPHIC SCALE
0 2 4 Miles

## Regional Map, 5 Mile Radius

**Distance from Landfill**

- 0.25 Mile
- 1 Mile
- 5 Miles
- Landfill Boundary
- City of El Paso Municipal Area
- Fort Bliss
- County Boundary
- State Boundary

**NOTES**

1. MAP CREATED USING ARCGIS SOFTWARE VERSION 9.2, ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE (ESRI) STREETMAP DATA, 2005 AND PASO DEL NORTE MAPA GIS DATASETS, 2008.

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REGIONAL MAP – FIVE MILE RADIUS

PROJECT NUMBER: 9631500115
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DRAWING NUMBER: P2–21

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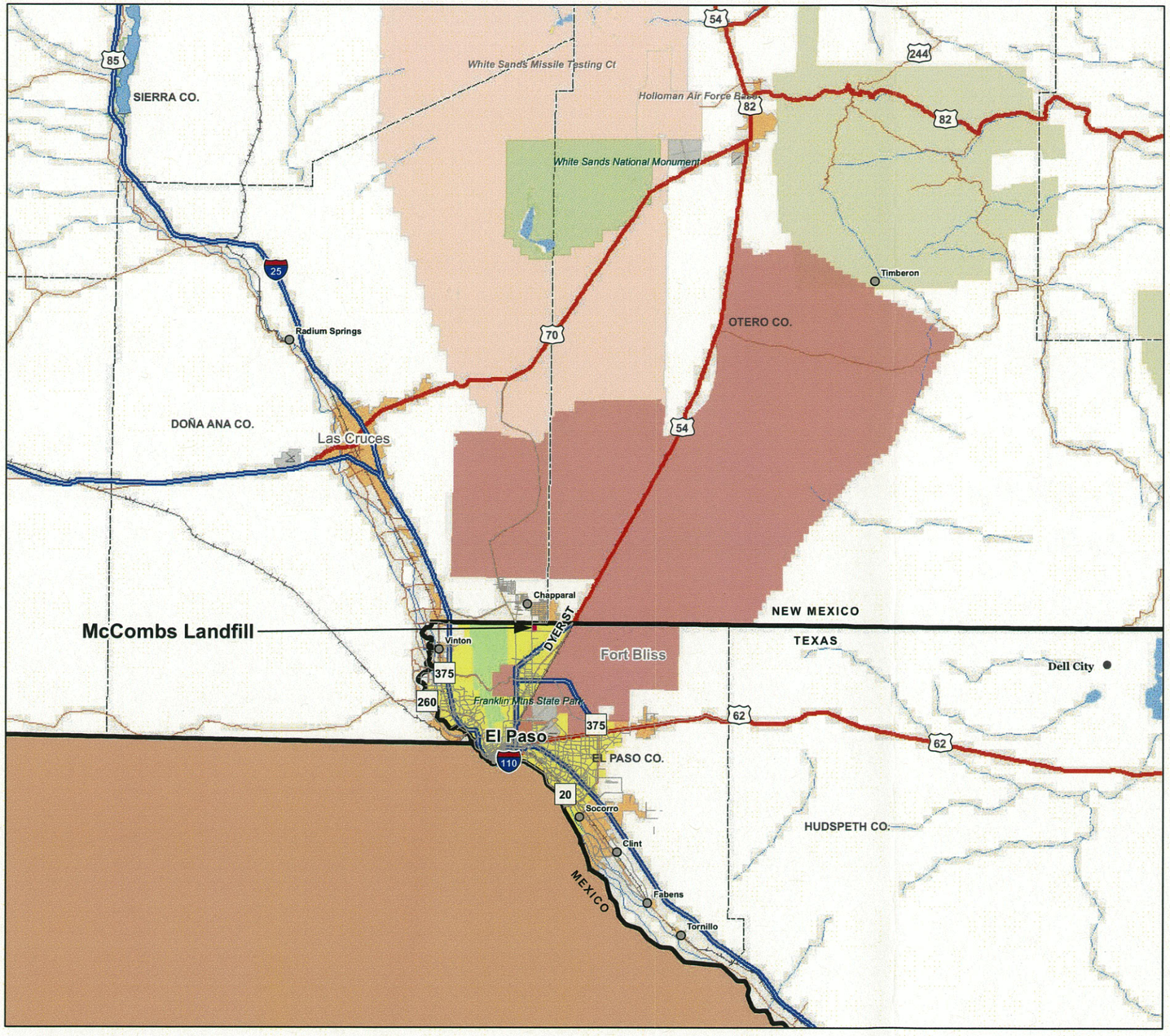


GRAPHIC SCALE
0 10 20 30 Miles

## Regional Map
## El Paso, Doña Ana and Otero Counties

- Landfill Boundary
- City of El Paso Municipal Area
- Town/City
- Fort Bliss
- County Boundary
- State Boundary

**NOTES**

1. MAP CREATED USING ARCGIS SOFTWARE VERSION 9.2, ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE (ESRI) STREETMAP DATA, 2005 AND PASO DEL NORTE MAPA GIS DATASETS, 2008.

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REGIONAL MAP – EL PASO COUNTY

PROJECT NUMBER: 9631500115
SHT. 28 OF: 78
DRAWING NUMBER: P2–22

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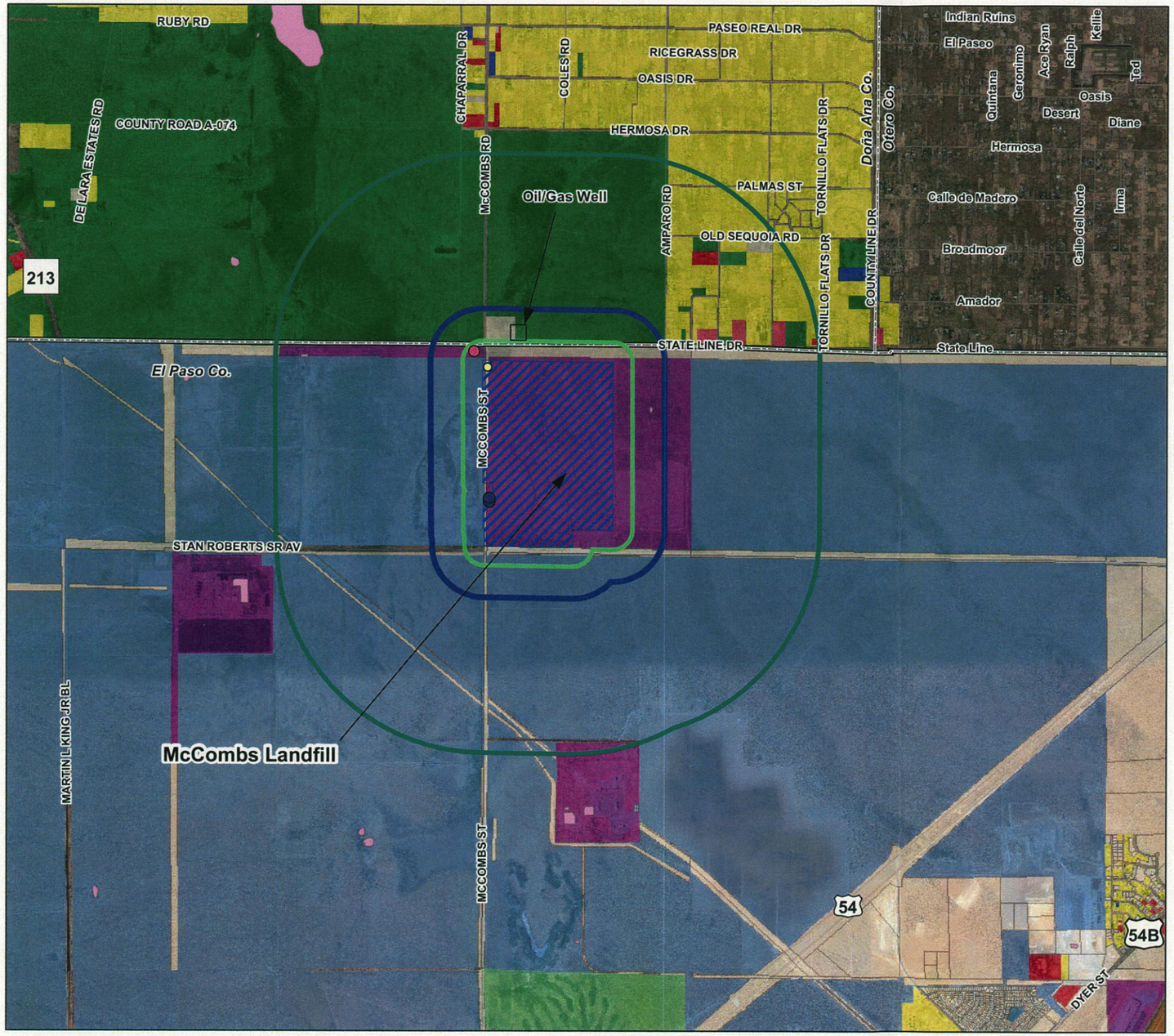


0 0.5 GRAPHIC SCALE 1 1.5 Miles

# Land Use Map

### Water Wells (From TWDB Database)

- Industrial Use
- Unused
- Not Classified

### Existing Land Use

- City of El Paso
- Residential
- Mixed Use
- Commercial
- Industrial
- Public/Institutional
- Undeveloped
- Military
- ROW/Utility
- Parks and Open Space
- No Classified Activity
- 500 Foot Radius Around Landfill
- 0.25 mile radius Around Landfill
- 1 Mile Around Landfill
- Landfill Boundary
- County Boundary
- State Boundary

## NOTES

1. LAND USE MAP CREATED USING PARCEL DATA PROVIDED BY EL PASO COUNTY, TEXAS AND DONA ANA COUNTY, NEW MEXICO.
2. MAP CREATED USING ARCGIS SOFTWARE VERSION 9.2.
3. NO ARCHAEOLOGICALLY SIGNIFICANT OR HISTORICAL SITES, LOCATIONS OF EXCEPTIONAL AESTHETIC QUALITY, SCHOOLS, LICENSED DAY-CARE FACILITIES, CHURCHES, CEMETERIES, HOSPITALS, LAKES OR STREAMS WERE IDENTIFIED WITHIN ONE MILE OF THE FACILITY BOUNDARY. ONE POND LOCATED APPROXIMATELY 1,800 FEET EAST OF THE FACILITY WAS IDENTIFIED. THE POND IS PART OF THE CEMEX QUARRY AREA FOR STORMWATER CONTROL AND IS DRY MOST OF THE YEAR.
4. REFER TO SECTION 2.4 FOR WATER WELL INFORMATION.
5. REFER TO DRAWING P2-7 FOR DRAINAGE, PIPELINE, AND FACILITY EASEMENTS WITHIN THE LANDFILL PROPERTY.

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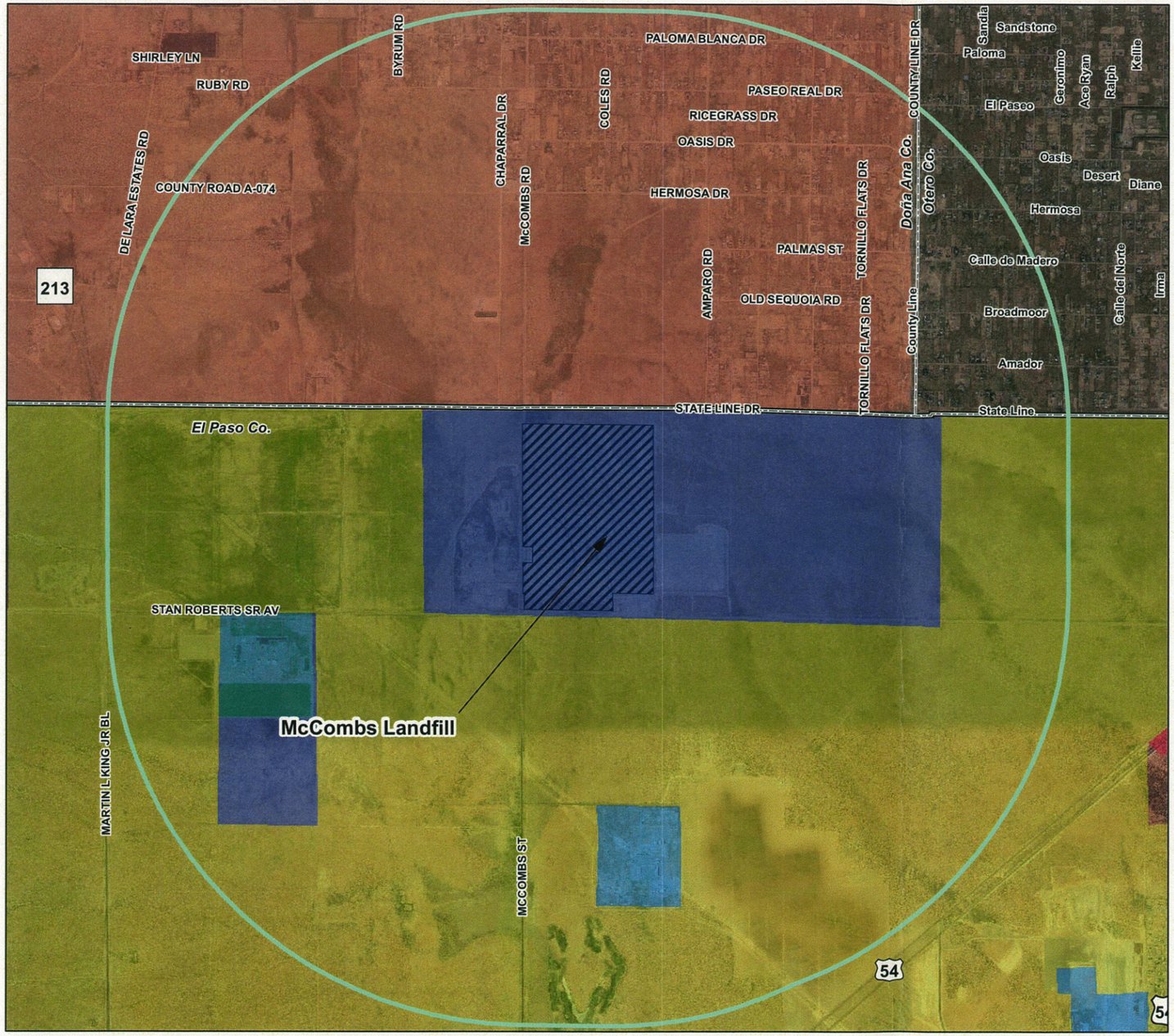
LAND USE MAP

PROJECT NUMBER: 9631500115
SHT. 29 OF: 78
DRAWING NUMBER: P2-23

Keller, Tonya L. 10/29/2012 10:17:45 AM – P:\00218000 el paso tx\9631500115\data analytical\CADD\P2-23 LAND USE MAP.dwg




GRAPHIC SCALE

0 0.5 1 1.5 Miles

## Zoning Map

- Medium Density Residential
- Community Commercial
- Regional Commercial
- Light Industrial
- Heavy Industrial
- Ranch and Farm District
- Performance District (Doña Ana County, NM)
- 2 Mile Radius Around Landfill
- Landfill Boundary
- County Boundary
- State Boundary

Note: Otero County (NM) has no zoning ordinance.

## NOTES

1. ZONING DATA PROVIDED BY THE DONA ANA COUNTY COMMUNITY DEVELOPMENT DEPARTMENT IN NEW MEXICO AND BY THE CITY OF EL PASO.
2. MAP CREATED USING ARCGIS SOFTWARE VERSION 9.2.

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STATE OF TEXAS
FREDRIC J. DORAN
111226
REGISTERED PROFESSIONAL ENGINEER
11/2/12

DESIGNED TLK
DRAWN CAD
VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 1/13/12 | FJD | CGL | ADMINISTRATIVE NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

THE CITY OF EL PASO TEXAS

SAIC®

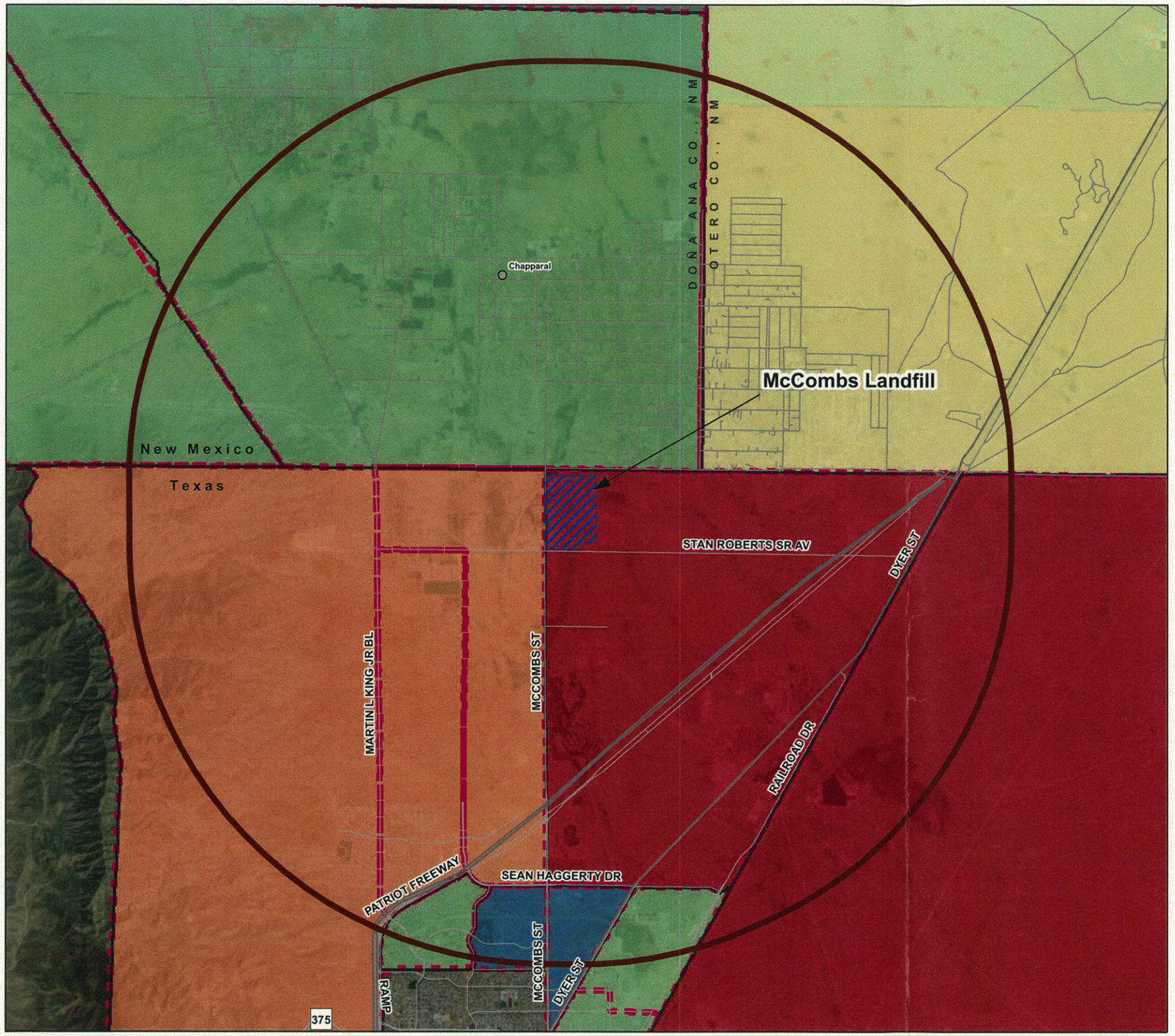
SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve
Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

ZONING MAP

PROJECT NUMBER: 9631500115
SHT. 30 OF: 78
DRAWING NUMBER: P2-24

Keller, Tonya L. 10/29/2012 10:24:27 AM — P:\00218000 el paso tx\9631500115\data analytical\CADD\P2-24 ZONING MAP.dwg




GRAPHIC SCALE

0 1.25 2.5 3.75 Miles

## NOTES

1. YEAR 2000 CENSUS TRACTS FOR GEOGRAPHY AND POPULATION OBTAINED FROM ESRI CENSUS DATA FILES PACKAGED WITH ARCGIS SOFTWARE VERSION 9.2.
2. YEAR 2010 CENSUS TRACTS FOR POPULATION IN EL PASO COUNTY, TEXAS DOWNLOADED FROM THE INSTITUTE FOR DEMOGRAPHIC AND SOCIOECONOMIC RESEARCH, TEXAS STATE DATA CENTER AND THE UNIVERSITY OF TEXAS AT SAN ANTONIO.
3. YEAR 2010 CENSUS TRACTS FOR POPULATION IN OTERO AND DONA ANA COUNTIES, NEW MEXICO PROVIDED BY THE BUREAU OF BUSINESS AND ECONOMIC RESEARCH, UNIVERSITY OF NEW MEXICO.
4. YEAR 2010 CENSUS TRACT FOR GEOGRAPHY DOWNLOADED FROM THE UNITED STATES CENSUS BUREAU.

# Population Change by Census Tract, 2000 - 2010

**2000 Census Tract Boundary**

**Population Change From 2000 to 2010**

- Less than 0%
- 1% - 30%
- 31% - 60%
- 61% - 100%
- Greater than 100%

- 2010 Census Tract Boundary*
- Landfill Boundary
- 5 Mile Radius Around Landfill

**Some 2000 Census tracts in the area shown were divided for the 2010 Census. In these cases, population totals for the 2010 tracts were summed to reflect an area equivalent to the original (2000) tract.*

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STATE OF TEXAS
FREDRIC J. DORAN
111226
REGISTERED
PROFESSIONAL ENGINEER
12/12/12

DESIGNED TLK
DRAWN CAD
VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
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| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

THE CITY OF EL PASO TEXAS

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Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

GROWTH TRENDS MAP

PROJECT NUMBER: 9631500115
SHT. 31 OF: 78
DRAWING NUMBER: P2-25

Kolter, Tonya L. 10/29/2012 3:01:02 PM – P:\00218000 el paso tx\9631500115\data analytical\CAD\P2-25 GROWTH TRENDS MAP.dwg

# Appendix 2C
# Transportation Report

SAIC®

U.S. Department
of Transportation
**Federal Aviation Administration**

Airports Division
Southwest Region
Arkansas, Louisiana,
New Mexico, Oklahoma,
Texas

2601 Meacham Boulevard
Fort Worth, Texas 76137

February 22, 2012

Mr. Fredric J. Doran, P.E.
Senior Environmental Engineer
SAIC Energy, Environment, and Infrastructure
1380 Corporate Center Curve, Suite 305
St. Paul, MN 55121

Dear Mr. Doran:

This is in response to your letter of January 11, 2012, about the proposed expansion of the McCombs Municipal Solid Waste Landfill in El Paso, Texas. Based on the information provided, we found no public-use airports within five miles of the site. We have no objection to the proposal from the standpoint of potential wildlife hazards to aircraft.

We have assigned this proposed landfill site File No. 2012-002TX. Please use this number in any future correspondence about this facility. Thank you for coordinating this project with the Federal Aviation Administration.

If you have any questions, please call me at (817) 222-5656.

Sincerely,

Faye Nedderman
Executive Technical Assistant

cc:
Texas Department of Transportation
Division of Aviation
125 East 11th Street
Austin, TX 78701-2483

SAIC

January 11, 2012

Faye Nedderman
Federal Aviation Administration
2601 Meacham Blvd
Fort Worth, Texas 76137

Subject: **Facility Compliance with Airport Safety**
**McCombs Municipal Solid Waste Landfill, El Paso, Texas**

Dear Ms. Nedderman:

The McCombs Municipal Solid Waste Landfill (Landfill) located in El Paso, Texas (City) is proposing a vertical expansion of the existing Landfill footprint to provide additional capacity. The Landfill is located in El Paso County within the El Paso city limits and serves the waste needs of the City and the surrounding area. The Landfill is an existing Type 1 MSW disposal facility owned and operated by the City. The Landfill is located at the northeast corner of the intersection of McCombs Road and Stan Roberts Road (FM 2529) in El Paso, Texas. The address of the Landfill is 13660 McCombs Road.

The proposed vertical expansion will increase the height of the Landfill from the currently permitted elevation of 4,125 feet mean sea level (MSL) to 4,305 feet MSL. The existing permitted boundary of the Landfill is currently 327 acres (permitted in 1984), and is not proposed to increase. The primary use for this facility will remain dedicated for disposal of municipal solid waste.

Pursuant to Texas Administrative Code Chapter 330 (30 TAC §330.61 (i)(5) and 30 TAC §330.545 (a)), please verify that the facility is not:

1. Located within 10,000 feet of any airport runway end used by turbojet aircraft;
2. Within 5,000 feet of any airport runway end used by only piston-type aircraft;
3. Within a six mile radius of any small general service airport runway end used by turbojet or piston-type aircraft; or
4. Within a five mile radius of any large general public commercial airport runway end used by turbojet or piston-type aircraft.



*SAIC Energy, Environment & Infrastructure, LLC*
*1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI*

If you have any questions or require additional information, please contact me at 651-994-8415 or fredric.j.doran@saic.com.

Sincerely,

**SAIC Energy, Environment & Infrastructure, LLC**

Fredric J. Doran, P.E.
Senior Environmental Engineer

cc: Miguel Parra, City of El Paso
Scott R. Pasternak, SAIC



*SAIC Energy, Environment & Infrastructure, LLC*
*1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI*

SAIC

January 11, 2012

Edgar E. Fino, P.E.
Transportation Engineer Supervisor
Texas Department of Transportation
13301 Gateway West
El Paso, Texas 79928-5410

Subject: **Transportation Impact Analysis**
**McCombs Municipal Solid Waste Landfill, El Paso, Texas**

Dear Mr. Fino:

The City of El Paso is anticipating reopening the McCombs Landfill (located on McCombs and Stan Roberts Road) and has prepared a Traffic Impact Analysis (TIA) that was sent to you previously for review, and is included as Attachment 1 for your reference. The Landfill is located at the northeast corner of the intersection of McCombs Road and Stan Roberts Road (FM 2529) in El Paso, Texas. The address of the Landfill is 13660 McCombs Road.

The purpose of this letter is to document correspondence with the Texas Department of Transportation (TxDOT) pursuant to Texas Administrative Code Chapter 330 (30 TAC §330.61 (i)). Please provide a written response to the TIA provided on any traffic or location restrictions that may exist.

If you have any questions or require additional information, please contact me at 651-994-8415 or fredric.j.doran@saic.com.

Sincerely,

**SAIC Energy, Environment & Infrastructure, LLC**

Fredric J. Doran, P.E.
Senior Environmental Engineer

c w/ encl: Miguel Parra, City of El Paso
Scott R. Pasternak, SAIC



*SAIC Energy, Environment & Infrastructure, LLC*
*1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI*

*Dedicated to Outstanding Customer Service for a Better Community*

S E R V I C E  S O L U T I O N S  S U C C E S S

November 21, 2011

Mark R. Vickery, P.G.
Executive Director
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Tx 78711-3087

Subject: Traffic Impact Analysis

Dear Mr. Vickery:

The enclosed Traffic Impact Analysis was prepared by the Traffic Engineer for the City of El Paso's Department of Transportation.

Sincerely,

Ellen A. Smyth, P.E.


**Mayor**
John F. Cook

**City Council**

*District 1*
Ann Morgan Lilly

*District 2*
Susie Byrd

*District 3*
Emma Acosta

*District 4*
Carl L. Robinson

*District 5*
Dr. Michiel R. Noe

*District 6*
Eddie Holguin Jr.

*District 7*
Steve Ortega

*District 8*
Cortney Carlisle Niland

**City Manager**
Joyce A. Wilson



**Environmental Services Department**
7968 San Paulo Drive, El Paso, TX 79907 • (915) 621-6700 • Fax (915) 621-6711
www.elpasotexas.gov



El Paso All-America City 2010

# Traffic Impact Analysis

## McCombs Land Fill Facility

**Department of Transportation**

Jan 12, 2011

STATE OF TEXAS
SERGIO REYES
106645
PROFESSIONAL ENGINEER

4-4-12

## Introduction

This Analysis was prepared for the proposed landfill, located immediately east of McCombs between State Line and Stan Roberts. The purpose of the study is to analyze the traffic and transportation impacts of the proposed development on adjacent road network.

### *Study Area*

Figure 1 shows the project site and the surrounding area. McCombs is a two lane undivided roadway which provides north/south travel within the study area. State Line and Stan Roberts are two lane undivided roadways which provides east/west travel.

Figure 1. Study Area

## Methodology

For this study, the following milestone years were analyzed:

- Existing (2010)
- Future traffic conditions in the build out year (2011)
- Future traffic conditions 10 year after build out (2021)
- Future traffic conditions end of life of the landfill (2040)

### *Data Collection*

The surrounding roadway network adjacent to the land fill site was analyzed to establish baseline traffic flow.

For this traffic impact study, AM, PM, and ADT volumes are needed to evaluate the roadway capacity analyses. Roadway Tube Counts were taken at various segments in the study area. Figure 2 also shows the existing weekday AM\PM, and 24-hour ADT volumes.

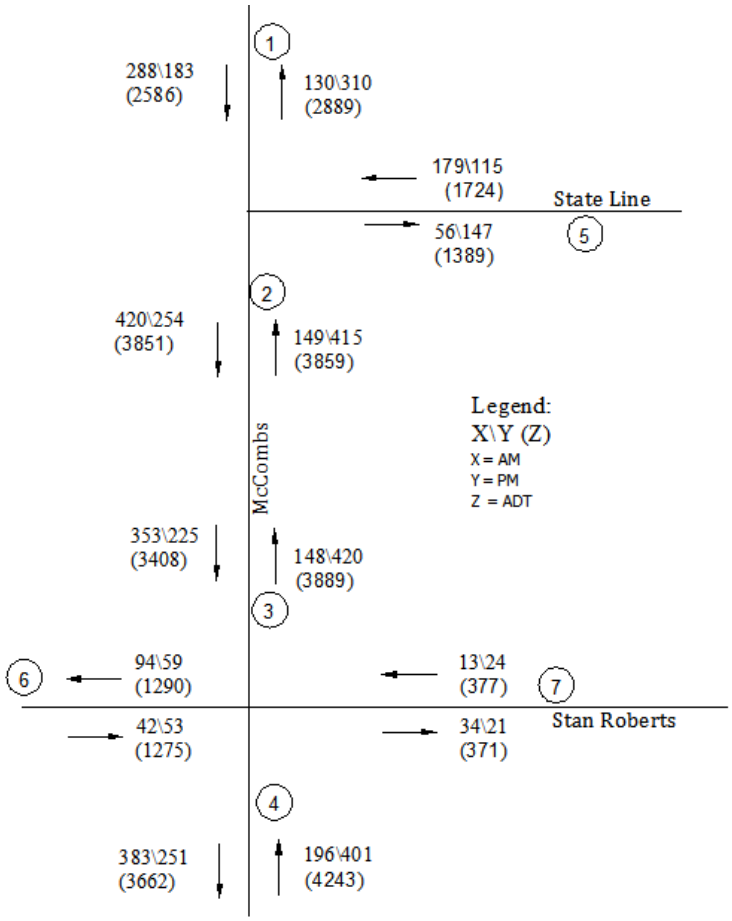



Figure 2: Existing AM\PM and ADT roadway count volumes (2010)

***Background Growth***
In order to obtain future year background traffic, a growth rate was applied to the existing (2010) traffic volumes to account for ambient growth in traffic. The growth rate was derived from the El Paso MPO model.

## Trip Generation and Distribution

***Site generated traffic***
Site generated traffic was determined based on the information provided by The City of El Paso's Environmental Services department. The trip generation for the Site is shown in Table 1.

| | ADT | |
|---|---|---|
| | 2011 | 2040 |
| City Trash | 80 | 96 |
| Commercial Trash | 100 | 120 |
| Employees | 30 | 36 |
| Public | 100 | 120 |

Table 1: Site trip generation

***Trip distribution***
Distribution of site traffic onto the street system was based on the existing traffic patterns. Multiplying the site generated trips by the percentage distribution provides the projected trip assignments to the road network.

## Traffic Operations Analysis

***Analysis Methodology***

The TransBorder 2035 Metropolitan Transportation Plan (MTP) examines projects based on the volume to capacity ratio (V/C) which was then defined in terms of level of mobility (LOM). Table 2 shows the definition of LOM rankings based on V/C.

Table 2- LOM criteria

| **Level of Mobility** | **V/C Ratio** |
|---|---|
| Tolerable | <0.85 |
| Moderate | >=0.85 <1.0 |
| Serious | >=1.0<1.25 |
| Severe | >=1.25 |

### *2010 Existing Traffic Conditions*

The existing traffic conditions are shown below. All roadway segments operate at a "Tolerable" LOM.

| 2010 Existing | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Daily | | | AM | | | PM | | |
| Road Segment | V | V/C | LOM | V | V/C | LOM | V | V/C | LOM |
| 1 | 5475 | 0.46 | Tolerable | 418 | 0.35 | Tolerable | 493 | 0.41 | Tolerable |
| 2 | 7710 | 0.64 | Tolerable | 569 | 0.47 | Tolerable | 669 | 0.56 | Tolerable |
| 3 | 7297 | 0.61 | Tolerable | 501 | 0.42 | Tolerable | 645 | 0.54 | Tolerable |
| 4 | 7905 | 0.66 | Tolerable | 579 | 0.48 | Tolerable | 652 | 0.54 | Tolerable |
| 5 | 3113 | 0.26 | Tolerable | 235 | 0.20 | Tolerable | 262 | 0.22 | Tolerable |
| 6 | 2565 | 0.21 | Tolerable | 136 | 0.11 | Tolerable | 112 | 0.09 | Tolerable |
| 7 | 748 | 0.06 | Tolerable | 47 | 0.04 | Tolerable | 45 | 0.04 | Tolerable |

### *2011 Full Site Build-Out No Build*

It is anticipated that the landfill will be at full build-out in 2011. One year of growth in background traffic results in minor increases in V/C ratio.

| 2011 Background No build | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Daily | | | AM | | | PM | | |
| Road Segment | V | V/C | LOM | V | V/C | LOM | V | V/C | LOM |
| 1 | 5519 | 0.46 | Tolerable | 421 | 0.35 | Tolerable | 497 | 0.41 | Tolerable |
| 2 | 7848 | 0.65 | Tolerable | 579 | 0.48 | Tolerable | 681 | 0.57 | Tolerable |
| 3 | 7428 | 0.62 | Tolerable | 510 | 0.42 | Tolerable | 657 | 0.55 | Tolerable |
| 4 | 7988 | 0.67 | Tolerable | 585 | 0.49 | Tolerable | 659 | 0.55 | Tolerable |
| 5 | 3228 | 0.27 | Tolerable | 244 | 0.20 | Tolerable | 272 | 0.23 | Tolerable |
| 6 | 2601 | 0.22 | Tolerable | 138 | 0.11 | Tolerable | 114 | 0.09 | Tolerable |
| 7 | 800 | 0.07 | Tolerable | 50 | 0.04 | Tolerable | 48 | 0.04 | Tolerable |

### *2011 Full Site Build-Out Plus Site Traffic Conditions*

With the addition of the opening day site-generated traffic to the 2011 background traffic, V/C ratio at the roadway segments tend to increase slightly as show below.

| 2011 Background + Site | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Daily | | | AM | | | PM | | |
| Road Segment | V | V/C | LOM | V | V/C | LOM | V | V/C | LOM |
| 1 | 5627 | 0.47 | Tolerable | 433 | 0.36 | Tolerable | 509 | 0.42 | Tolerable |
| 2 | 7884 | 0.66 | Tolerable | 579 | 0.48 | Tolerable | 681 | 0.57 | Tolerable |
| 3 | 7752 | 0.65 | Tolerable | 510 | 0.42 | Tolerable | 657 | 0.55 | Tolerable |
| 4 | 8416 | 0.70 | Tolerable | 628 | 0.52 | Tolerable | 702 | 0.59 | Tolerable |
| 5 | 3269 | 0.27 | Tolerable | 248 | 0.21 | Tolerable | 276 | 0.23 | Tolerable |
| 6 | 2634 | 0.22 | Tolerable | 140 | 0.12 | Tolerable | 115 | 0.10 | Tolerable |
| 7 | 810 | 0.07 | Tolerable | 51 | 0.04 | Tolerable | 49 | 0.04 | Tolerable |

### *2021 Background Traffic Conditions No Build*

An additional ten years of growth in the background traffic results in significant increases in the V/C ratio when compared to 2011, as shown below.

| 2021 Background No build | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Daily | | | AM | | | PM | | |
| Road Segment | V | V/C | LOM | V | V/C | LOM | V | V/C | LOM |
| 1 | 5975 | 0.50 | Tolerable | 456 | 0.38 | Tolerable | 538 | 0.45 | Tolerable |
| 2 | 9378 | 0.78 | Tolerable | 692 | 0.58 | Tolerable | 814 | 0.68 | Tolerable |
| 3 | 8872 | 0.74 | Tolerable | 609 | 0.51 | Tolerable | 784 | 0.65 | Tolerable |
| 4 | 8871 | 0.74 | Tolerable | 650 | 0.54 | Tolerable | 732 | 0.61 | Tolerable |
| 5 | 4644 | 0.39 | Tolerable | 351 | 0.29 | Tolerable | 391 | 0.33 | Tolerable |
| 6 | 2987 | 0.25 | Tolerable | 158 | 0.13 | Tolerable | 130 | 0.11 | Tolerable |
| 7 | 1567 | 0.13 | Tolerable | 98 | 0.08 | Tolerable | 94 | 0.08 | Tolerable |

### *2021 Background Traffic Conditions Plus Site Traffic*

With the addition of the site-generated traffic to the 2021 background traffic, the V/C ratio is approaching "Moderate" LOM for segments 2, 3, and 4.

| 2021 Background + Site | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Daily | | | AM | | | PM | | |
| Road Segment | V | V/C | LOM | V | V/C | LOM | V | V/C | LOM |
| 1 | 6083 | 0.51 | Tolerable | 467 | 0.39 | Tolerable | 550 | 0.46 | Tolerable |
| 2 | 9414 | 0.78 | Tolerable | 708 | 0.59 | Tolerable | 830 | 0.69 | Tolerable |
| 3 | 9196 | 0.77 | Tolerable | 671 | 0.56 | Tolerable | 846 | 0.71 | Tolerable |
| 4 | 9298 | 0.77 | Tolerable | 693 | 0.58 | Tolerable | 775 | 0.65 | Tolerable |
| 5 | 4685 | 0.39 | Tolerable | 355 | 0.30 | Tolerable | 395 | 0.33 | Tolerable |
| 6 | 3020 | 0.25 | Tolerable | 161 | 0.13 | Tolerable | 132 | 0.11 | Tolerable |
| 7 | 1577 | 0.13 | Tolerable | 99 | 0.08 | Tolerable | 95 | 0.08 | Tolerable |

### *2040 Background Traffic Conditions No Build*

By 2040, segment 2 and 3 is at a "Moderate" LOM for the PM peak hour, and "Serious" LOM for the daily traffic. Segment 4 is at a "Moderate" LOM for the daily traffic.

| 2040 Background No build | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Daily | | | AM | | | PM | | |
| Road Segment | V | V/C | LOM | V | V/C | LOM | V | V/C | LOM |
| 1 | 6948 | 0.58 | Tolerable | 530 | 0.44 | Tolerable | 626 | 0.52 | Tolerable |
| 2 | 13151 | 1.10 | Serious | 971 | 0.81 | Tolerable | 1141 | 0.95 | Moderate |
| 3 | 12433 | 1.04 | Serious | 854 | 0.71 | Tolerable | 1099 | 0.92 | Moderate |
| 4 | 10824 | 0.90 | Moderate | 793 | 0.66 | Tolerable | 893 | 0.74 | Tolerable |
| 5 | 9265 | 0.77 | Tolerable | 699 | 0.58 | Tolerable | 780 | 0.65 | Tolerable |
| 6 | 3885 | 0.32 | Tolerable | 206 | 0.17 | Tolerable | 170 | 0.14 | Tolerable |
| 7 | 5624 | 0.47 | Tolerable | 353 | 0.29 | Tolerable | 338 | 0.28 | Tolerable |

### *2040 Background Traffic Conditions Plus Site Traffic*

The addition of the site build-out traffic increases the V/C ratio, but does not result in changes to the LOM rankings. As seen in the following table, the site generated traffic slightly increases the V/C ratio. The roadway links which are projected to reach the "Moderate" or "Serious" LOM are a result of the continuing background traffic growth.

| 2040 Background + Site | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Daily | | | AM | | | PM | | |
| Road Segment | V | V/C | LOM | V | V/C | LOM | V | V/C | LOM |
| 1 | 7078 | 0.59 | Tolerable | 544 | 0.45 | Tolerable | 640 | 0.53 | Tolerable |
| 2 | 13330 | 1.11 | Serious | 989 | 0.82 | Tolerable | 1161 | 0.97 | Moderate |
| 3 | 13177 | 1.10 | Serious | 928 | 0.77 | Tolerable | 1173 | 0.98 | Moderate |
| 4 | 11338 | 0.94 | Moderate | 844 | 0.70 | Tolerable | 945 | 0.79 | Tolerable |
| 5 | 9314 | 0.78 | Tolerable | 705 | 0.59 | Tolerable | 785 | 0.65 | Tolerable |
| 6 | 3926 | 0.33 | Tolerable | 209 | 0.17 | Tolerable | 172 | 0.14 | Tolerable |
| 7 | 5636 | 0.47 | Tolerable | 354 | 0.30 | Tolerable | 339 | 0.28 | Tolerable |

### *2040 MTP Background Traffic Conditions Plus Site Traffic*

McCombs (segment 1, 2, 3, and 4) is indicated on the MTP as an eight lane super arterial. The following table shows the LOM with the recommended transportation improvements on McCombs.

| 2040 ***MTP*** Background + Site | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Daily | | | AM | | | PM | | |
| Road Segment | V | V/C | LOM | V | V/C | LOM | V | V/C | LOM |
| 1 | 7078 | 0.15 | Tolerable | 544 | 0.11 | Tolerable | 640 | 0.13 | Tolerable |
| 2 | 13330 | 0.28 | Tolerable | 989 | 0.21 | Tolerable | 1161 | 0.24 | Tolerable |
| 3 | 13177 | 0.27 | Tolerable | 928 | 0.19 | Tolerable | 1173 | 0.24 | Tolerable |
| 4 | 11338 | 0.24 | Tolerable | 844 | 0.18 | Tolerable | 945 | 0.20 | Tolerable |
| 5 | 9314 | 0.78 | Tolerable | 705 | 0.59 | Tolerable | 785 | 0.65 | Tolerable |
| 6 | 3926 | 0.33 | Tolerable | 209 | 0.17 | Tolerable | 172 | 0.14 | Tolerable |
| 7 | 5636 | 0.47 | Tolerable | 354 | 0.30 | Tolerable | 339 | 0.28 | Tolerable |

## **Conclusions:**

The segment on McCombs between State Line and Stan Roberts is projected to reach "Serious" LOM approaching the end of life year 2040 as a result of the continuing background traffic growth. With the addition of traffic from the proposed site, the V/C ratio increases slightly, but does not result in changes to the LOM rankings.

If the recommended improvements on McCombs are implemented according to the MTP, then all roadway segments operate at a "Tolerable" LOM.

## Shull, Stacey C.

**From:** Greggerson, Vernon L. [GreggersonVL@elpasotexas.gov]
**Sent:** Monday, February 28, 2011 9:22 AM
**To:** Shull, Stacey C.
**Cc:** Benitez, Cristian A.; Rodriguez-Hefner, Elda
**Subject:** FW: McCombs Landfill
**Attachments:** McCombs Landfill.pdf; Edgar Fino.vcf

Here are the comments from TxDOT

---

**From:** Rodriguez-Hefner, Elda
**Sent:** Thursday, January 20, 2011 8:14 AM
**To:** Greggerson, Vernon L.
**Subject:** FW: McCombs Landfill

Here is the report, and the response from TxDoT. I believe this meets the requirement under the 330 rules that apply to the impact study.

---

**From:** Do, Anthony T.
**Sent:** Wednesday, January 19, 2011 5:09 PM
**To:** Rodriguez-Hefner, Elda
**Subject:** FW: McCombs Landfill

Here is the reply from TxDot. Please let me know if you need anything further.

---

**From:** Edgar Fino [mailto:Edgar.Fino@txdot.gov]
**Sent:** Wednesday, January 19, 2011 2:44 PM
**To:** Do, Anthony T.
**Cc:** Gus Sanchez; Omar Madrid
**Subject:** Fwd: McCombs Landfill

TxDOT does not have comments to your TIA. FM 2529 (McCombs) does not extend from Stan Roberts to State Line. FM 2529 (McCombs) continues/turns left at Stan Roberts and ends at FM 3255 (MLK).

Edgar E. Fino, P.E.
Transportation Engineer Supervisor
TxDOT-El Paso District
Phone: (915) 790-4306
Fax: (915) 790-4368

>>> "Do, Anthony T." <DoAT@elpasotexas.gov> 01/12/11 9:25 AM >>>
Edgar,

Our environmental services department is looking to open a land fill on McCombs and Stan Roberts. Attached is a roadway capacity analysis for the surrounding roadway as part of their permit amendment for your review.

Please let me know if you have any comments or need further information.
Thank you for your assistance.

Anthony Do
Department of Transportation
City of El Paso, TX
(915) 621-6758

# Appendix 2D
# TPDES Multi-Sector General Permit

SAIC®

1005092011C
NOI Authorization

Bryan W. Shaw, Ph.D., *Chairman*
Buddy Garcia, *Commissioner*
Carlos Rubinstein, *Commissioner*
Mark R. Vickery, P.G., *Executive Director*

# TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

*Protecting Texas by Reducing and Preventing Pollution*

October 28, 2011

Dear Applicant:

Re: TPDES Multi-Sector General Permit (TXR050000)
Notice of Intent Authorization

Your Notice of Intent application for authorization under the general permit for discharge of storm water associated with industrial activities has been received. Pursuant to authorization from the Executive Director of the Texas Commission on Environmental Quality, the Division Director of the Water Quality Division has issued the enclosed Certificate.

Please refer to the attached certificate for the identification number that was assigned to your project/site and the coverage effective date. Please use this number to reference this project/site for future communications with the Texas Commission on Environmental Quality (TCEQ).

Authorization under the Edwards Aquifer Protection Program is required before construction can begin where the site is located within the Edwards Aquifer Recharge Zone, Contributing Zone, or Contributing Zone within the Transition Zone. See http://www.tceq.state.tx.us/compliance/field_ops/eapp/program.html for additional information.

A Notice of Termination must be submitted when permit coverage is no longer needed. You may obtain a Notice of Termination form at the web site listed below. All authorizations that are active on September 1st of each year will be assessed an annual fee. The Notice of Termination must be postmarked for delivery to TCEQ on or before September 1 to avoid the annual fee assessment.

The billing statement will be mailed to the Operator in January and payment must be made within 30 days to avoid late fees. It is the responsibility of the Operator to notify the TCEQ Storm Water Processing center of any change in address supplied on the original Notice of Intent.

For questions related to the status or processing of your application you may contact the Storm Water Processing Center by email at SWPERMIT@tceq.state.tx.us or by telephone at (512) 239-3700. If you have any questions regarding coverage under this general permit or other technical issues, you may contact the storm water technical staff at (512) 239-4671 or by email at swgp@tceq.state.tx.us. Also, you may obtain information on the storm water web site at www.tceq.state.tx.us. Permit and application status information can be found on the TCEQ web site at http://www5.tceq.state.tx.us/wq_dpa/.

Sincerely,

Charles W. Maguire, Director
Water Quality Division
Texas Commission on Environmental Quality

# TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Texas Pollutant Discharge Elimination System
Storm Water Multi-Sector General Permit

The Notice of Intent (NOI) for the facility listed below was received on September 19, 2011. The intent to discharge storm water associated with industrial activity under the terms and conditions imposed by the Texas Pollutant Discharge Elimination System (TPDES) storm water multi-sector general permit TXR050000 is acknowledged. Your facility's TPDES multi-sector storm water general permit number is:

**TXR05L795**
Coverage Effective: November 26, 2001

TCEQ's storm water multi-sector general permit requires certain storm water pollution prevention and control measures, possible monitoring and reporting, and periodic inspections. Among the conditions and requirements of this permit, you must have prepared and implemented a storm water pollution prevention plan (SWP3) that is tailored to your industrial site. As a facility authorized to discharge under the storm water multi-sector general permit, all terms and conditions must be complied with to maintain coverage and avoid possible penalties.

Project/Site Information:
RN100215599
MCCOMBS LANDFILL
13600 MCCOMBS ST
EL PASO, TX 79934-3307
EL PASO COUNTY

Operator:
CN601410244
CITY OF EL PASO
7968 SAN PAULO DR
EL PASO, TX 79907-1261

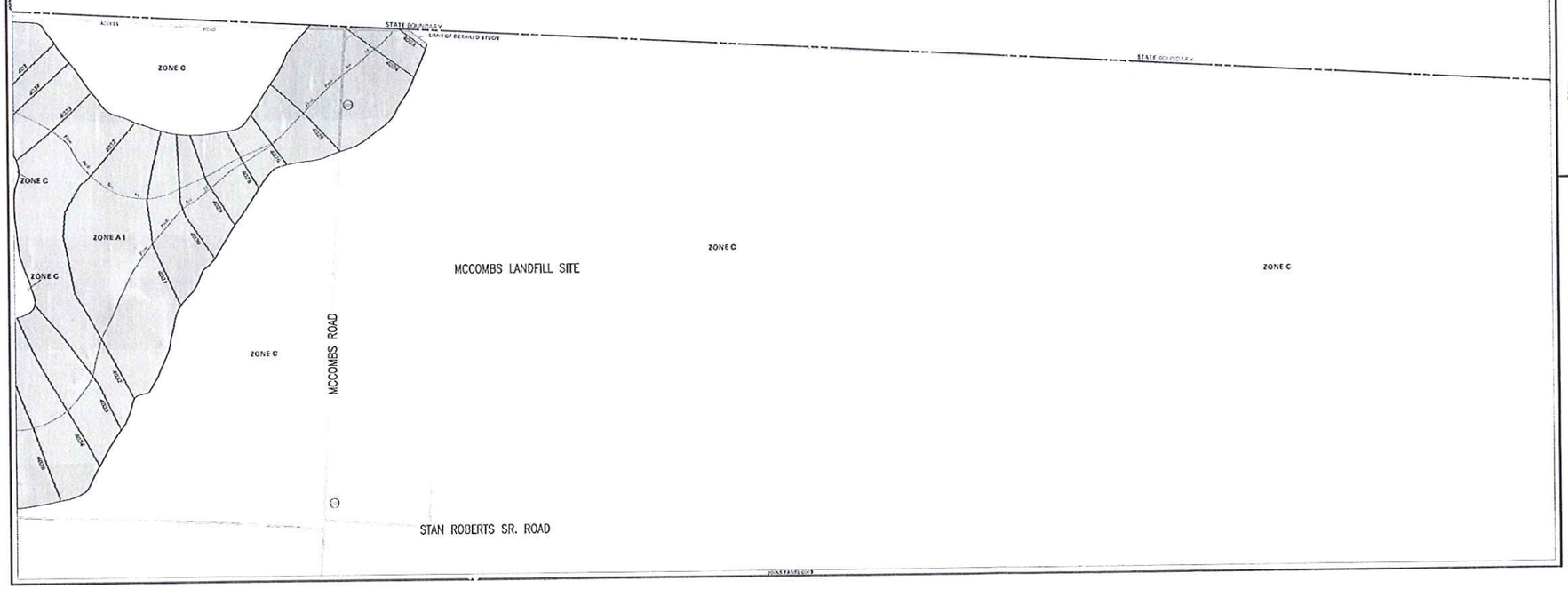
This permit expires on August 14, 2016, unless otherwise amended. If you have any questions related to processing you may contact the Storm Water Processing Center by **email at SWPERMIT@tceq.texas.gov or by telephone at (512) 239-3700**. For technical issues, you may contact the storm water technical staff by email at swgp@tceq.texas.gov or by telephone at (512) 239-4671. Also, you may obtain information on the storm water web site at http://www5.tceq.texas.gov/wq_dpa/. A copy of this document should be kept with your SWP3.

Issued Date: October 28, 2011

FOR THE COMMISSION

# Appendix 2E
# Floodplains and Wetlands Documentation

SAIC®




KEY TO MAP

| | |
|---|---|
| 500-Year Flood Boundary | ZONE B |
| 100-Year Flood Boundary | ZONE A1 |
| Zone Designations* | ZONE A5 |
| 100-Year Flood Boundary | ZONE B |
| 500-Year Flood Boundary | |
| Base Flood Elevation Line (BFE) | 513 |
| Base Flood Elevation in Feet (Elevation Reference Mark) | EL 5979 |
| Elevation Reference Mark | RM7x |
| Zone Boundary | |
| Cross Section | 4311 S |

*Referenced to the National Geodetic Vertical Datum of 1929

*EXPLANATION OF ZONE DESIGNATIONS

| ZONE | EXPLANATION |
|---|---|
| A | Areas of 100-year flood; base flood elevations and flood hazard factors not determined. |
| AO | Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined. |
| AH | Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined. |
| AE,A1-A30 | Areas of 100-year flood; base flood elevations and flood hazard factors determined. |
| A99 | Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined. |
| B | Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths of less than 1 foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading) |
| C | Areas of minimal flooding. (No shading) |
| D | Areas of undetermined, but possible, flood hazards. |
| V | Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined. |
| V1-V30 | Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined. |

NOTES TO USER

Certain areas not in the special flood hazard areas (Zones A and V) may be protected by flood control structures.

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside special flood hazard areas. The coastal flooding elevations shown may be higher than those developed by the National Weather Service for hurricane evacuation planning.

For adjoining map panels, see separately printed Index to Map Panels.

INITIAL IDENTIFICATION:
NOVEMBER 12, 1979

FLOOD BOUNDARY AND FLOODWAY MAP REVISIONS:
NONE

FLOOD INSURANCE RATE MAP EFFECTIVE:
SEPTEMBER 30, 1988

FLOOD INSURANCE RATE MAP REVISIONS:
JUNE 15, 1988 - To change Base Flood elevations, to add special flood hazard areas, to change zone designations, and to change some floodways.

For sale by the National Geodetic Survey, Rockville, MD 20852
For information on flood insurance in this community, contact your insurance agent or call the National Flood Insurance Program at (800) 638-6620.

APPROXIMATE SCALE

NATIONAL FLOOD INSURANCE PROGRAM

**FIRM**
**FLOOD INSURANCE RATE MAP**

CITY OF
EL PASO,
TEXAS
EL PASO COUNTY

PANEL 4 OF 52
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
480214 0004 C

MAP REVISED:
JUNE 15, 1988

Federal Emergency Management Agency

GRAPHIC SCALE: NTS

## NOTES

1. FEMA FLOOD INSURANCE FATE MAP (FIRM) PREPARED JUNE 15, 1988. BASE FLOOD ELEVATIONS PROVIDED ARE NGVD 29 VERTICAL DATUM. NGVD 29 DATUM TO CITY OF EL PASO DATUM, ADD 27.65-FEET.
2. THE LANDFILL PROPERTY AND SECTOR BOUNDARIES ASSOCIATED WITH THE 100-YEAR FLOODPLAIN ARE SHOWN ON DRAWING P2-27.
3. THE ORIGINAL FIRM FOR PANEL 4 OF 52 (480214 0004 C) FOR THE CITY OF EL PASO REVISED ON JUNE 15, 1988 HAS BEEN PROVIDED ATTACHED FOR REVIEW ASSISTANCE.

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CAMI VAN ABEL
113723
REGISTERED PROFESSIONAL ENGINEER
3/15/13

DESIGNED TLK
DRAWN CAD
VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 3 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

THE CITY OF EL PASO TEXAS

SAIC

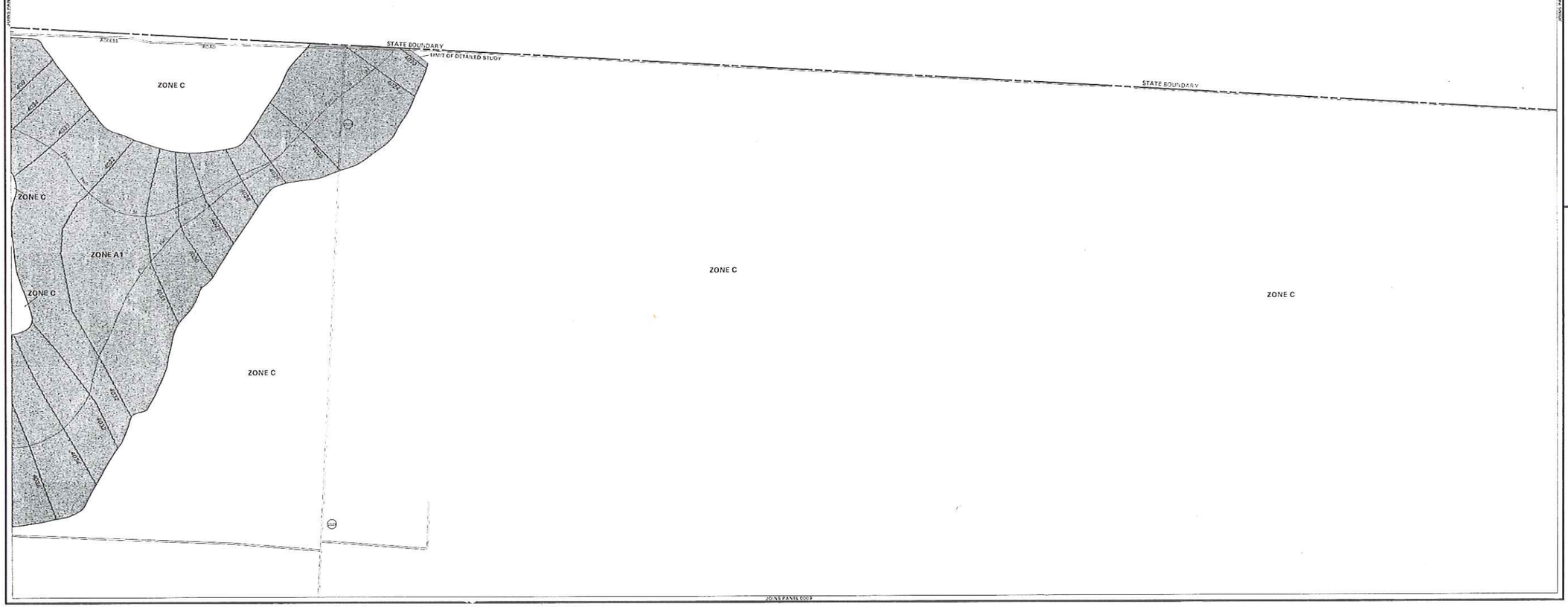
SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve
Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

FLOOD INSURANCE RATE MAP

PROJECT NUMBER: 9631500115
SHT. 32 OF: 78
DRAWING NUMBER: P2-26

Ron Jacob S. 3/13/2013 10:45:13 AM – R:\00218000 El Paso TX\9631500115 – McCombs\Data Analysis\CAD\P2-26 FLOOD INSURANCE RATE MAP.dwg




## KEY TO MAP

| | |
|---|---|
| 500-Year Flood Boundary | ZONE B |
| 100-Year Flood Boundary | ZONE A1 |
| Zone Designations* | ZONE A5 |
| 100-Year Flood Boundary | ZONE B |
| 100-Year Flood Boundary | |
| Base Flood Elevation Line With Elevation In Feet** | 513 |
| Base Flood Elevation In Feet Where Uniform Within Zone** | (EL 987) |
| Elevation Reference Mark | $RM7_X$ |
| Zone D Boundary | |
| River Mile | • M1.5 |

**Referenced to the National Geodetic Vertical Datum of 1929

## *EXPLANATION OF ZONE DESIGNATIONS

| ZONE | EXPLANATION |
|---|---|
| A | Areas of 100-year flood; base flood elevations and flood hazard factors not determined. |
| AO | Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of flooding are shown, but no Flood Hazard Factors are determined. |
| AH | Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no Flood Hazard Factors are determined. |
| A1-A30 | Areas of 100-year flood; base flood elevations and flood hazard factors determined. |
| A99 | Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined. |
| B | Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading) |
| C | Areas of minimal flooding. (No shading) |
| D | Areas of undetermined, but possible, flood hazards. |
| V | Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined. |
| V1-V30 | Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined. |

## NOTES TO USER

Certain areas not in the special flood hazard areas (zones A and V) may be protected by flood control structures.

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside special flood hazard areas. The coastal flooding elevations shown may differ significantly from those developed by the National Weather Service for hurricane evacuation planning.

For adjoining map panels, see separately printed Index to Map Panels.

INITIAL IDENTIFICATION:
NOVEMBER 29, 1977

FLOOD HAZARD BOUNDARY MAP REVISIONS:
NONE

FLOOD INSURANCE RATE MAP EFFECTIVE:
OCTOBER 15, 1987

FLOOD INSURANCE RATE MAP REVISIONS:
JUNE 15, 1988 - to change base flood elevations, to add base flood elevations, to add special flood hazard areas, to change special flood hazard areas and to change zone designations

To determine if flood insurance is available in this community, contact your insurance agent, or call the National Flood Insurance Program, at (800) 638-6620.

APPROXIMATE SCALE
500 0 500 FEET

NATIONAL FLOOD INSURANCE PROGRAM

# FIRM
## FLOOD INSURANCE RATE MAP

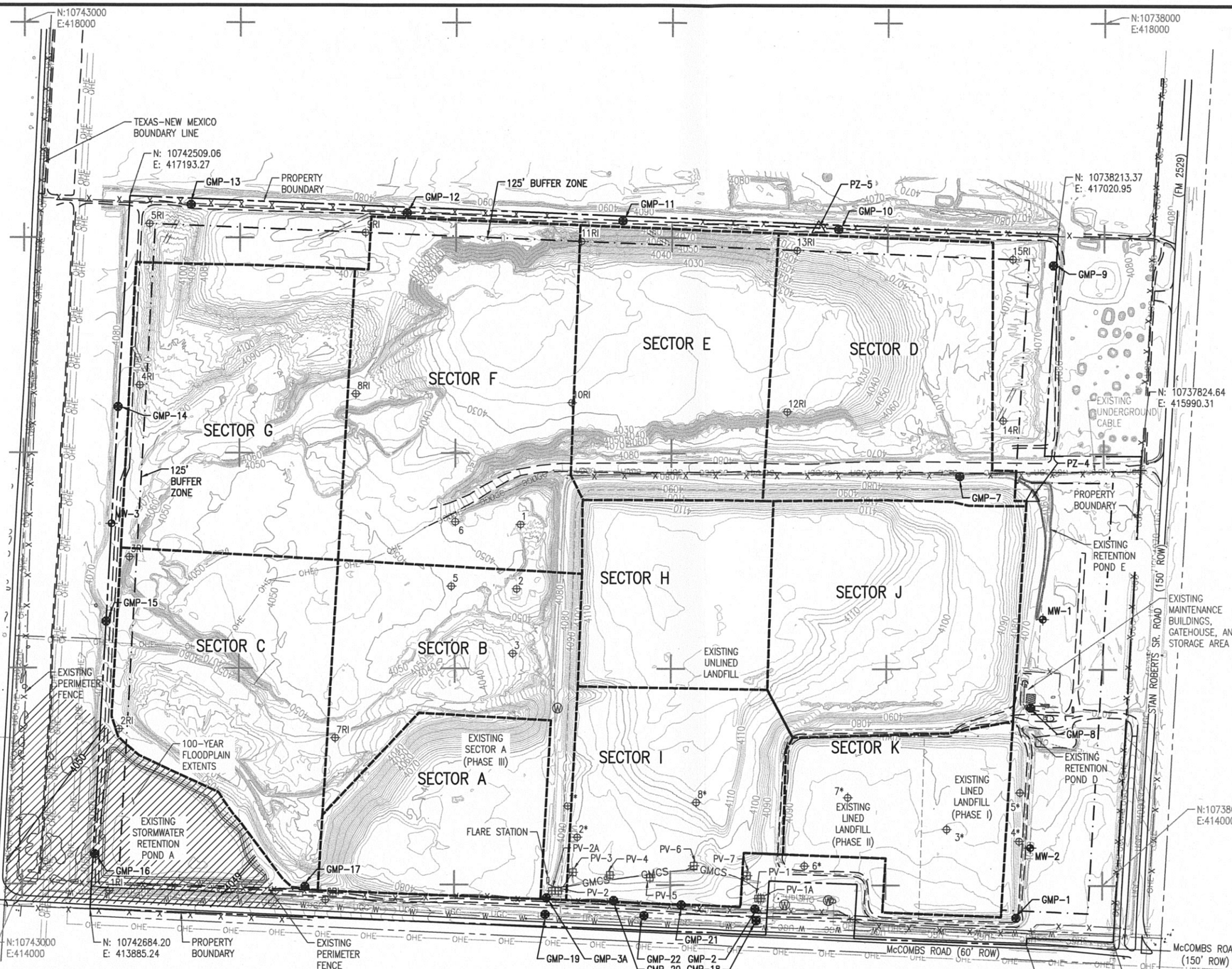
CITY OF
EL PASO,
TEXAS
EL PASO COUNTY

PANEL 4 OF 52
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
480214 0004 C

MAP REVISED:
JUNE 15, 1988

Federal Emergency Management Agency




## NOTES

1. DIGITIZED TOPOGRAPHY FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS.
2. COORDINATES ARE BASED ON THE TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NAD 83. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM. NAVD 88 DATUM TO NGVD 29 DATUM, SUTRACT 1.99–FEET. NGVD 29 DATUM TO CITY OF EL PASO DATUM, ADD 27.65–FEET.
3. EXISTING CONTOUR INTERVAL IS TWO FEET.
4. SITE TOPOGRAPHY MAY VARY DUE TO OWNER'S OPERATIONS.

## LEGEND

- 100 YEAR FLOOD PLAIN
- MW–3 — MONITORING WELL
- GMP–8 — GAS MONITORING PROBE
- PIEZOMETER
- PV–7 — VERTICAL GAS WELL
- 1*, 1RI, 1 — SOIL BORING, TYPICAL
- W — WATER WELL
- BUILDING/STRUCTURE
- 4050 — ELEVATION CONTOURS
- 4050 — BASE FLOOD ELEVATIONS
- CHAIN LINK OR OTHER FENCE
- 125' BUFFER ZONE
- UGE — UNDERGROUND ELECTRIC
- OHE — OVERHEAD ELECTRIC UTILITY
- UGC — UNDERGROUND COMMUNICATIONS
- GMCS — GAS MIGRATION CONTROL SYSTEM
- FACILITY/PROPERTY BOUNDARY
- SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- W — W — WATER LINE
- HIGHWAY
- LANDFILL ACCESS ROAD
- SECTION LINE

GRAPHIC SCALE

1"=250'–0" Scale: 250 0 250 500 Feet

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STATE OF TEXAS
FREDRIC J. DORAN
111226
REGISTERED PROFESSIONAL ENGINEER
11/2/12

DESIGNED TLK
DRAWN CAD
VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

THE CITY OF EL PASO TEXAS

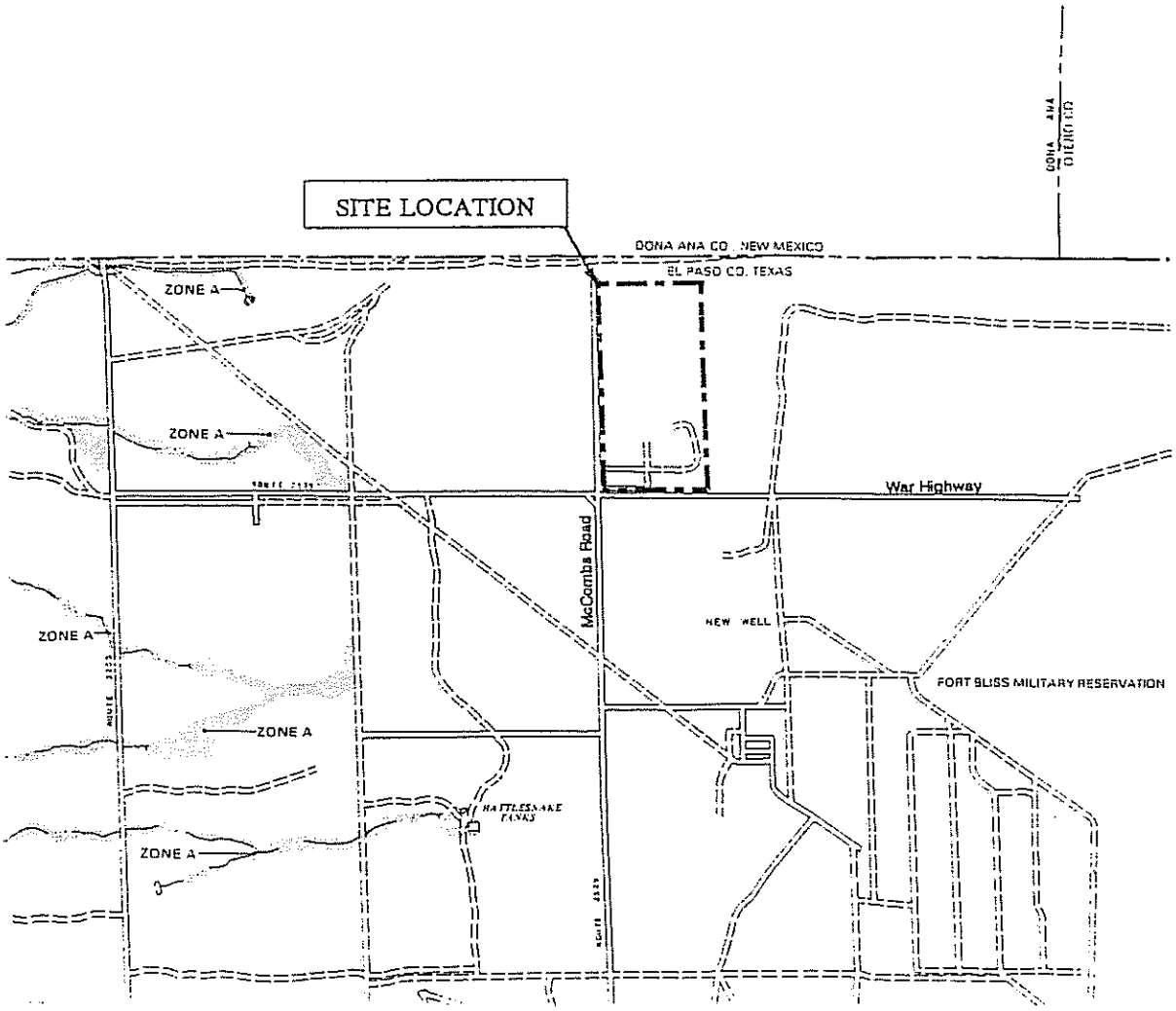
SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve
Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

100–YEAR FLOODPLAIN MAP

PROJECT NUMBER: 9631500115
SHT. 33 OF: 78
DRAWING NUMBER: P2–27

Keller, Tonya L. 10/16/2012 1:43:20 PM – P:\0021800 El Paso TX\9631500115\Data Analytical\CADD\P2-27 100-YEAR FLOODPLAIN MAP.dwg




Zone A - Special Flood Hazard Area

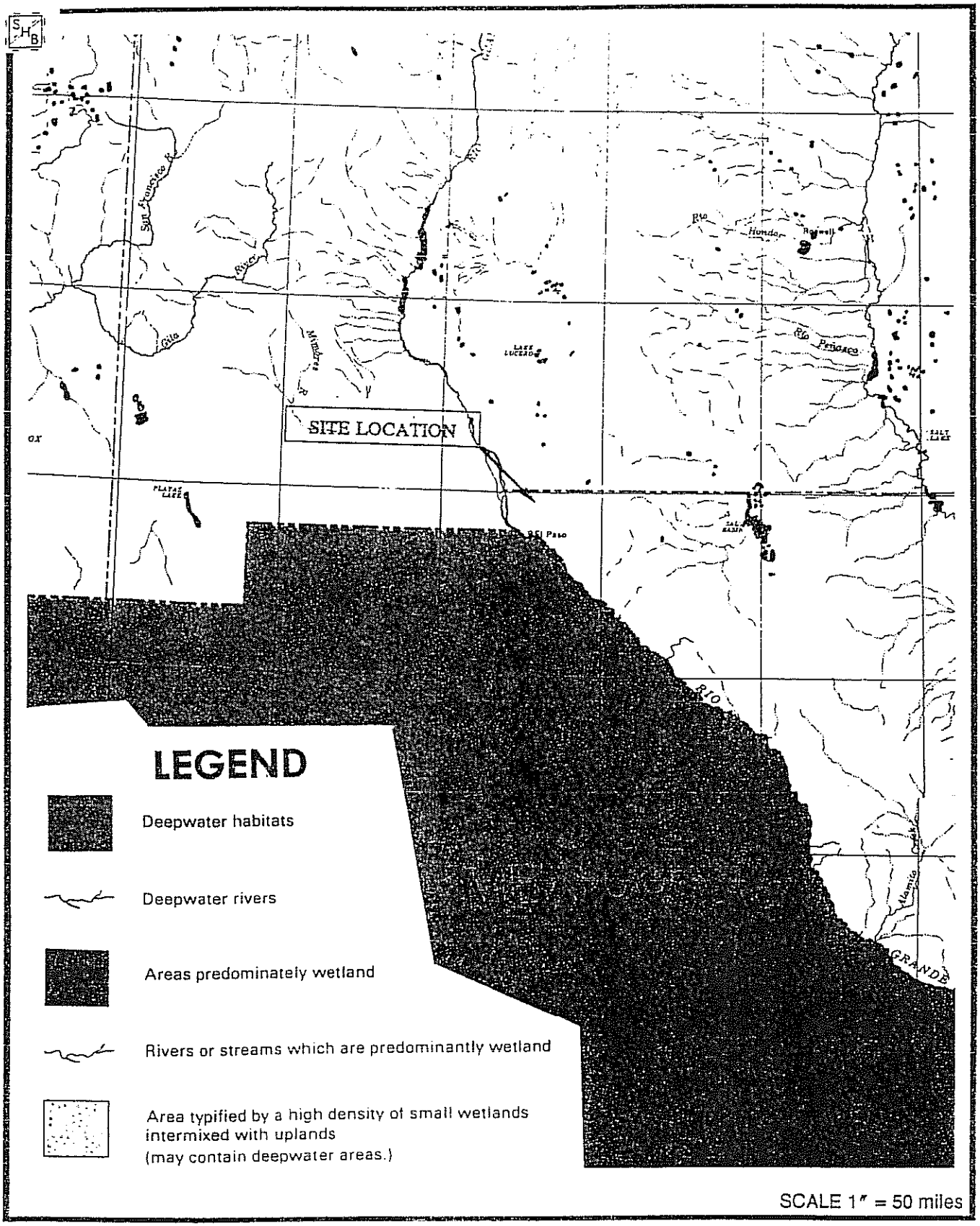
Approximate Scale 1" = 4000'

Location Restriction Evaluation
McCombs Landfill
El Paso, Texas
Job No. E94-4082

Ref: U.S. Dept. of H.U.D., Flood Hazard Boundary Map, July 19, 1977

Figure 3
Flood Zone Map

AGRA
Earth & Environmental Group




Location Restrictions Evaluation
McCombs Landfill
El Paso, Texas
Job No. E94-4082

Ref.: Wetland Resources of the U.S.; by T.E. Dohl; 1982

Figure 4
Wetlands Locations Map

AGRA
Earth & Environmental Group

# Appendix 2F
# Endangered Species Documentation

SAIC®

TEXAS PARKS & WILDLIFE

Life's better outside.®

Commissioners

T. Dan Friedkin
Chairman
Houston

Ralph H. Duggins
Vice-Chairman
Fort Worth

Antonio Falcon, M.D.
Rio Grande City

Karen J. Hixon
San Antonio

Dan Allen Hughes, Jr.
Beeville

Bill Jones
Austin

Margaret Martin
Boerne

S. Reed Morian
Houston

Dick Scott
Wimberley

Lee M. Bass
Chairman-Emeritus
Fort Worth

Carter P. Smith
Executive Director

July 5, 2012

Mr. Fredric J. Doran
SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve, Suite 305
St. Paul, MN 55121

RE: McCombs Municipal Solid Waste Landfill Vertical Expansion; El Paso County

Dear Mr. Doran:

Texas Parks and Wildlife Department (TPWD) received the request for information regarding listed threatened or endangered species within or near the above-referenced proposed project. TPWD staff has reviewed the information provided and offers the following comments and recommendations concerning this project.

Please be aware that a written response to a TPWD recommendation or informational comment received by a state governmental agency may be required by state law. For further guidance, see the Texas Parks and Wildlife Code, Section 12.0011, which can be found online at http://www.statutes.legis.state.tx.us/Docs/PW/htm/PW.12.htm#12.0011. For tracking purposes, please refer to TPWD project number 16900 in any return correspondence regarding this project.

Project Description

The proposed project entails the vertical expansion of an existing landfill to increase the height from the currently permitted elevation of 4,125 feet to 4,305 feet. The existing permitted boundary of the landfill is 327 acres and is not proposed to increase. No other information about the proposed project was provided with the request.

Federal Laws

*Endangered Species Act*

Federally-listed animal species and their habitats are protected from "take" on any property by the Endangered Species Act (ESA). Take of a federally-listed species can be allowed if it is "incidental" to an otherwise lawful activity and

4200 SMITH SCHOOL ROAD
AUSTIN, TEXAS 78744-3291
512.389.4800
www.tpwd.state.tx.us

must be permitted in accordance with Section 7 or 10 of the ESA. Federally-listed plants are not protected from take except on lands under federal/state jurisdiction or for which a federal/state nexus (i.e., permits or funding) exists. Any take of a federally-listed species or its habitat without the required take permit (or allowance) from the U.S. Fish and Wildlife Service (USFWS) is a violation of the ESA.

A record of consultation with the USFWS in 1982 was provided with the request. That correspondence addressed potential impacts to species that were listed as threatened or endangered at the time the landfill was constructed. Please note that since 1982 the following species have been listed as threatened or endangered under the ESA and have the potential to occur in El Paso County:

| **Species** | **Date Listed** |
|---|---|
| Least tern (*Sterna antillarum*) | 05/28/1985 |
| Northern Aplomado Falcon (*Falco femoralis septentrionalis*) | 02/25/1986 |
| Mexican Spotted Owl (*Strix occidentalis lucida*) | 03/16/1993 |
| Southwestern Willow Flycatcher (*Empidonax trailii extimus*) | 02/27/1995 |

It is the responsibility of the project proponent to determine if adverse impacts federally-listed species are expected to occur as a result of the proposed project and consult with the appropriate agency concerning those impacts.

**Recommendation:** TPWD recommends SAIC assess the proposed project for potential impacts to species that are protected by the ESA. Brief descriptions of suitable habitats for these species are provided on the attached TPWD El Paso County list. If potential impacts to federally listed species are anticipated, TPWD recommends SAIC contact the USFWS Austin Ecological Services Field office at (512) 490-0057.

*Migratory Bird Treaty Act*

The Migratory Bird Treaty Act (MBTA) prohibits taking, attempting to take, capturing, killing, selling/purchasing, possessing, transporting, and importing of migratory birds, their eggs, parts and nests, except when specifically authorized by the Department of the Interior. This protection applies to most native bird species, including ground nesting species. The US Fish and Wildlife Service (USFWS) Migratory Bird Office can be contacted at (505) 248-7882 for more information on potential impacts to migratory birds.

**Recommendation:** If migratory bird species are found nesting on or adjacent to the project area, they must be dealt with in a manner consistent with the MBTA. TPWD recommends excluding vegetation clearing activities during the general bird nesting season, March through August, to avoid adverse impacts to this group. If clearing vegetation during the migratory bird nesting season is unavoidable, TPWD recommends the facility survey the area proposed for disturbance to ensure that no nests with eggs or young will be disturbed by operations. Any vegetation (trees, shrubs, and grasses) where occupied nests are located should not be disturbed until the eggs have hatched and the young have fledged.

State Laws

*Parks and Wildlife Code, Section 68.015*

Section 68.015 of the Parks and Wildlife Code regulates state-listed species. Please note that there is no provision for take (incidental or otherwise) of state-listed species. A copy of *TPWD Guidelines for Protection of State-Listed Species*, which includes a list of penalties for take of species, is attached for your reference. State-listed species may only be handled by persons with a scientific collection permit obtained through TPWD. For more information on this permit, please contact the Wildlife Permits Office at (512) 389-4647.

Sparse vegetation consisting of grass, cactus, and scattered brush possibly found in the project area could potentially support the following state-listed threatened species:

- Texas horned lizard (*Phrynosoma cornutum*)
- Mountain short-horned lizard (*P. hernandesi*).

An additional indication of suitable habitat for the Texas horned lizard would be the presence of its primary food source, the Harvester ant (*Pogonomyrmex* sp.). Texas horned lizards and Mountain short-horned lizards are generally active in this part of Texas from March through September.

**Recommendation:** TPWD recommends avoiding disturbance of the Mountain short-horned lizard, Texas horned lizard, and colonies of the Harvester ant during clearing and construction. TPWD recommends a biological monitor be present during construction to try to relocate protected species if found. If the presence of a biological monitor during construction is not feasible, state-listed threatened species observed during construction should be allowed to safely leave the site.

A mixture of cover, food sources, and open ground is important to the Mountain short-horned lizard, Texas horned lizard, and Harvester ant. Disturbed areas within suitable habitat for these species should be revegetated with site-specific native, patchy vegetation rather than sod-forming grasses. TPWD recommends review and implementation of the attached monitoring and management guidelines for horned lizards.

Species of Concern

In addition to state- and federally-protected species, TPWD tracks special features, natural communities, and rare species that are not listed as threatened or endangered. These species and communities are tracked in the Texas Natural Diversity Database (TXNDD), and TPWD actively promotes their conservation. TPWD considers it important to evaluate and, if necessary, minimize impacts to rare species and their habitat to reduce the likelihood of endangerment.

Based on the project description, site location, a review of the TXNDD, and publicly-available aerial photographs, the following species of concern could be impacted as a result of the proposed project:

- Western Burrowing Owl (*Athene cunicularia hypugaea*)
- Desert night-blooming cereus (*Peniocereus greggii* var *greggii*)

A record of the Desert night-blooming cereus has been documented possibly within 1.5 miles of the project site. A printout of this occurrence record is attached for your reference.

**Recommendation:** If during construction the project area is found to contain rare species, natural plant communities, or special features, TPWD recommends that precautions be taken to avoid impacts to them.

Western Burrowing Owls reside primarily in open areas with short vegetation and bare ground, sometimes including areas near human habitation. They are dependent on the presence of fossorial (digging and burrowing) mammals, such as prairie dogs and ground squirrels, whose burrows are used for nesting and roosting. Burrowing owls residing in El Paso and surrounding counties are not only summer (breeding) residents but many owls stay in the El Paso region as winter residents. As stated above, the MBTA prohibits the intentional and unintentional take of migratory birds (including ground nesting species), their nests, and eggs. If mammal burrows would be disturbed as a result of the proposed project, TPWD recommends they be surveyed for burrowing owls. If nesting owls are found, disturbance should be avoided until the eggs have hatched and the young have fledged.

Please note that absence of TXNDD information in an area does not imply that a species is absent from that area. Given the small proportion of public versus private land in Texas, the TXNDD does not include a representative inventory of rare resources in the state. Although it is based on the best data available to TPWD regarding rare species, the data from the TXNDD do not provide a definitive statement as to the presence, absence or condition of special species, natural communities, or other significant features within your project area. These data are not inclusive and **cannot be used as presence/absence data.** They represent species that could potentially be in your project area. This information cannot be substituted for on-the-ground surveys. The TXNDD is updated continuously. As the project progresses and for future projects, please request the most current and accurate information at txndd@tpwd.state.tx.us.

**Recommendation:** Please review the attached TPWD county list of rare and protected species for El Paso County, as rare species in addition to those discussed above could be present depending upon habitat availability. These lists are also available online at http://www.tpwd.state.tx.us/landwater/land/maps/gis/ris/endangered_species/. The USFWS should be contacted for species occurrence data, guidance, permitting, survey protocols, and mitigation for federally listed species. For the USFWS rare species lists by county please visit http://www.fws.gov/endangered/.

Determining the actual presence of a species in a given area depends on many variables including daily and seasonal activity cycles, environmental activity cues, preferred habitat, transiency and population density (both wildlife and human). The absence of a species can be demonstrated only with great difficulty and then only with repeated negative observations, taking into account all the variable factors contributing to the lack of detectable presence. If encountered during construction, measures should be taken to avoid impacting wildlife.

I appreciate the opportunity to review and comment on this project. Please call me at (512) 389-4579 if we may be of further assistance.

Sincerely,

Julie C. Wicker

Julie C. Wicker
Wildlife Habitat Assessment Program
Wildlife Division

JCW:16900

Attachments (4)

Protection of State-Listed Species
Texas Parks and Wildlife Department Guidelines

## Protection of State-Listed Species

State law prohibits any take (incidental or otherwise) of state-listed species. State-listed species may only be handled by persons possessing a **Scientific Collecting Permit** or a **Letter of Authorization** issued to relocate a species.

- **Section 68.002 of the Texas Parks and Wildlife (TPW) Code** states that species of fish or wildlife indigenous to Texas are endangered if listed on the United States List of Endangered Native Fish and Wildlife or the list of fish or wildlife threatened with statewide extinction as filed by the director of Texas Park and Wildlife Department. Species listed as Endangered or Threatened by the Endangered Species Act are protected by both Federal and State Law. The State of Texas also lists and protects additional species considered to be threatened with extinction within Texas.

- **Animals** - Laws and regulations pertaining to state-listed endangered or threatened animal species are contained in **Chapters 67 and 68 of the Texas Parks and Wildlife (TPW) Code** and **Sections 65.171 - 65.176 of Title 31 of the Texas Administrative Code (TAC).** State-listed animals may be found at **31 TAC §65.175 & 176.**

- **Plants** - Laws and regulations pertaining to endangered or threatened plant species are contained in **Chapter 88 of the TPW Code and Sections 69.01 - 69.9 of the TAC.** State-listed plants may be found at **31 TAC §69.8(a) & (b).**

## Prohibitions on Take of State Listed Species

**Section 68.015 of the TPW Code** states that no person may capture, trap, take, or kill, or attempt to capture, trap, take, or kill, endangered fish or wildlife.

**Section 65.171 of the Texas Administrative Code** states that except as otherwise provided in this subchapter or **Parks and Wildlife Code, Chapters 67 or 68,** no person may take, possess, propagate, transport, export, sell or offer for sale, or ship any species of fish or wildlife listed by the department as endangered or threatened.

"Take" is defined in **Section 1.101(5) of the Texas Parks and Wildlife Code** as:

> *"Take," except as otherwise provided by this code, means collect, hook, hunt, net, shoot, or snare, by any means or device, and includes an attempt to take or to pursue in order to take.*

## Penalties

The penalties for take of state-listed species **(TPW Code, Chapter 67 or 68)** are:

- 1ST Offense = Class C Misdemeanor:
  $25-$500 fine

- One or more prior convictions = Class B Misdemeanor
  $200-$2,000 fine and/or up to 180 days in jail.

- Two or more prior convictions = Class A Misdemeanor
  $500-$4,000 fine and/or up to 1 year in jail.

Restitution values apply and vary by species. Specific values and a list of species may be obtained from the TPWD Wildlife Habitat Assessment Program.

TEXAS PARKS & WILDLIFE

# MANAGEMENT AND MONITORING PACKET

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## WHAT'S HAPPENED TO ALL THE HORNY TOADS?

Everyone loves horny toads, but for many Texans, the fierce-looking, yet amiable, reptiles are only a fond childhood memory. Once common throughout most of the state, horned lizards have disappeared from many parts of their former range.

A statewide survey conducted by the Horned Lizard Conservation Society in 1992 confirmed many Texans' personal experiences—in the latter part of the 20th century the Texas Horned Lizard nearly disappeared from the eastern third of Texas and many respondents reported that horned lizards were increasingly rare in Central and North Texas. Only in West and South Texas do populations seem somewhat stable.

Many factors have been proposed as culprits in the disappearance of horned lizards, often fondly called "horny toads," including collection for the pet trade, spread of the red imported fire ant, changes in agricultural land use, habitat loss and fragmentation as a result of urbanization, and environmental contaminants. For the most part, however, the decline of horned lizards has remained a mystery with little understanding of management actions that could be taken to reverse it. Even less is known about the status of our other two horned lizard species—the Round-tailed Horned Lizard and the Greater Short-horned Lizard.

But you can help! Through participation in Texas Horned Lizard Watch as a citizen scientist, you can collect data and observations about the presence or absence of horned lizards and habitat characteristics on your monitoring site. The data you provide to TPWD, ***even if you don't find horned lizards***, will help us understand how they are doing and offer some insights for people wishing to manage habitats for horned lizards. If you are a property owner, then keeping these management guidelines in mind can help you to enhance or perhaps even recruit horned lizard populations on your property, while at the same time benefitting other native wildlife. There's something everyone can do to help out horny toads!

*Texas Horned Lizard*

SEGHERS

*Round-tailed Horned Lizard*

D. MARTIN

*Greater Short-horned Lizard*

D. MARTIN

# ABOUT HORNED LIZARDS

## Appearance

Horned lizards are named for the crown of horns found on their heads, the size and number of which vary among species. Although often called horned toads, horny toads, or even horned frogs because of their wide, flattened bodies (their scientific name *Phrynosoma* actually means "toad-body"), they are not amphibians like other toads, but are reptiles with scales, claws and young produced on land. More than a dozen different species of horned lizards are found throughout western North America.

Three horned lizard species call Texas home, with the most widespread being the Texas Horned Lizard, or the familiar "horny toad." The geographic range of these species can overlap in West Texas, but they can each be readily distinguished from each other by the following characteristics.

LEE ANN LINAM

D. MARTIN

D. MARTIN

### Texas Horned Lizard

*Phrynosoma cornutum*

**Horns** – two prominent horns at the rear and center of the skull
**Scales** – two rows of spiky fringe scales on the side of the body
**Coloring** – gray to brown to rust, with dark spots in rows down the back, a light central stripe, and dark lines radiating from the eye.
**Length** – 3.5 to 5 inches
**Range** – most of Texas, though now nearly gone from the eastern third

### Round-tailed Horned Lizard

*Phrynosoma modestum*

**Horns** – four horns of medium length lined up on the back of the head
**Scales** – few enlarged scales on the body, sides without spiky fringe
**Coloring** – white to gray, brown or pink, with dark blotches at the legs and neck; bands on tail
**Length** – 3 to 4 inches
**Range** – rocky areas in the western third of Texas

### Greater Short-horned Lizard

*Phrynosoma hernandesi*

**Horns** – robust head that is wider than long and heart-shaped, back of the head is tipped only with small horns
**Scales** – one row of spiky fringe scales along the side of the body
**Coloring** – variable colors and patterns ranging from simple brown or grey to intricate patterns of bright colors including orange, yellow, white, red, blue and green
**Length** – 3.5 to 6 inches
**Range** – only higher elevations, in the forests of the Davis and Guadalupe mountains of West Texas

## TEXAS SPINY LIZARD

Another similar group of lizards occurs in Texas, the spiny lizards. Spiny lizards are sometimes confused with horned lizards because of the spiky scales found on their bodies and heads; however, the spiny lizards are much more slender with a longer tail. In addition, they tend to spend more time climbing, whereas horned lizards spend most of their time on the ground.

## Life History

Horned lizards are usually found in flat, open terrain, with sparse plant cover, although in the eastern portion of their distribution, vegetation cover may be somewhat thicker. They utilize mammal burrows, rock piles or clumps of vegetation for cover and may excavate shallow burrows in loose soils or scoop out a shallow depression in which to hide.

Horned lizards primarily eat harvester ants (also called big red ants), but their diet also includes termites, other native ants, other insects, spiders and sowbugs. Horned lizards or their droppings can sometimes be found near the beds of harvester ants, and an individual can consume 70–100 ants per day (one reason they are difficult to maintain in captivity!).

Horned lizards require warm temperatures to stimulate their appetite and activity. They sometimes begin their day by exposing only their heads to sunlight while keeping their bodies buried. Later, they will often be seen in a flattened body posture sunning themselves in open areas. They are not usually active at night or when temperatures fall below 75° F. In general, they are seen only in late spring through early fall and tend to hibernate a few inches underground from September/October to March/April.

Mating occurs soon after emergence from hibernation. The female digs a hole 6 to 8 inches deep and lays 13 to 50 eggs (6 to 18 for Round-tailed Horned Lizards), which are incubated by the warmth of the soil. Depending on ground temperatures, young horned lizards about 3/4-inch in length may begin to hatch 5 to 9 weeks later. The Greater Short-horned Lizard, which lives in cooler, higher-altitude climates, is unique among our species in giving birth to live young!

Texas Horned Lizards and Short-horned Lizards may live 5 to 8 years, while Round-tailed Horned Lizards are thought to live only 2 to 3 years. Although snakes, mammals and birds prey on them, horned lizards have developed some unique defenses. Their spiky appearance and coloration help Texas and Short-horned lizards to blend into the local vegetation, while the color and shape of the Round-tailed Horned Lizard actually help it to look like a rock! In addition to the deterrence that the horns on the head may provide to predators, horned lizards can inflate themselves to a larger apparent size or may tilt their body to appear larger. Finally, the horned lizard is renowned for its ability to shoot

## WHAT ARE HARVESTER ANTS?

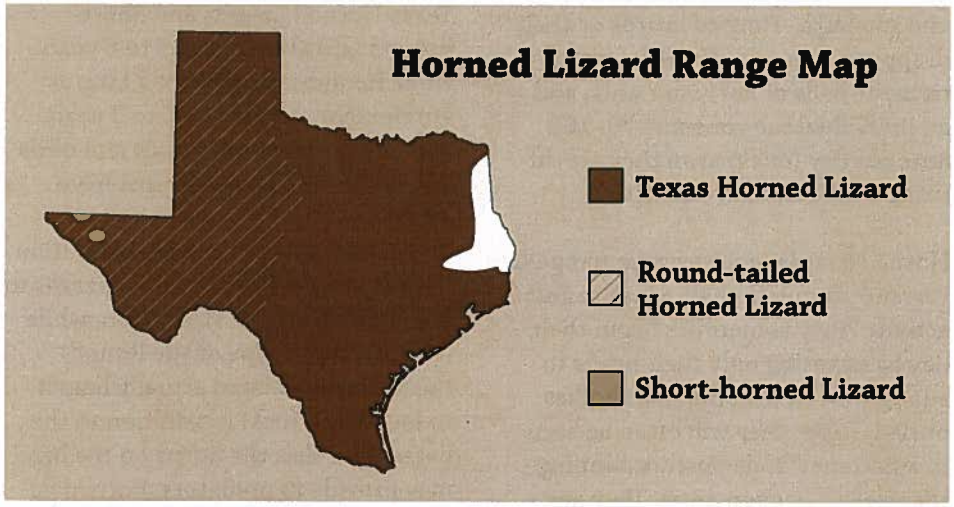
Harvester ants belong to the genera *Pogonomyrmex* or *Ephebomyrmex*. Twelve species of harvester ants are found in Texas, and the Red Harvester Ant (*Pogonomyrmex barbatus*) is the most widespread. Red harvester ants are easily identified by their large size (up to a half inch) and generally conspicuous mound. These ants clear vegetation, forming a large circular pattern of bare ground around their nest. This bare ground is often covered with small pebbles dug from within the nest itself. The mound usually has one main entrance/exit hole in the center of the cleared area. Extending in various directions from the main mound are foraging trails leading to various foraging zones. Harvesters, as the name implies, harvest seeds. Grass seeds make up the majority of their diet, and the husks of harvested seeds often surround harvester ant mounds.

MAYO

a stream of blood from its eye when under extreme stress (actually from ruptured blood vessels in the sinuses near the eyes). A chemical in the blood is especially distasteful to canine predators. Texas Horned Lizards and Short-horned Lizards are known to engage in blood-squirting, while the Round-tailed Horned Lizard does not.

Sometimes a horned lizard sign such as scat (or droppings) is much more visible than the species itself. Horned lizard scat is a dark brown oblong pellet that is straight or slightly curved. A white uric acid tip is often very prominent. Ant heads and other body parts are noticeable in the scat, especially when the scat is broken apart. The scat usually looks very large in relation to the lizard from which it came, ranging from 1/2 to 1-1/2 inches in length and 1/4 to 3/8 inch in diameter. Scat of other lizards have the uric acid tip; however, the shape of the scat is much less symmetrical and it will not contain a high percentage of ants.

NEWSOM




## Protected Status

Texans have a long history of concern for horned lizards. In 1967, the state legislature protected Texas Horned Lizards from the pet trade (horned lizards do not survive well in captivity), and in 1977, Texas Parks and Wildlife Department placed both the Texas Horned Lizard and the Greater Short-horned Lizard on the state threatened species list. In 1993, a group of schoolchildren successfully petitioned the Texas Legislature to name the Texas Horned Lizard the official state reptile. Though not listed as threatened or endangered, Round-tailed Horned Lizards receive some attention/regulation through the state's nongame permit process.

# MANAGEMENT OF HORNED LIZARDS

Many Texans are interested in having more horned lizards on their property. Although many people inquire about translocating or breeding horned lizards for release, unfortunately, initial research has not been very successful with these efforts and additional conservation questions need to be answered. In addition, because Texas Horned Lizards and Short-horned Lizards are listed as threatened species, anyone handling these species or attempting to do this must obtain a scientific permit. Horned lizards cannot survive and thrive without appropriate habitat, and probably the best strategy for bringing back horned lizards is to first restore or create suitable habitat that can support and conserve native ant populations as well as horned lizards.

Horned lizards in Texas can be found in a variety of habitats; however, researchers have noted several similarities among occupied habitat.

- First, horned lizards tend to be found in "patchy" habitat that is characterized by areas of bare ground (~40 percent) interspersed with native vegetation. This open ground allows horned lizards room for movement and basking, and it provides ants open areas for colony establishment.
- Second, Texas Horned Lizards seem to prefer sandy loam soils that are more than 2/3 sand and less than 15 percent clay. Loose, well-drained soils are more suitable for burrowing, hibernating and nesting.
- Third, horned lizards in Texas are usually found where native ants are abundant. Harvester (or "red") ants in the genus *Pogonomyrmex* are often very evident, although horned lizards also eat other native ants and insects.

One horned lizard can use five to six acres of habitat over the course of its activities, often feeding at a number of different harvester ant mounds. There is a minimal amount of overlap with other adult horned lizards. A viable population of horned lizards may thus require a substantial amount of suitable habitat.

## MANAGEMENT GUIDELINES

**The following management guidelines for horned lizards are adapted from a 1998 publication, *Management of Texas Horned Lizards*, written by Scott E. Henke and Wm. Scott Fair, and published by the Caesar Kleberg Wildlife Research Institute of Texas A&M University–Kingsville as Wildlife Management Bulletin No. 2.**

1. **Develop and maintain a habitat that contains a diversity of native plant species –** A diverse community of native plants will attract a diverse community of invertebrates. Such a variety of insects may be especially important to juvenile horned lizards. If you are interested in reclaiming a previous agricultural area or in landscaping at your residence, focus on native bunchgrasses, such as bluestems, forbs and shrubs. Bunchgrasses form clumps that allow horned lizards to easily move among the grass clumps; whereas carpet grasses form a thick mat that can impede horned lizard movement. Native grasses also produce seeds that are good food sources for harvester ants.

2. **Create a mosaic habitat of open areas intermixed within more dense cover –** Such a patchy environment will give horned lizards areas in which to warm or cool themselves, allow them room for movement, and offer sufficient escape cover from predators. You may also wish to create 1-square-yard areas devoid of any vegetation and ground litter. These spots may serve as valuable basking areas for horned lizards, and newly fertilized harvester ant queens need bare ground in which to establish new colonies. Grazing, burning, mowing, and scraping can help create and maintain the mosaic habitat desired.

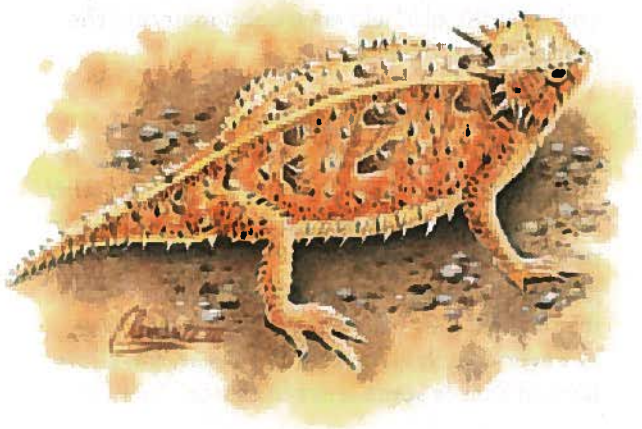
3. **Use prescribed fires to remove ground litter** – Horned lizards usually avoid areas with substantial dead vegetation on the ground (also called litter) because the litter can impede their movement. Burning is a useful tool to decrease ground litter and create open ground. Burning in small patches on a rotational basis, so that not every patch is burned every year, can allow horned lizards some areas to escape. In addi-

tion, conducting burns during the cool season (late winter/early spring) results in cooler fires, and research suggests that hibernating lizards can survive such fires while burrowed underground. Local Natural Resource Conservation Service staff can provide site-specific guidance on prescribed burning.

4. **Avoid overgrazing by livestock** – Horned lizards do not appear to be negatively affected by low to moderate grazing of livestock, and grazing may help increase some plant diversity and open areas. On the other hand, very heavy stocking rates can reduce needed cover and result in direct mortality of horned lizards. Use of a rotational grazing scheme can help create the desired mosaic of open areas and vegetative cover.

5. **Avoid road maintenance and limit traffic during the horned lizard active season** – Horned lizards make frequent use of roadsides, especially unpaved secondary roads, for basking, resting, and bedding sites. If possible, avoid disking or grading roads between mid-March and mid-October. In addition, vehicular strikes can be a significant mortality factor for horned lizards. Slower speeds and caution should be exhibited during the active season for horned lizards, especially in the mornings and late afternoons. If drivers are cautious, however, road-cruising can be a valuable way to survey horned lizard populations.

6. **Avoid the use of broadcast pesticides** – Pesticides could kill horned lizards directly by accumulating toxins within their body or indirectly by killing harvester ants and other valuable insects. If pesticides are needed, then spot treatment is recommended rather than broadcast application.



7. **Manage ant populations** – Findings from Texas Horned Lizard Watch indicate that efforts should be made to encourage native ant populations and discourage red imported fire ants. The first step should be to reduce red imported fire ant populations; however, fire ant control methods should be chosen carefully, as some pesticides used to kill fire ants can also kill native ants and other insects. In a small area, individual fire ant mound treatments, either with pesticides, organic mixes or soapy boiling water, can be used. When baits are used, application late in the day on the fire ant mound can increase the chances that fire ants will pick up bait and native ants will not. On larger acreages or with severe infestations, a broadcast treatment may be needed; however, steps can be taken to minimize the impact of such treatments on native ants. Try to find a bait that uses an active ingredient, such as Spinosad, that does not affect harvester ants. Several researchers suggest placing broadcast pesticides in small containers, such as film canisters that have small holes drilled in the container or its lid. The holes should be no larger than 1/16-inch in diameter so that fire ants can enter the container, but harvester ants cannot.

   As noted above, native ants can be encouraged by establishing native grasses and scattered patches of bare ground. Some landowners also choose to "feed" their harvester ant populations by providing native seed, oat flakes, crushed peanuts, or similar items within the foraging area of the mound.

8. **Remove feral domesticated predators** – Feral cats and dogs, along with pets, are predators of horned lizards. Keep pets from "hunting" in horned lizard habitat. Feral animals can be removed; you may wish to contact the Humane Society for assistance or suggestions. Keep in mind that wild avian predators, such as roadrunners or shrikes, are protected by federal law and cannot be killed or trapped; however, providing plenty of escape cover can help horned lizards survive among these natural predators.

# HOW TO MONITOR HORNED LIZARDS

**There are two ways you can participate in Texas Horned Lizard Watch, either by searching a site or setting up a transect. Please note that each survey type has its own unique data form.**

## Site Surveys

Site surveys can take place anywhere, from your backyard to your hunting ranch to your favorite state park. The enclosed data sheet asks you to provide information about the site location and its habitat and then provides a table where you can list information about each horned lizard (or horned lizard scat) seen. Feel free to submit maps or photos to supplement your information and to make copies of the data sheet if needed. You can survey as many different sites as you like; simply fill out a separate site form for each site.

For best results, we recommend that you visit your site at least five times between May and September; however, we are happy to accept data from sites that you visit less often. You can even fill out this form when you happen to spot a horned lizard by chance. Simply let us know how many hours you spent visiting the site, so that we can get an idea of the survey effort.

## Transects

Transects are a more quantitative method for monitoring species and require a more formal survey effort. The benefits of transects are that we can convert results to density estimates and thus compare horned lizard populations at different sites.

To conduct a Texas Horned Lizard transect you need to set up a route that is at least 3 miles long. The route can follow unpaved roads or trails or be of your own design. Walk, ride or drive the route, recording all Texas horned lizards and ant beds that occur within 3 feet of your route on either side. (If driving, be sure to keep speeds under 15 mph and stop and check the identification of any horned lizards seen.) Mark your transect location on a map if possible. Transects should be conducted at least five times between May and September if possible.

## Submitting Data

Data forms can be mailed, faxed, or scanned and e-mailed. We would like to receive your datasheet *even if you do not see horned lizards*. Not finding horned lizards is as important as finding them, because that helps us understand the types of sites or conditions where horned lizards are missing.

## Additional Monitoring Notes

Certain conditions apply to both methods. You should try to make sure that your surveys are conducted under sunny, or partly sunny, dry weather conditions when temperatures are 80-95° F and winds are light or moderate. One good indicator of horned lizard activity is to check to see whether harvester ants are active. Ideally, your five survey efforts should be at least several weeks apart (although you may conduct additional surveys more frequently). If you do visit a site more frequently, then you may want to collect any horned lizard scat you encounter so that you don't recount it on subsequent visits. Scat can also be sent in with your data sheets as verification.

The Texas Horned Lizard and the Short-horned Lizard are listed as threatened by Texas Parks and Wildlife, primarily to protect them from commercial exploitation. Because of this designation, you should not collect or move horned lizards that you encounter on your survey efforts.

Finally, be sure to send in your survey forms, even if you do not see any horned lizards. If you have any uncertainty about identification of the lizards or scat you see, don't hesitate to take a photo and send it to us.

### IMPORTANT:

### ABOUT THE LANDOWNER ACCESS REQUEST FORM

Texas Parks and Wildlife cannot use data collected from private land unless written permission is received from the landowner.

All Texas Horned Lizard Watch volunteers must send in a completed Landowner Access Request Form for any data collected from private land. This applies even if you are monitoring your own property.

Please respect the rights of private property owners during the course of your volunteer efforts.

TEXAS PARKS & WILDLIFE

**Texas Horned Lizard Watch**

# Landowner Access Request Form

To the landowner:

_____ (volunteer name) is participating as a volunteer in Texas Horned Lizard Watch. Texas Horned Lizard Watch is a monitoring program that uses citizen volunteers to gather data about the status and health of our state reptile. Texas Parks and Wildlife is very pleased to have the assistance of concerned Texans in watching over the health of the horny toad.

We have, however, instructed our volunteers that they cannot collect data on private land without the approval of the private landowner. Accordingly, we have prepared this form for your approval. The sections described below are the releases that we and our volunteers are required to obtain from you under Section 12.103 of the Texas Parks and Wildlife Code. If you are willing, then please sign one or both sections and provide a copy to our volunteer.

1. **Use of information**
   This documents my approval for TPWD volunteers and employees to use site-specific information from the property I own or manage. This may include placing that information onto a topographic map and entering the information into a department database. Thus, the information could be viewed by the public.

   _____ _____
   (Landowner or authorized agent signature) (Date)

2. **Reporting information**
   This also documents my approval for TPWD volunteers and employees to report (such as in publications or technical reports) the above approved information in a manner that permits identification of the location of the specific parcel of property that I own or manage.

   _____ _____
   (Landowner or authorized agent signature) (Date)

3. **Other Conditions**
   If there are any conditions that apply to this approval, please specify and initial below.

   _____
   _____
   _____

**Name and Address:** (of landowner or authorized agent)

Name _____
Address _____
City/ST/Zip _____
Phone _____
Phone _____

**Optional:**

Ranch or Tract Name _____
_____
County _____
Acreage _____
Location _____

Texas Parks and Wildlife Department maintains the information collected through this form. With few exceptions, you are entitled to be informed about the information we collect. Under Sections 552.021 and 552.023 of the Texas Government Code, you are also entitled to receive and review the information. Under Section 559.004, you are also entitled to have this information corrected. TPWD, 4200 Smith School Road, Austin, TX 78744. (800) 792-1112.
PWD 1280–W7000 (2/10)

TEXAS PARKS & WILDLIFE

**Texas Horned Lizard Watch**

# Site Survey Data Form

Complete a separate data form for each site

Name _____

Address _____

_____

_____

Phone _____

E-mail _____

Site Name _____

County _____

Lat-Long or distance and direction from nearest town

_____

*Please mark location on map if available.*

Approximate area of site _____ acre(s)

Are harvester ants present? ☐ Yes ☐ No

Are red imported fire ants present? ☐ Yes ☐ No

**Dominant habitat type**

- ☐ native grassland (n)
- ☐ improved grasses (i)
- ☐ mixed grass/shrubs (m)
- ☐ predominantly shrubland (s)
- ☐ woodland/forest (w)
- ☐ desert scrub (d)
- ☐ agriculture (a)

**Dominant land use**

- ☐ residential
- ☐ ranching
- ☐ agriculture
- ☐ park land/preserve
- ☐ not in current use

**Dominant soil type**

- ☐ rocky
- ☐ sandy
- ☐ clay
- ☐ loam (intermediate between sand/clay)

Approximate time (# people X # hours) spent searching this site this year: _____

## Horned Lizard Sightings (includes scat)

| Date | Time | Temp (F) | HL species[1] | Approxi-mate size (in.) | # HL scat (droppings) seen | Habitat[2] | Comments |
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[1]Indicate whether lizard was a Texas Horned Lizard (TLH), Round-tailed Horned Lizard (RTHL) or Short-horned Lizard (SHL).
[2]Indicate the habitat type where the lizard was seen (based on habitat types listed above).

Continue on additional pages if needed.

Send completed form(s) and map to:

**Please submit all forms by October 31**

Texas Horned Lizard Watch, Texas Parks and Wildlife Dept.
4200 Smith School Road, Austin, TX 78744
hornedlizards@tpwd.state.tx.us

Texas Parks and Wildlife Department maintains the information collected through this form. With few exceptions, you are entitled to be informed about the information we collect. Under Sections 552.021 and 552.023 of the Texas Government Code, you are also entitled to receive and review the information. Under Section 559.004, you are also entitled to have this information corrected. TPWD, 4200 Smith School Road, Austin, TX 78744. (800) 792-1112.
PWD 1280A–W7000 (2/10)

TEXAS PARKS & WILDLIFE

**Texas Horned Lizard Watch**

# Transect Data Form

Complete a separate data form for each transect

Name _____

Address _____

_____

_____

Phone _____

E-mail _____

Transect name _____

County _____

Lat-Long or distance and direction from nearest town

_____

*Please mark location on map if available.*

Length of transect _____ miles

Transect was: ☐ walked ☐ driven ☐ other

Maximum number of harvester ant beds _____

Maximum number of fire ant beds _____

**Dominant habitat type**

- ☐ native grassland (n)
- ☐ improved grasses (i)
- ☐ mixed grass/shrubs (m)
- ☐ predominantly shrubland (s)
- ☐ woodland/forest (w)
- ☐ desert scrub (d)
- ☐ agriculture (a)

**Dominant land use**

- ☐ residential
- ☐ ranching
- ☐ agriculture
- ☐ park land/preserve
- ☐ not in current use
- ☐ road right-of-way

**Dominant soil type**

- ☐ rocky
- ☐ sandy
- ☐ clay
- ☐ loam (intermediate between sand/clay)

Approximate time (# people X # hours) spent searching this transect this year: _____

## Horned Lizard Sightings (includes scat)

| Date | Time | Temp (F) | HL species[1] | Approxi-mate size (in.) | # HL scat (droppings) seen | Habitat[2] | Comments |
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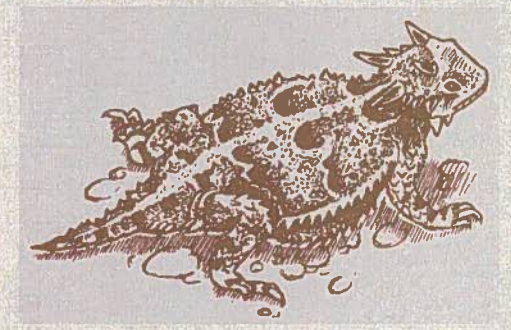
PWD 1280B–W7000 (2/10)

# NOW GET OUT THERE AND COUNT YOUR HORNY TOADS!



**If you have questions or need more information:**

Texas Horned Lizard Watch, 4200 Smith School Road, Austin, TX 78744

hornedlizards@tpwd.state.tx.us

www.tpwd.state.tx.us/hornytoads/

## NONGAME AND ENDANGERED SPECIES CONSERVATION FUND

The "Special Fund" was created by the Texas Legislature in 1983 to underwrite the conservation and management work performed on Texas' nongame and endangered wildlife. This fund, sustained entirely by voluntary contributions, has provided support for a variety of projects benefiting nongame and endangered species. For more information on this fund, call the TPWD Wildlife Diversity program at (800) 792-1112.

Texas conservation license plates help fund conservation efforts in the state. The most popular plate features a Texas horned lizard and provides funding for wildlife diversity projects, including horned lizard research. **http://conservation-plate.org/**

## FOR MORE INFORMATION CHECK OUT THE FOLLOWING REFERENCES


Davis, John M. Management of the Red Harvester Ant (*Pogonomyrmex barbatus*). Texas Parks and Wildlife Department. 9 pp.

Donaldson, W., A.H. Price, and J. Morse. 1997. The current and future prospects of the Texas horned lizard (*Phrynosoma cornutum*) in Texas. Texas Journal of Science 46:97-113.

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Henke, S. E. and W. S. Fair. 1998. Management of Texas Horned Lizards. Wildlife Management Bulletin 2, Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville. 7 pp.

Horned Lizard Conservation Society (www.hornedlizards.org).

Manaster, J. 2002. Horned Lizards. Texas Tech University Press. 84 pp.

Sherbrooke, W. 2003. Introduction to Horned Lizards of North America. University of California Press. 178 pp.

Texas Imported Fire Ant Research and Management Project (http://fireant.tamu.edu/).



TEXAS PARKS & WILDLIFE

PWD BK W7000-038 (2/10)

4200 Smith School Road
Austin, TX 78744
www.tpwd.state.tx.us



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# Element Occurrence Record

**Scientific Name:** *Peniocereus greggii var. greggii* **Occurrence #:** 12 **Eo Id:** 6446

**Common Name:** desert night-blooming cereus **TX Protection Status:** **ID Confirmed:** Y

**Global Rank:** G3G4T2 **State Rank:** S2 **Federal Status:**

## Location Information:

**Latitude:** 315702N **Longitude:** 1062631W

| Watershed Code: | Watershed Description: |
|---|---|
| 13030102 | El Paso-Las Cruces |
| 13050003 | Tularosa Valley |
| 13040100 | Rio Grande-Fort Quitman |

| County Code: | County Name: | Mapsheet Code: | Mapsheet Name: | State: |
|---|---|---|---|---|
| TXELPA | El Paso | 31106-H4 | North Franklin Mountain | TX |
| | | 31106-H5 | Canutillo | TX |
| | | 31106-G4 | El Paso | TX |
| | | 31106-G5 | Smeltertown | TX |

**Directions:**

DESERT SURROUNDING FRANKLIN MOUNTAINS

## Survey Information:

**First Observation:** **Survey Date:** **Last Observation:** 19??

**Eo Type:** **EO Rank:** **EO Rank Date:**

**Observed Area (acres);** **Estimated Representation Accuracy:**

## Comments:

**General Description:**

**Comments:** SEE ALSO CHAMPIE, C. 1973. STRANGERS IN THE FRANKLINS, P.40.

**Protection Comments:**

**Management Comments:**

## Data:

**EO Data:** RARE; FLOWERS IN APRIL

## Managed Area:

**Managed Area Name:** **Managed Area Type:**

# Element Occurrence Record

## Reference:

**Full Citation:**

CHAMPIE, C. 19??. CACTI AND SUCCULENTS OF EL PASO. ABBEY GARDEN PRESS, SANTA BARBARA, CA. 100 PP.

CHAMPIE, C. 1973. STRANGERS IN THE FRANKLINS.

## Specimen:

## Associated Species:

| Species Name | Type | Comments |
|---|---|---|

# Code Key for Printouts from
# Texas Parks and Wildlife Department
# Texas Natural Diversity Database (TXNDD)

This information is for your assistance only; due to continuing data updates, vulnerability of private land to trespass and of species to disturbance or collection, **please refer all requesters to our office to obtain the most current information available.** Also, please note, identification of a species in a given area does not necessarily mean the species currently exists at the point or area indicated.

## LEGAL STATUS AND CONSERVATION RANKS

**FEDERAL STATUS** (as determined by the US Fish and Wildlife Service)

| | |
|---|---|
| **LE** | Listed Endangered |
| **LT** | Listed Threatened |
| **PE** | Proposed to be listed Endangered |
| **PT** | Proposed to be listed Threatened |
| **PDL** | Proposed to be Delisted (Note: Listing status retained while proposed) |
| **SAE, SAT** | Listed Endangered on basis of Similarity of Appearance, Listed Threatened on basis of Similarity of Appearance |
| **DL** | Delisted Endangered/Threatened |
| **C** | Candidate. USFWS has substantial information on biological vulnerability and threats to support proposing to list as threatened or endangered. Data are being gathered on habitat needs and/or critical habitat designations. |
| **C*** | C, but lacking known occurrences |
| **C**** | C, but lacking known occurrences, except in captivity/cultivation |
| **XE** | Essential Experimental Population |
| **XN** | Non-essential Experimental Population |
| **Blank** | Species is not federally listed |

**TX PROTECTION** (as determined by the Texas Parks and Wildlife Department)

| | |
|---|---|
| **E** | Listed Endangered |
| **T** | Listed Threatened |
| **Blank** | Species not state-listed |

**GLOBAL RANK** (as determined by NatureServe)

| | |
|---|---|
| **G1** | Critically imperiled globally, extremely rare, typically 5 or fewer viable occurrences |
| **G2** | Imperiled globally, very rare, typically 6 to 20 viable occurrences |
| **G3** | Very rare and local throughout range or found locally in restricted range, typically 21 to 100 viable occurrences |
| **G4** | Apparently secure globally |
| **G5** | Demonstrably secure globally |
| **GH** | Of historical occurrence through its range |
| **GU** | Possibly in peril range-wide, but status uncertain |
| **G#G#** | Ranked within a range as status uncertain |
| **GX** | Apparently extinct throughout range |
| **Q** | Rank qualifier denoting taxonomic assignment is questionable |
| **#?** | Rank qualifier denoting uncertain rank |
| **C** | In captivity or cultivation only |
| **G#T#** | "G" refers to species rank; "T" refers to variety or subspecies rank |

**STATE (SUBNATIONAL) RANK** (as determined by the Texas Parks and Wildlife Department)

| | |
|---|---|
| **S1** | Critically imperiled in state, extremely rare, vulnerable to extirpation, typically 5 or fewer viable occurrences |
| **S2** | Imperiled in state, very rare, vulnerable to extirpation, typically 6 to 20 viable occurrences |
| **S3** | Rare or uncommon in state, typically 21 to 100 viable occurrences |
| **S4** | Apparently secure in State |
| **S5** | Demonstrably secure in State |
| **S#S#** | Ranked within a range as status uncertain |
| **SH** | Of historical occurrence in state and may be rediscovered |
| **SU** | Unrankable – due to lack of information or substantially conflicting information |
| **SX** | Apparently extirpated from State |
| **SNR** | Unranked – State status not yet assessed |
| **SNA** | Not applicable – species id not a suitable target for conservation activities |
| **?** | Rank qualifier denoting uncertain rank in State |

Revised 1 Apr 2008

## ELEMENT OCCURRENCE RECORD

**Element Occurrence Record (EOR)** Spatial and tabular record of an area of land and/or water in which a species, natural community, or other significant feature of natural diversity is, or was, present and associated information; may be a single contiguous area or may be comprised of discrete patches or subpopulations

**Occurrence #** Unique number assigned to each occurrence of each element when added to the NDD

## LOCATION INFORMATION

**Watershed Code** Eight digit numerical code determined by US Geological Survey (USGS)

**Watershed** Name of watershed as determined by USGS

**Quadrangle** Name of USGS topographical map

**Directions** Directions to geographic location where occurrence was observed, as described by observer or in source

## SURVEY INFORMATION

**First/Last Observation** Date a particular occurrence was first/last observed; refers only to species occurrence as noted in source and does not imply the first/last date the species was present

**Survey Date** If conducted, date of survey

**EO Type** State rank qualifiers:

- **M** Migrant – species occurring regularly on migration at staging areas, or concentration along particular corridors; status refers to the transient population in the State
- **B** Qualifier indicating basic rank refers to the breeding population in State
- **N** Qualifier indicating basic rank refers to the non-breeding population in State

**EO Rank**

| | | | |
|---|---|---|---|
| **A** | Excellent | **AI** | Excellent, Introduced |
| **B** | Good | **BI** | Good, Introduced |
| **C** | Marginal | **CI** | Marginal, Introduced |
| **D** | Poor | **DI** | Poor, Introduced |
| **E** | Extant/Present | **EI** | Extant, Introduced |
| **H** | Historical/No Field Information | **HI** | Historical, Introduced |
| **X** | Destroyed/Extirpated | **XI** | Destroyed, Introduced |
| **O** | Obscure | **OI** | Obscure, Introduced |

**EO Rank Date** Latest date EO rank was determined or revised

**Observed Area** Acres, unless indicated otherwise

## COMMENTS

**Description** General physical description of area and habitat where occurrence is located, including associated species, soils, geology, and surrounding land use

**Comments** Comments concerning the quality or condition of the element occurrence at time of survey

**Protection Comments** Observer comments concerning legal protection of the occurrence

**Management Comments** Observer comments concerning management recommendations appropriate for occurrence conservation

## DATA

**EO Data** Biological data; may include number of individuals, vigor, flowering/fruiting data, nest success, behaviors observed, or unusual characteristic, etc.

## SITE

**Site Name** Title given to site by surveyor

## MANAGED AREA INFORMATION

**Managed Area Name** Place name or (on EOR printout) name of area when the EO is located within or partially within an area identified for conservation, such as State or Federal lands, nature preserves, parks, etc.

**Alias** Additional names the property is known by

**Acres** Total acreage of property, including non-contiguous tracts

**Manager** Contact name, address, and telephone number for area or nearest area land steward

Please use one of the following citations to credit the source for the printout information:

Texas Natural Diversity Database. [year of printouts]. Wildlife Diversity Program of Texas Parks & Wildlife Department. [day month year of printouts].

Texas Natural Diversity Database. [year of printouts]. Element occurrence printouts for [scientific name] *records # [occurrence number(s)]. Wildlife Diversity Program of Texas Parks & Wildlife Department. [day month year of printouts]. *Use of record #'s is optional.

Revised 1 Apr 2008

# EL PASO COUNTY

## AMPHIBIANS

| | | Federal Status | State Status |
|---|---|---|---|
| **Northern leopard frog** | *Rana pipiens* | | |

streams, ponds, lakes, wet prairies, and other bodies of water; will range into grassy, herbaceous areas some distance from water; eggs laid March-May and tadpoles transform late June-August; may have disappeared from El Paso County due to habitat alteration

## BIRDS

| | | Federal Status | State Status |
|---|---|---|---|
| **American Peregrine Falcon** | *Falco peregrinus anatum* | DL | T |

year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.

| | | | |
|---|---|---|---|
| **Arctic Peregrine Falcon** | *Falco peregrinus tundrius* | DL | |

migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.

**Baird's Sparrow** *Ammodramus bairdii*

shortgrass prairie with scattered low bushes and matted vegetation; mostly migratory in western half of State, though winters in Mexico and just across Rio Grande into Texas from Brewster through Hudspeth counties

**Ferruginous Hawk** *Buteo regalis*

open country, primarily prairies, plains, and badlands; nests in tall trees along streams or on steep slopes, cliff ledges, river-cut banks, hillsides, power line towers; year-round resident in northwestern high plains, wintering elsewhere throughout western 2/3 of Texas

| | | | |
|---|---|---|---|
| **Interior Least Tern** | *Sterna antillarum athalassos* | LE | E |

subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish and crustaceans, when breeding forages within a few hundred feet of colony

| | | | |
|---|---|---|---|
| **Mexican Spotted Owl** | *Strix occidentalis lucida* | LT | T |

remote, shaded canyons of coniferous mountain woodlands (pine and fir); nocturnal predator of mostly small rodents and insects; day roosts in densely vegetated trees, rocky areas, or caves

**Montezuma Quail** *Cyrtonyx montezumae*

open pine-oak or juniper-oak with ground cover of bunch grass on flats and slopes of semi-desert mountains and hills; travels in pairs or small groups; eats succulents, acorns, nuts, and weed seeds, as well as various invertebrates

# EL PASO COUNTY

## BIRDS

| | | Federal Status | State Status |
|---|---|---|---|
| **Northern Aplomado Falcon** | *Falco femoralis septentrionalis* | LE | E |

open country, especially savanna and open woodland, and sometimes in very barren areas; grassy plains and valleys with scattered mesquite, yucca, and cactus; nests in old stick nests of other bird species

| | | | |
|---|---|---|---|
| **Peregrine Falcon** | *Falco peregrinus* | DL | T |

both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.

**Prairie Falcon** *Falco mexicanus*

open, mountainous areas, plains and prairie; nests on cliffs

**Snowy Plover** *Charadrius alexandrinus*

formerly an uncommon breeder in the Panhandle; potential migrant; winter along coast

| | | | |
|---|---|---|---|
| **Southwestern Willow Flycatcher** | *Empidonax traillii extimus* | LE | E |

thickets of willow, cottonwood, mesquite, and other species along desert streams

| | | |
|---|---|---|
| **Sprague's Pipit** | *Anthus spragueii* | C |

only in Texas during migration and winter, mid September to early April; short to medium distance, diurnal migrant; strongly tied to native upland prairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.

**Western Burrowing Owl** *Athene cunicularia hypugaea*

open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows

**Western Snowy Plover** *Charadrius alexandrinus nivosus*

uncommon breeder in the Panhandle; potential migrant; winter along coast

| | | |
|---|---|---|
| **Western Yellow-billed Cuckoo** | *Coccyzus americanus occidentalis* | C;NL |

status applies only to western population beyond the Pecos River Drainage; breeds in riparian habitat and associated drainages; springs, developed wells, and earthen ponds supporting mesic vegetation; deciduous woodlands with cottonwoods and willows; dense understory foliage is important for nest site selection; nests in willow, mesquite, cottonwood, and hackberry; forages in similar riparian woodlands; breeding season mid-May-late Sept

## FISHES

| | | Federal Status | State Status |
|---|---|---|---|
| **Bluntnose shiner** | *Notropis simus simus* | | T |

extinct; Rio Grande; main river channel, often below obstructions over substrate of sand, gravel, and silt; damming and irrigation practices presumed major factors contributing to decline

# EL PASO COUNTY

## FISHES

| | | Federal Status | State Status |
|---|---|---|---|
| **Rio Grande silvery minnow** | *Hybognathus amarus* | LE | E |

extirpated; historically Rio Grande and Pecos River systems and canals; reintroduced in Big Bend area; pools and backwaters of medium to large streams with low or moderate gradient in mud, sand, or gravel bottom; ingests mud and bottom ooze for algae and other organic matter; probably spawns on silt substrates of quiet coves

## INSECTS

| | | Federal Status | State Status |
|---|---|---|---|
| **A Royal moth** | *Sphingicampa raspa* | | |

woodland - hardwood; with oaks, junipers, legumes and other woody trees and shrubs; good density of legume caterpillar foodplants must be present; Prairie acacia (Acacia augustissima) is the documented caterpillar foodplant, but there could be a few other woody legumes used

**A tiger beetle** *Cicindela hornii*

grassland/herbaceous; burrowing in or using soil; dry areas on hillside or mesas where soil is rocky or loamy and covered with grasses, invertivore; diurnal, hibernates/aestivates, active mostly for several days after heavy rains. the life cycle probably takes two years so larvae would always be present in burrows in the soil

**Barbara Ann's tiger beetle** *Cicindela politula barbarannae*

limestone outcrops in arid treeless environments or in openings within less arid pine-juniper-oak communities; open limestone substrate itself is almost certainly an essential feature; roads and trails

**Poling's hairstreak** *Fixsenia polingi*

oak woodland with Quercus grisea as substantial component, probably also uses Q. emoryi; larvae feed on new growth of Q. grisea, adults utilize nectar from a variety of flowers including milkweed and catslaw acacia; adults fly mid May - Jun, again mid Aug - early Sept

## MAMMALS

| | | Federal Status | State Status |
|---|---|---|---|
| **Big free-tailed bat** | *Nyctinomops macrotis* | | |

habitat data sparse but records indicate that species prefers to roost in crevices and cracks in high canyon walls, but will use buildings, as well; reproduction data sparse, gives birth to single offspring late June-early July; females gather in nursery colonies; winter habits undetermined, but may hibernate in the Trans-Pecos; opportunistic insectivore

| | | | |
|---|---|---|---|
| **Black bear** | *Ursus americanus* | T/SA;NL | T |

bottomland hardwoods and large tracts of inaccessible forested areas; due to field characteristics similar to Louisiana Black Bear (LT, T), treat all east Texas black bears as federal and state listed Threatened

| | | | |
|---|---|---|---|
| **Black-footed ferret** | *Mustela nigripes* | LE | |

extirpated; inhabited prairie dog towns in the general area

**Black-tailed prairie dog** *Cynomys ludovicianus*

dry, flat, short grasslands with low, relatively sparse vegetation, including areas overgrazed by cattle; live in large family groups

# EL PASO COUNTY

## MAMMALS

Federal Status State Status

**Cave myotis bat** *Myotis velifer*

colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (Hirundo pyrrhonota) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum cave of Panhandle during winter; opportunistic insectivore

**Desert pocket gopher** *Geomys arenarius*

cottonwood-willow association along the Rio Grande in El Paso and Hudspeth counties; live underground, but build large and conspicuous mounds; life history not well documented, but presumed to eat mostly vegetation, be active year round, and bear more than one litter per year

**Fringed bat** *Myotis thysanodes*

habitat variable, ranging from mountainous pine, oak, and pinyon-juniper to desert-scrub, but prefers grasslands at intermediate elevations; highly migratory species that arrives in Trans-Pecos by May to form nursery colonies; single offspring born June-July; roosts colonially in caves, mine tunnels, rock crevices, and old buildings

**Gray wolf** *Canis lupus* LE E

extirpated; formerly known throughout the western two-thirds of the state in forests, brushlands, or grasslands

**Long-legged bat** *Myotis volans*

in Texas, Trans-Pecos region; high, open woods and mountainous terrain; nursery colonies (which may contain several hundred individuals) form in summer in buildings, crevices, and hollow trees; apparently do not use caves as day roosts, but may use such sites at night; single offspring born June-July

**Pale Townsend's big-eared bat** *Corynorhinus townsendii pallescens*

roosts in caves, abandoned mine tunnels, and occasionally old buildings; hibernates in groups during winter; in summer months, males and females separate into solitary roosts and maternity colonies, respectively; single offspring born May-June; opportunistic insectivore

**Pecos River muskrat** *Ondatra zibethicus ripensis*

creeks, rivers, lakes, drainage ditches, and canals; prefer shallow, fresh water with clumps of marshy vegetation, such as cattails, bulrushes, and sedges; live in dome-shaped lodges constructed of vegetation; diet is mainly vegetation; breed year round

**Western red bat** *Lasiurus blossevillii*

roosts in tree foliage in riparian areas, also inhabits xeric thorn scrub and pine-oak forests; likely winter migrant to Mexico; multiple pups born mid-May - late Jun

**Western small-footed bat** *Myotis ciliolabrum*

mountainous regions of the Trans-Pecos, usually in wooded areas, also found in grassland and desert scrub habitats; roosts beneath slabs of rock, behind loose tree bark, and in buildings; maternity colonies often small and located in abandoned houses, barns, and other similar structures; apparently occurs in Texas only during spring and summer months; insectivorous

# EL PASO COUNTY

## MAMMALS

| | | Federal Status | State Status |
|---|---|---|---|
| **Yuma myotis bat** | *Myotis yumanensis* | | |

desert regions; most commonly found in lowland habitats near open water, where forages; roosts in caves, abandoned mine tunnels, and buildings; season of partus is May to early July; usually only one young born to each female

## MOLLUSKS

| | | Federal Status | State Status |
|---|---|---|---|
| **Franklin Mountain talus snail** | *Sonorella metcalfi* | | |

terrestrial; bare rock, talus, scree; inhabits igneous talus most commonly of rhyolitic origin

**Franklin Mountain wood snail** *Ashmunella pasonis*

terrestrial; bare rock, talus, scree; talus slopes, usually of limestone, but also of rhyolite, sandstone, and siltstone, in arid mountain ranges

## REPTILES

| | | Federal Status | State Status |
|---|---|---|---|
| **Big Bend slider** | *Trachemys gaigeae* | | |

almost exclusively aquatic, sliders (Trachemys spp.) prefer quiet bodies of fresh water with muddy bottoms and abundant aquatic vegetation, which is their main food source; will bask on logs, rocks or banks of water bodies; breeding March-July

| | | | |
|---|---|---|---|
| **Chihuahuan Desert lyre snake** | *Trimorphodon vilkinsonii* | | T |

mostly crevice-dwelling in predominantly limestone-surfaced desert northwest of the Rio Grande from Big Bend to the Franklin Mountains, especially in areas with jumbled boulders and rock faults/fissures; secretive; egg-bearing; eats mostly lizards

| | | | |
|---|---|---|---|
| **Mountain short-horned lizard** | *Phrynosoma hernandesi* | | T |

diurnal, usually in open, shrubby, or openly wooded areas with sparse vegetation at ground level; soil may vary from rocky to sandy; burrows into soil or occupies rodent burrow when inactive; eats ants, spiders, snails, sowbugs, and other invertebrates; inactive during cold weather; breeds March-September

**New Mexico garter snake** *Thamnophis sirtalis dorsalis*

nearly any type of wet or moist habitat; irrigation ditches, and riparian-corridor farmlands, less often in running water; home range about 2 acres; active year round in warm weather, both diurnal and nocturnal, more nocturnal during hot weather; bears litter July-August

| | | | |
|---|---|---|---|
| **Texas horned lizard** | *Phrynosoma cornutum* | | T |

open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September

# EL PASO COUNTY

## PLANTS

Federal Status State Status

**Comal snakewood** *Colubrina stricta*

in El Paso County, found in a patch of thorny shrubs in colluvial deposits and sandy soils at the base of an igneous rock outcrop; the historic Comal County record does not describe the habitat; in Mexico ,found in shrublands on calcareous, gravelly, clay soils with woody associates; flowering late spring or early summer

**Desert night-blooming cereus** *Peniocereus greggii var greggii*

Chihuahuan Desert shrublands or shrub invaded grasslands in alluvial or gravelly soils at lower elevations, 1200-1500 m (3900-4900 ft), on slopes, benches, arroyos, flats, and washes; flowering synchronized over a few nights in early May to late June when almost all mature plants bloom, flowers last only one day and open just after dark, may flower as early as April

**Hueco rock-daisy** *Perityle huecoensis*

north-facing or otherwise mostly shaded limestone cliff faces within relatively mesic canyon system; flowering spring-fall

**Sand prickly-pear** *Opuntia arenaria*

deep, loose or semi-stabilized sands in sparsely vegetated dune or sandhill areas, or sandy floodplains in arroyos; flowering May-June

**Sand sacahuista** *Nolina arenicola*

Texas endemic; mesquite-sand sage shrublands on windblown Quarternary reddish sand in dune areas; flowering time uncertain May-June, June-September

**Sneed's pincushion cactus** *Escobaria sneedii var sneedii* LE E

xeric limestone outcrops on rocky, usually steep slopes in desert mountains, in the Chihuahuan Desert succulent shrublands or grasslands; flowering April-September (peak usually in April, sometimes opportunistically after summer rains; fruiting August - November

**Texas false saltgrass** *Allolepis texana*

sandy to silty soils of valley bottoms and river floodplains, not generally on alkaline or saline sites; flowering (May-) July-October depending on rainfall

**Wheeler's spurge** *Chamaesyce geyeri var wheeleriana*

sparingly vegetated, loose eolian quartz sand on reddish sand dunes or coppice mounds; flowering and fruiting at least August-September, probably earlier and later, as well

## Notes for
## County Lists of Texas' Special Species

The Texas Parks and Wildlife (TPWD) county lists **include**:

**Vertebrates, Invertebrates, and Vascular Plants** identified as being of conservation concern by TPWD within Texas. These special species lists are comprised of species, subspecies, and varieties that are federally listed; proposed to be federally listed; have federal candidate status; are state listed; or carry a global conservation status indicating a species is critically imperiled, very rare, vulnerable to extirpation, or uncommon.

The TPWD county lists **do not include**:

**Natural Plant Communities** such as Little Bluestem-Indiangrass Series (native prairie remnant), Water Oak-Willow Oak Series (bottomland hardwood community), Saltgrass-Cordgrass Series (salt or brackish marsh), Sphagnum-Beakrush Series (seepage bog).

**Other Significant Features** such as bird rookeries, migratory songbird fallout areas, comprehensive migratory bird information, bat roosts, bat caves, invertebrate caves, and prairie dog towns.

**These lists are not all inclusive for all rare species distributions.** The lists were compiled, developed, and are updated based on field guides, staff expertise, scientific publications, and the TPWD Texas Natural Diversity Database (TXNDD) (formerly the Biological and Conservation Data System) occurrence data. Historic ranges for some state extirpated species, full historic distributions for some extant species, accidentals and irregularly appearing species, and portions of migratory routes for particular species are not necessarily included. Species that appear on county lists do not all share the same probability of occurrence within a county. Some species are migrants or wintering residents only. Additionally, a few species may be historic or considered extirpated within a county.

TPWD includes the Federal listing status for your convenience and makes every attempt to keep the information current and correct. However, the US Fish and Wildlife Service (FWS) is the responsible authority for Federal listing status. The TPWD lists do not substitute for contact with the FWS and federally listed species county ranges may vary from the FWS county level species lists because of the inexact nature of range map development and use.

Status Key:

| | |
|---|---|
| LE, LT - | Federally Listed Endangered/Threatened |
| PE, PT - | Federally Proposed Endangered/Threatened |
| SAE, SAT - | Federally Listed Endangered/Threatened by Similarity of Appearance |
| C - | Federal Candidate for Listing; formerly Category 1 Candidate |
| DL, PDL - | Federally Delisted/Proposed for Delisting |
| NL - | Not Federally Listed |
| E, T - | State Listed Endangered/Threatened |
| NT - | Not tracked or no longer tracked by the State |
| "blank" - | Rare, but with no regulatory listing status |

This information is specifically for your assistance only; due to continuing data updates, **please do not redistribute the lists**, instead refer all requesters to the web site at: http://www.tpwd.state.tx.us/landwater/land/maps/gis/ris/endangered_species/ or to our office for the most current information available. For questions regarding county lists, please call (512) 389-4571.

Please use the following citation to credit the source for this county level information:

Texas Parks and Wildlife Department, Wildlife Division, Diversity and Habitat Assessment Programs. County Lists of Texas' Special Species. [county name(s) and revised date(s)].

SAIC

January 11, 2012

Texas Parks and Wildlife Department
Wildlife Division Wildlife Habitat Assessment Program
4200 Smith School Road
Austin, Texas 78744

Subject: **Threatened and Endangered Species Assessment**
**McCombs Municipal Solid Waste Landfill, El Paso, Texas**

Dear Wildlife Division:

The McCombs Municipal Solid Waste Landfill (Landfill) located in El Paso, Texas (City) is proposing a vertical expansion of the existing Landfill footprint to provide additional capacity. The Landfill is located in El Paso County within the El Paso city limits and serves the waste needs of the City and the surrounding area. The Landfill is an existing Type 1 MSW disposal facility owned and operated by the City. The Landfill is located at the northeast corner of the intersection of McCombs Road and Stan Roberts Road (FM 2529) in El Paso, Texas. The address of the Landfill is 13660 McCombs Road.

The proposed vertical expansion will increase the height of the Landfill from the currently permitted elevation of 4,125 feet mean sea level (MSL) to 4,305 feet MSL. The existing permitted boundary of the Landfill is currently 327 acres (permitted in 1984), and is not proposed to increase. The primary use for this facility will remain dedicated for disposal of municipal solid waste.

A letter dated August 13, 1982 from the United States Fish and Wildlife Service (USFWS) has been included in Attachment 1. According to the USFWS letter, the American Peregrine Falcon may use the project site as a feeding area or pass through the area during migration. According to the information provided on the USFWS website, the American Peregrine Falcon was delisted from the federal endangered species list on August 25, 1999. However, the American Peregrine Falcon remains a State of Texas protected species.

As indicated in the USFWS letter, it is unlikely that the Landfill will have any effect on this species. However, if the American Peregrine Falcon were to be observed within the permitted Landfill area, the employees will be instructed to follow the steps listed below:

1. Avoid contact with the bird;
2. Temporarily halt or move site operations to an area away from the bird's location to prevent disrupting the bird's activities while feeding or passing by the site;



*SAIC Energy, Environment & Infrastructure, LLC*
*1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI*

3. Wait until the bird abandons the site on its own will; and
4. Resume normal site operations once the bird has taken flight.

In addition, Landfill personnel will be trained regarding the bird's physical characteristics and appearance in order to be able to identify it at once and with certainty during operations. This training will prevent unnecessary and unwarranted disruptions of site activities due to the presence of birds that may look similar to the American Peregrine Falcon.

We are requesting information regarding any listed threatened or endangered species or their critical habitat within range of the project site. This information is required by Texas Administrative Code Chapter 330 (30 TAC §330.61 (n)).

If you have any questions or require additional information, please contact me at 651-994-8415 or fredric.j.doran@saic.com.

Sincerely,

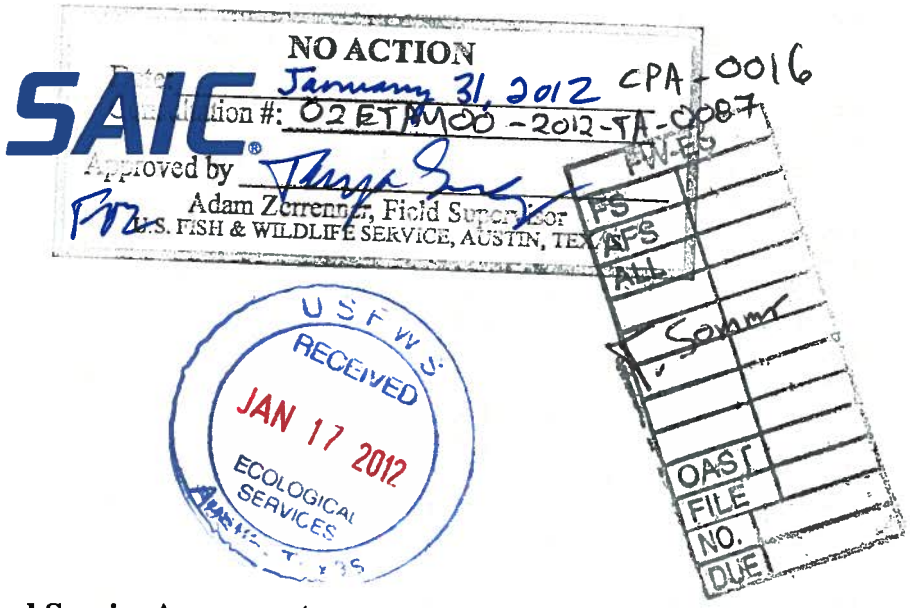
**SAIC Energy, Environment & Infrastructure, LLC**

Fredric J. Doran, P.E.
Senior Environmental Engineer

c w/ encl: Miguel Parra, City of El Paso
Scott R. Pasternak, SAIC



*SAIC Energy, Environment & Infrastructure, LLC*
*1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI*







January 11, 2012

U.S. Fish and Wildlife Service
Ecological Services
10711 Burnet Road, Suite 200
Austin, Texas 78758-4460

Subject: **Threatened and Endangered Species Assessment**
**McCombs Municipal Solid Waste Landfill, El Paso, Texas**

Dear Ecological Services:

The McCombs Municipal Solid Waste Landfill (Landfill) located in El Paso, Texas (City) is proposing a vertical expansion of the existing Landfill footprint to provide additional capacity. The Landfill is located in El Paso County within the El Paso city limits and serves the waste needs of the City and the surrounding area. The Landfill is an existing Type 1 MSW disposal facility owned and operated by the City. The Landfill is located at the northeast corner of the intersection of McCombs Road and Stan Roberts Road (FM 2529) in El Paso, Texas. The address of the Landfill is 13660 McCombs Road.

The proposed vertical expansion will increase the height of the Landfill from the currently permitted elevation of 4,125 feet mean sea level (MSL) to 4,305 feet MSL. The existing permitted boundary of the Landfill is currently 327 acres (permitted in 1984), and is not proposed to increase. The primary use for this facility will remain dedicated for disposal of municipal solid waste.

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As indicated in the USFWS letter, it is unlikely that the Landfill will have any effect on this species. However, if the American Peregrine Falcon were to be observed within the permitted Landfill area, the employees will be instructed to follow the steps listed below:

1. Avoid contact with the bird; 31.982554 -106.408597
2. Temporarily halt or move site operations to an area away from the bird's location to prevent disrupting the bird's activities while feeding or passing by the site;



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*1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI*

3. Wait until the bird abandons the site on its own will; and
4. Resume normal site operations once the bird has taken flight.

In addition, Landfill personnel will be trained regarding the bird's physical characteristics and appearance in order to be able to identify it at once and with certainty during operations. This training will prevent unnecessary and unwarranted disruptions of site activities due to the presence of birds that may look similar to the American Peregrine Falcon.

We are requesting information regarding any federally listed threatened or endangered species or their critical habitat within range of the project site. This information is required by Texas Administrative Code Chapter 330 (30 TAC §330.61 (n)).

If you have any questions or require additional information, please contact me at 651-994-8415 or fredric.j.doran@saic.com.

Sincerely,

**SAIC Energy, Environment & Infrastructure, LLC**

Fredric J. Doran, P.E.
Senior Environmental Engineer

c w/ encl: Miguel Parra, City of El Paso
Scott R. Pasternak, SAIC



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*1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI*

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Ecological Services
c/o CCSU, Campus Box 338
6300 Ocean Drive
Corpus Christi, Texas 78412

August 13, 1982

Rosemary Staley
Department of Planning,
Research and Development
#2 Civic Center Plaza - 5th Floor
El Paso, Texas 79999

Dear Ms. Staley:

By letter dated August 4, 1982, you provided the U.S. Fish and Wildlife Service (FWS) with maps showing the location of a proposed sanitary landfill at the intersection of McCombs Road and FM 2529 and requested information concerning endangered species. The proposed landfill would generally utilize an abandoned quarry adjacent to an existing landfill.

Federally listed endangered species present in El Paso County are the American peregrine falcon (Falco peregrinus anatum) and Sneed pincushion cactus (Coryphantha sneedii var. sneedii). It is unlikely that expanding the sanitary landfill would have any effect on the above listed species because the cactus is confined to the Franklin Mountains as is the nesting habitat of the peregrine falcon. The peregrine may use the project site as a feeding area or pass through the area during migration.

The letter describing the site contained insufficient information to assess the effect leaching from the landfill would have on ground water quality. The bottom of the abandoned quarry may need to be sealed to prevent contamination of ground water resources. If this is not a problem, the FWS believes that the proposed landfill site is a good location for expanding the City's waste disposal capability.

We appreciate the opportunity to review your project. If we may be of further assistance please, contact Don A. Meineke or me (Telephone 512/888-3346).

Sincerely yours,

ROGELIO PEREZ
Field Supervisor

RECEIVED
AUG 16 1982
PLANNING DEPARTMENT

Federal Register

Wednesday
August 25, 1999

## Part III

# Department of the Interior

**Fish and Wildlife Service**

**50 CFR Part 17**

**Endangered and Threatened Wildlife and Plants; Final Rule To Remove the American Peregrine Falcon From the Federal List of Endangered and Threatened Wildlife, and To Remove the Similarity of Appearance Provision for Free-Flying Peregrines in the Conterminous United States; Final Rule**

**DEPARTMENT OF THE INTERIOR**

**Fish and Wildlife Service**

**50 CFR Part 17**

**RIN 1018–AF04**

# Endangered and Threatened Wildlife and Plants; Final Rule To Remove the American Peregrine Falcon From the Federal List of Endangered and Threatened Wildlife, and To Remove the Similarity of Appearance Provision for Free-Flying Peregrines in the Conterminous United States

**AGENCY:** Fish and Wildlife Service, Interior.

**ACTION:** Final rule.

**SUMMARY:** We, the U.S. Fish and Wildlife Service (Service), have determined that the American peregrine falcon (*Falco peregrinus anatum*) is no longer an endangered or threatened species pursuant to the Endangered Species Act of 1973, as amended (Act). This determination is based on available data indicating that this subspecies has recovered following restrictions on organochlorine pesticides in the United States and Canada, and following the implementation of successful management activities. This action will remove the American peregrine falcon (*Falco peregrinus anatum*) throughout its range as an endangered species from the Federal List of Endangered and Threatened Wildlife, thereby removing all protections provided by the Act. It also will remove the designation of ''endangered due to similarity of appearance'' for any free-flying peregrine falcons within the 48 conterminous United States. It will not affect protection provided to this species by the Migratory Bird Treaty Act (MBTA), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), or state laws and regulations, nor will it affect the endangered listing status of the Eurasian peregrine falcon (*Falco peregrinus peregrinus*) under the Act.

**EFFECTIVE DATE:** August 25, 1999.

**ADDRESSES:** The administrative file for this rule is available for inspection, by appointment, during normal business hours at the U.S. Fish and Wildlife Service, Ventura Fish and Wildlife Office, 2493 Portola Road, Suite B, Ventura, California 93003 (telephone (805) 644–1766/facsimile 805/644–3958).

**FOR FURTHER INFORMATION CONTACT:** Robert Mesta at the above address for further information on the removal of the peregrine falcon from the endangered species list.

**SUPPLEMENTARY INFORMATION:**

## Background

The peregrine falcon (*Falco peregrinus*) is a medium-sized raptor weighing approximately 1,000 grams (36 ounces) and having a wing span of 112 centimeters (44 inches). The adult peregrine falcon has a dark gray back and crown, dark bars or streaks on a pale chest and abdomen, and heavy malar (cheek) stripes on the face. Immature falcons are buff-colored in front and have dark brown backs; adults are white or buff in front and bluish-gray on their backs. Peregrines prey almost entirely on other birds, and occasionally on bats, caught in midair (Hickey and Anderson 1969).

The peregrine falcon has an almost worldwide distribution, with three subspecies recognized in North America (Brown and Amadon 1968). The Peale's falcon (*F. p. pealei*) is a year-round resident of the northwest Pacific coast from northern Washington through British Columbia to the Aleutian Islands. The Arctic peregrine falcon (*F. p. tundrius*) nests in the tundra of Alaska, Canada, and Greenland, and is typically a long-distance migrant, wintering as far south as South America. The American peregrine falcon (*F. p. anatum*) occurs throughout much of North America from the subarctic boreal forests of Alaska and Canada south to Mexico. The American peregrine falcon nests from central Alaska, central Yukon Territory, and northern Alberta and Saskatchewan, east to the Maritimes and south (excluding coastal areas north of the Columbia River in Washington and British Columbia) throughout western Canada and the United States to Baja California, Sonora, and the highlands of central Mexico (48 FR 8799). American peregrine falcons that nest in subarctic areas generally winter in South America, while those that nest at lower latitudes exhibit variable migratory behavior; some are nonmigratory (Yates *et al.* 1988).

Since the early 1970s, efforts to reestablish peregrine falcons in the eastern and midwestern United States have successfully returned this species to areas from which it was extirpated (See ''Eastern United States'' under ''Peregrine Falcon Recovery''). Peregrine falcons are now found nesting in all States within their historical range east of the 100th meridian, except for Rhode Island, West Virginia, and Arkansas.

Peregrine falcons declined precipitously in North America following World War II (Kiff 1988). Research implicated organochlorine pesticides, mainly 1,1,1-trichloro-2,2-bis(p-chlorophenyl)-ethane (DDT), applied in the United States and Canada during this same period, as causing the decline (for a review, see Risebrough and Peakall 1988). Use of these chemicals peaked in the 1950s and early 1960s and continued through the early 1970s. Organochlorines and their metabolites, including DDT and its principal metabolite DDE (1,1-dichloro-2,2-bis(*p*-chlorophenyl)-ethylene), aldrin, dieldrin, and others, are stable, persistent compounds that are stored in the fatty tissues of animals ingesting contaminated food (Fyfe *et al.* 1988).

Organochlorines can affect peregrine falcons either by causing direct mortality or by adversely affecting reproduction. Because mortality in wild birds is difficult to study, the effect of organochlorines on mortality is not as well known as the effects on reproduction. Organochlorines can adversely affect reproduction by causing egg breakage, addling, hatching failure, and abnormal reproductive behavior by the parent birds (Risebrough and Peakall 1988). DDE prevents normal calcium deposition during eggshell formation, resulting in thin-shelled eggs that are susceptible to breakage during incubation. In general, populations laying eggs with shells that averaged more than 17 percent thinner than pre-DDT eggs had such high rates of reproductive failure that the number of peregrine falcon pairs declined (Peakall and Kiff 1988).

During the period of DDT use in North America, eggshell thinning and nesting failures were widespread in peregrine falcons, and in some areas, successful reproduction virtually ceased (Hickey and Anderson 1969). As a result, there was a slow but drastic decline in the number of peregrine falcons in many areas of North America. The degree of exposure to these pesticides varied among regions, and peregrine falcon numbers in more contaminated areas suffered greater declines. Peregrine falcons that nested outside of agricultural and forested areas where DDT was heavily used were affected less, although some of these individuals were still exposed to DDT when wintering in areas of pesticide use. Presumably all peregrine falcon individuals have eaten some migratory prey containing organochlorines (for reviews, see Hickey and Anderson 1969; Kiff 1988; Peakall and Kiff 1988).

Peregrine falcons nesting in the agricultural and forested areas east of the Mississippi River in the United States and in eastern Canada south of the boreal forest were the most heavily contaminated and were essentially

extirpated by the mid-1960s (Berger *et al.* 1969). Peregrine falcons in the Great Plains states east of the Rocky Mountains and south of the boreal forest in Canada and the United States were also extirpated in the DDT-era (Cade 1975; Enderson *et al.* 1995). No active eyries (nests) were found in surveys of 133 formerly used peregrine falcon eyries in the latter part of the 1964 nesting season in the eastern United States and the Maritime Provinces in Canada (Berger *et al.* 1969). By 1975, there were only three peregrine falcon pairs in Alberta, and no other peregrine falcon pairs were found south of latitude 60 degrees North and east of the Rocky Mountains in Canada (Erickson *et al.* 1988).

West of the 100th meridian, peregrine falcons were significantly reduced; only 33 percent of historical nest sites in the Rocky Mountains were still occupied by 1965 (Enderson 1969). The peregrine falcon disappeared as a breeding species from southern California, and major declines also occurred in other parts of the western United States and in much of southern Canada and the Northwest Territories (Kiff 1988). In contrast, peregrine falcons in most areas of the Pacific coast of Alaska remained fairly stable during this period, due to their lower exposure to organochlorine pesticides. The exact degree of local declines in much of western North America remains somewhat speculative due to a lack of accurate pre-pesticide era census data. For example, in the southwestern United States and mainland Mexico, peregrine falcons were not censused until after the beginning of the use of organochlorines (Kiff 1988).

**Previous Federal Actions**

Population declines due to negative impacts of DDT and its metabolites on peregrine falcon reproduction and survival led us to list two of the three North American subspecies, the Arctic peregrine falcon and the American peregrine falcon, as endangered in 1970 under the Endangered Species Conservation Act of 1969 (Public Law 91–135, 83 Stat. 275). Arctic and American peregrine falcons were included in the United States' list of endangered foreign species on June 2, 1970 (35 FR 8491) under the Endangered Species Conservation Act of 1969, and the native list of endangered species on October 13, 1970 (35 FR 16047). Upon passage of the Endangered Species Act of 1973, as amended (Act) (16 U.S.C. 1531 *et seq.*), the native and foreign species lists were combined into a single list of endangered and threatened species. Both the American and Arctic peregrine falcon subspecies were listed as endangered throughout their respective ranges. The Peale's peregrine falcon was not listed because it was reproducing at near normal levels with only traces of DDT.

On March 1, 1983, we published a proposed rule to (1) reclassify the Arctic peregrine falcon from endangered to threatened; (2) clarify the status of the American peregrine falcon (*Falco peregrinus anatum*) in some areas of its range; and (3) designate all free-flying peregrine falcons in the 48 conterminous United States as endangered under the similarity of appearance provisions of section 4(e) of the Act (48 FR 8796). A final rule was published on March 20, 1984 (49 FR 10520). Pursuant to the similarity of appearance provisions, species that are not considered to be endangered or threatened are treated as such for the purpose of providing protection to a species that is biologically endangered or threatened.

On June 12, 1991, we announced in the **Federal Register** a Notice of Status Review of American and Arctic peregrines (56 FR 26969). The Arctic peregrine was removed as a threatened species from the Federal List of Endangered and Threatened Wildlife on October 5, 1994 (59 FR 50796) but was still regulated under the Act in the lower 48 United States due to the similarity of appearance provision for all *Falco peregrinus* peregrine falcons. The similarity of appearance provision was maintained because the American peregrine falcon was still listed as endangered.

We published an Advanced Notice of a Proposal to Remove the American Peregrine Falcon from the Federal List of Endangered and Threatened Wildlife on June 30, 1995 (60 FR 34406). This was based on data indicating this subspecies was recovered following restrictions on the use of organochlorine pesticides in the United States and Canada and because of successful management activities, including the reintroduction of captive-bred and relocated wild hatchling peregrine falcons. Current data provides additional support for recovery of all North American peregrine falcons, including the American peregrine falcon subspecies. We published a proposed rule to remove the peregrine falcon in North America from the Federal List of Endangered and Threatened Wildlife on August 26, 1998, based on continuing data indicating this species was recovered (63 FR 45446).

The processing of this final rule conforms with our listing priority guidance published on May 8, 1998 (63 FR 25502). This guidance clarifies the order in which we will process rulemakings, giving highest priority to handling emergency situations (Tier 1) and second highest priority (Tier 2) to resolving the listing status of outstanding proposed listings, resolving the conservation status of candidate species, processing administrative findings on petitions to add species to the lists or reclassify species from threatened to endangered status, and delisting or reclassifying actions. The lowest priority actions, processing critical habitat designations, are in Tier 3. Processing of this final rule is a Tier 2 action.

**Peregrine Falcon Recovery**

Section 4(f) of the Act directs us to develop and implement recovery plans for listed species. In some cases, we appoint experts to recovery teams to assist in the writing of recovery plans. Between 1974 and 1975 we formed recovery teams consisting of Service, State, and other experts. In cooperation with us, these recovery teams produced four regional recovery plans: three for the American peregrine falcon (Alaska, Rocky Mountains/Southwest United States, and the Pacific Coast of the United States), and one for the peregrine falcon in the eastern United States. Although no United States recovery plans established recovery criteria for peregrine falcons nesting outside of the United States, the Canadian Wildlife Service published an *Anatum* Peregrine Falcon Recovery Plan (Erickson *et al.* 1988) establishing recovery criteria for American peregrine falcons in Canada. Recovery plans for peregrine falcons called for captive rearing and release of birds in several areas of North America. In the eastern United States, where peregrine falcons were extirpated, the initial recovery objective was to reestablish peregrine falcons through the release of offspring from a variety of wild stocks being held in captivity by falconers. The first experimental releases of captive-produced young occurred in 1974 and 1975 in the United States. Since then, approximately 6,000 falcons were released throughout its historic range in North America. These releases helped to re-establish breeding pairs in areas where the species was extirpated, and accelerated the recovery of the species.

Later, reintroduction was also pursued in eastern Canada using only *F. p. anatum* breeding stock from the boreal regions of the subspecies' range. All peregrine falcons released to augment wild populations in western North America west of the 100th meridian, where small numbers of

American peregrines survived the pesticide era, were derived from western *anatum* stock (Enderson *et al.* 1995).

The most significant factor in the recovery of the peregrine falcon was the restriction placed on the use of organochlorine pesticides. Use of DDT was banned in Canada in 1970 and in the United States in 1972 (37 FR 13369). Restrictions that controlled the use of aldrin and dieldrin were imposed in the United States in 1974 (39 FR 37246). Since implementation of these restrictions, residues of the pesticides have significantly decreased in many regions where they were formerly used. Consequently, reproductive rates in most surviving peregrine falcon populations in North America improved, and numbers began to increase (Kiff 1988; Enderson *et al.* 1995).

In Alaska and northwest Canada, American peregrine falcon populations were locally depressed, but enough individuals survived the pesticide era to allow populations to expand without the need for release of captive-bred falcons. Likewise, in the southwestern United States, very few captive-bred birds were released, and populations recovered naturally following restrictions on the use of organochlorine pesticides. In southwest Canada, the northern Rocky Mountain States, and the Pacific Coast States, however, local populations were greatly depressed or extirpated, and over 3,400 young American peregrine falcons were released to promote recovery in those areas (Enderson *et al.* 1995).

American peregrine falcon population growth was noted in Alaska in the late 1970s (Ambrose *et al.* 1988b), and, by 1980, population growth was found in many other areas (Enderson *et al.* 1995). The rate of increase varied among regions of North America, undoubtedly influenced by variation in patterns of pesticide use, potential differences in the rate of pesticide degradation, and the degree to which local populations had declined. Populations in some portions of the range of American peregrine falcons, such as Alaska, northwest Canada, and southwestern United States, reached densities several years ago that suggested recovery was approaching completion (Ambrose *et al.* 1988b; Mossop 1988; Geoff Holroyd, Canadian Wildlife Service, *in litt.* 1993; Enderson *et al.* 1995). Residual organochlorine pesticide contamination continues to affect eggshells in some areas, such as portions of coastal California (Jarman 1994) and western Texas (Bonnie McKinney, Texas Parks and Wildlife Department, pers. comm. 1997), but these effects are localized. Despite these localized effects and the variation in the rate of increase among regions, local populations throughout North America have increased in size, and positive trends in nearly all areas suggest that an extensive recovery of American peregrine falcons has taken place.

**Recovery Status**

To aid in assessing peregrine falcon recovery, the current status was compared to specific recovery plan objectives for American peregrine falcons in (1) Alaska, (2) Canada, (3) the Pacific Coast, (4) the Rocky Mountains and the Southwest, and for the peregrine falcon in, and (5) the eastern United States. The current status of the subspecies in Mexico is discussed below, although no recovery plan or recovery objectives are established for Mexico.

*Alaska*

The Peregrine Falcon Recovery Plan, Alaska Population (Alaska Recovery Plan) (U.S. Fish and Wildlife Service 1982a) includes both Arctic and American peregrine falcons nesting in Alaska. The following discussion relates only to provisions regarding the American peregrine falcon, as the Arctic peregrine falcon was delisted on October 5, 1994 (59 FR 50796).

The Alaska Recovery Plan established recovery objectives based on four measurements for assessing the status of American peregrine falcons including population size, reproductive performance, pesticide residues in eggs, and eggshell thickness. The recovery objectives included:

(1) 28 nesting pairs in 2 specified study areas (16 in upper Yukon and 12 in upper Tanana);

(2) An average of 1.8 young per territorial pair;

(3) Average organochlorine concentration in eggs of less than 5 parts per million (ppm) (wet weight basis DDE); and

(4) Eggshells no more than 10 percent thinner than pre-DDT era eggshells.

The Alaska Recovery Plan suggested that these objectives be maintained in the specified study areas for 5 years before reclassifying from endangered to threatened status, and remain constant or improve for an additional 5 years before delisting.

Surveys were conducted in the upper Yukon and Tanana Rivers, for which historical population data were available, using consistent methodology from 1973 to the present so trends would be discernable. Surveys conducted between 1966 and 1998 along the upper Yukon River demonstrated increases in the number of occupied nesting territories from a low of 11 known pairs in 1973 to 46 pairs in 1998 (Ambrose *et al.* 1988b; Robert Ambrose, U.S. Fish and Wildlife Service, *in litt.* 1997a, 1999). Similarly, along the upper Tanana River, the number of occupied nesting territories increased from 2 in 1975 to 33 in 1998 (R. Ambrose, *in litt.* 1997a; 1999). The recovery objective of 28 occupied nesting territories in the two study areas was first achieved (post-DDT) in 1988, with 23 nesting territories on the Yukon River and 12 on the Tanana River. The number has increased steadily since that time to the current level of 79 occupied nesting territories in 1998, with 46 pairs on the Yukon River and 33 pairs on the Tanana River (R. Ambrose, *in litt.* 1999). Thus, the recovery objective of 28 occupied nesting territories was achieved and surpassed for 10 years. A minimum of 301 breeding pairs of American peregrine falcons currently nest in Alaska.

Productivity measured along the upper Yukon and Tanana Rivers fell to a low of about 1.0 young per territorial pair per year (yg/pr) in the late 1960s, but began to increase in the mid-1970s. By 1982, productivity exceeded the objective of 1.8 yg/pr, and varied between 1.6 and 3.0 yg/pr in the years since. Between 1994 and 1998, productivity averaged 2.0 yg/pr (sample size (N) = 362 nests/pairs). Overall, between 1982 and 1998, the Yukon River study area averaged 1.79 yg/pr, and the Tanana River study area averaged 1.85 yg/pr (R. Ambrose, *in litt.* 1999). It is expected that there are yearly variations in productivity, which most wildlife species experience. However, average productivity for the peregrine falcon was constant or improving, thus meeting the goal of at least 1.8 yg/pr over the last 10 years as recommended by the Alaska Recovery Plan.

Mean concentrations of DDE in peregrine falcon eggs in excess of 15–20 ppm are associated with nesting failure, whereas productivity is usually sufficient to maintain population size if residues average less than this concentration (Peakall *et al.* 1975, as cited in Peakall and Kiff 1988; Newton *et al.* 1989). In Alaska, average DDE residues in American peregrine falcons averaged 12.2 ppm from 1979 through 1984, 5.8 ppm from 1988 through 1991, and 3.5 ppm from 1993 through 1995 (R. Ambrose, *in litt.* 1997b). Current data suggest that the concentrations of less than 5 ppm DDE residue levels in peregrine falcon eggs have improved in the last 10 years (R. Ambrose *in litt.* 1997b). As a result of lowered DDE

concentrations, there was consistent population growth during that time.

In Alaska, eggshells were as much as 20–22 percent thinner than pre-DDT era shells in the mid-1960s (Cade *et al.* 1988). By the early 1980s, shells were about 14 percent thinner than before the DDT era (Ambrose *et al.* 1988a). Eggshells averaged 13.0 percent thinner from 1979 through 1984, 13.1 percent thinner from 1988 through 1991, and 12.1 percent thinner from 1993 through 1995 (R. Ambrose, *in litt.* 1997b). The average thickness of pre-DDT American peregrine falcon eggs from Alaska is not precisely known, so current estimates of thinning could be inaccurate. While average eggshell thinning has not yet reached the level of 10 percent or less of the pre-DDT era, it has improved over the last 10 years. Also, reproduction was sufficient to allow consistent population growth since the late 1970s, and productivity has, on average, exceeded its stated recovery objective for 17 years.

In summary, based on the most current information (1998 survey and early 1990s contamination data), we conclude that goals underlying all four objectives were met or exceeded. On average, the number of pairs occupying nesting territories in the two study areas and productivity exceeded the recovery objectives for the past 17 years. Neither DDE residues in eggs nor eggshell thinning has prevented a dramatic population growth since the late 1970s.

*Canada*

The 1988 *Anatum* Peregrine Falcon Recovery Plan for Canada (Canadian Recovery Plan) (Erickson *et al.* 1988) categorized the historical range of the American peregrine falcon throughout Canada into three regions, which include the Western Mountains, Interior Plains, and the Eastern Seaboard and Great Lakes. These regions were subdivided into nine zones on the basis of historical population levels, habitat, political boundaries, and restoration needs. The zones are (1) Maritime, (2) Great Lakes, (3) Prairies, (4) Mackenzie River Valley, (5) Northern Mountains, (6) Southern Mountains, (7) Eastern Mackenzie Watershed, (8) Western Canadian Shield, and the (9) Eastern Canadian Shield. Coastal British Columbia was excluded from consideration in the Canadian Recovery Plan because that area is occupied by *F.p. pealei.*

The goal of the Canadian Recovery Plan was to increase the wild American peregrine falcon population in Canada so the subspecies is no longer considered endangered or threatened by the Committee on the Status of Endangered Wildlife in Canada. The proposed objectives were (1) to establish by 1992 a minimum of 10 territorial American peregrine falcon pairs in each of Zones 1 to 6, and (2) to establish by 1997, in each of 5 of these 6 zones, a minimum of 10 pairs naturally fledging 15 (1.5 yg/pr) or more young annually, measured as a 5-year average beginning in 1993. No recovery objectives were established for Zones 7, 8, and 9. The Canadian Recovery Plan did not contain separate objectives for reclassification of the subspecies in Canada from its current endangered status to threatened.

Starting in 1990, the Canadian Wildlife Service has coordinated and published a national range-wide peregrine falcon population survey once every 5 years. The results of the 1995 national population survey were used in the following status summary of the American peregrine falcon in Canada (Ursula Banasch, Canadian Wildlife Service, *in litt.* 1997).

There were 98 known nest sites in Zones 1 and 2 (southern Ontario and Quebec, northern Great Lakes, Bay of Fundy and Labrador), and surveys located 64 pairs. There were 98 known nest sites in Zone 3 (Manitoba, Saskatchewan and Alberta), and surveys located 41 pairs. There were 117 known nest sites in Zone 4 (eastern N.W. Territories), and surveys located 83 pairs. There were 125 known nest sites in Zone 5 (Yukon), and surveys located 113 pairs. There were 50 known nest sites in Zone 6 (Interior British Columbia), and surveys located 18 pairs. The total known number of pairs for all six zones in 1995 was 319, with minimum objectives achieved for every recovery zone.

The only comprehensive range-wide productivity surveys available to us were the national population surveys coordinated by the Canadian Wildlife Service in 1990 and 1995 (U. Banasch, *in litt.* 1997; Holroyd and Banasch 1996). Surveys conducted in the intervening years were not nationally coordinated, and therefore not complete. Thus, we used the combined average annual productivity data collected in the 1990 and 1995 surveys to address this recovery objective.

In Zones 1 and 2, average productivity was 1.7 yg/pr (N=104 nests). In Zone 3, average productivity was 1.5 yg/pr (N=55). In Zone 4, average productivity was 2.0 yg/pr (N=171). In Zone 5, average productivity was 1.8 yg/pr (N=626). No productivity data were available for Zone 6. The 2-year average annual productivity for the Canadian population of American peregrine falcons was 1.8 yg/pr.

Although the Canadian Recovery Plan did not identify recovery objectives for pesticide residue or eggshell thinning levels, 205 eggs and 62 samples from 28 specimens of peregrine falcons were collected in Canada between 1965 and 1987 to assess organochlorine residue concentrations. In all three subspecies (*F.p. anatum, F.p. tundrius, F.p. pealei*), the proportion of specimens having residue concentrations above established critical values (concentration at which egg failure occurs, which varies among organochlorine contaminants) had decreased and was inversely correlated with improvements in the reproductive success of the population (Peakall *et al.* 1990).

In summary, the Canadian Recovery Plan identified two objectives to determine recovery for the American peregrine falcon population in Canada. Based on current available information, both objectives were met. The total number of pairs for all six zones in 1995 was 319, with minimum objectives achieved for every recovery zone. This count exceeds the total recovery objective of 60 pairs by 259 pairs. The average annual productivity data for 1990 and 1995 either met or exceeded objectives in five of the six zones with an average annual productivity of 1.8 yg/pr for the American peregrine falcon population in Canada.

*Pacific Coast*

To reclassify the American peregrine falcon from endangered to threatened, the Pacific Coast Recovery Plan (Pacific Population Plan) (U.S. Fish and Wildlife Service 1982b) recommended that 122 pairs be established in a specified distribution spanning California, Washington, Oregon, and Nevada. The distribution goals were based on 22 management units distributed throughout the historic range of the Pacific Coast peregrine falcon population. For each management unit, the population must achieve a specified minimum number of active pairs before downlisting can be considered. The Pacific Population Plan also recommended that with attainment of 185 wild, self-sustaining pairs (California 120, Oregon 30, Washington 30, and Nevada 5 pairs) and an average productivity of 1.5 yg/pr for a 5-year period, the subspecies could be considered for delisting. Since this final rule addresses the delisting of the peregrine falcon, only the latter two objectives are discussed in this section. The Pacific Population Plan defined a ''self-sustaining'' population as one whose natural productivity without human management is equal to or greater than its mortality.

By 1976, no American peregrine falcons were found at 14 historical nest sites in Washington, and Oregon had also lost most of its peregrine falcons. In addition, only 1 or 2 pairs remained on the California coast, with no more than 10 nest sites known to be occupied in the entire State (Cade 1994). A steadily increasing number of American peregrine falcon pairs breeding in Washington, Oregon, and Nevada was indicated by surveys from 1991 through 1998. Known pairs in Washington increased from 17 to 45, in Oregon from 23 to 51, and in Nevada from 3 to 6 (Gary Herron, Nevada Division of Wildlife, pers. comm. 1997; Martin Nugent, Oregon Department of Fish and Wildlife, *in litt.* 1999; David Anderson, Washington Department of Fish and Game, *in litt.* 1997). The number of American peregrine falcons in California increased from an estimated low of 5 to 10 breeding pairs in the early 1970s (Herman 1971), to a minimum of 167 occupied sites in 1998 (Janet Linthicum, Santa Cruz Predatory Bird Research Group, *in litt.* 1999). The increase in California was concurrent with the restriction of DDT and management that included the release of over 750 American peregrine falcons, including captive-reared and relocated wild hatchlings, through 1997 (Walton 1997). Recovery of American peregrine falcons in some areas of California, however, was impeded by continuing elevated DDT levels (Jarman 1994; Walton 1997).

The recovery of the peregrine falcon could be the result of a lower than expected first-year mortality of released birds from the augmentation program, which accelerated the growth of the Pacific population (Brian Walton, Santa Cruz Predatory Bird Research Group, pers. comm. 1997). As a result, intensive human management has essentially ended, and the release of captive-bred American peregrine falcons was suspended in Nevada in 1989, in California in 1992 (although the relocation of wild hatchlings continues), and in Oregon and Washington in 1995. Based on available information, the first recovery objective was met; a minimum known population of 270 pairs exceeds the delisting goal of 185 by 85 pairs. Also, the distribution goals for the Pacific Coast population was met in all four States. Surveys conducted from 1991 through 1998 demonstrate a steadily increasing number of American peregrine falcon pairs, indicating that natural productivity is greater than mortality in this recovery region.

Productivity measured in Washington between 1993 and 1998 ranged from 1.3 to 1.8 yg/pr, with an average of 1.5 yg/pr (N=204) (D. Anderson, *in litt.* 1999). In Oregon, productivity between 1993 and 1998 ranged from 0.8 to 1.9 yg/pr, with an average of 1.3 yg/pr (N=178) (M. Nugent, *in litt.* 1997; David Peterson, U.S. Fish and Wildlife Service, *in litt.* 1999). Between 1993 and 1998, productivity in California ranged from 1.4 to 1.7 yg/pr (N=523), with an average of 1.6 yg/pr (J. Linthicum *in litt.* 1999). No productivity data were available for Nevada.

Productivity, an important measure of population health, can be difficult to determine in wide-ranging species nesting in remote landscapes that are often difficult to access. However, available data indicate that the average productivity from 1993 through 1998 in Washington, Oregon and California was 1.5 yg/pr (D. Anderson, *in litt.* 1999; M. Nugent, *in litt.* 1997; David Peterson, U.S. Fish and Wildlife Service, *in litt.* 1999; J. Linthicum *in litt.* 1999). Therefore, we consider this objective to be met.

The Pacific Population Plan did not identify recovery objectives for pesticide residue or eggshell thinning levels. However, organochlorine residues and eggshell thinning were measured in California starting in the early 1970s. Jarman (1994) reported DDE concentrations in 105 peregrine eggs collected from California from 1987 to 1992, and 11 eggs from Oregon from 1990 through 1993. Data collected in nine study regions in California (Jarman 1994) indicated the highest concentrations of DDE were found in California eggs from the Channel Islands and mid-coast with 21 and 13 ppm, respectively. The southern coast and San Francisco regions had the lowest concentrations of 5.5 and 4.3 ppm, respectively. The DDE concentrations in eggs collected along the coast of California (between San Francisco Bay and 34° N) did not decrease between 1969 and 1992 (Jarman 1994). Eggs from Oregon contained DDE levels of 10 ppm.

Eggshells from coastal California continued to show thinning. In northern and central coastal California, eggshells collected between 1975 and 1995 averaged 17.7 and 19.1 percent thinner than pre-DDT era, respectively (J. Linthicum, *in litt.* 1996). In northern interior California, where 104 of the 186 sites were active at least once from 1975–1993, eggshells averaged 15.6 percent thinner than pre-DDT era shells (J. Linthicum, *in litt.* 1996). Eggshells collected on the Channel Islands off the southern coast of California in 1992–1995 averaged 19.4 percent thinner than those collected in California prior to 1947 (J. Linthicum, *in litt.* 1996). In montane California, the average was 15 percent thinner than normal, and in the southern interior (coastal mountains) the average was 17.9 percent thinner than normal (J. Linthicum, *in litt.* 1996). Urban pairs experienced eggshell thinning averaging 8.7 percent in the San Francisco area and 10.9 percent in the Los Angeles/Orange County area. A summary of 633 clutch mean measurements representing 1,237 samples of one or more eggshells collected between 1975 and 1995 from the historical range of the American peregrine falcon in California averaged 16.1 percent thinner (J. Linthicum, *in litt.* 1996). However, current reproduction indicates an expanding population in most areas despite high organochlorine residue concentrations and associated eggshell thinning in some areas of the Pacific population.

*Rocky Mountain/Southwest*

The American Peregrine Falcon Rocky Mountain/Southwest Population Recovery Plan (U.S. Fish and Wildlife Service 1984) established three objectives for delisting, including (1) increasing the *Falco peregrinus anatum* population in the Rocky Mountain/Southwest region to a minimum of 183 breeding pairs and the following distribution: Arizona (46), Colorado (31), Idaho (17), Montana (20), Nebraska (1), New Mexico (23), North Dakota (1), South Dakota (1), Texas (8), Utah (21), and Wyoming (14); (2) sustaining a long-term average production of 1.25 yg/pr without manipulation by 1995; and (3) observing eggshell thinning of no more than 10 percent from the pre-DDT era for a 5-year span.

The prairie States of North Dakota, South Dakota, Nebraska, Kansas, and Oklahoma contain little peregrine falcon habitat, and historical data are incomplete. No recovery goals for a specific number of peregrine falcon pairs were set for Kansas or Oklahoma; nesting peregrine falcons are not known from Oklahoma. Currently, South Dakota, Nebraska and Kansas each have one peregrine falcon pair (Mark Martell, The Raptor Center, pers. comm. 1998; Tordoff *et al.* 1997); no peregrine falcon pairs are currently known to occur in North Dakota or Oklahoma.

The Rocky Mountain/Southwest population of the American peregrine falcon has made a profound comeback since the late 1970s when surveys showed no occupied nest sites in Idaho, Montana, or Wyoming and few pairs in Colorado, New Mexico, and the Colorado Plateau, including parts of southern Utah and Arizona (Cade 1994). Surveys conducted from 1991 through 1998 indicated that the number of American peregrine falcon pairs in the

Rocky Mountain/Southwest population is steadily increasing. In 1991, this population supported 367 known pairs; in 1998 the number of pairs increased to 535 (Robert Mesta, U.S. Fish and Wildlife Service, *in litt.* 1999). Surveys conducted from 1992 through 1998 showed that, with the exception of North Dakota, all States within the Rocky Mountain/Southwest population have met or exceeded their specific delisting goals for breeding pairs.

The current minimum known number of peregrine falcon pairs for each State include Arizona 159, Colorado 89, Idaho 17, Montana 18, Nebraska 1, New Mexico 32, North Dakota 0, South Dakota 1, Texas 11, Utah 164, Wyoming 42, and Kansas 1 (Greg Beatty, Arizona Game and Fish Department, *in litt.* 1997; James Enderson, Western Peregrine Falcon Recovery Team, pers. comm. 1999; Dennis Flath, Montana Department of Fish and Parks, *in litt.* 1999; Frank Howe, Utah Division of Wildlife Resources, *in litt.* 1999; Levine *et al.* 1998; McKinney 1994; B. McKinney, pers. comm. 1999; Robert Oakleaf, Wyoming Game and Fish Department, *in litt.* 1999; Sator O. Williams III, New Mexico Department of Game and Fish, *in litt.* 1999). The current Rocky Mountain/Southwest population is 535, which surpasses the objective of 183 by 352 pairs.

In Arizona , productivity from 1989 through 1997 ranged from 0.9 to 1.8 yg/yr, with an average productivity of 1.1 yg/pr (N=294). Recent average productivity (1994–1997) is 0.9 yg/pr (N=194) (Ward and Siemens 1995; G. Beatty, *in litt.* 1997).

In 1973, 1974, and 1975, productivity in Colorado was 0.2 (N=11), 1.9 (N=8), and 0.7 yg/pr (N=8), respectively, reflecting the irregular and generally poor productivity typical of the 1970s (Platt and Enderson 1988). Long term productivity measured in Colorado from 1985 through 1998 ranged from 1.2 to 1.9 yg/pr, with an average of 1.6 yg/pr (N=753) (Gerry Craig, Colorado Division of Wildlife, *in litt.* 1999; J.H. Enderson, pers. comm. 1999). Recent productivity from 1994 through 1998, averaged 1.6 yg/pr (N=395) (G. Craig, *in litt.* 1999).

In Idaho, productivity recorded from 1989 through 1998 ranged from 0 to 2.5 yg/pr, with an average of 1.6 yg/pr for this 10-year period (N=120). Recent productivity from 1994 through 1998 averaged 1.4 yg/pr (N=75) (Levine *et al.* 1998). In Montana, productivity between 1984 and 1998 ranged from 0.3 to 3.0 yg/pr, with an average of 1.7 yg/pr for the 15-year period (N=137). Recent productivity from 1994 through 1998 averaged 1.5 yg/pr (N=91) (D. Flath, *in litt.* 1999). In Nebraska, productivity between 1992 and 1998 for a single pair ranged from 0 to 5.0 yg/pr, with an average of 1.7 yg/pr for the 7-year period (N=7) (Lloyd Kiff, The Peregrine Fund, *in litt.* 1997; Tordoff *et al.* 1998).

For the period 1986 through 1998, New Mexico experienced a 12-year average productivity of 1.6 yg/pr (N=278). Recent productivity from 1995 through 1998 averaged 1.4 yg/pr (N=131) (S. Williams, *in litt.* 1997, 1999). In Texas, long term productivity recorded from 1975 through 1998 ranged from 0 to 2.3 yg/pr, with an average of 0.9 yg/pr (N=185) for the 23-year period. Recent productivity from 1994 through 1998 averaged 0.5 yg/pr (N=69) (McKinney 1994; B. McKinney, pers. comm. 1999).

In Utah, between 1985 and 1987, productivity averaged 0.8 yg/pr (N=117). From 1991 through 1996, productivity ranged from 0.9 to 2.0 yg/pr, with an average of 1.3 yg/pr (N=629) for the 6-year period (Bunnell 1994; F. Howe, *in litt.* 1997). In Wyoming, productivity between 1984 and 1998 ranged from 0.9 to 3.0 yg/pr, with an average of 1.7 yg/pr (N=282) for the 15-year period. Recent productivity between 1994 and 1998 averaged 1.8 yg/pr (N=179) (Joe White, Wyoming Game and Fish Department, *in litt.* 1995; R. Oakleaf, *in litt.* 1999).

In Kansas, productivity between 1993 and 1998 ranged from 0 to 3.0 yg/pr, with an average of 1.0 yg/pr (N=6) for the 4-year period (L. Kiff, *in litt.* 1997; Tordoff *et al.* 1998). In 1998, the first pair of peregrine falcons were located in South Dakota; they produced no young.

Although Texas and Arizona have exceeded their goals for number of pairs, current productivity is below the goal of 1.25 yg/pr and below their long term productivity averages by 44 and 18 percent respectively. Heavy metal contamination, particularly mercury, in adults and nestlings may be depressing productivity in Texas (Andrew Sansom, Texas Parks and Wildlife Department, *in litt.* 1995). Residual mercury contamination from mines operated along the Rio Grande River in the early 1900s is the suspected cause (B. McKinney, pers. comm. 1997). The current productivity level in Arizona is not fully understood, but may be a continuation of the variability exhibited in productivity between 1989 and 1995 (Garrison and Spencer 1996; Bruce Taubert, Arizona Game and Fish Department, pers. comm. 1999).

Kansas and South Dakota are two more States that currently have not met the productivity goal of 1.25 yg/pr. Kansas has had only one peregrine falcon pair since 1992, and breeding is sporadic each year.

Average productivity for the 11 States supporting breeding populations is 1.3 yg/pr, exceeding the goal of 1.25 yg/pr goal. Even though Texas, Kansas, South Dakota and Arizona currently have not met the productivity goal, productivity throughout the Rocky Mountain/Southwest region is more than sufficient for recruitment to exceed mortality, so dramatic population growth has resulted.

In Arizona, eggshells collected between 1978 and 1983 averaged 14.2 percent thinner, and 20 eggshell replicates collected from 1989 through 1994 averaged 13 percent thinner, than pre-DDT era eggshells (Ellis *et al.* 1989, Ward and Siemens 1995). In Colorado and New Mexico, shells from 260 eggs laid between 1977 and 1985 averaged 12 percent thinner than pre-DDT eggshells (Enderson *et al.* 1988). In another analysis of eggs from New Mexico, eggshells collected in 1977 averaged 20 percent thinner than pre-DDT eggshells, but in 1985 averaged only 14 percent thinner (Ponton *et al.* 1988). Eggshells collected in Colorado from 1973 through 1997 were as much as 25.1 percent thinner and at least 6.0 percent thinner than pre-DDT eggshells, with an average thinning of 13.5 percent. Only Colorado has achieved the objective for eggshell thickness. Sampling in Colorado in 1990, 1991, 1992, 1993, and 1994 produced measurements of 10.6, 11.7, 8.6, 8.1, and 6.0 percent thinning respectively, with an average annual mean of 9.0 percent thinning for this period (G. Craig, *in litt.* 1995). Although the recovery objective was not met in other States in the region, there is a general trend toward thicker eggshells in measurements taken since the mid-1970s (L. Kiff, pers. comm. 1995).

The Rocky Mountain/Southwest Recovery Plan did not identify a recovery objective for pesticide residue levels. However, organochlorine pesticide residues in American peregrine falcon eggs measured in Colorado and New Mexico between 1973 and 1979 averaged 26 ppm DDE, but the average declined to 15 ppm by 1980–1983 (Enderson *et al.* 1988). The average DDE concentration in 5 eggs collected in Colorado from 1986 through 1989 was 11 ppm (Jarman *et al.* 1993).

In summary, the first recovery objective in the Rocky Mountain/Southwest Recovery Plan was met; the current population of 535 pairs exceeds the goal of 183 pairs by 352 pairs. These pairs are distributed throughout the Rocky Mountain/Southwest States, meeting or exceeding the population goals in 10 of the 13 States in this

region. The second objective of sustaining a long-term average production of 1.25 yg/pr without manipulation by 1995 was met by all Rocky Mountain/Southwest States that have breeding American peregrine falcons except Texas, Kansas, South Dakota, and Arizona. By the mid-1980s the practice of fostering young into active nests was terminated, therefore, the long-term average productivity this recovery region has experienced was accomplished without nest manipulation. The current reproductive level in the 11 States with breeding populations is 1.3 yg/pr, exceeding the second objective of 1.25 yg/pr. Therefore, we consider the intent of this objective met. Based on the degree of recovery achieved, the third objective, that average eggshell thinning be no more than 10 percent from the pre-DDT era average for 5 years, appears to be conservative. The increase in numbers of American peregrine falcons indicates the subspecies has recovered without the necessity of reaching this specific recovery objective.

*Eastern United States*

The eastern peregrine population has a unique history and complex status under the Act. As stated previously, peregrine falcons were extirpated in the eastern United States and southeastern Canada by the mid-1960s. In 1974, shortly after the passage of the Act, the National Audubon Society sponsored a meeting of experts in peregrine biology, including representatives from the Service, to address the conservation of the species in North America (U.S. Fish and Wildlife Service 1991). This sparked the beginning of an effort to reestablish the peregrine in the eastern United States through the introduction of offspring from parents of multiple subspecies. Peregrine falcons were raised in captivity from parent subspecies then listed as endangered (*Falco peregrinus anatum, F. p. tundrius, F. p. peregrinus*), unlisted subspecies (*F. p. pealei, F. p. brookei, etc.*), and combinations of these subspecies. The first experimental releases of captive-produced young in the eastern States occurred in 1974 and 1975 (Cade 1994). These and future releases, coordinated by the Service, State fish and wildlife agencies, and representatives of The Peregrine Fund, demonstrated that hacking, the practice of retaining and feeding young captive-bred birds in partial captivity until they learn to fly and hunt on their own, was an effective method of introducing captive-bred peregrines to the wild (U.S. Fish and Wildlife Service 1991).

In 1978, we issued a policy statement confirming support for the use of North American peregrines to establish an eastern peregrine falcon population, supported with endangered species funds, and the use of peregrines from other geographic areas for specific research purposes. The policy applied only to peregrine falcons in the east (Keith M. Schreiner, U.S. Fish and Wildlife Service, *in litt.* 1978).

Thus, notwithstanding the similarity of appearance designation, we have continued to fully support the restoration of the eastern peregrine falcon under the 1991 revised Peregrine Falcon Eastern Population Recovery Plan. We have given the eastern peregrine falcon equal consideration with the American peregrine falcon with respect to recovery.

The Peregrine Falcon Eastern Population Recovery Plan (Eastern Plan), first published in 1979, and revised in 1985 and 1991 (U.S. Fish and Wildlife Service 1991), addressed the recovery of the peregrine falcon in the Eastern United States, a population re-established beginning in 1974 and 1975 by releasing captive-bred peregrine falcons of mixed genetic heritage. The recovery plan established two recovery objectives (1) establish a minimum of 20–25 nesting pairs in each of 5 recovery units and sustained them for a minimum of 3 years; and (2) an overall minimum of 175'200 pairs demonstrating successful, sustained nesting. The five recovery units are (1) Mid-Atlantic Coast, (2) Northern New York and New England, (3) Southern Appalachians, (4) Great Lakes, and (5) Southern New England/Central Appalachians.

The first recovery objective is nearly achieved, with three of the five recovery units (Mid-Atlantic Coast, Northern New York and New England, and Great Lakes) surpassing 20 to 25 nesting pairs of peregrine falcons for 3 years. The Mid-Atlantic Coast unit had 65 pairs fledging 110 young in 1998 and averaged 62 pairs and 90 fledglings annually from 1996 through 1998. The Northern New York and New England unit had 50 pairs fledging 70 young in 1998 and averaged 47 pairs and 61 fledglings annually from 1996 through 1998. The Great Lakes unit had 44 pairs fledging 95 young in 1998 and averaged 40 pairs and 74 fledglings from 1996 through 1998. The Southern Appalachians unit had 14 pairs fledging seven young in 1998, and averaged 11 pairs fledging 14 young from 1996 through 1998. The Southern New England and Central Appalachians unit had 20 pairs fledging 26 young in 1998 and averaged 15 pairs fledging 22 young from 1996 through 1998 (L. Kiff, *in litt.* 1997; David Flemming, U.S. Fish and Wildlife Service, *in litt.* 1997; Mike Amaral, U.S. Fish and Wildlife Service, *in litt.* 1999). In 1998, there was a total of 193 pairs counted in the five eastern State recovery units, which was the upper minimum recovery level of the Eastern Plan. The recovery goal, however, was probably met in 1997, because up to 10 percent of territorial pairs in any given year are believed to escape detection and are not counted (Cade *et al.* 1988). Importantly, the number of territorial pairs recorded in the eastern peregrine falcon recovery area has increased an average of 10 per cent annually for the past 7 years (1992–1998). Equally important is that the productivity of these pairs during the same 7-year period has averaged 1.5 yg/pr, thus demonstrating sustained successful nesting.

As of 1998, there were at least 32 nesting peregrine pairs in six midwestern States, which is outside the recovery area delineated in the 1991 Eastern Plan. The birds are nesting successfully in a larger area than was believed likely in 1991. Peregrine falcons now found in midwestern States are the result of captive-reared and released birds, and others that probably came from the peregrine falcons released in the eastern States. However, there appears to be a zone of no nesting in the northeastern Great Plains that separates the western American peregrine falcons from the introduced eastern peregrine falcons (Chuck Kjos, U.S. Fish and Wildlife Service, pers. comm. 1997). There are now more than 225 pairs of peregrine falcons in the midwestern and eastern States where peregrine falcons were extirpated.

*Mexico*

None of the existing recovery plans written for peregrine falcons in North America established recovery criteria for birds that nest in Mexico. There is very little historical or recent information on peregrine falcons in Mexico to accurately assess their current status in Mexico.

Porter *et al.* (1988) reported 42 known nesting territories on the western side of the Baja California Peninsula. From 1966 through 1971, only three pairs occurred in this region and none were found in 1976 (Porter *et al.* 1988), indicating a substantial decline had occurred by the mid-1970s. Most of these territories apparently were checked since that time, but seven pairs were located between 1985 and 1992 in areas not occupied in previous years (Massey and Palacios 1994).

In 1993, three active American peregrine falcon nests were discovered in Ojo de Liebre (Scammon's Lagoon) on the western side of the Baja California Peninsula in an area without historical nesting records (Castellanos *et al.* 1994). The central west coast of the Baja California Peninsula was an important breeding area with a historical population of about 13 pairs (Banks 1969). Between 1980 and 1994, Castellanos *et al.* (1997) conducted breeding surveys of American peregrine falcons in this area of the coast and found 10 nesting pairs. Castellanos *et al.* (1997) studied the reproductive success of three pairs in 1993 and five pairs in 1994 located at Ojo de Liebre and San Ignacio Lagoons. An average of three eggs, 1.8 nestlings, and 1.6 fledglings were produced per nest. This productivity appears to be within the range of normal productivity for healthy populations (Cade *et al.* 1988). These observations suggest some recent recovery on the west coast of the Baja California Peninsula.

On the western (Gulf of California) side of mainland Mexico, Porter *et al.* (1988) reported 23 historical nest sites. A number of new nest sites were found in this area between 1966 and 1984, increasing the number of known nest sites to 51. Territory occupancy averaged about 82 percent between 1967 and 1971 and 77 percent between 1971 through 1975, indicating that territory occupancy in that area never declined as significantly as on the west side of the Baja California Peninsula. Porter and Jenkins (1988) believed that the number of occupied territories in the Gulf area increased after 1967 following a reduction in DDE residues in prey.

Between 1989 and 1997, Robert Mesta, (*in litt.* 1997) found three pairs of American peregrine falcons, one pair on the Rio Aros and two on the Rio Yaqui, Sonora. Hunt *et al.* (1988) found 14 occupied nesting territories in the highlands of northeast Mexico in 1982. In this area and adjacent west Texas, territory occupancy averaged about 70 percent during 1973–1985.

Most of what is known about productivity and pesticide residues in Mexico comes from the western mainland near the Gulf of California. Porter *et al.* (1988) found that productivity along the Gulf of California between 1965 and 1984 was ''somewhat less than normal,'' and five addled eggs collected between 1976 and 1984 averaged 12.8 ppm DDE with a range of 2.4 to 25.0 ppm (Porter and Jenkins 1988). DDE residues in prey in the Gulf area declined from the 1960s to the 1980s, and this decline correlated with increases in productivity and the number of breeding pairs (Porter and Jenkins 1988). Some prey, however, still contained high pesticide residues, and reproduction appeared to be affected by organochlorine at three of 15 nests examined (Porter and Jenkins 1988).

Hunt *et al.* (1988) found that only five of 14 pairs produced young in northeast Mexico in 1982. Hunt *et al.* (1988) reported significant DDE residues in peregrine falcon prey species in western Texas in the mid 1980s, but prey species in Mexico were not sampled.

In summary, there was little research on the distribution, numbers, and status of American peregrine falcons in Mexico, and most research took place in the Baja California Peninsula and the Gulf of California regions. Numbers on the west coast of the Baja California Peninsula declined significantly (Porter *et al.* 1988), but observations suggest that numbers may have increased in recent years (Massey and Palacios 1994; Castellanos *et al.* 1994; and Castellanos *et al.* 1997). In the Gulf of California area, territory occupancy never was known to drop below 77 percent (Porter *et al.* 1988), and it increased in the 1970s and 1980s (Porter and Jenkins 1988).

No information on population trends for American peregrine falcons in Mexico is available. However, the status of the Mexican population may be similar to that of the population occupying similar habitat in nearby Arizona (G. Hunt, pers. comm. 1997). Exposure to organochlorine-based pesticides by Mexico nesting populations continues to be a concern. In 1997, as part of the North American Agreement for Environmental Cooperation, a parallel agreement to the North American Free Trade Agreement between the United States, Canada, and Mexico, the Commission for Environmental Cooperation (CEC) established a North American Regional Action Plan (NARA) on DDT. Mexico, a member nation of the CEC, proposes a phased reduction of DDT (Philip Johnson, U.S. Fish and Wildlife Service, pers. comm. 1999). Specific goals of this reduction are: (1) Reduce the use of DDT for malaria control in Mexico by 80 percent in 5 years (beginning in 1997); (2) eliminate the illegal use of DDT in agriculture in Mexico; (3) develop a cooperative approach to minimize movement of malaria-infected mosquitos across borders and reduce the illegal importation of DDT; and (4) advance global controls on DDT production, export and use.

Adverse effects of organochlorine pesticides in the environment remains an international concern for peregrine falcons nesting in Mexico, and for peregrine falcons wintering in or migrating through Latin America. By undertaking the steps proposed in the NARA, the United States, Canada, and Mexico are committing to ongoing cooperative activities and yearly reporting on progress made on these initiatives and objectives. Annual reports will be submitted to the North American Working Group for the Sound Management of Chemicals and subsequently disseminated to the Council of the Commission for Environmental Cooperation and the public.

*Summary of Peregrine Falcon Recovery*

Five regional peregrine falcon recovery plans, four for American peregrine falcons in Canada and the western United States, and one for the eastern United States introduced peregrine falcon population, were written to guide recovery efforts and establish criteria to be used in measuring recovery. These recovery plans included objectives for population size and reproductive performance. Only two of the recovery plans included specific objectives that applied to pesticide residues in eggs and eggshell thinning. The combined breeding population size goal for the four American peregrine falcon recovery plans is 456 pairs. Currently, a minimum of 1,425 pairs occupy the range of the American peregrine falcon in Alaska, Canada, and the western United States. There are 193 peregrine falcon pairs in the five recovery units included in the Eastern Plan, and an additional 32 peregrine falcon pairs occur in midwestern States in areas not included in the Eastern Plan recovery units. In 1998, the total known breeding population of peregrine falcons was 1,650 pairs in the United States and Canada.

Productivity is an important measure of population health, and each of the four American peregrine falcon recovery regions met or exceeded their respective productivity goals, as did the eastern peregrine population.

Other objectives, including those for pesticide residues in eggs and the degree to which eggshells are thinner than pre-pesticide era eggshells, vary among the plans. In the case of eggshell thinning, current measurements obtained in some areas fall short of recovery objectives. Eggshell thinning was originally suggested by recovery teams as an indicator of whether organochlorine contamination was preventing species recovery. Despite the failure of populations in localized areas to meet recovery objectives, overall, populations of American peregrine

falcons have increased considerably. This increase continues to occur even after reintroduction efforts were curtailed. The consistent and geographically widespread trends in increasing population size demonstrate that current levels of reproductive failure, pesticide residues, and eggshell thinning still affecting American peregrine falcons in some areas have not prevented recovery of the subspecies in North America.

Table 1 summarizes the recovery plan goals for each of the regions and Canada, as well as the current recovery status.

TABLE 1.—AMERICAN PEREGRINE FALCON RECOVERY PLAN GOALS AND CURRENT (1998) RECOVERY STATUS.

| Recovery plan | Delisting goal | Current status | Comments/degree to which delisting goals are met |
|---|---|---|---|
| Alaska: | | | |
| Pairs | 28 pairs in study areas. | 79 pairs in study areas. | Exceeded goal by 51 pairs in study areas. Approximately 301 pairs known State-wide. |
| Productivity (young/pair) | 1.8 yg/pr | 1.9 yg/pr | Exceeded goal. |
| DDT (parts per million) | less than 5 ppm | 3.5 ppm | Exceeded goal. |
| Eggshell thinning | less than 10 percent. | 12.1 percent | Goal not met, but has not prevented recovery; goal probably too conservative. |
| Canada: | | | |
| Pairs | 60 pairs (10 each in 6 zones). | 319 pairs | Exceeded goal by 259 pairs. |
| Productivity | 1.5 yg/pr | 1.8 yg/pr | Exceeded goal. |
| Pacific Coast: | | | |
| Pairs | 185 pairs | 270 pairs | Exceeded goal by 85 pairs. |
| Productivity | 1.5 yg/pr | 1.5 yg/pr | Goal met. |
| Rocky Mountain/Southwest: | | | |
| Pairs | 183 pairs | 535 pairs | Exceeded goal by 352 pairs. |
| Productivity | 1.25 yg/pr | 1.3 yg/pr | Exceeded goal. |
| Eggshell thinning | less than 10 percent. | | Goal measured by only a few States; cannot be assessed. |
| Eastern/Great Lakes: | | | |
| Pairs | 175–200 pairs (with no fewer than 20–25 in each of 5 recovery zones). | 193 pairs | Exceeded goal in 3 zones; goals in other 2 zones probably were met; an additional 32 peregrine falcon pairs occur in several Midwestern States not included under the Eastern Plan. |

**Summary of Issues and Recommendations**

In the August 26, 1998, proposed rule (63 FR 45446), we requested that all interested parties provide information and comments on the status of and proposal to delist the American peregrine falcon. Announcements of the proposed rule were sent to Federal, State, county, and city-elected officials, Federal and State agencies, interested private citizens, and local area newspapers and radio stations. We provided the governments of Canada and Mexico with the proposed rule, and both countries responded with comments. We held public hearings on December 3, 1998, in Wisconsin and December 8, 1998, in New Hampshire. In addition, we solicited formal scientific peer review of the proposal in accordance with our July 1, 1994, Interagency Cooperative Policy for Peer Review in Endangered Species Act Activities (59 FR 34270). We requested three individuals, who possess expertise in peregrine falcon biology, to review the proposed rule by the close of the comment period. All three individuals responded to our request and their comments were incorporated into this final rule.

We considered all comments, including oral testimony at the public hearings. We received a total of 29 oral comments and 893 comment letters from 49 States, and the District of Columbia, Canada, Mexico, Germany, Bali, four Federal agencies, 27 State resource agencies, 305 falconry associations or individual falconers, and 40 conservation organizations. Of the comments received, 633 supported the proposal to delist, 266 opposed the proposal, 11 supported downlisting, and 12 letters duplicated comments from individuals who previously provided oral comments.

Because many respondents offered similar comments, those comments of a similar nature are grouped. These comments, and our responses, are presented below.

*Issue 1:* In the Midwest, delisting will result in less cooperation by building owners and managers to protect peregrine falcons nesting on their buildings.

*Our Response:* Currently, 28 States in the midwestern and eastern United States support nesting peregrine falcons. Approximately 87 percent of the midwestern pairs and 33 percent of the eastern pairs are nesting on manmade structures: bridges, buildings and smokestacks (Martell and McNicoll 1999). Currently, there are 117 nests on nest boxes or trays in 19 States and the District of Columbia. Should delisting the peregrine falcon act as a disincentive for owners and managers to protect nesting peregrine falcons on their buildings, the long-term security of this urban population could be threatened (Martell and McNicoll 1999).

Between January and March of 1999, 75 people with information on 95 of the 117 nest sites were asked if delisting would affect their current management strategies. Responses were overwhelmingly in favor of continuing to manage for the presence of nesting pairs for some of the following reasons: pigeon control, good public relations, positive effect on building employees, and good environmental stewardship (Martell and McNicoll 1999). Survey results do not suggest that delisting of the peregrine falcon would result in widespread removal of nest boxes and trays or discouragement of nesting on manmade structures. Furthermore, the survey found the public widely appreciated and accommodated

peregrines at the manmade structures on which they nest (Martell and McNicoll 1999).

*Issue 2:* Disturbance due to recreational rock climbing poses a threat to nesting peregrine falcons.

*Our Response:* The increasing popularity of rock climbing throughout North America, particularly in the northeast, is becoming a serious problem for land managers trying to protect nesting peregrine falcons. Unlike the western landscape that provides rock climbers with more and larger cliffs and thus some alternatives to conflicts with nesting peregrine falcons, the smaller and limited cliffs of the northeast present fewer alternatives to peregrine/climber conflicts.

The peregrine falcon will still be protected by the MBTA. Additional protection is provided by other laws such as the National Forest Management Act (16 U.S.C. 1600) and the Federal Land Management and Policy Act (43 U.S.C. 1701). These continued protections are adequate to address this threat. See Factor D under Summary of Factors Affecting the Species.

In addition, we are aware of several very effective raptor management plans that were cooperatively developed by land managers, representatives of the climbing community, and other interested parties (plans that contain effective public education components). Some examples include plans developed by the Prescott National Forest in Arizona, Yosemite National Park in California, Adirondack State Park in New York, Zion National Park in Utah, Smith Rock State Park in Oregon, the Nantahala National Forest in North Carolina, and the Colorado National Monument in Colorado. All of these plans include seasonal rock climbing restrictions to prevent disturbance of raptor nests from rock climbing activities. The development of more of these partnerships is essential to the preservation of the peregrine falcon and the sport of rock climbing. Organizations like the Access Fund which represent the climbing community have continued to express a strong desire to work with both private and public land managers to resolve any conflicts originating from the use of cliffs by climbers.

*Issue 3:* The Act's section 6 funds currently being used by States to support peregrine falcon monitoring programs will not be available once the peregrine is delisted.

*Our Response:* We are authorized through the Secretary of the Interior to provide grants to States to assist in monitoring the status of recovered species pursuant to section 4(g) under section 6 of the Act. Existing and future Federal assistance in the form of section 6 funding to States for conservation work will not be affected by the delisting, as long as States continue to identify monitoring peregrine falcons as a high priority.

*Issue 4:* The data do not support delisting the American peregrine falcon throughout its range in the United States. The Service should consider downlisting the American peregrine falcon to threatened rather than delisting.

*Our Response:* Recent data show improvements in numbers of breeding pairs of peregrine falcons and productivity (Refer to Table 1, ''Recovery Status,'' and ''Summary of Peregrine Falcon Recovery''), and demonstrate that goals set for numbers and productivity for the American peregrine falcon recovery plans were met or exceeded. The combined population size goal for the four American peregrine falcon recovery plans is 456 pairs. Currently, a minimum of 1,425 known pairs occupy sites in Alaska, Canada, and the western United States, and a number of additional pairs have probably gone undetected. Overall average productivity goals in all four American peregrine falcon recovery plans, using productivity as a recovery criterion, were met or exceeded.

Only the Alaska recovery plan set a goal for DDT levels, and only two recovery plans (Alaska and Rocky Mountain/Southwest) specified objectives for eggshell thinning. The Alaska Recovery Plan set a delisting goal of less than 5 ppm DDT and less than 10 percent eggshell thinning. Recent data for American peregrine falcon eggs in Alaska indicate DDT levels at less than 3.5 ppm, exceeding that goal, and eggshell thinning is at 12.1 percent. Measurements for eggshell thinning were not consistently taken in the Rocky Mountain/Southwest States. Colorado has met the recovery plan eggshell thinning goal of less than 10 percent; the average of the annual means for 1990–1994 was 9.0 percent. Data for other States show a general trend toward thicker eggshells since the mid-1970s (refer to Rocky Mountain/Southwest section under Recovery Status).

Three of 5 peregrine falcon recovery units in the eastern United States have met recovery goals, and 193 pairs documented in 1998 indicate the overall recovery goal of 175–200 pairs was met. In addition, another 32 pairs are nesting in areas of the Midwest outside the recovery units specified in the Eastern Plan but nevertheless contribute to overall restoration goals.

We believe that the species has essentially achieved the goals established for recovery and, in many areas, has exceeded the goals. We believe the available information supports full delisting of the species throughout its range, and the species clearly is not in danger of extinction, is not likely to become endangered within the foreseeable future throughout a significant portion of its range, and warrants full delisting.

*Issue 5:* American peregrine falcons should not be delisted because they are not restored throughout the historical range.

*Our Response:* We have determined the American peregrine falcon has recovered throughout its historical range. Restoration of the American peregrine falcon within every area throughout its historical range is not required by the Act, is not required for recovery, nor was it a goal of any of the recovery plans. Generally, the goal of a recovery program is to restore the species to a point at which protection under the Act is no longer required. To be recovered, a species must not be endangered with extinction, or be likely to become endangered within the foreseeable future. Although a few, localized areas have not quite met their numerical recovery goals, the overall status of the American peregrine falcon has improved significantly such that it is considered recovered and warrants delisting. As a species recovers in numbers and populations expand, more of the historical range can be re-occupied where appropriate habitat remains.

*Issue 6:* There are gaps in the scientific knowledge about American peregrine falcon biology. A population viability analysis was not done, and genetic diversity, viable population size, population dynamics, and long-term stability of populations have not been determined.

*Our Response:* A complete understanding of the biology of a species is not required to determine a species' conservation status under the Act. Population viability analyses are important tools for attempting to quantify threats to a species, particularly those facing loss and fragmentation of habitat, and the consequences of conservation actions, as well as aiding in identifying critical factors for study, management, and monitoring. These analyses are not always essential, however, to determine when a species has achieved recovery, particularly in the case of the American peregrine falcon. It is evident that

recovery of this subspecies was largely achieved by eliminating the use of DDT and by successful management activities, including the reintroduction of captive-bred American peregrine falcons. Recovery goals established for the species were met or exceeded, with few exceptions.

*Issue 7:* Organochlorine pesticides still persist within the breeding range of the American peregrine falcon and continue to depress natural productivity.

*Our Response:* We recognize that although the peregrine falcon has made a dramatic recovery throughout its historical range in the United States, the presence of environmental contaminants is still affecting the productivity of certain regional populations. Eggs collected on the eastern shore of Virginia and Maryland had slightly elevated levels of DDE, dieldrin, and mercury, which was associated with reproductive problems (U.S. Fish and Wildlife Service 1994). On the Channel Islands in California, particularly Catalina, populations are still affected by organochlorine residues and eggshell thinning (Jarman 1994). In west Texas, heavy metal contamination, particularly mercury may be depressing productivity (A. Sansom, *in litt.*1995). Residual mercury from mines operated along the Rio Grande River in the early 1900s is the suspected source of this contamination (B. McKinney, pers. comm. 1997). We recognize the possible threat that environmental contaminants pose to the sustained recovery of this species and therefore, will include a contaminant monitoring component in the post-delisting monitoring plan. Refer to Factor E under Summary of Factors Affecting the Species, for an in-depth discussion of contaminants. See also our response to issue 8.

*Issue 8:* The continued unrestricted use of organochlorine pesticides in Latin America places the American peregrine falcon at risk of contamination while on migration and on its wintering grounds.

*Our Response:* Comparisons of blood samples collected during fall and spring migration indicate that, although migrant peregrine falcons are known to accumulate pesticides while wintering in Latin America, DDE residues in the blood taken from female peregrine falcons captured during spring migration at Padre Island, Texas decreased between 1978 and 1994 below levels that would affect reproduction (Henny *et al.* 1996). Despite the use of organochlorines in Latin America, the American peregrine falcon has recovered over its historical range, and Arctic peregrine falcons, which also winter in Latin America, were delisted due to their recovery. Refer to Factor E under Summary of Factors Affecting the Species for an in-depth discussion. The North American Working Group for the Sound Management of Chemicals promotes a regional perspective that encourages the active involvement of Central and South American countries in the implementation of the North American Regional Action Plan on DDT, and is facilitating international cooperation on combating malaria in these regions without the continued use of organochlorine pesticides. This effort could eventually eliminate or reduce one source of DDT in Central and South American countries.

*Issue 9:* The take of American peregrine falcons for falconry after its delisting will create an additional threat to the subspecies.

*Our Response:* Delisting the American peregrine falcon will not affect the protection given to all migratory bird species, including the peregrine falcon, under the MBTA. The regulations issued pursuant to the MBTA allow for issuance of permits to take raptors for falconry and other purposes provided the taking will not threaten wildlife populations (50 CFR 21.28 and 13.21(b)). Currently we are working with State wildlife agencies to develop biological criteria and two management plans to govern the issuance of permits for take of peregrine falcons to ensure the taking does not negatively impact wild populations, particularly those in need of further restoration. The first management plan will deal with the take of eyas (nestling) peregrines. A second management plan will deal with the take of passage (migrating first-year) peregrines. The management plans will include criteria for harvest, implementation criteria, and procedures for evaluating effects of the harvest. They will pertain to the take of all wild peregrine falcons in the U.S., including the American peregrine falcon, and will apply to all falconry, raptor propagation, and scientific collecting permits. Take will not be permitted under the MBTA until the draft management plans undergo public review, are approved, finalized, and published in the **Federal Register**. Some exceptions may be made on a case-by-case basis for scientific purposes. The effects of take for all purposes will be assessed during the monitoring period following delisting. Refer to Factor D under the Summary of Factors Affecting the Species section and the Effects of This Rule section for further information.

*Issue 10:* The Canadian Wildlife Service has expressed concern that American peregrine falcons breeding in Canada but migrating to or through the United States will be taken for falconry purposes.

*Our Response:* Canada's recovery program for American peregrine falcons is still in progress and the Canadian government is concerned that any take of American peregrines migrating from Canada could impact recovery. We are working with the governments of Canada and Greenland in considering the appropriateness of harvest of peregrines migrating through the United States. If take of these passage birds is approved, it would be designed to avoid take of American peregrines originating in Canada and instead target the more abundant Arctic peregrines from northern Alaska, Canada, and Greenland.

*Issue 11:* The Service cannot consider delisting the American peregrine falcon until all recovery goals in the four existing recovery plans for this subspecies are met or exceeded.

*Our Response:* Section 4(f) of the Act directs us to develop and implement recovery plans for species of animals or plants listed as endangered or threatened. Recovery is the process by which the decline of an endangered or threatened species is arrested or reversed and threats to its survival are neutralized so that long-term survival in nature can be ensured. The goal of this process is the maintenance of secure, self-sustaining wild populations of species with the minimum investment of resources. One of the main purposes of the recovery plan is to enumerate goals (guidelines) that will help us to determine when recovery for a particular species is achieved. Meeting or exceeding all of the specific recovery goals for a listed species is not required by the Act before delisting can occur.

We determine whether recovery is achieved based on a species' performance relative to the goals set in its recovery plan and the best available scientific information. A species is considered recovered when it is no longer in danger of extinction (i.e., endangered), or likely to become endangered within the foreseeable future throughout all or a significant portion of its range (i.e., threatened). The American peregrine falcon has either met, exceeded, or is very close to meeting the recovery goals set for this subspecies throughout its range. We believe that the intent of all the objectives are met and that the recovery of the subspecies justifies delisting.

*Issue 12:* The eastern peregrine falcon population has not met the recovery goals set forth in the Eastern Recovery

Plan and, therefore, should remain on the endangered species list.

*Our Response:* The eastern peregrine falcon population is protected only due to the similarity of appearance to *F. p. anatum*, which has protected individual eastern peregrine falcons from direct take. Thus, their status with respect to recovery has no direct impact on the decision to delist the American peregrine falcon. Nevertheless, we have supported and still fully support the restoration of this population.

Data through 1998 on the status of the eastern peregrine falcon population indicate that the intent of the recovery goals set for this population are met. The recovery plan established 2 recovery objectives including (1) a minimum of 20–25 nesting pairs in each of 5 recovery units which are established and sustained for a minimum of 3 years, and (2) an overall minimum of 175–200 pairs demonstrating successful, sustained nesting. Three of the five recovery units (Mid-Atlantic Coast, Northern New York and New England, and Great Lakes) have surpassed the nesting pair goal for 3 years. The Southern Appalachians and Southern New England/Central Appalachians units may not yet have achieved the goals established for the number of breeding pairs for those areas. However, the overall minimum of 175–200 successful pairs in the eastern region was achieved, and over the past 6 years (1992–1998), the number of territorial pairs has increased an average of 10 percent annually. There are now at least 193 pairs of peregrine falcons in the eastern States where falcons were extirpated, and pairs are successfully nesting throughout a greater range than was anticipated. We believe the intent of the recovery objectives are satisfied and that recovery of the peregrine in the eastern United States is sufficiently established. Refer to the Recovery Status section for additional discussion on this subject.

*Issue 13:* The status of the American peregrine falcon in Mexico was not adequately addressed.

*Our Response:* While population status and trends for falcons nesting in Mexico are not well known, American peregrine falcon populations in the United States and Canada, including those migrating to and from Latin America, have met or exceeded their criteria for delisting. Restoration of the American peregrine falcon within every area throughout its historical range is not required by the Act, nor is it required for recovery. Mexico's proposed phased reduction of DDT under the North American Regional Action Plan will make a significant contribution toward increasing peregrine falcon populations in Mexico. Refer to the Mexico section under Recovery Status for additional discussion on this subject.

*Issue 14:* The Service's delisting proposal is not supported by an adequate scientific review.

*Our Response:* The proposed rule to remove the peregrine falcon in North America from the Federal List of Endangered and Threatened Wildlife received reviews from a variety of scientific institutions and individual scientists. Two examples are the Ornithological Council and the Raptor Research Foundation. The Ornithological Council consists of nine leading scientific ornithological societies: the American Ornithologists' Union, Association of Field Ornithologists, Consejo Internacional para la Preservaciòn de las Aves, Cooper Ornithological Society, Colonial Waterbird Society, Pacific Seabird Group, Raptor Research Foundation, Society of Caribbean Ornithology, and Wilson Ornithological Society. Together it has a membership of approximately 6,500 ornithologists. One of its primary missions is to provide scientific information about birds to legislators, regulatory agencies, industry decision makers, conservation organizations and others, and to promote the use of scientific information in the making of policies that affect birds.

The task of evaluating the proposed rule on behalf of the Ornithological Council was accepted by a committee of Raptor Research Foundation scientists. The Raptor Research Foundation is a scientific society that represents professional raptor scientists and managers throughout North America and around the world. This committee of raptor scientists reviewed the available data and submitted a report that was endorsed by both the Ornithological Council and the Raptor Research Foundation as their position on the proposed rule. This report underwent peer review and was published in the Wildlife Society Bulletin (Millsap *et al.*, 1998, WSB 26(3); 522–538). While expressing some concern about the status of the eastern peregrine population, the authors concurred with our position that the peregrine falcon warranted delisting range-wide.

*Issue 15:* Recovery plans used to evaluate the recovery of the peregrine falcon are out of date and need to be revised to reflect more accurate contemporary goals and the Service should not misrepresent the goals in the current plans.

*Our Response:* As addressed in our response to Issue 11, section 4(f) of the Act directs us to develop and implement recovery plans for species of animals or plants listed as endangered or threatened. Recovery is the process by which the decline of an endangered or threatened species is arrested or reversed and threats to its survival are neutralized so that long-term survival in nature can be ensured. One of the main purposes of the recovery plan is to enumerate goals (guidelines) that will help us to determine when recovery of a particular species is achieved. Meeting or exceeding all of the specific recovery goals for a listed species before it can be delisted is not required by the Act. Section 4 of the Act and regulations (50 CFR Part 424) promulgated to implement the listing provisions of the Act, establish the procedures for listing, reclassifying, and delisting species. We may list a species if one or more of the five factors described in section 4(a)(1) of the Act threatens the continued existence of the species. A species may be delisted, according to 50 CFR 424.11(d), if the best scientific and commercial data available substantiate that the species is neither endangered or threatened because of (1) extinction, (2) recovery, or (3) the original data for classification of the species were in error. We have determined that substantial peregrine falcon recovery has taken place, and none of the five factors addressed in section 4(a)(1) of the Act is currently negatively affecting the peregrine falcon to the degree that the species is endangered or threatened.

*Issue 16:* Post-delisting monitoring for at least 5 years is essential.

*Our Response:* We agree. Section 4(g)(1) of the Act requires the Secretary to implement a system, in cooperation with the States, to monitor for not less than 5 years the status of all species which have recovered to the point that protection of the Act is no longer required (section 4(g)). If it becomes evident during the course of the post-delisting monitoring that the species again requires the protection of the Act, it would be relisted.

**Summary of Factors Affecting the Species**

Section 4 of the Act and regulations (50 CFR Part 424) promulgated to implement the listing provisions of the Act, set forth the procedures for listing, reclassifying, and delisting species on the Federal lists. We may list a species if one or more of the five factors described in section 4(a)(1) of the Act threatens the continued existence of the species. A species may be delisted, according to 50 CFR 424.11(d), if the

best scientific and commercial data available substantiate that the species is neither endangered or threatened because of (1) extinction, (2) recovery, or (3) the original data for classification of the species were in error.

After a thorough review of all available information, we have determined that substantial peregrine falcon recovery has taken place since the early 1980s. We determined that none of the five factors addressed in section 4(a)(1) of the Act, and discussed below, is currently affecting the species, including the American peregrine falcon subspecies and introduced peregrine falcon populations, such that the species is no longer endangered (in danger of extinction throughout all or a significant portion of its range) or threatened (likely to become endangered in the foreseeable future throughout all or a significant portion of its range). These factors and their application to the peregrine falcon in North America are as follows:

*A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range*

Peregrine falcons occupy a variety of habitat types and nest from the boreal forest region of Alaska and Canada, through much of Canada and the western United States, south to parts of central and western Mexico. Nesting habitat includes cliffs and bluffs in boreal forests, coastal cliffs and islands, urban skyscrapers and other structures, and cliffs and buttes in southwestern deserts. In some breeding areas, such as the southern United States, some or all of the birds remain year-round on their nesting territories. In other breeding areas, particularly in high latitudes, many or all of the individuals are highly migratory; these individuals occupy a number of regions and habitat types throughout the year as they nest, migrate to and from wintering areas, and occupy their wintering ranges. Due to the extensive geographic distribution of the peregrine falcon, the wide variety of habitat types in which the species nests, and the immense area that some of the more migratory individuals occupy during a year, the peregrine falcon occupies an extremely broad array of areas and habitats throughout its range. As a result, the degree to which peregrine falcons were affected by human-caused habitat modification varies widely by region, habitat type, and individual falcons within the population.

As the human population has grown in North America, the rate of habitat alteration has unquestionably increased. Certainly some peregrine falcon habitat was destroyed, such as the many wetlands drained in recent years that were previously used by peregrine falcons for foraging or as migratory staging areas during spring and fall. But peregrine falcons have colonized many cities in North America due to the abundance of nest sites on buildings and the abundance of prey, such as rock doves (*Columba livia*), that thrive in urban areas. Therefore, some forms of habitat modification have negatively affected peregrine falcons while other forms have benefited them. It would be burdensome to estimate the net, overall effect of habitat modification on the species throughout North America.

Although the rate of habitat modification in North America has increased in recent decades, the number of American peregrine falcons occupying the region has increased substantially since the late 1970s or early 1980s. In several parts of their range, including parts of Alaska, the Yukon and Northwest Territories, California, and the southwestern United States, the number of breeding pairs has increased rapidly in recent years, and some local populations now occur at very high densities (R. Ambrose, pers. comm. 1997; G. Holroyd, pers. comm. 1997; Enderson *et al.* 1995). Because these rapid population growth rates and high densities were achieved despite habitat modification in North America, we conclude that habitat modification or destruction was not a limiting factor in peregrine recovery. It does not currently threaten the existence of the American peregrine falcon nor is it likely to in the foreseeable future.

*B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes*

Delisting the peregrine falcon will not result in overutilization because the delisting will not affect protection provided the peregrine falcon by the MBTA. The take of all migratory birds, including peregrine falcons, is governed by the MBTA's regulations on the taking of migratory birds for educational, scientific, and recreational purposes and requiring harvest be limited to levels that prevent overutilization (See Factor D).

*C. Disease or Predation*

Peregrine falcons are susceptible to a number of diseases and parasites such as tapeworms, mites, ticks, botulism, fowl pox, and viral encephalitis (U.S. Fish and Wildlife Service 1982b; Trainer (1969) as cited in U.S. Fish and Wildlife Service 1984). However, these organisms are not known to affect the peregrine falcon at the population level.

Mammals and other raptors are known to prey on peregrine falcons, including such species as the great horned owl (*Bubo virginianus*), red-tailed hawk (*Buteo jamaicensis*), raccoon (*Procyon lotor*), and coyote (*Canis latrans*) (U.S. Fish and Wildlife Service 1982b, 1984). For example, great horned owls are natural predators of peregrine falcons (U.S. Fish and Wildlife Service 1991) and are possibly responsible for the slow recovery of peregrine falcons in the two northern recovery areas in the reestablished eastern population (M. Amaral *in litt.* 1995). Great horned owl predation was not documented as a significant cause of the decline in peregrine falcons and has not affected the species' overall recovery.

Golden eagles (*Aquila chrysaetos*) are also known to prey on young peregrine falcons. Barbara Behan (U.S. Fish and Wildlife Service, pers. comm. 1999) witnessed a golden eagle prey on young peregrine falcons at a hack site in Colorado, stooping and footing one of the falcons, and leaving the area with it in its talons. The same eagle, or another, returned numerous times over the next several days, and the other four falcons disappeared in that time, despite efforts by the hack site attendants to scare the eagles away from the site.

Though the peregrine falcon is occasionally preyed upon, this factor is not known to affect the peregrine falcon at the population level.

*D. The Inadequacy of Existing Regulatory Mechanisms*

Protection from take and commerce for the peregrine falcons under the Endangered Species Act will be removed upon delisting. However, peregrine falcons are still protected by the MBTA. Section 704 of the MBTA states that the Secretary of the Interior is authorized and directed to determine if, and by what means, the take of migratory birds is allowed and to adopt suitable regulations permitting and governing the take. In adopting regulations, the Secretary is to consider such factors as distribution and abundance to ensure that take is compatible with the protection of the species.

The MBTA and its implementing regulations (50 CFR Parts 20 and 21) prohibit take, possession, import, export, transport, selling, purchase, barter, or offering for sale, purchase or barter, any migratory bird, their eggs, parts, and nests, except as authorized under a valid permit (50 CFR 21.11). Regulations at 50 CFR 21.28 and 21.30 authorize the issuance of permits to take, possess, transport and engage in

commerce with raptors for falconry and for propagation. Other regulations authorize the issuance of permits for scientific collecting (50 CFR 21.23), special purposes such as rehabilitation or education (50 CFR 21.27), and depredation (50 CFR 21.41). Prior to issuance of these permits, meeting certain criteria is required, including a requirement that the issuance will not threaten a wildlife population (50 CFR 13.21(b)(4)). In cooperation with State wildlife agencies we will develop draft biological criteria for management of take of wild peregrines under the MBTA. The resulting management plans will include biological criteria for take, implementation criteria, and procedures for evaluating the effects of the taking. It will pertain to the take of peregrines in the United States for falconry and other purposes. With limited exceptions, take will not be permitted under MBTA until the draft management plans undergo public review, are approved, finalized, and published in the **Federal Register**. In addition to considering the effect on wild populations, issuance of raptor propagation permits requires that we consider whether suitable captive stock is available and whether wild stock is needed to enhance the genetic variability of captive stock (50 CFR 21.30(c)(4)).

These existing regulatory provisions will adequately protect against excessive take of peregrine falcons. If necessary, protective measures could be expanded by promulgation of a regulation under the MBTA. We have both the legal authority and the obligation to regulate take of peregrines under the MBTA (see additional discussion of the MBTA in the Effects of this Rule section below).

In the absence of habitat protection under the Act, there are no other existing Federal laws that specifically protect the habitat of this species (see ''Critical Habitat''). However, loss of habitat was not identified as a threat to the species and was not a factor identified as contributing to the species' listing.

An important regulatory mechanism affecting peregrine falcons is the requirement that pesticides be registered with the Environmental Protection Agency (EPA). Under the authority of the Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 136), the EPA requires environmental testing of all new pesticides. Testing the effects of pesticides on representative wildlife species prior to pesticide registration is specifically required. This protection from effects of pesticides are not altered by delisting the peregrine falcon.

On July 1, 1975, peregrine falcons were included in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora. This treaty was established to prevent international trade that may be detrimental to the survival of plants and animals. Generally, both import and export permits are required by the importing and exporting countries before an Appendix I species may be shipped, and Appendix I species may not be imported for primarily commercial purposes. Although CITES does not itself regulate take or domestic trade, CITES permits may not be issued if the export will be detrimental to the survival of the species or if the specimens were not legally acquired. This protection is not be altered by delisting the peregrine falcon under the Act.

Peregrine falcons are still afforded some protection by land management agencies under laws such as the National Forest Management Act (16 U.S.C. 1600) and the Federal Land Management and Policy Act (43 U.S.C. 1701). National Forest Management Act regulations specify that ''fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area.'' (36 CFR 219.19). Guidelines for each planning area must provide for a diversity of plant and animal communities based on the suitability of a specific land area. United States Forest Service regional foresters are responsible for identifying sensitive species occurring within their Region. Sensitive species are those that may require special management emphasis to ensure their viability and to preclude trends toward endangerment that would result in the need for Federal listing. The delisting of the peregrine falcon will require Federal land managers to consider the need for designating the peregrine falcon as a sensitive species to ensure that forest management activities do not contribute to a need for relisting. The Federal Land Policy and Management Act requires that public lands be managed to protect the quality of scientific, ecological, and environmental qualities, among others, and to preserve and protect certain lands in their natural condition to provide food and habitat for fish and wildlife.

Federal delisting of the peregrine falcon will not remove the peregrine falcon from State threatened and endangered species lists, or suspend any other legal protections provided by State law. States may have more restrictive laws protecting wildlife, including restrictions on use for falconry, and may retain State threatened or endangered status for the peregrine falcon (see 50 CFR 21.28). Depending on the biological status, States generally list peregrine falcons as endangered, threatened, critically imperiled or as a species of concern. Currently, the peregrine falcon is State-listed in 38 of the 40 States that have nesting pairs. The two States that do not have the species listed—Colorado and Arizona—removed the peregrine falcon from their lists due to its recovery in those States. However, both will continue to regulate take for falconry and other purposes. In many States, falconry is administered cooperatively by the Service and the States.

*E. Other Natural or Manmade Factors Affecting Its Continued Existence*

Egg collecting, shooting, harvest for falconry, habitat destruction, climate change, and the extinction of passenger pigeons were all considered as possible factors causing or contributing to the decline in peregrine falcon populations in North America; however, no evidence supports any of these factors as causing the widespread reproductive failure and population decline that occurred. In contrast, an overwhelming body of evidence has accumulated showing that organochlorine pesticides affected survival and reproductive performance sufficiently to cause the decline. There currently is no question within the scientific community that contamination with organochlorines was the principal cause for the drastic declines and extirpations in peregrine falcon populations that took place in most parts of North America (Kiff 1988).

Although the use of all organochlorine pesticides causing reproductive failure in peregrine falcons was restricted in the United States and Canada in the early 1970s, their use continues in some areas of Latin America. It was shown, by comparing blood samples collected during fall and spring migration, that migrant peregrine falcons accumulate organochlorines while wintering in Latin America (Henny *et al.* 1982). Henny *et al.* (1996) demonstrated that DDE residues in the blood taken from female peregrine falcons captured during spring migration at Padre Island, Texas decreased between 1978 and 1994. In second-year peregrines, residues dropped from 1.43 ppm between 1978 and 1979 to only 0.25 ppm in 1994 and from 0.88 to 0.41 ppm for older peregrines; these levels are well below those that would affect reproduction (Henny *et al.* 1996).

The widespread reproductive failure and population decline of peregrine

falcons in North America coincided with the period of heavy organochlorine use in the United States. Although there was not an immediate lowering of pesticide residues in eggs following restrictions on the use of organochlorines north of Mexico (Enderson *et al.* 1995), residues gradually declined following the restrictions (Ambrose *et al.* 1988b; Enderson *et al.* 1988; Peakall *et al.* 1990), and most surviving populations began to increase in size thereafter. Despite the continued use of organochlorines in Latin America, populations of American peregrine falcons in North America have recovered substantially in recent years. In fact, Arctic peregrine falcons that winter predominantly in Latin America recovered to the point that the subspecies was removed from the Federal List of Threatened and Endangered Wildlife on October 4, 1994 (59 FR 50796).

Additionally, some of the avian prey used during the nesting season by peregrine falcons throughout North America also winter in Latin America. Many of these prey return to their nesting areas with pesticide residues accumulated during the winter (Fyfe *et al.* 1990). Peregrine falcons preying upon these birds during the summer are further exposed to Latin American pesticides. Overall, pesticide use in Latin America does not appear to have adversely affected reproductive success in American peregrine falcon populations in North America.

We recognize that certain populations of American peregrine falcons have recovered to a lesser degree, and that in some of these populations organochlorine residues are still high and reproductive rates remain lower than normal. Populations on the Channel Islands off southern California are still affected by high organochlorine residues and eggshell thinning (Jarman 1994). This is a localized threat, and the result of using offshore islands as DDT disposal areas during the 1940s. Despite the residual effects of organochlorines on the Channel Islands, this population is continuing to increase, although some of the increase could be the result of the release of a significant number of captive-bred young or dispersal from other areas where recovery is greater (B. Walton, pers. comm. 1997). Based on published values in the literature, detected concentrations of DDT in peregrine falcon eggs collected in New Jersey were sufficient to impact reproduction. Productivity and eggshell thinning data, however, did not support a conclusion of reproductive impairment due to DDT contamination (U.S. Fish and Wildlife Service and New Jersey Department of Environmental Protection 1997). Jarman (1994) suggested that these locally higher egg residues result from a local source of DDT or DDE. As a result, the effects are localized, and the observations do not reflect the current status of peregrine falcons as a whole. In recent years, numbers of peregrine falcons have increased significantly throughout their historical range despite the effects of localized organochlorine residues.

Similarly, American peregrine falcons in southwest Canada have not recovered as well as in most other regions of North America. Despite the release of several hundred captive-bred young in the prairie Provinces and western Canada (Holroyd and Banasch 1990), the number of pairs occupying territories is still well below the number of known historical nest sites (G. Holroyd, *in litt.* 1993). In southern Canada, including the prairie region, the proportion of reintroduced young that entered the breeding population was considerably lower than in the United States (Peakall 1990; Enderson *et al.* 1995). The factor or factors causing this lower recruitment rate remain unknown, but survivorship of peregrine falcons released into this area may be lower than in adjacent portions of the subspecies' range. Pesticide residues in American peregrine falcon eggs do not appear to be higher in southwest Canada than in the United States (Peakall *et al.* 1990). Therefore, higher residual organochlorine contamination is apparently not responsible, and the number of pairs occupying this region continues to increase.

Exposure to organochlorine pesticides caused drastic population declines in peregrine falcons. Following restrictions on the use of organochlorines in the United States and Canada, residues in eggs declined and reproduction rates improved. Improved reproduction, combined with the release of thousands of captive-reared young and relocated wild hatchlings, allowed the American peregrine falcon to recover and peregrine falcons to be successfully reestablished in those areas of the historical range from which the species was extirpated. Pesticide residues, reproductive rates, and the rate of recovery have varied among regions within the vast range of this species. In some areas, such as the Channel Islands off the southern coast of California, the lingering effects of DDT have caused reproductive rates to remain low. Local source contamination may even cause continued reproductive problems in the Channel Islands. In southwest Canada, the rate of recovery, or onset of recovery, apparently lagged behind most other areas, but recent trends suggest that historical nest sites will continue to be gradually re-colonized.

The peregrine falcon has recovered throughout its historical range. Although the recovery is slow in a few parts of the historical range, these areas represent a small portion of the species' overall range. Furthermore, evidence collected in recent years shows that a combination of lingering residues of organochlorines in North America and contamination resulting from the continued use of organochlorines in Latin America has not prevented a widespread and substantial recovery of peregrine falcons, as numbers of peregrine falcons continue to increase. We conclude, therefore, that the continued existence of the American peregrine falcon is no longer threatened by exposure to organochlorine pesticides.

In summary, due to the reduction in the effects of pesticides and widespread positive trends in population size, we have determined that the American peregrine falcon has recovered and is no longer endangered with extinction, or likely to become endangered within the foreseeable future throughout all or a significant portion of its range. We considered the alternative of downlisting the species, but recent data show improvements in breeding pair numbers and productivity, demonstrating that the delisting goals set for the American peregrine falcon in recovery plans were met or exceeded. We believe this available information supports the full delisting of the species throughout its range. Therefore, we are removing the peregrine falcon from the Federal List of Endangered and Threatened Wildlife, thus, removing endangered status for the American peregrine falcon throughout its range, and the similarity of appearance provision for all free-flying peregrine falcons within the 48 conterminous United States.

In accordance with 5 U.S.C. 553(d), we have determined that this rule relieves an existing restriction and good cause exists to make the effective date of this rule immediate. Delay in implementation of this delisting would cost government agencies staff time and monies conducting formal section 7 consultation on actions which may affect species no longer in need of the protections under the Act. Relieving the existing restriction associated with this listed species will enable Federal agencies to minimize any further delays in project planning and implementation for actions that may affect peregrine falcons.

**Effects of This Rule**

This final rule will affect the protection afforded to North American peregrine falcons under the Act. It will not affect the status of the Eurasian peregrine falcon (*F. p. peregrinus*), currently listed under the Act as endangered wherever it occurs. The endangered designation under the Act for the American peregrine falcon will be removed and the designation of endangered due to similarity of appearance for all free-flying peregrine falcons found within the 48 conterminous United States, including the Arctic and Peale's peregrine falcons, and the reestablished eastern and midwestern populations, will be removed. Therefore, taking, interstate commerce, import, and export of North American peregrine falcons will no longer be prohibited under the Act. In addition, Federal agencies will no longer be required to consult with the Service under section 7 of the Act in the event activities they authorize, fund or carry out adversely affect peregrine falcons. However, as previously discussed, removal of the protection of the Act will not affect the protection afforded all peregrine falcons under the MBTA.

The take and use of peregrine falcons must comply with appropriate State regulations. State regulations applying to falconry vary among States and are subject to change over time. The applicable State regulations may be more but not less restrictive than Federal regulations.

This rule will not affect the peregrine falcon's Appendix I status under CITES, and CITES permits will still be required to import and export peregrine falcons to and from the United States. CITES permits will not be granted if the export will be detrimental to the survival of the species or if the falcon was not legally acquired.

**Critical Habitat**

Critical habitat for the American peregrine falcon includes five areas in northern California (50 CFR 17.95). The Act defines critical habitat as ''specific areas within the geographical area occupied by the species, at the time it is listed on which are found those physical or biological features essential to the conservation of the species and which may require special management considerations or protection.'' Since critical habitat can be designated only for species listed as endangered or threatened under the Act, all currently designated American peregrine falcon critical habitat will be removed upon publication of this final rule.

**Monitoring**

Section 4(g)(1) of the Act requires us to monitor a species for at least 5 years after delisting. A monitoring plan was provided in the proposed delisting rule on August 26, 1998 (63 FR 45446). We are currently developing a revised monitoring plan which will be made available for public review in the **Federal Register** in the near future.

**Take for Falconry and Other Purposes**

Wild American and Arctic peregrine falcons were unavailable for falconry and raptor propagation in the contiguous United States since these two subspecies of peregrine falcons were listed under the Act in 1970. In Alaska, the Arctic peregrine became available for take in 1994 when it was delisted, but take of this subspecies was still restricted in the contiguous United States pursuant to the similarity of appearance provision of the Act. Take of Peale's peregrines also was restricted in the contiguous United States since 1984 pursuant to the similarity of appearance provisions of the Act.

With this delisting, which removes protection of the Act, regulation and management of peregrine falcons in the United States will fall primarily under the MBTA and State regulations. In anticipation of delisting, we are working with the State wildlife agencies to develop draft biological criteria for management of take of peregrines. These criteria will serve as the basis for discussions with authorities in Canada and Greenland to identify appropriate limits for take of passage birds. We will then prepare environmental assessments on the management of nestlings and passage birds and solicit public comment. The resulting management plans will include biological criteria for harvest, implementation criteria, and procedures for evaluating the harvest. One objective of the plans is to allow a level of take that does not compromise continuing restoration of peregrine falcons in North America. We expect to complete the management plan for nestlings by the Spring of 2000, and the management plan for passage birds by the Fall of 2000. Take of peregrine falcons in the conterminous United States is not permitted under the MBTA until the management plans undergo public review and are finalized, approved, and published in the **Federal Register**. Some permit exceptions may be made for scientific research. In Alaska, take of American peregrine falcons is not permitted but take of Peale's and Arctic peregrines may be authorized.

**Executive Order 12866**

This rule was not reviewed by the Office of Management and Budget under Executive Order 12866.

**Paperwork Reduction Act**

Office of Management and Budget (OMB) regulations at 5 CFR 1320, which implement provisions of the Paperwork Reduction Act, require that interested members of the public and affected agencies have an opportunity to comment on agency information collection and recordkeeping activities (see 5 CFR 1320.8(d)). We cannot conduct or sponsor, and a person is not required to respond to a collection of information, unless we are in possession of a current OMB Control Number. We intend to collect information from the public during the post-delisting monitoring period. A description of the information that will be collected was provided in the proposed delisting rule. We are revising the monitoring plan that was described in the proposed delisting rule, and will obtain a revised OMB Control Number for, and request public comment on, the revised monitoring plan in the **Federal Register** in the near future.

**National Environmental Policy Act**

We have determined that an environmental assessment or environmental impact statement, as defined under the authority of the National Environmental Policy Act of 1969, need not be prepared in connection with regulations adopted pursuant to section 4(a) of the Endangered Species Act of 1973, as amended. We published a notice outlining our reasons for this determination in the **Federal Register** on October 25, 1983 (48 FR 49244).

**References Cited**

A list of all references cited herein is available upon request from the Ventura Fish and Wildlife Office (see **ADDRESSES** section).

**Author**

The primary author of this proposed rule is Robert Mesta, U.S. Fish and Wildlife Service, Ventura Fish and Wildlife Office (see **ADDRESSES** section).

**List of Subjects in 50 CFR Part 17**

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.

**Regulation Promulgation**

For the reasons set out in the preamble, we hereby amend part 17, subchapter B of chapter I, Title 50 of the

Code of Federal Regulations, as set forth below:

## PART 17—[AMENDED]

1. The authority citation for part 17 continues to read as follows:

**Authority:** 16 U.S.C. 1361–1407; 16 U.S.C. 1531–1544; 16 U.S.C. 4201–4245; Pub. L. 99–625, 100 Stat. 3500; unless otherwise noted.

**§ 17.11 [Amended]**

2. Section 17.11(h) is amended by removing the entries for ''Falcon, American peregrine, *Falco peregrinus anatum*'' and ''Falcon, peregrine, *Falco peregrinus*'' under ''BIRDS'' from the List of Endangered and Threatened Wildlife.

**§ 17.95 [Amended]**

3. Section 17.95(b) is amended by removing the critical habitat entry for ''American Peregrine Falcon.''

Dated: August 17, 1999.

**Jamie Rappaport Clark,**

*Director, U. S. Fish and Wildlife Service.*

[FR Doc. 99–21959 Filed 8–20–99; 8:45 am]

BILLING CODE 4310–55–P

# Appendix 2G
# Texas Historical Commission Documentation

SAIC®

## Memorandum

SAIC

To: TCEQ

From: Fred J. Doran, SAIC

Subject: Appendix 2G – Texas Historical Commission Documentation

Date: November 2, 2012

The attached correspondence with the Texas Historical Commission dated August 22, 2011 references MSW Permit No. 729A throughout. It should be noted that the correspondence is applicable to MSW Permit No. 729B and should be referenced as stating MSW Permit No. 729B.

TLK

SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI

August 22, 2011

Mr. Mark Wolfe
State Historic Preservation Officer
Texas Historical Commission
108 West 16th Street, 1st Floor
Austin, TX 78701

Subject: **Texas Historical Commission Review – McCombs Landfill**

Dear Mr. Wolfe:

On behalf of the City of El Paso (City), SAIC Energy, Environment and Infrastructure, LLC (SAIC) requests a consultation under Section 106 of the National Historic Preservation Act and the Antiquities Code of Texas for the City's McCombs Landfill (Landfill) in El Paso, Texas. A Request for a State Historical Preservation Officer (SHPO) Consultation Form and any additional required information is provided as an attachment to this letter for your review.

Please do not hesitate to contact Scott Pasternak at (512) 651-6405 with any questions or clarifications regarding this Texas Historical Commission review.

Sincerely,

**SAIC Energy, Environment & Infrastructure, LLC**

Scott Pasternak
Senior Project Manager

*SAIC Energy, Environment & Infrastructure, LLC*
*5806 Mesa Drive, Suite 310 | Austin, TX 78731 | tel: 512.450.0991 | fax: 512.450.0515 | saic.com/EEandI*

**TEXAS HISTORICAL COMMISSION**

# REQUEST FOR SHPO CONSULTATION:
# Projects Subject to Section 106 of the National Historic Preservation Act and/or the Antiquities Code of Texas

*Submission of this form only initiates consultation with the Texas Historical Commission, the State Historic Preservation Officer (SHPO) for Texas. The SHPO may require additional information to complete the review for some projects.*

*FCC projects: this form should not be completed when submitting Form 620 or 621 for communications towers.*

Section 106 of the National Historic Preservation Act of 1966, as amended, requires federal agencies to consider the effects of their undertakings on historic properties and to consult with the State Historic Preservation Officer (SHPO) regarding the undertaking. An undertaking is any action by or on behalf of a federal agency that has the potential to affect historic resources and includes funding, permits, or other approvals. Federal agencies are required to identify historic resources that may be affected and to avoid, minimize, or mitigate any adverse effects. The Section 106 regulations are codified in 36 CFR 800 and are available from the Advisory Council on Historic Preservation website at www.achp.gov. Regulations allow 30 days upon receipt for SHPO review.

The Antiquities Code of Texas (Title 9, Chapter 191 of the Texas Natural Resources Code) is intended to protect historic and archeological landmarks and is applicable to public lands owned by the state of Texas or a political subdivision of the state, including state agencies, counties, cities, school districts, and public colleges and universities, as well as other public authorities. Notification of the Texas Historical Commission is required before breaking ground at a project location on state or local public land.

☒ This is a new submission
Complete all pages of this form and include required attachments.

☐ This is additional information relating to original submission made on or about _____
Complete only the first page of this form and add any new information, including attachments.

## 1. Project Information

PROJECT NAME
City of El Paso McCombs Landfill - Texas Historical Commission Review

| PROJECT ADDRESS | PROJECT CITY | PROJECT ZIP CODE(S) |
|---|---|---|
| 13660 McCombs Road | El Paso | 79934 |

PROJECT COUNTY OR COUNTIES
El Paso

PROJECT TYPE (Check all that apply)

| | |
|---|---|
| ☐ Road/Highway Construction or Improvement | ☐ Repair, Rehabilitation or Renovation of Structure(s) |
| ☐ Site Excavation | ☐ Addition to Existing Structure(s) |
| ☐ Utilities & Infrastructure | ☐ Demolition or Relocation of Existing Structure(s) |
| ☐ New Construction | ☒ None of these |

BRIEF PROJECT SUMMARY: Please provide a one or two sentence description to explain the project. More details will be provided separately in Part 5, the Project Work Description Attachment.

The City of El Paso proposes to vertically expand the existing McCombs Landfill from the current maximum elevation of 4125' MSL to 4300 'MSL. No lateral expansion is proposed in the permit amendment.

## 2. Project Contact Information

| PROJECT CONTACT NAME | TITLE | ORGANIZATION |
|---|---|---|
| Scott Pasternak | Senior Project Manager | SAIC |

| ADDRESS | CITY | STATE | ZIP |
|---|---|---|---|
| 5806 Mesa Drive, Suite 310 | Austin | Texas | 78731 |

| PHONE | EMAIL |
|---|---|
| (512) 651-6405 | scott.r.pasternak@saic.com |

**For SHPO Use Only** **Date Stamp Below:**

Track Review to:

☐ Archeology Division: Reviewer:

☐ History Programs Division: Reviewer:

☐ Architecture Division: Reviewer:

## 3. Federal Involvement

Does this project involve approval, permit, license, or funding from a federal agency?

☐ Yes (Please complete this section) ☒ No (Skip to next box)

FEDERAL AGENCY

FEDERAL PROGRAM, FUNDING, OR PERMIT TYPE:

FEDERAL AGENCY CONTACT PERSON

PHONE

ADDRESS

EMAIL

Has the federal agency (if other than HUD) formally delegated authority to consult with SHPO on the agency's behalf? ☐ Yes (Please attach delegation letter) ☐ No

## 4. State Involvement

Does this project involve approval, permit, license, or funding from a state agency?

☒ Yes (Please complete this section) ☐ No (Skip to next box)

STATE AGENCY

Texas Commission on Environmental Quality

STATE PROGRAM, FUNDING, OR PERMIT TYPE:

Municipal Solid Waste Disposal Permit #729A

STATE AGENCY CONTACT PERSON

Dr. Richard Carmichael, P.E., Manager, Municipal Solid Waste Permits Section

PHONE

(512) 239-6784

ADDRESS

Municipal Solid Waste Permits Section - MC 124
Building A, Room 122, 12100 Park 35 Circle
Austin, Texas 78753-1808

EMAIL

RCarmich@tceq.state.tx.us

Will this project involve public land owned by the State of Texas or a political subdivision of the state? (State Agency, County, City, School District, Public Authority, Public College or University, etc.)

☒ Yes ☐ No

CURRENT OR FUTURE OWNER OF THE PUBLIC LAND

The City of El Paso currently owns the land permitted for the City of El Paso McCombs Landfill.

## 5. Project Work Description

**Attach** a detailed written description of the project that fully explains what will be constructed, altered, or demolished. Include architectural or engineering plans, site plans, specifications, or NEPA documents, as necessary, to illustrate the project.

## 6. Identification of Project Location and Area of Potential Effect (APE)

The APE includes the entire area within which historic properties could be affected by the project. This includes all areas of construction, demolition, and ground disturbance (direct effects) and the broader surrounding area that might experience visual or other effects from the project (indirect effects).

1. **Attach** map(s) indicating the location and specific boundaries of the project. Road names must be included and legible. Identify the project location, boundaries, and APE on the map(s) as precisely as possible. Suggested maps may include USGS 7.5 minute quadrangle maps (or relevant portions thereof), tax maps, satellite images, etc. The number and types of map(s) will depend on the nature and complexity of the project as well as the extent of the APE. **Projects involving ground disturbance must include the appropriate 7.5 minute USGS quadrangle.**
2. **Attach** a brief written description of the APE, including a discussion of the potential for direct and indirect effects that might result from the project and the justification for the boundaries chosen for the APE.

PROJECT NAME

City of El Paso McCombs Landfill - Texas Historical Commission Review

## 7. Identification of Historic Properties within the APE (Attach additional materials as necessary)

### *A. Archeological Resources*

Does this project involve ground-disturbing activity?

☒ Yes (Please complete this section) ☐ No (Skip to Structures section)

Describe the nature, width, length, and depth of the proposed ground-disturbing activity.

This project involves excavating landfill waste cells to currently permitted depths. The proposed permit amendment does not involve increasing the depth of excavation.

Describe previous land use and disturbances.

The land permitted for the McCombs Landfill has been used for waste disposal activities since the site was permitted in 1984.

Describe the current land use and conditions.

In Texas, the land immediately surrounding and including the McCombs Landfill is predominantly owned by the City of El Paso and is zoned for industrial use or as a ranch or farm district. The land in neighboring New Mexico is predominantly undeveloped and is zoned as a Performance District, used to allow flexibility for land use activities in rural areas.

### *B. Structures*

Are there any structures, buildings, or designed landscape features (park, cemetery, etc.) 45 years old or older within the project area or APE?

☐ Yes ☒ No

Is the project located within or adjacent to a district that is listed in or eligible for the National Register of Historic Places? Eligible districts may include locally designated districts or areas identified in historic resource surveys.

☐ Yes, name of district: ☐ No ☒ Do not know

If the Texas Historic Sites Atlas (http://atlas.thc.state.tx.us) has been consulted, were previously identified architectural resources identified within the project area or APE?

☐ Yes ☒ No ☐ Did not consult Atlas

If the answer to any of the above questions is yes, use the space below or provide an attachment indentifying each structure, building, designed landscape feature, or district within the APE that is 45 years old or older. Include an actual or estimated date of construction and the location of each of the features.

Does the project involve the rehabilitation, alteration, removal, or demolition of any structure, building, designed landscape feature, or district that is 45 years old or older?

☐ Yes ☒ No

If yes, include information with the attachments for Part 5: Project Work Description and Part 8: Photographs.

## 8. Photographs

**Attach** clear, high-resolution color photographs that illustrate the project area and APE as defined in Section 6. Images from the internet are not acceptable due to low resolution. Photography should document the project area and properties within the APE, including clear views of any buildings or structures. Please number and label all photographs, and include a map or site plan labeled to show the location and direction of each view. Where applicable, include photographs of the surrounding area from the project site and streetscape images. Should your project entail the alteration of existing structures, please also provide photographs of the existing conditions of sites, buildings, and exterior and interior areas to be affected.

## 9. Consulting Parties/Public Notification (Section 106 only)

**Attach** a description of the actions taken to notify the public or invite consultation with parties other than SHPO. Provide a summary of any consultation and comments received from consulting parties or the public.

The SHPO is only one consulting party under Section 106. Refer to 36 CFR 800.2 for information about other participants who are entitled to comment on the Section 106 process, including Native American tribes, interested parties, and the public. Consultation with the SHPO is not a substitution for consultation with Native American tribes. When identifying historic resources within the APE and determining the effect of an undertaking, applicants should consider consulting with the county historical commission and the local historic preservation officer, if any.

## 10. Applicant's Determination of Effect (Section 106 only)

An effect occurs when an action alters the characteristics of a property that qualify it for listing in the National Register of Historic Places, including changes to the property's location, design, setting, materials, workmanship, feeling, and association. Effects can be direct or indirect, and can be physical, visual, audible, or economic. They may include a change in ownership or change in use.

- ■ **No Historic Properties Affected** based on 36 CFR 800.4(d)(1). Please provide the basis for this determination.
- ☐ **No Adverse Effect** on historic properties based on 36 CFR 800.5(b). Please explain why the criteria of adverse effect at 36 CFR 800.5(a)(1) were not found to be applicable for your project.
- ☐ **Adverse Effect** on historic properties based on 36 CFR 800.5(d)(2). Please explain why the criteria of adverse effect at 36 CFR 800.5(a)(1) were found to be applicable to your project. You may also wish to include an explanation of how these adverse effects might be avoided, minimized, or mitigated.

In the space below or as an attachment, please explain the effect of the project on historic properties.

No historical properties are directly affected with the implementation of the vertical expansion at the McCombs Landfill due to the fact that no previously-undisturbed earth will be added to the waste footprint.

**Submit Completed Form and Attachments to:**

Via mail:
Mark Wolfe
State Historic Preservation Officer
Texas Historical Commission
PO Box 12276
Austin, TX 78711

Via hand delivery or private express delivery:
Mark Wolfe
State Historic Preservation Officer
Texas Historical Commission
108 West 16th St.
Austin, TX 78701

**Faxes and email are not acceptable.**

**For SHPO Use Only**

| PROJECT NAME | | |
|---|---|---|
| City of El Paso McCombs Landfill - Texas Historical Commission Review | | |
| PROJECT ADDRESS | PROJECT CITY | PROJECT ZIP CODE(S) |
| 13660 McCombs Road | El Paso | 79934 |
| PROJECT COUNTY OR COUNTIES | | |
| El Paso | | |

| PROJECT CONTACT NAME | TITLE | ORGANIZATION |
|---|---|---|
| Scott Pasternak | Senior Project Manager | SAIC |
| ADDRESS | CITY | STATE | ZIP |
| 5806 Mesa Drive, Suite 310 | Austin | Texas | 78731 |
| PHONE | EMAIL | |
| (512) 651-6405 | scott.r.pasternak@saic.com | |

# Attachment 1
# SHPO Consultation Form Written Responses

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## 5. Project Work Description

The City of El Paso (City) owns and operates the McCombs Landfill (Landfill) which is managed under Texas Commission on Environmental Quality (TCEQ) Municipal Solid Waste (MSW) permit 729A. The Landfill is located in El Paso County within the El Paso city limits and serves the waste needs of the City and the surrounding area.

In August of 2010, the City voted to implement flow control, a mandate to dispose of all waste generated within the City's jurisdictional area at City facilities. SAIC expects this legislation to increase the throughput to each of the City's landfills by approximately 525,000 Tons Per Year (TPY) in the first year of implementation. The City intends to undergo a vertical expansion of the McCombs Landfill to accommodate the anticipated increase in throughput for the solid waste stream.

The proposed vertical expansion will increase the height of the landfill from the currently permitted elevation of 4,125 feet MSL to 4,305 feet MSL. It is important to note that the proposed expansion will not include any previously undisturbed land as part of the waste footprint. Furthermore, the project involves increasing the above-ground height of the landfill and does not involve deeper excavation of the currently permitted waste cells.

The proposed landfill completion drawings are included as Attachment 2.

## 6. Identification of Project Location and Area of Potential Effect (APE)

A 7.5 minute USGS quadrangle map of the APE is included as Attachment 3. This map has been prepared to meet the standards of 30 TAC §330.61(e) and depicts a 1-mile radius of influence surrounding the Landfill as the Area of Potential Effect (APE). This radius has been chosen for consistency with the Impact on Surrounding Area report that is required by the TCEQ for the Major Permit Amendment effort.

## 8. Photographs

A series of aerial photographs showing the existing conditions of the landfill and the surrounding area are provided in Attachment 4.

## 9. Consulting Parties/Public Notification

Public notification will be required for the McCombs Major Permit Amendment. As per the requirements set forth in 30 TAC §330.69, The City of El Paso will provide notice of the opportunity to request a public meeting and will post notice signs no later than 45 days of the TCEQ executive director's receipt of the application in accordance

with the procedures contained in 30 TAC §39.501. If applicable, notice of a public meeting shall be provided as specified in 30 TAC §39.501(e)(3) and (4).

Furthermore, because the school system closest to the Landfill is required by the Texas Education Code to provide a bilingual program, the City of El Paso will provide public notification in both English and Spanish.

# Attachment 2
# Landfill Completion Drawing

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## NOTES

1. DIGITIZED TOPOGRAPHY FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS.
2. COORDINATES ARE BASED ON THE TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NAD 83. ELEVATIONS ARE NAVD 88 VERTICAL DATUM.
3. EXISTING CONTOUR INTERVAL IS TWO FEET.
4. SITE TOPOGRAPHY MAY VARY DUE TO OWNER'S OPERATIONS.
5. FINAL COVER CONTOURS SHOWN ARE DESIGN CONTOURS.
6. FINAL COVER CONTOUR INTERVAL IS FIVE FEET.

N:10743000 E:418000

N:10738000 E:418000

SECTION 6, BLOCK 80, TOWNSHIP 1 TEXAS & PACIFIC RAIL ROAD SURVEYS

TEXAS-NEW MEXICO BOUNDARY LINE

N: 10742509.06 E: 417193.27

N: 10738213.37 E: 417020.95

PROPERTY BOUNDARY

125' BUFFER ZONE

GMP-13 GMP-12 GMP-11 GMP-10 GMP-9 GMP-7 GMP-14 GMP-15 GMP-16 GMP-17 GMP-8 GMP-1 GMP-19 GMP-3A GMP-22 GMP-2 GMP-20 GMP-18 GMP-21

STORMWATER RETENTION POND B

STORMWATER RETENTION POND C

EXISTING RETENTION POND E

EXISTING MAINTENANCE BUILDINGS, GATEHOUSE, AND STORAGE AREA

MW-1 MW-2

SECTOR E SECTOR D SECTOR F SECTOR G SECTOR H SECTOR J SECTOR C SECTOR B SECTOR I SECTOR K SECTOR A

SLOPE 7% 3:1

EXISTING UNLINED LANDFILL

EXISTING LINED LANDFILL (PHASE I)

EXISTING LINED LANDFILL (PHASE II)

EXISTING SECTOR A (PHASE III)

EXISTING STORMWATER RETENTION POND A

EXISTING PERIMETER FENCE

300' EL PASO ELECTRIC COMPANY R.O.W.

STAN ROBERTS SR. ROAD (150' ROW) (FM 2529)

McCOMBS ROAD (60' ROW)

McCOMBS ROAD (150' ROW)

SECTION 7, BLOCK 80, TOWNSHIP 1 TEXAS & PACIFIC RAIL ROAD SURVEYS

SECTION 1, BLOCK 81, TOWNSHIP 1 TEXAS & PACIFIC RAIL ROAD SURVEYS

N:10743000 E:414000

N: 10742684.20 E: 413885.24

N:10738000 E:414000

N: 10738347.03 E: 413725.15

GRAPHIC SCALE

1"=250'-0" 250 0 250 500 Scale Feet

COPYRIGHT 2011, SAIC, ALL RIGHTS RESERVED

| | | | | | |
|---|---|---|---|---|---|
| DESIGNED TLK | | | | | |
| DRAWN CAD | | | | | |
| VERIFY SCALE BAR IS ONE INCH ON ANSI "D" DRAWING 0 1" | 0 | 9/26/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |
| | REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |

THE CITY OF EL PASO TEXAS

SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve
Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

LANDFILL COMPLETION PLAN

PROJECT NUMBER: 9631500115

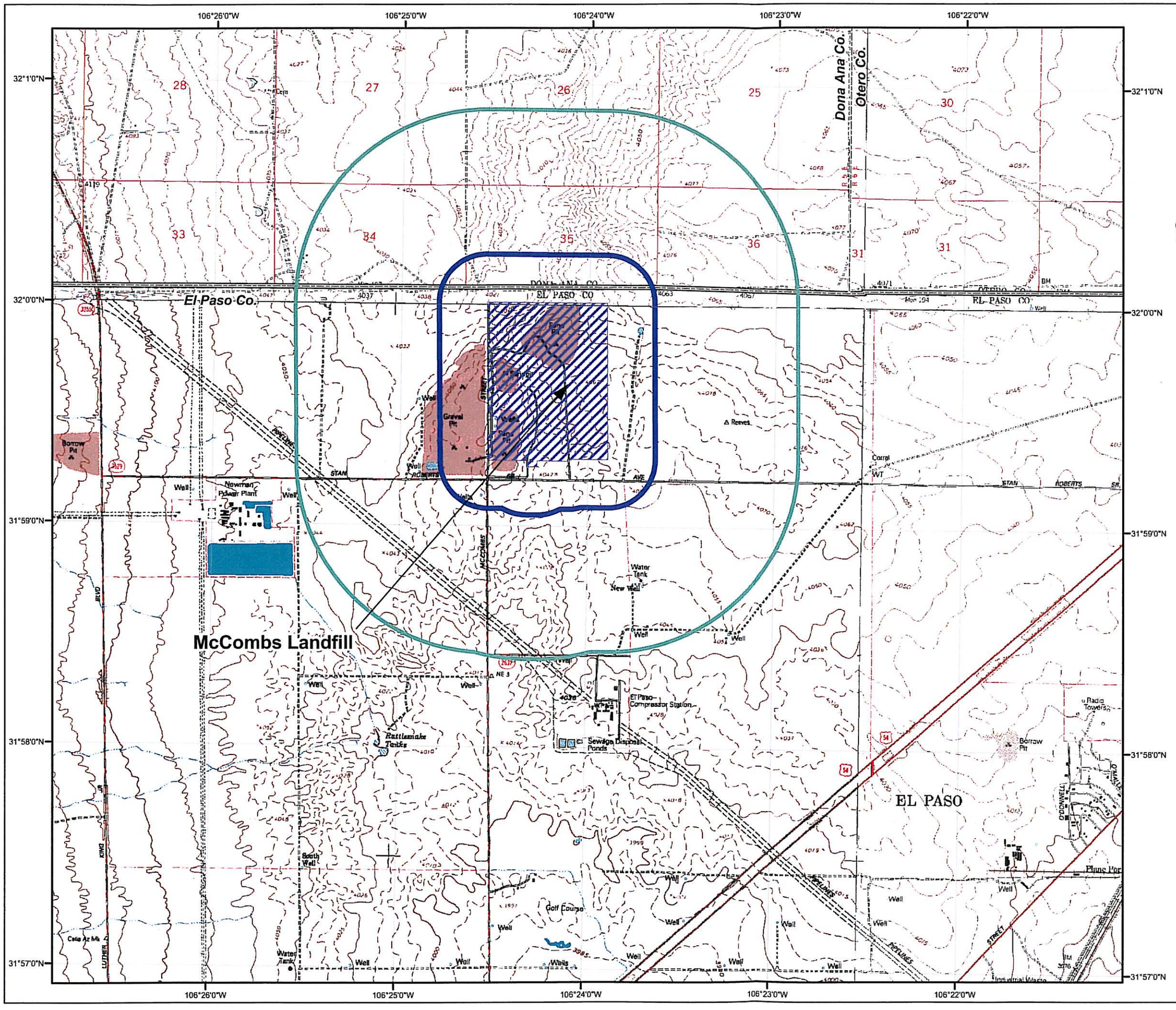
SHT. 1 OF 1

DRAWING NUMBER: Attachment 2

Keller, Tonya L. 8/30/2011 12:27:34 PM - P:\00218000 - El Paso TX\9631500115\Data Analytical\CADD\THC - Attachment 2.dwg

# Attachment 3
# 7.5 Minute USGS Quadrangle Map

SAIC®




## USGS 7.5 Minute Topographic Map

- Landfill Boundary
- 0.25 Radius Around Landfill
- 1 Mile Radius Around Landfill
- County Boundary
- State Boundary

Quadrangles:
Fort Bliss NE, Texas - 1995
North Franklin Mountain, Texas - 1995
Newman, NM - 1955
Newman SW, NM - 1955

# Attachment 4
# Aerial Photograph

SAIC®

## NOTES

1. AERIAL PHOTOGRAPH FROM SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, ARIZONA.

GRAPHIC SCALE
1"=250'-0" 250 0 250 500
Scale Feet

COPYRIGHT 2011, SAIC. ALL RIGHTS RESERVED

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|---|---|---|---|---|---|
| DESIGNED TLK | | | | | |
| DRAWN CAD | | | | | |
| VERIFY SCALE BAR IS ONE INCH ON ANSI "D" DRAWING 0 1" | 0 | 9/26/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |
| | REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |

THE CITY OF EL PASO TEXAS

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SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve
Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

AERIAL PHOTOGRAPH

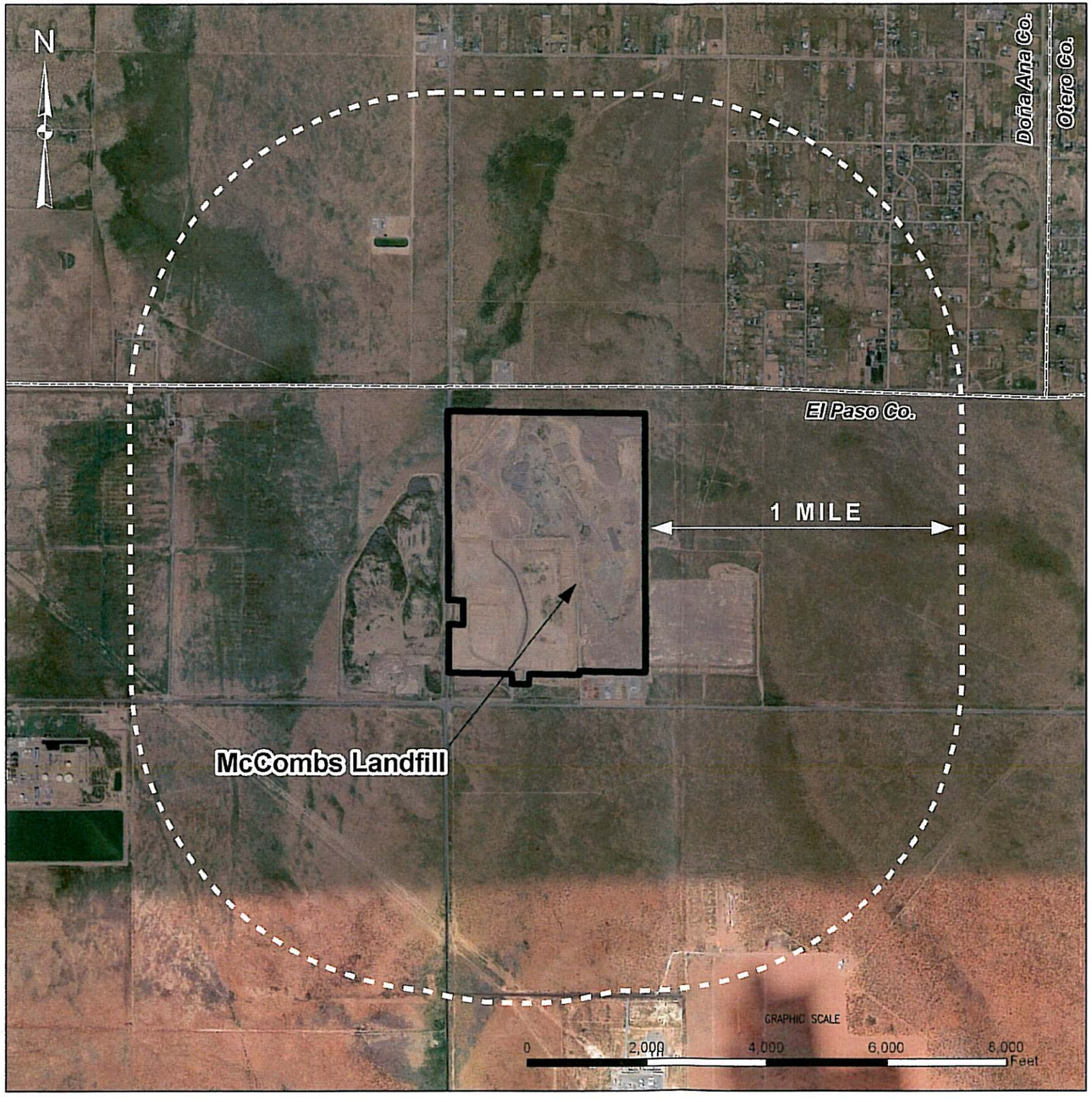
PROJECT NUMBER 9631500115

SHT 1 OF 2

DRAWING NUMBER Attachment 4A

## NOTES

1. MAP CREATED USING ARCGIS SOFTWARE VERSION 9.2.

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| DESIGNED TLK | | | | | |
| DRAWN CAD | | | | | |
| VERIFY SCALE BAR IS ONE INCH ON ANSI "D" DRAWING 0 1" | | | | | |
| | 0 | 9/26/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |
| | REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |

THE CITY OF EL PASO TEXAS

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1380 Corporate Center Curve
Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

AERIAL PHOTOGRAPH – ONE MILE RADIUS

PROJECT NUMBER: 9631500115

SHT 2 OF 2

DRAWING NUMBER: Attachment 4B

Keller, Tonya L. 8/30/2011 12:28:00 PM – P:\00216000 El Paso TX\9631500115\Data Analytical\CADD\ThC – Attachment 4B.dwg

SAIC

August 22, 2011

RECEIVED
SEP 07 2011
TEXAS HISTORICAL COMMISSION

Mr. Mark Wolfe
State Historic Preservation Officer
Texas Historical Commission
108 West 16th Street, 1st Floor
Austin, TX 78701

Subject: **Texas Historical Commission Review – McCombs Landfill**

Dear Mr. Wolfe:

On behalf of the City of El Paso (City), SAIC Energy, Environment and Infrastructure, LLC (SAIC) requests a consultation under Section 106 of the National Historic Preservation Act and the Antiquities Code of Texas for the City's McCombs Landfill (Landfill) in El Paso, Texas. A Request for a State Historical Preservation Officer (SHPO) Consultation Form and any additional required information is provided as an attachment to this letter for your review.

Please do not hesitate to contact Scott Pasternak at (512) 651-6405 with any questions or clarifications regarding this Texas Historical Commission review.

Sincerely,

**SAIC Energy, Environment & Infrastructure, LLC**

Scott Pasternak
Senior Project Manager

ANTIQUITIES CODE OF TEXAS REVIEW
NO SURVEY REQUIRED
PROJECT MAY PROCEED
by
for Mark Wolfe
Executive Director, THC
Date 10/3/11
Track# 201200260

SAIC Energy, Environment & Infrastructure, LLC
5806 Mesa Drive, Suite 310 | Austin, TX 78731 | tel: 512.450.0991 | fax: 512.450.0515 | saic.com/EEandI

# Appendix 2H
# RGCOG Review

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## Memorandum

SAIC

To: TCEQ

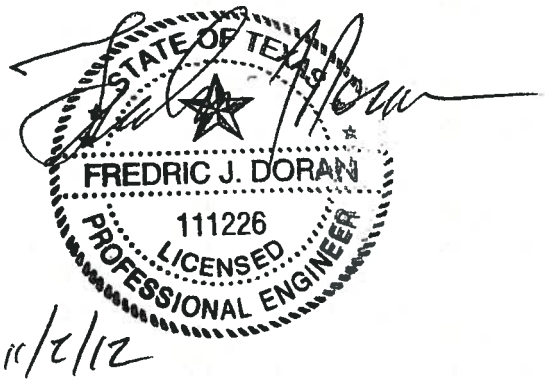
From: Fred J. Doran, SAIC

Subject: Appendix 2H – RGCOG Review

Date: November 2, 2012

The attached correspondence with the RGCOG dated September 22, 2011 and January 20, 2012 references MSW Permit No. 729A throughout. It should be noted that the correspondence is applicable to MSW Permit No. 729B and should be referenced as stating MSW Permit No. 729B.

TLK






SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI

RIO GRANDE
COUNCIL OF GOVERNMENTS

Annette Gutierrez - Executive Director
1100 N. Stanton, Suite 610
El Paso, Texas 79902

Phone: (915) 533-0998
Fax (915) 532-9385
www.riocog.org

January 20, 2012

Ms. Christine Bergren
MSW Section Manager
Waste Permits Division- MC 124
Texas Commission on Environmental Quality
12100 Park 35 circle
Austin, Texas 78753

Subject: Review of Conformance to the Regional Solid Waste Management Plan for the McCombs Municipal Landfill
MSW Permit Amendment No. 729A

Dear Ms. Bergren,

As required under the Texas Administrative Code Subchapter E § 330.61(p) the Rio Grande Council of Governments has reviewed the permit amendment application for the McCombs Municipal Landfill. On the 19th of October 2011, the Solid Waste Advisory Committee reviewed the permit amendment application for the McCombs Landfill, MSW Permit Amendment No. 729A. The findings from this review are that the permit application conforms to the Regional Solid Waste Management Plan. The recommendations made by the Solid Waste Advisory Committee were approved by the Rio Grande Council of Governments Board of Directors on the 20th of January 2012.

The Rio Grande Council of Governments has not included a review of land use compatibility conformance. As stated in the Regional Solid Waste Management Plan, this review is left to the communities except on those occasions when the Rio Grande Council of Governments is specifically asked to assist in this evaluation. The City of El Paso has expressed no concerns with the land use compatibility of this facility. The Rio Grande Council of Governments will support the local decision of the community.

Should you require any additional information please contact Korina Navarro, the Environmental Services Coordinator at 915-533-0998, ext. 121.

Sincerely,

Judge Veronica Escobar
President, Board of Directors

Att.: Conformance Checklist

September 22, 2011

Ms. Korina Navarro
Environmental Services Coordinator
Rio Grande Council of Governments
1100 N. Stanton, Suite 610
El Paso, Texas 79902

Subject: **Solid Waste Conformance Checklist for McCombs Municipal Landfill**

Dear Ms. Navarro:

The City of El Paso (City) is pleased to submit this solid waste conformance checklist and packet for the City's McCombs Municipal Landfill (Landfill). The City, with assistance from SAIC Energy, Environment and Infrastructure, LLC (SAIC), is preparing Major Permit Amendment #729A (MPA) application for submittal to the Texas Commission on Environmental Quality (TCEQ). This submittal contains the information requested on the checklist. The City, and by extension, the Landfill will support and conform to the goals of the Rio Grande Council of Governments (RGCOG). The City will specifically support the goals listed on the conformance checklist (Goals 1 and 3 from the Regional Solid Waste Management Plan (RSWMP)) in the following manner:

- **Goal 1 – Promote planning to ensure adequate services and facilities for the proper management and disposal of municipal solid waste:** The City is open to participating in public/private partnerships to share the cost burden of clean-up events and currently partners with Keep El Paso Beautiful and other non-profit entities on community events by providing roll-off containers, bulk waste pickup, scrap tire disposal, and/or waived or reduced landfill tipping fees.

Mayor
John E. Cook

City Council

District 1
Ann Morgan Lilly

District 2
Susie Byrd

District 3
Emma Acosta

District 4
Carl L. Robinson

District 5
Dr. Michiel R. Noe

District 6
Eddie Holguin Jr.

District 7
Steve Ortega

District 8
Cortney Carlisle Niland

City Manager
Joyce A. Wilson

- **Goal 3 – Reduce the amount of municipal solid waste disposed of, through waste reduction, recycling, and reuse:** The Landfill has plans in place to divert white goods, tires, yard waste, brush and scrap metal. Additionally, the City will be implementing a mulching program at the landfill to further reduce the net volume of brush disposed at the Landfill. Mulch will with used for City projects and remaining mulch will be offered to the public.

In addition, while RGCOG has not specifically included Goal 2 from the RSWMP as a part of the conformance checklist, this proposed vertical expansion will support this goal to provide technical support and services to promote local and regional municipal solid waste planning. The proposed vertical expansion will support this goal by ensuring long-term disposal capacity in the solid waste system by extending the Landfill's site life by approximately 30 years. The Landfill is an integral part of the regional solid waste system, and currently represents approximately 35 percent of the available disposal capacity for the region, according to the 2010 Annual Reports submitted to the TCEQ.

The City is also providing the requested contact information for the Applicant, the Applicant's Engineer and the TCEQ.

**Contact Information for the Applicant:**

City of El Paso
Attn: Ms. Ellen Smyth
Director of Environmental Services
7969 San Paulo Drive
El Paso, Texas 79907
915.621.6719 Phone
915.621.6711 Fax
smythea@elpasotexas.gov

**Applicant's Engineer:**

SAIC
Attn: Mr. Scott Pasternak
Assistant Vice President
5806 Mesa Drive, Suite 310
Austin, Texas 78731
512.651.6405 Phone
512.450.0515 Fax
scott.r.pasternak@saic.com

Mayor
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City Manager
Joyce A. Wilson

*Dedicated to Outstanding Customer Service for a Better Community*

S E R V I C E  S O L U T I O N S  S U C C E S S

**Contact Information for TCEQ:**

Ms. Christine Bergren
MSW Section Manager, Waste Permits Division – MC 124
12100 Park 35 Circle
Austin, Texas 78753-1808
512.239.6784 Phone
512.239.2007 Fax
christine.bergren@tceq.texas.gov

Please review the attached solid waste conformance checklist and packet for the McCombs Landfill to determine if the proposed changes are in accordance with the RGCOG RSWMP. City staff will also plan to attend the RGCOG meeting on October 19, and we will be pleased to answer any questions at that time. If you have any questions or comments regarding the content of this submittal please feel free to contact any of the people listed above.

Sincerely,

**City of El Paso**

Ellen A. Smyth, P.E.
Director of Environmental Services

THE CITY OF EL PASO TEXAS

Mayor
John F. Cook

City Council

*District 1*
Ann Morgan Lilly

*District 2*
Susie Byrd

*District 3*
Emma Acosta

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*District 5*
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*District 6*
Eddie Holguin Jr.

*District 7*
Steve Ortega

*District 8*
Cortney Carlisle Niland

City Manager
Joyce A. Wilson

El Paso
All-America City
2010

**Environmental Services Department**
7968 San Paulo Drive, El Paso, TX 79907 ◦ (915) 621-6700 ◦ Fax (915) 621-6711
www.elpasotexas.gov

**RIO GRANDE COUNCIL OF GOVERNMENTS**
**SOLID WASTE PLAN CONFORMANCE CHECKLIST**

All applicants seeking a MSW facility permit or registration are required to demonstrate conformance to the Regional Solid Waste Management Plan by the Texas Commission on Environmental Quality (TCEQ). The Texas Administrative Code Subchapter B § 330.61(p) states that the owner or operator shall submit documentation that Parts I and II of the application were submitted for review to the applicable council of governments for compliance with the Regional Solid Waste Plan.

The Solid Waste Advisory Committee (SWAC) will review the application based on the following checklist. These questions will provide the SWAC with information on how the proposed facility will support the goals and objections of the Plan. All questions must be answered entirely in order for the SWAC to review the proposal. Incomplete questionnaires will be returned to applicants. The certification box must be signed by the chief administrative officer of the applicant, indicating that all information provided is accurate and truthful.

---

*Instructions:*

To request a conformance review of a MSW registration or permit application, the following information must be submitted to the Rio Grande Council of Council (RGCOG):

1. Copy of the Application to the TCEQ, Parts I and II.
2. Solid Waste Plan Conformance Checklist (attached)
3. A cover letter with contact information for the applicant, the applicant's engineer and the TCEQ staff person to whom all review-related correspondence should be sent. Contact information should include name, phone number, mailing address, and email address (if available).
4. A map showing the physical location of proposed or existing facility.
5. Any additional information the applicant wishes to provide to facilitate the SWAC review process.

All documents and information should be submitted to the following address:

Environmental Services Coordinator
Rio Grande Council of Governments
1100 N. Stanton, Suite 610
El Paso, TX 79902

**RIO GRANDE COUNCIL OF GOVERNMENTS**
**SOLID WASTE PLAN CONFORMANCE CHECKLIST**

## Section 1: General Applicant Information

1.1 Applicant's Name: McCombs Municipal Landfill

1.2 Location of proposed facility
Nearest City: El Paso, Texas County: El Paso

1.3 ☐ New facility or ☒ Amendment to current permit/registration

1.4 Is this a permit or a registration application?
☒ Permit No.729A ☐ Registration No._____

1.5 What type of MSW facility is being registered or permitted?
☒ Type I Landfill
☐ Type I AE Landfill
☐ Type IV Landfill
☐ Type IV AE Landfill
☐ Type V Facility
☐ Other (please describe)
Describe "Other" below:

1.6 What types of waste(s) will be accepted at your facility?
Municipal Solid Waste, Class II Industrial Waste, Construction and Demolition, Regulated Asbestos Containing Material

1.7 Do you currently or plan to accept special or industrial waste? If so, which classes?
Class II Industrial Waste and Regulated Asbestos Containing Material

1.8 Do you currently or do you plan on accepting treatment plant sludge, treated septage or any other potentially odorous wastes?
Yes, any liquid wastes that are dewatered and will pass the paint filter test can be accepted at the facility. No liquid waste will be accepted.

1.9 What entity or entities in the RGCOG Region is this facility intended to serve?
City of El Paso area; El Paso County, Texas; Doña Ana County, New Mexico

1.10 Does your facility have an operating or host agreement with any RGCOG entity or entities? If so, please provide. If not, do you plan to enter into one?
No operating or host agreement and no intentions to enter into one.

1.11 If the proposed facility is other than a landfill, where will the stored or processed wastes be taken for disposal?
N/A

## Section 2: Regional Goal Conformance

Please provide information as to how your proposed facility will help to support or conform with the goals and objectives of RGCOG's Regional Solid Waste Management Plan.

**Community Clean-Up Events & Illegal Dumping:**

***Goal 1: Promote planning to ensure adequate services and facilities for the proper management and disposal of municipal solid waste.***

2.1.1 Do you plan to participate in any public/private partnerships to share the cost burden of clean-up events?

☐ Yes ☒ No

If yes, please describe:

The City is open to participating in public/private partnerships to share the cost burden, but no partnerships have been established. The City partners with non-profit entities including Keep El Paso Beautiful and Home Owners Associations on community clean-up events.

2.1.2 Do you plan to provide sponsorship for community clean-up events? (e.g., provide roll-off containers at no cost or at significantly reduced costs?)

☒ Yes ☐ No

If yes, please describe:

The City partners with HOAs and Keep El Paso Beautiful on community clean-up events by providing roll-off containers, bulk waste pickup, scrap tire disposal, and/or waived or reduced landfill tipping fees.

2.1.3 What measures do you plan to take to make your facility accessible to the general public? (e.g., operational hours that are public-friendly, extended daytime hours and/or weekend hours, posted fee scales, map availability, public advertising methods, etc.)

The landfill will offer operating hours from 7 am to 4 pm six days a week (Monday – Saturday). Operating hours and landfill tipping fees are posted at the site entrance and on the City's website. Public advertising in the form of press releases is made to inform the public of news events and any changes to the operations.

2.1.4 What plans do you have to help curtail illegal dumping in the vicinity of the proposed facility?

Posted signage outside the landfill informs the public that illegal dumping is a crime and

is not allowed. A security company patrols the landfill as a means of guarding the property and discouraging illegal dumping. Also, a security camera system will be installed to monitor the property and curtail illegal dumping.

2.1.5 As part of your operating plan, will you accept waste from locally sponsored litter and illegal dumping clean-up projects at no cost or at significantly reduced costs?

☒ Yes ☐ No

If yes, please explain:

Yes, the City participates in community clean-up events and accepts waste from locally sponsored cleanups at no cost or at reduced landfill tipping fees.

**Recycling:**

***Goal 3: Reduce the amount of municipal solid waste disposed of, through waste reduction, recycling, and reuse.***

2.2.1 If applicable, how will your facility manage scrap/used tires? Please explain in detail.

Whole used or scrap tires are accepted at the landfill and stored in a dedicated trailer for disposal off-site. Customers entering the landfill are questioned if they are bringing tires for disposal. Tires are placed in the tire trailer, and the tire trailer is transported off-site to the City's contracted Vendor for disposal. A manifest is prepared for each shipment to include the date/time, unit #, generator name & signature, driver name and signature. The tire trailer is weighed prior to leaving the site to document the weight. The manifest is completed at the point of disposal and returned to the landfill.

2.2.2 What are your plans for managing yard waste and brush? Please explain in detail.

The City will be implementing a mulching program at the landfill to help reduce the net volume of brush waste disposed at the landfill. A horizontal grinder will be used to grind the yard and brush waste at the landfill. Brush waste received at the City's Citizen Collection Stations will be transported to the landfill where it will be mulched. Mulch will be used for City projects and any remaining mulch will be offered to the public. A compost pilot project will be implemented to appropriately design the "recipe" and evaluate the market demand of compost.

2.2.3 Will any of the following items be diverted for recycling or reuse?

- ☐ Electronics
- ☒ White Goods
- ☐ Construction/Demolition Debris
- ☒ Tires
- ☒ Yard waste & brush
- ☒ Scrap Metal
- ☐ Other (please describe)

2.2.4 If the proposed facility is other than a landfill, what, if any, type of measures will be taken to minimize, reduce, or recycle the waste before it is hauled off for disposal?

Not applicable. The proposed facility is a landfill.

**Section 3: Certifications**

I hereby certify that the information contained herein is, to the best of my knowledge complete and accurate and that the information in fact represents the MSW facility for which this entity is requesting a TCEQ permit or registration.

Ellen A. Smyth

**Typed or Printed Name of Applicant' s Chief Administrative Officer**

Director, Environmental Services

**Title of Chief Administrative Officer**

Ellen A. Smyth 10-5-2011

**Signature of Chief Administrative Officer** **Date**

**NOTE:**

PLEASE COMPLETE THIS FORM AS FULLY AND AS ACCURATELY AS POSSIBLE. YOUR COMPLETED CHECKLIST WILL BE SUBMITTED TO THE PERMITS SECTION OF THE TEXAS COMMISSION ON ENVIRONMENTAL QUALITY ALONG WITH THE SOLID WASTE ADVISORY COMMITTEE'S CONFORMANCE REVIEW

Report

# Major Permit Amendment – Part III: Volume I
# McCombs Municipal Landfill
# El Paso County, Texas
# TCEQ MSW Permit No. 729B

Prepared for: City of El Paso

Revised July 2013, Revision 6

SAIC®

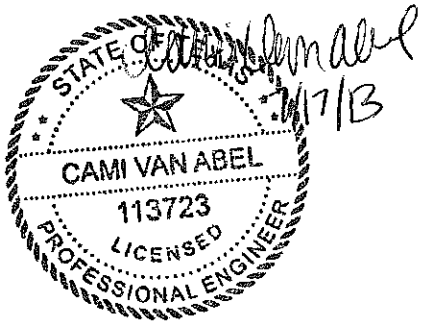
# McCombs Municipal Landfill
# El Paso County, Texas
# TCEQ MSW Permit No. 729B

# Major Permit Amendment Application
# Part III
# Volume I

Prepared for

**City of El Paso**

Updated July 2013, Revision 6




Prepared by

**SAIC**
5806 Mesa Drive, Suite 310 ♦ Austin, Texas 78731 ♦ 512.450.0991

Texas Board of Professional Engineers
Firm Registration No. 3823

## Table of Contents

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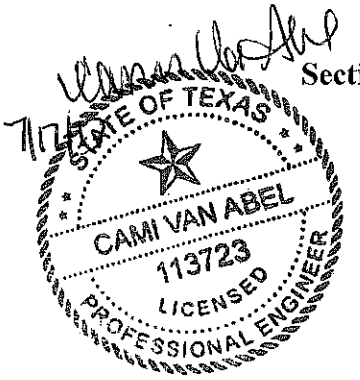

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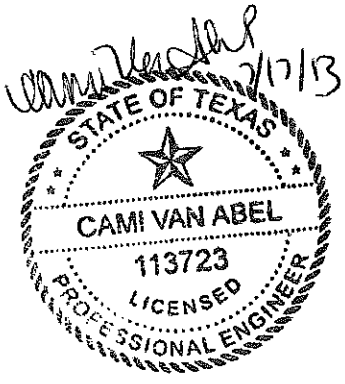

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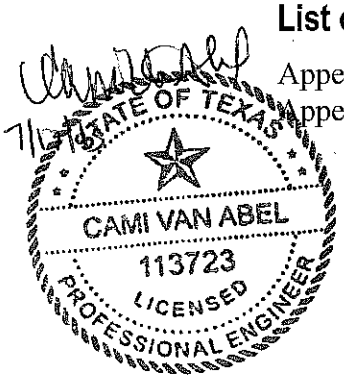

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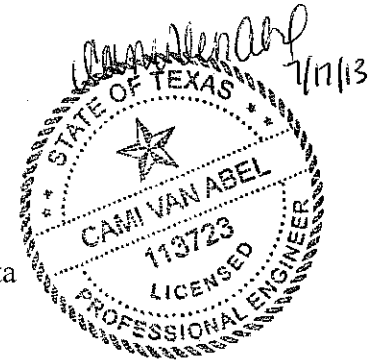

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CAM VAN ABEL
113723
REGISTERED PROFESSIONAL ENGINEER
STATE OF TEXAS
3/15/13

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| 3 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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1380 Corporate Center Curve
Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

INDEX

PROJECT NUMBER: 9631500115
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## LEGEND

| EXISTING | FUTURE | DESCRIPTION |
|---|---|---|
| MW-3 | MW-5 | MONITORING WELL |
| GMP-B, GRP-1 | | GAS MONITORING PROBE, GAS RECOVERY PROBE |
| △ | | PIEZOMETER |
| PV-7 | | VERTICAL GAS WELL |
| 1* | | SOIL BORING – LOCATION AND NUMBER PER DRA CONSULTANTS (MAY 1983) |
| 1RI | | SOIL BORING – LOCATION AND NUMBER PER DRA CONSULTANTS (NOVEMBER 1983) |
| 1 | | SOIL BORING – LOCATION AND NUMBER PER DICKINSON LABORATORIES (JUNE 1976) |
| △4 | | SURVEY CONTROL POINT |
| Ⓦ | | WATER WELL |
| | | LEACHATE COLLECTION PIPING CLEANOUT |
| | | BUILDING/STRUCTURE |
| 1500 | 1500 | ELEVATION CONTOURS |
| X X X | | CHAIN LINK OR OTHER FENCE |
| UGE UGE | | UNDERGROUND ELECTRIC |
| OHE OHE | | OVERHEAD ELECTRIC UTILITY |
| UGC UGC | | UNDERGROUND COMMUNICATIONS |
| GCCS | GCCS | GAS COLLECTION AND CONTROL SYSTEM |
| GMCS | | GAS MIGRATION CONTROL SYSTEM |
| | | FACILITY/PROPERTY BOUNDARY |
| | | 125' BUFFER ZONE |
| W W | | WATER LINE |
| | | STORMWATER RETENTION POND BOUNDARY |
| | | HIGHWAY |
| | | LANDFILL ACCESS ROAD |
| | | SECTION LINE |
| | | STORMWATER DRAINAGE DITCH AND FLOW DIRECTION |
| | | SECTOR BOUNDARIES |
| | Ⓐ | SECTOR DENOMINATION AND FILL DIRECTION |
| | | LEACHATE SUMP AND EXTRACTION PIPE |
| L L | | LEACHATE COLLECTION PIPING |
| | | DRAINAGE AREA BOUNDARY |
| | | FLOW DIRECTION |
| | | CLOSURE EXTENTS |

| EXISTING | FUTURE | DESCRIPTION |
|---|---|---|
| | | COMPACTED NATIVE SOIL |
| | | CALICHE SOIL |
| | | PROTECTIVE SOIL DRAINAGE MATERIAL OR BUFFER MATERIAL |
| | | COMMON BACKFILL/GENERAL FILL |
| | | PEA GRAVEL BACKFILL |
| | | TOPSOIL |
| | | DAILY/INTERMEDIATE COVER |
| | | EROSION LAYER |
| | | INFILTRATION LAYER |
| | | REFUSE |
| | | CONCRETE |
| | | AGGREGATE BACKFILL |
| | | AGGREGATE BASE COURSE |
| | | CLASS 5, AGGREGATE |
| | | SUBGRADE |
| | | BENTONITE |
| | | STEEL |
| | | 100 YEAR FLOOD PLAIN |
| | | PREPARED SUBGRADE |
| | | 60 MIL HDPE OR 40 MIL LLDPE GEOMEMBRANE LINER |
| | | GEOTEXTILE (CUSHION AND FILTER) |
| | | GEOGRID |
| | | GEOSYNTHETIC CLAY LINER (GCL) |
| | | EROSION CONTROL MATTING AND SEEDING |
| | | 6" DIA ROCK (UNLESS OTHERWISE SPECIFIED) OR RIPRAP |
| | | BURIED CULVERT |
| | | TREE LINE |

## ABBREVIATIONS

| | |
|---|---|
| & | AND |
| APPROX | APPROXIMATE |
| AZ | ARIZONA |
| BLDG | BUILDING |
| BOT | BOTTOM |
| C&D | CONSTRUCTION AND DEMOLITION DEBRIS |
| CB | CATCH BASIN |
| CFS | CUBIC FEET PER SECOND |
| ℄ | CENTERLINE |
| CLR | CLEAR |
| CM | CENTIMETERS |
| CMP | CORRUGATED METAL PIPE |
| CO | COMPANY, COUNTY |
| COEF | COEFFICIENT |
| CONC | CONCRETE |
| CONT | CONTINUOUS |
| CP | CONTROL POINT |
| CPE | CORRUGATED POLYETHYLENE |
| DEG | DEGREES |
| DEMO | DEMOLITION |
| DET | DETAIL |
| DIA | DIAMETER |
| DWG | DRAWING |
| E | EAST, EASTING |
| EL OR ELEV | ELEVATION |
| EQ | EQUAL |
| EW | EACH WAY |
| EX | EXISTING |
| GALV | GALVANIZED |
| GB | GRANULAR BED |
| GCCS | GAS COLLECTION AND CONTROL SYSTEM |
| GCL | GEOSYNTHETIC CLAY LINER |
| GMCS | GAS MIGRATION CONTROL SYSTEM |
| GMP | GAS MONITORING PROBE |
| GRP | GAS RECOVERY PROBE |
| GW | GAS WELL |
| GV | VERTICAL GAS WELL |
| HDPE | HIGH DENSITY POLYETHYLENE |
| ID | INSIDE DIAMETER |
| IE | INVERT ELEVATION |
| INC | INCORPORATED |
| L | LYSIMETER |
| LCO | LEACHATE CLEANOUT |
| LF | LANDFILL |
| LFG | LANDFILL GAS |
| LLDPE | LINEAR LOW DENSITY POLYETHYLENE |
| MAX | MAXIMUM |
| MFR | MANUFACTURER |
| MIN | MINIMUM |
| MSW | MUNICIPAL SOLID WASTE |
| MW | MONITORING WELL |
| N | NORTH, NORTHING |
| NAD | NORTH AMERICAN DATUM |
| NAVD | NORTH AMERICAN VERTICAL DATUM |
| NO | NUMBER |
| NPDES | NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM |
| NPT | NOMINAL PIPE THICKNESS |
| NSPS | STANDARD OF PERFORMANCE FOR NEW STATIONARY SOURCES |
| NTS | NOT TO SCALE |
| OC | ON CENTER |
| OPNG | OPENING |
| OSHA | OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION |
| P OR PZ | PIEZOMETER |
| PE | POLYETHYLENE |
| PERF | PERFORATED |
| PERM | PERMEABLE |
| POC | POINT OF CLOSURE |
| PSB | PUBLIC SERVICE BOARD |
| PT | POINT |
| PVC | POLYVINYL CHLORIDE |
| PV | VERTICAL GAS WELL |
| REINF | REINFORCED |
| REQD | REQUIRED |
| ROW | RIGHT-OF-WAY |
| S | STATION |
| SCH | SCHEDULE |
| SDR | STANDARD DIMENSION RATIO |
| SE | SOUTHEAST |
| SEC | SECOND |
| SHT | SHEET |
| SP | SPACING |
| SPEC | SPECIFICATION |
| SS OR SST | STAINLESS STEEL |
| SSR | SIDESLOPE RISER |
| SW | SOLID WASTE OR SOUTHWEST |
| TAC | TEXAS ADMINISTRATIVE CODE |
| TCEQ | TEXAS COMMISSION ON ENVIRONMENTAL QUALITY |
| TYP | TYPICAL |
| TX | TEXAS |
| UNO | UNLESS NOTED OTHERWISE |
| VERT | VERITCAL |
| W/ | WITH |
| W | WEST |

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STATE OF TEXAS
FREDRIC J. DORAN
111226
REGISTERED PROFESSIONAL ENGINEER
11/2/12

DESIGNED TLK
DRAWN CAD
VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
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| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 1 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

ABBREVIATIONS AND LEGEND

PROJECT NUMBER: 963150D115
SHT. 2 OF: 78
DRAWING NUMBER: PO-2

Koller, Tonya L. 10/16/2012 3:01:40 PM -- P:\00218000 el paso tx\963150D115\data analytical\CADD\PO-2 ABBREVIATIONS AND LEGEND.dwg

# Section 3.1
# SITE DEVELOPMENT PLAN NARRATIVE
30 TAC §330.63(a)

A Site Development Plan has been provided as Part III of this MPA application submittal as per the regulations set forth in 30 TAC §330.63. The following Section 3.1 provides a narrative which includes the criteria that, in the selection and design of the facility, will provide for the safeguarding of the health, welfare, and physical property of the people and the environment. This is accomplished through consideration of the site geology and soil conditions, drainage, land use, zoning, and adequacy of access roads and highways.

## 3.1.1 Site History

The Landfill is located approximately 20 miles northeast of downtown El Paso near the intersection of McCombs Road and Stan Roberts (FM 2529). The limits of the facility are approximately defined as McCombs Road to the west, Stan Roberts (FM 2529) to the south, State Highway/County Road 293 to the north, and vacant desert land to the east.

The McCombs Landfill was originally permitted on August 13, 1976 under Permit No. 729 for operation on 25 acres. A permit amendment was issued on May 30, 1984 which increased the total permitted area from 25 acres to 327 acres (327.292 acres in Section 6, Block 80, Township 1, Texas and Pacific Railway Survey, per the site legal description). The facility ceased regular solid waste disposal activities on February 3, 2005 and has only received limited waste since this time from City clean-up projects and storm events. Prior to landfilling operations, the site was owned by Prices Producers, Inc. (Prices). The City of El Paso purchased the property from Prices in September 1954. The site was subsequently leased to El Paso Sand Products to be used for aggregate mining.

Previous landfill activities were confined to approximately 95.2 acres (74.7 acres unlined and 20.5 acres lined (Phase I/II)) of land on the southwest quadrant of the permitted facility as well as existing Sector A (17.4 acres). A paved access road just north of the intersection of McCombs Road and Stan Roberts (FM 2529) provides access to the landfill facility.

## 3.1.2 Permit Amendment Overview

This MPA application develops a vertical expansion of the Landfill from a current maximum height of 4,125 feet MSL to 4,305 feet MSL. This corresponds to an increase in capacity of 47,084,981 CY from a previously permitted volume of 22,348,549 CY to a new permitted volume of 69,433,530 CY. The expansion will apply to all areas of the landfill, including the previously-filled 95.2 acre area in the southwest corner. 64.0-acres will have a piggyback liner, as described in Section 3.4 and portrayed on drawing P3-28B in Appendix 3G, Attachment 4. 11.5 acres will not

receive liner as they are the sideslopes of the expansion area and will not receive any MSW waste. 20.5 acres (currently Subtitle D lined Phase I/II) will continue to be used for MSW disposal (including RACM disposal as described in Section 4.9.22), but at an increased elevation. The additional acreage between the previous southwest area (95.2-acres) and the new total acreage in the southwest area (96.0-acres)is the acreage that previously existed between the unlined and lined areas (Phase I/II).

This vertical expansion will not involve excavation below the previous permitted elevations for the Landfill.

This MPA also increases the property/facility area from 327.292 acres (as described in Section 3.1.1) to 346.74 acres within Section 6, Block 80, Township 1, Texas and Pacific Railway Survey. An updated metes and bounds is provided in Appendix 1C. It should be noted that the increase is only for the property/facility boundary and the permitted waste footprint size is not increasing.

## 3.1.3 Geology and Soil Conditions

A detailed discussion of the geology and soil conditions at the Landfill can be found in Appendix 3K – Geology of this MPA application.

The Landfill is located on deposits of the Hueco Bolson, probably Camp Rice Formation. The Camp Rice Formation unconformably overlies the Fort Hancock Formation and is primarily composed of gravel, sand, silt and occasional discontinuous lenses of volcanic ash. The Camp Rice Formation is composed of two basic subdivisions, a fluvial and a piedmont facies. The fluvial facies is chiefly sand to pebbly river-channel deposits with subordinate fine-grained overbank units. This facies thickens toward the bolson axes and commonly wedges out against the piedmont facies. The permitted landfill area is probably underlain by fluvial deposits of the Camp Rice Formation.

The Hueco Bolson deposits primarily consist of clay, sand, and gravel, with some caliche. The landfill site is underlain by Tertiary and Quaternary basin (bolson) deposits, overlain by areas of gravel and caliche rimrock. Recent Quaternary alluvial deposits are also present in the landfill vicinity in topographically low areas.

In general, the relatively clean sand and silty sand are non-plastic, while clayey sand ranges from low to high plasticity. Permeability tests were not considered necessary based on the soil types encountered during the site characterization. Estimated coefficient of permeability are between 0.01 and 0.04 centimeters per second (cm/sec).

## 3.1.4 Surface Water and Drainage

The complete Facility Surface Water Drainage Report can be found in Section 3.3 of this MPA application submittal.

The stormwater on site is directed away from active portions of the landfill by ditches designed for the 25-year 24-hour storm event. The ditches direct water to the three onsite stormwater retention ponds (A, D, and E). These ponds are designed to hold the 100-year 24-hour storm event as well as contingency storage for sediment.

Four ponds will exist in the final cover condition (A, B, C, and E). Perimeter ditches will be constructed as the intermediate elevations increase above existing grade. These ditches will direct water to the retention ponds where they will retain the 100 year 24-hour event and sediment. The landfill will provide care and management, both during construction and long term, of soil erosion and control of sediment due to surface water.

The care and management of soil erosion and sedimentation is outlined in Appendix 3B – Surface Water Drainage Analysis. The facility will prevent discharge of pollutants to waters of the state. There are no waters of the United States or Corps of Engineers' jurisdictional waters of the state on site therefore no Section 404 permit is required. The McCombs Landfill submitted a notice of intent (NOI) to comply with the TPDES Multi-Sector General Permit relating to stormwater discharge and received Permit No. TXR05L795 from the TCEQ on October 28, 2011. A copy of this permit is included in Appendix 2D – TPDES Multi-Sector General Permit.

## 3.1.5 Land Use and Zoning

A detailed analysis of the land use and zoning of the area immediately surrounding the Landfill is included in Appendix 2B – Land Use Analysis of this MPA application. As described in this analysis, the Landfill is located within the City limits approximately 10 miles northeast of downtown, and lies within 500 feet of the Texas-New Mexico border.

In Texas, the land surrounding the landfill is predominately zoned for light or heavy industrial use, or as a ranch or farm district. From El Paso county plat records and from a visual survey conducted on November 10, 2010, the land immediately surrounding the landfill is primarily owned by the City and is mostly undeveloped.

In New Mexico, the surrounding land use is zoned as a Performance District (PD). According to the Dona Ana County Land Use Regulations and Zoning Ordinance, the purpose of zoning a region as a PD is to allow flexibility for land use activities in the rural areas of the County by acting as a mixed use zone.

No schools, licensed day-care facilities, churches, hospitals, cemeteries, or lakes were identified through visual survey or parcel records within one mile of the Landfill. One man-made pond was identified approximately 1,800-feet east of the facility. The pond is part of the CEMEX quarry area for stormwater control and is dry most of the year. It should also be noted that due to ongoing quarry operations, the size, number, and location of man-made ponds may vary at different times during mining operations.

## 3.1.6 Access Roads and Highways

A traffic impact analysis (TIA) completed by the City of El Paso has been included in Appendix 2C – Traffic Analysis of this MPA application.

The TIA explored the impact of the background traffic growth with the addition of the Landfill traffic to determine the level of mobility (LOM) for McCombs Road, the main access road for the site. As stated in the analysis, McCombs Road between State

## 3.2.1 Facility Access and Site Security

All public access will be controlled to minimize unauthorized traffic, illegal dumping and exposure to hazardous materials. Access to the Landfill will be restricted by existing barbed wire fencing along the perimeter of the facility as well as a locking gate at the facility entrance. These measures will act as deterrents for unauthorized entry during and outside of normal Landfill operating hours. Existing earthen berms along the western and northern boundaries of the Landfill also act as natural deterrents and provide a method of visual screening. The City will install debris netting as needed along the facility boundary.

During times in which the Landfill is accepting waste, access to the Landfill will be restricted to designated Landfill personnel, approved waste haulers, and citizens who have been properly identified by Landfill personnel. Citizens will be directed to a public drop-off area (PDA) and may only be granted access to the working face under the direction of Landfill staff.

## 3.2.2 Waste Movement

As noted in Section 2.2.1, the Landfill will accept MSW as defined by 30 TAC §330.3, inert construction and demolition waste (Class 3 like), and several types of special wastes. Special wastes accepted include Class II industrial waste and municipal commercial waste such as treated medical waste, processed grease/grit trap waste, dead animals, slaughterhouse wastes, and petroleum-product or crude oil contaminated soil. The Landfill also intends to accept RACM. The specific procedures for acceptance, processing and disposal of these wastes are described in Part IV – Site Operating Plan of this MPA application submittal.

Drawing P3-1 shows the general waste movement flow chart for the Landfill. As can be seen from this drawing, all waste will enter the Landfill through the site entrance and will be screened and documented by the scale house attendant. The scale house attendant will be knowledgeable in the types of waste that are accepted and not accepted at the Landfill and will direct each waste hauler to the appropriate area for processing and disposal. Landfill personnel will have the authority to reject any waste that cannot be accepted at the facility. Haulers identified as sources of identified prohibited waste will be responsible for removing the prohibited waste from the Landfill.

In the event that unauthorized waste is not discovered until after the waste hauler has left the Landfill, the waste will be separated and controlled as necessary. Landfill personnel will make an effort to identify the source of the unauthorized waste and have the waste hauler return to the site to remove the waste. If a positive identification cannot be achieved, Landfill personnel will notify the TCEQ and seek guidance on

practical disposal of the waste. A record of the removal of unauthorized waste will be kept in the Site Operating Record.

### 3.2.2.1 Public Drop-Off Area

All residents and some commercial haulers will be directed to the PDA to dispose of wastes in roll-off containers. Trained Landfill personnel will be positioned at the public drop-off area and working face to visually screen for prohibited items.

### 3.2.2.2 Bulky Items Storage

Customers disposing of bulky items and white goods will be directed towards the public drop-off area for unloading (as identified on Drawing P3-17). Acceptable bulky items and white goods include automobiles, metal tanks, large metal pieces, and household appliances that have had all chlorinated fluorocarbons (CFCs) removed in accordance with 40 CFR §82.156(f). These items will be recycled by a permitted salvage company under contract with the City.

## 3.2.3 Sanitation and Water Pollution Control

As described in Section 3.3 – Facility Surface Water Drainage Report, the Landfill will retain all stormwater collected from the property in on-site collection ponds. These ponds are designed to hold the runoff from the facility during the 100-year storm event with 25 percent emergency capacity as well as the volume of silt generated from the drainage area.

Stormwater runoff from the covered waste mass (i.e., not active) will be collected in v-ditches around the perimeter of the landfill. These v-ditches are designed to convey the 25-year storm event for each drainage basin and will direct the stormwater runoff into existing stormwater retention ponds. The retention ponds on site do not have an outlet structure and will drain down via infiltration (or evaporation). Stormwater runoff from the active waste mass will be contained with site run-on/runoff berms as described in Appendix 3I and will be treated as leachate.

Containment areas for the public drop-off area are identified on the Moreno Cardenas Drawing C13 (Appendix 3E). Additionally calculations for storage capacity as well as high water and top elevation for the containment ponds are provided on the drawing.

### 3.2.3.1 Public Drop-Off Area and Bulky Items Storage

Stormwater from the PDA will be conveyed to stormwater retention ponds located in the entrance facility area (Drawing P3-17 in Appendix 3E). Interior roads leading from the entrance of the facility to the grade-separated PDA will be paved using asphalt. The area under the roll-off containers will be paved with concrete. Both the asphalt and the concrete will be sloped to prevent ponding and to encourage the conveyance of water to the stormwater retention ponds.

## 3.2.4 Endangered Species Protection

Correspondence with the Texas Parks and Wildlife Department and the U.S. Fish and Wildlife Service regarding the identification and protection of endangered and threatened species is provided in Section 2.10 and Appendix 2F. Landfill staff will follow the recommendations specified if a species identified is encountered during excavation or filling operations.

This report has been prepared consistent with the requirements of 30 TAC §330.301-330.307. Included in this report are pre-developed, existing, and developed drainage area maps along with erosion control measures and drainage control features. Also provided are hydrologic calculations for pre-developed, existing and developed Landfill conditions. These calculations demonstrate that there is no significant alteration in drainage patterns due to the development of the Landfill. During all phases of construction, the Facility will be constructed, maintained and operated to ensure that run-on and runoff during the 25-year storm event is controlled within the site.

# 3.3.1 Drainage Analysis

## 3.3.1.1 Concepts and Methods

The hydrologic and hydraulic methods employed in this report are consistent with TCEQ regulations. The criterion used is located in the Texas Department of Transportation Bridge Division Hydraulic Design Manual (DOT Drainage Manual). The hydrologic and hydraulic analyses were performed using the Rational Method and Manning's Equation respectively. The Rational Method is based on the maximum flow rate from a drainage area being produced by flows at a given rainfall intensity contributing to the flow at the point of discharge.

The Rational Method equation (in English Units) is as follows:

$Q = CIA$

Where:

Q = Flow rate of Discharge, in cubic feet per second (cfs)

C = Runoff Coefficient, which is unitless

I = Rainfall Intensity, in inches per hour (in/hr)

A = Drainage Area, in acres

The Intensity (I) for a rainstorm is determined from the formula (in English units):

$I = b/[T_c+d)^e]$

Where:

I = Rainfall Intensity, in inches per hour

$T_c$ = Time of Concentration, in minutes (Calculated using the Watershed Lag Method)

e,b,d = Coefficients for specific frequencies, unitless

The runoff coefficient, C, is based on the topography, land cover, and land development of the contributing drainage area. Values of C from the DOT Drainage Manual are shown in Appendix 3B, Attachment 1 – Stormwater Calculations.

The rainfall intensity, I, is based on the time of concentration, $T_c$, in minutes. This is the time it takes the runoff to flow from the furthest point in the drainage area to the point of discharge.

The coefficients used for El Paso County, as obtained from the DOT Drainage Manual are shown in Appendix 3B, Attachment 1 – Stormwater Calculations.

The 24-hr, 25-yr storm event was used for the design of conveyance facilities and the 24-hr, 100-yr storm event was used for the design of ponding facilities and to check overtopping of conveyance facilities.

The volume of runoff for each drainage sub-basin was found using the NRCS Runoff Curve Number Method as discussed in the DOT Drainage Manual.

The NRCS method is expressed by the following equation (in English units):

$S = (1000/CN)-10$

Where:

S = Potential Maximum Retention (inches)

CN = Curve Number

Runoff Depth is determined from the formula (in English units):

$R = [(P-0.2S)^2]/[P+0.8S]$

Where:

R = Runoff Depth (inches)

P = Precipitation (inches)

A curve number of 68 was used for existing conditions, representing range land conditions. The closed Landfill with the rock armoring was given a conservative curve number of 73 for final developed conditions. The precipitation for the design events as discussed in the DOT drainage manual can be seen Appendix 3B, Attachment 1 – Stormwater Calculations.

## 3.3.1.2 Existing Conditions

The McCombs Landfill is an existing municipal solid waste disposal facility located in Section 6, Block 80, Township 1, within the city limits of El Paso, at the intersection of McCombs Road and FM 2529 (Stan Roberts Sr. Road). The site covers 347 acres and the surrounding areas are largely undeveloped. Located west of McCombs Road is the Public Service Board - El Paso Water Utilities' Sludge Monofill.

The soils in the Landfill area are predominantly Turney-Berino Association, moderately deep over soft caliche, in the Hueco Bolson. The soils are characterized as moderately permeable, having high water-holding capacity, and having a slow runoff

rate. Caliche covers the entire Bolson surface and ranges in thicknesses of immeasurable to 8 feet thick.

Pre-Developed drainage patterns and flow rates are shown on Drawing P3-3 – Pre-developed Drainage Conditions, in Appendix 3C. This drawing and drainage discharge values are from the permit dated April 2002, by Moreno Cardenas and remain the same in the Permit Modification dated April 2009 by Parkhill, Smith and Cooper, Inc. (PSC). The existing drainage patterns and flow rates are shown on Drawing P3-4 - Existing Drainage Conditions, in Appendix 3C. It should be noted that the existing drainage patterns have been updated to include the 19.4 acre site facilities drainage area.

Stormwater runoff is collected in a v-ditch around the perimeter of the existing Landfill units and is directed into one of the site stormwater ponds. Runoff generated to the north and east of the existing Landfill is captured in the mined pit area. Some of the runoff in the northwest corner continues to the site of existing Retention Pond A. Runoff generated to the west and south of the existing Landfill area is conveyed into existing Retention Pond D (located west of the existing fee house) and existing Retention Pond E (located in the southeastern corner of the developed Landfill area). Stormwater from the 19.4 acre site entrance facilities area (existing conditions) generally flows to natural low lying areas infiltrates.

Intermediate and long term erosion stability of this site will be dependent upon the implementation of both structural and non-structural best management practices (BMPs) which are also discussed in Appendix 3B – Surface Water Drainage Analysis.

### 3.3.1.3 Developed Conditions

The Final Drainage Conditions plan, provided in Appendix 3C, Drawing P3-6 shows the final developed conditions. The final contours include four ponds to break up drainage areas (the existing Retention Ponds A and E, and Ponds B and C), and in effect reduce sheet flow and minimize erosion. Existing Pond D is no longer needed as that area is filled to grade and flow is conveyed in a v-ditch to Pond E. Also, the final drainage conditions plan for the site entrance facilities area is provided as Drawing C-13 in Appendix 3E. Stormwater from the site entrance facilities area will be contained in one of six onsite detention areas (labeled as DA-1 through DA-6). All runoff from the site will be contained in onsite retention basins.

A total of eight drainage sub-areas are included in the developed drainage conditions plan as shown on Drawing P3-6 - Final Drainage Conditions. Peak flow rates were calculated for each sub-area and are shown on a table within the drawing. Calculations for peak flow rates are included in Appendix 3B, Attachment 1 – Stormwater Calculations.

Stormwater runoff down the side slopes will be captured by a v-ditch, and directed to one of the four ponds. The perimeter drainage system of v-ditches is designed to convey the 25-yr storm event for each drainage basin. All ditches have also been checked to ensure no overtopping occurs in the 100-yr storm event. Calculations for the perimeter ditch designs are provided in Appendix 3B, Attachment 2 – Ditch Calculations. The earthen v-ditches range in depth from 1.71 to 2.26 feet in depth

with 3H:1V side slopes which includes at least 25% depth of freeboard. Velocities in the ditches range from 3.42 to 6.74 feet per second, as shown in Appendix 3B, Attachment 2 – Ditch Calculations. The ditches with velocities exceeding 4.0 feet per second will require erosion protection, according to maximum non-erodible velocities as published in the USDA-SCS Engineering Field Manual, as outlined in a table on the Final Drainage Conditions drawing (Drawing P3-6).

Culverts will be required to convey water from the existing stormwater Retention Pond E to Pond C, as shown on the Final Drainage Conditions drawing. The culverts were sized by Moreno Cardenas using the Heasted Methods Flowmaster program and are provided in Appendix 3B, Attachment 3. The final drainage conditions of the updated closure plan have been evaluated to ensure the culverts sized previously are adequate. The culverts can be seen on the Final Drainage Conditions drawing and the details as provided previously by Moreno Cardenas are provided on Drawings P3-9 and P3-10 in Appendix 3C.

There are two future retention ponds (B and C) and two existing retention ponds (A and E) for the McCombs Landfill final conditions. The ponds are designed to hold the runoff from the 100-yr storm event, 25% emergency capacity, and silt volume (0.012 ac-ft/acre) generated from the drainage area. Pond A is located in the northwest corner of the site within the 100-year floodplain and retains water from drainage areas DEV-2, DEV-3 and DEV-4. See Section 3.3.2 for a discussion of the 100-Year Floodplain area. This area is not regulated under the Section 404 provisions of the Clean Water Act and the Department of the Army permit is not required. A letter from the Department of the Army, date July 2002, is provided in Appendix 3B, Attachment 4. Pond B is located in the northeast corner of the site and retains water from drainage areas DEV-5 and DEV-6, which includes some minimal offsite run-on storm water from just outside the east property boundary. Pond C is located in the southeast corner of the site and retains water from drainage areas DEV-7, DEV-8 and discharge from Pond E, through three 36 inch culverts, which retains water from drainage area DEV-1. The ponds are shown on Drawing P3-6 - Final Drainage Conditions. Calculations for the pond capacities are provided in Appendix 3B, Attachment 1 – Stormwater Calculations. Results of modeling the culverts from the existing pond are provided in Appendix 3B, Attachment 3 – Culvert Calculations.

Developed drainage patterns do not alter the pre-developed and existing conditions in such a way that hinders off-site areas. The perimeter v-ditches and ponding areas will control all runoff generated within the site. The Landfill retains the stormwater onsite as well as accepts some off-site run-on from adjacent properties located to the north, east and south. The off-site run-on is created by visual screening berms that are located approximately 30 feet beyond the property line. All drainage calculations for the facility (both existing and future conditions) include the additional run-on from these off-site areas.

The mined pit area will act as a natural low-lying infiltration basin during interim phases of Landfill operation (applicable to Sectors A through F). The low-lying areas will be graded during Sector construction so that the drainage is away from the developed Sector, preventing run-on. In addition, as each Sector is developed, delineation berms will be placed around the current Sector to prevent runoff from the

working face and run-on from the surrounding features. Retention Ponds B and C will be developed as fill progresses and interim phases are built (Sectors F and D, respectively); Retention Ponds A and E are already constructed. The site retention basins are designed to handle stormwater during all phases of construction (and also for final closure) for any stormwater runoff that leaves the non-active Landfill footprint. The calculations provided for the site retention basins in Appendix 3B, Attachment 6 are for the final closure condition (i.e., the worst case scenario in which the most runoff will be directed to the retention basins); therefore the basins are adequately sized for all phases of Landfill construction. The site drainage collection, conveyance, and detention structures are designed to operate during all phases of Landfill construction so that the existing drainage patterns will not be adversely altered in accordance with 30 TAC §330.305(a). Existing and final stormwater calculations are provided in Appendix 3B, Attachment 6 – Drainage Calculations. Interim structures include delineation (run-on, runoff) berms as identified on Drawing P3-29, Detail 4. Non-erodible velocities and soil loss calculations during all phases of Landfill construction are summarized in Appendix 3B (calculations are provided in Appendix 3B, Attachment 6 and 5, respectively).

### 3.3.1.4 Erosion and Sedimentation Control Plan

The facility has been designed to prevent discharge of pollutants into waters of the State or waters of the United States, as defined by the Texas Water Code and the Federal Clean Water Act. An Erosion and Sedimentation Control Plan is provided in Appendix 3B. The Landfill supervisor is responsible for maintaining drainage structures to ensure proper working order per the Site Operating Plan maintenance requirements. The Landfill submitted a notice of intent (NOI) to comply with the TPDES Multi-Sector General Permit relating to stormwater discharge and received Permit No. TXR05L795 from the TCEQ on October 28, 2011. A copy of this permit is included in Appendix 2D – TPDES Multi-Sector General Permit.

## 3.3.2 Flood Control and Analysis

There is an area of the Landfill, including existing Pond A, to the northwest corner that lies in the 100-year floodplain as shown on the Flood Insurance Rate Map (FIRM) Panel No. 480214 0004 C and Appendix 3D, Drawing P3-14 - 100-Year Floodplain Map. The zone designation for the floodplain is A1, which is an area of 100-year flood with already determined base flood elevations (BFE's) and flood hazard factors. The BFE's were converted from NGVD29 Datum to the City of El Paso Datum with a factor provided by Land-Mark Professional Surveying Incorporated. As shown on Drawing P3-8, the BFE's are below the site berms located around the site, and therefore the 100-year flood will be diverted around the Landfill site to the north and will not affect stormwater elevations within Pond A nor will the BFE's affect Landfill operations. The FIRM map is provided in Appendix 3D, Drawing P3-13.

Pond A was sized as described above with a storage capacity of 19.77 ac-ft. The 100-year 24-hour storm event contributes 17.67 ac-ft of runoff volume (including 25% emergency capacity and silt volume of 0.012 ac-ft/yr). Note from the high-water elevation provided on the cross sections, at least three feet of freeboard is provided in

accordance with 30 TAC §330.307(b)(1). Pond A was sized to contain the volume of runoff plus a 25% emergency capacity and silt accumulations thus minimizing the impact to the BFEs for the area. The floodplain does not come into contact with the Landfill operational areas as described above.

## 3.3.3 Conclusion

The facility has been designed to comply with 30 TAC §330.301 through §330.307.

This waste management unit design plan for the Landfill addresses all weather operation, identifies the method used for landfilling, identifies the deepest excavation, estimates the waste deposition rate, projects site life, provides cross sections of the Landfill, provides a liner quality control plan, and provides a final cover quality control plan.

# 3.4.1 Landfill Unit Design

## 3.4.1.1 Provisions for All-Weather Operation

30 TAC §330.63(d)(4)(A)

Precautions will be taken to ensure all roads are passable during all weather conditions. New all-weather roads will be constructed as fill progresses in each area of the Landfill. The roads will consist of a compacted layer on the road surface to minimize mud tracking and allow access during all weather conditions. The main access road to the site will be constructed with a top layer of flexible pavement.

## 3.4.1.2 Proposed Landfill Method

30 TAC §330.63(d)(4)(B)

The McCombs Landfill has broken up development into eleven sectors. These sectors are identified as A through K. Drawings depicting this layout, existing site conditions, final fill height, drainage structures, and entrance facilities are provided in Appendix 3E - Site Layout Plans. Area filling will take place in each sector before moving onto the next. The settlement rate will be affected by the method of landfilling, the amount of moisture in the refuse, and by the amount of compaction received. Poor compaction and high lifts would result in more settlement. Decomposition is anticipated to be slow due to the low amount of precipitation received on average in the area. An in-place density of 1,200 pounds per cubic yard (lb/cy) or greater will reduce the amount of settlement.

Excavation side slopes and final side slopes will be no steeper than 3H:1V, and the final top slope will be approximately 7%. Placement of final cover will generally follow the same sequence of development, sector A through K. Closure of each sector will be in accordance with the closure plan provided in Section 3.8 – Final Closure Plan.

## 3.4.1.3 Elevation of Deepest Excavation

30 TAC §330.63(d)(4)(C)

The deepest elevation of excavation will be approximately 4017 feet above mean sea level (msl) in the leachate collection sumps. The minimum waste placement elevation will be approximately 4024 above msl (minimum base elevation of 4022 plus two-feet for protective sand layer). The maximum elevation of final cover will be 4305 feet above msl. The maximum elevation for disposed waste will be 4301.7 feet above msl (for the alternative cover profile). All elevations listed are in City of El Paso vertical datum.

## 3.4.1.4 Estimated Waste Deposition Rate and Site Life

30 TAC §330.63(d)(4)(D)

The estimated rate of disposal was calculated assuming an annual population increase of 2% in growth, and assuming a disposal rate of 497,309 tons per year (in 2014 tonnage) until Clint Landfill closes in 2030. 3,000 tons per year are assumed from 2011 through 2013. After Clint Landfill closes, McCombs Landfill will receive all of the waste that would have previously been received at the Clint Landfill, therefore the disposal rate at McCombs will raise from 45% of the county waste allocation to 100%. The 1990 base population for central, northeastern and northwestern areas of El Paso (areas where solid waste is planned to go to the McCombs Landfill) was used for the growth rate estimation. The population for the above mentioned areas in 1990 was 322,842 people. Using the rate above, and an airspace utilization factor of 1200 lb/cy, the estimated life of the Landfill is to 2059.

The total remaining Landfill volume available for waste disposal in Sector A is approximately 640,890 cubic yards (including waste and daily, intermediate and final cover), which provides capacity through 2014, based on table 3.4H-1 in Appendix 3H - Site Life Projections. The total remaining Landfill volume available for waste disposal including the remainder of Sector A and all subsequent planned sectors (B through K) is 63,469,470 CY, which provides a site life until 2059 or 2060, depending on final cover. Calculations and assumptions for this waste volume and site life are included in Appendix 3H - Site Life Projections.

## 3.4.1.5 Landfill Cross-Sections

30 TAC §330.63(d)(4)(E)and(F)

Cross sections of the Landfill are located in Appendix 3F as drawings P3-19 through P3-24. These sections show the existing ground elevations; anticipated base elevation of excavation; bottom, side slope and vertical fill elevations; permitted fill elevations; existing groundwater monitoring wells; and the liner and cover system elevations. Top of waste elevation; perimeter or toe berm details; gas vents or wells; and groundwater elevations are included by reference to other portions of the permit document. The sections shown are representative of the entire site.

## 3.4.1.6 Liner Quality Control Plan

30 TAC §330.63(d)(4)(G)

A quality control plan for the base composite liner system in accordance with §330.339 is provided in Appendix 3J - Liner Quality Control Plan. The components of the current alternative liner system (Scenario 1) are listed from top to bottom in Table 3.4-1 and components of the proposed alternative liner system (Scenario 2) are listed from top to bottom in Table 3.4-2. It should be noted that the modeling results for both Scenario 1 and Scenario 2 are provided in Appendix 3J.

Table 3.4-1
Components of the Scenario 1 Liner System in Descending Order

| Liner System Component | Description | Thickness |
|---|---|---|
| Protective Cover | Sand with coefficient of permeability greater than or equal to $1x10^{-3}$ cm/sec | 24 inches |
| Geomembrane Liner | Textured HDPE Geomembrane (permeability less than or equal to $2x10^{-13}$ cm/sec) | 60 mil |
| Compacted Soil Liner | Compacted Caliche with a coefficient of permeability less than or equal to $1x10^{-7}$ cm/sec | 6 inches |
| Compacted Soil Liner | Compacted Native Soil or Interim Cover Soil | 6 inches |

Table 3.4-2
Components of the Scenario 2 Liner System in Descending Order

| Liner System Component | Description | Thickness |
|---|---|---|
| Protective Cover | Sand with coefficient of permeability greater than or equal to $1x10^{-3}$ cm/sec | 24 inches |
| Geomembrane Liner | Textured HDPE Geomembrane (permeability less than or equal to $2x10^{-13}$ cm/sec) | 60 mil |
| Geosynthetic Clay Liner | Geosynthetic Clay Liner (GCL) with a coefficient of permeability less than or equal to $5x10^{-9}$ cm/sec | Approx. 0.24 inches |
| Compacted Soil Liner | Compacted Native Soil or Interim Cover Soil | 6 inches |

Section 1.1.2 discusses a liner system where select C&D material will be placed over the existing unlined landfill (referred to as Scenario 3). The existing unlined landfill grade has a varying slope. In order to attain the minimum designed leachate collection slope of 5% to collect and convey leachate to the centrally located leachate collection piping within Sector J, the area over the unlined landfill will be required to be filled.

The design for Scenario 3 includes a 30-foot thick layer of select C&D material (a list of select material is included in Section 2.2.1) to be placed over the existing unlined landfill, overlain by up to 25 feet of uncontaminated fill soil. Drawing P3-26 depicts the maximum C&D fill elevation over the unlined landfill area. A comparison of the existing grade and anticipated C&D and soil fill elevations are shown in Drawing P3-26B. The blue contours shown on this drawing represent "fill" and the green contours represent no fill (i.e. zero feet). The design for the liner base grades are governed by the low area on the east portion of Sectors H and J, and the base grades are designed with a minimum 5% slope. Drawing P3-26C depicts the C&D and soil fill profile over the unlined landfill, showing the leachate collection trench within the east area of Sector J to the west area of Sector J, and the north-south cross section through the leachate collection area in Sector J.

In addition to attain the designed liner base grades to facilitate leachate collection and conveyance, the C&D and soil fill material will also provide surcharging of the underlying waste material, improving the settlement and strength properties of the unlined landfill to provide a more stable area to build the piggyback liner system.

The components for the expansion piggyback liner (Scenario 3) onto the existing unlined MSW area are listed from top to bottom in Table 3.4-3. The expansion piggyback liner will be placed in Sectors H, I, and J (approximately 64 acres, see Drawing P3-28B in Appendix 3G, Attachment 4). Detail drawings of the liner system are located in Appendix 3G - Construction Design Details, Drawing P3-28 – Landfill Base Plan.

Table 3.4-3
Components of the Scenario 3 Liner System in Descending Order

| Liner System Component | Description | Thickness |
|---|---|---|
| Protective Cover | Sand with coefficient of permeability greater than or equal to $1x10^{-3}$ cm/sec | 24 inches |
| Geomembrane Liner | Textured HDPE Geomembrane (permeability less than or equal to $2x10^{-13}$ cm/sec) | 60 mil |
| Geosynthetic Clay Liner | Geosynthetic Clay Liner (GCL) with a coefficient of permeability less than or equal to $5x10^{-9}$ cm/sec | Approx. 0.24 inches |
| Geogrid Stabilization Layer | Uniaxial Layers Placed Perpendicular to One Another | 2 layers |
| Interim Cover Soil | Sand with coefficient of permeability greater than or equal to $1x10^{-3}$ cm/sec | 6 inches |
| Compacted Buffer Soil | On Site Soil | 36 inches |

## 3.4.1.7 Final Cover Quality Control Plan

30 TAC §330.457

A quality control plan for the final cover system is included in Appendix 3O. Detail drawings of the final cover system are provided in Appendix 3G, Drawing P3-33 - Final Cover Plan, and Drawing P3-34 – Final Cover Details. The components of the prescriptive final cover system for lined areas of the Landfill are listed from top to bottom in Table 3.4-4 below. The components of the prescriptive final cover system for unlined areas of the Landfill are listed from top to bottom in Table 3.4-5. The components of the alternative final cover system (for both lined and unlined Landfill areas) are listed from top to bottom in Table 3.4-6.

Table 3.4-4
Components of the Prescriptive Final Cover System in Descending Order (Lined Landfill)

| Cover System Component | Description | Thickness |
|---|---|---|
| Topsoil Layer | Native Topsoil or Rock Armoring | 6 inches topsoil or 4 inches rock |
| Erosion Layer | Earthen Material | 12 inches |
| Flexible Membrane Cover | Textured LLDPE or VLPE Liner | 40 mil |
| Infiltration Layer | Sand with a permeability less than or equal to $1x10^{-5}$ cm/sec | 18 inches |
| Intermediate/Daily Cover | Native Soil | 12 inches |

Table 3.4-5
Components of the Prescriptive Final Cover System in Descending Order (Unlined Landfill)

| Cover System Component | Description | Thickness |
|---|---|---|
| Topsoil Layer | Native Topsoil or Rock Armoring | 6 inches topsoil or 4 inches rock |
| Erosion Layer | Soil with a coefficient of permeability less than or equal to $1x10^{-5}$ cm/sec | 18 inches |
| Intermediate/Daily Cover | Native Soil | 12 inches |

Table 3.4-6
Components of the Alternative Final Cover System in Descending Order

| Cover System Component | Description | Thickness |
|---|---|---|
| Top Layer | Rock Armoring | 4 inches |
| Erosion Layer | Material placed at 90% compaction | 18 inches |
| Support Layer | Material placed at 80% compaction | 6 inches |
| Intermediate/Daily Cover | Native Soil | 12 inches |

## 3.4.2 Storage and Transfer Units

### 3.4.2.1 Citizen's Collection Area

All residents and some commercial haulers will be directed to the PDA to dispose of wastes in roll-off containers. Trained Landfill personnel will be positioned at the public drop-off area and working face to visually screen for prohibited items. Customers disposing of bulky items and white goods will also be directed towards the PDA for unloading. Acceptable bulky items and white goods include automobiles, metal tanks, large metal pieces, and household appliances that have had all chlorinated fluorocarbons (CFCs) removed in accordance with 40 CFR §82.156(f). These items will be recycled by a permitted salvage company under contract with the City.

The geologic data submitted to the TCEQ as part of the 2002 MPA has been reviewed and approved by George Richardson, Professional Geologist in the State of Texas. The geologic data, including the boring logs and cross sections, are located in Appendix 3K – Geology.

An updated Site Characteristics and Monitoring Plan has been developed by Parkhill, Smith and Cooper to conform with the requirements of 30 TAC §330.63(e) (Appendix 3K, Attachment 1).

The information provided within the Geology Report and supporting documents in Appendix 3K generally conforms with the requirements of 30 TAC §330.63(e). This permit amendment includes a request for a vertical expansion of the Landfill but no lateral expansion of the Landfill footprint. Prior to starting work on this permit amendment and during the subsequent permit review and comment period, TCEQ stated, since there is no lateral expansion of the Landfill no additional geologic site characterization is necessary.

# Section 3.6
# GROUNDWATER SAMPLING AND ANALYSIS PLAN
30 TAC §330.63(f)

A Groundwater Sampling and Analysis Plan prepared by Parkhill, Smith and Cooper (PSC) in 2009 has been provided in Appendix 3L – Groundwater Sampling and Analysis. This plan was prepared in accordance with the standards set forth in 30 TAC §330.63(f).

# 3.7.1 Introduction

This landfill gas (LFG) management plan (Plan) has been developed as required by 30 TAC §330.63(g) for the Landfill located in El Paso, Texas. This LFG management plan is consistent with the requirements set forth in 30 TAC §330.371 and provides a site-specific approach for completing LFG management. This Plan describes the existing and potential future LFG management system and discusses the operation and monitoring of these systems, including verification of results, notification procedures, and possible remediation activities. Landfill Gas Management Plans developed by R.W. Beck, dated April 3, 2009, VIVA Environmental, Inc, dated November 27, 2001, and AGRA Earth and Environmental Group, dated April 8, 1994, were used in the development of the following section and are included for reference as Appendix 3M, Attachment 4.

## 3.7.1.1 Purpose

Compliance with §330.371(a) requires landfills to implement a routine LFG monitoring program to ensure that the following conditions are met:

- Concentrations of methane gas does not exceed 1.25% by volume in facility structures (excluding gas control or recovery system components); and
- Concentrations of methane gas does not exceed 5% by volume in monitoring points, probes, or other matrices at the facility boundary.

The purpose of this plan is to provide guidelines for the management of LFG and to provide guidance if the levels of methane exceed the limits specified above. Pursuant to §330.371(c), if methane levels are exceeded, the owner or operator shall take the following steps:

- Ensure protection of human health, and notify the Executive Director, local and county officials, emergency officials, and the public of the exceedance;
- Within seven days of the detection, operating records shall be updated to reflect the concentration of methane gas levels detected and the steps that were taken to protect human health; and
- Within 60 days of exceedance, a remediation plan shall be implemented to control methane gas releases. Copies of the remediation plan shall be placed in the operating record, provided to the Executive Director, and notification to the Executive Director that the plan has been implemented. The remediation plan shall include the nature and extent of the problem and the proposed remedy. After review, the Executive Director may require additional remediation measures.

### 3.7.1.2 General

In accordance with §330.371(d), the Executive Director may establish alternative schedules for demonstrating compliance with subsections §330.371(b) and §330.371(c).

In accordance with §330.371(e), the LFG monitoring and control program will continue for a period of 30 years after certification of final closure of the facility or until the owner or operator receives written authorization to reduce the program. Authorization to reduce LFG monitoring and control shall be based on demonstration that there is not potential for gas migration beyond the property boundary or into site structures. Demonstration shall be supported by collected data and additional studies, as required.

In accordance with §330.371(f), the LFG monitoring and control system shall be revised as needed to maintain current and effective LFG monitoring and control. Post-closure shall not interfere with the function of the LFG monitoring and control systems. Any underground utility trenches that cross the facility boundary shall be vented and monitored regularly.

## 3.7.2 Site Characteristics

In accordance with §330.371(b), the Landfill shall implement a routine LFG monitoring program to ensure the standards of §330.371(a) are met. The type and frequency of monitoring shall be based on the existing site conditions. The minimum frequency of monitoring shall be quarterly.

### 3.7.2.1 Soil Conditions

The site geologic conditions present at the Landfill are discussed in Appendix 3K - Geology.

### 3.7.2.2 Hydrogeologic Conditions

The hydrogeologic conditions present at the Landfill are discussed in Appendix 3K – Geology.

### 3.7.2.3 Hydraulic Conditions

Hydraulic conditions at the Landfill are discussed in Section 3.3 – Facility Surface Water Drainage Report.

### 3.7.2.4 Facility Structures within the Property Boundary

The Landfill has a permit boundary of approximately 347-acres. The existing structures located within the property boundary include the existing gatehouse (fee collection building), the maintenance building and a small storage building. The scale house building shall be monitored quarterly with a hand held gas meter at the base of each exterior wall and ambient air. As part of the facility expansion, it is anticipated

that a new equipment maintenance building and scale house will be constructed to the south of the existing buildings within the property boundary (Drawing P3-17 in Appendix 3E). Any new Landfill structures will be monitored similarly to the existing structures.

### 3.7.2.5 Underground Utilities

Underground utility lines that exist within the future disposal footprint of the landfill will be removed prior to the landfill expansion. No utility lines exist within the current disposal footprint of the landfill. Overhead lines provide electricity and telephone service to the buildings on-site. Consequently, monitoring or reporting of easement for buried utilities is not applicable.

### 3.7.2.6 Offsite Structures

In accordance with §330.371(h), since off-site habitable structures are located within 3,000 feet of the waste placement boundary, a permanent perimeter monitoring system is installed at the Landfill and is discussed in more detail below.

## 3.7.3 Existing Monitoring System

The existing LFG systems consists of gas monitoring probes (GMP) located along the perimeter of the landfill property as well as a landfill gas migration control system (GMCS) located along the western perimeter of the Landfill. The existing systems are shown on Drawing P3-43 in Appendix 3M and are described in further detail below.

### 3.7.3.1 Gas Monitoring Probes

GMP-1 through GMP-8 were installed in 1994. Description of the installation practices and sample boring and well installation logs are provide in the Landfill Gas Management Plan prepared by AGRA Earth & Environmental Group (AGRA) on April 8, 1994.

GMP-9 through GMP-17 were installed in 2001 by VIVA Environmental, Inc. (VIVA). Description of the installation practices, boring logs and well installation logs are provide in the Landfill Gas Management Plan prepared by VIVA on November 27, 2001.

In 2003, GMP-3 was replaced with GMP-3A and GMP-3 was decommissioned, plugged and abandoned. GMP-3A was installed adjacent to GMP-3 at a depth of approximately 67 feet below ground surface (bgs). The City also decommissioned, plugged and abandoned GMP-4, GMP-5, and GMP-6 based on previous TCEQ approval due to the GMPs no longer falling on the outside perimeter of the landfill. The GMPs were abandoned in November 2003.

In 2004, GMP-18 and GMP-19 were installed to eventually replace GMP-2 and GMP-3A, respectively. The current locations of GMP-2 and GMP-3A are too close to the waste limits, and the locations of GMP-18 and GMP-19 are more suitable for gas monitoring at these two locations. GMP-2 and GMP-3A readings have returned to

compliance due to the installation and operation of the active GMCS along a portion of the western perimeter as part of the gas migration remediation plan, but the GMPs have yet to be decommissioned, plugged and abandoned.

Temporary gas monitoring probes GMP-20, GMP-21, and GMP-22 were installed in 2006 to provide additional information on gas migration. Readings taken from the temporary probes have demonstrated that the gas migration issue has been mitigated. These probes are to be decommissioned, plugged and abandoned at a future date.

Boring and well installation logs for GMP-18 through GMP-22 are provided in the Landfill Gas Management Plan prepared by R.W. Beck in 2009.

The permanent Site Methane Monitoring Network currently consists of fourteen (14) GMPs (GMP-1 and GMP-7 through GMP-19) spaced approximately 1,000 feet apart. The GMPs were installed along the permitted area and property boundary. A review of on-site geological/soil data revealed little evidence of any laterally extensive stratographic units which could significantly influence migration of any gases produced within the landfill cells (AGRA, 1994). Additionally, geomembrane liner systems that will exist in future landfill cells should minimize potential for LFG migration away from the landfill footprint.

### 3.7.3.2 Passive Gas Vents

In June 2000, two passive venting wells (PV-1 and PV-2) were installed in order to intercept and vent methane gas prior to reaching GMP-2 and GMP-3. Both venting wells were installed to a depth of approximately 60-feet bgs in order to capture methane gas at depths where the majority of the elevated methane gas levels were detected and may be generated. In 2001, one vertical passive venting well (PV-3) was installed to a depth of 55-feet below grade.

In November of 2003, PV-1A and PV-2A were constructed to help mitigate the high methane readings recorded in GMP-2 and GMP-3. PV-1, PV-1A and PV-2A still exist within in the LFG management system; however, these wells were capped during the installation of the GMCS.

Five additional passive gas vents were installed in 2006 to provide additional gas venting in the area between GMP-2 and GMP-3. PV-3R was a replacement vent of PV-3 installed in 2001. PV-3 was abandoned in November 2003 as it falls within the landfill footprint and was no longer required to reduce methane levels measured at GMP-4.

PV-2 through PV-7 were converted into active gas extraction wells as part of the GMCS construction. The GMCS system is described in more detail in Section 3.7.3.3 below.

It should be noted that existing PVs (capped and active) will likely be decommissioned, plugged and abandoned prior to the vertical expansion on top of the existing landfill, assuming that this section of the existing landfill is no longer producing significant amounts of LFG at that time. However, in the event that the PVs still contain a significant amount of LFG, the PVs will be piped horizontally to

the landfill perimeter for LFG venting/collection. PVs will not be extended vertically through the future expansion landfill geomembrane liner.

The locations of all active and abandoned GMPs and PVs are shown on Drawing P3-42 in Appendix 3M. Table 3.7-1 provides the approximate coordinates, elevations, and installed depths below ground surface at the time of installation of the GMPs and PVs of the existing system.

Table 3.7-1
Existing LFG Monitoring System Monitoring Points

| Reference Point | Date Installed | Northing[1] | Easting[1] | Depth Below Ground Surface | Ground Elevation |
|---|---|---|---|---|---|
| GMP-1 | 1994 | 10738395.3 | 413850.0 | 55-feet | 4086.41[2] |
| GMP-2 | 1994 | 10739603.6 | 413889.0 | 55-feet | 4088.11[2] |
| GMP-3 | 1994 | | Abandoned | | |
| GMP-3A | 2003 | 10740576.6 | 413938.6 | 55-feet | 4096.68[2] |
| GMP-4 | 1994 | | Abandoned | | |
| GMP-5 | 1994 | | Abandoned | | |
| GMP-6 | 1994 | | Abandoned | | |
| GMP-7 | 1994 | 10738660.9 | 415896.4 | 10-feet | 4072.61[2] |
| GMP-8 | 1994 | 10738332.2 | 414822.2 | 55-feet | 4072.38[2] |
| GMP-9 | 2001 | 10738234.7 | 416875.7 | 55-feet | 4078.55[2] |
| GMP-10 | 2001 | 10739228.3 | 417042.1 | 55-feet | 4084.32[2] |
| GMP-11 | 2001 | 10740226.8 | 417080.2 | 55-feet | 4087.33[2] |
| GMP-12 | 2001 | 10741225.2 | 417116.3 | 55-feet | 4082.85[2] |
| GMP-13 | 2001 | 10742226.1 | 417153.5 | 55-feet | 4082.21[2] |
| GMP-14 | 2001 | 10742561.4 | 416214.0 | 55-feet | 4075.69[2] |
| GMP-15 | 2001 | 10742613.3 | 415216.7 | 55-feet | 4067.69[2] |
| GMP-16 | 2001 | 10742664.4 | 414138.6 | 55-feet | 4048.13[2] |
| GMP-17 | 2001 | 10741690.8 | 413989.8 | 55-feet | 4056.37[2] |
| GMP-18 | 2004 | 10739597.9 | 413835.6 | 65-feet | 4086.00[1] |
| GMP-19 | 2004 | 10740582.1 | 413863.0 | 65-feet | 4085.39[1] |
| GMP-20 | 2006 | 10740260.4 | 413927.8 | 65-feet | 4098.00[1] |
| GMP-21 | 2006 | 10739947.8 | 413908.1 | 65-feet | 4094.53[1] |
| GMP-22 | 2006 | 10740120.7 | 413858.4 | 65-feet | 4085.69[1] |
| PV-1 | 2000 | 10739588.0 | 413938.6 | 60-feet | 4092.70[2] |
| PV-1A | 2003 | 10739578.0 | 413938.6 | 55-feet | 4090.00[1] |
| PV-2 | 2000 | 10740520.5 | 413971.0 | 60-feet | 4101.28[2] |
| PV-2A | 2003 | 10740550.5 | 413971.0 | 55-feet | 4093.11[1] |
| PV-3 | 2001 | | Abandoned | | |
| PV-3R | 2006 | 10740452.5 | 414057.0 | 60-feet | 4081.81[2] |
| PV-4 | 2006 | 10740279.1 | 414045.0 | 60-feet | 4102.00[1] |
| PV-5 | 2006 | 10740094.4 | 414034.1 | 60-feet | 4101.72[1] |
| PV-6 | 2006 | 10739890.3 | 414088.3 | 60-feet | 4101.50[1] |
| PV-7 | 2006 | 10739641.6 | 414044.0 | 60-feet | 4090.41[1] |

[1] Northing and Easting locations and ground elevations provided are approximate and based on existing conditions locations and 2011 surveyed contours.
[2] Elevations obtained from VIVA, 2001.

### 3.7.3.3 Gas Migration Control System (Western Perimeter)

Existing gas monitoring probes (GMP-2, GMP-3, GMP-20, and GMP-21) located along the western perimeter of the Landfill have had periodic elevated methane readings above the regulatory limit of 5%. The Landfill was placed under enforcement action by the TCEQ to mitigate the affected GMPs due to the elevated methane readings.

In an attempt to reduce the methane readings, PV-1A and PV-2A were installed in 2003 and PV-3R through PV-7 were installed in 2006 along the western waste limit of the Landfill; however, the passive vents installed were not effective in controlling gas migration toward the affected GMPs. As a result, the City decided to install an active gas migration control system (GMCS) as part of the site gas remediation plan.

The GMCS is an active extraction system to control LFG migration in the affected area. The system is a partial active system, because it was installed only along a distance of approximately 1,000 feet over the northwestern portion of the unlined landfill. Existing PV-2 through PV-7 were converted into active gas extraction wells as part of the GMCS. In addition to the 6 converted extraction wells, the GMCS consists of LFG header and lateral pipes, a condensate sump and pump system, a blower/flare station, a condensate storage tank, and an air compressor system to power the condensate pump system. Since the GMCS system installation and subsequent start up in August of 2009, the GMP readings have been in compliance. If there are methane readings out of compliance in the future, further investigation will be conducted to ensure that the existing system is performing optimally. In the case that the system is running at peak performance and methane readings are still out of compliance, additional PVs may be added to the GMCS network. GMCS details are provided in the R.W. Beck Landfill Gas Management Plan of 2009.

## 3.7.4 Potential Future LFG Management System

### 3.7.4.1 NSPS Requirements

Pursuant to 40 CFR Part 60, Subpart Cc §60.33c, "a State plan shall include control of MSW landfill emissions at each MSW landfill meeting the following three conditions:

1. The landfill has accepted waste at any time since November 8, 1987, or has additional design capacity available for future waste deposition;
2. The landfill has a design capacity greater than or equal to 2.5 million megagrams and 2.5 million cubic meters. The landfill may calculate design capacity in either megagrams or cubic meters for comparison with the exemption values. Any density conversions shall be documented and submitted with the design capacity report; and,
3. The landfill has a nonmethane organic compound emission rate of 50 megagrams per year or more."

### Design Capacity

One threshold for NSPS requirements is the Landfill having a design capacity of 2.5 million megagrams (Mg) or cubic meters. The Landfill design capacity is over the NSPS threshold of 2.5 million Mg.

### NMOCs

Because the Landfill is over the design capacity threshold, nonmethane organic compound (NMOC) monitoring is required at a Tier II level. The last NMOC monitoring event conducted at the Landfill was completed in March 2007. The results from the NMOC monitoring indicate that the maximum NMOC concentration will occur in year 2047 at a concentration of 34.69 Mg (under the 50 Mg threshold). According to the 2007 test results, the Landfill is currently under the annual air emissions threshold of the Federal New Source Performance Standards (NSPS), and as a result, there is no present requirement for the City to install a LFG collection and control system (GCCS) covering the entire landfill. The latest NMOC results are provided in Appendix 3M.

NMOC monitoring will continue, as necessary, in accordance with the site air permit and the Landfill will continue to evaluate the need for an active GCCS based on future NMOC monitoring results.

## 3.7.4.2 Active Gas Collection and Control System

Although the Landfill is currently not required to install an active GCCS system, the following system has been designed with the assumption that the Landfill will either eventually have to comply with NSPS standards, or will choose to install an active GCCS voluntarily to further landfill gas to energy efforts.

The designed active GCCS will consist of a series of wells and piping used to convey LFG to an open flare station for combustion or to a landfill-gas-to-energy conversion system. The GCCS will be constructed in a similar manner to the GMCS and may include some of the same components as the GMCS. GCCS components will include:

- Header/Manifold
- Lateral
- Vertical Gas Wells (GW)
- Cleanout Stations
- Condensate Sumps
- Flare Station

As shown on Drawing P3-39 in Appendix 3M, the GWs were designed at a radius of influence (ROI) of 150-feet. The ROI was developed based on previous experience with similar type soils (silty sand/sandy) and drier waste moisture content. The actual location of the GWs may vary dependent on site conditions at the time of installation.

### 3.7.4.3 Existing System Modifications

Upon Landfill expansion, it is anticipated that GMP-7 will be removed from the monitoring system and that GMP-23 will replace GMP-7 in the monitoring network (Drawing P3-43 in Appendix 3M). GMP-23 will be located on the outside of the Landfill limits, but inside the property boundary. GMP-7 will be decommissioned, plugged and abandoned upon installation of GMP-23. GMP-23 will be installed following the guidelines set forth in Section 4.2 of the AGRA Landfill Gas Monitoring Plan, 1994 (Appendix 3M, Attachment 4).

## 3.7.5 Monitoring Plan

### 3.7.5.1 Perimeter Monitoring

#### Perimeter Monitoring Network

The LFG monitoring probe network at the Landfill includes a total of fourteen existing LFG monitoring probes (GMP-1 and GMP-7 through GMP-19) located along the perimeter of the waste fill area. Locations of the existing GMPs are shown on Drawing P3-43 in Appendix 3M. As mentioned previously, GMP-7 will be replaced with GMP-23 in the permanent monitoring network.

#### Landfill Gas Monitoring Probes

LFG monitoring probes have been installed along the perimeter of the waste fill area. Boring logs and typical construction details for the GMPs have been provided in previous versions of the LFG Management Plan (R.W. Beck 2009, VIVA 2001, AGRA 1994) which are provided in Appendix 3M, Attachment 4. Future LFG monitoring probes will be installed in accordance with the detail shown on Drawing P3-44 in Appendix 3M.

#### Monitoring Procedures

During each monitoring event, the GMPs will be monitored for the following parameters:

- Probe gas pressure at each probe;
- Methane gas concentrations at each probe;
- Barometric pressure during the monitoring event; and
- Ambient temperature during the monitoring event.

Monitoring for gas composition and pressure will be performed using a portable combustible gas indicator capable of measuring the above parameters. Prior to the start of monitoring, the tester shall calibrate monitoring instruments in accordance with the manufacturer's specifications. The instrument is factory calibrated semi-annually. The tester should also record time, temperature, barometric pressure, and weather conditions prior to the start of the monitoring period. Each GMP shall be monitored using the following monitoring procedures:

- Check GMP's integrity;
- Determine pressure within sealed monitoring tube;
- Determine methane concentrations at each location; and
- Record all data on the LFG Monitoring Report Form (Appendix 3M).

### Maintenance Procedures

Each time LFG monitoring is conducted, the sampler will inspect the integrity of the LFG monitoring probes. The sampler will record pertinent information on the LFG Monitoring Report Form provided in Appendix 3M. The LFG Monitoring Report Form will be kept in the Site Operating Record. The sampler will perform the following at each monitoring event:

- Verify that the GMP identification number is clearly labeled on the outer casing or lid;
- Verify that the protective casing is intact and is not bent or excessively corroded;
- Verify that the protective barrier pipes are intact;
- Verify that the working pad is intact;
- Verify that the lock is functional;
- Verify that the hinged cover is in working order; and
- Verify that the inner casing is intact.

If damage or excessive wear to the LFG monitoring probe is observed, it will be reported to the landfill manager and repaired within 30 days of the date damage is observed. If it is not possible to repair the GMP, the LFG monitoring probe will be decommissioned and replaced within 60 days from the TCEQ approval date of the permit modification requesting replacement of the GMP. Upon completion of the replacement GMP, an as-built documentation report including boring and well installation logs will be submitted to the TCEQ.

The combustible gas monitoring instrument will be calibrated and maintained in accordance with the manufacturer's instructions.

## 3.7.5.2 GMCS/GCCS Monitoring

### GMCS Monitoring Network

The gas migration control system network currently consists of 6 active gas wells that were converted from passive gas vents (PV-2 to PV-7). The system was installed to mitigate methane exceedance detected in GMP-2, GMP-3, GMP-20 and GMP-21 along the western perimeter of the unlined landfill area. In the event that the levels of methane increase above regulatory standards in the affected GMPs, expansion of the existing GMCS may occur. It is anticipated that this system will eventually be replaced by the GCCS network.

### GCCS Monitoring Network

The GCCS is anticipated to be installed either upon the landfill reaching NSPS standards requirements or on a voluntary basis. This is dependent both on the current permitted waste capacity (which the landfill is currently exceeding the limits of 2.5 million megagrams or 2.5 million cubic meters) and the current NMOC concentration within the LFG. As described in Section 3.7.4.1, the actual timing for the Landfill reaching NSPS standards is currently unknown and will be dependent on future NMOC monitoring.

### Monitoring Procedures

The GMCS and GCCS are designed to collect LFG and prevent fugitive emissions from the Landfill. Since the rate of LFG production within the landfill varies, the amount of gas withdrawn by the GMCS/GCCS GWs should also be adjusted. During each monitoring event, the Flare (and/or potential gas-to-energy conversion system) will be monitored and the GWs will likely be monitored for the following parameters:

- Gas flow at each location;
- Gas pressure at each location;
- Gas temperature at each location;
- Methane gas concentrations at each location;
- Oxygen gas concentrations at each location;
- Barometric pressure during the monitoring event; and
- Ambient temperature during the monitoring event.

Monitoring for gas composition, pressure, and temperature will be performed using a portable combustible gas indicator capable of measuring the above parameters. Prior to the start of monitoring, the tester shall calibrate monitoring instruments in accordance with the manufacturer's specifications. The GMCS/GCCS will likely be sampled using the following sampling procedure:

- Record date, time and current weather conditions;
- Record initial data from Flare skid;
- Perform GW maintenance check at each GW;
- Record above parameters at each GW;
- Adjust flow through the wellhead at each GW based on the methane and oxygen measurements (if necessary); and
- Record end data from Flare skid.

### Maintenance Procedures

When the GCMS/GCCS monitoring includes the monitoring of the GWs, the sampler will inspect the integrity of the GWs. The sampler will record pertinent information on the LFG Monitoring Report Form which will be placed in the Site Operating Record. The sampler will also observe the wellhead during the monitoring event to

ensure no damage has occurred to the wellhead. If damage or excessive wear to the GW or wellhead is observed, it will be reported to the landfill manager and repaired within 30 days of the date damage is observed. If it is not possible to repair the GW, the Landfill will evaluate the effectiveness of replacing the GW within the gas collection system. If the GW is replaced, an as-built documentation report will be submitted to the TCEQ including boring and well installation logs.

The combustible gas monitoring instrument will be calibrated and maintained in accordance with the manufacturer's instructions.

## 3.7.5.3 Facility Structures Monitoring

### Monitoring Procedures

On-site buildings and structures designed for human occupation will be monitored, at a minimum, quarterly with a portable combustible gas indicator. The buildings shall be monitored quarterly with a hand held gas meter at the base of each exterior wall and also the ambient air.

If methane concentration exceeded allowable limits within structures, the building will be immediate evacuated and ventilated by opening doors and windows and placing a portable blower to blow clean air into the building. Notification consistent with the procedures outlined in Section 3.7.6.2 will be implemented immediately.

### Maintenance Procedures

The combustible gas monitoring instrument will be calibrated and maintained in accordance with the manufacturer's instructions.

## 3.7.5.4 Recordkeeping/Reporting

Field monitoring data records will be placed in the Site Operating Record and maintained onsite for inspection. Field data will be recorded on the LFG Monitoring Report Form provided in Appendix 3M.

## 3.7.5.5 Monitoring Frequency

LFG monitoring probes and facility structures will be monitored quarterly at a minimum. The facility will monitor the locations more frequently if monitoring results indicate that LFG migration is occurring or is accumulating in the structures.

GMCS monitoring is required on a monthly basis; however, Landfill personnel typically monitor on a weekly basis. GCCS monitoring will occur similarly to the GMCS monitoring and shall comply with 40 CFR Part 60, Subpart WWW §60.756.

# 3.7.6 Action Plan

## 3.7.6.1 Initial Response Measures

This action plan has been prepared for the protection of human health in the event concentrations of methane exceed allowable limits as required under 30 TAC §330.371. The action plan will address methane level exceedance measurements for both buildings and perimeter monitoring probes.

### Emergency Action

As defined in Section 3.7.1.1, the first action in the event that methane is detected at levels above regulatory limits is to protect human health. The following actions will be taken to protect human health dependent on the exceedance location.

#### *Permit Boundary*

If methane levels are detected above the regulatory limit in one of the GMPs, the landfill manager will be notified. The immediate emergency response measure will be for the landfill manager to determine if any nearby buildings or structures (including offsite) are at risk and if evacuation of the buildings or structures should be requested.

#### *Structures*

If methane concentration exceeded allowable limits within structures, the building will be immediate evacuated and ventilated by opening doors and windows and placing a portable blower to blow clean air into the building. The landfill manager will be notified of the exceedance, and personnel will not be allowed to reenter the building until additional measurements are taken.

### Verification Procedures

Once emergency action measures have been taken to protect human health, the landfill manager will require monitoring personnel to begin verification procedures. Verification procedures are intended to determine if the methane levels detected are accurate, or if erroneous levels have been detected.

#### *Permit Boundary*

Verification of the detected methane levels above regulatory limits in the GMPs will be conducted within 24 hours using the following procedures:

- Recalibrate gas detection equipment according to manufacturer's recommendations;
- After recalibration of the gas detection equipment, recheck the methane concentration in the GMP; and
- Recheck the methane concentration again within 7 days of the initial reading.

If the measured concentrations of methane are not above regulatory limits in the verification procedure, routine monitoring procedures will resume.

If the follow-up readings suggest that there are methane gas levels exceeding the regulatory limits, notification and remediate procedures must be implemented as described in Section 3.7.6.2 and Section 3.7.7.

*Structures*

Verification of detected methane levels in the facility structures shall be conducted within 24 hours of the exceedance by monitoring methane levels throughout the structure using a portable gas meter. Readings will be taken in each room and in any confined spaces. If any natural gas appliances exist in the structure, they should be checked for leaks.

If concentrations of methane above the regulatory limit are not detected, personnel may return to the structure. Daily follow-up verification readings must be made for a period of one week after the exceedance measurement. If the follow-up readings suggest that there are methane gas levels exceeding the regulatory limits, notification and remediate procedures must be implemented as described in Section 3.7.6.2 and Section 3.7.7.

### 3.7.6.2 Notification Procedures

When methane concentrations are detected above the regulatory limit, notification will be made immediately in accordance with §330.371. Within seven days from the date of an initial reading above allowable limits, the owner shall place in the Site Operating Record:

- Concentration of methane gas levels detected as well as time, date, and location;
- Description of steps taken to protect human health; and
- Information regarding the notifications to the Executive Director, local and county officials, emergency officials, and the public of the exceedance;

Within 60 days, the City shall take the following actions:

- Submit and implement a remediation plan for the methane gas releases that describes the nature and extent of gas migration and proposed remedy to the Executive Director; and
- Provide notification to the Executive Director that the remediation plan has been implemented.
- Place a copy of the remediation plan in the Site Operating Record.

## 3.7.7 Remediation Plan

If verification procedures confirm that the methane levels detected are above the regulatory limits in either an onsite structure or GMP, remediation actions shall be implemented within 60 days of detection. The initial remediation action will be an investigation of the cause of the exceeding methane levels. The investigation will be completed using all or part of the following items:

- Additional gas sampling at the landfill to determine concentrations of methane;

- Soil gas sampling to determine the extent of gas migration beyond the permitted landfill facility;
- Additional or increased GMP monitoring in the area of exceedance;
- Installation of additional GMPs or PVs in the area of exceedance; and
- Installation/expansion of an active LFG collection and control system.

Based on the results of the investigation, the Landfill will determine the appropriate course of action to ensure future methane concentration levels are below regulatory standards. In accordance with 30 TAC §330.371, a remediation plan describing the nature and extent of the problem and the proposed remedy will be submitted to the Executive Director within 60 days of detection that notifies the Executive Director of the plan and that the plan has been implemented. Copies of the remediation plan will be kept in the Site Operation Record. If the remediation plan includes any changes to the LFG Management Plan, approval will be received from the TCEQ prior to implementation.

## 3.7.8 Backup Plan

This backup plan will be applicable under the assumption that the active GCCS is required to be installed under NSPS and has been developed in accordance with 30 TAC §330.371(g)(3). In the event that the GMCS/GCCS breaks down, the backup plan will be to repair the GMCS/GCCS as soon as possible, dependent on weather, contractor, material, and equipment availability. During the repair period, monitoring frequency on the site GMPs will increase to monitoring levels determined at the time of repair.

The Final Closure Plan has been prepared in compliance with applicable regulations (30 TAC §330.63(h), 330.457, and 330.459) for the McCombs Landfill. Within 180 days of the last receipt of wastes for any MSWLF unit, the owner or operator will complete the installation of a final cover system as permitted, designed and constructed to minimize infiltration and erosion. This final closure plan includes the following:

- A description of the prescriptive final cover design, including methods for installation;
- A description of the alternative final cover design, including justification in accordance with the *Guidance for Authorizing a Water Balance Alternative Final Cover for a Municipal Solid Waste Landfill,* and methods for installation;
- An estimate of the largest area requiring final cover at any time during the active life of the landfill;
- An estimate of the maximum inventory of wastes on-site over the active life of the landfill; and
- A schedule for completing all final cover activities.

A copy of this closure plan will be included in the site operating record.

The Final Contour Map for the Landfill depicting the final contours, site access roads, top and side slopes, and surface drainage features is located in Appendix 3E - Site Layout Plans.

The estimated cost to hire a third party to perform the closure project can be found in Appendix 3N, Attachment 2 - Closure Cost Estimates.

## 3.8.1 Description of Final Cover Design

30 TAC §330.457(e)(1)

The final cover will be applied to areas of the Landfill as they reach final contour elevations shown on the Final Cover Plan in Appendix 3G - Construction Design Details, Drawing P3-33. The prescriptive final cover for areas of the Landfill with a synthetic bottom liner consists of a minimum of an eighteen inch infiltration layer over the intermediate and daily cover layers having a coefficient of permeability less than or equal to $1x10^{-5}$ cm/sec. The infiltration layer is then overlain with a synthetic flexible membrane with permeability less than that of the bottom liner system. Twelve inches of earthen material are then placed, providing the erosion layer. On top of the erosion layer, six inches of vegetative layer (or 4 inches of rock layer) is placed that can support and sustain native plan growth. The rock layer, if used instead of the

vegetative layer, would consist of rounded to sub-rounded river rock, crushed angular to sub-angular rock, or a combination of the two.

The synthetic membrane shall be a minimum of 40 mils (LLDPE) to ensure proper seaming. Drawing P3-34 in Appendix 3G - Construction Design Details, shows details for the prescriptive final cover system design for areas of the landfill that have a synthetic bottom liner. Drawing P3-29 in Appendix 3G details the Typical Landfill Perimeter Section, which shows how the liner is anchored to the existing grades.

An alternative final cover system has been designed for the McCombs Landfill. The alternative cover system includes only soil cover as opposed to a synthetic liner. The system will include the 12 inches of preliminary cover (6 inches of daily cover and 6 inches of intermediate cover) as is in the prescriptive cover, a 6-inch support layer, an 18 inch erosion layer, and a 4-inch top layer consisting of rock armor. The alternative final cover is in lieu of the low permeability soil, synthetic membrane liner and topsoil (or rock) described in the prescriptive cover above. Drawing P3-35 in Appendix 3G provides detail on the alternative final cover profile.

Appendix 3N - Closure Details presents a demonstration of the infiltration equivalency of the two final cover system options and justification for the alternative earth cover in accordance with the "*Guidance for Authorizing a Water Balance Alternative Final Cover for a Municipal Solid Waste Landfill"*.

Appendix 3B, Attachment 5 presents the calculated soil loss for the two final cover system options.

The prescriptive cover sequencing will be different for areas with bottom liner than for those without and both are described below.

### 3.8.1.1 Sequence of the Final Cover Installation

The following provides a general sequencing plan for the prescriptive final cover system installation for the Landfill areas that include a synthetic bottom liner:

- Apply the final six inches of daily cover, and if not closed within 180 days apply six inches of intermediate cover;
- Place 18 inches of earthen material (with a coefficient of permeability less than or equal to 1 X $10^{-5}$ cm/sec) that will serve as the infiltration layer;
- Place 40 mil LLDPE geomembrane;
- Place 12 inches of earthen material that will serve as the erosion layer;
- Place the 6 inch minimum earthen vegetative layer that is capable of supporting and sustaining native plant growth (or place 4 inches of crushed rock or river rock armoring in lieu of 6 inch earthen vegetative layer); and
- Refer to Drawing P3-34 - Final Cover Details, in Appendix 3G for details of this final cover system design.

The following provides a general sequencing plan for the prescriptive final cover system installation for the McCombs Landfill areas that do not include a synthetic bottom liner:

- Apply the final six inches of daily cover, and if not closed within 180 days apply six inches of intermediate cover;
- Place 18 inches of earthen material (with a coefficient of permeability less than or equal to 1 X $10^{-5}$ cm/sec) that will serve as the infiltration layer;
- Place the 6 inch minimum earthen vegetative layer that is capable of supporting and sustaining native plant growth (or place 4 inches of crushed rock or river rock armoring in lieu of 6 inch earthen vegetative layer);
- Refer to Drawing P3-34 in Appendix 3G for details of this final cover system design.

It should be noted that the only area that may receive the prescriptive final cover for areas that do not include a synthetic bottom liner include areas of existing unlined Landfill that will not receive any further waste, the western outside slope of Sector I and the southern outside slope of Sector J. The areas of the slopes for Sectors I and Sectors J are identified on Drawing P3-33B in Appendix 3G, Attachment 4. All other areas will either receive the prescriptive final cover system (with bottom liner) or the alternative final cover system described below.

The following provides a general sequencing plan for the alternative final cover system installation for the McCombs Landfill areas (both with and without a synthetic bottom liner:

- Apply the final six inches of daily cover and 6 inches of intermediate cover;
- Apply 6 inches of support soil compacted to 80%;
- Apply 18 inches of erosion soil compacted to 90%;
- Apply 4 inches of top layer consisting of rock armor;
- Refer to Drawing P3-35 - Alternative Cover Details, in Appendix 3G for details of this final cover system design.

### 3.8.1.2 Site Preparation

Site preparation includes clearing and grubbing vegetation in areas to receive intermediate cover. The intermediate cover will be prepared and graded to meet the criteria set forth in the Final Cover Quality Control Plan. Additional clean fill material from on-site native soil can be used to meet the required contour elevations.

### 3.8.1.3 Prescriptive Final Cover Construction

Testing and Evaluation of the prescriptive final cover system will be completed in accordance with 30 TAC §330.457(c). For the prescriptive cover, the infiltration material will be placed in accordance with the Final Cover Quality Control Plan (located in Appendix 3P) and will be tested at least once per surface acre for coefficient of permeability. Permeability data will be submitted to the TCEQ executive director. A liquid limit (LL) of not less than 30 and a plasticity index (PI) of not less than 15 are required, but lower values of Atterburg limits may be acceptable.

The remaining layers (membrane, erosion and vegetative or rock layers) will be installed in accordance with the Final Cover Quality Control Plan. If rock is chosen as the final layer, it will be graded to provide an interlocking framework for slope stability and to minimize erosion for surface water.

### 3.8.1.4 Alternative Final Cover Construction

Testing and Evaluation of the alternative final cover system will be completed in accordance with the TCEQ Guidance for Authorizing a Water Balance Alternative Final Cover for a Municipal Solid Waste Landfill and findings of the Unsat-H model and report found in Appendix 3N - Closure Details. For the alternative cover, the support layer will be much less dense than the infiltration material utilized in the prescriptive cover. The Interstate Technology and Regulatory Council (ITRC) Alternative Landfill Technologies Team states that a range of 75-85% compaction is best for evapotranspiration monolithic soil final cover systems. This layer will be placed at 80% compaction.

The erosion layer will be installed in accordance to the TCEQ Guidance for Authorizing a Water Balance Alternative Final Cover for a Municipal Solid Waste Landfill and finding of the Unsat-H model and report found in Appendix 3N. This layer will be placed at 90% compaction.

### 3.8.1.5 Final Cover Construction Activities for both Prescriptive and Alternative Systems

A gas venting system will be implemented to dissipate the gas produced by anaerobic degradation of the waste at the site. Drawings P3-41 and P3-42, in Appendix 3M - Landfill Gas Management Details, provide landfill gas venting system details. Any gas collection system used at the site will be designed and installed with approval of the TCEQ.

Erosion and soil loss preventative measures and maintenance will be required for the final cover. Calculations using the Revised Universal Soil Loss Equation (RUSLE) for estimating soil loss on the final cover of the landfill can be seen in Appendix 3B, Attachment 5 – Closure Soil Loss Calculations. Refer to Appendix 3G for slope stability analysis.

## 3.8.2 Largest Area Requiring Final Cover

30 TAC §330.457(e)(2)

The largest open area at the McCombs Landfill at any given time is not expected to exceed approximately 222.8 acres for areas that will ever require final cover. The landfill development plan has been broken into different sections to be constructed over time and therefore smaller sections of the total may be closed individually or collectively as they reach permitted maximum elevations. The largest area of closure is during Sector G development, prior to the closure of Sector F, for which the total open area is 113.2 acres and the incremental closure area is 18.3 acres. Also included

at that time will be 70.8 acres in the existing unlined landfill area and 20.5 acres lined landfill area in the existing Phase I and II areas. The filling sequence is provided in the Appendix 3E - Site Layout Plans.

P3-45 provides the largest open area at any time during site development that will require final cover (222.8-acres). The final cover portrayed is for both the existing and future sector boundary extensions. P3-45 is only applicable at the time of Sector G development (i.e., prior to the development of the piggyback area). It should be noted final cover will not be placed on the existing unlined (70.8 acres) and lined (20.5 acres) areas prior to the piggyback liner unless the Landfill is closed prior to development of the piggyback area (Sectors H-J) and the vertical expansion of Sector K.

## 3.8.3 Maximum Waste Inventory

30 TAC §330.457(e)(3)

Approximately 5,964,060 cubic yards (cy) of waste (and intermediate cover) have been landfilled in the existing completed phases of the Landfill, as of December 31, 2010.

The total Landfill volume was estimated using AutoCAD by comparing the top of geomembrane to the top of final cover. The total remaining Landfill volume available for waste disposal in Sector A is approximately 640,890 cubic yards (including waste and daily**,** intermediate, and final cover), which provides capacity through 2014 based on table 3H-1 in Appendix 3H-Site Life Projections. The total remaining Landfill volume available for waste disposal including the remainder of Sector A and all subsequent planned sectors (B through K) is 63,469,470 CY. Given the remaining capacity above, the remaining estimated life of the Landfill is until 2059. The total volume in place at that time will be 69,433,530 CY.

## 3.8.4 Closure Schedule

30 TAC §330.457(e)(4), 330.457(f), and 330.457(g)

The McCombs Landfill will be efficiently closed by the following procedure:

- The Owner/Operator will provide written notification to the TCEQ within 45 days prior to beginning final closure activities stating their intent to close a section of the facility or the entire facility site. This notice will also be placed in the operating record.
- The Owner/Operator will publish a public notice of final closure in the largest circulating newspaper in the facility area within 90 days prior to beginning final closure activities of the entire facility site. This notice will include name, address, location of the facility, permit number, and date of final receipt of waste. Copies of the final closure plan will be made available for the public to review.

- At least one sign will be posted at the main entrance (and others where appropriate around the site perimeter) following the closure date notifying readers of the final date of closure.
- Barriers shall be installed at all entrances, gates, or access points to the Landfill following closure in order to prevent unauthorized dumping of solid waste.
- Final closure for the entire facility site shall begin no later than 30 days after the date on which the Landfill receives final waste. If the Landfill has remaining capacity and will likely continue to receive additional waste then final closure will continue no later than one year after receipt of final waste. If time beyond the one year is necessary, a request for extension may be submitted to the executive director for review and approval. The request must include documentation demonstrating the site had capacity to receive additional waste and that the owner/operator has taken steps and will continue to take steps to prevent threats to human health and environment from the unclosed portions of the site.
- The Final closure in accordance with this plan shall be completed within 180 of initiation of final closure activities. If it is likely to take beyond 180 days, an extension can be requested in writing to the executive director. The request must include all documentation demonstrating that closure will take longer than 180 days and that the owner/operator has taken steps and will continue to take steps to prevent threats to human health and environment from the unclosed portions of the site.
- Documented certification by an independent licensed Professional Engineer will be submitted to the TCEQ following completion of final closure certifying completion in accordance with the final closure plan and including all documentation necessary for certification of final closure. A copy of the approved certification from the TCEQ will be placed in the operating record.
- Within 10 days of final completion of closure activities for the Landfill, the owner/operator will submit a certified copy of an Affidavit to the Public to the Executive Director. A copy will also be placed in the operating record. The affidavit will include an updated metes and bounds description of the extent of the disposal areas.
- A certified notation will be recorded on the deed to the property the facility is on that will in perpetuity notify a potential purchaser that the land has previously been used as a landfill. The use of this land will be restricted to the provisions specified in Section 3.9 - Post-Closure Plan. The owner/operator will submit a certified copy of the modified deed to the Executive Director and place a copy in the site operating record within 10 days of final completion of closure activities for the Landfill.

## 3.8.5 Final Contour Map

30 TAC §330.457(e)(5)

A final contour map depicting the final contours, 100-year floodplain, and establishing top slopes and sideslopes for the McCombs Landfill is provided in Appendix 3E - Site

Layout Plan, Drawing P3-16. No structural designs for collection and conveyance along the top and side slopes (i.e., berms, dikes, chutes) are recommended as the final cover design meets the requirements for soil loss and non-erodible velocities.

## 3.8.6 Final Closure Costs

30 TAC §330.503

The estimated cost to hire a third party to perform the closure project (for the largest area to ever require final cover, identified in section 3.3.2) can be found in Appendix 3N, Attachment 3 - Closure Cost Estimates.

Additionally, in order to comply with 30 TAC §330.503(b), a copy of the City's current financial assurance cost estimates for the facility are provided in Appendix 3N, Attachment 3.

The Post-Closure Plan has been prepared in compliance with applicable regulations (30 TAC §330.463(b) and 330.465) for the McCombs Landfill. Post-closure care maintenance will begin upon completion of final-closure activities and approval by the TCEQ. This post closure plan includes the following:

- Provisions for groundwater and landfill gas monitoring, leachate collection, and maintenance activities for the final cover system and drainage facilities to be conducted during post-closure care period, and the frequency at which these activities will be performed;
- Provisions for reducing the post-closure care period;
- The name, address, and phone number for the responsible party in charge of the post-closure care activities during the duration of the 30-year post-closure period; and
- Provisions for certification at the completion of the post-closure care period.

## 3.9.1 Post-Closure Monitoring and Maintenance Activities

The period of post-closure will be 30 years unless approval from TCEQ allows a change in duration. The City of El Paso will maintain the right of entry and all right-of-ways to the facility throughout this period. Maintenance activities include annual site inspections (unless otherwise stated below) with a written summary and will consist of, but are not limited to the following:

- Maintenance and/or remediation activities, as needed, to maintain the integrity and effectiveness of the final cover system, site vegetation, and storm water drainage control systems. Activities may include regrading, addition of soil, seeding, and erosion and sedimentation control structure repairs;
- Control surface run-on and run-off in order to minimize erosion of the final cover system. Activities may include regarding, addition of soil, seeding, and erosion and sedimentation control structure repairs or cleaning;
- Control of undesirable vegetation growth on the final cover system;
- Correct the effects of settlement, subsidence, ponded water, erosion, or other events or failures in as much as these situations are detrimental to the integrity of the closed landfill. Activities may include regarding, addition of soil, seeding, or removal of water or sediment;
- Maintain the integrity of on-site structures, roads, gates and fences;
- Maintain groundwater monitoring in accordance with Section 3.6, Groundwater Sampling and Analysis Plan and 30 TAC §330.401–330.421. The monitoring

frequency shall be semi-annual. Parameters to be monitored will be in accordance with 30 TAC §330.419 unless otherwise approved by the TCEQ;

- Maintain and operate the leachate control system in accordance with Section 3.5, Waste Management Unit Design Plan, Appendix 3I, Leachate and Contaminated Water Plan, and 30 TAC §330.331 and 330.333 unless otherwise approved by the TCEQ and leachate no longer poses a threat to human health and the environment;
- Maintain and operate the landfill gas monitoring system in accordance with Section 3.7, Landfill Gas Management Plan and 30 TAC §330.371. Monitoring frequency shall be quarterly unless otherwise approved by the TCEQ;
- Retain the Site Operating Record and documentation of post-closure care activities, including monitoring results and records of inspections and maintenance performed;
- Maintain the required benchmark and landfill markers; and
- Repair/Replace gas probes, gas extraction wells, leachate collection and removal system components, groundwater monitoring system components as necessary.

## 3.9.2 Post-Closure Care Period

The length of the post-closure maintenance period may be decreased or increased by the TCEQ. If the Landfill submits documentation, signed by an independent registered professional engineer, that demonstrates that a reduced period will sufficiently protect human health and the environment, the TCEQ may review and approve a decrease in the post-closure care period. If it is determined that an increased duration is necessary to protect human health and the environment, notification will be given to the Landfill prior to any such change by the TCEQ.

Certification of completion of the post-closure care period and voluntary permit revocation will be in accordance with 30 TAC §330.465 upon completion of the post-closure care maintenance period. The Landfill must submit a documented certification, signed by an independent registered professional engineer, verifying the post-closure care has been in accordance with the approved plan. The submittal shall also include all necessary documentation for certification of completion of post-closure care.

## 3.9.3 Contact for Post-Closure Activities

The following is the current responsible party overseeing the post-closure care maintenance activities for the facility:

The City of El Paso
Environmental Services
7968 San Paulo Drive
El Paso, Texas 79907
Phone: (915) 621-6700
Fax: (915) 621-6711

The person responsible for post-closure care activities is subject to change. In the event there is a change, the TCEQ will be notified.

## 3.9.4 Post-Closure Land Use

Other than open space, there are no proposed uses or plans at this time for the McCombs Landfill following closure. Any proposed uses will be submitted to the TCEQ for review and approval.

## 3.9.5 Post-Closure Costs

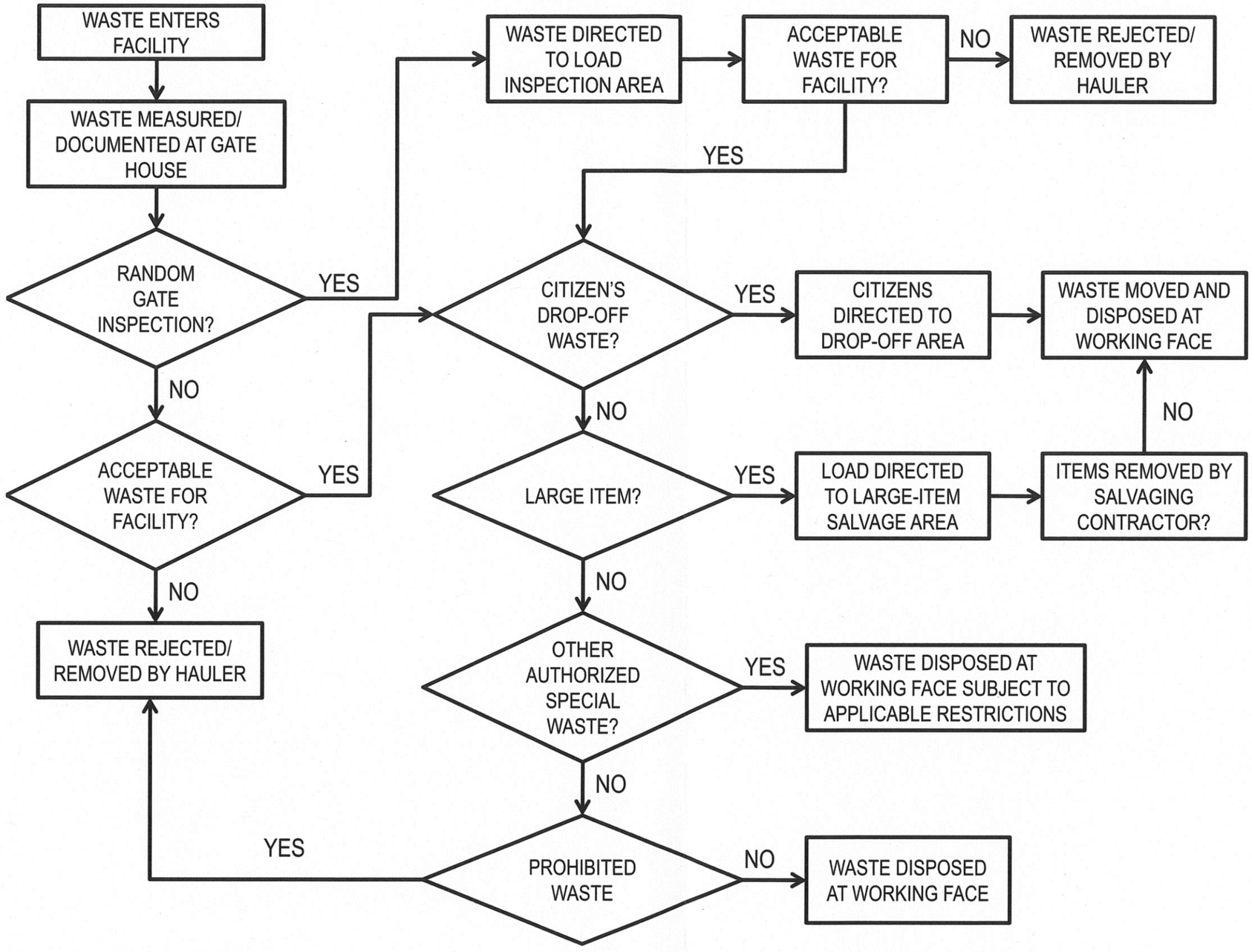
30 TAC §330.507

The estimated costs associated with post-closure care maintenance of the McCombs Landfill can be found in Appendix 3O - Post-Closure Details.

Additionally, in order to comply with 30 TAC §330.503(b), a copy of the City's current financial assurance cost estimates for the facility are provided in Appendix 3N, Attachment 3.

# Appendix 3A
# General Facility Drawings

SAIC®




GRAPHIC SCALE: NO SCALE

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STATE OF TEXAS
FREDRIC J. DORAN
111226
REGISTERED
PROFESSIONAL ENGINEER
11/2/12

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THE CITY OF EL PASO TEXAS

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1380 Corporate Center Curve
Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

WASTE MOVEMENT FLOW CHART

PROJECT NUMBER: 9631500115
SHT. 34 OF: 78
DRAWING NUMBER: P3-1

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## NOTES

1. DIGITIZED TOPOGRAPHY FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS.
2. COORDINATES ARE BASED ON THE TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NAD 83. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM. NAVD 88 DATUM TO NGVD 29 DATUM, SUBTRACT 1.99–FEET. NGVD 29 DATUM TO CITY OF EL PASO DATUM, ADD 27.65–FEET.
3. EXISTING CONTOUR INTERVAL IS TWO FEET.
4. SITE TOPOGRAPHY MAY VARY DUE TO OWNER'S OPERATIONS.
5. REFER TO DRAWING P3–17 FOR PLANNED UPDATES TO ENTRANCE ROAD AND FACILITIES (INCLUDING SCALE HOUSE AND PUBLIC DROP OFF).

## LEGEND

| | |
|---|---|
| MW–3 | MONITORING WELL |
| GMP–8 | GAS MONITORING PROBE |
| GRP | GAS RECOVERY PROBE |
| △ | PIEZOMETER |
| PV–7 | VERTICAL GAS WELL |
| 1*, 1RI, 1 | SOIL BORING, TYPICAL |
| △4 | SURVEY CONTROL POINT |
| W | WATER WELL |
| | BUILDING/STRUCTURE |
| 1500 | ELEVATION CONTOURS |
| —x—x—x— | CHAIN LINK OR OTHER FENCE |
| UGE | UNDERGROUND ELECTRIC |
| OHE | OVERHEAD ELECTRIC UTILITY |
| UGC | UNDERGROUND COMMUNICATIONS |
| GMCS | GAS MIGRATION CONTROL SYSTEM |
| | FACILITY/PROPERTY BOUNDARY |
| | SECTOR BOUNDARIES |
| | STORMWATER RETENTION POND BOUNDARY |
| W W | WATER LINE |
| | HIGHWAY |
| | LANDFILL ACCESS ROAD |
| | SECTION LINE |

GRAPHIC SCALE
1"=250'–0"
250 0 250 500
Scale Feet

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| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

WASTE DISPOSAL, PROCESSING, AND STORAGE SCHEMATIC

PROJECT NUMBER: 9631500115
SHT. 35 OF: 78
DRAWING NUMBER: P3–2

Keller, Tonya L. 10/18/2012 11:00:12 AM – P:\00218000 el paso tx\9631500115\data analytical\CADD\P3–2 WASTE DISPOSAL, PROCESSING, AND STORAGE SCHEMATIC.dwg

# Appendix 3B
# Surface Water Drainage Analysis

SAIC®

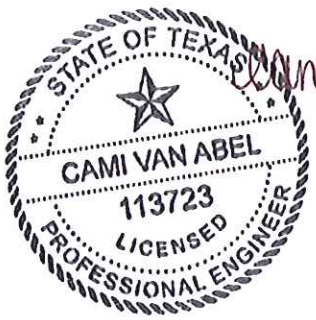
# McCombs Municipal Landfill
# El Paso County, Texas
# TCEQ MSW Permit No. 729B

## Part III
## Appendix 3B
## Erosion and Sediment Control Plan

Prepared for

**City of El Paso**

Updated June 2013, Revision 4




Cami Vanabel
6/3/13

Prepared by

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Texas Board of Professional Engineers
Firm Registration No. 3823

# Part III

# Appendix 3B – Erosion and Sediment Control Plan

## City of El Paso

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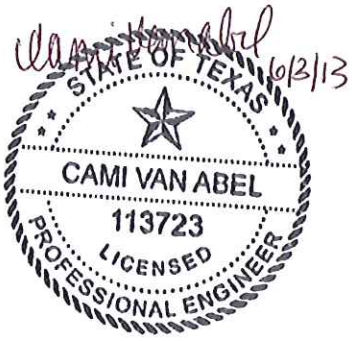

The Erosion and Sedimentation Control Plan has been developed to provide proper management and control measures for existing and developed conditions. These measures will provide management of soil erosion and control of sedimentation due to stormwater runoff.

## 3B.1 Drainage Conditions

The McCombs Landfill is an existing municipal solid waste disposal facility located in Section 6, Block 80, Township 1, within the city limits of El Paso, at the intersection of McCombs Road and FM 2529 (Stan Roberts Sr. Road). The site covers 347 acres and the surrounding areas are largely undeveloped. To the west of McCombs Road is the Public Service Board - El Paso Water Utilities' Sludge Monofill.

The soils in the Landfill area are predominantly Turney-Berino Association, moderately deep over soft caliche, in the Hueco Bolson. The soils are characterized as moderately permeable, having high water-holding capacity, and having a slow runoff rate. Caliche covers the entire Bolson surface and ranges in thicknesses of immeasurable to 8 feet thick.

### 3B.1.1 Existing Conditions

The existing drainage patterns and flow rates are shown on Drawing P3-4 - Existing Drainage Conditions in Appendix 3C.

Stormwater runoff is collected in a v-ditch around the perimeter of the Landfill units and is directed into an existing stormwater pond. Runoff from north of the existing Landfill is currently captured within the mined pit area. Some of the runoff in the northwest corner continues to the site of existing Retention Pond A. Runoff generated to the east is captured in the mined pit area. Runoff generated in the existing landfill areas is conveyed into existing Retention Pond D, west of the existing fee house, and existing Retention Pond E, in the southeastern corner of the developed Landfill area. These exiting stormwater patterns are shown on Drawing P3-4 - Existing Drainage Conditions, in Appendix 3C. Stormwater from the 19.4 acre site entrance facilities area (existing conditions) generally flows to natural low lying areas and infiltrates.

There is an area of the Landfill, including Pond A, to the northwest corner that lies within the 100-year floodplain as shown on the Flood Insurance Rate Map (FIRM) Panel No. 480214 0004 C and Appendix 3D, Drawing P3-14 – 100-Year Floodplain Map. The base flood elevations (BFE's) were converted from NGVD 29 Datum to the City of El Paso Vertical Datum with a factor provided by Land-Mark Professional Surveying Incorporated. As shown on Drawing P3-8, the BFE's are below the site berms located around the site, and therefore the 100-year flood will be diverted around the Landfill site to the north and will not affect stormwater elevations within Pond A

nor will the BFE's affect Landfill operations. The FIRM map is provided in Appendix 3D, Drawing P3-13.

### 3B.1.2 Developed Conditions

The Landfill Completion Plan is provided as Drawing P3-16 in Appendix 3E–and shows all final developed conditions. The final contours include four ponds to break up drainage areas (the existing Retention Ponds A and E, and Ponds B and C), and in effect reduce sheet flow and minimize erosion. Existing Pond D is no longer needed as that area is filled to grade and flow is conveyed in a v-ditch to Pond E.

During construction, temporary diversions and drainage swales will be constructed to prevent unauthorized discharge of surface water and sediment. The final developed conditions will include perimeter v-ditches and ponding areas to control all site stormwater runoff. The retention ponds on site do not have an outlet structure and water will drain down via infiltration or evaporate. Drawing P3-6 in Appendix 3C shows final drainage conditions and controls.

The final drainage conditions plan for the site entrance facilities area is provided as Drawing C-13 in Appendix 3E. Stormwater from the site entrance facilities area will be contained in one of six onsite detention areas (labeled as DA-1 through DA-6). All runoff from the site will be contained in onsite retention basins.

## 3B.2 Erosion and Sedimentation Controls

### 3B.2.1 TPDES Multi-Sector General Permit

The facility has been designed to prevent discharge of pollutants into waters of the State or waters of the United States, as defined by the Texas Water Code and the Federal Clean Water Act. An erosion and sedimentation control plan is provided in Appendix 3C, Drawing P3-11. The McCombs Landfill submitted a notice of intent (NOI) to comply with the TPDES Multi-Sector General Permit relating to stormwater discharge and received Permit No. TXR05L795 from the TCEQ on October 28, 2011. A copy of this permit is included in Appendix 2D – TPDES Multi-Sector General Permit.

### 3B.2.2 Best Management Practices (BMP's) Structural Controls

During construction phases, temporary controls will be implemented for erosion and sedimentation management. Throughout the entire phasing of construction intermediate controls will be implemented and upon final closure permanent erosion control practices will be implemented.

Structural controls may include, but are not limited to, silt fence, earthen diversion berms and dikes, drainage swales, and rip-rap. These structural controls will be implemented as follows:

- Upon final completion of Landfill development and closure, perimeter v-ditches will be constructed to divert stormwater runoff to the ponding areas shown on Drawing P3-11 - Erosion Control Plan. Ditches having velocities that exceed 4 feet per second (fps) will be protected against erosion as required by the maximum

non-erodible velocities as published in the USDA-SCS Engineering Field Manual. The default lining condition for all channels with peak velocity below 4 fps is vegetative lining. For all channels with maximum velocities below 4 fps another structural control option is velocity control. These controls include either ditch checks or sediment logs, and will be placed with appropriate size and spacing to keep the velocity in the channel lower than the maximum non-erodible velocity for the selected cover conditions (1.5 fps for bare soil and 4 fps for vegetation).

- For channels where neither an appropriate lining system or velocity control system, a sediment capture and replenishment system may be used instead. Because each retention pond on the site has been designed to hold a 100-year storm plus a sediment load, these ponds will be used as temporary sediment capture facilities. After each storm event each pond which has an upstream channel which lacks appropriate lining or velocity control shall have captured sediment removed such that the pond remains at the permitted capacity. The removed sediment will be placed in the upstream channels such that they maintain their permitted shape and slope. Suggested capture structures include silt fences, and sediment traps.
- When areas of the Landfill reach final design elevations, proper care will be taken to ensure that the vegetative layer is maintained to support native plant growth or that the rock cover is properly maintained. Intermediate slopes may also be vegetated depending on the length of time the area is exposed prior to commencing final grade preparations. The site will stockpile excess soil that will be used for operations at the Landfill, and thus will vegetate a portion of the stockpile material to prevent soil erosion due to wind and water along with silt fencing measures.
- In accordance with the Final Closure Plan, Section 3.8, a vegetative layer will be established upon final closure to prevent erosion. The soils used for the vegetative layer shall be evaluated for proper nutrient contact for supporting native plant life. Areas requiring intermediate vegetative cover for erosion protection during cool seasons will be mulched and seeded with a fast germination species such as red and/or winter wheat, western wheatgrass, and tall fescue or other species as recommended by local NRCS Texas Agricultural Extension Service Officials.
- Silt fence or earthen berms will be installed around stockpile areas, construction areas, or other areas of open soil to prevent sedimentation to stormwater runoff. Other BMP's as stated above may be utilized during different phases of Landfill development.
- Silt fence, sediment traps, sediment logs, and any other sediment capture devices will be placed at the toe of slope for intermediate cover side slopes which do not receive vegetative cover as a part of a sediment capture and slope replenishment program. For this program all sediment captured by the installed structural controls will be removed from the control and replaced on the slope upstream of the control. Controls will also be placed on the side slopes which will be placed such to keep the flow velocity below 1 fps. The structural controls will be checked for sediment build-up as specified in Table 3B-2.

Parameters for the installation of the structural controls can be found in Table 3B-1.

Table 3B-1
Structural Control Parameters[A]

| Control | Typical Placement | Max Spacing/ Max Drainage Area | Slope Restrictions |
|---|---|---|---|
| Silt Fence | Downstream of disturbed area which has not received permanent erosion controls | 100 ft<br>75 ft<br>50 ft<br>25 ft | 3%-5%<br>5%-10%<br>10%-20%<br>20%-50% |
| Hay Bales | Downstream of disturbed area which has not received permanent erosional controls | 100 ft max spacing | 3:1 max |
| Rock Filter Dam (Type 1) | Toe of slope, around inlets, in small ditches, and swale outlets | 5 acres max | 2:1 max |
| Rock Filter Dam (Type 2) | In larger ditches and at swale outlets | 5 acres max | 2:1 max |
| Rock Filter Dam (Type 3) | In stream flow, attached to the stream bed | 5 acres max | 2:1 max |
| Rock Filter Dam (Type 4) | In ditches and smaller channels | 5 acres max | 2:1 max |
| Ditch Checks | In swales or channels | 5 acre max, spaced for desired velocity | 3:1 max |
| Sediment Logs | In swales, channels, or on slopes | 25 to 50 ft. while slowing flow, 100 ft. once at desired velocity | 2:1 max |

[A] – Table obtained from the Erosion and Sedimentation Control Plan by Parkhill, Smith & Cooper dated July 2009.

### 3B.2.3 Best Management Practices (BMP's) Non-Structural Controls

Non-structural controls include maintenance during daily operations at the Landfill. Any visual evidence of soil erosion shall be addressed by placing addition soil or adding/relocating structural controls. All drainage ways will be inspected for accumulation of sediment and maintained as necessary to ensure proper capacity for stormwater conveyance. The suggested inspection and maintenance schedule and the Controls Installation Schedule are provided in Tables 3B-2 and 3B-3, respectively. It is the Site Supervisors responsibility to ensure that these maintenance activities are completed and controls are in place and operational.

Non-Structural controls include:

- Plans and designs to disturb only the smallest area necessary to perform current activities and to minimize disruption of the natural drainage, topography, and vegetative cover features.
- Phased development to minimize the area of bare soil exposed at any given time.
- Specific plans for the stabilization of exposed surfaces in a timely manner.
- Scheduling of construction activities during the time of year with the least erosion potential.

Table 3B-2 lists suggested maintenance and inspection schedule for the Landfill.

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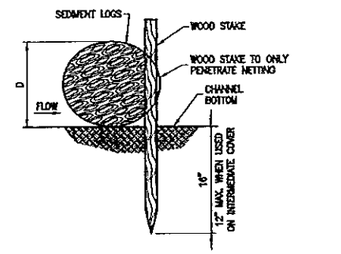
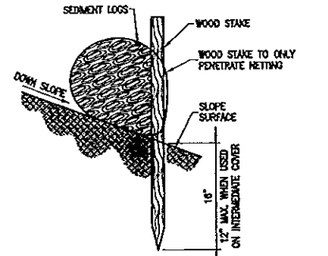
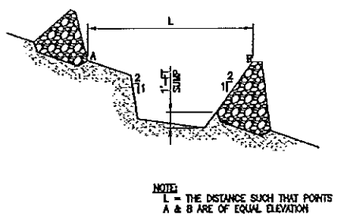


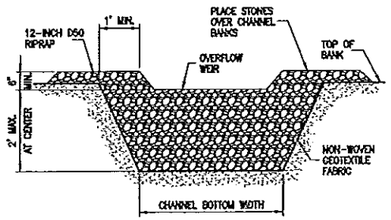

C4 STAKE DETAILS (NO TRENCH)
NO SCALE



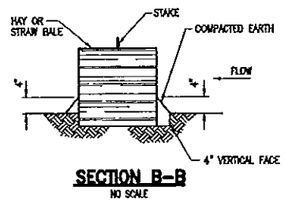

C5 STAKE DETAILS (ON BARE SOIL)
NO SCALE



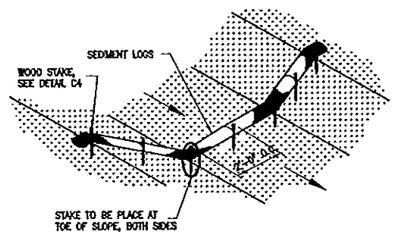

B1 SPACING BETWEEN DITCH CHECK
NO SCALE



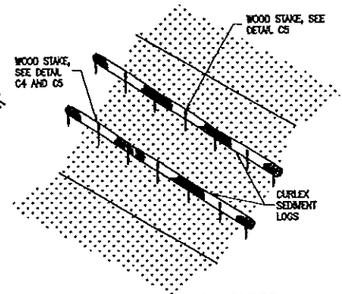

B2 CROSS SECTION A-A
NO SCALE



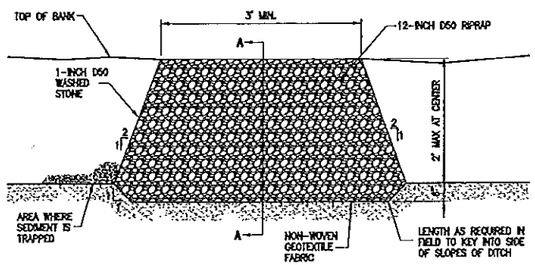

SECTION B-B
NO SCALE



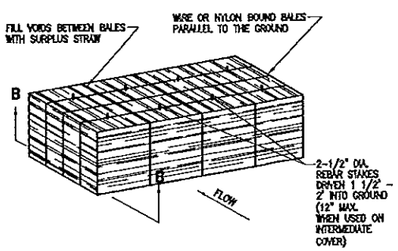

B4 SEDIMENT LOG IN CHANNEL
NO SCALE




B5 SEDIMENT LOG ON SLOPE
NO SCALE




A1 TYPICAL DITCH CHECK SECTION
NO SCALE




A3 STRAW BALE BARRICADE
NO SCALE

$$\left[\text{DISTANCE BETWEEN CHANNEL BOTTOM AND TOP OF INSTALLED SEDIMENT LOGS (D)(ft)} \Big/ \text{CHANNEL GRADIENT (\%)}\right] \times 100 = \text{SEDIMENT LOGS SPACING (ft)}$$

NOTES:
TRENCH OPTION IS MOST APPLICABLE IN LOOSE, UNCONSOLIDATED SOILS.

1 1/8" X 1 1/8" X 30" WOODEN STAKES ARE RECOMMENDED FOR 6", 9", AND 12" SEDIMENT LOGS.

1 1/8" X 1 1/8" X 48" WOODEN STAKES ARE RECOMMENDED FOR 20" SEDIMENT LOGS.

REFER ALSO TO THE SPACING PARAMETERS IN B1, THIS SHEET. SEDIMENT LOGS SHALL BE SPACED ACCORDING TO MANUFACTURER RECOMMENDATIONS AS SHOWN IN TABLE 6-E-1 OR AS SHOWN IN DETAIL B1, WHICHEVER IS SMALLER.

A4 RECOMMENDED PLACEMENT INTERVAL BETWEEN SEDIMENT LOGS
NO SCALE

FIRM REGISTRATION #560

| DATE | REVISIONS | BY |
|---|---|---|
| 07/09 | SUBCHAPTER G PERMIT MODIFICATION | MK |

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ENGINEERING • PLANNING • SURVEYING
500 E. YANDELL EL PASO, TX. 79902 (915)534-4001

ENGINEER'S SEAL

SCALE
Hor. AS SHOWN
Ver. AS SHOWN
DATE 02-18-09
DESIGN BY
DRAWN BY
CHKD. BY
APPD. BY

PROJECT NAME
McCOMBS LANDFILL
TCEQ MSW PERMIT NO. 729B

CITY OF EL PASO

SHEET TITLE
EROSION CONTROL DETAILS

DRAWING
App 3B, F1

# Appendix 3B - Attachment 1
# Stormwater Calculations

SAIC®

McCombs Landfill
MSW Permit No. 729B Major Permit Amendment
Stormwater Runoff Calculations

| Runoff Calculations - Existing Conditions | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Drainage Area ID | Drainage Area (ac) | C value | CN | S | $R_{25}$ (in) | $R_{100}$ (in) | C × A | $T_c$ | $I_{25}$ (in/hr) | $Q_{25}$ (cfs) | $I_{100}$ (in/hr) | $Q_{100}$ (cfs) | $V_{25}$ (ac-ft) | $V_{100}$ (ac-ft) |
| EX-1 | 113.22 | 0.4 | 68 | 4.71 | 0.68 | 1.11 | 45.29 | 126.9 | 0.94 | 42 | 1.13 | 51 | 6.46 | 10.48 |
| EX-2 | 90.57 | 0.4 | 68 | 4.71 | 0.68 | 1.11 | 36.23 | 32.2 | 2.46 | 89 | 2.99 | 108 | 5.16 | 8.39 |
| EX-3 | 129.01 | 0.4 | 68 | 4.71 | 0.68 | 1.11 | 51.60 | 38.7 | 2.19 | 113 | 2.66 | 137 | 7.36 | 11.95 |
| EX-4 | 2.98 | 0.4 | 68 | 4.71 | 0.68 | 1.11 | 1.19 | 31.3 | 2.50 | 3 | 3.05 | 4 | 0.17 | 0.28 |
| EX-5 | 2.14 | 0.4 | 68 | 4.71 | 0.68 | 1.11 | 0.86 | 12.7 | 4.02 | 3 | 5.04 | 4 | 0.12 | 0.20 |
| EX-6 | 10.28 | 0.4 | 68 | 4.71 | 0.68 | 1.11 | 4.11 | 16.5 | 3.56 | 15 | 4.42 | 18 | 0.59 | 0.95 |
| EX-7 | 10.11 | 0.4 | 68 | 4.71 | 0.68 | 1.11 | 4.04 | 39.8 | 2.15 | 9 | 2.61 | 11 | 0.58 | 0.94 |

| Runoff Calculations - Developed Conditions* | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Drainage Area ID | Drainage Area (ac) | C value | CN | S | $R_{25}$ (in) | $R_{100}$ (in) | C × A | $T_c$ | $I_{25}$ (in/hr) | $Q_{25}$ (cfs) | $I_{100}$ (in/hr) | $Q_{100}$ (cfs) | $V_{25}$ (ac-ft) | $V_{100}$ (ac-ft) |
| DEV-1 | 86.56 | 0.4 | 73 | 3.70 | 0.93 | 1.42 | 34.62 | 147.5 | 0.83 | 29 | 1.00 | 35 | 6.68 | 10.25 |
| DEV-2 | 27.60 | 0.4 | 73 | 3.70 | 0.93 | 1.42 | 11.04 | 45.4 | 1.97 | 22 | 2.39 | 26 | 2.13 | 3.27 |
| DEV-3 | 32.77 | 0.4 | 73 | 3.70 | 0.93 | 1.42 | 13.11 | 18.9 | 3.33 | 44 | 4.11 | 54 | 2.53 | 3.88 |
| DEV-4 | 36.96 | 0.4 | 73 | 3.70 | 0.93 | 1.42 | 14.78 | 37.5 | 2.24 | 33 | 2.71 | 40 | 2.85 | 4.38 |
| DEV-5 | 46.63 | 0.4 | 73 | 3.70 | 0.93 | 1.42 | 18.65 | 22.4 | 3.04 | 57 | 3.73 | 70 | 3.60 | 5.52 |
| DEV-6 | 19.52 | 0.4 | 73 | 3.70 | 0.93 | 1.42 | 7.81 | 47.8 | 1.91 | 15 | 2.30 | 18 | 1.51 | 2.31 |
| DEV-7 | 40.71 | 0.4 | 73 | 3.70 | 0.93 | 1.42 | 16.28 | 51.7 | 1.81 | 29 | 2.18 | 36 | 3.14 | 4.82 |
| DEV-8 | 40.50 | 0.4 | 73 | 3.70 | 0.93 | 1.42 | 16.20 | 24.0 | 2.93 | 47 | 3.59 | 58 | 3.12 | 4.80 |

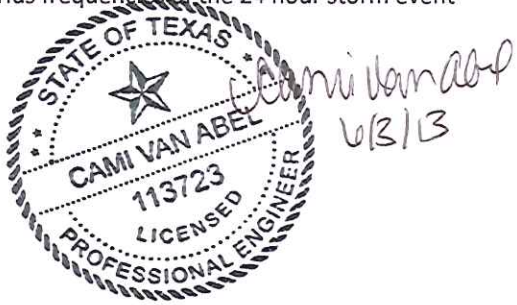
* Refer to Drawing C-13 in Appendix 3E for Entrance Road and Entrance Facilities drainage calculations

| | 25 yr | 100yr | | 25yr-24hr | 100yr-24hr |
|---|---|---|---|---|---|
| e[a] | 0.843 | 0.825 | P[b] | 3.11 | 3.85 |
| b[a] | 60 | 65 | | | |
| d[a] | 12 | 9.5 | | | |

[a]e, b, and d coeffients are provided in the Hydrology section of the Hydraulic Design Manual for Texas counties for various frequencies and are based on the rainfall-frequency-duration data contained in the National Weather Service Technical Paper 40 (TP 40)

[b]Accumulated Rainfall (P) is provided in the NRCS section of the Hydraulic Design Manual for Texas counties for varius frequencies of the 24 hour storm event

| | | |
|---|---|---|
| Calculation by: | JSR | 6/3/13 |
| Checked by: | CAV | 6/3/13 |

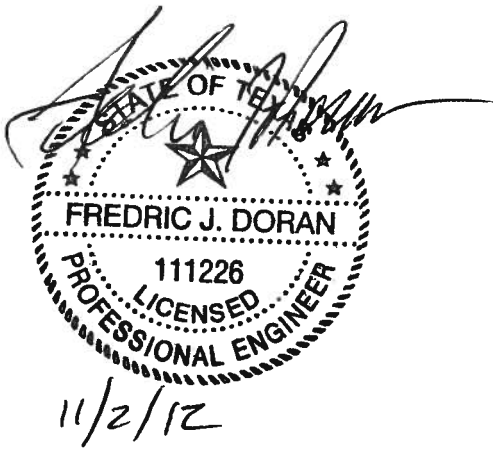


McCombs Landfill
MSW Permit No. 729B Major Permit Amendment
Pond Storage Calculations

| Pond A, 100 yr-24 hr Event | |
|---|---|
| DEV-2 Volume (ac-ft) | 4.40 |
| DEV-3 Volume (ac-ft) | 3.93 |
| DEV-4 Volume (ac-ft) | 4.50 |
| Silt Volume (ac-ft) | 1.30 |
| Emergency 25% Capacity (ac-ft) | 3.53 |
| Total Capacity Required (ac-ft): | 17.67 |
| Total Capacity Provided (ac-ft): | 19.77 |

| Pond B, 100 yr-24 hr Event | |
|---|---|
| DEV-5 Volume (ac-ft) | 6.30 |
| DEV-6 Volume (ac-ft) | 1.76 |
| Silt Volume (ac-ft) | 0.82 |
| Emergency 25% Capacity (ac-ft) | 2.22 |
| Total Capacity Required (ac-ft): | 11.10 |
| Total Capacity Provided (ac-ft): | 53.12 |

| Pond C, 100 yr-24 hr Event | |
|---|---|
| DEV-7 Volume (ac-ft) | 4.43 |
| DEV-8 Volume (ac-ft) | 4.17 |
| DEV-1 Volume (ac-ft) through Ex Pond | 9.72 |
| Silt Volume (ac-ft) | 1.86 |
| Emergency 25% Capacity (ac-ft) | 5.05 |
| Total Capacity Required (ac-ft): | 25.23 |
| Total Capacity Provided (ac-ft): | 56.63 |



11/2/12

| Existing Pond E, 100 yr-24 hr Event | |
|---|---|
| DEV-1 Volume (ac-ft) | 9.72 |
| Silt Volume (ac-ft) | 0.98 |
| Emergency 25% Capacity (ac-ft) | 2.68 |
| Total Capacity Required (ac-ft): | 13.38 |
| Total Capacity Provided (ac-ft): | 27.02 |

| | | |
|---|---|---|
| Calculation by: | JSR | 11/02/2012 |
| Checked by: | FJD | 11/02/2012 |

# Appendix 3B - Attachment 2
# Ditch Calculations

SAIC®

McCombs Landfill
MSW Permit No. 729B Major Permit Amendment
Calculation for Ditch Sizing

# Channel 1

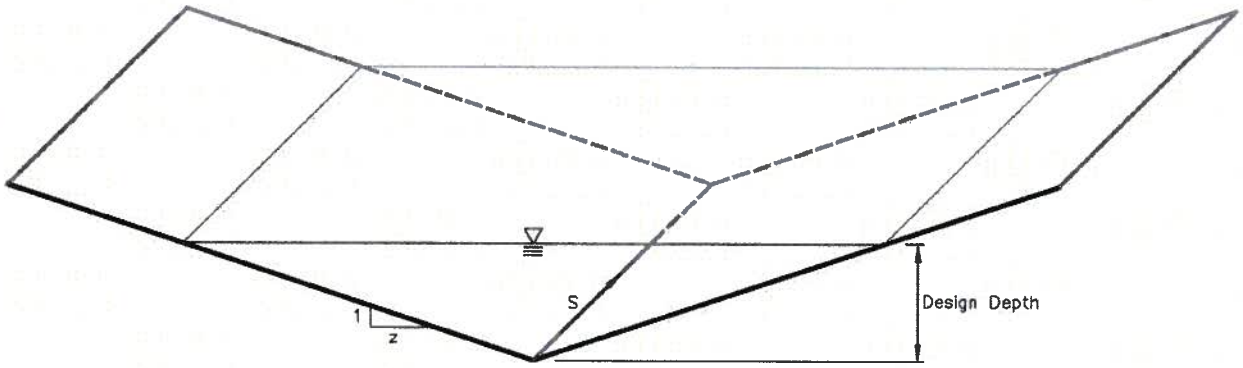
Design Depth

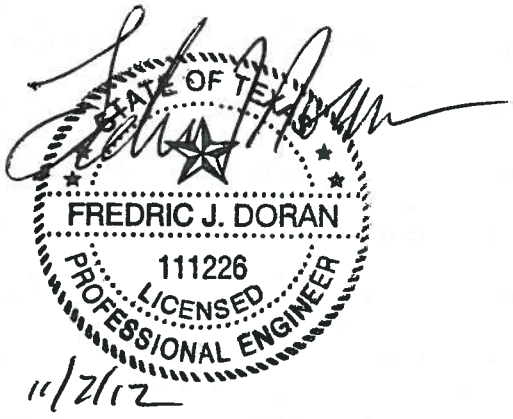
| DEV-1 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 25-year | | | | | | | | | | |
| Q | n | S | z | d | A | Pw | R | V | Qcheck | Design Depth (ft.) |
| 41 | 0.03 | 0.01 | 3 | 1.76 | 9.29 | 11.13 | 0.83 | 4.40 | 40.91 | 2.26 |
| 100-year check | | | | | | | | | | |
| Q | n | S | z | d | A | Pw | R | V | Qcheck | Overtops? |
| 48.77 | 0.03 | 0.01 | 3 | 1.88 | 10.58 | 11.88 | 0.89 | 4.60 | 48.66 | no |

Design Velocity

| DEV-1 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 25-year | | | | | | | | | |
| Q | n | S | z | d | A | Pw | R | V | Qcheck |
| 41 | 0.03 | 0.01 | 3 | 1.76 | 9.29 | 11.13 | 0.83 | 4.40 | 40.91 |
| 100-year check | | | | | | | | | |
| Q | n | S | z | d | A | Pw | R | V | Qcheck |
| 48.77 | 0.03 | 0.01 | 3 | 1.88 | 10.58 | 11.88 | 0.89 | 4.60 | 48.66 |

| Legend: | | |
|---|---|---|
| Q = | Flow Rate (cfs) | Q = VA |
| n = | Roughness Coefficient | Mannings Number |
| S= | Slope of Ditch (ft/ft) | Design Value |
| z = | Side Slope of Ditch (ft/ft) | Design Value |
| d = | Ditch Depth (ft) | Design Value |
| A = | Ditch Cross-Section Area ($ft^2$) | $A = z*d^2$ |
| Pw = | Wet Perimeter (ft) | $Pw = 2*\sqrt{(z^2+1)}*d$ |
| R = | Hydraulic Radius (ft) | R = A / Pw |
| V = | Velocity (ft/s) | $V = (1.49/n)*R^{2/3}*\sqrt{s}$ |




11/2/12

| | | |
|---|---|---|
| Calculation by: | JSR | 11/02/2012 |
| Checked by: | FJD | 11/02/2012 |

McCombs Landfill
MSW Permit No. 729B Major Permit Amendment
Calculation for Ditch Sizing

## Channel 2

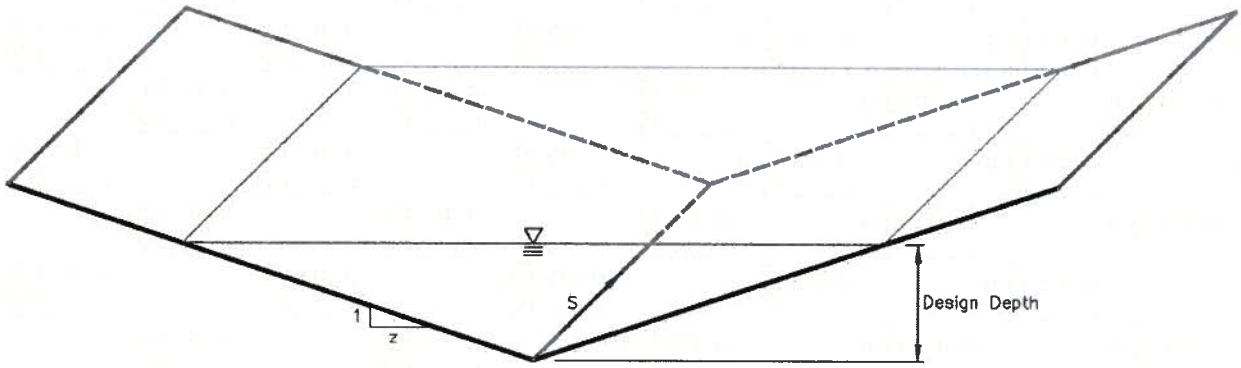
Design Depth

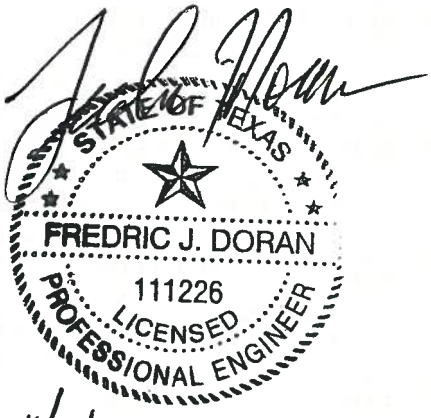
| DEV-2 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 25-year | | | | | | | | | | |
| Q | n | S | z | d | A | Pw | R | V | Qcheck | Design Depth (ft.) |
| 48 | 0.03 | 0.028 | 3 | 1.54 | 7.11 | 9.74 | 0.73 | 6.74 | 47.89 | 2.04 |
| 100-year check | | | | | | | | | | |
| Q | n | S | z | d | A | Pw | R | V | Qcheck | Overtops? |
| 59 | 0.03 | 0.028 | 3 | 1.66 | 8.30 | 10.52 | 0.79 | 7.09 | 58.87 | no |

Design Velocity

| DEV-2 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 25-year | | | | | | | | | |
| Q | n | S | z | d | A | Pw | R | V | Qcheck |
| 48 | 0.03 | 0.028 | 3 | 1.54 | 7.11 | 9.74 | 0.73 | 6.74 | 47.89 |
| 100-year check | | | | | | | | | |
| Q | n | S | z | d | A | Pw | R | V | Qcheck |
| 59 | 0.03 | 0.028 | 3 | 1.66 | 8.30 | 10.52 | 0.79 | 7.09 | 58.87 |

| Legend: | | |
|---|---|---|
| Q = | Flow Rate (cfs) | Q = VA |
| n = | Roughness Coefficient | Mannings Number |
| S= | Slope of Ditch (ft/ft) | Design Value |
| z = | Side Slope of Ditch (ft/ft) | Design Value |
| d = | Ditch Depth (ft) | Design Value |
| A = | Ditch Cross-Section Area ($ft^2$) | $A = z*d^2$ |
| Pw = | Wet Perimeter (ft) | $Pw = 2*\sqrt{(z^2+1)}*d$ |
| R = | Hydraulic Radius (ft) | R = A / Pw |
| V = | Velocity (ft/s) | $V = (1.49/n)*R^{2/3}*\sqrt{s}$ |




11/2/12

| | | |
|---|---|---|
| Calculation by: | JSR | 11/02/2012 |
| Checked by: | FJD | 11/02/2012 |

McCombs Landfill
MSW Permit No. 729B Major Permit Amendment
Calculation for Ditch Sizing

## Channel 3

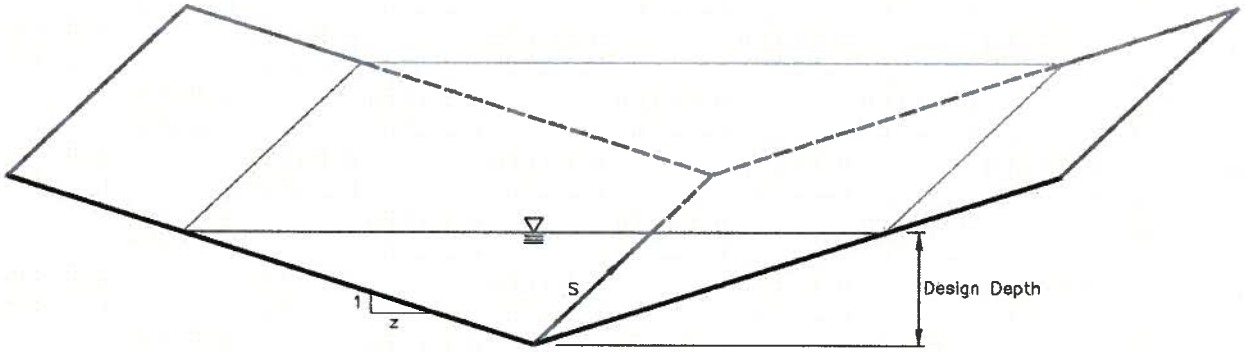
Design Depth

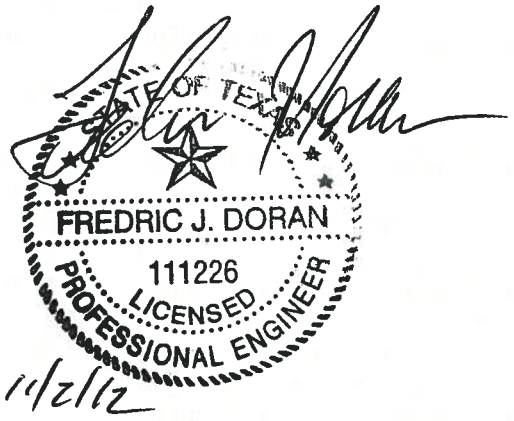
| DEV-4 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 25-year | | | | | | | | | | |
| Q | n | S | z | d | A | Pw | R | V | Qcheck | Design Depth (ft.) |
| 32 | 0.03 | 0.014 | 3 | 1.51 | 6.80 | 9.52 | 0.71 | 4.69 | 31.93 | 2.01 |
| 100-year check | | | | | | | | | | |
| Q | n | S | z | d | A | Pw | R | V | Qcheck | Overtops? |
| 39 | 0.03 | 0.014 | 3 | 1.62 | 7.89 | 10.26 | 0.77 | 4.93 | 38.91 | no |

Design Velocity

| DEV-4 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 25-year | | | | | | | | | |
| Q | n | S | z | d | A | Pw | R | V | Qcheck |
| 32 | 0.03 | 0.014 | 3 | 1.51 | 6.80 | 9.52 | 0.71 | 4.69 | 31.93 |
| 100-year check | | | | | | | | | |
| Q | n | S | z | d | A | Pw | R | V | Qcheck |
| 39 | 0.03 | 0.014 | 3 | 1.62 | 7.89 | 10.26 | 0.77 | 4.93 | 38.91 |

| Legend: | | |
|---|---|---|
| Q = | Flow Rate (cfs) | Q = VA |
| n = | Roughness Coefficient | Mannings Number |
| S= | Slope of Ditch (ft/ft) | Design Value |
| z = | Side Slope of Ditch (ft/ft) | Design Value |
| d = | Ditch Depth (ft) | Design Value |
| A = | Ditch Cross-Section Area ($ft^2$) | $A = z*d^2$ |
| Pw = | Wet Perimeter (ft) | $Pw = 2*\sqrt{(z^2+1)}*d$ |
| R = | Hydraulic Radius (ft) | R = A / Pw |
| V = | Velocity (ft/s) | $V = (1.49/n)*R^{2/3}*\sqrt{s}$ |




| | | |
|---|---|---|
| Calculation by: | JSR | 11/02/2012 |
| Checked by: | FJD | 11/02/2012 |

McCombs Landfill
MSW Permit No. 729B Major Permit Amendment
Calculation for Ditch Sizing

## Channel 4

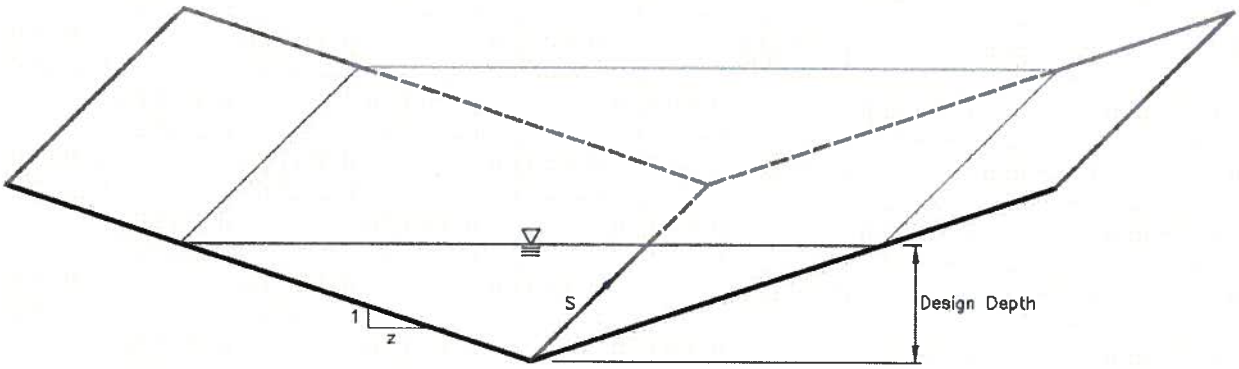
Design Depth

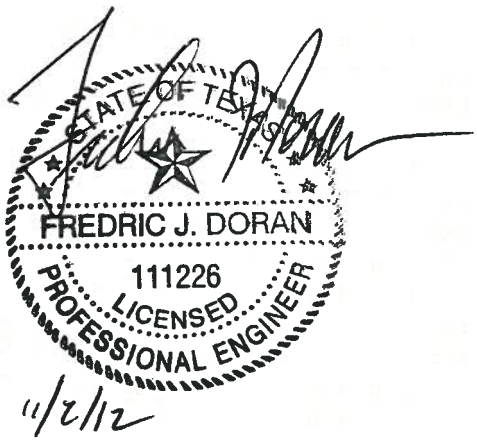
| DEV-6 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **25-year** | | | | | | | | | | |
| Q | n | S | z | d | A | Pw | R | V | Qcheck | **Design Depth (ft.)** |
| 15 | 0.03 | 0.01 | 3 | 1.21 | 4.37 | 7.63 | 0.57 | 3.42 | 14.97 | **1.71** |
| **100-year check** | | | | | | | | | | |
| Q | n | S | z | d | A | Pw | R | V | Qcheck | **Overtops?** |
| 19 | 0.03 | 0.01 | 3 | 1.32 | 5.22 | 8.34 | 0.63 | 3.63 | 18.96 | **no** |

Design Velocity

| DEV-6 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **25-year** | | | | | | | | | |
| Q | n | S | z | d | A | Pw | R | V | Qcheck |
| 15 | 0.03 | 0.01 | 3 | 1.21 | 4.37 | 7.63 | 0.57 | 3.42 | 14.97 |
| **100-year check** | | | | | | | | | |
| Q | n | S | z | d | A | Pw | R | V | Qcheck |
| 19 | 0.03 | 0.01 | 3 | 1.32 | 5.22 | 8.34 | 0.63 | 3.63 | 18.96 |

| **Legend:** | | |
|---|---|---|
| Q = | Flow Rate (cfs) | Q = VA |
| n = | Roughness Coefficient | Mannings Number |
| S= | Slope of Ditch (ft/ft) | Design Value |
| z = | Side Slope of Ditch (ft/ft) | Design Value |
| d = | Ditch Depth (ft) | Design Value |
| A = | Ditch Cross-Section Area ($ft^2$) | $A = z*d^2$ |
| Pw = | Wet Perimeter (ft) | $Pw = 2*\sqrt{(z^2+1)}*d$ |
| R = | Hydraulic Radius (ft) | R = A / Pw |
| V = | Velocity (ft/s) | $V = (1.49/n)*R^{2/3}*\sqrt{s}$ |




| | | |
|---|---|---|
| Calculation by: | JSR | 11/02/2012 |
| Checked by: | FJD | 11/02/2012 |

McCombs Landfill
MSW Permit No. 729B Major Permit Amendment
Calculation for Ditch Sizing

## Channel 5

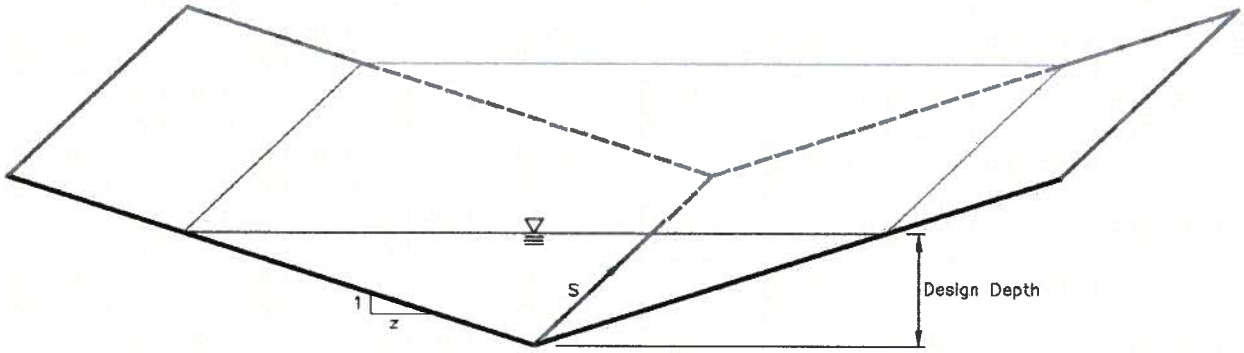
Design Depth

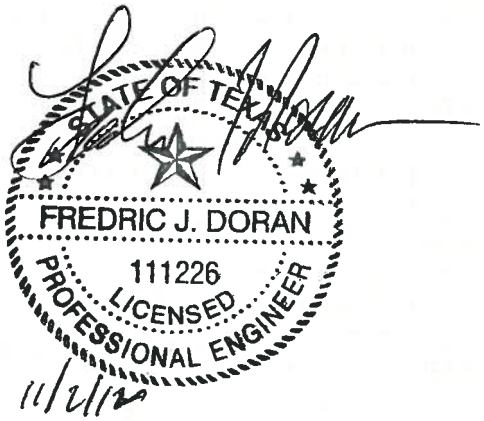
| DEV-7 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **25-year** | | | | | | | | | | |
| Q | n | S | z | d | A | Pw | R | V | Qcheck | **Design Depth (ft.)** |
| 30 | 0.03 | 0.01 | 3 | 1.57 | 7.35 | 9.90 | 0.74 | 4.07 | 29.93 | **2.07** |
| **100-year check** | | | | | | | | | | |
| Q | n | S | z | d | A | Pw | R | V | Qcheck | **Overtops?** |
| 36 | 0.03 | 0.01 | 3 | 1.68 | 8.43 | 10.60 | 0.80 | 4.26 | 35.92 | **no** |

Design Velocity

| DEV-7 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **25-year** | | | | | | | | | |
| Q | n | S | z | d | A | Pw | R | V | Qcheck |
| 30 | 0.03 | 0.01 | 3 | 1.57 | 7.35 | 9.90 | 0.74 | 4.07 | 29.93 |
| **100-year check** | | | | | | | | | |
| Q | n | S | z | d | A | Pw | R | V | Qcheck |
| 36 | 0.03 | 0.01 | 3 | 1.68 | 8.43 | 10.60 | 0.80 | 4.26 | 35.92 |

| Legend: | | |
|---|---|---|
| Q = | Flow Rate (cfs) | Q = VA |
| n = | Roughness Coefficient | Mannings Number |
| S= | Slope of Ditch (ft/ft) | Design Value |
| z = | Side Slope of Ditch (ft/ft) | Design Value |
| d = | Ditch Depth (ft) | Design Value |
| A = | Ditch Cross-Section Area ($ft^2$) | $A = z*d^2$ |
| Pw = | Wet Perimeter (ft) | $Pw = 2*\sqrt{(z^2+1)}*d$ |
| R = | Hydraulic Radius (ft) | R = A / Pw |
| V = | Velocity (ft/s) | $V = (1.49/n)*R^{2/3}*\sqrt{s}$ |



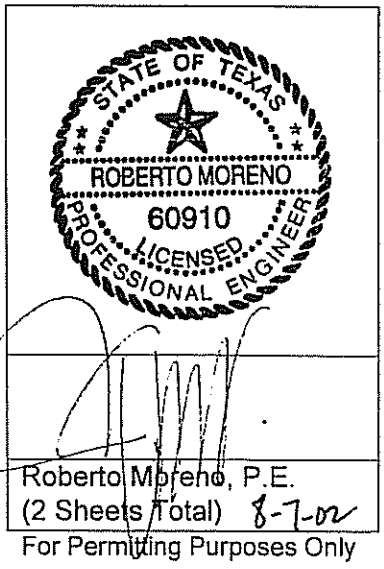




| | | |
|---|---|---|
| Calculation by: | JSR | 11/02/2012 |
| Checked by: | FJD | 11/02/2012 |

# Appendix 3B – Attachment 3
# Culvert Calculations

SAIC®

# APPENDIX 6-C
Culvert Calculations



# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\01117.fm2 |
| Worksheet | McCombs 7 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Discharge |

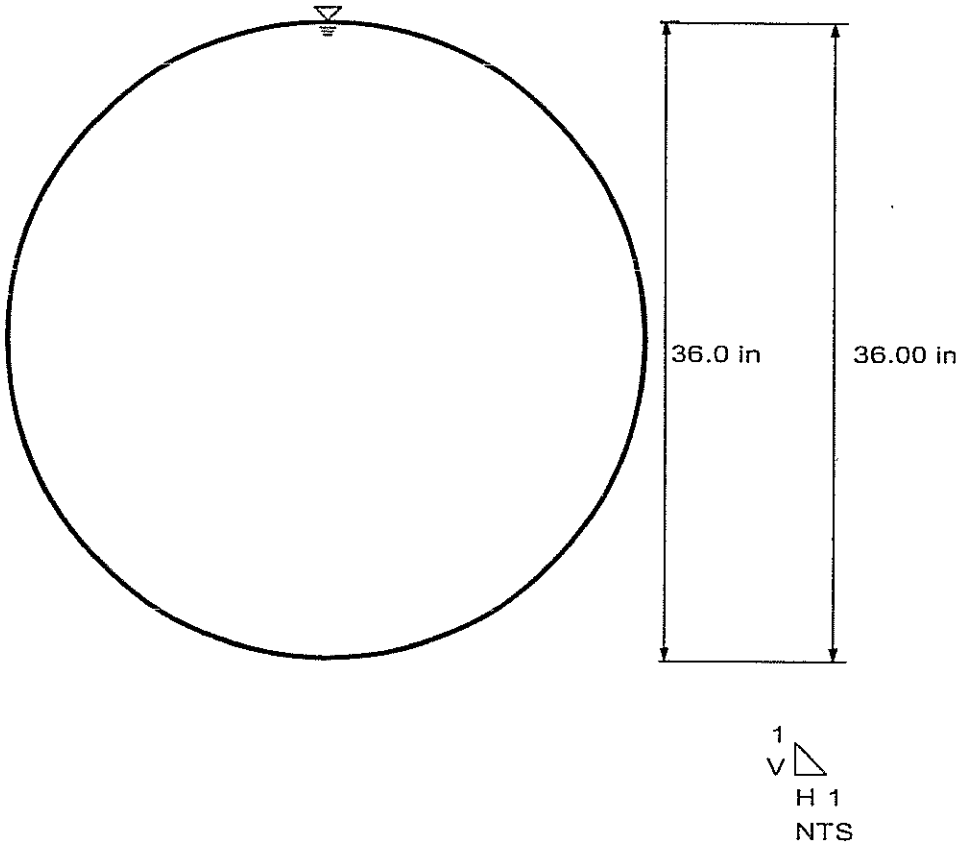
| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Channel Slope | 1.0000 | % |
| Depth | 36.0 | in |
| Diameter | 36.00 | in |

| Results | | |
|---|---|---|
| Discharge | 66.69 | cfs |
| Flow Area | 7.07 | ft² |
| Wetted Perimeter | 9.42 | ft |
| Top Width | 0.00 | ft |
| Critical Depth | 2.61 | ft |
| Percent Full | 100.00 | |
| Critical Slope | 0.009116 | ft/ft |
| Velocity | 9.44 | ft/s |
| Velocity Head | 1.38 | ft |
| Specific Energy | FULL | ft |
| Froude Number | FULL | |
| Maximum Discharge | 71.74 | cfs |
| Full Flow Capacity | 66.69 | cfs |
| Full Flow Slope | 0.010000 | ft/ft |

# Cross Section
## Cross Section for Circular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\01117.fm2 |
| Worksheet | McCombs 7 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Discharge |

| Section Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Channel Slope | 1.0000 | % |
| Depth | 36.0 | in |
| Diameter | 36.00 | in |
| Discharge | 66.69 | cfs |



# HY-8 Analysis Results

## Crossing Summary Table

Culvert Crossing: Crossing 1

| Headwater Elevation (ft) | Total Discharge (cfs) | Culvert 1 Discharge (cfs) | Roadway Discharge (cfs) | Iterations |
|---|---|---|---|---|
| 4063.09 | 10.00 | 10.00 | 0.00 | 1 |
| 4063.10 | 10.64 | 10.64 | 0.00 | 1 |
| 4063.12 | 11.28 | 11.28 | 0.00 | 1 |
| 4063.13 | 11.92 | 11.92 | 0.00 | 1 |
| 4063.15 | 12.56 | 12.56 | 0.00 | 1 |
| 4063.17 | 13.20 | 13.20 | 0.00 | 1 |
| 4063.18 | 13.67 | 13.67 | 0.00 | 1 |
| 4063.20 | 14.48 | 14.48 | 0.00 | 1 |
| 4063.22 | 15.12 | 15.12 | 0.00 | 1 |
| 4063.24 | 15.76 | 15.76 | 0.00 | 1 |
| 4063.26 | 16.40 | 16.40 | 0.00 | 1 |
| 4074.00 | 103.01 | 103.01 | 0.00 | Overtopping |

8/9/2012

# Appendix 3B – Attachment 4
# Letter from the Department of the Army

SAIC®

DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
EL PASO REGULATORY OFFICE
P.O. BOX 6096
FORT BLISS, TEXAS 79906-0096
FAX (915) 568-1348

RECEIVED
JUL 18 2002
BY:

July 17, 2002

REPLY TO
ATTENTION OF:

Operations Division
Regulatory Branch

Mr. Roberto Moreno, P.E.
Moreno Cardenas Inc.
2505 E. Missouri Ave.
El Paso, TX 79903

Dear Mr. Moreno:

This replies to your July 16, 2002, letter regarding the proposed expansion of McCombs Landfill in El Paso, El Paso County, Texas. We have assigned Action No. 2002 00462 to this activity.

We have evaluated the information you provided and studied the project description, other records, and documents available to us. We concur with your findings that no waters of the United States are located within the project site. There are no Corps of Engineers' jurisdictional waters on the site. Therefore, the project is not regulated under the provisions of Section 404 of the Clean Water Act and a Department of the Army permit will not be required.

Our disclaimer of jurisdiction is only for Section 404 of the Federal Clean Water Act. Other Federal, state and local laws may apply to the activities. Therefore, you should also contact other Federal, state and local regulatory authorities to determine whether the activities may require other authorizations or permits.

This jurisdictional determination will be valid for 5 years from the date of this letter unless new information warrants revision of the determination within that time.

If you have any questions, please feel free to contact me at (915) 568-1359 or e-mail me at daniel.malanchuk@usace.army.mil.

For more information about the regulatory program, please see our web site at www.spa.usace.army.mil/reg.

Sincerely,

Daniel Malanchuk
Chief, El Paso Regulatory Office

Copies furnished:

CESPA-OD-R-EP

# Appendix 3B – Attachment 5
# Closure Soil Loss Calculations

SAIC®

## NOTES

1. MAXIMUM LENGTHS FOR EACH DRAINAGE AREA (DEV) FOR BOTH THE TOP DOME AND SIDE SLOPE ARE INDICATED ON THE DRAWING. THE SELECTED MAXIMUM LENGTH UTILIZED IN THE SOIL LOSS CALCULATIONS IS INDICATED BY THE LEGEND BELOW. THE MAXIMUM DRAINAGE LENGTH IS SELECTED TO PORTRAY THE SOIL LOSS VALUES AS IT IS THE MOST CONSERVATIVE FOR ALL DRAINAGE AREAS.

## LEGEND

TOP DOME

UNSELECTED LENGTH

SELECTED LENGTH

EXTERNAL SIDE SLOPE

UNSELECTED LENGTH

SELECTED LENGTH

N: 10742509.06
E: 417193.27

PROPERTY BOUNDARY

CHANNEL 4

CHANNEL 5

N: 10738213.37
E: 417020.95

STORMWATER RETENTION POND B

STORMWATER RETENTION POND C

SEE NOTE 2

N: 1073
E: 4159

CHANNEL 3

EXISTING RETENTION POND E

EXISTING STORMWATER RETENTION POND A

CHANNEL 1

CHANNEL 2

N: 10742684.20
E: 413885.24

PROPERTY BOUNDARY

N: 10738347.03
E: 413725.15

N: 10737947.
E: 413739.68

DEV-1

DEV-2

DEV-3

DEV-4

DEV-5

DEV-6

DEV-7

DEV-8

332 LF

193 LF

650 LF

195 LF

435 LF

103 LF

1,035 LF

927 LF

1,033 LF

715 LF

544 LF

767 LF

947 LF

1,042 LF

848 LF

978 LF

587 LF

480 LF

738 LF

GRAPHIC SCALE

1"=200'-0" 200 0 200 400

Scale Feet

Figure 1
HORIZONTAL SLOPE LENGTH FOR SOIL LOSS CALCULATIONS
McCombs Landfill, El Paso, Texas

SAIC.

## NOTES

1. THE MAXIMUM SIDE SLOPE LENGTH FOR THE INTERIM LANDFILL PHASES IS INDICATED ON THE DRAWING. THE MAXIMUM LENGTH IS UTILIZED IN THE SOIL LOSS CALCULATIONS. THE MAXIMUM INTERIM DRAINAGE LENGTH IS SELECTED TO PORTRAY THE INTERIM SOIL LOSS VALUE AS IT IS THE MOST CONSERVATIVE FOR ALL INTERIM DRAINAGE AREAS.

## LEGEND

INTERIM SLOPE MAXIMUM LENGTH

N: 10742509.06
E: 417193.27

PROPERTY BOUNDARY

CHANNEL 4

CHANNEL 5

N: 10738213.37
E: 417020.95

STORMWATER RETENTION POND B

STORMWATER RETENTION POND C

SECTOR E

SECTOR D

SECTOR F

SECTOR G

SECTOR H

SECTOR J

SECTOR C

SECTOR B

SECTOR A

SECTOR I

SECTOR K

4025 4030 4035 4040 4060 4080 4100 4120 4140 4160 4180 4200 4220 4240 4265 4260

CHANNEL 3

SEE NOTE 2

N: 1073
E: 4159

EXISTING RETENTION POND E

935 LF

CHANNEL 1

EXISTING STORMWATER RETENTION POND A

CHANNEL 2

N: 10742684.20
E: 413885.24

PROPERTY BOUNDARY

CHANNEL 1

N: 10738347.03
E: 413725.15

N: 10737947.
E: 413739.68

STATE OF TEXAS
FREDRIC J. DORAN
111226
LICENSED
PROFESSIONAL ENGINEER
11/2/12

GRAPHIC SCALE
1"=200'-0"
200 0 200 400
Scale Feet

Figure 2
HORIZONTAL SLOPE LENGTH FOR SOIL LOSS CALCULATIONS
McCombs Landfill, El Paso, Texas

SAIC

McCombs Landfill
MSW Permit No. 729B Major Permit Amendment
Soil Loss Calculations

# Side Slope Interim Cover

**Soil Loss Equation using Intermediate Cover:**

R Rainfall Value

See attached values for El Paso

= 10

K Soil Erodibility Factor

Value from Parkhill, Smith & Cooper, Inc. Revision 2 July 2009

= 0.26

S Slope Factor — for slopes where sin Θ > 0.09

= (16.8 sin Θ) - 0.5 — Θ = slope angle

Θ = 18.43°

= 4.81

L Slope Length Factor

= $(\ell/72.6)^m$ — $\ell$ = horizontal slope length in feet

$\ell$ = 935 feet (Value from Figure 2)

m = 0.66 for 30% slope with moderate rill to interill erosion

= 5.40

C Cover Management Factor

Value from Parkhill, Smith & Cooper, Inc. Revision 2 July 2009

= 0.110

P Support Practices Factor

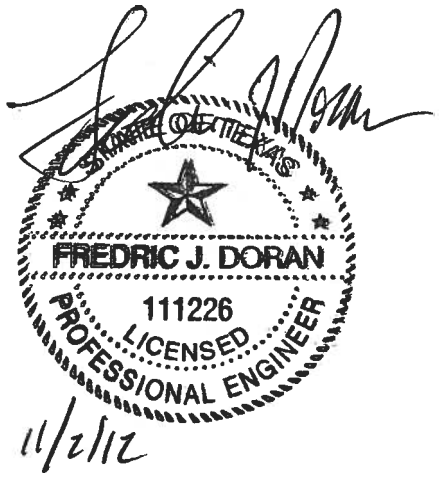
Conservative Value - from Parkhill, Smith & Cooper, Inc. Revision 2 July 2009

= 1

**A** Calculated Soils Loss (ton/acre/year)

= R*K*S*L*C*P

= **7.43** (to meet soil erosion criterion in 30 TAC 330.305 (d)(2), A ≤ 50 tons/acre/year)




| | | |
|---|---|---|
| Calculation by: | JSR | 11/02/2012 |
| Checked by: | FJD | 11/02/2012 |

McCombs Landfill
MSW Permit No. 729B Major Permit Amendment
Soil Loss Calculations

# Side Slope Intermediate Cover

**Soil Loss Equation using Intermediate Cover:**

R Rainfall Value
See attached values for El Paso
= 10

K Soil Erodibility Factor
Value from Parkhill, Smith & Cooper, Inc. Revision 2 July 2009
= 0.26

S Slope Factor — for slopes where sin Θ > 0.09
= (16.8 sin Θ) - 0.5 — Θ = slope angle
Θ = 18.43°
= 4.81

L Slope Length Factor
= $(\ell/72.6)^m$ — $\ell$ = horizontal slope length in feet
$\ell$ = 738 feet (Value from Figure 1)
m = 0.66 for 30% slope with moderate rill to interill erosion
= 4.62

C Cover Management Factor
Value from Parkhill, Smith & Cooper, Inc. Revision 2 July 2009
= 0.110

P Support Practices Factor
Conservative Value - from Parkhill, Smith & Cooper, Inc. Revision 2 July 2009
= 1

**A** Calculated Soils Loss (ton/acre/year)
= R*K*S*L*C*P
= **6.36** (to meet soil erosion criterion in 30 TAC 330.305 (d)(2), A ≤ 50 tons/acre/year)

Cami Van Abel
6/3/13

| | | |
|---|---|---|
| Calculation by: | JSR | 06/03/2013 |
| Checked by: | CAV | 06/03/2013 |

McCombs Landfill
MSW Permit No. 729B Major Permit Amendment
Soil Loss Calculations

# Side Slope Final Cover

**Soil Loss Equation using Vegetative Cover:**

R Rainfall Value
See attached values for El Paso
= 10

K Soil Erodibility Factor
Value from Parkhill, Smith & Cooper, Inc. Revision 2 July 2009
= 0.26

S Slope Factor — for slopes where sin Θ > 0.09
= (16.8 sin Θ) - 0.5 — Θ = slope angle
Θ = 18.43°
= 4.81

L Slope Length Factor
= $(\ell/72.6)^m$ — $\ell$ = horizontal slope length in feet
$\ell$ = 738 feet (Value from Figure 1)
m = 0.66 for 30% slope with moderate rill to interill erosion
= 4.62

C Cover Management Factor
Value from Parkhill, Smith & Cooper, Inc. Revision 2 July 2009
= 0.019

P Support Practices Factor
Conservative Value - from Parkhill, Smith & Cooper, Inc. Revision 2 July 2009
= 1

A Calculated Soils Loss (ton/acre/year)
= R*K*S*L*C*P
= **1.10** (to meet soil erosion criterion in 30 TAC 330.305 (d)(2), A ≤ 2 tons/acre/year)

**Soil Loss Equation using Rock Cover:**

R Rainfall Value
See attached values for El Paso
= 10

K Soil Erodibility Factor
Value from Parkhill, Smith & Cooper, Inc. Revision 2 July 2009
= 0.17

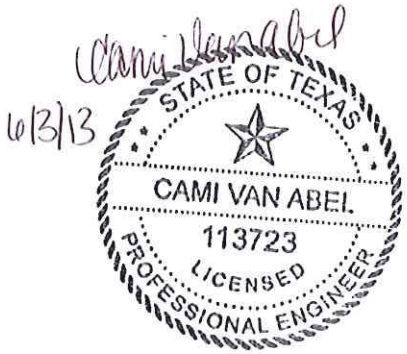
S Slope Factor
Calculated Above
= 4.81

L Slope Length Factor
Calculated Above
= 4.62

C Cover Management Factor
Value from Parkhill, Smith & Cooper, Inc. Revision 2 July 2009
= 0.007

P Support Practices Factor
Conservative Value - from Parkhill, Smith & Cooper, Inc. Revision 2 July 2009
= 1

A Calculated Soils Loss (ton/acre/year)
= R*K*S*L*C*P
= **0.26** (to meet soil erosion criterion in 30 TAC 330.305 (d)(2), A ≤ 2 tons/acre/year)




| | | |
|---|---|---|
| Calculation by: | JSR | 06/03/2013 |
| Checked by: | CAV | 06/03/2013 |

McCombs Landfill
MSW Permit No. 729B Major Permit Amendment
Soil Loss Calculations

# Top Dome Intermediate Cover

**Soil Loss Equation using Intermediate Cover:**

R Rainfall Value
See attached values for El Paso
= 10

K Soil Erodibility Factor
Value from Parkhill, Smith & Cooper, Inc. Revision 2 July 2009
= 0.26

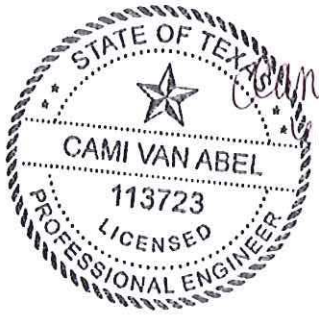
S Slope Factor
= (10.8 sin Θ) + 0.3 for slopes where sin Θ > 0.09
Θ = slope angle
Θ = 4.00°
= 1.05

L Slope Length Factor
= $(\ell/72.6)^m$
$\ell$ = horizontal slope length in feet
$\ell$ = 1,042 feet (Value from Figure 1)
m = 0.46 for 7% slope with moderate rill to interill erosion
= 3.41

C Cover Management Factor
Value from Parkhill, Smith & Cooper, Inc. Revision 2 July 2009
= 0.110

P Support Practices Factor
Conservative Value - from Parkhill, Smith & Cooper, Inc. Revision 2 July 2009
= 1

**A** Calculated Soils Loss (ton/acre/year)
= R*K*S*L*C*P
**= 1.02** (to meet soil erosion criterion in 30 TAC 330.305 (d)(2), A ≤ 50 tons/acre/year)




Cami Van Abel 6/13/13

| | | |
|---|---|---|
| Calculation by: | JSR | 06/03/2013 |
| Checked by: | CAV | 06/03/2013 |

McCombs Landfill
MSW Permit No. 729B Major Permit Amendment
Soil Loss Calculations

# Top Dome Final Cover

**Soil Loss Equation using Vegetative Cover:**

R Rainfall Value — See attached values for El Paso
= 10

K Soil Erodibility Factor — Value from Parkhill, Smith & Cooper, Inc. Revision 2 July 2009
= 0.26

S Slope Factor — for slopes where sin Θ > 0.09
= (10.8 sin Θ) + 0.3 — Θ = slope angle
Θ = 4.00°
= 1.05

L Slope Length Factor
= $(\ell/72.6)^m$ — $\ell$ = horizontal slope length in feet
$\ell$ = 1,042 feet (Value from Figure 1)
m = 0.46 for 7% slope with moderate rill to interill erosion
= 3.41

C Cover Management Factor — Value from Parkhill, Smith & Cooper, Inc. Revision 2 July 2009
= 0.019

P Support Practices Factor — Conservative Value - from Parkhill, Smith & Cooper, Inc. Revision 2 July 2009
= 1

A Calculated Soils Loss (ton/acre/year)
= R*K*S*L*C*P
= **0.18** (to meet soil erosion criterion in 30 TAC 330.305 (d)(2), A ≤ 2 tons/acre/year)

**Soil Loss Equation using Rock Cover:**

R Rainfall Value — See attached values for El Paso
= 10

K Soil Erodibility Factor — Value from Parkhill, Smith & Cooper, Inc. Revision 2 July 2009
= 0.17

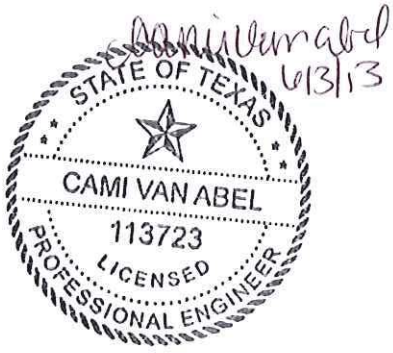
S Slope Factor — Calculated Above
= 1.05

L Slope Length Factor — Calculated Above
= 3.41

C Cover Management Factor — Value from Parkhill, Smith & Cooper, Inc. Revision 2 July 2009
= 0.007

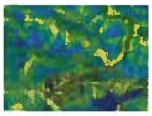
P Support Practices Factor — Conservative Value - from Parkhill, Smith & Cooper, Inc. Revision 2 July 2009
= 1

A Calculatd Soils Loss (ton/acre/year)
= R*K*S*L*C*P
= **0.04** (to meet soil erosion criterion in 30 TAC 330.305 (d)(2), A ≤ 2 tons/acre/year)



Cami Van Abel 6/3/13

| | | |
|---|---|---|
| Calculation by: | JSR | 06/03/2013 |
| Checked by: | CAV | 06/03/2013 |



# Using Soil Erosion Modeling for Improved Conservation Planning: A GIS-based Tutorial

## Rainfall (R) values for major cities

| PLACE | R-VALUE |
|---|---|
| BIRMINGHAM, AL: | 350 |
| MOBILE, AL: | 615 |
| MONTGOMERY, AL: | 395 |
| FLAGSTAFF, AZ: | 30 |
| PHOENIX, AZ: | 22 |
| YUMA, AZ: | 11 |
| TOMBSTONE, AZ: | 65 |
| WILCOX, AZ: | 50 |
| PEARCE, AZ: | 50 |
| FORT SMITH, AR: | 285 |
| LITTLE ROCK, AR: | 315 |
| BAKERSFIELD, CA: | 5 |
| BLUE CANYON, CA: | 40 |
| EUREKA, CA: | 95 |
| FRESNO, CA: | 12 |
| MT.SHASTA, CA: | 30 |
| SAN DIEGO, CA: | 20 |
| SAN FRANCISCO, CA: | 45 |
| DENVER, CO: | 40 |
| GRAND JUNCTION, CO: | 10 |
| PUEBLO, CO: | 40 |
| HARTFORD, CT: | 130 |
| WILMINGTON, DE: | 180 |
| JACKSONVILLE, FL: | 450 |
| MIAMI, FL: | 600 |
| TALLAHASSEE, FL: | 450 |
| TAMPA, FL: | 500 |
| ATLANTA, GA: | 295 |
| AUGUSTA, GA: | 290 |
| MACON, GA: | 325 |
| SAVANNAH, GA: | 400 |
| EWA PLANTATION, HI: | 150 |
| HALEAKALA FARM, HI: | 400 |
| HANA, HI: | 400 |
| HONOLULU, HI: | 150 |
| HONOMU MAUKA, HI: | 200 |
| KAANAPALI AIRPORT, HI: | 100 |
| KAHUKU, HI: | 250 |
| KAINALIU, HI: | 300 |
| KALAUPAPA, HI: | 200 |
| KEALIA, HI: | 300 |
| KEKAHA, HI: | 150 |
| KOLOA, HI: | 400 |

| | |
|---|---|
| KUALAPUU, HI: | 200 |
| KUKUIHAELE MILL, HI: | 400 |
| BOISE, ID: | 12 |
| POCATELLO, ID: | 12 |
| CHICAGO, IL: | 150 |
| EVANSVILLE, IN: | 200 |
| FORT WAYNE, IN: | 125 |
| INDIANAPOLIS, IN: | 155 |
| DES MOINES, IA: | 160 |
| DUBUQUE, IA: | 160 |
| DODGE CITY, KS: | 115 |
| TOPEKA, KS: | 190 |
| WICHITA, KS: | 195 |
| LEXINGTON, KY: | 165 |
| LOUISVILLE, KY: | 175 |
| BATON ROUGE, LA: | 625 |
| NEW ORLEANS, LA: | 700 |
| SHREVEPORT, LA: | 380 |
| CARIBOU, ME: | 60 |
| PORTLAND, ME: | 100 |
| BALTIMORE, MD: | 185 |
| BOSTON, MA: | 115 |
| DETROIT, MI: | 90 |
| GRAND RAPIDS, MI: | 95 |
| DULUTH, MN: | 95 |
| MINNEAPOLIS, MN: | 115 |
| MORRIS, MN: | 90 |
| JACKSON, MS: | 440 |
| COLUMBIA, MO: | 205 |
| KANSAS CITY, MO: | 195 |
| ST. LOUIS, MO: | 200 |
| BILLINGS, MT: | 15 |
| GREAT FALLS, MT: | 22 |
| HAVRE, MT: | 10 |
| HELENA, MT: | 14 |
| KALISPELL, MT: | 15 |
| MILES CITY, MT: | 24 |
| GRAND ISLAND, NE: | 125 |
| NORTH PLATTE, NE: | 85 |
| SCOTTSBLUFF, NE: | 45 |
| ELKO, NV: | 9 |
| LAS VEGAS, NV: | 8 |
| RENO, NV: | 10 |
| WINNEMUCCA, NV: | 8 |
| CONCORD, NH: | 100 |
| MOUNT WASHINGTON, NH: | 90 |
| NEWARK, NJ: | 160 |
| ALBUQUERQUE, NM: | 26 |
| ROSWELL, NM: | 45 |
| ALBANY, NY: | 100 |
| BUFFALO, NY: | 75 |
| NEW YORK, NY: | 160 |
| SYRACUSE, NY: | 75 |
| ASHEVILLE, NC: | 200 |
| GREENSBORO, NC: | 210 |
| RALEIGH, NC: | 265 |
| BISMARCK, ND: | 50 |
| WILLISTON, ND: | 35 |
| CLEVELAND, OH: | 100 |
| COLUMBUS, OH: | 125 |
| TOLEDO, OH: | 105 |
| OKLAHOMA CITY, OK: | 235 |

| | |
|---|---|
| TULSA, OK: | 260 |
| BURNS, OR: | 5 |
| MEDFORD, OR: | 30 |
| PENDLETON, OR: | 8 |
| PORTLAND, OR: | 65 |
| SALEM, OR: | 55 |
| PHILADELPHIA, PA: | 170 |
| PITTSBURGH, PA: | 155 |
| PROVIDENCE, RI: | 145 |
| CHARLESTON, SC: | 400 |
| COLUMBIA, SC: | 290 |
| HURON, SD: | 80 |
| RAPID CITY, SD: | 45 |
| CHATTANOOGA, TN: | 255 |
| KNOXVILLE, TN: | 180 |
| MEMPHIS, TN: | 285 |
| NASHVILLE, TN: | 225 |
| AMARILLO, TX: | 100 |
| AUSTIN, TX: | 285 |
| BROWNSVILLE, TX: | 280 |
| CORPUS CHRISTI, TX: | 270 |
| DALLAS, TX: | 290 |
| EL PASO, TX: | 10 |
| GALVESTON, TX: | 500 |
| HOUSTON, TX: | 475 |
| SAN ANTONIO, TX: | 250 |
| WACO, TX: | 290 |
| SALT LAKE CITY, UT: | 20 |
| MILFORD, UT: | 8 |
| NORFOLK, VA: | 250 |
| RICHMOND, VA: | 220 |
| OLYMPIA, WA: | 70 |
| PULLMAN, WA: | 15 |
| SPOKANE, WA: | 10 |
| STAMPEDE PASS, WA: | 50 |
| WALLA WALLA, WA: | 10 |
| PULLMAN.REQ, WA: | 15 |
| CHARLESTON, WV: | 140 |
| GREEN BAY, WI: | 95 |
| LA CROSSE, WI: | 155 |
| MADISON, WI: | 135 |
| MILWAUKEE, WI: | 105 |
| CHEYENNE, WY: | 25 |
| WASHINGTON, DC: | 185 |

Source: Extracted from RUSLE binary and data files, available for download at:
http://www.sedlab.olemiss.edu/rusle/

Up

HOME
UIUC

H. Mitasova, et al., Geographic Modeling Systems Lab,

RUSLE Soil Data

Survey Area EL PASO COUNTY, TEXAS
Component Table Date: Oct 25 Layer Table Date: Oct 25

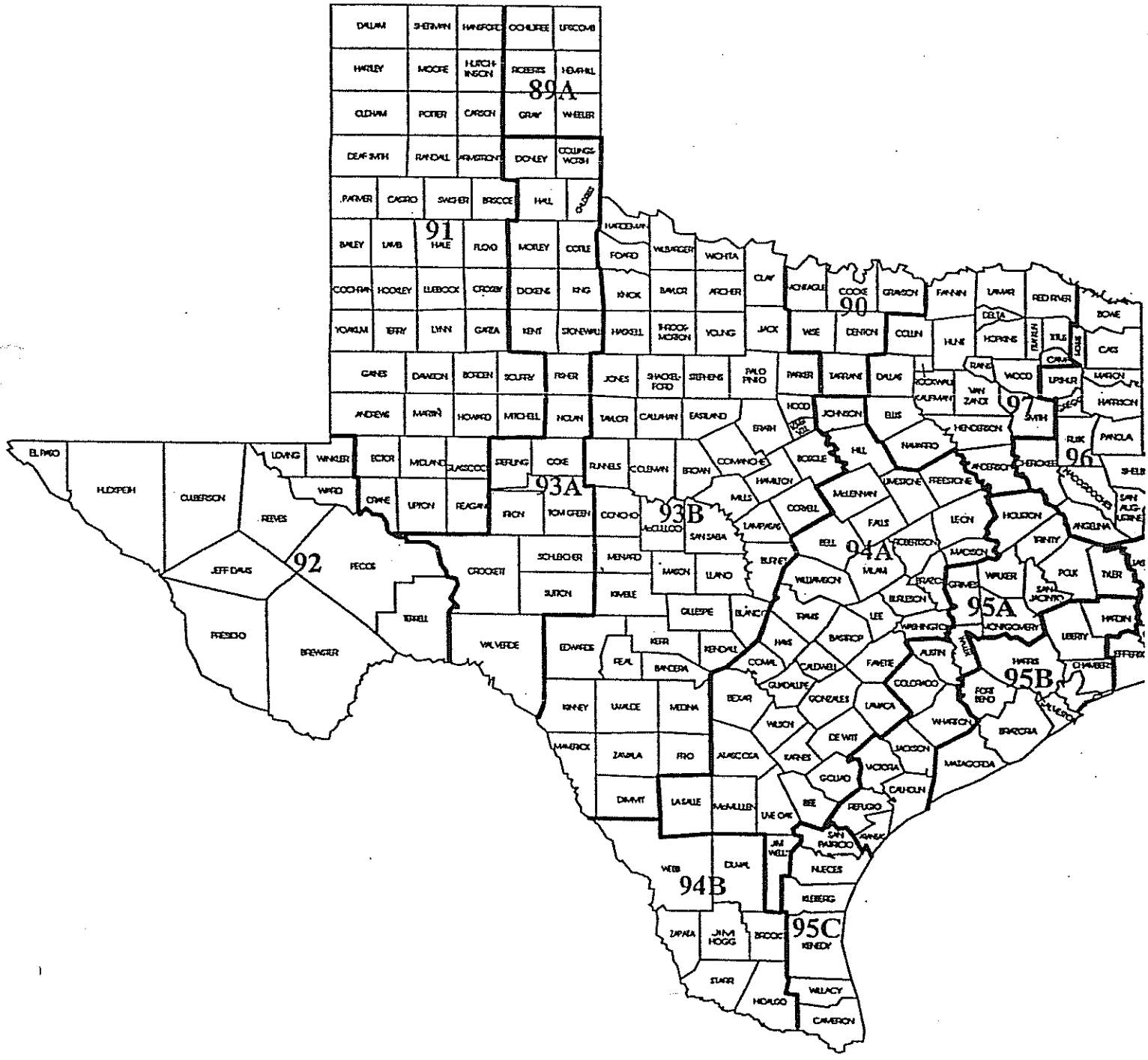
| Map Unit Symbol | Component Name | Surface Texture | Percent of Map Unit | Hyd. Grp. | Kf | T | Rock Cover % |
|---|---|---|---|---|---|---|---|
| AGB | AGUSTIN | GR-L | 100 | B | .24 | 5 | 25 |
| An | ANAPRA | SICL | 90 | B | .43 | 3 | 0 |
| BA | BADLANDS | VAR | 100 | D | .43 | 2 | NO DATA |
| BPC | BLUEPOINT | LFS | 100 | A | .17 | 5 | 0 |
| BUC | BLUEPOINT GRAVEL | GR-FS | 100 | A | .20 | 5 | 30 |
| Br | BRAZITO | LFS | 90 | A | .20 | 5 | 5 |
| DCB | DELNORTE | GRV-L | 75 | D | .32 | 1 | 30 |
| DCB | CANUTIO | GRV-SL | 25 | B | .32 | 5 | 55 |
| DCD | DELNORTE | GRV-L | 60 | D | .32 | 1 | 30 |
| DCD | CANUTIO | GRV-SL | 20 | B | .32 | 5 | 55 |
| DU | DUNE LAND | FS | 100 | A | .15 | 5 | 0 |
| Ga | GILA | FSL | 90 | B | .24 | 5 | 0 |
| Gc | GILA | L | 90 | B | .37 | 5 | 0 |
| Gd | GLENDALE | L | 90 | B | .32 | 5 | 0 |
| Ge | GLENDALE | SICL | 90 | B | .37 | 5 | 0 |
| Gs | GLENDALE | SIC | 90 | B | .32 | 5 | 0 |
| HW | HUECO | LFS | 45 | C | .17 | 2 | 0 |
| HW | WINK | FSL | 35 | B | .20 | 3 | 5 |
| Ha | HARKEY | L | 90 | B | .55 | 5 | 0 |
| Hk | HARKEY | SICL | 90 | B | .37 | 5 | 0 |
| IG | IGNEOUS ROCK LAN | VAR | 100 | D | | | NO DATA |
| IN | IGNEOUS ROCKLAND | VAR | 60 | D | | | NO DATA |
| IN | BREWSTER | ST-CL | 30 | D | .32 | 1 | 55 |
| LM | LIMESTONE ROCKLA | VAR | 50 | D | | | NO DATA |
| LM | LOZIER | ST-L | 35 | D | .37 | 1 | 50 |
| LOD | LOZIER | ST-L | 100 | D | .37 | 1 | 50 |
| MBA | MIMBRES | SIL | 100 | B | .43 | 5 | 0 |
| Mg | GILA | FSL | 90 | B | .24 | 5 | 0 |
| PAA | PAJARITO | FSL | 100 | B | .24 | 5 | 0 |
| SMB | SIMONA | GR-FSL | 100 | D | .28 | 1 | 25 |
| Sa | SANELI | SICL | 90 | D | .32 | 3 | 0 |
| Sc | SANELI | SIC | 90 | D | .28 | 3 | 0 |
| TBB | TURNEY | FSL | 75 | B | .28 | 5 | 5 |
| TBB | BERINO | FSL | 20 | B | .24 | 3 | 0 |
| Tg | TIGUA | SIC | 90 | D | .32 | 4 | 0 |
| Vn | VINTON | FSL | 90 | B | .24 | 5 | NO DATA |
| WKA | WINK | FSL | 100 | B | .20 | 3 | 5 |

# TABLE 5

## SLOPE LENGTH EXPONENTS (m) FOR A RANGE OF SLOPES AND RILL/INTERRILL EROSION CLASSES

| Slope (%) | Rill/Interrill Ratio | | |
|---|---|---|---|
| | Low | Moderate | High |
| 0.2 | 0.02 | 0.04 | 0.07 |
| 0.5 | 0.04 | 0.08 | 0.16 |
| 1.0 | 0.08 | 0.15 | 0.26 |
| 2.0 | 0.14 | 0.24 | 0.39 |
| 3.0 | 0.18 | 0.31 | 0.47 |
| 4.0 | 0.22 | 0.36 | 0.53 |
| 5.0 | 0.25 | 0.40 | 0.57 |
| 6.0 | 0.28 | 0.43 | 0.60 |
| 8.0 | 0.32 | 0.48 | 0.65 |
| 10.0 | 0.35 | 0.52 | 0.68 |
| 12.0 | 0.37 | 0.55 | 0.71 |
| 14.0 | 0.40 | 0.57 | 0.72 |
| 16.0 | 0.41 | 0.59 | 0.74 |
| 20.0 | 0.44 | 0.61 | 0.76 |
| 25.0 | 0.47 | 0.64 | 0.78 |
| 30.0 | 0.49 | 0.66 | 0.79 |
| 40.0 | 0.52 | 0.68 | 0.81 |
| 50.0 | 0.54 | 0.70 | 0.82 |
| 60.0 | 0.55 | 0.71 | 0.83 |

# RUSLE
# C Factor Zones



# RUSLE

## "C" Factors for Rangeland, Pastureland, Grazed Forest Lands and Idle Land [1]

## "C" Factor Zone 92

| Vegetative Canopy [2] | | Cover that contacts the surface [5] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Type and Height of Raised Canopy [3] | %Canopy Cover [4] | Percent Ground Cover | | | | | | | | | |
| | | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | ≥ 90 |
| No Appreciable Canopy | | 0.110 | 0.076 | 0.054 | 0.038 | 0.027 | 0.019 | 0.013 | 0.009 | 0.007 | 0.005 |
| Canopy of Tall Grasses or Forbs | 25 | 0.089 | 0.062 | 0.044 | 0.031 | 0.022 | 0.015 | 0.011 | 0.008 | 0.005 | 0.004 |
| or Short Brush | 50 | 0.069 | 0.048 | 0.034 | 0.024 | 0.017 | 0.012 | 0.008 | 0.006 | 0.004 | 0.003 |
| Average Fall Height 3 Feet | 75 | 0.049 | 0.034 | 0.024 | 0.017 | 0.012 | 0.008 | 0.006 | 0.004 | 0.003 | 0.002 |
| Canopy of Appreciable Brush | 25 | 0.095 | 0.067 | 0.047 | 0.033 | 0.023 | 0.016 | 0.012 | 0.008 | 0.006 | 0.004 |
| Average Fall Height 6.5 Feet | 50 | 0.081 | 0.057 | 0.040 | 0.028 | 0.020 | 0.014 | 0.01 | 0.007 | 0.005 | 0.003 |
| | 75 | 0.067 | 0.047 | 0.033 | 0.023 | 0.017 | 0.017 | 0.008 | 0.006 | 0.004 | 0.003 |
| Canopy of Trees but no Appreciable | 25 | 0.101 | 0.071 | 0.050 | 0.035 | 0.025 | 0.018 | 0.012 | 0.009 | 0.006 | 0.004 |
| Low Brush, Grasses or Forbs | 50 | 0.094 | 0.066 | 0.047 | 0.033 | 0.023 | 0.016 | 0.012 | 0.008 | 0.006 | 0.004 |
| Average Fall Height 13 Feet | 75 | 0.087 | 0.061 | 0.043 | 0.031 | 0.022 | 0.015 | 0.011 | 0.008 | 0.005 | 0.004 |

[1] Assumes a random distribution of cover types over the entire area of evaluation. Idle land refers to land with a soil profile that has not been disturbed for at least 3 consecutive years.

[2] Expresses the effectiveness of the vegetative canopy in reducing the energy of rainfall striking the soil surface.

[3] Average fall height of water droplets from the canopy to the soil surface or ground cover.

[4] Portion of total area of the surface that would be hidden from view by the canopy in an overhead projection.

[5] Portion of vegetation, mulch, cryptogams, rocks and other non-erodible material that is in direct contact with the soil surface. Affects erosion by reducing the transport capacity of runoff water by causing deposition.

# Appendix 3B – Attachment 6
# Drainage Calculations

SAIC®

McCombs Landfill
MSW Permit No. 729B Major Permit Amendment
Non-Erodible Velocities - Equations

$T_c$ = Time of Concentration (minutes)
Calculated using the Watershed Lag Method in the National Engineering Handbook §630.1502
$= (L / 0.6) \times 60$

L = Lag Time (hours)
$= /^{0.8} (S + 1)^{0.7} / 1900 \times Y^{0.5}$

S = Potential Maximum Retention (inches)
$= (1000 / CN) - 10$

Y = Average Land Slope (%)

/ = Hydraulic Length of Watershed (feet)

CN = Curve Number

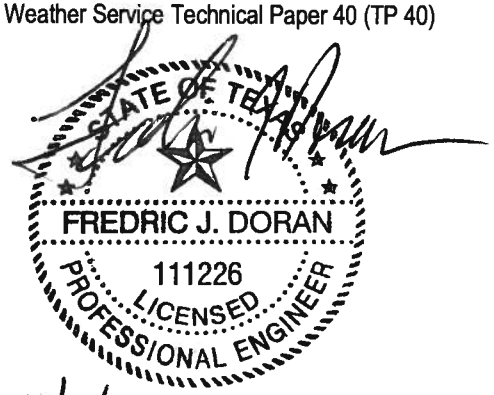
$I_{25}$ = 25-year Intensity (in/hr)
$= b / (T_c + d)^e$

| | |
|---|---|
| $e_{25}$* | 0.843 |
| $b_{25}$* | 60 |
| $d_{25}$* | 12 |

*e, b, and d coeffients are provided in the Hydrology section of the Hydraulic Design Manual for Texas counties for various frequencies and are based on the rainfall-frequency-duration data contained in the National Weather Service Technical Paper 40 (TP 40)

$V_{25}$ = 25-year Volume (ac-ft)
$= C \times I_{25}$

| | | |
|---|---|---|
| Calculation by: | JSR | 11/02/12 |
| Checked by: | FJD | 11/02/12 |




11/2/12

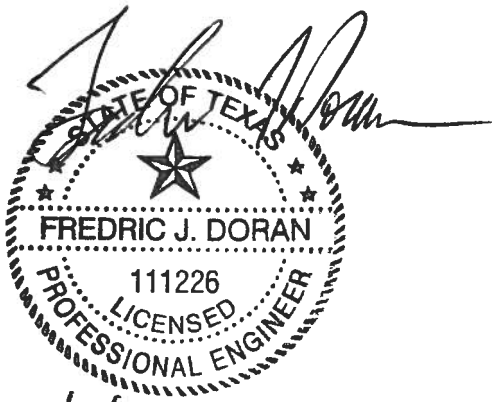
McCombs Landfill
MSW Permit No. 729B Major Permit Amendment
Non-Erodible Velocities - Interim Side Slopes

| Interim Side Slope (3:1) | | | | | | |
|---|---|---|---|---|---|---|
| Drainage Area ID | Max Length (/) | C value | Description | $T_c$ [A, B] | $I_{25}$ (in/hr) [B] | $V_{25}$ (ac-ft) [B] |
| SECTOR B | 450 | 0.20 | Sandy Soil, Steep (Range: 0.15 - 0.20) | 3.6 | 5.93 | 1.19 |
| SECTOR C | 630 | 0.20 | Sandy Soil, Steep (Range: 0.15 - 0.20) | 4.7 | 5.60 | 1.12 |
| SECTOR D | 660 | 0.20 | Sandy Soil, Steep (Range: 0.15 - 0.20) | 4.9 | 5.55 | 1.11 |
| SECTOR E | 660 | 0.20 | Sandy Soil, Steep (Range: 0.15 - 0.20) | 4.9 | 5.55 | 1.11 |
| SECTOR F | 675 | 0.20 | Sandy Soil, Steep (Range: 0.15 - 0.20) | 4.9 | 5.52 | 1.10 |
| SECTOR G | 935 | 0.20 | Sandy Soil, Steep (Range: 0.15 - 0.20) | 6.4 | 5.15 | 1.03 |
| SECTOR H | 585 | 0.20 | Sandy Soil, Steep (Range: 0.15 - 0.20) | 4.4 | 5.67 | 1.13 |
| SECTOR I | 792 | 0.20 | Sandy Soil, Steep (Range: 0.15 - 0.20) | 5.6 | 5.34 | 1.07 |
| SECTOR J | 650 | 0.20 | Sandy Soil, Steep (Range: 0.15 - 0.20) | 4.8 | 5.56 | 1.11 |
| SECTOR K | 600 | 0.20 | Sandy Soil, Steep (Range: 0.15 - 0.20) | 4.5 | 5.65 | 1.13 |

[A] - It should be noted that the Time of Concentration ($T_c$) values listed above may vary slightly from those provided elsewhere in this permit document (The $T_c$ value above is only for the slope length, not the entire drainage area).

[B] - Refer to Page 1 of this appendix for formulas used.

| | | |
|---|---|---|
| Calculation by: | JSR | 11/02/12 |
| Checked by: | FJD | 11/02/12 |




11/2/12

McCombs Landfill
MSW Permit No. 729B Major Permit Amendment
Non-Erodible Velocities - External Side Slopes

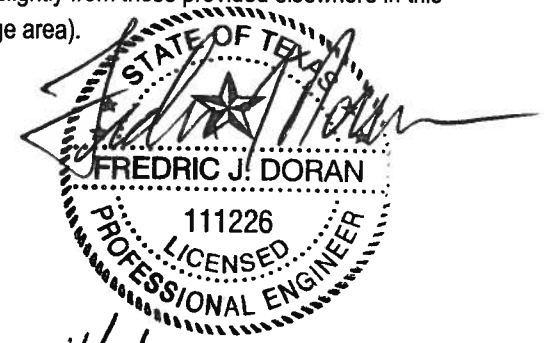
| External Side Slope - Non-Vegetated (3:1) | | | | | | |
|---|---|---|---|---|---|---|
| Drainage Area ID | Max Length (/) | C value | Description | $T_c$ [A, B] | $I_{25}$ (in/hr) [B] | $V_{25}$ (ac-ft) [B] |
| DEV-1 | 759 | 0.20 | Sandy Soil, Steep (Range: 0.15 - 0.20) | 5.4 | 5.39 | 1.08 |
| DEV-2 | 510 | 0.20 | Sandy Soil, Steep (Range: 0.15 - 0.20) | 3.9 | 5.81 | 1.16 |
| DEV-3 | 587 | 0.20 | Sandy Soil, Steep (Range: 0.15 - 0.20) | 4.4 | 5.67 | 1.13 |
| DEV-4 | 526 | 0.20 | Sandy Soil, Steep (Range: 0.15 - 0.20) | 4.0 | 5.78 | 1.16 |
| DEV-5 | 501 | 0.20 | Sandy Soil, Steep (Range: 0.15 - 0.20) | 3.9 | 5.83 | 1.17 |
| DEV-6 | 332 | 0.20 | Sandy Soil, Steep (Range: 0.15 - 0.20) | 2.8 | 6.19 | 1.24 |
| DEV-7 | 445 | 0.20 | Sandy Soil, Steep (Range: 0.15 - 0.20) | 3.5 | 5.94 | 1.19 |
| DEV-8 | 715 | 0.20 | Sandy Soil, Steep (Range: 0.15 - 0.20) | 5.2 | 5.46 | 1.09 |

| External Side Slope - Vegetated (3:1) | | | | | | |
|---|---|---|---|---|---|---|
| Drainage Area ID | Max Length (/) | C value | Description | $T_c$ [A, B] | $I_{25}$ (in/hr) [B] | $V_{25}$ (ac-ft) [B] |
| DEV-1 | 759 | 0.25 | Pasture, Sandy Soil (Range: 0.05 - 0.25) | 5.4 | 5.39 | 1.35 |
| DEV-2 | 510 | 0.25 | Pasture, Sandy Soil (Range: 0.05 - 0.25) | 3.9 | 5.81 | 1.45 |
| DEV-3 | 587 | 0.25 | Pasture, Sandy Soil (Range: 0.05 - 0.25) | 4.4 | 5.67 | 1.42 |
| DEV-4 | 526 | 0.25 | Pasture, Sandy Soil (Range: 0.05 - 0.25) | 4.0 | 5.78 | 1.45 |
| DEV-5 | 501 | 0.25 | Pasture, Sandy Soil (Range: 0.05 - 0.25) | 3.9 | 5.83 | 1.46 |
| DEV-6 | 332 | 0.25 | Pasture, Sandy Soil (Range: 0.05 - 0.25) | 2.8 | 6.19 | 1.55 |
| DEV-7 | 445 | 0.25 | Pasture, Sandy Soil (Range: 0.05 - 0.25) | 3.5 | 5.94 | 1.48 |
| DEV-8 | 715 | 0.25 | Pasture, Sandy Soil (Range: 0.05 - 0.25) | 5.2 | 5.46 | 1.37 |

[A] - It should be noted that the Time of Concentration ($T_c$) values listed above may vary slightly from those provided elsewhere in this permit document (The $T_c$ value above is only for the slope length, not the entire drainage area).

[B] - Refer to Page 1 of this appendix for formulas used.

| | | |
|---|---|---|
| Calculation by: | JSR | 11/02/12 |
| Checked by: | FJD | 11/02/12 |




11/2/12

McCombs Landfill
MSW Permit No. 729B Major Permit Amendment
Non-Erodible Velocities - Top Dome

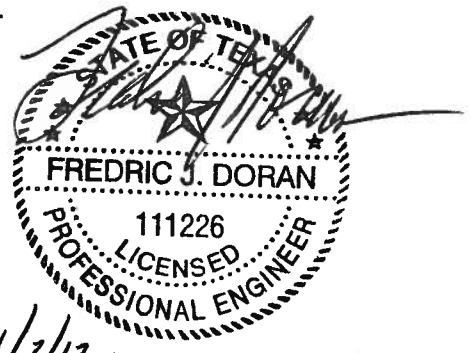
| Top Dome - Non-Vegetated (7%) | | | | | | |
|---|---|---|---|---|---|---|
| Drainage Area ID | Max Length (/) | C value | Description | $T_c$ [A, B] | $I_{25}$ (in/hr) [B] | $V_{25}$ (ac-ft) [B] |
| DEV-1 | 1,020 | 0.15 | Sandy Soil, Average (Range: 0.10 - 0.15) | 15.0 | 3.73 | 0.56 |
| DEV-2 | 916 | 0.15 | Sandy Soil, Average (Range: 0.10 - 0.15) | 13.8 | 3.88 | 0.58 |
| DEV-3 | 863 | 0.15 | Sandy Soil, Average (Range: 0.10 - 0.15) | 13.1 | 3.96 | 0.59 |
| DEV-4 | 820 | 0.15 | Sandy Soil, Average (Range: 0.10 - 0.15) | 12.6 | 4.03 | 0.61 |
| DEV-5 | 1,226 | 0.15 | Sandy Soil, Average (Range: 0.10 - 0.15) | 17.4 | 3.47 | 0.52 |
| DEV-6 | 541 | 0.15 | Sandy Soil, Average (Range: 0.10 - 0.15) | 9.0 | 4.60 | 0.69 |
| DEV-7 | 993 | 0.15 | Sandy Soil, Average (Range: 0.10 - 0.15) | 14.7 | 3.77 | 0.56 |
| DEV-8 | 947 | 0.15 | Sandy Soil, Average (Range: 0.10 - 0.15) | 14.1 | 3.83 | 0.57 |

| Top Dome - Vegetated (7%) | | | | | | |
|---|---|---|---|---|---|---|
| Drainage Area ID | Max Length (/) | C value | Description | $T_c$ [A, B] | $I_{25}$ (in/hr) [B] | $V_{25}$ (ac-ft) [B] |
| DEV-1 | 1,020 | 0.25 | Pasture, Sandy Soil (Range: 0.05 - 0.25) | 15.0 | 3.73 | 0.93 |
| DEV-2 | 916 | 0.25 | Pasture, Sandy Soil (Range: 0.05 - 0.25) | 13.8 | 3.88 | 0.97 |
| DEV-3 | 863 | 0.25 | Pasture, Sandy Soil (Range: 0.05 - 0.25) | 13.1 | 3.96 | 0.99 |
| DEV-4 | 820 | 0.25 | Pasture, Sandy Soil (Range: 0.05 - 0.25) | 12.6 | 4.03 | 1.01 |
| DEV-5 | 1,226 | 0.25 | Pasture, Sandy Soil (Range: 0.05 - 0.25) | 17.4 | 3.47 | 0.87 |
| DEV-6 | 541 | 0.25 | Pasture, Sandy Soil (Range: 0.05 - 0.25) | 9.0 | 4.60 | 1.15 |
| DEV-7 | 993 | 0.25 | Pasture, Sandy Soil (Range: 0.05 - 0.25) | 14.7 | 3.77 | 0.94 |
| DEV-8 | 947 | 0.25 | Pasture, Sandy Soil (Range: 0.05 - 0.25) | 14.1 | 3.83 | 0.96 |

[A] - It should be noted that the Time of Concentration ($T_c$) values listed above may vary slightly from those provided elsewhere in this permit document (The $T_c$ value above is only for the slope length, not the entire drainage area).

[B] - Refer to Page 1 of this appendix for formulas used.

| | | |
|---|---|---|
| Calculation by: | JSR | 11/02/12 |
| Checked by: | FJD | 11/02/12 |




11/2/12

McCombs Landfill
MSW Permit No. 729B Major Permit Amendment
Non-Erodible Velocities - Rock Armor

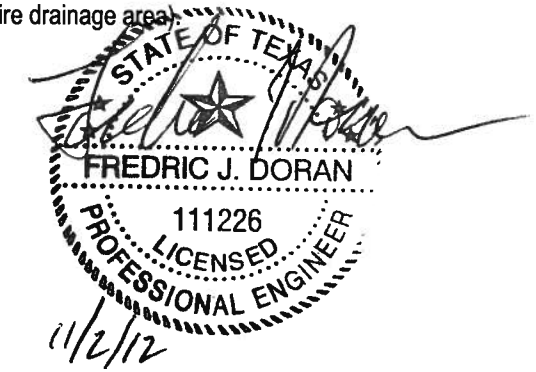
| Final Cover - Rock Armor (3:1) | | | | | | |
|---|---|---|---|---|---|---|
| Drainage Area ID | Max Length (/) | C value | Description | $T_c$, [A, B] | $I_{25}$ (in/hr) [B] | $V_{25}$ (ac-ft) [B] |
| DEV-1 | 759 | 0.50 | Shallow Soil on Rock (0.50) | 5.4 | 5.39 | 2.70 |
| DEV-2 | 510 | 0.50 | Shallow Soil on Rock (0.50) | 3.9 | 5.81 | 2.91 |
| DEV-3 | 587 | 0.50 | Shallow Soil on Rock (0.50) | 4.4 | 5.67 | 2.84 |
| DEV-4 | 526 | 0.50 | Shallow Soil on Rock (0.50) | 4.0 | 5.78 | 2.89 |
| DEV-5 | 501 | 0.50 | Shallow Soil on Rock (0.50) | 3.9 | 5.83 | 2.91 |
| DEV-6 | 332 | 0.50 | Shallow Soil on Rock (0.50) | 2.8 | 6.19 | 3.09 |
| DEV-7 | 445 | 0.50 | Shallow Soil on Rock (0.50) | 3.5 | 5.94 | 2.97 |
| DEV-8 | 715 | 0.50 | Shallow Soil on Rock (0.50) | 5.2 | 5.46 | 2.73 |

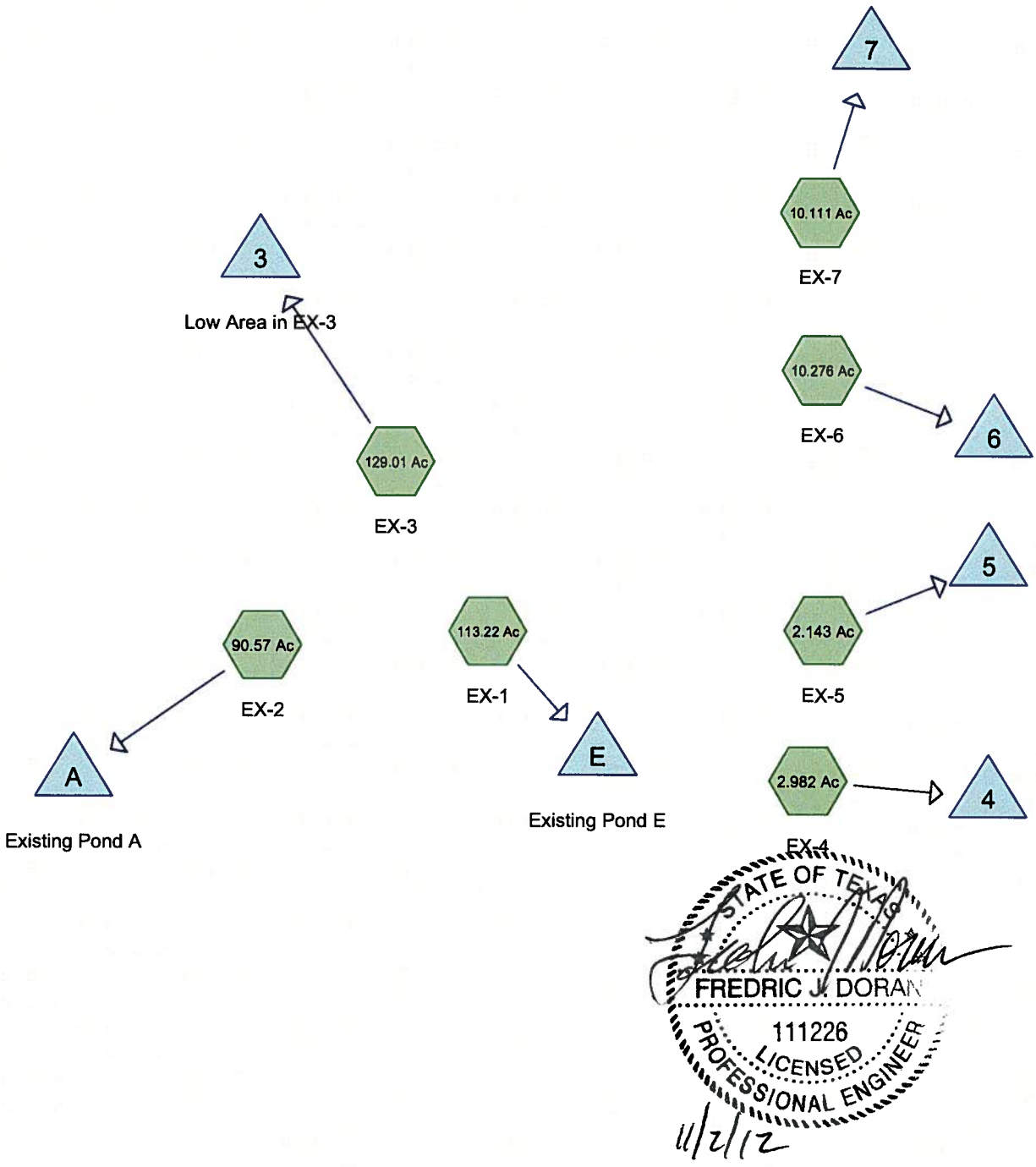
| Final Cover - Rock Armor (7%) | | | | | | |
|---|---|---|---|---|---|---|
| Drainage Area ID | Max Length (/) | C value | Description | $T_c$, [A, B] | $I_{25}$ (in/hr) [B] | $V_{25}$ (ac-ft) [B] |
| DEV-1 | 1,020 | 0.50 | Shallow Soil on Rock (0.50) | 15.0 | 3.73 | 1.86 |
| DEV-2 | 916 | 0.50 | Shallow Soil on Rock (0.50) | 13.8 | 3.88 | 1.94 |
| DEV-3 | 863 | 0.50 | Shallow Soil on Rock (0.50) | 13.1 | 3.96 | 1.98 |
| DEV-4 | 820 | 0.50 | Shallow Soil on Rock (0.50) | 12.6 | 4.03 | 2.02 |
| DEV-5 | 1,226 | 0.50 | Shallow Soil on Rock (0.50) | 17.4 | 3.47 | 1.74 |
| DEV-6 | 541 | 0.50 | Shallow Soil on Rock (0.50) | 9.0 | 4.60 | 2.30 |
| DEV-7 | 993 | 0.50 | Shallow Soil on Rock (0.50) | 14.7 | 3.77 | 1.88 |
| DEV-8 | 947 | 0.50 | Shallow Soil on Rock (0.50) | 14.1 | 3.83 | 1.92 |

[A] - It should be noted that the Time of Concentration ($T_c$) values listed above may vary slightly from those provided elsewhere in this permit document (The $T_c$ value above is only for the slope length, not the entire drainage area).

[B] - Refer to Page 1 of this appendix for formulas used.

| | | |
|---|---|---|
| Calculation by: | JSR | 11/02/12 |
| Checked by: | FJD | 11/02/12 |






**Routing Diagram for McCombs Landfill - Existing Conditions**
Prepared by SAIC, Printed 10/23/2012
HydroCAD® 10.00 s/n 05001 © 2012 HydroCAD Software Solutions LLC

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 358.309 | 68 | (2.143 Ac, 2.982 Ac, 10.111 Ac, 10.276 Ac, 90.57 Ac, 113.22 Ac, 129.01 Ac) |
| **358.309** | **68** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 0.000 | HSG A | |
| 0.000 | HSG B | |
| 0.000 | HSG C | |
| 0.000 | HSG D | |
| 358.309 | Other | 2.143 Ac, 2.982 Ac, 10.111 Ac, 10.276 Ac, 90.57 Ac, 113.22 Ac, 129.01 Ac |
| **358.309** | | **TOTAL AREA** |

## Ground Covers (all nodes)

| HSG-A (acres) | HSG-B (acres) | HSG-C (acres) | HSG-D (acres) | Other (acres) | Total (acres) | Ground Cover | Subcatchment Numbers |
|---|---|---|---|---|---|---|---|
| 0.000 | 0.000 | 0.000 | 0.000 | 358.309 | 358.309 | | 2.143 Ac, 2.982 Ac, 10.111 Ac, 10.276 Ac, 90.57 Ac, 113.22 Ac, 129.01 Ac |
| **0.000** | **0.000** | **0.000** | **0.000** | **358.309** | **358.309** | **TOTAL AREA** | |

Time span=1.00-72.00 hrs, dt=0.01 hrs, 7101 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Sim-Route method - Pond routing by Sim-Route method

**Subcatchment 2.143 Ac: EX-5** Runoff Area=2.143 ac 0.00% Impervious Runoff Depth=0.68"
Flow Length=432' Slope=0.0324 '/' Tc=12.7 min CN=68 Runoff=1.82 cfs 0.122 af

**Subcatchment 2.982 Ac: EX-4** Runoff Area=2.982 ac 0.00% Impervious Runoff Depth=0.68"
Flow Length=534' Slope=0.0075 '/' Tc=31.3 min CN=68 Runoff=1.41 cfs 0.170 af

**Subcatchment 10.111 Ac: EX-7** Runoff Area=10.111 ac 0.00% Impervious Runoff Depth=0.68"
Flow Length=1,096' Slope=0.0146 '/' Tc=39.8 min CN=68 Runoff=4.02 cfs 0.577 af

**Subcatchment 10.276 Ac: EX-6** Runoff Area=10.276 ac 0.00% Impervious Runoff Depth=0.68"
Flow Length=555' Slope=0.0288 '/' Tc=16.5 min CN=68 Runoff=7.50 cfs 0.586 af

**Subcatchment 90.57 Ac: EX-2** Runoff Area=90.570 ac 0.00% Impervious Runoff Depth=0.68"
Flow Length=1,299' Slope=0.0293 '/' Tc=32.2 min CN=68 Runoff=41.81 cfs 5.164 af

**Subcatchment 113.22 Ac: EX-1** Runoff Area=113.217 ac 0.00% Impervious Runoff Depth=0.68"
Flow Length=3,785' Slope=0.0135 '/' Tc=111.7 min CN=68 Runoff=20.90 cfs 6.455 af

**Subcatchment 129.01 Ac: EX-3** Runoff Area=129.010 ac 0.00% Impervious Runoff Depth=0.68"
Flow Length=1,329' Slope=0.0211 '/' Tc=38.7 min CN=68 Runoff=52.25 cfs 7.356 af

**Pond 3: Low Area in EX-3** Peak Elev=4,052.38' Storage=320,390 cf Inflow=52.25 cfs 7.356 af
Outflow=0.00 cfs 0.000 af

**Pond 4:** Peak Elev=4,082.49' Storage=7,400 cf Inflow=1.41 cfs 0.170 af
Outflow=0.00 cfs 0.000 af

**Pond 5:** Peak Elev=4,074.31' Storage=5,310 cf Inflow=1.82 cfs 0.122 af
Outflow=0.00 cfs 0.000 af

**Pond 6:** Peak Elev=4,066.65' Storage=25,140 cf Inflow=7.50 cfs 0.586 af
Outflow=0.00 cfs 0.000 af

**Pond 7:** Peak Elev=4,074.96' Storage=25,104 cf Inflow=4.02 cfs 0.577 af
Outflow=0.00 cfs 0.000 af

**Pond A: Existing Pond A** Peak Elev=4,044.00' Storage=224,947 cf Inflow=41.81 cfs 5.164 af
Outflow=0.00 cfs 0.000 af

**Pond E: Existing Pond E** Peak Elev=4,067.50' Storage=280,893 cf Inflow=20.90 cfs 6.455 af
Outflow=0.00 cfs 0.000 af

**Total Runoff Area = 358.309 ac Runoff Volume = 20.430 af Average Runoff Depth = 0.68"**
**100.00% Pervious = 358.309 ac 0.00% Impervious = 0.000 ac**

## Summary for Subcatchment 2.143 Ac: EX-5

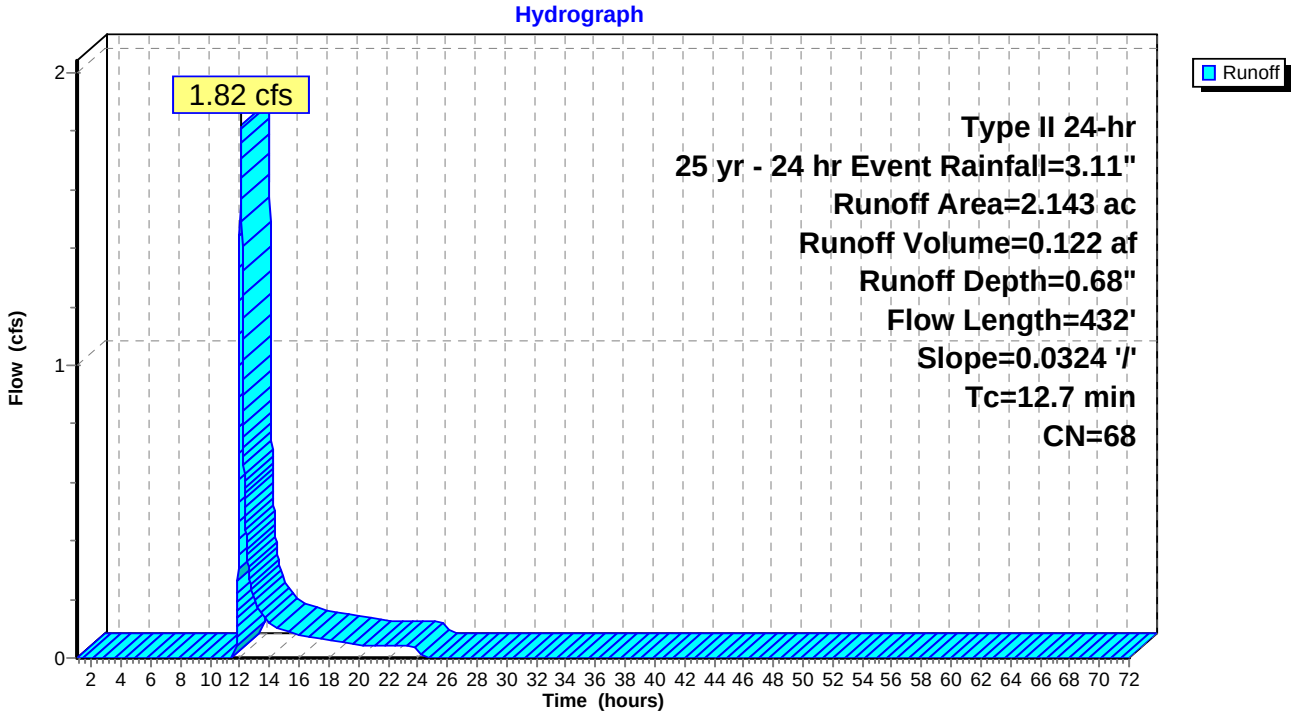
Runoff = 1.82 cfs @ 12.06 hrs, Volume= 0.122 af, Depth= 0.68"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 yr - 24 hr Event Rainfall=3.11"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 2.143 | 68 | |
| | 2.143 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 12.7 | 432 | 0.0324 | 0.57 | | **Lag/CN Method,** |

## Subcatchment 2.143 Ac: EX-5



## Summary for Subcatchment 2.982 Ac: EX-4

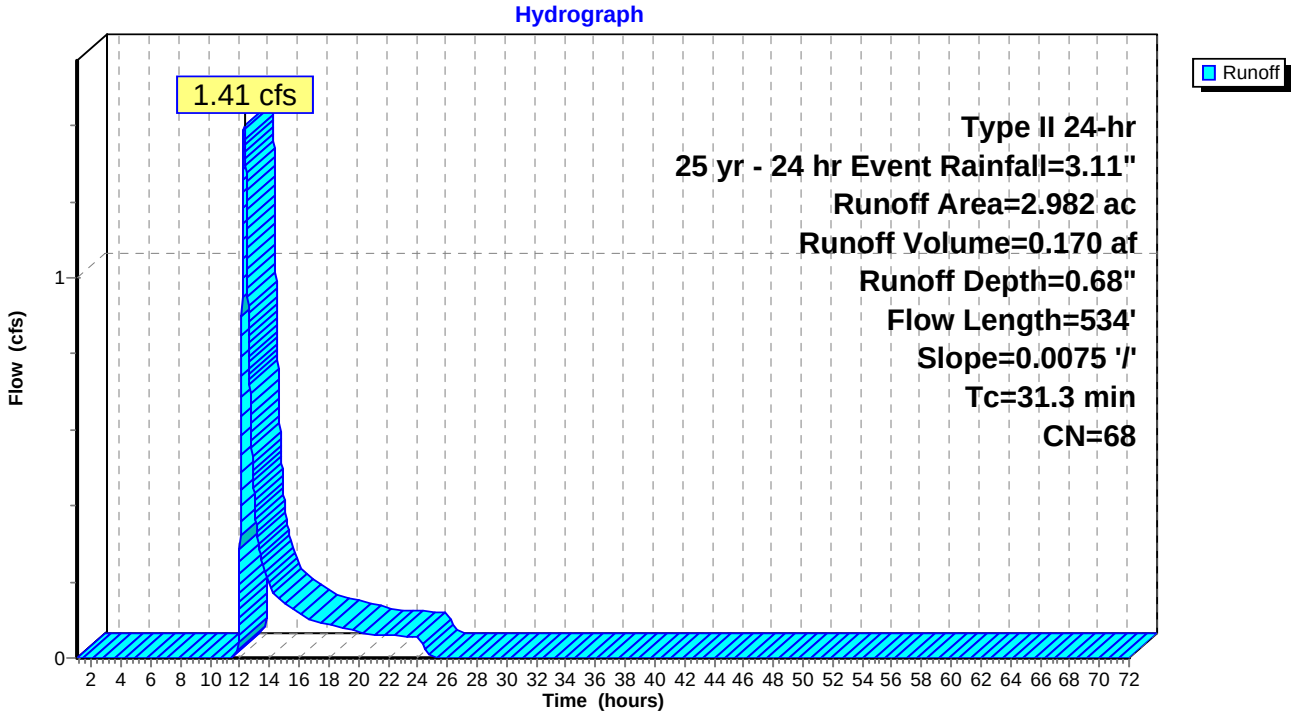
Runoff = 1.41 cfs @ 12.31 hrs, Volume= 0.170 af, Depth= 0.68"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 yr - 24 hr Event Rainfall=3.11"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 2.982 | 68 | |
| | 2.982 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 31.3 | 534 | 0.0075 | 0.28 | | **Lag/CN Method,** |

## Subcatchment 2.982 Ac: EX-4



## Summary for Subcatchment 10.111 Ac: EX-7

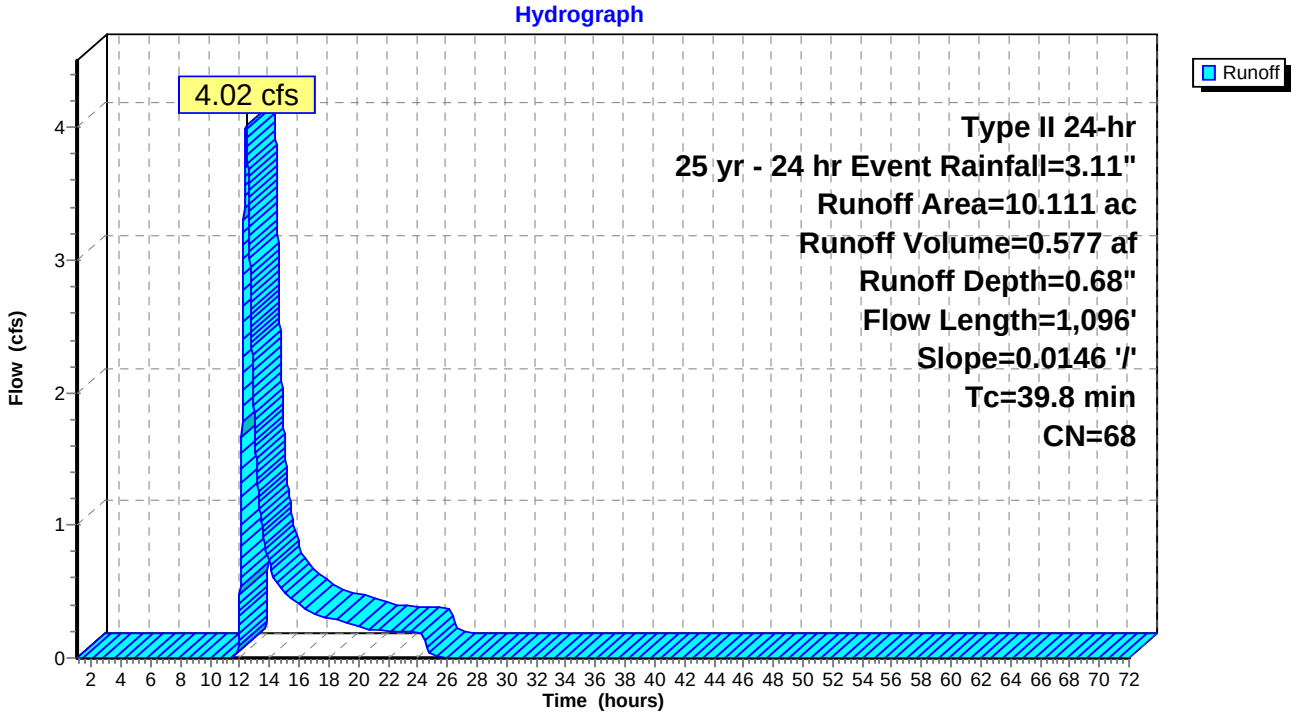
Runoff = 4.02 cfs @ 12.43 hrs, Volume= 0.577 af, Depth= 0.68"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 yr - 24 hr Event Rainfall=3.11"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 10.111 | 68 | |
| | 10.111 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 39.8 | 1,096 | 0.0146 | 0.46 | | **Lag/CN Method,** |

## Subcatchment 10.111 Ac: EX-7



## Summary for Subcatchment 10.276 Ac: EX-6

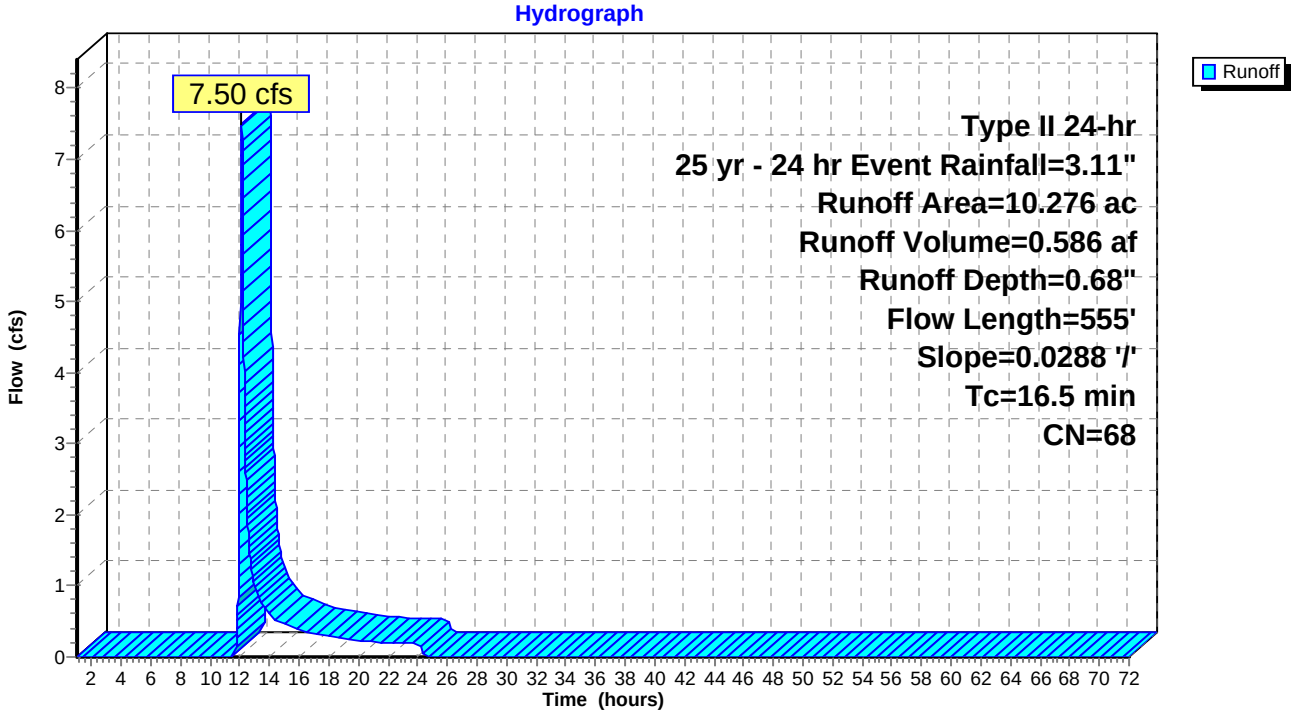
Runoff = 7.50 cfs @ 12.11 hrs, Volume= 0.586 af, Depth= 0.68"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 yr - 24 hr Event Rainfall=3.11"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 10.276 | 68 | |
| | 10.276 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 16.5 | 555 | 0.0288 | 0.56 | | **Lag/CN Method,** |

## Subcatchment 10.276 Ac: EX-6



## Summary for Subcatchment 90.57 Ac: EX-2

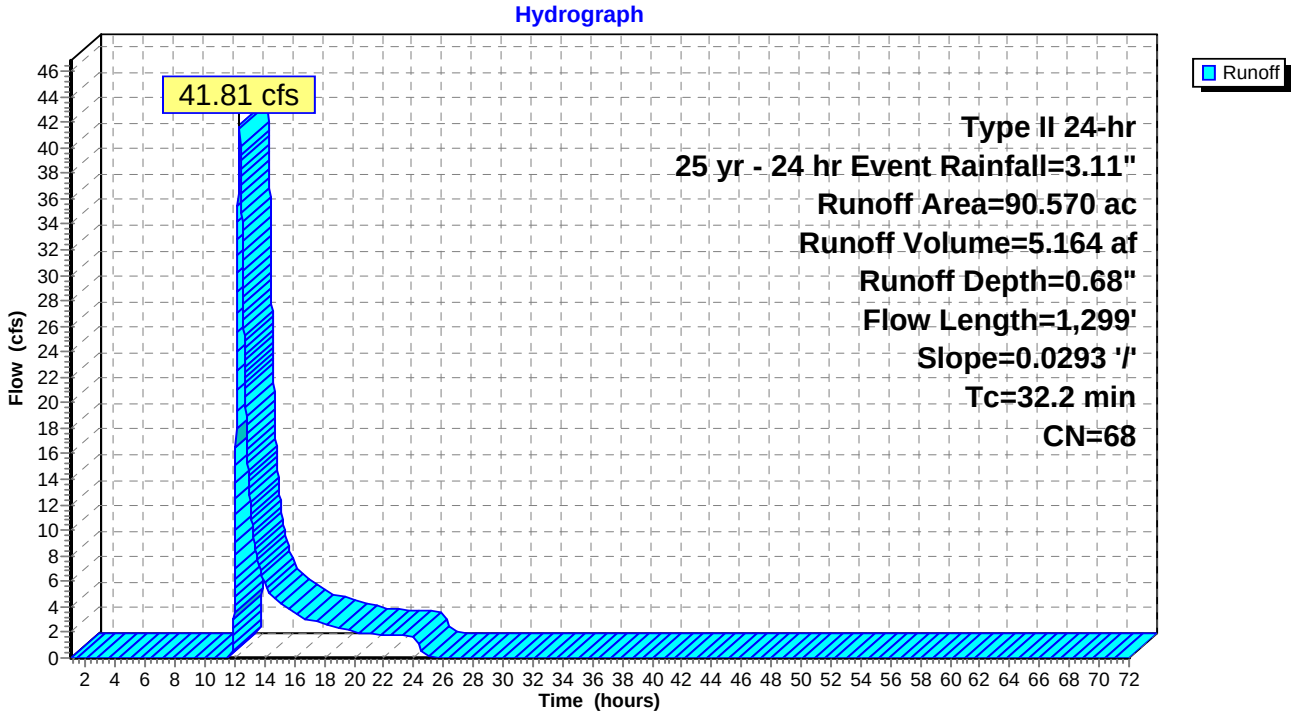
Runoff = 41.81 cfs @ 12.31 hrs, Volume= 5.164 af, Depth= 0.68"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 yr - 24 hr Event Rainfall=3.11"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 90.570 | 68 | |
| | 90.570 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 32.2 | 1,299 | 0.0293 | 0.67 | | **Lag/CN Method,** |

## Subcatchment 90.57 Ac: EX-2



## Summary for Subcatchment 113.22 Ac: EX-1

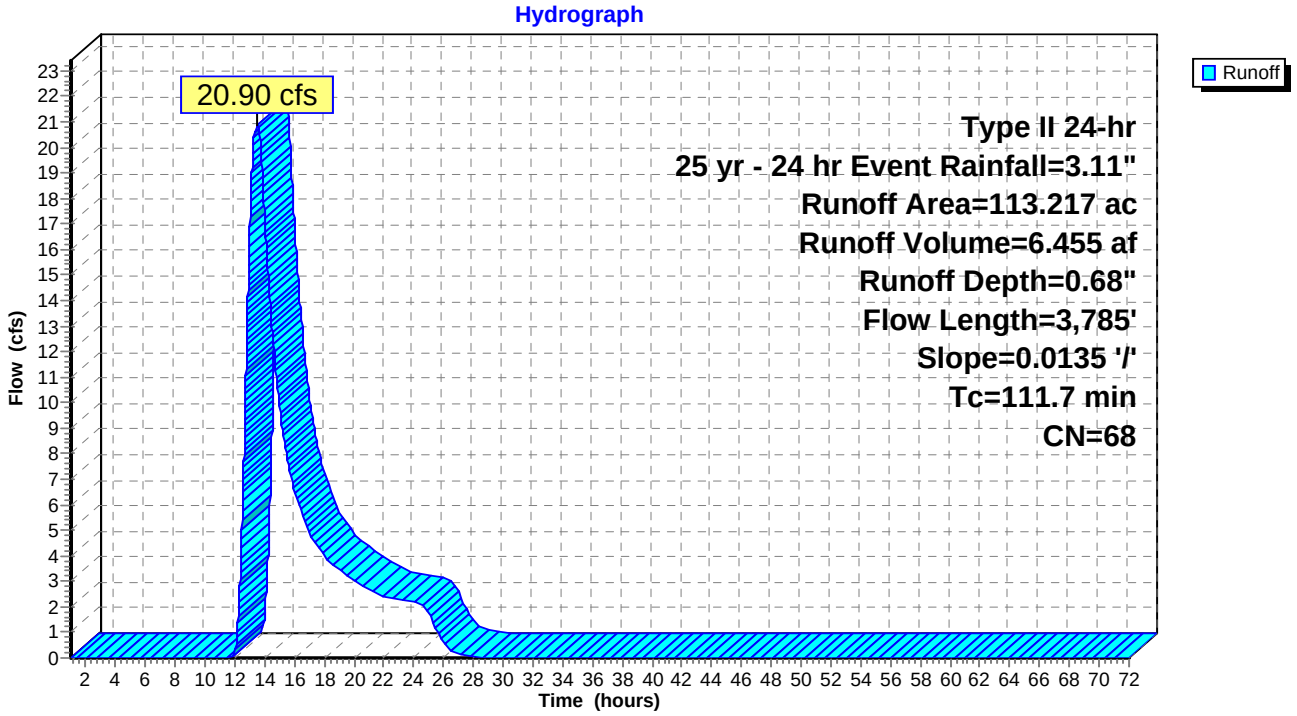
Runoff = 20.90 cfs @ 13.52 hrs, Volume= 6.455 af, Depth= 0.68"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 yr - 24 hr Event Rainfall=3.11"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 113.217 | 68 | |
| | 113.217 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 111.7 | 3,785 | 0.0135 | 0.56 | | **Lag/CN Method,** |

## Subcatchment 113.22 Ac: EX-1



## Summary for Subcatchment 129.01 Ac: EX-3

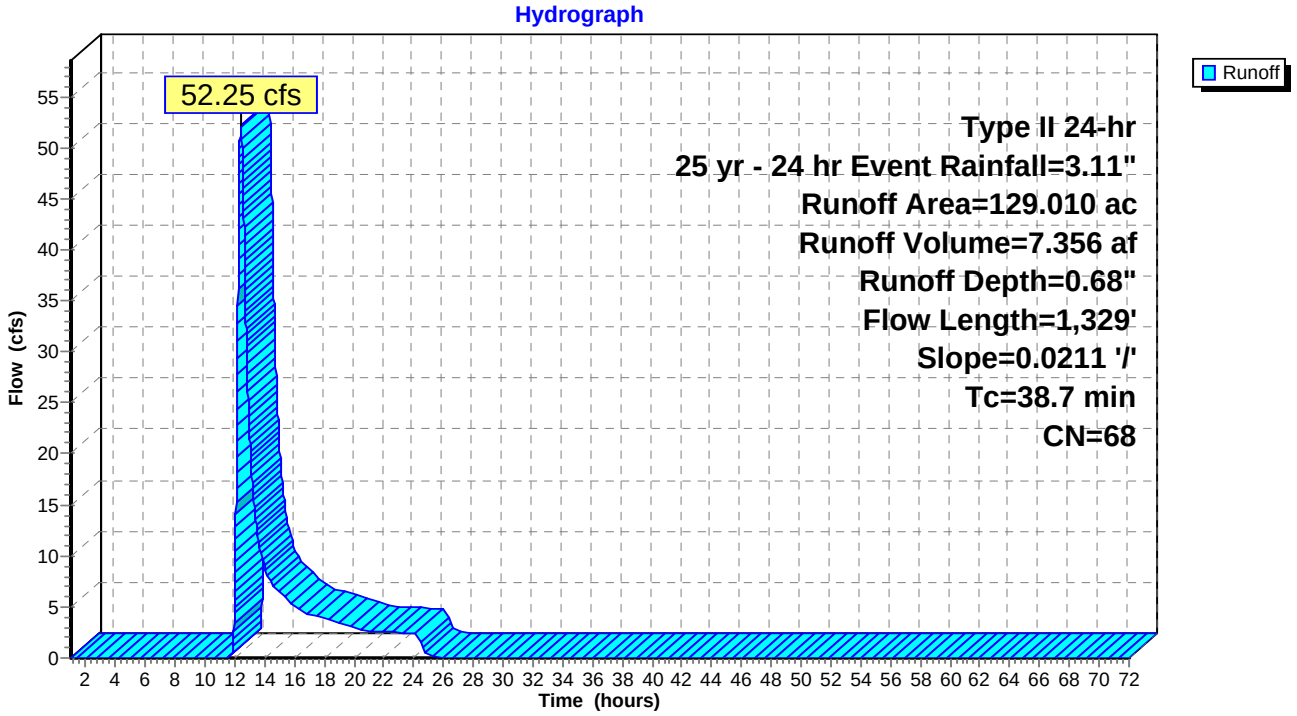
Runoff = 52.25 cfs @ 12.42 hrs, Volume= 7.356 af, Depth= 0.68"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 yr - 24 hr Event Rainfall=3.11"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 129.010 | 68 | |
| | 129.010 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 38.7 | 1,329 | 0.0211 | 0.57 | | **Lag/CN Method,** |

## Subcatchment 129.01 Ac: EX-3



## Summary for Pond 3: Low Area in EX-3

Inflow Area = 129.010 ac, 0.00% Impervious, Inflow Depth = 0.68" for 25 yr - 24 hr Event event
Inflow = 52.25 cfs @ 12.42 hrs, Volume= 7.356 af
Outflow = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

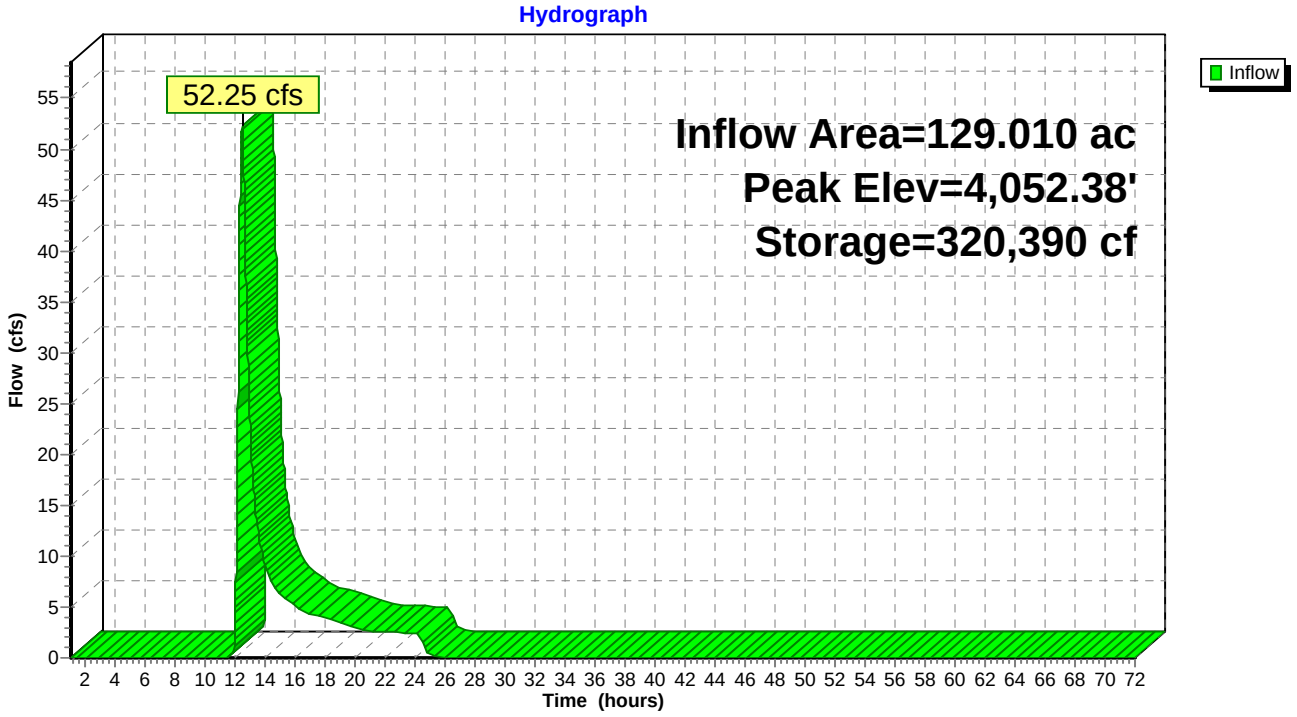
Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,052.38' @ 26.24 hrs Surf.Area= 57,729 sf Storage= 320,390 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 4,045.00' | 2,274,080 cf | **Custom Stage Data (Prismatic)**Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 4,045.00 | 29,699 | 0 | 0 |
| 4,050.00 | 48,031 | 194,325 | 194,325 |
| 4,060.00 | 88,713 | 683,720 | 878,045 |
| 4,070.00 | 134,664 | 1,116,885 | 1,994,930 |
| 4,072.00 | 144,486 | 279,150 | 2,274,080 |

## Pond 3: Low Area in EX-3



## Summary for Pond 4:

Inflow Area = 2.982 ac, 0.00% Impervious, Inflow Depth = 0.68" for 25 yr - 24 hr Event event
Inflow = 1.41 cfs @ 12.31 hrs, Volume= 0.170 af
Outflow = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

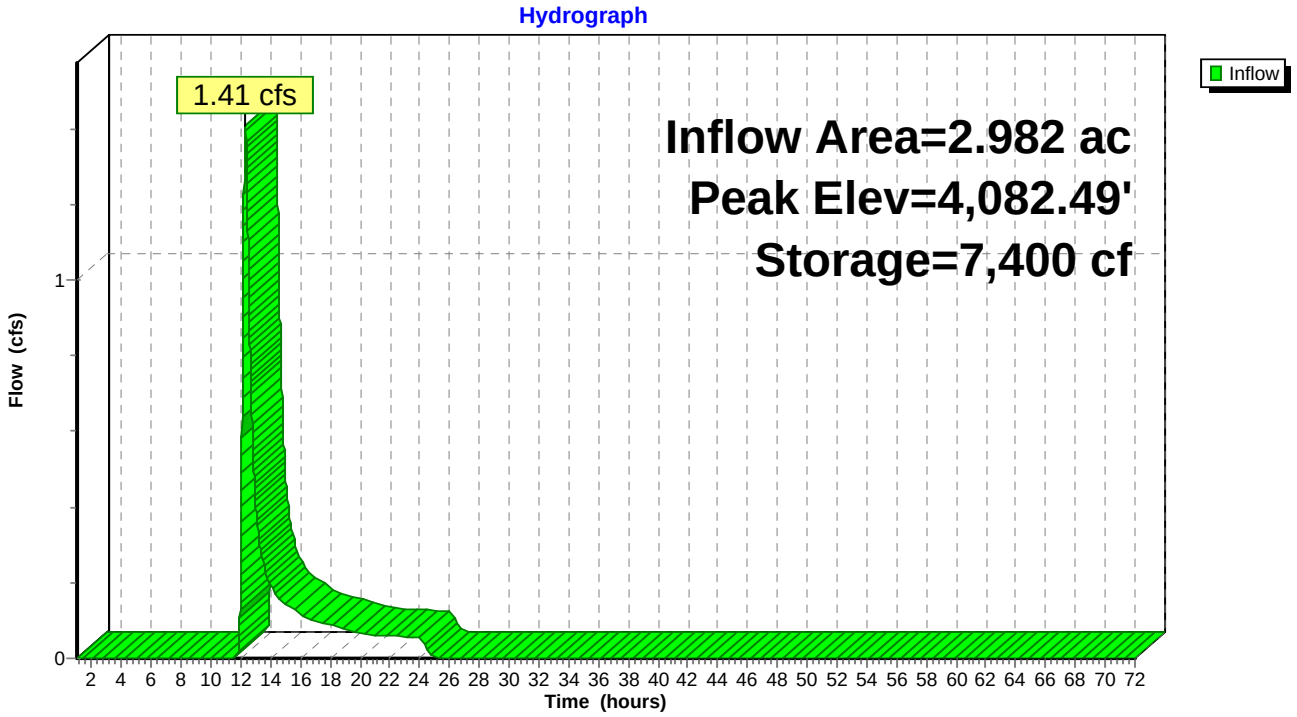
Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,082.49' @ 25.81 hrs Surf.Area= 21,043 sf Storage= 7,400 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 4,082.00' | 505,396 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 4,082.00 | 9,139 | 0 | 0 |
| 4,084.00 | 57,691 | 66,830 | 66,830 |
| 4,086.00 | 125,485 | 183,176 | 250,006 |
| 4,088.00 | 129,905 | 255,390 | 505,396 |

## Pond 4:



## Summary for Pond 5:

Inflow Area = 2.143 ac, 0.00% Impervious, Inflow Depth = 0.68" for 25 yr - 24 hr Event event
Inflow = 1.82 cfs @ 12.06 hrs, Volume= 0.122 af
Outflow = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

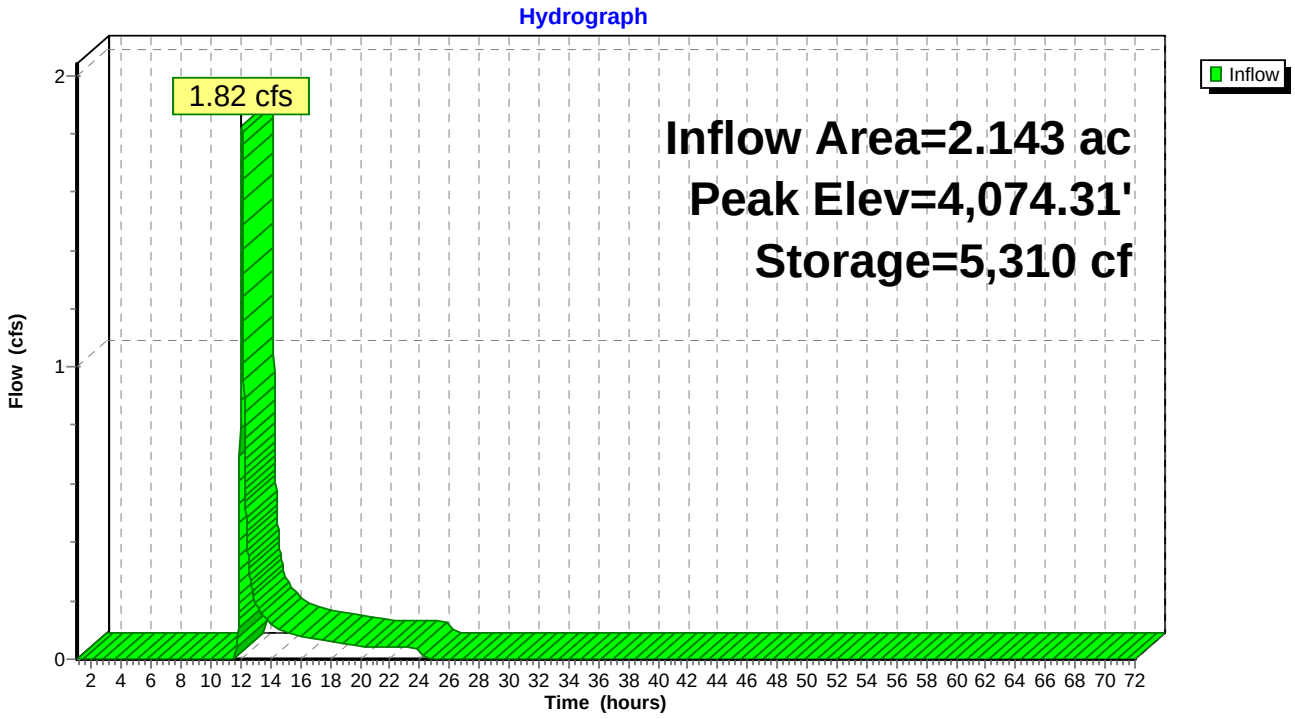
Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,074.31' @ 24.73 hrs Surf.Area= 18,595 sf Storage= 5,310 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 4,074.00' | 856,004 cf | **Custom Stage Data (Prismatic)**Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 4,074.00 | 16,005 | 0 | 0 |
| 4,076.00 | 32,882 | 48,887 | 48,887 |
| 4,078.00 | 49,247 | 82,129 | 131,016 |
| 4,080.00 | 59,954 | 109,201 | 240,217 |
| 4,082.00 | 67,894 | 127,848 | 368,065 |
| 4,084.00 | 75,540 | 143,434 | 511,499 |
| 4,086.00 | 87,806 | 163,346 | 674,845 |
| 4,088.00 | 93,353 | 181,159 | 856,004 |

## Pond 5:



## Summary for Pond 6:

Inflow Area = 10.276 ac, 0.00% Impervious, Inflow Depth = 0.68" for 25 yr - 24 hr Event event
Inflow = 7.50 cfs @ 12.11 hrs, Volume= 0.586 af
Outflow = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

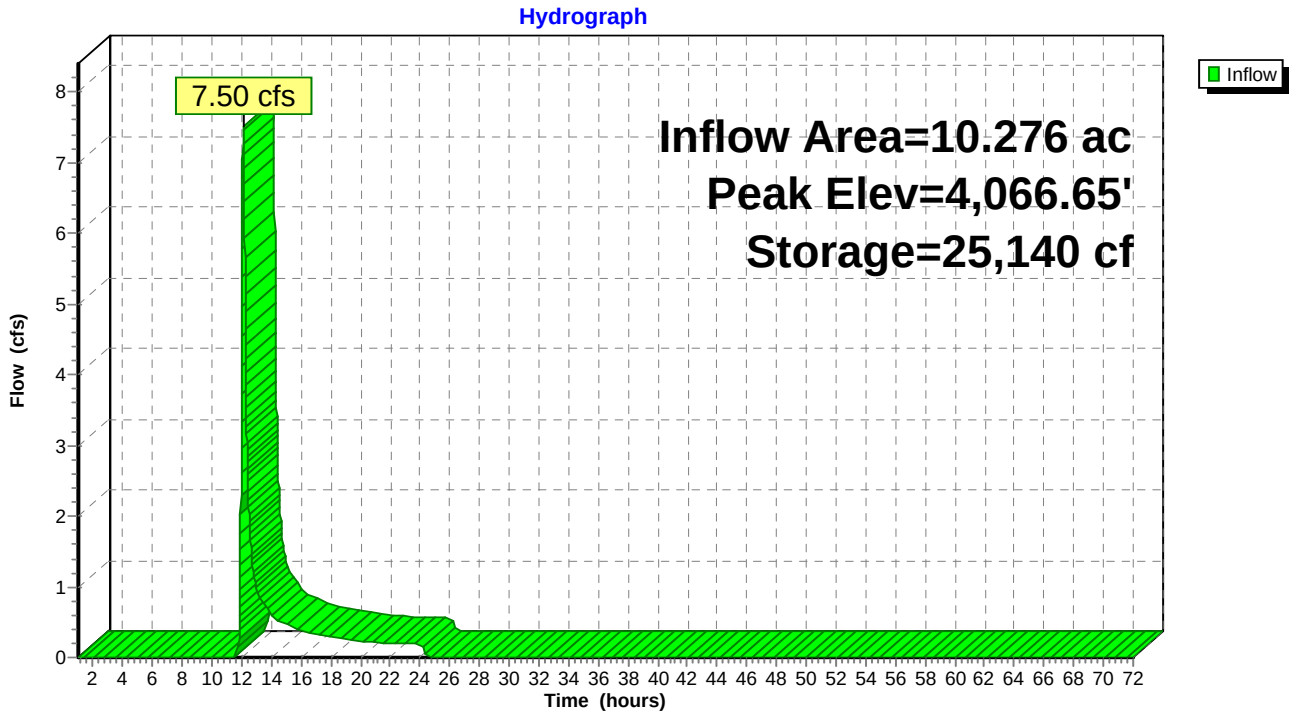
Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,066.65' @ 24.94 hrs Surf.Area= 70,878 sf Storage= 25,140 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 4,066.00' | 6,518,580 cf | **Custom Stage Data (Prismatic)**Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 4,066.00 | 6,541 | 0 | 0 |
| 4,068.00 | 204,667 | 211,208 | 211,208 |
| 4,070.00 | 284,587 | 489,254 | 700,462 |
| 4,072.00 | 368,419 | 653,006 | 1,353,468 |
| 4,074.00 | 423,258 | 791,677 | 2,145,145 |
| 4,076.00 | 436,696 | 859,954 | 3,005,099 |
| 4,078.00 | 438,253 | 874,949 | 3,880,048 |
| 4,080.00 | 439,503 | 877,756 | 4,757,804 |
| 4,082.00 | 440,288 | 879,791 | 5,637,595 |
| 4,084.00 | 440,697 | 880,985 | 6,518,580 |

## Pond 6:



## Summary for Pond 7:

Inflow Area = 10.111 ac, 0.00% Impervious, Inflow Depth = 0.68" for 25 yr - 24 hr Event event
Inflow = 4.02 cfs @ 12.43 hrs, Volume= 0.577 af
Outflow = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

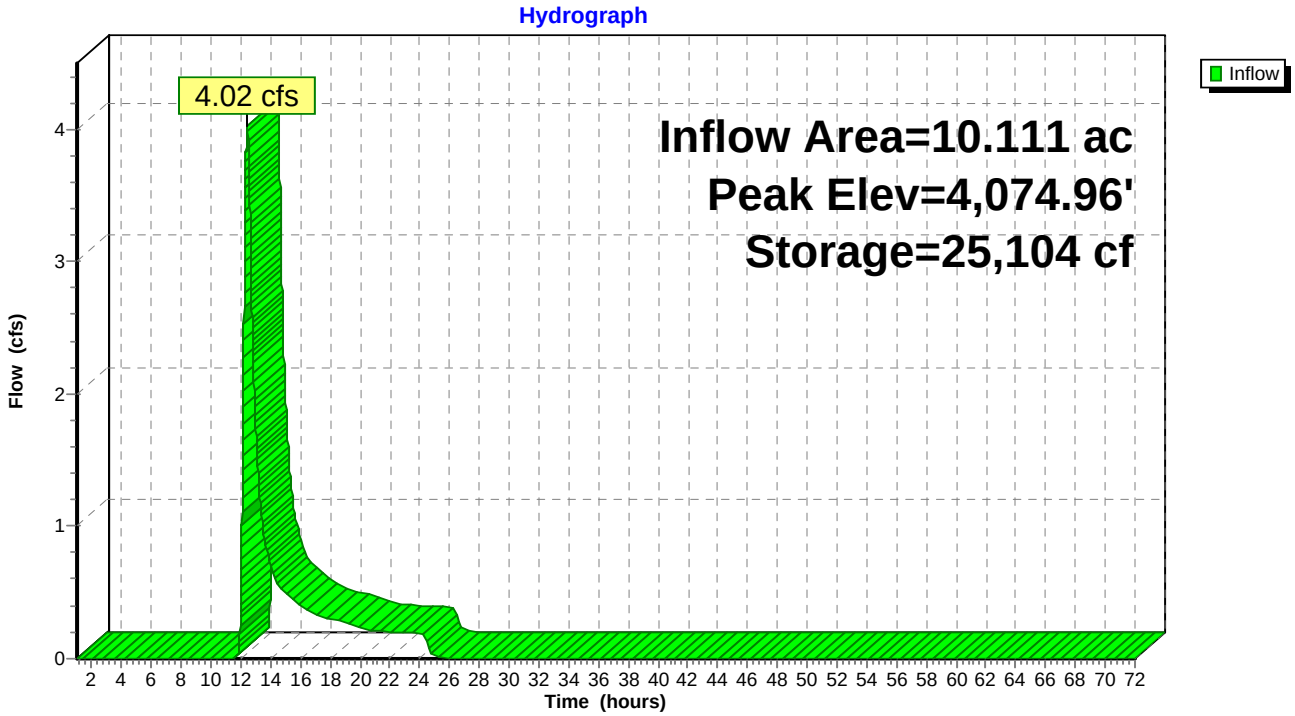
Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,074.96' @ 26.28 hrs Surf.Area= 45,915 sf Storage= 25,104 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 4,074.00' | 5,182,547 cf | **Custom Stage Data (Prismatic)**Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 4,074.00 | 6,537 | 0 | 0 |
| 4,076.00 | 88,813 | 95,350 | 95,350 |
| 4,078.00 | 221,764 | 310,577 | 405,927 |
| 4,080.00 | 338,943 | 560,707 | 966,634 |
| 4,082.00 | 406,222 | 745,165 | 1,711,799 |
| 4,084.00 | 435,796 | 842,018 | 2,553,817 |
| 4,086.00 | 437,995 | 873,791 | 3,427,608 |
| 4,088.00 | 438,826 | 876,821 | 4,304,429 |
| 4,090.00 | 439,292 | 878,118 | 5,182,547 |

## Pond 7:



## Summary for Pond A: Existing Pond A

Inflow Area = 90.570 ac, 0.00% Impervious, Inflow Depth = 0.68" for 25 yr - 24 hr Event event
Inflow = 41.81 cfs @ 12.31 hrs, Volume= 5.164 af
Outflow = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

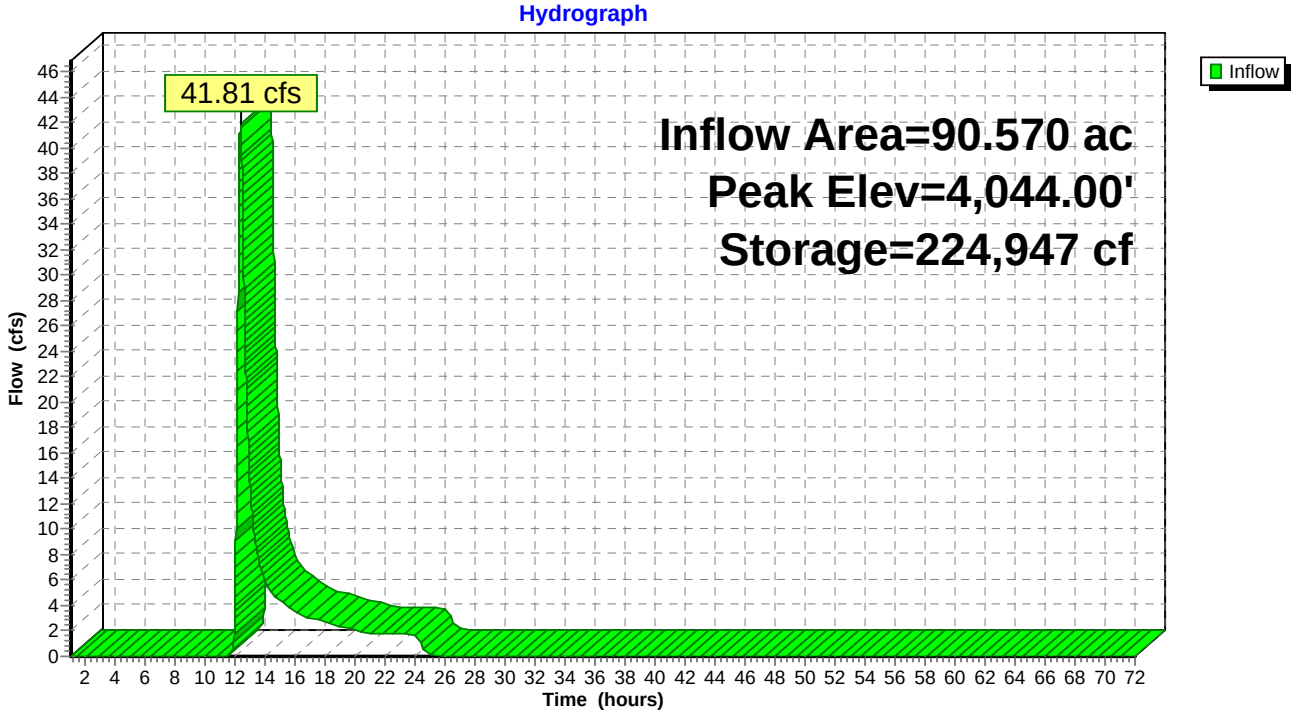
Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,044.00' @ 25.84 hrs Surf.Area= 234,888 sf Storage= 224,947 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 4,042.00' | 2,731,456 cf | **Custom Stage Data (Irregular)**Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Perim. (feet) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 4,042.00 | 24,911 | 828.4 | 0 | 0 | 24,911 |
| 4,044.00 | 234,832 | 1,999.4 | 224,152 | 224,152 | 288,435 |
| 4,046.00 | 269,364 | 2,202.0 | 503,801 | 727,953 | 356,302 |
| 4,048.00 | 315,141 | 2,380.0 | 583,907 | 1,311,860 | 421,367 |
| 4,050.00 | 358,700 | 2,479.0 | 673,371 | 1,985,231 | 459,954 |
| 4,052.00 | 387,713 | 2,618.0 | 746,225 | 2,731,456 | 516,563 |

## Pond A: Existing Pond A



## Summary for Pond E: Existing Pond E

Inflow Area = 113.217 ac, 0.00% Impervious, Inflow Depth = 0.68" for 25 yr - 24 hr Event event
Inflow = 20.90 cfs @ 13.52 hrs, Volume= 6.455 af
Outflow = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

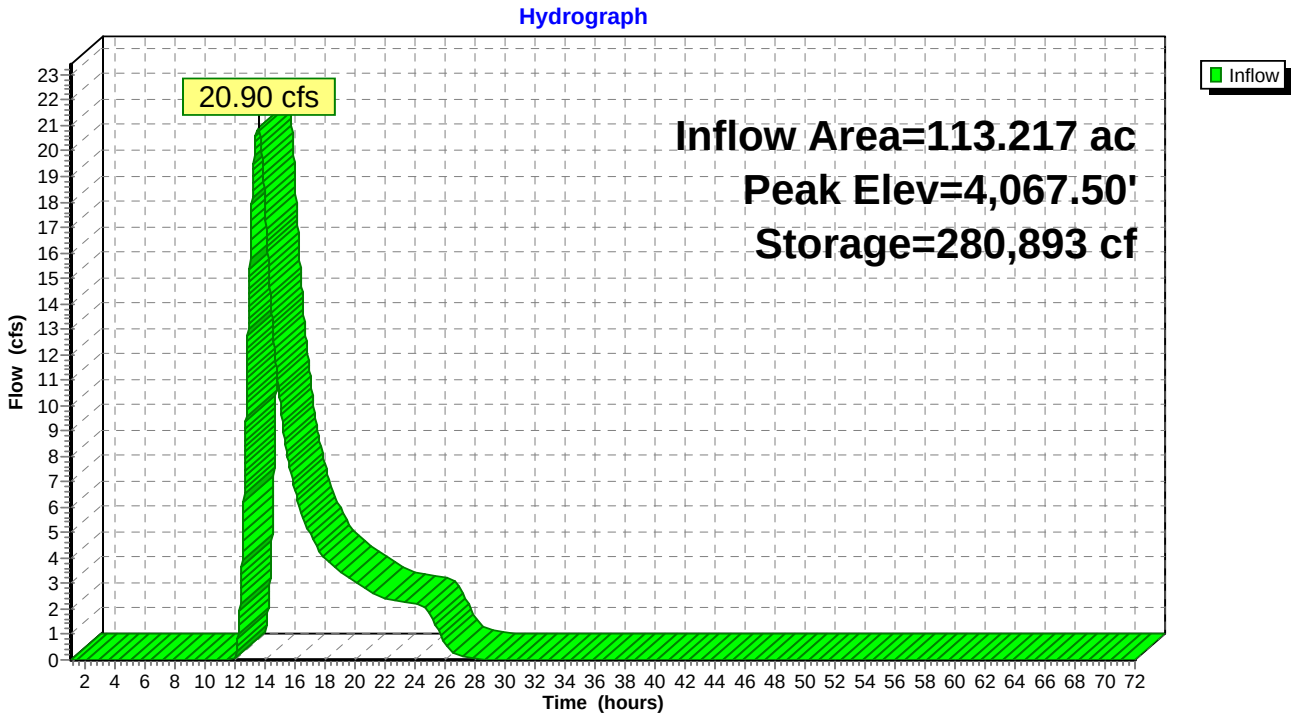
Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,067.50' @ 30.29 hrs Surf.Area= 272,616 sf Storage= 280,893 cf

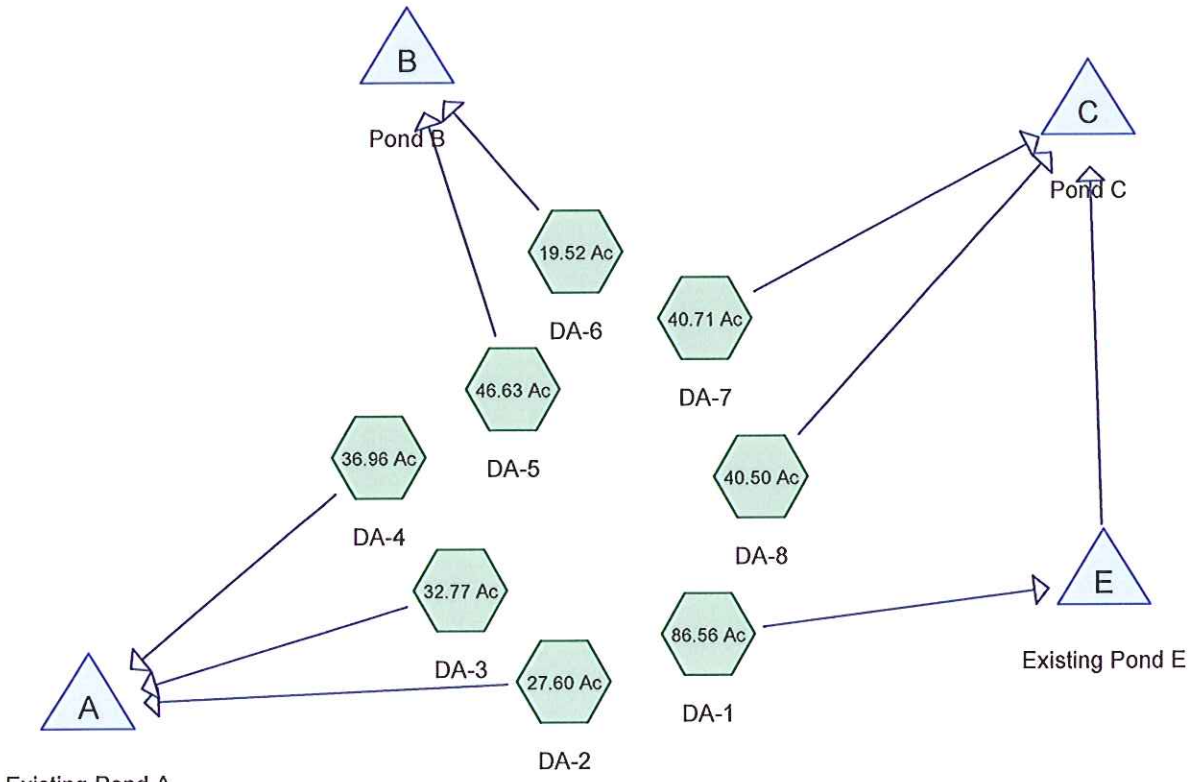
Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 4,060.00' | 2,469,482 cf | **Custom Stage Data (Prismatic)**Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 4,060.00 | 5,874 | 0 | 0 |
| 4,062.00 | 8,361 | 14,235 | 14,235 |
| 4,064.00 | 11,864 | 20,225 | 34,460 |
| 4,066.00 | 17,520 | 29,384 | 63,844 |
| 4,068.00 | 358,515 | 376,035 | 439,879 |
| 4,070.00 | 509,709 | 868,224 | 1,308,103 |
| 4,072.00 | 651,670 | 1,161,379 | 2,469,482 |

## Pond E: Existing Pond E






STATE OF TEXAS
CAMI VAN ABEL
113723
LICENSED
PROFESSIONAL ENGINEER

Cami Vanabel
6/13/13

Subcat Reach Pond Link

**Routing Diagram for McCombs Landfill - Final Conditions (2013-06-03)**
Prepared by {enter your company name here}, Printed 5/30/2013
HydroCAD® 10.00 s/n 05001 © 2012 HydroCAD Software Solutions LLC

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 331.250 | 73 | (19.52 Ac, 27.60 Ac, 32.77 Ac, 36.96 Ac, 40.50 Ac, 40.71 Ac, 46.63 Ac, 86.56 Ac) |
| **331.250** | **73** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 0.000 | HSG A | |
| 0.000 | HSG B | |
| 0.000 | HSG C | |
| 0.000 | HSG D | |
| 331.250 | Other | 19.52 Ac, 27.60 Ac, 32.77 Ac, 36.96 Ac, 40.50 Ac, 40.71 Ac, 46.63 Ac, 86.56 Ac |
| **331.250** | | **TOTAL AREA** |

## Ground Covers (all nodes)

| HSG-A (acres) | HSG-B (acres) | HSG-C (acres) | HSG-D (acres) | Other (acres) | Total (acres) | Ground Cover | Subcatchment Numbers |
|---|---|---|---|---|---|---|---|
| 0.000 | 0.000 | 0.000 | 0.000 | 331.250 | 331.250 | | 19.52 Ac, 27.60 Ac, 32.77 Ac, 36.96 Ac, 40.50 Ac, 40.71 Ac, 46.63 Ac, 86.56 Ac |
| **0.000** | **0.000** | **0.000** | **0.000** | **331.250** | **331.250** | **TOTAL AREA** | |

## Pipe Listing (all nodes)

| Line# | Node Number | In-Invert (feet) | Out-Invert (feet) | Length (feet) | Slope (ft/ft) | n | Diam/Width (inches) | Height (inches) | Inside-Fill (inches) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | E | 4,060.00 | 4,046.00 | 289.0 | 0.0484 | 0.013 | 36.0 | 0.0 | 0.0 |

Time span=1.00-72.00 hrs, dt=0.01 hrs, 7101 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Sim-Route method - Pond routing by Sim-Route method

**Subcatchment 19.52 Ac: DA-6** Runoff Area=19.520 ac 0.00% Impervious Runoff Depth=0.93"
Flow Length=2,720' Tc=47.8 min CN=73 Runoff=10.22 cfs 1.506 af

**Subcatchment 27.60 Ac: DA-2** Runoff Area=27.600 ac 0.00% Impervious Runoff Depth=0.93"
Flow Length=2,607' Tc=45.4 min CN=73 Runoff=15.04 cfs 2.129 af

**Subcatchment 32.77 Ac: DA-3** Runoff Area=32.770 ac 0.00% Impervious Runoff Depth=0.93"
Flow Length=1,532' Tc=18.9 min CN=73 Runoff=32.55 cfs 2.528 af

**Subcatchment 36.96 Ac: DA-4** Runoff Area=36.960 ac 0.00% Impervious Runoff Depth=0.93"
Flow Length=2,261' Tc=37.5 min CN=73 Runoff=23.14 cfs 2.851 af

**Subcatchment 40.50 Ac: DA-8** Runoff Area=40.500 ac 0.00% Impervious Runoff Depth=0.93"
Flow Length=1,811' Tc=24.0 min CN=73 Runoff=34.59 cfs 3.124 af

**Subcatchment 40.71 Ac: DA-7** Runoff Area=40.710 ac 0.00% Impervious Runoff Depth=0.93"
Flow Length=2,774' Tc=51.7 min CN=73 Runoff=20.16 cfs 3.141 af

**Subcatchment 46.63 Ac: DA-5** Runoff Area=46.630 ac 0.00% Impervious Runoff Depth=0.93"
Flow Length=1,548' Tc=22.4 min CN=73 Runoff=41.70 cfs 3.597 af

**Subcatchment 86.56 Ac: DA-1** Runoff Area=86.560 ac 0.00% Impervious Runoff Depth=0.93"
Flow Length=4,401' Tc=147.5 min CN=73 Runoff=19.54 cfs 6.678 af

**Pond A: Existing Pond A** Peak Elev=4,044.43' Storage=327,051 cf Inflow=55.21 cfs 7.508 af
Outflow=0.00 cfs 0.000 af

**Pond B: Pond B** Peak Elev=4,050.57' Storage=222,257 cf Inflow=46.39 cfs 5.103 af
Outflow=0.00 cfs 0.000 af

**Pond C: Pond C** Peak Elev=4,055.71' Storage=563,728 cf Inflow=44.46 cfs 12.942 af
Outflow=0.00 cfs 0.000 af

**Pond E: Existing Pond E** Peak Elev=4,060.96' Storage=6,204 cf Inflow=19.54 cfs 6.678 af
36.0" Round Culvert x 3.00 n=0.013 L=289.0' S=0.0484 '/' Outflow=19.47 cfs 6.677 af

**Total Runoff Area = 331.250 ac Runoff Volume = 25.554 af Average Runoff Depth = 0.93"**
**100.00% Pervious = 331.250 ac 0.00% Impervious = 0.000 ac**

## Summary for Subcatchment 19.52 Ac: DA-6

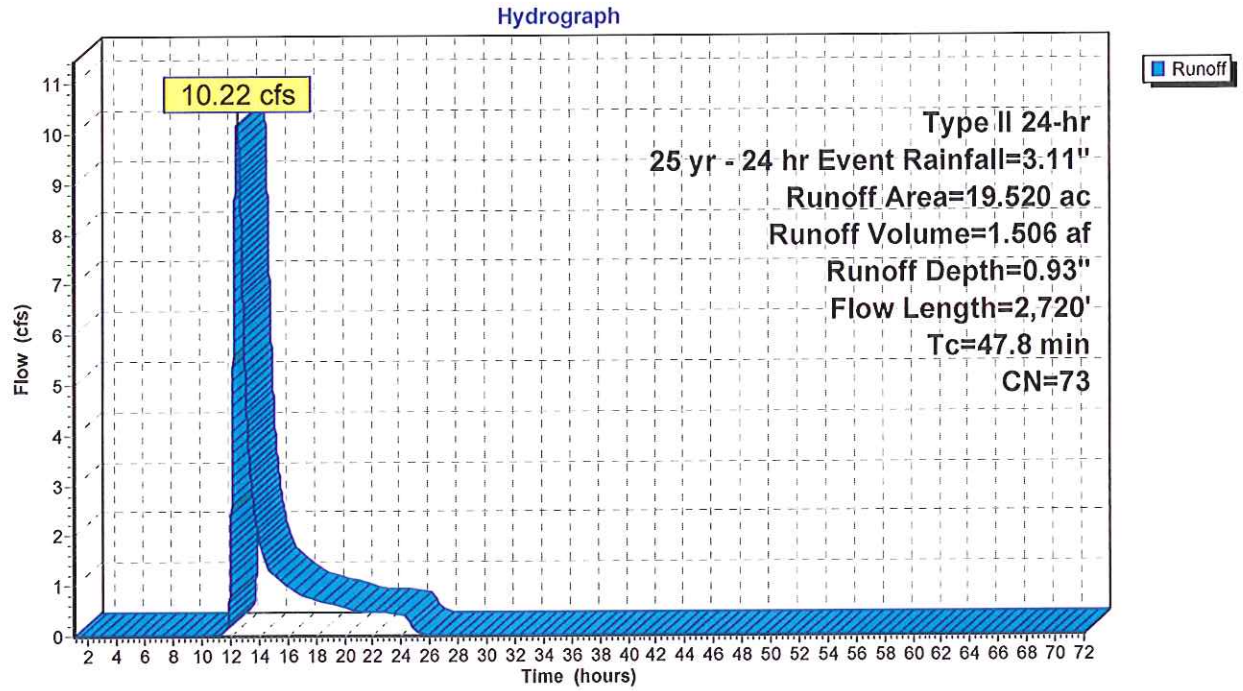
Runoff = 10.22 cfs @ 12.49 hrs, Volume= 1.506 af, Depth= 0.93"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 yr - 24 hr Event Rainfall=3.11"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 19.520 | 73 | |
| | 19.520 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 14.0 | 1,036 | 0.0827 | 1.24 | | **Lag/CN Method, Top Dome** |
| 4.4 | 540 | 0.2884 | 2.03 | | **Lag/CN Method, Side Slope** |
| 29.4 | 1,144 | 0.0219 | 0.65 | | **Lag/CN Method, Ditch** |
| 47.8 | 2,720 | Total | | | |

## Subcatchment 19.52 Ac: DA-6



## Summary for Subcatchment 27.60 Ac: DA-2

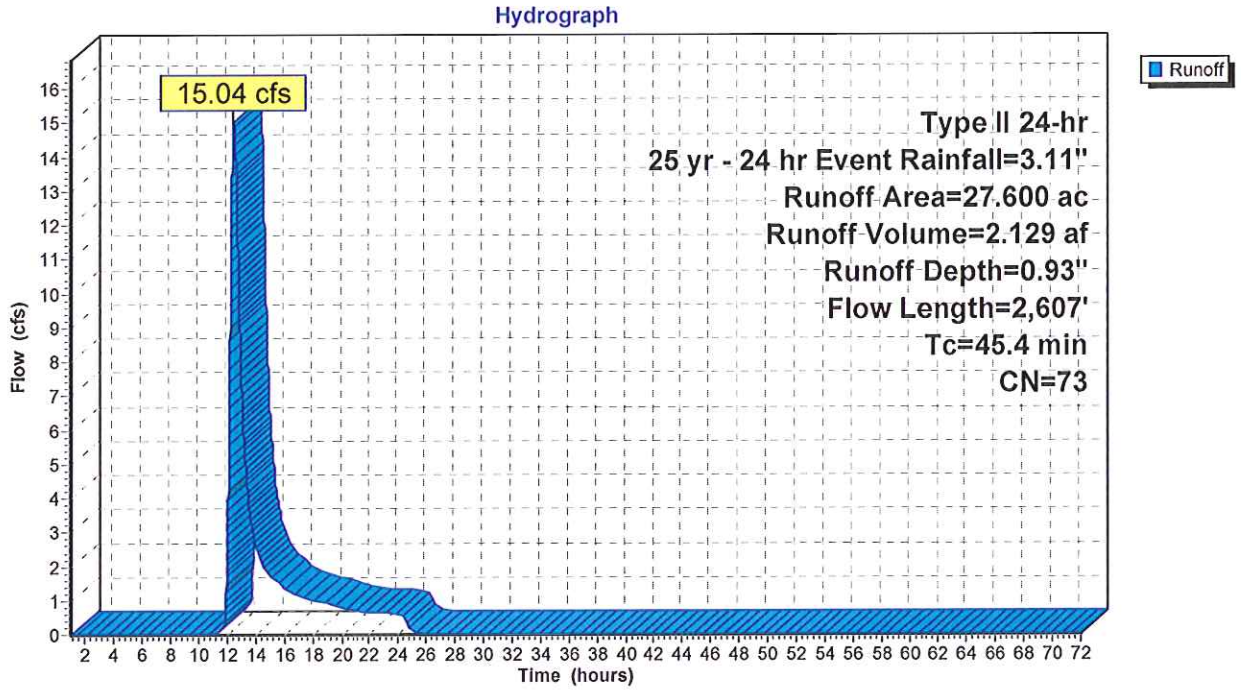
Runoff = 15.04 cfs @ 12.46 hrs, Volume= 2.129 af, Depth= 0.93"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 yr - 24 hr Event Rainfall=3.11"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 27.600 | 73 | |
| | 27.600 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 14.7 | 983 | 0.0688 | 1.12 | | **Lag/CN Method, Top Dome** |
| 3.8 | 480 | 0.3333 | 2.13 | | **Lag/CN Method, Side Slope** |
| 26.9 | 1,144 | 0.0262 | 0.71 | | **Lag/CN Method, Ditch** |
| 45.4 | 2,607 | Total | | | |

## Subcatchment 27.60 Ac: DA-2



## Summary for Subcatchment 32.77 Ac: DA-3

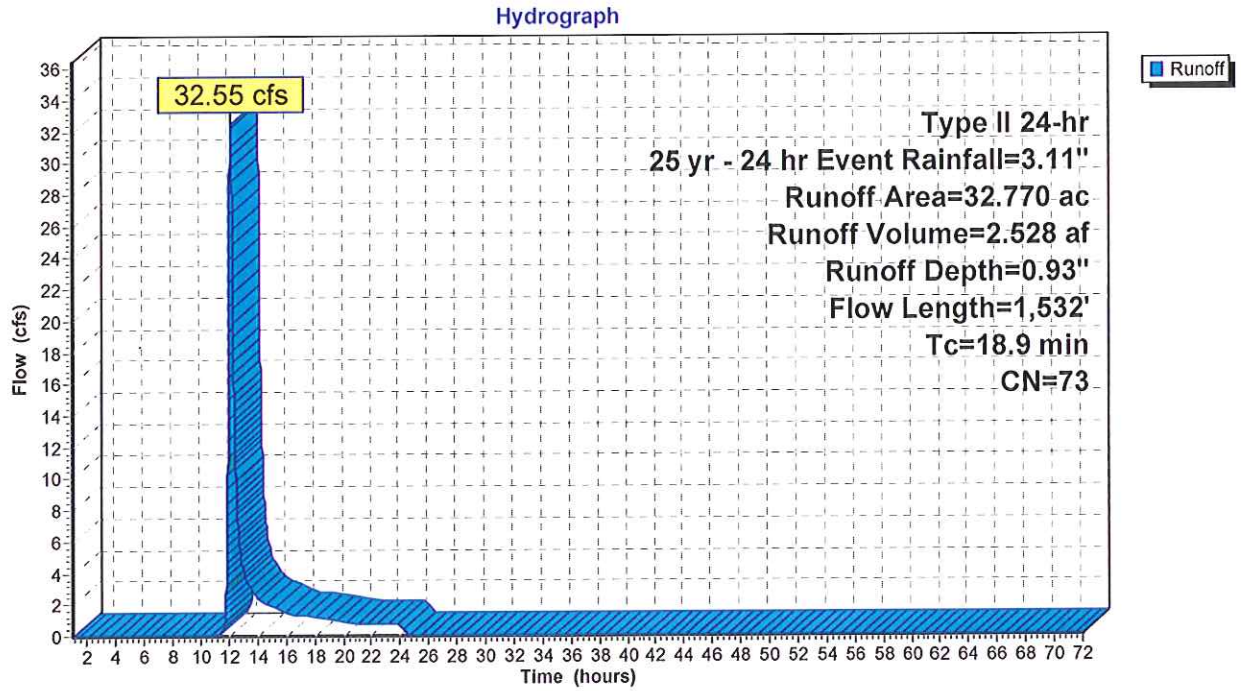
Runoff = 32.55 cfs @ 12.12 hrs, Volume= 2.528 af, Depth= 0.93"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 yr - 24 hr Event Rainfall=3.11"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 32.770 | 73 | |
| | 32.770 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 14.4 | 945 | 0.0676 | 1.10 | | **Lag/CN Method, Top Dome** |
| 4.5 | 587 | 0.3216 | 2.18 | | **Lag/CN Method, Side Slope** |
| 18.9 | 1,532 | Total | | | |

## Subcatchment 32.77 Ac: DA-3



## Summary for Subcatchment 36.96 Ac: DA-4

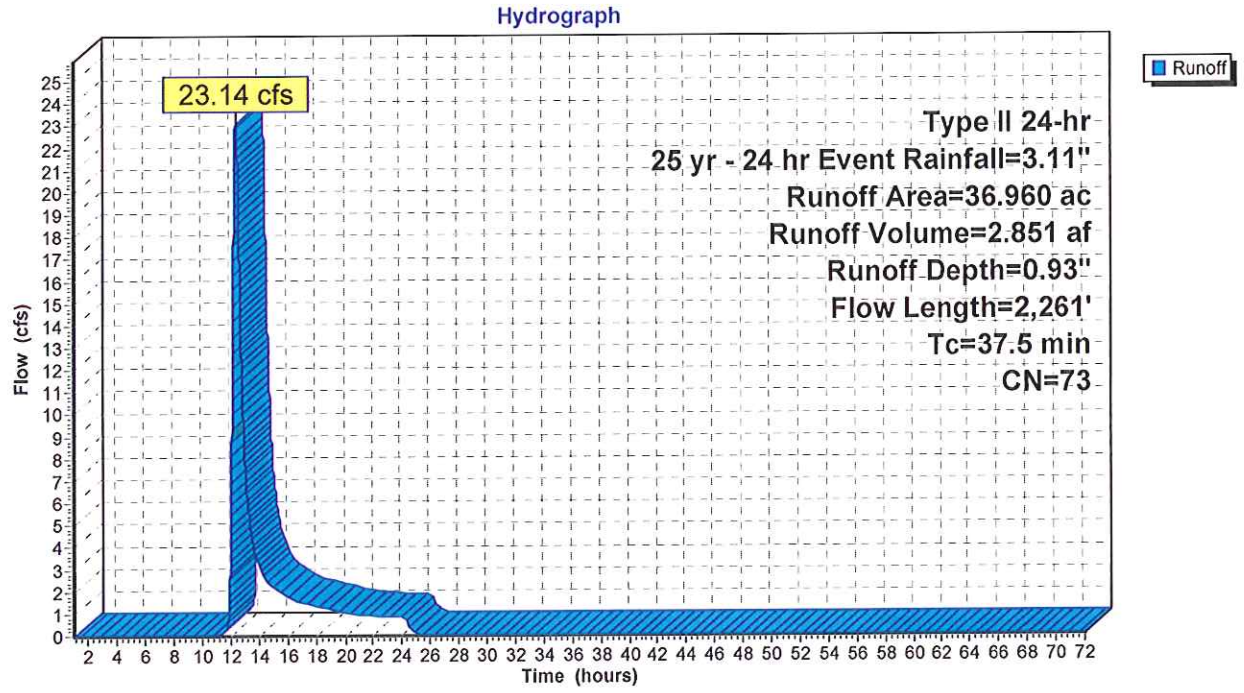
Runoff = 23.14 cfs @ 12.37 hrs, Volume= 2.851 af, Depth= 0.93"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 yr - 24 hr Event Rainfall=3.11"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 36.960 | 73 | |
| | 36.960 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 12.2 | 786 | 0.0695 | 1.07 | | **Lag/CN Method, Top Dome** |
| 4.2 | 526 | 0.3050 | 2.07 | | **Lag/CN Method, Side Slope** |
| 21.1 | 949 | 0.0316 | 0.75 | | **Lag/CN Method, Ditch** |
| 37.5 | 2,261 | Total | | | |

## Subcatchment 36.96 Ac: DA-4



## Summary for Subcatchment 40.50 Ac: DA-8

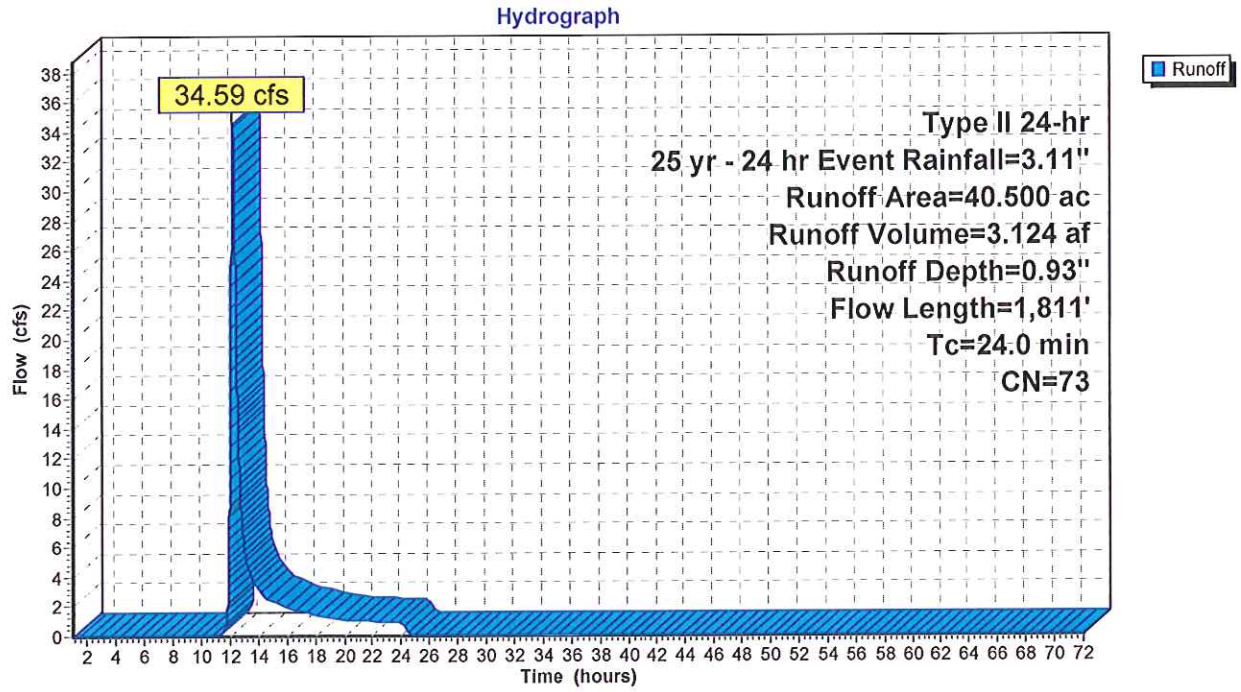
Runoff = 34.59 cfs @ 12.19 hrs, Volume= 3.124 af, Depth= 0.93"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 yr - 24 hr Event Rainfall=3.11"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 40.500 | 73 | |
| | 40.500 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 14.8 | 947 | 0.0634 | 1.06 | | **Lag/CN Method, Top Dome** |
| 5.9 | 715 | 0.2595 | 2.03 | | **Lag/CN Method, Side Slope** |
| 3.3 | 149 | 0.0671 | 0.76 | | **Lag/CN Method, Ditch** |
| 24.0 | 1,811 | Total | | | |

## Subcatchment 40.50 Ac: DA-8



## Summary for Subcatchment 40.71 Ac: DA-7

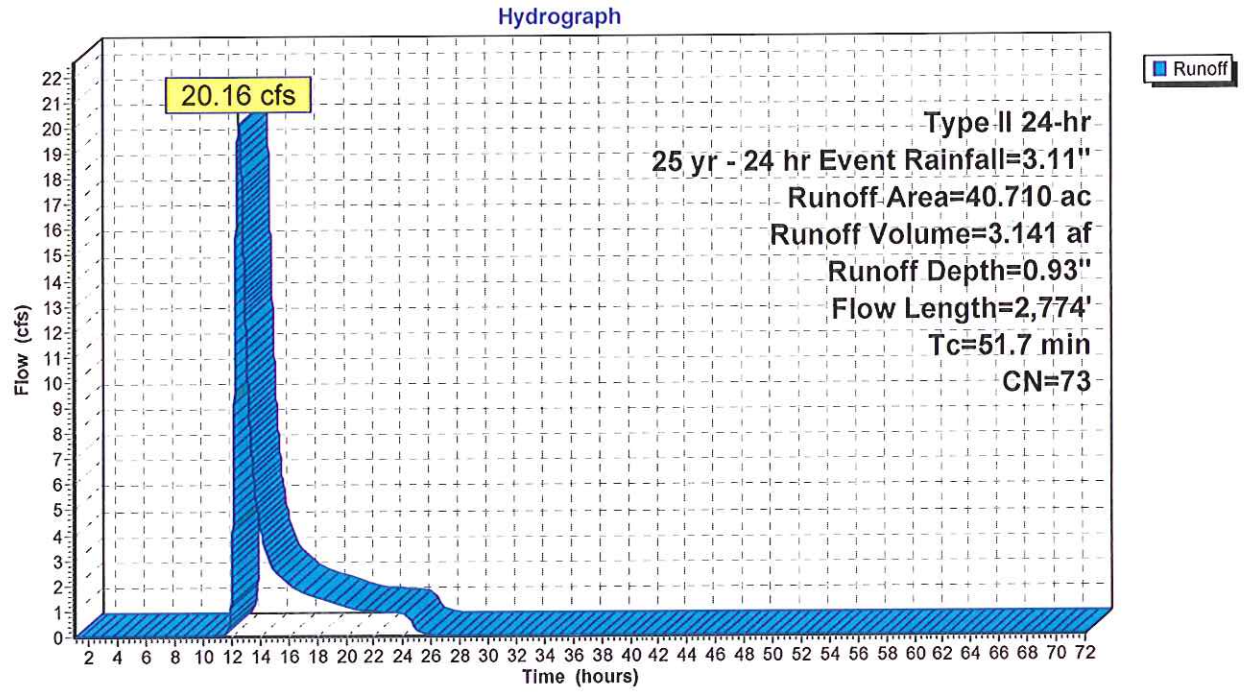
Runoff = 20.16 cfs @ 12.58 hrs, Volume= 3.141 af, Depth= 0.93"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 yr - 24 hr Event Rainfall=3.11"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 40.710 | 73 | |
| | 40.710 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 16.3 | 1,037 | 0.0605 | 1.06 | | **Lag/CN Method, Top Dome** |
| 4.5 | 549 | 0.2945 | 2.05 | | **Lag/CN Method, Side Slope** |
| 30.9 | 1,188 | 0.0211 | 0.64 | | **Lag/CN Method, Ditch** |
| 51.7 | 2,774 | Total | | | |

## Subcatchment 40.71 Ac: DA-7



## Summary for Subcatchment 46.63 Ac: DA-5

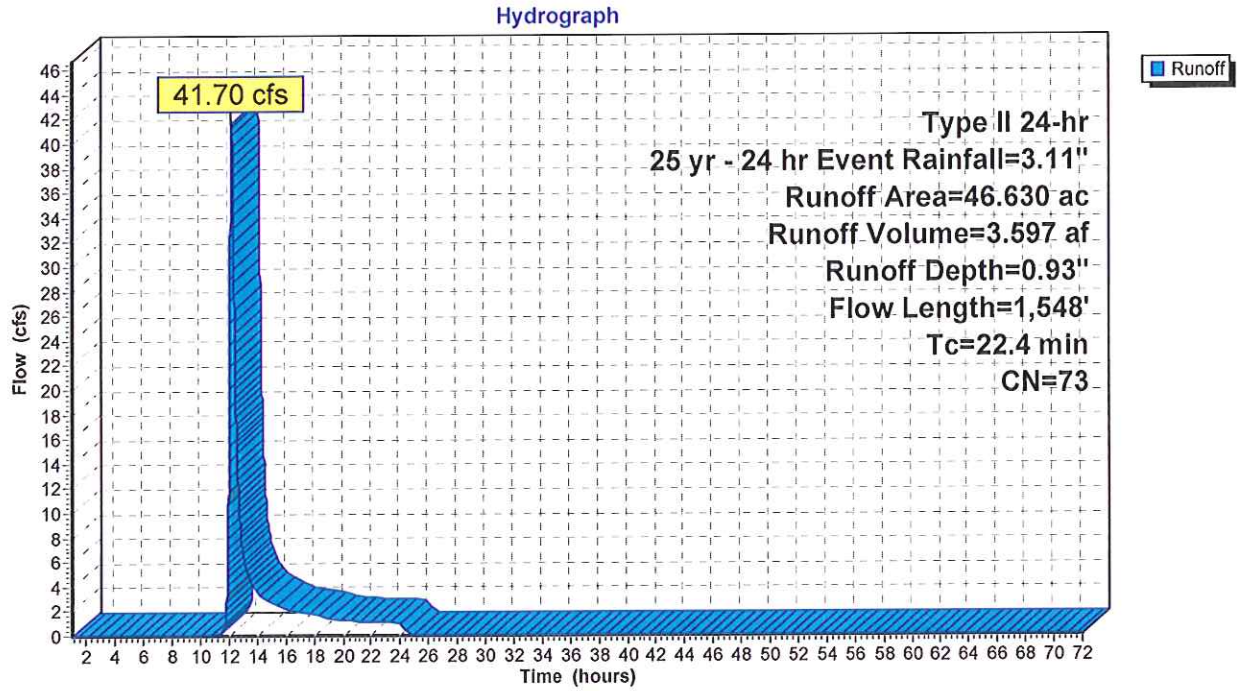
Runoff = 41.70 cfs @ 12.17 hrs, Volume= 3.597 af, Depth= 0.93"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 yr - 24 hr Event Rainfall=3.11"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 46.630 | 73 | |
| | 46.630 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 17.6 | 1,033 | 0.0518 | 0.98 | | **Lag/CN Method, Top Dome** |
| 4.8 | 515 | 0.2288 | 1.79 | | **Lag/CN Method, Side Slope** |
| 22.4 | 1,548 | Total | | | |

## Subcatchment 46.63 Ac: DA-5



## Summary for Subcatchment 86.56 Ac: DA-1

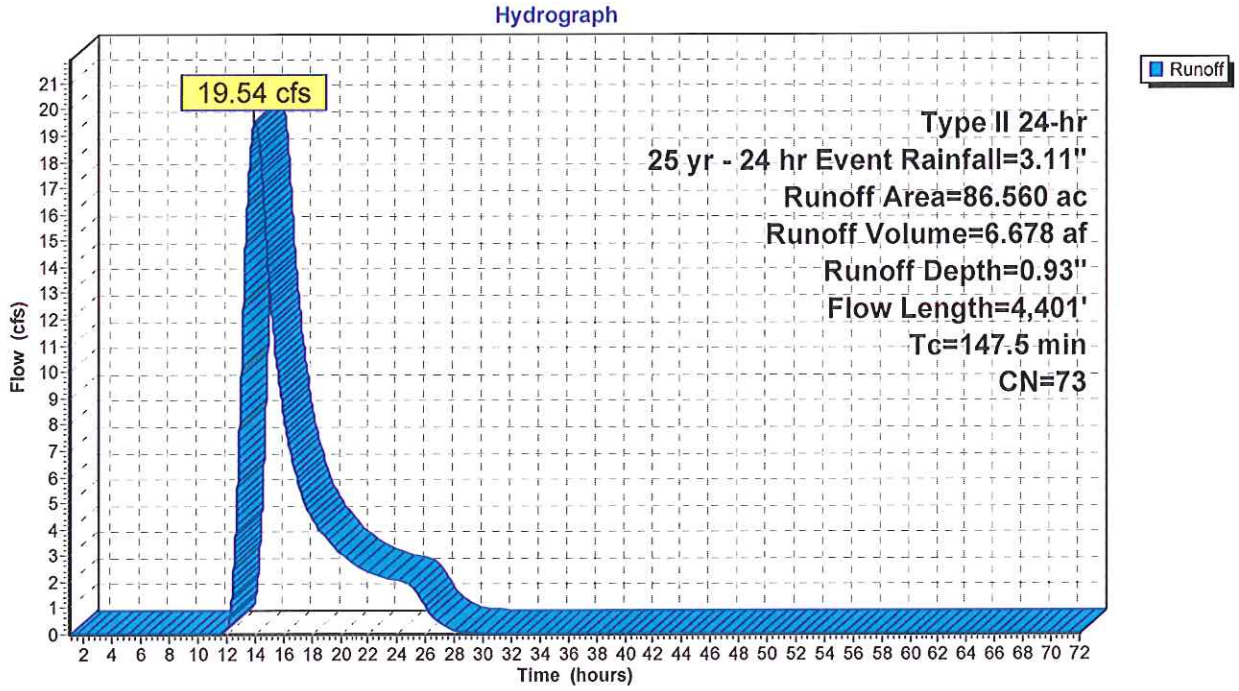
Runoff = 19.54 cfs @ 13.93 hrs, Volume= 6.678 af, Depth= 0.93"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 yr - 24 hr Event Rainfall=3.11"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 86.560 | 73 | |
| | 86.560 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 16.0 | 1,042 | 0.0637 | 1.09 | | **Lag/CN Method, Top Dome** |
| 4.8 | 465 | 0.1976 | 1.63 | | **Lag/CN Method, Side Slope** |
| 126.7 | 2,894 | 0.0052 | 0.38 | | **Lag/CN Method, Ditch** |
| 147.5 | 4,401 | Total | | | |

## Subcatchment 86.56 Ac: DA-1



## Summary for Pond A: Existing Pond A

Inflow Area = 97.330 ac, 0.00% Impervious, Inflow Depth = 0.93" for 25 yr - 24 hr Event event
Inflow = 55.21 cfs @ 12.21 hrs, Volume= 7.508 af
Outflow = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

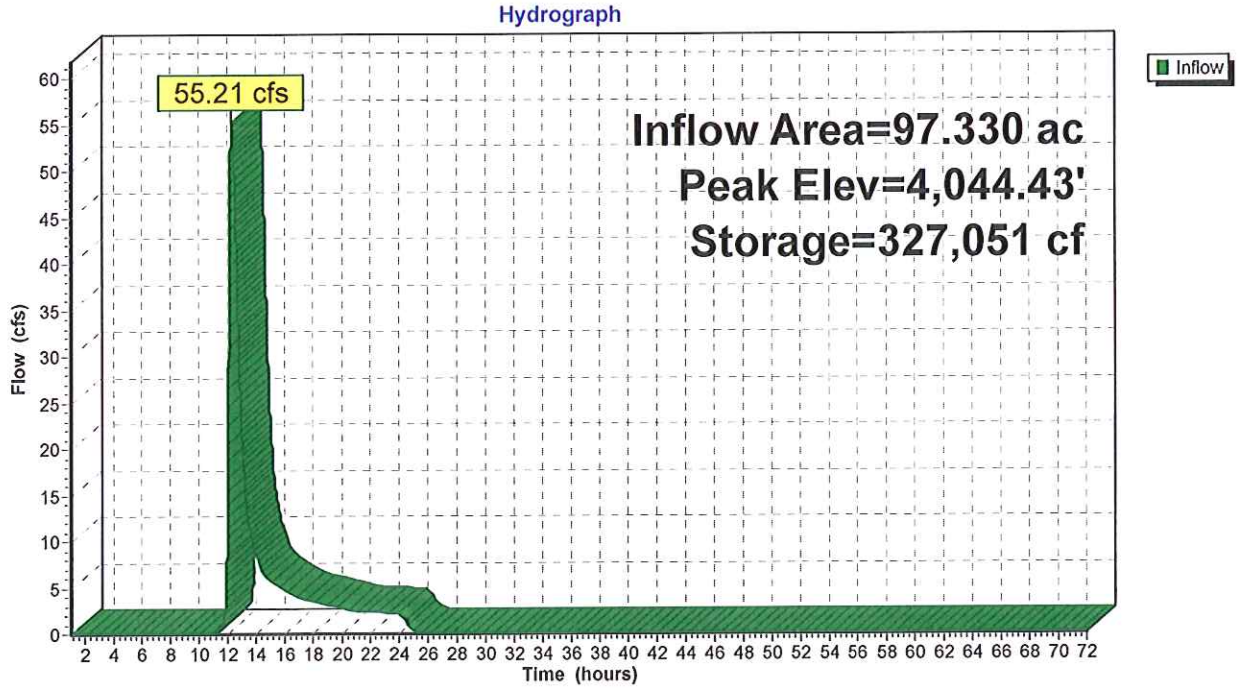
Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,044.43' @ 26.54 hrs Surf.Area= 242,083 sf Storage= 327,051 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 4,042.00' | 2,731,456 cf | **Custom Stage Data (Irregular)**Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Perim. (feet) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 4,042.00 | 24,911 | 828.4 | 0 | 0 | 24,911 |
| 4,044.00 | 234,832 | 1,999.4 | 224,152 | 224,152 | 288,435 |
| 4,046.00 | 269,364 | 2,202.0 | 503,801 | 727,953 | 356,302 |
| 4,048.00 | 315,141 | 2,380.0 | 583,907 | 1,311,860 | 421,367 |
| 4,050.00 | 358,700 | 2,479.0 | 673,371 | 1,985,231 | 459,954 |
| 4,052.00 | 387,713 | 2,618.0 | 746,225 | 2,731,456 | 516,563 |

## Pond A: Existing Pond A



## Summary for Pond B: Pond B

Inflow Area = 66.150 ac, 0.00% Impervious, Inflow Depth = 0.93" for 25 yr - 24 hr Event event
Inflow = 46.39 cfs @ 12.19 hrs, Volume= 5.103 af
Outflow = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

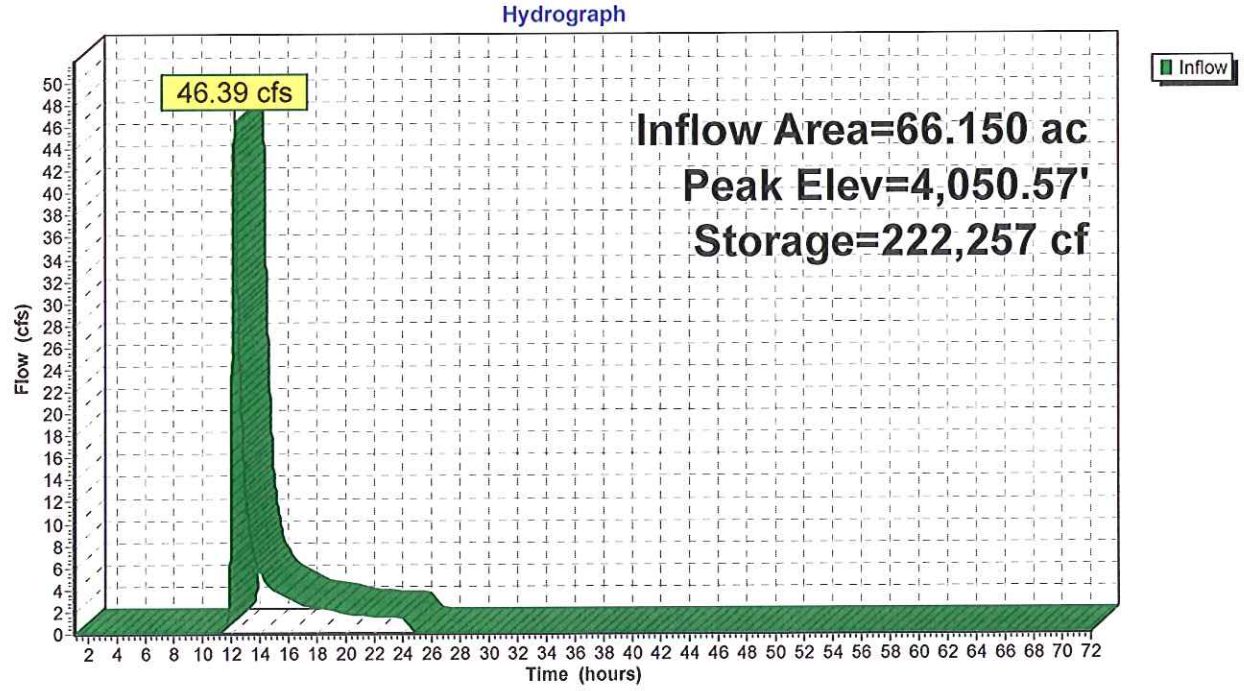
Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,050.57' @ 26.67 hrs Surf.Area= 50,341 sf Storage= 222,257 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 4,045.00' | 2,274,080 cf | **Custom Stage Data (Prismatic)**Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 4,045.00 | 29,699 | 0 | 0 |
| 4,050.00 | 48,031 | 194,325 | 194,325 |
| 4,060.00 | 88,713 | 683,720 | 878,045 |
| 4,070.00 | 134,664 | 1,116,885 | 1,994,930 |
| 4,072.00 | 144,486 | 279,150 | 2,274,080 |

## Pond B: Pond B



## Summary for Pond C: Pond C

Inflow Area = 167.770 ac, 0.00% Impervious, Inflow Depth = 0.93" for 25 yr - 24 hr Event event
Inflow = 44.46 cfs @ 12.24 hrs, Volume= 12.942 af
Outflow = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

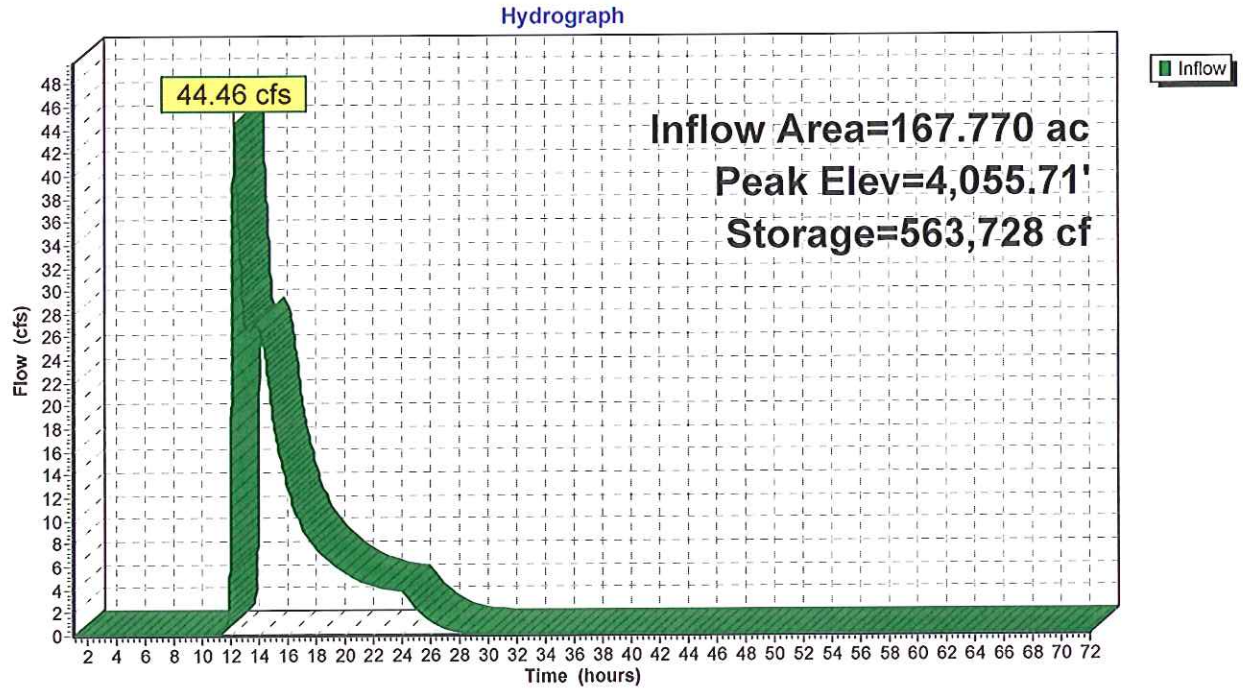
Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,055.71' @ 72.00 hrs Surf.Area= 76,077 sf Storage= 563,728 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 4,045.00' | 2,434,331 cf | **Custom Stage Data (Prismatic)**Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 4,045.00 | 30,253 | 0 | 0 |
| 4,050.00 | 50,559 | 202,030 | 202,030 |
| 4,060.00 | 95,230 | 728,945 | 930,975 |
| 4,070.00 | 145,224 | 1,202,270 | 2,133,245 |
| 4,072.00 | 155,862 | 301,086 | 2,434,331 |

## Pond C: Pond C



## Summary for Pond E: Existing Pond E

Inflow Area = 86.560 ac, 0.00% Impervious, Inflow Depth = 0.93" for 25 yr - 24 hr Event event
Inflow = 19.54 cfs @ 13.93 hrs, Volume= 6.678 af
Outflow = 19.47 cfs @ 13.98 hrs, Volume= 6.677 af, Atten= 0%, Lag= 2.7 min
Primary = 19.47 cfs @ 13.98 hrs, Volume= 6.677 af

Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,060.96' @ 13.98 hrs Surf.Area= 7,066 sf Storage= 6,204 cf

Plug-Flow detention time= 8.9 min calculated for 6.676 af (100% of inflow)
Center-of-Mass det. time= 9.0 min ( 1,004.9 - 995.9 )

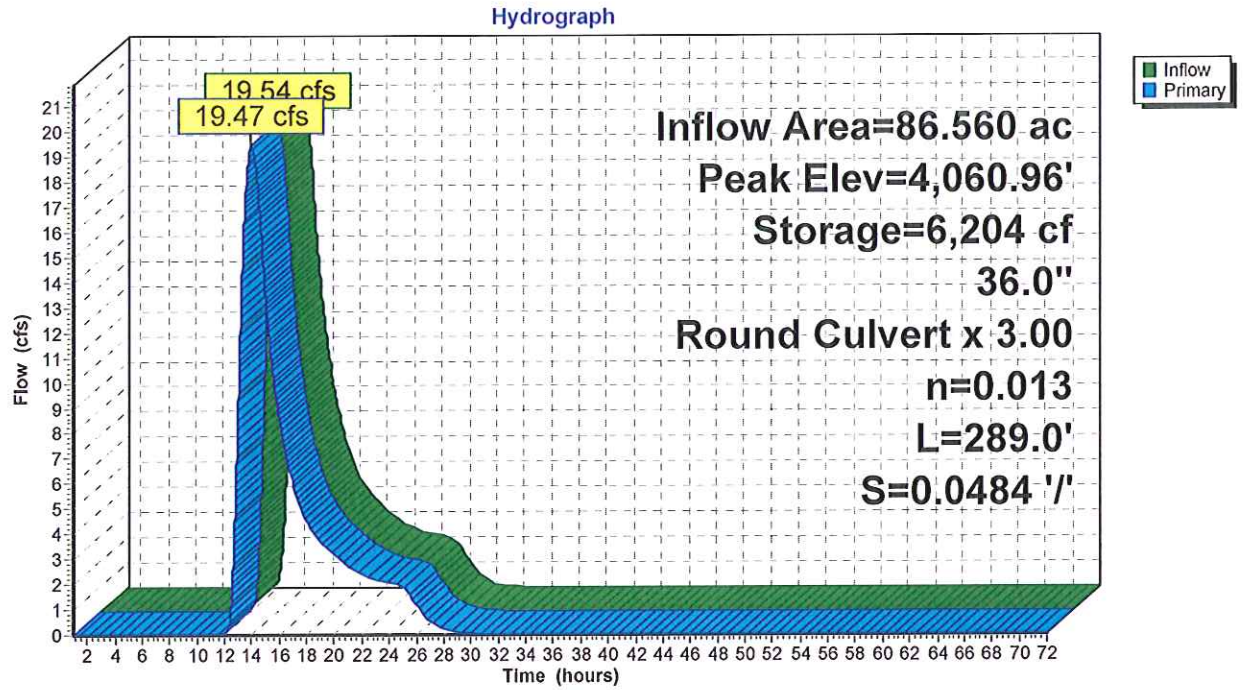
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 4,060.00' | 63,844 cf | **Custom Stage Data (Prismatic)**Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 4,060.00 | 5,874 | 0 | 0 |
| 4,062.00 | 8,361 | 14,235 | 14,235 |
| 4,064.00 | 11,864 | 20,225 | 34,460 |
| 4,066.00 | 17,520 | 29,384 | 63,844 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 4,060.00' | **36.0" Round Culvert X 3.00**<br>L= 289.0' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 4,060.00' / 4,046.00' S= 0.0484 '/' Cc= 0.900<br>n= 0.013, Flow Area= 7.07 sf |

**Primary OutFlow** Max=19.47 cfs @ 13.98 hrs HW=4,060.96' TW=4,050.44' (Dynamic Tailwater)
↑**1=Culvert** (Inlet Controls 19.47 cfs @ 3.33 fps)

## Pond E: Existing Pond E



Time span=1.00-72.00 hrs, dt=0.01 hrs, 7101 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Sim-Route method - Pond routing by Sim-Route method

**Subcatchment 19.52 Ac: DA-6** Runoff Area=19.520 ac 0.00% Impervious Runoff Depth=1.42"
Flow Length=2,720' Tc=47.8 min CN=73 Runoff=16.59 cfs 2.311 af

**Subcatchment 27.60 Ac: DA-2** Runoff Area=27.600 ac 0.00% Impervious Runoff Depth=1.42"
Flow Length=2,607' Tc=45.4 min CN=73 Runoff=24.36 cfs 3.268 af

**Subcatchment 32.77 Ac: DA-3** Runoff Area=32.770 ac 0.00% Impervious Runoff Depth=1.42"
Flow Length=1,532' Tc=18.9 min CN=73 Runoff=52.01 cfs 3.880 af

**Subcatchment 36.96 Ac: DA-4** Runoff Area=36.960 ac 0.00% Impervious Runoff Depth=1.42"
Flow Length=2,261' Tc=37.5 min CN=73 Runoff=37.33 cfs 4.376 af

**Subcatchment 40.50 Ac: DA-8** Runoff Area=40.500 ac 0.00% Impervious Runoff Depth=1.42"
Flow Length=1,811' Tc=24.0 min CN=73 Runoff=55.49 cfs 4.795 af

**Subcatchment 40.71 Ac: DA-7** Runoff Area=40.710 ac 0.00% Impervious Runoff Depth=1.42"
Flow Length=2,774' Tc=51.7 min CN=73 Runoff=32.53 cfs 4.820 af

**Subcatchment 46.63 Ac: DA-5** Runoff Area=46.630 ac 0.00% Impervious Runoff Depth=1.42"
Flow Length=1,548' Tc=22.4 min CN=73 Runoff=66.79 cfs 5.521 af

**Subcatchment 86.56 Ac: DA-1** Runoff Area=86.560 ac 0.00% Impervious Runoff Depth=1.42"
Flow Length=4,401' Tc=147.5 min CN=73 Runoff=31.45 cfs 10.248 af

**Pond A: Existing Pond A** Peak Elev=4,045.14' Storage=501,945 cf Inflow=90.13 cfs 11.524 af
Outflow=0.00 cfs 0.000 af

**Pond B: Pond B** Peak Elev=4,052.74' Storage=341,126 cf Inflow=75.07 cfs 7.832 af
Outflow=0.00 cfs 0.000 af

**Pond C: Pond C** Peak Elev=4,059.30' Storage=865,213 cf Inflow=73.06 cfs 19.863 af
Outflow=0.00 cfs 0.000 af

**Pond E: Existing Pond E** Peak Elev=4,061.24' Storage=8,240 cf Inflow=31.45 cfs 10.248 af
36.0" Round Culvert x 3.00 n=0.013 L=289.0' S=0.0484 '/' Outflow=31.38 cfs 10.248 af

**Total Runoff Area = 331.250 ac Runoff Volume = 39.219 af Average Runoff Depth = 1.42"**
**100.00% Pervious = 331.250 ac 0.00% Impervious = 0.000 ac**

## Summary for Subcatchment 19.52 Ac: DA-6

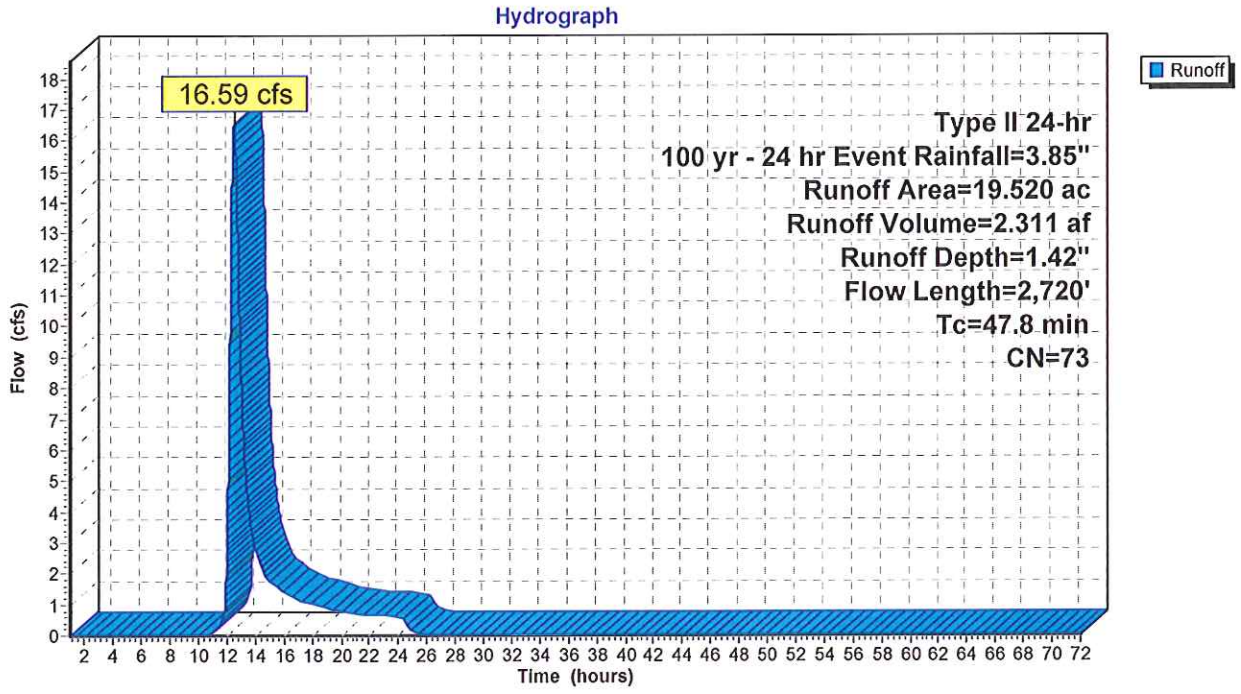
Runoff = 16.59 cfs @ 12.48 hrs, Volume= 2.311 af, Depth= 1.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 yr - 24 hr Event Rainfall=3.85"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 19.520 | 73 | |
| | 19.520 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 14.0 | 1,036 | 0.0827 | 1.24 | | **Lag/CN Method, Top Dome** |
| 4.4 | 540 | 0.2884 | 2.03 | | **Lag/CN Method, Side Slope** |
| 29.4 | 1,144 | 0.0219 | 0.65 | | **Lag/CN Method, Ditch** |
| 47.8 | 2,720 | Total | | | |

## Subcatchment 19.52 Ac: DA-6



## Summary for Subcatchment 27.60 Ac: DA-2

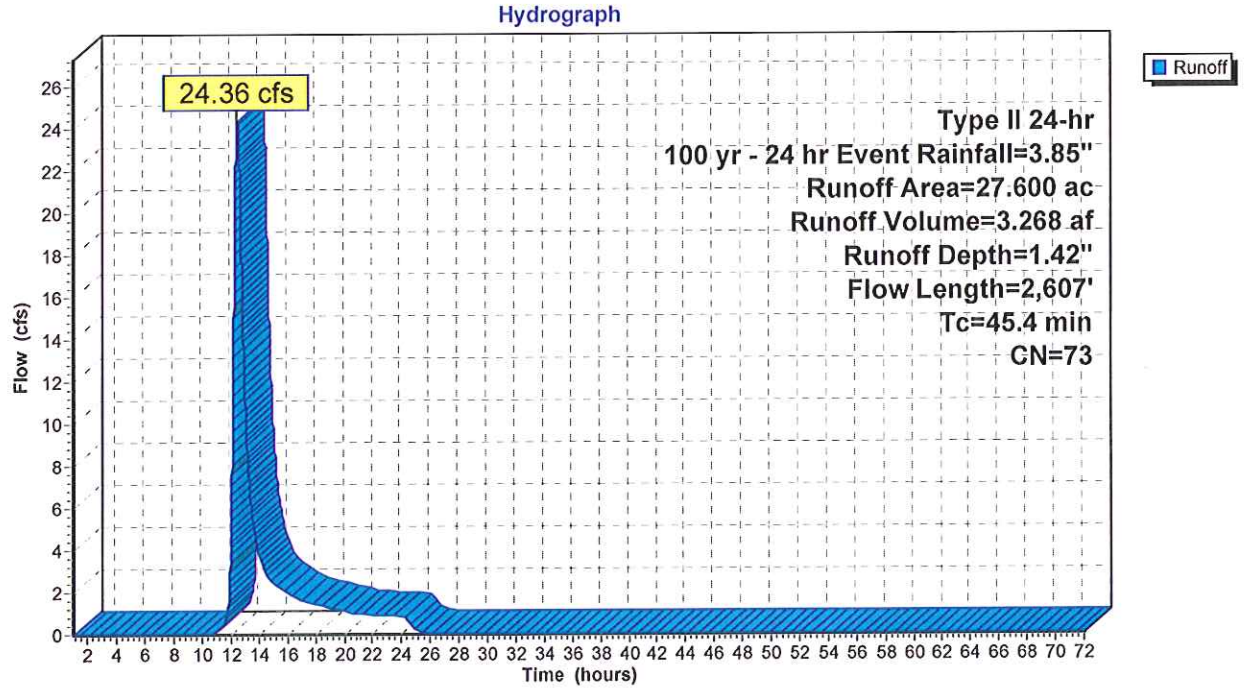
Runoff = 24.36 cfs @ 12.46 hrs, Volume= 3.268 af, Depth= 1.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 yr - 24 hr Event Rainfall=3.85"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 27.600 | 73 | |
| | 27.600 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 14.7 | 983 | 0.0688 | 1.12 | | **Lag/CN Method, Top Dome** |
| 3.8 | 480 | 0.3333 | 2.13 | | **Lag/CN Method, Side Slope** |
| 26.9 | 1,144 | 0.0262 | 0.71 | | **Lag/CN Method, Ditch** |
| 45.4 | 2,607 | Total | | | |

## Subcatchment 27.60 Ac: DA-2



## Summary for Subcatchment 32.77 Ac: DA-3

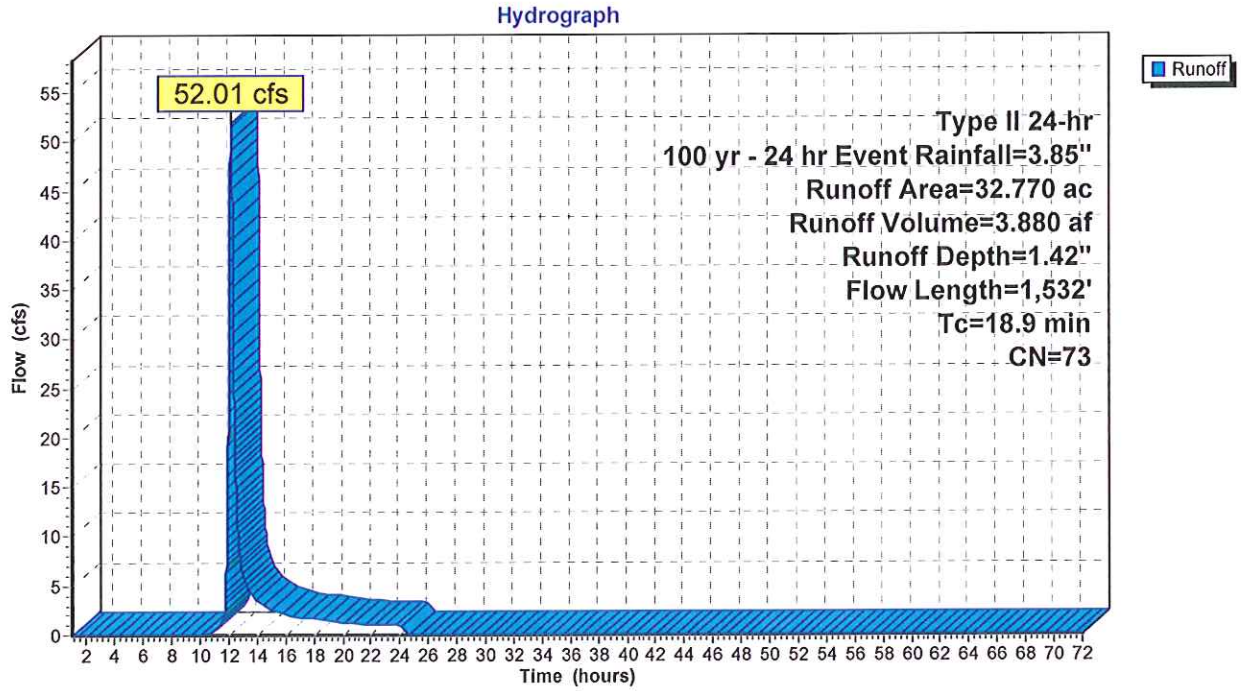
Runoff = 52.01 cfs @ 12.12 hrs, Volume= 3.880 af, Depth= 1.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 yr - 24 hr Event Rainfall=3.85"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 32.770 | 73 | |
| | 32.770 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 14.4 | 945 | 0.0676 | 1.10 | | **Lag/CN Method, Top Dome** |
| 4.5 | 587 | 0.3216 | 2.18 | | **Lag/CN Method, Side Slope** |
| 18.9 | 1,532 | Total | | | |

## Subcatchment 32.77 Ac: DA-3



## Summary for Subcatchment 36.96 Ac: DA-4

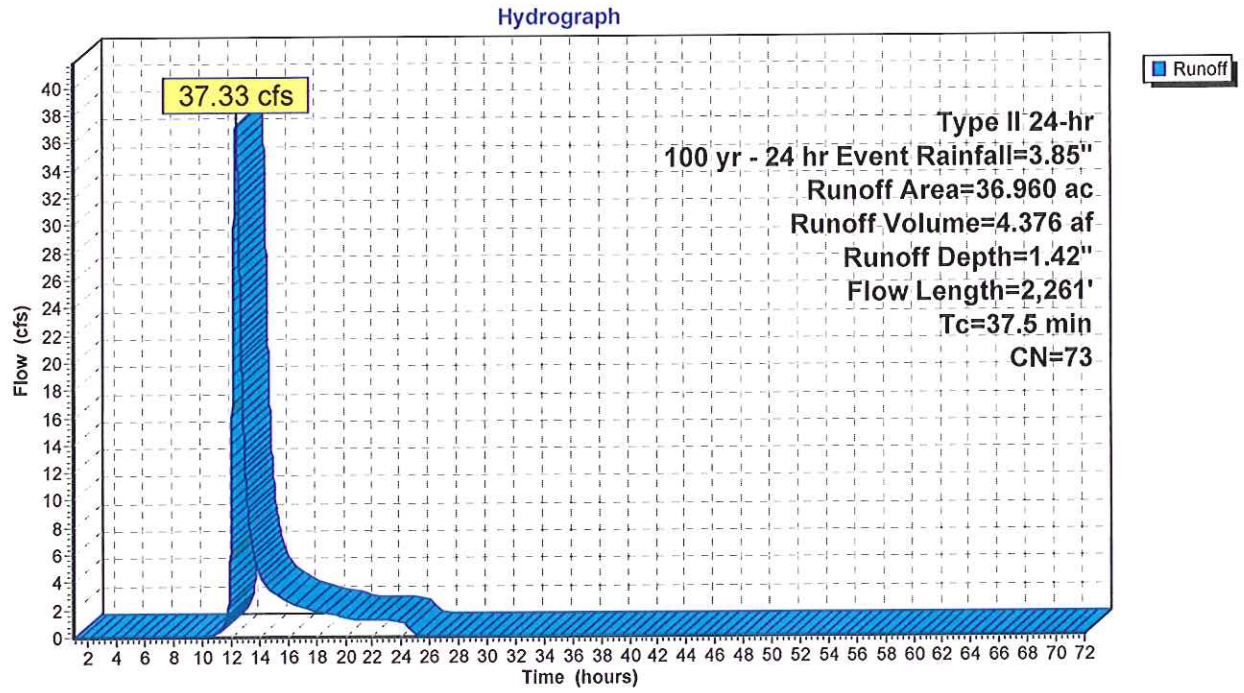
Runoff = 37.33 cfs @ 12.37 hrs, Volume= 4.376 af, Depth= 1.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 yr - 24 hr Event Rainfall=3.85"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 36.960 | 73 | |
| | 36.960 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 12.2 | 786 | 0.0695 | 1.07 | | **Lag/CN Method, Top Dome** |
| 4.2 | 526 | 0.3050 | 2.07 | | **Lag/CN Method, Side Slope** |
| 21.1 | 949 | 0.0316 | 0.75 | | **Lag/CN Method, Ditch** |
| 37.5 | 2,261 | Total | | | |

## Subcatchment 36.96 Ac: DA-4



## Summary for Subcatchment 40.50 Ac: DA-8

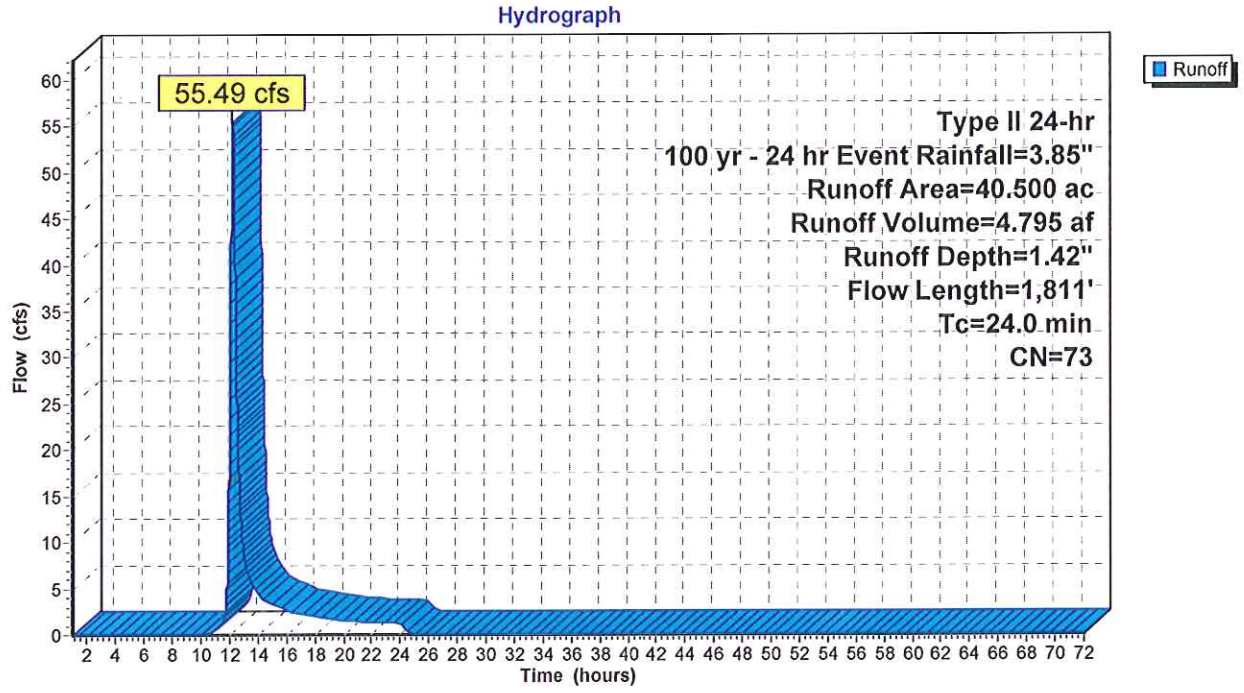
Runoff = 55.49 cfs @ 12.19 hrs, Volume= 4.795 af, Depth= 1.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 yr - 24 hr Event Rainfall=3.85"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 40.500 | 73 | |
| | 40.500 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 14.8 | 947 | 0.0634 | 1.06 | | **Lag/CN Method, Top Dome** |
| 5.9 | 715 | 0.2595 | 2.03 | | **Lag/CN Method, Side Slope** |
| 3.3 | 149 | 0.0671 | 0.76 | | **Lag/CN Method, Ditch** |
| 24.0 | 1,811 | Total | | | |

## Subcatchment 40.50 Ac: DA-8



## Summary for Subcatchment 40.71 Ac: DA-7

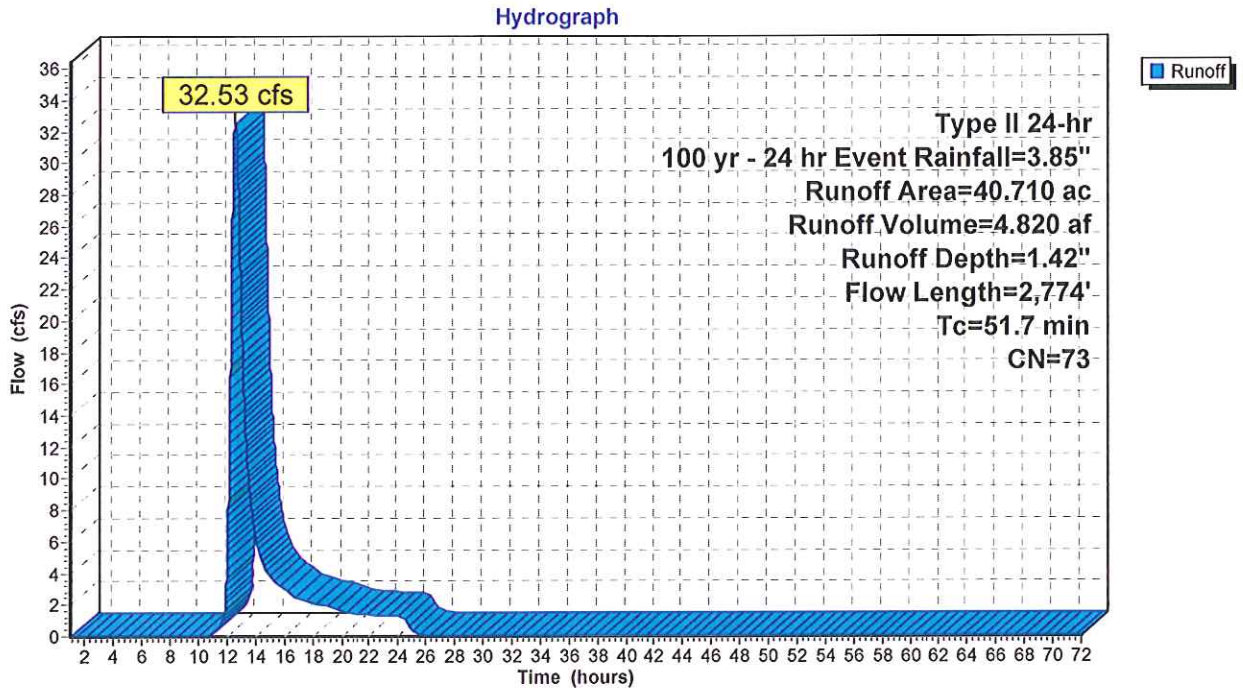
Runoff = 32.53 cfs @ 12.57 hrs, Volume= 4.820 af, Depth= 1.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 yr - 24 hr Event Rainfall=3.85"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 40.710 | 73 | |
| | 40.710 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 16.3 | 1,037 | 0.0605 | 1.06 | | **Lag/CN Method, Top Dome** |
| 4.5 | 549 | 0.2945 | 2.05 | | **Lag/CN Method, Side Slope** |
| 30.9 | 1,188 | 0.0211 | 0.64 | | **Lag/CN Method, Ditch** |
| 51.7 | 2,774 | Total | | | |

## Subcatchment 40.71 Ac: DA-7



## Summary for Subcatchment 46.63 Ac: DA-5

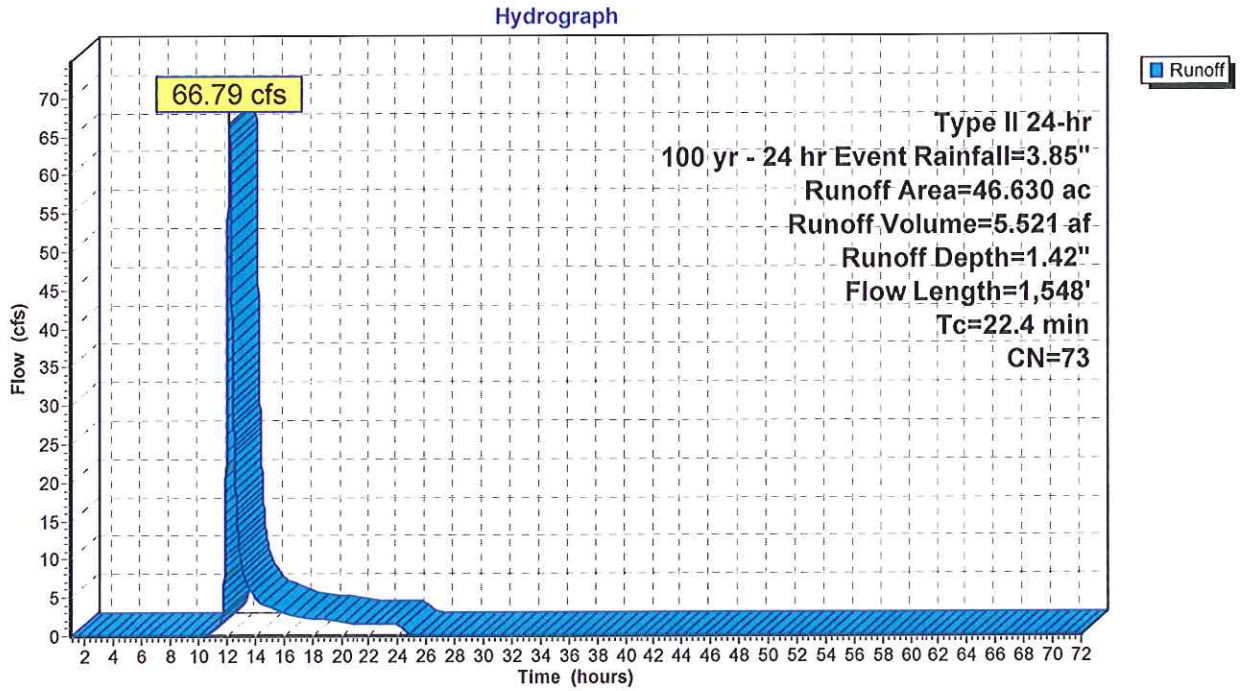
Runoff = 66.79 cfs @ 12.17 hrs, Volume= 5.521 af, Depth= 1.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 yr - 24 hr Event Rainfall=3.85"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 46.630 | 73 | |
| | 46.630 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 17.6 | 1,033 | 0.0518 | 0.98 | | **Lag/CN Method, Top Dome** |
| 4.8 | 515 | 0.2288 | 1.79 | | **Lag/CN Method, Side Slope** |
| 22.4 | 1,548 | Total | | | |

## Subcatchment 46.63 Ac: DA-5



## Summary for Subcatchment 86.56 Ac: DA-1

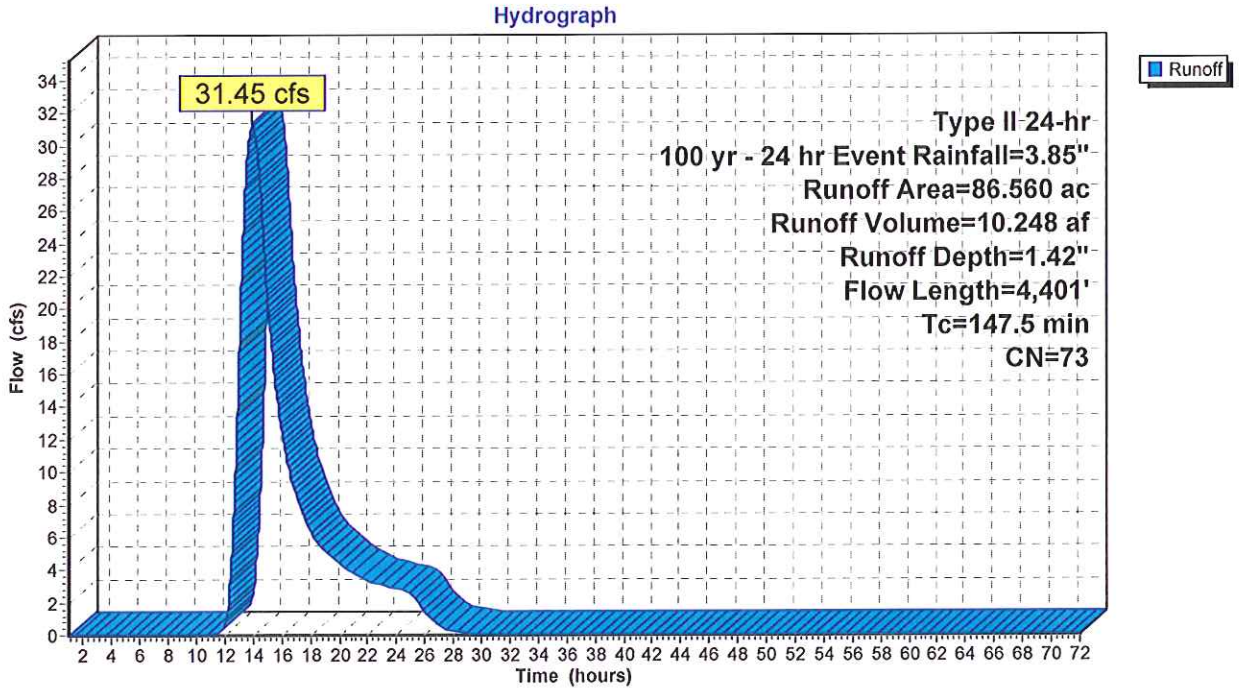
Runoff = 31.45 cfs @ 13.93 hrs, Volume= 10.248 af, Depth= 1.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 yr - 24 hr Event Rainfall=3.85"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 86.560 | 73 | |
| | 86.560 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 16.0 | 1,042 | 0.0637 | 1.09 | | **Lag/CN Method, Top Dome** |
| 4.8 | 465 | 0.1976 | 1.63 | | **Lag/CN Method, Side Slope** |
| 126.7 | 2,894 | 0.0052 | 0.38 | | **Lag/CN Method, Ditch** |
| 147.5 | 4,401 | Total | | | |

## Subcatchment 86.56 Ac: DA-1



## Summary for Pond A: Existing Pond A

Inflow Area = 97.330 ac, 0.00% Impervious, Inflow Depth = 1.42" for 100 yr - 24 hr Event event
Inflow = 90.13 cfs @ 12.20 hrs, Volume= 11.524 af
Outflow = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

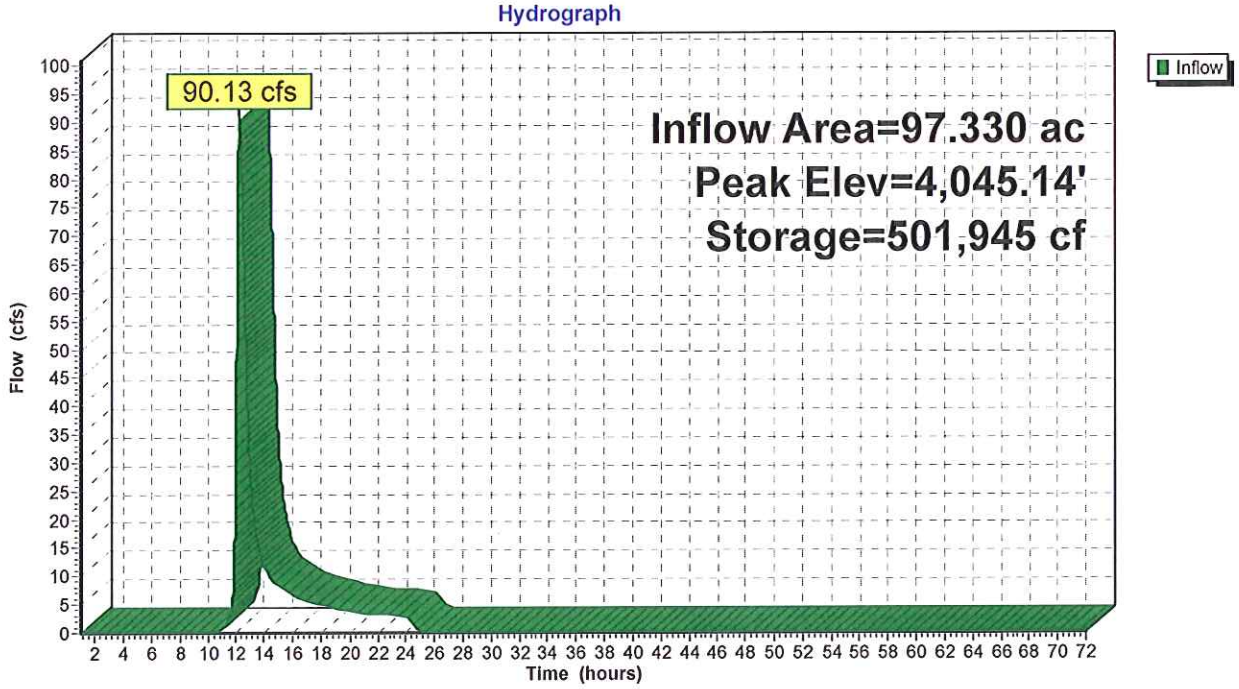
Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,045.14' @ 26.54 hrs Surf.Area= 254,164 sf Storage= 501,945 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 4,042.00' | 2,731,456 cf | **Custom Stage Data (Irregular)**Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Perim. (feet) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 4,042.00 | 24,911 | 828.4 | 0 | 0 | 24,911 |
| 4,044.00 | 234,832 | 1,999.4 | 224,152 | 224,152 | 288,435 |
| 4,046.00 | 269,364 | 2,202.0 | 503,801 | 727,953 | 356,302 |
| 4,048.00 | 315,141 | 2,380.0 | 583,907 | 1,311,860 | 421,367 |
| 4,050.00 | 358,700 | 2,479.0 | 673,371 | 1,985,231 | 459,954 |
| 4,052.00 | 387,713 | 2,618.0 | 746,225 | 2,731,456 | 516,563 |

## Pond A: Existing Pond A



## Summary for Pond B: Pond B

Inflow Area = 66.150 ac, 0.00% Impervious, Inflow Depth = 1.42" for 100 yr - 24 hr Event event
Inflow = 75.07 cfs @ 12.17 hrs, Volume= 7.832 af
Outflow = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

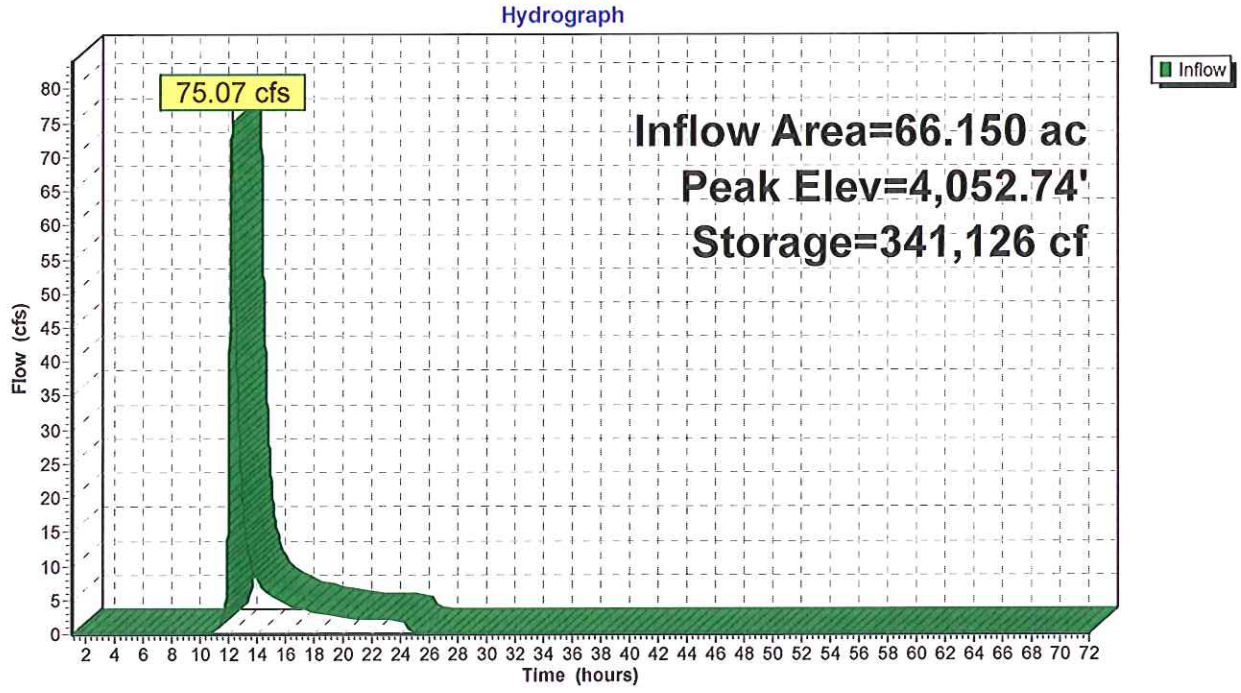
Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,052.74' @ 26.67 hrs Surf.Area= 59,173 sf Storage= 341,126 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 4,045.00' | 2,274,080 cf | **Custom Stage Data (Prismatic)**Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 4,045.00 | 29,699 | 0 | 0 |
| 4,050.00 | 48,031 | 194,325 | 194,325 |
| 4,060.00 | 88,713 | 683,720 | 878,045 |
| 4,070.00 | 134,664 | 1,116,885 | 1,994,930 |
| 4,072.00 | 144,486 | 279,150 | 2,274,080 |

### Pond B: Pond B



## Summary for Pond C: Pond C

Inflow Area = 167.770 ac, 0.00% Impervious, Inflow Depth = 1.42" for 100 yr - 24 hr Event event
Inflow = 73.06 cfs @ 12.24 hrs, Volume= 19.863 af
Outflow = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

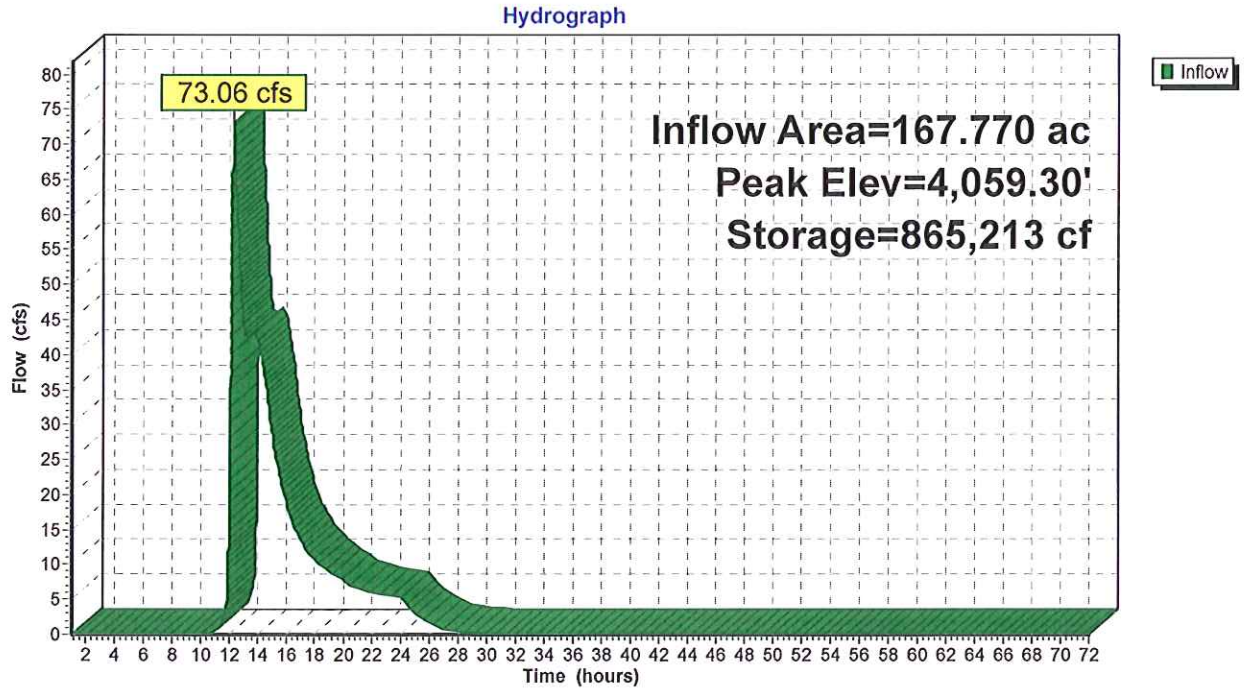
Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,059.30' @ 72.00 hrs Surf.Area= 92,094 sf Storage= 865,213 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 4,045.00' | 2,434,331 cf | **Custom Stage Data (Prismatic)**Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 4,045.00 | 30,253 | 0 | 0 |
| 4,050.00 | 50,559 | 202,030 | 202,030 |
| 4,060.00 | 95,230 | 728,945 | 930,975 |
| 4,070.00 | 145,224 | 1,202,270 | 2,133,245 |
| 4,072.00 | 155,862 | 301,086 | 2,434,331 |

## Pond C: Pond C



## Summary for Pond E: Existing Pond E

Inflow Area = 86.560 ac, 0.00% Impervious, Inflow Depth = 1.42" for 100 yr - 24 hr Event event
Inflow = 31.45 cfs @ 13.93 hrs, Volume= 10.248 af
Outflow = 31.38 cfs @ 13.95 hrs, Volume= 10.248 af, Atten= 0%, Lag= 1.5 min
Primary = 31.38 cfs @ 13.95 hrs, Volume= 10.248 af

Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,061.24' @ 13.95 hrs Surf.Area= 7,416 sf Storage= 8,240 cf

Plug-Flow detention time= 7.9 min calculated for 10.248 af (100% of inflow)
Center-of-Mass det. time= 7.8 min ( 990.3 - 982.6 )

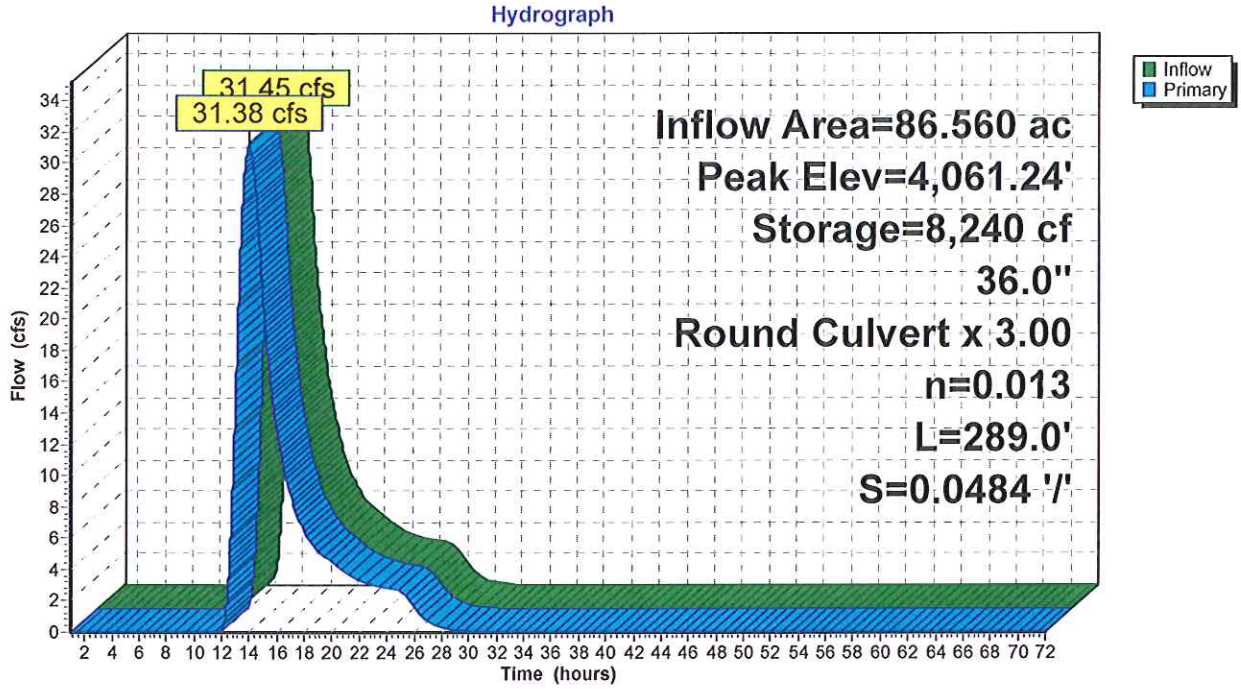
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 4,060.00' | 63,844 cf | **Custom Stage Data (Prismatic)**Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 4,060.00 | 5,874 | 0 | 0 |
| 4,062.00 | 8,361 | 14,235 | 14,235 |
| 4,064.00 | 11,864 | 20,225 | 34,460 |
| 4,066.00 | 17,520 | 29,384 | 63,844 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 4,060.00' | **36.0" Round Culvert X 3.00**<br>L= 289.0' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 4,060.00' / 4,046.00' S= 0.0484 '/' Cc= 0.900<br>n= 0.013, Flow Area= 7.07 sf |

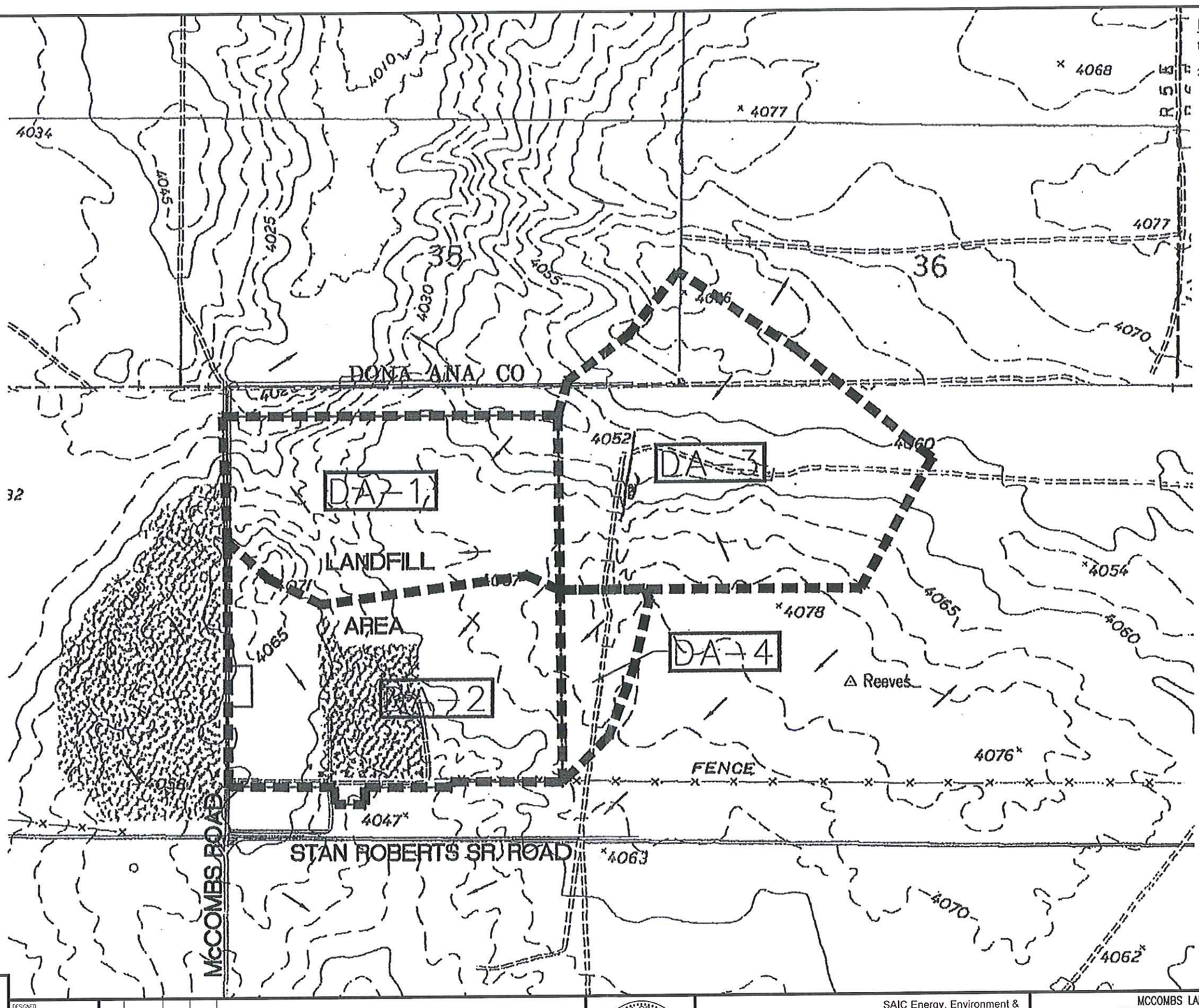
**Primary OutFlow** Max=31.37 cfs @ 13.95 hrs HW=4,061.24' TW=4,052.91' (Dynamic Tailwater)
↑**1=Culvert** (Inlet Controls 31.37 cfs @ 3.79 fps)

## Pond E: Existing Pond E



# Appendix 3C
# Surface Water Drainage Plans

SAIC®




## NOTES

1. DRAWING FROM PERMIT DATED APRIL 2002, BY MORENO CARDENAS, INC.
2. DRAINAGE AREA VALUES FROM PERMIT DATED APRIL 2002, BY MORENO CARDENAS, INC. SIGNED BY ROBERTO MORENO, P.E.

## DRAINAGE AREAS

| ID | AREA (ACRES) | Q25 (CFS) |
|---|---|---|
| DA-1 | 150 | 106 |
| DA-2 | 177 | 108 |
| DA-3 | 189 | 115 |
| DA-4 | 29 | 27 |

GRAPHIC SCALE: NTS

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STATE OF TEXAS
CAMI VAN ABEL
113723
REGISTERED PROFESSIONAL ENGINEER
3/15/13

| DESIGNED | SEK |
|---|---|
| DRAWN | CAD |
| VERIFY SCALE | BAR IS ONE INCH ON ANSI "D" DRAWING |
| | 0 — 1" |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 2 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |
| 1 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

THE CITY OF EL PASO TEXAS

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1380 Corporate Center Curve
Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

PRE-DEVELOPED DRAINAGE CONDITIONS

PROJECT NUMBER: 9631500115
SHT. 36 OF: 78
DRAWING NUMBER: P3-3

Rob, Jacob S. 3/13/2013 10:45:33 AM – R:\00218000 El Paso TX\9631500115 – McCombs\Data Analysis\CADD\P3-3 PRE-DEVELOPED DRAINAGE CONDITIONS.dwg

## NOTES

1. DIGITIZED TOPOGRAPHY FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS.
2. COORDINATES ARE BASED ON THE TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NAD 83. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM. NAVD 88 DATUM TO NGVD 29 DATUM, SUBTRACT 1.99-FEET. NGVD 29 DATUM TO CITY OF EL PASO DATUM, ADD 27.65-FEET.
3. EXISTING CONTOUR INTERVAL IS TWO FEET.
4. SITE TOPOGRAPHY MAY VARY DUE TO OWNER'S OPERATIONS.
5. THE HATCHED AREAS DELINEATED ARE INDICATIVE OF OFF-SITE RUN-ON FROM ADJACENT PROPERTIES. THE QUANTITY OF RUN-ON IS ACCOUNTED FOR IN THE DRAINAGE CALCULATIONS.

## LEGEND

- DRAINAGE AREA BOUNDARY
- FLOW DIRECTION
- STORMWATER DRAINAGE DITCH
- 100 YEAR FLOOD PLAIN
- ON-SITE RUN-OFF AREA
- OFF-SITE RUN-ON AREA
- EX-1 EXISTING CONDITIONS DRAINAGE AREA ID
- 1500 ELEVATION CONTOURS
- CHAIN LINK OR OTHER FENCE
- FACILITY/PROPERTY BOUNDARY
- SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- LANDFILL ACCESS ROAD
- SECTION LINE

## EXISTING DRAINAGE AREAS

| ID | AREA (ACRES) | Q25 (CFS)* |
|---|---|---|
| EX-1 | 113.22 | 42 |
| EX-2 | 90.57 | 89 |
| EX-3 | 129.01 | 113 |
| EX-4 | 2.98 | 3 |
| EX-5 | 2.14 | 3 |
| EX-6 | 10.28 | 15 |
| EX-7 | 10.11 | 9 |

* VALUES FROM APPENDIX 3B, ATTACHMENT 1

GRAPHIC SCALE
1"=200'-0"
200 0 200 400
Scale Feet

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STATE OF TEXAS
FREDRIC V. DORAN
111226
REGISTERED
PROFESSIONAL ENGINEER
11/2/12

| DESIGNED | DRAWN | VERIFY SCALE |
|---|---|---|
| SEK | CAD | BAR IS ONE INCH ON ANSI "D" DRAWING 0 — 1" |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

THE CITY OF EL PASO TEXAS

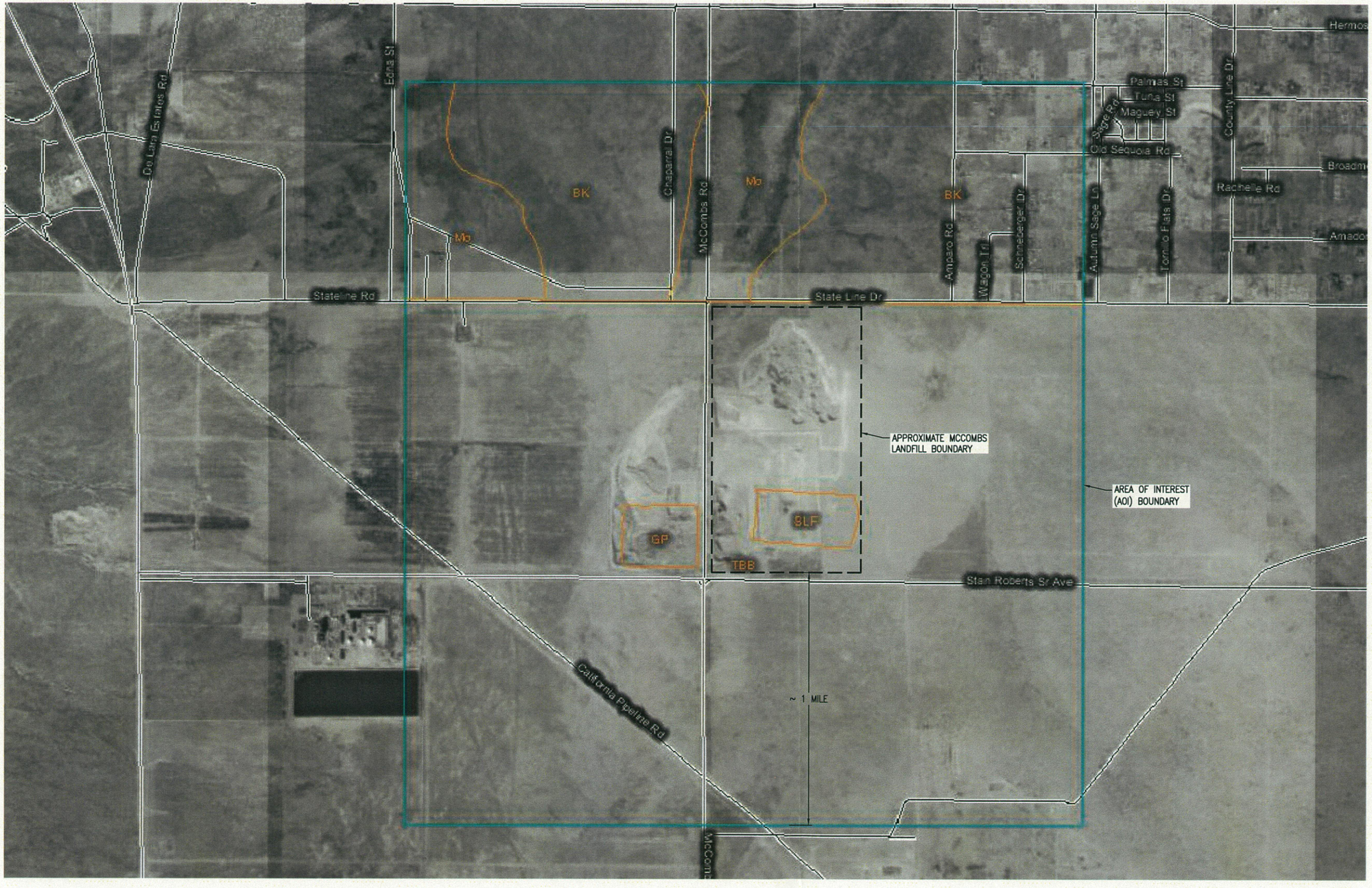
SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve
Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

EXISTING DRAINAGE CONDITIONS

PROJECT NUMBER: 9631500115
SHT. 37 OF: 78
DRAWING NUMBER: P3-4

Keller, Tonya L. 10/23/2012 3:05:11 PM - P:\00218000 el paso tx\9631500115\data analytical\CAD\P3-4 EXISTING DRAINAGE CONDITIONS.dwg




## NOTES

1. SOILS INFORMATION FROM WEB SOIL SURVEY COMPILED BY THE UNITED STATES DEPARTMENT OF AGRICULTURE (USDA) AND THE NATIONAL RESOURCE CONSERVATION SERVICE (NRCS), MARCH 2011.
2. THE SOIL SURVEY FOR DONA ANA COUNTY, NEW MEXICO WAS COMPLETED ON SEPTEMBER 24, 2009.
3. THE SOIL SURVEY FOR EL PASO COUNTY, TEXAS WAS COMPLETED ON OCTOBER 28, 2009.
4. AERIAL IMAGE WAS PHOTOGRAPHED ON JANUARY 28, 1996.

## MAP UNIT LEGEND

| DONA ANA COUNTY AREA, NEW MEXICO | |
|---|---|
| UNIT SYMBOL | UNIT NAME |
| BK | BERINO–DONA ANA ASSOCIATION |
| MO | MIMBRES SILTY CLAY LOAM |
| EL PASO COUNTY, TEXAS | |
| UNIT SYMBOL | UNIT NAME |
| GP | PITS, GRAVEL |
| SLF | URBAN LAND, SANITARY LANDFILL |
| TBB | TURNEY–BERINO ASSOCIATION, UNDULATING |

GRAPHIC SCALE

1"=1000'-0" 1000 0 1000 2000

Scale Feet

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STATE OF NEW MEXICO
FREDRIC J. DORAN
111226
REGISTERED
PROFESSIONAL ENGINEER
11/2/12

| DESIGNED | TLK |
|---|---|
| DRAWN | CAD |
| VERIFY SCALE BAR IS ONE INCH ON ANSI "D" DRAWING | 0 1" |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 1 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

SOILS MAP

PROJECT NUMBER: 9631500115

SHT. 38 OF: 78

DRAWING NUMBER: P3-5

Keller, Tonya L. 10/18/2012 9:21:09 AM – P:\00218000 el paso tx\9631500115\data analysis\CAD\P3-5 SOILS MAP.dwg

N: 10742509.06
E: 417193.27

PROPERTY BOUNDARY

CHANNEL 4

CHANNEL 5

N: 10738213.37
E: 417020.95

STORMWATER RETENTION POND B

C P3-7

D P3-7

B P3-7

STORMWATER RETENTION POND C

SEE NOTE 2

CHANNEL 3

DEV-6

DEV-7

DEV-5

DEV-8

DEV-4

DEV-3

DEV-2

DEV-1

SLOPE 7%

3:1

4080 4100 4120 4140 4160 4180 4200 4220 4240

4290 4280 4270 4260 4250

4300 4290 4280 4270 4260 4250 4240 4230 4220 4210 4200 4190 4180 4170 4160 4150 4140 4130 4120 4110 4100 4090 4080 4070 4060

A P3-7

E P3-7

EXISTING RETENTION POND E

SEE NOTE 4

CHANNEL 1

G P3-8

EXISTING STORMWATER RETENTION POND A

CHANNEL 2

NEW ENTRA FACIL

N: 10742684.20
E: 413885.24

F P3-8

PROPERTY BOUNDARY

N: 10738347.03
E: 413725.15

N: 10737947.76
E: 413739.68

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## NOTES

1. PONDING AREAS AND PONDING CAPACITY, AS SHOWN IN TABLES BELOW, PROVIDED BY PREVIOUS PERMIT. UPDATE TO GROUNDWATER/SURFACE WATER PROTECTION PLAN, DATED MARCH 2009, BY PARKHILL, SMITH & COOPER, INC.
2. FUTURE 3-36" RCP CULVERTS AS PROVIDED BY PREVIOUS PERMIT, DATED APRIL 2002, BY MORENO CARDENAS, INC. HEADWALL DETAILS PROVIDED ON P3-10.
3. CONTOUR INTERVAL IS FIVE FEET. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM.
4. SEE DRAWING C-13 IN APPENDIX 3E FOR ENTRANCE ROAD AND ENTRANCE FACILITIES DRAINAGE PLAN AND CALCULATIONS.

## LEGEND

- DRAINAGE AREA BOUNDARY
- FLOW DIRECTION
- STORMWATER DRAINAGE DITCH
- 100 YEAR FLOOD PLAIN
- RIP RAP
- DEV-1 — DEVELOPED CONDITIONS DRAINAGE AREA ID
- CHANNEL 1 — DRAINAGE CHANNEL ID

## DEVELOPED DRAINAGE AREAS

| ID | AREA (ACRES) | Q25 (CFS) |
|---|---|---|
| DEV-1 | 86.56 | 29 |
| DEV-2 | 27.60 | 22 |
| DEV-3 | 32.77 | 44 |
| DEV-4 | 36.96 | 33 |
| DEV-5 | 46.63 | 57 |
| DEV-6 | 19.52 | 15 |
| DEV-7 | 40.71 | 29 |
| DEV-8 | 40.50 | 47 |

## PONDING AREAS*

| ID | ACRES |
|---|---|
| POND A | 7.95 |
| POND B | 4.48 |
| POND C | 4.82 |
| EX. POND | 11.00 |

## PONDING CAPACITY*

| ID | CAPACITY (AC-FT) |
|---|---|
| POND A | 19.77 |
| POND B | 53.12 |
| POND C | 56.63 |
| EX. POND | 27.02 |

*SEE NOTE 1.

## DRAINAGE CHANNELS

| ID | FLOW (CFS) | VELOCITY (FPS) | SUGGESTED LINING |
|---|---|---|---|
| CHANNEL 1 | 41 | 4.40 | RIP RAP |
| CHANNEL 2 | 48 | 6.74 | CURRENTLY CONC RIP RAP |
| CHANNEL 3 | 32 | 4.69 | RIP RAP |
| CHANNEL 4 | 15 | 3.42 | VEGITATION OR VELOCITY CONTROL |
| CHANNEL 5 | 30 | 4.07 | RIP RAP |

GRAPHIC SCALE
1"=200'-0"
200 0 200 400
Scale Feet

CAVI VAN ASEL
113723
REGISTERED PROFESSIONAL ENGINEER
STATE OF TEXAS
6/3/13

DESIGNED SEK
DRAWN CAD
VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 3 | 6/3/13 | JSR | CAV | FOURTH TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

THE CITY OF EL PASO TEXAS

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MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

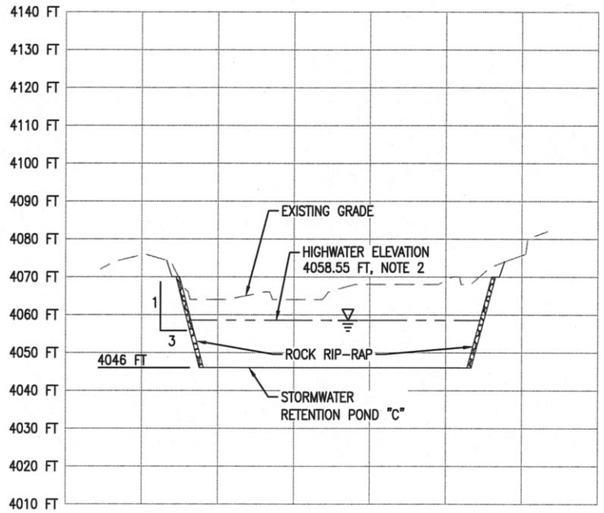
FINAL DRAINAGE CONDITIONS

PROJECT NUMBER 9631500115
SHT. 39 OF: 78
DRAWING NUMBER: P3-6

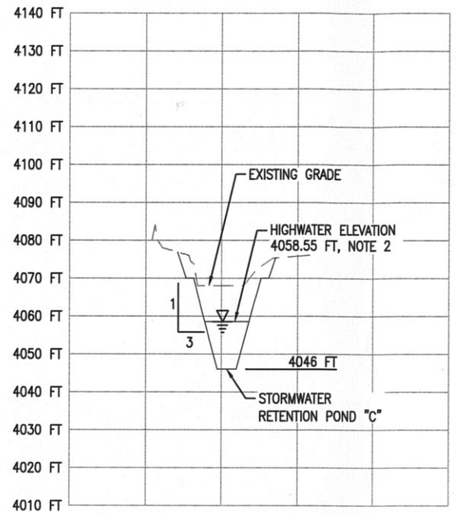
Ron, Jacob S. 5/30/2013 4:38:44 PM - R:\0021800 El Paso TX\9631500115 - McCombs\Data Analytical\CAD\P3-6 FINAL DRAINAGE CONDITIONS.dwg

## NOTES

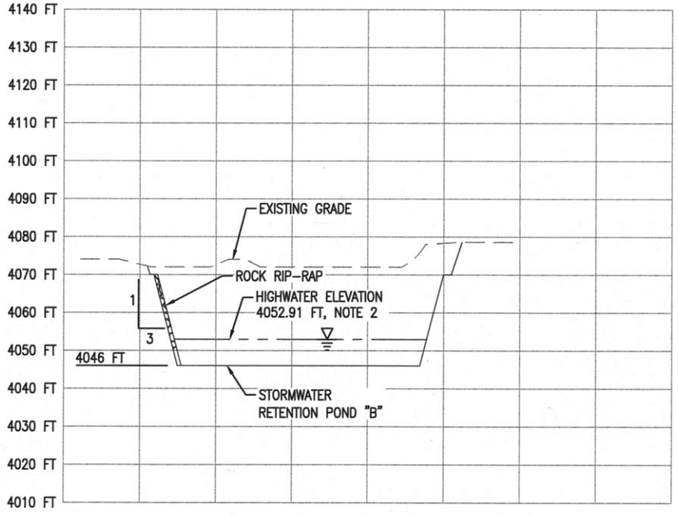
1. POND DESIGN CAPACITIES PROVIDED BY PREVIOUS PERMIT, DATED APRIL 2002, BY MORENO CARDENAS; AND UPDATE TO GROUNDWATER/SURFACE WATER PROTECTION PLAN, DATED MARCH 2009, BY PARKHILL, SMITH & COOPER, INC.
2. POND HIGH WATER ELEVATIONS ARE 100 YEAR, 24 HOUR STORM EVENT VOLUMES FOR THE FINAL DRAINAGE CONDITIONS SHOWN ON P3–6.
3. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM.



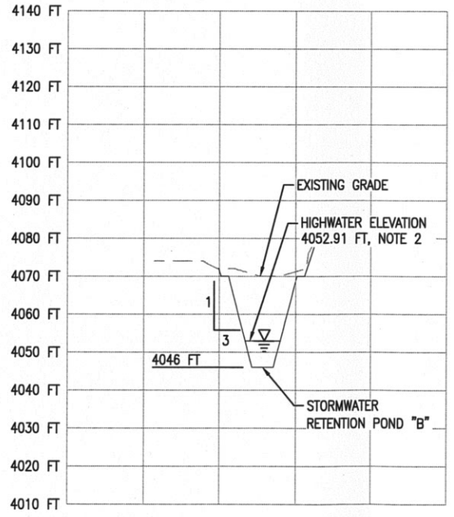

**SECTION** A P3–6
RETENTION POND C
VERTICAL SCALE: 1"=20'
HORIZONTAL SCALE: 1"=200'



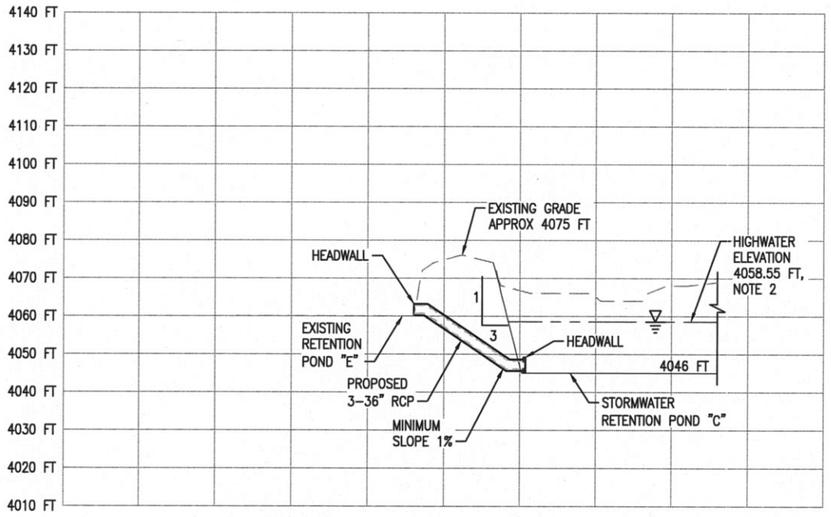

**SECTION** B P3–6
RETENTION POND C
VERTICAL SCALE: 1"=20'
HORIZONTAL SCALE: 1"=200'




**SECTION** C P3–6
RETENTION POND B
VERTICAL SCALE: 1"=20'
HORIZONTAL SCALE: 1"=200'




**SECTION** D P3–6
RETENTION POND B
VERTICAL SCALE: 1"=20'
HORIZONTAL SCALE: 1"=200'




**SECTION** E P3–6
EXISTING RETENTION POND TO POND C
VERTICAL SCALE: 1"=20'
HORIZONTAL SCALE: 1"=200'

HORIZONTAL SCALE
1"=200'–0" 200 0 200 400
Scale Feet

VERTICAL SCALE
1"=20'–0" 20 0 20 40
Scale Feet

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STATE OF TEXAS
FREDRIC J. DORAN
111226
REGISTERED
PROFESSIONAL ENGINEER
11/2/12

DESIGNED SEK
DRAWN CAD
VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

THE CITY OF EL PASO TEXAS

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1380 Corporate Center Curve
Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

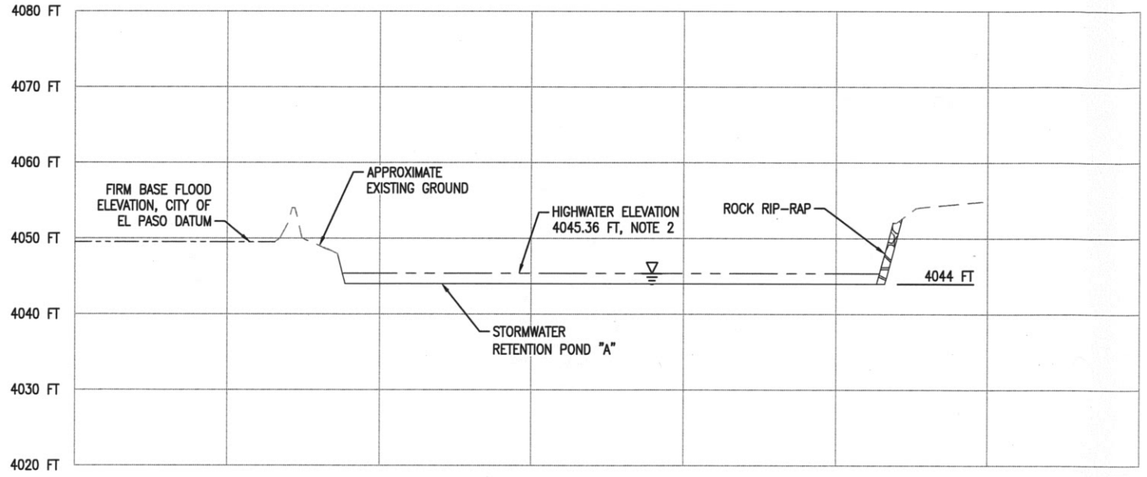
PONDING AREA CROSS SECTIONS, SHEET 1 OF 2

PROJECT NUMBER: 9631500115
SHT. 40 OF: 78
DRAWING NUMBER: P3–7

Keller, Tonya L. 10/18/2012 9:35:21 AM – P:\00218000 el paso tx\9631500115\data analytical\CAD\P3–7 PONDING AREA CROSS SECTIONS, SHEET 1 OF 2.dwg

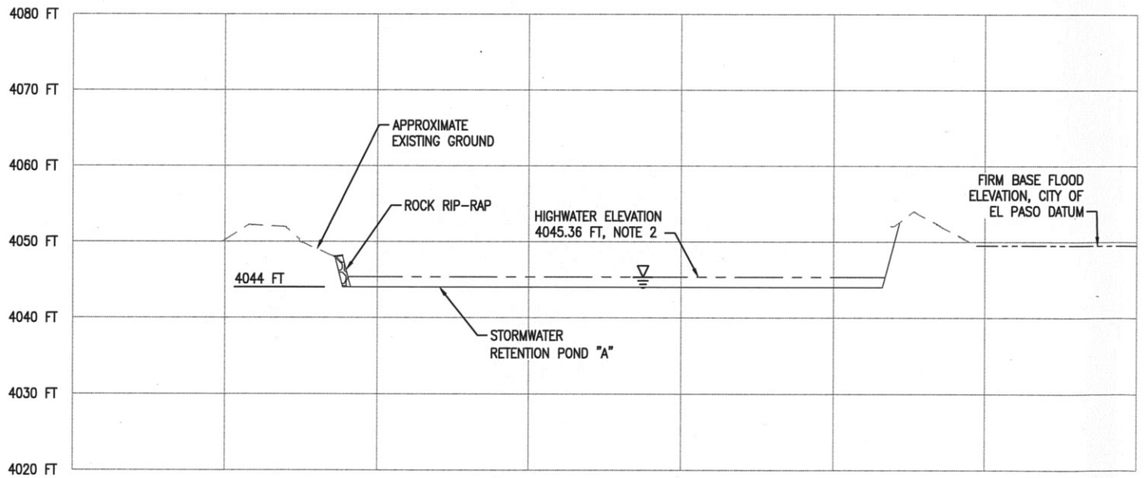
## NOTES

1. POND DESIGN CAPACITIES PROVIDED BY PREVIOUS PERMIT, DATED APRIL 2002, BY MORENO CARDENAS; AND UPDATE TO GROUNDWATER/SURFACE WATER PROTECTION PLAN, DATED MARCH 2009, BY PARKHILL, SMITH & COOPER, INC.
2. POND HIGH WATER ELEVATIONS ARE 100 YEAR, 24 HOUR STORM EVENT VOLUMES FOR THE FINAL DRAINAGE CONDITIONS SHOWN ON P3–6.
3. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM.




**SECTION** F P3–6

RETENTION POND A
VERTICAL SCALE: 1"=10'
HORIZONTAL SCALE: 1"=100'




**SECTION** G P3–6

RETENTION POND A
VERTICAL SCALE: 1"=10'
HORIZONTAL SCALE: 1"=100'

HORIZONTAL SCALE
1"=100'–0" 100 0 100 200
Scale Feet

VERTICAL SCALE
1"=10'–0" 10 5 0 10 20
Scale Feet

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111226
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PROFESSIONAL ENGINEER
11/2/12

DESIGNED SEK
DRAWN CAD
VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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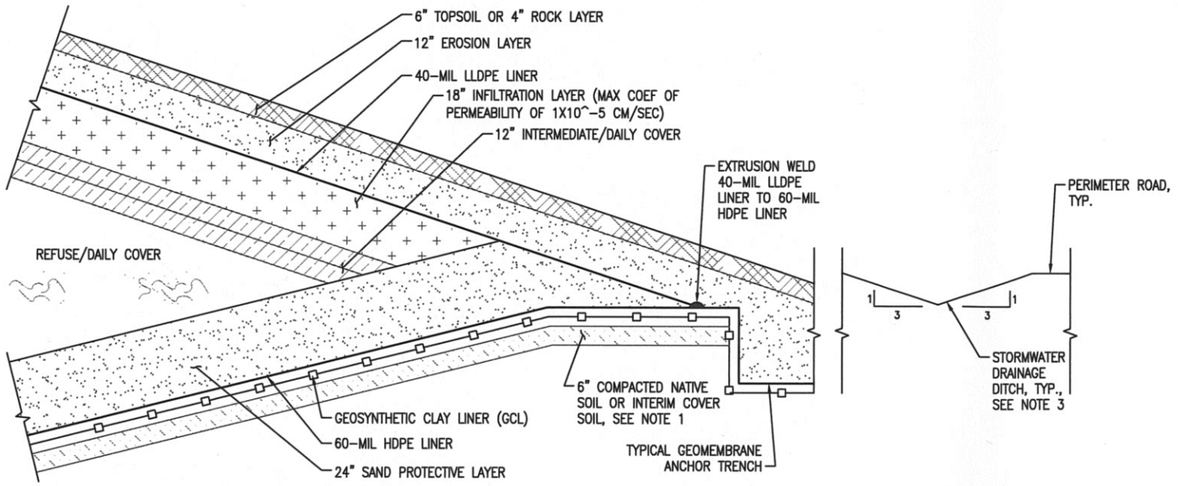
PONDING AREA CROSS SECTIONS, SHEET 2 OF 2

PROJECT NUMBER: 9631500115
SHT. 41 OF: 78
DRAWING NUMBER: P3–8

Keller, Tonya L. 10/18/2012 9:35:42 AM – P:\00218000 el paso lx\9631500115\data analytical\CADD\P3–8 PONDING AREA CROSS SECTIONS, SHEET 2 OF 2.dwg




**DETAIL** 1

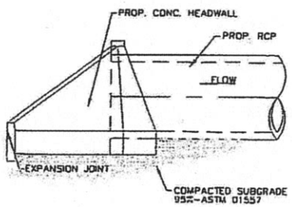
TYPICAL PERIMETER STORMWATER DITCH
SCALE: 1/2"=1'-0"

## NOTES

1. DETAILS PROVIDED IN PREVIOUS PERMIT, DATED APRIL 2002, BY MORENO CARDENAS, INC. SIGNED BY ROBERTO MORENO, P.E.
2. SEE P3-10 FOR ADDITIONAL TYPICAL HEADWALL DETAILS.
3. SEE P3-6 FOR SUGGESTED CHANNEL LINING AND APPENDIX 3B FOR DITCH SIZING CALCULATIONS.

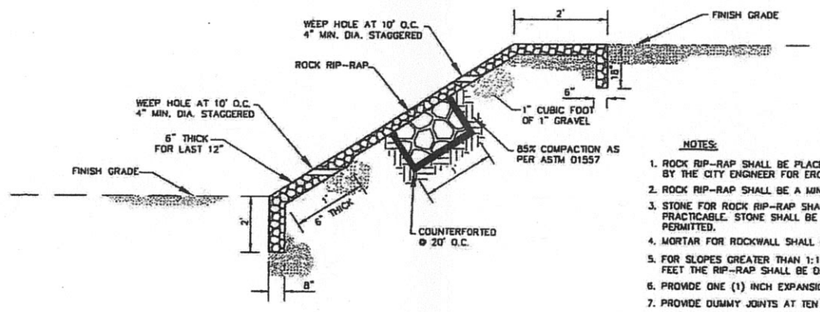
## LEGEND

- COMPACTED NATIVE SOIL
- PROTECTIVE SOIL DRAINAGE MATERIAL OR BUFFER MATERIAL
- TOPSOIL
- DAILY/INTERMEDIATE COVER
- EROSION LAYER
- INFILTRATION LAYER
- REFUSE
- AGGREGATE BACKFILL
- 40 MIL LLDPE GEOMEMBRANE LINER
- GEOSYNTHETIC CLAY LINER (GCL)
- RIPRAP




**DETAIL** 2

TYPICAL HEADWALL DETAIL
SCALE: N.T.S.
SEE NOTES 1 AND 2




NOTES:

1. ROCK RIP-RAP SHALL BE PLACED ON EMBANKMENTS OR SLOPES WHERE REQUIRED BY THE CITY ENGINEER FOR EROSION PROTECTION, EXCEPT FOR PONDING AREAS.
2. ROCK RIP-RAP SHALL BE A MINIMUM OF 8" MORTARED ROCK.
3. STONE FOR ROCK RIP-RAP SHALL BE AS NEARLY UNIFORM IN SECTION AS IN PRACTICABLE. STONE SHALL BE QUARRIED; FRACTURED RIVER ROCK SHALL NOT BE PERMITTED.
4. MORTAR FOR ROCKWALL SHALL BE TYPE S, 1800 P.S.I. AS PER ASTM C270.
5. FOR SLOPES GREATER THAN 1:1 OR VERTICAL HEIGHT OF MORE THAN SIX (6) FEET THE RIP-RAP SHALL BE DESIGNED BY A PROFESSIONAL ENGINEER.
6. PROVIDE ONE (1) INCH EXPANSION JOINT AT EVERY FIFTY (50) FEET.
7. PROVIDE DUMMY JOINTS AT TEN (10) FEET O.C.
8. NON-MORTARED ROCK RIP-RAP SHALL BE ALLOWED WHERE APPROVED BY DEPUTY DIRECTOR FOR ENGINEERING.

**DETAIL** 3

ROCK RIP-RAP
SCALE: N.T.S.
SEE NOTE 1

GRAPHIC SCALE:

1/2"=1'-0" 1 0 1 2 3 4 5
Scale Feet

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STATE OF TEXAS
FREDRIC J. DORAN
111226
REGISTERED PROFESSIONAL ENGINEER
11/2/12

| | |
|---|---|
| DESIGNED | SEK |
| DRAWN | CAD |
| VERIFY SCALE | BAR IS ONE INCH ON ANSI "D" DRAWING |
| 0 | 1" |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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MAJOR PERMIT AMENDMENT

DRAINAGE DETAILS, SHEET 1 OF 2

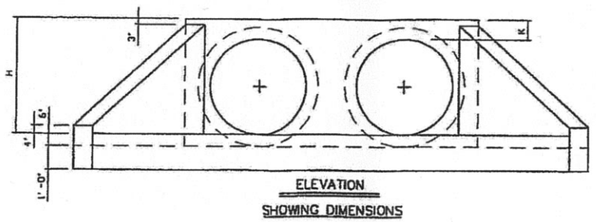
PROJECT NUMBER: 9631500115
SHT. 42 OF: 78
DRAWING NUMBER: P3-9

Keller, Tonya L. 10/18/2012 9:57:22 AM – P:\00218000 el paso tx\9631500115\data analytical\CADD\03-9 DRAINAGE DETAILS, SHEET 1 OF 2.dwg

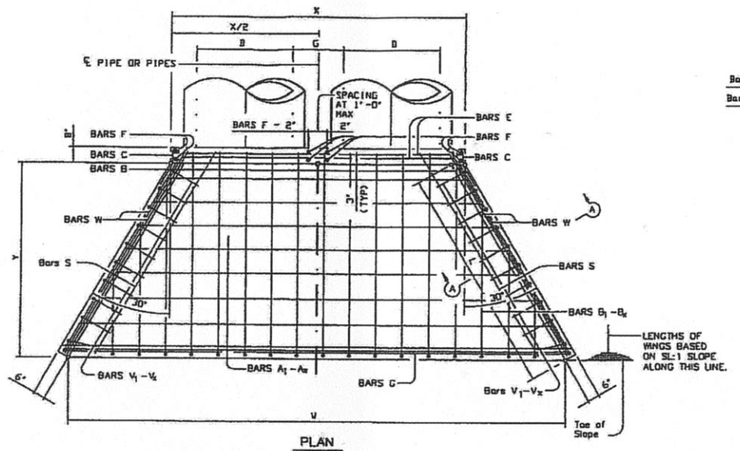
## TABLE OF VARIABLE DIMENSIONS AND QUANTITIES FOR ONE HEADWALL

| SLOPE | DIA OF PIPE, D | VALUES FOR ONE PIPE W | X | Y | L | REINF (LBS) | CONC (CY) (1) | VALUES TO BE ADDED FOR EACH ADDTL PIPE X AND W | REINF (Lbs) | CONC (CY) (1) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2:1 | 12" | 4'-7 1/2" | 2'-6" | 2'-10" | 3'-3 1/4" | 84 | 0.6 | 1'-9" | 20 | 0.2 |
| | 15" | 5'-5 3/4" | 2'-9 1/2" | 3'-4" | 3'-10 1/4" | 98 | 0.7 | 2'-2" | 24 | 0.3 |
| | 18" | 6'-4 1/4" | 3'-1" | 3'-10" | 4'-5" | 120 | 0.9 | 2'-8" | 32 | 0.3 |
| | 21" | 7'-2 3/4" | 3'-4 1/2" | 4'-4" | 5'-0" | 137 | 1.1 | 3'-1" | 43 | 0.4 |
| | 24" | 8'-2 1/2" | 3'-9 1/2" | 4'-10" | 5'-7" | 158 | 1.3 | 3'-7" | 50 | 0.5 |
| | 27" | 9'-1" | 4'-1" | 5'-4" | 6'-2" | 173 | 1.5 | 3'-11" | 56 | 0.6 |
| | 30" | 9'-11 1/2" | 4'-4 1/2" | 5'-10" | 6'-8 3/4" | 187 | 1.7 | 4'-4" | 65 | 0.8 |
| | 33" | 10'-10" | 4'-8" | 6'-4" | 7'-3 3/4" | 216 | 2.0 | 4'-8" | 71 | 0.9 |
| | 36" | 11'-8 1/4" | 4'-11 1/2" | 6'-10" | 7'-10 3/4" | 241 | 2.2 | 5'-1" | 81 | 1.0 |
| | 42" | 13'-5 1/4" | 5'-6 1/2" | 7'-10" | 9'-0 1/2" | 280 | 2.6 | 5'-10" | 97 | 1.3 |
| | 48" | 15'-8" | 6'-1 1/2" | 9'-4" | 10'-9 1/4" | 350 | 3.6 | 6'-7" | 117 | 1.7 |
| | 54" | 17'-9 3/4" | 6'-8 1/2" | 10'-4" | 11'-11 1/4" | 415 | 4.5 | 7'-5" | 151 | 2.1 |
| | 60" | 19'-2 3/4" | 7'-3 1/2" | 11'-4" | 13'-1" | 469 | 5.3 | 8'-3" | 174 | 2.5 |
| | 66" | 20'-11 1/2" | 7'-10 1/2" | 12'-4" | 14'-3" | 530 | 6.2 | 8'-9" | 194 | 2.9 |
| | 72" | 22'-8 1/2" | 8'-5 1/2" | 13'-4" | 15'-4 3/4" | 587 | 7.1 | 9'-4" | 213 | 3.3 |
| 3:1 | 12" | 6'-3" | 2'-6" | 4'-3" | 4'-11" | 114 | 0.8 | 1'-9" | 22 | 0.2 |
| | 15" | 7'-5" | 2'-9 1/2" | 5'-0" | 5'-9 1/4" | 133 | 1.1 | 2'-2" | 28 | 0.3 |
| | 18" | 8'-8 3/4" | 3'-1" | 5'-9" | 6'-7 3/4" | 186 | 1.3 | 2'-8" | 37 | 0.5 |
| | 21" | 9'-8 3/4" | 3'-4 1/2" | 6'-6" | 7'-6" | 189 | 1.6 | 3'-1" | 48 | 0.6 |
| | 24" | 11'-0" | 3'-9 1/2" | 7'-3" | 8'-4 1/2" | 221 | 2.0 | 3'-7" | 58 | 0.7 |
| | 27" | 12'-2" | 4'-1" | 8'-0" | 9'-2 3/2" | 245 | 2.3 | 3'-11" | 67 | 0.8 |
| | 30" | 13'-4" | 4'-4 1/2" | 8'-9" | 10'-1 1/4" | 287 | 2.7 | 4'-4" | 77 | 1.0 |
| | 33" | 14'-3 3/4" | 4'-8" | 9'-5" | 10'-11 3/4" | 310 | 3.1 | 4'-8" | 84 | 1.2 |
| | 36" | 15'-7 3/4" | 4'-11 1/2" | 10'-3" | 11'-10" | 343 | 3.5 | 5'-1" | 98 | 1.4 |
| | 42" | 17'-11 1/2" | 5'-6 1/2" | 11'-9" | 13'-6 3/4" | 424 | 4.5 | 5'-10" | 119 | 1.7 |
| | 48" | 21'-1 3/4" | 6'-1 1/2" | 14'-0" | 16'-2" | 527 | 6.1 | 6'-7" | 146 | 2.3 |
| | 54" | 23'-5 1/2" | 6'-8 1/2" | 15'-6" | 17'-10 3/4" | 616 | 7.3 | 7'-6" | 186 | 2.9 |
| | 60" | 25'-9 1/4" | 7'-3 1/2" | 17'-0" | 19'-7 1/2" | 707 | 8.7 | 8'-3" | 219 | 3.4 |
| | 66" | 28'-1" | 7'-10 1/2" | 18'-6" | 21'-4 1/4" | 797 | 10.1 | 8'-9" | 242 | 3.9 |
| | 72" | 30'-4 3/4" | 8'-5 1/2" | 20'-0" | 23'-1 1/4" | 910 | 11.7 | 9'-4" | 272 | 4.4 |
| 4:1 | 12" | 7'-10 3/4" | 2'-6" | 5'-8" | 6'-6 1/2" | 144 | 1.1 | 1'-9" | 24 | 0.3 |
| | 15" | 9'-4" | 2'-9 1/2" | 6'-8" | 7'-8 1/2" | 177 | 1.5 | 2'-2" | 32 | 0.4 |
| | 18" | 10'-9 1/2" | 3'-1" | 7'-8" | 8'-10 1/4" | 217 | 1.9 | 2'-8" | 42 | 0.5 |
| | 21" | 12'-2 3/4" | 3'-4 1/2" | 8'-8" | 10'-0" | 254 | 2.3 | 3'-1" | 57 | 0.7 |
| | 24" | 13'-9 1/2" | 3'-9 1/2" | 9'-8" | 11'-2" | 295 | 2.8 | 3'-7" | 67 | 0.9 |
| | 27" | 15'-3" | 4'-1" | 10'-8" | 12'-3 3/4" | 328 | 3.3 | 3'-11" | 77 | 1.0 |
| | 30" | 16'-8 1/4" | 4'-4 1/2" | 11'-8" | 13'-5 3/4" | 379 | 3.8 | 4'-4" | 89 | 1.3 |
| | 33" | 18'-1 3/4" | 4'-8" | 12'-8" | 14'-7 1/2" | 417 | 4.3 | 4'-8" | 101 | 1.4 |
| | 36" | 19'-7" | 4'-11 1/2" | 13'-8" | 15'-8 1/4" | 484 | 5.1 | 5'-1" | 115 | 1.7 |
| | 42" | 22'-5 3/4" | 5'-6 1/2" | 15'-8" | 18'-1" | 575 | 6.5 | 5'-10" | 141 | 2.1 |
| | 48" | 26'-8 1/4" | 6'-1 1/2" | 18'-8" | 21'-6 3/4" | 720 | 8.9 | 6'-7" | 175 | 2.8 |
| | 54" | 29'-5" | 6'-8 1/2" | 20'-8" | 23'-10 1/4" | 863 | 10.7 | 7'-6" | 226 | 3.6 |
| | 60" | 32'-3 3/4" | 7'-3 1/2" | 22'-8" | 26'-2" | 984 | 12.7 | 8'-3" | 264 | 4.3 |
| | 66" | 35'-2 1/2" | 7'-10 1/2" | 24'-8" | 28'-5 3/4" | 1126 | 14.9 | 8'-9" | 300 | 4.9 |
| | 72" | 38'-1 1/4" | 8'-5 1/2" | 26'-8" | 30'-9 1/2" | 1283 | 17.3 | 9'-4" | 334 | 5.6 |
| 6:1 | 12" | 11'-2" | 2'-8" | 8'-6" | 9'-9 3/4" | 220 | 1.9 | 1'-9" | 26 | 0.4 |
| | 15" | 13'-2 1/4" | 2'-9 1/2" | 10'-0" | 11'-6 1/2" | 264 | 2.5 | 2'-2" | 37 | 0.5 |
| | 18" | 15'-2 1/2" | 3'-1" | 11'-6" | 13'-3 1/4" | 326 | 3.2 | 2'-8" | 50 | 0.7 |
| | 21" | 17'-2 3/4" | 3'-4 1/2" | 13'-0" | 15'-0 1/4" | 381 | 3.9 | 3'-1" | 69 | 0.9 |
| | 24" | 19'-4 1/2" | 3'-9 1/2" | 14'-6" | 16'-8" | 447 | 4.8 | 3'-7" | 80 | 1.2 |
| | 27" | 21'-4 3/4" | 4'-1" | 15'-0" | 18'-5 3/4" | 506 | 5.7 | 3'-11" | 96 | 1.4 |
| | 30" | 23'-5 1/4" | 4'-4 1/2" | 17'-6" | 20'-2 1/2" | 587 | 6.7 | 4'-4" | 110 | 1.7 |
| | 33" | 25'-5 1/2" | 4'-8" | 19'-0" | 21'-11 1/4" | 667 | 7.8 | 4'-8" | 127 | 2.0 |
| | 36" | 27'-5 3/4" | 4'-11 1/2" | 20'-6" | 23'-8" | 727 | 9.0 | 5'-1" | 144 | 2.3 |
| | 42" | 31'-6 1/4" | 5'-6 1/2" | 23'-6" | 27'-1 1/2" | 914 | 11.5 | 5'-10" | 179 | 3.0 |
| | 48" | 37'-3 1/2" | 6'-1 1/2" | 28'-0" | 32'-4" | 1181 | 15.9 | 6'-7" | 231 | 4.0 |
| | 54" | 41'-4 1/4" | 6'-8 1/2" | 31'-0" | 35'-9 1/2" | 1412 | 19.2 | 7'-6" | 300 | 5.0 |
| | 60" | 45'-4 3/4" | 7'-3 1/2" | 34'-0" | 39'-3" | 1618 | 22.9 | 8'-3" | 353 | 6.0 |

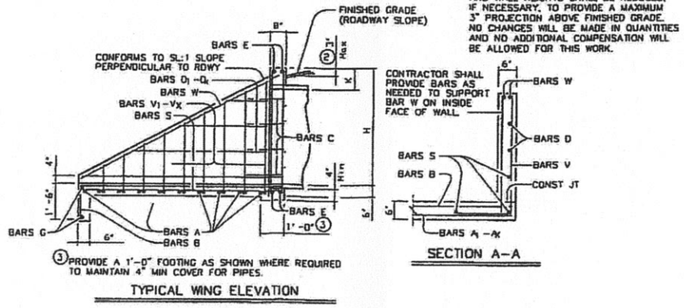
(1) QUANTITIES INCREASE SLIGHTLY FOR METAL PIPE INSTALLATIONS.




ELEVATION
SHOWING DIMENSIONS




PLAN




(3) PROVIDE A 1'-0" FOOTING AS SHOWN WHERE REQUIRED TO MAINTAIN 4" MIN COVER FOR PIPES.

TYPICAL WING ELEVATION

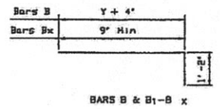
SECTION A-A

(2) FOR VEHICLE SAFETY, CURB HEIGHTS AND WALL HEIGHTS SHALL BE REDUCED, IF NECESSARY, TO PROVIDE A MAXIMUM 3" PROJECTION ABOVE FINISHED GRADE. NO CHANGES WILL BE MADE IN QUANTITIES AND NO ADDITIONAL COMPENSATION WILL BE ALLOWED FOR THIS WORK.

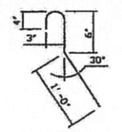
| (4) TABLE OF REINFORCING STEEL | | | |
|---|---|---|---|
| Bar | Size | Spa | No. |
| A | # 4 | 1'-0" | ~ |
| B | # 3 | 1'-6" | ~ |
| C | # 4 | 1'-0" | ~ |
| D | # 3 | 1'-0" | ~ |
| E | # 5 | ~ | 4 |
| F | # 5 | ~ | ~ |
| G | # 3 | ~ | 2 |
| S | # 4 | ~ | 6 |
| V | # 4 | 1'-0" | ~ |
| W | # 5 | ~ | 4 |

(4) QUANTITIES SHOWN ARE FOR ONE STRUCTURE END. (ONE HEADWALL)

| TABLE OF CONSTANT DIMENSIONS | | | |
|---|---|---|---|
| DIA OF PIPE, D | G | K | H |
| 12" | 9" | 1'- 0" | 2'- 0" |
| 15" | 11" | 1'- 0" | 2'- 3" |
| 18" | 1'- 2" | 1'- 0" | 2'- 6" |
| 21" | 1'- 4" | 1'- 0" | 2'- 9" |
| 24" | 1'- 7" | 1'- 0" | 3'- 0" |
| 27" | 1'- 8" | 1'- 0" | 3'- 3" |
| 30" | 1'-10" | 1'- 0" | 3'- 6" |
| 33" | 1'-11" | 1'- 0" | 3'- 9" |
| 36" | 2'- 1" | 1'- 0" | 4'- 0" |
| 42" | 2'- 4" | 1'- 0" | 4'- 6" |
| 48" | 2'- 7" | 1'- 3" | 5'- 3" |
| 54" | 3'- 0" | 1'- 3" | 5'- 9" |
| 60" | 3'- 3" | 1'- 3" | 6'- 3" |
| 66" | 3'- 3" | 1'- 3" | 6'- 9" |
| 72" | 3'- 4" | 1'- 3" | 7'- 3" |



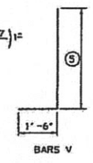

BARS B & B1 - B6 x




BARS C
(2'-0" LONG)

(5) MIN LENGTH = 6" + 3" x $\left(\frac{12 \times H - 7}{12 \times L}\right)$

MAX LENGTH = 12 x H - 3" x $\left(\frac{12 \times H - 7}{12 \times L}\right)$




BARS V

GENERAL NOTES:
DESIGNED ACCORDING TO CURRENT AASHTO STANDARD AND INTERIM SPECIFICATIONS.
REINFORCING STEEL SHALL BE PLACED WITH THE CENTER OF THE OUTSIDE LAYER OF BARS 2" FROM THE SURFACE OF THE CONCRETE.
ALL REINFORCING STEEL SHALL BE GRADE 60.
ALL CONCRETE SHALL BE CLASS "C" AND SHALL HAVE A MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 3600 PSI.

## NOTES

1. DETAILS PROVIDED IN PREVIOUS PERMIT, DATED APRIL 2002, BY MORENO CARBENAS, INC. SIGNED BY ROBERTO MORENO, P.E.
2. THE LOCATION OF THIS HEADWALL IS SHOWN ON P3-6. THE CULVERTS WILL DISCHARGE WATER FROM THE EXISTING RETENTION POND TO STORMWATER RETENTION POND C.

# TYPICAL STORM SEWER HEADWALL DETAILS

GRAPHIC SCALE: NTS

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STATE OF TEXAS
FREDRIC J. DORAN
111226
REGISTERED
PROFESSIONAL ENGINEER
11/2/12

| DESIGNED | SEK |
|---|---|
| DRAWN | CAD |
| VERIFY SCALE | BAR IS ONE INCH ON ANSI "D" DRAWING |
| 0 | 1" |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 1 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

THE CITY OF EL PASO TEXAS

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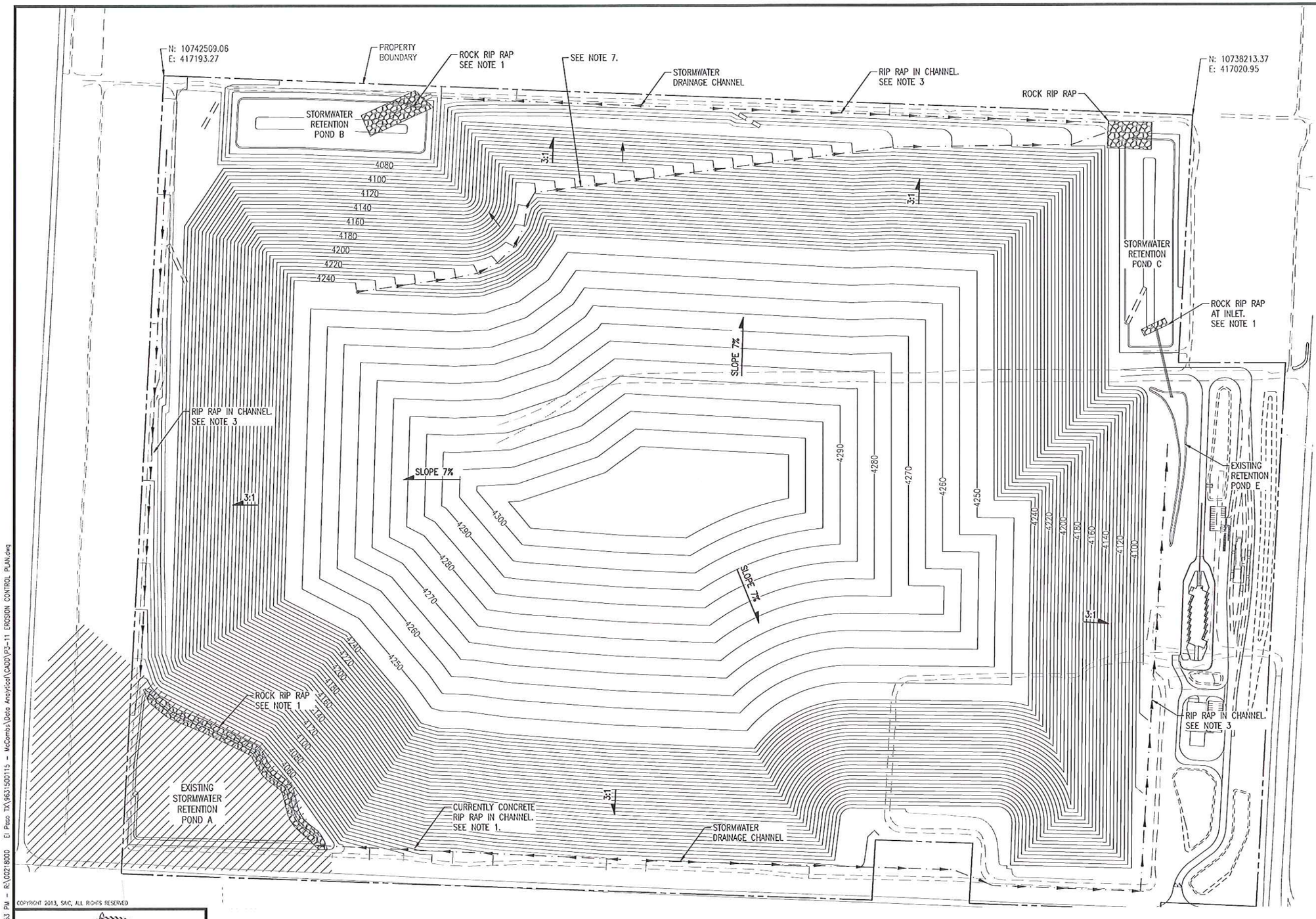
MAJOR PERMIT AMENDMENT

DRAINAGE DETAILS, SHEET 2 OF 2

PROJECT NUMBER: 9631500115
SHT. 43 OF: 78
DRAWING NUMBER: P3-10

Keller, Tonya L 10/18/2012 11:35:54 AM – P:\00218000 el paso tx\9631500115\data analytical\CADD\P3-10 DRAINAGE DETAILS, SHEET 2 OF 2.dwg




## NOTES

1. A STORMWATER POLLUTION PREVENTION PLAN FOR CONSTRUCTION ACTIVITIES WILL BE PREPARED PRIOR TO INITIAL CONSTRUCTION.
2. A STORMWATER POLLUTION PREVENTION PLAN FOR INDUSTRIAL ACTIVITIES WILL BE PREPARED PRIOR TO LANDFILLING ACTIVITIES.
3. RIP-RAP OR OTHER EROSION PROTECTION SHALL BE USED WHERE VELOCITIES EXCEED 4.0 FPS.
4. A VEGETATIVE OR ROCK ANCHORING LAYER SHALL BE ESTABLISHED UPON FINAL CLOSURE TO PREVENT EROSION.
5. SILT FENCE OR EARTHEN BERMS SHALL BE USED AS NEEDED DURING CONSTRUCTION OF FINAL COVER.
6. DETAILS OF SOME EROSION CONTROL BMP'S CAN BE SEEN ON P3-12.
7. DRAINAGE DITCH ALONG ACCESS ROAD WILL HAVE CONVEYANCES AT THE TWO LOCATIONS SHOWN TO ENSURE DRAINAGE PATTERNS ON P3-6.
8. CONTOUR INTERVAL IS FIVE FEET. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM.

## LEGEND

- FACILITY/PROPERTY BOUNDARY
- FLOW DIRECTION
- STORMWATER DRAINAGE DITCH
- 100 YEAR FLOOD PLAIN
- RIP RAP
- 4200 — ELEVATION CONTOURS
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- LANDFILL ACCESS ROAD

GRAPHIC SCALE

1"=200'-0" 200 0 200 400

Scale Feet

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Ron, Jacob S. 5/30/2013 4:38:53 PM – R:\00218000 El Paso TX\9631500115 – McCombs\Data Analysis\CADD\P3-11 EROSION CONTROL PLAN.dwg

CAMI VAN ABEL 113723 REGISTERED PROFESSIONAL ENGINEER STATE OF TEXAS
2/13/13

DESIGNED SEK
DRAWN CAD
VERIFY SCALE BAR IS ONE INCH ON ANSI "D" DRAWING 0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 3 | 6/3/13 | JSR | CAV | FOURTH TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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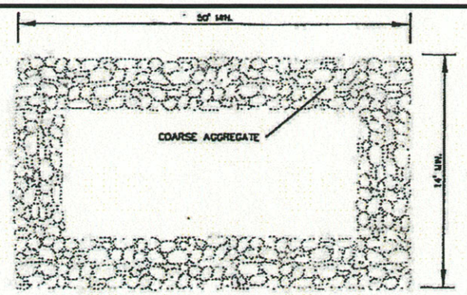
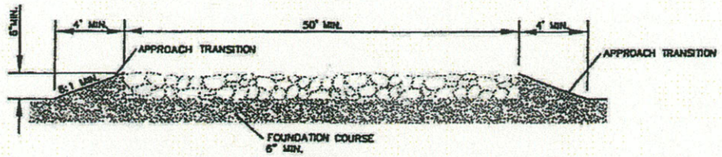
EROSION CONTROL PLAN

PROJECT NUMBER 9631500115
SHT. 44 OF: 78
DRAWING NUMBER: P3-11




PLAN

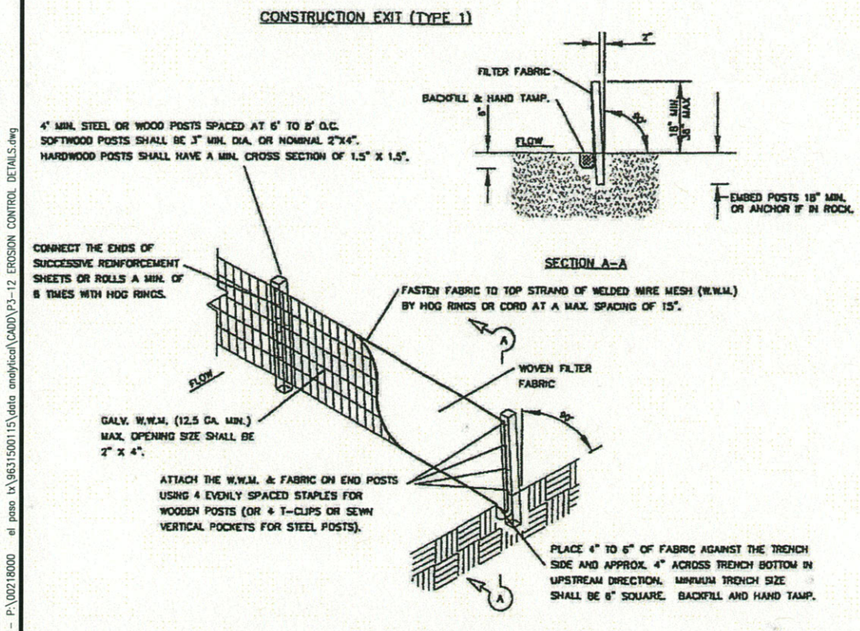



PROFILE

GENERAL NOTES

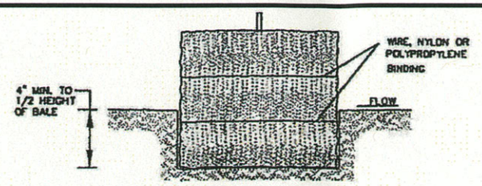
1. THE LENGTH OF THE TYPE 1 CONSTRUCTION EXIT SHALL BE AS INDICATED ON THE PLANS, BUT NOT LESS THAN 50'.
2. THE COARSE AGGREGATE SHOULD BE OPEN GRADED WITH A SIZE OF 4" TO 8".
3. THE APPROACH TRANSITIONS SHOULD BE NO STEEPER THAN 6:1 AND CONSTRUCTED AS DIRECTED BY THE ENGINEER.
4. THE CONSTRUCTION EXIT FOUNDATION COURSE SHALL BE FLEXIBLE BASE, BITUMINOUS CONCRETE, PORTLAND CEMENT CONCRETE OR OTHER MATERIAL AS APPROVED BY THE ENGINEER.
5. THE CONSTRUCTION EXIT SHALL BE GRADED TO ALLOW DRAINAGE TO A SEDIMENT TRAPPING DEVICE.
6. THE GUIDELINES SHOWN HEREON ARE SUGGESTIONS ONLY AND MAY BE MODIFIED BY THE ENGINEER.

CONSTRUCTION EXIT (TYPE 1)

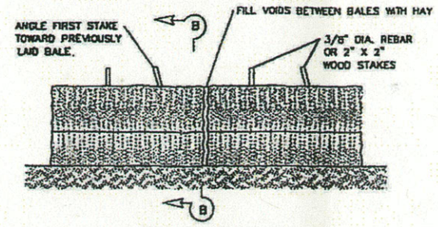



SECTION A-A

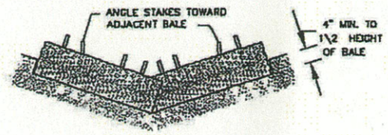
TEMPORARY SEDIMENT CONTROL FENCE




SECTION B-B




BALED HAY FOR EROSION CONTROL




PROFILE VIEW

BALED HAY USAGE GUIDELINES

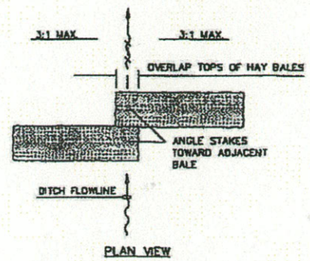
A BALED HAY INSTALLATION MAY BE CONSTRUCTED NEAR THE DOWNSTREAM PERIMETER OF A DISTURBED AREA ALONG A CONTOUR TO INTERCEPT SEDIMENT FROM OVERLAND RUNOFF. A TWO YEAR STORM FREQUENCY MAY BE USED TO CALCULATE THE FLOW RATE TO BE FILTERED. THE INSTALLATION SHOULD BE SIZED TO FILTER A MAXIMUM FLOW THRU RATE OF 5 GPM/FT$^2$ OF CROSS SECTIONAL AREA. BALED HAY MAY BE USED AT THE FOLLOWING LOCATIONS:

1. WHERE THE RUNOFF APPROACHING THE BALED HAY FLOWS OVER DISTURBED SOIL FOR LESS THAN 100'. IF THE SLOPE OF THE DISTURBED SOIL EXCEEDS 10%, THE LENGTH OF SLOPE UPSTREAM THE BALED HAY SHOULD BE LESS THAN 50'.
2. WHERE THE INSTALLATION WILL BE REQUIRED FOR LESS THAN 3 MONTHS.
3. WHERE THE CONTRIBUTING DRAINAGE AREA IS LESS THAN 1/2 ACRE.

FOR BALED HAY INSTALLATIONS IN SMALL DITCHES, THE ADDITIONAL FOLLOWING CONSIDERATIONS APPLY:

1. THE DITCH SIDESLOPES SHOULD BE GRADED AS FLAT AS POSSIBLE TO MAXIMIZE THE DRAINAGE FLOWRATE THRU THE HAY.
2. THE DITCH SHOULD BE GRADED LARGE ENOUGH TO CONTAIN THE OVERTOPPING DRAINAGE WHEN SEDIMENT HAS FILLED TO THE TOP OF THE BALED HAY.

BALES SHOULD BE REPLACED USUALLY EVERY 2 MONTHS OR MORE OFTEN DURING WET WEATHER WHEN LOSS OF STRUCTURAL INTEGRITY IS ACCELERATED.




PLAN VIEW

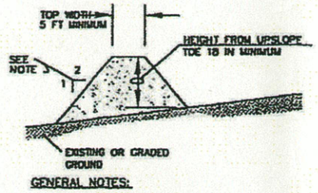
GENERAL NOTES

1. HAY BALES SHALL BE A MINIMUM OF 36" IN LENGTH AND WEIGH A MINIMUM OF 50 LBS.
2. HAY BALES SHALL BE BOUND BY EITHER WIRE OR NYLON OR POLYPROPYLENE STRING. THE BALES SHALL BE COMPOSED ENTIRELY OF VEGETABLE MATTER.
3. HAY BALES SHALL BE EMBEDDED IN THE SOIL A MINIMUM OF 4" AND WHERE POSSIBLE 1/2 THE HEIGHT OF THE BALE.
4. HAY BALES SHALL BE PLACED IN A ROW WITH ENDS TIGHTLY ABUTTING THE ADJACENT BALES. THE BALES SHALL BE PLACED WITH BINDINGS PARALLEL TO THE GROUND.
5. HAY BALES SHALL BE SECURELY ANCHORED IN PLACE WITH 3/8" DIA. REBAR OR 2" X 2" WOOD STAKES, DRIVEN THROUGH THE BALES. THE FIRST STAKE SHALL BE ANGLED TOWARDS THE PREVIOUSLY LAID BALE TO FORCE THE BALES TOGETHER.
6. THE GUIDELINES SHOWN HEREON ARE SUGGESTIONS ONLY AND MAY BE MODIFIED BY THE ENGINEER.

BALED HAY FOR EROSION CONTROL

## NOTES

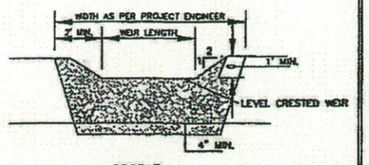
1. DETAILS PROVIDED IN PREVIOUS PERMIT, DATED APRIL 2002, BY MORENO CARDENAS, INC., SIGNED BY ROBERTO MORENO, P.E.




GENERAL NOTES:

1. SOIL USED IN BERM CONSTRUCTION SHALL BE MACHINE COMPACTED.
2. TOP WIDTH AND HEIGHT OF BERM MAY BE MODIFIED WITH PRIOR APPROVAL OF THE ENGINEER.
3. SIDE SLOPES WITHIN THE SAFETY CLEAR ZONE OF A ROADWAY SHALL BE 6:1 OR FLATTER.
4. GRADING SHALL BE SHOWN ELSEWHERE IN THE PLANS OR AS DIRECTED BY THE ENGINEER.
5. THE ENGINEER RESERVES THE RIGHT TO MODIFY THE DIMENSIONS SHOWN FOR THE BERM DEPENDENT ON RUNOFF VOLUME CHARACTERISTICS.
6. BERM THAT ARE IN PLACE FOR MORE THAN 14 CALENDAR DAYS SHOULD BE STABILIZED TO PREVENT SEDIMENT RUNOFF.
7. THE GUIDELINES SHOWN HEREON ARE SUGGESTIONS ONLY AND MAY BE MODIFIED BY THE ENGINEER.

TYPICAL BERM CONFIGURATION




PROFILE

ROCK FILTER DAM USAGE GUIDELINES

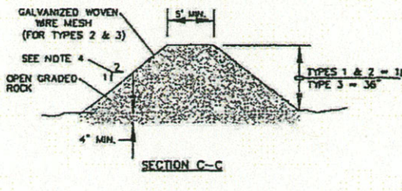
ROCK FILTER DAMS SHOULD BE CONSTRUCTED DOWNSTREAM FROM DISTURBED AREAS TO INTERCEPT SEDIMENT FROM OVERLAND RUNOFF AND/OR CONCENTRATED FLOW. THE DAMS SHOULD BE SIZED TO FILTER A MAXIMUM FLOW THROUGH RATE OF 40 GPM/FT$^2$ OF CROSS SECTIONAL AREA. A 2 YEAR STORM FREQUENCY MAY BE USED TO CALCULATE THE FLOW RATE.

TYPE 1 (18" HIGH WITH NO WIRE MESH): TYPE 1 MAY BE USED AT THE TOE OF SLOPES, AROUND INLETS, IN SMALL DITCHES, AND AT DIKE OR SWALE OUTLETS. THIS TYPE OF DAM IS RECOMMENDED TO CONTROL EROSION FROM A DRAINAGE AREA OF 5 ACRES OR LESS. TYPE 1 MAY NOT BE USED IN CONCENTRATED HIGH VELOCITY FLOWS (APPROX. 8 FT/SEC OR MORE) IN WHICH AGGREGATE WASH OUT MAY OCCUR. SANDBAGS MAY BE USED AT THE EMBEDDED FOUNDATION (4" DEEP MIN.) FOR BETTER FILTERING EFFICIENCY OF LOW FLOWS IF CALLED FOR ON THE PLANS OR DIRECTED BY THE ENGINEER.

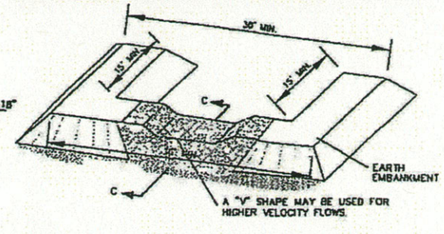
TYPE 2 (18" HIGH WITH WIRE MESH): TYPE 2 MAY BE USED IN DITCHES AND AT DIKE OR SWALE OUTLETS.

TYPE 3 (36" HIGH WITH WIRE MESH): TYPE 3 MAY BE USED IN STREAM FLOW AND SHOULD BE SECURED TO THE STREAM BED.

TYPE 4 (SACK GABIONS): TYPE 4 MAY BE USED IN DITCHES AND SMALLER CHANNELS TO FORM AN EROSION CONTROL DAM.




SECTION C-C




FILTER DAM AT SEDIMENT TRAP

GRAPHIC SCALE: NOT TO SCALE

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111226
REGISTERED PROFESSIONAL ENGINEER
11/2/12

| | |
|---|---|
| DESIGNED | SEK |
| DRAWN | CAD |
| VERIFY SCALE | BAR IS ONE INCH ON ANSI "D" DRAWING |
| 0 | 1" |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 1 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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EROSION CONTROL DETAILS

PROJECT NUMBER: 9631500115

SHT. 45 OF: 78

DRAWING NUMBER: P3-12

Koller, Tonya L. 10/16/2012 11:53:20 AM – P:\0021800 el paso tx\9631500115\data analytical\CAD\P3-12 EROSION CONTROL DETAILS.dwg

# Appendix 3D
# Flood Maps

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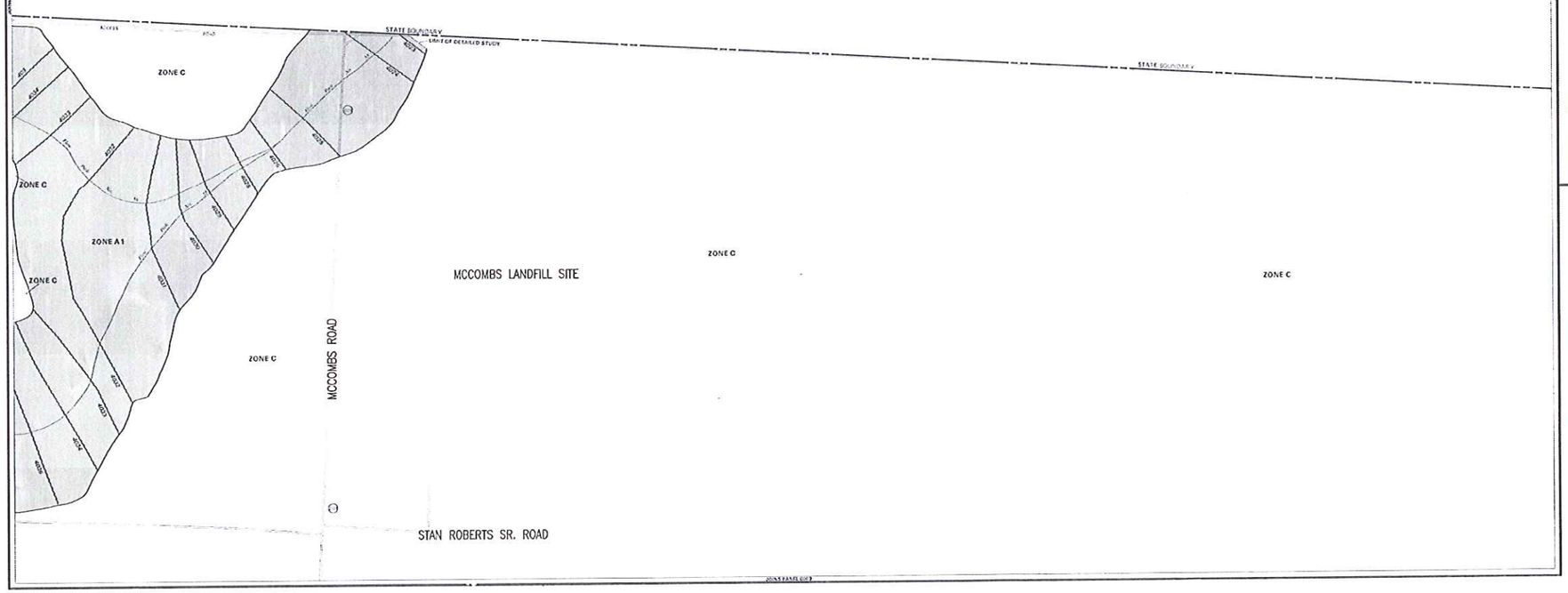


KEY TO MAP

| | |
|---|---|
| 500-Year Flood Boundary | ZONE B |
| 100-Year Flood Boundary | ZONE A1<br>ZONE A3 |
| Zone Designations* | ZONE B |
| 100-Year Flood Boundary | ZONE C |
| 500-Year Flood Boundary | |
| Base Flood Elevation Line With Elevation in Feet** | 513 |
| Base Flood Elevation in Feet Where Uniform Within Zone** | (EL 987) |
| Elevation Reference Mark | RM7x |
| Zone D Boundary | |
| River Mile | RM15 |

**Referenced to the National Geodetic Vertical Datum of 1929

*EXPLANATION OF ZONE DESIGNATIONS

| ZONE | EXPLANATION |
|---|---|
| A | Areas of 100-year flood; base flood elevations and flood hazard factors not determined. |
| AO | Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined. |
| AH | Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined. |
| A1-A30 | Areas of 100-year flood; base flood elevations and flood hazard factors determined. |
| A99 | Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined. |
| B | Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading) |
| C | Areas of minimal flooding. (No shading) |
| D | Areas of undetermined, but possible, flood hazards. |
| V | Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined. |
| V1-V30 | Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined. |

NOTES TO USER

Certain areas not in the special flood hazard areas (Zones A and V) may be protected by flood control structures.

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside special flood hazard areas. The coastal flooding elevations shown were derived from those developed by the National Weather Service for hurricane evacuation planning.

For adjoining map panels, see separately printed Index to Map Panels.

INITIAL IDENTIFICATION:
NOVEMBER 15, 1979

FLOOD HAZARD BOUNDARY MAP REVISIONS:
NONE

FLOOD INSURANCE RATE MAP EFFECTIVE:
OCTOBER 15, 1987

FLOOD INSURANCE RATE MAP REVISED:
JUNE 15, 1988 - Revised to reflect results of detailed flood studies, to add special flood hazard areas, to add additional flood boundaries, to change special flood hazard areas and to change some zone designations

For information on flood insurance for this community, contact your insurance agent or call the National Flood Insurance Program at (800) 638-6620.

APPROXIMATE SCALE

NATIONAL FLOOD INSURANCE PROGRAM

**FIRM**
**FLOOD INSURANCE RATE MAP**

CITY OF
EL PASO,
TEXAS
EL PASO COUNTY

PANEL 4 OF 52
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
480214 0004 C

MAP REVISED:
JUNE 15, 1988

Federal Emergency Management Agency

GRAPHIC SCALE: NTS

## NOTES

1. FEMA FLOOD INSURANCE FATE MAP (FIRM) PREPARED JUNE 15, 1988.
2. THE LANDFILL PROPERTY AND SECTOR BOUNDARIES ASSOCIATED WITH THE 100-YEAR FLOODPLAIN ARE SHOWN ON DRAWING P3-14.
3. BASE FLOOD ELEVATIONS NGVD 29 DATUM. CONVERSION FROM NGVD 29 DATUM TO CITY OF EL PASO VERTICAL DATUM, ADD 27.65-FEET.
4. THE ORIGINAL FIRM FOR PANEL 4 OF 52 (480214 0004 C) FOR THE CITY OF EL PASO REVISED ON JUNE 15, 1988 HAS BEEN PROVIDED ATTACHED FOR REVIEW ASSISTANCE.

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113723
REGISTERED PROFESSIONAL ENGINEER
3/15/13

| | |
|---|---|
| DESIGNED | TLK |
| DRAWN | CAD |
| VERIFY SCALE | BAR IS ONE INCH ON ANSI "D" DRAWING |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 3 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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FLOOD INSURANCE RATE MAP

PROJECT NUMBER: 9631500115
SHT. 46 OF: 78
DRAWING NUMBER: P3-13

Rev. Jacob S. 3/13/2013 10:45:58 AM - R:\0021B000 El Paso TX\9631500115 - McCombs\Data Analysis\CADD\P3-13 FLOOD INSURANCE RATE MAP.dwg

## NOTES

1. DIGITIZED TOPOGRAPHY FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS.
2. COORDINATES ARE BASED ON THE TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NAD 83. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM. NAVD 88 DATUM TO NGVD 29 DATUM, SUBTRACT 1.99–FEET. NGVD 29 DATUM TO CITY OF EL PASO DATUM, ADD 27.65–FEET.
3. EXISTING CONTOUR INTERVAL IS TWO FEET.
4. SITE TOPOGRAPHY MAY VARY DUE TO OWNER'S OPERATIONS.

## LEGEND

- 100 YEAR FLOOD PLAIN
- MW–3 — MONITORING WELL
- GMP–8 — GAS MONITORING PROBE
- PIEZOMETER
- PV–7 — VERTICAL GAS WELL
- 1*, 1RI, 1 — SOIL BORING, TYPICAL
- WATER WELL
- BUILDING/STRUCTURE
- 4050 — ELEVATION CONTOURS
- 4050 — BASE FLOOD ELEVATIONS
- CHAIN LINK OR OTHER FENCE
- 125' BUFFER ZONE
- UGE — UNDERGROUND ELECTRIC
- OHE — OVERHEAD ELECTRIC UTILITY
- UGC — UNDERGROUND COMMUNICATIONS
- GMCS — GAS MIGRATION CONTROL SYSTEM
- FACILITY/PROPERTY BOUNDARY
- SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- W — W — WATER LINE
- HIGHWAY
- LANDFILL ACCESS ROAD
- SECTION LINE

GRAPHIC SCALE

1"=250'–0" (Scale) 250 0 250 500 (Feet)

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STATE OF TEXAS
FREDRIC J. DORAN
111226
REGISTERED PROFESSIONAL ENGINEER
11/2/12

DESIGNED TLK
DRAWN CAD
VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
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MAJOR PERMIT AMENDMENT

100–YEAR FLOODPLAIN MAP

PROJECT NUMBER: 9631500115
SHT. 47 OF: 78
DRAWING NUMBER: P3–14

Keller, Tonya L. 10/18/2012 1:28:10 PM – P:\00218000 el paso tx\9631500115\data analytical\CAD\P3–14 100–YEAR FLOODPLAIN MAP.dwg

# Appendix 3E
# Site Layout Plans

SAIC®

## Memorandum

To: TCEQ

From: Cami Van Abel, P.E.

Subject: Appendix 3E, Sheet C13

Date: March 15, 2013

Sheet C13 prepared by Moreno Cardenas and dated October 22, 2012 is provided to provide the drainage area runoff computations and retention pond computations for the site facility improvements. The calculations provided are current to the site facility improvements.

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1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI

## DRAINAGE AREA RUNOFF COMPUTATIONS

| DRAINAGE AREA NO (1) | DRAINAGE AREA (AC) (2) | DESIGN STORM INTENSITY (3) | TIME OF CONCENTRATION (4) | A1 PAVEMENT (5) | A2 DIRT (6) | C1 PAVEMENT (7) | C2 DIRT (8) | RUNOFF COEFF (C/W) (9) | $Q_{100}$ (CFS) (10) |
|---|---|---|---|---|---|---|---|---|---|
| DA-1 | 2.50 | 4.13 | 10 | 0.16 | 2.34 | 0.95 | 0.33 | 0.37 | 3.8 |
| DA-2 | 2.86 | 4.13 | 10 | 0.19 | 2.67 | 0.95 | 0.33 | 0.37 | 4.4 |
| DA-3 | 8.87 | 4.13 | 10 | 1.11 | 7.76 | 0.95 | 0.33 | 0.40 | 14.9 |
| DA-4 | 1.35 | 4.13 | 10 | 0.11 | 1.24 | 0.95 | 0.33 | 0.38 | 2.1 |
| DA-5 | 1.37 | 4.13 | 10 | 0.42 | 0.95 | 0.95 | 0.33 | 0.50 | 2.9 |
| DA-6 | 4.21 | 4.13 | 10 | 2.55 | 1.66 | 0.95 | 0.33 | 0.68 | 12.3 |

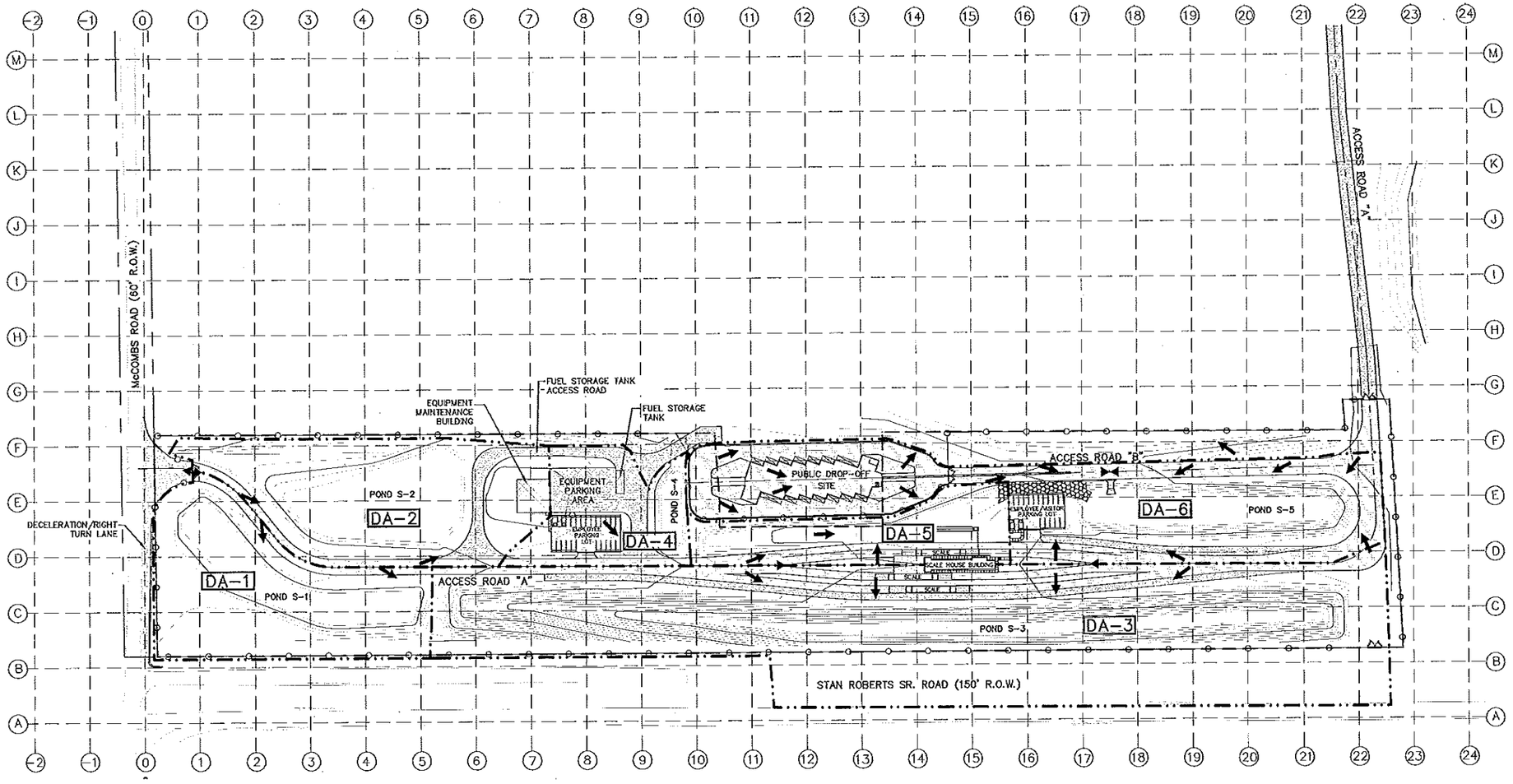
REFERENCE: CITY OF EL PASO DRAINAGE DESIGN MANUAL (JUNE 2008)
(1) WATERSHED AREA IDENTIFICATION
(2) AREA FROM DRAINAGE PLAN
(3) RAINFALL INTENSITY CENTRAL REGION INTENSITY EQUATION 4-7 $I_{100} = \frac{111.04}{(Tc + 26.09)^{0.9177}}$
(4) TIME OF CONCENTRATION: TC = 10 MINUTES (V.N)
(5) PAVED AREA (AC)
(6) DIRT AREA (AC)
(7,8) RUNOFF COEFFICIENT => PAVEMENT C=0.95, DIRT C=0.33 100 YEAR TABLE 4-5
(9) RUNOFF WEIGHTED COEFFICIENT
(10) $Q_{100} = C \times A \times I$

## RETENTION POND COMPUTATIONS

| POND ID (1) | DRAINAGE AREA ID (2) | AREA (ACRES) (3) | C/W COEFFICIENT (4) | $R_{100}$ (5) | 100-YR RUNOFF VOL (AC-FT) (6) | AVAILABLE CAPACITY (AC-FT) (7) | HIGH WATER SURFACE ELEVATION (8) | BOTTOM ELEVATION (FT) (9) | TOP ELEVATION (FT) (10) |
|---|---|---|---|---|---|---|---|---|---|
| POND S-1 | DA-1 | 2.50 | 0.37 | 4.00 | 0.31 | 0.75 | 4079.41 | 4079 | 4080 |
| POND S-2 | DA-2 | 2.86 | 0.37 | 4.00 | 0.35 | 0.93 | 4078.37 | 4078 | 4079 |
| POND S-3 | DA-3 | 8.87 | 0.41 | 4.00 | 1.21 | 5.25 | 4062.13 | 4061 | 4066 |
| POND S-4 | DA-4 | 1.35 | 0.38 | 4.00 | 0.17 | 0.25 | 4073.36 | 4072 | 4074 |
| POND S-5 | DA-5,6 | 5.58 | 0.66 | 4.00 | 1.23 | 1.32 | 4067.43 | 4066 | 4068 |

REFERENCE: CITY OF EL PASO DRAINAGE DESIGN MANUAL (JUNE 2008)
(1) PONDONG AREA IDENTIFICATION
(2) WATERSHED IDENTIFICATION
(3) WATERSHED AREA
(4) RUNOFF WEIGHTED COEFFICIENT
(5) $R_{100}$ = 4-INCHES (STANDARD 2-1)
(6) $QT_{100}$ = ARC/12 (STANDARD 2-1)
(7) PONDING AREA CAPACITY
(8) PONDING AREA 100 YEAR WATER SURFACE ELEVATION
(9) PONDING AREA BOTTOM ELEVATION
(10) PONDING AREA TOP ELEVATION

GRAPHIC SCALE
0 50 100




FILE No. 238341

| No. | DATE | REVISION REMARKS | BY |
|---|---|---|---|

MCi Moreno Cardenas Inc. consulting engineering
Planning, Engineering, Project Management
2501 E Mabel Ave, El Paso, Texas 79903, 915-585-2690, Fax 915-585-2697
Texas Board of Professional Engineers Registration No. F-000604

ENGINEER'S SEAL
MARVIN HENRY GOMEZ 85920 LICENSED PROFESSIONAL ENGINEER

ENGINEER'S NOTE
THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY MARVIN H. GOMEZ, PE #85920 ON OCTOBER 22, 2012
ALTERATION OF A SEALED DOCUMENT WITHOUT PROPER NOTIFICATION TO THE RESPONSIBLE ENGINEER IS AN OFFENSE UNDER THE TEXAS ENGINEERING PRACTICE ACT

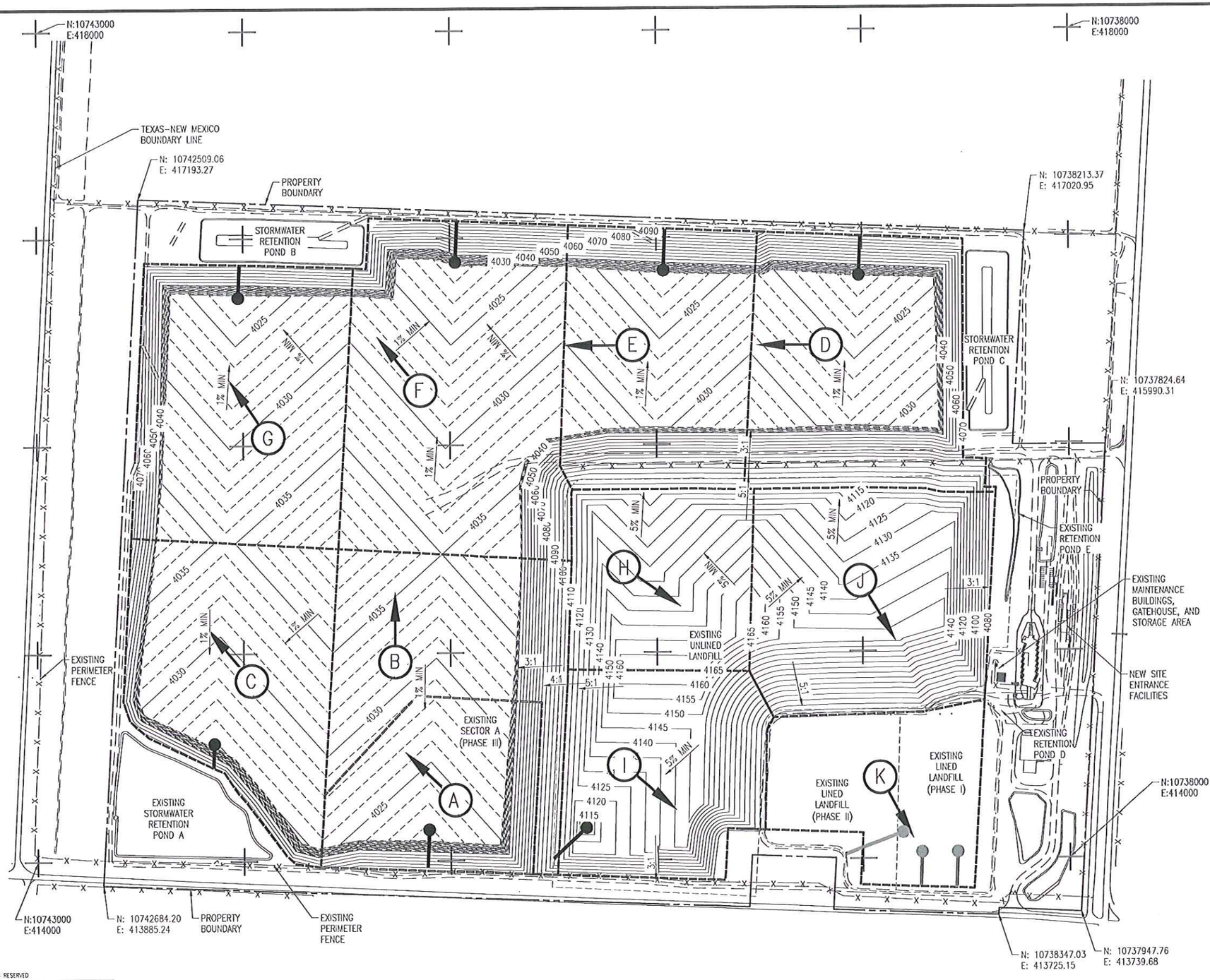
SCALE: HORZ. 1"=100', VERT. N/A
DATE: 01-31-11
DESIGN BY: G.A.P.
DRAWN BY: A.A.
CHECKED BY: M.G.
APPROVED BY: R.M.
JOB No. 10-121.

PROJECT NAME
McCOMBS LANDFILL
MSW-729 B

CITY OF EL PASO
#2 CIVIC CENTER PLAZA PH. (915) 541-4200

SHEET TITLE
SITE IMPROVEMENTS LAYOUT AND DRAINAGE PLAN

SHEET
C13
13 OF 78




## NOTES

1. CONTOURS SHOWN REPRESENT TOP OF COMPACTED NATIVE SUBGRADE SOIL IN FUTURE CELLS OR INTERIM COVER SOIL IN EXISTING CELLS.
2. BASE CONTOUR INTERVAL FOR SOLID CONTOURS IS FIVE FEET. BASE CONTOUR INTERVAL FOR DASHED CONTOURS IS ONE FOOT. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM.
3. INTERIOR SECTOR BOUNDARY LOCATIONS FOR SECTORS B, D, E, AND F ARE CONSIDERED TO BE A MOVING TARGET AND MAY VARY DEPENDING ON THE AMOUNT OF FILL ON THE EXISTING UNLINED LANDFILL AT THE TIME OF CELL DEVELOPMENT. CURRENT INTERIOR SECTOR BOUNDARIES ARE BASED ON EXISTING CONDITIONS AS OF FEBRUARY 2011.
4. SECTOR A THROUGH J WILL BE UTILIZED FOR MUNICIPAL SOLID WASTE PLACEMENT. SECTOR K WILL BE UTILIZED FOR CONTINUED MSW/ASBESTOS PLACEMENT DURING SITE DEVELOPMENT.

## LEGEND

- BUILDING/STRUCTURE
- 4025 — 5-FOOT ELEVATION CONTOURS
- 4022 — 1-FOOT ELEVATION CONTOURS
- CHAIN LINK OR OTHER FENCE
- FACILITY/PROPERTY BOUNDARY
- SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- LANDFILL ACCESS ROAD
- A — SECTOR DENOMINATION AND FILL DIRECTION
- LEACHATE SUMP AND EXTRACTION PIPE

GRAPHIC SCALE
1"=250'-0"
250 0 250 500
Scale Feet

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STATE OF TEXAS
CAMI VAN ABEL
113723
REGISTERED PROFESSIONAL ENGINEER
3/15/13

| DESIGNED | DRAWN | VERIFY SCALE |
|---|---|---|
| TLK | CAD | BAR IS ONE INCH ON ANSI "D" DRAWING (0 — 1") |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 3 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

THE CITY OF EL PASO TEXAS

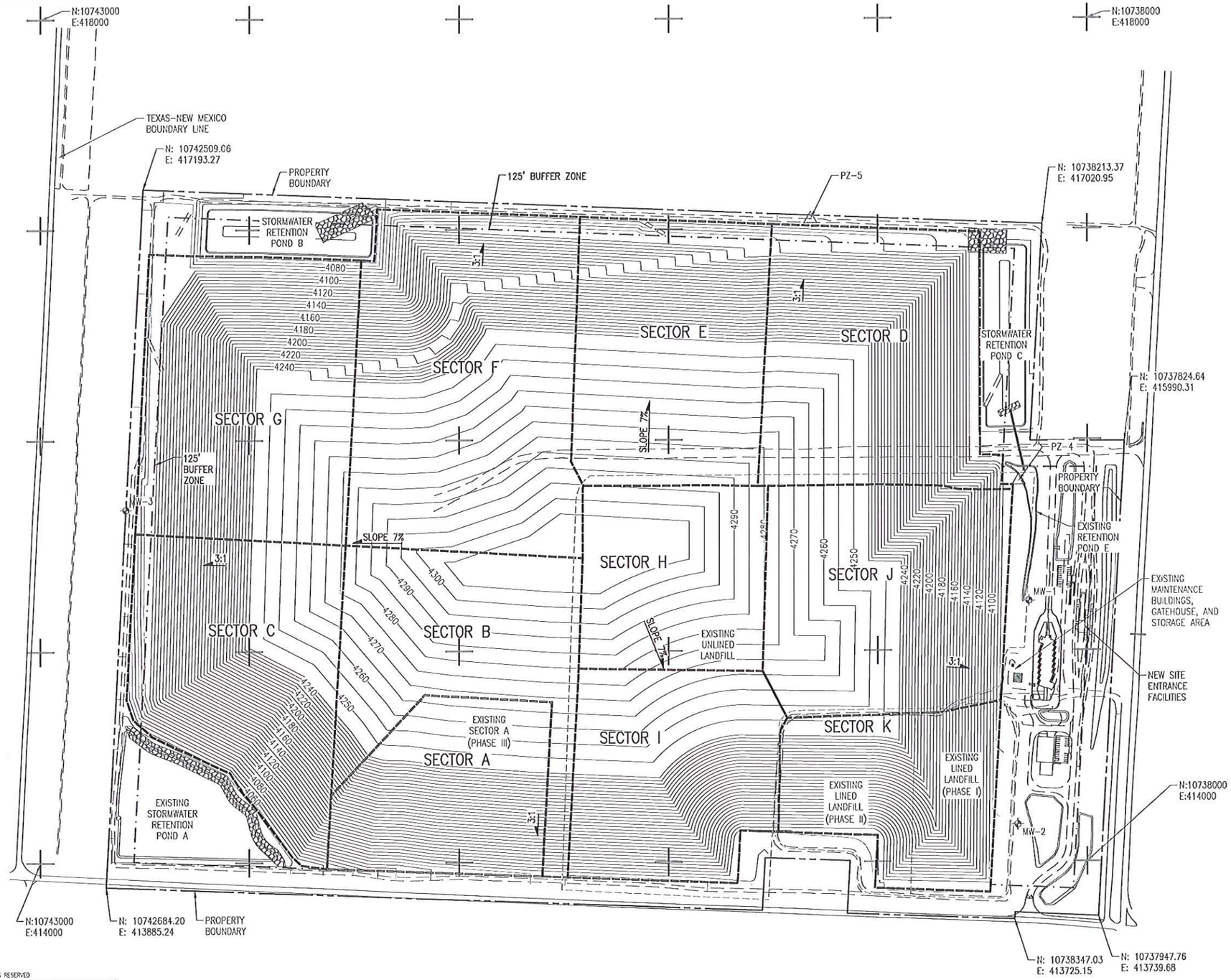
SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve
Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

LANDFILL EXCAVATION PLAN

PROJECT NUMBER: 9631500115
SHT. 48 OF: 78
DRAWING NUMBER: P3-15

Rob, Jacob S. 3/13/2013 10:46:24 AM - R:\00216000 El Paso TX\9631500115 - McCombs\Data Analysis\CAD\P3-15 LANDFILL EXCAVATION PLAN.dwg




## NOTES

1. DESIGN CONTOURS SHOWN REPRESENT TOP OF FINAL CONTOURS. CONTOUR INTERVAL IS FIVE FEET. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM.
2. DIGITIZED TOPOGRAPHY FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS. CONTOUR INTERVAL IS TWO FEET.
3. COORDINATES ARE BASED ON THE TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NAD 83. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM. NAVD 88 DATUM TO NGVD 29 DATUM, SUBTRACT 1.99-FEET. NGVD 29 DATUM TO CITY OF EL PASO DATUM, ADD 27.65-FEET.

## LEGEND

- MW-3 — MONITORING WELL
- △ — PIEZOMETER
- BUILDING/STRUCTURE
- RIPRAP
- 4250 — ELEVATION CONTOURS
- FACILITY/PROPERTY BOUNDARY
- 125' BUFFER ZONE
- FUTURE SECTOR BOUNDARIES
- EXISTING SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- LANDFILL ACCESS ROAD

GRAPHIC SCALE
1"=250'-0"
250 0 250 500
Scale Feet

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CAVI VAN ABEL
113723
REGISTERED PROFESSIONAL ENGINEER
STATE OF TEXAS
6/3/13

| | |
|---|---|
| DESIGNED | TLK |
| DRAWN | CAD |
| VERIFY SCALE | BAR IS ONE INCH ON ANSI "D" DRAWING |
| 0 | 1" |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 3 | 6/3/13 | JSR | CAV | FOURTH TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

THE CITY OF EL PASO TEXAS

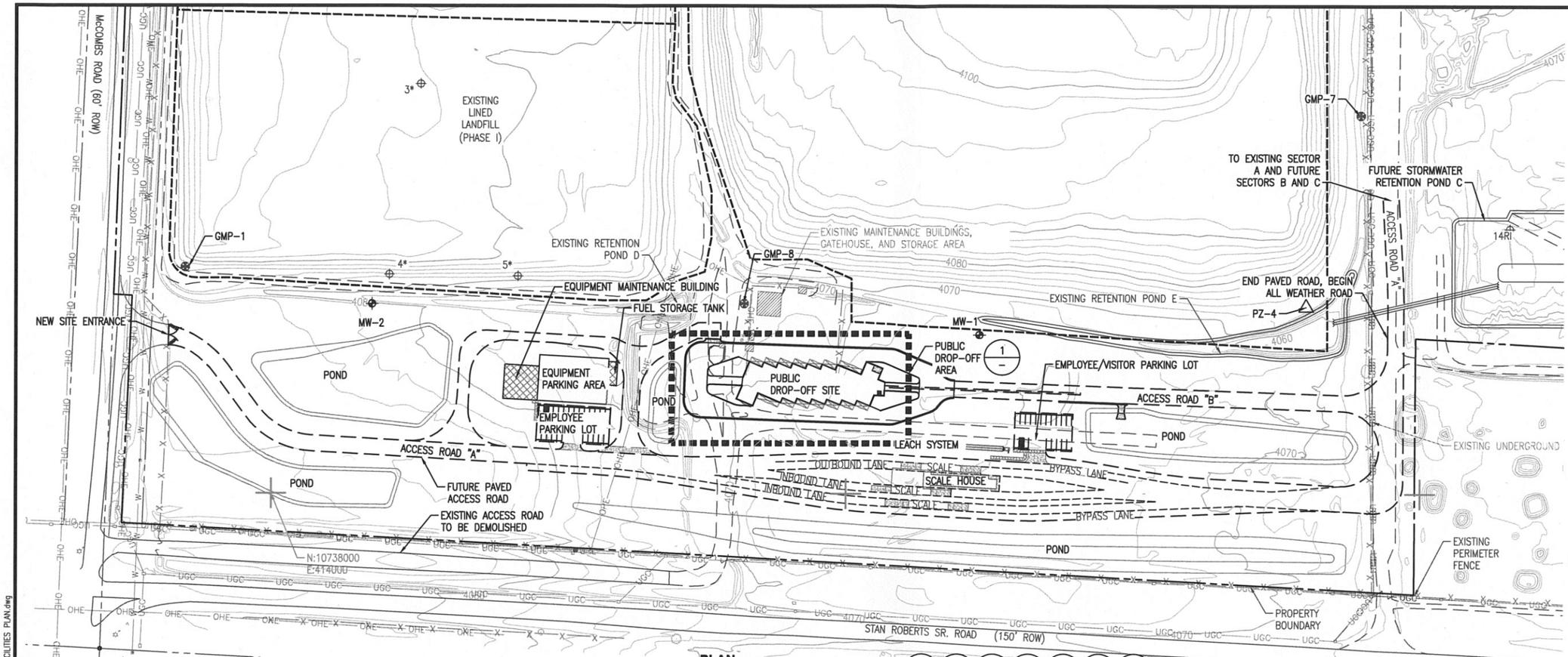
SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve
Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

LANDFILL COMPLETION PLAN

PROJECT NUMBER: 9631500115
SHT. 49 OF: 78
DRAWING NUMBER: P3-16

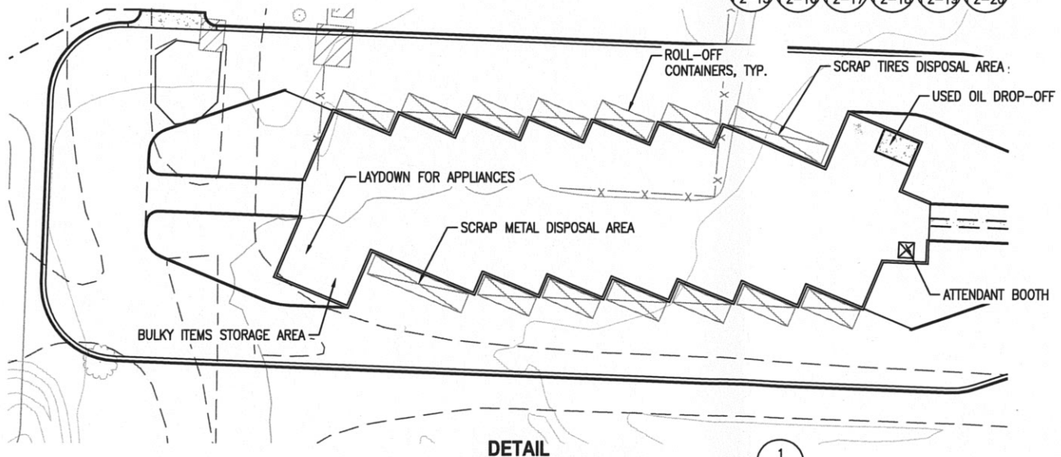
Rev. Jacob S. 5/30/2013 4:39:09 PM - R:\00218000 El Paso TX\9631500115 - McCombs\Data Analysis\Civil\CADD\P3-16 LANDFILL COMPLETION PLAN.dwg




## PLAN

ENTRANCE ROAD AND ENTRANCE FACILITIES
SCALE: 1" = 100'

A P2-8 A P2-9 A P2-10 A P2-11 A P2-12 A P2-13 A P2-14
A P2-15 A P2-16 A P2-17 A P2-18 A P2-19 A P2-20




## DETAIL

1

PUBLIC DROP OFF AREA
SCALE: 1" = 30'

## NOTES

1. NEW FACILITIES AND ENTRANCE ROAD DESIGN COMPLETED BY MORENO CARDENAS, DECEMBER 2010.
2. DIGITIZED TOPOGRAPHY FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS.
3. COORDINATES ARE BASED ON THE TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NAD 83. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM. NAVD 88 DATUM TO NGVD 29 DATUM, SUBTRACT 1.99-FEET. NGVD 29 DATUM TO CITY OF EL PASO DATUM, ADD 27.65-FEET.
4. EXISTING CONTOUR INTERVAL IS TWO FEET.
5. SITE TOPOGRAPHY MAY VARY DUE TO OWNER'S OPERATIONS.

## LEGEND

| | |
|---|---|
| MW-3 | MONITORING WELL |
| GMP-8 | GAS MONITORING PROBE |
| △ | PIEZOMETER |
| 1*, 1RI, 1 | SOIL BORING, TYPICAL |
| | BUILDING/STRUCTURE |
| 4060 | ELEVATION CONTOURS |
| X X X | CHAIN LINK OR OTHER FENCE |
| UGE | UNDERGROUND ELECTRIC |
| OHE | OVERHEAD ELECTRIC UTILITY |
| UGC | UNDERGROUND COMMUNICATIONS |
| | FACILITY/PROPERTY BOUNDARY |
| | SECTOR BOUNDARIES |
| | STORMWATER RETENTION POND BOUNDARY |
| W W | WATER LINE |
| | HIGHWAY |
| | EXISTING LANDFILL ACCESS ROAD |
| | FUTURE LANDFILL ACCESS ROAD |
| | SECTION LINE |

GRAPHIC SCALE

1"=30'-0" 30 0 30 60 Scale Feet

1"=100'-0" 100 0 100 200 Scale Feet

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STATE OF TEXAS
FREDRIC J. DORAN
111226
REGISTERED
PROFESSIONAL ENGINEER
11/2/12

| | |
|---|---|
| DESIGNED | TLK |
| DRAWN | CAD |
| VERIFY SCALE | BAR IS ONE INCH ON ANSI "D" DRAWING 0 1" |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

ENTRANCE ROAD AND ENTRANCE FACILITIES PLAN

PROJECT NUMBER: 9631500115
SHT. 50 OF: 78
DRAWING NUMBER: P3-17

Koller, Tonya L. 10/18/2012 3:10:38 PM - P:\0021800 el paso tx\9631500115\data analytical\CADD\P3-17 ENTRANCE ROAD AND ENTRANCE FACILITIES PLAN.dwg

## DRAINAGE AREA RUNOFF COMPUTATIONS

| DRAINAGE AREA NO (1) | DRAINAGE AREA (AC) (2) | DESIGN STORM INTENSITY (3) | TIME OF CONCENTRATION (4) | A1 PAVEMENT (5) | A2 DIRT (6) | C1 PAVEMENT (7) | C2 DIRT (8) | RUNOFF COEFF (CW) (9) | $Q_{100}$ (CFS) (10) |
|---|---|---|---|---|---|---|---|---|---|
| DA-1 | 2.50 | 4.13 | 10 | 0.16 | 2.34 | 0.95 | 0.33 | 0.37 | 3.8 |
| DA-2 | 2.86 | 4.13 | 10 | 0.19 | 2.67 | 0.95 | 0.33 | 0.37 | 4.4 |
| DA-3 | 8.87 | 4.13 | 10 | 1.11 | 7.76 | 0.95 | 0.33 | 0.40 | 14.9 |
| DA-4 | 1.35 | 4.13 | 10 | 0.11 | 1.24 | 0.95 | 0.33 | 0.38 | 2.1 |
| DA-5 | 1.37 | 4.13 | 10 | 0.42 | 0.95 | 0.95 | 0.33 | 0.50 | 2.9 |
| DA-6 | 4.21 | 4.13 | 10 | 2.55 | 1.66 | 0.95 | 0.33 | 0.68 | 12.3 |

REFERENCE: CITY OF EL PASO DRAINAGE DESIGN MANUAL (JUNE 2008)

(1) WATERSHED AREA IDENTIFICATION
(2) AREA FROM DRAINAGE PLAN
(3) RAINFALL INTENSITY CENTRAL REGION INTENSITY EQUATION 4-7 $i_{100} = \frac{111.04}{(Tc + 26.09)^{0.9177}}$
(4) TIME OF CONCENTRATION: TC = 10 MINUTES (MIN)
(5) PAVED AREA (AC)
(6) DIRT AREA (AC)
(7,8) RUNOFF COEFFICIENT => PAVEMENT C=0.95, DIRT C=0.33 100 YEAR TABLE 4-5
(9) RUNOFF WEIGHTED COEFFICIENT
(10) $Q_{100} = C \times A \times I$

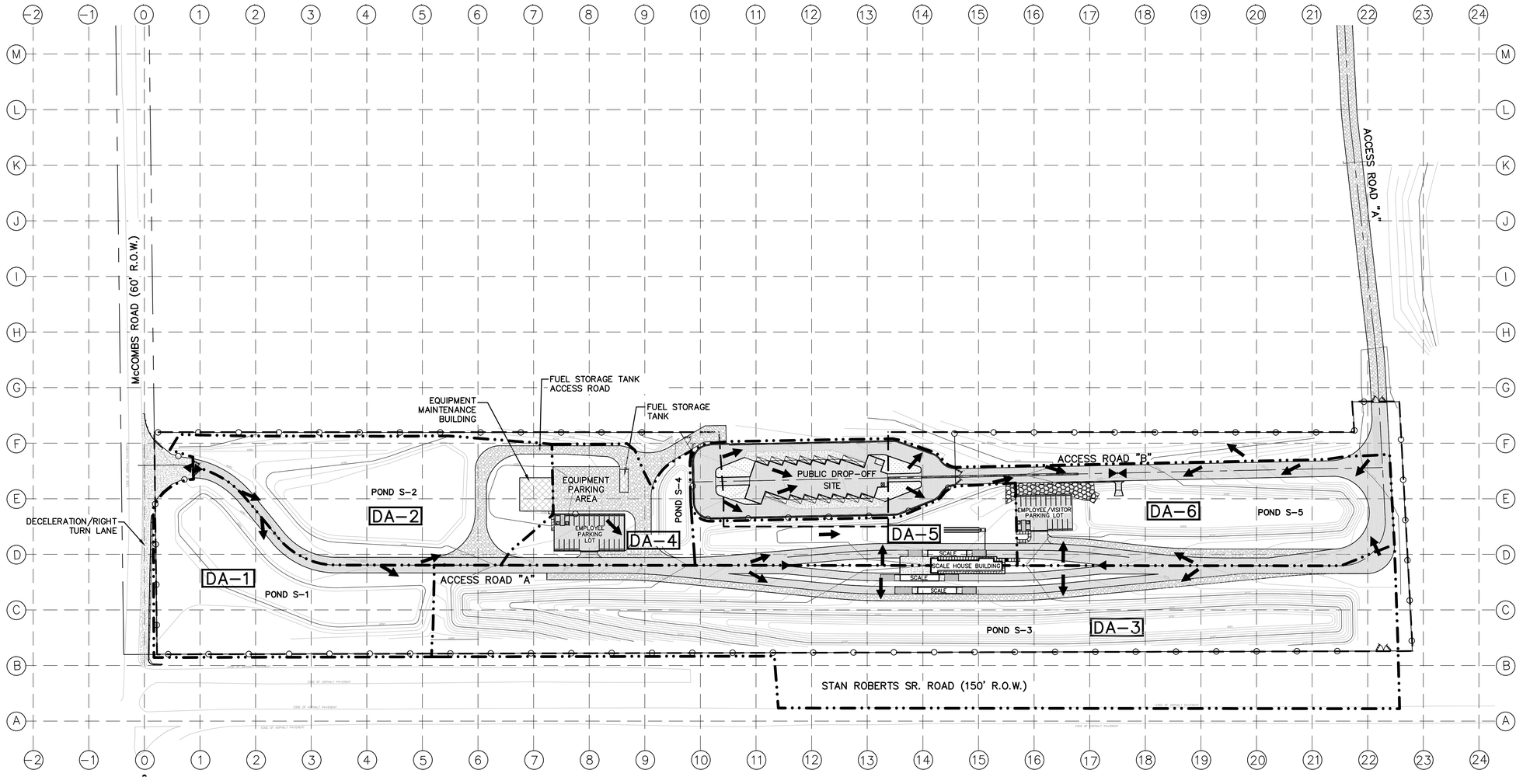
## RETENTION POND COMPUTATIONS

| POND ID (1) | DRAINAGE AREA ID (2) | AREA (ACRES) (3) | CW COEFFICIENT (4) | $R_{100}$ (5) | 100-YR RUNOFF VOL (AC-FT) (6) | AVAILABLE CAPACITY (AC-FT) (7) | HIGH WATER SURFACE ELEVATION (8) | BOTTOM ELEVATION (FT) (9) | TOP ELEVATION (FT) (10) |
|---|---|---|---|---|---|---|---|---|---|
| POND S-1 | DA-1 | 2.50 | 0.37 | 4.00 | 0.31 | 0.75 | 4079.41 | 4079 | 4080 |
| POND S-2 | DA-2 | 2.86 | 0.37 | 4.00 | 0.35 | 0.93 | 4078.37 | 4078 | 4079 |
| POND S-3 | DA-3 | 8.87 | 0.41 | 4.00 | 1.21 | 5.25 | 4062.13 | 4061 | 4066 |
| POND S-4 | DA-4 | 1.35 | 0.38 | 4.00 | 0.17 | 0.25 | 4073.36 | 4072 | 4074 |
| POND S-5 | DA-5,6 | 5.58 | 0.66 | 4.00 | 1.23 | 1.32 | 4067.43 | 4066 | 4068 |

REFERENCE: CITY OF EL PASO DRAINAGE DESIGN MANUAL (JUNE 2008)

(1) PONDONG AREA IDENTIFICATION
(2) WATERSHED IDENTIFICATION
(3) WATERSHED AREA
(4) RUNOFF WEIGHTED COEFFICIENT
(5) $R_{100}$ = 4-INCHES (STANDARD 2-1)
(6) $QT_{100}$ = ARC/12 (STANDARD 2-1)
(7) PONDING AREA CAPACITY
(8) PONDING AREA 100 YEAR WATER SURFACE ELEVATION
(9) PONDING AREA BOTTOM ELEVATION
(10) PONDING AREA TOP ELEVATION

GRAPHIC SCALE
0 50 100




**FILE No. 238341**

| No. | DATE | REVISION REMARKS | BY |
|---|---|---|---|


Moreno Cardenas Inc.
consulting engineers
2505 E. Missouri Ave.
El Paso, Texas 79903
915-533-3998
Fax 915-542-0307
Planning
Engineering
Project Management
Texas Board of Professional Engineers Registration No. F-000654


ENGINEER'S SEAL

MARVIN HENRY GOMEZ 86920 LICENSED PROFESSIONAL ENGINEER

ENGINEER'S NOTE

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SCALE
HORIZ. 1"=100'
VERT. N/A.
DATE: 01-31-11
DESIGN BY: G.S./B.O.
DRAWN BY: A.A.
CHECKED BY: M.G.
APPROVED BY: M.M.
JOB No.: 10-121

PROJECT NAME
**McCOMBS LANDFILL MSW-729AB**
**CELL (SECTOR) "B"**
**CONSTRUCTION & SITE DEVELOPMENT IMPROVEMENTS**

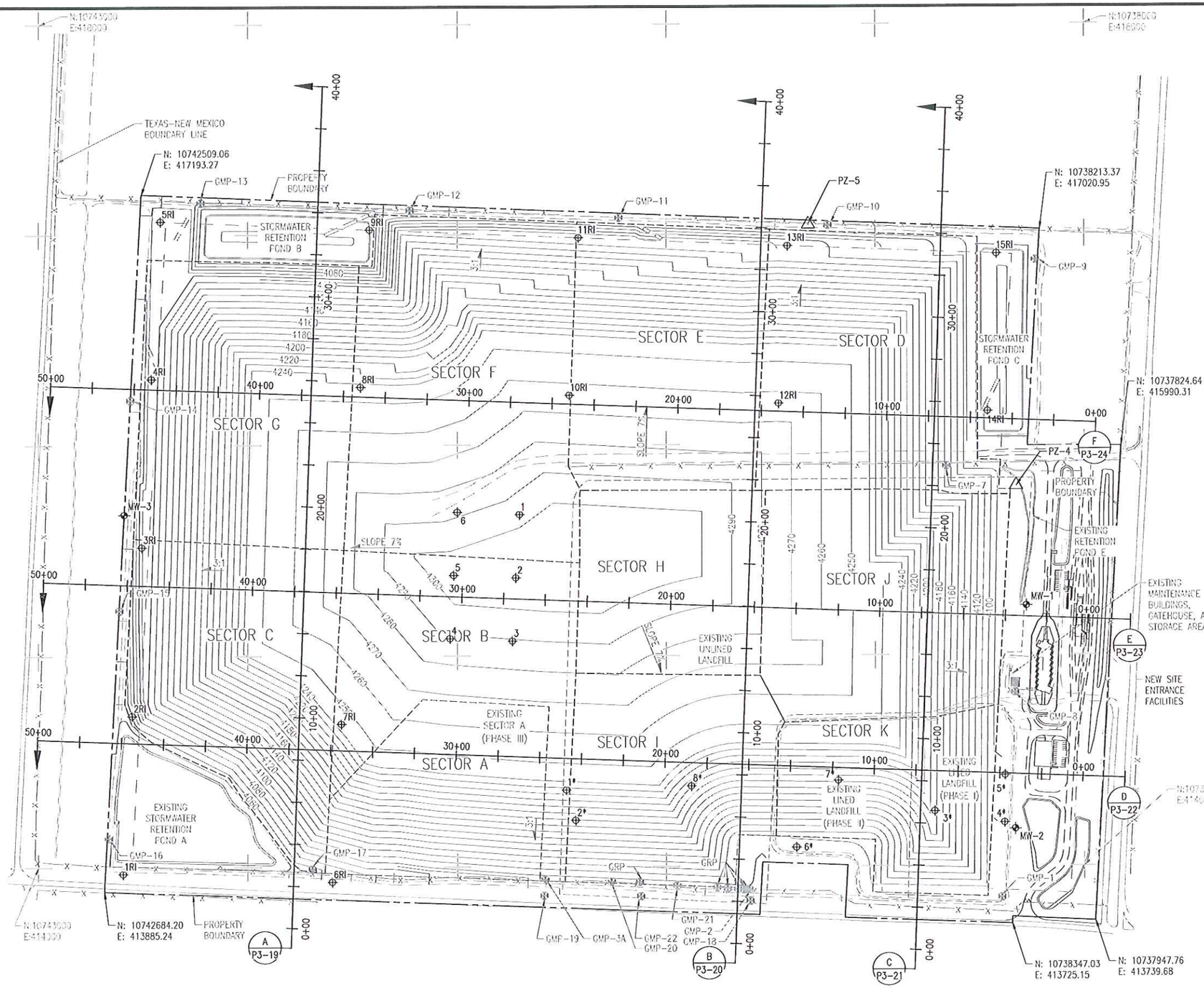
CITY OF EL PASO
#2 CIVIC CENTER PLAZA PH. (915) 541-4200

SHEET TITLE
SITE IMPROVEMENTS LAYOUT AND DRAINAGE PLAN

SHEET
C13
13 OF 78

# Appendix 3F
# Landfill Cross Sections

SAIC®




## NOTES

1. CONTOURS PROVIDED WITHIN LANDFILL BOUNDARY REPRESENT TOP OF FINAL CONTOURS. CONTOUR INTERVAL IS TEN FEET
2. DIGITIZED TOPOGRAPHY FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS. EXISTING CONTOUR INTERVAL IS TWO FEET.
3. COORDINATES ARE BASED ON THE TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NAD 83. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM. NAVD 88 DATUM TO NGVD 29 DATUM, SUBTRACT 1.99-FEET. NGVD 29 DATUM TO CITY OF EL PASO DATUM, ADD 27.65-FEET

## LEGEND

| | |
|---|---|
| 1* | BORING LOCATION AND NUMBER PER DRA CONSULTANTS (MAY 1983) |
| 1RI | BORING LOCATION AND NUMBER PER DRA CONSULTANTS (NOVEMBER 1983) |
| 1 | BORING LOCATION AND NUMBER PER DICKINSON LABORATORIES (JUNE 1976) |
| MW-3 | MONITORING WELL |
| GMP-8 | GAS MONITORING PROBE |
| GRP | GAS RECOVERY PROBE |
| △ | PIEZOMETER |
| | BUILDING/STRUCTURE |
| 4100 | ELEVATION CONTOURS |
| -x-x-x- | CHAIN LINK OR OTHER FENCE |
| | FACILITY/PROPERTY BOUNDARY |
| | SECTOR BOUNDARIES |
| | STORMWATER RETENTION POND BOUNDARY |
| | HIGHWAY |
| | LANDFILL ACCESS ROAD |

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Cami Van Abel 6/3/13
STATE OF TEXAS
CAMI VAN ABEL
113723
REGISTERED PROFESSIONAL ENGINEER

| | |
|---|---|
| DESIGNED | TLK |
| DRAWN | CAD |
| VERIFY SCALE | BAR IS ONE INCH ON ANSI "D" DRAWING |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 4 | 6/3/13 | JSR | CAV | FOURTH TECHNICAL NOD |
| 3 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

THE CITY OF EL PASO TEXAS

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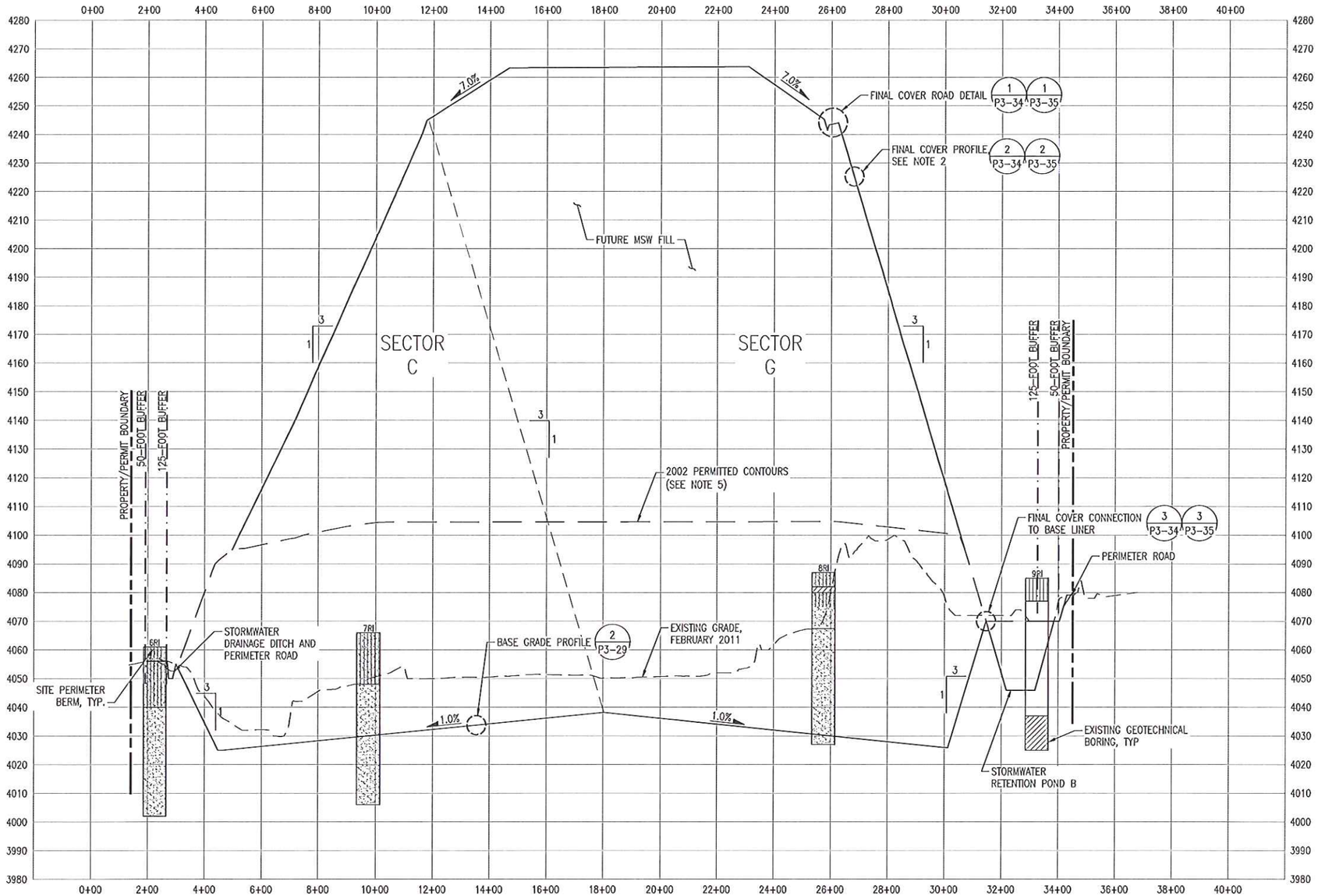
SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve
Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

SECTION LAYOUT PLAN

PROJECT NUMBER: 9631500115
SHT. 51 OF: 78
DRAWING NUMBER: P3-18

Rod. Jacob S. 5/30/2013 4:39:23 PM - R:\00216000 El Paso TX\9631500115 - McCombs\Data Archylical\CADD\P3-18 SECTION LAYOUT PLAN.dwg



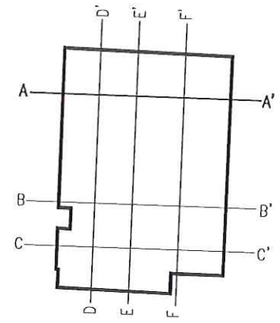

## SECTION

A P3-18 A P3-26

TYPICAL LANDFILL
VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 200'

## NOTES

1. EXISTING GRADE FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS.
2. ACTUAL WASTE ELEVATIONS WILL BE DEPENDENT ON THE FINAL COVER PROFILE UTILIZED (I.E., PRESCRIPTIVE OR ALTERNATIVE FINAL COVER), BUT WILL GENERALLY BE 40 OR 48-INCHES LOWER THAN THE FINAL CONTOUR ELEVATIONS (REFER TO DETAILS).
3. TYPICAL GAS WELL LOCATIONS AND CROSS SECTIONS ARE PROVIDED ON P3-39 THROUGH P3-44 IN APPENDIX 3M, ATTACHMENT 3.
4. REFER TO DRAWING P3-37 FOR APPROXIMATE GROUND WATER ELEVATIONS (LOCATED APPROXIMATELY 340-FEET BELOW LANDFILL BASE).
5. PREVIOUSLY APPROVED PERMITTED CONTOURS SUBMITTED TO THE TNRCC BY MORENO CARDENAS FOR THE 2002 APPLICATION FOR PERMIT AMENDMENT NO. 729A.




## KEY MAP

SCALE: NTS

## LEGEND

- ⊕1* – BORING LOCATION AND NUMBER PER DRA CONSULTANTS (MAY 1983)
- ⊕1RI – BORING LOCATION AND NUMBER PER DRA CONSULTANTS (NOVEMBER 1983)
- ⊕1 – BORING LOCATION AND NUMBER PER DICKINSON LABORATORIES (JUNE 1976)

SAND
SILTY SAND
CLAYEY SAND
SILT

GRAPHIC SCALES

1"=20'-0" 20 0 20 40 Scale Feet

1"=200'-0" 200 0 200 400 Scale Feet

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CAMI VAN ABEL 113723 REGISTERED PROFESSIONAL ENGINEER TEXAS 6/3/13

| DESIGNED | DRAWN | VERIFY SCALE |
|---|---|---|
| TLK | CAD | BAR IS ONE INCH ON ANSI "D" DRAWING 0 1" |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 4 | 6/3/13 | JSR | CAV | FOURTH TECHNICAL NOD |
| 3 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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TYPICAL LANDFILL SECTION A

PROJECT NUMBER 9631500115
SHT. 52 OF: 78
DRAWING NUMBER: P3-19

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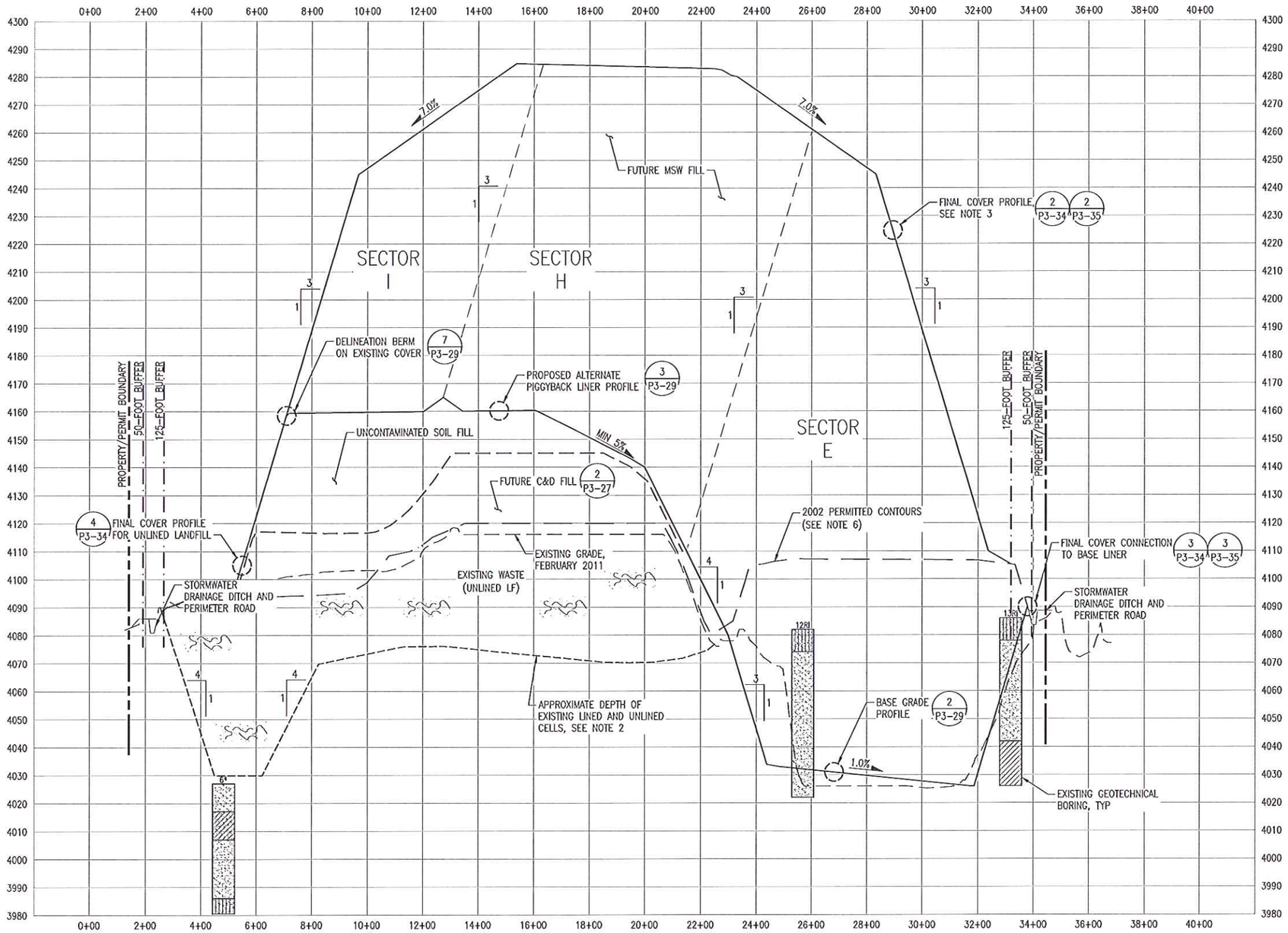


## SECTION

B P3-18 — B P3-26

TYPICAL LANDFILL
VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 200'

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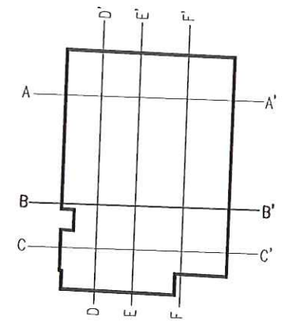


## KEY MAP

SCALE: NTS

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CLAYEY SAND
SILT

GRAPHIC SCALES

1"=20'-0" — 20 0 20 40 — Scale Feet

1"=200'-0" — 200 0 200 400 — Scale Feet

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DRAWING NUMBER: P3-20

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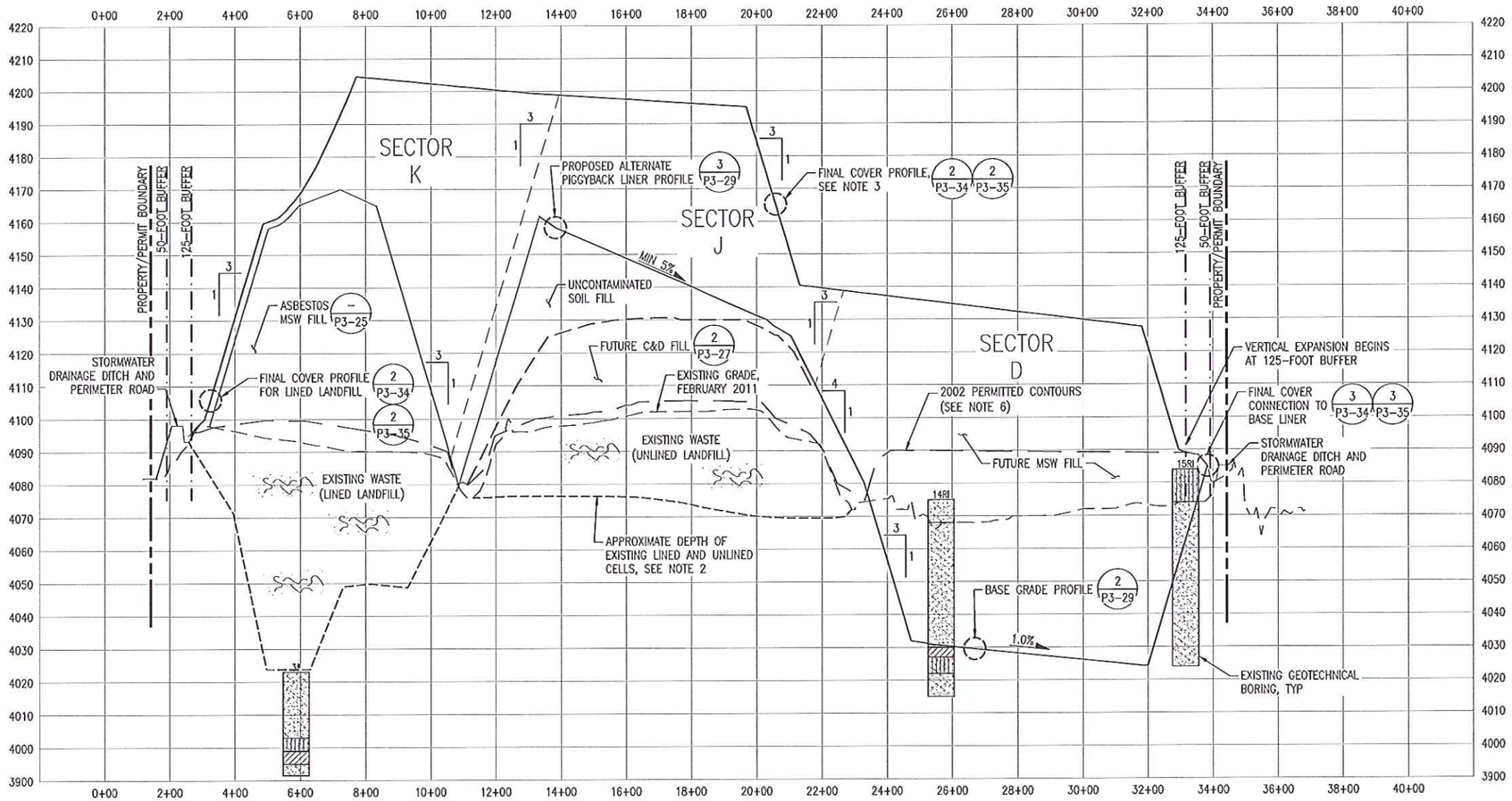


## SECTION

TYPICAL LANDFILL
VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 200'

C P3-18 C P3-26

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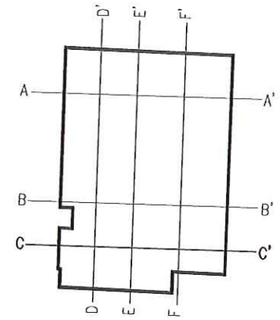


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TYPICAL LANDFILL SECTION C

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SHT. 54 OF: 78
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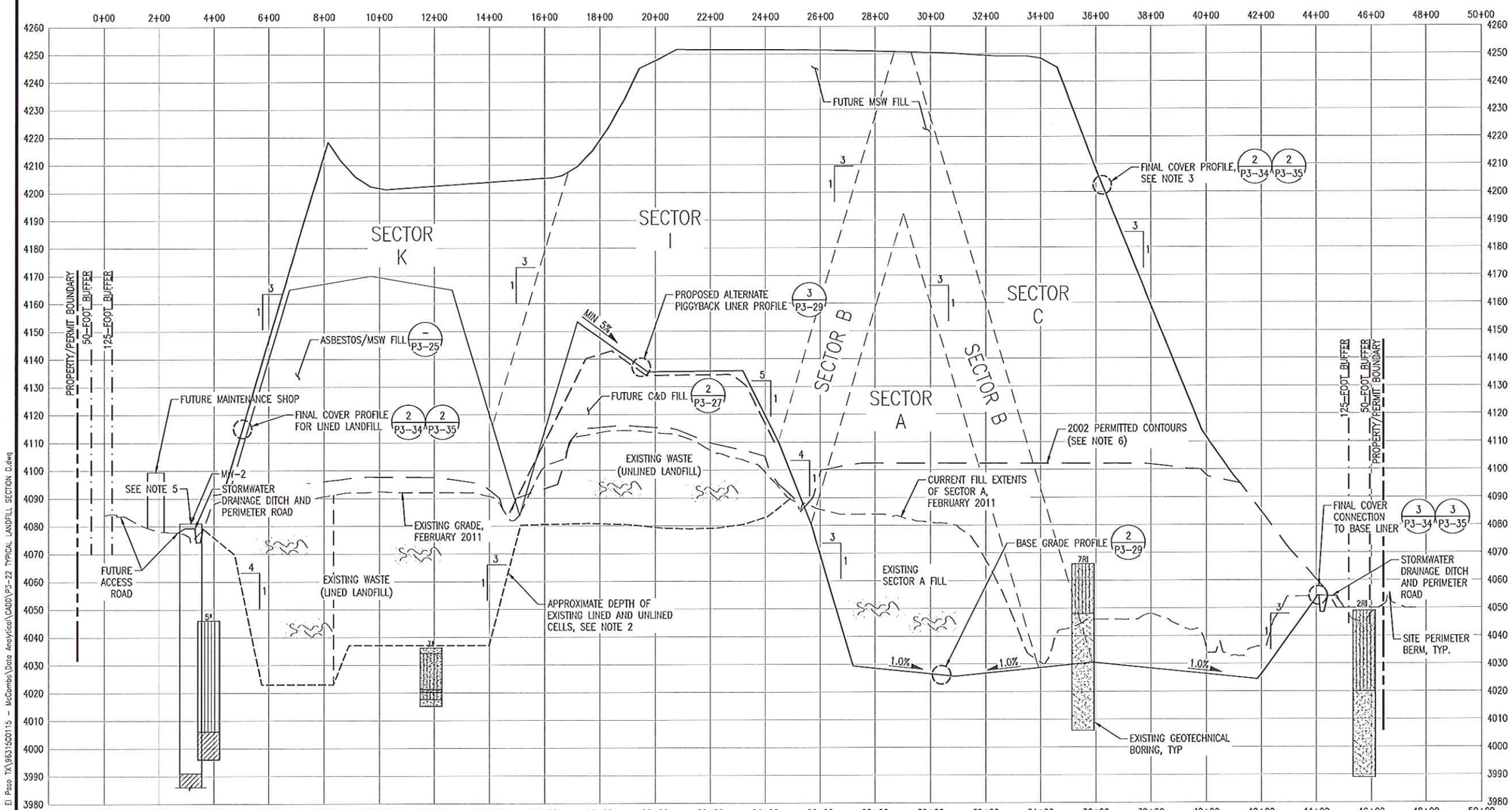


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TYPICAL LANDFILL
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D P3-18 D P3-26

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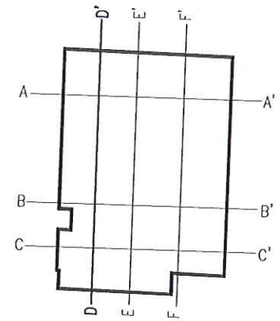


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TYPICAL LANDFILL SECTION D

PROJECT NUMBER: 9631500115
SHT. 55 OF: 78
DRAWING NUMBER: P3-22

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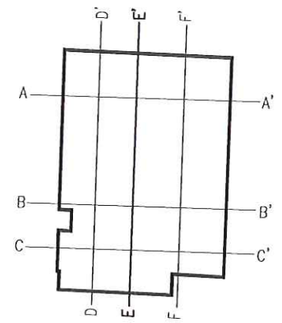


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## SECTION

TYPICAL LANDFILL
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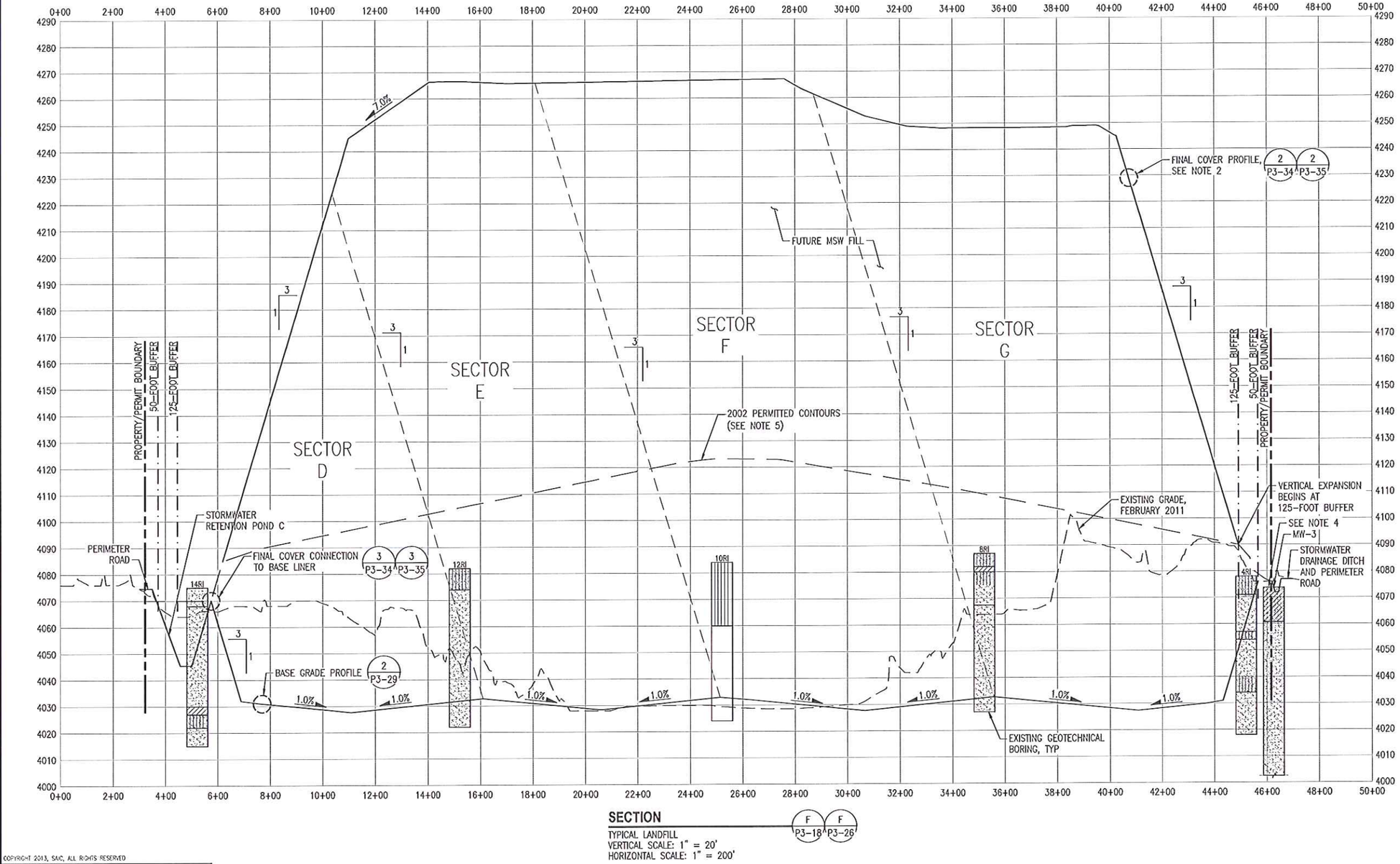


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F P3-18 F P3-26

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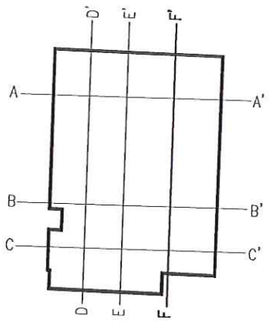


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TYPICAL LANDFILL SECTION F

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# Appendix 3G
# Construction Design Details

SAIC®

# McCombs Municipal Landfill
# El Paso County, Texas
# TCEQ MSW Permit No. 729B

# Part III
# Appendix 3G
# Construction Design Details

Prepared for

**City of El Paso**

Updated June 2013, Revision 4

Cami VanAbel
6/3/13

Prepared by

**SAIC**
5806 Mesa Drive, Suite 310 ♦ Austin, Texas 78731 ♦ 512.450.0991

Texas Board of Professional Engineers
Firm Registration No. 3823

# Part III

# Appendix 3G – Construction Design Details

## City of El Paso

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113723
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7/17/13

Appendix 3G, Attachment 1
AET Report June 1, 2011

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# Memorandum

SAIC

To: City of El Paso

From: Fred J. Doran, P.E., SAIC

Subject: AET Report of Waste Mass Stability

Date: November 22, 2011

Attached is a copy of the Report of Waste Mass Stability prepared by American Engineering Testing, Inc. (AET), dated June 1, 2011. The report was developed to:

- Estimate compression of the waste within the existing landfill due to construction of the vertical expansion;
- Recommend geosynthetic reinforcement requirements to be incorporated into the cover design at the base of the vertical landfill construction; and
- Perform waste mass stability analyses of the new landfill construction.

It should be noted that when determining the settlement of the existing waste, AET estimated that the age of the existing in place waste was 8 years old. This number was used as the last waste placed within the area was approximately 8 years ago. This assumption of the waste age is very conservative, as a large portion of the waste would be older than 8 years, and therefore will have gone through more settlement prior to placement of the new waste. Additionally, AET assumed that the C&D waste placed prior to MSW was all new waste, and did not consider the C&D as a surcharge in their analyses. This is also a conservative way to do the analyses. Using the two above conservative assumptions, AET estimated that the existing waste would settle anywhere from 5.5 – 17.6 feet (Appendix B of the AET report).

Based on AET's findings, they recommend using two layers of uniaxial geogrid placed perpendicular to each other for the geosynthetic reinforcement on top of the existing waste mass. The suggested product is a Fortrac 80MP (see attached for a specification sheet). Additionally, AET recommends a minimum of 6 inches of sand to underlay the geogrid.

For the waste mass stability, AET "anticipates that the planned landfill configuration should be stable, provided that no excess pore pressures are generated within the waste or that there is no increase in piezometric head above 1 foot within the underlying sand liner cover."

TLK

STATE OF TEXAS
FREDRIC J. DORAN
111226
LICENSED
PROFESSIONAL ENGINEER
8/5/2012



SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI

HUESKER
Engineering with Geosynthetics

# Fortrac® 80MP

Huesker's Fortrac 80MP geogrid is comprised of high tenacity polyvinyl alcohol (PVA) yarns crafted into a stable interlocked pattern then coated for protection from installation damage and short term ultraviolet exposure. Fortrac geogrids are easy to install, unaffected by freeze-thaw conditions and naturally occurring chemical/biological environments. Fortrac is utilized as a tensile element in retaining wall, steepened slope and void bridging applications. Fortrac geogrids are produced at Huesker's manufacturing facility which has achieved ISO 9001 approval for its systematic approach to quality in development, manufacture, inspection, sales and application support for geosynthetic materials. Huesker's ISO 9001 certificate is available upon request.

## Physical Properties of Fortrac 80MP

| PROPERTY | TEST METHOD | ENGLISH units[1] | SI units[1] |
|---|---|---|---|
| **Mass/Unit Area** | ASTM D-5261 | 11 oz/yd$^2$ | 375 g/m$^2$ |
| **Aperture Size** | Measured | 0.8 x 1.2 inch | 20 x 30 mm |
| **Percent Open Area** | CWO 22125 | 70 % | 70 % |
| **Wide Width Tensile Strength (MD)** | | | |
| Machine Direction @ Ultimate | ASTM D-6637 | 5480 lb/ft | 80 kN/m |
| **Elongation at Break** | ASTM D-6637 | 4 - 6 % | 4 - 6 % |
| **Creep Limited Strength** (100 Year) | | | |
| @ 2% Total Strain | ASTM D-6992 | 1150 lb/ft | 16.8 kN/m |
| @ 5% Total Strain | ASTM D-6992 | 3616 lb/ft | 52.8 kN/m |
| **Allowable Design Strength @ 5%** | GRI GG4 | 3389 lb/ft | 49.5 kN/m |
| **pH Resistance Range** | ASTM D-5819 | 2 - 13 | 2 - 13 |

[1] MARV - Minimum Average Roll Values are based on a 95% confidence level.

Standard Roll Size: 12.14 ft (3.7 m) wide x 328.1 ft (100 m) long = 443 yds$^2$ (370 m$^2$)
Standard Roll Weight: 305 lbs (138 kg)

Each roll of Fortrac geogrid delivered to the project site is labeled by Huesker® with a roll label that indicates manufacturer's name, product identification, lot number, roll number and roll dimensions. All rolls of Fortrac are encased in a sturdy polyethylene wrap to shield the product from rain, dirt, dust and UV exposure. Contact Huesker for information on our material warranty.

P.O. Box 411529, Charlotte, NC 28241-1529 • (800) 942-9418 • FAX (704) 588-5988
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- MATERIALS
- FORENSICS

# REPORT OF
# WASTE MASS STABILITY

McCombs Landfill Expansion
El Paso, Texas

AET Project No. 01-05106

**Date:**

June 1, 2011

**Prepared for:**

SAIC Energy, Environmental & Infrastructure, LLC
1380 Corporate Center Curve, Suite 305
St. Paul, MN 55121

www.amengtest.com

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June 1, 2011

SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve, Suite 305
St. Paul, MN 55121

Attn: Mr. Fred Doran, PE

RE: Report of Waste Mass Stability
McCombs Landfill Expansion
El Paso, Texas
Report No. 01-05106

Dear Mr. Doran:

This report presents the results of our geotechnical review for the referenced project. We are submitting an electronic copy and three hard copies of the report to you.

We appreciate the opportunity to be of assistance to you on this project. Please contact me if you have any questions about the report.

Sincerely,

**American Engineering Testing, Inc.**

Gregory R. Reuter, PE
Principal Engineer – Geotechnical Division
Phone: (651) 789-4660
Fax: (651) 659-1347
greuter@amengtest.com



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## SIGNATURE PAGE

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**AMERICAN ENGINEERING TESTING, INC.**
**TEXAS REGISTERED ENGINEERING FIRM F-10340**

Reviewed by:

James C. Rudd, PE
Principal Engineer/Vice President

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## 1.0 INTRODUCTION

This report presents the results of our geotechnical review concerning waste mass stability, settlement predictions, and reinforcement recommendations for the landfill expansion of the McCombs Landfill near El Paso, Texas.

## 2.0 SCOPE OF SERVICES

AET's services were performed according to your Purchase Order Number P500115201, dated May 12, 2011. The authorized scope consists of the following:

- Estimate compression of the waste within the existing landfill due to construction of the new vertical expansion.
- Recommend geosynthetic reinforcement requirements to be incorporated into the cover design at the base of the vertical landfill construction
- Perform waste mass stability analyses of the new landfill construction.

## 3.0 PROJECT INFORMATION

The McCombs Landfill is planning to expand the existing municipal solid waste (MSW) landfill. The existing landfill has not received any new MSW since 2003. The landfill expansion will have dimensions of approximately 4,200 feet (north-south) and 2,900 feet (east-west). The new waste will be piggybacked onto the existing MSW refuse. Prior to receiving the MSW refuse, an approximately 25-foot to 55-foot thickness of construction and demolition (C&D) debris will be placed over the existing MSW waste. The maximum final landfill height will be about 270 feet above the proposed subgrade elevation, with a maximum thickness of new MSW/new C&D refuse above the existing MSW refuse on the order of 190 feet. The final landfill side slopes will be at a maximum of 3(H):1(V).

Project information for the specific analyses we performed are presented in the following sections. The stated information represents our understanding of the proposed construction. This information is an integral part of our engineering review. It is important that you contact us if there are changes from that described so that we can evaluate whether modifications to our recommendations are appropriate.

## 4.0 VERTICAL LANDFILL EXPANSION

### 4.1 Settlement of Existing Waste

According to conventional consolidation theory, the area-wide compression settlement of municipal solid waste (MSW) when subjected to the weight of the vertical expansion can be the total of two components: primary settlement and secondary settlement. No specific testing was authorized to evaluate the necessary settlement properties of the waste, therefore the following parameters, based on published information (1)(2), were assumed for our calculations.

- Unit weight of new waste = 65 pcf
- Unit weight of existing waste = 65 pcf
- Modified primary compression index, $C_c$', of existing waste = 0.17 to 0.36
- Modified secondary compression index, $C_\alpha$', of existing waste = 0.03 to 0.10
- Age of existing waste = 8 years
- Ending time of secondary settlement = 58 years

For our analyses, we used procedures described in (1), and we also used the geometry from the cross-sections presented on the following SAIC drawings:

- Drawing Number P3-22.0, Typical Landfill Section B, dated 4/13/2011.
- Drawing Number P3-25.0, Typical Landfill Section E, dated 4/13/2011.

Copies of these sections are attached. Our settlement estimates due to the compression of the existing waste from the weight of the new, overlying waste are presented in Tables B-1 and B-2 (Appendix B) for varying primary and secondary compression indices. Please note that this does not include any immediate or consolidation settlement of the foundation soils due to the weight of the overlying landfill material.

Landfill settlements can be minimized by pretreating the landfill wastes. Pretreatment could be performed by deep dynamic compaction (DDC) or by preloading by surcharge. DDC is carried out by dropping a heavy compaction weight repeatedly at each impact location which compresses the waste. It may also be possible to pre-compress (surcharge) the existing waste by temporarily stockpiling soil from the expansion on top of the existing closed landfill, if there is sufficient time and available surcharge soil. In our judgment, this could be effective in reducing some of the anticipated primary settlement, depending on the thickness of the surcharge and duration. If you elect to surcharge this area, we suggest placing settlement instrumentation on top of the existing landfill prior to surcharge fill placement. The settlement instrumentation should then be read periodically to evaluate the effectiveness of the surcharge program.

### 4.2 Reinforcement Design

The planned piggyback liner profile to be constructed over the top of the C&D waste will consist of (from bottom upwards) 36 inches of compacted clay "buffer soil," a 6-inch thickness of compacted clay "interim cover soil," a geogrid stabilization layer, a geosynthetic clay liner (GCL), a 60 mil HDPE geomembrane, and 2 feet of drainage sand. The municipal solid waste (MSW) will be placed directly on the sand layer.

Our design of the geosynthetic reinforcement follows the procedure described in (1), and is

based on the scenario that a void develops, or is located, immediately underneath the liner. The liner is then assumed to bridge over the void, carrying the load from the proposed overlying waste. The "rusted refrigerator" scenario is used, with the design depression having a radius of 3 feet. Other assumptions are listed below and in Tables 4.2-1 and 4.2-2.

- Design life of 50 years
- Maximum height of MSW on the lining system is 190 feet

**TABLE 4.2-1 ASSUMED MATERIAL PROPERTIES**

| Material | Unit Weight (pcf) | Friction Angle (deg.) | Cohesion (psf) |
|---|---|---|---|
| MSW | 65 | 25 | 0 |
| Bedding Sand | 120 | 30 | 0 |

**TABLE 4.2-2 ASSUMED GEOSYNTHETIC PROPERTIES**

| Material | Yield Strain (%) |
|---|---|
| HDPE | 10% |
| GCL | 8% |

Based on our analyses, we recommend that the geosynthetic reinforcement consist of two layers of chemically resistant uniaxial geogrid placed perpendicular to each other. The geogrid should have a minimum design tensile strength of 3500 pounds per foot at an allowable stress of 5%, or less over the 50 year design life. The geogrid should be placed on top of a minimum 6 inch thick bedding layer of free-draining sand placed between the existing clay cap and the new GCL. Based on our conversations with a representative of Huesker (Tel. 1-512-266-3790), a geogrid such as Fortrac® 80MP would be suitable in this application. Please note that the inclusion of geogrid reinforcement is intended to reduce, but not eliminate, the probability of failure.

## 5.0 WASTE MASS STABILITY

### 5.1 Background Information

The liner system for the new expansion will consist of a 6-inch thick layer of compacted native soil covered by a 6-inch thick compacted caliche layer or as an alternative, a geosynthetic clay liner (GCL). A 60 mil HDPE geomembrane will be placed on the GCL, and will be anchored within trenches at the top of the slope. The geomembrane will be textured on both sides. A 2-foot thick sand layer will be placed over the HDPE geomembrane.

We evaluated the deep-seated stability of the waste by performing two-dimensional, effective stress slope stability analyses for the final, closed geometry, using the computer program GSLOPE Version 5.10. This program performs a limit equilibrium analysis for potential mass failure along assumed failure surfaces. For our analyses, we assumed potential failure of the waste material occurring within the waste or along the top of the HDPE liner for the deep-seated failures. Our scope does not included analyzing potential failure of, or through the HDPE liner, through the C&D waste or existing waste, the adequacy of the anchor trench design system, or stability of the underlying soil/GCL, or stability of interim slopes.

For our analyses, we used the geometry from the cross-sections presented on the following SAIC drawings:

- Drawing Number P3-21.0, "Typical Landfill Section A" dated 4/13/2011
- Drawing Number P3-22.0, "Typical Landfill Section B" dated 4/13/2011
- Drawing Number P3-25.0, "Typical Landfill Section E" dated 4/13/2011

Copies of these sections are presented in Appendix A.

### 5.2 Assumed Parameters

No new laboratory testing has been authorized as part of this work. The analyses are to be based on assumed or published strength and interface friction values for the sand and HDPE geomembrane. It is important that our assumed parameters are confirmed by specific testing prior to construction.

Due to the high variability of municipal waste, conventional *in situ* testing or laboratory testing to evaluate the engineering properties of the waste is not practical. Therefore, for our analyses we used published and assumed estimated effective stress values of shear strength, cohesion, and unit weight for municipal solid waste (2)(3). The engineering properties used in our analyses are presented in Table C-1 (Appendix C).

### 5.3 Analysis and Results

We analyzed potential circular failure surfaces and potential block or sliding failure surfaces. Our analyses assume that no more than one foot of head will develop within the sand drainage layer. We also assume that excess pore pressure will not develop within the waste either through hydrostatic pressure or gas pressure. The development of excess pore pressure would substantially reduce the factor of safety for stability. The results of our stability analyses using peak strength values are attached and are summarized in Table C-2 (Appendix C).

Due to the potential for variability of the engineering properties of the waste, we also performed a limited sensitivity analysis by evaluating the effect on the factor of safety by varying the strength parameters. The results of this limited sensitivity analysis are presented in Table C-3.

To address the potential for progressive failure, we also performed a secondary stability analysis

using assumed large displacement interface shear strengths. The results of this analysis are presented in Table C-4.

### 5.4 Conclusions

The calculated factor of safety for the peak displacement conditions exceeded 1.5 for our assumed strength and unit weight parameters, the analyzed cross sections, and assumed failure geometry. In addition, the calculated factor of safety for the large displacement condition exceeds 1.3, which in our judgment, and based on published information, is acceptable.

The results of the limited sensitivity analysis indicates a factor of safety of at least 1.89 with respect to deep seated wedge failure. Please note that the calculated factor of safety of 1.46 shown for the circular analyses is not for deep seated failure, but rather a reflection of potential near surface failure, and is due to the lack of cohesion in the analysis which is needed for deep seated circular failure analysis.

Based on our results, in our opinion, we anticipate that the planned landfill configuration should be stable, provided that no excess pore pressures are generated within the waste or that there is no increase in piezometric head above 1 foot within the underlying sand liner cover. The generation of pore pressures and increase in piezometric head within these materials will substantially reduce the factor of safety and increase the risk for stability problems

To reduce the potential for the development of excess pore pressures and piezometric head within the waste, we strongly recommend that the intermediate cover soils be sufficiently permeable so that as the height of the waste increases, the leachate does not become ponded on the underlying buried cover layers. That is, leachate should be allowed to permeate through the buried cover soils down to the underlying sand leachate collection system. If the permeability of

the intermediate cover soils is low and will not allow the rapid transmission of the leachate through the buried cover soils, then the intermediate cover soils should be breached by excavating trenches through the cover soils prior to continued waste placement to allow the leachate to permeate through down to the leachate collection system.

We strongly recommend that laboratory testing be performed using the specific HDPE liner material chosen for the project to confirm our assumed interface friction values used in our analyses. Additional stability analyses may also be required at that time.

## 6.0 LIMITATIONS

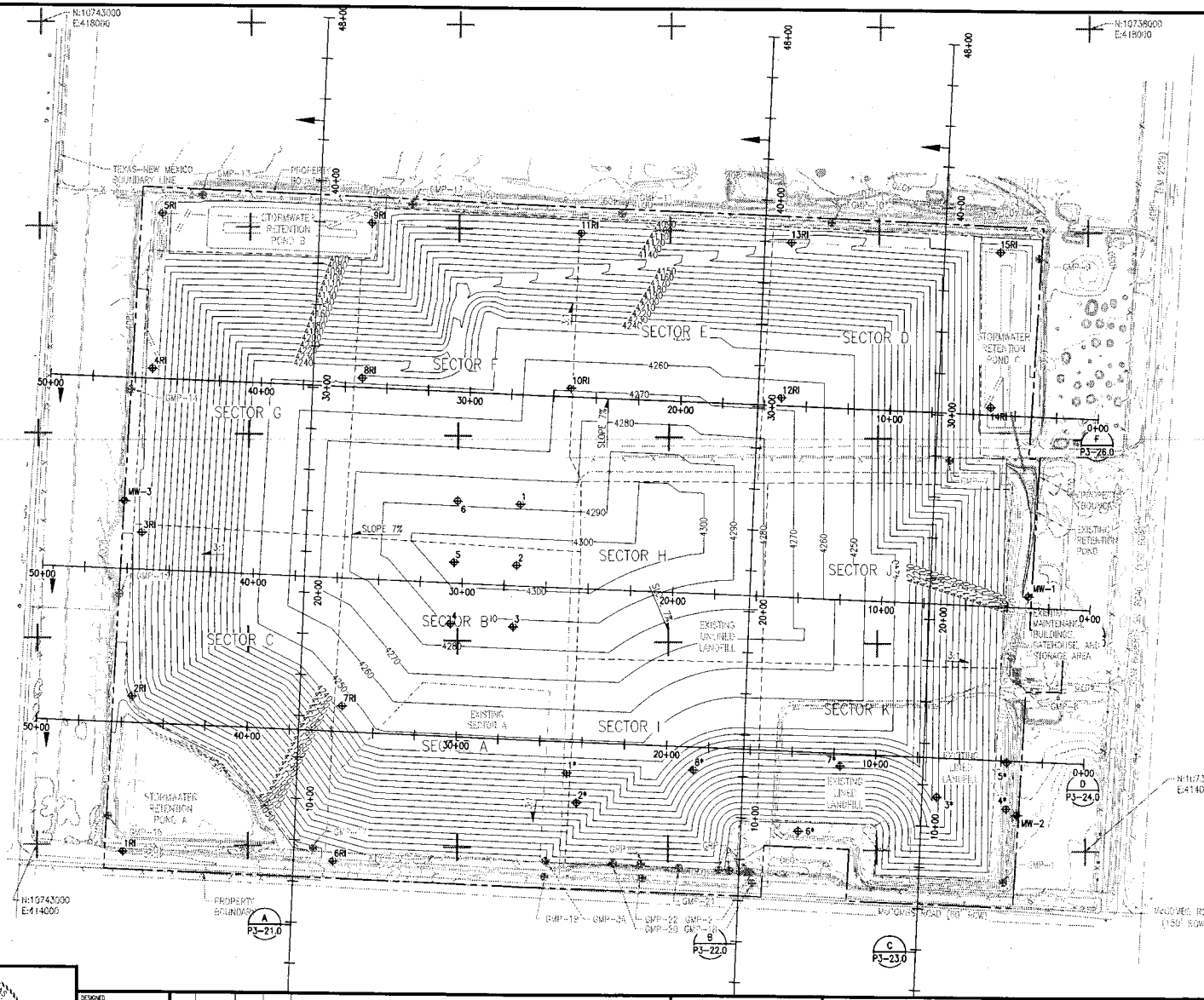
Within the limitations of scope, budget, and schedule, we have endeavored to provide our services according to generally accepted geotechnical engineering practices at this time and location. Other than this, no warranty, either express or implied, is intended.

## 7.0 REFERENCES

1. Qian, X. et.al., (2002), "Geotechnical Aspects of Landfill Design and Construction," Prentice Hall
2. Eid, H.T., et. al., (2000), "Municipal Solid Waste Slope Failure I: Waste and Foundation Soil Properties," *Journal of Geotechnical and Geoenvironmental Engineering*, ASCE, 126(5) p. 397-407
3. Singh, S. and Murphy, B., "Evaluation of the Stability of Sanitary Landfills," (1990), *in* Geotechnics of Waste Fills – Theory and Practice, ASTM STP 1070, Landva, A., and Knowles, G.D., eds.

# Appendix A

SAIC Drawings




## NOTES

1. CONTOURS PROVIDED WITHIN LANDFILL BOUNDARY REPRESENT TOP OF FINAL CONTOURS. CONTOUR INTERVAL IS TEN FEET
2. DIGITIZED TOPOGRAPHY FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS. EXISTING CONTOUR INTERVAL IS TWO FEET.
3. COORDINATES ARE BASED ON THE TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NAD 83. ELEVATIONS ARE NAVD 88 VERTICAL DATUM.

DRAFT
04/13/2011

## LEGEND

- ⊕1* – BORING LOCATION AND NUMBER PER DRA CONSULTANTS (MAY 1983)
- ⊕1RI – BORING LOCATION AND NUMBER PER DRA CONSULTANTS (NOVEMBER 1983)
- ⊕1 – BORING LOCATION AND NUMBER PER DICKINSON LABORATORIES (JUNE 1976)

GRAPHIC SCALE
1"=250'-0" 250 0 250 500
Scale Feet

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STATE OF TEXAS
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Suite 305
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(651) 994-8415

MCCOMBS LANDFILL – MSW PERMIT NO. 729A
MAJOR PERMIT AMENDMENT

SECTION LAYOUT PLAN

PROJECT NUMBER: 9631500115
SHT 53 OF XX
DRAWING NUMBER: P3-20.0

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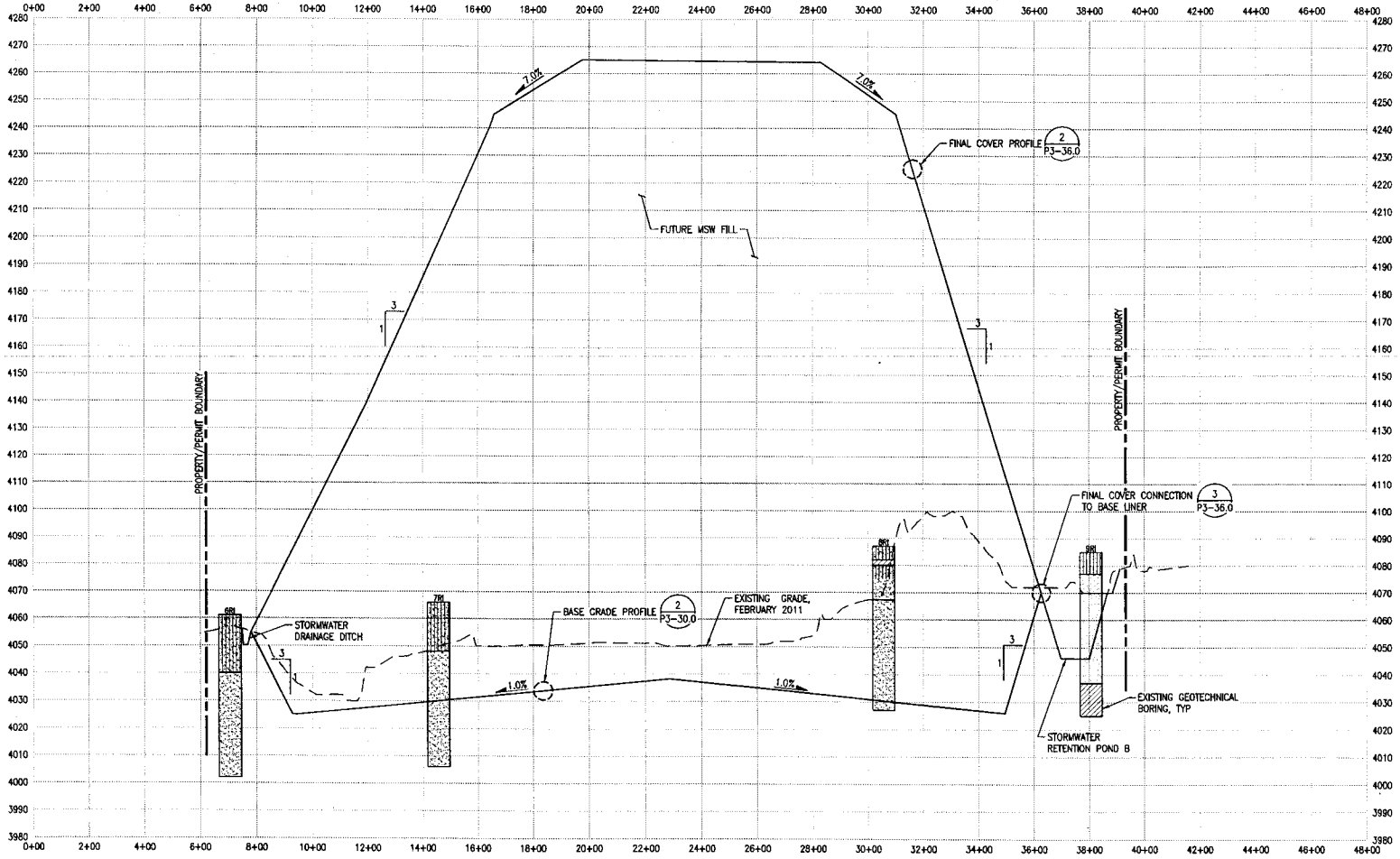


**SECTION** A P3-20.0
TYPICAL LANDFILL
VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 200'

## NOTES

1. EXISTING GRADE FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS.

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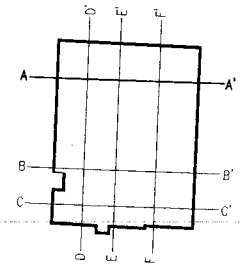
04/13/2011




**KEY MAP**
SCALE: NTS

## LEGEND

- 1* – BORING LOCATION AND NUMBER PER DRA CONSULTANTS (MAY 1983)
- 1RI – BORING LOCATION AND NUMBER PER DRA CONSULTANTS (NOVEMBER 1983)
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SAND
SILTY SAND
CLAYEY SAND
SILT

GRAPHIC SCALES
1"=20'-0" 20 0 20 40 Scale Feet
1"=200'-0" 200 0 200 400 Scale Feet

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MCCOMBS LANDFILL – MSW PERMIT NO. 729A
MAJOR PERMIT AMENDMENT

TYPICAL LANDFILL SECTION A

PROJECT NUMBER: 9631500115
SHT 54 OF XX
DRAWING NUMBER: P3-21.0

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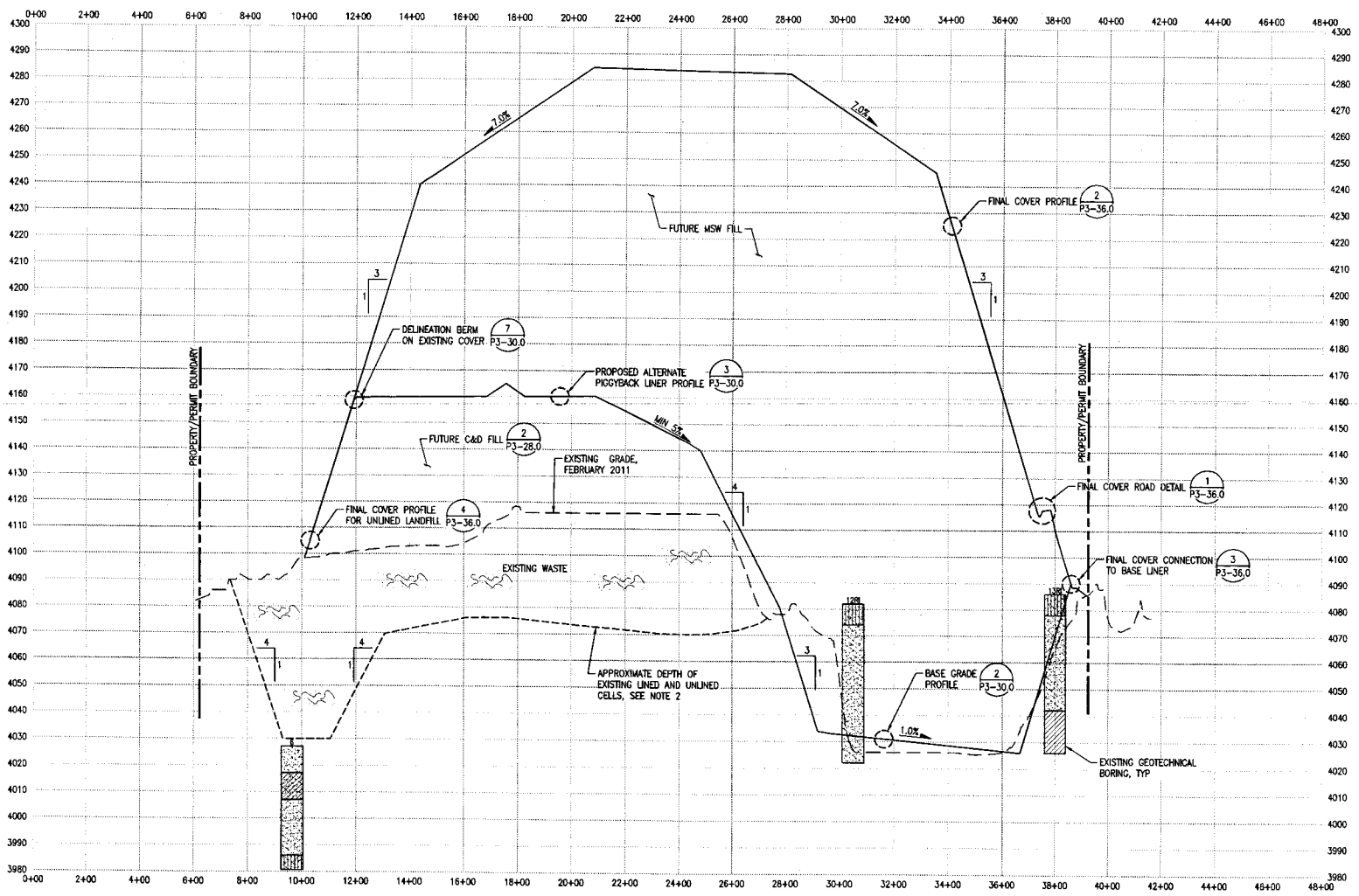


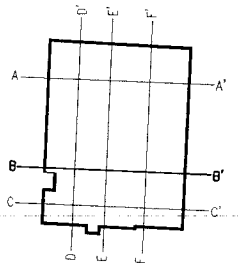

**SECTION** B P3-20.0

TYPICAL LANDFILL
VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 200'

## NOTES

1. EXISTING GRADE FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS.
2. EXISTING UNLINED AND LINED BASE CONTOURS OBTAINED FROM DRA CONSULTANTS APPLICATION FOR PERMIT AMENDMENT NO. 729, ATTACHMENT NO. 11, SHEET A1, DATED APRIL 1983.

DRAFT
04/13/2011




KEY MAP
SCALE: NTS

## LEGEND

- ⊕1* – BORING LOCATION AND NUMBER PER DRA CONSULTANTS (MAY 1983)
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SAND
SILTY SAND
CLAYEY SAND
SILT

GRAPHIC SCALES
1"=20'-0" 20 0 20 40 Scale Feet
1"=200'-0" 200 0 200 400 Scale Feet

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STATE OF TEXAS name number REGISTERED PROFESSIONAL ENGINEER

DESIGNED TLK
DRAWN CAD
VERIFY SCALE BAR IS ONE INCH ON ANSI "D" DRAWING 0 1"

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| 0 | 4/15/11 | SEK | FJD | MAJOR PERMIT MODIFICATION |

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MCCOMBS LANDFILL – MSW PERMIT NO. 729A
MAJOR PERMIT AMENDMENT

TYPICAL LANDFILL SECTION B

PROJECT NUMBER: 9631500115
SHT: 55 OF: XX
DRAWING NUMBER: P3-22.0

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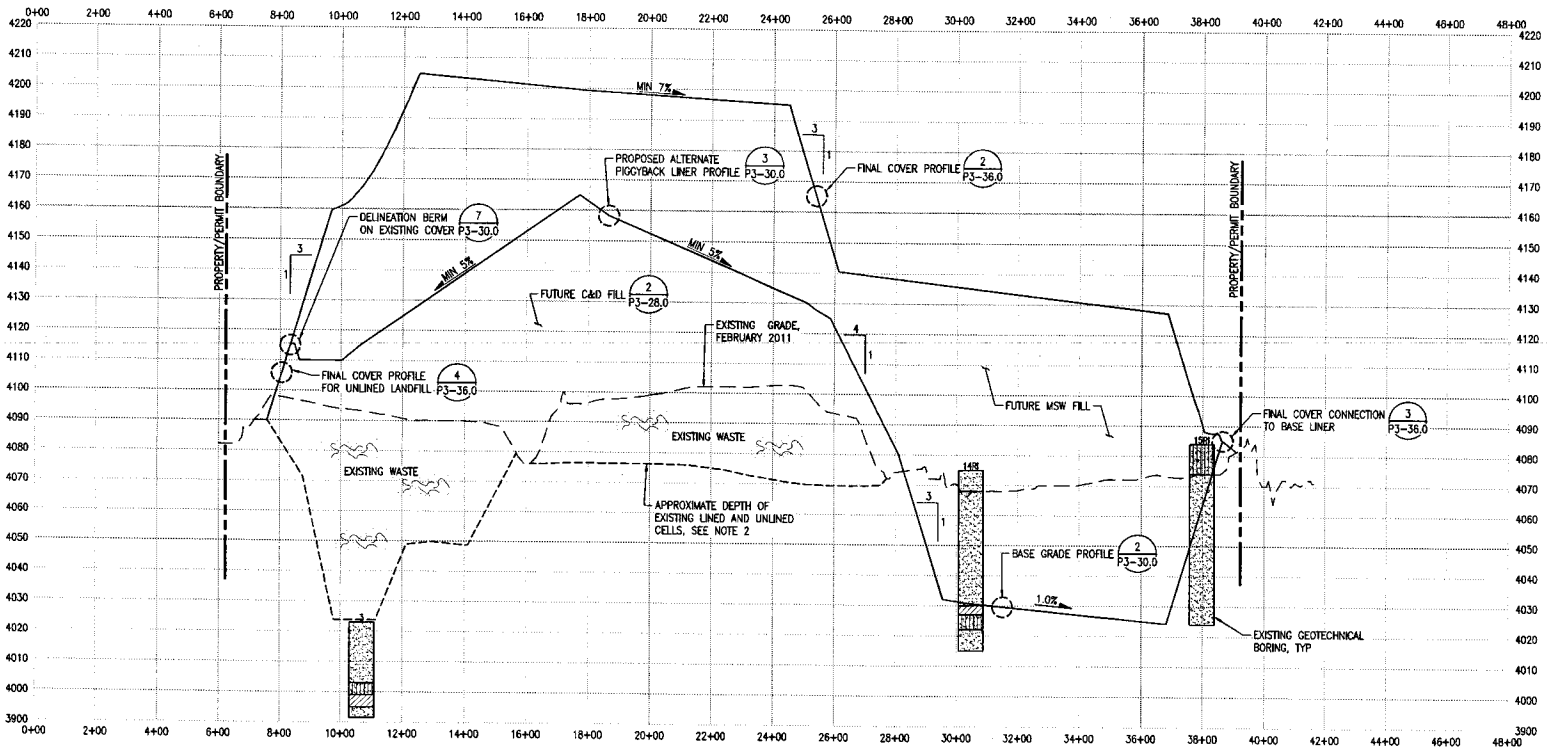


**SECTION** C P3-20.0

TYPICAL LANDFILL
VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 200'

## NOTES

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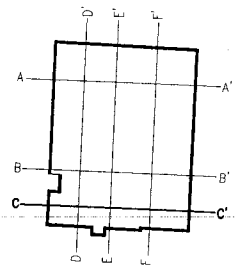
DRAFT
04/13/2011




KEY MAP
SCALE: NTS

## LEGEND

- ⊕1* – BORING LOCATION AND NUMBER PER DRA CONSULTANTS (MAY 1983)
- ⊕1RI – BORING LOCATION AND NUMBER PER DRA CONSULTANTS (NOVEMBER 1983)
- ⊕1 – BORING LOCATION AND NUMBER PER DICKINSON LABORATORIES (JUNE 1976)

SAND
SILTY SAND
CLAYEY SAND
SILT

GRAPHIC SCALES
1"=20'-0" 20 0 20 40 Scale Feet
1"=200'-0" 200 0 200 400 Scale Feet

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STATE OF TEXAS name number REGISTERED PROFESSIONAL ENGINEER

DESIGNED TLK
DRAWN CAD
VERIFY SCALE BAR IS ONE INCH ON ANSI "D" DRAWING 0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 0 | 4/15/11 | SEK | FJD | MAJOR PERMIT MODIFICATION |

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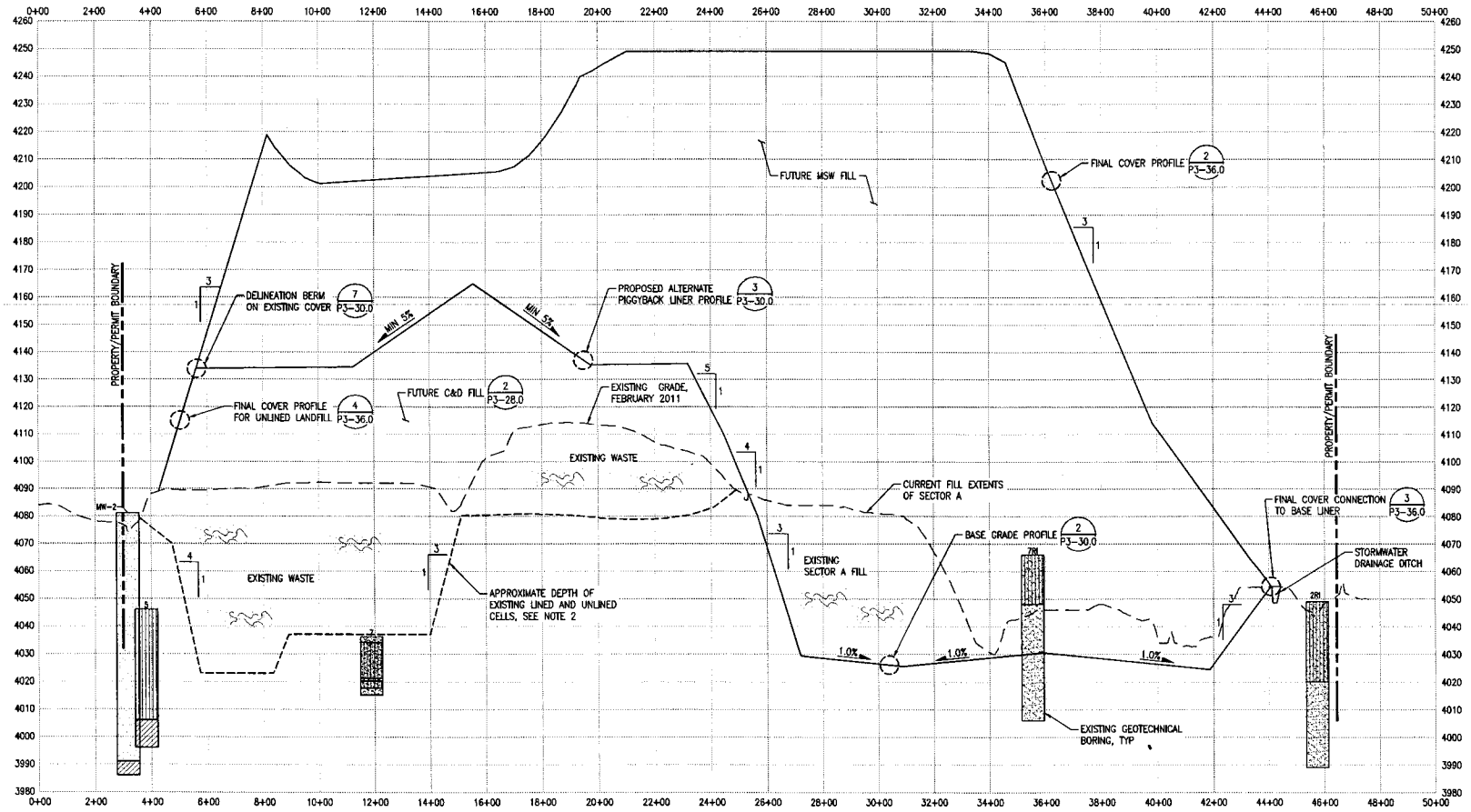
Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL – MSW PERMIT NO. 729A
MAJOR PERMIT AMENDMENT

TYPICAL LANDFILL SECTION C

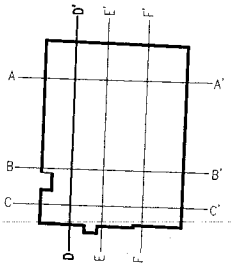
PROJECT NUMBER: 9631500115
SHT 56 OF: XX
DRAWING NUMBER: P3–23.0




## SECTION D
TYPICAL LANDFILL
VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 200'
(D P3-20.0)

## NOTES
1. EXISTING GRADE FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS.
2. EXISTING UNLINED AND LINED BASE CONTOURS OBTAINED FROM DRA CONSULTANTS APPLICATION FOR PERMIT AMENDMENT NO. 729, ATTACHMENT NO. 11, SHEET A1, DATED APRIL 1983.

DRAFT
04/13/2011




KEY MAP
SCALE: NTS

## LEGEND
- ⊕1* – BORING LOCATION AND NUMBER PER DRA CONSULTANTS (MAY 1983)
- ⊕1RI – BORING LOCATION AND NUMBER PER DRA CONSULTANTS (NOVEMBER 1983)
- ⊕1 – BORING LOCATION AND NUMBER PER DICKINSON LABORATORIES (JUNE 1976)

SAND
SILTY SAND
CLAYEY SAND
SILT

GRAPHIC SCALES
1"=20'-0" 20 0 20 40 Scale Feet
1"=200'-0" 200 0 200 400 Scale Feet

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DESIGNED TLK
DRAWN CAD
VERIFY SCALE BAR IS ONE INCH ON ANSI "D" DRAWING 0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 0 | 4/15/11 | SEK | FJD | MAJOR PERMIT MODIFICATION |

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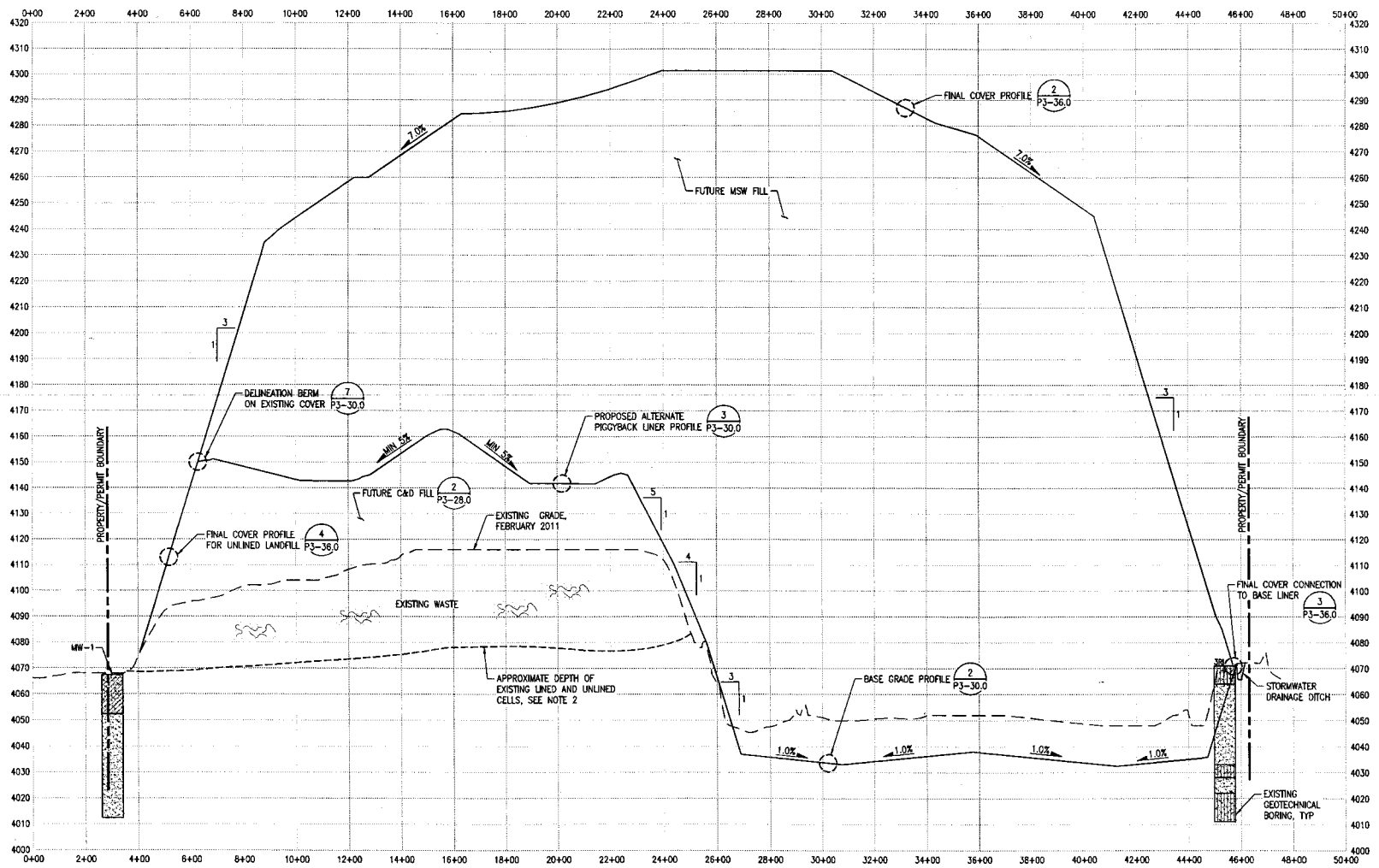
MCCOMBS LANDFILL – MSW PERMIT NO. 729A
MAJOR PERMIT AMENDMENT

TYPICAL LANDFILL SECTION D

PROJECT NUMBER: 9631500115
SHT. 57 OF: XX
DRAWING NUMBER: P3-24.0

Keller, Tonya L 4/13/2011 4:03:01 PM – R:\Minneapolis\00218000 El Paso, TX\9631500115\Data Analysis\CAD\P3-24.0 TYPICAL LANDFILL SECTION D.dwg



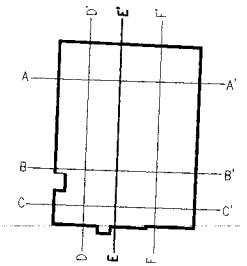

## SECTION E P3-20.0

TYPICAL LANDFILL
VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 200'

## NOTES

1. EXISTING GRADE FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS.
2. EXISTING UNLINED AND LINED BASE CONTOURS OBTAINED FROM DRA CONSULTANTS APPLICATION FOR PERMIT AMENDMENT NO. 729, ATTACHMENT NO. 11, SHEET A1, DATED APRIL 1983.

DRAFT
04/13/2011




KEY MAP
SCALE: NTS

## LEGEND

- 1* – BORING LOCATION AND NUMBER PER DRA CONSULTANTS (MAY 1983)
- 1RI – BORING LOCATION AND NUMBER PER DRA CONSULTANTS (NOVEMBER 1983)
- 1 – BORING LOCATION AND NUMBER PER DICKINSON LABORATORIES (JUNE 1976)

SAND
SILTY SAND
CLAYEY SAND
SILT

GRAPHIC SCALES
1"=20'-0" 20 0 20 40 Scale Feet
1"=200'-0" 200 0 200 400 Scale Feet

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| | |
|---|---|
| DESIGNED | TLK |
| DRAWN | CAD |
| VERIFY SCALE BAR IS ONE INCH ON ANSI "D" DRAWING | 0 1" |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
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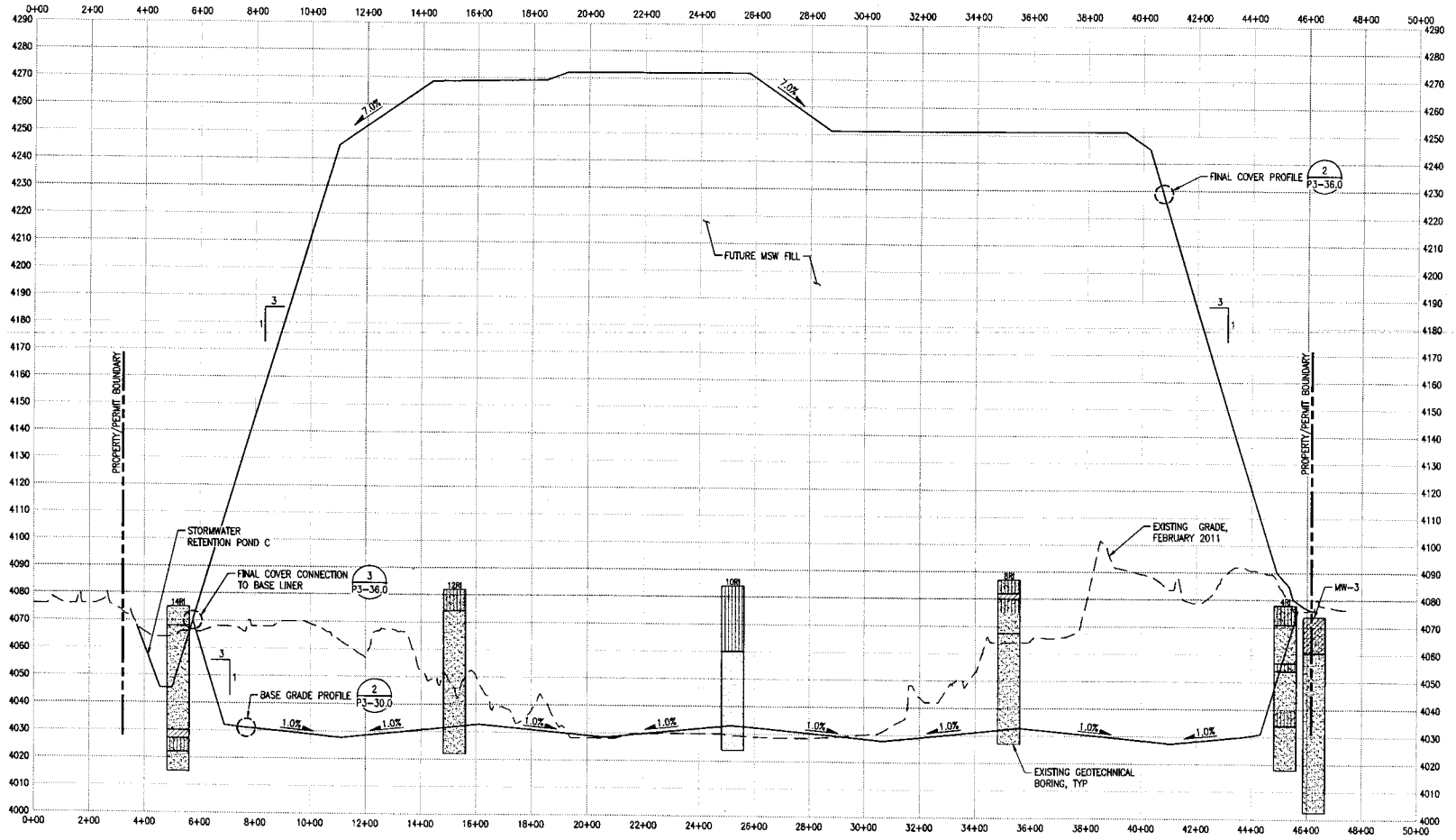
MCCOMBS LANDFILL – MSW PERMIT NO. 729A
MAJOR PERMIT AMENDMENT

TYPICAL LANDFILL SECTION E

PROJECT NUMBER: 9631500115
SHT. 58 OF: XX
DRAWING NUMBER: P3-25.0

Koller, Tonya L. 4/13/2011 4:04:14 PM – R:\Minneapolis\9631500115\Geo Analysis\CAD\P3-25.0 TYPICAL LANDFILL SECTION E.dwg




## SECTION

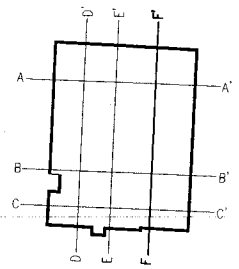
TYPICAL LANDFILL
VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 200'

F
P3-20.0

## NOTES

1. EXISTING GRADE FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS.

DRAFT
04/13/2011




KEY MAP
SCALE: NTS

## LEGEND

- ⊕1* – BORING LOCATION AND NUMBER PER DRA CONSULTANTS (MAY 1983)
- ⊕1RI – BORING LOCATION AND NUMBER PER DRA CONSULTANTS (NOVEMBER 1983)
- ⊕1 – BORING LOCATION AND NUMBER PER DICKINSON LABORATORIES (JUNE 1976)

SAND
SILTY SAND
CLAYEY SAND
SILT

GRAPHIC SCALES

1"=20'-0" 20 0 20 40 Scale Feet

1"=200'-0" 200 0 200 400 Scale Feet

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STATE OF TEXAS name number REGISTERED PROFESSIONAL ENGINEER

| DESIGNED | TLK |
|---|---|
| DRAWN | CAD |
| VERIFY SCALE BAR IS ONE INCH ON ANSI "D" DRAWING 0 1" | |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
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St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL – MSW PERMIT NO. 729A
MAJOR PERMIT AMENDMENT

TYPICAL LANDFILL SECTION F

PROJECT NUMBER: 9631500115
SHT. 59 OF XX
DRAWING NUMBER: P3-26.0

Kolle, Tonya L. 4/13/2011 4:05:15 PM - R:\Minneapolis\00218000 El Paso, TX\631500115\Data Analysis\CAD\P3-26.0 TYPICAL LANDFILL SECTION F.dwg

# Appendix B

Settlement of Existing Waste

| TABLE B-1. SECTION B | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Station | Existing Waste Thickness (feet) | New MSW/CD Thickness (feet) | Estimated Settlement (feet) of Existing Waste | | | | | |
| | | | $C_c'$=0.17, $C_\alpha'$=0.03 | | | $C_c'$=0.36, $C_\alpha'$=0.10 | | |
| | | | Primary Settlement | Secondary Settlement | Total Settlement | Primary Settlement | Secondary Settlement | Total Settlement |
| 12+00 | 52 | 60 | 4.6 | 1.2 | 5.8 | 9.7 | 3.6 | 13.3 |
| 13+00 | 35 | 97 | 4.9 | 0.8 | 5.7 | 10.3 | 2.1 | 12.4 |
| 14+50 | 30 | 137 | 5.1 | 0.6 | 5.7 | 10.9 | 1.7 | 12.6 |
| 16+00 | 30 | 147 | 5.3 | 0.6 | 5.9 | 11.2 | 1.6 | 12.8 |
| 18+00 | 41 | 148 | 6.4 | 0.9 | 7.3 | 13.5 | 2.4 | 15.9 |
| 21+00 | 43 | 169 | 6.9 | 0.9 | 7.8 | 14.7 | 2.4 | 17.1 |
| 25+00 | 45 | 167 | 7.1 | 1.0 | 8.1 | 15.0 | 2.6 | 17.6 |

| TABLE B-2. SECTION E | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Station | Existing Waste Thickness (feet) | New MSW/CD Thickness (feet) | Estimated Settlement (feet) of Existing Waste | | | | | |
| | | | $C_c'$=0.17, $C_\alpha'$=0.03 | | | $C_c'$=0.36, $C_\alpha'$=0.10 | | |
| | | | Primary Settlement | Secondary Settlement | Total Settlement | Primary Settlement | Secondary Settlement | Total Settlement |
| 5+00 | 24 | 20 | 1.7 | 0.6 | 2.3 | 3.7 | 1.8 | 5.5 |
| 6+03 | 27 | 55 | 3.2 | 0.6 | 3.8 | 6.9 | 1.7 | 8.6 |
| 8+80 | 31 | 133 | 5.2 | 0.7 | 5.9 | 11.0 | 1.7 | 12.7 |
| 12+00 | 35 | 150 | 5.8 | 0.8 | 6.6 | 12.4 | 2.0 | 14.4 |
| 15+50 | 38 | 163 | 6.3 | 0.8 | 7.1 | 13.4 | 2.1 | 15.4 |
| 16+50 | 38 | 170 | 6.5 | 0.8 | 7.3 | 13.7 | 2.1 | 15.8 |
| 19+00 | 38 | 170 | 6.5 | 0.8 | 7.3 | 13.7 | 2.1 | 15.8 |
| 21+50 | 40 | 176 | 6.7 | 0.9 | 7.6 | 14.3 | 2.1 | 16.4 |
| 22+50 | 40 | 180 | 6.8 | 0.9 | 7.7 | 14.4 | 2.2 | 16.6 |
| 24+00 | 33 | 191 | 6.2 | 0.7 | 6.9 | 13.1 | 1.7 | 14.8 |

# Appendix C

Waste Mass Stability

| TABLE C-1 ASSUMED ENGINEERING PROPERTIES FOR ANALYSES | | | | | |
|---|---|---|---|---|---|
| Material | Effective Friction Angle, peak $\phi'$(degrees) | Effective Friction Angle, L.D.[1] $\phi'$(degrees) | Unit Weight, $\gamma$ (pcf) | Effective Cohesion (peak), c' (psf) | Effective Cohesion (L.D.[1]), c' (psf) |
| MSW Waste | 35 | 28 | 65 | 525 | 0 |
| Drainage Sand | 29 | 29 | 110 | 0 | 0 |
| Sand/textured HDPE | 30 | 25 | N/A | 0 | 0 |
| | | | | | |

1: Large Displacement

| TABLE C-2 RESULTS OF WASTE MASS STABILITY ANALYSIS – PEAK PARAMETERS | | |
|---|---|---|
| Cross Section | Factor of Safety – Circular Failure | Factor of Safety – Block Failure |
| A | 2.89 | 2.90 |
| B | 3.16 | 2.69 |
| E | 2.99 | 2.92 |

| TABLE C-3 RESULTS OF WASTE MASS STABILITY ANALYSIS – SENSITIVITY ANALYSIS | | | | | |
|---|---|---|---|---|---|
| Condition | $\gamma$ (pcf) | $\phi'$ (deg.) | $c'$ (psf) | Factor of Safety | |
| | | | | Circular | Wedge |
| Base | 65 | 35 | 525 | 3.16 | 2.69 |
| 1 | 65 | 35 | 0 | 2.10 | 2.21 |
| 2 | 65 | 26 | 0 | 1.46 | 1.89 |

| TABLE C-4 RESULTS OF WASTE MASS STABILITY ANALYSIS – LARGE DISPLACEMENT PARAMETERS | | |
|---|---|---|
| Cross Section | Factor of Safety – Circular Failure | Factor of Safety – Block Failure |
| A | 1.58 | 2.06 |
| B | 1.58 | 1.74 |
| E | 1.58 | 2.00 |

| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 525 | 35 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Foundation Soils | 125 | 10000 | 35 | 0 |

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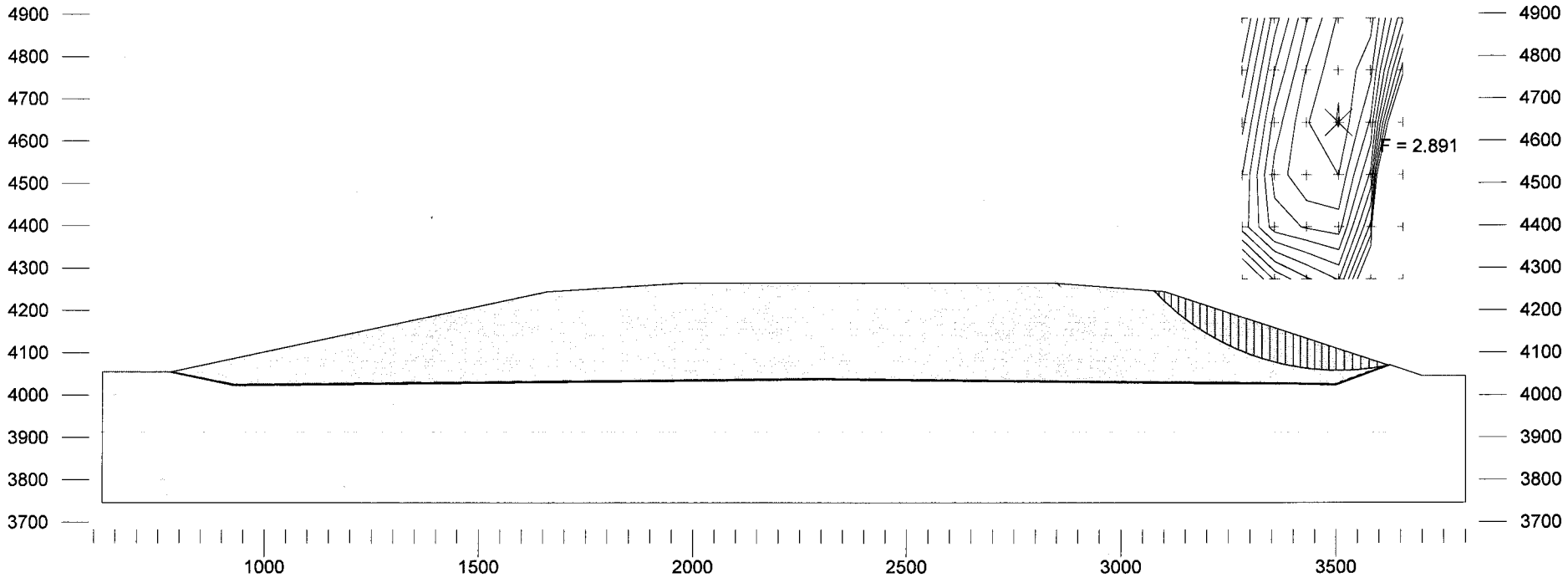
01-05106
McCombs Landfill Expansion
April 2011
Section A

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| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 525 | 35 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Foundation Soils | 125 | 10000 | 35 | 0 |

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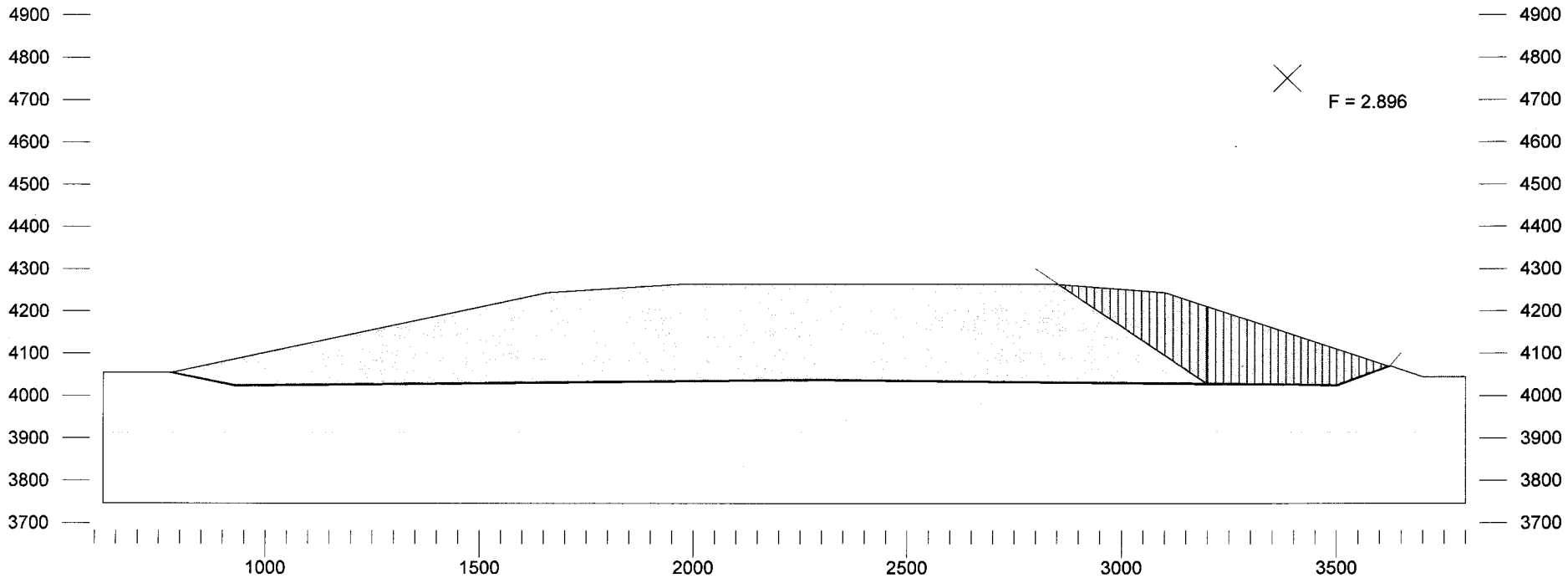
01-05106
McCombs Landfill Expansion
April 2011
Section A



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| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 0 | 28 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 25 | 1 |
| Foundation Soils | 125 | 10000 | 35 | 0 |

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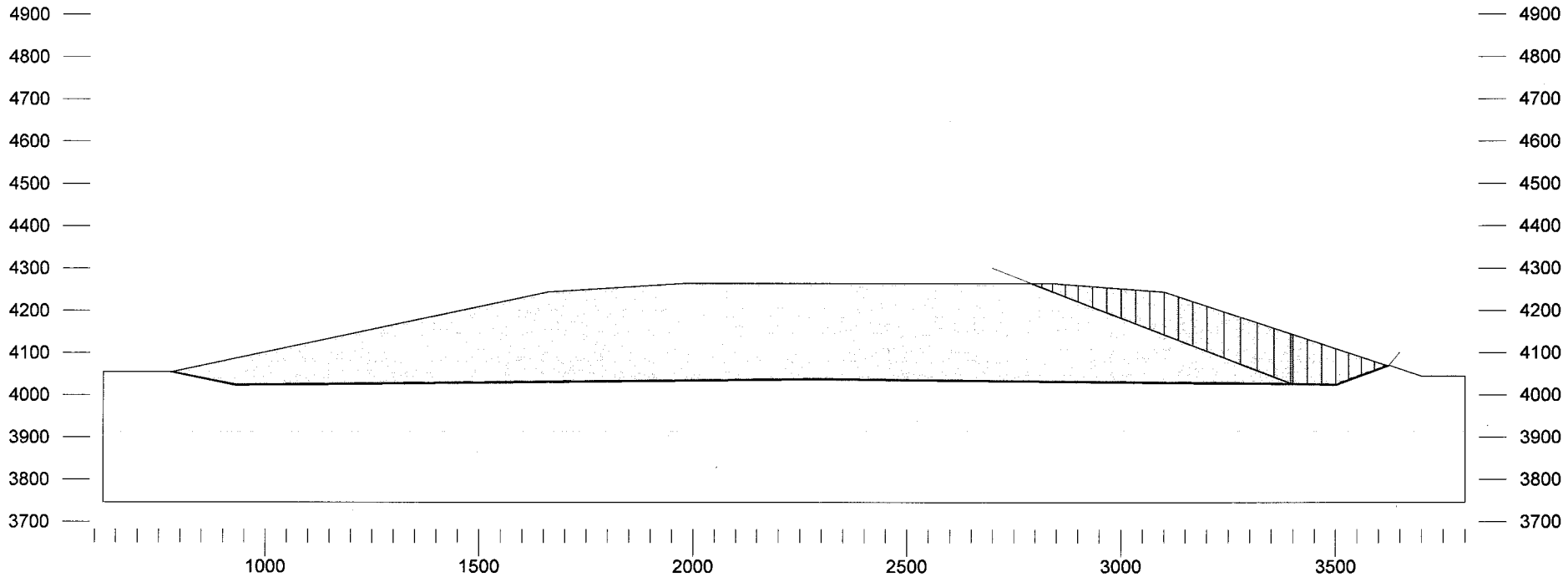
01-05106
McCombs Landfill Expansion
April 2011
Section A

F = 2.058



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| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
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| MSW Waste | 65 | 525 | 35 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 110 | 10000 | 35 | 0 |
| Foundation Soils | 125 | 10000 | 35 | 0 |

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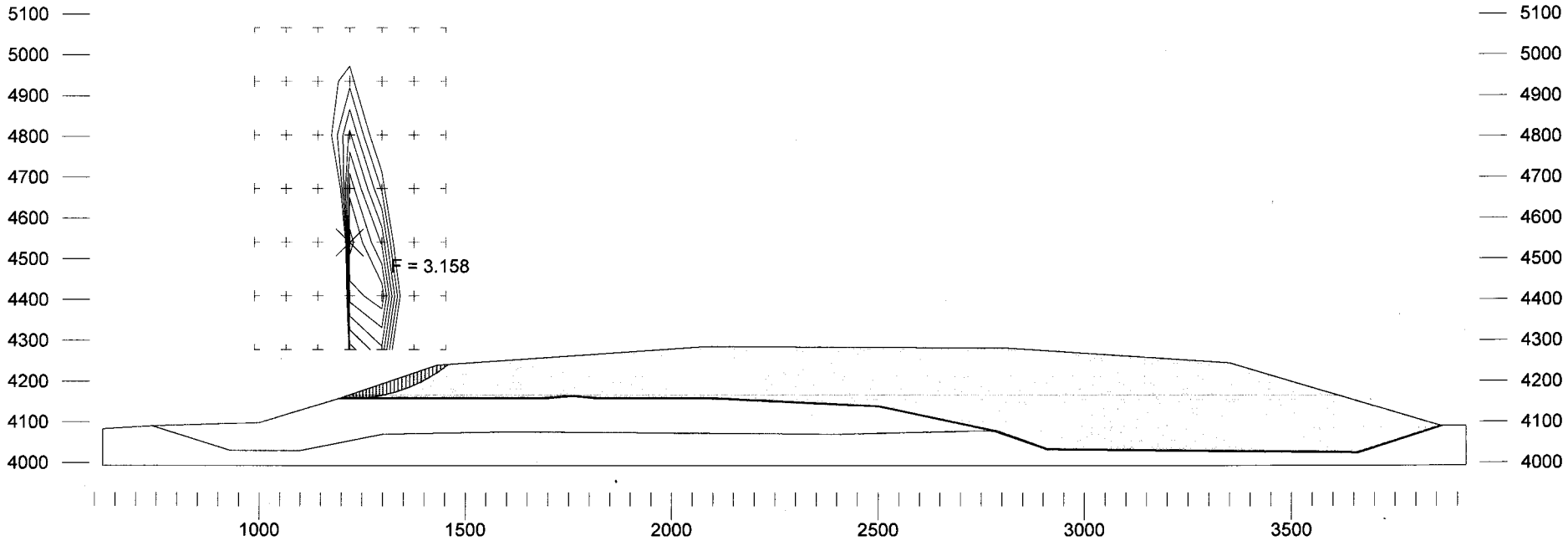
01-05106
McCombs Landfill Expansion
April 2011
Section B

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| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
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| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 110 | 10000 | 35 | 0 |
| Foundation Soils | 125 | 10000 | 35 | 0 |

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01-05106
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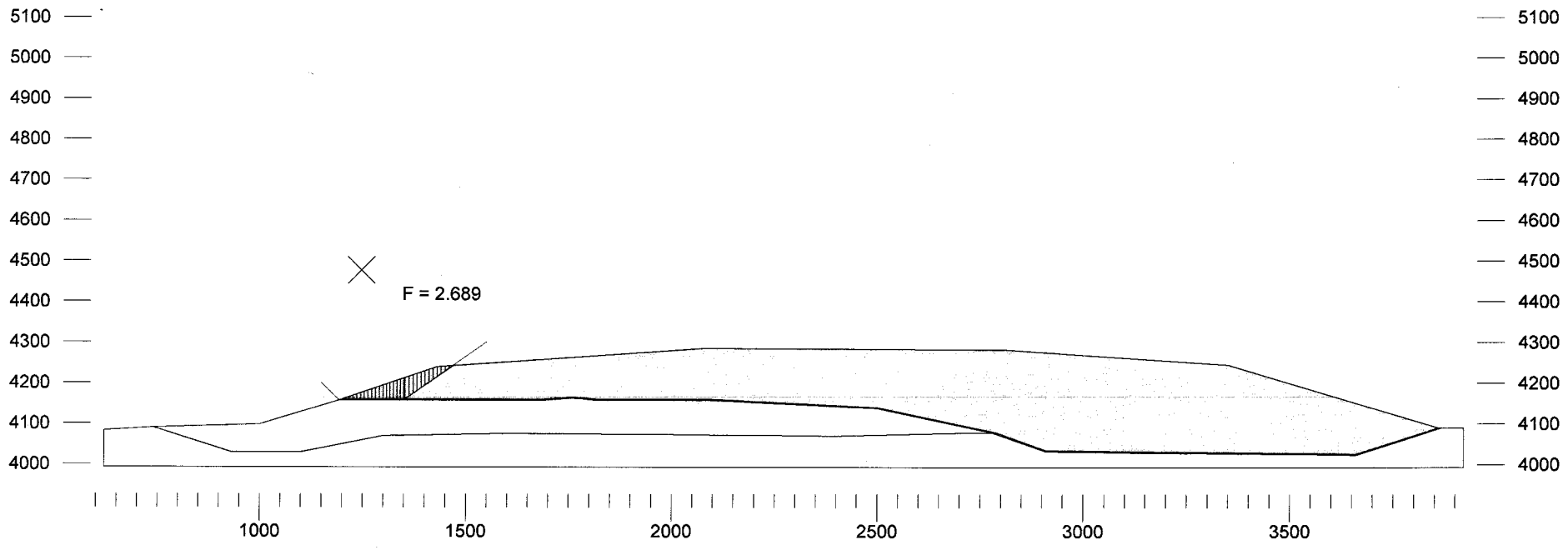
April 2011
Section B



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| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 0 | 28 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 25 | 1 |
| Exist.Waste/Fut.C&D | 110 | 10000 | 35 | 0 |
| Foundation Soils | 125 | 10000 | 35 | 0 |

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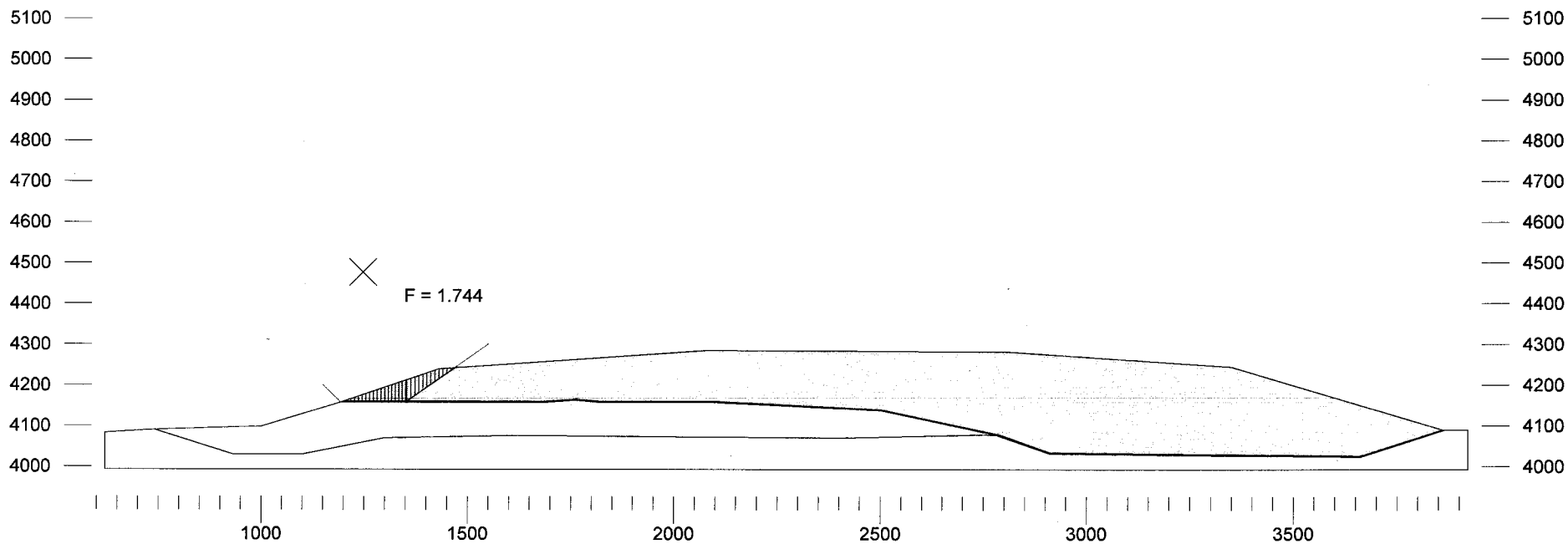
01-05106
McCombs Landfill Expansion
April 2011
Section B



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| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 110 | 10000 | 35 | 0 |
| Foundation Soils | 125 | 10000 | 35 | 0 |

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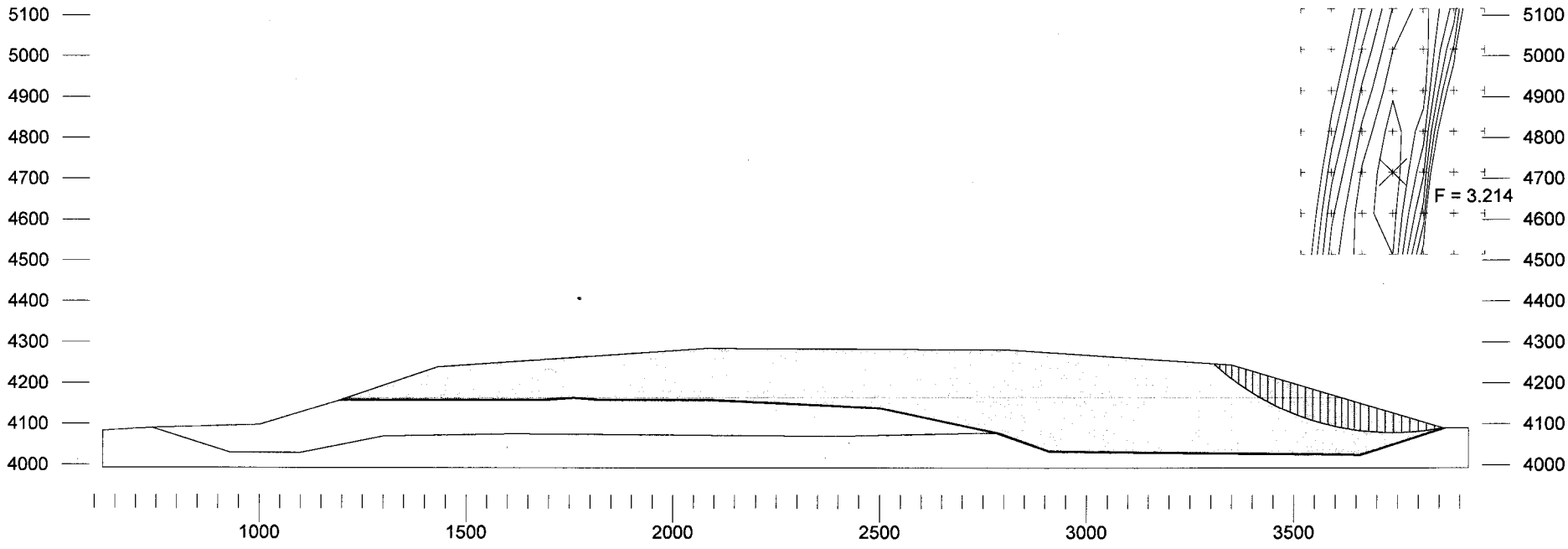
01-05106
McCombs Landfill Expansion
April 2011
Section B

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| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
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| MSW Waste | 65 | 525 | 35 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 110 | 10000 | 35 | 0 |
| Foundation Soils | 125 | 10000 | 35 | 0 |

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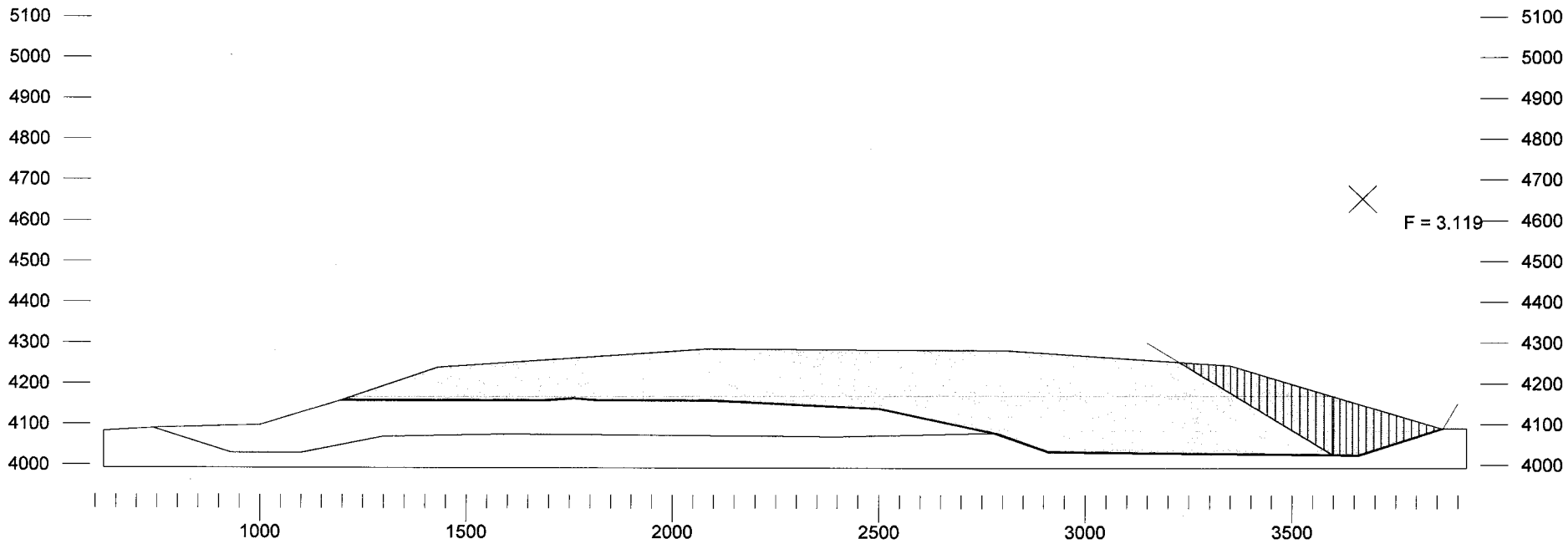
April 2011
Section B



| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 0 | 28 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 25 | 1 |
| Exist.Waste/Fut.C&D | 110 | 10000 | 35 | 0 |
| Foundation Soils | 125 | 10000 | 35 | 0 |

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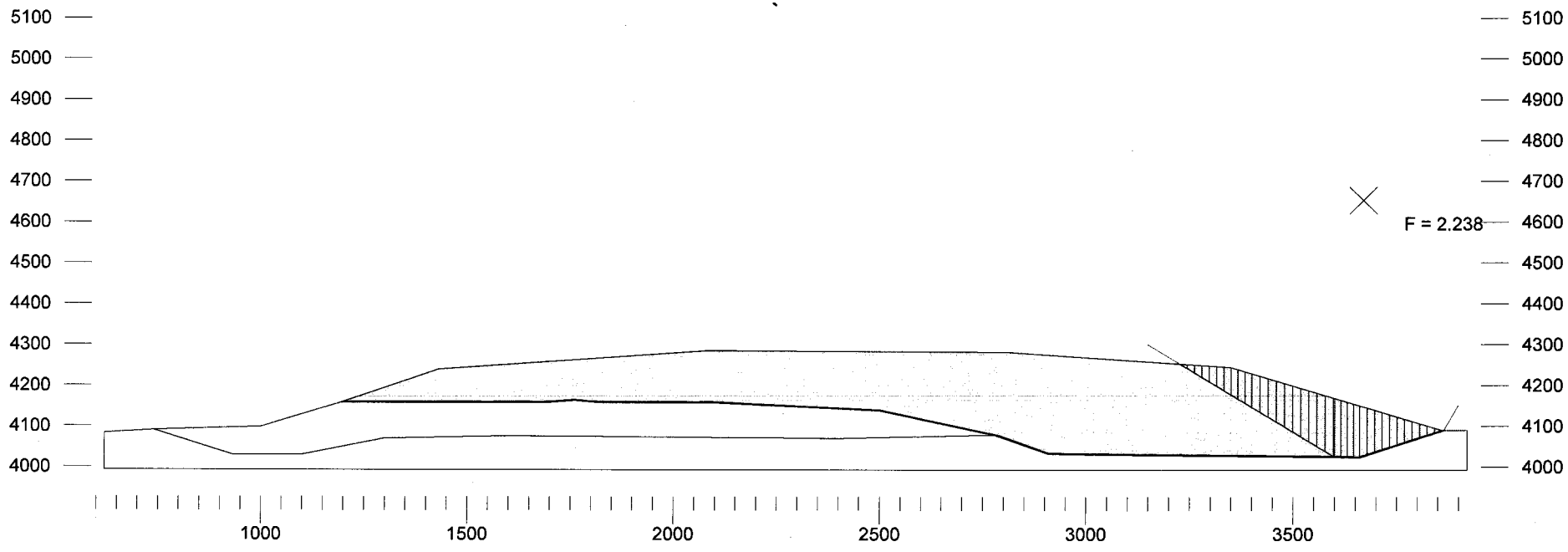
Section B

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| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 125 | 10000 | 35 | 0 |
| Foundation Soils | 125 | 10000 | 35 | 0 |

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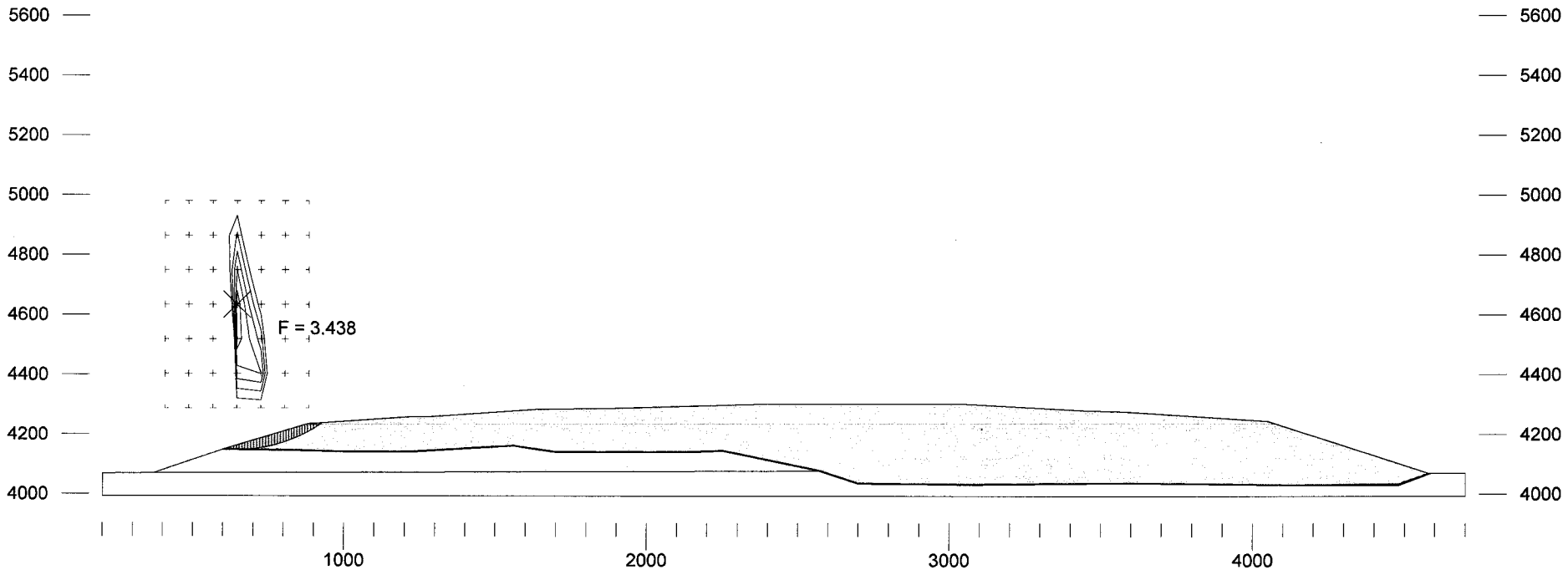


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| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 525 | 35 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 125 | 10000 | 35 | 0 |
| Foundation Soils | 125 | 10000 | 35 | 0 |

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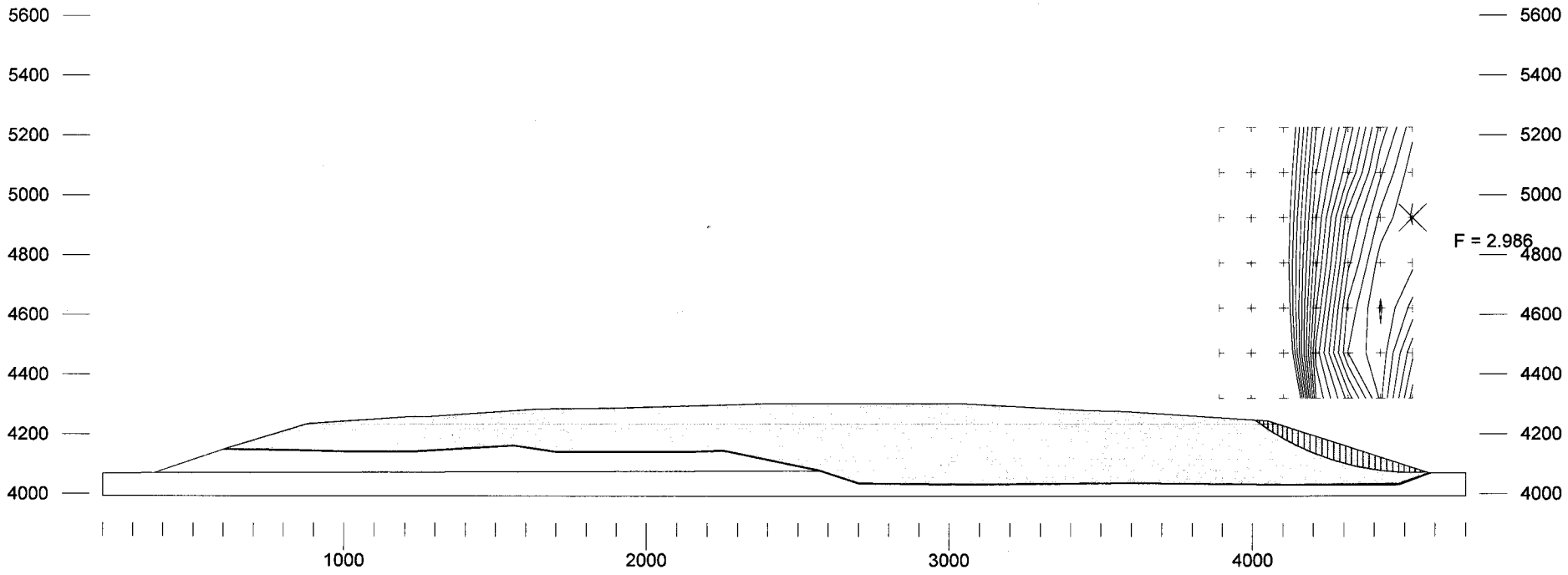
Section E





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| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 125 | 10000 | 35 | 0 |
| Foundation Soils | 125 | 10000 | 35 | 0 |

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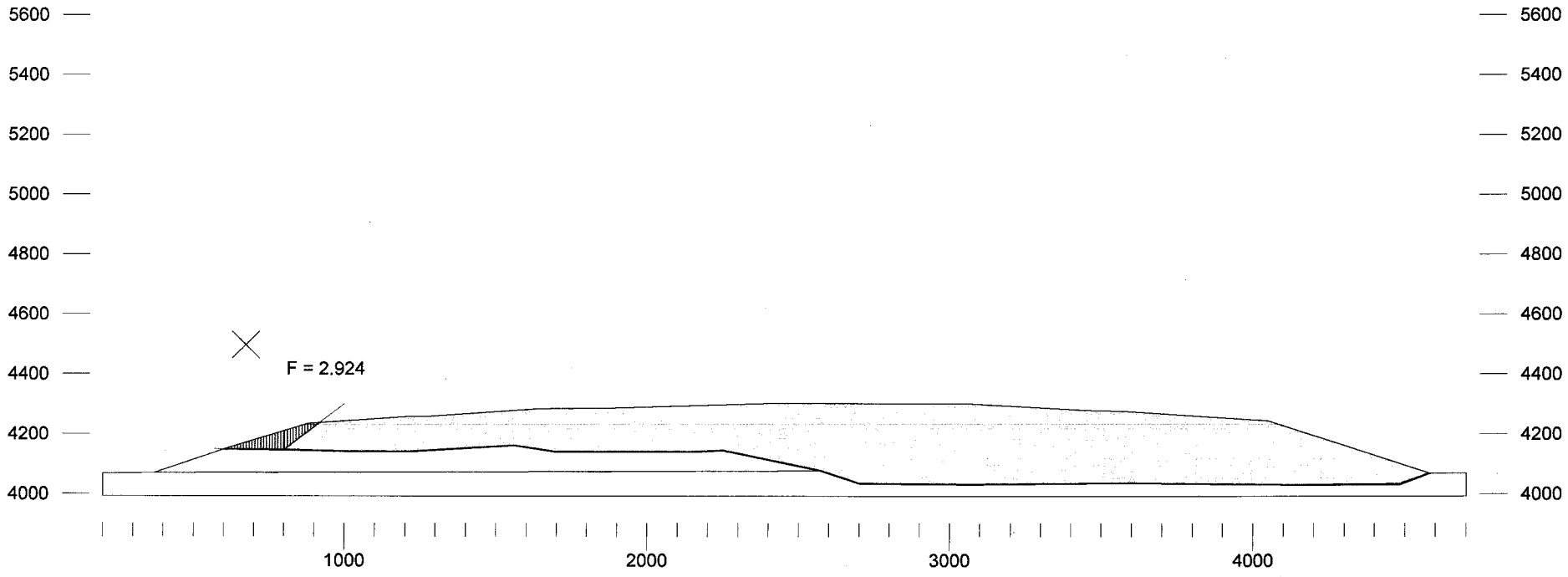


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| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 125 | 10000 | 35 | 0 |
| Foundation Soils | 125 | 10000 | 35 | 0 |

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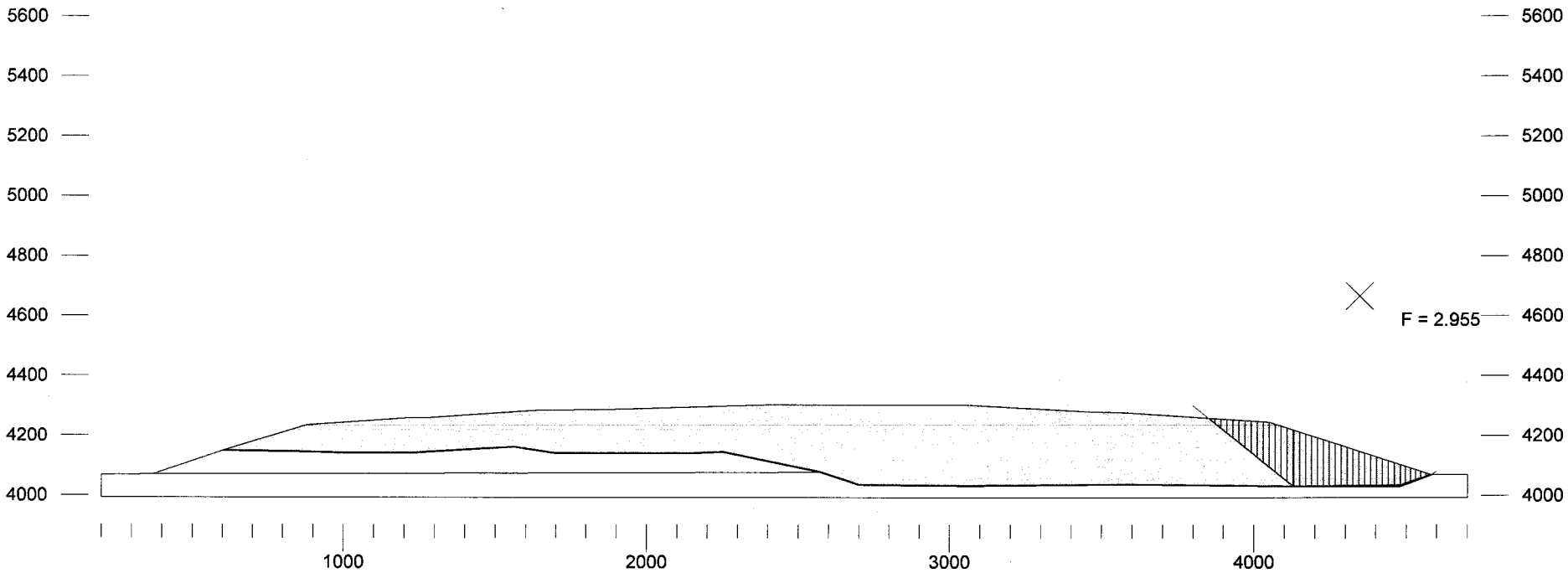


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|---|---|---|---|---|
| MSW Waste | 65 | 0 | 28 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 25 | 1 |
| Exist.Waste/Fut.C&D | 125 | 10000 | 35 | 0 |
| Foundation Soils | 125 | 10000 | 35 | 0 |

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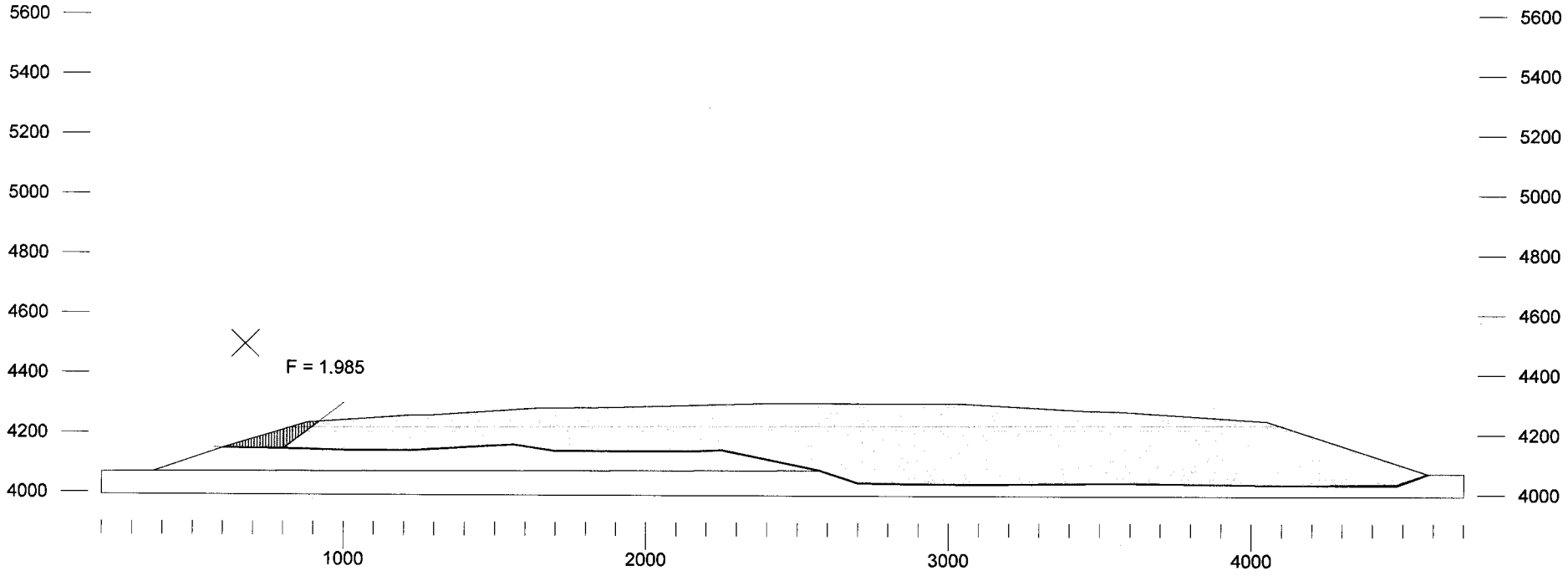


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| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 25 | 1 |
| Exist.Waste/Fut.C&D | 125 | 10000 | 35 | 0 |
| Foundation Soils | 125 | 10000 | 35 | 0 |

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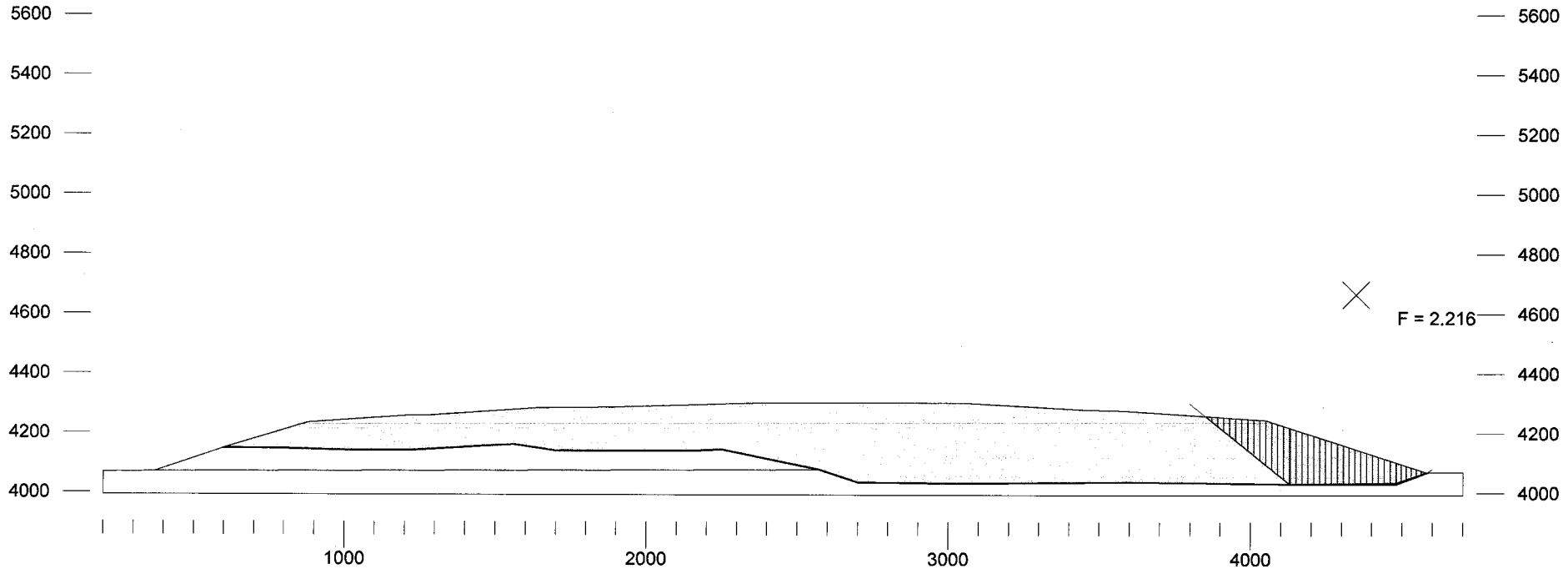
Section E

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| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 110 | 10000 | 35 | 0 |
| Foundation Soils | 125 | 10000 | 35 | 0 |

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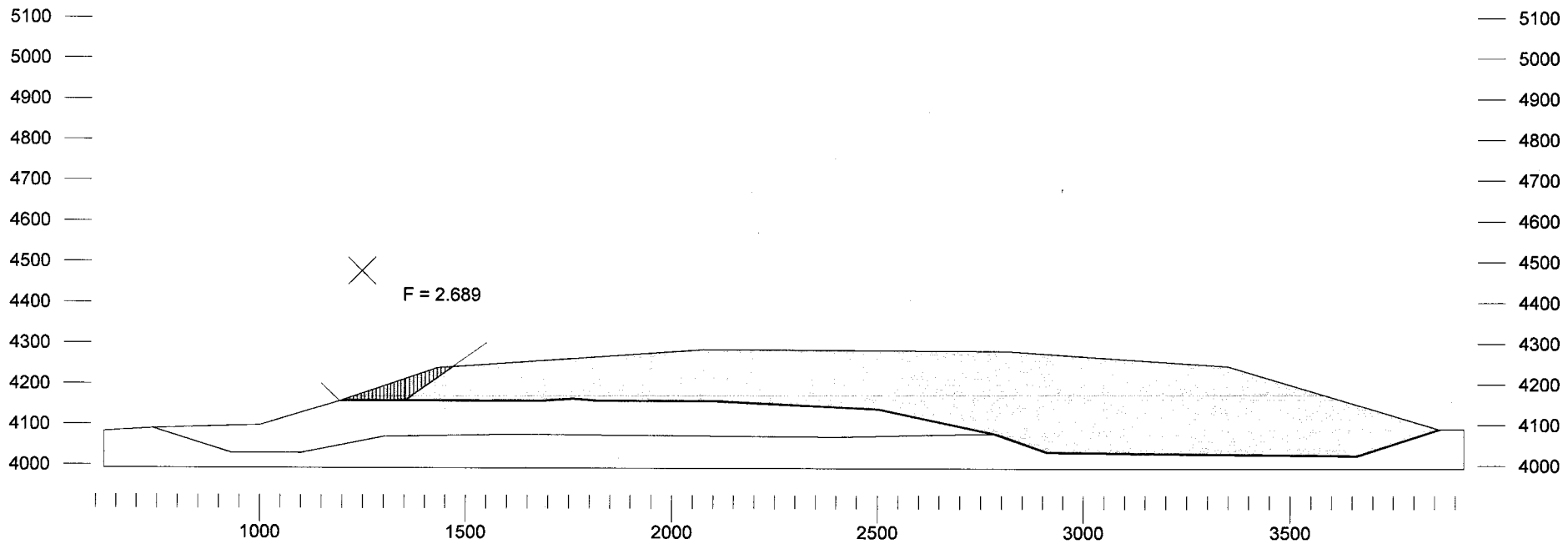
01-05106
McCombs Landfill Expansion
April 2011
Section B
Sensitivity Analysis



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| MSW Waste | 65 | 0 | 35 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 110 | 10000 | 35 | 0 |
| Foundation Soils | 125 | 10000 | 35 | 0 |

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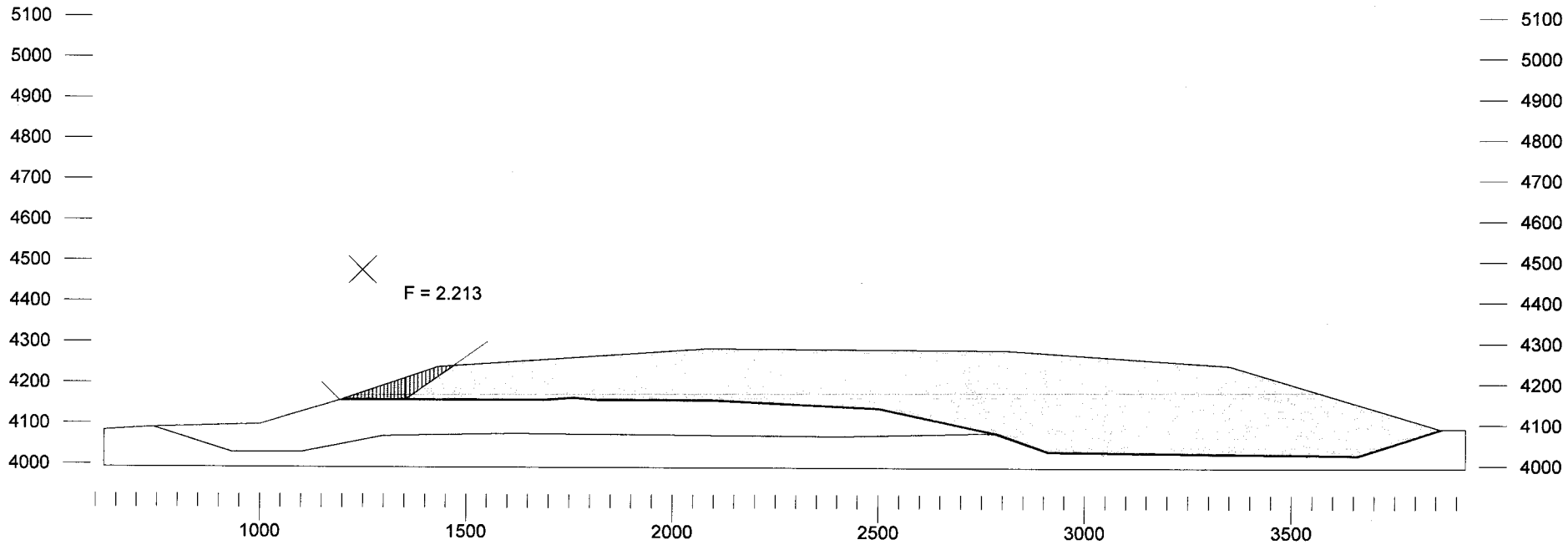
April 2011
Section B
Sensitivity Analysis



| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 0 | 26 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 110 | 10000 | 35 | 0 |
| Foundation Soils | 125 | 10000 | 35 | 0 |

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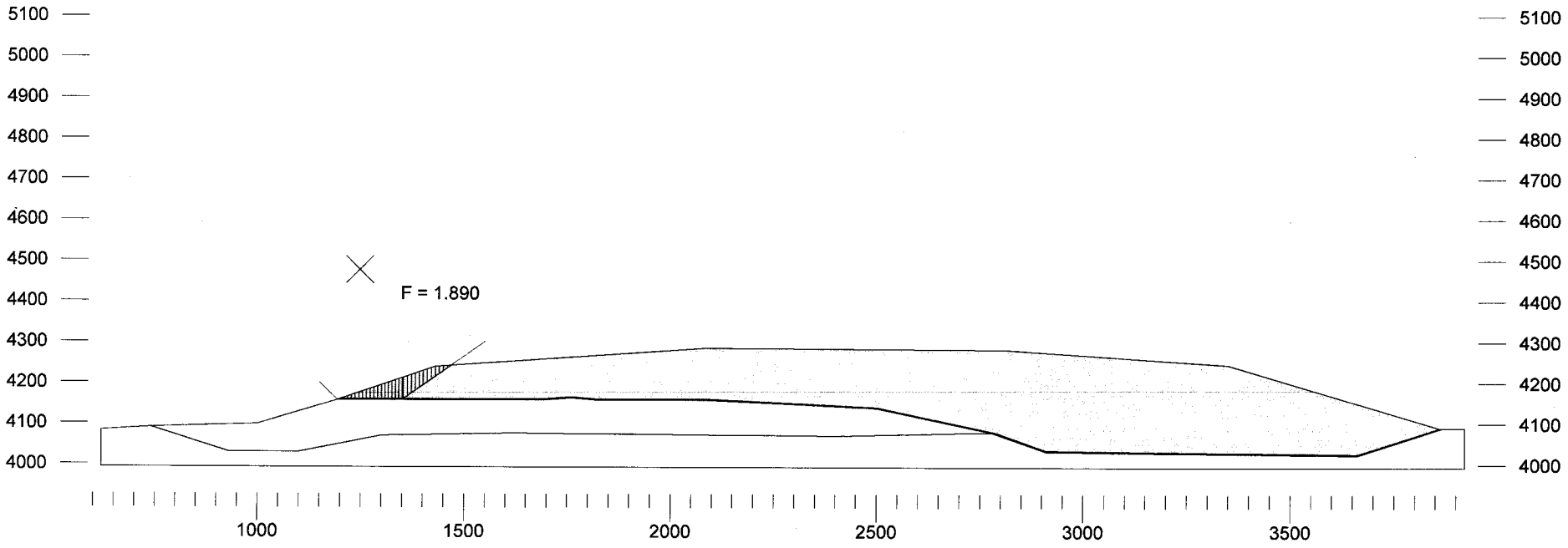
Section B
Sensitivity Analysis





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# Appendix D

Geotechnical Report Limitations and Guidelines for Use

# Appendix D
# Geotechnical Report Limitations and Guidelines for Use
# Report No. 01-05106

## B.1 REFERENCE

This appendix provides information to help you manage your risks relating to subsurface problems which are caused by construction delays, cost overruns, claims, and disputes. This information was developed and provided by ASFE[1], of which, we are a member firm.

## B.2 RISK MANAGEMENT INFORMATION

### B.2.1 Geotechnical Services are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared solely for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. And no one, not even you, should apply the report for any purpose or project except the one originally contemplated.

### B.2.2 Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

### B.2.3 A Geotechnical Engineering Report is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typically factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, always inform your geotechnical engineer of project changes, even minor ones, and request an assessment of their impact. Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.

### B.2.4 Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. Do not rely on a geotechnical engineering report whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. Always contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

1 ASFE, 8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733: www.asfe.org

**B.2.5 Most Geotechnical Findings Are Professional Opinions**
Site exploration identified subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ, sometimes significantly, from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

**B.2.6 A Report's Recommendations Are Not Final**
Do not overrely on the construction recommendations included in your report. Those recommendations are not final, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.

**B.2.7 A Geotechnical Engineering Report Is Subject to Misinterpretation**
Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

**B.2.8 Do Not Redraw the Engineer's Logs**
Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, but recognizes that separating logs from the report can elevate risk.

**B.2.9 Give Contractors a Complete Report and Guidance**
Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, but preface it with a clearly written letter of transmittal. In the letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. Be sure contractors have sufficient time to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

**B.2.10 Read Responsibility Provisions Closely**
Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their report. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. Read these provisions closely. Ask questions. Your geotechnical engineer should respond fully and frankly.

**B.2.11 Geoenvironmental Concerns Are Not Covered**
The equipment, techniques, and personnel used to perform a geoenvironmental study differ significantly from those used to perform a geotechnical study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Unanticipated environmental problems have led to numerous project failures. If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. Do not rely on an environmental report prepared for someone else.

Appendix 3G, Attachment 2
AET Report August 3, 2012

SAIC®

## Memorandum

To: TCEQ

From: Fred J. Doran, P.E., SAIC

Subject: AET Report of Supplemental Geotechnical Evaluation and Anchor Trench Stability Calculations

Date: November 2, 2012

Attached is a copy of the Supplemental Geotechnical Evaluation prepared by American Engineering Testing, Inc. (AET), dated August 3, 2012. The report was developed to supplement the original report titled "Report of Waste Mass Stability, McCombs Landfill Expansion, El Paso, Texas". Furthermore, this report includes the following analyses and results (some results taken verbatim from the report):

- Perform a waste mass stability analysis that includes the proposed C&D waste and the existing municipal solid waste;
  - Minimum factor of safety utilizing peak strength values is greater than 1.5. Additionally, a limited sensitivity analysis was completed by varying the strength parameters. Results indicate a factor of safety ranging from 1.47 to 2.78 (acceptable).
- Perform a waste mass stability of interim slopes;
  - Waste mass stability was completed for interim slopes at a 3H:1V slope at a maximum length of 270 feet. The factor of safety using peak strength parameters was 2.64 (circular failure) and 2.42 (block failure). The factor of safety assuming large displacement strength parameters was 1.60 (circular failure) and 1.76 (block failure).
- Evaluate stability and settlement of the final cover (both prescriptive and alternative);
  - Veneer Stability for Prescriptive Cover: 1.33 with parallel seepage and 1.61 for gravity conditions only.
    - The calculations for veneer stability with a factor of safety of 1.33 were calculated using a 28° internal friction angle of the erosion layer (drainage layer consisting of sand) and a saturated depth of 0.49 feet (Appendix 3I, Attachment 2, Page 104: peak daily value for maximum head on top of layer 3 equals 5.85 inches, or 0.49 feet).
    - In order to obtain a factor of safety of 1.5, the internal friction angle of the erosion layer (drainage layer consisting of sand) needs to be 31°. Published values for the internal friction angle of sand are 26° - 40° and should be readily obtainable from the material onsite. As shown on the drawings provided in Appendix 3F – Landfill Cross Sections, the boring logs for the area consist predominately of sand. The sand onsite will be tested prior to use to ensure that the internal friction angle is 31°. In the event that the



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friction angle is unobtainable with onsite soil, alternative off-site sources will be located to provide for an erosion layer soil with the required internal friction angle.

- Veneer Stability for Alternative Cover: 1.41 for no water flow.
  - An internal friction angle of 25° was utilized to calculate the factor of safety of 1.41.
  - An internal friction angle of 27° for the sand is required to increase the factor of safety to 1.5 for the no flow conditions. Soils testing will be completed prior to construction to ensure that the internal friction angle of the sand is at least 27° to ensure the 1.5 factor of safety (which should be readily obtainable as described above). Furthermore, it should be noted that the parallel seepage analysis completed by AET does not apply to the alternative cover system as there is no saturation depth for the alternative cover. The alternative cover is designed so that a zone of saturation will never be established as the water entering will be countered by evapotranspiration.

- Evaluate final cover settlement and strain;
  - Analyses completed in initial report. In summary, the maximum tensile strain calculated in the final cover is less than 0.01%, with most values less than zero (compression). Published information indicates that LLDPE can generally be assumed to have a yield strain on the order of 12% or more. The calculated tensile strain should not adversely affect the final cover material.
- Evaluate piggyback liner settlement and strain;
  - Analyses completed in initial report. In summary, the maximum tensile strain calculated is 0.206%. Published information indicates that HDPE can generally be assumed to have a yield strain in excess of 12% and GCL can generally be assumed to have a yield strain of 1% to 10%. The geogrid will have an allowable strain of 5%. The calculated tensile strain should not adversely affect the piggyback liner materials.
- Evaluate settlement of the foundation soils; and
  - The foundation settlement is estimated to be less than one foot, and the strain is estimated to be 0.03% or less. This amount of settlement and strain should not adversely affect the existing HDPE liner.
- Perform a preliminary review of our stability analyses with respect to seismic stability.
  - Although not required for a vertical expansion of Landfills, AET performed a preliminary review of the stability analyses with respect to seismic stability. Results are included here within.



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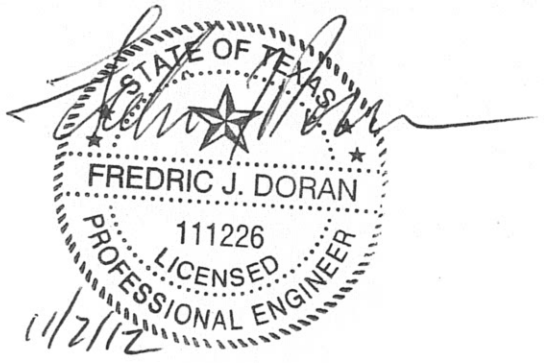
Additionally, anchor trench stability calculations with regards to pullout and the interface liner system stability for gravity and equipment conditions were completed by SAIC and are included in Appendix 3G, Attachment 3. Results indicate the following factors of safety:

- Anchor trench pullout versus tear: 1.10
  - The anchor trench was designed with both constructability and strength in mind. The anchor trench should fail and pullout rather than the sideslope geomembrane liner failing and tearing, since it will be easier to observe and repair an anchor trench failure. However, the anchor trench also has to aid in construction, and providing a shallower anchor trench may have issues with wind and water migration under the liner edge. The calculated factor of safety of 1.1 is considered adequate as it shows that anchor trench pullout will be the governing failure mode. Also note that the configuration is temporary as the slope will be filled against after phase construction.
- Interface liner system stability (gravity): 1.37
  - The interface liner system stability calculations are also most critical during and immediately after phase construction (until waste filling begins within the phase) and are a temporary condition. As waste is filled against the slope, the waste creates a buttress to provide more strength against failure. The calculated 1.37 factor of safety is considered adequate for temporary conditions.
- Interface liner system stability (equipment): 1.31 and 1.36
  - As described above, the calculated factors of safety are for temporary conditions during phase construction and are considered adequate.

It should be noted that all construction materials should be tested prior to use to ensure compliance with these calculations. If materials do not meet the requirements specified, analysis should be recompleted for the actual material properties.

All recommendations within the AET Report dated August 3, 2012 will be implemented in full upon permit amendment approval.

TLK



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AMERICAN ENGINEERING TESTING, INC.

CONSULTANTS
• ENVIRONMENTAL
• GEOTECHNICAL
• MATERIALS
• FORENSICS

August 3, 2012

SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve, Suite 305
St. Paul, MN 55121

Attn: Mr. Fred Doran, PE

RE: Supplemental Geotechnical Evaluation
McCombs Landfill Expansion
El Paso, Texas
AET Report No. 01-05106

Dear Mr. Doran:

This report presents the results of our supplemental geotechnical evaluation for the referenced project. We are submitting an electronic copy and three hard copies of the report to you. This work was performed in accordance with our proposal to you dated May 2, 2012, which was authorized by your Purchase Order No. P500115201, dated May 12, 2012. This report is a supplement to our original report to you titled *Report of Waste Mass Stability, McCombs Landfill Expansion, El Paso, Texas*, dated June 1, 2011, and addresses comments you received from the Texas Commission on Environmental Quality (TCEQ).

## 1.0 Scope of Supplemental Services

Our scope of services for this supplemental evaluation consists of the following items:

1. Perform a waste mass stability analysis that includes the proposed C&D waste and the existing municipal solid waste
2. Perform a waste mass stability of interim slopes
3. Evaluate stability and settlement of the final and alternate covers
4. Evaluate settlement of the foundation soils
5. Perform a preliminary review of our stability analyses with respect to seismic stability

## 2.0 Supplemental Waste Mass Stability Analyses

### *2.1 Discussion*

We evaluated the deep-seated stability by performing two-dimensional, effective stress slope stability analyses for the final, closed geometry, using the computer program *GSLOPE Version 5.10*. This program performs a limit equilibrium analysis for potential mass failure along assumed failure surfaces. We assumed that the failure surfaces extend through the new waste, and into the underlying C&D waste and existing MSW waste. For our analyses, we used the geometry from the cross-sections presented on the following SAIC drawings:



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- Drawing Number P3-20.0, "Typical Landfill Section B" dated 11/22/2011
- Drawing Number P3-23.0, "Typical Landfill Section E" dated 11/22/2011

Copies of these sections are attached in Appendix A. We understand that the final cover for the existing MSW landfill, below the new C&D waste, will consist of 3 feet of soil with no geosynthetics. We assume that this soil will be sand. We also assumed that there is a textured HDPE liner beneath the existing MSW landfill.

Due to the high variability of municipal waste, conventional *in situ* testing or laboratory testing to evaluate the engineering properties of the waste is not practical. There is no data available concerning the engineering properties of the new MSW waste, the C&D waste, the asbestos fill, and the existing MSW waste. Therefore, for our analyses we used published and assumed estimated effective stress values of shear strength, cohesion, and unit weight for municipal solid waste (Eid, et al, 2000, Singh and Murphy 1990), and we also used these same values for the C&D waste, asbestos fill, and the existing MSW waste. Please contact us if specific shear strength and unit weight data become available, and we can then re-evaluate our analyses. In addition, because specific laboratory test results are not available, we have assumed engineering properties for the drainage sand ("Protective Soil Layer") and the interface friction angle between the sand the geomembrane. The engineering properties used in our analyses are presented in Table 2-1.

**TABLE 2-1 ASSUMED ENGINEERING PROPERTIES FOR ANALYSES**

| Material | Effective Friction Angle, peak $\phi$'(degrees) | Effective Friction Angle, L.D.[1] $\phi$'(degrees) | Unit Weight, $\gamma$ (pcf) | Effective Cohesion (peak), c' (psf) | Effective Cohesion (L.D.[1]), c' (psf) |
|---|---|---|---|---|---|
| New and Existing MSW, New C&D Waste, Asbestos Fill | 35° | 28° | 65 | 525 | 0 |
| Drainage Sand | 29° | 29° | 110 | 0 | 0 |
| Interface between Sand/textured HDPE or LLDPE | 30° | 25° | N/A | 0 | 0 |

1: Large Displacement

### *2.2 Waste Mass Stability*

We analyzed potential circular failure surfaces and potential block (sliding) failure surfaces at Sections B and E. We assume that excess pore pressure will not develop within the waste either through hydrostatic pressure or gas pressure. The development of excess pore pressure would substantially reduce the factor of safety for stability. The results of our stability analyses using

peak strength values are presented in Appendix B. In summary, the minimum factor of safety is greater than 1.5, and in our judgment, is acceptable.

Due to the potential for variability of the engineering properties of the waste, we also performed a limited sensitivity analysis by evaluating the effect on the factor of safety by varying the strength parameters. The shear strength parameters used are presented in Table C-3 of our original report. The results of this limited sensitivity analysis are presented in attached Appendix B. The results indicate a factor of safety ranging from 1.47 to 2.78. In our judgment, these are acceptable.

To address the potential for progressive failure, we also performed an additional stability analysis using the assumed large displacement interface shear strengths presented in Table 2-1. The results of this analysis are presented in attached Appendix B. The calculated factor of safeties are in excess of 1.5, and in our judgment, are acceptable.

### *2.3 Interim Slopes*

We understand that interim slopes will be constructed no steeper than 3H:1V. We evaluated the interim slope waste mass stability assuming a cross section from Section E for the apparent tallest interim slope height of about 270 feet, with the waste placed on the maximum 1% sloping foundation grade. We assume that the interim waste will not be placed on slopes steeper than 1%, nor will they be constructed with a slope face steeper than 3H:1V. The results are presented in Appendix C. For the assumed peak strength parameters, the calculated factor of safety was 2.64 for a theoretical circular failure surface, and 2.42 for a theoretical block failure surface. The factor of safety assuming large displacement strength parameters was 1.60 and 1.76, respectively. In our judgment, these factor of safeties are acceptable.

## 3.0 Stability Analysis of Final and Alternate Cover Systems

We performed an "infinite" slope stability analysis to evaluate the stability of the final and alternate cover system following procedures described by Qian, et al (2002). The final cover profile consists of a 6-inch thick topsoil or 4-inch thick rock layer, a 12-inch thick erosion layer, a 40 mil textured LLDPE liner, an 18-inch thick infiltration layer, a 6-inch thick intermediate cover layer, and a 6-inch thick daily cover layer overlying the refuse. We understand that the maximum calculated head on top of the LLDPE liner within the erosion layer along the 3H:1V side slopes is 5.825 inches (0.49 feet). We assume that the erosion layer will consist of sand having less than 10% passing the No. 200 sieve.

For our analyses, we assumed a maximum slope grade of 3H:1V. We also assumed that the LLDPE liner is appropriately anchored such that there will be no slippage between this and the underlying materials. The scope of our analyses does not include an evaluation of the anchored trench design nor the adequacy of the strength of the geomembrane to prevent material rupture or creep failure. We understand that the landfill will incorporate an adequate landfill gas collection system; therefore, landfill gas pressures have not been included in the calculations. Landfill gas

pressure can substantially reduce the factor of safety. We assumed a peak interface friction angle of 28° between the LLDPE and the sand ("erosion layer") cover. We also assumed a friction angle of 29° for the sand cover soils.

The results are presented in Appendix E. The results indicate that for a no water flow condition, the calculated factor of safety is 1.61. Assuming a saturated depth of 0.49 feet within the cover soil above the LLDPE, with seepage parallel to the liner, the calculated factor of safety is 1.33 for the assumed interface friction angle between the LLDPE and the cover soil of 28°. To achieve a factor of safety of 1.5 for this seepage condition, both the interface friction angle and the internal friction angle of the sand cover soils needs to be at least 31°.

The alternate cover will consist of a 4-inch thickness of "rock armor," 18 inches of sand compacted to 90% Standard Proctor maximum dry density, and 6 inches of sand compacted to 80% Standard Proctor maximum dry density, overlying the refuse. Laboratory test results provided to us indicate that this sand has 13.7% passing the No. 200 sieve. The sand compacted to 90% has a friction angle of 25° as tested by the direct shear test. The results of our calculations are presented in Appendix E. Assuming a friction angle of 25° for both the "90% density" sand and the "80% density" sand, the results indicate that for a no water flow condition, the calculated factor of safety is 1.41. Seepage flow within the sand will lower the factor of safety. We have included a graph showing factor of safety versus saturation depth for parallel seepage, which indicates that the factor of safety drops below 1.0 for a saturation depth of about 1.25 feet.

## 4.0 Settlement Evaluation

### *4.1 Final Cover Settlement and Strain*

Our settlement evaluation for the final cover followed procedures and assumptions stated in our original report. As part of our settlement calculations we also evaluated the strain in the liner cover system, and also the anticipated change in surface grade between evaluation points. We evaluated the settlement at two cross sections; Sections B and E, as referenced in Section 2.0 of this report. The results are attached in Appendix D. In summary, the maximum tensile strain calculated is less than 0.01%, with most values less than zero (compression). Published information indicates that LLDPE can generally be assumed to have a yield strain on the order of 12%, or more; therefore, in our judgment, the calculated tensile strain should not adversely affect the LLDPE liner.

### *4.2 Piggyback Liner Settlement and Strain*

Our settlement evaluation for the piggyback liner followed procedures and assumptions stated in our original report. As part of our settlement calculations we also evaluated the strain in the piggyback liner cover system, and also the anticipated change in grade between evaluation points. We evaluated the settlement at two cross sections; Sections B and E, as referenced in Section 2.0 of this report. The results are attached in Appendix D. In summary, the maximum tensile strain calculated is 0.206%. Published information indicates that HDPE can generally be assumed to have a yield strain on the order of 12%, or more, and GCL can generally be assumed

to have a yield strain of 1% to 10%. The geogrid will have an allowable strain of 5%. Based on our results, in our judgment, the calculated tensile strain should not adversely affect these geosynthetic materials.

### *4.3 Foundation Settlement, Heave, and Strain*

Previous borings performed in the area were used to evaluate the subsurface conditions needed for estimation of foundation settlement and excavation-induced heave evaluation (see *SAIC Appendix 3K – Attachment 3, Borings*). The foundation is defined in this report as the base of the existing MSW landfill. No new borings or laboratory testing were performed for this evaluation.

The settlement analyses were made using the computer program *FoSSA 2.0*, which utilizes conventional Boussinesq stress theory. The program assesses stresses and settlements under embankments. The landfill was modeled as a two-dimensional embankment. We used elastic theory for the foundation soils and conventional consolidation theory for the different waste materials (i.e. the existing MSW, the C&D fill, and the asbestos fill).

The estimated heave of the foundation soils due excavation is plotted as estimated elastic rebound and are presented on the attached graphs in Appendix E. The amount of excavation-induced heave calculated is, in our opinion, small, generally less than about 0.25 feet.

The estimated foundation settlement due to the full MSW height are presented on the attached graphs in Appendix E. The foundation settlement is estimated to be less than one foot, and the strain is estimated to be 0.03%, or less. Published information indicates that HDPE can generally be assumed to have a yield strain on the order of 12%, or more. In our judgment, the estimated amount of settlement and strain should not adversely affect the existing HDPE liner.

## 5.0 Preliminary Seismic Stability Analyses

You indicated that originally the landfill was located outside any designated seismic impact zones at the time of the original construction; however, based on current USGS seismic maps the facility is now within a seismic impact zone that exceeds the 30 TAC §330.557 standard. A seismic impact zone is defined as an area with a 10% or greater probability that the maximum horizontal acceleration in rock will exceed 0.10g in 250 years. You explained; however, that this standard only applies to new MSW facilities and not vertical expansions as proposed. Although not specifically required, we have, however, performed a preliminary review of our stability analyses with respect to seismic stability.

According to the USGS Ground Motion Parameter Calculator, the site specific maximum seismic horizontal acceleration with a 2% probability of exceedance in 50 years (equivalent to 10% probability in 250 years) is 0.116g for a one second period. We performed a pseudo-static screening analysis following procedures described by Bray, et al (1998), and Duncan and Wright (2005). Our analysis assumed an acceleration multiplier of 0.75. The results are attached. In summary, the screening analysis for the interim slope, and waste mass stability through Section

E, resulted in a factor of safety of in excess of 1.2. The screening analysis for the final cover, assuming a large displacement interface friction angle of 25° between the LLDPE and the cover soils, and a dry condition, resulted in a factor of safety of 1.08. The calculated factor of safety for these screening analyses are greater than 1.0, and as such, permanent seismic displacements are estimated to be less than one foot.

## 6.0 Concluding Comments

No new laboratory testing has been authorized as part of this supplemental work. It is important; however, that our assumed engineering properties are confirmed by specific testing prior to construction. Apart from the typical testing required, such as Proctor tests and gradation analyses, additional testing to address the assumed parameters in this report should include, but not be limited to, the following items:

1. Final Cover System
    a. Direct shear test on the Final Cover "Erosion Layer" soil.
    b. Large-scale direct shear test to determine the interface friction angle between the "Erosion Layer" soil and the 40 mil LLDPE.
2. Alternate Cover System
    a. Direct shear test on the sand compacted to 80% of the maximum Standard Proctor dry density.
3. Piggyback Liner System
    a. Large-scale direct shear test to determine the interface friction angle between the "Protective Soil Layer" and the 60 mil HDPE.
4. Basal Permitted and Alternate Liner Systems
    a. Direct shear test on the "Protective Soil Layer."
    b. Large-scale direct shear test to determine the interface friction angle between the "Protective Soil Layer" and the 60 mil HDPE.

The geosynthetic manufacturers should also provide the allowable yield strain for all of their proposed materials.

## 7.0 Limitations

Within the limitations of scope, budget, and schedule, we have endeavored to provide our services according to generally accepted geotechnical engineering practices at this time and location. Other than this, no warranty, either express or implied, is intended.

**American Engineering Testing, Inc.**

Authored by:

Gregory R. Reuter, PE
Principal Engineer

Enc.

Reviewed by:

James C. Rudd, PE
Principal Engineer/Vice President

**AMERICAN ENGINEERING TESTING, INC.**
**TEXAS REGISTERED ENGINEERING FIRM F-10340**

## References

Bray, J.D., Rathje, E.M., Augello, A.J., and Merry, S.M. (1998). "Simplified Seismic Design Procedure for Geosynthetic-Lined, Solid-Waste Landfills," *Geosynthetics International*, Vol. 5, Nos. 1-2: 203-235.

Duncan, J.M, and Wright, S.G. (2005). Soil Strength and Slope Stability. John Wiley & Sons, Inc.

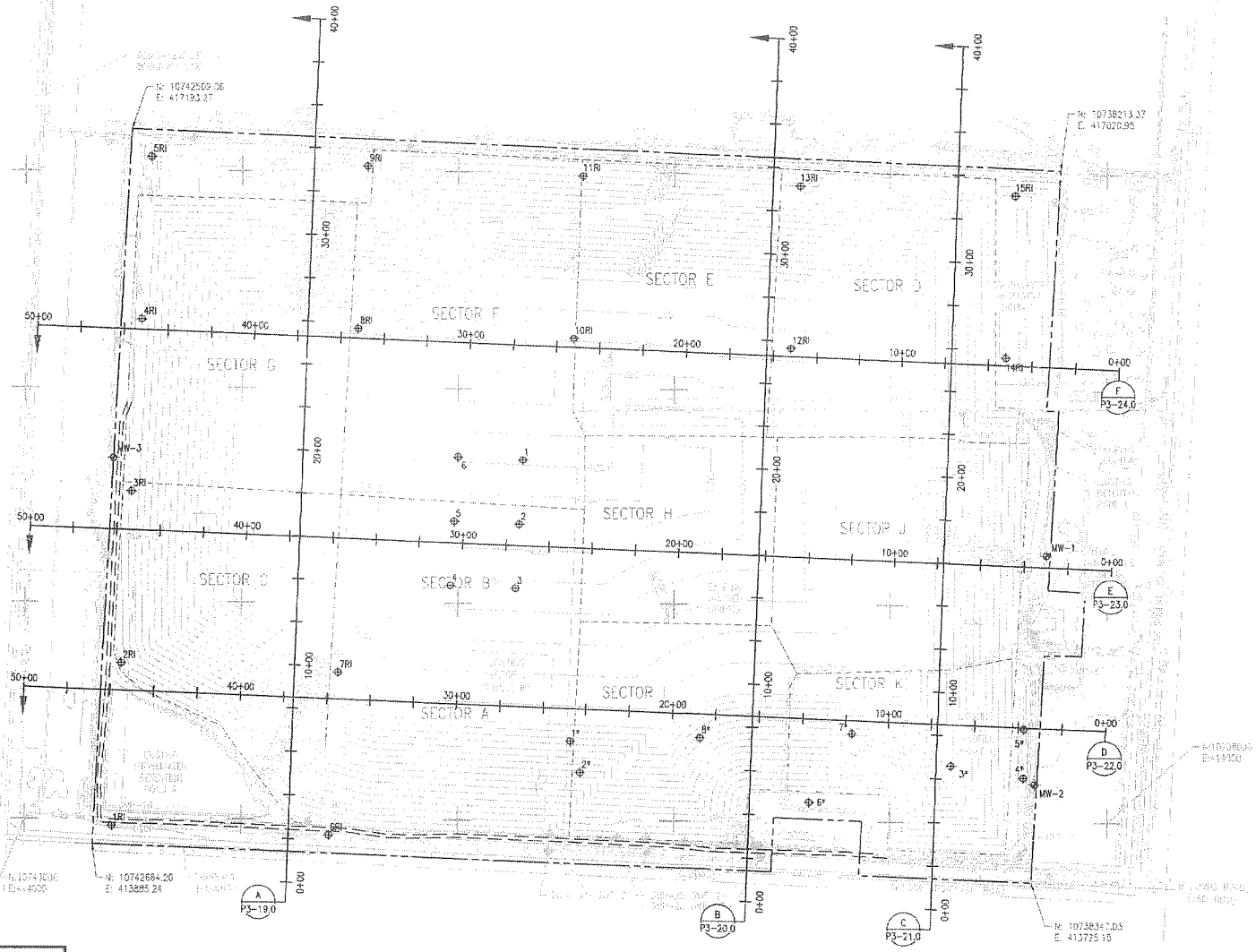
Eid, H.T., Stark, T.D., Evans, W.D., and Sherry, P.E. (2000). "Municipal Solid Waste Slope Failure I: Waste and Foundation Soil Properties," *Journal of Geotechnical and Geoenvironmental Engineering*, ASCE, 126(5): 397-407

Singh, S. and Murphy, B., "Evaluation of the Stability of Sanitary Landfills," (1990), *in* Geotechnics of Waste Fills – Theory and Practice, ASTM STP 1070, Landva, A., and Knowles, G.D., eds.

Qian, X., Koerner, R.M., and Gray, D.H. (2002). "Geotechnical Aspects of Landfill Design and Construction," Prentice Hall

Attachments: Appendix A –SAIC Drawings
Appendix B – Waste Mass Stability Analysis through existing MSW
Appendix C – Waste Mass Stability Analysis, Interim Slopes
Appendix D – Settlement, Strain, and Heave Analysis
Appendix E – Final and Alternate Cover Stability Analyses

APPENDIX A
SAIC DRAWINGS




## NOTES

1. CONTOURS PROVIDED WITHIN LANDFILL BOUNDARY REPRESENT TOP OF FINAL CONTOURS. CONTOUR INTERVAL IS TEN FEET
2. DIGITIZED TOPOGRAPHY FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS. EXISTING CONTOUR INTERVAL IS TWO FEET.
3. COORDINATES ARE BASED ON THE TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NAD 83. ELEVATIONS ARE NAVD 88 VERTICAL DATUM.

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- ⊕1RI – BORING LOCATION AND NUMBER PER DRA CONSULTANTS (NOVEMBER 1983)
- ⊕1 – BORING LOCATION AND NUMBER PER DICKINSON LABORATORIES (JUNE 1976)

GRAPHIC SCALE
1"=250'-0" 250 0 250 500
Scale Feet

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PROJECT NUMBER 9631500115
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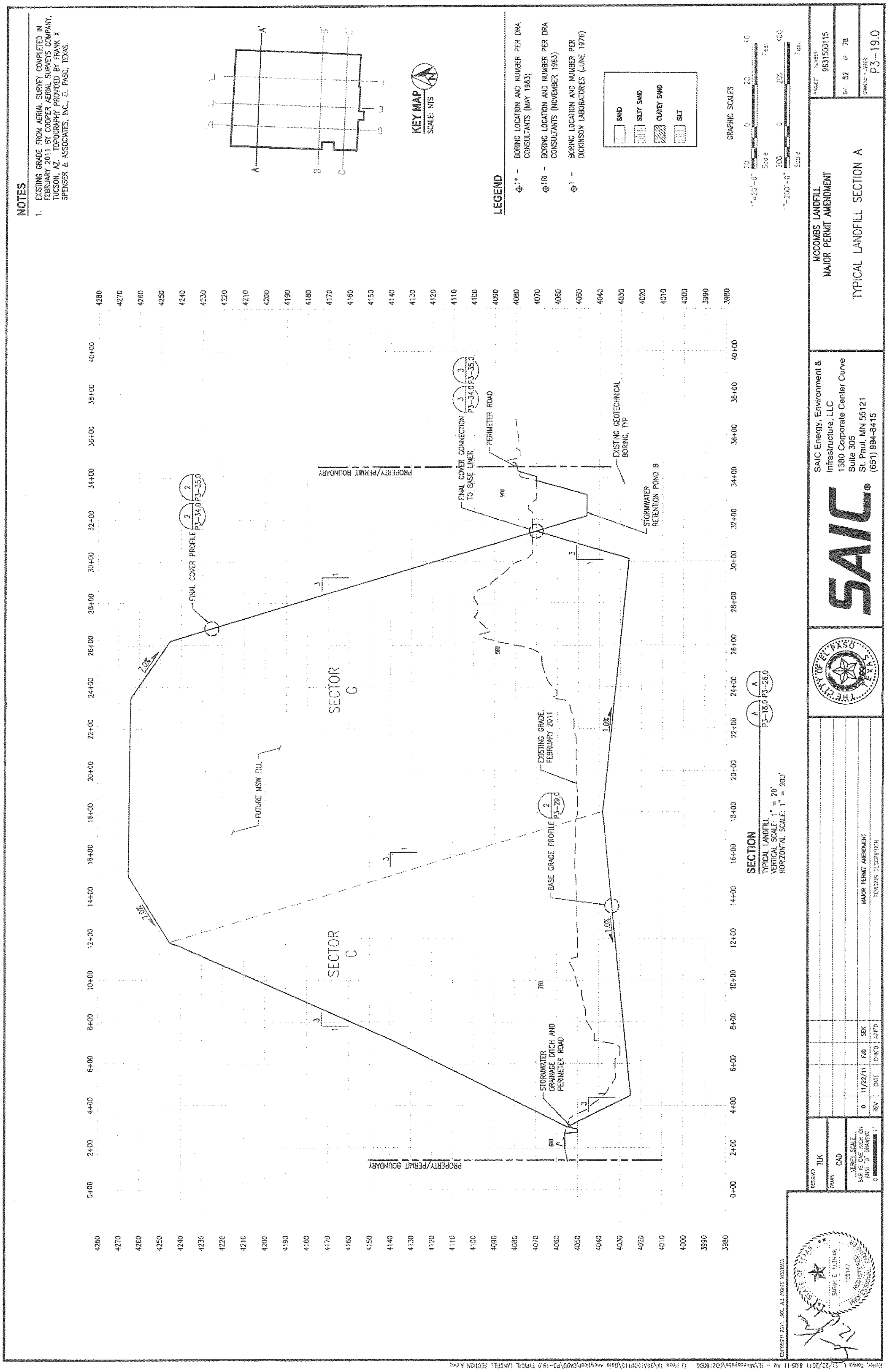
DRAWING NUMBER P3-18.0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BORING LOCATION AND NUMBER PER DICKINSON LABORATORIES (JUNE 1976)
SAND
SILTY SAND
CLAYEY SAND
SILT
GRAPHIC SCALES
SECTOR G
SECTOR C
FUTURE MSW FILL
FINAL COVER PROFILE
BASE GRADE PROFILE
EXISTING GRADE, FEBRUARY 2011
FINAL COVER CONNECTION TO BASE LINER
PERIMETER ROAD
EXISTING GEOTECHNICAL BORING, TYP
STORMWATER RETENTION POND B
STORMWATER DRAINAGE DITCH AND PERIMETER ROAD
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TYPICAL LANDFILL
VERTICAL SCALE: 1" = 20'
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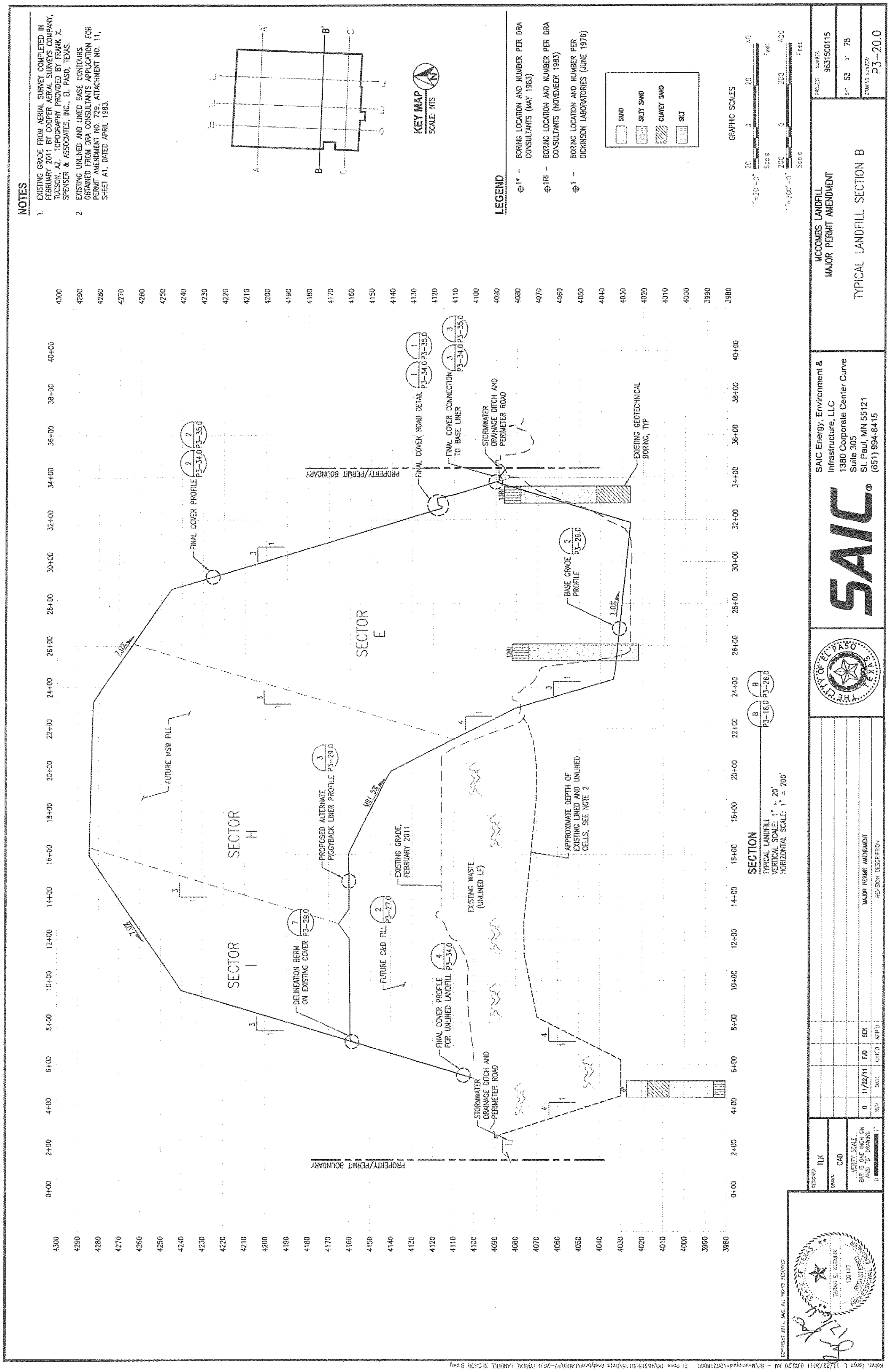
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2. EXISTING UNLINED AND LINED BASE CONTOURS OBTAINED FROM DRA CONSULTANTS APPLICATION FOR PERMIT AMENDMENT NO. 729, ATTACHMENT NO. 11, SHEET A1, DATED APRIL 1983.
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FUTURE MSW FILL
FINAL COVER PROFILE
FINAL COVER ROAD DETAIL
FINAL COVER CONNECTION TO BASE LINER
STORMWATER DRAINAGE DITCH AND PERIMETER ROAD
EXISTING GEOTECHNICAL BORING, TYP
PROPERTY/PERMIT BOUNDARY
BASE GRADE PROFILE
PROPOSED ALTERNATE PIGGYBACK LINER PROFILE
EXISTING GRADE, FEBRUARY 2011
EXISTING WASTE (UNLINED LF)
APPROXIMATE DEPTH OF EXISTING LINED AND UNLINED CELLS, SEE NOTE 2
DELINEATION BERM ON EXISTING COVER
FUTURE C&D FILL
FINAL COVER PROFILE FOR UNLINED LANDFILL
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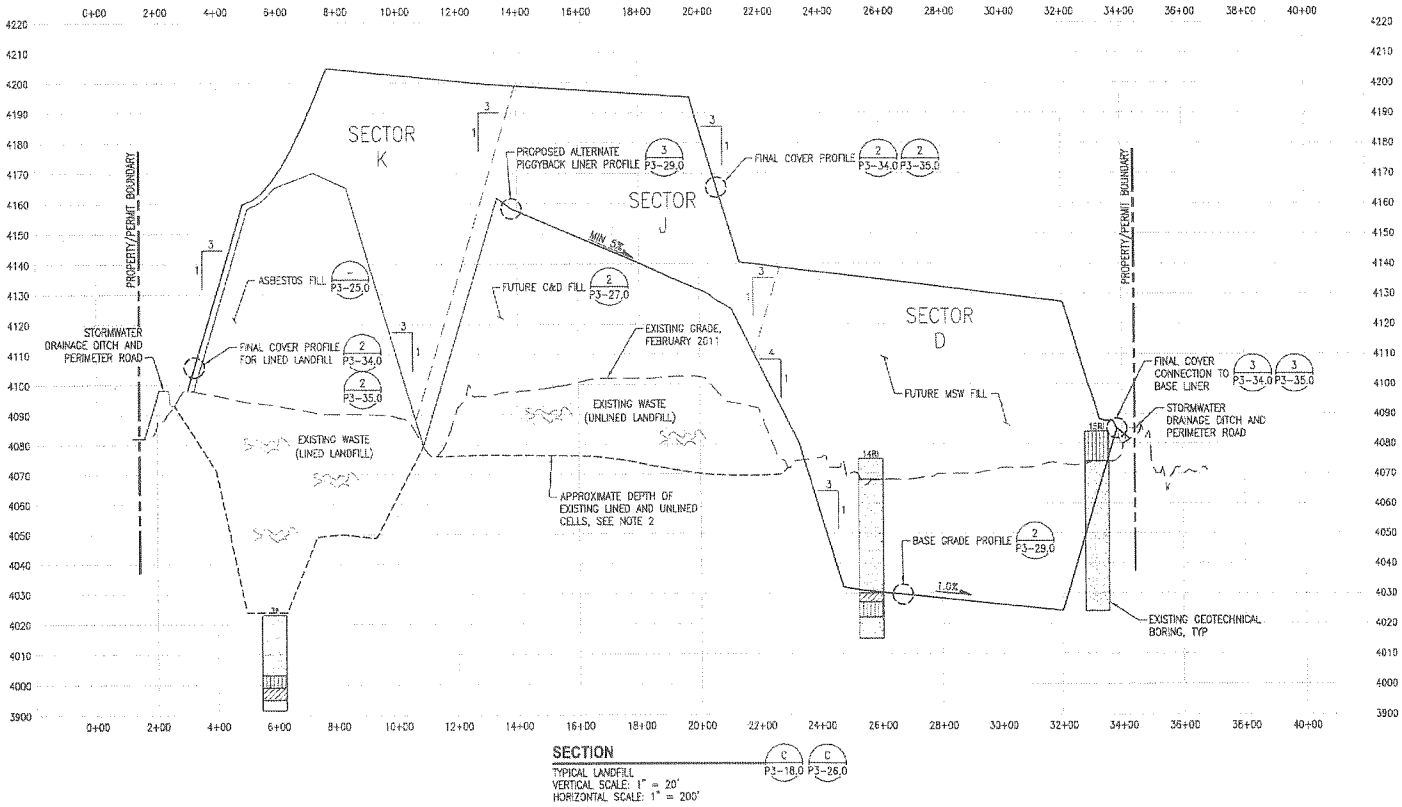


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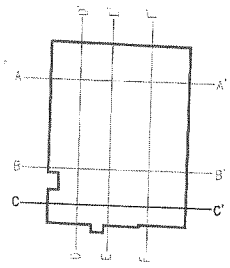


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GRAPHIC SCALES
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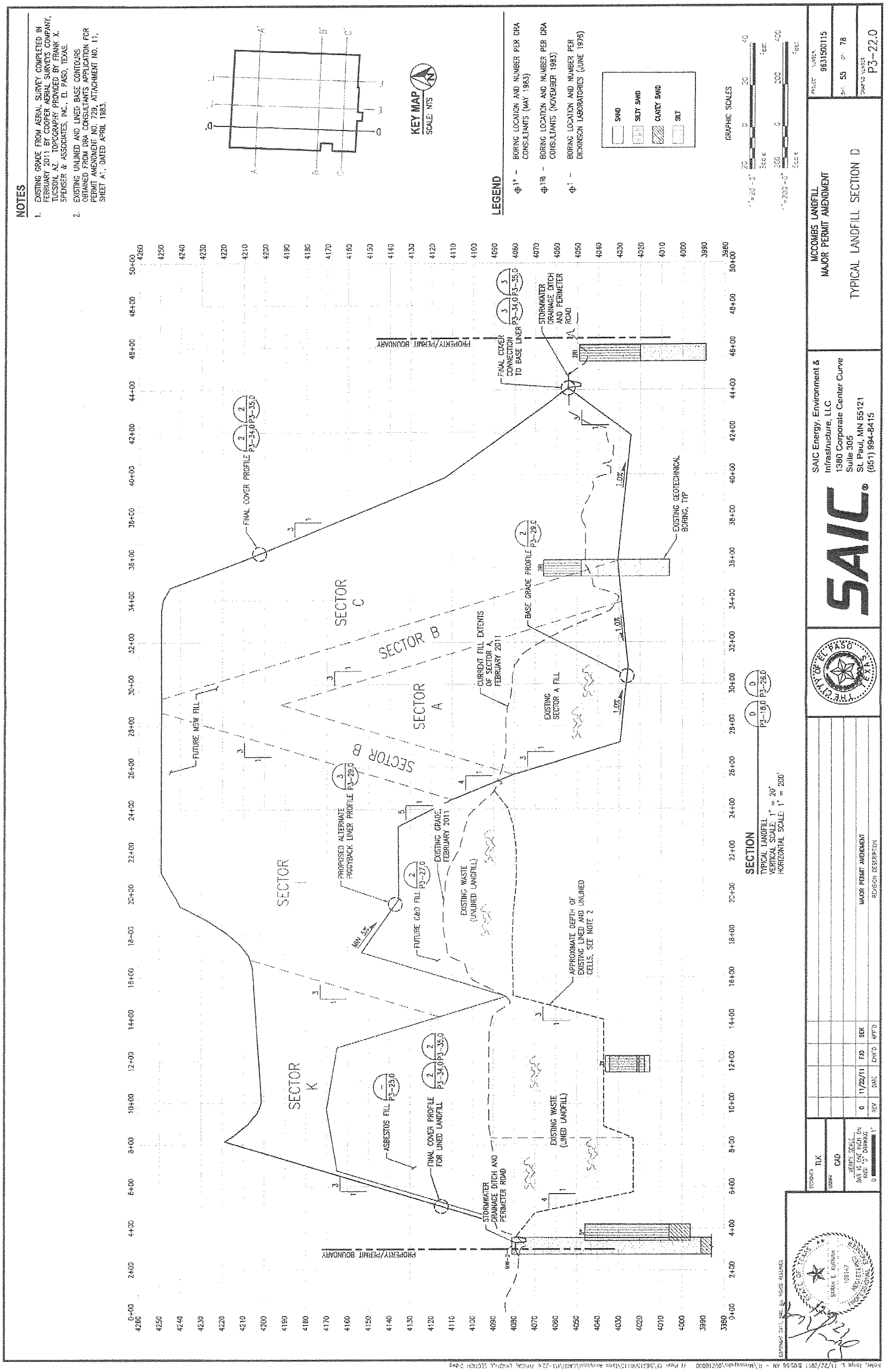

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FUTURE MSW FILL
PROPOSED ALTERNATE PIGGYBACK LINER PROFILE
FUTURE C&D FILL
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EXISTING WASTE (UNLINED LANDFILL)
EXISTING WASTE (LINED LANDFILL)
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FINAL COVER PROFILE FOR LINED LANDFILL
STORMWATER DRAINAGE DITCH AND PERIMETER ROAD
APPROXIMATE DEPTH OF EXISTING LINED AND UNLINED CELLS, SEE NOTE 2
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EXISTING SECTOR A FILL
BASE GRADE PROFILE
EXISTING GEOTECHNICAL BORING, TYP
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TYPICAL LANDFILL
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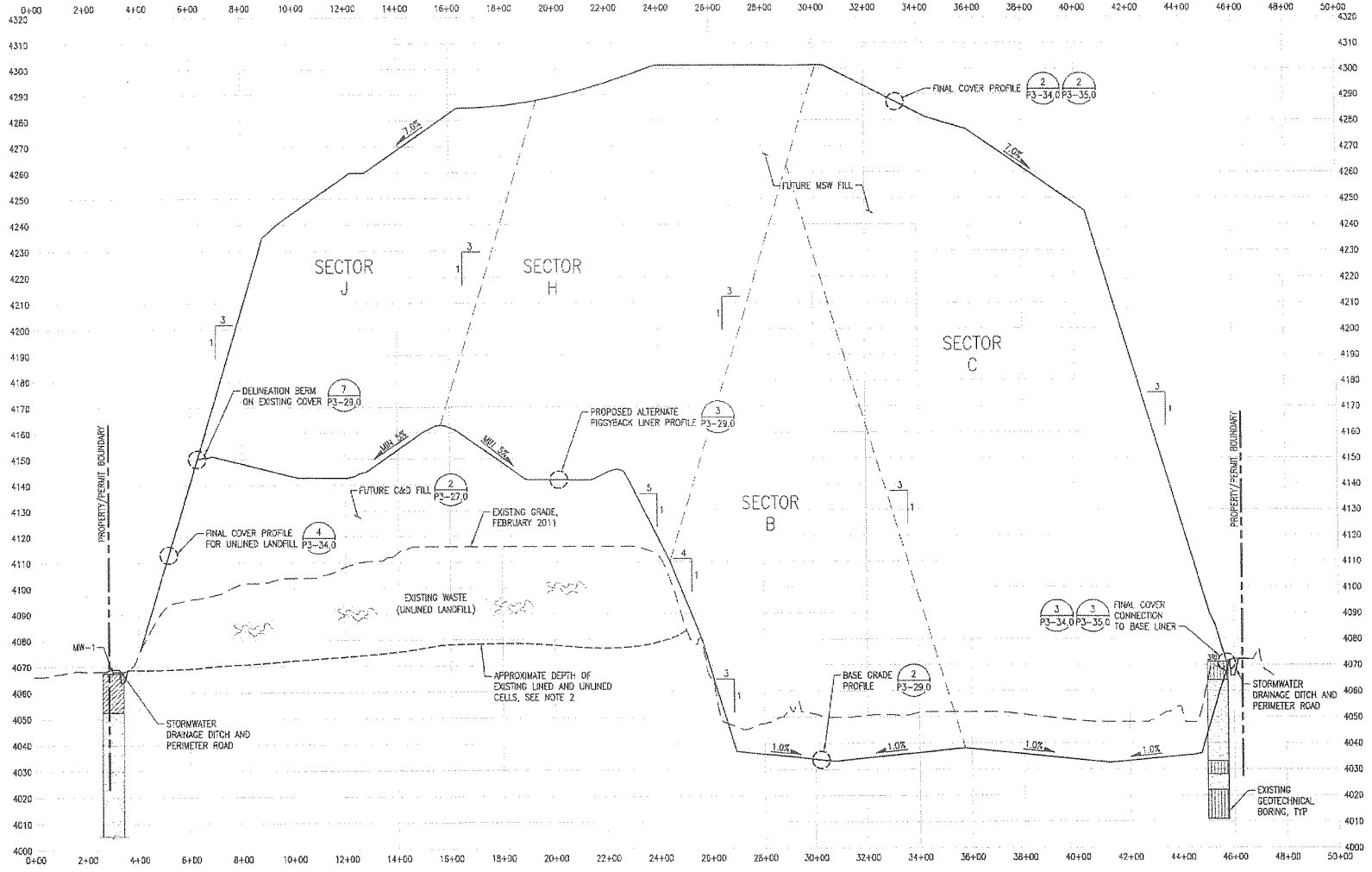


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## NOTES

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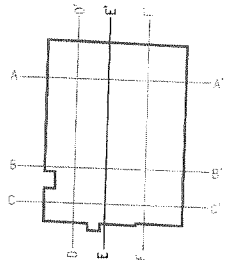


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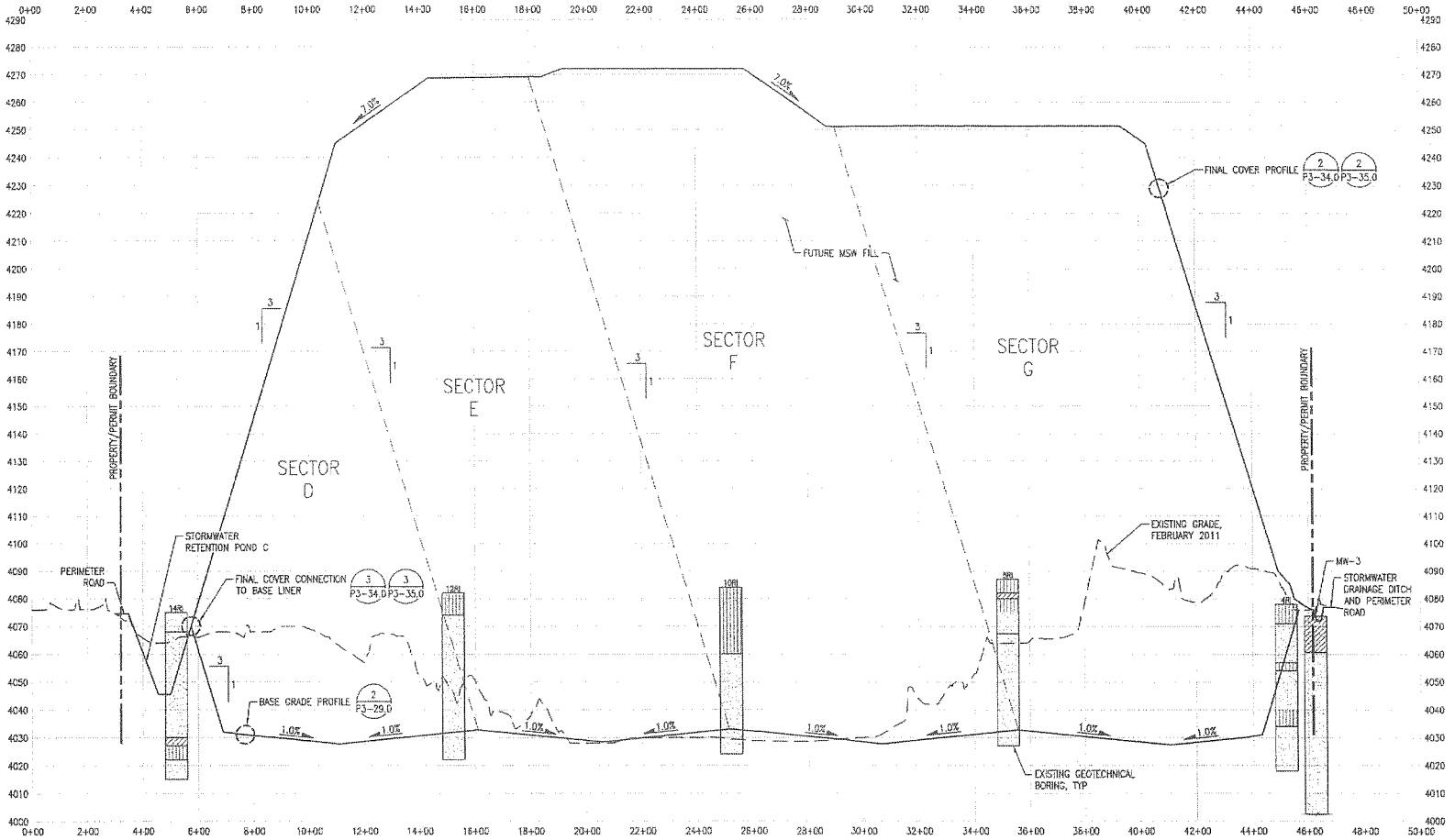


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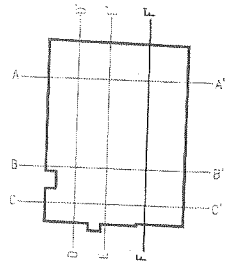


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GRAPHIC SCALES

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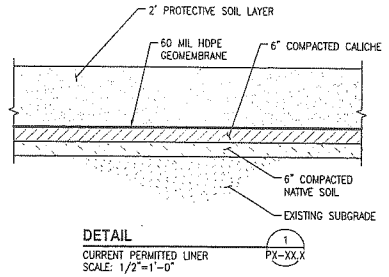
Suite 305
St. Paul, MN 55121
(651) 994-8415

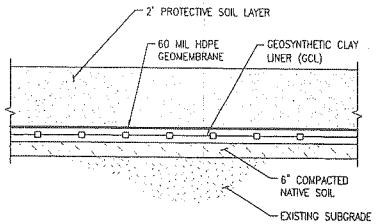
McCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

TYPICAL LANDFILL SECTION F

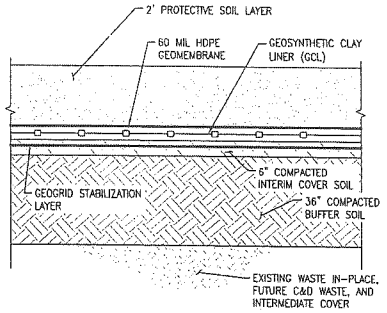
PROJECT NUMBER 9631500115
SHT 57 OF 78
DRAWING NUMBER P3-24.0




DETAIL 1 PX-XX.X
CURRENT PERMITTED LINER
SCALE: 1/2"=1'-0"



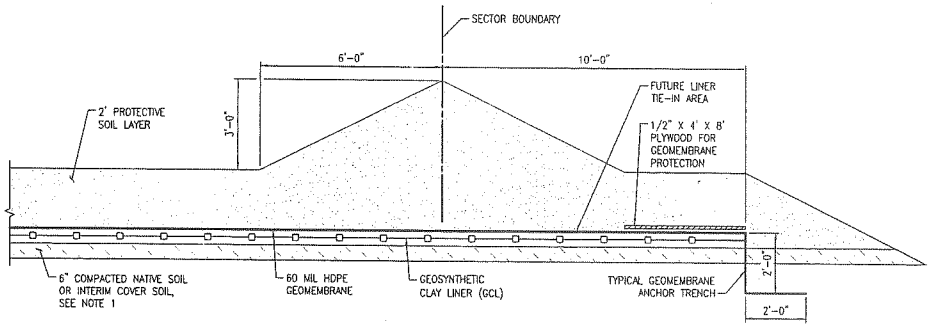

DETAIL 2 PX-XX.X
PROPOSED ALTERNATIVE LINER
SCALE: 1/2"=1'-0"



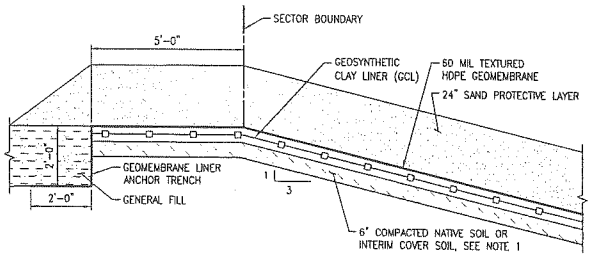

DETAIL 3 PX-XX.X
PROPOSED ALTERNATIVE PIGGYBACK LINER
SCALE: 1/2"=1'-0"

## NOTES

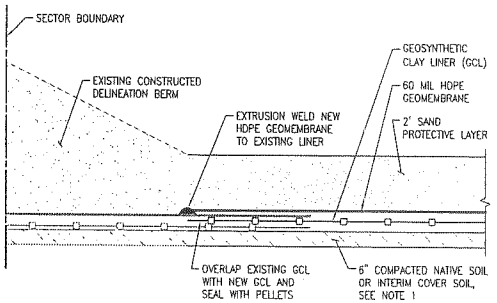
1. FOR THE PROPOSED ALTERNATIVE PIGGYBACK, THE COMPACTED INTERIM COVER SOIL SHALL CONTAIN A GEOGRID STABILIZATION LAYER AS SHOWN ON DETAIL 3.




DETAIL 4 PX-XX.X
TYPICAL SECTOR DELINEATION BERM
SCALE: 1/2"=1'-0"




DETAIL 5 PX-XX.X
TYPICAL GEOMEMBRANE ANCHOR TRENCH
SCALE: 1/2"=1'-0"




DETAIL 6 PX-XX.X
EXISTING LINER TIE-IN
SCALE: 1/2"=1'-0"

GRAPHIC SCALE
1/2"=1'-0"
1 0 1 2 3 4 5
Scale Feet

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STATE OF TEXAS — name — number — REGISTERED PROFESSIONAL ENGINEER

| | | | | | |
|---|---|---|---|---|---|
| DESIGNED | TLK | | | | |
| DRAWN | CAD | | | | |
| VERIFY SCALE BAR IS ONE INCH ON ANSI "D" DRAWING | 0 1" | 0 | 4/15/11 | SEK | FJD |
| | | REV | DATE | CHK'D | APP'D |

MAJOR PERMIT MODIFICATION
REVISION DESCRIPTION

CITY OF EL PASO, TEXAS

SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve
Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL – MSW PERMIT NO. 729A
MAJOR PERMIT AMENDMENT

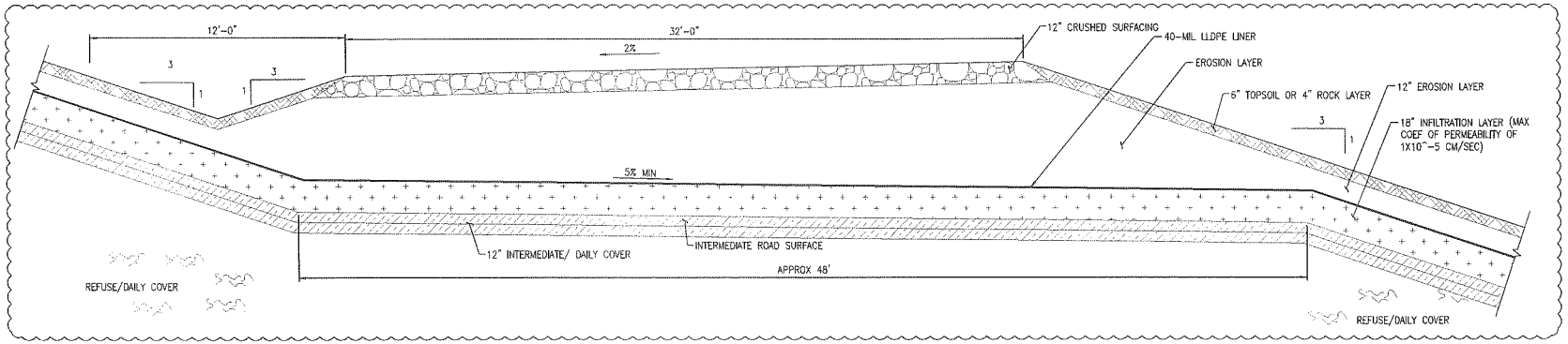
LINER DETAILS

PROJECT NUMBER: 9631500115
SHT. 62 OF XX
DRAWING NUMBER: P3-30.0

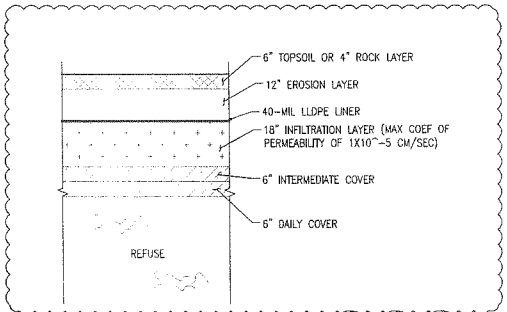
Keller, Joyce L. 3/20/2012 7:27:18 AM - R:\Minneapolis\9631500115\Data Analysis\CAD\P3-30.0 LINER DETAILS.dwg

## NOTES

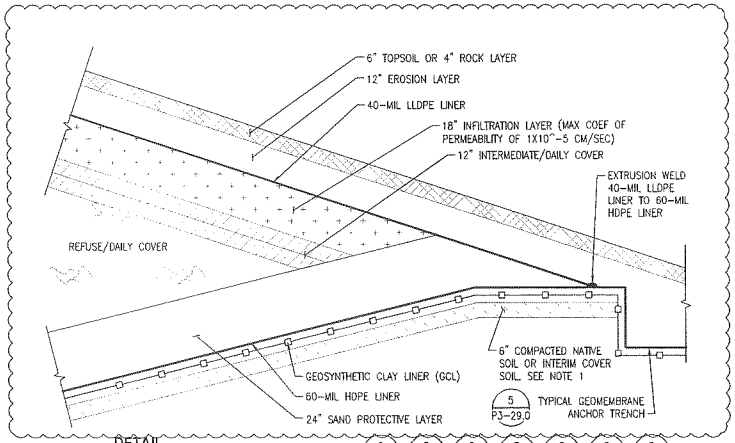
1. FOR THE PROPOSED ALTERNATIVE PIGGYBACK DESIGN, THE INTERIM COVER SOIL LAYER SHALL UNDERLAY GEOGRID STABILIZATION LAYERS AS SHOWN ON DETAIL 3, DWG P3-29.0.



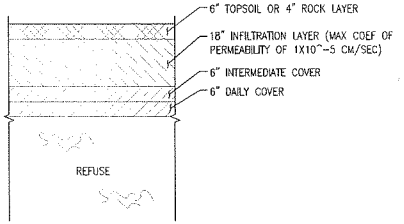

**DETAIL** — TYPICAL ROAD DETAIL (1 P3-20.0, 1 P3-33.0)
SCALE: 3/8"=1'-0"




**DETAIL** — TYPICAL FINAL COVER PROFILE FOR SIDESLOPE OR CROWN (2 P3-19.0, 2 P3-20.0, 2 P3-21.0, 2 P3-22.0, 2 P3-23.0, 2 P3-24.0, 2 P3-29.0, 2 P3-33.0)
SCALE: 1/2"=1'-0"




**DETAIL** — TYPICAL FINAL COVER CONNECTION TO EXISTING BASE LINER (3 P3-19.0, 3 P3-20.0, 3 P3-21.0, 3 P3-22.0, 3 P3-23.0, 3 P3-24.0, 3 P3-29.0)
SCALE: 1/2"=1'-0"




**DETAIL** — FINAL COVER PROFILE FOR UNLINED LANDFILL (4 P3-20.0, 4 P3-23.0, 4 P3-29.0)
SCALE: 1/2"=1'-0"

GRAPHIC SCALE
1/2"=1'-0" Scale
3/8"=1'-0" Scale

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REGISTERED PROFESSIONAL ENGINEER — FREDERIC J. DEPAIN — STATE OF TEXAS

| | | | | | |
|---|---|---|---|---|---|
| DESIGNED | TLK | | | | |
| DRAWN | CAD | | | | |
| VERIFY SCALE BAR IS ONE INCH ON ANSI "D" DRAWING | 1 | 6/9/12 | TLK | FJD | FIRST TECHNICAL MOD RESPONSE |
| | 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |
| | REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |

THE CITY OF EL PASO TEXAS

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(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

FINAL COVER DETAILS

PROJECT NUMBER 9631500115
SHT 57 OF 78
DRAWING NUMBER P3-34.1

Keller, Floyd L. 6/13/2012 - 12:58:09 PM - P:\2012\9631500115\Data And\Cad\C4D\P3-34.1 FINAL COVER DETAILS.dwg

APPENDIX B
WASTE MASS STABILITY ANALYSIS
ASSUMED FAILURE THROUGH EXISTING MSW

**AMERICAN ENGINEERING TESTING, INC.**
**TEXAS REGISTERED ENGINEERING FIRM F-10340**

McCombs Landfill
American Engineering Testing, Inc.
AET No. 01-05106

| TABLE B-1: RESULTS OF WASTE MASS STABILITY ANALYSIS – PEAK PARAMETERS, BASE CONDITION | | |
|---|---|---|
| Cross Section | Factor of Safety Circular Failure | Factor of Safety Block Failure |
| B | 3.04 | 3.01 |
| E | 2.78 | 2.56 |

| TABLE B-2 : RESULTS OF WASTE MASS STABILITY ANALYSIS – SENSITIVITY ANALYSIS, CROSS SECTION E | | | | | |
|---|---|---|---|---|---|
| Condition | $\gamma'$ (pcf) | $\phi'$ (deg.) | $c'$ (psf) | Factor of Safety | |
| | | | | Circular | Block |
| Base | 65 | 35 | 525 | 2.78 | 2.56 |
| 1 | 65 | 35 | 0 | 2.10 | 2.18 |
| 2 | 65 | 26 | 0 | 1.47 | 1.80 |

| TABLE B-3: RESULTS OF WASTE MASS STABILITY ANALYSIS – LARGE DISPLACEMENT PARAMETERS | | |
|---|---|---|
| Cross Section | Factor of Safety Circular Failure | Factor of Safety Block Failure |
| B | 1.60 | 2.14 |
| E | 1.60 | 1.71 |

SECTION B

| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 525 | 35 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 65 | 525 | 35 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 30 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

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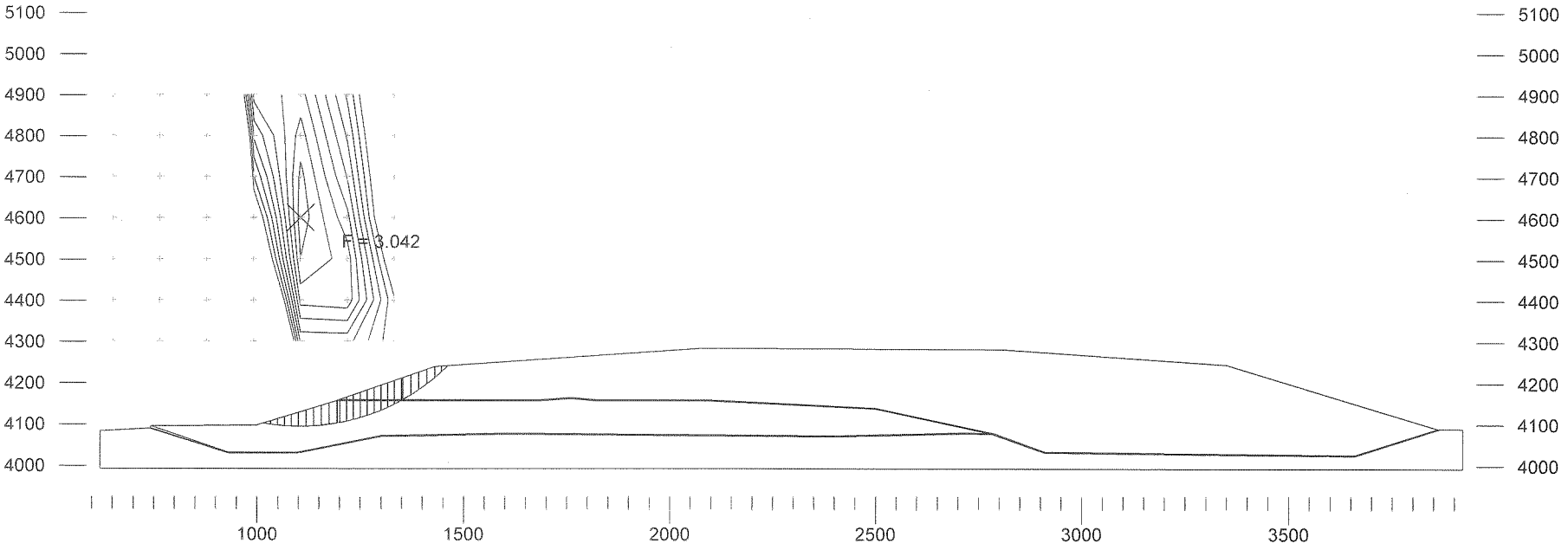
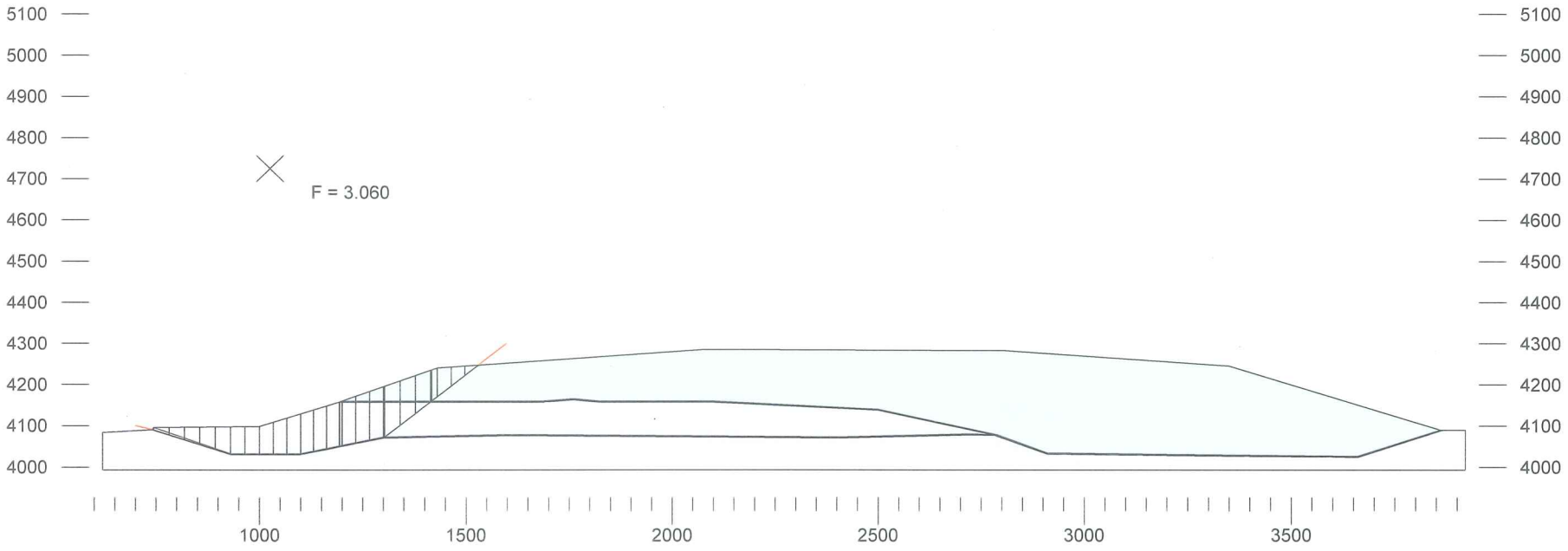
Section B



| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 525 | 35 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 65 | 525 | 35 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 30 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

American Engineering Testing - St. Paul, MN
01-05106
McCombs Landfill Expansion
July 2012
Section B

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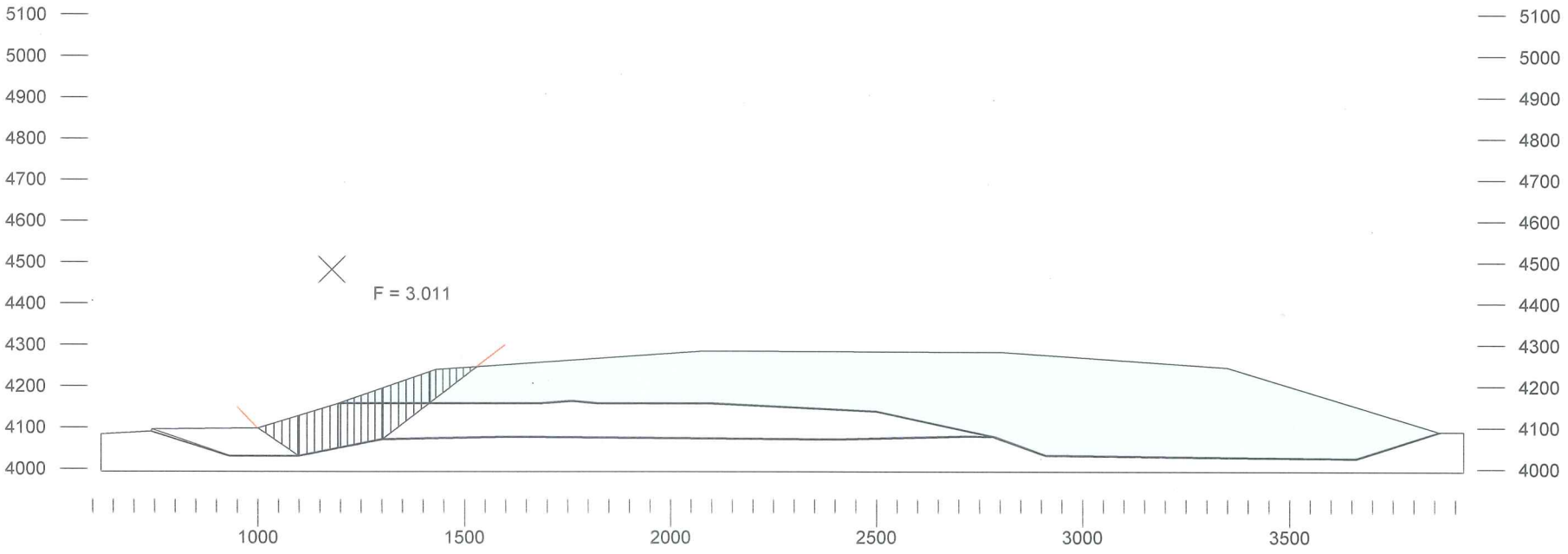
| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 525 | 35 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 65 | 525 | 35 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 30 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

American Engineering Testing - St. Paul, MN
01-05106
McCombs Landfill Expansion
July 2012
Section B

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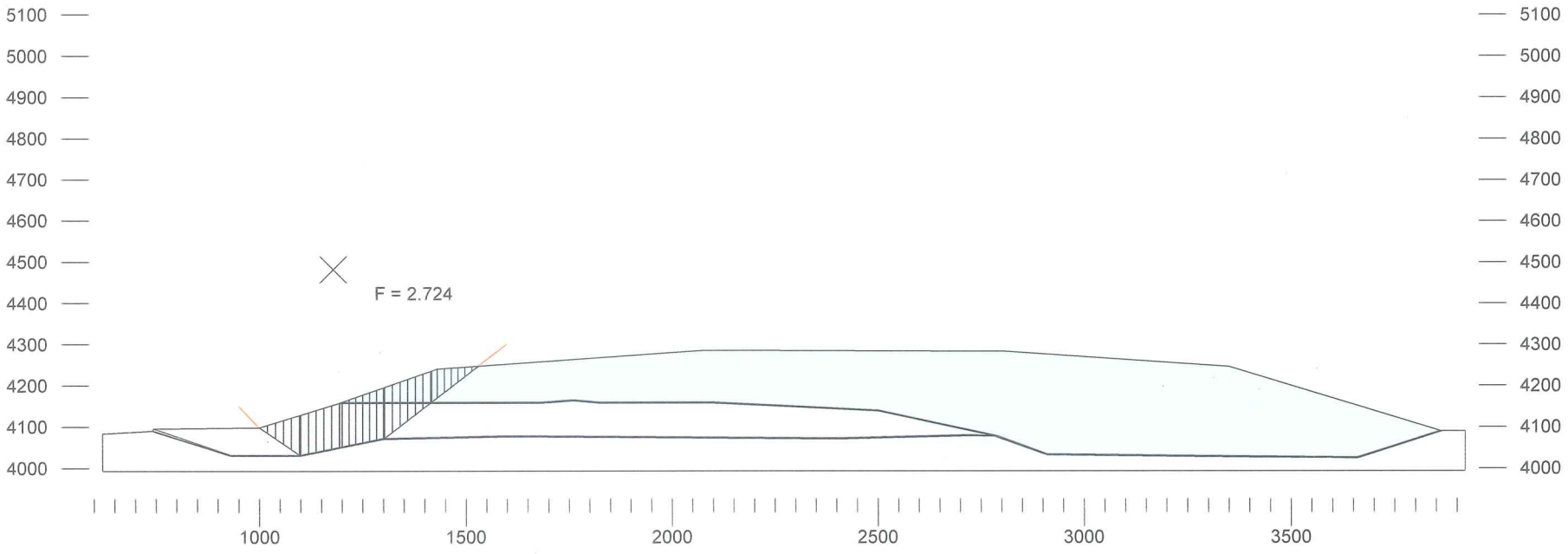
| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 0 | 35 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 65 | 0 | 35 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 30 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

American Engineering Testing - St. Paul, MN
01-05106
McCombs Landfill Expansion
July 2012
Section B
Sensitivity Analysis - Case 1



| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 0 | 26 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 65 | 0 | 26 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 30 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

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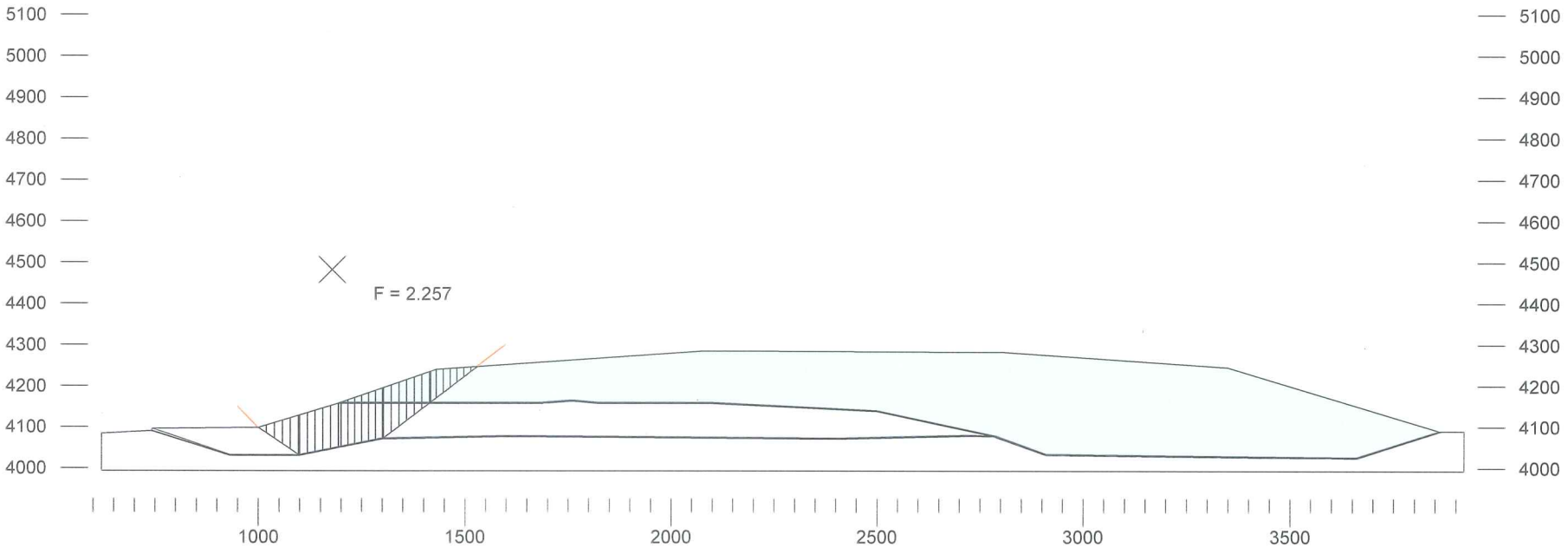
01-05106
McCombs Landfill Expansion
July 2012
Section B
Sensitivity Analysis - Case 2

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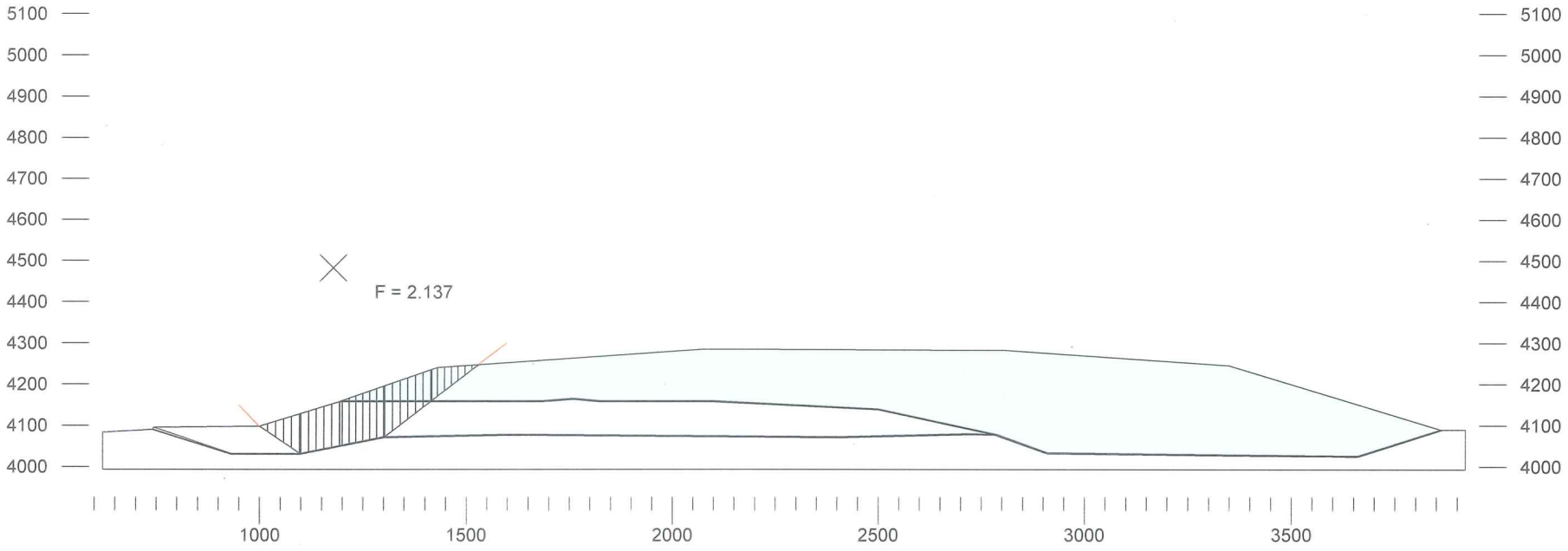
| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 0 | 28 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 25 | 1 |
| Exist.Waste/Fut.C&D | 65 | 0 | 28 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 25 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

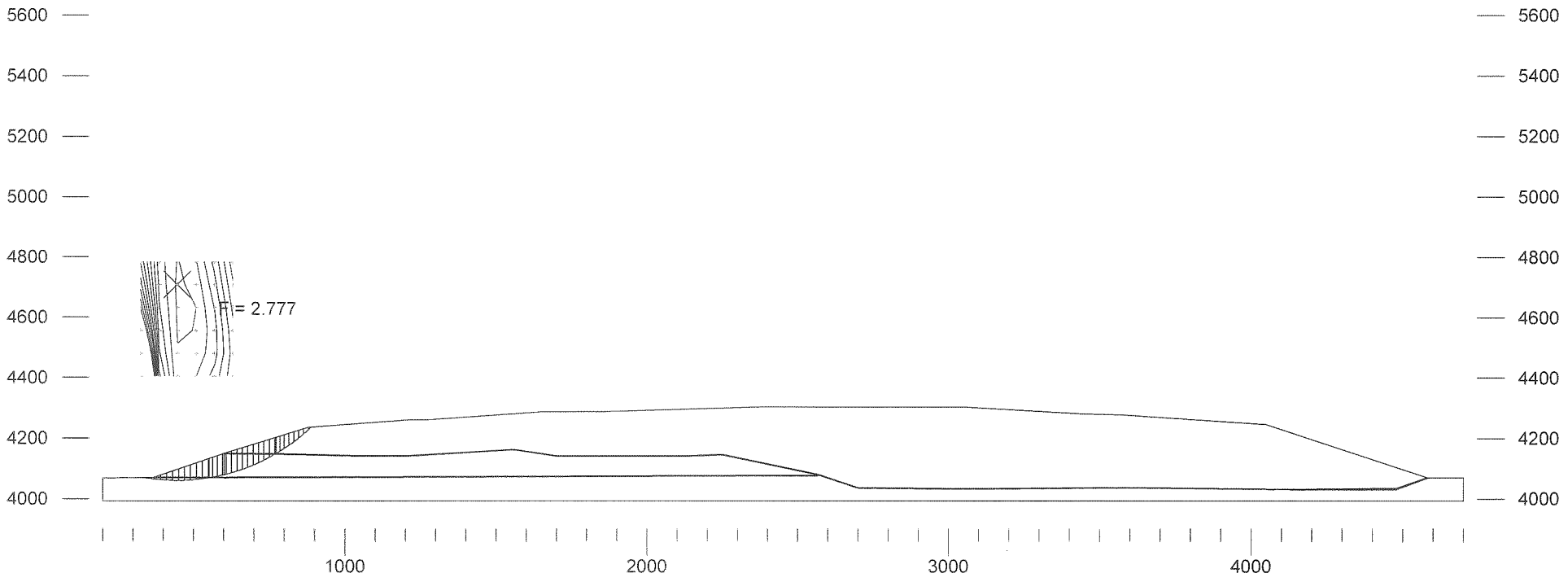
American Engineering Testing - St. Paul, MN
01-05106
McCombs Landfill Expansion
July 2012
Section B
Large Displacement Parameters



SECTION E

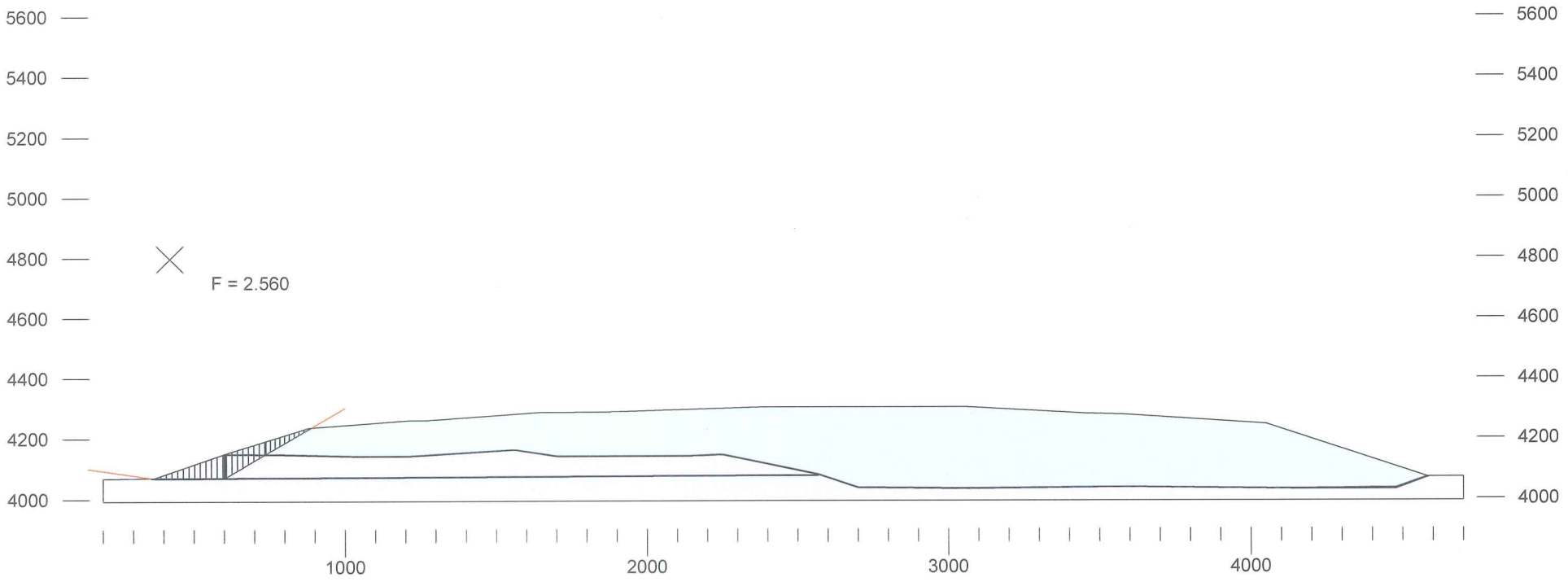
| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 525 | 35 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 65 | 525 | 35 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 30 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

American Engineering Testing - St. Paul, MN
01-05106
McCombs Landfill Expansion
July 2012
Section E



| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 525 | 35 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 65 | 525 | 35 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 30 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

American Engineering Testing - St. Paul, MN
01-05106
McCombs Landfill Expansion
July 2012
Section E

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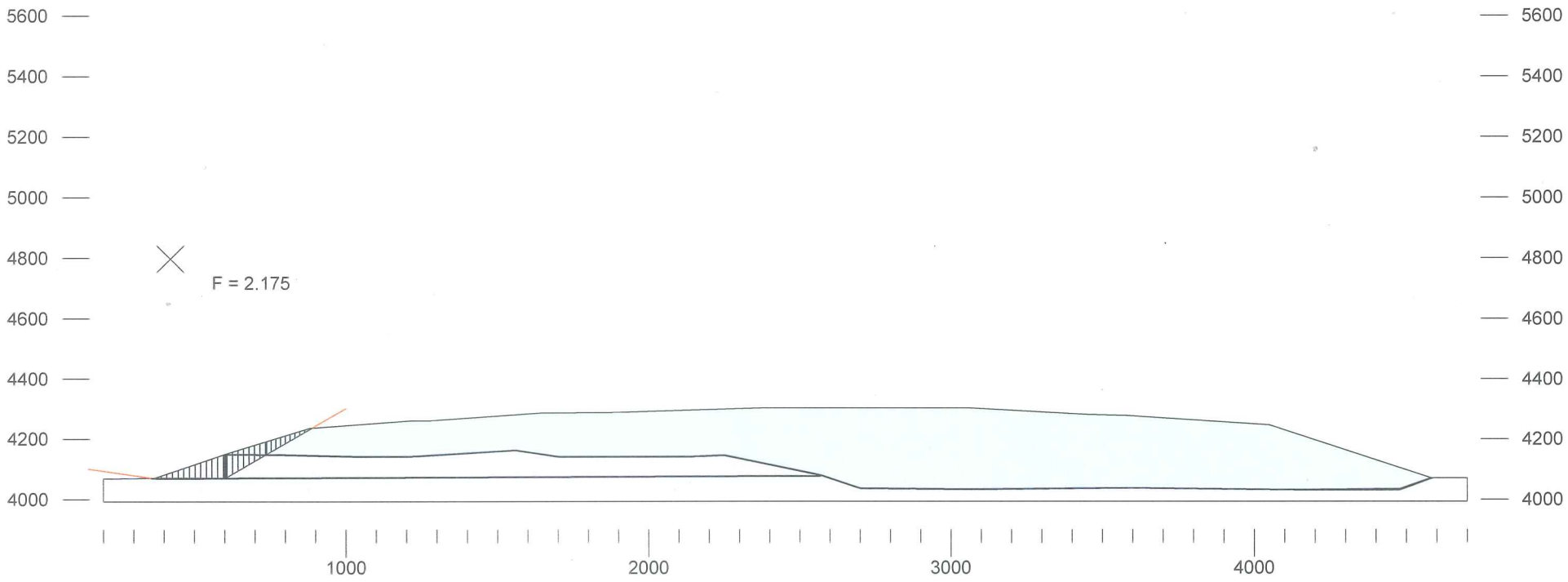
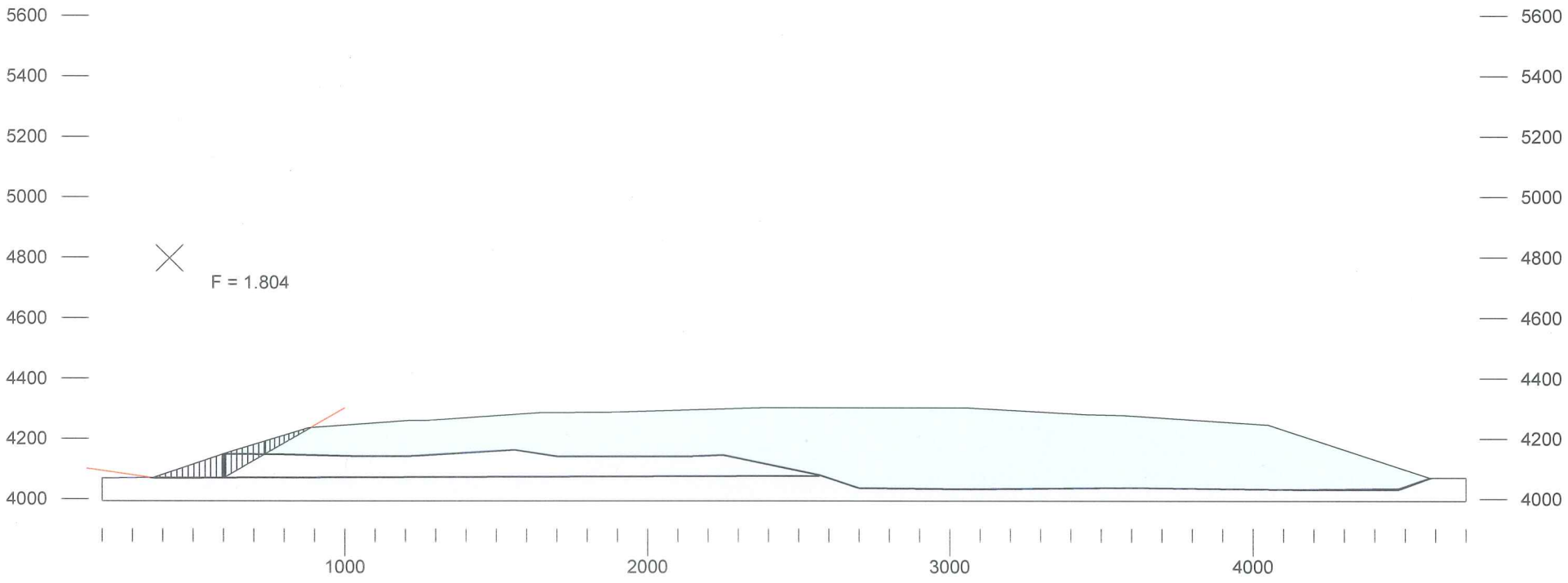
| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 0 | 35 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 65 | 0 | 35 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 30 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

American Engineering Testing - St. Paul, MN
01-05106
McCombs Landfill Expansion
July 2012
Section E
Sensitivity Analysis - Case 1



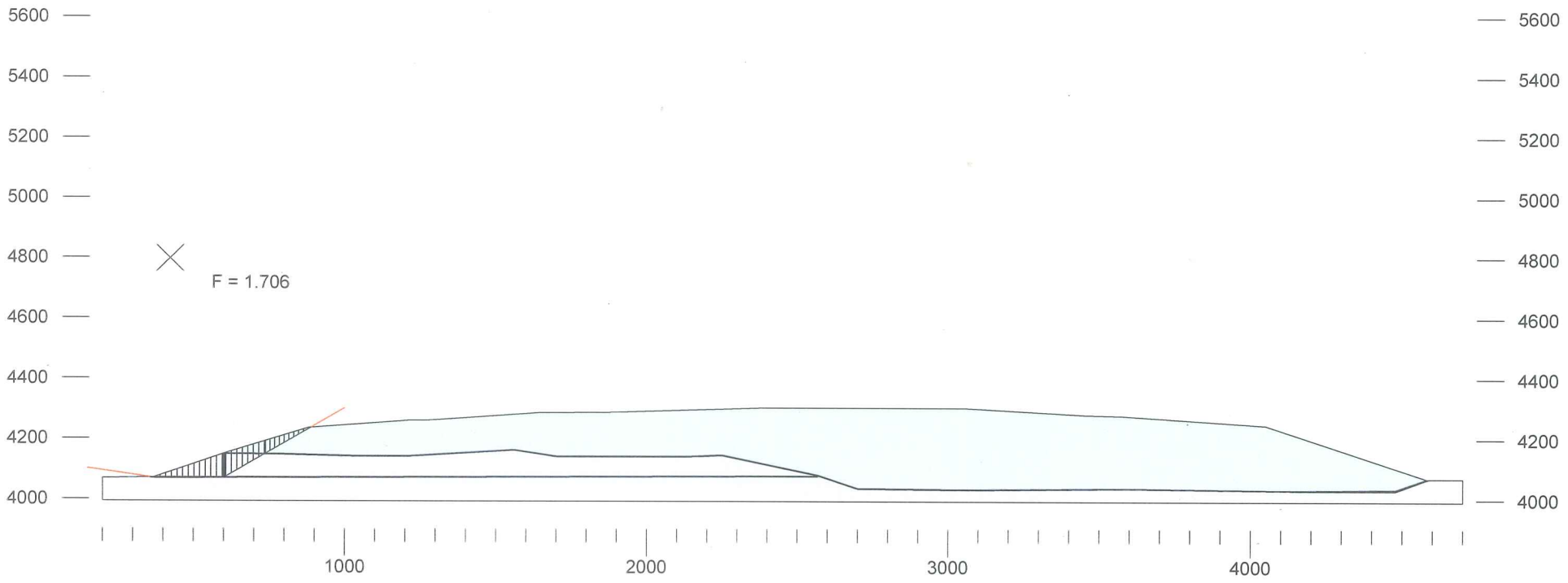
| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 0 | 26 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 65 | 0 | 26 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 30 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

American Engineering Testing - St. Paul, MN
01-05106
McCombs Landfill Expansion
July 2012
Section E
Sensitivity Analysis - Case 2



| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 0 | 28 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 25 | 1 |
| Exist.Waste/Fut.C&D | 65 | 0 | 28 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 25 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

American Engineering Testing - St. Paul, MN
01-05106
McCombs Landfill Expansion
July 2012
Section E
Large Displacement Parameters



APPENDIX C
WASTE MASS STABILITY ANALYSIS
INTERIM SLOPES

AMERICAN ENGINEERING TESTING, INC.
TEXAS REGISTERED ENGINEERING FIRM F-10340

McCombs Landfill
American Engineering Testing, Inc.
AET No. 01-05106

| TABLE C-1: RESULTS OF WASTE MASS STABILITY ANALYSIS – INTERIM SLOPE, PEAK PARAMETERS, BASE CONDITION | | |
|---|---|---|
| Cross Section | Factor of Safety Circular Failure | Factor of Safety Block Failure |
| E | 2.64 | 2.42 |
| | | |

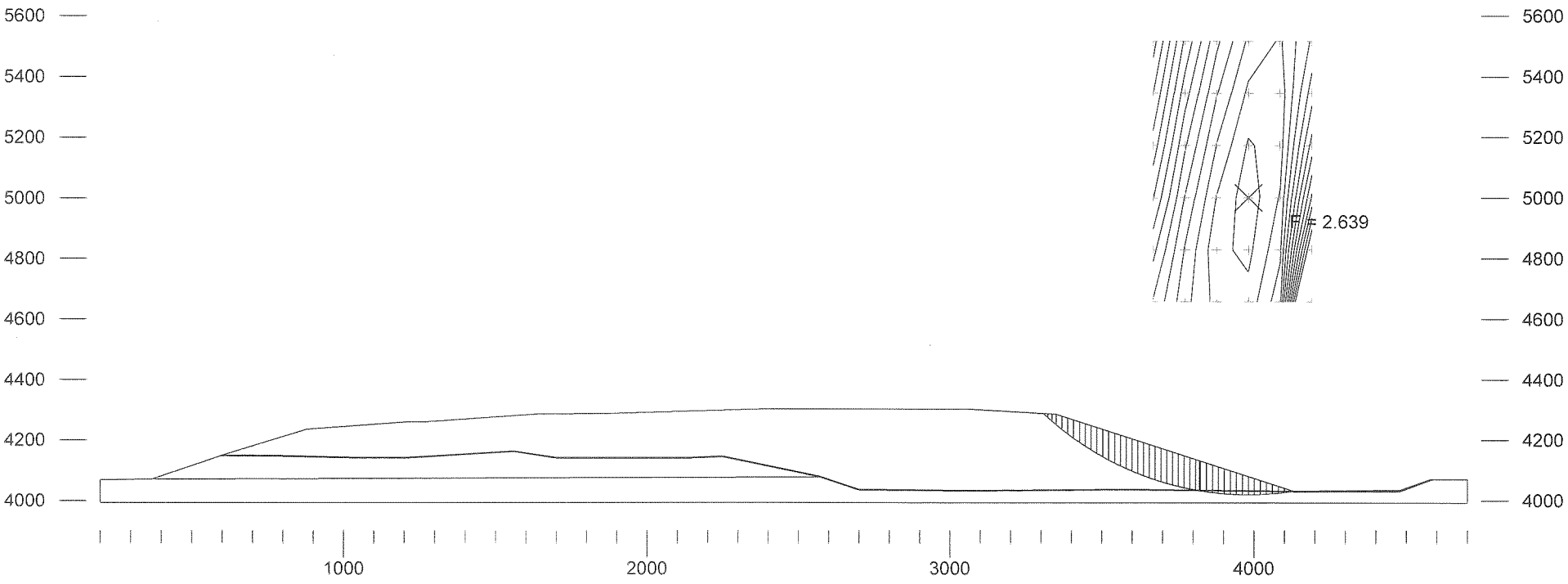
| TABLE C-2: RESULTS OF WASTE MASS STABILITY ANALYSIS – INTERIM SLOPE, SENSITIVITY ANALYSIS, CROSS SECTION E | | | | | |
|---|---|---|---|---|---|
| Condition | $\gamma'$ (pcf) | $\phi'$ (deg.) | $c'$ (psf) | Factor of Safety | |
| | | | | Circular | Block |
| Base | 65 | 35 | 525 | 2.64 | 2.42 |
| 1 | 65 | 35 | 0 | 2.10 | 2.19 |
| 2 | 65 | 26 | 0 | 1.47 | 1.85 |

| TABLE C-3: RESULTS OF WASTE MASS STABILITY ANALYSIS – INTERIM SLOPE, LARGE DISPLACEMENT PARAMETERS | | |
|---|---|---|
| Cross Section | Factor of Safety Circular Failure | Factor of Safety Block Failure |
| E | 1.60 | 1.76 |
| | | |

SECTION E

| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 525 | 35 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 125 | 0 | 35 | 0 |
| Foundation Soils | 125 | 0 | 32 | 0 |

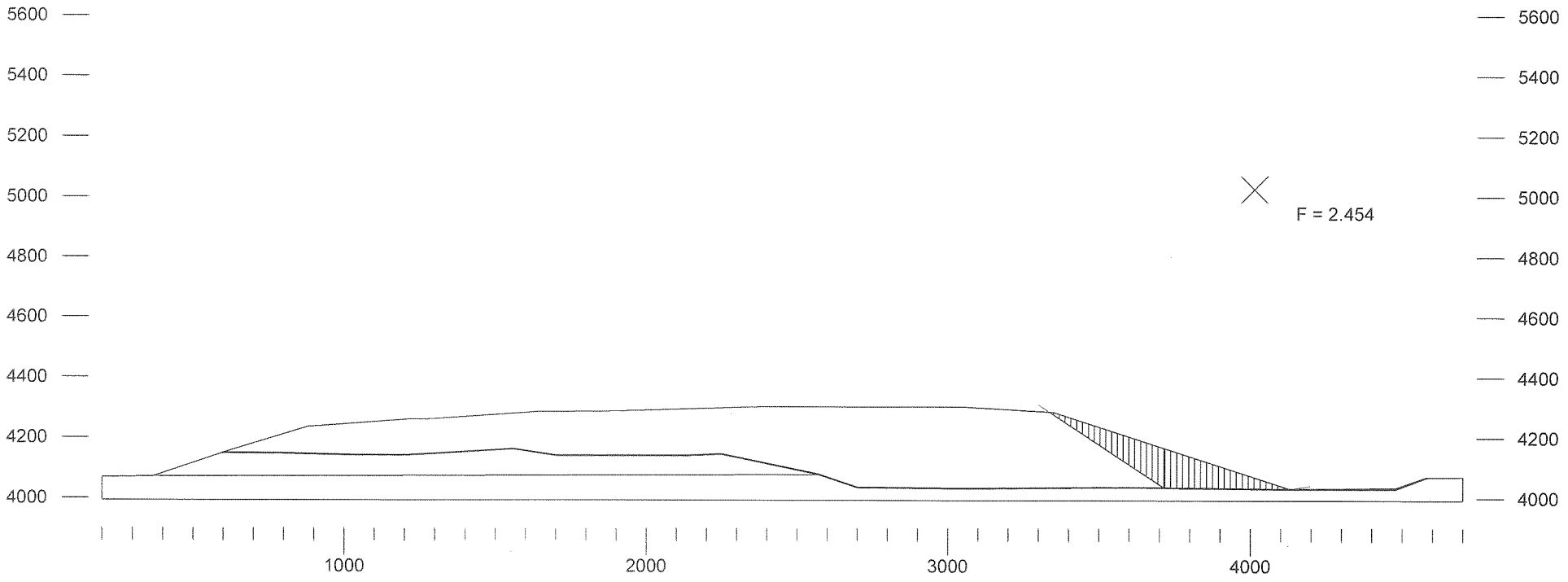
American Engineering Testing - St. Paul, MN
01-05106
McCombs Landfill Expansion
July 2012
Section E
Interim Slope



| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 525 | 35 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 125 | 0 | 35 | 0 |
| Foundation Soils | 125 | 0 | 32 | 0 |

American Engineering Testing - St. Paul, MN
01-05106
McCombs Landfill Expansion
July 2012
Section E
Interim Slope - Sliding on HDPE





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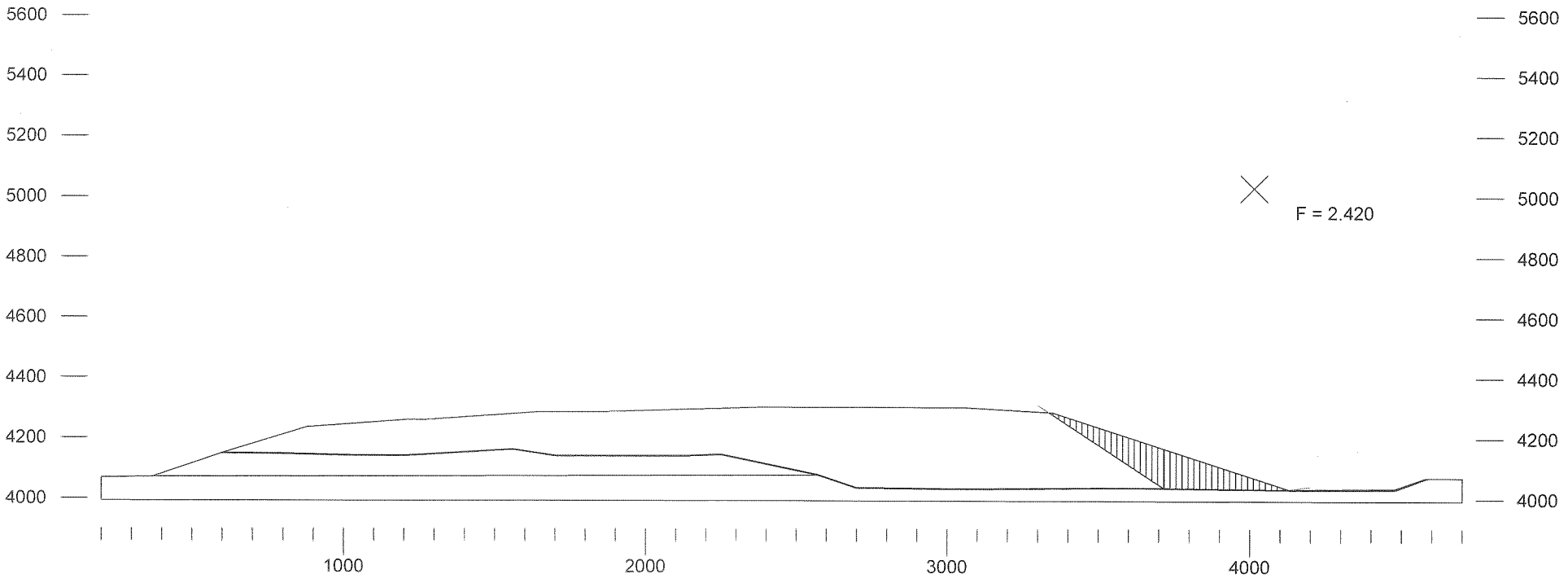
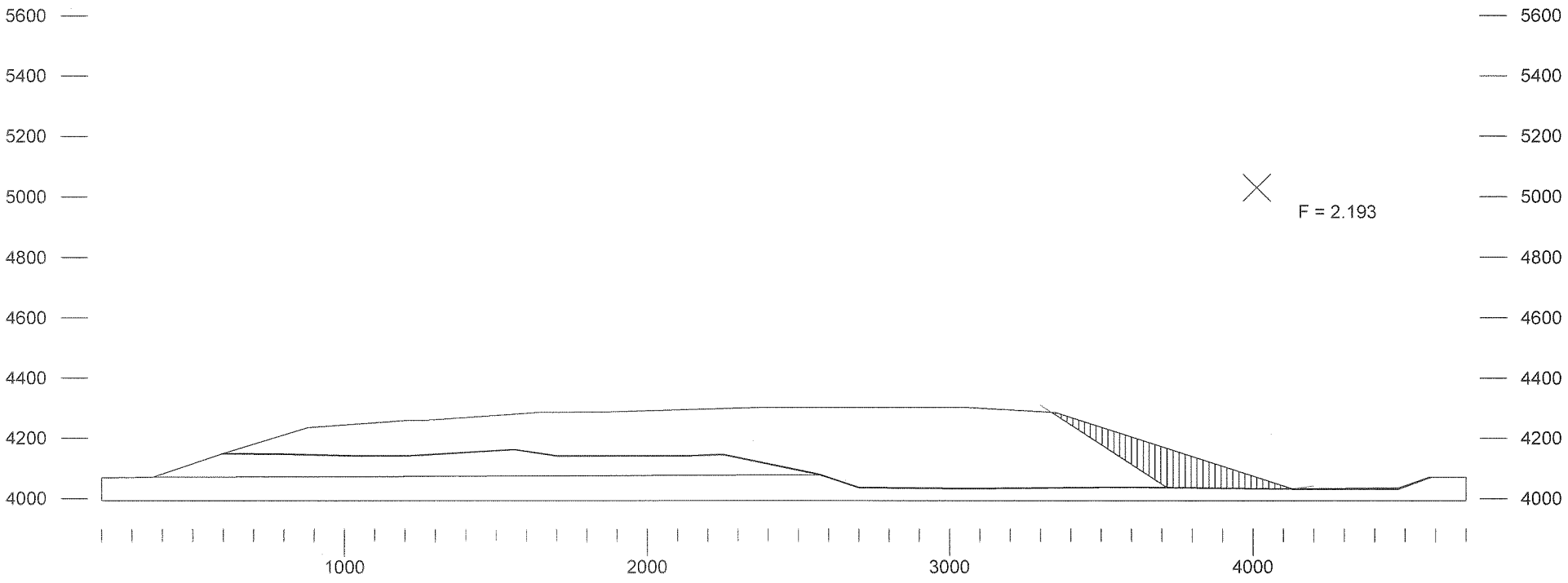
| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 525 | 35 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 125 | 0 | 35 | 0 |
| Foundation Soils | 125 | 0 | 32 | 0 |

American Engineering Testing - St. Paul, MN
01-05106
McCombs Landfill Expansion
July 2012
Section E
Interim Slope - Sliding in Sand Cover



| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 0 | 35 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 125 | 0 | 35 | 0 |
| Foundation Soils | 125 | 0 | 32 | 0 |

American Engineering Testing - St. Paul, MN
01-05106
McCombs Landfill Expansion
July 2012
Section E - Sensitivity Analysis Case 1
Interim Slope - Sliding in Sand Cover



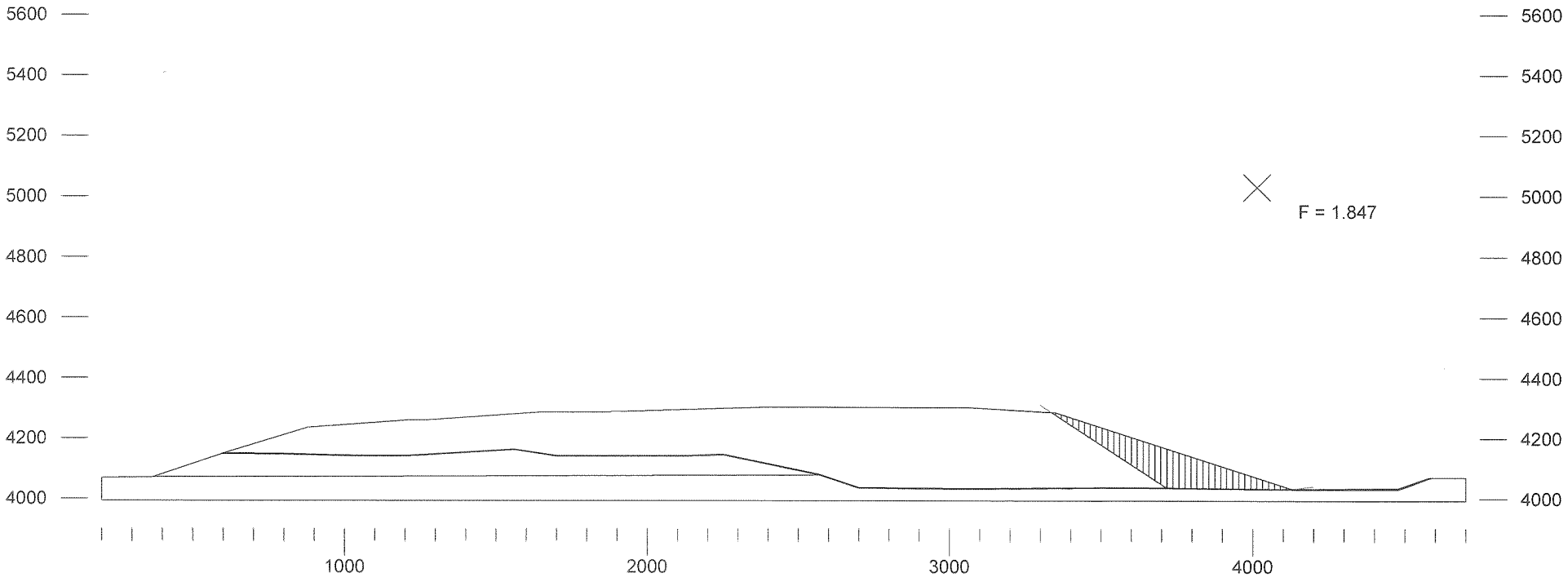



7/17/2012 11:39:32 AM Z:\AET Projects - Proposals\AET Projects\01-05106 McCombs LF El Paso Phase 2\GSLOPE\Interim Slopes\E3ea Sens Case 1.gsl American Engineering Testing - St. Paul, MN F = 2.193

| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 0 | 26 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Exist.Waste/Fut.C&D | 125 | 0 | 26 | 0 |
| Foundation Soils | 125 | 0 | 32 | 0 |

American Engineering Testing - St. Paul, MN
01-05106
McCombs Landfill Expansion
July 2012
Section E - Sensitivity Analysis Case 2
Interim Slope - Sliding in Sand Cover

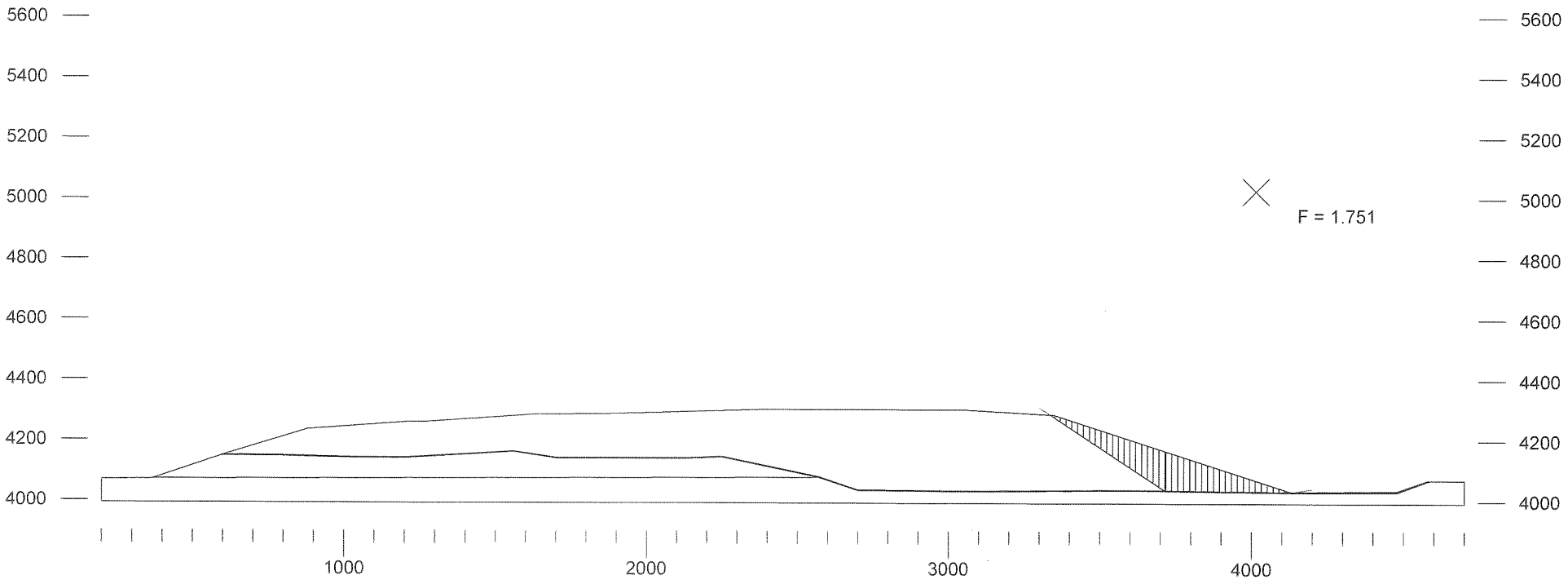




| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 0 | 28 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 25 | 1 |
| Exist.Waste/Fut.C&D | 125 | 0 | 28 | 0 |
| Foundation Soils | 125 | 0 | 32 | 0 |

American Engineering Testing - St. Paul, MN
01-05106
McCombs Landfill Expansion
July 2012
Section E
Interim Slope - Large Displacement Parameters





APPENDIX D
SETTLEMENT, STRAIN, AND HEAVE ANALYSIS

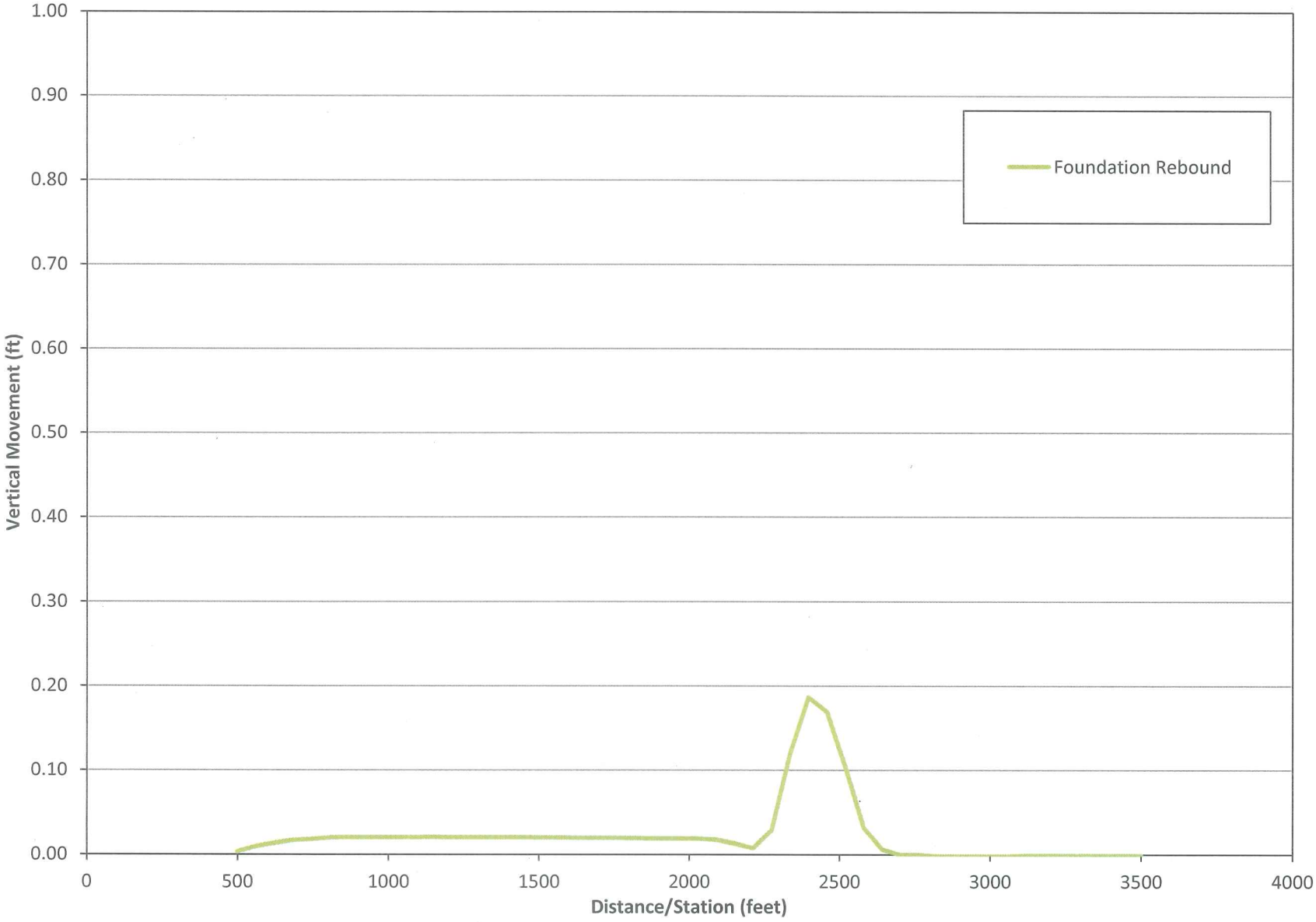
**AMERICAN ENGINEERING TESTING, INC.**
**TEXAS REGISTERED ENGINEERING FIRM F-10340**

McCombs Landfill
American Engineering Testing, Inc.
AET No. 01-05106

# PREDICTED FOUNDATION HEAVE DUE TO EXCAVATION
# AND
# PREDICTED FOUNDATION SETTLEMENT

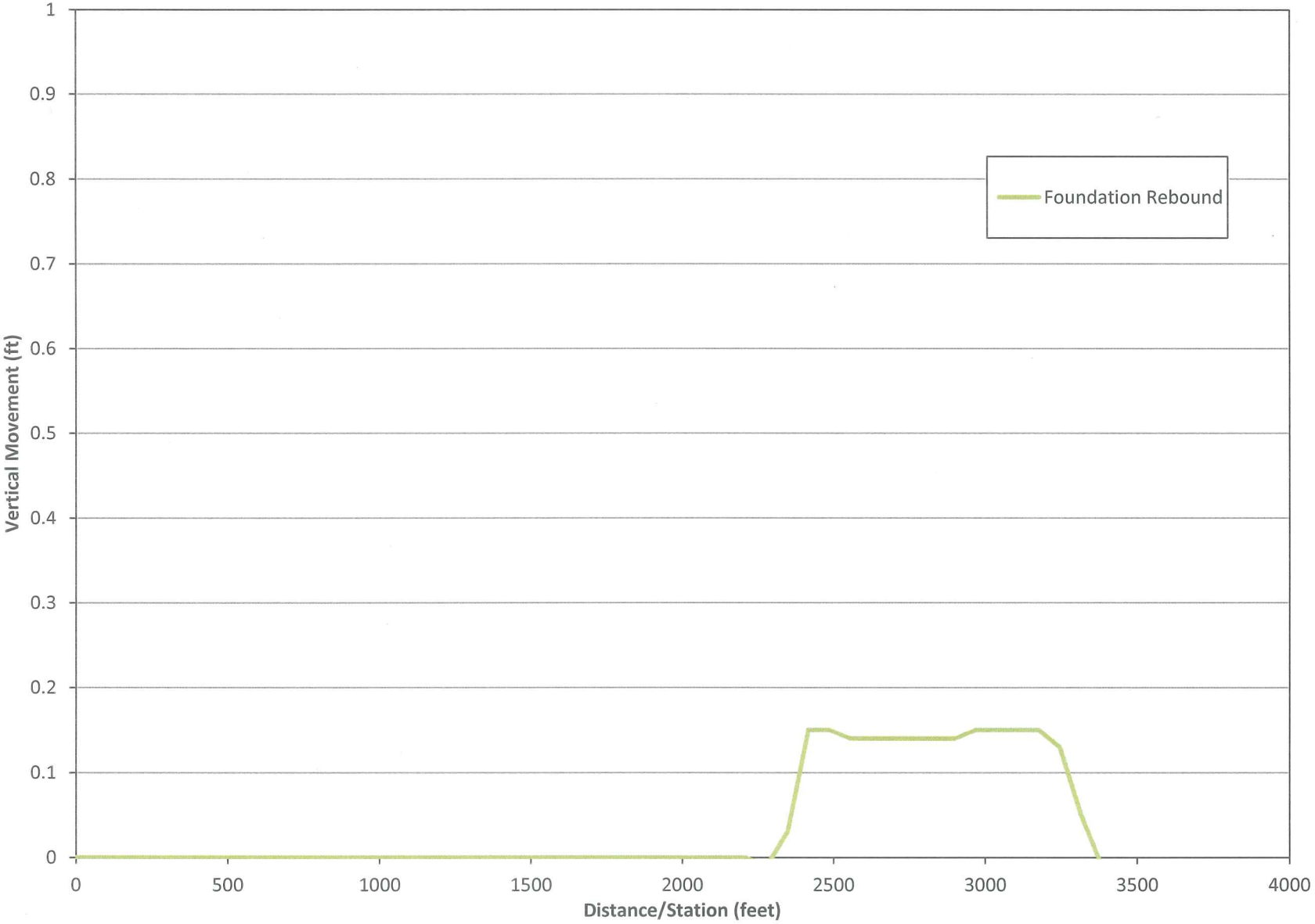
McCombs Landfill
American Engineering Testing, Inc.
AET No. 01-05106

## Section B, Elastic Rebound
## McCombs Landfill; El Paso, TX



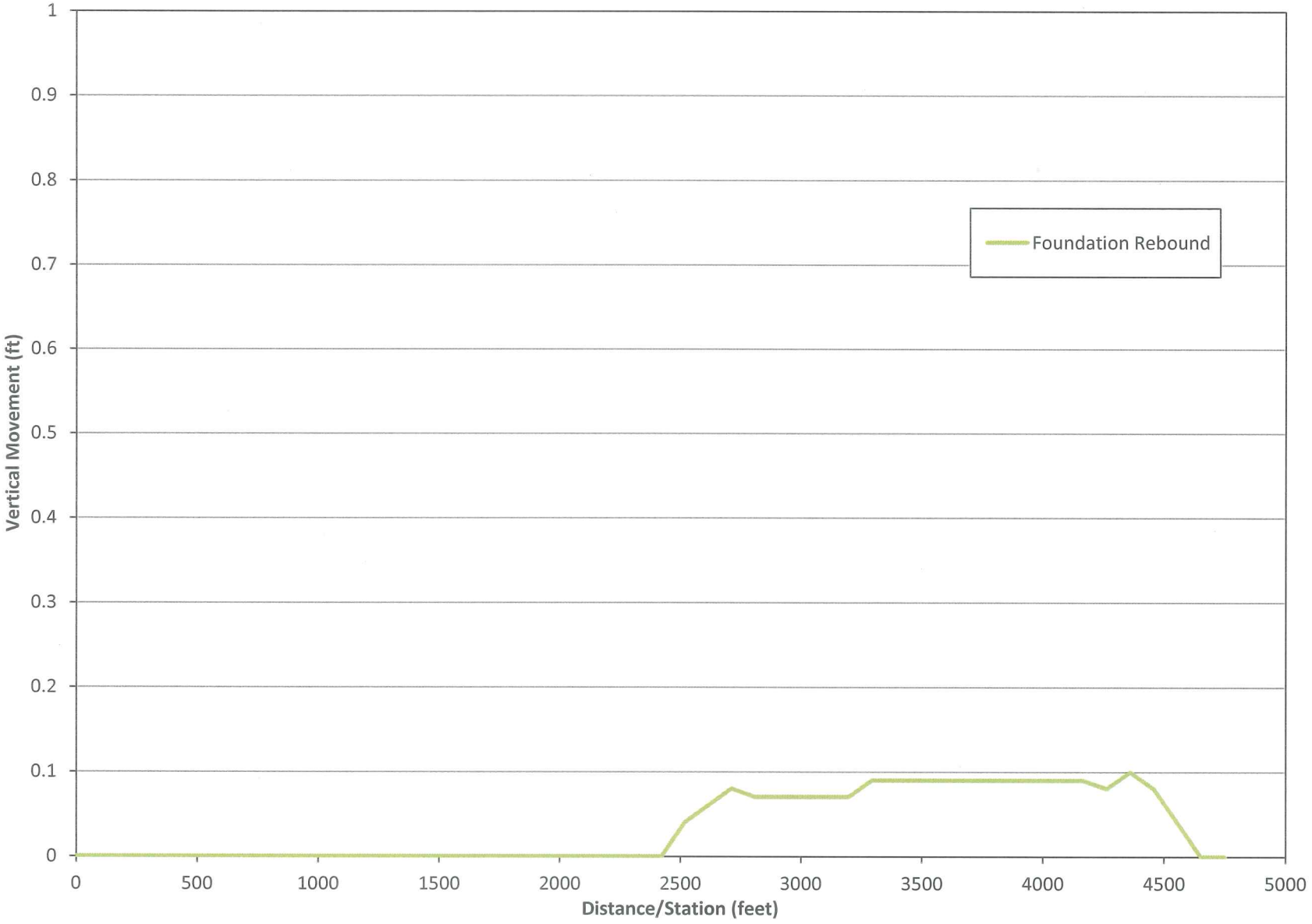

American Engineering Testing, Inc.
AET Project No. 01-05106

## Section C, Elastic Rebound
## McCombs Landfill; El Paso, TX



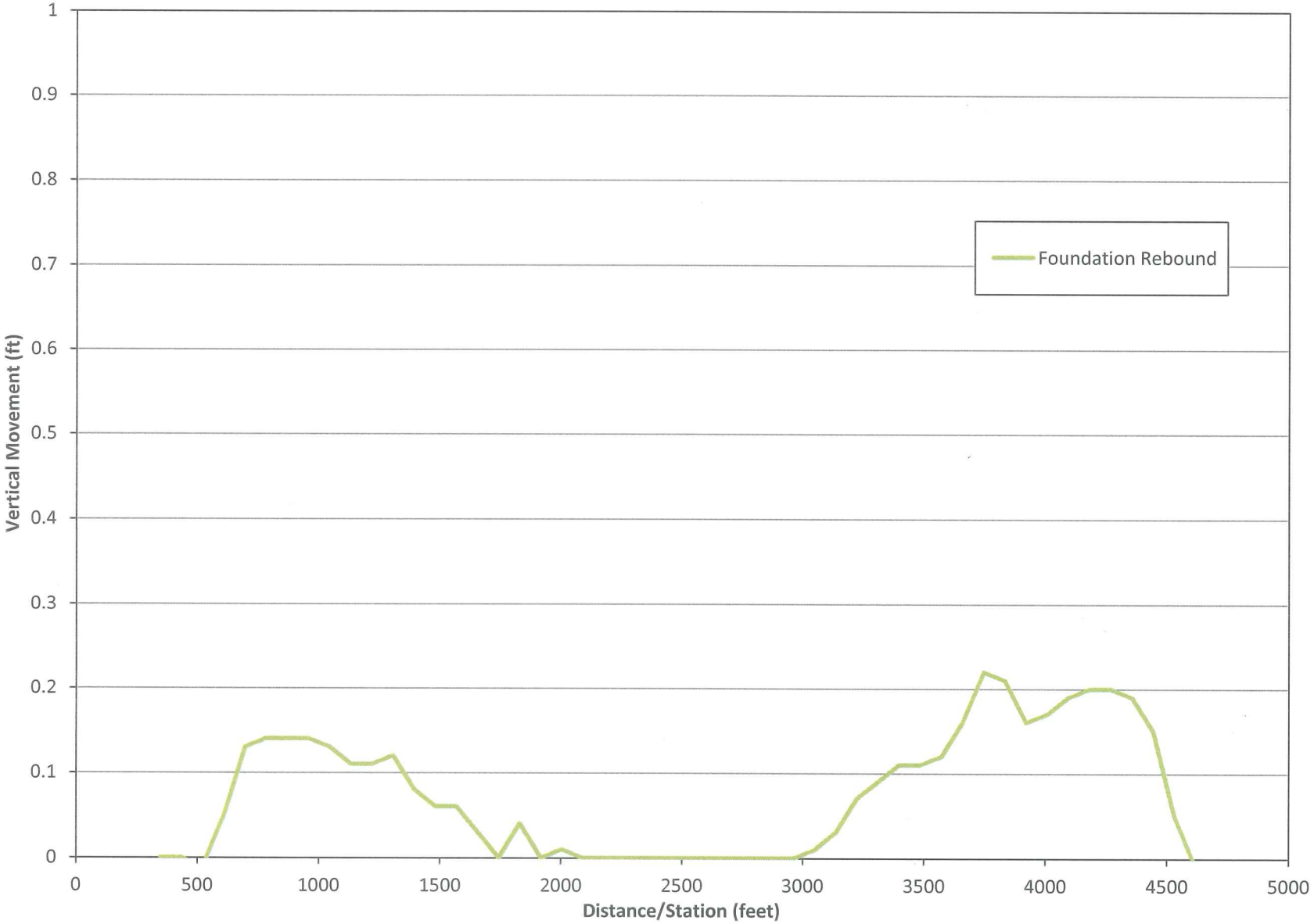

American Engineering Testing, Inc.
AET Project No. 01-05106

## Section E, Elastic Rebound;
## McCombs Landfill; El Paso, TX

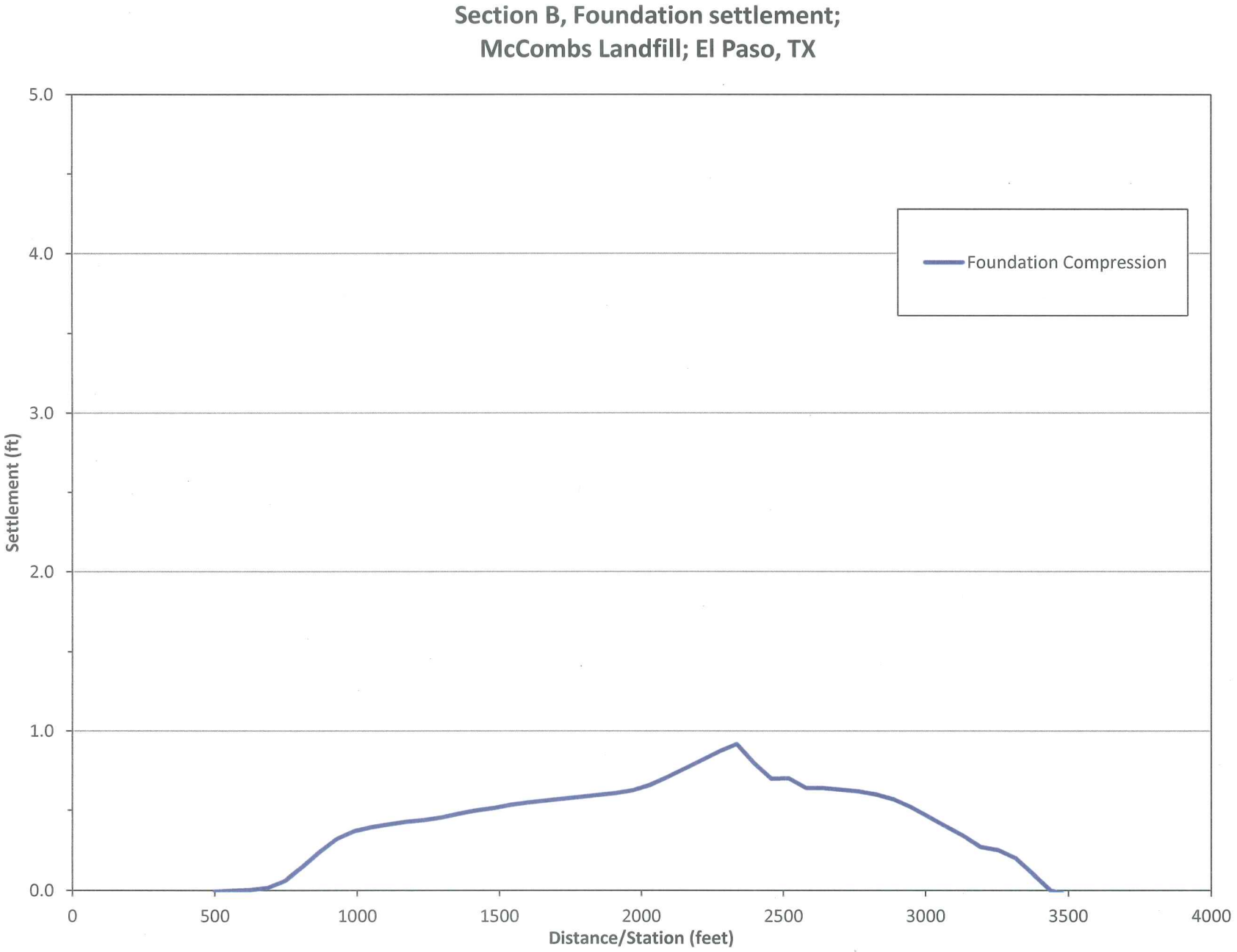



American Engineering Testing, Inc.
AET Project No. 01-05106

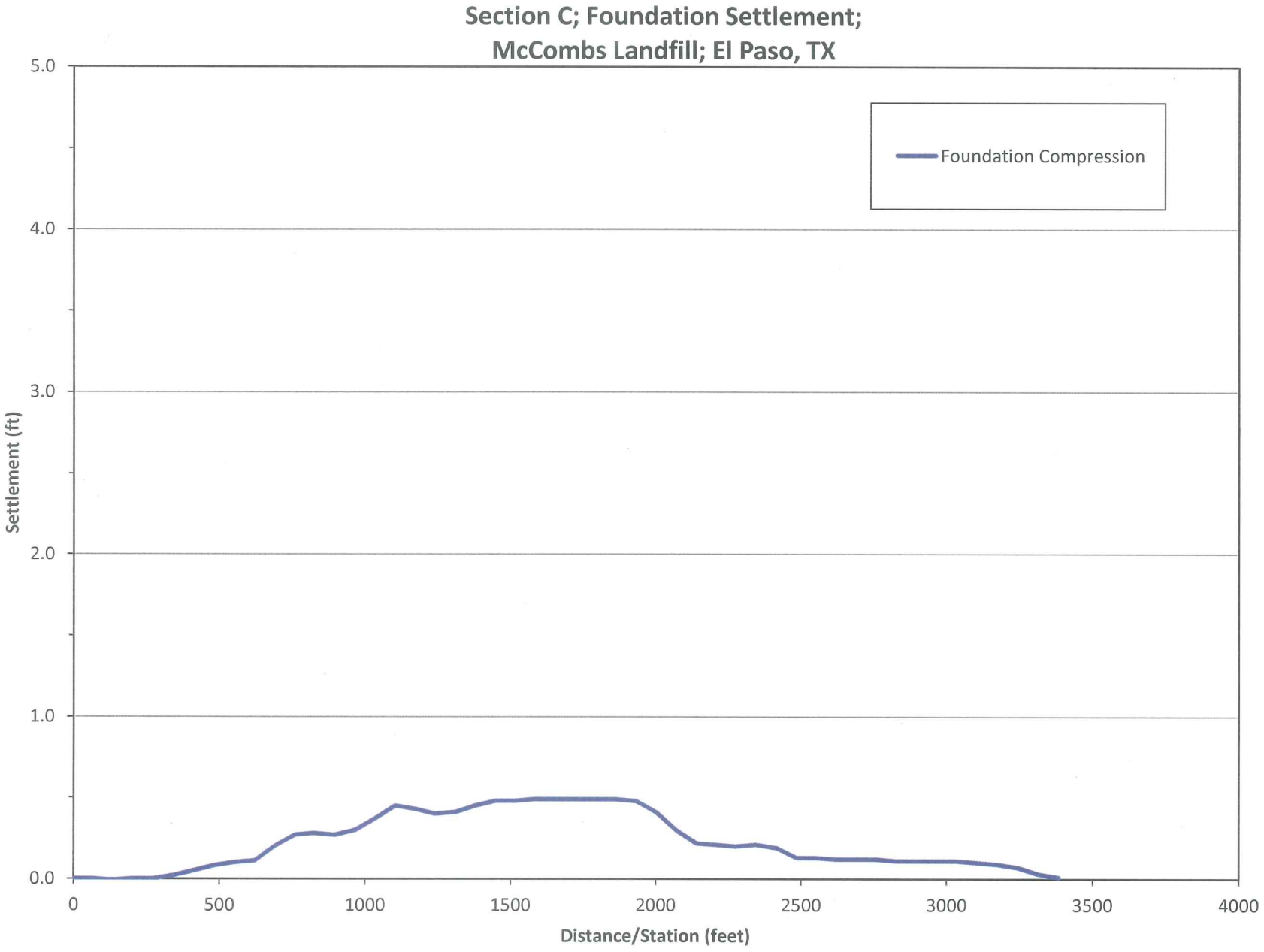
## Section F, Elastic Rebound;
## McCombs Landfill; El Paso, TX

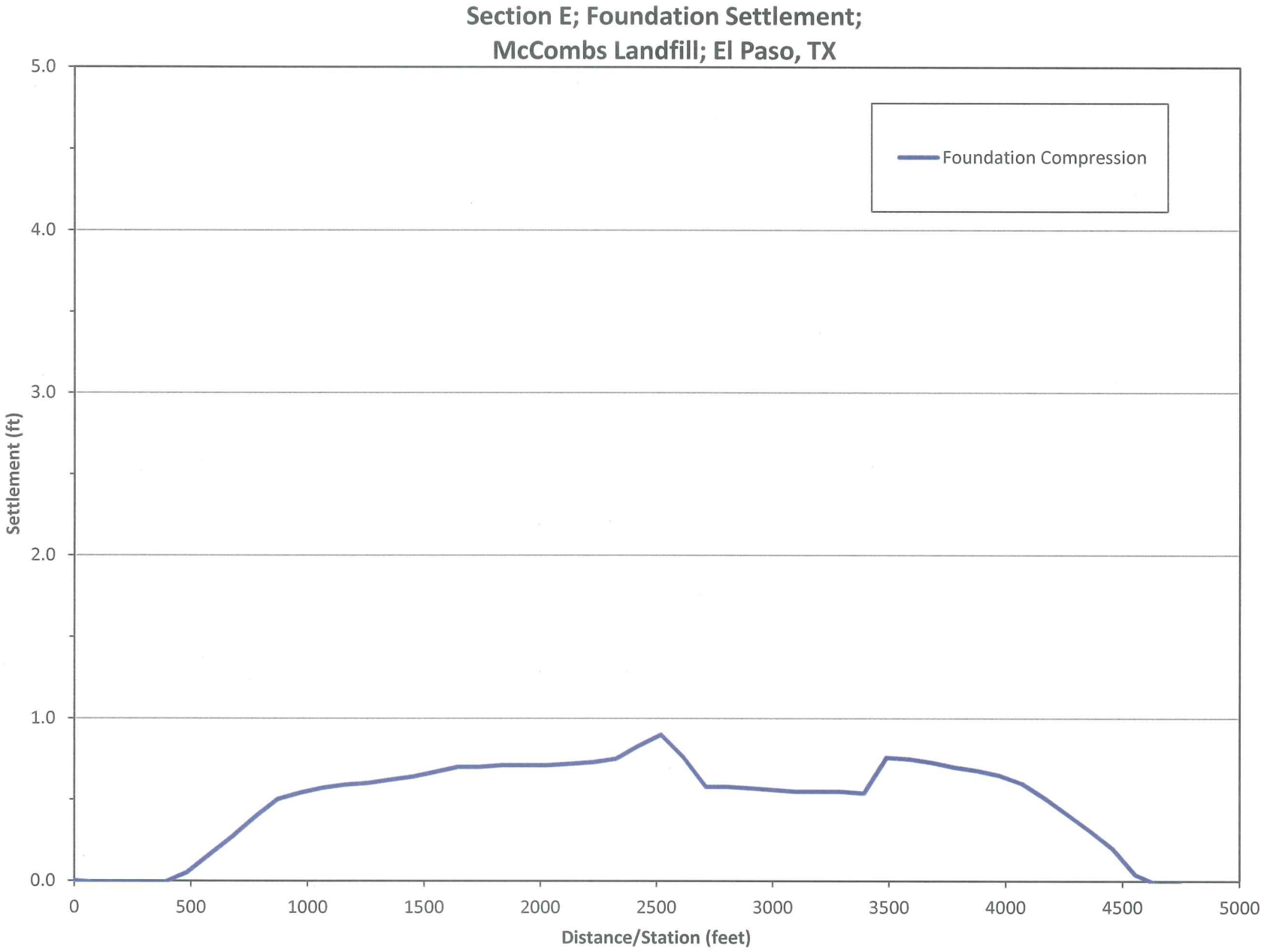


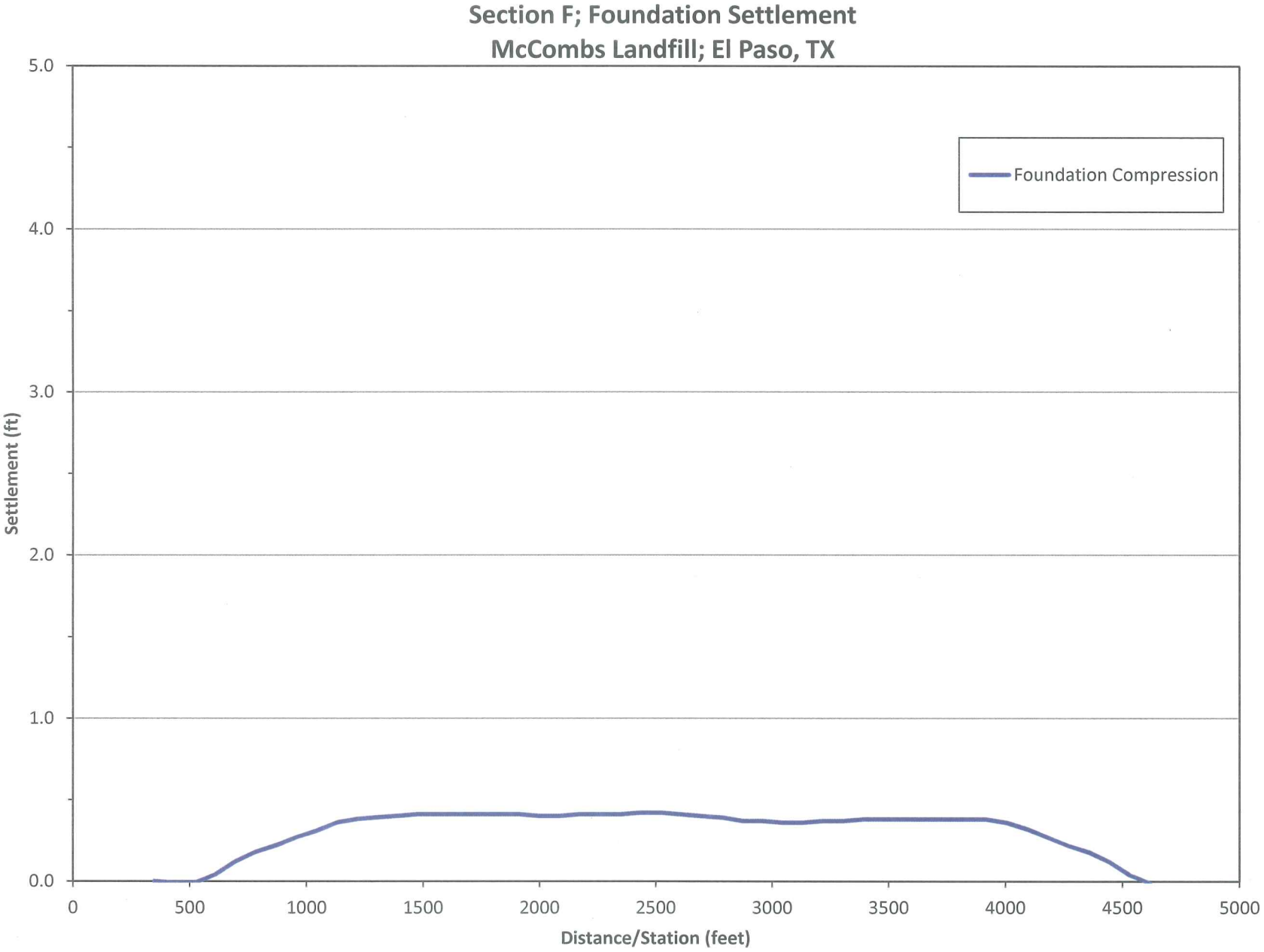

American Engineering Testing, Inc.
AET Project No. 01-05106




American Engineering Testing, Inc.
AET Project No. 01-05106


Section C; Foundation Settlement;
McCombs Landfill; El Paso, TX
Foundation Compression
Settlement (ft)
5.0
4.0
3.0
2.0
1.0
0.0
0
500
1000
1500
2000
2500
3000
3500
4000
Distance/Station (feet)


Section E; Foundation Settlement;
McCombs Landfill; El Paso, TX
Foundation Compression
Settlement (ft)
5.0
4.0
3.0
2.0
1.0
0.0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Distance/Station (feet)


Section F; Foundation Settlement
McCombs Landfill; El Paso, TX
Foundation Compression
Settlement (ft)
5.0
4.0
3.0
2.0
1.0
0.0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Distance/Station (feet)

# PREDICTED SETTLEMENT AND STRAIN OF PIGGYBACK LINER DUE TO COMPRESSION OF THE EXISTING MSW AND NEW C&D WASTE

McCombs Landfill
American Engineering Testing, Inc.
AET No. 01-05106

## Settlement of Existing Landfill

Ref. Qian, X., et. al., "Geotechnical Aspects of Landfill Design and Construction," Prentice Hall, 2002, pg. 548

**Project:** McCombs Landfill **AET No.** 01-05106
**Section:** Section B **Date:** July 2012

### Compression of Existing MSW and New C-D

**Primary Settlement**

$\Delta Z_c = C_c' \times H_o \times \log (\sigma_o + \Delta\sigma / \sigma_o)$

$\Delta Z_c$ = primary settlement of existing landfill
$H_o$ = initial thickness of the waste layer of the existing landfill
$C_c'$ = modified primary compression index. Cc'= 0.17~0.36
$\sigma_o$ = existing overburden pressure acting at the mid level of the waste layer
$\Delta\sigma$ = increment of overburden pressure due to vertical expansion

**Secondary Settlement**

$\Delta Z_\alpha = C_\alpha' \times H_o \times \log (t2 / t1)$

$\Delta Z_\alpha$ = secondary settlement of existing landfill
$H_o$ = initial thickness of the waste layer before starting secondary settlement
$C_\alpha'$ = modified secondary compression index. $C_\alpha'$ = 0.03~0.1
t1 = starting time of the secondary settlement. It is assumed to be equal to the age of existing landfill
t2 = ending time of the secondary settlement

**Enter Assumed Parameters**

| | | | |
|---|---|---|---|
| Cc' = | 0.17 | t1 = | 9 |
| Ca' = | 0.03 | t2 = | 59 |
| Unit Weight of existing waste (pcf) = | 65 | | |
| Unit Weight of new waste (pcf) = | 65 | | |

| | | Settlement Calculation | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Existing Landfill | | | New Landfill | | Primary | | Secondary | Total |
| Point | Station | Top Elev. | Thickness, ft. | $\sigma_o$ (psf) | Thickness, ft. | $\Delta\sigma$ (psf) | Settlement (ft) | $H_o$ (feet) | Settlement (ft) | **Settlement, ft.** |
| 1 | 520 | 4098 | 0 | 0 | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 720 | 4160 | 112 | 3640 | 0 | 0 | 0.00 | 112.00 | 2.74 | 2.74 |
| 3 | 820 | 4160 | 90 | 2925 | 40 | 2600 | 4.23 | 85.77 | 2.10 | 6.33 |
| 4 | 970 | 4160 | 88 | 2860 | 82 | 5330 | 6.84 | 81.16 | 1.99 | 8.82 |
| 5 | 1120 | 4160 | 85 | 2763 | 93 | 6045 | 7.28 | 77.72 | 1.90 | 9.18 |
| 6 | 1220 | 4160 | 85 | 2763 | 98 | 6370 | 7.50 | 77.50 | 1.90 | 9.40 |
| 7 | 1285 | 4165 | 90 | 2925 | 97 | 6305 | 7.64 | 82.36 | 2.02 | 9.65 |
| 8 | 1350 | 4160 | 85 | 2763 | 108 | 7020 | 7.94 | 77.06 | 1.89 | 9.82 |
| 9 | 1620 | 4160 | 88 | 2860 | 126 | 8190 | 8.78 | 79.22 | 1.94 | 10.72 |
| 10 | 2020 | 4140 | 70 | 2275 | 145 | 9425 | 8.46 | 61.54 | 1.51 | 9.97 |
| 11 | 2220 | 4076 | 0 | 0 | 207 | 13455 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | Tensile Strain Calculation* | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Differential | Initial Tan. | Final Tan. | Distance Calcs | | |
| Point | Station | Elevation | Points | Settlement, ft. | Slope Angle | Slope Angle | Initial | Final | **Strain, %** |
| 1 | 520 | 4098 | 0-1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2 | 720 | 4160 | 1-2 | 2.74 | 0.31 | 0.30 | 209.39 | 208.59 | -0.3801 |
| 3 | 820 | 4160 | 2-3 | 3.58 | 0.00 | 0.04 | 100.00 | 100.06 | 0.0642 |
| 4 | 970 | 4160 | 3-4 | 2.50 | 0.00 | 0.02 | 150.00 | 150.02 | 0.0139 |
| 5 | 1120 | 4160 | 4-5 | 0.36 | 0.00 | 0.00 | 150.00 | 150.00 | 0.0003 |
| 6 | 1220 | 4160 | 5-6 | 0.22 | 0.00 | 0.00 | 100.00 | 100.00 | 0.0002 |
| 7 | 1285 | 4165 | 6-7 | 0.25 | 0.08 | 0.07 | 65.19 | 65.17 | -0.0288 |
| 8 | 1350 | 4160 | 7-8 | 0.17 | 0.08 | 0.07 | 65.19 | 65.18 | -0.0196 |
| 9 | 1620 | 4160 | 8-9 | 0.90 | 0.00 | 0.00 | 270.00 | 270.00 | 0.0006 |
| 10 | 2020 | 4140 | 9-10 | 0.75 | 0.05 | 0.05 | 400.50 | 400.46 | -0.0092 |
| 11 | 2220 | 4076 | 10-11 | 9.97 | 0.32 | 0.27 | 209.99 | 207.17 | -1.3434 |

*Tensile strain of the proposed piggyback liner

## Settlement of Existing Landfill

Ref. Qian, X., et. al., "Geotechnical Aspects of Landfill Design and Construction," Prentice Hall, 2002, pg. 548

**Project:** McCombs Landfill
**Section:** Section B

**AET No.** 01-05106
**Date:** July 2012

### Compression of Existing MSW and New C-D

**Primary Settlement**

$\Delta Z_c = C_c' \times H_o \times \log (\sigma_o + \Delta\sigma / \sigma_o)$

$\Delta Z_c$ = primary settlement of existing landfill
$H_o$ = initial thickness of the waste layer of the existing landfill
$C_c'$ = modified primary compression index. Cc'= 0.17~0.36
$\sigma_o$ = existing overburden pressure acting at the mid level of the waste layer
$\Delta\sigma$ = increment of overburden pressure due to vertical expansion

**Secondary Settlement**

$\Delta Z_\alpha = C_\alpha' \times H_o \times \log (t2 / t1)$

$\Delta Z_\alpha$ = secondary settlement of existing landfill
$H_o$ = initial thickness of the waste layer before starting secondary settlement
$C_\alpha'$ = modified secondary compression index. $C_\alpha'$ = 0.03~0.1
t1 = starting time of the secondary settlement. It is assumed to be equal to the age of existing landfill
t2 = ending time of the secondary settlement

**Enter Assumed Parameters**

| | | | |
|---|---|---|---|
| Cc' = | 0.36 | t1 = | 9 |
| Ca' = | 0.1 | t2 = | 59 |
| Unit Weight of existing waste (pcf) = | 65 | | |
| Unit Weight of new waste (pcf) = | 65 | | |

| | | Settlement Calculation | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Existing Landfill | | | New Landfill | | Primary | | Secondary | Total |
| Point | Station | Top Elev. | Thickness, ft. | $\sigma_o$ (psf) | Thickness, ft. | $\Delta\sigma$ (psf) | Settlement (ft) | $H_o$ (feet) | Settlement (ft) | **Settlement, ft.** |
| 1 | 520 | 4098 | 0 | 0 | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 720 | 4160 | 112 | 3640 | 0 | 0 | 0.00 | 112.00 | 9.15 | 9.15 |
| 3 | 820 | 4160 | 90 | 2925 | 40 | 2600 | 8.95 | 81.05 | 6.62 | 15.57 |
| 4 | 970 | 4160 | 88 | 2860 | 82 | 5330 | 14.48 | 73.52 | 6.00 | 20.48 |
| 5 | 1120 | 4160 | 85 | 2763 | 93 | 6045 | 15.41 | 69.59 | 5.68 | 21.09 |
| 6 | 1220 | 4160 | 85 | 2763 | 98 | 6370 | 15.89 | 69.11 | 5.64 | 21.53 |
| 7 | 1285 | 4165 | 90 | 2925 | 97 | 6305 | 16.17 | 73.83 | 6.03 | 22.20 |
| 8 | 1350 | 4160 | 85 | 2763 | 108 | 7020 | 16.80 | 68.20 | 5.57 | 22.37 |
| 9 | 1620 | 4160 | 88 | 2860 | 126 | 8190 | 18.60 | 69.40 | 5.67 | 24.26 |
| 10 | 2020 | 4140 | 70 | 2275 | 145 | 9425 | 17.92 | 52.08 | 4.25 | 22.18 |
| 11 | 2220 | 4076 | 0 | 0 | 207 | 13455 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | Tensile Strain Calculation* | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Differential | Initial Tan. | Final Tan. | Distance Calcs | | |
| Point | Station | Elevation | Points | Settlement, ft. | Slope Angle | Slope Angle | Initial | Final | **Strain, %** |
| 1 | 520 | 4098 | 0-1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2 | 720 | 4160 | 1-2 | 9.15 | 0.31 | 0.26 | 209.39 | 206.87 | -1.2052 |
| 3 | 820 | 4160 | 2-3 | 6.42 | 0.00 | 0.06 | 100.00 | 100.21 | 0.2060 |
| 4 | 970 | 4160 | 3-4 | 4.91 | 0.00 | 0.03 | 150.00 | 150.08 | 0.0536 |
| 5 | 1120 | 4160 | 4-5 | 0.61 | 0.00 | 0.00 | 150.00 | 150.00 | 0.0008 |
| 6 | 1220 | 4160 | 5-6 | 0.44 | 0.00 | 0.00 | 100.00 | 100.00 | 0.0010 |
| 7 | 1285 | 4165 | 6-7 | 0.67 | 0.08 | 0.07 | 65.19 | 65.14 | -0.0731 |
| 8 | 1350 | 4160 | 7-8 | 0.17 | 0.08 | 0.07 | 65.19 | 65.18 | -0.0201 |
| 9 | 1620 | 4160 | 8-9 | 1.89 | 0.00 | 0.01 | 270.00 | 270.01 | 0.0025 |
| 10 | 2020 | 4140 | 9-10 | 2.09 | 0.05 | 0.04 | 400.50 | 400.40 | -0.0247 |
| 11 | 2220 | 4076 | 10-11 | 22.18 | 0.32 | 0.21 | 209.99 | 204.33 | -2.6972 |

*Tensile strain of the proposed piggyback liner

## Settlement of Existing Landfill

Ref. Qian, X., et. al., "Geotechnical Aspects of Landfill Design and Construction," Prentice Hall, 2002, pg. 548

**Project:** McCombs Landfill
**Section:** Section E

**AET No.** 01-05106
**Date:** July 2012

### Settlement of Existing MSW and New C-D

**Primary Settlement**

$\Delta Z_c = C_c' \times H_o \times \log (\sigma_o + \Delta\sigma / \sigma_o)$

$\Delta Z_c$ = primary settlement of existing landfill
$H_o$ = initial thickness of the waste layer of the existing landfill
$C_c'$ = modified primary compression index. Cc'= 0.17~0.36
$\sigma_o$ = existing overburden pressure acting at the mid level of the waste layer
$\Delta\sigma$ = increment of overburden pressure due to vertical expansion

**Secondary Settlement**

$\Delta Z_\alpha = C_\alpha' \times H_o \times \log (t2 / t1)$

$\Delta Z_\alpha$ = secondary settlement of existing landfill
$H_o$ = initial thickness of the waste layer before starting secondary settlement
$C_\alpha'$ = modified secondary compression index. $C_\alpha'$ = 0.03~0.1
t1 = starting time of the secondary settlement. It is assumed to be equal to the age of existing landfill
t2 = ending time of the secondary settlement

**Enter Assumed Parameters**

| | |
|---|---|
| Cc' = | 0.17 |
| Ca' = | 0.03 |
| Unit Weight of existing waste (pcf) = | 65 |
| Unit Weight of new waste (pcf) = | 65 |

| | |
|---|---|
| t1 = | 9 |
| t2 = | 59 |

| | | Settlement Calculation | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Existing Landfill | | | New Landfill | | Primary | | Secondary | Total |
| Point | Station | Top Elev. | Thickness, ft. | $\sigma_o$ (psf) | Thickness, ft. | $\Delta\sigma$ (psf) | Settlement (ft) | $H_o$ (feet) | Settlement (ft) | Settlement, ft. |
| 1 | 380 | 4068 | 0 | 0 | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 500 | 4094 | 0 | 0 | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 603 | 4096 | 80 | 2600 | 0 | 0 | 0.00 | 80.00 | 1.96 | 1.96 |
| 4 | 880 | 4108 | 75 | 2438 | 90 | 5850 | 6.78 | 68.22 | 1.67 | 8.45 |
| 5 | 1200 | 4109 | 70 | 2275 | 117 | 7605 | 7.59 | 62.41 | 1.53 | 9.12 |
| 6 | 1550 | 4117 | 85 | 2763 | 120 | 7800 | 8.42 | 76.58 | 1.88 | 10.29 |
| 7 | 1650 | 4117 | 82 | 2665 | 127 | 8255 | 8.54 | 73.46 | 1.80 | 10.34 |
| 8 | 1900 | 4117 | 64 | 2080 | 145 | 9425 | 8.08 | 55.92 | 1.37 | 9.45 |
| 9 | 2150 | 4117 | 65 | 2113 | 153 | 9945 | 8.36 | 56.64 | 1.39 | 9.75 |
| 10 | 2250 | 4117 | 70 | 2275 | 152 | 9880 | 8.66 | 61.34 | 1.50 | 10.16 |
| 11 | 2400 | 4103 | 33 | 1073 | 190 | 12350 | 6.16 | 26.84 | 0.66 | 6.81 |
| 12 | 2500 | 4084 | 0 | 0 | 218 | 14170 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | Tensile Strain Calculation* | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Differential | Initial Tan. | Final Tan. | Distance Calcs | | |
| Point | Station | Elevation | Points | Settlement, ft. | Slope Angle | Slope Angle | Initial | Final | Strain, % |
| 1 | 380 | 4068 | 0-1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2 | 500 | 4094 | 1-2 | 0.00 | 0.22 | 0.22 | 122.78 | 122.78 | 0.0000 |
| 3 | 603 | 4096 | 2-3 | 1.96 | 0.02 | 0.00 | 103.02 | 103.00 | -0.0188 |
| 4 | 880 | 4108 | 3-4 | 6.49 | 0.04 | 0.02 | 277.26 | 277.05 | -0.0739 |
| 5 | 1200 | 4109 | 4-5 | 0.67 | 0.00 | 0.00 | 320.00 | 320.00 | -0.0004 |
| 6 | 1550 | 4117 | 5-6 | 1.17 | 0.02 | 0.02 | 350.09 | 350.07 | -0.0071 |
| 7 | 1650 | 4117 | 6-7 | 0.05 | 0.00 | 0.00 | 100.00 | 100.00 | 0.0000 |
| 8 | 1900 | 4117 | 7-8 | 0.89 | 0.00 | 0.00 | 250.00 | 250.00 | 0.0006 |
| 9 | 2150 | 4117 | 8-9 | 0.29 | 0.00 | 0.00 | 250.00 | 250.00 | 0.0001 |
| 10 | 2250 | 4117 | 9-10 | 0.42 | 0.00 | 0.00 | 100.00 | 100.00 | 0.0009 |
| 11 | 2400 | 4103 | 10-11 | 3.35 | 0.09 | 0.07 | 150.65 | 150.38 | -0.1820 |
| 12 | 2500 | 4084 | 11-12 | 6.81 | 0.19 | 0.12 | 101.79 | 100.74 | -1.0308 |

* Tensile strain of the proposed piggyback liner.

## Settlement of Existing Landfill

Ref. Qian, X., et. al., "Geotechnical Aspects of Landfill Design and Construction," Prentice Hall, 2002, pg. 548

**Project:** McCombs Landfill
**Section:** Section E

**AET No.** 01-05106
**Date:** July 2012

### Settlement of Existing MSW and New C-D

**Primary Settlement**

$\Delta Z_c = C_c' \times H_o \times \log (\sigma_o + \Delta\sigma / \sigma_o)$

$\Delta Z_c$ = primary settlement of existing landfill
$H_o$ = initial thickness of the waste layer of the existing landfill
$C_c'$ = modified primary compression index. Cc'= 0.17~0.36
$\sigma_o$ = existing overburden pressure acting at the mid level of the waste layer
$\Delta\sigma$ = increment of overburden pressure due to vertical expansion

**Secondary Settlement**

$\Delta Z_\alpha = C_\alpha' \times H_o \times \log (t2 / t1)$

$\Delta Z_\alpha$ = secondary settlement of existing landfill
$H_o$ = initial thickness of the waste layer before starting secondary settlement
$C_\alpha'$ = modified secondary compression index. $C_\alpha'$ = 0.03~0.1
t1 = starting time of the secondary settlement. It is assumed to be equal to the age of existing landfill
t2 = ending time of the secondary settlement

**Enter Assumed Parameters**

| | |
|---|---|
| Cc' = | 0.36 |
| Ca' = | 0.1 |
| Unit Weight of existing waste (pcf) = | 65 |
| Unit Weight of new waste (pcf) = | 65 |

| | |
|---|---|
| t1 = | 9 |
| t2 = | 59 |

| | | Settlement Calculation | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Existing Landfill | | | New Landfill | | Primary | | Secondary | Total |
| Point | Station | Top Elev. | Thickness, ft. | $\sigma_o$ (psf) | Thickness, ft. | $\Delta\sigma$ (psf) | Settlement (ft) | $H_o$ (feet) | Settlement (ft) | **Settlement, ft.** |
| 1 | 380 | 4068 | 0 | 0 | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 500 | 4094 | 0 | 0 | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 603 | 4096 | 80 | 2600 | 0 | 0 | 0.00 | 80.00 | 6.53 | 6.53 |
| 4 | 880 | 4108 | 75 | 2438 | 90 | 5850 | 14.35 | 60.65 | 4.95 | 19.30 |
| 5 | 1200 | 4109 | 70 | 2275 | 117 | 7605 | 16.07 | 53.93 | 4.40 | 20.48 |
| 6 | 1550 | 4117 | 85 | 2763 | 120 | 7800 | 17.82 | 67.18 | 5.49 | 23.31 |
| 7 | 1650 | 4117 | 82 | 2665 | 127 | 8255 | 18.08 | 63.92 | 5.22 | 23.30 |
| 8 | 1900 | 4117 | 64 | 2080 | 145 | 9425 | 17.11 | 46.89 | 3.83 | 20.94 |
| 9 | 2150 | 4117 | 65 | 2113 | 153 | 9945 | 17.70 | 47.30 | 3.86 | 21.56 |
| 10 | 2250 | 4117 | 70 | 2275 | 152 | 9880 | 18.34 | 51.66 | 4.22 | 22.56 |
| 11 | 2400 | 4103 | 33 | 1073 | 190 | 12350 | 13.04 | 19.96 | 1.63 | 14.67 |
| 12 | 2500 | 4084 | 0 | 0 | 218 | 14170 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | Tensile Strain Calculation* | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Differential | Initial Tan. | Final Tan. | Distance Calcs | | |
| Point | Station | Elevation | Points | Settlement, ft. | Slope Angle | Slope Angle | Initial | Final | **Strain, %** |
| 1 | 380 | 4068 | 0-1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2 | 500 | 4094 | 1-2 | 0.00 | 0.22 | 0.22 | 122.78 | 122.78 | 0.0000 |
| 3 | 603 | 4096 | 2-3 | 6.53 | 0.02 | 0.04 | 103.02 | 103.10 | 0.0779 |
| 4 | 880 | 4108 | 3-4 | 12.77 | 0.04 | 0.00 | 277.26 | 277.00 | -0.0933 |
| 5 | 1200 | 4109 | 4-5 | 1.17 | 0.00 | 0.00 | 320.00 | 320.00 | -0.0005 |
| 6 | 1550 | 4117 | 5-6 | 2.83 | 0.02 | 0.01 | 350.09 | 350.04 | -0.0152 |
| 7 | 1650 | 4117 | 6-7 | 0.01 | 0.00 | 0.00 | 100.00 | 100.00 | 0.0000 |
| 8 | 1900 | 4117 | 7-8 | 2.36 | 0.00 | 0.01 | 250.00 | 250.01 | 0.0044 |
| 9 | 2150 | 4117 | 8-9 | 0.62 | 0.00 | 0.00 | 250.00 | 250.00 | 0.0003 |
| 10 | 2250 | 4117 | 9-10 | 0.99 | 0.00 | 0.01 | 100.00 | 100.00 | 0.0049 |
| 11 | 2400 | 4103 | 10-11 | 7.89 | 0.09 | 0.04 | 150.65 | 150.12 | -0.3502 |
| 12 | 2500 | 4084 | 11-12 | 14.67 | 0.19 | 0.04 | 101.79 | 100.09 | -1.6654 |

* Tensile strain of the proposed piggyback liner.

# PREDICTED SETTLEMENT AND STRAIN OF FINAL COVER

McCombs Landfill
American Engineering Testing, Inc.
AET No. 01-05106

## Settlement of Existing Landfill

Ref. Qian, X., et. al., "Geotechnical Aspects of Landfill Design and Construction," Prentice Hall, 2002, pg. 548

**Project:** McCombs Landfill
**Section:** Section B

**AET No.** 01-05106
**Date:** July 2012

### Final Cover Settlement

### Primary Settlement

$\Delta Z_c = C_c' \times H_o \times \log (\sigma_o + \Delta\sigma / \sigma_o)$

$\Delta Z_c$ = primary settlement of existing landfill
$H_o$ = initial thickness of the waste layer of the existing landfill
$C_c'$ = modified primary compression index. Cc'= 0.17~0.36
$\sigma_o$ = existing overburden pressure acting at the mid level of the waste layer
$\Delta\sigma$ = increment of overburden pressure due to vertical expansion

### Secondary Settlement

$\Delta Z_\alpha = C_\alpha' \times H_o \times \log (t2 / t1)$

$\Delta Z_\alpha$ = secondary settlement of existing landfill
$H_o$ = initial thickness of the waste layer before starting secondary settlement
$C_\alpha'$ = modified secondary compression index. $C_\alpha'$ = 0.03~0.1
t1 = starting time of the secondary settlement. It is assumed to be equal to the age of existing landfill
t2 = ending time of the secondary settlement

### Enter Assumed Parameters

| | |
|---|---|
| Cc' = | 0.17 |
| Ca' = | 0.03 |
| Unit Weight of existing waste (pcf) = | 65 |
| Unit Weight of new cover soils (pcf) = | 125 |

| | |
|---|---|
| t1 = | 9 |
| t2 = | 59 |

| | | Settlement Calculation | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | MSW | | | New Cover | | Primary | | Secondary | Total |
| Point | Station | Top Elev. | Thickness, ft. | $\sigma_o$ (psf) | Thickness, ft. | $\Delta\sigma$ (psf) | Settlement (ft) | $H_o$ (feet) | Settlement (ft) | Settlement, ft. |
| 1 | 520 | 4094 | 66 | 2145 | 4 | 500 | 1.02 | 64.98 | 1.59 | 2.61 |
| 2 | 710 | 4156 | 104 | 3380 | 4 | 500 | 1.06 | 102.94 | 2.52 | 3.58 |
| 3 | 970 | 4236 | 163 | 5298 | 4 | 500 | 1.09 | 161.91 | 3.97 | 5.05 |
| 4 | 1600 | 4281 | 208 | 6760 | 4 | 500 | 1.10 | 206.90 | 5.07 | 6.16 |
| 5 | 2340 | 4279 | 211 | 6858 | 4 | 500 | 1.10 | 209.90 | 5.14 | 6.24 |
| 6 | 2870 | 4241 | 211 | 6858 | 4 | 500 | 1.10 | 209.90 | 5.14 | 6.24 |
| 7 | 3260 | 4111 | 64 | 2080 | 4 | 500 | 1.02 | 62.98 | 1.54 | 2.56 |

| | | | | Tensile Strain Calculation* | | | | | | Final |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Differential | Initial Tan. | Final Tan. | Distance Calcs | | | |
| Point | Station | Elevation | Points | Settlement, ft. | Slope Angle | Slope Angle | Initial | Final | Strain, % | Grade |
| 1 | 520 | 4094 | | n/a | n/a | n/a | n/a | n/a | n/a | |
| 2 | 710 | 4156 | 1-2 | 0.97 | 0.33 | 0.32 | 199.86 | 199.56 | -0.1492 | 32% |
| 3 | 970 | 4236 | 2-3 | 1.47 | 0.31 | 0.30 | 272.03 | 271.60 | -0.1577 | 30% |
| 4 | 1600 | 4281 | 3-4 | 1.11 | 0.07 | 0.07 | 631.61 | 631.53 | -0.0124 | 7% |
| 5 | 2340 | 4279 | 4-5 | 0.07 | 0.00 | 0.00 | 740.00 | 740.00 | 0.0000 | 0% |
| 6 | 2870 | 4241 | 5-6 | 0.00 | 0.07 | 0.07 | 531.36 | 531.36 | 0.0000 | -7% |
| 7 | 3260 | 4111 | 6-7 | 3.68 | 0.33 | 0.32 | 411.10 | 409.95 | -0.2793 | -32% |

*Tensile strain of the proposed final cover liner

## Settlement of Existing Landfill

Ref. Qian, X., et. al., "Geotechnical Aspects of Landfill Design and Construction," Prentice Hall, 2002, pg. 548

**Project:** McCombs Landfill **AET No.** 01-05106
**Section:** Section B **Date:** July 2012

**Final Cover Settlement**

**Primary Settlement**

$\Delta Z_c = C_c' \times H_o \times \log (\sigma_o + \Delta\sigma / \sigma_o)$

$\Delta Z_c$ = primary settlement of existing landfill
$H_o$ = initial thickness of the waste layer of the existing landfill
$C_c'$ = modified primary compression index. Cc'= 0.17~0.36
$\sigma_o$ = existing overburden pressure acting at the mid level of the waste layer
$\Delta\sigma$ = increment of overburden pressure due to vertical expansion

**Secondary Settlement**

$\Delta Z_\alpha = C_\alpha' \times H_o \times \log (t2 / t1)$

$\Delta Z_\alpha$ = secondary settlement of existing landfill
$H_o$ = initial thickness of the waste layer before starting secondary settlement
$C_\alpha'$ = modified secondary compression index. $C_\alpha'$ = 0.03~0.1
t1 = starting time of the secondary settlement. It is assumed to be equal to the age of existing landfill
t2 = ending time of the secondary settlement

**Enter Assumed Parameters**

| | | | |
|---|---|---|---|
| Cc' = | 0.36 | t1 = | 9 |
| Ca' = | 0.1 | t2 = | 59 |
| Unit Weight of existing waste (pcf) = | 65 | | |
| Unit Weight of new cover soils (pcf) = | 125 | | |

| | | Settlement Calculation | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | MSW | | | New Cover | | Primary | | Secondary | Total |
| Point | Station | Top Elev. | Thickness, ft. | $\sigma_o$ (psf) | Thickness, ft. | $\Delta\sigma$ (psf) | Settlement (ft) | $H_o$ (feet) | Settlement (ft) | **Settlement, ft.** |
| 1 | 520 | 4094 | 66 | 2145 | 4 | 500 | 2.16 | 63.84 | 5.21 | 7.38 |
| 2 | 710 | 4156 | 104 | 3380 | 4 | 500 | 2.24 | 101.76 | 8.31 | 10.55 |
| 3 | 970 | 4236 | 163 | 5298 | 4 | 500 | 2.30 | 160.70 | 13.12 | 15.42 |
| 4 | 1600 | 4281 | 208 | 6760 | 4 | 500 | 2.32 | 205.68 | 16.80 | 19.12 |
| 5 | 2340 | 4279 | 211 | 6858 | 4 | 500 | 2.32 | 208.68 | 17.04 | 19.36 |
| 6 | 2870 | 4241 | 211 | 6858 | 4 | 500 | 2.32 | 208.68 | 17.04 | 19.36 |
| 7 | 3260 | 4111 | 64 | 2080 | 4 | 500 | 2.16 | 61.84 | 5.05 | 7.21 |

| | | | | Tensile Strain Calculation* | | | | | | Final |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Differential | Initial Tan. | Final Tan. | Distance Calcs | | | |
| Point | Station | Elevation | Points | Settlement, ft. | Slope Angle | Slope Angle | Initial | Final | Strain, % | Grade |
| 1 | 520 | 4094 | | n/a | n/a | n/a | n/a | n/a | n/a | |
| 2 | 710 | 4156 | 1-2 | 3.18 | 0.33 | 0.31 | 199.86 | 198.90 | -0.4817 | 31% |
| 3 | 970 | 4236 | 2-3 | 4.87 | 0.31 | 0.29 | 272.03 | 270.64 | -0.5116 | 29% |
| 4 | 1600 | 4281 | 3-4 | 3.69 | 0.07 | 0.07 | 631.61 | 631.35 | -0.0400 | 7% |
| 5 | 2340 | 4279 | 4-5 | 0.25 | 0.00 | 0.00 | 740.00 | 740.00 | -0.0001 | 0% |
| 6 | 2870 | 4241 | 5-6 | 0.00 | 0.07 | 0.07 | 531.36 | 531.36 | 0.0000 | -7% |
| 7 | 3260 | 4111 | 6-7 | 12.16 | 0.33 | 0.30 | 411.10 | 407.42 | -0.8954 | -30% |

*Tensile strain of the proposed final cover liner

## Settlement of Existing Landfill

Ref. Qian, X., et. al., "Geotechnical Aspects of Landfill Design and Construction," Prentice Hall, 2002, pg. 548

**Project:** McCombs Landfill
**Section:** Section E

**AET No.** 01-05106
**Date:** July 2012

### Final Cover Settlement

### Primary Settlement

$\Delta Z_c = C_c' \times H_o \times \log (\sigma_o + \Delta\sigma / \sigma_o)$

$\Delta Z_c$ = primary settlement of existing landfill
$H_o$ = initial thickness of the waste layer of the existing landfill
$C_c'$ = modified primary compression index. Cc'= 0.17~0.36
$\sigma_o$ = existing overburden pressure acting at the mid level of the waste layer
$\Delta\sigma$ = increment of overburden pressure due to vertical expansion

### Secondary Settlement

$\Delta Z_\alpha = C_\alpha' \times H_o \times \log (t2 / t1)$

$\Delta Z_\alpha$ = secondary settlement of existing landfill
$H_o$ = initial thickness of the waste layer before starting secondary settlement
$C_\alpha'$ = modified secondary compression index. $C_\alpha'$ = 0.03~0.1
t1 = starting time of the secondary settlement. It is assumed to be equal to the age of existing landfill
t2 = ending time of the secondary settlement

### Enter Assumed Parameters

| | | | |
|---|---|---|---|
| Cc' = | 0.17 | t1 = | 9 |
| Ca' = | 0.03 | t2 = | 59 |
| Unit Weight of existing waste (pcf) = | 65 | | |
| Unit Weight of new cover soils (pcf) = | 125 | | |

| | | Settlement Calculation | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | MSW | | | New Cover | | Primary | | Secondary | Total |
| Point | Station | Top Elev. | Thickness, ft. | $\sigma_o$ (psf) | Thickness, ft. | $\Delta\sigma$ (psf) | Settlement (ft) | $H_o$ (feet) | Settlement (ft) | Settlement, ft. |
| 1 | 370 | 4069 | 0 | 0 | 4 | 500 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 900 | 4231 | 160 | 5200 | 4 | 500 | 1.08 | 158.92 | 3.89 | 4.98 |
| 3 | 1210 | 4256 | 182 | 5915 | 4 | 500 | 1.09 | 180.91 | 4.43 | 5.52 |
| 4 | 1300 | 4256 | 182 | 5915 | 4 | 500 | 1.09 | 180.91 | 4.43 | 5.52 |
| 5 | 1620 | 4281 | 204 | 6630 | 4 | 500 | 1.10 | 202.90 | 4.97 | 6.07 |
| 6 | 1950 | 4284 | 206 | 6695 | 4 | 500 | 1.10 | 204.90 | 5.02 | 6.12 |
| 7 | 2400 | 4306 | 219 | 7118 | 4 | 500 | 1.10 | 217.90 | 5.34 | 6.44 |
| 8 | 3050 | 4306 | 264 | 8580 | 4 | 500 | 1.10 | 262.90 | 6.44 | 7.54 |
| 9 | 3470 | 4276 | 240 | 7800 | 4 | 500 | 1.10 | 238.90 | 5.85 | 6.95 |
| 10 | 3600 | 4273 | 236 | 7670 | 4 | 500 | 1.10 | 234.90 | 5.75 | 6.85 |
| 11 | 4040 | 4242 | 209 | 6793 | 4 | 500 | 1.10 | 207.90 | 5.09 | 6.19 |
| 12 | 4570 | 4070 | 0 | 0 | 4 | 500 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | Tensile Strain Calculation* | | | | | | Final |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Differential | Initial Tan. | Final Tan. | Distance Calcs | | | |
| Point | Station | Elevation | Points | Settlement, ft. | Slope Angle | Slope Angle | Initial | Final | Strain, % | Grade |
| 1 | 370 | 4069 | | n/a | n/a | n/a | n/a | n/a | n/a | |
| 2 | 900 | 4231 | 1-2 | 4.98 | 0.31 | 0.30 | 554.21 | 552.77 | -0.2588 | 30% |
| 3 | 1210 | 4256 | 2-3 | 0.54 | 0.08 | 0.08 | 311.01 | 310.96 | -0.0139 | 8% |
| 4 | 1300 | 4256 | 3-4 | 0.00 | 0.00 | 0.00 | 90.00 | 90.00 | 0.0000 | 0% |
| 5 | 1620 | 4281 | 4-5 | 0.54 | 0.08 | 0.08 | 320.98 | 320.93 | -0.0130 | 8% |
| 6 | 1950 | 4284 | 5-6 | 0.05 | 0.01 | 0.01 | 330.01 | 330.01 | -0.0001 | 1% |
| 7 | 2400 | 4306 | 6-7 | 0.32 | 0.05 | 0.05 | 450.54 | 450.52 | -0.0035 | 5% |
| 8 | 3050 | 4306 | 7-8 | 1.11 | 0.00 | 0.00 | 650.00 | 650.00 | 0.0001 | 0% |
| 9 | 3470 | 4276 | 8-9 | 0.59 | 0.07 | 0.07 | 421.07 | 421.03 | -0.0099 | -7% |
| 10 | 3600 | 4273 | 9-10 | 0.10 | 0.02 | 0.02 | 130.03 | 130.03 | -0.0017 | -2% |
| 11 | 4040 | 4242 | 10-11 | 0.67 | 0.07 | 0.07 | 441.09 | 441.04 | -0.0105 | -7% |
| 12 | 4570 | 4070 | 11-12 | 6.19 | 0.32 | 0.31 | 557.21 | 555.33 | -0.3373 | -31% |

*Tensile strain of the proposed final cover liner

## Settlement of Existing Landfill

Ref. Qian, X., et. al., "Geotechnical Aspects of Landfill Design and Construction," Prentice Hall, 2002, pg. 548

**Project:** McCombs Landfill
**Section:** Section E

**AET No.** 01-05106
**Date:** July 2012

### Final Cover Settlement

### Primary Settlement

$\Delta Z_c = C_c' \times H_o \times \log (\sigma_o + \Delta\sigma / \sigma_o)$

$\Delta Z_c$ = primary settlement of existing landfill
$H_o$ = initial thickness of the waste layer of the existing landfill
$C_c'$ = modified primary compression index. Cc'= 0.17~0.36
$\sigma_o$ = existing overburden pressure acting at the mid level of the waste layer
$\Delta\sigma$ = increment of overburden pressure due to vertical expansion

### Secondary Settlement

$\Delta Z_\alpha = C_\alpha' \times H_o \times \log (t2 / t1)$

$\Delta Z_\alpha$ = secondary settlement of existing landfill
$H_o$ = initial thickness of the waste layer before starting secondary settlement
$C_\alpha'$ = modified secondary compression index. $C_\alpha'$ = 0.03~0.1
t1 = starting time of the secondary settlement. It is assumed to be equal to the age of existing landfill
t2 = ending time of the secondary settlement

### Enter Assumed Parameters

| | |
|---|---|
| Cc' = | 0.36 |
| Ca' = | 0.1 |
| Unit Weight of existing waste (pcf) = | 65 |
| Unit Weight of new cover soils (pcf) = | 125 |

| | |
|---|---|
| t1 = | 9 |
| t2 = | 59 |

| | | Settlement Calculation | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | MSW | | | New Cover | | Primary | | Secondary | Total |
| Point | Station | Top Elev. | Thickness, ft. | $\sigma_o$ (psf) | Thickness, ft. | $\Delta\sigma$ (psf) | Settlement (ft) | $H_o$ (feet) | Settlement (ft) | Settlement, ft. |
| 1 | 370 | 4069 | 0 | 0 | 4 | 500 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 900 | 4231 | 160 | 5200 | 4 | 500 | 2.30 | 157.70 | 12.88 | 15.17 |
| 3 | 1210 | 4256 | 182 | 5915 | 4 | 500 | 2.31 | 179.69 | 14.67 | 16.98 |
| 4 | 1300 | 4256 | 182 | 5915 | 4 | 500 | 2.31 | 179.69 | 14.67 | 16.98 |
| 5 | 1620 | 4281 | 204 | 6630 | 4 | 500 | 2.32 | 201.68 | 16.47 | 18.79 |
| 6 | 1950 | 4284 | 206 | 6695 | 4 | 500 | 2.32 | 203.68 | 16.63 | 18.95 |
| 7 | 2400 | 4306 | 219 | 7118 | 4 | 500 | 2.32 | 216.68 | 17.69 | 20.02 |
| 8 | 3050 | 4306 | 264 | 8580 | 4 | 500 | 2.34 | 261.66 | 21.37 | 23.71 |
| 9 | 3470 | 4276 | 240 | 7800 | 4 | 500 | 2.33 | 237.67 | 19.41 | 21.74 |
| 10 | 3600 | 4273 | 236 | 7670 | 4 | 500 | 2.33 | 233.67 | 19.08 | 21.41 |
| 11 | 4040 | 4242 | 209 | 6793 | 4 | 500 | 2.32 | 206.68 | 16.88 | 19.20 |
| 12 | 4570 | 4070 | 0 | 0 | 4 | 500 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | Tensile Strain Calculation* | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Differential | Initial Tan. | Final Tan. | Distance Calcs | | | Final |
| Point | Station | Elevation | Points | Settlement, ft. | Slope Angle | Slope Angle | Initial | Final | Strain, % | Grade |
| 1 | 370 | 4069 | | n/a | n/a | n/a | n/a | n/a | n/a | |
| 2 | 900 | 4231 | 1-2 | 15.17 | 0.31 | 0.28 | 554.21 | 549.96 | -0.7658 | 28% |
| 3 | 1210 | 4256 | 2-3 | 1.81 | 0.08 | 0.07 | 311.01 | 310.87 | -0.0451 | 7% |
| 4 | 1300 | 4256 | 3-4 | 0.00 | 0.00 | 0.00 | 90.00 | 90.00 | 0.0000 | 0% |
| 5 | 1620 | 4281 | 4-5 | 1.81 | 0.08 | 0.07 | 320.98 | 320.84 | -0.0422 | 7% |
| 6 | 1950 | 4284 | 5-6 | 0.16 | 0.01 | 0.01 | 330.01 | 330.01 | -0.0004 | 1% |
| 7 | 2400 | 4306 | 6-7 | 1.07 | 0.05 | 0.05 | 450.54 | 450.49 | -0.0113 | 5% |
| 8 | 3050 | 4306 | 7-8 | 3.69 | 0.00 | 0.01 | 650.00 | 650.01 | 0.0016 | -1% |
| 9 | 3470 | 4276 | 8-9 | 1.97 | 0.07 | 0.07 | 421.07 | 420.93 | -0.0322 | -7% |
| 10 | 3600 | 4273 | 9-10 | 0.33 | 0.02 | 0.02 | 130.03 | 130.03 | -0.0055 | -2% |
| 11 | 4040 | 4242 | 10-11 | 2.21 | 0.07 | 0.07 | 441.09 | 440.94 | -0.0340 | -7% |
| 12 | 4570 | 4070 | 11-12 | 19.20 | 0.32 | 0.29 | 557.21 | 551.59 | -1.0093 | -29% |

*Tensile strain of the proposed final cover liner

APPENDIX E
FINAL AND ALTERNATE COVER STABILITY ANALYSES

**AMERICAN ENGINEERING TESTING, INC.**
**TEXAS REGISTERED ENGINEERING FIRM F-10340**

McCombs Landfill
American Engineering Testing, Inc.
AET No. 01-05106

# Veneer Cover Soils

Ref: Koerner & Soong "Analysis and Design of Veneer Cover Soils", 1998

**Project:** McCombs LF, El Paso, TX

**Job #:** 01-05106

**Case:** Sliding along cover & LLDPE

Gravity Only

| | | | | | | |
|---|---|---|---|---|---|---|
| $\beta$ = | 18.4 | slope angle from horiz. (degrees) | cotan $\beta$ = | 3.0 | | |
| $\delta$ = | 28 | interface friction angle between cover and landfill mass (degrees) | | | Wa = | 1652.55 |
| $c_a$ = | 0 | cohesion between cover and landfill mass (psf) | 0 | ($kN/m^2$) | Wp= | 6.41 |
| $\phi$ = | 29 | friction angle of cover soil (degrees) | | | Na = | 1568.06 |
| $\gamma$ = | 117 | Unit Weight of cover soil (pcf) | 18.4 | ($kN/m^3$) | Ca = | 0 |
| h = | 1.5 | Cover thickness (feet) | 457.2 | mm | C = | 0 |
| L = | 650 | Length of slope (feet) | 198.2 | m | a = | 156.2 |
| c = | 0 | cohesion at base of passive wedge (psf) | 0 | ($kN/m^2$) | b = | -279.6 |
| | | | | | c = | 46.0 |
| H = | 205.17 | Slope height (ft.) | | | **FS =** | **1.61** |

Infinite slope: FS = 1.60

# Veneer Cover Soils

Ref: Koerner & Soong "Analysis and Design of Veneer Cover Soils", 1998

**Project:** McCombs LF, El Paso, TX

**Job #:** 01-05106

**Case:** Sliding along cover & LLDPE

Parallel Seepage

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $\beta$ = | 18.4 | slope angle from horiz. (degrees) | | | | | |
| $\delta$ = | 28 | interface friction angle between cover and landfill mass (degrees) | | | | Wa = | 5654.15 |
| $\phi$ = | 29 | friction angle of cover soil (degrees) | | | | Wp= | 6.49 |
| $\gamma$ = | 117 | Unit Weight of partially saturated cover soil (pcf) | 18.4 | (kN/m$^3$) | | Un= | 902.67 |
| $\gamma_{sat}$ = | 130 | Unit Weight of saturated cover soil (pcf) | 20.4 | (kN/m$^3$) | | Uh = | 0.11 |
| h = | 1.5 | Cover thickness (feet) | 457.2 | mm | | Uv = | 0.328668 |
| L= | 650 | Length of slope (feet) | 198.17 | m | | Na = | 4462.42 |
| $\gamma_w$ = | 62.4 | Unit Weight of water (pcf) | 9.8 | (kN/m$^3$) | | a = | 1693.50 |
| hw = | 0.49 | Parallel seepage thickness in cover soils (ft.) | 149.352 | mm | | b = | -2567.07 |
| | | | | | | c = | 415.15 |
| H = | 205.17 | Slope height (ft) | | | | | |

**FS = 1.33**

# Veneer Cover Soils

Ref: Koerner & Soong "Analysis and Design of Veneer Cover Soils", 1998

**Project:** McCombs LF, El Paso, TX

**Job #:** 01-05106

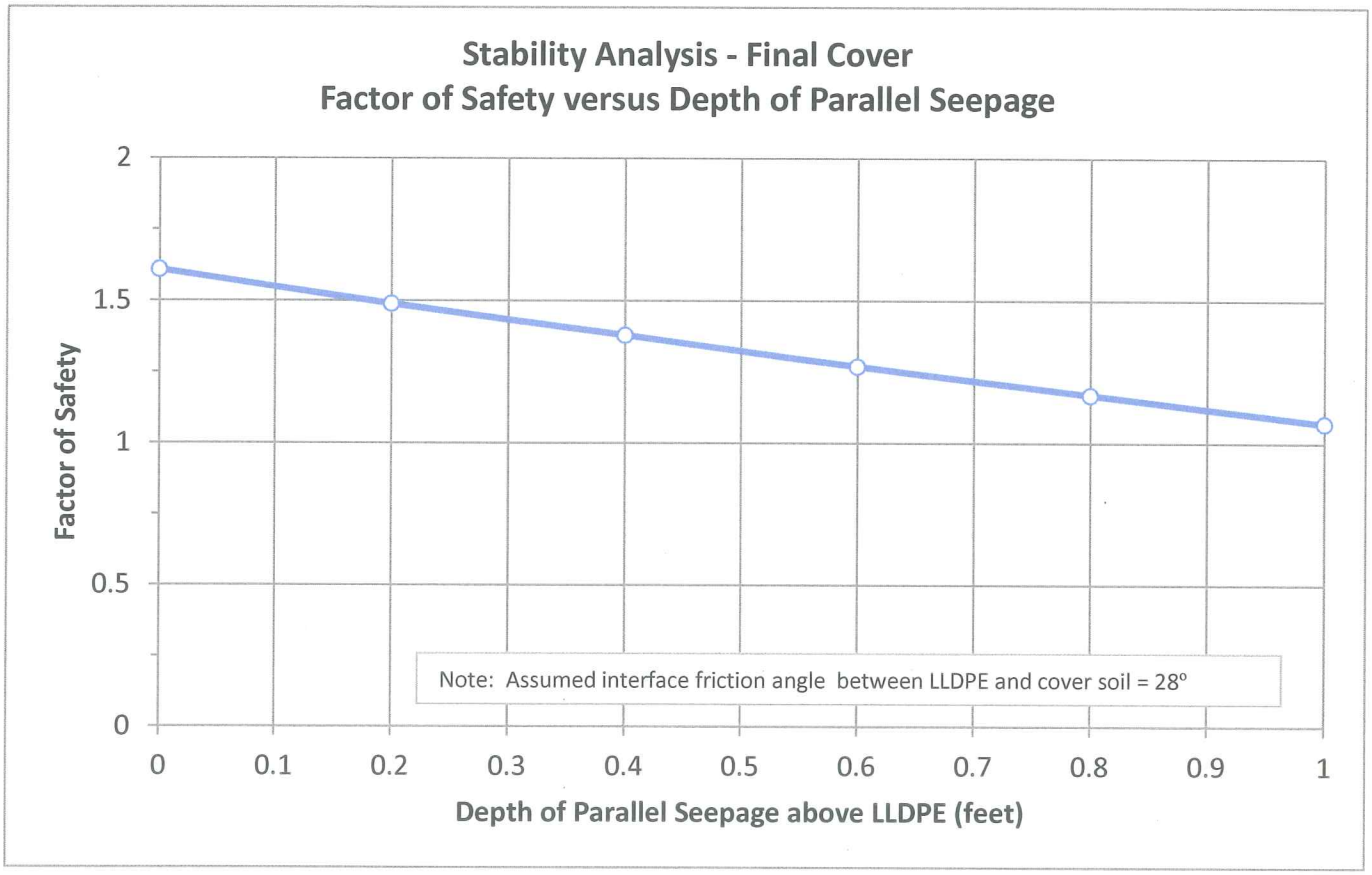
**Case:** Sliding along cover & LLDPE — Gravity plus Seismic

| | | | | | | |
|---|---|---|---|---|---|---|
| Cs = | 0.09 | seismic coefficient | | | Wa = | 1652.55 |
| $\beta$ = | 18.4 | slope angle from horiz. (degrees) | | | Wp= | 6.41 |
| $\delta$ = | 25 | interface friction angle between cover and landfill mass (degrees) | | | Na = | 1568.06 |
| $c_a$ = | 0 | cohesion between cover and landfill mass (psf) | 0 | ($kN/m^2$) | Ca = | 0 |
| $\phi$ = | 23 | friction angle of cover soil (degrees) | | | C = | 0 |
| $\gamma$ = | 117 | Unit Weight of cover soil (pcf) | 18.4 | ($kN/m^3$) | a = | 611.3 |
| L = | 650 | Length of slope (feet) | 457.2 | mm | b = | -747.2 |
| h = | 1.5 | Cover thickness (feet) | 198.2 | m | c = | 93.0 |
| c = | 0 | cohesion at base of passive wedge | 0 | ($kN/m^2$) | | |

H = 205.17 Slope height (ft.)

**FS = 1.08**

Infinite slope: FS = 1.40


Stability Analysis - Final Cover
Factor of Safety versus Depth of Parallel Seepage
Factor of Safety
2
1.5
1
0.5
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Depth of Parallel Seepage above LLDPE (feet)
Note: Assumed interface friction angle between LLDPE and cover soil = 28°

# Veneer Cover Soils

Ref: Koerner & Soong "Analysis and Design of Veneer Cover Soils", 1998

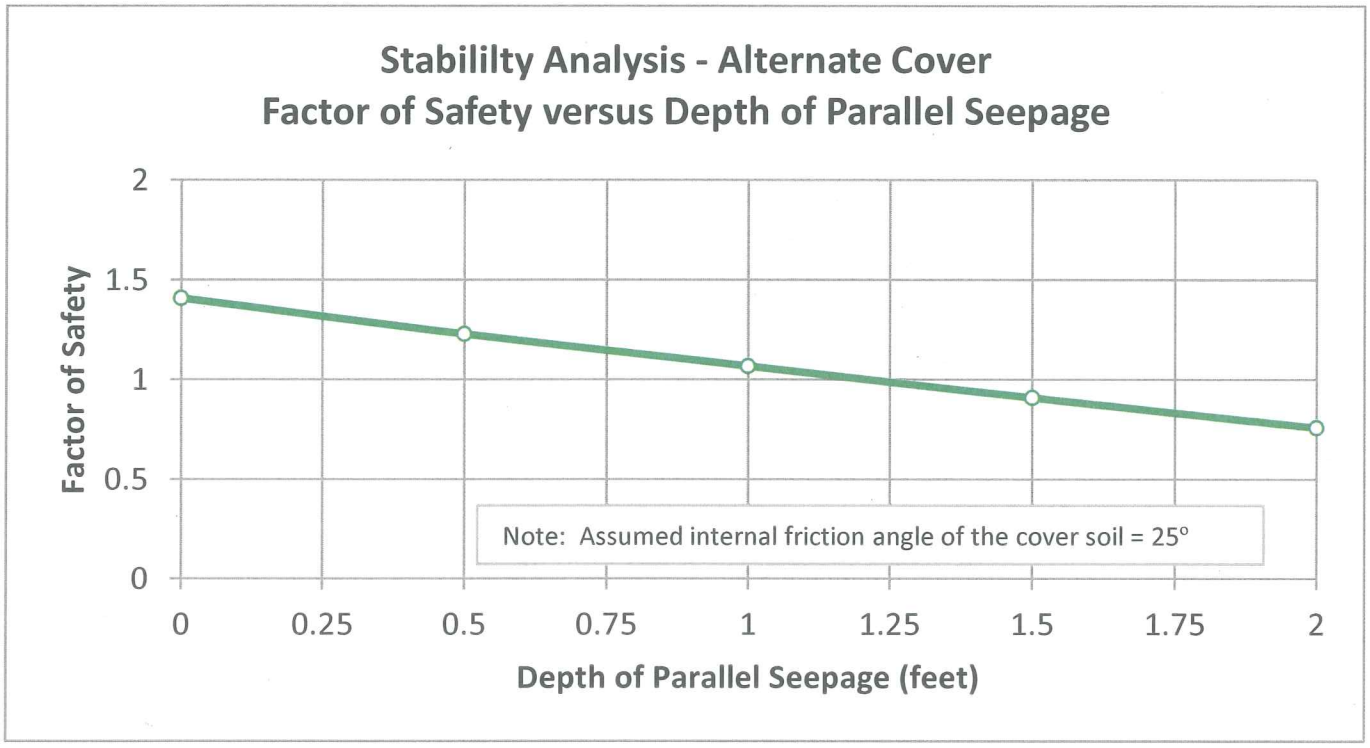
**Project:** McCombs LF, El Paso, TX

**Job #:** 01-05106

**Case:** Sliding within 6 inch intermediate cover material  Gravity Only

| | | | | | | |
|---|---|---|---|---|---|---|
| $\beta$ = | 18.4 | slope angle from horiz. (degrees) | cotan $\beta$ = | 3.0 | | |
| $\delta$ = | 25 | interface friction angle between cover and landfill mass (degrees) | | | Wa = | 2347.97 |
| $c_a$ = | 0 | cohesion between cover and landfill mass (psf) | 0 | ($kN/m^2$) | Wp= | 12.18 |
| $\phi$ = | 25 | friction angle of cover soil (degrees) | | | Na = | 2227.94 |
| $\gamma$ = | 125 | Unit Weight of cover soil (pcf) | 19.6 | ($kN/m^3$) | Ca = | 0 |
| h = | 2 | Cover thickness (feet) | 609.6 | mm | C = | 0 |
| L = | 650 | Length of slope (feet) | 198.2 | m | a = | 222.0 |
| c = | 0 | cohesion at base of passive wedge (psf) | 0 | ($kN/m^2$) | b = | -347.4 |
| | | | | | c = | 48.3 |
| H = | 205.17 | Slope height (ft.) | | | **FS =** | **1.41** |

Infinite slope: FS = 1.40


Stabililty Analysis - Alternate Cover
Factor of Safety versus Depth of Parallel Seepage
Factor of Safety
2
1.5
1
0.5
0
0
0.25
0.5
0.75
1
1.25
1.5
1.75
2
Depth of Parallel Seepage (feet)
Note: Assumed internal friction angle of the cover soil = 25°

# Appendix 3G, Attachment 3
# Anchor Trench Calculations

SAIC®

## Memorandum

To: TCEQ

From: Fred J. Doran, P.E., SAIC

Subject: Anchor Trench Design for Pullout and Interface Liner System Stability Calculations

Date: November 2, 2012

Attached is the anchor trench design for pullout and interface liner system stability calculations completed by SAIC on July 17, 2012. The calculations were completed using the references identified here within. Results indicate the following factors of safety:

- Anchor trench pullout versus tear: 1.10

The anchor trench was designed with both constructability and strength in mind. The anchor trench should fail and pullout rather than the sideslope geomembrane liner failing and tearing, since it will be easier to observe and repair an anchor trench failure. However, the anchor trench also has to aid in construction, and providing a shallower anchor trench may have issues with wind and water migration under the liner edge. The calculated factor of safety of 1.1 is considered adequate as it shows that anchor trench pullout will be the governing failure mode. Also note that the configuration is temporary as the slope will be filled against after phase construction.

- Interface liner system stability (gravity): 1.37

The interface liner system stability calculations are also most critical during and immediately after phase construction (until waste filling begins within the phase) and are a temporary condition. As waste is filled against the slope, the waste creates a buttress to provide more strength against failure. The calculated 1.37 factor of safety is considered adequate for temporary conditions.

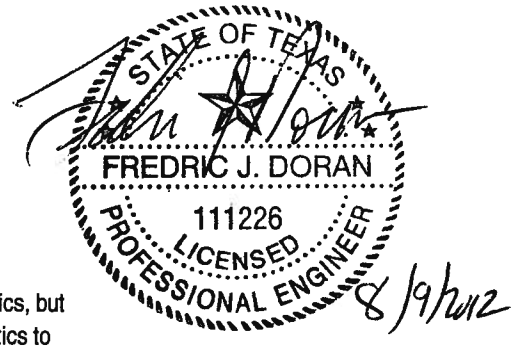
- Interface liner system stability (equipment): 1.31 and 1.36

As described above, the calculated factors of safety are for temporary conditions during phase construction and are considered adequate.

TLK

SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI

# Anchor Trench Design for Pullout
# McCombs Landfill MSW Permit 729B




Completed By: TLK 7/17/2012
Checked By: FJD 7/17/2012

*Problem Statement:*

PROBLEM: The anchor trench is designed to prevent wind and water migration under the geosynthetics, but is not designed to allow the geosynthetics to be in tension. In failure this design allows the geosynthetics to pull out of the anchor trench rather than tear.

OBJECTIVE: Determine if the designed anchor trench is adequate.

*Equation:*

**Anchor Trench Capacity = $F_U + F_L + F_{AT1} + F_{AT2} + F_{BU} + F_{BL}$**

*Where:*

| | | | |
|---|---|---|---|
| **$F_U$ =** | **0** | **lb/ft** | Frictional force above geomembrane (assumed to be negligible since cover soil likely moves with geomembrane) |
| $F_L = d_{cs} * \gamma_{cs} * L_{ro} * \tan\phi_2$ | | | |
| $d_{cs}$ = | 2 | ft | Depth of protective cover on the liner runout, design value |
| $\gamma_{cs}$ = | 110 | pcf | Unit weight of protective cover of anchor trench, assumed value |
| $L_{RO}$ = | 4 | ft | Runout length with soil cover, design value |
| $\phi_2$ = | 24 | ° | Most critical friction angle below geomembrane (woven geotextile to soil, assumed value) |
| | 0.42 | radians | |
| **$F_L$ =** | **391.58** | **lb/ft** | Calculated |
| $F_{AT1} = K_A([0.5d_{AT} * \gamma_{cc} + d_{cs} * \gamma_{cs}]d_{AT})*\tan\phi_1$ | | | |
| $K_a = \tan(45° - \phi_0/2)^2$ | | | Active coefficient of earth pressure |
| $\phi_0$ = | 30 | ° | Internal friction angle of backfill soil, assumed value |
| | 0.52 | radians | |
| $K_a$ = | 0.33 | | Calculated |
| $d_{AT}$ = | 2 | ft | Depth of ancor trench, design value |
| $\gamma_{cc}$ = | 110 | pcf | Unit weight of anchor trench backfill, assumed value |
| $d_{cs}$ = | 2 | ft | Depth of protective cover on the liner runout, design value |
| $\gamma_{cs}$ = | 110 | pcf | Unit weight of protective cover of anchor trench, assumed value |
| $\phi_1$ = | 25 | ° | Most critical friction angle above geomembrane (sand to textured geomembrane, assumed value) |
| | 0.44 | radians | |
| **$F_{AT1}$ =** | **102.4** | **lb/ft** | Calculated |
| $F_{AT2} = K_p([0.5d_{AT} * \gamma_{cc} + d_{cs} * \gamma_{cs}]d_{AT})*\tan\phi_2$ | | | |
| $K_p = \tan(45° + \phi_0/2)^2$ | | | Passive coefficient of earth pressure |
| $\phi_0$ = | 30 | ° | Internal friction angle of backfill soil, assumed value |
| | 0.52 | radians | |
| $K_p$ = | 2.99 | | Calculated |
| $d_{AT}$ = | 2 | ft | Depth of ancor trench, design value |
| $\gamma_{cc}$ = | 110 | pcf | Unit weight of anchor trench backfill, assumed value |
| $d_{cs}$ = | 2 | ft | Depth of protective cover on the liner runout, design value |
| $\gamma_{cs}$ = | 110 | pcf | Unit weight of protective cover of anchor trench, assumed value |
| $\phi_2$ = | 24 | ° | Most critical friction angle below geomembrane (woven geotextile to soil, assumed value) |
| | 0.42 | radians | |
| **$F_{AT2}$ =** | **878.9** | **lb/ft** | Calculated |

$F_{BU} = \gamma_{cs}(d_{AT} + d_{cs})d_{BT} * \tan\phi_1$

| | | | |
|---|---|---|---|
| $\gamma_{cs}$ = | 110 | pcf | Unit weight of protective cover of anchor trench, assumed value |
| $d_{AT}$ = | 2 | ft | Depth of ancor trench, design value |
| $d_{cs}$ = | 2 | ft | Depth of protective cover on the liner runout, design value |
| $d_{BT}$ = | 0 | ft | Runout length at base of anchor trench, design value |
| $\phi_1$ = | 25 | ° | Most critical friction angle above geomembrane (sand to textured geomembrane, assumed value) |
| | 0.44 | radians | |
| **$F_{BU}$ =** | **0** | **lb/ft** | Calculated |

$F_{BL} = \gamma_{cs}(d_{AT} + d_{cs})d_{BT} * \tan\phi_2$

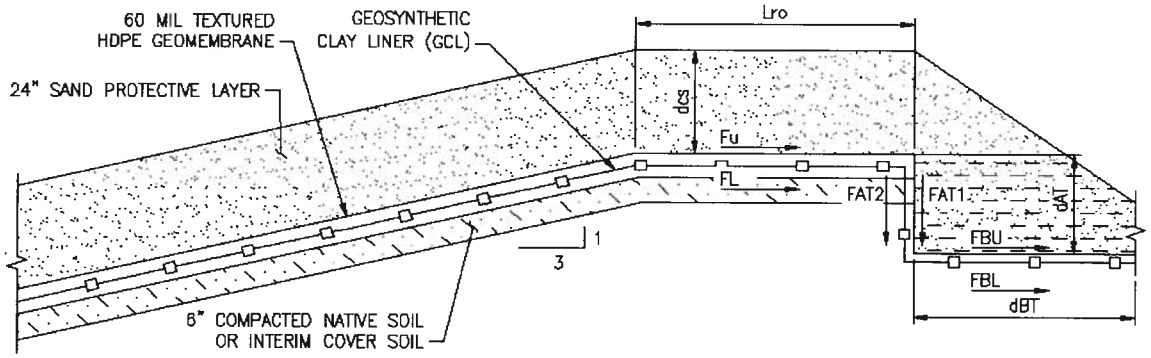
| | | | |
|---|---|---|---|
| $\gamma_{cs}$ = | 110 | pcf | Unit weight of protective cover of anchor trench, assumed value |
| $d_{AT}$ = | 2 | ft | Depth of ancor trench, design value |
| $d_{cs}$ = | 2 | ft | Depth of protective cover on the liner runout, design value |
| $d_{BT}$ = | 0 | ft | Runout length at base of anchor trench, design value |
| $\phi_2$ = | 24 | ° | Most critical friction angle below geomembrane (woven geotextile to soil, assumed value) |
| | 0.42 | radians | |
| **$F_{BL}$ =** | **0** | **lb/ft** | Calculated |

*Anchor Trench Capacity* = $F_U + F_L + F_{AT1} + F_{AT2} + F_{BU} + F_{BL}$

**Anchor Trench Capacity = 1,373 lb/ft**

The yield strength for textured 60 mil HDPE geomembrane is: **1,512 lb/ft**

Factor of Safety = HDPE Strength/Anchor Trench Capacity **FS = 1.10**



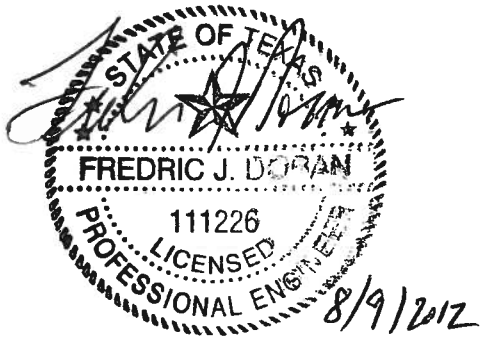

References:

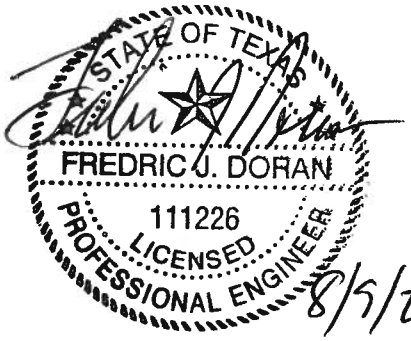

Koerner, Robert M, *Designing with Geosynthetics*, 5th Edition, 2005.

Sharma, & Lewis, *Waste Containment Systems, Waste Stabilization, and Landfills*, 1994.

Qunn, M. and Chandler, M., Landfill Liner Side Slope Design to Minimize Geomembrane Tensile Stress, 1991.

Zhang, S., Wu, D., and Chen, Y., Natural Shear Strength for Municipal Solid Waste, 2011.




8/5/2012

## Interface Liner System Stability
## McCombs Landfill MSW Permit 729B
## Koerner and Soong Analysis of Liner System

| | | |
|---|---|---|
| Completed By: | TLK | 7/17/2012 |
| Checked By: | FJD | 7/17/2012 |

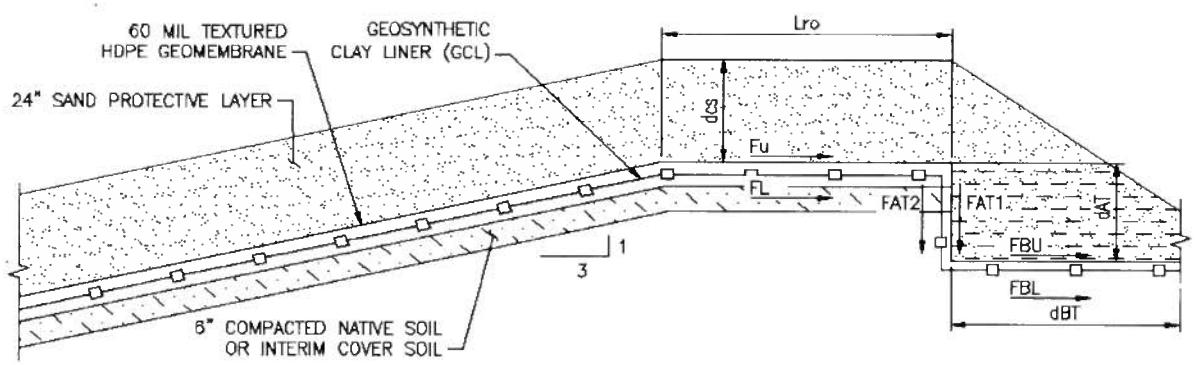
*Problem Statement:*

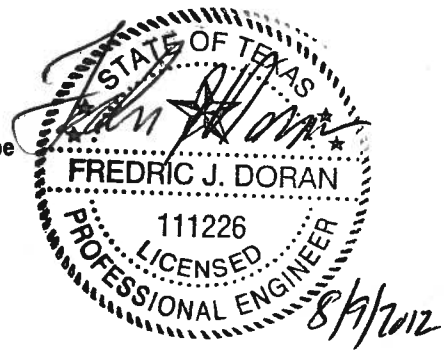
In order to determine the required tensile strength of the geosynthetics to be placed as the liner beneath the protective soil, it is necessary to calculate the tensile forces placed on the liner system. After determining the tensile forces present in the cover liner system, it would be possible to define the requirements for an anchor trench. Tensile forces have been calculated by Koerner methodologies.

| n | Variable | Value | Units | Source |
|---|---|---|---|---|
| Slope Length | L | | 75.2 Meters | Design (ft) |
| Protective Soil Density (Saturated) | $Dens_{ps(sat)}$ | | 1762 $kg/m^3$ | Assumed (pcf) |
| Protective Soil Depth | $D_{ps}$ | | 0.610 Meters | Design |
| Slope Ratio | Sr | | 3 to 1 | Design |
| Gravity | g | | 9.81 $m/s^2$ | Standard Gravitation Acceleration |
| Soil/HDPE Angle | d | | 25.0 Degrees | Bentofix Slope Design with Bentofix GCLs |
| HDPE/GCL Angle | d | | 27.0 Degrees | Bentofix Slope Design with Bentofix GCLs |
| GCL/soil Angle | d | | 24.0 Degrees | Bentofix Slope Design with Bentofix GCLs |
| Cohesion | c | | 0 $kN/m^2$ | Assumed based on soil type |
| Adhesion | ca | | 0 $kN/m^2$ | Assumed (Conservative) |
| Protective Soil Friction Angle | f | | 30.00 Degrees | Assumed based on soil type |

| **Calculated Values** | **Variable** | **Value** | **Units** | **Source** |
|---|---|---|---|---|
| Total Soil Depth | h | | 0.61 Meters | Sum of cover soil component depths |
| Slope Angle | b | | 18.43 Degrees | ATAN (1/Sr) |
| Cover Soil Density | $Dens_{ts}$ | | 1762 $kg/m^3$ | Weighted average of cover soil component densities |
| Cover Soil Weight | $g_{cs}$ | | 17.3 $kN/m^3$ | $Dens_{ts}$ * g / 1000 |
| Minimum interface angle | d | | 24.0 Degrees | Minimum Value from liner interface friction angles |
| Active Wedge Weight | Wa | | 771 kN/m | Equation 3 |
| Eff Normal Force | Na | | 731 kN/m | Equation 4 |
| Passive Wedge Weight | Wp | | 11 kN/m | Equation 8 |
| Cohesion Force | C | | 0 kN/m | Equation 10 |
| Adhesive Force | Ca | | 0 kN/m | Equation 5 |

| Conclusions | | |
|---|---|---|
| | a | 73.1 kN/m |
| | b | -113.7 kN/m |
| | c | 18.8 kN/m |
| ***Factor of Safety*** | ***FS*** | ***1.37*** |






**Interface Liner System Stability - D6N LGP Dozer on Slope**
**McCombs Landfill MSW Permit 729B**
**Koerner and Soong Analysis of Liner System**

| | | |
|---|---|---|
| Completed By: | TLK | 7/17/2012 |
| Checked By: | FJD | 7/17/2012 |

*Problem Statement:*

Further analysis was performed using Koerner and Soong's methodologies for analysis and design of veneer soils. This analysis included examination of the impact on that factor of safety by construction equipment.

| Data Inputs | Variable | Value | Units | Source |
|---|---|---|---|---|
| Slope Length | L | 75.2 | Meters | Design (ft) |
| Protective Soil Density (Saturated) | $Dens_{cs}$ | 1762 | $kg/m^3$ | Assumed (pcf) |
| Protective Soil Depth | Dcs | 0.610 | Meters | Design |
| Slope Ratio | Sr | 3 | to 1 | Design |
| Bulldozer Model | | D6N LGP | | CAT Handbook |
| Bulldozer Mass | $M_b$ | 17722 | kg | CAT Handbook |
| Dozer Track Width | b | 0.86 | m | CAT Handbook |
| Dozer Track Length | w | 3.102 | m | CAT Handbook |
| Gravity | g | 9.81 | $m/s^2$ | Standard Gravitational Acceleration |
| Dozer Velocity | v | 12 | km/hr | CAT Handbook, maximum reverse |
| Dozer Stopping Time | t | 3 | sec | Assumed, same as Koerner Example 2b |
| Soil/HDPE Angle | d | 25.0 | Degrees | Bentofix Slope Design with Bentofix GCLs |
| HDPE/GCL Angle | d | 27.0 | Degrees | Bentofix Slope Design with Bentofix GCLs |
| GCL/soil Angle | d | 24.0 | Degrees | Bentofix Slope Design with Bentofix GCLs |
| Cohesion | c | 0 | $kN/m^2$ | Assumed based on soil type |
| Adhesion | $c_a$ | 0 | $kN/m^2$ | Assumed (Conservative) |
| Protective Soil Friction Angle | f | 30 | Degrees | Assumed based on soil type |

| Calculated Values | Variable | Value | Units | Source |
|---|---|---|---|---|
| Total Soil Depth | h | 0.61 | Meters | Sum of cover soil component depths |
| Slope Angle | b | 18.43 | Degrees | ATAN (1/Sr) |
| Track/Soil Ratio | b/h | 1.411 | - | See Figure 7, Page 7 |
| Influence Factor | I | 0.94 | - | Lookup Table |
| Weight of Dozer | $W_b$ | 174 | kN | $M_b$ * g / 1000 |
| Dozer Deceleration | a | 1.11 | $m/s^2$ | v * 1000 / 60 / 60 / t |
| Protective Soil Density | $Dens_{ts}$ | 1762 | $kg/m^3$ | Weighted average of cover soil component densities |
| Protective Soil Weight | $g_{cs}$ | 17.3 | $kN/m^3$ | $Dens_{ts}$ * g / 1000 |
| Minimum interface angle | d | 24.0 | Degrees | Minimum Value from liner interface friction angles |
| Active Wedge Weight | Wa | 771 | kN/m | Equation 3 |
| | q | 32.6 | $kN/m^2$ | (See Definition, page 6) |
| Equipment Force | $W_e$ | 95 | kN/m | Equation16 |
| Dynamic Force | $F_e$ | 10.76 | kN/m | Equation 17 |
| Eff Normal Force | $N_a$ | 731 | kN/m | Equation 4 |
| Eff Equip Normal Force | $N_e$ | 90 | kN/m | Equation 19 |
| Passive Wedge Weight | $W_p$ | 11 | kN/m | Equation 8 |
| Cohesion Force | C | 0 | kN/m | Equation 10 |
| Adhesion Force | $C_a$ | 0 | kN/m | Equation 5 |

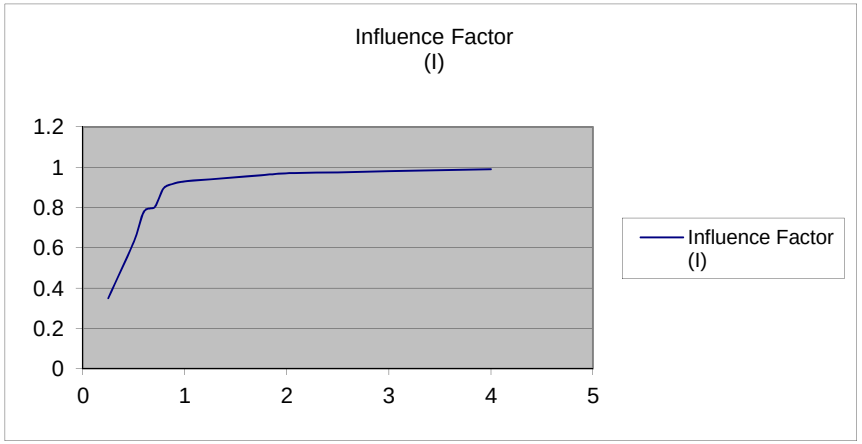
**Conclusions**

| Equipment Moving Up Slope | | |
|---|---|---|
| | a | 259.7 kN/m |
| | b | -403.1 kN/m |
| | c | 66.8 kN/m |
| ***Factor of Safety*** | ***FS*** | ***1.36*** |

| Equipment Moving Down Slope | | |
|---|---|---|
| | a | 270.0 kN/m |
| | b | -405.1 kN/m |
| | c | 66.8 kN/m |
| ***Factor of Safety*** | ***FS*** | ***1.31*** |

Interface Liner System Stability - CONSTRUCTION (Influence Factor)
McCombs Landfill MSW Permit 729B

| Width of Track/ Cover Soil Thickness (b/h) | Influence Factor (I) |
|---|---|
| 0.25 | 0.35 |
| 0.5 | 0.63 |
| 0.6 | 0.78 |
| 0.7 | 0.8 |
| 0.75 | 0.85 |
| 0.8 | 0.9 |
| 0.9 | 0.92 |
| 1 | 0.93 |
| 1.25 | 0.94 |
| 1.5 | 0.95 |
| 1.75 | 0.96 |
| 2 | 0.97 |
| 2.5 | 0.975 |
| 3 | 0.98 |
| 3.5 | 0.985 |
| 4 | 0.99 |



# Appendix 3G, Attachment 4
# Design Drawings

SAIC®

## NOTES

1. DIGITIZED TOPOGRAPHY FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS.
2. COORDINATES ARE BASED ON THE TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NAD 83. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM. NAVD 88 DATUM TO NGVD 29 DATUM, SUBTRACT 1.99–FEET. NGVD 29 DATUM TO CITY OF EL PASO DATUM, ADD 27.65–FEET.
3. EXISTING CONTOUR INTERVAL IS TWO FEET.
4. SITE TOPOGRAPHY MAY VARY DUE TO OWNER'S OPERATIONS.
5. DESIGN CONTOURS SHOWN REPRESENT TOP OF ASBESTOS FILL AREA. CONTOUR INTERVAL IS FIVE FEET.
6. TOP OF ASBESTOS CONTOURS ARE A MINIMUM OF 20–FEET FROM FINAL SIDESLOPE CONTOURS (SOUTH AND WEST SIDES) AND A MINIMUM OF 10–FEET FROM THE FINAL SURFACE OF THE AREA.

## LEGEND

- MW–2 — MONITORING WELL
- GMP–8 — GAS MONITORING PROBE
- PV–7 — VERTICAL GAS WELL
- W — WATER WELL
- BUILDING/STRUCTURE
- 4100 — ELEVATION CONTOURS
- CHAIN LINK OR OTHER FENCE
- GMCS — GAS MIGRATION CONTROL SYSTEM
- FACILITY/PROPERTY BOUNDARY
- SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- LANDFILL ACCESS ROAD
- ASBESTOS BOUNDARY

GRAPHIC SCALE

1"=60'-0" — 60 0 60 120 — Scale Feet

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STATE OF TEXAS — FREDRIC J. DORAN — 111226 — REGISTERED PROFESSIONAL ENGINEER

11/2/12

| DESIGNED | DRAWN | VERIFY SCALE |
|---|---|---|
| TLK | CAD | BAR IS ONE INCH ON ANSI "D" DRAWING (0 — 1") |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

THE CITY OF EL PASO TEXAS

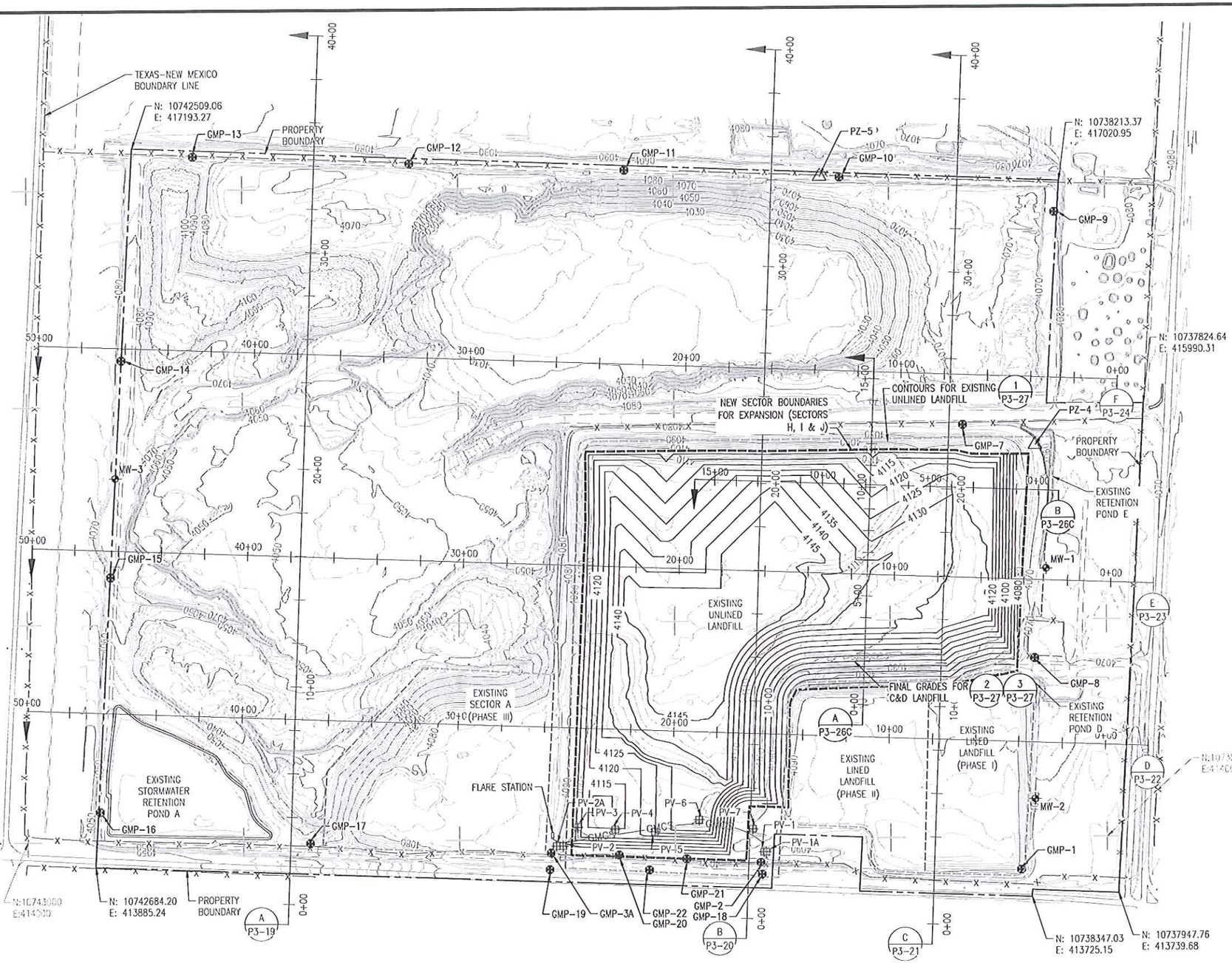
SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve
Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

ASBESTOS LOCATION AND FINAL GRADES

PROJECT NUMBER: 9631500115
SHT. 58 OF: 78
DRAWING NUMBER: P3–25

Keller, Tonya L. 11/1/2012 11:36:37 AM — P:\00218000 el paso tx\9631500115\data analytical\CADD\P3-25 ASBESTOS LOCATION AND FINAL GRADES.dwg




## NOTES

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3. EXISTING CONTOUR INTERVAL IS TWO FEET.
4. SITE TOPOGRAPHY MAY VARY DUE TO OWNER'S OPERATIONS.
5. DESIGN CONTOURS SHOWN REPRESENT TOP OF C&D FILL AREA. CONTOUR INTERVAL IS FIVE FEET.
6. TOP OF C&D CONTOURS ARE (AT MINIMUM) THREE FEET BELOW BASE GRADE CONTOURS FOR FUTURE CELLS. DUE TO DIFFERENTIAL SETTLEMENT WITHIN THE EXISTING LANDFILL, THE FINAL C&D GRADES MAY END UP FURTHER THAN THREE FEET FROM THE VERTICAL EXPANSION BASE GRADES. SEE DETAIL 4 SHEET P3-27
7. C&D WASTE PLACED OVER THE EXISTING UNLINED LANDFILL WILL CONSIST OF INERT (CLASS 3 LIKE) WASTE AND SOIL FILL. REFER TO SECTION 2.2.1 FOR A MORE COMPLETE LIST OF WASTE TO BE ACCEPTED.
8. C&D WASTE DEPTH WILL BE LIMITED TO 30-FEET.

## LEGEND

| | |
|---|---|
| MW-2 | MONITORING WELL |
| GMP-8 | GAS MONITORING PROBE |
| △ | PIEZOMETER |
| PV-7 | VERTICAL GAS WELL |
| 4100 | ELEVATION CONTOURS |
| x x x | CHAIN LINK OR OTHER FENCE |
| GMCS | GAS MIGRATION CONTROL SYSTEM |
| | FACILITY/PROPERTY BOUNDARY |
| | SECTOR BOUNDARIES |
| | EXISTING SECTOR BOUNDARIES |
| | STORMWATER RETENTION POND BOUNDARY |
| | HIGHWAY |
| | LANDFILL ACCESS ROAD |

GRAPHIC SCALE

1"=250'-0" Scale: 250 0 250 500 Feet

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STATE OF TEXAS
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113723
REGISTERED PROFESSIONAL ENGINEER
3/15/13

DESIGNED TLK
DRAWN CAD
VERIFY SCALE BAR IS ONE INCH ON ANSI "D" DRAWING 0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 3 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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C&D FINAL GRADES

PROJECT NUMBER: 9631500115
SHT. 59 OF: 78
DRAWING NUMBER: P3-26

Rev. Jacob S. 3/13/2013 10:35:07 AM – R:\0021B300 El Paso TX\9631500115 – McCombs\Data Analysis\CADD\P3-26 C&D FINAL GRADES.dwg

## NOTES

1. COORDINATES ARE BASED ON THE TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NAD 83. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM. NAVD 88 DATUM TO NGVD 29 DATUM, SUBTRACT 1.99-FEET. NGVD 29 DATUM TO CITY OF EL PASO DATUM, ADD 27.65-FEET.
2. FILL CONTOUR INTERVAL SHOWN IS FIVE FEET. CONTOURS REPRESENT THE DIFFERENCE BETWEEN THE FEBRUARY 2011 SURVEY AND THE TOP OF C&D FILL. THE C&D FILL IS LIMITED TO 30-FEET. THE REMAINDER OF FILL NEEDED TO OBTAIN MSW BASE GRADES WILL BE UNCONTAMINATED SOIL.
3. SITE TOPOGRAPHY MAY VARY DUE TO OWNER'S OPERATIONS.
4. TOP OF C&D CONTOURS ARE (AT MINIMUM) THREE FEET BELOW BASE GRADE CONTOURS FOR FUTURE CELLS. DUE TO DIFFERENTIAL SETTLEMENT WITHIN THE EXISTING LANDFILL AND THE 30-FOOT C&D LIMIT, THE FINAL C&D GRADES MAY END UP FURTHER THAN THREE FEET FROM THE VERTICAL EXPANSION BASE GRADES. SEE DETAIL 4 SHEET P3-27
5. C&D WASTE PLACED OVER THE EXISTING UNLINED LANDFILL WILL CONSIST OF INERT (CLASS 3 LIKE) WASTE AND SOIL FILL. REFER TO SECTION 2.2.1 FOR A MORE COMPLETE LIST OF WASTE TO BE ACCEPTED.

## LEGEND

- MW-2 — MONITORING WELL
- PIEZOMETER
- 30 — FILL CONTOURS
- CHAIN LINK OR OTHER FENCE
- FACILITY/PROPERTY BOUNDARY
- SECTOR BOUNDARIES
- EXISTING SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- LANDFILL ACCESS ROAD

TEXAS-NEW MEXICO BOUNDARY LINE
N: 10742509.06
E: 417193.27
PROPERTY BOUNDARY
PZ-5
N: 10738213.37
E: 417020.95
N: 10737824.64
E: 415990.31
NEW SECTOR BOUNDARIES FOR EXPANSION (SECTORS H, I & J)
PZ-4
PROPERTY BOUNDARY
EXISTING RETENTION POND E
B P3-26C
MW-1
MW-3
EXISTING UNLINED LANDFILL
EXISTING SECTOR A (PHASE III)
EXISTING STORMWATER RETENTION POND A
C&D FILL COMPARISON (EXISTING CONTOURS 2011 TO FINAL C&D FILL CONTOURS)
A P3-26C
EXISTING LINED LANDFILL (PHASE II)
EXISTING LINED LANDFILL (PHASE I)
EXISTING RETENTION POND D
MW-2
N:10738000 E:414000
N:10743000 E:414000
N: 10742684.20 E: 413885.24
PROPERTY BOUNDARY
N: 10738347.03 E: 413725.15
N: 10737947.76 E: 413739.68

GRAPHIC SCALE
1"=250'-0" 250 0 250 500
Scale Feet

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| DESIGNED | DRAWN | VERIFY SCALE |
|---|---|---|
| TLK | CAD | BAR IS ONE INCH ON ANSI "D" DRAWING 0 1" |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 0 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |

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MCCOMBS LANDFILL
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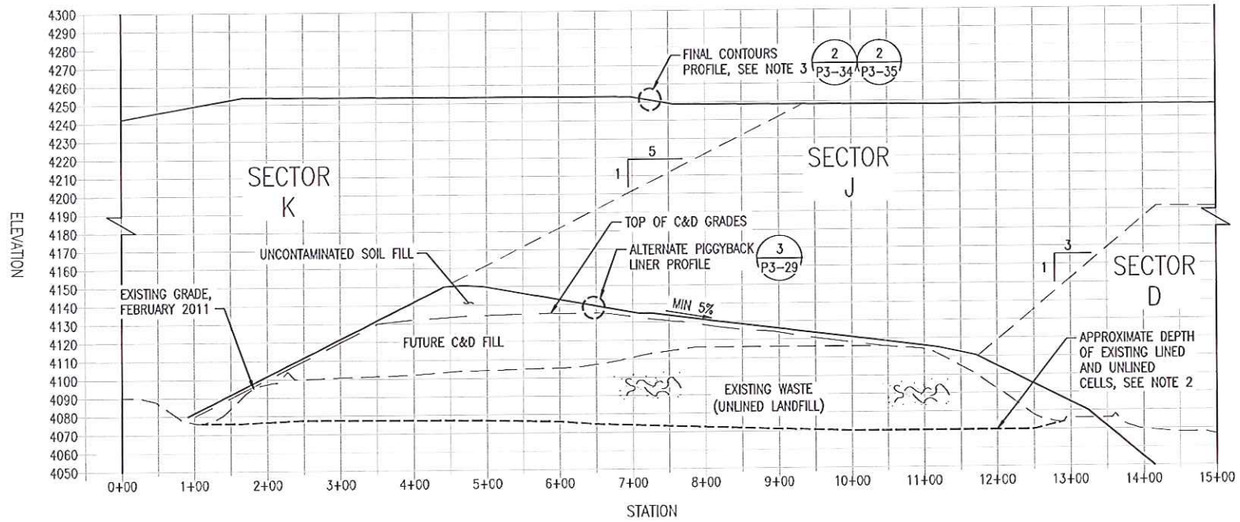
C&D FILL ISOPACH

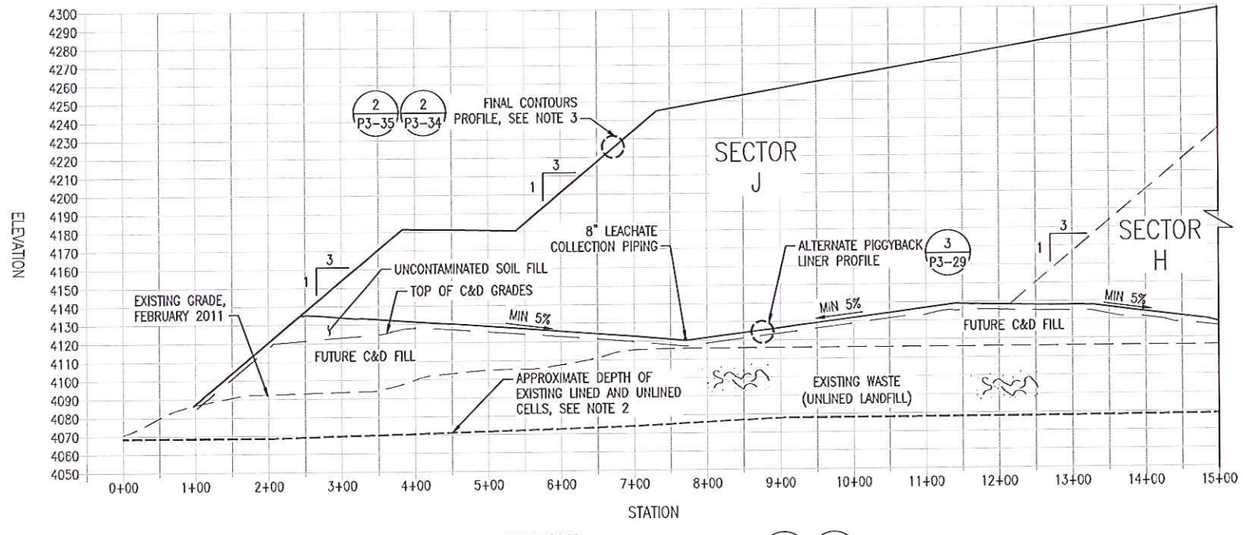
PROJECT NUMBER: 9631500115
SHT. 59B OF: 78
DRAWING NUMBER: P3-26B

Von Abel, Cami A. 3/14/2013 12:50:03 PM - P:\00218000 El Paso TX\9631500115 - McCombs\Data Analytical\CADD\P3-26B C&D FILL ISOPACH.dwg




**SECTION** A P3-26 / A P3-26B

SECTOR J CROSS SECTION
VERTICAL SCALE: 1" = 40'
HORIZONTAL SCALE: 1" = 100'

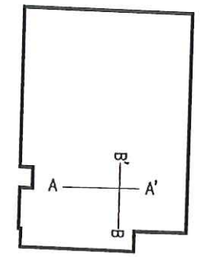



**SECTION** B P3-26 / B P3-26B

SECTOR J CROSS SECTION
VERTICAL SCALE: 1" = 40'
HORIZONTAL SCALE: 1" = 100'

## NOTES

1. EXISTING GRADE FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS.
2. EXISTING UNLINED AND LINED BASE CONTOURS OBTAINED FROM DRA CONSULTANTS APPLICATION FOR PERMIT AMENDMENT NO. 729, ATTACHMENT NO. 11, SHEET A1, DATED APRIL 1983.
3. ACTUAL WASTE ELEVATIONS WILL BE DEPENDENT ON THE FINAL COVER PROFILE UTILIZED (I.E., ALTERNATIVE 1 OR ALTERNATE 2 FINAL COVER), BUT WILL GENERALLY BE 40 OR 48-INCHES LOWER THAN THE FINAL CONTOUR ELEVATIONS (REFER TO DETAILS).
4. TYPICAL GAS WELL LOCATIONS AND CROSS SECTIONS ARE PROVIDED ON P3-39 THROUGH P3-44 IN APPENDIX 3M, ATTACHMENT 3.
5. REFER TO DRAWING P3-37 FOR APPROXIMATE GROUND WATER ELEVATIONS (LOCATED APPROXIMATELY 340-FEET BELOW LANDFILL BASE).




**KEY MAP**
SCALE: NTS

## LEGEND

- WASTE
- SECTOR BOUNDARY
- TOP OF C&D WASTE
- EXISTING GRADE FEBRUARY 2011
- APPROXIMATE UNLINED GRADES
- DESIGN ELEVATIONS (BASE AND FINAL)

GRAPHIC SCALE

1"=40'-0" — 40 0 40 80 — Scale Feet

1"=100'-0" — 100 0 100 200 — Scale Feet

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| DESIGNED | DRAWN | VERIFY SCALE | REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|---|---|---|
| TLK | CAD | BAR IS ONE INCH ON ANSI "D" DRAWING (0 — 1") | 0 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |

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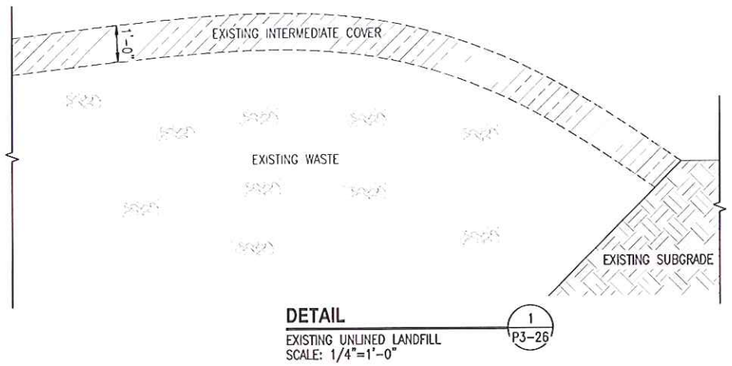
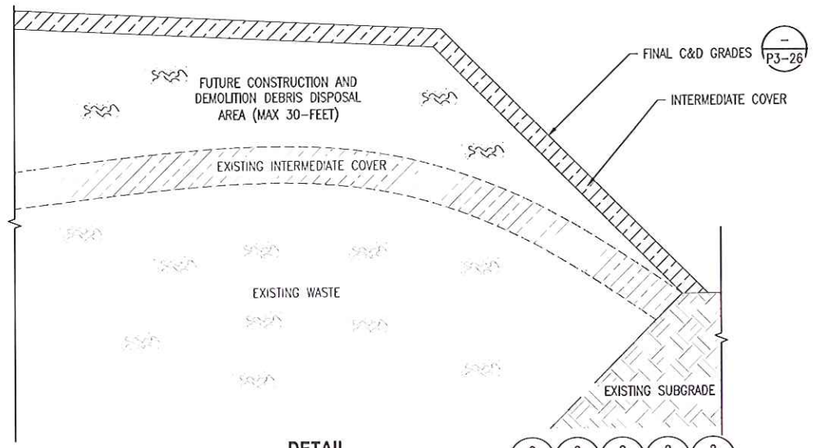
C&D CROSS SECTIONS

PROJECT NUMBER: 9631500115
SHT. 59C OF: 78
DRAWING NUMBER: P3-26C

Rec. Jacob S. 3/13/2013 10:36:13 AM - R:\0021600 El Paso TX\9631500115 - McCombs\Data Analysis\CAD\P3-26C C&D CROSS SECTIONS.dwg




**DETAIL** 1 / P3-26
EXISTING UNLINED LANDFILL
SCALE: 1/4"=1'-0"



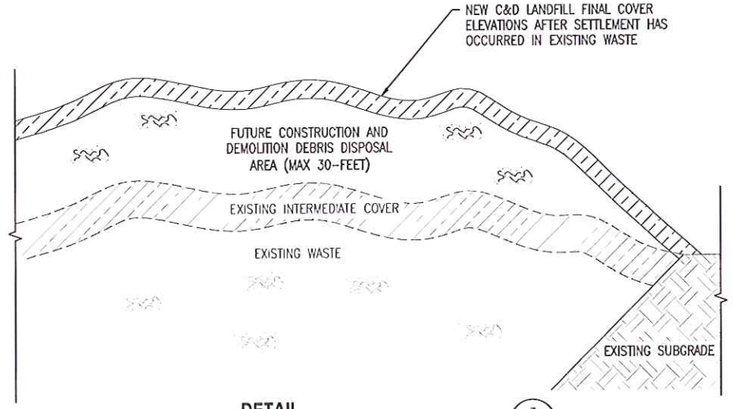

**DETAIL** 2 / P3-20 2 / P3-21 2 / P3-22 2 / P3-23 2 / P3-26
FUTURE C&D LANDFILL
SCALE: 1/4"=1'-0"

## NOTES

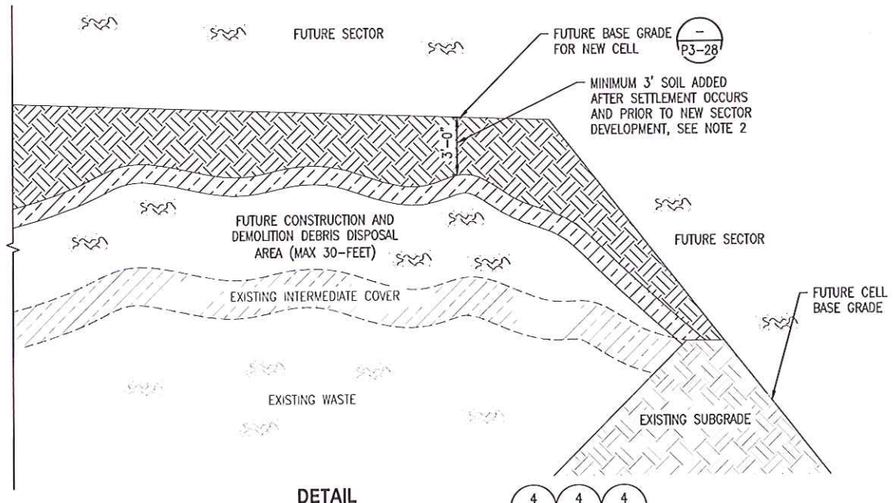
1. THE PIGGYBACK DESIGN ILLUSTRATES THE SEQUENCING FOR THE FILLING OF CONSTRUCTION AND DEMOLITION DEBRIS (C&D) AND SOILS OVER THE EXISTING UNLINED AND LINED AREAS OF THE LANDFILL. AFTER THE SURCHARGE OF C&D, SOIL WILL BE PLACED TO ACT AS THE SUBGRADE FOR THE VERTICAL EXPANSION.
2. ADDITIONAL SOIL MAY BE NECESSARY TO ACHIEVE BASE GRADES FOR THE MSW AREA. IN THE EVENT THAT MORE THAN 3-FEET OF SOIL IS ADDED ON TOP OF THE C&D FILL, ONLY THE TOP 3-FEET SHALL BE COMPACTED.

## LEGEND

- EXISTING SUBGRADE
- FUTURE BASE GRADE
- DAILY/INTERMEDIATE COVER
- REFUSE




**DETAIL** 3 / P3-26
C&D LANDFILL SURCHARGES EXISTING WASTE
SCALE: 1/4"=1'-0"




**DETAIL** 4 / P3-26 4 / P3-28 4 / P3-29
ADDITIONAL SOIL ADDED TO C&D
SCALE: 1/4"=1'-0"

GRAPHIC SCALE
1/4"=1'-0" Scale 2 0 2 4 6 8 10 Feet

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| DESIGNED | TLK |
|---|---|
| DRAWN | CAD |

VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 2 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |
| 1 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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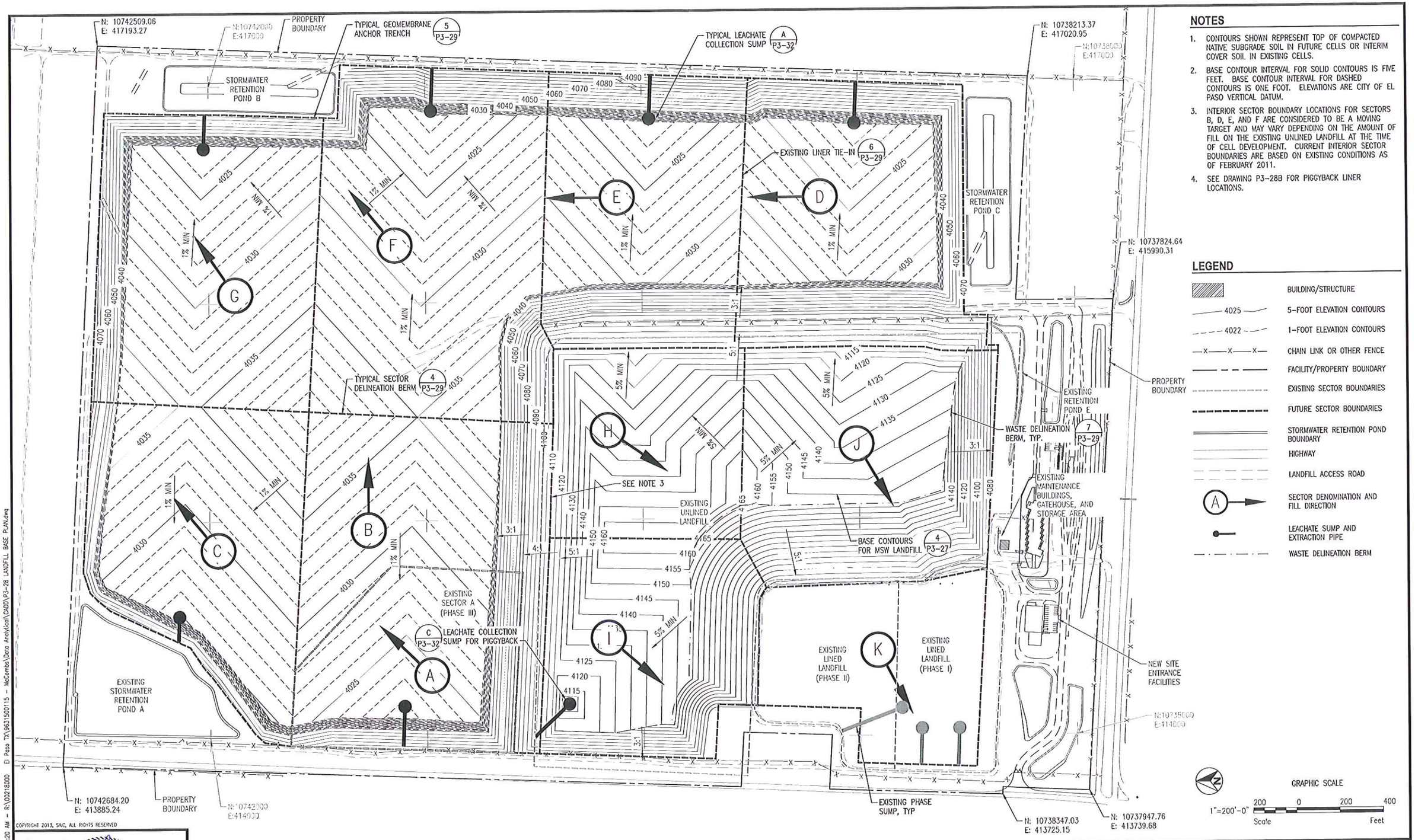
PIGGYBACK DESIGN OVER EXISTING LANDFILL

PROJECT NUMBER: 9631500115
SHT. 60 OF: 78
DRAWING NUMBER: P3-27

Rao, Jacob S. 3/13/2013 10:36:36 AM - R:\00218000 El Paso TX\9631500115 - McCombs\Data Analytical\CAD\P3-27 PIGGYBACK DESIGN OVER EXISTING LANDFILL.dwg




## NOTES

1. CONTOURS SHOWN REPRESENT TOP OF COMPACTED NATIVE SUBGRADE SOIL IN FUTURE CELLS OR INTERIM COVER SOIL IN EXISTING CELLS.
2. BASE CONTOUR INTERVAL FOR SOLID CONTOURS IS FIVE FEET. BASE CONTOUR INTERVAL FOR DASHED CONTOURS IS ONE FOOT. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM.
3. INTERIOR SECTOR BOUNDARY LOCATIONS FOR SECTORS B, D, E, AND F ARE CONSIDERED TO BE A MOVING TARGET AND MAY VARY DEPENDING ON THE AMOUNT OF FILL ON THE EXISTING UNLINED LANDFILL AT THE TIME OF CELL DEVELOPMENT. CURRENT INTERIOR SECTOR BOUNDARIES ARE BASED ON EXISTING CONDITIONS AS OF FEBRUARY 2011.
4. SEE DRAWING P3-28B FOR PIGGYBACK LINER LOCATIONS.

## LEGEND

- BUILDING/STRUCTURE
- 4025 — 5-FOOT ELEVATION CONTOURS
- 4022 — 1-FOOT ELEVATION CONTOURS
- CHAIN LINK OR OTHER FENCE
- FACILITY/PROPERTY BOUNDARY
- EXISTING SECTOR BOUNDARIES
- FUTURE SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- LANDFILL ACCESS ROAD
- A — SECTOR DENOMINATION AND FILL DIRECTION
- LEACHATE SUMP AND EXTRACTION PIPE
- WASTE DELINEATION BERM

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Ros, Jocos S. 3/13/2013 10:37:20 AM – R:\00218000 – El Paso, TX\9631500115 – McCombs\Data Analytics\CADD\P3-28 LANDFILL BASE PLAN.dwg

CAMI VAN ABEL 113723 REGISTERED PROFESSIONAL ENGINEER TEXAS 3/15/13

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VERIFY SCALE BAR IS ONE INCH ON ANSI "D" DRAWING 0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 3 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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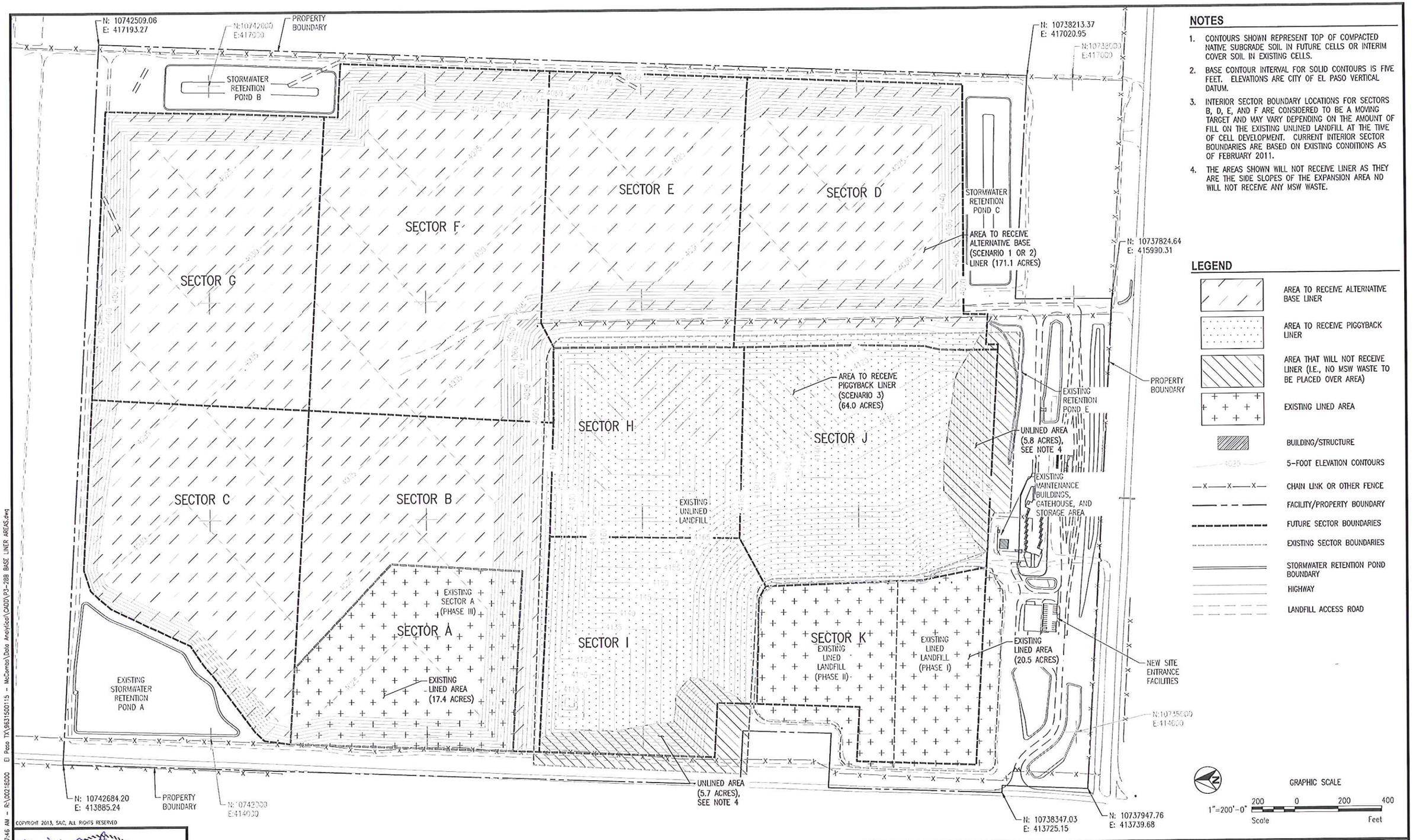
LANDFILL BASE PLAN

PROJECT NUMBER: 9631500115
SHT. 61 OF: 78
DRAWING NUMBER: P3-28




## NOTES

1. CONTOURS SHOWN REPRESENT TOP OF COMPACTED NATIVE SUBGRADE SOIL IN FUTURE CELLS OR INTERIM COVER SOIL IN EXISTING CELLS.
2. BASE CONTOUR INTERVAL FOR SOLID CONTOURS IS FIVE FEET. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM.
3. INTERIOR SECTOR BOUNDARY LOCATIONS FOR SECTORS B, D, E, AND F ARE CONSIDERED TO BE A MOVING TARGET AND MAY VARY DEPENDING ON THE AMOUNT OF FILL ON THE EXISTING UNLINED LANDFILL AT THE TIME OF CELL DEVELOPMENT. CURRENT INTERIOR SECTOR BOUNDARIES ARE BASED ON EXISTING CONDITIONS AS OF FEBRUARY 2011.
4. THE AREAS SHOWN WILL NOT RECEIVE LINER AS THEY ARE THE SIDE SLOPES OF THE EXPANSION AREA NO WILL NOT RECEIVE ANY MSW WASTE.

## LEGEND

- AREA TO RECEIVE ALTERNATIVE BASE LINER
- AREA TO RECEIVE PIGGYBACK LINER
- AREA THAT WILL NOT RECEIVE LINER (I.E., NO MSW WASTE TO BE PLACED OVER AREA)
- EXISTING LINED AREA
- BUILDING/STRUCTURE
- 5-FOOT ELEVATION CONTOURS
- CHAIN LINK OR OTHER FENCE
- FACILITY/PROPERTY BOUNDARY
- FUTURE SECTOR BOUNDARIES
- EXISTING SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- LANDFILL ACCESS ROAD

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TEXAS
3/15/13

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|---|---|---|
| TLK | CAD | BAR IS ONE INCH ON ANSI "D" DRAWING 0 1" |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 0 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |

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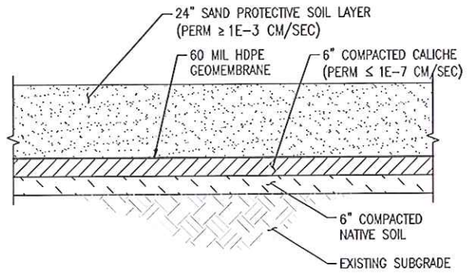
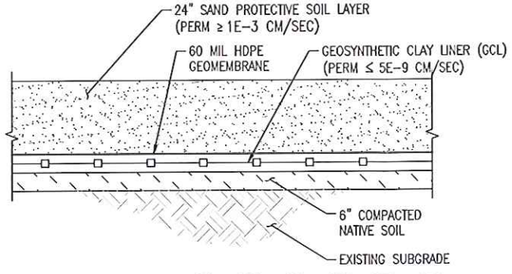
BASE LINER AREAS

PROJECT NUMBER: 9631500115
SHT. 61B OF: 78
DRAWING NUMBER: P3-28B

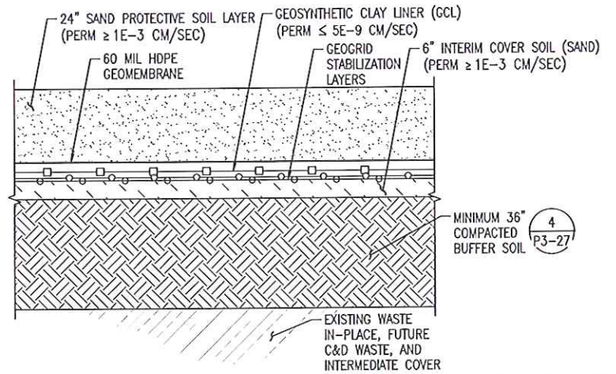
Rev: Jacob S. 3/13/2013 10:37:46 AM - R:\0021600 El Paso TX\9631500115 - McCombs\Data Analytics\CADD\P3-28B BASE LINER AREAS.dwg




**DETAIL** (1 / –)
CURRENT PERMITTED (PRESCRIPTIVE) LINER SCENARIO 1
SCALE: 1/2"=1'-0"



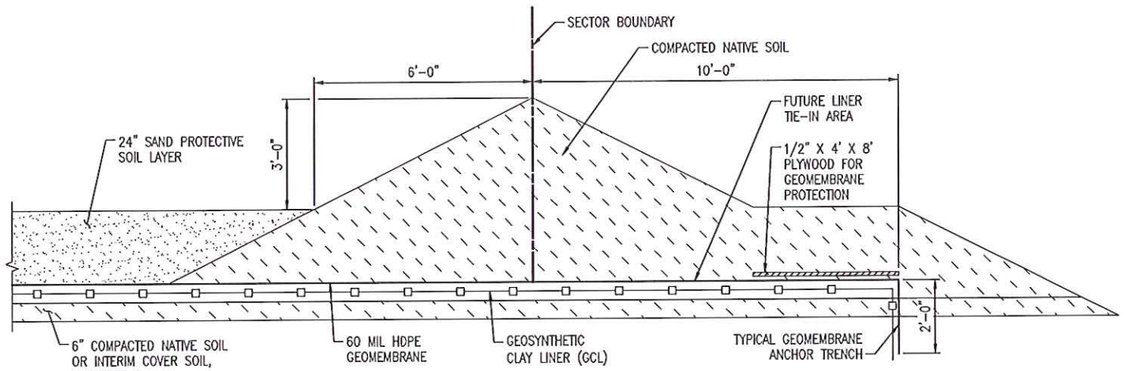

**DETAIL** (2 / P3-19 | 2 / P3-20 | 2 / P3-21 | 2 / P3-22 | 2 / P3-23 | 2 / P3-24)
NEW ALTERNATIVE LINER SCENARIO 2
SCALE: 1/2"=1'-0"



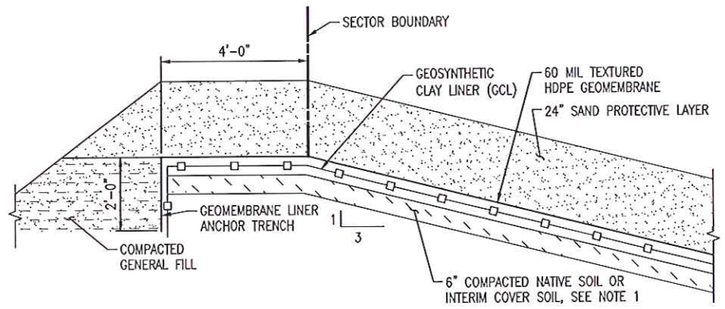

**DETAIL** (3 / – | 3 / P3-20 | 3 / P3-21 | 3 / P3-22 | 3 / P3-23 | 3 / P3-26C | 3 / P3-31 | 3 / P3-32 | 3 / P3-34)
ALTERNATIVE PIGGYBACK LINER SCENARIO 3
SCALE: 1/2"=1'-0"

## NOTES

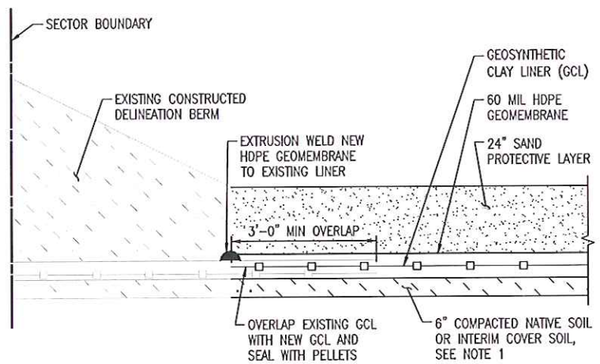
1. FOR THE ALTERNATIVE PIGGYBACK, THE INTERIM COVER SOIL LAYER SHALL UNDERLAY GEOGRID STABILIZATION LAYERS AS SHOWN ON DETAIL 3.
2. DETAIL SHOWN FOR DELINEATION BERM OVER UNLINED LANDFILL. IF THE VERTICAL EXPANSION AREA IS OVER THE EXISTING LINED LANDFILL, THE FINAL COVER GRADE TO MATCH DETAIL 2, SHEET P3-34 AND FINAL COVER GEOMEMBRANE WILL TIE INTO BASE LINER GEOMEMBRANE FOR THE VERTICAL EXPANSION AS SHOWN ON DETAIL 3, P3-34. IF THE VERTICAL EXPANSION AREA IS OVER THE EXISTING LINED LANDFILL, AND THE ALTERNATIVE FINAL COVER IS UTILIZED, THE FINAL COVER GRADE WILL MATCH DETAIL 2, SHEET P3-35 AND THE FINAL COVER WILL TIE INTO THE BASE LINER FOR THE VERTICAL EXPANSION AS SHOWN ON DETAIL 3, SHEET P3-35.



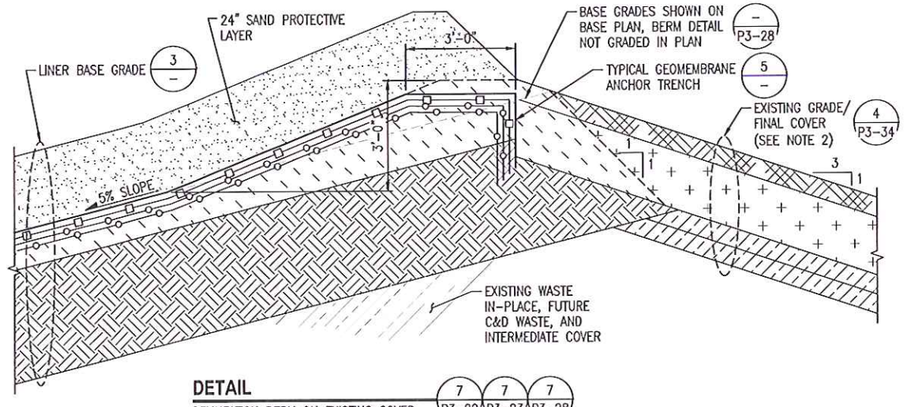

**DETAIL** (4 / P2-9 | 4 / P2-10 | 4 / P2-11 | 4 / P2-12 | 4 / P2-13 | 4 / P2-14 | 4 / P2-15 | 4 / P2-16 | 4 / P2-17 | 4 / P2-18 | 4 / P3-28)
TYPICAL SECTOR DELINEATION BERM
SCALE: 1/2"=1'-0"




**DETAIL** (5 / – | 5 / P3-28 | 5 / P3-31 | 5 / P3-32 | 5 / P3-34 | 5 / P3-35)
TYPICAL GEOMEMBRANE ANCHOR TRENCH
SCALE: 1/2"=1'-0"




**DETAIL** (6 / P3-28)
EXISTING LINER TIE-IN
SCALE: 1/2"=1'-0"




**DETAIL** (7 / P3-20 | 7 / P3-23 | 7 / P3-28)
DELINEATION BERM ON EXISTING COVER
SCALE: NTS

## LEGEND

- EXISTING COMPACTED NATIVE SOIL
- COMPACTED NATIVE SOIL
- SAND PROTECTIVE LAYER
- COMPACTED BUFFER SOIL
- EXISTING SUBGRADE
- EXISTING WASTE
- COMPACTED GENERAL FILL
- CALICHE
- INTERMEDIATE/DAILY COVER
- INFILTRATION LAYER
- TOPSOIL
- GEOMEMBRANE LINER
- GEOSYNTHETIC CLAY LINER (GCL)
- GEOGRID STABILIZATION LAYER

GRAPHIC SCALE
1/2"=1'-0" (Scale) 1 0 1 2 3 4 5 (Feet)

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STATE OF TEXAS
3/15/13

| REV | DATE | CHK'D | APP'D | |
|---|---|---|---|---|
| 3 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

DESIGNED TLK
DRAWN CAD
VERIFY SCALE BAR IS ONE INCH ON ANSI "D" DRAWING 0 1"

CITY OF EL PASO, TEXAS

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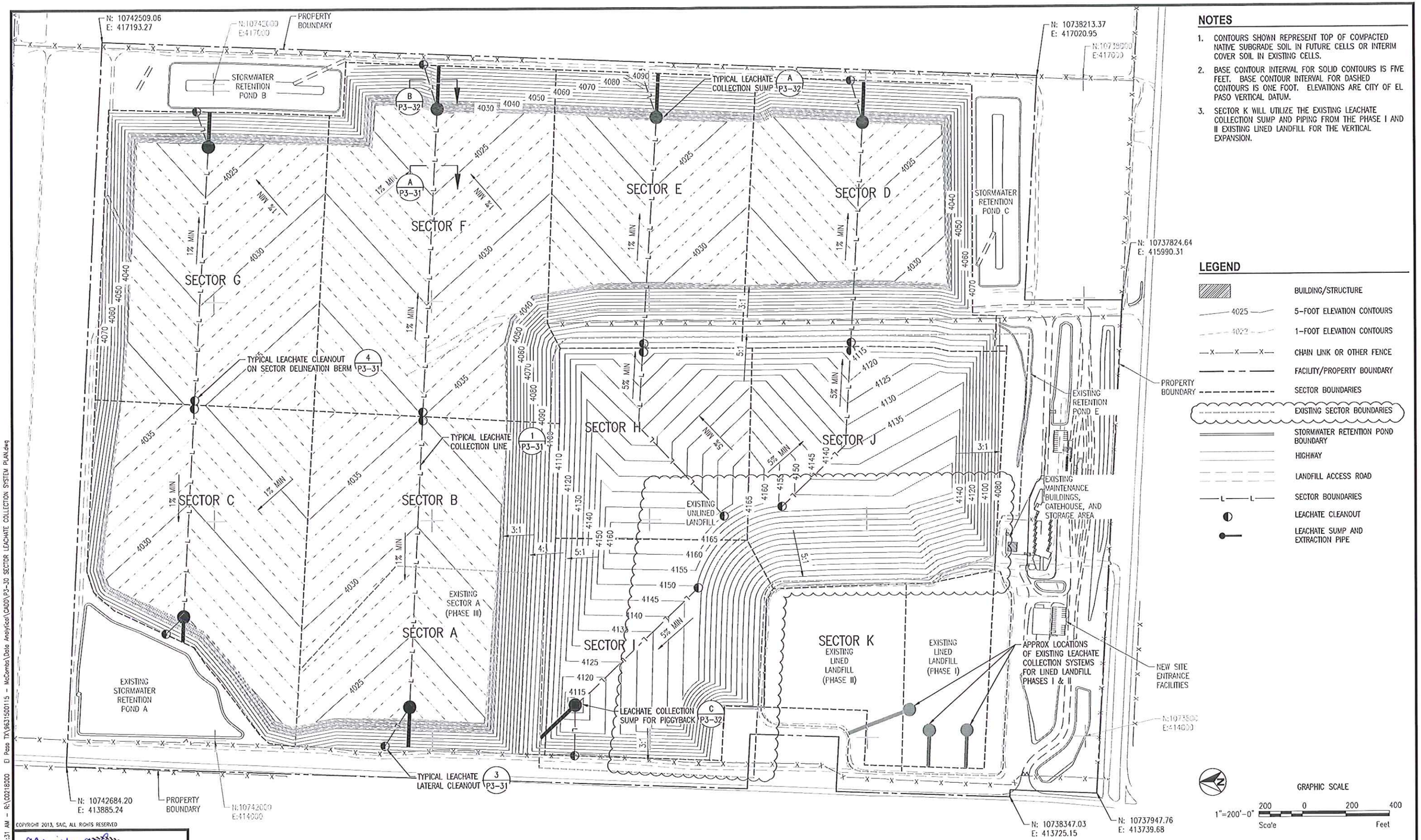
Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

LINER DETAILS

PROJECT NUMBER: 9631500115
SHT. 62 OF: 78
DRAWING NUMBER: P3-29

Ron, Jacob S. 3/13/2013 10:38:26 AM – R:\0021800 El Paso TX\9631500115 – McCombs\Data Analysis\CADD\P3-29 LINER DETAILS.dwg




## NOTES

1. CONTOURS SHOWN REPRESENT TOP OF COMPACTED NATIVE SUBGRADE SOIL IN FUTURE CELLS OR INTERIM COVER SOIL IN EXISTING CELLS.
2. BASE CONTOUR INTERVAL FOR SOLID CONTOURS IS FIVE FEET. BASE CONTOUR INTERVAL FOR DASHED CONTOURS IS ONE FOOT. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM.
3. SECTOR K WILL UTILIZE THE EXISTING LEACHATE COLLECTION SUMP AND PIPING FROM THE PHASE I AND II EXISTING LINED LANDFILL FOR THE VERTICAL EXPANSION.

## LEGEND

- BUILDING/STRUCTURE
- 4025 — 5-FOOT ELEVATION CONTOURS
- 4022 — 1-FOOT ELEVATION CONTOURS
- CHAIN LINK OR OTHER FENCE
- FACILITY/PROPERTY BOUNDARY
- SECTOR BOUNDARIES
- EXISTING SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- LANDFILL ACCESS ROAD
- L—L SECTOR BOUNDARIES
- LEACHATE CLEANOUT
- LEACHATE SUMP AND EXTRACTION PIPE

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113723
REGISTERED PROFESSIONAL ENGINEER
STATE OF TEXAS
3/13/13

| | |
|---|---|
| DESIGNED | TLK |
| DRAWN | CAD |
| VERIFY SCALE | BAR IS ONE INCH ON ANSI "D" DRAWING |
| 0 | 1" |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 3 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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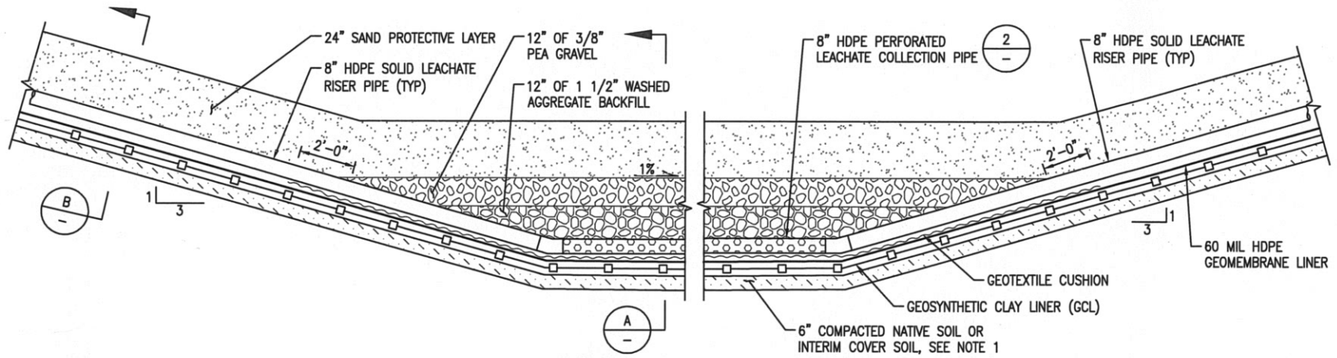
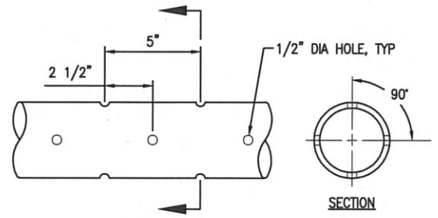
SECTOR LEACHATE COLLECTION SYSTEM PLAN

PROJECT NUMBER: 9631500115
SHT. 63 OF: 78
DRAWING NUMBER: P3-30

Rev. Jacob S. 3/13/2013 10:39:31 AM – R:\0021B000 El Paso TX\9631500115 – McCombs\Data Analysis\CADD\P3-30 SECTOR LEACHATE COLLECTION SYSTEM PLAN.dwg



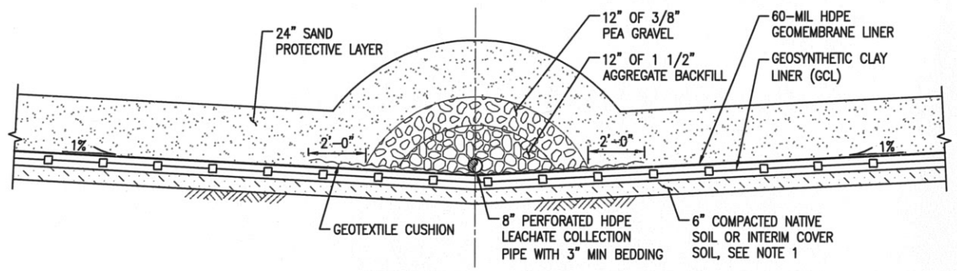

**DETAIL** 1 / P3–30
TYPICAL LEACHATE COLLECTION LINE
SCALE: 3/8"=1'–0"



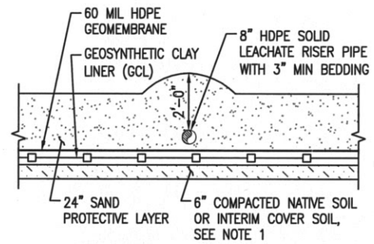

**DETAIL** 2 / – — 2 / P3–32
PIPE PERFORATION
SCALE: 3"=1'–0"

## NOTES

1. FOR THE ALTERNATIVE PIGGYBACK, THE INTERIM COVER SOIL LAYER SHALL UNDERLAY GEOGRID STABILIZATION LAYERS AS SHOWN ON DETAIL 3, DWG P3–29.



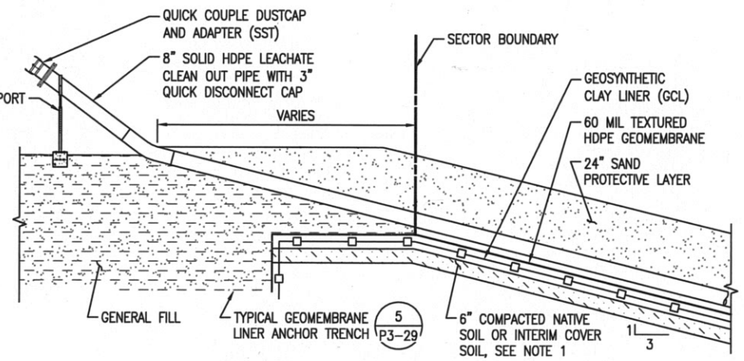

**SECTION** A / – — A / P3–30
TYPICAL LEACHATE COLLECTION LINE
SCALE: 3/8"=1'–0"



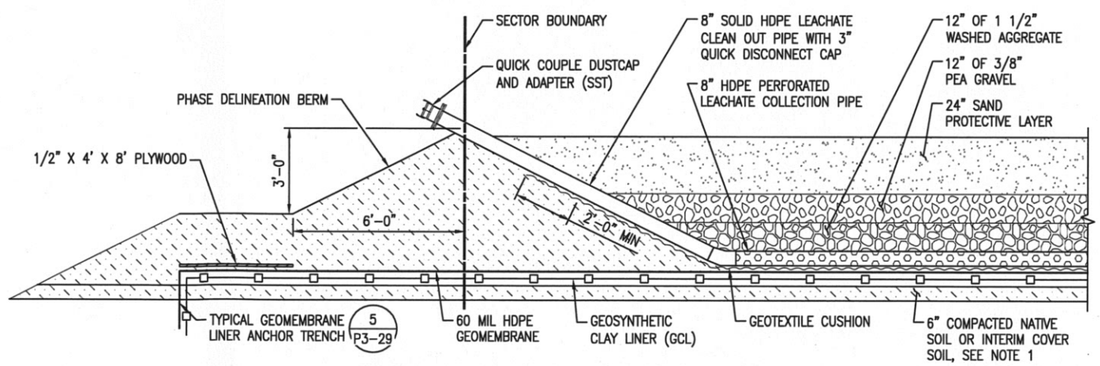

**SECTION** B / –
TYPICAL LEACHATE CLEANOUT RISER
SCALE: 3/8"=1'–0"

## LEGEND

- COMPACTED NATIVE SOIL
- SAND PROTECTIVE LAYER
- SUBGRADE
- GENERAL FILL
- PEA GRAVEL
- WASHED AGGREGATE
- GEOMEMBRANE LINER
- GEOSYNTHETIC CLAY LINER (GCL)
- GEOTEXTILE




**DETAIL** 3 / P3–30
TYPICAL LEACHATE LATERAL CLEANOUT
SCALE: 3/8"=1'–0"




**DETAIL** 4 / P3–30
TYPICAL LEACHATE CLEANOUT ON SECTOR DELINEATION BERM
SCALE: 3/8"=1'–0"

GRAPHIC SCALES
3"=1'–0" Scale 3" 6" 9" 1 Feet
3/8"=1'–0" Scale 1 0 1 2 3 4 5 6 7 Feet

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STATE OF TEXAS
FREDRIC J. DORAN
111226
REGISTERED PROFESSIONAL ENGINEER
11/2/12

DESIGNED TLK
DRAWN CAD
VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 1 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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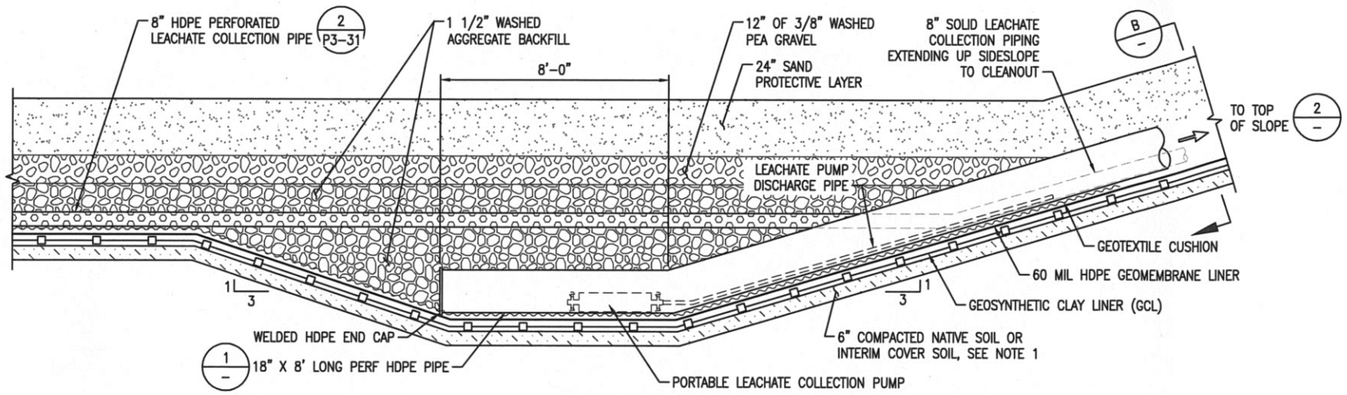
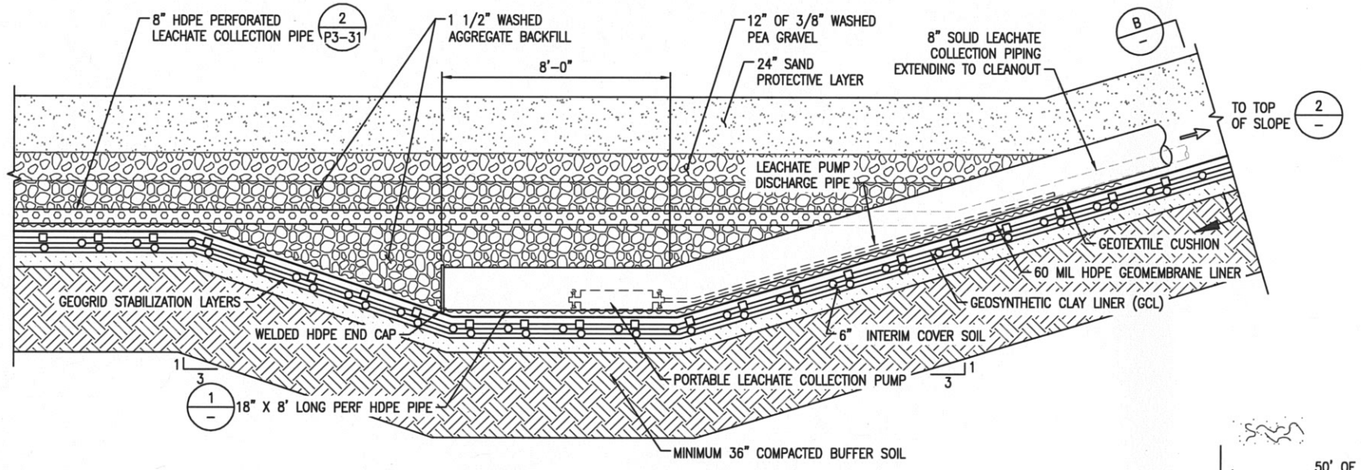
LEACHATE COLLECTION SYSTEM DETAILS

PROJECT NUMBER: 9631500115
SHT. 64 OF: 78
DRAWING NUMBER: P3–31

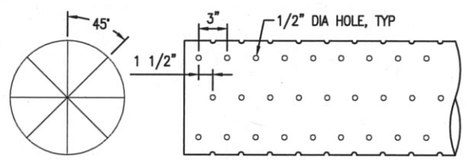
Keller, Tonya L 11/1/2012 9:52:29 AM – P:\0021800 el paso tx\9631500115\data analytical\CADD\P3-31 LEACHATE COLLECTION SYSTEM DETAILS.dwg




**SECTION**
LEACHATE COLLECTION SUMP
SCALE: 3/8"=1'-0"
A P3-28 A P3-30



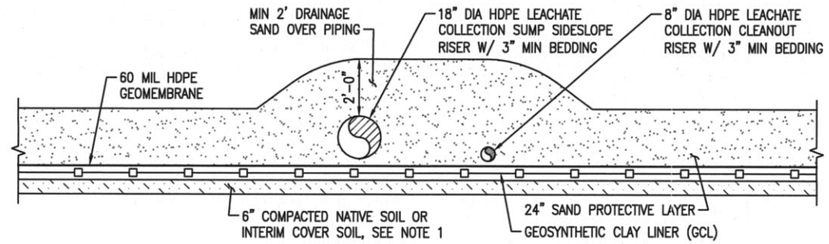

**SECTION**
LEACHATE COLLECTION SUMP OVER PIGGYBACK LINER
SCALE: 3/8"=1'-0"
C P3-28 C P3-30




**DETAIL**
LEACHATE SUMP PIPE PERFORATION
SCALE: 1 1/2"=1'-0"
1 –

## NOTES

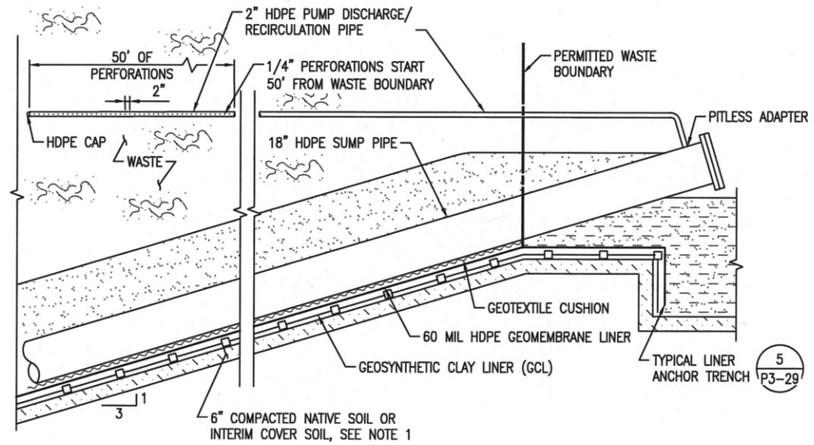
1. FOR THE ALTERNATIVE PIGGYBACK DESIGN, THE INTERIM COVER SOIL LAYER SHALL UNDERLAY GEOGRID STABILIZATION LAYERS AS SHOWN ON DETAIL 3, DWG P3-29.




**SECTION**
LEACHATE COLLECTION SUMP
SCALE: 3/8"=1'-0"
B – B P3-30

## LEGEND

- COMPACTED NATIVE SOIL
- SAND PROTECTIVE LAYER
- GENERAL FILL
- COMPACTED BUFFER SOIL
- PEA GRAVEL
- WASHED AGGREGATE
- REFUSE/WASTE
- GEOMEMBRANE LINER
- GEOSYNTHETIC CLAY LINER (GCL)
- GEOTEXTILE
- GEOGRID STABILIZATION LAYER




**DETAIL**
TOP OF SUMP PIPE AND RECIRCULATION
SCALE: 3/8"=1'-0"
2 –

GRAPHIC SCALE
1-1/2"=1'-0" 12" 9" 6" 3" 0 1 Scale Feet
3/8"=1'-0" 1 0 1 2 3 4 5 6 7 Scale Feet

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STATE OF TEXAS
FREDRIC J. DORAN
111226
REGISTERED PROFESSIONAL ENGINEER
11/2/12

DESIGNED TLK
DRAWN CAD
VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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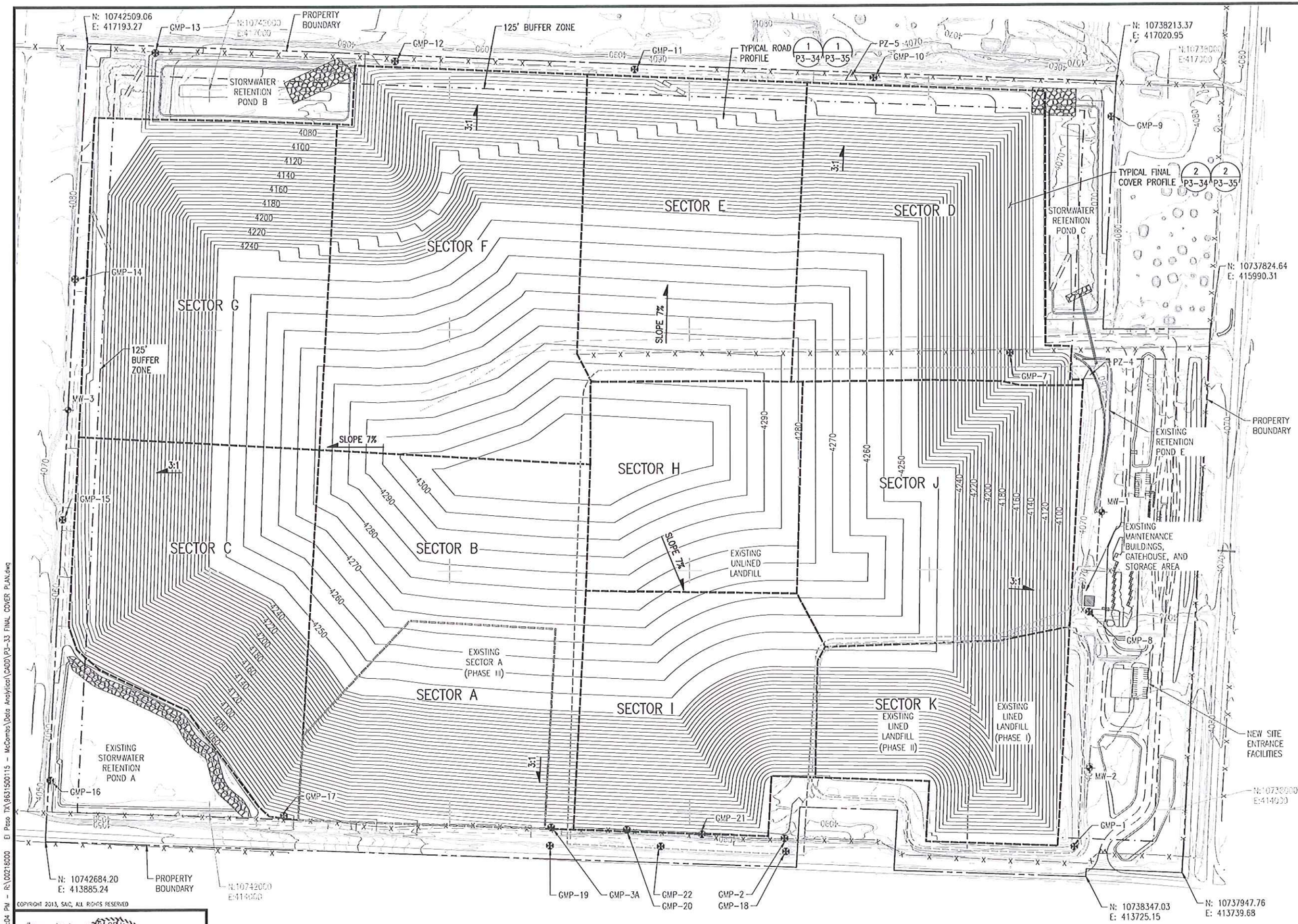
MAJOR PERMIT AMENDMENT

LEACHATE COLLECTION SUMP DETAILS

PROJECT NUMBER: 9631500115
SHT. 65 OF: 78
DRAWING NUMBER: P3-32

Keller, Tonya L. 11/1/2012 9:53:25 AM – P:\00218000 el paso tx\9631500115\data analytical\CADD\P3-32 LEACHATE COLLECTION SUMP DETAILS.dwg




## NOTES

1. DIGITIZED TOPOGRAPHY FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS.
2. COORDINATES ARE BASED ON THE TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NAD 83. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM. NAVD 88 DATUM TO NGVD 29 DATUM, SUBTRACT 1.99-FEET. NGVD 29 DATUM TO CITY OF EL PASO DATUM, ADD 27.65-FEET.
3. EXISTING CONTOUR INTERVAL IS TWO FEET.
4. SITE TOPOGRAPHY MAY VARY DUE TO OWNER'S OPERATIONS.
5. CONTOURS SHOWN REPRESENT TOP OF FINAL DESIGN CONTOURS. CONTOUR INTERVAL IS FIVE FEET. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM.

## LEGEND

- MW-3 — MONITORING WELL
- PIEZOMETER
- GMP-8 — GAS MONITORING PROBE
- BUILDING/STRUCTURE
- RIPRAP
- 4050 — ELEVATION CONTOURS
- FACILITY/PROPERTY BOUNDARY
- 125' BUFFER ZONE
- SECTOR BOUNDARIES
- EXISTING SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- LANDFILL ACCESS ROAD

GRAPHIC SCALE
1"=200'-0"
200 0 200 400
Scale Feet

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CAMI VAN ABEL 113723 REGISTERED PROFESSIONAL ENGINEER STATE OF TEXAS
6/3/13

DESIGNED TLK
DRAWN CAD
VERIFY SCALE BAR IS ONE INCH ON ANSI "D" DRAWING 0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 4 | 6/3/13 | JSR | CAV | FOURTH TECHNICAL NOD |
| 3 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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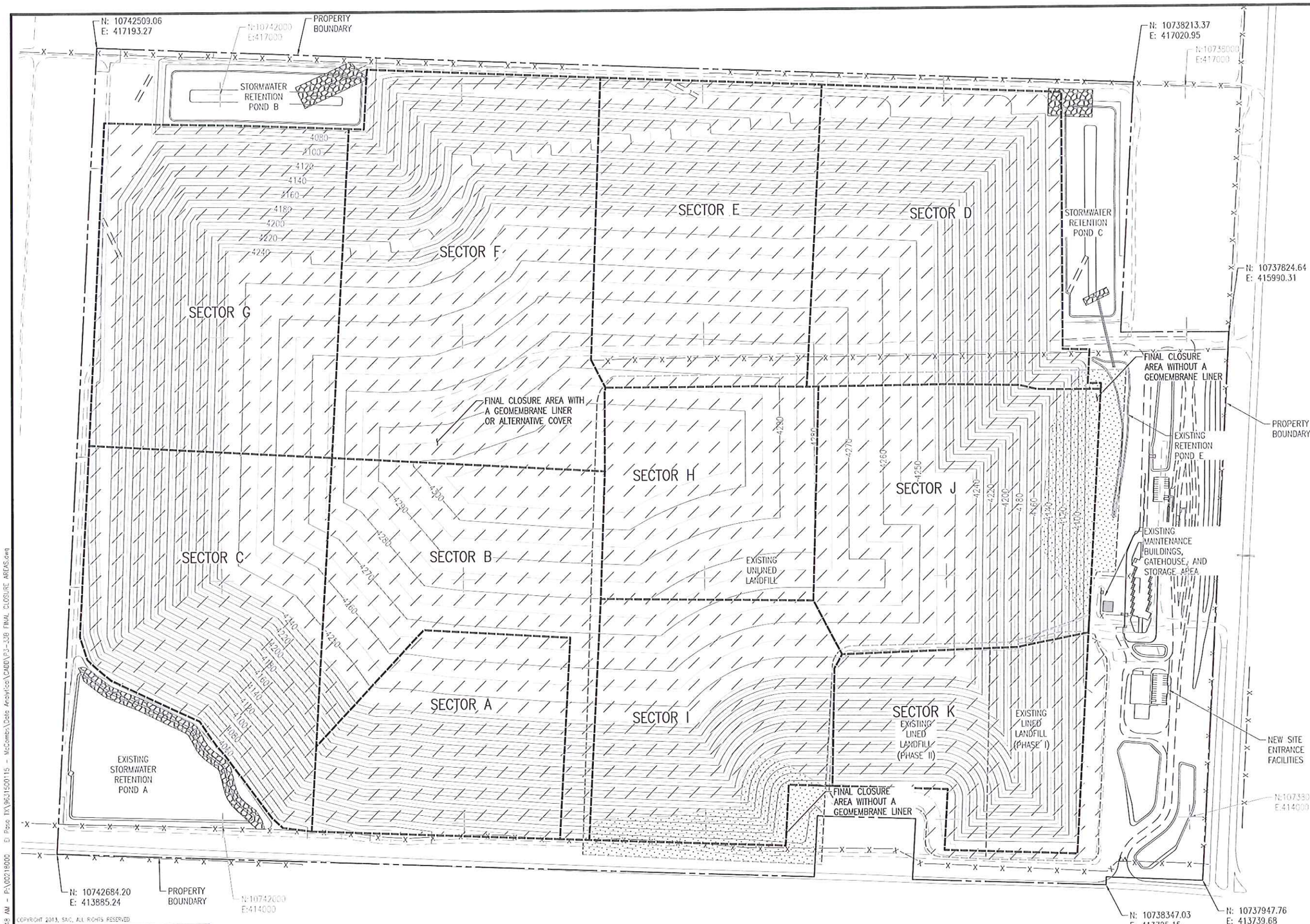
FINAL COVER PLAN

PROJECT NUMBER: 9631500115
SHT. 66 OF: 78
DRAWING NUMBER: P3-33

Rec. Jacob S. 5/30/2013 4:43:04 PM - R:\0021600 El Paso TX\9631500115 - McCombs\Data Analytical\CADD\P3-33 FINAL COVER PLAN.dwg




## NOTES

1. THE TOTAL AREAS TO RECEIVE FINAL CLOSURE INCLUDE 273 ACRES WITH A LINER OR ALTERNATIVE COVER AND 11.5 ACRES WITHOUT A LINER (CLOSURE OVER UNLINED AREAS).
2. CONTOURS SHOWN REPRESENT THE DESIGNED FINAL CLOSURE CONTOURS. DESIGN CONTOUR INTERVAL IS FIVE FEET.
3. DIGITIZED TOPOGRAPHY FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS.
4. COORDINATES ARE BASED ON THE TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NAD 83. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM. NAVD 88 DATUM TO NGVD 29 DATUM, SUBTRACT 1.99-FEET. NGVD 29 DATUM TO CITY OF EL PASO DATUM, ADD 27.65-FEET.

## LEGEND

- AREA REQUIRING FINAL COVER WITH A GEOMEMBRANE LINER OR ALTERNATIVE COVER
- AREA REQUIRING FINAL COVER WITHOUT A GEOMEMBRANE LINER
- BUILDING/STRUCTURE
- RIPRAP
- 4050 — ELEVATION CONTOURS
- FACILITY/PROPERTY BOUNDARY
- EXISTING SECTOR BOUNDARIES
- FUTURE SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- LANDFILL ACCESS ROAD

GRAPHIC SCALE
1"=200'-0"
200 0 200 400
Scale Feet

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CAM VAN ABEL
113723
REGISTERED PROFESSIONAL ENGINEER
6/13/13

| DESIGNED | DRAWN | VERIFY SCALE BAR IS ONE INCH ON ANSI "D" DRAWING |
|---|---|---|
| TLK | CAD | 0 1" |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 1 | 6/03/13 | TLK | CAV | FOURTH TECHNICAL NOD |
| 0 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |

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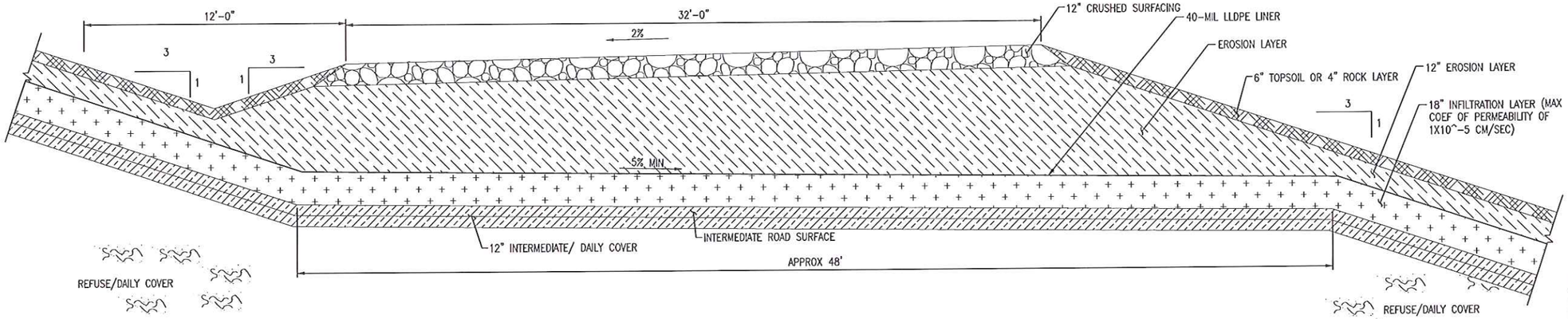
FINAL CLOSURE AREAS

PROJECT NUMBER: 9631500115
SHT 66B OF 78
DRAWING NUMBER: P3-33B

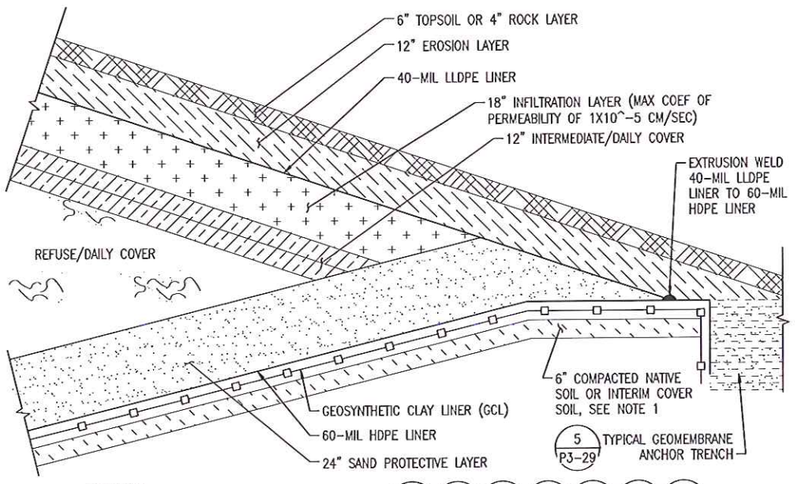
Van Abel, Cami A. 6/3/2013 11:59:48 AM - P:\002218000 El Paso TX\9631500115 - McCombs\Data Analytics\CADD\P3-33B FINAL CLOSURE AREAS.dwg

## NOTES

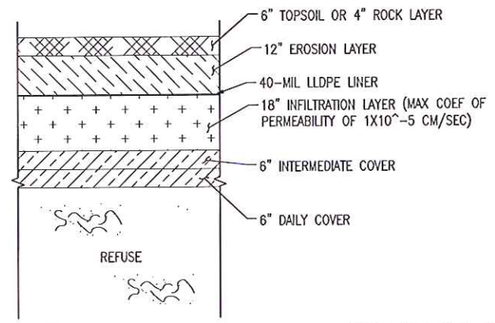
1. FOR THE ALTERNATIVE PIGGYBACK DESIGN, THE INTERIM COVER SOIL LAYER SHALL UNDERLAY GEOGRID STABILIZATION LAYERS AS SHOWN ON DETAIL 3, DWG P3-29.



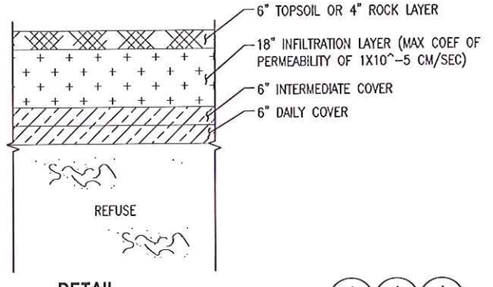

**DETAIL** 1 P3-20 1 P3-33
TYPICAL ROAD DETAIL
SCALE: 3/8"=1'-0"




**DETAIL** 3 P3-19 3 P3-20 3 P3-21 3 P3-22 3 P3-23 3 P3-24 3 P3-29
FINAL COVER CONNECTION TO EXISTING BASE LINER
SCALE: 1/2"=1'-0"




**DETAIL** 2 P3-19 2 P3-20 2 P3-21 2 P3-22 2 P3-23 2 P3-24 2 P3-26C 2 P3-29 2 P3-33
TYPICAL FINAL COVER PROFILE FOR SIDESLOPE OR CROWN
SCALE: 1/2"=1'-0"




**DETAIL** 4 P3-20 4 P3-23 4 P3-29
FINAL COVER PROFILE FOR UNLINED LANDFILL
SCALE: 1/2"=1'-0"

## LEGEND

- COMPACTED NATIVE SOIL
- SAND PROTECTIVE LAYER
- TOPSOIL
- DAILY/INTERMEDIATE COVER
- INFILTRATION LAYER
- REFUSE
- GENERAL FILL
- EROSION LAYER
- 12" CRUSHED SURFACING
- GEOMEMBRANE LINER
- GEOSYNTHETIC CLAY LINER (GCL)

GRAPHIC SCALE
1/2"=1'-0" 1 0 1 2 3 4 5 Scale Feet
3/8"=1'-0" 1 0 1 2 3 4 5 6 7 Scale Feet

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CAMI VAN ABEL 113723 REGISTERED PROFESSIONAL ENGINEER TEXAS 3/15/13

DESIGNED TLK
DRAWN CAD
VERIFY SCALE BAR IS ONE INCH ON ANSI "D" DRAWING 0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 3 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

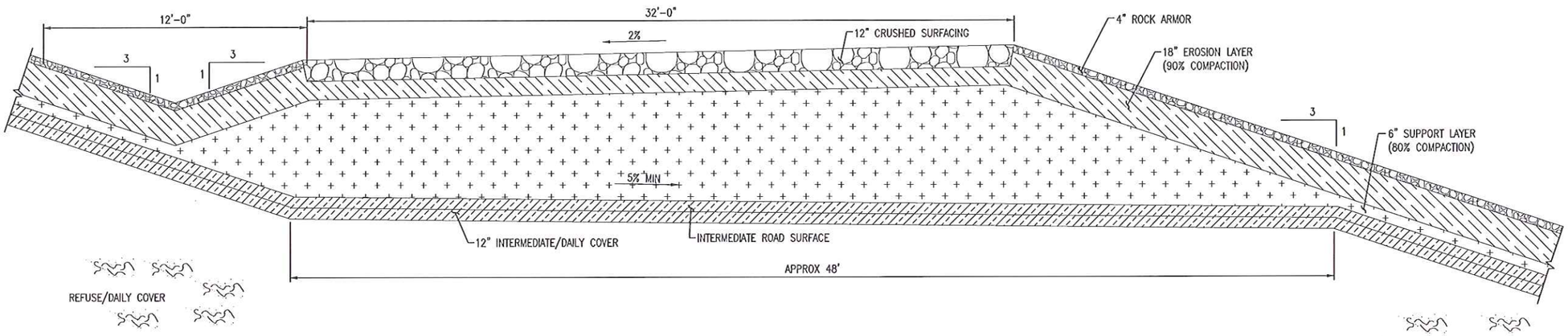
FINAL COVER DETAILS

PROJECT NUMBER: 9631500115
SHT. 67 OF: 78
DRAWING NUMBER: P3-34

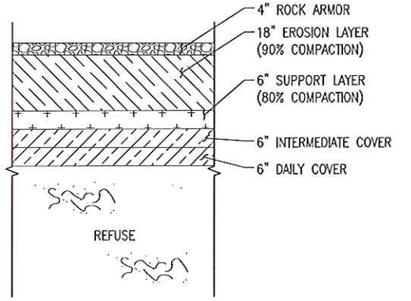
Rev. Jacob S. 3/13/2013 10:40:42 AM - R:\00216000 El Paso TX\9631500115 - McCombs\Data Analysis\CAD\P3-34 FINAL COVER DETAILS.dwg

## NOTES

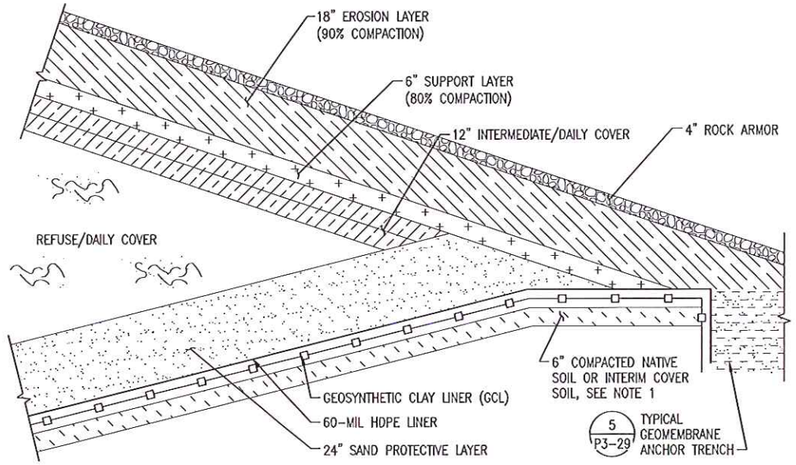
1. FOR THE ALTERNATIVE PIGGYBACK DESIGN, THE INTERIM COVER SOIL LAYER SHALL UNDERLAY GEOGRID STABILIZATION LAYERS AS SHOWN ON DETAIL 3, DWG P3-29.



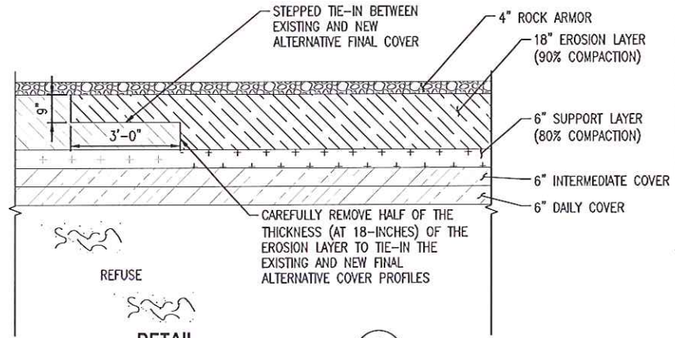

**DETAIL** — TYPICAL ROAD DETAIL (1 / P3-20, 1 / P3-33)
SCALE: 3/8"=1'-0"




**DETAIL** — TYPICAL FINAL COVER PROFILE FOR SIDESLOPE OR CROWN (2 / P3-19, P3-20, P3-21, P3-22, P3-23, P3-24, P3-26C, P3-29, P3-33)
SCALE: 1/2"=1'-0"




**DETAIL** — FINAL COVER CONNECTION TO EXISTING BASE LINER (3 / P3-19, P3-20, P3-21, P3-22, P3-23, P3-24, P3-29)
SCALE: 1/2"=1'-0"




**DETAIL** — STEPPED FINAL COVER TIE-IN, TYP. (4 / –)
SCALE: 1/2"=1'-0"

## LEGEND

- COMPACTED NATIVE SOIL
- SAND PROTECTIVE LAYER
- DAILY/INTERMEDIATE COVER
- INFILTRATION LAYER
- REFUSE
- GENERAL FILL
- EROSION LAYER
- ROCK ARMOR
- 12" CRUSHED SURFACING
- GEOMEMBRANE LINER
- GEOSYNTHETIC CLAY LINER (GCL)

GRAPHIC SCALE

1/2"=1'-0" — 1 0 1 2 3 4 5 Scale Feet

3/8"=1'-0" — 1 0 1 2 3 4 5 6 7 Scale Feet

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| DESIGNED | DRAWN | VERIFY SCALE |
|---|---|---|
| TLK | CAD | BAR IS ONE INCH ON ANSI "D" DRAWING (0 — 1") |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 3 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

# ALTERNATIVE FINAL COVER DETAILS

PROJECT NUMBER: 9631500115
SHT. 68 OF: 78
DRAWING NUMBER: P3-35

Rec. Jacob S. 3/13/2013 10:40:59 AM - R:\00218000 - El Paso TX\9631500115 - McCombs\Data Analysis\CAD\P3-35 ALTERNATIVE FINAL COVER DETAILS.dwg

Appendix 3G, Attachment 5

AET Report July 17, 2013

SAIC®

## Memorandum

SAIC

To: TCEQ

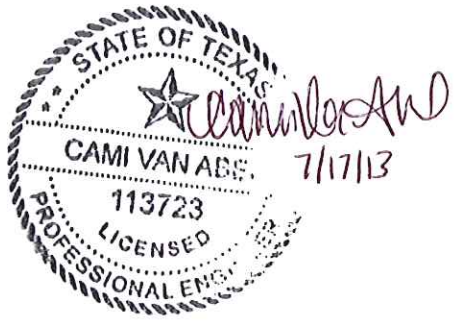
From: Cami Van Abel, P.E., SAIC

Subject: Waste Mass Stability

Date: July 17, 2013

Attached is a copy of the Supplemental Geotechnical Evaulation for Waste Mass Stability prepared by American Engineering Testing (AET) dated July 17, 2013. The report was developed to update the initial waste mass stability analysis performed based on adjustments made to the final cover design and adjusting the C&D material thickness, overlain by uncontaminated soil, within the piggyback expansion area. The results of the analysis indicate a factor of safety ranging from 1.48 to 2.32, which is an acceptable range.

CAV



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AMERICAN ENGINEERING TESTING, INC.

CONSULTANTS
• ENVIRONMENTAL
• GEOTECHNICAL
• MATERIALS
• FORENSICS

July 17, 2013

SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve, Suite 305
St. Paul, MN 55121

Attn: Ms. Cami Van Abel, PE

RE: Supplemental Geotechnical Evaluation
McCombs Landfill Expansion
El Paso, Texas
AET Project No. 01-05106

Dear Ms. Abel:

This report presents the results of your requested supplemental geotechnical evaluation for the referenced project. We are submitting an electronic copy and three hard copies of the report to you. This work was performed in accordance with our proposal to you dated July 8, 2013. This report addresses comments you received from the Texas Commission on Environmental Quality (TCEQ) requesting supplemental waste mass stability analyses due to a change in landfill materials. This report is a supplement to our original reports to you titled *Report of Waste Mass Stability, McCombs Landfill Expansion, El Paso, Texas*, dated June 1, 2011, and *Supplemental Geotechnical Evaluation, McCombs Landfill Expansion, El Paso, Texas,* dated August 3, 2012.

## 1.0 Scope of Supplemental Services

Our scope of services for this supplemental evaluation consists of the following:

- Perform a waste mass stability analysis of 2 cross-sections that includes the proposed C&D waste, the now proposed soil fill, and the existing municipal solid waste

No field or laboratory testing were performed for these supplemental analyses.

## 2.0 Supplemental Waste Mass Stability Analyses

### *2.1 Discussion*

We understand that some of the original volume reserved for future C&D waste will now be replaced with "uncontaminated soil fill." The actual soil type, however, is not known. This uncontaminated soil fill will be placed on top of the C&D waste. There will not be a liner between the two.

We evaluated the deep-seated stability by performing two-dimensional, effective stress slope stability analyses for the final, closed geometry, using the computer program *GSLOPE Version*



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*5.10.* This program performs a limit equilibrium analysis for potential mass failure along assumed failure surfaces. We assumed that the failure surfaces extend through the new waste, and into the underlying uncontaminated soil fill, C&D waste and existing MSW waste. For our analyses, we used the geometry from the cross-sections presented on the following SAIC drawings:

- Drawing Number P3-20, "Typical Landfill Section B" dated 6/3/13
- Drawing Number P3-23, "Typical Landfill Section E" dated 6/3/13

Copies of these sections are attached in Appendix A. We understand that the final cover for the existing MSW landfill, below the new C&D waste, will consist of 3 feet of soil with no geosynthetics. We assume that this soil will be sand. We also assumed that there is a textured HDPE liner beneath the existing MSW landfill.

Due to the high variability of municipal waste, conventional *in situ* testing or laboratory testing to evaluate the engineering properties of the waste is not practical. There is no data available concerning the engineering properties of the new MSW waste, the C&D waste, the asbestos fill, and the existing MSW waste. Therefore, for our analyses we used published and assumed estimated effective stress values of shear strength, cohesion, and unit weight for municipal solid waste (Eid, et al, 2000, Singh and Murphy 1990), and we also used these same values for the C&D waste, asbestos fill, and the existing MSW waste. Please contact us if specific shear strength and unit weight data become available, and we can then re-evaluate our analyses. The type of soil to be used for the "uncontaminated soil fill" is not known. For our analyses we have assumed that this soil fill would consist of sand, and that a phreatic surface would not develop within the sand. The engineering properties used in our analyses are presented in Table A.

### *2.2 Waste Mass Stability*

We analyzed potential circular failure surfaces and potential block (sliding) failure surfaces at Sections B and E. We assume that excess pore pressure will not develop within the waste either through hydrostatic pressure or gas pressure. The development of excess pore pressure would substantially reduce the factor of safety for stability. The results of our stability analyses using peak strength values are presented in Appendix B. In summary, the minimum factor of safety is greater than 1.5, and in our judgment, is acceptable.

Due to the potential for variability of the engineering properties of the waste, we also performed a limited sensitivity analysis by evaluating the effect on the factor of safety by varying the strength parameters. The shear strength parameters used are presented in Table C-3 of our original report. The results of this limited sensitivity analysis are presented in attached Appendix B. The results indicate a factor of safety ranging from 1.48 to 2.32. In our judgment, these are acceptable.

To address the potential for progressive failure, we also performed an additional stability analysis using the assumed large displacement interface shear strengths presented in Table A. The results of this analysis are presented in attached Appendix B. The results indicate a factor of safety ranging from 1.47 to 2.12. In our judgment, these are acceptable.

**TABLE A: ASSUMED ENGINEERING PROPERTIES FOR ANALYSES**

| Material | Effective Friction Angle, peak $\phi'$(degrees) | Effective Friction Angle, L.D.[1] $\phi'$(degrees) | Unit Weight, $\gamma$ (pcf) | Effective Cohesion (peak), c' (psf) | Effective Cohesion (L.D.[1]), c' (psf) |
|---|---|---|---|---|---|
| New and Existing MSW, New C&D Waste, Asbestos Fill | 35° | 28° | 65 | 525 | 0 |
| "Uncontaminated Soil Fill" (Sand) | 29° | 29° | 125 | 0 | 0 |
| Drainage Sand | 29° | 29° | 110 | 0 | 0 |
| Interface between Sand/textured HDPE or LLDPE | 30° | 25° | N/A | 0 | 0 |

1: Large Displacement

## 3.0 Concluding Comments

No new laboratory testing has been authorized as part of this supplemental work. It is important; however, that our assumed engineering properties are confirmed by specific testing prior to construction. Apart from the typical testing required, such as Proctor tests and gradation analyses, additional testing to address the assumed parameters were presented in our August 3, 2012 report. Testing of the uncontaminated soil fill should also include classification testing and strength testing (direct shear and triaxial shear).

## 4.0 Limitations

Within the limitations of scope, budget, and schedule, we have endeavored to provide our services according to generally accepted geotechnical engineering practices at this time and location. Other than this, no warranty, either express or implied, is intended.

**American Engineering Testing, Inc.**

Authored by:

Gregory R. Reuter, PE
Principal Engineer

Enc.

Reviewed by:

James C. Rudd, PE (MN)
Principal Engineer/Vice President

**AMERICAN ENGINEERING TESTING, INC.**
**TEXAS REGISTERED ENGINEERING FIRM F-10340**

## References

Eid, H.T., Stark, T.D., Evans, W.D., and Sherry, P.E. (2000). "Municipal Solid Waste Slope Failure I: Waste and Foundation Soil Properties," *Journal of Geotechnical and Geoenvironmental Engineering*, ASCE, 126(5): 397-407

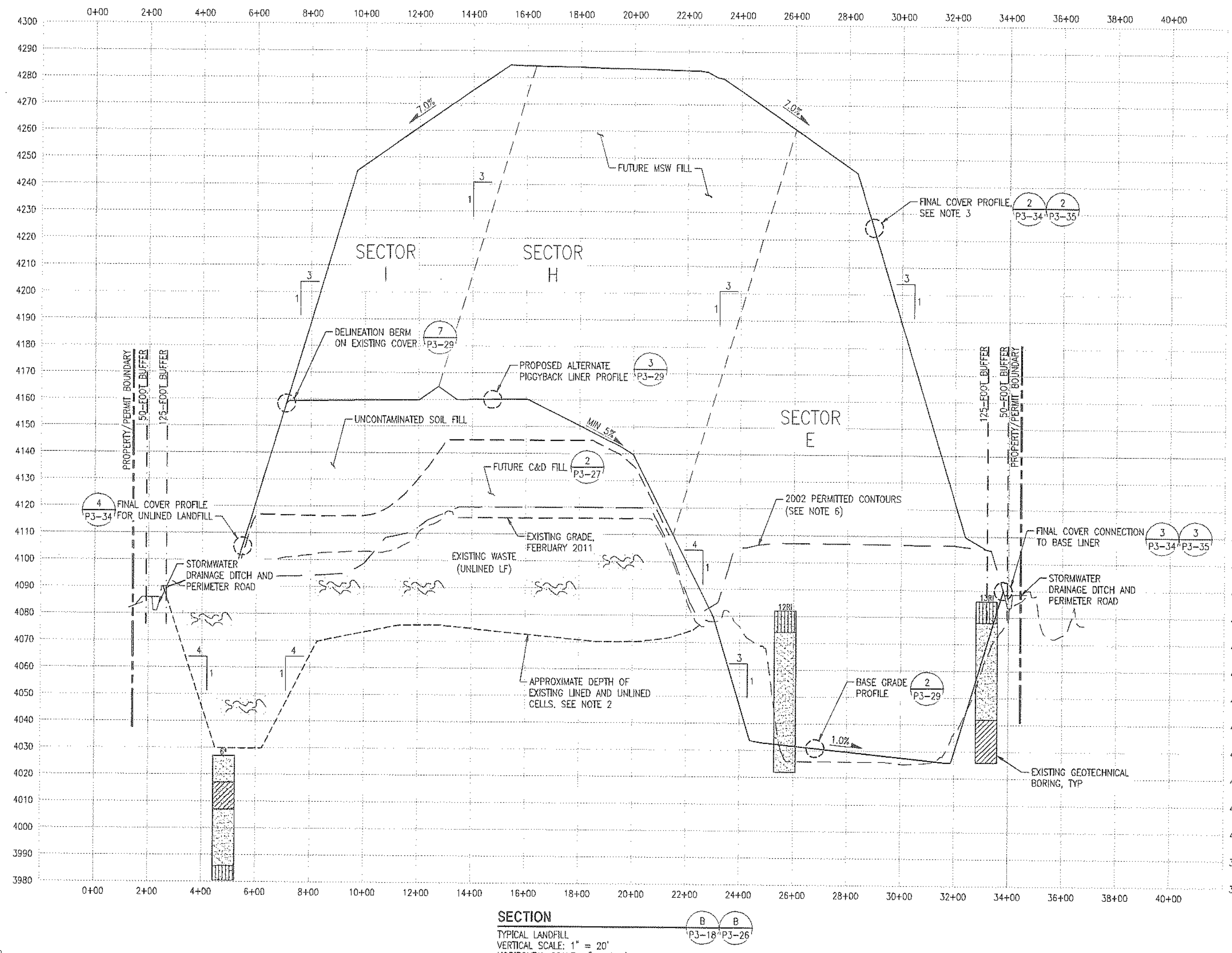
Singh, S. and Murphy, B., "Evaluation of the Stability of Sanitary Landfills," (1990), *in* Geotechnics of Waste Fills – Theory and Practice, ASTM STP 1070, Landva, A., and Knowles, G.D., eds.

Attachments: Appendix A –SAIC Drawings
Appendix B – Waste Mass Stability Analysis

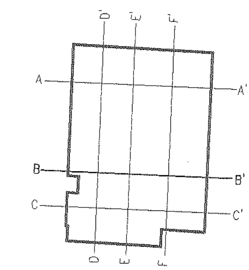
APPENDIX A
SAIC DRAWINGS

## NOTES

1. EXISTING GRADE FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS.
2. EXISTING UNLINED AND LINED BASE CONTOURS OBTAINED FROM DRA CONSULTANTS APPLICATION FOR PERMIT AMENDMENT NO. 729, ATTACHMENT NO. 11, SHEET A1, DATED APRIL 1983.
3. ACTUAL WASTE ELEVATIONS WILL BE DEPENDENT ON THE FINAL COVER PROFILE UTILIZED (I.E., PRESCRIPTIVE OR ALTERNATIVE FINAL COVER), BUT WILL GENERALLY BE 40 OR 48-INCHES LOWER THAN THE FINAL CONTOUR ELEVATIONS (REFER TO DETAILS).
4. TYPICAL GAS WELL LOCATIONS AND CROSS SECTIONS ARE PROVIDED ON P3-39 THROUGH P3-44 IN APPENDIX 3M, ATTACHMENT 3.
5. REFER TO DRAWING P3-37 FOR APPROXIMATE GROUND WATER ELEVATIONS (LOCATED APPROXIMATELY 340-FEET BELOW LANDFILL BASE).
6. PREVIOUSLY APPROVED PERMITTED CONTOURS SUBMITTED TO THE TNRCC BY MORENO CARDENAS FOR THE 2002 APPLICATION FOR PERMIT AMENDMENT NO. 729A.




**SECTION**
TYPICAL LANDFILL
VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 200'



**KEY MAP**
SCALE: NTS

## LEGEND

- 1 – BORING LOCATION AND NUMBER PER DRA CONSULTANTS (MAY 1983)
- 1RI – BORING LOCATION AND NUMBER PER DRA CONSULTANTS (NOVEMBER 1983)
- 1 – BORING LOCATION AND NUMBER PER DICKINSON LABORATORIES (JUNE 1976)

SAND
SILTY SAND
CLAYEY SAND
SILT

GRAPHIC SCALES
1"=20'-0" 20 0 20 40 Scale Feet
1"=200'-0" 200 0 200 400 Scale Feet

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| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
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| 3 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

DESIGNED TLK
DRAWN CAD
VERIFY SCALE: BAR IS ONE INCH ON ANSI "D" DRAWING

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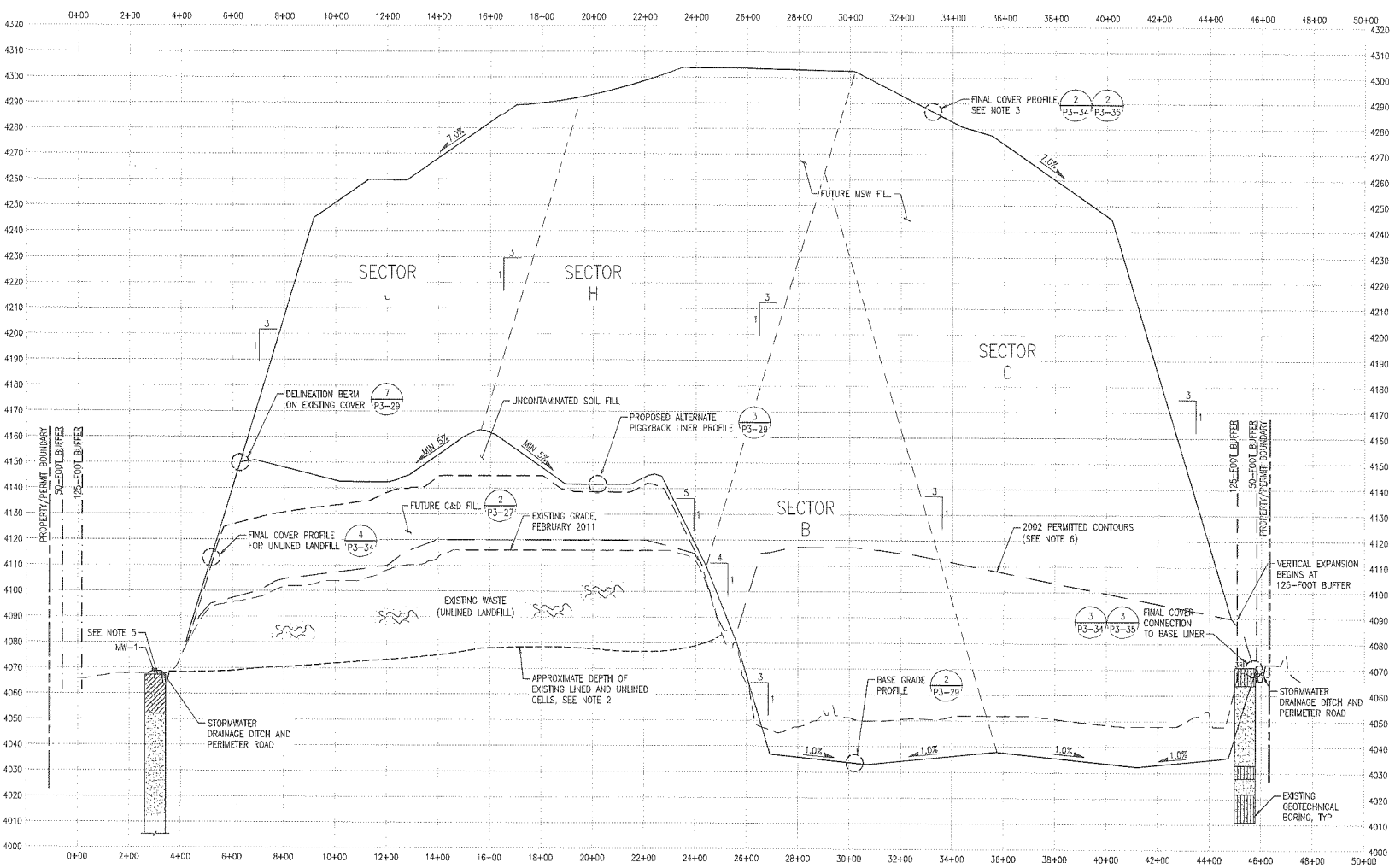
MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

TYPICAL LANDFILL SECTION B

PROJECT NUMBER: 9631500115
SHT. 53 OF: 78
DRAWING NUMBER: P3-20




## SECTION

TYPICAL LANDFILL
VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 200'

## NOTES

1. EXISTING GRADE FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS.
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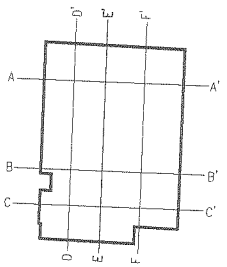
4. TYPICAL GAS WELL LOCATIONS AND CROSS SECTIONS ARE PROVIDED ON P3-39 THROUGH P3-44 IN APPENDIX 3M, ATTACHMENT 3.
5. REFER TO DRAWING P3-37 FOR APPROXIMATE GROUND WATER ELEVATIONS (LOCATED APPROXIMATELY 340-FEET BELOW LANDFILL BASE). REFER TO APPENDIX L FOR REMAINDER OF WELL BORING LOG.
6. PREVIOUSLY APPROVED PERMITTED CONTOURS SUBMITTED TO THE TNRCC BY MORENO CARDENAS FOR THE 2002 APPLICATION FOR PERMIT AMENDMENT NO 729A.




KEY MAP
SCALE: NTS

## LEGEND

- ⊕1* – BORING LOCATION AND NUMBER PER DRA CONSULTANTS (MAY 1983)
- ⊕1RI – BORING LOCATION AND NUMBER PER DRA CONSULTANTS (NOVEMBER 1983)
- ⊕1 – BORING LOCATION AND NUMBER PER DICKINSON LABORATORIES (JUNE 1976)

SAND
SILTY SAND
CLAYEY SAND
SILT

GRAPHIC SCALES

1"=20'-0" 20 0 20 40 Scale Feet
1"=200'-0" 200 0 200 400 Scale Feet

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113723
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DESIGNED TLK
DRAWN CAD
VERIFY SCALE BAR IS ONE INCH ON ANSI "D" DRAWING

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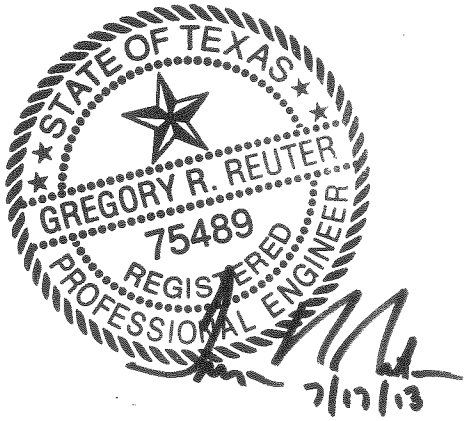
TYPICAL LANDFILL SECTION E

PROJECT NUMBER: 9631500115
SHT. 56 OF: 78
DRAWING NUMBER: P3-23

Revised: 7/17/2013 4:41:50 PM – M:\Combs\Data Analysis\CAD\P3-23 TYPICAL LANDFILL SECTION E.dwg

APPENDIX B
WASTE MASS STABILITY ANALYSIS

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SECTION B

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|---|---|---|---|---|
| MSW Waste | 65 | 525 | 35 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Uncontaminated Soil | 125 | 0 | 29 | 0 |
| Exist.Waste/Fut.C&D | 65 | 525 | 35 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 30 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

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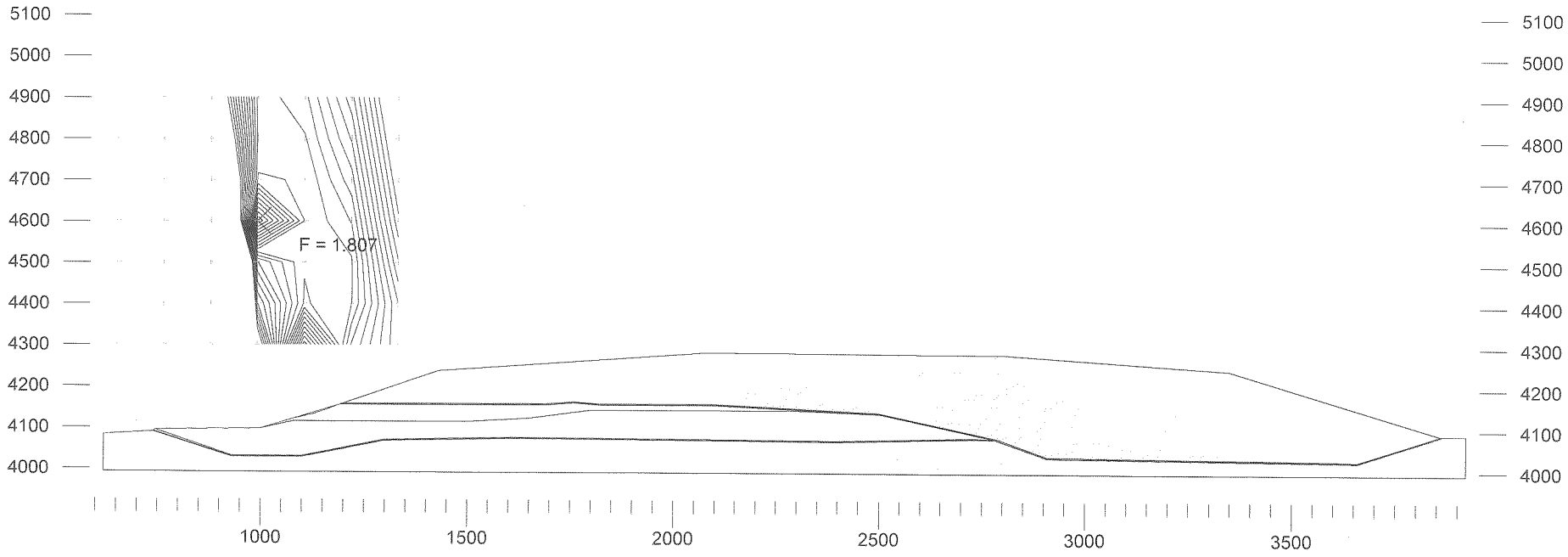
Section B





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| Exist.Waste/Fut.C&D | 65 | 525 | 35 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 30 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

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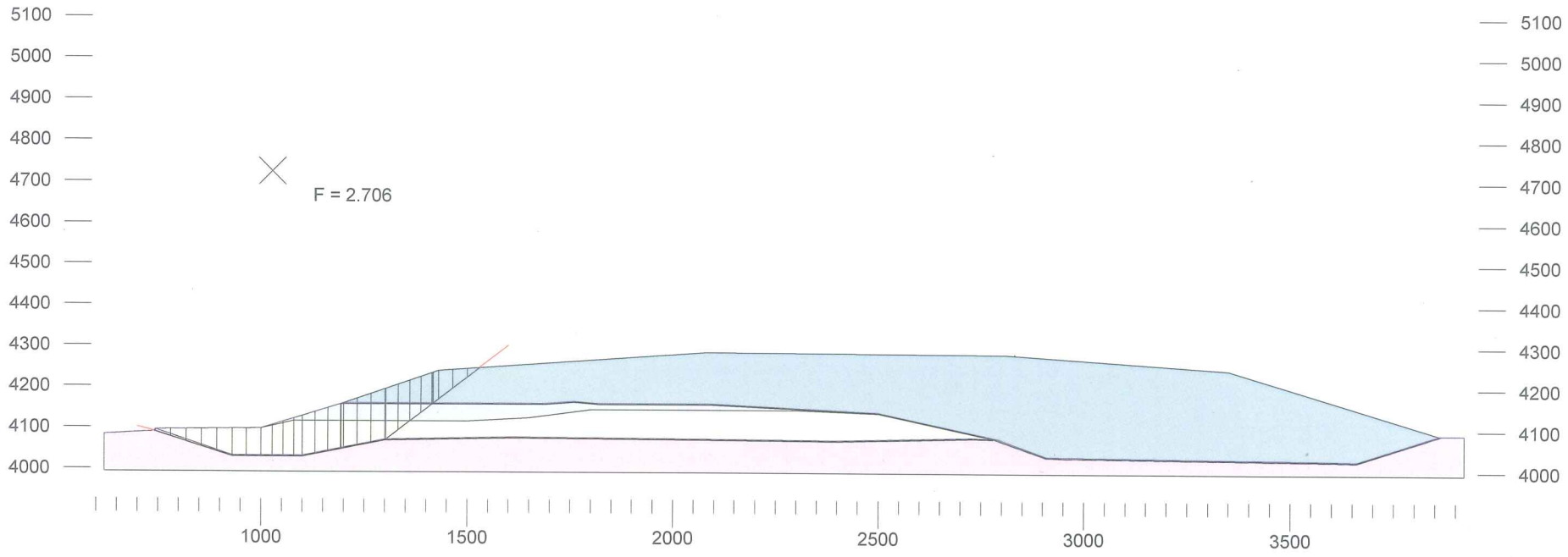




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| Textured HDPE | 110 | 0 | 30 | 1 |
| Uncontaminated Soil | 125 | 0 | 29 | 0 |
| Exist.Waste/Fut.C&D | 65 | 525 | 35 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 30 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

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01-05106
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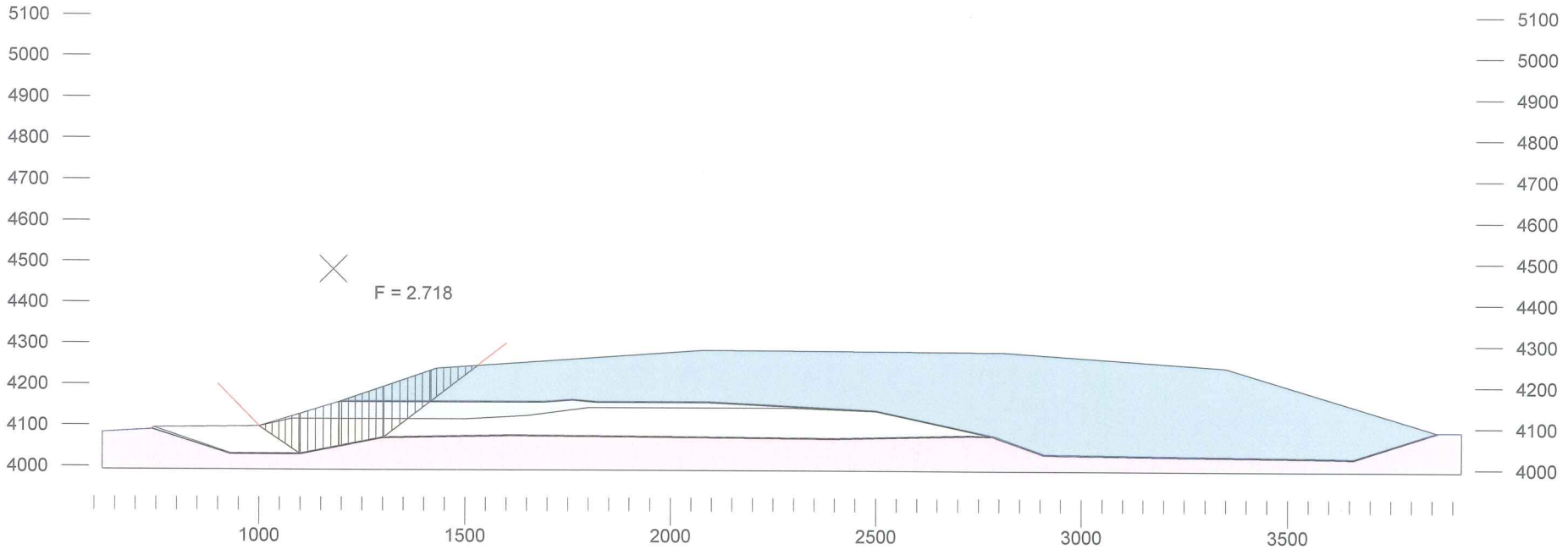
July 2013
Section B





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| Exist. Sand Cover | 110 | 0 | 29 | 2 |
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| Foundation Soils | 125 | 0 | 32 | 0 |

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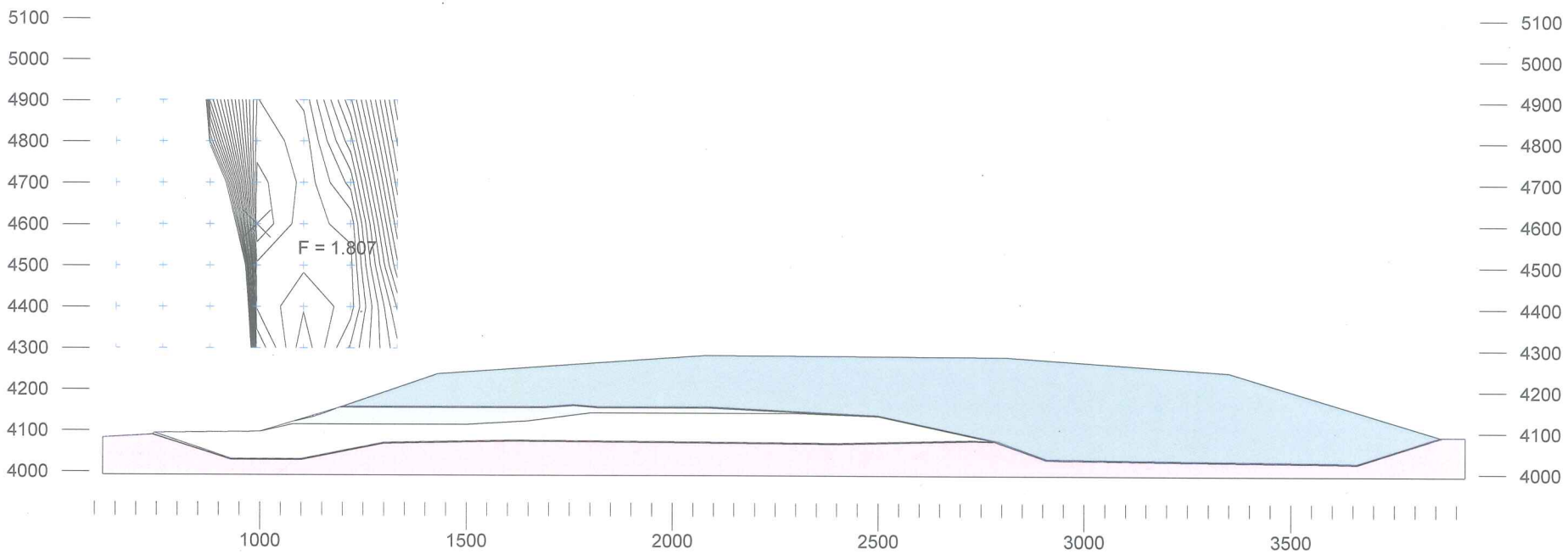
July 2013
Section B
Sensitivity Analysis - Case 1





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| Uncontaminated Soil | 125 | 0 | 29 | 0 |
| Exist.Waste/Fut.C&D | 65 | 0 | 35 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 30 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

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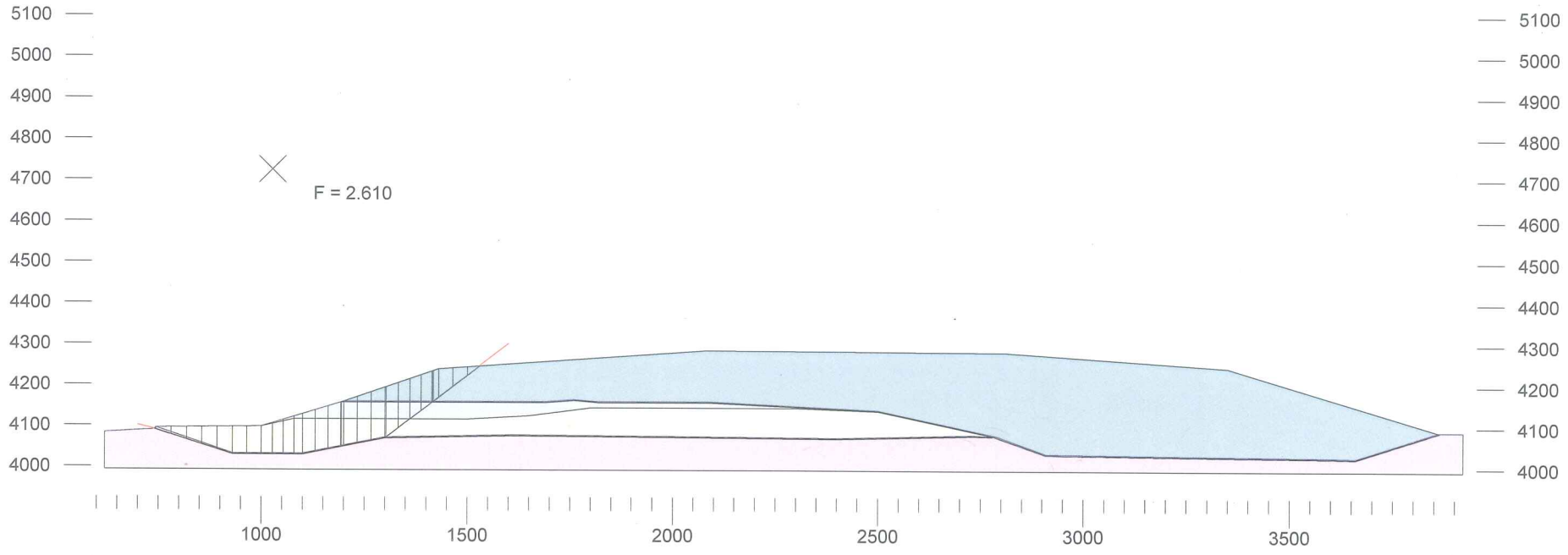
McCombs Landfill Expansion
July 2013
Section B
Sensitivity Analysis - Case 1



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| Uncontaminated Soil | 125 | 0 | 29 | 0 |
| Exist.Waste/Fut.C&D | 65 | 0 | 26 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 30 | 2 |
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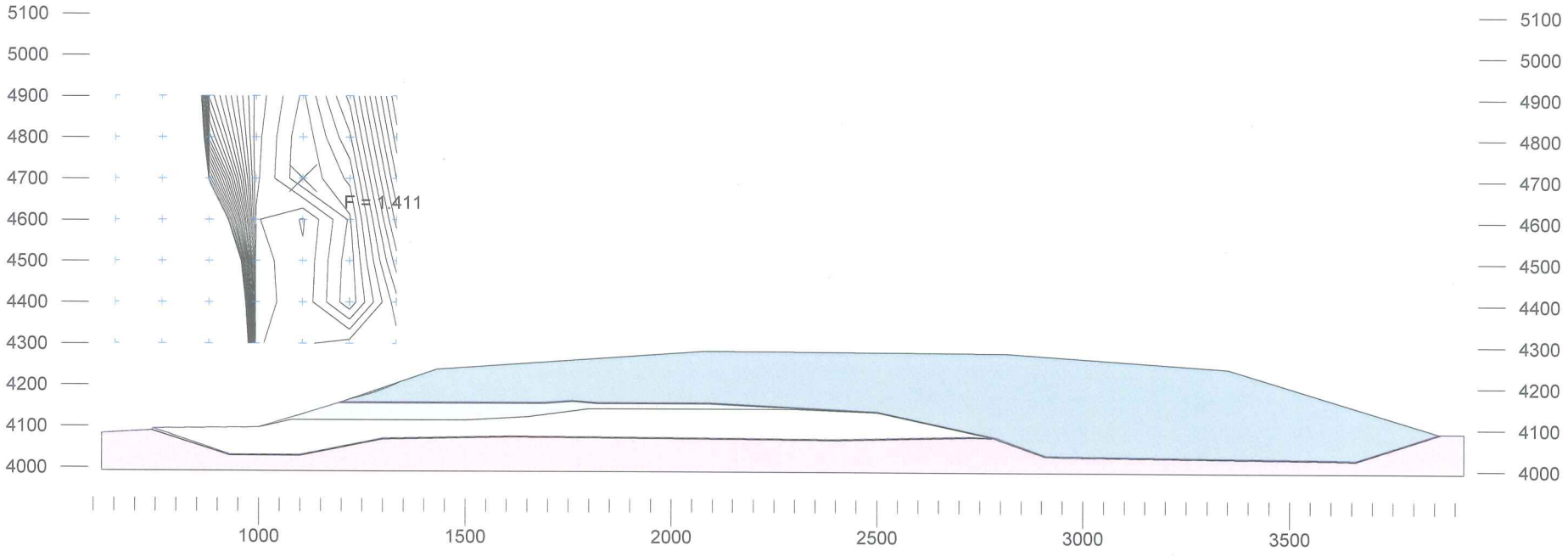
01-05106
McCombs Landfill Expansion
July 2013
Section B
Sensitivity Analysis - Case 2





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| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Uncontaminated Soil | 125 | 0 | 29 | 0 |
| Exist.Waste/Fut.C&D | 65 | 0 | 26 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 30 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

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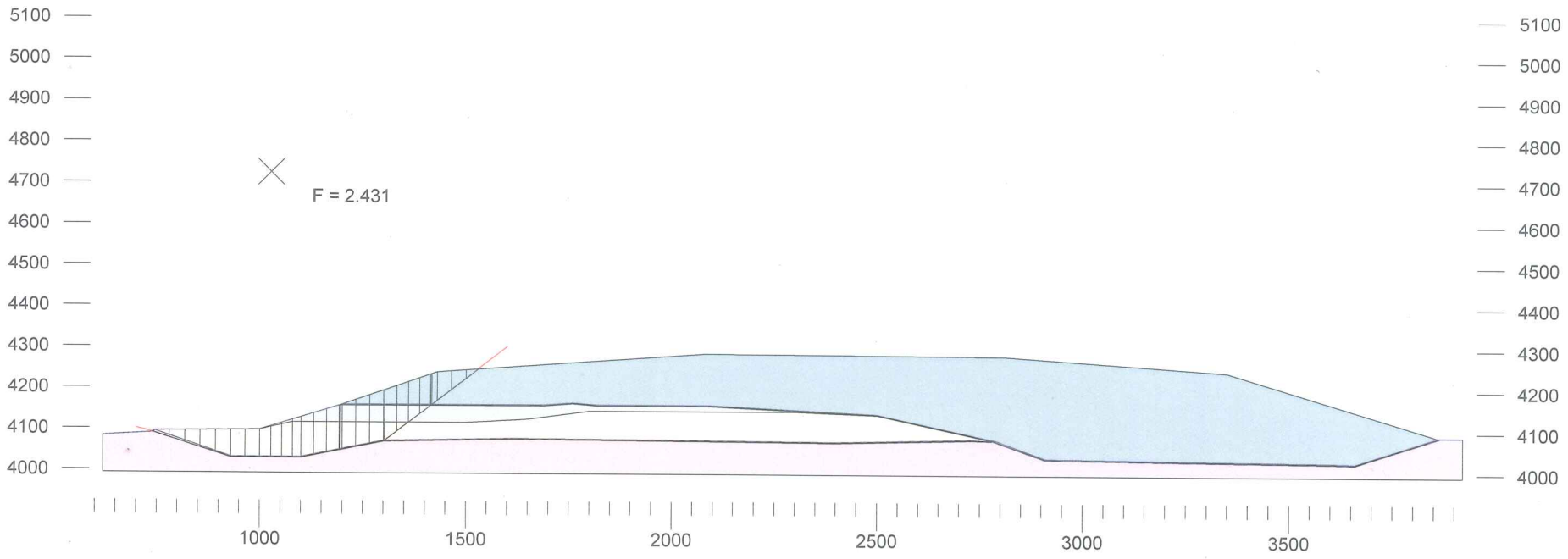


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| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 0 | 28 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 25 | 1 |
| Uncontaminated Soil | 125 | 0 | 29 | 0 |
| Exist.Waste/Fut.C&D | 65 | 0 | 28 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 25 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

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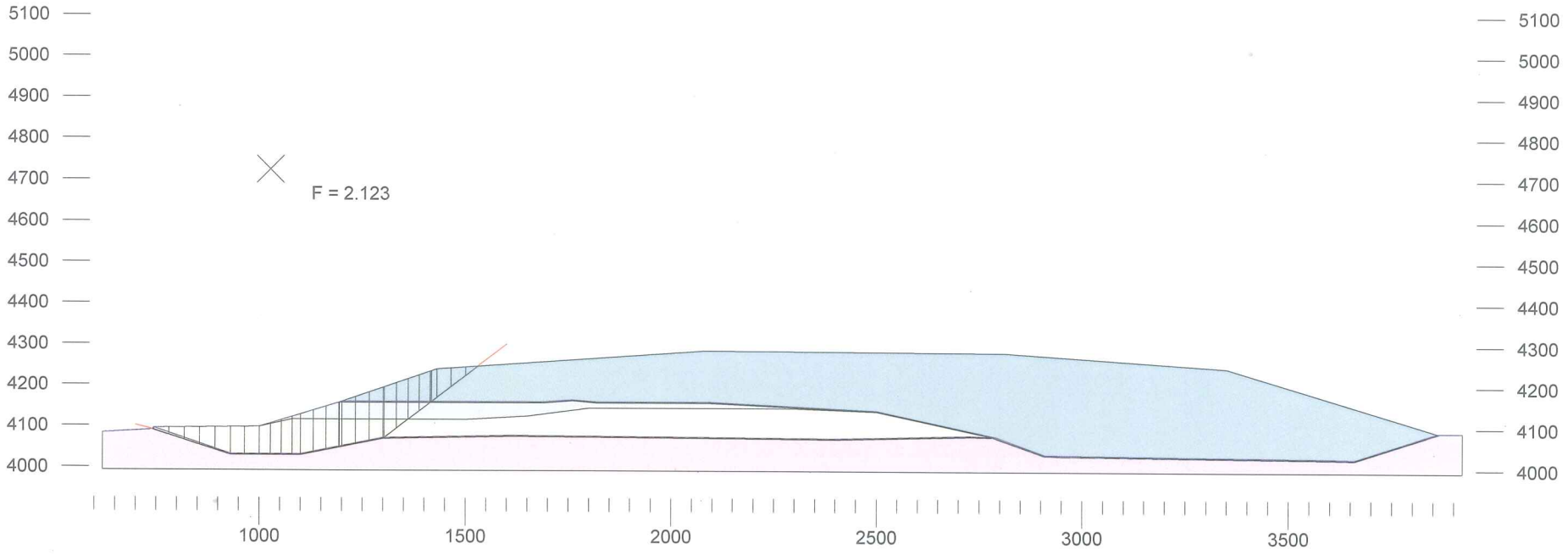

SECTION E

| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 525 | 35 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Uncontaminated Soil | 125 | 0 | 29 | 0 |
| Exist.Waste/Fut.C&D | 65 | 525 | 35 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 30 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

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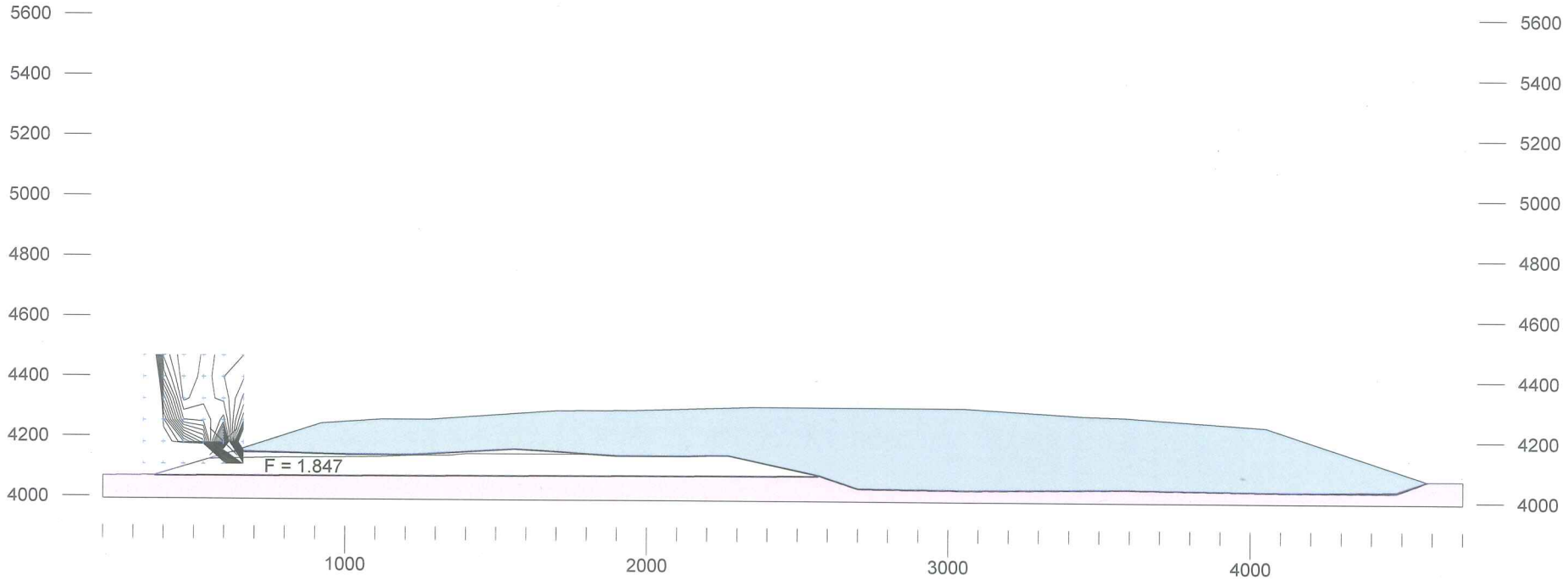
Section E



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| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 525 | 35 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Uncontaminated Soil | 125 | 0 | 29 | 0 |
| Exist.Waste/Fut.C&D | 65 | 525 | 35 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 30 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

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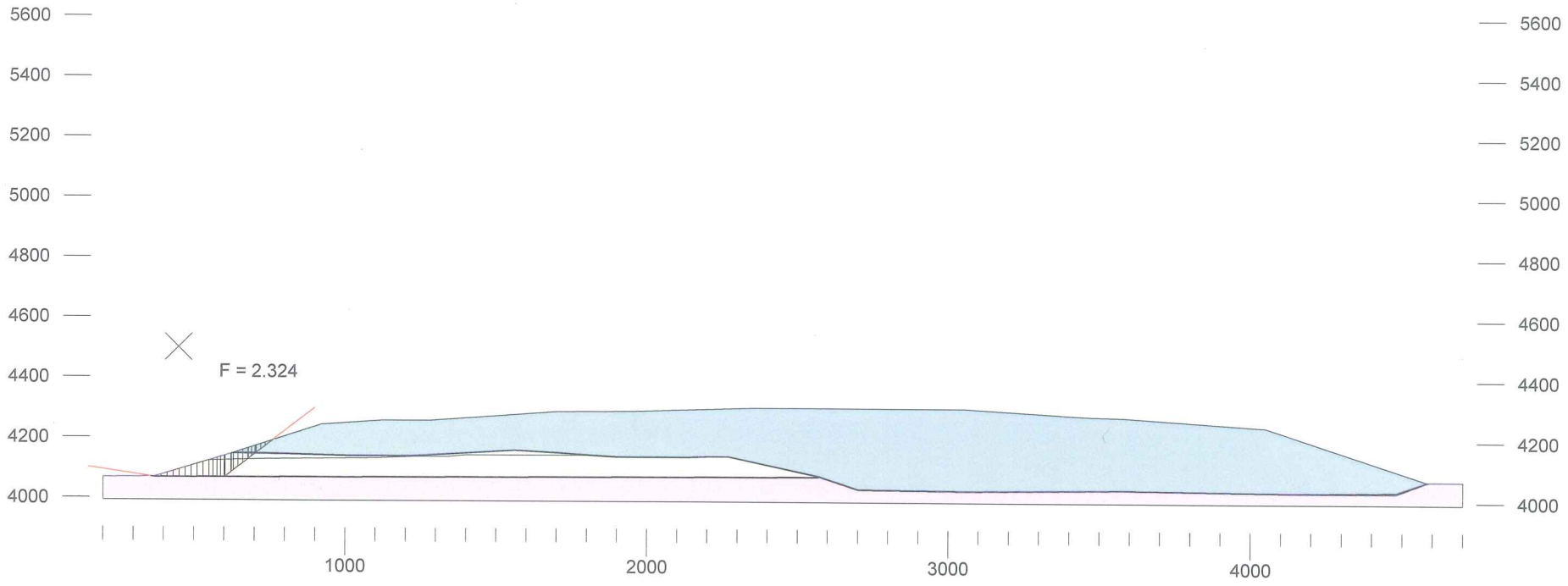


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| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 0 | 35 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Uncontaminated Soil | 125 | 0 | 29 | 0 |
| Exist.Waste/Fut.C&D | 65 | 0 | 35 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 30 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

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Section E
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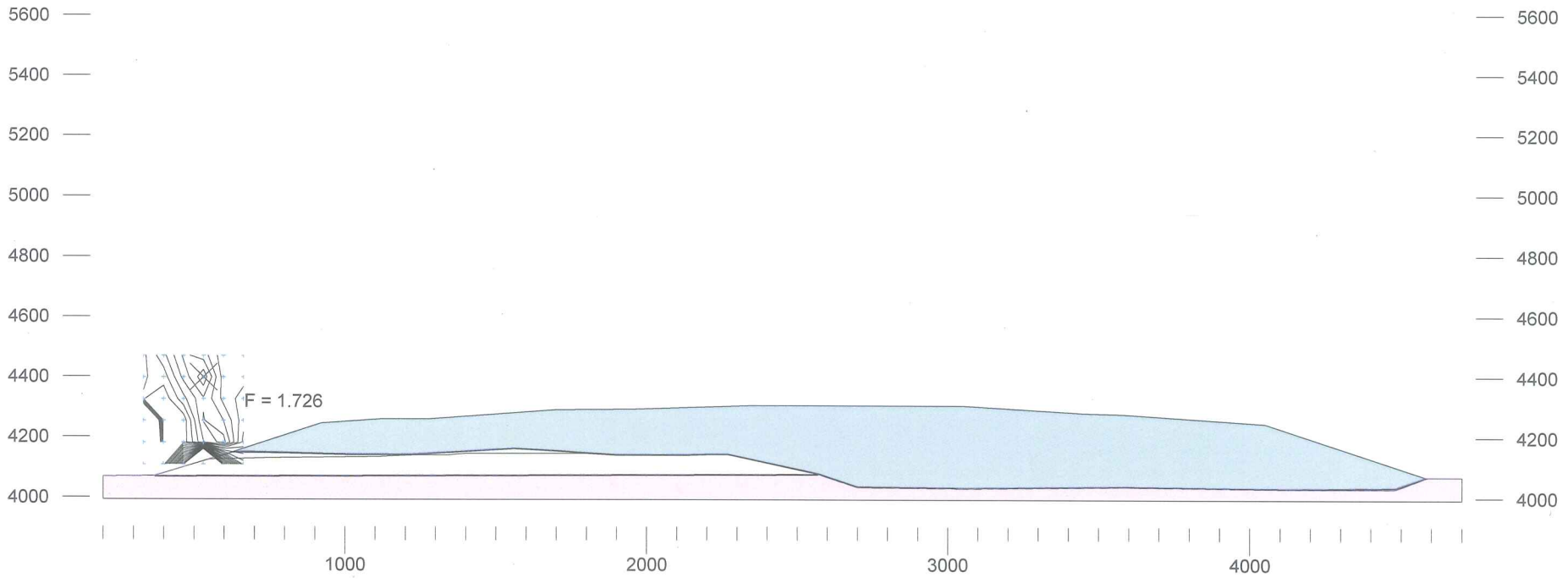

| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 0 | 35 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Uncontaminated Soil | 125 | 0 | 29 | 0 |
| Exist.Waste/Fut.C&D | 65 | 0 | 35 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 30 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

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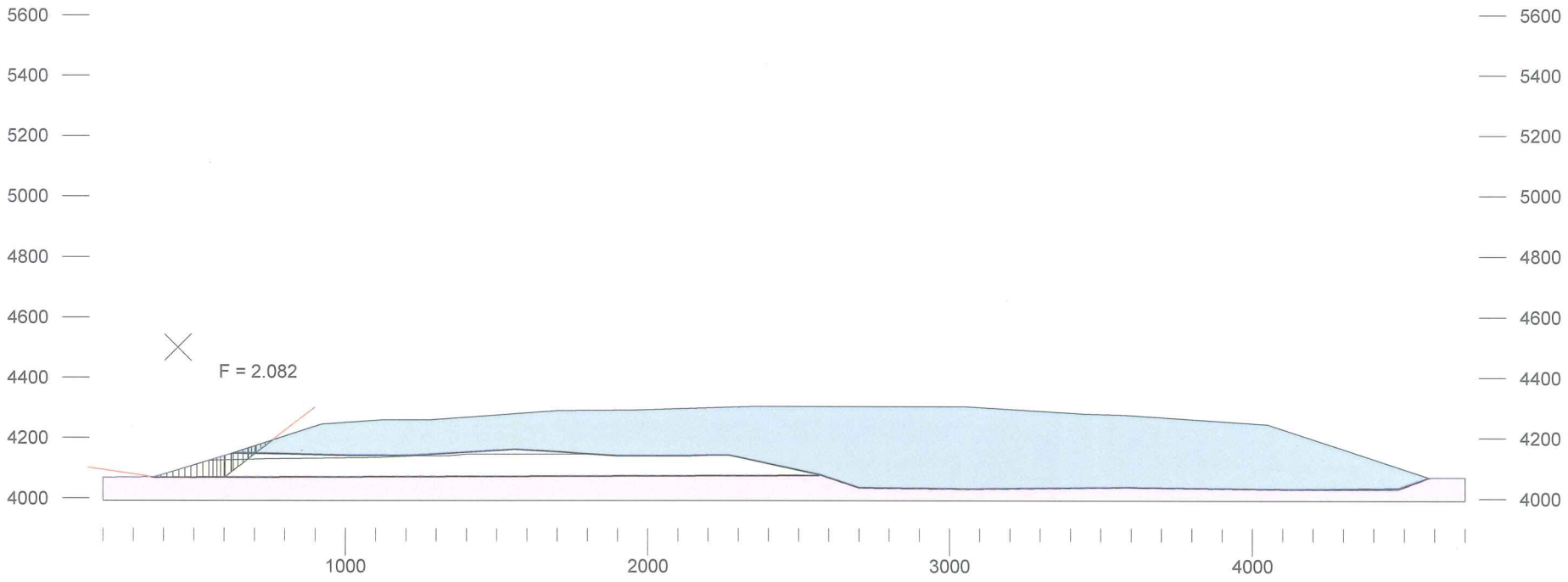
Sensitivity Analysis - Case 1





| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 0 | 26 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Uncontaminated Soil | 125 | 0 | 29 | 0 |
| Exist.Waste/Fut.C&D | 65 | 0 | 26 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 30 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

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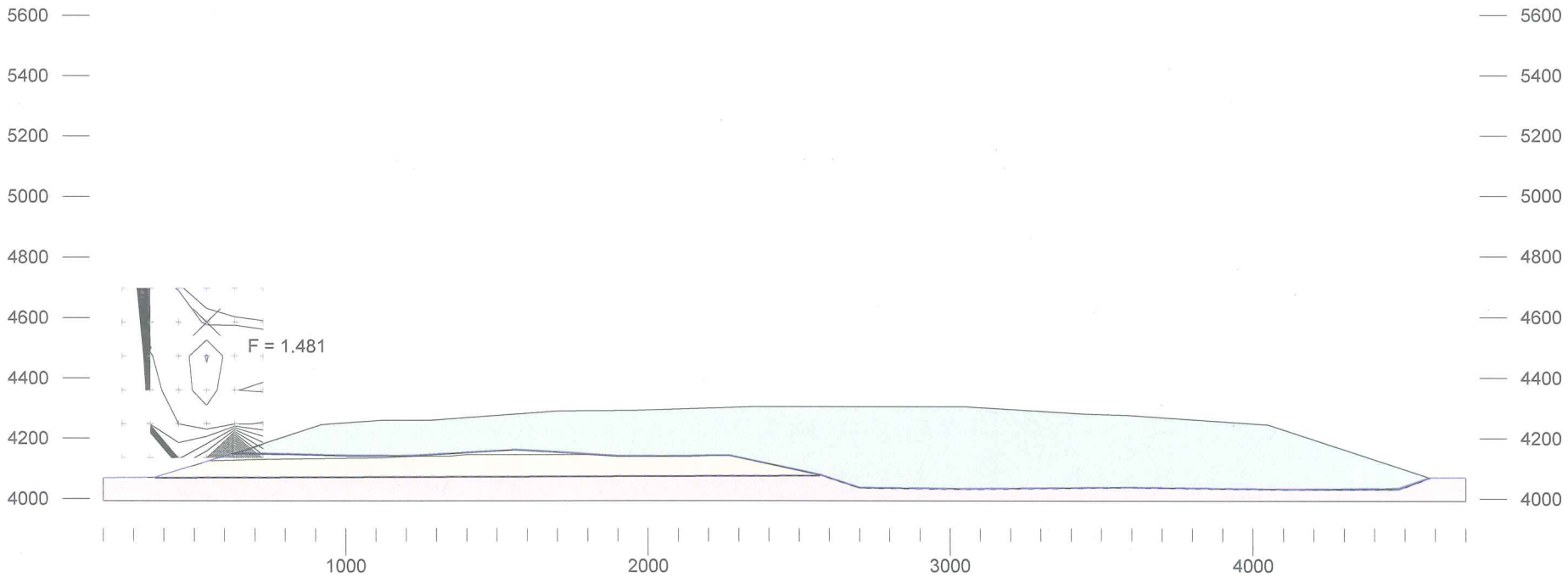
Sensitivity Analysis - Case 2



| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 0 | 26 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 30 | 1 |
| Uncontaminated Soil | 125 | 0 | 29 | 0 |
| Exist.Waste/Fut.C&D | 65 | 0 | 26 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 30 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

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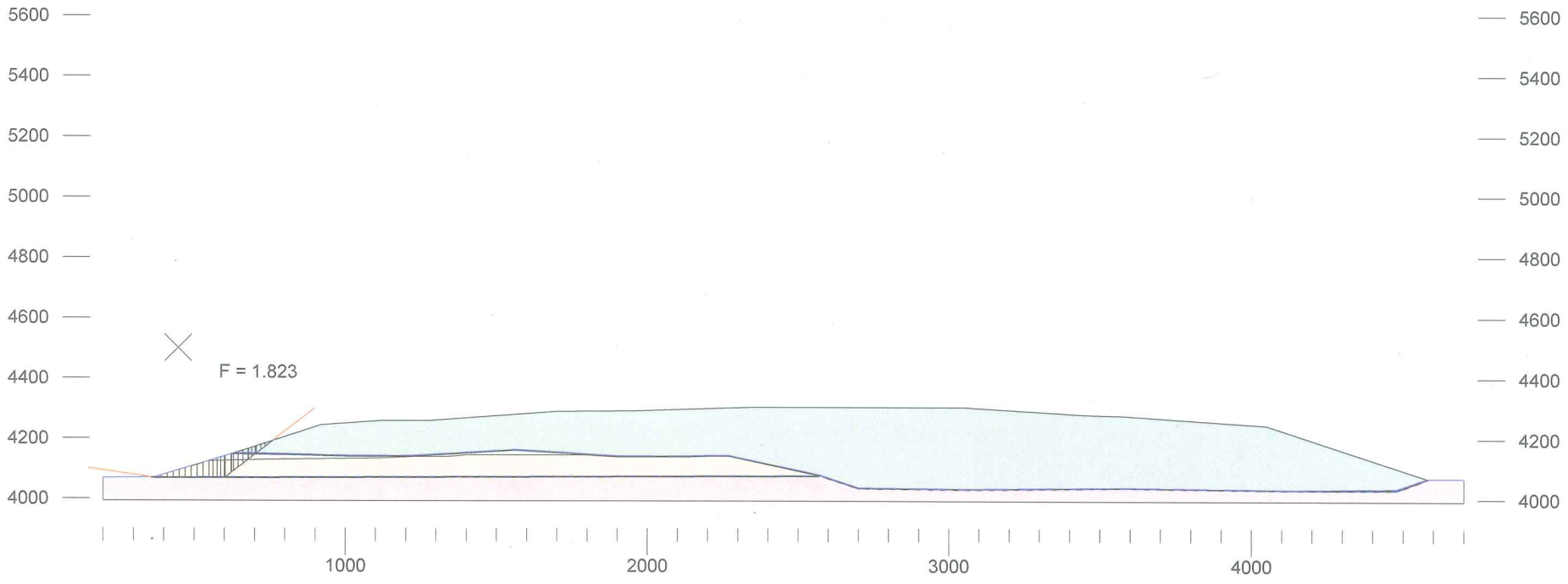


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| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 0 | 28 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 25 | 1 |
| Uncontaminated Soil | 125 | 0 | 29 | 0 |
| Exist.Waste/Fut.C&D | 65 | 0 | 28 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 25 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

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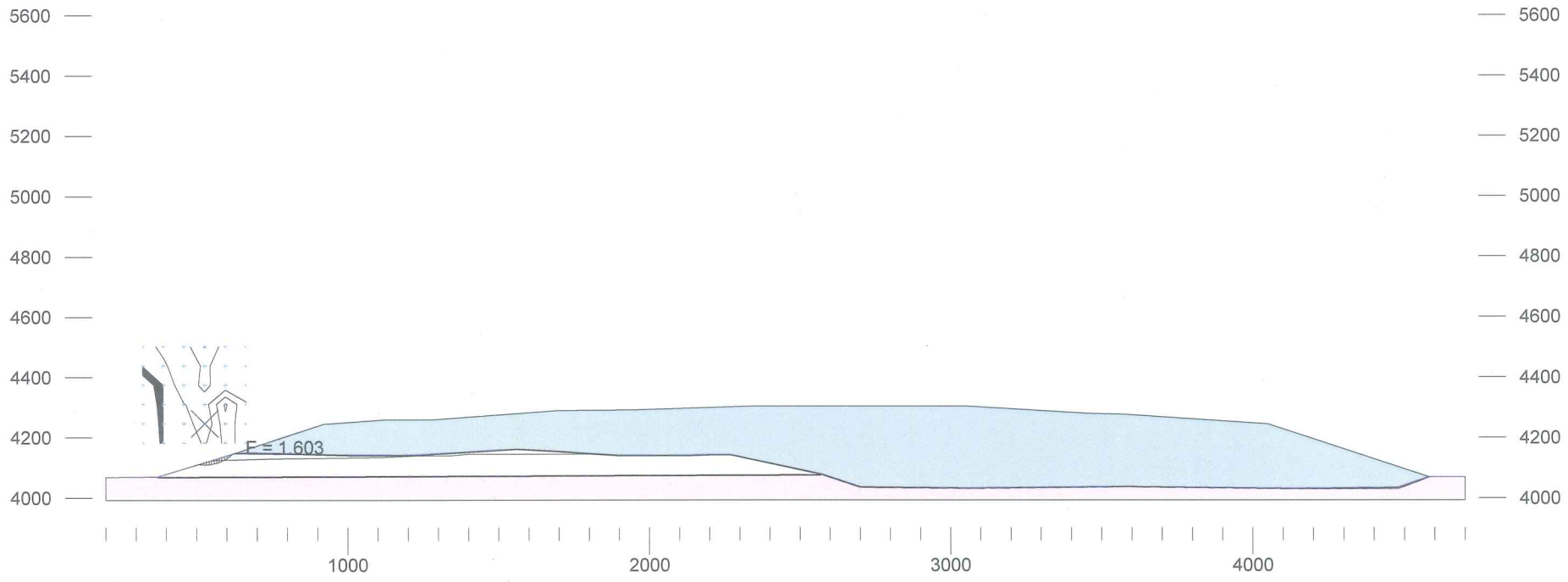

| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 0 | 28 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 25 | 1 |
| Uncontaminated Soil | 125 | 0 | 29 | 0 |
| Exist.Waste/Fut.C&D | 65 | 0 | 28 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 25 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

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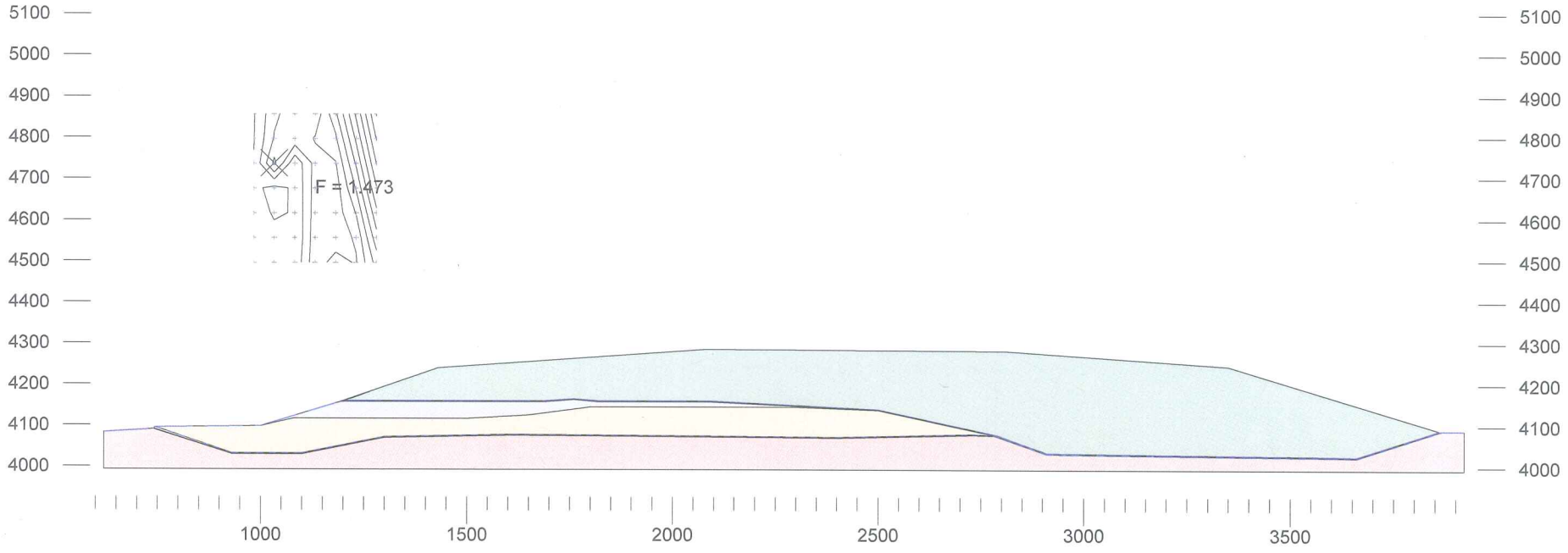

| | Gamma pcf | C psf | Phi deg | Piezo Surf. |
|---|---|---|---|---|
| MSW Waste | 65 | 0 | 28 | 0 |
| Sand Cover | 110 | 0 | 29 | 1 |
| Textured HDPE | 110 | 0 | 25 | 1 |
| Uncontaminated Soil | 125 | 0 | 29 | 0 |
| Exist.Waste/Fut.C&D | 65 | 0 | 28 | 0 |
| Exist. Sand Cover | 110 | 0 | 29 | 2 |
| Exist. HDPE | 110 | 0 | 25 | 2 |
| Foundation Soils | 125 | 0 | 32 | 0 |

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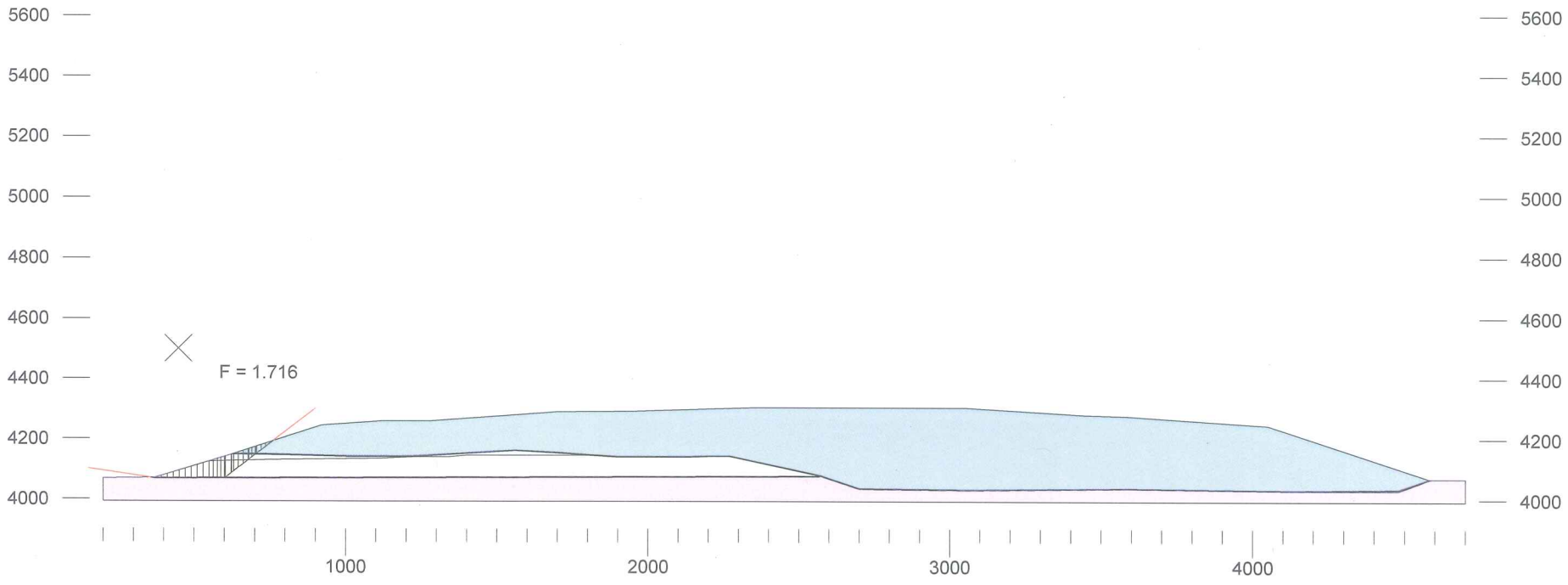
Large Displacement Parameters





| TABLE B-1: RESULTS OF WASTE MASS STABILITY ANALYSIS – PEAK PARAMETERS, BASE CONDITION | | |
|---|---|---|
| Cross Section | Factor of Safety Circular Failure | Factor of Safety Block Failure |
| B | 1.81 | 2.58 |
| E | 1.85 | 2.32 |

| TABLE B-2 : RESULTS OF WASTE MASS STABILITY ANALYSIS – SENSITIVITY ANALYSIS, CROSS SECTION E | | | | | |
|---|---|---|---|---|---|
| Condition | $\gamma'$ (pcf) | $\phi'$ (deg.) | $c'$ (psf) | Factor of Safety | |
| | | | | Circular | Block |
| Base | 65 | 35 | 525 | 1.85 | 2.32 |
| 1 | 65 | 35 | 0 | 1.73 | 2.08 |
| 2 | 65 | 26 | 0 | 1.48 | 1.82 |

| TABLE B-3: RESULTS OF WASTE MASS STABILITY ANALYSIS – LARGE DISPLACEMENT PARAMETERS | | |
|---|---|---|
| Cross Section | Factor of Safety Circular Failure | Factor of Safety Block Failure |
| B | 1.47 | 2.12 |
| E | 1.60 | 1.72 |

# Appendix 3H
# Site Life Projections

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# Appendix 3H
# SITE LIFE PROJECTIONS

## 3H.1 Solid Waste Generation

The McCombs Landfill accepts waste generated in El Paso County, Texas. The Clint Landfill also accepts waste generated in El Paso County. The estimated rate of disposal was calculated assuming an annual population increase of 2% in growth, and assuming a disposal rate of 497,309 tons per year (in 2014 tonnage) until Clint Landfill closes in 2030. 3,000 tons per year are assumed from 2011 through 2013. After Clint Landfill closes, McCombs Landfill will receive all of the waste that would have previously gone to Clint Landfill, therefore the disposal rate at McCombs will raise from 45% of the county waste allocation to 100%. The 1990 base population for central, northeastern and northwestern areas of El Paso (areas where solid waste is planned to go to the McCombs Landfill) was used for the growth rate estimation. The population for the above mentioned areas in 1990 was 322,842 people.

The disposal rate for C&D waste was calculated assuming a disposal rate of 60,000 tons per year (this is the approximate tonnage of C&D disposed of at Clint Landfill 2284 in FY 2010), also with an annual increase of 2% growth.

## 3H.2 Airspace Utilization

An airspace utilization factor (AUF) of 0.60 tons per cubic yard (1200 pounds per cubic yard) of landfill airspace was utilized to calculate the site life projections for the volume available at the McCombs Landfill.

## 3H.3 Landfill Capacity

The total landfill capacity represents a total volume available for disposal of solid waste, daily cover material and intermediate cover material. AutoCAD Civil 3D 2011 computer software was utilized to estimate the total capacity. The total capacity is defined as the volume between the top of the geomembrane on the cell liner system and top of the final cover system. Sector A is currently being filled with waste so the existing capacity in that sector was evaluated between the existing contours in that sector and the top of the final cover system of that sector.

The total remaining landfill volume available for waste disposal in Sector A is approximately 640,890 cubic yards (including waste and daily, intermediate and final cover), which provides capacity through 2014 based on Table 3H-1. The total remaining landfill volume available for waste disposal, protective soil and daily, intermediate and final cover (including the remainder of Sector A) and all subsequent planned sectors (B through K) is 63,469,470 CY. The total remaining volume for waste disposal including intermediate cover using the prescriptive final cover profile is 61,292,030 CY. The total volume remaining for waste disposal including intermediate cover utilizing the alternative final cover profile is 61,589,822 CY. The sector

development plan can be seen in Appendix 3E - Site Layout Plans, Drawing P3-16 - Landfill Completion Plan.

## 3H.4 Site Life Calculations

Using the rate of 2% growth per year, an AUF of 1200 lb/cy for MSW and 1800 lb/cy for C&D, an increase in waste received after 2030, and the remaining capacity above, the remaining estimated life of the Landfill is until 2059 for both prescriptive and alternative final cover profiles. See Table 3H-1 and Table 3H-2 for MSW Prescriptive and Alternative Site Life Calculations and Table 3H-3 for C&D Site Life Calculations. See Table 3H-4 for Sector Volume Calculations.

Table 3H-1
Site Life Calculations for MSW (Prescriptive)

| | | |
|---|---|---|
| Growth Rate | 2% | |
| In Place Tons | 0 | |
| AUF (tons/cy lb/cy) | 0.6 | 1200 |
| Beginning Tons per Year (in 2014 tons) | | 497,309 |
| Remaining Sector A Capacity (Including Final Cover) | | 640,890 |
| Waste Allocation: | 45% McCombs | 55% Clint |

| Year | Tons/Year | CY/Year | Cumulative CY | Remaining CY | |
|---|---|---|---|---|---|
| 2011 | 3,000 | 5,000 | 5,000 | 635,890 | |
| 2012 | 3,000 | 5,000 | 10,000 | 630,890 | |
| 2013 | 3,000 | 5,000 | 15,000 | 4,215,430 | Build Sector B |
| 2014 | 497,309 | 828,848 | 843,848 | 3,386,583 | Sector A Exhausted |
| 2015 | 507,255 | 845,424 | 1,689,272 | 2,541,158 | |
| 2016 | 517,400 | 862,333 | 2,551,605 | 1,678,826 | |
| 2017 | 527,748 | 879,580 | 3,431,184 | 799,246 | |
| 2018 | 538,303 | 897,171 | 4,328,356 | 5,962,552 | Build Sector C |
| 2019 | 549,069 | 915,115 | 5,243,470 | 5,047,438 | Sector B Exhausted |
| 2020 | 560,050 | 933,417 | 6,176,887 | 4,114,021 | |
| 2021 | 571,251 | 952,085 | 7,128,972 | 3,161,936 | |
| 2022 | 582,676 | 971,127 | 8,100,099 | 2,190,809 | |
| 2023 | 594,330 | 990,549 | 9,090,649 | 1,200,259 | |
| 2024 | 606,216 | 1,010,360 | 10,101,009 | 3,564,447 | Build Sector D |
| 2025 | 618,341 | 1,030,568 | 11,131,577 | 2,533,879 | Sector C Exhausted |
| 2026 | 630,707 | 1,051,179 | 12,182,756 | 1,482,700 | |
| 2027 | 643,322 | 1,072,203 | 13,254,959 | 410,497 | |
| 2028 | 656,188 | 1,093,647 | 14,348,605 | 4,978,751 | Build Sector E |
| 2029 | 669,312 | 1,115,520 | 15,464,125 | 3,863,232 | Sector D Exhausted |
| 2030 | 1,517,107 | 1,137,830 | 16,601,955 | 2,725,402 | |
| 2031 | 1,547,449 | 1,160,587 | 17,762,542 | 1,564,815 | |

| Year | Tons/Year | CY/Year | Cumulative CY | Remaining CY | |
|---|---|---|---|---|---|
| 2032 | 1,578,398 | 1,183,798 | 18,946,340 | 381,017 | |
| 2033 | 1,609,966 | 1,207,474 | 20,153,814 | 9,650,175 | Build Sector F |
| 2034 | 1,642,165 | 1,231,624 | 21,385,438 | 8,418,551 | Sector E Exhausted |
| 2035 | 1,675,008 | 1,256,256 | 22,641,694 | 7,162,295 | |
| 2036 | 1,708,509 | 1,281,381 | 23,923,076 | 5,880,914 | |
| 2037 | 1,742,679 | 1,307,009 | 25,230,085 | 4,573,905 | |
| 2038 | 1,777,532 | 1,333,149 | 26,563,234 | 3,240,756 | |
| 2039 | 1,813,083 | 1,359,812 | 27,923,046 | 1,880,943 | |
| 2040 | 1,849,345 | 1,387,008 | 29,310,054 | 493,935 | |
| 2041 | 1,886,331 | 1,414,749 | 30,724,803 | 13,321,039 | Build Sector G |
| 2042 | 1,924,058 | 1,443,044 | 32,167,847 | 11,877,996 | Sector F Exhausted |
| 2043 | 1,962,539 | 1,471,904 | 33,639,751 | 10,406,091 | |
| 2044 | 2,001,790 | 1,501,343 | 35,141,094 | 8,904,749 | |
| 2045 | 2,041,826 | 1,531,369 | 36,672,463 | 7,373,379 | |
| 2046 | 2,082,662 | 1,561,997 | 38,234,460 | 5,811,383 | |
| 2047 | 2,124,316 | 1,593,237 | 39,827,696 | 4,218,146 | |
| 2048 | 2,166,802 | 1,625,101 | 41,452,798 | 2,593,045 | |
| 2049 | 2,210,138 | 1,657,603 | 43,110,401 | 5,330,561 | Build Sector H |
| 2050 | 2,254,341 | 1,690,756 | 44,801,157 | 3,639,805 | Sector G Exhausted |
| 2051 | 2,299,428 | 1,724,571 | 46,525,727 | 5,160,180 | Build Sector I |
| 2052 | 2,345,416 | 1,759,062 | 48,284,789 | 3,401,118 | Sector H Exhausted |
| 2053 | 2,392,324 | 1,794,243 | 50,079,033 | 4,960,446 | Build Sector J |
| 2054 | 2,440,171 | 1,830,128 | 51,909,161 | 3,130,318 | Sector I Exhausted |
| 2055 | 2,488,974 | 1,866,731 | 53,775,892 | 6,336,552 | Build Sector K |
| 2056 | 2,538,754 | 1,904,065 | 55,679,957 | 4,432,487 | Sector J Exhausted |
| 2057 | 2,589,529 | 1,942,147 | 57,622,104 | 2,490,340 | |
| 2058 | 2,641,319 | 1,980,990 | 59,603,093 | 509,351 | |
| 2059 | 2,694,146 | 2,020,609 | 61,623,703 | (1,511,259) | Sector K Exhausted |

Table 3H-2
Site Life Calculations for MSW (Alternative)

| | | |
|---|---|---|
| Growth Rate | 2% | |
| In Place Tons | 0 | |
| AUF (tons/cy lb/cy) | 0.6 | 1200 |
| Beginning Tons per Year (in 2014 tons) | | 497,309 |
| Remaining Sector A Capacity (Including Final Cover) | | 640,890 |
| Waste Allocation: | 45% McCombs | 55% Clint |

| Year | Tons/Year | CY/Year | Cumulative CY | Remaining CY | |
|---|---|---|---|---|---|
| 2011 | 3,000 | 5,000 | 5,000 | 635,890 | |
| 2012 | 3,000 | 5,000 | 10,000 | 630,890 | |
| 2013 | 3,000 | 5,000 | 15,000 | 4,239,748 | Build Sector B |
| 2014 | 497,309 | 828,848 | 843,848 | 3,410,901 | Sector A Exhausted |
| 2015 | 507,255 | 845,424 | 1,689,272 | 2,565,476 | |
| 2016 | 517,400 | 862,333 | 2,551,605 | 1,703,143 | |
| 2017 | 527,748 | 879,580 | 3,431,184 | 823,564 | |
| 2018 | 538,303 | 897,171 | 4,328,356 | 6,016,227 | Build Sector C |
| 2019 | 549,069 | 915,115 | 5,243,470 | 5,101,112 | Sector B Exhausted |
| 2020 | 560,050 | 933,417 | 6,176,887 | 4,167,695 | |
| 2021 | 571,251 | 952,085 | 7,128,972 | 3,215,610 | |
| 2022 | 582,676 | 971,127 | 8,100,099 | 2,244,483 | |
| 2023 | 594,330 | 990,549 | 9,090,649 | 1,253,933 | |
| 2024 | 606,216 | 1,010,360 | 10,101,009 | 3,649,629 | Build Sector D |
| 2025 | 618,341 | 1,030,568 | 11,131,577 | 2,619,061 | Sector C Exhausted |
| 2026 | 630,707 | 1,051,179 | 12,182,756 | 1,567,882 | |
| 2027 | 643,322 | 1,072,203 | 13,254,959 | 495,679 | |
| 2028 | 656,188 | 1,093,647 | 14,348,605 | 5,092,071 | Build Sector E |
| 2029 | 669,312 | 1,115,520 | 15,464,125 | 3,976,551 | Sector D Exhausted |
| 2030 | 1,517,107 | 1,137,830 | 16,601,955 | 2,838,721 | |
| 2031 | 1,547,449 | 1,160,587 | 17,762,542 | 1,678,135 | |
| 2032 | 1,578,398 | 1,183,798 | 18,946,340 | 494,336 | |
| 2033 | 1,609,966 | 1,207,474 | 20,153,814 | 9,805,239 | Build Sector F |
| 2034 | 1,642,165 | 1,231,624 | 21,385,438 | 8,573,616 | Sector E Exhausted |
| 2035 | 1,675,008 | 1,256,256 | 22,641,694 | 7,317,359 | |
| 2036 | 1,708,509 | 1,281,381 | 23,923,076 | 6,035,978 | |
| 2037 | 1,742,679 | 1,307,009 | 25,230,085 | 4,728,969 | |
| 2038 | 1,777,532 | 1,333,149 | 26,563,234 | 3,395,820 | |
| 2039 | 1,813,083 | 1,359,812 | 27,923,046 | 2,036,008 | |
| 2040 | 1,849,345 | 1,387,008 | 29,310,054 | 648,999 | |

| Year | Tons/Year | CY/Year | Cumulative CY | Remaining CY | |
|---|---|---|---|---|---|
| 2041 | 1,886,331 | 1,414,749 | 30,724,803 | 13,509,560 | Build Sector G |
| 2042 | 1,924,058 | 1,443,044 | 32,167,847 | 12,066,517 | Sector F Exhausted |
| 2043 | 1,962,539 | 1,471,904 | 33,639,751 | 10,594,612 | |
| 2044 | 2,001,790 | 1,501,343 | 35,141,094 | 9,093,270 | |
| 2045 | 2,041,826 | 1,531,369 | 36,672,463 | 7,561,900 | |
| 2046 | 2,082,662 | 1,561,997 | 38,234,460 | 5,999,904 | |
| 2047 | 2,124,316 | 1,593,237 | 39,827,696 | 4,406,667 | |
| 2048 | 2,166,802 | 1,625,101 | 41,452,798 | 2,781,566 | |
| 2049 | 2,210,138 | 1,657,603 | 43,110,401 | 1,123,962 | |
| 2050 | 2,254,341 | 1,690,756 | 44,801,157 | 3,847,281 | Build Sector H |
| 2051 | 2,299,428 | 1,724,571 | 46,525,727 | 2,122,711 | Sector G Exhausted |
| 2052 | 2,345,416 | 1,759,062 | 48,284,789 | 3,631,694 | Build Sector I |
| 2053 | 2,392,324 | 1,794,243 | 50,079,033 | 5,221,336 | Build Sector J/Sector H Exhausted |
| 2054 | 2,440,171 | 1,830,128 | 51,909,161 | 3,391,207 | Sector I Exhausted |
| 2055 | 2,488,974 | 1,866,731 | 53,775,892 | 7,879,265 | Build Sector K |
| 2056 | 2,538,754 | 1,904,065 | 55,679,957 | 5,975,199 | Sector J Exhausted |
| 2057 | 2,589,529 | 1,942,147 | 57,622,104 | 4,033,053 | |
| 2058 | 2,641,319 | 1,980,990 | 59,603,093 | 2,052,063 | |
| 2059 | 2,694,146 | 2,020,609 | 61,623,703 | 31,454 | |
| 2060 | 2,748,029 | 2,061,022 | 63,684,724 | (2,029,568) | Sector K Exhausted |

Table 3H-3
Site Life Calculations for C&D

| | | |
|---|---|---|
| Growth Rate | 2% | |
| In Place Tons | 0 | |
| AUF (tons/cy lb/cy) | 0.9 | 1800 |
| Beginning Tons per Year (in 2013 tons) | | 60,000 |
| C&D Capacity | | 2,072,752 |

| Year | Tons/Year | CY/Year | Cumulative CY | Remaining CY |
|---|---|---|---|---|
| 2012 | 0 | 0 | | 2,072,752 |
| 2013 | 60,000 | 68,000 | 68,000 | 2,004,752 |
| 2014 | 61,200 | 69,360 | 137,360 | 1,935,392 |
| 2015 | 62,424 | 70,747 | 208,107 | 1,864,645 |
| 2016 | 63,672 | 72,162 | 280,269 | 1,792,483 |
| 2017 | 64,946 | 73,605 | 353,875 | 1,718,877 |
| 2018 | 66,245 | 75,077 | 428,952 | 1,643,800 |
| 2019 | 67,570 | 76,579 | 505,531 | 1,567,221 |
| 2020 | 68,921 | 78,111 | 583,642 | 1,489,110 |
| 2021 | 70,300 | 79,673 | 663,315 | 1,409,437 |
| 2022 | 71,706 | 81,266 | 744,581 | 1,328,171 |
| 2023 | 73,140 | 82,892 | 827,473 | 1,245,279 |
| 2024 | 74,602 | 84,549 | 912,022 | 1,160,730 |
| 2025 | 76,095 | 86,240 | 998,263 | 1,074,489 |
| 2026 | 77,616 | 87,965 | 1,086,228 | 986,524 |
| 2027 | 79,169 | 89,725 | 1,175,952 | 896,800 |
| 2028 | 80,752 | 91,519 | 1,267,471 | 805,281 |
| 2029 | 82,367 | 93,349 | 1,360,821 | 711,931 |
| 2030 | 84,014 | 95,216 | 1,456,037 | 616,715 |
| 2031 | 85,695 | 97,121 | 1,553,158 | 519,594 |
| 2032 | 87,409 | 99,063 | 1,652,221 | 420,531 |
| 2033 | 89,157 | 101,044 | 1,753,266 | 319,486 |
| 2034 | 90,940 | 103,065 | 1,856,331 | 216,421 |
| 2035 | 92,759 | 105,127 | 1,961,457 | 111,294 |
| 2036 | 94,614 | 107,229 | 2,068,687 | 4,065 |
| 2037 | 96,506 | 109,374 | 2,178,060 | (105,308) |

Table 3H-4
Sector Volumes

| Sector | Area (SF) | Area (Acres) | Net Volume (Inclusive of Final Cover) (CY) | Waste Volume (Prescriptive Cover) (CY)[A, C] | Waste Volume (Alternative Cover) (CY)[B, C] |
|---|---|---|---|---|---|
| Sector A | 756,005 | 17.36 | 640,890 | 556,890 | 575,556 |
| Sector B | 984,867 | 22.61 | 3,771,923 | 3,589,540 | 3,613,858 |
| Sector C | 1,188,943 | 27.29 | 6,280,652 | 6,060,478 | 6,089,834 |
| Sector D | 1,276,055 | 29.29 | 3,610,855 | 3,374,548 | 3,406,056 |
| Sector E | 1,139,570 | 26.16 | 5,872,932 | 5,661,901 | 5,690,038 |
| Sector F | 1,690,662 | 38.81 | 10,789,718 | 10,476,633 | 10,518,377 |
| Sector G | 1,355,001 | 31.11 | 14,492,779 | 14,241,853 | 14,275,310 |
| Sector H | 767,684 | 17.62 | 4,537,283 | 4,395,120 | 4,414,075 |
| Sector I | 935,531 | 21.48 | 3,418,192 | 3,244,945 | 3,268,045 |
| Sector J | 1,227,717 | 28.18 | 3,580,926 | 3,353,571 | 3,383,885 |
| Sector K | 738,542 | 16.95 | 6,473,319 | 6,336,552 | 6,354,788 |
| Total A-K | 12,060,576 | 276.87 | 63,469,470 | 61,292,030 | 61,589,822 |
| Total C&D | 2,930,931.26 | 67.28 | 2,072,752 | NA | NA |

[A] – Net Volume less 60-inches (36-inches for prescriptive final cover and 24-inches for protective cover). Sector A volume only less 36-inches for prescriptive final cover.

[B] – Net Volume less 52-inches (24-inches for alternative final cover and 28-inches for protective cover). Sector A volume only less 28-inches for alternative final cover.

[C] – Volumes include intermediate cover.

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# Appendix 3H
# SITE LIFE PROJECTIONS

## 3H.1 Solid Waste Generation

The McCombs Landfill accepts waste generated in El Paso County, Texas. The Clint Landfill also accepts waste generated in El Paso County. The estimated rate of disposal was calculated assuming an annual population increase of 2% in growth, and assuming a disposal rate of 497,309 tons per year (in 2014 tonnage) until Clint Landfill closes in 2030. 3,000 tons per year are assumed from 2011 through 2013. After Clint Landfill closes, McCombs Landfill will receive all of the waste that would have previously gone to Clint Landfill, therefore the disposal rate at McCombs will raise from 45% of the county waste allocation to 100%. The 1990 base population for central, northeastern and northwestern areas of El Paso (areas where solid waste is planned to go to the McCombs Landfill) was used for the growth rate estimation. The population for the above mentioned areas in 1990 was 322,842 people.

The disposal rate for C&D waste was calculated assuming a disposal rate of 60,000 tons per year (this is the approximate tonnage of C&D disposed of at Clint Landfill 2284 in FY 2010), also with an annual increase of 2% growth.

## 3H.2 Airspace utilization

An airspace utilization factor (AUF) of 0.60 tons per cubic yard (1200 pounds per cubic yard) of landfill airspace was utilized to calculate the site life projections for the volume available at the McCombs Landfill.

## 3H.3 Landfill Capacity

The total landfill capacity represents a total volume available for disposal of solid waste, daily cover material and intermediate cover material. AutoCAD Civil 3D 2011 computer software was utilized to estimate the total capacity. The total capacity is defined as the volume between the top of the geomembrane on the cell liner system and top of the final cover system. Sector A is currently being filled with waste so the existing capacity in that sector was evaluated between the existing contours in that sector and the top of the final cover system of that sector.

The total remaining landfill volume available for waste disposal in Sector A is approximately 640,890 cubic yards (including waste and daily, intermediate and final cover), which provides capacity through 2014 based on Table 3H-1. The total remaining landfill volume available for waste disposal, protective soil and daily, intermediate and final cover (including the remainder of Sector A) and all subsequent planned sectors (B through K) is ~~62,853,182~~ ***63,469,470*** CY. The total remaining volume for waste disposal including intermediate cover using the prescriptive final cover profile is ~~60,675,743~~ ***61,292,030*** CY. The total volume remaining for waste disposal including intermediate cover utilizing the alternative final cover profile is

~~60,973,535~~ ***61,589,822*** CY. The sector development plan can be seen in Appendix 3E - Site Layout Plans, Drawing P3-16 - Landfill Completion Plan.

## 3H.4 Site Life Calculations

Using the rate of 2% growth per year, an AUF of 1200 lb/cy for MSW and 1800 lb/cy for C&D, an increase in waste received after 2030, and the remaining capacity above, the remaining estimated life of the Landfill is until 2059 for both prescriptive and alternative final cover profiles. See Table 3H-1 and Table 3H-2 for MSW Prescriptive and Alternative Site Life Calculations and Table 3H-3 for C&D Site Life Calculations. See Table 3H-4 for Sector Volume Calculations.

Table 3H-1
Site Life Calculations for MSW (Prescriptive)

| | | |
|---|---|---|
| Growth Rate | 2% | |
| In Place Tons | 0 | |
| AUF (tons/cy lb/cy) | 0.6 | 1200 |
| Beginning Tons per Year (in 2014 tons) | | 497,309 |
| Remaining Sector A Capacity (Including Final Cover) | | 640,890 |
| Waste Allocation: | 45% McCombs | 55% Clint |

| Year | Tons/Year | CY/Year | Cumulative CY | Remaining CY | | |
|---|---|---|---|---|---|---|
| 2011 | 3,000 | 5,000 | 5,000 | ~~635,890~~ | | |
| 2012 | 3,000 | 5,000 | 10,000 | ~~630,890~~ | | |
| 2013 | 3,000 | 5,000 | 15,000 | ~~4,241,457~~ | *4,215,430* | Build Sector B |
| 2014 | 497,309 | 828,848 | 843,848 | ~~3,412,609~~ | *3,386,583* | Sector A Exhausted |
| 2015 | 507,255 | 845,424 | 1,689,272 | ~~2,567,185~~ | *2,541,158* | |
| 2016 | 517,400 | 862,333 | 2,551,605 | ~~1,704,852~~ | *1,678,826* | |
| 2017 | 527,748 | 879,580 | 3,431,184 | ~~825,272~~ | *799,246* | |
| 2018 | 538,303 | 897,171 | 4,328,356 | ~~6,001,366~~ | *5,962,552* | Build Sector C |
| 2019 | 549,069 | 915,115 | 5,243,470 | ~~5,086,251~~ | *5,047,438* | Sector B Exhausted |
| 2020 | 560,050 | 933,417 | 6,176,887 | ~~4,152,834~~ | *4,114,021* | |
| 2021 | 571,251 | 952,085 | 7,128,972 | ~~3,200,749~~ | *3,161,936* | |
| 2022 | 582,676 | 971,127 | 8,100,099 | ~~2,229,622~~ | *2,190,809* | |
| 2023 | 594,330 | 990,549 | 9,090,649 | ~~1,239,072~~ | *1,200,259* | |
| 2024 | 606,216 | 1,010,360 | 10,101,009 | ~~3,633,296~~ | *3,564,447* | Build Sector D |
| 2025 | 618,341 | 1,030,568 | 11,131,577 | ~~2,602,728~~ | *2,533,879* | Sector C Exhausted |
| 2026 | 630,707 | 1,051,179 | 12,182,756 | ~~1,551,549~~ | *1,482,700* | |
| 2027 | 643,322 | 1,072,203 | 13,254,959 | ~~479,347~~ | *410,497* | |
| 2028 | 656,188 | 1,093,647 | 14,348,605 | ~~5,220,316~~ | *4,978,751* | Build Sector E |
| 2029 | 669,312 | 1,115,520 | 15,464,125 | ~~4,104,797~~ | *3,863,232* | Sector D Exhausted |
| 2030 | 1,517,107 | 1,137,830 | 16,601,955 | ~~2,966,967~~ | *2,725,402* | |
| 2031 | 1,547,449 | 1,160,587 | 17,762,542 | ~~1,806,380~~ | *1,564,815* | |

| Year | Tons/Year | CY/Year | Cumulative CY | Remaining CY | | |
|---|---|---|---|---|---|---|
| 2032 | 1,578,398 | 1,183,798 | 18,946,340 | ~~622,582~~ | *381,017* | |
| 2033 | 1,609,966 | 1,207,474 | 20,153,814 | ~~10,062,852~~ | *9,650,175* | Build Sector F |
| 2034 | 1,642,165 | 1,231,624 | 21,385,438 | ~~8,831,228~~ | *8,418,551* | Sector E Exhausted |
| 2035 | 1,675,008 | 1,256,256 | 22,641,694 | ~~7,574,971~~ | *7,162,295* | |
| 2036 | 1,708,509 | 1,281,381 | 23,923,076 | ~~6,293,590~~ | *5,880,914* | |
| 2037 | 1,742,679 | 1,307,009 | 25,230,085 | ~~4,986,581~~ | *4,573,905* | |
| 2038 | 1,777,532 | 1,333,149 | 26,563,234 | ~~3,653,432~~ | *3,240,756* | |
| 2039 | 1,813,083 | 1,359,812 | 27,923,046 | ~~2,293,620~~ | *1,880,943* | |
| 2040 | 1,849,345 | 1,387,008 | 29,310,054 | ~~906,611~~ | *493,935* | |
| 2041 | 1,886,331 | 1,414,749 | 30,724,803 | ~~13,094,332~~ | *13,321,039* | Build Sector G |
| 2042 | 1,924,058 | 1,443,044 | 32,167,847 | ~~11,651,289~~ | *11,877,996* | Sector F Exhausted |
| 2043 | 1,962,539 | 1,471,904 | 33,639,751 | ~~10,179,384~~ | *10,406,091* | |
| 2044 | 2,001,790 | 1,501,343 | 35,141,094 | ~~8,678,042~~ | *8,904,749* | |
| 2045 | 2,041,826 | 1,531,369 | 36,672,463 | ~~7,146,672~~ | *7,373,379* | |
| 2046 | 2,082,662 | 1,561,997 | 38,234,460 | ~~5,584,676~~ | *5,811,383* | |
| 2047 | 2,124,316 | 1,593,237 | 39,827,696 | ~~3,991,439~~ | *4,218,146* | |
| 2048 | 2,166,802 | 1,625,101 | 41,452,798 | ~~2,366,337~~ | *2,593,045* | |
| 2049 | 2,210,138 | 1,657,603 | 43,110,401 | ~~5,028,241~~ | *5,330,561* | Build Sector H |
| 2050 | 2,254,341 | 1,690,756 | 44,801,157 | ~~3,337,486~~ | *3,639,805* | Sector G Exhausted |
| 2051 | 2,299,428 | 1,724,571 | 46,525,727 | ~~4,678,733~~ | *5,160,180* | Build Sector I |
| 2052 | 2,345,416 | 1,759,062 | 48,284,789 | ~~2,919,671~~ | *3,401,118* | Sector H Exhausted |
| 2053 | 2,392,324 | 1,794,243 | 50,079,033 | ~~4,509,071~~ | *4,960,446* | Build Sector J |
| 2054 | 2,440,171 | 1,830,128 | 51,909,161 | ~~2,678,943~~ | *3,130,318* | Sector I Exhausted |
| 2055 | 2,488,974 | 1,866,731 | 53,775,892 | ~~6,983,852~~ | *6,336,552* | Build Sector K |
| 2056 | 2,538,754 | 1,904,065 | 55,679,957 | ~~5,079,786~~ | *4,432,487* | Sector J Exhausted |
| 2057 | 2,589,529 | 1,942,147 | 57,622,104 | ~~3,137,640~~ | *2,490,340* | |
| 2058 | 2,641,319 | 1,980,990 | 59,603,093 | ~~1,156,650~~ | *509,351* | |
| 2059 | 2,694,146 | 2,020,609 | 61,623,703 | ~~(863,959)~~ | *(1,511,259)* | Sector K Exhausted |

## Table 3H-2
## Site Life Calculations for MSW (Alternative)

| | | |
|---|---|---|
| Growth Rate | 2% | |
| In Place Tons | 0 | |
| AUF (tons/cy lb/cy) | 0.6 | 1200 |
| Beginning Tons per Year (in 2014 tons) | | 497,309 |
| Remaining Sector A Capacity (Including Final Cover) | | 640,890 |
| Waste Allocation: | 45% McCombs | 55% Clint |

| Year | Tons/Year | CY/Year | Cumulative CY | Remaining CY | | |
|---|---|---|---|---|---|---|
| 2011 | 3,000 | 5,000 | 5,000 | ~~635,890~~ | | |
| 2012 | 3,000 | 5,000 | 10,000 | ~~630,890~~ | | |
| 2013 | 3,000 | 5,000 | 15,000 | ~~4,265,775~~ | *4,239,748* | Build Sector B |
| 2014 | 497,309 | 828,848 | 843,848 | ~~3,436,927~~ | *3,410,901* | Sector A Exhausted |
| 2015 | 507,255 | 845,424 | 1,689,272 | ~~2,591,503~~ | *2,565,476* | |
| 2016 | 517,400 | 862,333 | 2,551,605 | ~~1,729,170~~ | *1,703,143* | |
| 2017 | 527,748 | 879,580 | 3,431,184 | ~~849,590~~ | *823,564* | |
| 2018 | 538,303 | 897,171 | 4,328,356 | ~~6,055,040~~ | *6,016,227* | Build Sector C |
| 2019 | 549,069 | 915,115 | 5,243,470 | ~~5,139,925~~ | *5,101,112* | Sector B Exhausted |
| 2020 | 560,050 | 933,417 | 6,176,887 | ~~4,206,508~~ | *4,167,695* | |
| 2021 | 571,251 | 952,085 | 7,128,972 | ~~3,254,423~~ | *3,215,610* | |
| 2022 | 582,676 | 971,127 | 8,100,099 | ~~2,283,296~~ | *2,244,483* | |
| 2023 | 594,330 | 990,549 | 9,090,649 | ~~1,292,747~~ | *1,253,933* | |
| 2024 | 606,216 | 1,010,360 | 10,101,009 | ~~3,718,478~~ | *3,649,629* | Build Sector D |
| 2025 | 618,341 | 1,030,568 | 11,131,577 | ~~2,687,910~~ | *2,619,061* | Sector C Exhausted |
| 2026 | 630,707 | 1,051,179 | 12,182,756 | ~~1,636,731~~ | *1,567,882* | |
| 2027 | 643,322 | 1,072,203 | 13,254,959 | ~~564,528~~ | *495,679* | |
| 2028 | 656,188 | 1,093,647 | 14,348,605 | ~~5,333,636~~ | *5,092,071* | Build Sector E |
| 2029 | 669,312 | 1,115,520 | 15,464,125 | ~~4,218,116~~ | *3,976,551* | Sector D Exhausted |
| 2030 | 1,517,107 | 1,137,830 | 16,601,955 | ~~3,080,286~~ | *2,838,721* | |
| 2031 | 1,547,449 | 1,160,587 | 17,762,542 | ~~1,919,699~~ | *1,678,135* | |
| 2032 | 1,578,398 | 1,183,798 | 18,946,340 | ~~735,901~~ | *494,336* | |
| 2033 | 1,609,966 | 1,207,474 | 20,153,814 | ~~10,217,916~~ | *9,805,239* | Build Sector F |
| 2034 | 1,642,165 | 1,231,624 | 21,385,438 | ~~8,986,292~~ | *8,573,616* | Sector E Exhausted |
| 2035 | 1,675,008 | 1,256,256 | 22,641,694 | ~~7,730,036~~ | *7,317,359* | |
| 2036 | 1,708,509 | 1,281,381 | 23,923,076 | ~~6,448,654~~ | *6,035,978* | |
| 2037 | 1,742,679 | 1,307,009 | 25,230,085 | ~~5,141,645~~ | *4,728,969* | |
| 2038 | 1,777,532 | 1,333,149 | 26,563,234 | ~~3,808,496~~ | *3,395,820* | |
| 2039 | 1,813,083 | 1,359,812 | 27,923,046 | ~~2,448,684~~ | *2,036,008* | |
| 2040 | 1,849,345 | 1,387,008 | 29,310,054 | ~~1,061,675~~ | *648,999* | |

| Year | Tons/Year | CY/Year | Cumulative CY | Remaining CY | | |
|---|---|---|---|---|---|---|
| 2041 | 1,886,331 | 1,414,749 | 30,724,803 | ~~13,282,853~~ | *13,509,560* | Build Sector G |
| 2042 | 1,924,058 | 1,443,044 | 32,167,847 | ~~11,839,810~~ | *12,066,517* | Sector F Exhausted |
| 2043 | 1,962,539 | 1,471,904 | 33,639,751 | ~~10,367,905~~ | *10,594,612* | |
| 2044 | 2,001,790 | 1,501,343 | 35,141,094 | ~~8,866,563~~ | *9,093,270* | |
| 2045 | 2,041,826 | 1,531,369 | 36,672,463 | ~~7,335,193~~ | *7,561,900* | |
| 2046 | 2,082,662 | 1,561,997 | 38,234,460 | ~~5,773,197~~ | *5,999,904* | |
| 2047 | 2,124,316 | 1,593,237 | 39,827,696 | ~~4,179,960~~ | *4,406,667* | |
| 2048 | 2,166,802 | 1,625,101 | 41,452,798 | ~~2,554,858~~ | *2,781,566* | |
| 2049 | 2,210,138 | 1,657,603 | 43,110,401 | ~~897,255~~ | *1,123,962* | |
| 2050 | 2,254,341 | 1,690,756 | 44,801,157 | ~~3,544,962~~ | *3,847,281* | Build Sector H |
| 2051 | 2,299,428 | 1,724,571 | 46,525,727 | ~~1,820,391~~ | *2,122,711* | Sector G Exhausted |
| 2052 | 2,345,416 | 1,759,062 | 48,284,789 | ~~3,150,246~~ | *3,631,694* | Build Sector I |
| 2053 | 2,392,324 | 1,794,243 | 50,079,033 | ~~4,769,961~~ | *5,221,336* | Build Sector J/Sector H Exhausted |
| 2054 | 2,440,171 | 1,830,128 | 51,909,161 | ~~2,939,833~~ | *3,391,207* | Sector I Exhausted |
| 2055 | 2,488,974 | 1,866,731 | 53,775,892 | ~~7,262,977~~ | *7,879,265* | Build Sector K |
| 2056 | 2,538,754 | 1,904,065 | 55,679,957 | ~~5,358,912~~ | *5,975,199* | Sector J Exhausted |
| 2057 | 2,589,529 | 1,942,147 | 57,622,104 | ~~3,416,765~~ | *4,033,053* | |
| 2058 | 2,641,319 | 1,980,990 | 59,603,093 | ~~1,435,775~~ | *2,052,063* | |
| 2059 | 2,694,146 | 2,020,609 | 61,623,703 | ~~(584,834)~~ | *31,454* | ~~Sector K Exhausted~~ |
| *2060* | *2,748,029* | *2,061,022* | *63,684,724* | | *(2,029,568)* | *Sector K Exhausted* |

Table 3H-3
Site Life Calculations for C&D

| | | |
|---|---|---|
| Growth Rate | 2% | |
| In Place Tons | 0 | |
| AUF (tons/cy lb/cy) | 0.9 | 1800 |
| Beginning Tons per Year (in 2013 tons) | | 60,000 |
| C&D Capacity | | 2,072,752 |

| Year | Tons/Year | CY/Year | Cumulative CY | Remaining CY |
|---|---|---|---|---|
| 2012 | 0 | 0 | | 2,072,752 |
| 2013 | 60,000 | 68,000 | 68,000 | 2,004,752 |
| 2014 | 61,200 | 69,360 | 137,360 | 1,935,392 |
| 2015 | 62,424 | 70,747 | 208,107 | 1,864,645 |
| 2016 | 63,672 | 72,162 | 280,269 | 1,792,483 |
| 2017 | 64,946 | 73,605 | 353,875 | 1,718,877 |
| 2018 | 66,245 | 75,077 | 428,952 | 1,643,800 |
| 2019 | 67,570 | 76,579 | 505,531 | 1,567,221 |
| 2020 | 68,921 | 78,111 | 583,642 | 1,489,110 |
| 2021 | 70,300 | 79,673 | 663,315 | 1,409,437 |
| 2022 | 71,706 | 81,266 | 744,581 | 1,328,171 |
| 2023 | 73,140 | 82,892 | 827,473 | 1,245,279 |
| 2024 | 74,602 | 84,549 | 912,022 | 1,160,730 |
| 2025 | 76,095 | 86,240 | 998,263 | 1,074,489 |
| 2026 | 77,616 | 87,965 | 1,086,228 | 986,524 |
| 2027 | 79,169 | 89,725 | 1,175,952 | 896,800 |
| 2028 | 80,752 | 91,519 | 1,267,471 | 805,281 |
| 2029 | 82,367 | 93,349 | 1,360,821 | 711,931 |
| 2030 | 84,014 | 95,216 | 1,456,037 | 616,715 |
| 2031 | 85,695 | 97,121 | 1,553,158 | 519,594 |
| 2032 | 87,409 | 99,063 | 1,652,221 | 420,531 |
| 2033 | 89,157 | 101,044 | 1,753,266 | 319,486 |
| 2034 | 90,940 | 103,065 | 1,856,331 | 216,421 |
| 2035 | 92,759 | 105,127 | 1,961,457 | 111,294 |
| 2036 | 94,614 | 107,229 | 2,068,687 | 4,065 |
| 2037 | 96,506 | 109,374 | 2,178,060 | (105,308) |

## Table 3H-4
## Sector Volumes

| Sector | Area (SF) | Area (Acres) | Net Volume (Inclusive of Final Cover) (CY) | | Waste Volume (Prescriptive Cover) (CY)[A, C] | | Waste Volume (Alternative Cover) (CY)[B, C] | |
|---|---|---|---|---|---|---|---|---|
| Sector A | 756,005 | 17.36 | 640,890 | | 556,890 | | 575,556 | |
| Sector B | 984,867 | 22.61 | ~~3,797,950~~ | *3,771,923* | ~~3,615,567~~ | *3,589,540* | ~~3,639,885~~ | *3,613,858* |
| Sector C | 1,188,943 | 27.29 | ~~6,293,439~~ | *6,280,652* | ~~6,073,264~~ | *6,060,478* | ~~6,102,621~~ | *6,089,834* |
| Sector D | 1,276,055 | 29.29 | ~~3,640,890~~ | *3,610,855* | ~~3,404,584~~ | *3,374,548* | ~~3,436,091~~ | *3,406,056* |
| Sector E | 1,139,570 | 26.16 | ~~6,045,648~~ | *5,872,932* | ~~5,834,616~~ | *5,661,901* | ~~5,862,754~~ | *5,690,038* |
| Sector F | 1,690,662 | 38.81 | ~~10,960,830~~ | *10,789,718* | ~~10,647,744~~ | *10,476,633* | ~~10,689,489~~ | *10,518,377* |
| Sector G | 1,355,001 | 31.11 | ~~13,853,396~~ | *14,492,779* | ~~13,602,470~~ | *14,241,853* | ~~13,635,926~~ | *14,275,310* |
| Sector H | 767,684 | 17.62 | ~~4,461,671~~ | *4,537,283* | ~~4,319,507~~ | *4,395,120* | ~~4,338,463~~ | *4,414,075* |
| Sector I | 935,531 | 21.48 | ~~3,239,064~~ | *3,418,192* | ~~3,065,818~~ | *3,244,945* | ~~3,088,917~~ | *3,268,045* |
| Sector J | 1,227,717 | 28.18 | ~~3,610,999~~ | *3,580,926* | ~~3,383,644~~ | *3,353,571* | ~~3,413,958~~ | *3,383,885* |
| Sector K | 738,542 | 16.95 | ~~6,308,406~~ | *6,473,319* | ~~6,171,639~~ | *6,336,552* | ~~6,189,875~~ | *6,354,788* |
| Total A-K | 12,060,576 | 276.87 | ~~62,853,182~~ | *63,469,470* | ~~60,675,743~~ | *61,292,030* | ~~60,973,535~~ | *61,589,822* |
| Total C&D | 2,930,931.26 | 67.28 | 2,072,752 | | NA | | NA | |

[A] – Net Volume less 60-inches (36-inches for prescriptive final cover and 24-inches for protective cover). Sector A volume only less 36-inches for prescriptive final cover.

[B] – Net Volume less 52-inches (24-inches for alternative final cover and 28-inches for protective cover). Sector A volume only less 28-inches for alternative final cover.

[C] – Volumes include intermediate cover.

# Appendix 3H
# SITE LIFE PROJECTIONS

## 3H.1 Solid Waste Generation

The McCombs Landfill accepts waste generated in El Paso County, Texas. The Clint Landfill also accepts waste generated in El Paso County. The estimated rate of disposal was calculated assuming an annual population increase of 2% in growth, and assuming a disposal rate of 497,309 tons per year (in 2014 tonnage) until Clint Landfill closes in 2030. 3,000 tons per year are assumed from 2011 through 2013. After Clint Landfill closes, McCombs Landfill will receive all of the waste that would have previously gone to Clint Landfill, therefore the disposal rate at McCombs will raise from 45% of the county waste allocation to 100%. The 1990 base population for central, northeastern and northwestern areas of El Paso (areas where solid waste is planned to go to the McCombs Landfill) was used for the growth rate estimation. The population for the above mentioned areas in 1990 was 322,842 people.

The disposal rate for C&D waste was calculated assuming a disposal rate of 60,000 tons per year (this is the approximate tonnage of C&D disposed of at Clint Landfill 2284 in FY 2010), also with an annual increase of 2% growth.

## 3H.2 Air Apace utilization

An airspace utilization factor (AUF) of 0.60 tons per cubic yard (1200 pounds per cubic yard) of landfill airspace was utilized to calculate the site life projections for the volume available at the McCombs Landfill.

## 3H.3 Landfill Capacity

The total landfill capacity represents a total volume available for disposal of solid waste, daily cover material and intermediate cover material. AutoCAD Civil 3D 2011 computer software was utilized to estimate the total capacity. The total capacity is defined as the volume between the top of the geomembrane on the cell liner system and top of the final cover system. Sector A is currently being filled with waste so the existing capacity in that sector was evaluated between the existing contours in that sector and the top of the final cover system of that sector.

The total remaining landfill volume available for waste disposal in Sector A is approximately 640,890 cubic yards (including ~~both~~ waste and daily, intermediate and final cover), which provides capacity through 2014 based on Table 3H-1. The total remaining landfill volume available for waste disposal, protective soil and daily, intermediate and final cover (including the remainder of Sector A) and all subsequent planned sectors (B through K) is ~~62,532,764~~***62,853,182*** CY. The total remaining volume for waste disposal including intermediate cover using the prescriptive final cover profile is ~~60,355,32~~***60,675,743*** CY. The total volume remaining for waste disposal including intermediate cover utilizing the alternative final cover profile is

~~60,653,116~~***60,973,535*** CY. The sector development plan can be seen in Appendix 3E - Site Layout Plans, Drawing P3-16 - Landfill Completion Plan.

## 3H.4 Site Life Calculations

Using the rate of 2% growth per year, an AUF of 1200 lb/cy for MSW and 1800 lb/cy for C&D, an increase in waste received after 2030, and the remaining capacity above, the remaining estimated life of the Landfill is until 2059 for both prescriptive and alternative final cover profiles. See Table 3H-1 and Table 3H-2 for MSW Prescriptive and Alternative Site Life Calculations and Table 3H-3 for C&D Site Life Calculations. See Table 3H-4 for Sector Volume Calculations.

Table 3H-1
Site Life Calculations for MSW (Prescriptive)

| | | |
|---|---|---|
| Growth Rate | 2% | |
| In Place Tons | 0 | |
| AUF (tons/cy lb/cy) | 0.6 | 1200 |
| Beginning Tons per Year (in 2014 tons) | | 497,309 |
| Remaining Sector A Capacity *(Including Final Cover)* | | 640,890 |
| Waste Allocation: | 45% McCombs | 55% Clint |

| Year | Tons/Year | CY/Year | Cumulative CY | Remaining CY | |
|---|---|---|---|---|---|
| 2011 | 3,000 | 5,000 | 5,000 | 635,890 | |
| 2012 | 3,000 | 5,000 | 10,000 | 630,890 | |
| 2013 | 3,000 | 5,000 | 15,000 | 4,241,457 | Build Sector B |
| 2014 | 497,309 | 828,848 | 843,848 | 3,412,609 | Sector A Exhausted |
| 2015 | 507,255 | 845,424 | 1,689,272 | 2,567,185 | |
| 2016 | 517,400 | 862,333 | 2,551,605 | 1,704,852 | |
| 2017 | 527,748 | 879,580 | 3,431,184 | 825,272 | |
| 2018 | 538,303 | 897,171 | 4,328,356 | 6,001,366 | Build Sector C |
| 2019 | 549,069 | 915,115 | 5,243,470 | 5,086,251 | Sector B Exhausted |
| 2020 | 560,050 | 933,417 | 6,176,887 | 4,152,834 | |
| 2021 | 571,251 | 952,085 | 7,128,972 | 3,200,749 | |
| 2022 | 582,676 | 971,127 | 8,100,099 | 2,229,622 | |
| 2023 | 594,330 | 990,549 | 9,090,649 | 1,239,072 | |
| 2024 | 606,216 | 1,010,360 | 10,101,009 | 3,633,296 | Build Sector D |
| 2025 | 618,341 | 1,030,568 | 11,131,577 | 2,602,728 | Sector C Exhausted |
| 2026 | 630,707 | 1,051,179 | 12,182,756 | 1,551,549 | |
| 2027 | 643,322 | 1,072,203 | 13,254,959 | 479,347 | |
| 2028 | 656,188 | 1,093,647 | 14,348,605 | 5,220,316 | Build Sector E |
| 2029 | 669,312 | 1,115,520 | 15,464,125 | 4,104,797 | Sector D Exhausted |
| 2030 | 1,517,107 | 1,137,830 | 16,601,955 | 2,966,967 | |

| Year | Tons/Year | CY/Year | Cumulative CY | Remaining CY | |
|---|---|---|---|---|---|
| 2031 | 1,547,449 | 1,160,587 | 17,762,542 | 1,806,380 | |
| 2032 | 1,578,398 | 1,183,798 | 18,946,340 | 622,582 | |
| 2033 | 1,609,966 | 1,207,474 | 20,153,814 | 10,062,852 | Build Sector F |
| 2034 | 1,642,165 | 1,231,624 | 21,385,438 | 8,831,228 | Sector E Exhausted |
| 2035 | 1,675,008 | 1,256,256 | 22,641,694 | 7,574,971 | |
| 2036 | 1,708,509 | 1,281,381 | 23,923,076 | 6,293,590 | |
| 2037 | 1,742,679 | 1,307,009 | 25,230,085 | 4,986,581 | |
| 2038 | 1,777,532 | 1,333,149 | 26,563,234 | 3,653,432 | |
| 2039 | 1,813,083 | 1,359,812 | 27,923,046 | 2,293,620 | |
| 2040 | 1,849,345 | 1,387,008 | 29,310,054 | 906,611 | |
| 2041 | 1,886,331 | 1,414,749 | 30,724,803 | 13,094,332 | Build Sector G |
| 2042 | 1,924,058 | 1,443,044 | 32,167,847 | 11,651,289 | Sector F Exhausted |
| 2043 | 1,962,539 | 1,471,904 | 33,639,751 | 10,179,384 | |
| 2044 | 2,001,790 | 1,501,343 | 35,141,094 | 8,678,042 | |
| 2045 | 2,041,826 | 1,531,369 | 36,672,463 | 7,146,672 | |
| 2046 | 2,082,662 | 1,561,997 | 38,234,460 | 5,584,676 | |
| 2047 | 2,124,316 | 1,593,237 | 39,827,696 | 3,991,439 | |
| 2048 | 2,166,802 | 1,625,101 | 41,452,798 | 2,366,337 | |
| 2049 | 2,210,138 | 1,657,603 | 43,110,401 | ~~708,734~~*5,028,241* | *Build Sector H* |
| 2050 | 2,254,341 | 1,690,756 | 44,801,157 | ~~3,380,103~~*3,337,486* | ~~Build Sector H~~*Sector G Exhausted* |
| 2051 | 2,299,428 | 1,724,571 | 46,525,727 | ~~1,655,532~~*4,678,733* | ~~Sector G Exhausted~~*Build Sector I* |
| 2052 | 2,345,416 | 1,759,062 | 48,284,789 | ~~3,728,850~~*2,919,671* | ~~Build Sector I~~*Sector H Exhausted* |
| 2053 | 2,392,324 | 1,794,243 | 50,079,033 | ~~1,934,606~~*4,509,071* | *Build Sector J* |
| 2054 | 2,440,171 | 1,830,128 | 51,909,161 | ~~4,689,835~~*2,678,943* | Sector ~~H~~*I* Exhausted~~/ Build Sector J~~ |
| 2055 | 2,488,974 | 1,866,731 | 53,775,892 | ~~2,823,104~~*6,983,852* | ~~Sector I Exhausted~~*Build Sector K* |
| 2056 | 2,538,754 | 1,904,065 | 55,679,957 | ~~919,039~~*5,079,786* | *Sector J Exhausted* |
| 2057 | 2,589,529 | 1,942,147 | 57,622,104 | ~~2,817,221~~*3,137,640* | ~~Build Sector K~~ |
| 2058 | 2,641,319 | 1,980,990 | 59,603,093 | ~~836,232~~*1,156,650* | ~~Sector J Exhausted~~ |
| 2059 | 2,694,146 | 2,020,609 | 61,623,703 | (~~1,184,378~~*863,959*) | Sector K Exhausted |

## Table 3H-2
## Site Life Calculations for MSW (Alternative)

| | | |
|---|---|---|
| Growth Rate | 2% | |
| In Place Tons | 0 | |
| AUF (tons/cy lb/cy) | 0.6 | 1200 |
| Beginning Tons per Year (in 2014 tons) | | 497,309 |
| Remaining Sector A Capacity (Including Final Cover) | | 640,890 |
| Waste Allocation: | 45% McCombs | 55% Clint |

| *Year* | *Tons/Year* | *CY/Year* | *Cumulative CY* | *Remaining CY* | |
|---|---|---|---|---|---|
| 2011 | 3,000 | 5,000 | 5,000 | 635,890 | |
| 2012 | 3,000 | 5,000 | 10,000 | 630,890 | |
| 2013 | 3,000 | 5,000 | 15,000 | 4,265,775 | Build Sector B |
| 2014 | 497,309 | 828,848 | 843,848 | 3,436,927 | Sector A Exhausted |
| 2015 | 507,255 | 845,424 | 1,689,272 | 2,591,503 | |
| 2016 | 517,400 | 862,333 | 2,551,605 | 1,729,170 | |
| 2017 | 527,748 | 879,580 | 3,431,184 | 849,590 | |
| 2018 | 538,303 | 897,171 | 4,328,356 | 6,055,040 | Build Sector C |
| 2019 | 549,069 | 915,115 | 5,243,470 | 5,139,925 | Sector B Exhausted |
| 2020 | 560,050 | 933,417 | 6,176,887 | 4,206,508 | |
| 2021 | 571,251 | 952,085 | 7,128,972 | 3,254,423 | |
| 2022 | 582,676 | 971,127 | 8,100,099 | 2,283,296 | |
| 2023 | 594,330 | 990,549 | 9,090,649 | 1,292,747 | |
| 2024 | 606,216 | 1,010,360 | 10,101,009 | 3,718,478 | Build Sector D |
| 2025 | 618,341 | 1,030,568 | 11,131,577 | 2,687,910 | Sector C Exhausted |
| 2026 | 630,707 | 1,051,179 | 12,182,756 | 1,636,731 | |
| 2027 | 643,322 | 1,072,203 | 13,254,959 | 564,528 | |
| 2028 | 656,188 | 1,093,647 | 14,348,605 | 5,333,636 | Build Sector E |
| 2029 | 669,312 | 1,115,520 | 15,464,125 | 4,218,116 | Sector D Exhausted |
| 2030 | 1,517,107 | 1,137,830 | 16,601,955 | 3,080,286 | |
| 2031 | 1,547,449 | 1,160,587 | 17,762,542 | 1,919,699 | |
| 2032 | 1,578,398 | 1,183,798 | 18,946,340 | 735,901 | |
| 2033 | 1,609,966 | 1,207,474 | 20,153,814 | 10,217,916 | Build Sector F |
| 2034 | 1,642,165 | 1,231,624 | 21,385,438 | 8,986,292 | Sector E Exhausted |
| 2035 | 1,675,008 | 1,256,256 | 22,641,694 | 7,730,036 | |
| 2036 | 1,708,509 | 1,281,381 | 23,923,076 | 6,448,654 | |
| 2037 | 1,742,679 | 1,307,009 | 25,230,085 | 5,141,645 | |
| 2038 | 1,777,532 | 1,333,149 | 26,563,234 | 3,808,496 | |
| 2039 | 1,813,083 | 1,359,812 | 27,923,046 | 2,448,684 | |
| 2040 | 1,849,345 | 1,387,008 | 29,310,054 | 1,061,675 | |

| Year | Tons/Year | CY/Year | Cumulative CY | Remaining CY | |
|---|---|---|---|---|---|
| 2041 | 1,886,331 | 1,414,749 | 30,724,803 | 13,282,853 | Build Sector G |
| 2042 | 1,924,058 | 1,443,044 | 32,167,847 | 11,839,810 | Sector F Exhausted |
| 2043 | 1,962,539 | 1,471,904 | 33,639,751 | 10,367,905 | |
| 2044 | 2,001,790 | 1,501,343 | 35,141,094 | 8,866,563 | |
| 2045 | 2,041,826 | 1,531,369 | 36,672,463 | 7,335,193 | |
| 2046 | 2,082,662 | 1,561,997 | 38,234,460 | 5,773,197 | |
| 2047 | 2,124,316 | 1,593,237 | 39,827,696 | 4,179,960 | |
| 2048 | 2,166,802 | 1,625,101 | 41,452,798 | 2,554,858 | |
| 2049 | 2,210,138 | 1,657,603 | 43,110,401 | 897,255 | |
| 2050 | 2,254,341 | 1,690,756 | 44,801,157 | ~~3,587,579~~3,544,962 | Build Sector H |
| 2051 | 2,299,428 | 1,724,571 | 46,525,727 | ~~1,863,008~~1,820,391 | Sector G Exhausted |
| 2052 | 2,345,416 | 1,759,062 | 48,284,789 | ~~103,946~~3,150,246 | *Build Sector I* |
| 2053 | 2,392,324 | 1,794,243 | 50,079,033 | ~~2,165,182~~4,769,961 | Build Sector ~~I~~J/ *Sector H Exhausted* |
| 2054 | 2,440,171 | 1,830,128 | 51,909,161 | ~~4,950,724~~2,939,833 | Sector ~~H~~I Exhausted~~/ Build Sector J~~ |
| 2055 | 2,488,974 | 1,866,731 | 53,775,892 | ~~3,083,994~~7,262,977 | ~~Sector I Exhausted~~*Build Sector K* |
| 2056 | 2,538,754 | 1,904,065 | 55,679,957 | ~~1,179,928~~5,358,912 | *Sector J Exhausted* |
| 2057 | 2,589,529 | 1,942,147 | 57,622,104 | ~~3,096,346~~3,416,765 | ~~Build Sector K~~ |
| 2058 | 2,641,319 | 1,980,990 | 59,603,093 | ~~1,115,357~~1,435,775 | ~~Sector J Exhausted~~ |
| 2059 | 2,694,146 | 2,020,609 | 61,623,703 | (~~905,253~~584,834) | Sector K Exhausted |

## Table 3H-3
## Site Life Calculations for C&D

| | | |
|---|---|---|
| Growth Rate | 2% | |
| In Place Tons | 0 | |
| AUF (tons/cy lb/cy) | 0.9 | 1800 |
| Beginning Tons per Year (in 2013 tons) | | 60,000 |
| C&D Capacity | | ~~2,581,306~~*2,072,752* |

| Year | Tons/Year | CY/Year | Cumulative CY | Remaining CY |
|---|---|---|---|---|
| 2012 | - | - | | ~~2,581,306~~*2,072,752* |
| 2013 | 60,000 | 68,000 | 68,000 | ~~2,513,306~~*2,004,752* |
| 2014 | 61,200 | 69,360 | 137,360 | ~~2,443,946~~*1,935,392* |
| 2015 | 62,424 | 70,747 | 208,107 | ~~2,373,199~~*1,864,645* |
| 2016 | 63,672 | 72,162 | 280,269 | ~~2,301,037~~*1,792,483* |
| 2017 | 64,946 | 73,605 | 353,875 | ~~2,227,431~~*1,718,877* |
| 2018 | 66,245 | 75,077 | 428,952 | ~~2,152,354~~*1,643,800* |
| 2019 | 67,570 | 76,579 | 505,531 | ~~2,075,775~~*1,567,221* |
| 2020 | 68,921 | 78,111 | 583,642 | ~~1,997,664~~*1,489,110* |
| 2021 | 70,300 | 79,673 | 663,315 | ~~1,917,991~~*1,409,437* |
| 2022 | 71,706 | 81,266 | 744,581 | ~~1,836,725~~*1,328,171* |
| 2023 | 73,140 | 82,892 | 827,473 | ~~1,753,834~~*1,245,279* |
| 2024 | 74,602 | 84,549 | 912,022 | ~~1,669,284~~*1,160,730* |
| 2025 | 76,095 | 86,240 | 998,263 | ~~1,583,044~~*1,074,489* |
| 2026 | 77,616 | 87,965 | 1,086,228 | ~~1,495,078~~*986,524* |
| 2027 | 79,169 | 89,725 | 1,175,952 | ~~1,405,354~~*896,800* |
| 2028 | 80,752 | 91,519 | 1,267,471 | ~~1,313,835~~*805,281* |
| 2029 | 82,367 | 93,349 | 1,360,821 | ~~1,220,485~~*711,931* |
| 2030 | 84,014 | 95,216 | 1,456,037 | ~~1,125,269~~*616,715* |
| 2031 | 85,695 | 97,121 | 1,553,158 | ~~1,028,148~~*519,594* |
| 2032 | 87,409 | 99,063 | 1,652,221 | ~~929,085~~*420,531* |
| 2033 | 89,157 | 101,044 | 1,753,266 | ~~828,041~~*319,486* |
| 2034 | 90,940 | 103,065 | 1,856,331 | ~~724,975~~*216,421* |
| 2035 | 92,759 | 105,127 | 1,961,457 | ~~619,849~~*111,294* |
| 2036 | 94,614 | 107,229 | 2,068,687 | ~~512,620~~*4,065* |
| 2037 | 96,506 | 109,374 | 2,178,060 | ~~403,246~~*(105,308)* |
| ~~2038~~ | ~~98,436~~ | ~~111,561~~ | ~~2,289,622~~ | ~~291,685~~ |
| ~~2039~~ | ~~100,405~~ | ~~113,792~~ | ~~2,403,414~~ | ~~177,892~~ |
| ~~2040~~ | ~~102,413~~ | ~~116,068~~ | ~~2,519,482~~ | ~~61,824~~ |
| ~~2041~~ | ~~104,461~~ | ~~118,390~~ | ~~2,637,872~~ | ~~(56,566)~~ |

Table 3H-4
Sector Volumes

| Sector | Area (SF) | Area (Acres) | Net Volume (Inclusive of Final Cover) (CY) | Waste Volume (Prescriptive Cover) (CY)[A,C] | Waste Volume (Alternative Cover) (CY)[B,C] |
|---|---|---|---|---|---|
| Sector A | 756,005 | 17.36 | 640,890 | 556,890 | 575,556 |
| Sector B | 984,867 | 22.61 | 3,797,950 | 3,615,567 | 3,639,885 |
| Sector C | 1,188,943 | 27.29 | 6,293,439 | 6,073,264 | 6,102,621 |
| Sector D | 1,276,055 | 29.29 | 3,640,890 | 3,404,584 | 3,436,091 |
| Sector E | 1,139,570 | 26.16 | 6,045,648 | 5,834,616 | 5,862,754 |
| Sector F | 1,690,662 | 38.81 | 10,960,830 | 10,647,744 | 10,689,489 |
| Sector G | 1,355,001 | 31.11 | 13,853,396 | 13,602,470 | 13,635,926 |
| Sector H | 767,684 | 17.62 | ~~4,504,288~~*4,461,671* | ~~4,362,124~~*4,319,507* | ~~4,381,080~~*4,338,463* |
| Sector I | 935,531 | 21.48 | ~~4,005,626~~*3,239,064* | ~~3,832,380~~*3,065,818* | ~~3,855,479~~*3,088,917* |
| Sector J | 1,227,717 | 28.18 | ~~4,812,711~~*3,610,999* | ~~4,585,356~~*3,383,644* | ~~4,615,670~~*3,413,958* |
| Sector K | 738,542 | 16.95 | ~~3,977,096~~*6,308,406* | ~~3,840,329~~*6,171,639* | ~~3,858,565~~*6,189,875* |
| Total A-K | 12,060,576 | 276.87 | ~~62,532,764~~*62,853,182* | ~~60,355,324~~*60,675,743* | ~~60,653,116~~*60,973,535* |
| Total C&D | 2,930,931.26 | 67.28 | ~~2,581,306~~*2,072,752* | NA | NA |

[A] – Net Volume less 60-inches (36-inches for prescriptive final cover and 24-inches for protective cover). Sector A volume only less 36-inches for prescriptive final cover.

[B] – Net Volume less 52-inches (24-inches for alternative final cover and 28-inches for protective cover). Sector A volume only less 28-inches for alternative final cover.

[C] – *Volumes include intermediate cover.*

# Appendix 3H
# SITE LIFE PROJECTIONS

## 3H.1 Solid Waste Generation

The McCombs Landfill accepts waste generated in El Paso County, Texas. The Clint Landfill also accepts waste generated in El Paso County. The estimated rate of disposal was calculated assuming an annual population increase of 2% in growth, and assuming a disposal rate of 497,309 tons per year (in 2014 tonnage) until Clint Landfill closes in 2030. 3,000 tons per year are assumed from 2011 through 2013. After Clint Landfill closes, McCombs Landfill will receive all of the waste that would have previously gone to Clint Landfill, therefore the disposal rate at McCombs will raise from 45% of the county waste allocation to 100%. The 1990 base population for central, northeastern and northwestern areas of El Paso (areas where solid waste is planned to go to the McCombs Landfill) was used for the growth rate estimation. The population for the above mentioned areas in 1990 was 322,842 people.

The disposal rate for C&D waste was calculated assuming a disposal rate of 60,000 tons per year (this is the approximate tonnage of C&D disposed of at Clint Landfill 2284 in FY 2010), also with an annual increase of 2% growth.

## 3H.2 Air Apace utilization

An airspace utilization factor (AUF) of 0.60 tons per cubic yard (1200 pounds per cubic yard) of landfill airspace was utilized to calculate the site life projections for the volume available at the McCombs Landfill.

## 3H.3 Landfill Capacity

The total landfill capacity represents a total volume available for disposal of solid waste, daily cover material and intermediate cover material. AutoCAD Civil 3D 2011 computer software was utilized to estimate the total capacity. The total capacity is defined as the volume between the top of the ***geomembrane*** ~~protective soil layer~~ on the cell liner system and ***top*** ~~bottom~~ of the final cover system. Sector A is currently being filled with waste so the existing capacity in that sector was evaluated between the existing contours in that sector and the ***top*** ~~bottom~~ of the final cover system of that sector.

The total remaining landfill volume available for waste disposal in Sector A is approximately 640,890 cubic yards (including ~~both~~ waste and daily***, intermediate and final*** cover), which provides capacity through 2014 based on Table 3H-1. The total remaining landfill volume available for waste disposal***, protective soil and daily, intermediate and final cover (***including the remainder of Sector A***)*** and all subsequent planned sectors (B through K) is 62,532,764 CY. ***The total remaining volume for waste disposal using the prescriptive final cover profile is 60,355,324 CY. The total volume remaining for waste disposal utilizing the alternative final cover profile is***

***60,653,116 CY.*** The sector development plan can be seen in Appendix 3E - Site Layout Plans, Drawing P3-16 - Landfill Completion Plan.

## 3H.4 Site Life Calculations

Using the rate of 2% growth per year, an AUF of 1200 lb/cy ***for MSW and 1800 lb/cy for C&D***, an increase in waste received after 2030, and the remaining capacity above, the remaining estimated life of the Landfill is ***until 2059 for both prescriptive and alternative final cover profiles*** ~~49 years~~. See Table 3H-1 and Table 3H-2 for MSW ***Prescriptive and Alternative*** ~~and C&D~~ Site Life Calculations ***and Table 3H-3 for C&D Site Life Calculations***. See Table 3H-~~3~~***4*** for Sector Volume Calculations.

Table 3H-1
Site Life Calculations for MSW *(Prescriptive)*

| | | |
|---|---|---|
| Growth Rate | 2% | |
| In Place Tons | 0 | |
| AUF (tons/cy lb/cy) | 0.6 | 1200 |
| Beginning Tons per Year (in 2014 tons) | | 497,309 |
| Remaining Sector A Capacity *(Including Final Cover)* | | 640,890 |
| Waste Allocation: | 45% McCombs | 55% Clint |

| Year | Tons/Year | CY/Year | Cumulative CY | Remaining CY | |
|---|---|---|---|---|---|
| 2011 | *3,000* | *5,000* | *5,000* | *635,890* | |
| 2012 | *3,000* | *5,000* | *10,000* | *630,890* | |
| 2013 | *3,000* | *5,000* | *15,000* | *4,241,457* | *Build Sector B* |
| 2014 | *497,309* | *828,848* | *843,848* | *3,412,609* | *Sector A Exhausted* |
| 2015 | *507,255* | *845,424* | *1,689,272* | *2,567,185* | |
| 2016 | *517,400* | *862,333* | *2,551,605* | *1,704,852* | |
| 2017 | *527,748* | *879,580* | *3,431,184* | *825,272* | |
| 2018 | *538,303* | *897,171* | *4,328,356* | *6,001,366* | *Build Sector C* |
| 2019 | *549,069* | *915,115* | *5,243,470* | *5,086,251* | *Sector B Exhausted* |
| 2020 | *560,050* | *933,417* | *6,176,887* | *4,152,834* | |
| 2021 | *571,251* | *952,085* | *7,128,972* | *3,200,749* | |
| 2022 | *582,676* | *971,127* | *8,100,099* | *2,229,622* | |
| 2023 | *594,330* | *990,549* | *9,090,649* | *1,239,072* | |
| 2024 | *606,216* | *1,010,360* | *10,101,009* | *3,633,296* | *Build Sector D* |
| 2025 | *618,341* | *1,030,568* | *11,131,577* | *2,602,728* | *Sector C Exhausted* |
| 2026 | *630,707* | *1,051,179* | *12,182,756* | *1,551,549* | |
| 2027 | *643,322* | *1,072,203* | *13,254,959* | *479,347* | |
| 2028 | *656,188* | *1,093,647* | *14,348,605* | *5,220,316* | *Build Sector E* |
| 2029 | *669,312* | *1,115,520* | *15,464,125* | *4,104,797* | *Sector D Exhausted* |
| 2030 | *1,517,107* | *1,137,830* | *16,601,955* | *2,966,967* | |

| Year | Tons/Year | CY/Year | Cumulative CY | Remaining CY | |
|---|---|---|---|---|---|
| 2031 | *1,547,449* | *1,160,587* | *17,762,542* | *1,806,380* | |
| 2032 | *1,578,398* | *1,183,798* | *18,946,340* | *622,582* | |
| 2033 | *1,609,966* | *1,207,474* | *20,153,814* | *10,062,852* | *Build Sector F* |
| 2034 | *1,642,165* | *1,231,624* | *21,385,438* | *8,831,228* | *Sector E Exhausted* |
| 2035 | *1,675,008* | *1,256,256* | *22,641,694* | *7,574,971* | |
| 2036 | *1,708,509* | *1,281,381* | *23,923,076* | *6,293,590* | |
| 2037 | *1,742,679* | *1,307,009* | *25,230,085* | *4,986,581* | |
| 2038 | *1,777,532* | *1,333,149* | *26,563,234* | *3,653,432* | |
| 2039 | *1,813,083* | *1,359,812* | *27,923,046* | *2,293,620* | |
| 2040 | *1,849,345* | *1,387,008* | *29,310,054* | *906,611* | |
| 2041 | *1,886,331* | *1,414,749* | *30,724,803* | *13,094,332* | *Build Sector G* |
| 2042 | *1,924,058* | *1,443,044* | *32,167,847* | *11,651,289* | *Sector F Exhausted* |
| 2043 | *1,962,539* | *1,471,904* | *33,639,751* | *10,179,384* | |
| 2044 | *2,001,790* | *1,501,343* | *35,141,094* | *8,678,042* | |
| 2045 | *2,041,826* | *1,531,369* | *36,672,463* | *7,146,672* | |
| 2046 | *2,082,662* | *1,561,997* | *38,234,460* | *5,584,676* | |
| 2047 | *2,124,316* | *1,593,237* | *39,827,696* | *3,991,439* | |
| 2048 | *2,166,802* | *1,625,101* | *41,452,798* | *2,366,337* | |
| 2049 | *2,210,138* | *1,657,603* | *43,110,401* | *708,734* | |
| 2050 | *2,254,341* | *1,690,756* | *44,801,157* | *3,380,103* | *Build Sector H* |
| 2051 | *2,299,428* | *1,724,571* | *46,525,727* | *1,655,532* | *Sector G Exhausted* |
| 2052 | *2,345,416* | *1,759,062* | *48,284,789* | *3,728,850* | *Build Sector I* |
| 2053 | *2,392,324* | *1,794,243* | *50,079,033* | *1,934,606* | |
| 2054 | *2,440,171* | *1,830,128* | *51,909,161* | *4,689,835* | *Sector H Exhausted/ Build Sector J* |
| 2055 | *2,488,974* | *1,866,731* | *53,775,892* | *2,823,104* | *Sector I Exhausted* |
| 2056 | *2,538,754* | *1,904,065* | *55,679,957* | *919,039* | |
| 2057 | *2,589,529* | *1,942,147* | *57,622,104* | *2,817,221* | *Build Sector K* |
| 2058 | *2,641,319* | *1,980,990* | *59,603,093* | *836,232* | *Sector J Exhausted* |
| 2059 | *2,694,146* | *2,020,609* | *61,623,703* | *(1,184,378)* | *Sector K Exhausted* |

*Table 3H-2*
*Site Life Calculations for MSW (Alternative)*

| | | |
|---|---|---|
| *Growth Rate* | *2%* | |
| *In Place Tons* | *0* | |
| *AUF (tons/cy lb/cy)* | *0.6* | *1200* |
| *Beginning Tons per Year (in 2014 tons)* | | *497,309* |
| *Remaining Sector A Capacity (Including Final Cover)* | | *640,890* |
| *Waste Allocation:* | *45% McCombs* | *55% Clint* |

| *Year* | *Tons/Year* | *CY/Year* | *Cumulative CY* | *Remaining CY* | |
|---|---|---|---|---|---|
| *2011* | *3,000* | *5,000* | *5,000* | *635,890* | |
| *2012* | *3,000* | *5,000* | *10,000* | *630,890* | |
| *2013* | *3,000* | *5,000* | *15,000* | *4,265,775* | *Build Sector B* |
| *2014* | *497,309* | *828,848* | *843,848* | *3,436,927* | *Sector A Exhausted* |
| *2015* | *507,255* | *845,424* | *1,689,272* | *2,591,503* | |
| *2016* | *517,400* | *862,333* | *2,551,605* | *1,729,170* | |
| *2017* | *527,748* | *879,580* | *3,431,184* | *849,590* | |
| *2018* | *538,303* | *897,171* | *4,328,356* | *6,055,040* | *Build Sector C* |
| *2019* | *549,069* | *915,115* | *5,243,470* | *5,139,925* | *Sector B Exhausted* |
| *2020* | *560,050* | *933,417* | *6,176,887* | *4,206,508* | |
| *2021* | *571,251* | *952,085* | *7,128,972* | *3,254,423* | |
| *2022* | *582,676* | *971,127* | *8,100,099* | *2,283,296* | |
| *2023* | *594,330* | *990,549* | *9,090,649* | *1,292,747* | |
| *2024* | *606,216* | *1,010,360* | *10,101,009* | *3,718,478* | *Build Sector D* |
| *2025* | *618,341* | *1,030,568* | *11,131,577* | *2,687,910* | *Sector C Exhausted* |
| *2026* | *630,707* | *1,051,179* | *12,182,756* | *1,636,731* | |
| *2027* | *643,322* | *1,072,203* | *13,254,959* | *564,528* | |
| *2028* | *656,188* | *1,093,647* | *14,348,605* | *5,333,636* | *Build Sector E* |
| *2029* | *669,312* | *1,115,520* | *15,464,125* | *4,218,116* | *Sector D Exhausted* |
| *2030* | *1,517,107* | *1,137,830* | *16,601,955* | *3,080,286* | |
| *2031* | *1,547,449* | *1,160,587* | *17,762,542* | *1,919,699* | |
| *2032* | *1,578,398* | *1,183,798* | *18,946,340* | *735,901* | |
| *2033* | *1,609,966* | *1,207,474* | *20,153,814* | *10,217,916* | *Build Sector F* |
| *2034* | *1,642,165* | *1,231,624* | *21,385,438* | *8,986,292* | *Sector E Exhausted* |
| *2035* | *1,675,008* | *1,256,256* | *22,641,694* | *7,730,036* | |
| *2036* | *1,708,509* | *1,281,381* | *23,923,076* | *6,448,654* | |
| *2037* | *1,742,679* | *1,307,009* | *25,230,085* | *5,141,645* | |
| *2038* | *1,777,532* | *1,333,149* | *26,563,234* | *3,808,496* | |
| *2039* | *1,813,083* | *1,359,812* | *27,923,046* | *2,448,684* | |
| *2040* | *1,849,345* | *1,387,008* | *29,310,054* | *1,061,675* | |

| *Year* | *Tons/Year* | *CY/Year* | *Cumulative CY* | *Remaining CY* | |
|---|---|---|---|---|---|
| *2041* | *1,886,331* | *1,414,749* | *30,724,803* | *13,282,853* | *Build Sector G* |
| *2042* | *1,924,058* | *1,443,044* | *32,167,847* | *11,839,810* | *Sector F Exhausted* |
| *2043* | *1,962,539* | *1,471,904* | *33,639,751* | *10,367,905* | |
| *2044* | *2,001,790* | *1,501,343* | *35,141,094* | *8,866,563* | |
| *2045* | *2,041,826* | *1,531,369* | *36,672,463* | *7,335,193* | |
| *2046* | *2,082,662* | *1,561,997* | *38,234,460* | *5,773,197* | |
| *2047* | *2,124,316* | *1,593,237* | *39,827,696* | *4,179,960* | |
| *2048* | *2,166,802* | *1,625,101* | *41,452,798* | *2,554,858* | |
| *2049* | *2,210,138* | *1,657,603* | *43,110,401* | *897,255* | |
| *2050* | *2,254,341* | *1,690,756* | *44,801,157* | *3,587,579* | *Build Sector H* |
| *2051* | *2,299,428* | *1,724,571* | *46,525,727* | *1,863,008* | *Sector G Exhausted* |
| *2052* | *2,345,416* | *1,759,062* | *48,284,789* | *103,946* | |
| *2053* | *2,392,324* | *1,794,243* | *50,079,033* | *2,165,182* | *Build Sector I* |
| *2054* | *2,440,171* | *1,830,128* | *51,909,161* | *4,950,724* | *Sector H Exhausted/ Build Sector J* |
| *2055* | *2,488,974* | *1,866,731* | *53,775,892* | *3,083,994* | *Sector I Exhausted* |
| *2056* | *2,538,754* | *1,904,065* | *55,679,957* | *1,179,928* | |
| *2057* | *2,589,529* | *1,942,147* | *57,622,104* | *3,096,346* | *Build Sector K* |
| *2058* | *2,641,319* | *1,980,990* | *59,603,093* | *1,115,357* | *Sector J Exhausted* |
| *2059* | *2,694,146* | *2,020,609* | *61,623,703* | *(905,253)* | *Sector K Exhausted* |

Table 3H-~~2~~3
Site Life Calculations for C&D

| | | |
|---|---|---|
| Growth Rate | 2% | |
| In Place Tons | 0 | |
| AUF (tons/cy lb/cy) | 0.9 | 1800 |
| Beginning Tons per Year (in *2013* tons) | | 60,000 |
| C&D Capacity | | 2,581,306 |

| Year | Tons/Year | CY/Year | Cumulative CY | Remaining CY |
|---|---|---|---|---|
| *2012* | - | - | | 2,581,306 |
| *2013* | 60,000 | 68,000 | 68,000 | 2,513,306 |
| *2014* | 61,200 | 69,360 | 137,360 | 2,443,946 |
| *2015* | 62,424 | 70,747 | 208,107 | 2,373,199 |
| *2016* | 63,672 | 72,162 | 280,269 | 2,301,037 |
| *2017* | 64,946 | 73,605 | 353,875 | 2,227,431 |
| *2018* | 66,245 | 75,077 | 428,952 | 2,152,354 |
| *2019* | 67,570 | 76,579 | 505,531 | 2,075,775 |
| *2020* | 68,921 | 78,111 | 583,642 | 1,997,664 |
| *2021* | 70,300 | 79,673 | 663,315 | 1,917,991 |
| *2022* | 71,706 | 81,266 | 744,581 | 1,836,725 |
| *2023* | 73,140 | 82,892 | 827,473 | 1,753,834 |
| *2024* | 74,602 | 84,549 | 912,022 | 1,669,284 |
| *2025* | 76,095 | 86,240 | 998,263 | 1,583,044 |
| *2026* | 77,616 | 87,965 | 1,086,228 | 1,495,078 |
| *2027* | 79,169 | 89,725 | 1,175,952 | 1,405,354 |
| *2028* | 80,752 | 91,519 | 1,267,471 | 1,313,835 |
| *2029* | 82,367 | 93,349 | 1,360,821 | 1,220,485 |
| *2030* | 84,014 | 95,216 | 1,456,037 | 1,125,269 |
| *2031* | 85,695 | 97,121 | 1,553,158 | 1,028,148 |
| *2032* | 87,409 | 99,063 | 1,652,221 | 929,085 |
| *2033* | 89,157 | 101,044 | 1,753,266 | 828,041 |
| *2034* | 90,940 | 103,065 | 1,856,331 | 724,975 |
| *2035* | 92,759 | 105,127 | 1,961,457 | 619,849 |
| *2036* | 94,614 | 107,229 | 2,068,687 | 512,620 |
| *2037* | 96,506 | 109,374 | 2,178,060 | 403,246 |
| *2038* | 98,436 | 111,561 | 2,289,622 | 291,685 |
| *2039* | 100,405 | 113,792 | 2,403,414 | 177,892 |
| *2040* | 102,413 | 116,068 | 2,519,482 | 61,824 |
| *2041* | 104,461 | 118,390 | 2,637,872 | (56,566) |

Table 3H-3
Sector Volumes

| Sector | Area (SF) | Area (Acres) | Net Volume *(Inclusive of Final Cover)* (CY) | *Waste Volume (Prescriptive Cover) (CY)*[A] | *Waste Volume (Alternative Cover) (CY)*[B] |
|---|---|---|---|---|---|
| Sector A | 756,005 | 17.36 | 640,890 | *556,890* | *575,556* |
| Sector B | 984,867 | 22.61 | 3,797,950 | *3,615,567* | *3,639,885* |
| Sector C | 1,188,943 | 27.29 | 6,293,439 | *6,073,264* | *6,102,621* |
| Sector D | 1,276,055 | 29.29 | 3,640,890 | *3,404,584* | *3,436,091* |
| Sector E | 1,139,570 | 26.16 | 6,045,648 | *5,834,616* | *5,862,754* |
| Sector F | 1,690,662 | 38.81 | 10,960,830 | *10,647,744* | *10,689,489* |
| Sector G | 1,355,001 | 31.11 | 13,853,396 | *13,602,470* | *13,635,926* |
| Sector H | 767,684 | 17.62 | 4,504,288 | *4,362,124* | *4,381,080* |
| Sector I | 935,531 | 21.48 | 4,005,626 | *3,832,380* | *3,855,479* |
| Sector J | 1,227,717 | 28.18 | 4,812,711 | *4,585,356* | *4,615,670* |
| Sector K | 738,542 | 16.95 | 3,977,096 | *3,840,329* | *3,858,565* |
| Total A-K | 12,060,576 | 276.87 | 62,532,764 | *60,355,324* | *60,653,116* |
| Total C&D | 2,930,931.26 | 67.28 | 2,581,306 | *NA* | *NA* |

*[A] – Net Volume less 60-inches (36-inches for prescriptive final cover and 24-inches for protective cover). Sector A volume only less 36-inches for prescriptive final cover.*

*[B] – Net Volume less 52-inches (24-inches for alternative final cover and 28-inches for protective cover). Sector A volume only less 28-inches for alternative final cover.*

# Appendix 3I
# Leachate and Contaminated Water Plan

SAIC®

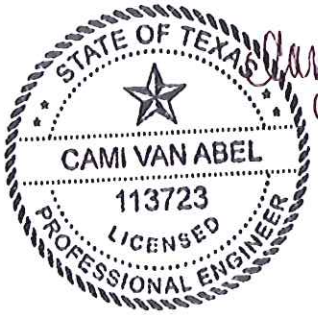
# McCombs Municipal Landfill
# El Paso County, Texas
# TCEQ MSW Permit No. 729B

# Part III
# Appendix 3I
# Leachate and Contaminated Water Plan

Prepared for

**City of El Paso**

Updated June 2013, Revision 4




Cami VanAbel
6/3/13

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Texas Board of Professional Engineers
Firm Registration No. 3823

# Part III

# Appendix 3I – Leachate and Contaminated Water Plan

## City of El Paso

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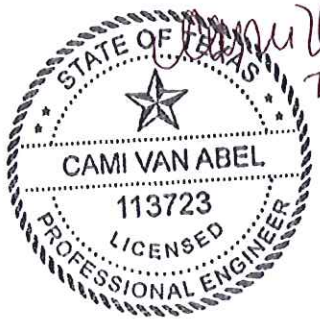


Cami Van Abel 7/17/13

# 3I.1 Introduction

This Leachate and Contaminated Water Plan has been developed in accordance with 30 TAC §330.65(c), §330.177, §330.207, §330.331(a)(2), and §330.333 for the McCombs Landfill (Landfill) located in El Paso, TX. This plan provides details of the collection, storage, and disposal of contaminated water, leachate, and gas condensate from the leachate collection system, gas monitoring and collection systems, and site operations.

## 3I.1.1 Definitions

Definitions for the following have been defined by TAC §330.3.

- (36) Contaminated Water – "Leachate, gas condensate, or water that has come into contact with waste."
- (57) Gas Condensate – "The liquid generated as a result of any gas recovery process at a municipal solid waste facility."
- (78) Leachate – "A liquid that has passed through or emerged from solid waste and contains soluble, suspended, or miscible materials removed from such waste."

# 3I.2 Leachate Management

The Leachate Management Plan developed by Raba-Kistner Consultants, Inc., dated April 24, 2002 (Revision 1 – July 29, 2002) was used to assist in the development of the following section and is provided in partial form as Appendix 3I, Attachment 3. Sections, Figures and Appendices not provided have been updated within.

## 3I.2.1 Leachate Generation

Leachate generation was estimated by running the Hydrologic Evaluation of Landfill Performance (HELP) Model, Version 3.07. The HELP model is a program that computes the water balance for municipal landfills based on weather, soil, and design data and uses solution techniques that account for the effects of surface storage, runoff, infiltration, evapotranspiration, vegetation, soil moisture storage, subsurface drainage, recirculation, and leakage.

The climate data for the simulations was synthetically generated using coefficients for El Paso, Texas. The various conditions modeled were as follows:

Table 3I-1
HELP Modeling Methodology/Assumptions

| Scenario | Open Condition (Daily Cover) | Intermediate Cover Condition | Final Cover Condition (Crown) | Final Cover Condition (Side-Slopes) | Final Cover Condition (Crown) – Alt. Cap | Final Cover Condition (Side-Slopes) – Alt. Cap |
|---|---|---|---|---|---|---|
| Subgrade | 6-Inch Compacted Native Soil | 6-Inch Compacted Native Soil | 6-Inch Compacted Native Soil | 6-Inch Compacted Native Soil | 6-Inch Compacted Native Soil | 6-Inch Compacted Native Soil |
| Low Perm Layer | GCL or 6-inch Barrier Soil[1] | GCL | GCL | GCL | GCL | GCL |
| Base Geomembrane | 60-mil HDPE | 60-mil HDPE | 60-mil HDPE | 60-mil HDPE | 60-mil HDPE | 60-mil HDPE |
| Protective Soil Layer | 2-Feet Drainage Sand ($1.0x10^{-3}$ cm/sec) | 2-Feet Drainage Sand ($1.0x10^{-3}$ cm/sec) | 2-Feet Drainage Sand ($1.0x10^{-3}$ cm/sec) | 2-Feet Drainage Sand ($1.0x10^{-3}$ cm/sec) | 2-Feet Drainage Sand ($5.8x10^{-3}$ cm/sec) | 2-Feet Drainage Sand ($5.8x10^{-3}$ cm/sec) |
| Waste Depth | 10-Feet | 264-Feet | 264-Feet | 214-Feet | 264-Feet | 214-Feet |
| Cover Soil | 6-Inches Daily | 12-Inches Intermediate | 12-Inches Intermediate | 12-Inches Intermediate | 12-Inches Intermediate | 12-Inches Intermediate |
| Infiltration (Support) Layer | None | None | 18-Inch Layer ($1x10^{-5}$ cm/sec) | 18-Inch Layer ($1x10^{-5}$ cm/sec) | 6-Inch Layer | 6-Inch Layer |
| Final Cover Geomembrane | None | None | 40-mil LLDPE | 40-mil LLDPE | None | None |
| Erosion Layer | None | None | 12-Inches | 12-Inches | 18-Inches | 18-Inches |
| Topsoil | None | None | 6-Inches | 6-Inches | 4-Inches Rock | 4-Inches Rock |
| Ground Cover | Bare | Poor Grass | Poor Grass | Poor Grass | Bare | Bare |
| Recirculation | Yes – 100% | Yes – 100% | Yes – 100% | Yes – 100% | Yes – 100% | Yes – 100% |
| Liner Defects (Base and Final Cover, If Applicable) | 1.0 Pinhole/ Acre, 2 Defects/Acre, "Good" Placement | 1.0 Pinhole/ Acre, 2 Defects/Acre, "Good" Placement | 1.0 Pinhole/ Acre, 2 Defects/Acre, "Good" Placement | 1.0 Pinhole/ Acre, 2 Defects/Acre, "Good" Placement | 1.0 Pinhole/ Acre, 2 Defects/Acre, "Good" Placement | 1.0 Pinhole/ Acre, 2 Defects/Acre, "Good" Placement |
| Leaf Index | 0 | 0 | 0 | 0 | 0 | 0 |
| SCS Runoff Curve Number | 84.2 | 77.5 | 85.3 | 86.1 | 68.7 | 60.9 |
| Evaporative Zone Depth | 24-Inches | 24-Inches | 18-Inches | 18-Inches | 24-Inches | 24-Inches |
| Allowable Runoff | 0% | 0% | 100% | 100% | 100% | 100% |
| Simulation Period | 4-Years | 20-Years | 30-Years | 30-Years | 30-Years | 30-Years |

1. Barrier soil (clay) utilized in original prescriptive liner and replaced by caliche in the 2002 Major Permit Amendment. A HELP model demonstration of the effectiveness of the GCL as compared to the barrier soil has been included in this analysis. Modeling for both caliche and GCL alternative liners is provided in Appendix 3J.

Each scenario was evaluated over a simulation period ranging from 4 years to 30 years, as noted in Table 3I-1. Scenarios were modeled to determine the peak daily value for hydraulic head over the liner, liner/cover system efficiency, and leachate generation. Detailed HELP model outputs for each scenario are included in Attachment 1 in Appendix 3I and Peak Daily Hydraulic Head Over Liner values are listed in Table 3I-2.

Table 3I-2
Peak Daily Hydraulic Head Over Base Liner

| Scenario[1] | Average Head (inches) | Maximum Head (inches) |
|---|---|---|
| Open Condition –Scenario 1 Liner System[1] | 2.216 | 3.677 |
| Open Condition –Scenario 2 Liner System[1] | 3.517 | 5.504 |
| Intermediate Cover Condition | 0.406 | 0.765 |
| Final Cover Condition (Crown) | 0.011 | 0.021 |
| Final Cover Condition (Side Slopes) | 0.003 | 0.008 |
| Final Cover Condition (Crown) – Alternative Cap | 0.032 | 0.032 |
| Final Cover Condition (Side Slopes) – Alternative Cap | 0.032 | 0.064 |

[1] – Scenario profiles are detailed in Section 3.4.
[2] – All scenarios shown with 100 percent recirculation of leachate collected from the liner.

## 3I.2.2 Leachate Collection

### Leachate Collection System Design

The leachate collection system was designed in accordance with 30 TAC §330.331(a)(2) and §330.333. The leachate collection system and piping must be:

- Designed to maintain less than 30-centimeters (12-inches) of leachate depth over the liner;
- Made of materials that are chemically resistant. The leachate collection system materials shall be constructed of high density poly-ethylene (HDPE);
- Of sufficient strength and thickness to prevent collapse under the pressures exerted by overlying wastes, cover materials, and any equipment; and
- Designed and operated to function through the scheduled closure and post-closure care period.

The system design shall consist of the following components:

- Estimated rate of leachate removal from the sump;
- Capacity of the sump;
- Pipe material and strength;
- Pipe network spacing and grading;
- Collection sump materials and strength;

- Drainage media specifications and performance; and,
- Demonstrate that pipes and perforations will be resistant to clogging and can be cleaned.

These design requirements are discussed in further detail in the sections below. Leachate collection system details are provided on Drawing P3-31 in Appendix 3G.

### Leachate Collection Layer

*30 TAC §330.333(3)(D) and (F)*

The leachate collection layer consist of a 24-inch sand protective layer (drainage material) overlying the geomembrane liner. The drainage material will have a minimum coefficient of permeability of $1.0 \times 10^{-3}$ cm/sec. The effectiveness of this drainage layer is demonstrated in the HELP model analyses completed in Attachment 1 in Appendix 3I. The leachate collection layer will slope at a minimum of one-percent to the leachate collection trench and pipe (maximum of 600-feet).

Existing Sector K sand was also constructed to have a minimum coefficient of permeability of $1.0 \times 10^{-3}$cm/sec.

### Leachate Aggregate

As outlined in the drawings, the leachate aggregate shall consist of 12-inches of 1 ½-inch washed aggregate and 12-inches of pea-gravel. The aggregate gradation change is implemented to substitute using a geotextile to encase the aggregate, which can be a clogging potential long-term.

The 1 ½-inch washed aggregate backfill shall meet the following specifications:

- Clean, washed, non-carbonate, sub-angular to rounded material, bank run gravel with no organic matter. Crushed aggregate, concrete, bituminous, or limestone not allowed. Soil Classification of GW or GP;
- Meeting the following Gradation (ASTM D422):
  1. 100% passing 1 ½-inch sieve
  2. 0% passing ¾-inch sieve

The pea-gravel backfill shall meet the following specifications:

- Durable washed, non-carbonate, coarse-rounded to sub-angular gravel exhibiting the following relationship to the drainage sand layer:
  1. D15 (Pea-gravel)/D85 (Drainage Sand) < 4 to 5
  2. D15 (Pea-gravel)/D15 (Drainage Sand) < 20
     - Where $D_{15}$ and $D_{85}$ are the diameters which 15% and 85% by weight (respectively) are finer.

## Leachate Collection Trenches and Piping

*30 TAC §330.333(2) and §330.333(3)(C), (E) and (G)*

The leachate collection trenches will slope at a minimum of one-percent to the leachate collection sumps. The leachate collection piping will be placed at the center of the leachate collection trench and will be required to meet the following specifications:

- HDPE pipe designated as PE 3408;
- SDR 9 for perforated leachate collection pipe in trenches (8-inch), cleanout riser pipes (8-inch), and for side-slope riser (SSR) pipes (18-inch);
- Maximum deflection of five percent;
- Pipe perforations for leachate collection piping: ½-inch in diameter, 90-degrees apart symmetrical around the pipe, 5-inch linear spacing (Drawing P3-31 in Appendix 3G); and
- Pipe perforations for sump collection piping: ½-inch in diameter, 45-degrees apart symmetrical around the pipe, 3-inch linear spacing (Drawing P3-32 in Appendix 3G).

Calculations for wall crushing, wall buckling, and ring deflection based on the above design parameters are provided in Attachment 2 in Appendix 3I. Calculations show that the leachate collection systems are of sufficient strength and thickness to prevent collapse under the pressures exerted by overlying wastes, waste cover materials, and by any equipment used at the landfill.

Pipe strength calculations were performed separately for the existing lined Phase I/II area (Sector K) to check the pipe strength of the existing pipe in place (6" SDR 11 HDPE pipe). The Sector K pipe calculations are also provided in Appendix 3I, Attachment 2. Calculations show that the existing pipe meets or exceeds the wall crushing, wall buckling and ring deflection requirements for all but the Watkins-Gaube ring deflection. The Watkins-Gaube ring deflection was calculated at 5.15% deflection, which is slightly over the recommended maximum deflection (5%) but under the allowable deflection (7.5%). The pipe is considered to be of sufficient strength and thickness to prevent collapse under the pressures exerted by the additional overlying wastes and waste cover materials for Sector K. Equipment calculations were not provided for Sector K as the critical time for equipment operations over pipe is during the initial lifts of waste being placed in the cell and Sector K already has approximately 50-feet of waste in place to help prevent collapse from equipment.

All leachate piping will have an attached pipe that leads to a reachable point so that the pipe is able to be accessed for cleaning (detail provided on Drawing P3-31 in Appendix 3G).

### Geotextile Cushion

Cushion geotextile will be placed between the geomembrane and the leachate collection backfill (and piping) for puncture protection. The geotextile cushion layer shall be a non-woven polypropylene or polyester fabric required to meet the following specifications:

- Fabric Weight: 16 oz per square yard minimum;
- Puncture Resistance: 240 lbs (ASTM D-4833);

Geotextiles will be required to have a sewn seam or an 18-inch minimum sheet overlap.

### Leachate Sump and Pump

*30 TAC §330.333(3)(A) and (B)*

The leachate sump will consist of a 3-foot deep rectangular area. The sump will have a minimum nominal dimension of 8-foot by 8-foot at the base and 26-foot by 26-foot at the top; for a minimum volume of 948 cubic feet (CF). The capacity of the sump has been selected to limit the maximum head on the liner. The media within the sump is to meet the same specifications as that of the 1½-inch aggregate specified for leachate collection aggregate. The average porosity for this aggregate is assumed to be 30%. Based on the porosity, 284 CF (2,124 gallons) in the sump will be available for leachate storage.

Based on the HELP model, the average yearly leachate generation rate for the open condition (maximum leachate generation) is 418 CF/acre/year (or 0.2 gallons per minute (gpm) based on the largest designed sector of 39-acres). Therefore, the recommended pumping size is from 5 gpm to 10 gpm to allow for periodic increases in precipitation.

The pumps will be operated by level transducers to ensure that leachate head does not exceed 12-inches over the liner (or approximately 48-inches in the sump, dependent on actual construction). Transducers will cycle on at approximately 36-inches of head within the sump (or 0-inches of head on the liner) and cycle off at approximately 6-inches of head within the sump. The pump hour reading will be recorded on a quarterly basis and kept in the Site Operating Record.

The leachate sump for Sector K was designed to have a nominal dimension of 7-foot by 7-foot at the base and 21-foot by 21-foot at the top; for a minimum volume of 735 cubic feet (CF). The average porosity for the aggregate is assumed to be 30%. Based on the porosity, 221 CF (1,653 gallons) in the sump are available for leachate storage. Based on the HELP model, the average yearly leachate generation rate for the open condition is 418 CF/acre/year (or 0.1 gpm based on Sector K size of 16.95 acres).

## 3I.2.3 Leachate Storage

Leachate will be stored within the leachate sump and within the waste mass on site.

### 3I.2.4 Leachate Disposal

Leachate will be disposed of within the waste mass on site.

### 3I.2.5 Leachate Recirculation

Leachate removed from the sumps will be recirculated within the waste mass. As shown in the HELP model results in Attachment 1 in Appendix 3I, 100% of the leachate can be recirculated back into the waste mass, while still maintaining less than 12-inches of leachate head on the liner.

The volume of leachate removed and recirculated, based on the sump pump hour meter reading, will be recorded quarterly in the Site Operating Record. Periodic analysis of leachate quality will also be placed in the Site Operating Record.

## 3I.3 Contaminated Water Management

The Contaminated Water Management Plan developed by Raba-Kistner Consultants, Inc., dated April 24, 2002 (Revision 1 – July 29, 2002) is included in partial form for compliance with 30 TAC §330.305 (b) and (c) Attachment 3 in Appendix 3I. No changes are recommended from this design.

Stormwater that comes into contact with the active working face and is not contained within the site run-on/runoff berms will be managed in the following manner:

- Contaminated water will be contained as best possible within site sedimentation basins or other low-lying areas onsite;
- Testing will be completed on the contaminated water in accordance with the site SWPPP; and
- If testing indicates that the water is contaminated, it will be pumped out of the containment area into a tanker truck and transferred to the El Paso Waste Water Treatment Plant.

Any water that infiltrates or evaporates prior to being transferred offsite shall be considered mitigated or controlled and no further action will be taken.

## 3I.4 Gas Condensate Management

If gas condensate is produced, it will be stored and disposed of as leachate.

# Appendix 3I - Attachment 1
# HELP Model Results

SAIC®

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**
**  HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE  **
**  HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)  **
**  DEVELOPED BY ENVIRONMENTAL LABORATORY  **
**  USAE WATERWAYS EXPERIMENT STATION  **
**  FOR USEPA RISK REDUCTION ENGINEERING LABORATORY  **
**
**
**********
**********

PRECIPITATION DATA FILE: C:\PROGRAM\ELPASO\PRECIP.D4
TEMPERATURE DATA FILE: C:\PROGRAM\ELPASO\TEMP.D7
SOLAR RADIATION DATA FILE: C:\PROGRAM\ELPASO\SOLAR.D13
EVAPOTRANSPIRATION DATA: C:\PROGRAM\ELPASO\EVAP.D11
SOIL AND DESIGN DATA FILE: C:\PROGRAM\ELPASO\LIN10DC.D10
OUTPUT DATA FILE: C:\PROGRAM\ELPASO\LIN10DC.OUT

TIME: 10:42 DATE: 7/19/2012

**********

TITLE: OPEN CONDITIONS - 10FT MSW 6" DAILY COVER

**********

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1
---

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 6

| | | | |
|---|---|---|---|
| THICKNESS | = | 6.00 | INCHES |
| POROSITY | = | 0.4530 | VOL/VOL |
| FIELD CAPACITY | = | 0.1900 | VOL/VOL |
| WILTING POINT | = | 0.0850 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.2097 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.720000011000E-03 | CM/SEC |

NOTE: 100.00 PERCENT OF THE DRAINAGE COLLECTED FROM LAYER # 4
IS RECIRCULATED INTO THIS LAYER.

LAYER 2
---

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

| | | | |
|---|---|---|---|
| THICKNESS | = | 120.00 | INCHES |
| POROSITY | = | 0.6710 | VOL/VOL |
| FIELD CAPACITY | = | 0.2920 | VOL/VOL |
| WILTING POINT | = | 0.0770 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.2696 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.100000005000E-02 | CM/SEC |

LAYER 3
---

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

| | | | |
|---|---|---|---|
| THICKNESS | = | 12.00 | INCHES |
| POROSITY | = | 0.4370 | VOL/VOL |
| FIELD CAPACITY | = | 0.0620 | VOL/VOL |
| WILTING POINT | = | 0.0240 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.1084 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.100000005000E-02 | CM/SEC |

LAYER 4
---

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

| | | | |
|---|---|---|---|
| THICKNESS | = | 12.00 | INCHES |
| POROSITY | = | 0.4370 | VOL/VOL |
| FIELD CAPACITY | = | 0.0620 | VOL/VOL |
| WILTING POINT | = | 0.0240 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0881 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.100000005000E-02 | CM/SEC |
| SLOPE | = | 1.00 | PERCENT |
| DRAINAGE LENGTH | = | 350.0 | FEET |

NOTE: 100.00 PERCENT OF THE DRAINAGE COLLECTED FROM THIS LAYER IS RECIRCULATED INTO LAYER # 1.

LAYER 5
---

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

| | | | |
|---|---|---|---|
| THICKNESS | = | 0.06 | INCHES |
| POROSITY | = | 0.0000 | VOL/VOL |
| FIELD CAPACITY | = | 0.0000 | VOL/VOL |
| WILTING POINT | = | 0.0000 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0000 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.199999996000E-12 | CM/SEC |
| FML PINHOLE DENSITY | = | 1.00 | HOLES/ACRE |
| FML INSTALLATION DEFECTS | = | 2.00 | HOLES/ACRE |
| FML PLACEMENT QUALITY | = | 3 - GOOD | |

LAYER 6

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 10

| | | | |
|---|---|---|---|
| THICKNESS | = | 6.00 | INCHES |
| POROSITY | = | 0.3980 | VOL/VOL |
| FIELD CAPACITY | = | 0.2440 | VOL/VOL |
| WILTING POINT | = | 0.1360 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.3980 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.119999997000E-03 | CM/SEC |

LAYER 7

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 2

| | | | |
|---|---|---|---|
| THICKNESS | = | 6.00 | INCHES |
| POROSITY | = | 0.4370 | VOL/VOL |
| FIELD CAPACITY | = | 0.0620 | VOL/VOL |
| WILTING POINT | = | 0.0240 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0722 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.579999993000E-02 | CM/SEC |

## GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 6 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 2000. FEET.

| | | | |
|---|---|---|---|
| SCS RUNOFF CURVE NUMBER | = | 84.20 | |
| FRACTION OF AREA ALLOWING RUNOFF | = | 0.0 | PERCENT |
| AREA PROJECTED ON HORIZONTAL PLANE | = | 1.000 | ACRES |
| EVAPORATIVE ZONE DEPTH | = | 24.0 | INCHES |
| INITIAL WATER IN EVAPORATIVE ZONE | = | 3.826 | INCHES |
| UPPER LIMIT OF EVAPORATIVE STORAGE | = | 14.796 | INCHES |
| LOWER LIMIT OF EVAPORATIVE STORAGE | = | 1.896 | INCHES |
| INITIAL SNOW WATER | = | 0.000 | INCHES |
| INITIAL WATER IN LAYER MATERIALS | = | 38.790 | INCHES |
| TOTAL INITIAL WATER | = | 38.790 | INCHES |
| TOTAL SUBSURFACE INFLOW | = | 0.00 | INCHES/YEAR |

## EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
EL PASO TEXAS

STATION LATITUDE = 31.80 DEGREES

| | | |
|---|---|---|
| MAXIMUM LEAF AREA INDEX | = | 0.00 |
| START OF GROWING SEASON (JULIAN DATE) | = | 66 |
| END OF GROWING SEASON (JULIAN DATE) | = | 315 |
| EVAPORATIVE ZONE DEPTH | = | 24.0 INCHES |
| AVERAGE ANNUAL WIND SPEED | = | 9.20 MPH |
| AVERAGE 1ST QUARTER RELATIVE HUMIDITY | = | 40.00 % |
| AVERAGE 2ND QUARTER RELATIVE HUMIDITY | = | 27.00 % |
| AVERAGE 3RD QUARTER RELATIVE HUMIDITY | = | 46.00 % |
| AVERAGE 4TH QUARTER RELATIVE HUMIDITY | = | 48.00 % |

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

| JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|
| 0.38 | 0.45 | 0.32 | 0.19 | 0.24 | 0.56 |
| 1.60 | 1.21 | 1.42 | 0.73 | 0.33 | 0.39 |

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

| JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|
| 44.20 | 48.40 | 55.10 | 63.60 | 71.90 | 80.80 |
| 82.50 | 80.30 | 74.10 | 63.60 | 51.40 | 44.40 |

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS
AND STATION LATITUDE = 31.80 DEGREES

**********

ANNUAL TOTALS FOR YEAR 1

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.15 | 29584.502 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.992 | 29009.543 | 98.06 |
| RECIRCULATION INTO LAYER 1 | 0.058948 | 213.982 | 0.72 |
| DRAINAGE COLLECTED FROM LAYER 4 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 4 | 0.058948 | 213.982 | 0.72 |
| PERC./LEAKAGE THROUGH LAYER 6 | 0.105486 | 382.915 | 1.29 |

| | | | |
|---|---|---|---|
| AVG. HEAD ON TOP OF LAYER 5 | 0.9964 | | |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.012002 | 43.567 | 0.15 |
| CHANGE IN WATER STORAGE | 0.146 | 531.240 | 1.80 |
| SOIL WATER AT START OF YEAR | 38.790 | 140805.922 | |
| SOIL WATER AT END OF YEAR | 38.936 | 141337.156 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.152 | 0.00 |

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ANNUAL TOTALS FOR YEAR 2

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.52 | 30927.602 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 9.136 | 33164.297 | 107.23 |
| RECIRCULATION INTO LAYER 1 | 0.061835 | 224.459 | 0.73 |
| DRAINAGE COLLECTED FROM LAYER 4 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 4 | 0.061835 | 224.459 | 0.73 |
| PERC./LEAKAGE THROUGH LAYER 6 | 0.110252 | 400.214 | 1.29 |
| AVG. HEAD ON TOP OF LAYER 5 | 1.0462 | | |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.100860 | 366.121 | 1.18 |
| CHANGE IN WATER STORAGE | -0.717 | -2602.734 | -8.42 |
| SOIL WATER AT START OF YEAR | 38.936 | 141337.156 | |
| SOIL WATER AT END OF YEAR | 38.219 | 138734.422 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.080 | 0.00 |

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ANNUAL TOTALS FOR YEAR 3

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 10.09 | 36626.703 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.848 | 28489.568 | 77.78 |
| RECIRCULATION INTO LAYER 1 | 0.060984 | 221.373 | 0.60 |
| DRAINAGE COLLECTED FROM LAYER 4 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 4 | 0.060984 | 221.373 | 0.60 |
| PERC./LEAKAGE THROUGH LAYER 6 | 0.108783 | 394.881 | 1.08 |
| AVG. HEAD ON TOP OF LAYER 5 | 1.0310 | | |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.100440 | 364.596 | 1.00 |
| CHANGE IN WATER STORAGE | 2.141 | 7772.173 | 21.22 |
| SOIL WATER AT START OF YEAR | 38.219 | 138734.422 | |
| SOIL WATER AT END OF YEAR | 39.876 | 144751.422 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.484 | 1755.166 | 4.79 |
| ANNUAL WATER BUDGET BALANCE | 0.0001 | 0.368 | 0.00 |

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ANNUAL TOTALS FOR YEAR 4

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.63 | 27696.900 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 8.254 | 29961.854 | 108.18 |
| RECIRCULATION INTO LAYER 1 | 0.123819 | 449.463 | 1.62 |
| DRAINAGE COLLECTED FROM LAYER 4 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 4 | 0.123819 | 449.463 | 1.62 |
| PERC./LEAKAGE THROUGH LAYER 6 | 0.209845 | 761.736 | 2.75 |
| AVG. HEAD ON TOP OF LAYER 5 | 2.0881 | | |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.175253 | 636.169 | 2.30 |

| | | | |
|---|---|---|---|
| CHANGE IN WATER STORAGE | -0.799 | -2901.464 | -10.48 |
| SOIL WATER AT START OF YEAR | 39.876 | 144751.422 | |
| SOIL WATER AT END OF YEAR | 39.561 | 143605.125 | |
| SNOW WATER AT START OF YEAR | 0.484 | 1755.166 | 6.34 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0001 | 0.343 | 0.00 |

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 4

| | JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|---|
| **PRECIPITATION** | | | | | | |
| TOTALS | 0.75 | 0.33 | 0.15 | 0.14 | 0.08 | 0.88 |
| | 0.74 | 1.43 | 2.65 | 0.58 | 0.20 | 0.67 |
| STD. DEVIATIONS | 0.59 | 0.19 | 0.26 | 0.18 | 0.07 | 0.83 |
| | 0.56 | 0.21 | 1.26 | 0.43 | 0.24 | 0.36 |
| **RUNOFF** | | | | | | |
| TOTALS | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| STD. DEVIATIONS | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| **EVAPOTRANSPIRATION** | | | | | | |
| TOTALS | 0.453 | 0.367 | 0.398 | 0.272 | 0.245 | 0.493 |
| | 0.697 | 0.887 | 2.689 | 0.882 | 0.421 | 0.504 |
| STD. DEVIATIONS | 0.178 | 0.251 | 0.312 | 0.115 | 0.071 | 0.329 |
| | 0.945 | 0.594 | 0.939 | 0.408 | 0.043 | 0.046 |
| **LATERAL DRAINAGE RECIRCULATED INTO LAYER 1** | | | | | | |
| TOTALS | 0.0058 | 0.0054 | 0.0061 | 0.0061 | 0.0065 | 0.0063 |
| | 0.0066 | 0.0066 | 0.0063 | 0.0068 | 0.0067 | 0.0072 |
| STD. DEVIATIONS | 0.0019 | 0.0021 | 0.0025 | 0.0027 | 0.0029 | 0.0029 |
| | 0.0031 | 0.0031 | 0.0029 | 0.0028 | 0.0026 | 0.0027 |
| **LATERAL DRAINAGE COLLECTED FROM LAYER 4** | | | | | | |
| TOTALS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

| | | | | | | |
|---|---|---|---|---|---|---|
| STD. DEVIATIONS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

LATERAL DRAINAGE RECIRCULATED FROM LAYER 4

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTALS | 0.0058 | 0.0054 | 0.0061 | 0.0061 | 0.0065 | 0.0063 |
| | 0.0066 | 0.0066 | 0.0063 | 0.0068 | 0.0067 | 0.0072 |
| STD. DEVIATIONS | 0.0019 | 0.0021 | 0.0025 | 0.0027 | 0.0029 | 0.0029 |
| | 0.0031 | 0.0031 | 0.0029 | 0.0028 | 0.0026 | 0.0027 |

PERCOLATION/LEAKAGE THROUGH LAYER 6

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTALS | 0.0102 | 0.0095 | 0.0107 | 0.0107 | 0.0113 | 0.0110 |
| | 0.0114 | 0.0114 | 0.0111 | 0.0118 | 0.0117 | 0.0125 |
| STD. DEVIATIONS | 0.0031 | 0.0034 | 0.0041 | 0.0044 | 0.0047 | 0.0047 |
| | 0.0049 | 0.0049 | 0.0047 | 0.0044 | 0.0042 | 0.0044 |

PERCOLATION/LEAKAGE THROUGH LAYER 7

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTALS | 0.0058 | 0.0059 | 0.0069 | 0.0072 | 0.0080 | 0.0081 |
| | 0.0087 | 0.0089 | 0.0089 | 0.0094 | 0.0094 | 0.0100 |
| STD. DEVIATIONS | 0.0040 | 0.0040 | 0.0047 | 0.0051 | 0.0059 | 0.0062 |
| | 0.0069 | 0.0072 | 0.0069 | 0.0068 | 0.0061 | 0.0059 |

## AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5

| | | | | | | |
|---|---|---|---|---|---|---|
| AVERAGES | 1.1548 | 1.1794 | 1.2140 | 1.2611 | 1.2874 | 1.3007 |
| | 1.3057 | 1.3052 | 1.3056 | 1.3512 | 1.3828 | 1.4371 |
| STD. DEVIATIONS | 0.3780 | 0.4260 | 0.5008 | 0.5569 | 0.5856 | 0.6028 |
| | 0.6087 | 0.6076 | 0.5972 | 0.5523 | 0.5326 | 0.5398 |

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## AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 4

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.60 ( 1.060) | 31208.9 | 100.00 |
| RUNOFF | 0.000 ( 0.0000) | 0.00 | 0.000 |
| EVAPOTRANSPIRATION | 8.308 ( 0.5774) | 30156.31 | 96.627 |
| DRAINAGE RECIRCULATED INTO LAYER 1 | 0.07640 ( 0.03164) | 277.320 | 0.88859 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 4 | 0.00000 ( 0.00000) | 0.000 | 0.00000 |

| | | | |
|---|---|---|---|
| DRAINAGE RECIRCULATED FROM LAYER 4 | 0.07640 ( 0.03164) | 277.320 | 0.88859 |
| PERCOLATION/LEAKAGE THROUGH LAYER 6 | 0.13359 ( 0.05087) | 484.936 | 1.55384 |
| AVERAGE HEAD ON TOP OF LAYER 5 | 1.290 ( 0.532) | | |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.09714 ( 0.06677) | 352.613 | 1.12985 |
| CHANGE IN WATER STORAGE | 0.193 ( 1.3675) | 699.80 | 2.242 |

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 4

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 1.69 | 6134.700 |
| RUNOFF | 0.000 | 0.0000 |
| DRAINAGE RECIRCULATED INTO LAYER 1 | 0.00036 | 1.30256 |
| DRAINAGE COLLECTED FROM LAYER 4 | 0.00000 | 0.00000 |
| DRAINAGE RECIRCULATED FROM LAYER 4 | 0.00036 | 1.30256 |
| PERCOLATION/LEAKAGE THROUGH LAYER 6 | 0.000606 | 2.19954 |
| AVERAGE HEAD ON TOP OF LAYER 5 | 2.216 | |
| MAXIMUM HEAD ON TOP OF LAYER 5 | 3.677 | |
| LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN) | 59.6 FEET | |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.000602 | 2.18409 |
| SNOW WATER | 0.56 | 2033.9432 |

| | |
|---|---|
| MAXIMUM VEG. SOIL WATER (VOL/VOL) | 0.3021 |
| MINIMUM VEG. SOIL WATER (VOL/VOL) | 0.1209 |

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 4

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 0.7684 | 0.1281 |
| 2 | 32.8046 | 0.2734 |
| 3 | 1.4598 | 0.1216 |
| 4 | 1.5611 | 0.1301 |
| 5 | 0.0000 | 0.0000 |
| 6 | 2.3880 | 0.3980 |
| 7 | 0.5787 | 0.0965 |
| SNOW WATER | 0.000 | |

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**
**  HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE  **
**  HELP MODEL VERSION 3.07 (1 NOVEMBER 1997)  **
**  DEVELOPED BY ENVIRONMENTAL LABORATORY  **
**  USAE WATERWAYS EXPERIMENT STATION  **
**  FOR USEPA RISK REDUCTION ENGINEERING LABORATORY  **
**
**
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PRECIPITATION DATA FILE: C:\PROGRAM\ELPASO\PRECIP.D4
TEMPERATURE DATA FILE: C:\PROGRAM\ELPASO\TEMP.D7
SOLAR RADIATION DATA FILE: C:\PROGRAM\ELPASO\SOLAR.D13
EVAPOTRANSPIRATION DATA: C:\PROGRAM\ELPASO\EVAP.D11
SOIL AND DESIGN DATA FILE: C:\PROGRAM\ELPASO\ALIN10DC.D10
OUTPUT DATA FILE: C:\PROGRAM\ELPASO\ALIN10DC.OUT

TIME: 10: 0 DATE: 3/13/2013

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TITLE: OPEN CONDITIONS - 10FT MSW 6" DAILY COVER_ALT LINER

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NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1
---

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 6

| | | | |
|---|---|---|---|
| THICKNESS | = | 6.00 | INCHES |
| POROSITY | = | 0.4530 | VOL/VOL |
| FIELD CAPACITY | = | 0.1900 | VOL/VOL |
| WILTING POINT | = | 0.0850 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.2098 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.720000011000E-03 | CM/SEC |

NOTE: 100.00 PERCENT OF THE DRAINAGE COLLECTED FROM LAYER # 4
IS RECIRCULATED INTO THIS LAYER.

LAYER 2
---

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

| | | |
|---|---|---|
| THICKNESS | = | 120.00 INCHES |
| POROSITY | = | 0.6710 VOL/VOL |
| FIELD CAPACITY | = | 0.2920 VOL/VOL |
| WILTING POINT | = | 0.0770 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.2697 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.100000005000E-02 CM/SEC |

LAYER 3
---

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

| | | |
|---|---|---|
| THICKNESS | = | 12.00 INCHES |
| POROSITY | = | 0.4370 VOL/VOL |
| FIELD CAPACITY | = | 0.0620 VOL/VOL |
| WILTING POINT | = | 0.0240 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.1074 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.100000005000E-02 CM/SEC |

LAYER 4
---

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

| | | |
|---|---|---|
| THICKNESS | = | 12.00 INCHES |
| POROSITY | = | 0.4370 VOL/VOL |
| FIELD CAPACITY | = | 0.0620 VOL/VOL |
| WILTING POINT | = | 0.0240 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0932 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.100000005000E-02 CM/SEC |
| SLOPE | = | 1.00 PERCENT |
| DRAINAGE LENGTH | = | 350.0 FEET |

NOTE: 100.00 PERCENT OF THE DRAINAGE COLLECTED FROM THIS LAYER IS RECIRCULATED INTO LAYER # 1.

LAYER 5
---

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

| | | |
|---|---|---|
| THICKNESS | = | 0.06 INCHES |
| POROSITY | = | 0.0000 VOL/VOL |
| FIELD CAPACITY | = | 0.0000 VOL/VOL |
| WILTING POINT | = | 0.0000 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0000 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.199999996000E-12 CM/SEC |
| FML PINHOLE DENSITY | = | 1.00 HOLES/ACRE |
| FML INSTALLATION DEFECTS | = | 2.00 HOLES/ACRE |
| FML PLACEMENT QUALITY | = | 3 - GOOD |

LAYER 6

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 0

| | | | |
|---|---|---|---|
| THICKNESS | = | 0.24 | INCHES |
| POROSITY | = | 0.7500 | VOL/VOL |
| FIELD CAPACITY | = | 0.7470 | VOL/VOL |
| WILTING POINT | = | 0.4000 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.7500 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.499999997000E-08 | CM/SEC |

LAYER 7

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 2

| | | | |
|---|---|---|---|
| THICKNESS | = | 6.00 | INCHES |
| POROSITY | = | 0.4370 | VOL/VOL |
| FIELD CAPACITY | = | 0.0620 | VOL/VOL |
| WILTING POINT | = | 0.0240 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0610 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.579999993000E-02 | CM/SEC |

## GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 6 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 2000. FEET.

| | | | |
|---|---|---|---|
| SCS RUNOFF CURVE NUMBER | = | 84.20 | |
| FRACTION OF AREA ALLOWING RUNOFF | = | 0.0 | PERCENT |
| AREA PROJECTED ON HORIZONTAL PLANE | = | 1.000 | ACRES |
| EVAPORATIVE ZONE DEPTH | = | 24.0 | INCHES |
| INITIAL WATER IN EVAPORATIVE ZONE | = | 3.839 | INCHES |
| UPPER LIMIT OF EVAPORATIVE STORAGE | = | 14.796 | INCHES |
| LOWER LIMIT OF EVAPORATIVE STORAGE | = | 1.896 | INCHES |
| INITIAL SNOW WATER | = | 0.000 | INCHES |
| INITIAL WATER IN LAYER MATERIALS | = | 36.576 | INCHES |
| TOTAL INITIAL WATER | = | 36.576 | INCHES |
| TOTAL SUBSURFACE INFLOW | = | 0.00 | INCHES/YEAR |

## EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
EL PASO TEXAS

STATION LATITUDE = 31.80 DEGREES

| | | |
|---|---|---|
| MAXIMUM LEAF AREA INDEX | = | 0.00 |
| START OF GROWING SEASON (JULIAN DATE) | = | 66 |
| END OF GROWING SEASON (JULIAN DATE) | = | 315 |
| EVAPORATIVE ZONE DEPTH | = | 24.0 INCHES |
| AVERAGE ANNUAL WIND SPEED | = | 9.20 MPH |
| AVERAGE 1ST QUARTER RELATIVE HUMIDITY | = | 40.00 % |
| AVERAGE 2ND QUARTER RELATIVE HUMIDITY | = | 27.00 % |
| AVERAGE 3RD QUARTER RELATIVE HUMIDITY | = | 46.00 % |
| AVERAGE 4TH QUARTER RELATIVE HUMIDITY | = | 48.00 % |

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

| JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|
| 0.38 | 0.45 | 0.32 | 0.19 | 0.24 | 0.56 |
| 1.60 | 1.21 | 1.42 | 0.73 | 0.33 | 0.39 |

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

| JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|
| 44.20 | 48.40 | 55.10 | 63.60 | 71.90 | 80.80 |
| 82.50 | 80.30 | 74.10 | 63.60 | 51.40 | 44.40 |

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS
AND STATION LATITUDE = 31.80 DEGREES

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ANNUAL TOTALS FOR YEAR 1

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.15 | 29584.502 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.992 | 29010.729 | 98.06 |
| RECIRCULATION INTO LAYER 1 | 0.074656 | 271.000 | 0.92 |
| DRAINAGE COLLECTED FROM LAYER 4 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 4 | 0.074656 | 271.000 | 0.92 |
| PERC./LEAKAGE THROUGH LAYER 6 | 0.000162 | 0.589 | 0.00 |

| | | | |
|---|---|---|---|
| AVG. HEAD ON TOP OF LAYER 5 | 1.2616 | | |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.004925 | 17.878 | 0.06 |
| CHANGE IN WATER STORAGE | 0.153 | 555.639 | 1.88 |
| SOIL WATER AT START OF YEAR | 36.576 | 132770.500 | |
| SOIL WATER AT END OF YEAR | 36.729 | 133326.141 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0001 | 0.257 | 0.00 |

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ANNUAL TOTALS FOR YEAR 2

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.52 | 30927.602 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 9.133 | 33152.133 | 107.19 |
| RECIRCULATION INTO LAYER 1 | 0.089163 | 323.663 | 1.05 |
| DRAINAGE COLLECTED FROM LAYER 4 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 4 | 0.089163 | 323.663 | 1.05 |
| PERC./LEAKAGE THROUGH LAYER 6 | 0.000199 | 0.721 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 5 | 1.5082 | | |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.004294 | 15.588 | 0.05 |
| CHANGE IN WATER STORAGE | -0.617 | -2240.169 | -7.24 |
| SOIL WATER AT START OF YEAR | 36.729 | 133326.141 | |
| SOIL WATER AT END OF YEAR | 36.112 | 131085.984 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.049 | 0.00 |

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ANNUAL TOTALS FOR YEAR 3

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 10.09 | 36626.703 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.843 | 28468.750 | 77.73 |
| RECIRCULATION INTO LAYER 1 | 0.101952 | 370.084 | 1.01 |
| DRAINAGE COLLECTED FROM LAYER 4 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 4 | 0.101952 | 370.084 | 1.01 |
| PERC./LEAKAGE THROUGH LAYER 6 | 0.000234 | 0.851 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 5 | 1.7230 | | |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.003790 | 13.759 | 0.04 |
| CHANGE IN WATER STORAGE | 2.243 | 8143.462 | 22.23 |
| SOIL WATER AT START OF YEAR | 36.112 | 131085.984 | |
| SOIL WATER AT END OF YEAR | 37.872 | 137474.266 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.484 | 1755.166 | 4.79 |
| ANNUAL WATER BUDGET BALANCE | 0.0002 | 0.733 | 0.00 |

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ANNUAL TOTALS FOR YEAR 4

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.63 | 27696.900 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 8.254 | 29961.703 | 108.18 |
| RECIRCULATION INTO LAYER 1 | 0.194321 | 705.385 | 2.55 |
| DRAINAGE COLLECTED FROM LAYER 4 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 4 | 0.194321 | 705.385 | 2.55 |
| PERC./LEAKAGE THROUGH LAYER 6 | 0.000516 | 1.875 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 5 | 3.2775 | | |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.003173 | 11.519 | 0.04 |

| | | | |
|---|---|---|---|
| CHANGE IN WATER STORAGE | -0.627 | -2276.740 | -8.22 |
| SOIL WATER AT START OF YEAR | 37.872 | 137474.266 | |
| SOIL WATER AT END OF YEAR | 37.728 | 136952.703 | |
| SNOW WATER AT START OF YEAR | 0.484 | 1755.166 | 6.34 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0001 | 0.418 | 0.00 |

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 4

| | JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|---|
| PRECIPITATION | | | | | | |
| TOTALS | 0.75 | 0.33 | 0.15 | 0.14 | 0.08 | 0.88 |
| | 0.74 | 1.43 | 2.65 | 0.58 | 0.20 | 0.67 |
| STD. DEVIATIONS | 0.59 | 0.19 | 0.26 | 0.18 | 0.07 | 0.83 |
| | 0.56 | 0.21 | 1.26 | 0.43 | 0.24 | 0.36 |
| RUNOFF | | | | | | |
| TOTALS | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| STD. DEVIATIONS | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| EVAPOTRANSPIRATION | | | | | | |
| TOTALS | 0.452 | 0.367 | 0.398 | 0.272 | 0.245 | 0.493 |
| | 0.697 | 0.887 | 2.687 | 0.881 | 0.421 | 0.505 |
| STD. DEVIATIONS | 0.179 | 0.251 | 0.312 | 0.115 | 0.071 | 0.329 |
| | 0.945 | 0.593 | 0.940 | 0.408 | 0.043 | 0.046 |
| LATERAL DRAINAGE RECIRCULATED INTO LAYER 1 | | | | | | |
| TOTALS | 0.0087 | 0.0082 | 0.0091 | 0.0090 | 0.0095 | 0.0093 |
| | 0.0097 | 0.0098 | 0.0095 | 0.0105 | 0.0105 | 0.0114 |
| STD. DEVIATIONS | 0.0041 | 0.0042 | 0.0046 | 0.0046 | 0.0048 | 0.0046 |
| | 0.0048 | 0.0048 | 0.0046 | 0.0046 | 0.0044 | 0.0049 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 4 | | | | | | |
| TOTALS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

| | | | | | | |
|---|---|---|---|---|---|---|
| STD. DEVIATIONS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

LATERAL DRAINAGE RECIRCULATED FROM LAYER 4

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTALS | 0.0087 | 0.0082 | 0.0091 | 0.0090 | 0.0095 | 0.0093 |
| | 0.0097 | 0.0098 | 0.0095 | 0.0105 | 0.0105 | 0.0114 |
| STD. DEVIATIONS | 0.0041 | 0.0042 | 0.0046 | 0.0046 | 0.0048 | 0.0046 |
| | 0.0048 | 0.0048 | 0.0046 | 0.0046 | 0.0044 | 0.0049 |

PERCOLATION/LEAKAGE THROUGH LAYER 6

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTALS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

PERCOLATION/LEAKAGE THROUGH LAYER 7

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTALS | 0.0004 | 0.0003 | 0.0004 | 0.0003 | 0.0003 | 0.0003 |
| | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 |
| STD. DEVIATIONS | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |

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AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

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DAILY AVERAGE HEAD ON TOP OF LAYER 5

| | | | | | | |
|---|---|---|---|---|---|---|
| AVERAGES | 1.7241 | 1.7704 | 1.8054 | 1.8519 | 1.8865 | 1.9107 |
| | 1.9292 | 1.9437 | 1.9633 | 2.0880 | 2.1703 | 2.2675 |
| STD. DEVIATIONS | 0.8073 | 0.8692 | 0.9163 | 0.9389 | 0.9500 | 0.9563 |
| | 0.9581 | 0.9565 | 0.9490 | 0.9078 | 0.9124 | 0.9683 |

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 4

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| | INCHES | | CU. FEET | PERCENT |
|---|---|---|---|---|
| PRECIPITATION | 8.60 | ( 1.060) | 31208.9 | 100.00 |
| RUNOFF | 0.000 | ( 0.0000) | 0.00 | 0.000 |
| EVAPOTRANSPIRATION | 8.305 | ( 0.5773) | 30148.33 | 96.602 |
| DRAINAGE RECIRCULATED INTO LAYER 1 | 0.11502 | ( 0.05403) | 417.533 | 1.33786 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 4 | 0.00000 | ( 0.00000) | 0.000 | 0.00000 |

| | | | |
|---|---|---|---|
| DRAINAGE RECIRCULATED FROM LAYER 4 | 0.11502 ( 0.05403) | 417.533 | 1.33786 |
| PERCOLATION/LEAKAGE THROUGH LAYER 6 | 0.00028 ( 0.00016) | 1.009 | 0.00323 |
| AVERAGE HEAD ON TOP OF LAYER 5 | 1.943 ( 0.910) | | |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.00405 ( 0.00074) | 14.686 | 0.04706 |
| CHANGE IN WATER STORAGE | 0.288 ( 1.3538) | 1045.55 | 3.350 |

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 4

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 1.69 | 6134.700 |
| RUNOFF | 0.000 | 0.0000 |
| DRAINAGE RECIRCULATED INTO LAYER 1 | 0.00057 | 2.06777 |
| DRAINAGE COLLECTED FROM LAYER 4 | 0.00000 | 0.00000 |
| DRAINAGE RECIRCULATED FROM LAYER 4 | 0.00057 | 2.06777 |
| PERCOLATION/LEAKAGE THROUGH LAYER 6 | 0.000002 | 0.00561 |
| AVERAGE HEAD ON TOP OF LAYER 5 | 3.517 | |
| MAXIMUM HEAD ON TOP OF LAYER 5 | 5.504 | |
| LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN) | 76.1 FEET | |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.000015 | 0.05288 |
| SNOW WATER | 0.56 | 2033.9432 |

| | |
|---|---|
| MAXIMUM VEG. SOIL WATER (VOL/VOL) | 0.3075 |
| MINIMUM VEG. SOIL WATER (VOL/VOL) | 0.1214 |

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 4

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 0.7830 | 0.1305 |
| 2 | 32.8370 | 0.2736 |
| 3 | 1.5147 | 0.1262 |
| 4 | 2.0621 | 0.1718 |
| 5 | 0.0000 | 0.0000 |
| 6 | 0.1800 | 0.7500 |
| 7 | 0.3512 | 0.0585 |
| SNOW WATER | 0.000 | |

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**
**  HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
**  HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)
**  DEVELOPED BY ENVIRONMENTAL LABORATORY
**  USAE WATERWAYS EXPERIMENT STATION
**  FOR USEPA RISK REDUCTION ENGINEERING LABORATORY
**
**
**********
**********

PRECIPITATION DATA FILE: C:\PROGRAM\ELPASO\PRECIP.D4
TEMPERATURE DATA FILE: C:\PROGRAM\ELPASO\TEMP.D7
SOLAR RADIATION DATA FILE: C:\PROGRAM\ELPASO\SOLAR.D13
EVAPOTRANSPIRATION DATA: C:\PROGRAM\ELPASO\EVAP.D11
SOIL AND DESIGN DATA FILE: C:\PROGRAM\ELPASO\ALIN_INT.D10
OUTPUT DATA FILE: C:\PROGRAM\ELPASO\ALIN_INT.OUT

TIME: 10: 3 DATE: 3/13/2013

**********

TITLE: OPEN CONDITIONS -264FT MSW 12" INTERMEDIATE COVER_ALT LINER

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NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
WERE SPECIFIED BY THE USER.

LAYER 1
---

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 6

| | | | |
|---|---|---|---|
| THICKNESS | = | 12.00 | INCHES |
| POROSITY | = | 0.4530 | VOL/VOL |
| FIELD CAPACITY | = | 0.1900 | VOL/VOL |
| WILTING POINT | = | 0.0850 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.1688 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.720000011000E-03 | CM/SEC |

LAYER 2
---

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

| | | |
|---|---|---|
| THICKNESS | = | 2928.00 INCHES |
| POROSITY | = | 0.6710 VOL/VOL |
| FIELD CAPACITY | = | 0.2920 VOL/VOL |
| WILTING POINT | = | 0.0770 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.2500 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.100000005000E-02 CM/SEC |

NOTE: 100.00 PERCENT OF THE DRAINAGE COLLECTED FROM LAYER # 5 IS RECIRCULATED INTO THIS LAYER.

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

| | | |
|---|---|---|
| THICKNESS | = | 240.00 INCHES |
| POROSITY | = | 0.6710 VOL/VOL |
| FIELD CAPACITY | = | 0.2920 VOL/VOL |
| WILTING POINT | = | 0.0770 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.2920 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.100000005000E-02 CM/SEC |

LAYER 4

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 0

| | | |
|---|---|---|
| THICKNESS | = | 12.00 INCHES |
| POROSITY | = | 0.4370 VOL/VOL |
| FIELD CAPACITY | = | 0.0620 VOL/VOL |
| WILTING POINT | = | 0.0240 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.1001 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.100000005000E-02 CM/SEC |

LAYER 5

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 0

| | | |
|---|---|---|
| THICKNESS | = | 12.00 INCHES |
| POROSITY | = | 0.4370 VOL/VOL |
| FIELD CAPACITY | = | 0.0620 VOL/VOL |
| WILTING POINT | = | 0.0240 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0662 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.100000005000E-02 CM/SEC |
| SLOPE | = | 1.00 PERCENT |
| DRAINAGE LENGTH | = | 350.0 FEET |

NOTE: 100.00 PERCENT OF THE DRAINAGE COLLECTED FROM THIS LAYER IS RECIRCULATED INTO LAYER # 2.

LAYER 6

ALIN_INT.OUT
--------

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

| | | |
|---|---|---|
| THICKNESS | = | 0.06 INCHES |
| POROSITY | = | 0.0000 VOL/VOL |
| FIELD CAPACITY | = | 0.0000 VOL/VOL |
| WILTING POINT | = | 0.0000 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0000 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.199999996000E-12 CM/SEC |
| FML PINHOLE DENSITY | = | 1.00 HOLES/ACRE |
| FML INSTALLATION DEFECTS | = | 2.00 HOLES/ACRE |
| FML PLACEMENT QUALITY | = | 3 - GOOD |

LAYER 7
--------

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 0

| | | |
|---|---|---|
| THICKNESS | = | 0.24 INCHES |
| POROSITY | = | 0.7500 VOL/VOL |
| FIELD CAPACITY | = | 0.7470 VOL/VOL |
| WILTING POINT | = | 0.4000 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.7500 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.499999997000E-08 CM/SEC |

LAYER 8
--------

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 2

| | | |
|---|---|---|
| THICKNESS | = | 6.00 INCHES |
| POROSITY | = | 0.4370 VOL/VOL |
| FIELD CAPACITY | = | 0.0620 VOL/VOL |
| WILTING POINT | = | 0.0240 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0610 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.579999993000E-02 CM/SEC |

GENERAL DESIGN AND EVAPORATIVE ZONE DATA
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NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 6 WITH A POOR STAND OF GRASS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 2000. FEET.

| | | | |
|---|---|---|---|
| SCS RUNOFF CURVE NUMBER | = | 77.50 | |
| FRACTION OF AREA ALLOWING RUNOFF | = | 0.0 | PERCENT |
| AREA PROJECTED ON HORIZONTAL PLANE | = | 1.000 | ACRES |
| EVAPORATIVE ZONE DEPTH | = | 24.0 | INCHES |
| INITIAL WATER IN EVAPORATIVE ZONE | = | 5.026 | INCHES |
| UPPER LIMIT OF EVAPORATIVE STORAGE | = | 13.488 | INCHES |
| LOWER LIMIT OF EVAPORATIVE STORAGE | = | 1.944 | INCHES |

| | | | |
|---|---|---|---|
| INITIAL SNOW WATER | = | 0.000 | INCHES |
| INITIAL WATER IN LAYER MATERIALS | = | 806.647 | INCHES |
| TOTAL INITIAL WATER | = | 806.647 | INCHES |
| TOTAL SUBSURFACE INFLOW | = | 0.00 | INCHES/YEAR |

## EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
EL PASO TEXAS

| | | | |
|---|---|---|---|
| STATION LATITUDE | = | 31.80 | DEGREES |
| MAXIMUM LEAF AREA INDEX | = | 0.00 | |
| START OF GROWING SEASON (JULIAN DATE) | = | 66 | |
| END OF GROWING SEASON (JULIAN DATE) | = | 315 | |
| EVAPORATIVE ZONE DEPTH | = | 24.0 | INCHES |
| AVERAGE ANNUAL WIND SPEED | = | 9.20 | MPH |
| AVERAGE 1ST QUARTER RELATIVE HUMIDITY | = | 40.00 | % |
| AVERAGE 2ND QUARTER RELATIVE HUMIDITY | = | 27.00 | % |
| AVERAGE 3RD QUARTER RELATIVE HUMIDITY | = | 46.00 | % |
| AVERAGE 4TH QUARTER RELATIVE HUMIDITY | = | 48.00 | % |

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

| JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|
| 0.38 | 0.45 | 0.32 | 0.19 | 0.24 | 0.56 |
| 1.60 | 1.21 | 1.42 | 0.73 | 0.33 | 0.39 |

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

| JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|
| 44.20 | 48.40 | 55.10 | 63.60 | 71.90 | 80.80 |
| 82.50 | 80.30 | 74.10 | 63.60 | 51.40 | 44.40 |

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS
AND STATION LATITUDE = 31.80 DEGREES

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## ANNUAL TOTALS FOR YEAR 1

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|

| | | | |
|---|---|---|---|
| PRECIPITATION | 8.15 | 29584.502 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.892 | 28646.201 | 96.83 |
| RECIRCULATION INTO LAYER 2 | 0.013653 | 49.560 | 0.17 |
| DRAINAGE COLLECTED FROM LAYER 5 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 5 | 0.013653 | 49.560 | 0.17 |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.000027 | 0.099 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 6 | 0.2306 | | |
| PERC./LEAKAGE THROUGH LAYER 8 | 0.005007 | 18.177 | 0.06 |
| CHANGE IN WATER STORAGE | 0.254 | 920.350 | 3.11 |
| SOIL WATER AT START OF YEAR | 806.647 | 2928129.250 | |
| SOIL WATER AT END OF YEAR | 806.901 | 2929049.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | -0.0001 | -0.226 | 0.00 |

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ANNUAL TOTALS FOR YEAR 2

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.52 | 30927.602 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 8.918 | 32373.168 | 104.67 |
| RECIRCULATION INTO LAYER 2 | 0.020298 | 73.681 | 0.24 |
| DRAINAGE COLLECTED FROM LAYER 5 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 5 | 0.020298 | 73.681 | 0.24 |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.000040 | 0.147 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 6 | 0.3432 | | |
| PERC./LEAKAGE THROUGH LAYER 8 | 0.004375 | 15.882 | 0.05 |
| CHANGE IN WATER STORAGE | -0.403 | -1461.616 | -4.73 |
| SOIL WATER AT START OF YEAR | 806.901 | 2929049.500 | |

| | | | |
|---|---|---|---|
| SOIL WATER AT END OF YEAR | 806.498 | 2927588.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.167 | 0.00 |

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ANNUAL TOTALS FOR YEAR 3

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 10.09 | 36626.703 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.961 | 28897.416 | 78.90 |
| RECIRCULATION INTO LAYER 2 | 0.023068 | 83.737 | 0.23 |
| DRAINAGE COLLECTED FROM LAYER 5 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 5 | 0.023068 | 83.737 | 0.23 |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.000046 | 0.167 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 6 | 0.3902 | | |
| PERC./LEAKAGE THROUGH LAYER 8 | 0.003882 | 14.092 | 0.04 |
| CHANGE IN WATER STORAGE | 2.125 | 7715.066 | 21.06 |
| SOIL WATER AT START OF YEAR | 806.498 | 2927588.000 | |
| SOIL WATER AT END OF YEAR | 808.140 | 2933547.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.484 | 1755.166 | 4.79 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.131 | 0.00 |

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ANNUAL TOTALS FOR YEAR 4

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.63 | 27696.900 | 100.00 |

| | | | |
|---|---|---|---|
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 8.284 | 30072.559 | 108.58 |
| RECIRCULATION INTO LAYER 2 | 0.024019 | 87.190 | 0.31 |
| DRAINAGE COLLECTED FROM LAYER 5 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 5 | 0.024019 | 87.190 | 0.31 |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.000048 | 0.174 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 6 | 0.4052 | | |
| PERC./LEAKAGE THROUGH LAYER 8 | 0.003495 | 12.688 | 0.05 |
| CHANGE IN WATER STORAGE | -0.658 | -2387.935 | -8.62 |
| SOIL WATER AT START OF YEAR | 808.140 | 2933547.750 | |
| SOIL WATER AT END OF YEAR | 807.966 | 2932915.000 | |
| SNOW WATER AT START OF YEAR | 0.484 | 1755.166 | 6.34 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | -0.0001 | -0.411 | 0.00 |

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ANNUAL TOTALS FOR YEAR 5

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 9.02 | 32742.605 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 8.084 | 29344.531 | 89.62 |
| RECIRCULATION INTO LAYER 2 | 0.023815 | 86.448 | 0.26 |
| DRAINAGE COLLECTED FROM LAYER 5 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 5 | 0.023815 | 86.448 | 0.26 |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.000047 | 0.172 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 6 | 0.4029 | | |
| PERC./LEAKAGE THROUGH LAYER 8 | 0.003161 | 11.473 | 0.04 |
| CHANGE IN WATER STORAGE | 0.933 | 3386.508 | 10.34 |
| SOIL WATER AT START OF YEAR | 807.966 | 2932915.000 | |
| SOIL WATER AT END OF YEAR | 808.898 | 2936301.500 | |

| | | | |
|---|---|---|---|
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.093 | 0.00 |

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ANNUAL TOTALS FOR YEAR 6

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.98 | 28967.406 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 8.677 | 31498.787 | 108.74 |
| RECIRCULATION INTO LAYER 2 | 0.023101 | 83.855 | 0.29 |
| DRAINAGE COLLECTED FROM LAYER 5 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 5 | 0.023101 | 83.855 | 0.29 |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.000046 | 0.167 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 6 | 0.3908 | | |
| PERC./LEAKAGE THROUGH LAYER 8 | 0.002889 | 10.489 | 0.04 |
| CHANGE IN WATER STORAGE | -0.700 | -2541.931 | -8.78 |
| SOIL WATER AT START OF YEAR | 808.898 | 2936301.500 | |
| SOIL WATER AT END OF YEAR | 808.198 | 2933759.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.061 | 0.00 |

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ANNUAL TOTALS FOR YEAR 7

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.77 | 24575.102 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 6.264 | 22739.154 | 92.53 |

| | | | |
|---|---|---|---|
| RECIRCULATION INTO LAYER 2 | 0.022067 | 80.103 | 0.33 |
| DRAINAGE COLLECTED FROM LAYER 5 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 5 | 0.022067 | 80.103 | 0.33 |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.000044 | 0.159 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 6 | 0.3733 | | |
| PERC./LEAKAGE THROUGH LAYER 8 | 0.002660 | 9.655 | 0.04 |
| CHANGE IN WATER STORAGE | 0.503 | 1826.299 | 7.43 |
| SOIL WATER AT START OF YEAR | 808.198 | 2933759.500 | |
| SOIL WATER AT END OF YEAR | 808.701 | 2935586.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.007 | 0.00 |

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ANNUAL TOTALS FOR YEAR 8

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 5.21 | 18912.301 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 4.881 | 17717.299 | 93.68 |
| RECIRCULATION INTO LAYER 2 | 0.020923 | 75.952 | 0.40 |
| DRAINAGE COLLECTED FROM LAYER 5 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 5 | 0.020923 | 75.952 | 0.40 |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.000042 | 0.151 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 6 | 0.3530 | | |
| PERC./LEAKAGE THROUGH LAYER 8 | 0.002469 | 8.962 | 0.05 |
| CHANGE IN WATER STORAGE | 0.327 | 1186.219 | 6.27 |
| SOIL WATER AT START OF YEAR | 808.701 | 2935586.000 | |
| SOIL WATER AT END OF YEAR | 809.028 | 2936772.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |

| | | | |
|---|---|---|---|
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.180 | 0.00 |

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ANNUAL TOTALS FOR YEAR 9

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.01 | 29076.297 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.650 | 27770.994 | 95.51 |
| RECIRCULATION INTO LAYER 2 | 0.019596 | 71.133 | 0.24 |
| DRAINAGE COLLECTED FROM LAYER 5 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 5 | 0.019596 | 71.133 | 0.24 |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.000039 | 0.141 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 6 | 0.3315 | | |
| PERC./LEAKAGE THROUGH LAYER 8 | 0.002291 | 8.316 | 0.03 |
| CHANGE IN WATER STORAGE | 0.357 | 1296.777 | 4.46 |
| SOIL WATER AT START OF YEAR | 809.028 | 2936772.250 | |
| SOIL WATER AT END OF YEAR | 809.385 | 2938069.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0001 | 0.210 | 0.00 |

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ANNUAL TOTALS FOR YEAR 10

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.80 | 24683.996 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.074 | 25677.578 | 104.03 |
| RECIRCULATION INTO LAYER 2 | 0.018318 | 66.495 | 0.27 |

| | | | |
|---|---|---|---|
| DRAINAGE COLLECTED FROM LAYER 5 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 5 | 0.018318 | 66.495 | 0.27 |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.000036 | 0.132 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 6 | 0.3099 | | |
| PERC./LEAKAGE THROUGH LAYER 8 | 0.002141 | 7.773 | 0.03 |
| CHANGE IN WATER STORAGE | -0.276 | -1001.219 | -4.06 |
| SOIL WATER AT START OF YEAR | 809.385 | 2938069.000 | |
| SOIL WATER AT END OF YEAR | 809.110 | 2937067.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.136 | 0.00 |

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ANNUAL TOTALS FOR YEAR 11

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.13 | 25881.900 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.673 | 27851.629 | 107.61 |
| RECIRCULATION INTO LAYER 2 | 0.017069 | 61.961 | 0.24 |
| DRAINAGE COLLECTED FROM LAYER 5 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 5 | 0.017069 | 61.961 | 0.24 |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.000034 | 0.123 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 6 | 0.2888 | | |
| PERC./LEAKAGE THROUGH LAYER 8 | 0.002009 | 7.293 | 0.03 |
| CHANGE IN WATER STORAGE | -0.545 | -1976.959 | -7.64 |
| SOIL WATER AT START OF YEAR | 809.110 | 2937067.750 | |
| SOIL WATER AT END OF YEAR | 808.565 | 2935090.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.063 | 0.00 |

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ANNUAL TOTALS FOR YEAR 12

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 5.05 | 18331.498 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 4.876 | 17700.559 | 96.56 |
| RECIRCULATION INTO LAYER 2 | 0.015914 | 57.766 | 0.32 |
| DRAINAGE COLLECTED FROM LAYER 5 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 5 | 0.015914 | 57.766 | 0.32 |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.000032 | 0.115 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 6 | 0.2685 | | |
| PERC./LEAKAGE THROUGH LAYER 8 | 0.001896 | 6.884 | 0.04 |
| CHANGE IN WATER STORAGE | 0.172 | 623.906 | 3.40 |
| SOIL WATER AT START OF YEAR | 808.565 | 2935090.750 | |
| SOIL WATER AT END OF YEAR | 808.737 | 2935714.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.149 | 0.00 |

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ANNUAL TOTALS FOR YEAR 13

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.36 | 30346.803 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 8.423 | 30576.115 | 100.76 |
| RECIRCULATION INTO LAYER 2 | 0.014736 | 53.491 | 0.18 |
| DRAINAGE COLLECTED FROM LAYER 5 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 5 | 0.014736 | 53.491 | 0.18 |

| | | | |
|---|---|---|---|
| PERC./LEAKAGE THROUGH LAYER 7 | 0.000029 | 0.106 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 6 | 0.2493 | | |
| PERC./LEAKAGE THROUGH LAYER 8 | 0.001786 | 6.483 | 0.02 |
| CHANGE IN WATER STORAGE | -0.065 | -235.737 | -0.78 |
| SOIL WATER AT START OF YEAR | 808.737 | 2935714.750 | |
| SOIL WATER AT END OF YEAR | 808.672 | 2935479.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.058 | 0.00 |

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ANNUAL TOTALS FOR YEAR 14

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.02 | 25482.598 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 6.654 | 24154.359 | 94.79 |
| RECIRCULATION INTO LAYER 2 | 0.013675 | 49.641 | 0.19 |
| DRAINAGE COLLECTED FROM LAYER 5 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 5 | 0.013675 | 49.641 | 0.19 |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.000027 | 0.099 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 6 | 0.2314 | | |
| PERC./LEAKAGE THROUGH LAYER 8 | 0.001691 | 6.139 | 0.02 |
| CHANGE IN WATER STORAGE | 0.364 | 1322.034 | 5.19 |
| SOIL WATER AT START OF YEAR | 808.672 | 2935479.000 | |
| SOIL WATER AT END OF YEAR | 809.036 | 2936801.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.066 | 0.00 |

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ANNUAL TOTALS FOR YEAR 15

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 4.78 | 17351.398 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 4.977 | 18066.865 | 104.12 |
| RECIRCULATION INTO LAYER 2 | 0.012689 | 46.060 | 0.27 |
| DRAINAGE COLLECTED FROM LAYER 5 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 5 | 0.012689 | 46.060 | 0.27 |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.000025 | 0.092 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 6 | 0.2147 | | |
| PERC./LEAKAGE THROUGH LAYER 8 | 0.001606 | 5.828 | 0.03 |
| CHANGE IN WATER STORAGE | -0.199 | -721.170 | -4.16 |
| SOIL WATER AT START OF YEAR | 809.036 | 2936801.000 | |
| SOIL WATER AT END OF YEAR | 808.837 | 2936079.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.125 | 0.00 |

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ANNUAL TOTALS FOR YEAR 16

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.20 | 29766.002 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 8.165 | 29637.604 | 99.57 |
| RECIRCULATION INTO LAYER 2 | 0.011807 | 42.859 | 0.14 |
| DRAINAGE COLLECTED FROM LAYER 5 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 5 | 0.011807 | 42.859 | 0.14 |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.000024 | 0.085 | 0.00 |

| | | | |
|---|---|---|---|
| AVG. HEAD ON TOP OF LAYER 6 | 0.1992 | | |
| PERC./LEAKAGE THROUGH LAYER 8 | 0.001532 | 5.561 | 0.02 |
| CHANGE IN WATER STORAGE | 0.034 | 122.521 | 0.41 |
| SOIL WATER AT START OF YEAR | 808.837 | 2936079.750 | |
| SOIL WATER AT END OF YEAR | 808.871 | 2936202.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0001 | 0.318 | 0.00 |

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ANNUAL TOTALS FOR YEAR 17

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 5.88 | 21344.396 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 6.340 | 23012.902 | 107.82 |
| RECIRCULATION INTO LAYER 2 | 0.010933 | 39.686 | 0.19 |
| DRAINAGE COLLECTED FROM LAYER 5 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 5 | 0.010933 | 39.686 | 0.19 |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.000022 | 0.079 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 6 | 0.1850 | | |
| PERC./LEAKAGE THROUGH LAYER 8 | 0.001456 | 5.287 | 0.02 |
| CHANGE IN WATER STORAGE | -0.461 | -1673.425 | -7.84 |
| SOIL WATER AT START OF YEAR | 808.871 | 2936202.250 | |
| SOIL WATER AT END OF YEAR | 808.410 | 2934528.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | -0.0001 | -0.368 | 0.00 |

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ANNUAL TOTALS FOR YEAR 18

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.59 | 23921.701 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 6.864 | 24916.594 | 104.16 |
| RECIRCULATION INTO LAYER 2 | 0.010160 | 36.881 | 0.15 |
| DRAINAGE COLLECTED FROM LAYER 5 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 5 | 0.010160 | 36.881 | 0.15 |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.000020 | 0.074 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 6 | 0.1719 | | |
| PERC./LEAKAGE THROUGH LAYER 8 | 0.001391 | 5.051 | 0.02 |
| CHANGE IN WATER STORAGE | -0.276 | -1000.111 | -4.18 |
| SOIL WATER AT START OF YEAR | 808.410 | 2934528.750 | |
| SOIL WATER AT END OF YEAR | 808.135 | 2933528.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.168 | 0.00 |

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ANNUAL TOTALS FOR YEAR 19

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.46 | 23449.803 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 6.139 | 22284.383 | 95.03 |
| RECIRCULATION INTO LAYER 2 | 0.009452 | 34.311 | 0.15 |
| DRAINAGE COLLECTED FROM LAYER 5 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 5 | 0.009452 | 34.311 | 0.15 |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.000019 | 0.069 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 6 | 0.1599 | | |
| PERC./LEAKAGE THROUGH LAYER 8 | 0.001331 | 4.833 | 0.02 |

| | | | |
|---|---|---|---|
| CHANGE IN WATER STORAGE | 0.320 | 1160.519 | 4.95 |
| SOIL WATER AT START OF YEAR | 808.135 | 2933528.750 | |
| SOIL WATER AT END OF YEAR | 808.454 | 2934689.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.067 | 0.00 |

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ANNUAL TOTALS FOR YEAR 20

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.50 | 27224.996 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.495 | 27205.129 | 99.93 |
| RECIRCULATION INTO LAYER 2 | 0.008827 | 32.043 | 0.12 |
| DRAINAGE COLLECTED FROM LAYER 5 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 5 | 0.008827 | 32.043 | 0.12 |
| PERC./LEAKAGE THROUGH LAYER 7 | 0.000018 | 0.064 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 6 | 0.1489 | | |
| PERC./LEAKAGE THROUGH LAYER 8 | 0.001280 | 4.645 | 0.02 |
| CHANGE IN WATER STORAGE | 0.004 | 15.287 | 0.06 |
| SOIL WATER AT START OF YEAR | 808.454 | 2934689.250 | |
| SOIL WATER AT END OF YEAR | 808.459 | 2934704.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.065 | 0.00 |

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

| | JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|---|
| **PRECIPITATION** | | | | | | |
| TOTALS | 0.41 | 0.48 | 0.22 | 0.24 | 0.24 | 0.58 |
| | 1.20 | 0.94 | 1.34 | 0.71 | 0.46 | 0.44 |
| STD. DEVIATIONS | 0.38 | 0.54 | 0.21 | 0.33 | 0.26 | 0.53 |
| | 0.64 | 0.47 | 1.06 | 0.66 | 0.53 | 0.34 |
| **RUNOFF** | | | | | | |
| TOTALS | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| STD. DEVIATIONS | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| **EVAPOTRANSPIRATION** | | | | | | |
| TOTALS | 0.367 | 0.379 | 0.321 | 0.275 | 0.207 | 0.352 |
| | 1.033 | 0.957 | 1.462 | 0.813 | 0.593 | 0.405 |
| STD. DEVIATIONS | 0.190 | 0.344 | 0.268 | 0.171 | 0.069 | 0.325 |
| | 0.774 | 0.546 | 0.882 | 0.569 | 0.579 | 0.127 |
| **LATERAL DRAINAGE RECIRCULATED INTO LAYER 2** | | | | | | |
| TOTALS | 0.0014 | 0.0013 | 0.0014 | 0.0014 | 0.0014 | 0.0014 |
| | 0.0014 | 0.0014 | 0.0014 | 0.0014 | 0.0014 | 0.0014 |
| STD. DEVIATIONS | 0.0005 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0004 |
| | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0005 |
| **LATERAL DRAINAGE COLLECTED FROM LAYER 5** | | | | | | |
| TOTALS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **LATERAL DRAINAGE RECIRCULATED FROM LAYER 5** | | | | | | |
| TOTALS | 0.0014 | 0.0013 | 0.0014 | 0.0014 | 0.0014 | 0.0014 |
| | 0.0014 | 0.0014 | 0.0014 | 0.0014 | 0.0014 | 0.0014 |
| STD. DEVIATIONS | 0.0005 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0004 |
| | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0005 |
| **PERCOLATION/LEAKAGE THROUGH LAYER 7** | | | | | | |
| TOTALS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **PERCOLATION/LEAKAGE THROUGH LAYER 8** | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTALS | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 |
| | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 |
| STD. DEVIATIONS | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 6

| | | | | | | |
|---|---|---|---|---|---|---|
| AVERAGES | 0.2814 | 0.2819 | 0.2823 | 0.2826 | 0.2828 | 0.2829 |
| | 0.2829 | 0.2828 | 0.2827 | 0.2824 | 0.2821 | 0.2818 |
| STD. DEVIATIONS | 0.0900 | 0.0890 | 0.0883 | 0.0879 | 0.0877 | 0.0877 |
| | 0.0878 | 0.0880 | 0.0883 | 0.0887 | 0.0892 | 0.0896 |

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

| | INCHES | | CU. FEET | PERCENT |
|---|---|---|---|---|
| PRECIPITATION | 7.26 | ( 1.369) | 26344.7 | 100.00 |
| RUNOFF | 0.000 | ( 0.0000) | 0.00 | 0.000 |
| EVAPOTRANSPIRATION | 7.165 | ( 1.2556) | 26007.19 | 98.719 |
| DRAINAGE RECIRCULATED INTO LAYER 2 | 0.01671 | ( 0.00518) | 60.643 | 0.23019 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 5 | 0.00000 | ( 0.00000) | 0.000 | 0.00000 |
| DRAINAGE RECIRCULATED FROM LAYER 5 | 0.01671 | ( 0.00518) | 60.643 | 0.23019 |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.00003 | ( 0.00001) | 0.121 | 0.00046 |
| AVERAGE HEAD ON TOP OF LAYER 6 | 0.282 | ( 0.088) | | |
| PERCOLATION/LEAKAGE THROUGH LAYER 8 | 0.00242 | ( 0.00108) | 8.776 | 0.03331 |
| CHANGE IN WATER STORAGE | 0.091 | ( 0.6420) | 328.77 | 1.248 |

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 2.02 | 7332.600 |
| RUNOFF | 0.000 | 0.0000 |
| DRAINAGE RECIRCULATED INTO LAYER 2 | 0.00007 | 0.23897 |
| DRAINAGE COLLECTED FROM LAYER 5 | 0.00000 | 0.00000 |
| DRAINAGE RECIRCULATED FROM LAYER 5 | 0.00007 | 0.23897 |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.000000 | 0.00048 |
| AVERAGE HEAD ON TOP OF LAYER 6 | 0.406 | |
| MAXIMUM HEAD ON TOP OF LAYER 6 | 0.765 | |
| LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN) | 20.5 FEET | |
| PERCOLATION/LEAKAGE THROUGH LAYER 8 | 0.000015 | 0.05355 |
| SNOW WATER | 0.56 | 2033.9432 |

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3075

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1017

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 20

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 1.4468 | 0.1206 |
| 2 | 734.7726 | 0.2509 |
| 3 | 70.0800 | 0.2920 |
| 4 | 0.8629 | 0.0719 |
| 5 | 0.7979 | 0.0665 |

ALIN_INT.OUT

| | | |
|---|---|---|
| 6 | 0.0000 | 0.0000 |
| 7 | 0.1800 | 0.7500 |
| 8 | 0.3183 | 0.0531 |
| SNOW WATER | 0.000 | |

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**
**  HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
**  HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)
**  DEVELOPED BY ENVIRONMENTAL LABORATORY
**  USAE WATERWAYS EXPERIMENT STATION
**  FOR USEPA RISK REDUCTION ENGINEERING LABORATORY
**
**
**********
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PRECIPITATION DATA FILE: C:\PROGRAM\ELPASO\PRECIP.D4
TEMPERATURE DATA FILE: C:\PROGRAM\ELPASO\TEMP.D7
SOLAR RADIATION DATA FILE: C:\PROGRAM\ELPASO\SOLAR.D13
EVAPOTRANSPIRATION DATA: C:\PROGRAM\ELPASO\EVAP.D11
SOIL AND DESIGN DATA FILE: C:\PROGRAM\ELPASO\FIN_COV.D10
OUTPUT DATA FILE: C:\PROGRAM\ELPASO\FIN_COV.OUT

TIME: 14:17 DATE: 3/13/2013

**********

TITLE: CLOSED CONDITIONS - PRESCRIBED FINAL COVER

**********

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
WERE SPECIFIED BY THE USER.

LAYER 1
---

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 8

| | | |
|---|---|---|
| THICKNESS | = | 6.00 INCHES |
| POROSITY | = | 0.4630 VOL/VOL |
| FIELD CAPACITY | = | 0.2320 VOL/VOL |
| WILTING POINT | = | 0.1160 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.2639 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.369999994000E-03 CM/SEC |

LAYER 2
---

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 2

| | | | |
|---|---|---|---|
| THICKNESS | = | 12.00 | INCHES |
| POROSITY | = | 0.4370 | VOL/VOL |
| FIELD CAPACITY | = | 0.0620 | VOL/VOL |
| WILTING POINT | = | 0.0240 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0655 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.579999993000E-02 | CM/SEC |
| SLOPE | = | 7.00 | PERCENT |
| DRAINAGE LENGTH | = | 600.0 | FEET |

LAYER 3

TYPE 4 - FLEXIBLE MEMBRANE LINER

MATERIAL TEXTURE NUMBER 36

| | | | |
|---|---|---|---|
| THICKNESS | = | 0.04 | INCHES |
| POROSITY | = | 0.0000 | VOL/VOL |
| FIELD CAPACITY | = | 0.0000 | VOL/VOL |
| WILTING POINT | = | 0.0000 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0000 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.399999993000E-12 | CM/SEC |
| FML PINHOLE DENSITY | = | 1.00 | HOLES/ACRE |
| FML INSTALLATION DEFECTS | = | 2.00 | HOLES/ACRE |
| FML PLACEMENT QUALITY | = | 3 - GOOD | |

LAYER 4

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 0

| | | | |
|---|---|---|---|
| THICKNESS | = | 18.00 | INCHES |
| POROSITY | = | 0.4570 | VOL/VOL |
| FIELD CAPACITY | = | 0.1310 | VOL/VOL |
| WILTING POINT | = | 0.0580 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.4570 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.999999975000E-05 | CM/SEC |

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 6

| | | | |
|---|---|---|---|
| THICKNESS | = | 12.00 | INCHES |
| POROSITY | = | 0.4530 | VOL/VOL |
| FIELD CAPACITY | = | 0.1900 | VOL/VOL |
| WILTING POINT | = | 0.0850 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.1900 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.720000011000E-03 | CM/SEC |

LAYER 6

```
          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  18
  THICKNESS                   =   2928.00   INCHES
  POROSITY                    =      0.6710 VOL/VOL
  FIELD CAPACITY              =      0.2920 VOL/VOL
  WILTING POINT               =      0.0770 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.2500 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC
NOTE:  100.00 PERCENT OF THE DRAINAGE COLLECTED FROM LAYER # 9
         IS RECIRCULATED INTO THIS LAYER.
```

LAYER 7

```
          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  18
  THICKNESS                   =    240.00   INCHES
  POROSITY                    =      0.6710 VOL/VOL
  FIELD CAPACITY              =      0.2920 VOL/VOL
  WILTING POINT               =      0.0770 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.2920 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC
```

LAYER 8

```
          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
  THICKNESS                   =     12.00   INCHES
  POROSITY                    =      0.4370 VOL/VOL
  FIELD CAPACITY              =      0.0620 VOL/VOL
  WILTING POINT               =      0.0240 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.0625 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC
```

LAYER 9

```
            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   0
  THICKNESS                   =     12.00   INCHES
  POROSITY                    =      0.4370 VOL/VOL
  FIELD CAPACITY              =      0.0620 VOL/VOL
  WILTING POINT               =      0.0240 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.0620 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC
  SLOPE                       =      1.00   PERCENT
  DRAINAGE LENGTH             =    350.0    FEET
NOTE:  100.00 PERCENT OF THE DRAINAGE COLLECTED FROM THIS
         LAYER IS RECIRCULATED INTO LAYER #  6.
```

LAYER 10
--------

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

| | | |
|---|---|---|
| THICKNESS | = | 0.06 INCHES |
| POROSITY | = | 0.0000 VOL/VOL |
| FIELD CAPACITY | = | 0.0000 VOL/VOL |
| WILTING POINT | = | 0.0000 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0000 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.199999996000E-12 CM/SEC |
| FML PINHOLE DENSITY | = | 1.00 HOLES/ACRE |
| FML INSTALLATION DEFECTS | = | 2.00 HOLES/ACRE |
| FML PLACEMENT QUALITY | = | 3 - GOOD |

LAYER 11
--------

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 0

| | | |
|---|---|---|
| THICKNESS | = | 0.24 INCHES |
| POROSITY | = | 0.7500 VOL/VOL |
| FIELD CAPACITY | = | 0.7470 VOL/VOL |
| WILTING POINT | = | 0.4000 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.7500 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.499999997000E-08 CM/SEC |

LAYER 12
--------

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 2

| | | |
|---|---|---|
| THICKNESS | = | 6.00 INCHES |
| POROSITY | = | 0.4370 VOL/VOL |
| FIELD CAPACITY | = | 0.0620 VOL/VOL |
| WILTING POINT | = | 0.0240 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0610 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.579999993000E-02 CM/SEC |

GENERAL DESIGN AND EVAPORATIVE ZONE DATA
---

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 8 WITH A POOR STAND OF GRASS, A SURFACE SLOPE OF 7.% AND A SLOPE LENGTH OF 1019. FEET.

| | | | |
|---|---|---|---|
| SCS RUNOFF CURVE NUMBER | = | 85.30 | |
| FRACTION OF AREA ALLOWING RUNOFF | = | 100.0 | PERCENT |
| AREA PROJECTED ON HORIZONTAL PLANE | = | 1.000 | ACRES |
| EVAPORATIVE ZONE DEPTH | = | 18.0 | INCHES |
| INITIAL WATER IN EVAPORATIVE ZONE | = | 2.369 | INCHES |

| | | | |
|---|---|---|---|
| UPPER LIMIT OF EVAPORATIVE STORAGE | = | 8.022 | INCHES |
| LOWER LIMIT OF EVAPORATIVE STORAGE | = | 0.984 | INCHES |
| INITIAL SNOW WATER | = | 0.000 | INCHES |
| INITIAL WATER IN LAYER MATERIALS | = | 816.995 | INCHES |
| TOTAL INITIAL WATER | = | 816.995 | INCHES |
| TOTAL SUBSURFACE INFLOW | = | 0.00 | INCHES/YEAR |

## EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
EL PASO TEXAS

| | | | |
|---|---|---|---|
| STATION LATITUDE | = | 31.80 | DEGREES |
| MAXIMUM LEAF AREA INDEX | = | 0.00 | |
| START OF GROWING SEASON (JULIAN DATE) | = | 66 | |
| END OF GROWING SEASON (JULIAN DATE) | = | 315 | |
| EVAPORATIVE ZONE DEPTH | = | 18.0 | INCHES |
| AVERAGE ANNUAL WIND SPEED | = | 9.20 | MPH |
| AVERAGE 1ST QUARTER RELATIVE HUMIDITY | = | 40.00 | % |
| AVERAGE 2ND QUARTER RELATIVE HUMIDITY | = | 27.00 | % |
| AVERAGE 3RD QUARTER RELATIVE HUMIDITY | = | 46.00 | % |
| AVERAGE 4TH QUARTER RELATIVE HUMIDITY | = | 48.00 | % |

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

| JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|
| 0.38 | 0.45 | 0.32 | 0.19 | 0.24 | 0.56 |
| 1.60 | 1.21 | 1.42 | 0.73 | 0.33 | 0.39 |

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

| JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|
| 44.20 | 48.40 | 55.10 | 63.60 | 71.90 | 80.80 |
| 82.50 | 80.30 | 74.10 | 63.60 | 51.40 | 44.40 |

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS
AND STATION LATITUDE = 31.80 DEGREES

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ANNUAL TOTALS FOR YEAR 1
Page 5

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.15 | 29584.502 | 100.00 |
| RUNOFF | 0.045 | 162.888 | 0.55 |
| EVAPOTRANSPIRATION | 7.789 | 28275.809 | 95.58 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.3761 | 1365.212 | 4.61 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.004509 | 16.368 | 0.06 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.2685 | | |
| RECIRCULATION INTO LAYER 6 | 0.000088 | 0.321 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000088 | 0.321 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.010 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0015 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.005029 | 18.256 | 0.06 |
| CHANGE IN WATER STORAGE | -0.065 | -237.731 | -0.80 |
| SOIL WATER AT START OF YEAR | 816.996 | 2965693.750 | |
| SOIL WATER AT END OF YEAR | 816.930 | 2965456.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.070 | 0.00 |

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ANNUAL TOTALS FOR YEAR 2

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.52 | 30927.602 | 100.00 |
| RUNOFF | 0.138 | 500.881 | 1.62 |
| EVAPOTRANSPIRATION | 9.014 | 32721.529 | 105.80 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.4792 | 1739.435 | 5.62 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.006062 | 22.007 | 0.07 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.3449 | | |
| RECIRCULATION INTO LAYER 6 | 0.000246 | 0.893 | 0.00 |

| | | | |
|---|---|---|---|
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000246 | 0.893 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.011 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0042 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.004403 | 15.982 | 0.05 |
| CHANGE IN WATER STORAGE | -1.116 | -4050.295 | -13.10 |
| SOIL WATER AT START OF YEAR | 816.930 | 2965456.000 | |
| SOIL WATER AT END OF YEAR | 815.814 | 2961405.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.068 | 0.00 |

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ANNUAL TOTALS FOR YEAR 3

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 10.09 | 36626.703 | 100.00 |
| RUNOFF | 0.395 | 1435.112 | 3.92 |
| EVAPOTRANSPIRATION | 7.245 | 26300.625 | 71.81 |
| DRAINAGE COLLECTED FROM LAYER 2 | 1.3129 | 4765.793 | 13.01 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.014796 | 53.711 | 0.15 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.9435 | | |
| RECIRCULATION INTO LAYER 6 | 0.000378 | 1.372 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000378 | 1.372 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.011 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0064 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.003908 | 14.187 | 0.04 |
| CHANGE IN WATER STORAGE | 1.132 | 4110.767 | 11.22 |
| SOIL WATER AT START OF YEAR | 815.814 | 2961405.750 | |
| SOIL WATER AT END OF YEAR | 816.463 | 2963761.500 | |

| | | | |
|---|---|---|---|
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.484 | 1755.166 | 4.79 |
| ANNUAL WATER BUDGET BALANCE | 0.0001 | 0.220 | 0.00 |

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ANNUAL TOTALS FOR YEAR 4

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.63 | 27696.900 | 100.00 |
| RUNOFF | 0.012 | 44.808 | 0.16 |
| EVAPOTRANSPIRATION | 8.292 | 30098.941 | 108.67 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.2750 | 998.220 | 3.60 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.003473 | 12.608 | 0.05 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.1978 | | |
| RECIRCULATION INTO LAYER 6 | 0.000489 | 1.777 | 0.01 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000489 | 1.777 | 0.01 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.012 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0083 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.003518 | 12.769 | 0.05 |
| CHANGE IN WATER STORAGE | -0.953 | -3457.836 | -12.48 |
| SOIL WATER AT START OF YEAR | 816.463 | 2963761.500 | |
| SOIL WATER AT END OF YEAR | 815.994 | 2962058.750 | |
| SNOW WATER AT START OF YEAR | 0.484 | 1755.166 | 6.34 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.002 | 0.00 |

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ANNUAL TOTALS FOR YEAR 5

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 9.02 | 32742.605 | 100.00 |
| RUNOFF | 0.299 | 1085.878 | 3.32 |
| EVAPOTRANSPIRATION | 7.614 | 27637.395 | 84.41 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.4630 | 1680.726 | 5.13 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.005738 | 20.829 | 0.06 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.3307 | | |
| RECIRCULATION INTO LAYER 6 | 0.000580 | 2.104 | 0.01 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000580 | 2.104 | 0.01 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.012 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0098 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.003178 | 11.537 | 0.04 |
| CHANGE IN WATER STORAGE | 0.641 | 2327.241 | 7.11 |
| SOIL WATER AT START OF YEAR | 815.994 | 2962058.750 | |
| SOIL WATER AT END OF YEAR | 816.635 | 2964386.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.172 | 0.00 |

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ANNUAL TOTALS FOR YEAR 6

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.98 | 28967.406 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 8.663 | 31445.102 | 108.55 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.0761 | 276.416 | 0.95 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.001080 | 3.920 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0559 | | |
| RECIRCULATION INTO LAYER 6 | 0.000609 | 2.210 | 0.01 |

| | | | |
|---|---|---|---|
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000609 | 2.210 | 0.01 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.013 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0103 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.002902 | 10.536 | 0.04 |
| CHANGE IN WATER STORAGE | -0.762 | -2764.596 | -9.54 |
| SOIL WATER AT START OF YEAR | 816.635 | 2964386.000 | |
| SOIL WATER AT END OF YEAR | 815.874 | 2961621.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.050 | 0.00 |

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ANNUAL TOTALS FOR YEAR 7

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.77 | 24575.102 | 100.00 |
| RUNOFF | 0.004 | 13.881 | 0.06 |
| EVAPOTRANSPIRATION | 6.011 | 21820.555 | 88.79 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.2226 | 807.936 | 3.29 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.002970 | 10.780 | 0.04 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.1588 | | |
| RECIRCULATION INTO LAYER 6 | 0.000524 | 1.903 | 0.01 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000524 | 1.903 | 0.01 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.012 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0089 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.002668 | 9.687 | 0.04 |
| CHANGE IN WATER STORAGE | 0.530 | 1922.899 | 7.82 |
| SOIL WATER AT START OF YEAR | 815.874 | 2961621.500 | |
| SOIL WATER AT END OF YEAR | 816.403 | 2963544.250 | |

| | | | |
|---|---|---|---|
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.144 | 0.00 |

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ANNUAL TOTALS FOR YEAR 8

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 5.21 | 18912.301 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 4.757 | 17267.916 | 91.31 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.0530 | 192.390 | 1.02 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000754 | 2.738 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0377 | | |
| RECIRCULATION INTO LAYER 6 | 0.000448 | 1.628 | 0.01 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000448 | 1.628 | 0.01 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.012 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0076 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.002474 | 8.981 | 0.05 |
| CHANGE IN WATER STORAGE | 0.398 | 1443.226 | 7.63 |
| SOIL WATER AT START OF YEAR | 816.403 | 2963544.250 | |
| SOIL WATER AT END OF YEAR | 816.801 | 2964987.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | -0.0001 | -0.214 | 0.00 |

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ANNUAL TOTALS FOR YEAR 9

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|

| | | | |
|---|---|---|---|
| PRECIPITATION | 8.01 | 29076.297 | 100.00 |
| RUNOFF | 0.004 | 13.356 | 0.05 |
| EVAPOTRANSPIRATION | 7.682 | 27885.937 | 95.91 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.0586 | 212.805 | 0.73 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000887 | 3.221 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0424 | | |
| RECIRCULATION INTO LAYER 6 | 0.000381 | 1.384 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000381 | 1.384 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.011 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0065 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.002293 | 8.322 | 0.03 |
| CHANGE IN WATER STORAGE | 0.263 | 955.578 | 3.29 |
| SOIL WATER AT START OF YEAR | 816.801 | 2964987.500 | |
| SOIL WATER AT END OF YEAR | 817.064 | 2965943.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0001 | 0.298 | 0.00 |

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ANNUAL TOTALS FOR YEAR 10

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.80 | 24683.996 | 100.00 |
| RUNOFF | 0.004 | 15.514 | 0.06 |
| EVAPOTRANSPIRATION | 7.185 | 26080.900 | 105.66 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.1325 | 480.953 | 1.95 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.001923 | 6.979 | 0.03 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0949 | | |
| RECIRCULATION INTO LAYER 6 | 0.000325 | 1.181 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |

| | | | |
|---|---|---|---|
| RECIRCULATION FROM LAYER 9 | 0.000325 | 1.181 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.011 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0055 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.002140 | 7.768 | 0.03 |
| CHANGE IN WATER STORAGE | -0.524 | -1901.186 | -7.70 |
| SOIL WATER AT START OF YEAR | 817.064 | 2965943.000 | |
| SOIL WATER AT END OF YEAR | 816.540 | 2964042.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.046 | 0.00 |

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ANNUAL TOTALS FOR YEAR 11

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.13 | 25881.900 | 100.00 |
| RUNOFF | 0.008 | 29.090 | 0.11 |
| EVAPOTRANSPIRATION | 7.428 | 26962.074 | 104.17 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.1654 | 600.546 | 2.32 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.002250 | 8.168 | 0.03 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.1186 | | |
| RECIRCULATION INTO LAYER 6 | 0.000277 | 1.007 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000277 | 1.007 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.011 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0047 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.002005 | 7.280 | 0.03 |
| CHANGE IN WATER STORAGE | -0.473 | -1716.850 | -6.63 |
| SOIL WATER AT START OF YEAR | 816.540 | 2964042.000 | |
| SOIL WATER AT END OF YEAR | 816.068 | 2962325.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |

| | | | |
|---|---|---|---|
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | -0.0001 | -0.239 | 0.00 |

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ANNUAL TOTALS FOR YEAR 12

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 5.05 | 18331.498 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 4.318 | 15674.812 | 85.51 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.0443 | 160.905 | 0.88 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000624 | 2.263 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0320 | | |
| RECIRCULATION INTO LAYER 6 | 0.000237 | 0.861 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000237 | 0.861 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.011 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0040 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001891 | 6.864 | 0.04 |
| CHANGE IN WATER STORAGE | 0.686 | 2488.978 | 13.58 |
| SOIL WATER AT START OF YEAR | 816.068 | 2962325.000 | |
| SOIL WATER AT END OF YEAR | 816.753 | 2964814.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.062 | 0.00 |

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ANNUAL TOTALS FOR YEAR 13

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|

| | | | |
|---|---|---|---|
| PRECIPITATION | 8.36 | 30346.803 | 100.00 |
| RUNOFF | 0.045 | 165.124 | 0.54 |
| EVAPOTRANSPIRATION | 8.672 | 31480.215 | 103.73 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.0898 | 325.794 | 1.07 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.001208 | 4.385 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0639 | | |
| RECIRCULATION INTO LAYER 6 | 0.000202 | 0.732 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000202 | 0.732 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.010 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0034 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001779 | 6.456 | 0.02 |
| CHANGE IN WATER STORAGE | -0.449 | -1630.664 | -5.37 |
| SOIL WATER AT START OF YEAR | 816.753 | 2964814.000 | |
| SOIL WATER AT END OF YEAR | 816.304 | 2963183.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.124 | 0.00 |

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ANNUAL TOTALS FOR YEAR 14

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.02 | 25482.598 | 100.00 |
| RUNOFF | 0.091 | 331.375 | 1.30 |
| EVAPOTRANSPIRATION | 6.064 | 22011.268 | 86.38 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.3827 | 1389.294 | 5.45 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.004769 | 17.312 | 0.07 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.2729 | | |
| RECIRCULATION INTO LAYER 6 | 0.000172 | 0.623 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |

| | | | |
|---|---|---|---|
| RECIRCULATION FROM LAYER 9 | 0.000172 | 0.623 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.010 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0029 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001683 | 6.108 | 0.02 |
| CHANGE IN WATER STORAGE | 0.481 | 1744.323 | 6.85 |
| SOIL WATER AT START OF YEAR | 816.304 | 2963183.250 | |
| SOIL WATER AT END OF YEAR | 816.784 | 2964927.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0001 | 0.230 | 0.00 |

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ANNUAL TOTALS FOR YEAR 15

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 4.78 | 17351.398 | 100.00 |
| RUNOFF | 0.001 | 2.318 | 0.01 |
| EVAPOTRANSPIRATION | 4.950 | 17969.369 | 103.56 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.1533 | 556.617 | 3.21 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.002130 | 7.730 | 0.04 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.1115 | | |
| RECIRCULATION INTO LAYER 6 | 0.000146 | 0.531 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000146 | 0.531 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.010 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0025 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001596 | 5.792 | 0.03 |
| CHANGE IN WATER STORAGE | -0.326 | -1182.675 | -6.82 |
| SOIL WATER AT START OF YEAR | 816.784 | 2964927.750 | |
| SOIL WATER AT END OF YEAR | 816.459 | 2963745.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |

| | | | |
|---|---|---|---|
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.024 | 0.00 |

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ANNUAL TOTALS FOR YEAR 16

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.20 | 29766.002 | 100.00 |
| RUNOFF | 0.009 | 34.281 | 0.12 |
| EVAPOTRANSPIRATION | 8.027 | 29137.576 | 97.89 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.2492 | 904.699 | 3.04 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.003064 | 11.121 | 0.04 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.1784 | | |
| RECIRCULATION INTO LAYER 6 | 0.000125 | 0.453 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000125 | 0.453 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.010 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0021 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001521 | 5.521 | 0.02 |
| CHANGE IN WATER STORAGE | -0.087 | -316.163 | -1.06 |
| SOIL WATER AT START OF YEAR | 816.459 | 2963745.000 | |
| SOIL WATER AT END OF YEAR | 816.372 | 2963428.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.089 | 0.00 |

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ANNUAL TOTALS FOR YEAR 17

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 5.88 | 21344.396 | 100.00 |

| | | | |
|---|---|---|---|
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 6.021 | 21857.053 | 102.40 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.2187 | 793.765 | 3.72 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.002939 | 10.669 | 0.05 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.1566 | | |
| RECIRCULATION INTO LAYER 6 | 0.000106 | 0.385 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000106 | 0.385 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.010 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0018 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001445 | 5.245 | 0.02 |
| CHANGE IN WATER STORAGE | -0.361 | -1311.621 | -6.15 |
| SOIL WATER AT START OF YEAR | 816.372 | 2963428.750 | |
| SOIL WATER AT END OF YEAR | 816.010 | 2962117.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.046 | 0.00 |

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ANNUAL TOTALS FOR YEAR 18

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.59 | 23921.701 | 100.00 |
| RUNOFF | 0.085 | 308.085 | 1.29 |
| EVAPOTRANSPIRATION | 6.755 | 24521.504 | 102.51 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.0706 | 256.292 | 1.07 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000897 | 3.257 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0499 | | |
| RECIRCULATION INTO LAYER 6 | 0.000090 | 0.327 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000090 | 0.327 | 0.00 |

| | | | |
|---|---|---|---|
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.010 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0015 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001379 | 5.007 | 0.02 |
| CHANGE IN WATER STORAGE | -0.322 | -1169.160 | -4.89 |
| SOIL WATER AT START OF YEAR | 816.010 | 2962117.250 | |
| SOIL WATER AT END OF YEAR | 815.688 | 2960948.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.027 | 0.00 |

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ANNUAL TOTALS FOR YEAR 19

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.46 | 23449.803 | 100.00 |
| RUNOFF | 0.061 | 220.315 | 0.94 |
| EVAPOTRANSPIRATION | 5.582 | 20264.014 | 86.41 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.3853 | 1398.644 | 5.96 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.004852 | 17.612 | 0.08 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.2756 | | |
| RECIRCULATION INTO LAYER 6 | 0.000077 | 0.278 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000077 | 0.278 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.010 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0013 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001319 | 4.788 | 0.02 |
| CHANGE IN WATER STORAGE | 0.430 | 1561.981 | 6.66 |
| SOIL WATER AT START OF YEAR | 815.688 | 2960948.000 | |
| SOIL WATER AT END OF YEAR | 816.118 | 2962510.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |

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|---|---|---|---|
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.061 | 0.00 |

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ANNUAL TOTALS FOR YEAR 20

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.50 | 27224.996 | 100.00 |
| RUNOFF | 0.005 | 19.677 | 0.07 |
| EVAPOTRANSPIRATION | 7.299 | 26496.207 | 97.32 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.0090 | 32.745 | 0.12 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000142 | 0.516 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0067 | | |
| RECIRCULATION INTO LAYER 6 | 0.000065 | 0.237 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000065 | 0.237 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.010 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0011 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001267 | 4.598 | 0.02 |
| CHANGE IN WATER STORAGE | 0.185 | 671.984 | 2.47 |
| SOIL WATER AT START OF YEAR | 816.118 | 2962510.000 | |
| SOIL WATER AT END OF YEAR | 816.304 | 2963182.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | -0.0001 | -0.215 | 0.00 |

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ANNUAL TOTALS FOR YEAR 21

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 4.95 | 17968.502 | 100.00 |

| | | | |
|---|---|---|---|
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 4.572 | 16597.463 | 92.37 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.0322 | 117.013 | 0.65 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000445 | 1.615 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0228 | | |
| RECIRCULATION INTO LAYER 6 | 0.000055 | 0.200 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000055 | 0.200 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0009 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001212 | 4.399 | 0.02 |
| CHANGE IN WATER STORAGE | 0.344 | 1249.585 | 6.95 |
| SOIL WATER AT START OF YEAR | 816.304 | 2963182.000 | |
| SOIL WATER AT END OF YEAR | 816.648 | 2964431.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.041 | 0.00 |

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ANNUAL TOTALS FOR YEAR 22

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.24 | 29911.195 | 100.00 |
| RUNOFF | 0.219 | 795.778 | 2.66 |
| EVAPOTRANSPIRATION | 8.258 | 29976.916 | 100.22 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.2157 | 783.015 | 2.62 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.002873 | 10.427 | 0.03 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.1548 | | |
| RECIRCULATION INTO LAYER 6 | 0.000047 | 0.170 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000047 | 0.170 | 0.00 |

| | | | |
|---|---|---|---|
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0008 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001164 | 4.227 | 0.01 |
| CHANGE IN WATER STORAGE | -0.454 | -1648.832 | -5.51 |
| SOIL WATER AT START OF YEAR | 816.648 | 2964431.500 | |
| SOIL WATER AT END OF YEAR | 816.194 | 2962782.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.093 | 0.00 |

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ANNUAL TOTALS FOR YEAR 23

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.61 | 23994.301 | 100.00 |
| RUNOFF | 0.006 | 21.986 | 0.09 |
| EVAPOTRANSPIRATION | 6.455 | 23431.910 | 97.66 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.0581 | 210.766 | 0.88 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000854 | 3.098 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0417 | | |
| RECIRCULATION INTO LAYER 6 | 0.000040 | 0.143 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000040 | 0.143 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0007 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001120 | 4.066 | 0.02 |
| CHANGE IN WATER STORAGE | 0.090 | 325.247 | 1.36 |
| SOIL WATER AT START OF YEAR | 816.194 | 2962782.750 | |
| SOIL WATER AT END OF YEAR | 816.283 | 2963108.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |

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|---|---|---|---|
| ANNUAL WATER BUDGET BALANCE | 0.0001 | 0.325 | 0.00 |

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ANNUAL TOTALS FOR YEAR 24

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 5.96 | 21634.799 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 5.270 | 19129.264 | 88.42 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.1708 | 620.141 | 2.87 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.002326 | 8.442 | 0.04 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.1230 | | |
| RECIRCULATION INTO LAYER 6 | 0.000033 | 0.122 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000033 | 0.122 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0006 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001082 | 3.927 | 0.02 |
| CHANGE IN WATER STORAGE | 0.518 | 1881.689 | 8.70 |
| SOIL WATER AT START OF YEAR | 816.283 | 2963108.000 | |
| SOIL WATER AT END OF YEAR | 816.802 | 2964989.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | -0.0001 | -0.222 | 0.00 |

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ANNUAL TOTALS FOR YEAR 25

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.24 | 26281.201 | 100.00 |
| RUNOFF | 0.050 | 181.362 | 0.69 |

| | | | |
|---|---|---|---|
| EVAPOTRANSPIRATION | 7.094 | 25750.363 | 97.98 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.4065 | 1475.691 | 5.62 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.005189 | 18.838 | 0.07 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.2938 | | |
| RECIRCULATION INTO LAYER 6 | 0.000028 | 0.102 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000028 | 0.102 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0005 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001041 | 3.777 | 0.01 |
| CHANGE IN WATER STORAGE | -0.311 | -1129.944 | -4.30 |
| SOIL WATER AT START OF YEAR | 816.802 | 2964989.750 | |
| SOIL WATER AT END OF YEAR | 816.490 | 2963859.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.048 | 0.00 |

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ANNUAL TOTALS FOR YEAR 26

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.83 | 32052.902 | 100.00 |
| RUNOFF | 0.088 | 320.803 | 1.00 |
| EVAPOTRANSPIRATION | 9.043 | 32824.594 | 102.41 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.2936 | 1065.865 | 3.33 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.003883 | 14.094 | 0.04 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.2114 | | |
| RECIRCULATION INTO LAYER 6 | 0.000024 | 0.086 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000024 | 0.086 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.009 | 0.00 |

| | | | |
|---|---|---|---|
| AVG. HEAD ON TOP OF LAYER 10 | 0.0004 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001005 | 3.647 | 0.01 |
| CHANGE IN WATER STORAGE | -0.596 | -2162.181 | -6.75 |
| SOIL WATER AT START OF YEAR | 816.490 | 2963859.750 | |
| SOIL WATER AT END OF YEAR | 815.895 | 2961697.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.174 | 0.00 |

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ANNUAL TOTALS FOR YEAR 27

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.32 | 22941.602 | 100.00 |
| RUNOFF | 0.007 | 26.470 | 0.12 |
| EVAPOTRANSPIRATION | 6.440 | 23378.205 | 101.90 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.0021 | 7.524 | 0.03 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000034 | 0.125 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0015 | | |
| RECIRCULATION INTO LAYER 6 | 0.000020 | 0.072 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000020 | 0.072 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0003 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.000971 | 3.524 | 0.02 |
| CHANGE IN WATER STORAGE | -0.131 | -473.912 | -2.07 |
| SOIL WATER AT START OF YEAR | 815.895 | 2961697.500 | |
| SOIL WATER AT END OF YEAR | 815.764 | 2961223.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | -0.0001 | -0.212 | 0.00 |

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ANNUAL TOTALS FOR YEAR 28

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.90 | 25047.002 | 100.00 |
| RUNOFF | 0.029 | 103.759 | 0.41 |
| EVAPOTRANSPIRATION | 5.883 | 21356.275 | 85.26 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.2362 | 857.288 | 3.42 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.003176 | 11.527 | 0.05 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.1687 | | |
| RECIRCULATION INTO LAYER 6 | 0.000017 | 0.060 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000017 | 0.060 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0003 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.000942 | 3.419 | 0.01 |
| CHANGE IN WATER STORAGE | 0.751 | 2726.045 | 10.88 |
| SOIL WATER AT START OF YEAR | 815.764 | 2961223.750 | |
| SOIL WATER AT END OF YEAR | 816.515 | 2963949.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0001 | 0.214 | 0.00 |

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ANNUAL TOTALS FOR YEAR 29

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 9.20 | 33396.008 | 100.00 |
| RUNOFF | 0.000 | 0.395 | 0.00 |

| | | | |
|---|---|---|---|
| EVAPOTRANSPIRATION | 9.447 | 34292.586 | 102.68 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.1167 | 423.518 | 1.27 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.001648 | 5.984 | 0.02 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0832 | | |
| RECIRCULATION INTO LAYER 6 | 0.000014 | 0.050 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000014 | 0.050 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0002 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.000909 | 3.301 | 0.01 |
| CHANGE IN WATER STORAGE | -0.365 | -1323.807 | -3.96 |
| SOIL WATER AT START OF YEAR | 816.515 | 2963949.750 | |
| SOIL WATER AT END OF YEAR | 816.150 | 2962626.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.015 | 0.00 |

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ANNUAL TOTALS FOR YEAR 30

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.05 | 29221.498 | 100.00 |
| RUNOFF | 0.000 | 1.435 | 0.00 |
| EVAPOTRANSPIRATION | 7.878 | 28596.102 | 97.86 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.1726 | 626.642 | 2.14 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.002434 | 8.835 | 0.03 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.1243 | | |
| RECIRCULATION INTO LAYER 6 | 0.000011 | 0.041 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000011 | 0.041 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.009 | 0.00 |

| | | | |
|---|---|---|---|
| AVG. HEAD ON TOP OF LAYER 10 | 0.0002 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.000881 | 3.200 | 0.01 |
| CHANGE IN WATER STORAGE | -0.002 | -5.539 | -0.02 |
| SOIL WATER AT START OF YEAR | 816.150 | 2962626.000 | |
| SOIL WATER AT END OF YEAR | 816.149 | 2962620.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | -0.0001 | -0.343 | 0.00 |

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

| | JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|---|
| PRECIPITATION | | | | | | |
| TOTALS | 0.45 | 0.43 | 0.25 | 0.22 | 0.27 | 0.51 |
| | 1.35 | 1.00 | 1.25 | 0.70 | 0.40 | 0.41 |
| STD. DEVIATIONS | 0.42 | 0.48 | 0.23 | 0.27 | 0.28 | 0.49 |
| | 1.10 | 0.55 | 1.00 | 0.62 | 0.49 | 0.32 |
| RUNOFF | | | | | | |
| TOTALS | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | 0.012 | 0.000 | 0.036 | 0.002 | 0.000 | 0.000 |
| STD. DEVIATIONS | 0.008 | 0.000 | 0.000 | 0.001 | 0.001 | 0.001 |
| | 0.043 | 0.002 | 0.091 | 0.008 | 0.001 | 0.000 |
| EVAPOTRANSPIRATION | | | | | | |
| TOTALS | 0.409 | 0.356 | 0.310 | 0.246 | 0.185 | 0.343 |
| | 1.186 | 1.032 | 1.374 | 0.714 | 0.466 | 0.370 |
| STD. DEVIATIONS | 0.372 | 0.355 | 0.235 | 0.233 | 0.069 | 0.372 |
| | 0.985 | 0.617 | 0.849 | 0.484 | 0.467 | 0.266 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 2 | | | | | | |
| TOTALS | 0.0162 | 0.0152 | 0.0115 | 0.0131 | 0.0127 | 0.0128 |
| | 0.0103 | 0.0134 | 0.0312 | 0.0434 | 0.0296 | 0.0215 |
| STD. DEVIATIONS | 0.0241 | 0.0206 | 0.0151 | 0.0230 | 0.0231 | 0.0187 |
| | 0.0132 | 0.0218 | 0.0740 | 0.0757 | 0.0533 | 0.0364 |
| PERCOLATION/LEAKAGE THROUGH LAYER 4 | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTALS | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 |
| | 0.0001 | 0.0002 | 0.0004 | 0.0005 | 0.0004 | 0.0003 |
| STD. DEVIATIONS | 0.0003 | 0.0003 | 0.0002 | 0.0003 | 0.0003 | 0.0002 |
| | 0.0002 | 0.0003 | 0.0008 | 0.0008 | 0.0006 | 0.0004 |

LATERAL DRAINAGE RECIRCULATED INTO LAYER 6

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTALS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

LATERAL DRAINAGE COLLECTED FROM LAYER 9

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTALS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

LATERAL DRAINAGE RECIRCULATED FROM LAYER 9

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTALS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

PERCOLATION/LEAKAGE THROUGH LAYER 11

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTALS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

PERCOLATION/LEAKAGE THROUGH LAYER 12

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTALS | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 |
| | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 |
| STD. DEVIATIONS | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |

## AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

| | | | | | | |
|---|---|---|---|---|---|---|
| AVERAGES | 0.1365 | 0.1408 | 0.0976 | 0.1141 | 0.1073 | 0.1115 |
| | 0.0867 | 0.1136 | 0.2725 | 0.3665 | 0.2581 | 0.1814 |
| STD. DEVIATIONS | 0.2038 | 0.1903 | 0.1276 | 0.2012 | 0.1949 | 0.1633 |
| | 0.1112 | 0.1842 | 0.6462 | 0.6400 | 0.4658 | 0.3075 |

DAILY AVERAGE HEAD ON TOP OF LAYER 10

| | | | | | | |
|---|---|---|---|---|---|---|
| AVERAGES | 0.0033 | 0.0033 | 0.0033 | 0.0033 | 0.0033 | 0.0033 |
| | 0.0033 | 0.0033 | 0.0033 | 0.0033 | 0.0033 | 0.0033 |
| STD. DEVIATIONS | 0.0032 | 0.0032 | 0.0032 | 0.0032 | 0.0032 | 0.0032 |
| | 0.0032 | 0.0032 | 0.0032 | 0.0032 | 0.0032 | 0.0032 |

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.25 ( 1.338) | 26311.5 | 100.00 |
| RUNOFF | 0.054 ( 0.0950) | 194.49 | 0.739 |
| EVAPOTRANSPIRATION | 6.990 ( 1.4232) | 25374.75 | 96.440 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 2 | 0.23073 ( 0.24694) | 837.555 | 3.18323 |
| PERCOLATION/LEAKAGE THROUGH LAYER 4 | 0.00293 ( 0.00282) | 10.639 | 0.04044 |
| AVERAGE HEAD ON TOP OF LAYER 3 | 0.166 ( 0.177) | | |
| DRAINAGE RECIRCULATED INTO LAYER 6 | 0.00020 ( 0.00019) | 0.708 | 0.00269 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 9 | 0.00000 ( 0.00000) | 0.000 | 0.00000 |
| DRAINAGE RECIRCULATED FROM LAYER 9 | 0.00020 ( 0.00019) | 0.708 | 0.00269 |
| PERCOLATION/LEAKAGE THROUGH LAYER 11 | 0.00000 ( 0.00000) | 0.010 | 0.00004 |
| AVERAGE HEAD ON TOP OF LAYER 10 | 0.003 ( 0.003) | | |
| PERCOLATION/LEAKAGE THROUGH LAYER 12 | 0.00196 ( 0.00111) | 7.106 | 0.02701 |
| CHANGE IN WATER STORAGE | -0.028 ( 0.5461) | -102.45 | -0.389 |

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 2.02 | 7332.600 |

| | | |
|---|---|---|
| RUNOFF | 0.299 | 1085.1659 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.01602 | 58.15517 |
| PERCOLATION/LEAKAGE THROUGH LAYER 4 | 0.000169 | 0.61463 |
| AVERAGE HEAD ON TOP OF LAYER 3 | 4.197 | |
| MAXIMUM HEAD ON TOP OF LAYER 3 | 7.952 | |
| LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN) | 28.8 FEET | |
| DRAINAGE RECIRCULATED INTO LAYER 6 | 0.00000 | 0.00635 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.00000 | 0.00000 |
| DRAINAGE RECIRCULATED FROM LAYER 9 | 0.00000 | 0.00635 |
| PERCOLATION/LEAKAGE THROUGH LAYER 11 | 0.000000 | 0.00003 |
| AVERAGE HEAD ON TOP OF LAYER 10 | 0.011 | |
| MAXIMUM HEAD ON TOP OF LAYER 10 | 0.021 | |
| LOCATION OF MAXIMUM HEAD IN LAYER 9 (DISTANCE FROM DRAIN) | 1.8 FEET | |
| PERCOLATION/LEAKAGE THROUGH LAYER 12 | 0.000015 | 0.05369 |
| SNOW WATER | 0.56 | 2033.9432 |

| | |
|---|---|
| MAXIMUM VEG. SOIL WATER (VOL/VOL) | 0.2622 |
| MINIMUM VEG. SOIL WATER (VOL/VOL) | 0.0547 |

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 30

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 0.9816 | 0.1636 |
| 2 | 0.5119 | 0.0427 |

| | | |
|---|---|---|
| 3 | 0.0000 | 0.0000 |
| 4 | 8.2260 | 0.4570 |
| 5 | 2.0820 | 0.1735 |
| 6 | 732.2919 | 0.2501 |
| 7 | 70.0800 | 0.2920 |
| 8 | 0.7440 | 0.0620 |
| 9 | 0.7441 | 0.0620 |
| 10 | 0.0000 | 0.0000 |
| 11 | 0.1800 | 0.7500 |
| 12 | 0.3074 | 0.0512 |
| SNOW WATER | 0.000 | |

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**
**  HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE  **
**  HELP MODEL VERSION 3.07 (1 NOVEMBER 1997)  **
**  DEVELOPED BY ENVIRONMENTAL LABORATORY  **
**  USAE WATERWAYS EXPERIMENT STATION  **
**  FOR USEPA RISK REDUCTION ENGINEERING LABORATORY  **
**
**
**********
**********

PRECIPITATION DATA FILE: C:\PROGRAM\ELPASO\PRECIP.D4
TEMPERATURE DATA FILE: C:\PROGRAM\ELPASO\TEMP.D7
SOLAR RADIATION DATA FILE: C:\PROGRAM\ELPASO\SOLAR.D13
EVAPOTRANSPIRATION DATA: C:\PROGRAM\ELPASO\EVAP.D11
SOIL AND DESIGN DATA FILE: C:\PROGRAM\ELPASO\FINCOVSS.D10
OUTPUT DATA FILE: C:\PROGRAM\ELPASO\FINCOVSS.OUT

TIME: 11:24 DATE: 3/13/2013

**********

TITLE: CLOSED CONDITIONS - PRESCRIBED FINAL COVER (SIDESLOPES)

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NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
WERE SPECIFIED BY THE USER.

LAYER 1
---

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 8

| | | | |
|---|---|---|---|
| THICKNESS | = | 6.00 | INCHES |
| POROSITY | = | 0.4630 | VOL/VOL |
| FIELD CAPACITY | = | 0.2320 | VOL/VOL |
| WILTING POINT | = | 0.1160 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.2638 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.369999994000E-03 | CM/SEC |

LAYER 2
---

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 2

| | | | |
|---|---|---|---|
| THICKNESS | = | 12.00 | INCHES |
| POROSITY | = | 0.4370 | VOL/VOL |
| FIELD CAPACITY | = | 0.0620 | VOL/VOL |
| WILTING POINT | = | 0.0240 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0400 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.579999993000E-02 | CM/SEC |
| SLOPE | = | 33.00 | PERCENT |
| DRAINAGE LENGTH | = | 475.0 | FEET |

## LAYER 3

TYPE 4 - FLEXIBLE MEMBRANE LINER

MATERIAL TEXTURE NUMBER 36

| | | | |
|---|---|---|---|
| THICKNESS | = | 0.04 | INCHES |
| POROSITY | = | 0.0000 | VOL/VOL |
| FIELD CAPACITY | = | 0.0000 | VOL/VOL |
| WILTING POINT | = | 0.0000 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0000 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.399999993000E-12 | CM/SEC |
| FML PINHOLE DENSITY | = | 1.00 | HOLES/ACRE |
| FML INSTALLATION DEFECTS | = | 2.00 | HOLES/ACRE |
| FML PLACEMENT QUALITY | = | 3 - GOOD | |

## LAYER 4

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 0

| | | | |
|---|---|---|---|
| THICKNESS | = | 18.00 | INCHES |
| POROSITY | = | 0.4570 | VOL/VOL |
| FIELD CAPACITY | = | 0.1310 | VOL/VOL |
| WILTING POINT | = | 0.0580 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.4570 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.999999975000E-05 | CM/SEC |

## LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 6

| | | | |
|---|---|---|---|
| THICKNESS | = | 12.00 | INCHES |
| POROSITY | = | 0.4530 | VOL/VOL |
| FIELD CAPACITY | = | 0.1900 | VOL/VOL |
| WILTING POINT | = | 0.0850 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.1900 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.720000011000E-03 | CM/SEC |

## LAYER 6

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

| | | |
|---|---|---|
| THICKNESS | = | 2400.00 INCHES |
| POROSITY | = | 0.6710 VOL/VOL |
| FIELD CAPACITY | = | 0.2920 VOL/VOL |
| WILTING POINT | = | 0.0770 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.2500 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.100000005000E-02 CM/SEC |

NOTE: 100.00 PERCENT OF THE DRAINAGE COLLECTED FROM LAYER # 9 IS RECIRCULATED INTO THIS LAYER.

LAYER 7

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

| | | |
|---|---|---|
| THICKNESS | = | 168.00 INCHES |
| POROSITY | = | 0.6710 VOL/VOL |
| FIELD CAPACITY | = | 0.2920 VOL/VOL |
| WILTING POINT | = | 0.0770 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.2920 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.100000005000E-02 CM/SEC |

LAYER 8

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

| | | |
|---|---|---|
| THICKNESS | = | 12.00 INCHES |
| POROSITY | = | 0.4370 VOL/VOL |
| FIELD CAPACITY | = | 0.0620 VOL/VOL |
| WILTING POINT | = | 0.0240 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0621 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.100000005000E-02 CM/SEC |

LAYER 9

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

| | | |
|---|---|---|
| THICKNESS | = | 12.00 INCHES |
| POROSITY | = | 0.4370 VOL/VOL |
| FIELD CAPACITY | = | 0.0620 VOL/VOL |
| WILTING POINT | = | 0.0240 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0620 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.100000005000E-02 CM/SEC |
| SLOPE | = | 1.00 PERCENT |
| DRAINAGE LENGTH | = | 350.0 FEET |

NOTE: 100.00 PERCENT OF THE DRAINAGE COLLECTED FROM THIS LAYER IS RECIRCULATED INTO LAYER # 6.

LAYER 10
--------

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

| | | |
|---|---|---|
| THICKNESS | = | 0.06 INCHES |
| POROSITY | = | 0.0000 VOL/VOL |
| FIELD CAPACITY | = | 0.0000 VOL/VOL |
| WILTING POINT | = | 0.0000 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0000 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.199999996000E-12 CM/SEC |
| FML PINHOLE DENSITY | = | 1.00 HOLES/ACRE |
| FML INSTALLATION DEFECTS | = | 2.00 HOLES/ACRE |
| FML PLACEMENT QUALITY | = | 3 - GOOD |

LAYER 11
--------

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 0

| | | |
|---|---|---|
| THICKNESS | = | 0.24 INCHES |
| POROSITY | = | 0.7500 VOL/VOL |
| FIELD CAPACITY | = | 0.7470 VOL/VOL |
| WILTING POINT | = | 0.4000 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.7500 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.499999997000E-08 CM/SEC |

LAYER 12
--------

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 2

| | | |
|---|---|---|
| THICKNESS | = | 6.00 INCHES |
| POROSITY | = | 0.4370 VOL/VOL |
| FIELD CAPACITY | = | 0.0620 VOL/VOL |
| WILTING POINT | = | 0.0240 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0610 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.579999993000E-02 CM/SEC |

GENERAL DESIGN AND EVAPORATIVE ZONE DATA
---

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 8 WITH A POOR STAND OF GRASS, A SURFACE SLOPE OF 33.% AND A SLOPE LENGTH OF 759. FEET.

| | | | |
|---|---|---|---|
| SCS RUNOFF CURVE NUMBER | = | 86.10 | |
| FRACTION OF AREA ALLOWING RUNOFF | = | 100.0 | PERCENT |
| AREA PROJECTED ON HORIZONTAL PLANE | = | 1.000 | ACRES |
| EVAPORATIVE ZONE DEPTH | = | 18.0 | INCHES |
| INITIAL WATER IN EVAPORATIVE ZONE | = | 2.063 | INCHES |

| | | | |
|---|---|---|---|
| UPPER LIMIT OF EVAPORATIVE STORAGE | = | 8.022 | INCHES |
| LOWER LIMIT OF EVAPORATIVE STORAGE | = | 0.984 | INCHES |
| INITIAL SNOW WATER | = | 0.000 | INCHES |
| INITIAL WATER IN LAYER MATERIALS | = | 663.660 | INCHES |
| TOTAL INITIAL WATER | = | 663.660 | INCHES |
| TOTAL SUBSURFACE INFLOW | = | 0.00 | INCHES/YEAR |

## EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
EL PASO TEXAS

| | | | |
|---|---|---|---|
| STATION LATITUDE | = | 31.80 | DEGREES |
| MAXIMUM LEAF AREA INDEX | = | 0.00 | |
| START OF GROWING SEASON (JULIAN DATE) | = | 66 | |
| END OF GROWING SEASON (JULIAN DATE) | = | 315 | |
| EVAPORATIVE ZONE DEPTH | = | 18.0 | INCHES |
| AVERAGE ANNUAL WIND SPEED | = | 9.20 | MPH |
| AVERAGE 1ST QUARTER RELATIVE HUMIDITY | = | 40.00 | % |
| AVERAGE 2ND QUARTER RELATIVE HUMIDITY | = | 27.00 | % |
| AVERAGE 3RD QUARTER RELATIVE HUMIDITY | = | 46.00 | % |
| AVERAGE 4TH QUARTER RELATIVE HUMIDITY | = | 48.00 | % |

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

| JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|
| 0.38 | 0.45 | 0.32 | 0.19 | 0.24 | 0.56 |
| 1.60 | 1.21 | 1.42 | 0.73 | 0.33 | 0.39 |

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

| JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|
| 44.20 | 48.40 | 55.10 | 63.60 | 71.90 | 80.80 |
| 82.50 | 80.30 | 74.10 | 63.60 | 51.40 | 44.40 |

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS
AND STATION LATITUDE = 31.80 DEGREES

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ANNUAL TOTALS FOR YEAR 1
Page 5

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.15 | 29584.502 | 100.00 |
| RUNOFF | 0.058 | 211.824 | 0.72 |
| EVAPOTRANSPIRATION | 7.644 | 27748.844 | 93.80 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.4531 | 1644.917 | 5.56 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.001090 | 3.957 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0599 | | |
| RECIRCULATION INTO LAYER 6 | 0.000083 | 0.301 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000083 | 0.301 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.010 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0014 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.005029 | 18.256 | 0.06 |
| CHANGE IN WATER STORAGE | -0.011 | -39.437 | -0.13 |
| SOIL WATER AT START OF YEAR | 663.660 | 2409086.000 | |
| SOIL WATER AT END OF YEAR | 663.649 | 2409046.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.099 | 0.00 |

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ANNUAL TOTALS FOR YEAR 2

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.52 | 30927.602 | 100.00 |
| RUNOFF | 0.165 | 598.811 | 1.94 |
| EVAPOTRANSPIRATION | 8.656 | 31422.779 | 101.60 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.6613 | 2400.388 | 7.76 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.001699 | 6.168 | 0.02 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0877 | | |
| RECIRCULATION INTO LAYER 6 | 0.000163 | 0.591 | 0.00 |

| | | | |
|---|---|---|---|
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000163 | 0.591 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.010 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0028 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.004403 | 15.983 | 0.05 |
| CHANGE IN WATER STORAGE | -0.967 | -3510.359 | -11.35 |
| SOIL WATER AT START OF YEAR | 663.649 | 2409046.500 | |
| SOIL WATER AT END OF YEAR | 662.682 | 2405536.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.002 | 0.00 |

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ANNUAL TOTALS FOR YEAR 3

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 10.09 | 36626.703 | 100.00 |
| RUNOFF | 0.423 | 1533.929 | 4.19 |
| EVAPOTRANSPIRATION | 7.134 | 25896.160 | 70.70 |
| DRAINAGE COLLECTED FROM LAYER 2 | 1.8089 | 6566.425 | 17.93 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.003999 | 14.517 | 0.04 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.2414 | | |
| RECIRCULATION INTO LAYER 6 | 0.000139 | 0.506 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000139 | 0.506 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.010 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0024 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.003909 | 14.188 | 0.04 |
| CHANGE IN WATER STORAGE | 0.721 | 2616.139 | 7.14 |
| SOIL WATER AT START OF YEAR | 662.682 | 2405536.250 | |
| SOIL WATER AT END OF YEAR | 662.919 | 2406397.000 | |

| | | | |
|---|---|---|---|
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.484 | 1755.166 | 4.79 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.137 | 0.00 |

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ANNUAL TOTALS FOR YEAR 4

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.63 | 27696.900 | 100.00 |
| RUNOFF | 0.017 | 61.523 | 0.22 |
| EVAPOTRANSPIRATION | 8.108 | 29432.459 | 106.27 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.0594 | 215.626 | 0.78 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000153 | 0.554 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0078 | | |
| RECIRCULATION INTO LAYER 6 | 0.000119 | 0.432 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000119 | 0.432 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.010 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0020 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.003518 | 12.771 | 0.05 |
| CHANGE IN WATER STORAGE | -0.558 | -2025.245 | -7.31 |
| SOIL WATER AT START OF YEAR | 662.919 | 2406397.000 | |
| SOIL WATER AT END OF YEAR | 662.845 | 2406127.000 | |
| SNOW WATER AT START OF YEAR | 0.484 | 1755.166 | 6.34 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | -0.0001 | -0.233 | 0.00 |

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ANNUAL TOTALS FOR YEAR 5

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 9.02 | 32742.605 | 100.00 |
| RUNOFF | 0.340 | 1234.263 | 3.77 |
| EVAPOTRANSPIRATION | 7.432 | 26979.443 | 82.40 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.6796 | 2466.816 | 7.53 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.001578 | 5.728 | 0.02 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0900 | | |
| RECIRCULATION INTO LAYER 6 | 0.000101 | 0.366 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000101 | 0.366 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.010 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0017 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.003179 | 11.539 | 0.04 |
| CHANGE IN WATER STORAGE | 0.565 | 2050.073 | 6.26 |
| SOIL WATER AT START OF YEAR | 662.845 | 2406127.000 | |
| SOIL WATER AT END OF YEAR | 663.410 | 2408177.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0001 | 0.472 | 0.00 |

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ANNUAL TOTALS FOR YEAR 6

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.98 | 28967.406 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 8.410 | 30527.271 | 105.38 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.1787 | 648.570 | 2.24 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000454 | 1.647 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0245 | | |
| RECIRCULATION INTO LAYER 6 | 0.000086 | 0.312 | 0.00 |

| | | | |
|---|---|---|---|
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000086 | 0.312 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.010 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0015 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.002903 | 10.538 | 0.04 |
| CHANGE IN WATER STORAGE | -0.611 | -2218.678 | -7.66 |
| SOIL WATER AT START OF YEAR | 663.410 | 2408177.000 | |
| SOIL WATER AT END OF YEAR | 662.798 | 2405958.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | -0.0001 | -0.294 | 0.00 |

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ANNUAL TOTALS FOR YEAR 7

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.77 | 24575.102 | 100.00 |
| RUNOFF | 0.008 | 27.566 | 0.11 |
| EVAPOTRANSPIRATION | 5.915 | 21471.936 | 87.37 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.2984 | 1083.040 | 4.41 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000783 | 2.843 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0395 | | |
| RECIRCULATION INTO LAYER 6 | 0.000073 | 0.265 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000073 | 0.265 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.010 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0012 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.002669 | 9.688 | 0.04 |
| CHANGE IN WATER STORAGE | 0.546 | 1982.941 | 8.07 |
| SOIL WATER AT START OF YEAR | 662.798 | 2405958.500 | |
| SOIL WATER AT END OF YEAR | 663.345 | 2407941.250 | |

| | | | |
|---|---|---|---|
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.070 | 0.00 |

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ANNUAL TOTALS FOR YEAR 8

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 5.21 | 18912.301 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 5.415 | 19654.744 | 103.93 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.2279 | 827.458 | 4.38 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000584 | 2.120 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0301 | | |
| RECIRCULATION INTO LAYER 6 | 0.000062 | 0.225 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000062 | 0.225 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0010 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.002474 | 8.981 | 0.05 |
| CHANGE IN WATER STORAGE | -0.435 | -1578.820 | -8.35 |
| SOIL WATER AT START OF YEAR | 663.345 | 2407941.250 | |
| SOIL WATER AT END OF YEAR | 662.910 | 2406362.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.064 | 0.00 |

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ANNUAL TOTALS FOR YEAR 9

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|

| | | | |
|---|---|---|---|
| PRECIPITATION | 8.01 | 29076.297 | 100.00 |
| RUNOFF | 0.010 | 35.729 | 0.12 |
| EVAPOTRANSPIRATION | 6.731 | 24431.789 | 84.03 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.0585 | 212.412 | 0.73 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000177 | 0.643 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0078 | | |
| RECIRCULATION INTO LAYER 6 | 0.000052 | 0.190 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000052 | 0.190 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0009 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.002293 | 8.323 | 0.03 |
| CHANGE IN WATER STORAGE | 1.209 | 4387.949 | 15.09 |
| SOIL WATER AT START OF YEAR | 662.910 | 2406362.500 | |
| SOIL WATER AT END OF YEAR | 664.119 | 2410750.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.097 | 0.00 |

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ANNUAL TOTALS FOR YEAR 10

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.80 | 24683.996 | 100.00 |
| RUNOFF | 0.010 | 37.471 | 0.15 |
| EVAPOTRANSPIRATION | 7.192 | 26105.291 | 105.76 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.2766 | 1004.205 | 4.07 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000774 | 2.808 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0367 | | |
| RECIRCULATION INTO LAYER 6 | 0.000044 | 0.161 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |

| | | | |
|---|---|---|---|
| RECIRCULATION FROM LAYER 9 | 0.000044 | 0.161 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0008 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.002140 | 7.768 | 0.03 |
| CHANGE IN WATER STORAGE | -0.681 | -2470.811 | -10.01 |
| SOIL WATER AT START OF YEAR | 664.119 | 2410750.500 | |
| SOIL WATER AT END OF YEAR | 663.438 | 2408279.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.071 | 0.00 |

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ANNUAL TOTALS FOR YEAR 11

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.13 | 25881.900 | 100.00 |
| RUNOFF | 0.016 | 58.877 | 0.23 |
| EVAPOTRANSPIRATION | 7.374 | 26768.617 | 103.43 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.2894 | 1050.683 | 4.06 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000743 | 2.696 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0381 | | |
| RECIRCULATION INTO LAYER 6 | 0.000038 | 0.136 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000038 | 0.136 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0006 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.002005 | 7.279 | 0.03 |
| CHANGE IN WATER STORAGE | -0.552 | -2003.767 | -7.74 |
| SOIL WATER AT START OF YEAR | 663.438 | 2408279.750 | |
| SOIL WATER AT END OF YEAR | 662.886 | 2406276.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |

| | | | |
|---|---|---|---|
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0001 | 0.211 | 0.00 |

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ANNUAL TOTALS FOR YEAR 12

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 5.05 | 18331.498 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 4.611 | 16738.088 | 91.31 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.0502 | 182.170 | 0.99 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000158 | 0.572 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0067 | | |
| RECIRCULATION INTO LAYER 6 | 0.000032 | 0.115 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000032 | 0.115 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0005 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001891 | 6.863 | 0.04 |
| CHANGE IN WATER STORAGE | 0.387 | 1404.454 | 7.66 |
| SOIL WATER AT START OF YEAR | 662.886 | 2406276.000 | |
| SOIL WATER AT END OF YEAR | 663.273 | 2407680.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.078 | 0.00 |

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ANNUAL TOTALS FOR YEAR 13

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|

| | | | |
|---|---|---|---|
| PRECIPITATION | 8.36 | 30346.803 | 100.00 |
| RUNOFF | 0.061 | 220.970 | 0.73 |
| EVAPOTRANSPIRATION | 8.292 | 30098.311 | 99.18 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.0347 | 125.916 | 0.41 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000104 | 0.377 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0046 | | |
| RECIRCULATION INTO LAYER 6 | 0.000027 | 0.097 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000027 | 0.097 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0005 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001778 | 6.456 | 0.02 |
| CHANGE IN WATER STORAGE | -0.029 | -104.797 | -0.35 |
| SOIL WATER AT START OF YEAR | 663.273 | 2407680.250 | |
| SOIL WATER AT END OF YEAR | 663.244 | 2407575.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.055 | 0.00 |

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ANNUAL TOTALS FOR YEAR 14

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.02 | 25482.598 | 100.00 |
| RUNOFF | 0.134 | 484.821 | 1.90 |
| EVAPOTRANSPIRATION | 5.681 | 20623.229 | 80.93 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.9014 | 3272.027 | 12.84 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.002079 | 7.545 | 0.03 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.1193 | | |
| RECIRCULATION INTO LAYER 6 | 0.000022 | 0.081 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |

| | | | |
|---|---|---|---|
| RECIRCULATION FROM LAYER 9 | 0.000022 | 0.081 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0004 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001682 | 6.107 | 0.02 |
| CHANGE IN WATER STORAGE | 0.302 | 1096.489 | 4.30 |
| SOIL WATER AT START OF YEAR | 663.244 | 2407575.500 | |
| SOIL WATER AT END OF YEAR | 663.546 | 2408672.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.073 | 0.00 |

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ANNUAL TOTALS FOR YEAR 15

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 4.78 | 17351.398 | 100.00 |
| RUNOFF | 0.003 | 10.214 | 0.06 |
| EVAPOTRANSPIRATION | 4.911 | 17826.158 | 102.74 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.0252 | 91.357 | 0.53 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000089 | 0.321 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0034 | | |
| RECIRCULATION INTO LAYER 6 | 0.000019 | 0.068 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000019 | 0.068 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0003 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001596 | 5.792 | 0.03 |
| CHANGE IN WATER STORAGE | -0.160 | -582.253 | -3.36 |
| SOIL WATER AT START OF YEAR | 663.546 | 2408672.000 | |
| SOIL WATER AT END OF YEAR | 663.386 | 2408089.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |

| | | | |
|---|---|---|---|
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.130 | 0.00 |

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ANNUAL TOTALS FOR YEAR 16

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.20 | 29766.002 | 100.00 |
| RUNOFF | 0.018 | 63.767 | 0.21 |
| EVAPOTRANSPIRATION | 8.024 | 29125.709 | 97.85 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.4628 | 1680.130 | 5.64 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.001114 | 4.044 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0615 | | |
| RECIRCULATION INTO LAYER 6 | 0.000016 | 0.057 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000016 | 0.057 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0003 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001521 | 5.520 | 0.02 |
| CHANGE IN WATER STORAGE | -0.306 | -1109.117 | -3.73 |
| SOIL WATER AT START OF YEAR | 663.386 | 2408089.750 | |
| SOIL WATER AT END OF YEAR | 663.080 | 2406980.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.005 | 0.00 |

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ANNUAL TOTALS FOR YEAR 17

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 5.88 | 21344.396 | 100.00 |

| | | | |
|---|---|---|---|
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 5.812 | 21097.646 | 98.84 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.1385 | 502.736 | 2.36 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000360 | 1.305 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0186 | | |
| RECIRCULATION INTO LAYER 6 | 0.000013 | 0.047 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000013 | 0.047 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0002 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001445 | 5.244 | 0.02 |
| CHANGE IN WATER STORAGE | -0.072 | -261.216 | -1.22 |
| SOIL WATER AT START OF YEAR | 663.080 | 2406980.750 | |
| SOIL WATER AT END OF YEAR | 663.008 | 2406719.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.012 | 0.00 |

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ANNUAL TOTALS FOR YEAR 18

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.59 | 23921.701 | 100.00 |
| RUNOFF | 0.105 | 381.419 | 1.59 |
| EVAPOTRANSPIRATION | 6.689 | 24279.754 | 101.50 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.1883 | 683.369 | 2.86 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000462 | 1.678 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0247 | | |
| RECIRCULATION INTO LAYER 6 | 0.000011 | 0.039 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000011 | 0.039 | 0.00 |

| | | | |
|---|---|---|---|
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0002 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001379 | 5.006 | 0.02 |
| CHANGE IN WATER STORAGE | -0.393 | -1427.717 | -5.97 |
| SOIL WATER AT START OF YEAR | 663.008 | 2406719.500 | |
| SOIL WATER AT END OF YEAR | 662.615 | 2405291.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.129 | 0.00 |

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ANNUAL TOTALS FOR YEAR 19

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.46 | 23449.803 | 100.00 |
| RUNOFF | 0.079 | 285.507 | 1.22 |
| EVAPOTRANSPIRATION | 5.348 | 19411.705 | 82.78 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.4874 | 1769.168 | 7.54 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.001229 | 4.460 | 0.02 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0647 | | |
| RECIRCULATION INTO LAYER 6 | 0.000009 | 0.032 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000009 | 0.032 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0001 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001319 | 4.787 | 0.02 |
| CHANGE IN WATER STORAGE | 0.545 | 1978.510 | 8.44 |
| SOIL WATER AT START OF YEAR | 662.615 | 2405291.750 | |
| SOIL WATER AT END OF YEAR | 663.160 | 2407270.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |

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|---|---|---|---|
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.125 | 0.00 |

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ANNUAL TOTALS FOR YEAR 20

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.50 | 27224.996 | 100.00 |
| RUNOFF | 0.010 | 35.879 | 0.13 |
| EVAPOTRANSPIRATION | 7.400 | 26860.951 | 98.66 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.0248 | 90.051 | 0.33 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000078 | 0.283 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0033 | | |
| RECIRCULATION INTO LAYER 6 | 0.000007 | 0.026 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000007 | 0.026 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000003 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0001 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001267 | 4.598 | 0.02 |
| CHANGE IN WATER STORAGE | 0.064 | 233.300 | 0.86 |
| SOIL WATER AT START OF YEAR | 663.160 | 2407270.250 | |
| SOIL WATER AT END OF YEAR | 663.224 | 2407503.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0001 | 0.218 | 0.00 |

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ANNUAL TOTALS FOR YEAR 21

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 4.95 | 17968.502 | 100.00 |

| | | | |
|---|---|---|---|
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 4.565 | 16571.598 | 92.23 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.1236 | 448.692 | 2.50 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000344 | 1.248 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0163 | | |
| RECIRCULATION INTO LAYER 6 | 0.000006 | 0.021 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000006 | 0.021 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000002 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0001 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001212 | 4.398 | 0.02 |
| CHANGE IN WATER STORAGE | 0.260 | 944.057 | 5.25 |
| SOIL WATER AT START OF YEAR | 663.224 | 2407503.500 | |
| SOIL WATER AT END OF YEAR | 663.484 | 2408447.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | -0.0001 | -0.244 | 0.00 |

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ANNUAL TOTALS FOR YEAR 22

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.24 | 29911.195 | 100.00 |
| RUNOFF | 0.262 | 951.825 | 3.18 |
| EVAPOTRANSPIRATION | 7.589 | 27547.160 | 92.10 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.2535 | 920.310 | 3.08 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000696 | 2.526 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0333 | | |
| RECIRCULATION INTO LAYER 6 | 0.000005 | 0.017 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000005 | 0.017 | 0.00 |

| | | | |
|---|---|---|---|
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000002 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0001 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001164 | 4.226 | 0.01 |
| CHANGE IN WATER STORAGE | 0.134 | 487.648 | 1.63 |
| SOIL WATER AT START OF YEAR | 663.484 | 2408447.500 | |
| SOIL WATER AT END OF YEAR | 663.619 | 2408935.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.026 | 0.00 |

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ANNUAL TOTALS FOR YEAR 23

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.61 | 23994.301 | 100.00 |
| RUNOFF | 0.012 | 44.551 | 0.19 |
| EVAPOTRANSPIRATION | 6.799 | 24679.566 | 102.86 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.2122 | 770.395 | 3.21 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000541 | 1.966 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0281 | | |
| RECIRCULATION INTO LAYER 6 | 0.000004 | 0.013 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000004 | 0.013 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000002 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0001 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001120 | 4.065 | 0.02 |
| CHANGE IN WATER STORAGE | -0.414 | -1504.376 | -6.27 |
| SOIL WATER AT START OF YEAR | 663.619 | 2408935.250 | |
| SOIL WATER AT END OF YEAR | 663.204 | 2407431.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |

| | | | |
|---|---|---|---|
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.099 | 0.00 |

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ANNUAL TOTALS FOR YEAR 24

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 5.96 | 21634.799 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 5.230 | 18985.828 | 87.76 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.2139 | 776.621 | 3.59 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000584 | 2.118 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0290 | | |
| RECIRCULATION INTO LAYER 6 | 0.000003 | 0.010 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000003 | 0.010 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000002 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001082 | 3.927 | 0.02 |
| CHANGE IN WATER STORAGE | 0.515 | 1868.617 | 8.64 |
| SOIL WATER AT START OF YEAR | 663.204 | 2407431.000 | |
| SOIL WATER AT END OF YEAR | 663.719 | 2409299.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | -0.0001 | -0.194 | 0.00 |

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ANNUAL TOTALS FOR YEAR 25

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.24 | 26281.201 | 100.00 |
| RUNOFF | 0.069 | 250.386 | 0.95 |

| | | | |
|---|---|---|---|
| EVAPOTRANSPIRATION | 6.923 | 25128.979 | 95.62 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.4312 | 1565.391 | 5.96 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.001105 | 4.011 | 0.02 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0581 | | |
| RECIRCULATION INTO LAYER 6 | 0.000002 | 0.007 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000002 | 0.007 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000002 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001040 | 3.776 | 0.01 |
| CHANGE IN WATER STORAGE | -0.184 | -667.332 | -2.54 |
| SOIL WATER AT START OF YEAR | 663.719 | 2409299.500 | |
| SOIL WATER AT END OF YEAR | 663.535 | 2408632.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.000 | 0.00 |

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ANNUAL TOTALS FOR YEAR 26

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.83 | 32052.902 | 100.00 |
| RUNOFF | 0.121 | 440.008 | 1.37 |
| EVAPOTRANSPIRATION | 8.993 | 32643.881 | 101.84 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.4431 | 1608.428 | 5.02 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.001192 | 4.327 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0586 | | |
| RECIRCULATION INTO LAYER 6 | 0.000001 | 0.005 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000001 | 0.005 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000002 | 0.009 | 0.00 |

| | | | |
|---|---|---|---|
| AVG. HEAD ON TOP OF LAYER 10 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.001004 | 3.646 | 0.01 |
| CHANGE IN WATER STORAGE | -0.728 | -2643.182 | -8.25 |
| SOIL WATER AT START OF YEAR | 663.535 | 2408632.250 | |
| SOIL WATER AT END OF YEAR | 662.807 | 2405989.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.123 | 0.00 |

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ANNUAL TOTALS FOR YEAR 27

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.32 | 22941.602 | 100.00 |
| RUNOFF | 0.017 | 60.692 | 0.26 |
| EVAPOTRANSPIRATION | 6.228 | 22608.398 | 98.55 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.1440 | 522.800 | 2.28 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000395 | 1.432 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0188 | | |
| RECIRCULATION INTO LAYER 6 | 0.000001 | 0.003 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000001 | 0.003 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000002 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.000971 | 3.524 | 0.02 |
| CHANGE IN WATER STORAGE | -0.070 | -253.683 | -1.11 |
| SOIL WATER AT START OF YEAR | 662.807 | 2405989.000 | |
| SOIL WATER AT END OF YEAR | 662.737 | 2405735.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.131 | 0.00 |

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ANNUAL TOTALS FOR YEAR 28

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.90 | 25047.002 | 100.00 |
| RUNOFF | 0.023 | 83.078 | 0.33 |
| EVAPOTRANSPIRATION | 5.902 | 21425.982 | 85.54 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.1300 | 471.748 | 1.88 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000366 | 1.330 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0172 | | |
| RECIRCULATION INTO LAYER 6 | 0.000000 | 0.001 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000000 | 0.001 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000002 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.000942 | 3.418 | 0.01 |
| CHANGE IN WATER STORAGE | 0.844 | 3062.812 | 12.23 |
| SOIL WATER AT START OF YEAR | 662.737 | 2405735.250 | |
| SOIL WATER AT END OF YEAR | 663.581 | 2408798.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.038 | 0.00 |

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ANNUAL TOTALS FOR YEAR 29

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 9.20 | 33396.008 | 100.00 |
| RUNOFF | 0.002 | 5.740 | 0.02 |

| | | | |
|---|---|---|---|
| EVAPOTRANSPIRATION | 9.572 | 34745.168 | 104.04 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.1931 | 701.107 | 2.10 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000511 | 1.856 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0258 | | |
| RECIRCULATION INTO LAYER 6 | 0.000000 | 0.000 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000000 | 0.000 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000000 | 0.001 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 10 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.000086 | 0.312 | 0.00 |
| CHANGE IN WATER STORAGE | -0.566 | -2056.276 | -6.16 |
| SOIL WATER AT START OF YEAR | 663.581 | 2408798.000 | |
| SOIL WATER AT END OF YEAR | 663.014 | 2406741.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.044 | 0.00 |

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ANNUAL TOTALS FOR YEAR 30

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.05 | 29221.498 | 100.00 |
| RUNOFF | 0.002 | 7.389 | 0.03 |
| EVAPOTRANSPIRATION | 7.815 | 28369.303 | 97.08 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.2374 | 861.827 | 2.95 |
| PERC./LEAKAGE THROUGH LAYER 4 | 0.000651 | 2.365 | 0.01 |
| AVG. HEAD ON TOP OF LAYER 3 | 0.0319 | | |
| RECIRCULATION INTO LAYER 6 | 0.000000 | 0.000 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 9 | 0.000000 | 0.000 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000000 | 0.000 | 0.00 |

| | | | |
|---|---|---|---|
| AVG. HEAD ON TOP OF LAYER 10 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 12 | 0.000000 | 0.000 | 0.00 |
| CHANGE IN WATER STORAGE | -0.005 | -17.060 | -0.06 |
| SOIL WATER AT START OF YEAR | 663.014 | 2406741.750 | |
| SOIL WATER AT END OF YEAR | 663.010 | 2406724.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.037 | 0.00 |

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

| | JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|---|
| PRECIPITATION | | | | | | |
| TOTALS | 0.45 | 0.43 | 0.25 | 0.22 | 0.27 | 0.51 |
| | 1.35 | 1.00 | 1.25 | 0.70 | 0.40 | 0.41 |
| STD. DEVIATIONS | 0.42 | 0.48 | 0.23 | 0.27 | 0.28 | 0.49 |
| | 1.10 | 0.55 | 1.00 | 0.62 | 0.49 | 0.32 |
| RUNOFF | | | | | | |
| TOTALS | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | 0.016 | 0.001 | 0.042 | 0.003 | 0.000 | 0.000 |
| STD. DEVIATIONS | 0.010 | 0.000 | 0.000 | 0.002 | 0.002 | 0.001 |
| | 0.053 | 0.003 | 0.101 | 0.011 | 0.003 | 0.000 |
| EVAPOTRANSPIRATION | | | | | | |
| TOTALS | 0.451 | 0.370 | 0.313 | 0.230 | 0.177 | 0.252 |
| | 1.151 | 1.043 | 1.324 | 0.701 | 0.464 | 0.405 |
| STD. DEVIATIONS | 0.387 | 0.355 | 0.240 | 0.230 | 0.073 | 0.285 |
| | 0.972 | 0.608 | 0.803 | 0.478 | 0.479 | 0.302 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 2 | | | | | | |
| TOTALS | 0.0117 | 0.0124 | 0.0123 | 0.0139 | 0.0093 | 0.0132 |
| | 0.0248 | 0.0224 | 0.0871 | 0.0820 | 0.0246 | 0.0093 |
| STD. DEVIATIONS | 0.0322 | 0.0304 | 0.0337 | 0.0468 | 0.0287 | 0.0277 |
| | 0.0421 | 0.0365 | 0.2178 | 0.1313 | 0.0524 | 0.0317 |
| PERCOLATION/LEAKAGE THROUGH LAYER 4 | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTALS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0001 | 0.0001 | 0.0002 | 0.0002 | 0.0001 | 0.0000 |
| STD. DEVIATIONS | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| | 0.0001 | 0.0001 | 0.0005 | 0.0003 | 0.0001 | 0.0001 |

LATERAL DRAINAGE RECIRCULATED INTO LAYER 6

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTALS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

LATERAL DRAINAGE COLLECTED FROM LAYER 9

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTALS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

LATERAL DRAINAGE RECIRCULATED FROM LAYER 9

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTALS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

PERCOLATION/LEAKAGE THROUGH LAYER 11

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTALS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

PERCOLATION/LEAKAGE THROUGH LAYER 12

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTALS | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 |
| | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 |
| STD. DEVIATIONS | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |

## AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

| | | | | | | |
|---|---|---|---|---|---|---|
| AVERAGES | 0.0184 | 0.0213 | 0.0192 | 0.0225 | 0.0145 | 0.0213 |
| | 0.0388 | 0.0350 | 0.1409 | 0.1284 | 0.0398 | 0.0146 |
| STD. DEVIATIONS | 0.0504 | 0.0522 | 0.0528 | 0.0758 | 0.0449 | 0.0448 |
| | 0.0659 | 0.0572 | 0.3524 | 0.2055 | 0.0848 | 0.0497 |

DAILY AVERAGE HEAD ON TOP OF LAYER 10

| | | | | | | |
|---|---|---|---|---|---|---|
| AVERAGES | 0.0006 | 0.0006 | 0.0006 | 0.0006 | 0.0006 | 0.0006 |
| | 0.0006 | 0.0006 | 0.0006 | 0.0006 | 0.0006 | 0.0006 |
| STD. DEVIATIONS | 0.0008 | 0.0008 | 0.0008 | 0.0008 | 0.0008 | 0.0008 |
| | 0.0008 | 0.0008 | 0.0008 | 0.0008 | 0.0008 | 0.0008 |

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.25 ( 1.338) | 26311.5 | 100.00 |
| RUNOFF | 0.065 ( 0.1059) | 237.54 | 0.903 |
| EVAPOTRANSPIRATION | 6.880 ( 1.3328) | 24973.56 | 94.915 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 2 | 0.32291 ( 0.35216) | 1172.160 | 4.45494 |
| PERCOLATION/LEAKAGE THROUGH LAYER 4 | 0.00080 ( 0.00079) | 2.915 | 0.01108 |
| AVERAGE HEAD ON TOP OF LAYER 3 | 0.043 ( 0.047) | | |
| DRAINAGE RECIRCULATED INTO LAYER 6 | 0.00004 ( 0.00005) | 0.138 | 0.00052 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 9 | 0.00000 ( 0.00000) | 0.000 | 0.00000 |
| DRAINAGE RECIRCULATED FROM LAYER 9 | 0.00004 ( 0.00005) | 0.138 | 0.00052 |
| PERCOLATION/LEAKAGE THROUGH LAYER 11 | 0.00000 ( 0.00000) | 0.009 | 0.00003 |
| AVERAGE HEAD ON TOP OF LAYER 10 | 0.001 ( 0.001) | | |
| PERCOLATION/LEAKAGE THROUGH LAYER 12 | 0.00190 ( 0.00118) | 6.899 | 0.02622 |
| CHANGE IN WATER STORAGE | -0.022 ( 0.5287) | -78.70 | -0.299 |

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 2.02 | 7332.600 |

| | | |
|---|---|---|
| RUNOFF | 0.338 | 1226.6219 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.06119 | 222.13600 |
| PERCOLATION/LEAKAGE THROUGH LAYER 4 | 0.000123 | 0.44740 |
| AVERAGE HEAD ON TOP OF LAYER 3 | 2.971 | |
| MAXIMUM HEAD ON TOP OF LAYER 3 | 5.850 | |
| LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN) | 0.0 FEET | |
| DRAINAGE RECIRCULATED INTO LAYER 6 | 0.00000 | 0.00174 |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.00000 | 0.00000 |
| DRAINAGE RECIRCULATED FROM LAYER 9 | 0.00000 | 0.00174 |
| PERCOLATION/LEAKAGE THROUGH LAYER 11 | 0.000000 | 0.00003 |
| AVERAGE HEAD ON TOP OF LAYER 10 | 0.003 | |
| MAXIMUM HEAD ON TOP OF LAYER 10 | 0.008 | |
| LOCATION OF MAXIMUM HEAD IN LAYER 9 (DISTANCE FROM DRAIN) | 0.0 FEET | |
| PERCOLATION/LEAKAGE THROUGH LAYER 12 | 0.000015 | 0.05369 |
| SNOW WATER | 0.56 | 2033.9432 |

| | |
|---|---|
| MAXIMUM VEG. SOIL WATER (VOL/VOL) | 0.2613 |
| MINIMUM VEG. SOIL WATER (VOL/VOL) | 0.0547 |

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 30

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 0.9812 | 0.1635 |
| 2 | 0.4640 | 0.0387 |

| | | |
|---|---|---|
| 3 | 0.0000 | 0.0000 |
| 4 | 8.2260 | 0.4570 |
| 5 | 2.0819 | 0.1735 |
| 6 | 600.2233 | 0.2501 |
| 7 | 49.0560 | 0.2920 |
| 8 | 0.7440 | 0.0620 |
| 9 | 0.7440 | 0.0620 |
| 10 | 0.0000 | 0.0000 |
| 11 | 0.1800 | 0.7500 |
| 12 | 0.3091 | 0.0515 |
| SNOW WATER | 0.000 | |

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**                                                                           **
**                                                                           **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                 **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
**                    USAE WATERWAYS EXPERIMENT STATION                      **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY               **
**                                                                           **
**                                                                           **
*******************************************************************************
*******************************************************************************


PRECIPITATION DATA FILE:    C:\PROGRAM\ELPASO\PRECIP.D4
TEMPERATURE DATA FILE:      C:\PROGRAM\ELPASO\TEMP.D7
SOLAR RADIATION DATA FILE:  C:\PROGRAM\ELPASO\SOLAR.D13
EVAPOTRANSPIRATION DATA:    C:\PROGRAM\ELPASO\EVAP.D11
SOIL AND DESIGN DATA FILE:  C:\PROGRAM\ELPASO\FIN_ECOV.D10
OUTPUT DATA FILE:           C:\PROGRAM\ELPASO\FIN_ECOV.OUT


TIME:  10: 6     DATE:   7/17/2013


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     TITLE:  CLOSED CONDITIONS - FINAL COVER_EVAP

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                LAYER  1
                                --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER  21
          THICKNESS                     =      4.00   INCHES
          POROSITY                      =      0.3970 VOL/VOL
          FIELD CAPACITY                =      0.0320 VOL/VOL
          WILTING POINT                 =      0.0130 VOL/VOL
          INITIAL SOIL WATER CONTENT    =      0.0130 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.300000012000     CM/SEC



                                LAYER  2
                                --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
```

MATERIAL TEXTURE NUMBER 0

| | | | |
|---|---|---|---|
| THICKNESS | = | 18.00 | INCHES |
| POROSITY | = | 0.4370 | VOL/VOL |
| FIELD CAPACITY | = | 0.1050 | VOL/VOL |
| WILTING POINT | = | 0.0470 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.1038 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.659999996000E-02 | CM/SEC |

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 0

| | | | |
|---|---|---|---|
| THICKNESS | = | 6.00 | INCHES |
| POROSITY | = | 0.4370 | VOL/VOL |
| FIELD CAPACITY | = | 0.1050 | VOL/VOL |
| WILTING POINT | = | 0.0470 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.1394 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.130000000000E-02 | CM/SEC |

LAYER 4

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 1

| | | | |
|---|---|---|---|
| THICKNESS | = | 12.00 | INCHES |
| POROSITY | = | 0.4170 | VOL/VOL |
| FIELD CAPACITY | = | 0.0450 | VOL/VOL |
| WILTING POINT | = | 0.0180 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0476 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.999999978000E-02 | CM/SEC |

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

| | | | |
|---|---|---|---|
| THICKNESS | = | 2328.00 | INCHES |
| POROSITY | = | 0.6710 | VOL/VOL |
| FIELD CAPACITY | = | 0.2920 | VOL/VOL |
| WILTING POINT | = | 0.0770 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.2500 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.100000005000E-02 | CM/SEC |

LAYER 6

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

| | | | |
|---|---|---|---|
| THICKNESS | = | 240.00 | INCHES |
| POROSITY | = | 0.6710 | VOL/VOL |

FIELD CAPACITY = 0.2920 VOL/VOL
WILTING POINT = 0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000005000E-02 CM/SEC

LAYER 7
---

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0
THICKNESS = 12.00 INCHES
POROSITY = 0.4370 VOL/VOL
FIELD CAPACITY = 0.0620 VOL/VOL
WILTING POINT = 0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0630 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000005000E-02 CM/SEC

LAYER 8
---

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0
THICKNESS = 12.00 INCHES
POROSITY = 0.4370 VOL/VOL
FIELD CAPACITY = 0.0620 VOL/VOL
WILTING POINT = 0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0620 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000005000E-02 CM/SEC

LAYER 9
---

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35
THICKNESS = 0.06 INCHES
POROSITY = 0.0000 VOL/VOL
FIELD CAPACITY = 0.0000 VOL/VOL
WILTING POINT = 0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY = 1.00 HOLES/ACRE
FML INSTALLATION DEFECTS = 2.00 HOLES/ACRE
FML PLACEMENT QUALITY = 3 - GOOD

LAYER 10
---

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 0
THICKNESS = 0.24 INCHES
POROSITY = 0.7500 VOL/VOL

| | | |
|---|---|---|
| FIELD CAPACITY | = | 0.7470 VOL/VOL |
| WILTING POINT | = | 0.4000 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.7500 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.499999997000E-08 CM/SEC |

LAYER 11

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 2

| | | |
|---|---|---|
| THICKNESS | = | 6.00 INCHES |
| POROSITY | = | 0.4370 VOL/VOL |
| FIELD CAPACITY | = | 0.0620 VOL/VOL |
| WILTING POINT | = | 0.0240 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0610 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.579999993000E-02 CM/SEC |

## GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #21 WITH A POOR STAND OF GRASS, A SURFACE SLOPE OF 7.% AND A SLOPE LENGTH OF 1019. FEET.

| | | | |
|---|---|---|---|
| SCS RUNOFF CURVE NUMBER | = | 57.90 | |
| FRACTION OF AREA ALLOWING RUNOFF | = | 100.0 | PERCENT |
| AREA PROJECTED ON HORIZONTAL PLANE | = | 1.000 | ACRES |
| EVAPORATIVE ZONE DEPTH | = | 24.0 | INCHES |
| INITIAL WATER IN EVAPORATIVE ZONE | = | 2.199 | INCHES |
| UPPER LIMIT OF EVAPORATIVE STORAGE | = | 10.328 | INCHES |
| LOWER LIMIT OF EVAPORATIVE STORAGE | = | 0.992 | INCHES |
| INITIAL SNOW WATER | = | 0.000 | INCHES |
| INITIAL WATER IN LAYER MATERIALS | = | 657.454 | INCHES |
| TOTAL INITIAL WATER | = | 657.454 | INCHES |
| TOTAL SUBSURFACE INFLOW | = | 0.00 | INCHES/YEAR |

## EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
EL PASO TEXAS

| | | | |
|---|---|---|---|
| STATION LATITUDE | = | 31.80 | DEGREES |
| MAXIMUM LEAF AREA INDEX | = | 0.00 | |
| START OF GROWING SEASON (JULIAN DATE) | = | 66 | |
| END OF GROWING SEASON (JULIAN DATE) | = | 315 | |
| EVAPORATIVE ZONE DEPTH | = | 24.0 | INCHES |
| AVERAGE ANNUAL WIND SPEED | = | 9.20 | MPH |
| AVERAGE 1ST QUARTER RELATIVE HUMIDITY | = | 40.00 | % |
| AVERAGE 2ND QUARTER RELATIVE HUMIDITY | = | 27.00 | % |
| AVERAGE 3RD QUARTER RELATIVE HUMIDITY | = | 46.00 | % |
| AVERAGE 4TH QUARTER RELATIVE HUMIDITY | = | 48.00 | % |

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

| JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|
| 0.38 | 0.45 | 0.32 | 0.19 | 0.24 | 0.56 |
| 1.60 | 1.21 | 1.42 | 0.73 | 0.33 | 0.39 |

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

| JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|
| 44.20 | 48.40 | 55.10 | 63.60 | 71.90 | 80.80 |
| 82.50 | 80.30 | 74.10 | 63.60 | 51.40 | 44.40 |

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS
AND STATION LATITUDE = 31.80 DEGREES

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ANNUAL TOTALS FOR YEAR 1

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.15 | 29584.502 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.308 | 26527.861 | 89.67 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000003 | 0.010 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0017 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.005029 | 18.256 | 0.06 |
| CHANGE IN WATER STORAGE | 0.837 | 3037.998 | 10.27 |
| SOIL WATER AT START OF YEAR | 657.454 | 2386558.500 | |
| SOIL WATER AT END OF YEAR | 658.291 | 2389596.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0001 | 0.386 | 0.00 |

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ANNUAL TOTALS FOR YEAR 2

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.52 | 30927.602 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 8.155 | 29604.148 | 95.72 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000003 | 0.011 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0051 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.004403 | 15.982 | 0.05 |
| CHANGE IN WATER STORAGE | 0.360 | 1307.633 | 4.23 |
| SOIL WATER AT START OF YEAR | 658.291 | 2389596.500 | |
| SOIL WATER AT END OF YEAR | 658.651 | 2390904.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.162 | 0.00 |

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ANNUAL TOTALS FOR YEAR 3

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 10.09 | 36626.703 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.019 | 25477.959 | 69.56 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000003 | 0.012 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0084 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.003908 | 14.187 | 0.04 |
| CHANGE IN WATER STORAGE | 3.067 | 11134.365 | 30.40 |
| SOIL WATER AT START OF YEAR | 658.651 | 2390904.000 | |

| | | | |
|---|---|---|---|
| SOIL WATER AT END OF YEAR | 661.235 | 2400283.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.484 | 1755.166 | 4.79 |
| ANNUAL WATER BUDGET BALANCE | 0.0001 | 0.193 | 0.00 |

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ANNUAL TOTALS FOR YEAR 4

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.63 | 27696.900 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 8.049 | 29218.904 | 105.50 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000004 | 0.013 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0117 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.003517 | 12.768 | 0.05 |
| CHANGE IN WATER STORAGE | -0.423 | -1534.495 | -5.54 |
| SOIL WATER AT START OF YEAR | 661.235 | 2400283.250 | |
| SOIL WATER AT END OF YEAR | 661.296 | 2400504.000 | |
| SNOW WATER AT START OF YEAR | 0.484 | 1755.166 | 6.34 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | -0.0001 | -0.277 | 0.00 |

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ANNUAL TOTALS FOR YEAR 5

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 9.02 | 32742.605 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.543 | 27381.842 | 83.63 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000004 | 0.014 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0149 | | |

| | | | |
|---|---|---|---|
| PERC./LEAKAGE THROUGH LAYER 11 | 0.003178 | 11.536 | 0.04 |
| CHANGE IN WATER STORAGE | 1.474 | 5349.287 | 16.34 |
| SOIL WATER AT START OF YEAR | 661.296 | 2400504.000 | |
| SOIL WATER AT END OF YEAR | 662.769 | 2405853.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.060 | 0.00 |

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ANNUAL TOTALS FOR YEAR 6

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.98 | 28967.406 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 8.682 | 31514.439 | 108.79 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000004 | 0.015 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0180 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.002902 | 10.534 | 0.04 |
| CHANGE IN WATER STORAGE | -0.705 | -2557.661 | -8.83 |
| SOIL WATER AT START OF YEAR | 662.769 | 2405853.250 | |
| SOIL WATER AT END OF YEAR | 662.065 | 2403295.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.095 | 0.00 |

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ANNUAL TOTALS FOR YEAR 7

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.77 | 24575.102 | 100.00 |

| | | | |
|---|---|---|---|
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 5.687 | 20644.398 | 84.01 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000004 | 0.016 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0211 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.002668 | 9.684 | 0.04 |
| CHANGE IN WATER STORAGE | 1.080 | 3921.127 | 15.96 |
| SOIL WATER AT START OF YEAR | 662.065 | 2403295.500 | |
| SOIL WATER AT END OF YEAR | 663.145 | 2407216.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.107 | 0.00 |

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ANNUAL TOTALS FOR YEAR 8

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 5.21 | 18912.301 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 5.845 | 21217.945 | 112.19 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000005 | 0.017 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0242 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.002473 | 8.977 | 0.05 |
| CHANGE IN WATER STORAGE | -0.638 | -2314.612 | -12.24 |
| SOIL WATER AT START OF YEAR | 663.145 | 2407216.750 | |
| SOIL WATER AT END OF YEAR | 662.507 | 2404902.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.009 | 0.00 |

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ANNUAL TOTALS FOR YEAR 9

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.01 | 29076.297 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.508 | 27253.570 | 93.73 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000005 | 0.018 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0272 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.002292 | 8.318 | 0.03 |
| CHANGE IN WATER STORAGE | 0.500 | 1814.335 | 6.24 |
| SOIL WATER AT START OF YEAR | 662.507 | 2404902.000 | |
| SOIL WATER AT END OF YEAR | 663.007 | 2406716.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.073 | 0.00 |

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ANNUAL TOTALS FOR YEAR 10

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.80 | 24683.996 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 6.588 | 23915.861 | 96.89 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000005 | 0.018 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0302 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.002139 | 7.764 | 0.03 |
| CHANGE IN WATER STORAGE | 0.209 | 760.386 | 3.08 |
| SOIL WATER AT START OF YEAR | 663.007 | 2406716.250 | |
| SOIL WATER AT END OF YEAR | 663.217 | 2407476.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.016 | 0.00 |

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ANNUAL TOTALS FOR YEAR 11

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.13 | 25881.900 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 6.969 | 25295.871 | 97.74 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000005 | 0.019 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0319 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.002004 | 7.275 | 0.03 |
| CHANGE IN WATER STORAGE | 0.159 | 578.930 | 2.24 |
| SOIL WATER AT START OF YEAR | 663.217 | 2407476.750 | |
| SOIL WATER AT END OF YEAR | 663.376 | 2408055.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.175 | 0.00 |

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ANNUAL TOTALS FOR YEAR 12

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 5.05 | 18331.498 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 5.116 | 18570.033 | 101.30 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000005 | 0.019 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0319 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.001890 | 6.859 | 0.04 |
| CHANGE IN WATER STORAGE | -0.068 | -245.486 | -1.34 |
| SOIL WATER AT START OF YEAR | 663.376 | 2408055.750 | |

| | | | |
|---|---|---|---|
| SOIL WATER AT END OF YEAR | 663.309 | 2407810.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.090 | 0.00 |

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ANNUAL TOTALS FOR YEAR 13

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.36 | 30346.803 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.782 | 28249.221 | 93.09 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000005 | 0.019 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0319 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.001777 | 6.452 | 0.02 |
| CHANGE IN WATER STORAGE | 0.576 | 2091.061 | 6.89 |
| SOIL WATER AT START OF YEAR | 663.309 | 2407810.250 | |
| SOIL WATER AT END OF YEAR | 663.885 | 2409901.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.068 | 0.00 |

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ANNUAL TOTALS FOR YEAR 14

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.02 | 25482.598 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 5.714 | 20743.623 | 81.40 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000005 | 0.019 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0319 | | |

| | | | |
|---|---|---|---|
| PERC./LEAKAGE THROUGH LAYER 11 | 0.001681 | 6.104 | 0.02 |
| CHANGE IN WATER STORAGE | 1.304 | 4732.914 | 18.57 |
| SOIL WATER AT START OF YEAR | 663.885 | 2409901.250 | |
| SOIL WATER AT END OF YEAR | 665.188 | 2414634.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.042 | 0.00 |

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ANNUAL TOTALS FOR YEAR 15

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 4.78 | 17351.398 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 5.288 | 19193.857 | 110.62 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000005 | 0.019 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0318 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.001595 | 5.789 | 0.03 |
| CHANGE IN WATER STORAGE | -0.509 | -1848.234 | -10.65 |
| SOIL WATER AT START OF YEAR | 665.188 | 2414634.250 | |
| SOIL WATER AT END OF YEAR | 664.679 | 2412786.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.013 | 0.00 |

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ANNUAL TOTALS FOR YEAR 16

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.20 | 29766.002 | 100.00 |

| | | | |
|---|---|---|---|
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.018 | 25475.930 | 85.59 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000005 | 0.019 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0318 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.001520 | 5.518 | 0.02 |
| CHANGE IN WATER STORAGE | 1.180 | 4284.703 | 14.39 |
| SOIL WATER AT START OF YEAR | 664.679 | 2412786.000 | |
| SOIL WATER AT END OF YEAR | 665.860 | 2417070.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.147 | 0.00 |

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ANNUAL TOTALS FOR YEAR 17

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 5.88 | 21344.396 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 6.142 | 22294.023 | 104.45 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000005 | 0.019 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0318 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.001444 | 5.242 | 0.02 |
| CHANGE IN WATER STORAGE | -0.263 | -954.913 | -4.47 |
| SOIL WATER AT START OF YEAR | 665.860 | 2417070.750 | |
| SOIL WATER AT END OF YEAR | 665.597 | 2416115.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.044 | 0.00 |

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ANNUAL TOTALS FOR YEAR 18

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.59 | 23921.701 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 6.381 | 23164.729 | 96.84 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000005 | 0.019 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0318 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.001378 | 5.004 | 0.02 |
| CHANGE IN WATER STORAGE | 0.207 | 751.967 | 3.14 |
| SOIL WATER AT START OF YEAR | 665.597 | 2416115.750 | |
| SOIL WATER AT END OF YEAR | 665.804 | 2416867.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.002 | 0.00 |

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ANNUAL TOTALS FOR YEAR 19

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.46 | 23449.803 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 5.440 | 19748.779 | 84.22 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000005 | 0.019 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0318 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.001318 | 4.785 | 0.02 |
| CHANGE IN WATER STORAGE | 1.018 | 3696.246 | 15.76 |
| SOIL WATER AT START OF YEAR | 665.804 | 2416867.750 | |
| SOIL WATER AT END OF YEAR | 666.822 | 2420564.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.008 | 0.00 |

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ANNUAL TOTALS FOR YEAR 20

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.50 | 27224.996 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.417 | 26922.061 | 98.89 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000005 | 0.019 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0318 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.001266 | 4.596 | 0.02 |
| CHANGE IN WATER STORAGE | 0.082 | 298.217 | 1.10 |
| SOIL WATER AT START OF YEAR | 666.822 | 2420564.000 | |
| SOIL WATER AT END OF YEAR | 666.904 | 2420862.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.123 | 0.00 |

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ANNUAL TOTALS FOR YEAR 21

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 4.95 | 17968.502 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 5.125 | 18605.199 | 103.54 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000005 | 0.019 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0318 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.001211 | 4.397 | 0.02 |
| CHANGE IN WATER STORAGE | -0.177 | -640.966 | -3.57 |
| SOIL WATER AT START OF YEAR | 666.904 | 2420862.250 | |

| | | | |
|---|---|---|---|
| SOIL WATER AT END OF YEAR | 666.728 | 2420221.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.128 | 0.00 |

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ANNUAL TOTALS FOR YEAR 22

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.24 | 29911.195 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 6.555 | 23795.857 | 79.56 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000005 | 0.019 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0317 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.001164 | 4.224 | 0.01 |
| CHANGE IN WATER STORAGE | 1.684 | 6111.224 | 20.43 |
| SOIL WATER AT START OF YEAR | 666.728 | 2420221.250 | |
| SOIL WATER AT END OF YEAR | 668.411 | 2426332.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.110 | 0.00 |

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ANNUAL TOTALS FOR YEAR 23

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.61 | 23994.301 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 6.657 | 24163.648 | 100.71 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000005 | 0.019 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0317 | | |

| | | | |
|---|---|---|---|
| PERC./LEAKAGE THROUGH LAYER 11 | 0.001120 | 4.064 | 0.02 |
| CHANGE IN WATER STORAGE | -0.048 | -173.480 | -0.72 |
| SOIL WATER AT START OF YEAR | 668.411 | 2426332.500 | |
| SOIL WATER AT END OF YEAR | 668.363 | 2426159.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.067 | 0.00 |

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ANNUAL TOTALS FOR YEAR 24

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 5.96 | 21634.799 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 6.106 | 22165.961 | 102.46 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000005 | 0.019 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0317 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.001081 | 3.926 | 0.02 |
| CHANGE IN WATER STORAGE | -0.147 | -534.840 | -2.47 |
| SOIL WATER AT START OF YEAR | 668.363 | 2426159.000 | |
| SOIL WATER AT END OF YEAR | 668.216 | 2425624.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | -0.0001 | -0.247 | 0.00 |

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ANNUAL TOTALS FOR YEAR 25

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.24 | 26281.201 | 100.00 |

| | | | |
|---|---|---|---|
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 6.414 | 23282.986 | 88.59 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000005 | 0.019 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0317 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.001040 | 3.775 | 0.01 |
| CHANGE IN WATER STORAGE | 0.825 | 2994.130 | 11.39 |
| SOIL WATER AT START OF YEAR | 668.216 | 2425624.000 | |
| SOIL WATER AT END OF YEAR | 669.041 | 2428618.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0001 | 0.310 | 0.00 |

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ANNUAL TOTALS FOR YEAR 26

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.83 | 32052.902 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 8.117 | 29465.127 | 91.93 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000005 | 0.019 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0317 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.001004 | 3.645 | 0.01 |
| CHANGE IN WATER STORAGE | 0.712 | 2584.026 | 8.06 |
| SOIL WATER AT START OF YEAR | 669.041 | 2428618.250 | |
| SOIL WATER AT END OF YEAR | 669.753 | 2431202.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.104 | 0.00 |

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ANNUAL TOTALS FOR YEAR 27

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.32 | 22941.602 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 6.389 | 23191.143 | 101.09 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000005 | 0.019 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0317 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000971 | 3.523 | 0.02 |
| CHANGE IN WATER STORAGE | -0.070 | -252.797 | -1.10 |
| SOIL WATER AT START OF YEAR | 669.753 | 2431202.250 | |
| SOIL WATER AT END OF YEAR | 669.683 | 2430949.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | -0.0001 | -0.267 | 0.00 |

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ANNUAL TOTALS FOR YEAR 28

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.90 | 25047.002 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 5.857 | 21260.109 | 84.88 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000005 | 0.019 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0317 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000941 | 3.418 | 0.01 |
| CHANGE IN WATER STORAGE | 1.042 | 3783.318 | 15.10 |
| SOIL WATER AT START OF YEAR | 669.683 | 2430949.500 | |
| SOIL WATER AT END OF YEAR | 670.725 | 2434732.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.157 | 0.00 |

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ANNUAL TOTALS FOR YEAR 29

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 9.20 | 33396.008 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 9.202 | 33401.609 | 100.02 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000005 | 0.019 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0317 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000909 | 3.300 | 0.01 |
| CHANGE IN WATER STORAGE | -0.003 | -9.084 | -0.03 |
| SOIL WATER AT START OF YEAR | 670.725 | 2434732.750 | |
| SOIL WATER AT END OF YEAR | 670.723 | 2434723.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.179 | 0.00 |

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ANNUAL TOTALS FOR YEAR 30

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.05 | 29221.498 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.844 | 28472.514 | 97.44 |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000005 | 0.019 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 9 | 0.0316 | | |
| PERC./LEAKAGE THROUGH LAYER 11 | 0.000881 | 3.199 | 0.01 |
| CHANGE IN WATER STORAGE | 0.206 | 745.984 | 2.55 |
| SOIL WATER AT START OF YEAR | 670.723 | 2434723.750 | |

| | | | |
|---|---|---|---|
| SOIL WATER AT END OF YEAR | 670.928 | 2435469.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | -0.0001 | -0.199 | 0.00 |

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

| | JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|---|
| **PRECIPITATION** | | | | | | |
| TOTALS | 0.45 | 0.43 | 0.25 | 0.22 | 0.27 | 0.51 |
| | 1.35 | 1.00 | 1.25 | 0.70 | 0.40 | 0.41 |
| STD. DEVIATIONS | 0.42 | 0.48 | 0.23 | 0.27 | 0.28 | 0.49 |
| | 1.10 | 0.55 | 1.00 | 0.62 | 0.49 | 0.32 |
| **RUNOFF** | | | | | | |
| TOTALS | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| STD. DEVIATIONS | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| **EVAPOTRANSPIRATION** | | | | | | |
| TOTALS | 0.464 | 0.378 | 0.304 | 0.236 | 0.217 | 0.351 |
| | 1.151 | 1.047 | 1.170 | 0.647 | 0.441 | 0.393 |
| STD. DEVIATIONS | 0.374 | 0.346 | 0.211 | 0.214 | 0.215 | 0.330 |
| | 0.821 | 0.560 | 0.684 | 0.442 | 0.415 | 0.264 |
| **PERCOLATION/LEAKAGE THROUGH LAYER 10** | | | | | | |
| TOTALS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **PERCOLATION/LEAKAGE THROUGH LAYER 11** | | | | | | |
| TOTALS | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 |
| | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 |
| STD. DEVIATIONS | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 9

| | | | | | | |
|---|---|---|---|---|---|---|
| AVERAGES | 0.0261 | 0.0262 | 0.0263 | 0.0264 | 0.0265 | 0.0265 |
| | 0.0266 | 0.0267 | 0.0268 | 0.0269 | 0.0270 | 0.0271 |
| STD. DEVIATIONS | 0.0098 | 0.0096 | 0.0095 | 0.0094 | 0.0093 | 0.0092 |
| | 0.0091 | 0.0090 | 0.0089 | 0.0088 | 0.0087 | 0.0086 |

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

| | INCHES | | CU. FEET | PERCENT |
|---|---|---|---|---|
| PRECIPITATION | 7.25 | ( 1.338) | 26311.5 | 100.00 |
| RUNOFF | 0.000 | ( 0.0000) | 0.00 | 0.000 |
| EVAPOTRANSPIRATION | 6.797 | ( 1.0802) | 24673.98 | 93.777 |
| PERCOLATION/LEAKAGE THROUGH LAYER 10 | 0.00000 | ( 0.00000) | 0.017 | 0.00007 |
| AVERAGE HEAD ON TOP OF LAYER 9 | 0.027 | ( 0.009) | | |
| PERCOLATION/LEAKAGE THROUGH LAYER 11 | 0.00196 | ( 0.00111) | 7.103 | 0.02700 |
| CHANGE IN WATER STORAGE | 0.449 | ( 0.8090) | 1630.38 | 6.196 |

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 2.02 | 7332.600 |
| RUNOFF | 0.000 | 0.0000 |
| PERCOLATION/LEAKAGE THROUGH LAYER 10 | 0.000000 | 0.00005 |
| AVERAGE HEAD ON TOP OF LAYER 9 | 0.032 | |
| PERCOLATION/LEAKAGE THROUGH LAYER 11 | 0.000015 | 0.05369 |
| SNOW WATER | 0.56 | 2033.9432 |

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.2009

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0519

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FINAL WATER STORAGE AT END OF YEAR 30

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 0.0520 | 0.0130 |
| 2 | 1.4352 | 0.0797 |
| 3 | 0.7443 | 0.1240 |
| 4 | 0.8775 | 0.0731 |
| 5 | 595.7520 | 0.2559 |
| 6 | 70.0800 | 0.2920 |
| 7 | 0.7440 | 0.0620 |
| 8 | 0.7559 | 0.0630 |
| 9 | 0.0000 | 0.0000 |
| 10 | 0.1800 | 0.7500 |
| 11 | 0.3074 | 0.0512 |
| SNOW WATER | 0.000 | |

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**                                                                           **
**                                                                           **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                 **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
**                    USAE WATERWAYS EXPERIMENT STATION                      **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY               **
**                                                                           **
**                                                                           **
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PRECIPITATION DATA FILE:    C:\PROGRAM\ELPASO\PRECIP.D4
TEMPERATURE DATA FILE:      C:\PROGRAM\ELPASO\TEMP.D7
SOLAR RADIATION DATA FILE:  C:\PROGRAM\ELPASO\SOLAR.D13
EVAPOTRANSPIRATION DATA:    C:\PROGRAM\ELPASO\EVAP.D11
SOIL AND DESIGN DATA FILE:  C:\PROGRAM\ELPASO\FINECOSS.D10
OUTPUT DATA FILE:           C:\PROGRAM\ELPASO\FINECOSS.OUT


TIME:  13:53     DATE:   3/13/2013


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     TITLE:  CLOSED CONDITIONS - FINAL COVER_EVAP (SIDESLOPES)

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                LAYER  1
                                --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER  21
          THICKNESS                     =      4.00   INCHES
          POROSITY                      =      0.3970 VOL/VOL
          FIELD CAPACITY                =      0.0320 VOL/VOL
          WILTING POINT                 =      0.0130 VOL/VOL
          INITIAL SOIL WATER CONTENT    =      0.0130 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.300000012000     CM/SEC



                                LAYER  2
                                --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
```

MATERIAL TEXTURE NUMBER 0

| | | | |
|---|---|---|---|
| THICKNESS | = | 18.00 | INCHES |
| POROSITY | = | 0.4370 | VOL/VOL |
| FIELD CAPACITY | = | 0.1050 | VOL/VOL |
| WILTING POINT | = | 0.0470 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0610 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.659999996000E-02 | CM/SEC |

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

| | | | |
|---|---|---|---|
| THICKNESS | = | 6.00 | INCHES |
| POROSITY | = | 0.4370 | VOL/VOL |
| FIELD CAPACITY | = | 0.1050 | VOL/VOL |
| WILTING POINT | = | 0.0470 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0620 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.130000000000E-02 | CM/SEC |

LAYER 4

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 1

| | | | |
|---|---|---|---|
| THICKNESS | = | 12.00 | INCHES |
| POROSITY | = | 0.4170 | VOL/VOL |
| FIELD CAPACITY | = | 0.0450 | VOL/VOL |
| WILTING POINT | = | 0.0180 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0460 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.999999978000E-02 | CM/SEC |

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

| | | | |
|---|---|---|---|
| THICKNESS | = | 2328.00 | INCHES |
| POROSITY | = | 0.6710 | VOL/VOL |
| FIELD CAPACITY | = | 0.2920 | VOL/VOL |
| WILTING POINT | = | 0.0770 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.2500 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.100000005000E-02 | CM/SEC |

NOTE: 85.00 PERCENT OF THE DRAINAGE COLLECTED FROM LAYER # 7
IS RECIRCULATED INTO THIS LAYER.

LAYER 6

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

| | | |
|---|---|---|
| THICKNESS | = | 240.00 INCHES |
| POROSITY | = | 0.6710 VOL/VOL |
| FIELD CAPACITY | = | 0.2920 VOL/VOL |
| WILTING POINT | = | 0.0770 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.2900 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.100000005000E-02 CM/SEC |

LAYER 7

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 2

| | | |
|---|---|---|
| THICKNESS | = | 24.00 INCHES |
| POROSITY | = | 0.4370 VOL/VOL |
| FIELD CAPACITY | = | 0.0620 VOL/VOL |
| WILTING POINT | = | 0.0240 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0630 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.579999993000E-02 CM/SEC |
| SLOPE | = | 1.00 PERCENT |
| DRAINAGE LENGTH | = | 350.0 FEET |

NOTE: 85.00 PERCENT OF THE DRAINAGE COLLECTED FROM THIS LAYER IS RECIRCULATED INTO LAYER # 5.

LAYER 8

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

| | | |
|---|---|---|
| THICKNESS | = | 0.06 INCHES |
| POROSITY | = | 0.0000 VOL/VOL |
| FIELD CAPACITY | = | 0.0000 VOL/VOL |
| WILTING POINT | = | 0.0000 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0000 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.199999996000E-12 CM/SEC |
| FML PINHOLE DENSITY | = | 1.00 HOLES/ACRE |
| FML INSTALLATION DEFECTS | = | 2.00 HOLES/ACRE |
| FML PLACEMENT QUALITY | = | 3 - GOOD |

LAYER 9

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 0

| | | |
|---|---|---|
| THICKNESS | = | 0.24 INCHES |
| POROSITY | = | 0.7500 VOL/VOL |
| FIELD CAPACITY | = | 0.7470 VOL/VOL |
| WILTING POINT | = | 0.4000 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.7500 VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.499999997000E-08 CM/SEC |

LAYER 10

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 2

| | | | |
|---|---|---|---|
| THICKNESS | = | 6.00 | INCHES |
| POROSITY | = | 0.4370 | VOL/VOL |
| FIELD CAPACITY | = | 0.0620 | VOL/VOL |
| WILTING POINT | = | 0.0240 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.0610 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | = | 0.579999993000E-02 | CM/SEC |

## GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #21 WITH A POOR STAND OF GRASS, A SURFACE SLOPE OF 33.% AND A SLOPE LENGTH OF 759. FEET.

| | | | |
|---|---|---|---|
| SCS RUNOFF CURVE NUMBER | = | 60.90 | |
| FRACTION OF AREA ALLOWING RUNOFF | = | 100.0 | PERCENT |
| AREA PROJECTED ON HORIZONTAL PLANE | = | 1.000 | ACRES |
| EVAPORATIVE ZONE DEPTH | = | 24.0 | INCHES |
| INITIAL WATER IN EVAPORATIVE ZONE | = | 1.274 | INCHES |
| UPPER LIMIT OF EVAPORATIVE STORAGE | = | 10.328 | INCHES |
| LOWER LIMIT OF EVAPORATIVE STORAGE | = | 0.992 | INCHES |
| INITIAL SNOW WATER | = | 0.000 | INCHES |
| INITIAL WATER IN LAYER MATERIALS | = | 655.732 | INCHES |
| TOTAL INITIAL WATER | = | 655.732 | INCHES |
| TOTAL SUBSURFACE INFLOW | = | 0.00 | INCHES/YEAR |

## EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
EL PASO TEXAS

| | | | |
|---|---|---|---|
| STATION LATITUDE | = | 31.80 | DEGREES |
| MAXIMUM LEAF AREA INDEX | = | 0.00 | |
| START OF GROWING SEASON (JULIAN DATE) | = | 66 | |
| END OF GROWING SEASON (JULIAN DATE) | = | 315 | |
| EVAPORATIVE ZONE DEPTH | = | 24.0 | INCHES |
| AVERAGE ANNUAL WIND SPEED | = | 9.20 | MPH |
| AVERAGE 1ST QUARTER RELATIVE HUMIDITY | = | 40.00 | % |
| AVERAGE 2ND QUARTER RELATIVE HUMIDITY | = | 27.00 | % |
| AVERAGE 3RD QUARTER RELATIVE HUMIDITY | = | 46.00 | % |
| AVERAGE 4TH QUARTER RELATIVE HUMIDITY | = | 48.00 | % |

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

| JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| 0.38 | 0.45 | 0.32 | 0.19 | 0.24 | 0.56 |
| 1.60 | 1.21 | 1.42 | 0.73 | 0.33 | 0.39 |

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

| JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|
| 44.20 | 48.40 | 55.10 | 63.60 | 71.90 | 80.80 |
| 82.50 | 80.30 | 74.10 | 63.60 | 51.40 | 44.40 |

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS
AND STATION LATITUDE = 31.80 DEGREES

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ANNUAL TOTALS FOR YEAR 1

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.15 | 29584.502 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.221 | 26210.637 | 88.60 |
| RECIRCULATION INTO LAYER 5 | 0.008229 | 29.870 | 0.10 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0015 | 5.271 | 0.02 |
| RECIRCULATION FROM LAYER 7 | 0.008229 | 29.870 | 0.10 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000005 | 0.018 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0282 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.005027 | 18.249 | 0.06 |
| CHANGE IN WATER STORAGE | 0.923 | 3350.173 | 11.32 |
| SOIL WATER AT START OF YEAR | 655.732 | 2380307.000 | |
| SOIL WATER AT END OF YEAR | 656.655 | 2383657.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.173 | 0.00 |

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ANNUAL TOTALS FOR YEAR 2

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.52 | 30927.602 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 8.156 | 29605.127 | 95.72 |
| RECIRCULATION INTO LAYER 5 | 0.006587 | 23.910 | 0.08 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0012 | 4.219 | 0.01 |
| RECIRCULATION FROM LAYER 7 | 0.006587 | 23.910 | 0.08 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000004 | 0.016 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0226 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.004402 | 15.979 | 0.05 |
| CHANGE IN WATER STORAGE | 0.359 | 1302.537 | 4.21 |
| SOIL WATER AT START OF YEAR | 656.655 | 2383657.000 | |
| SOIL WATER AT END OF YEAR | 657.014 | 2384959.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | -0.0001 | -0.262 | 0.00 |

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ANNUAL TOTALS FOR YEAR 3

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 10.09 | 36626.703 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.005 | 25426.576 | 69.42 |
| RECIRCULATION INTO LAYER 5 | 0.003341 | 12.128 | 0.03 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0006 | 2.140 | 0.01 |
| RECIRCULATION FROM LAYER 7 | 0.003341 | 12.128 | 0.03 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000004 | 0.013 | 0.00 |

| | | | |
|---|---|---|---|
| AVG. HEAD ON TOP OF LAYER 8 | 0.0115 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.003909 | 14.189 | 0.04 |
| CHANGE IN WATER STORAGE | 3.081 | 11183.772 | 30.53 |
| SOIL WATER AT START OF YEAR | 657.014 | 2384959.750 | |
| SOIL WATER AT END OF YEAR | 659.611 | 2394388.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.484 | 1755.166 | 4.79 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.026 | 0.00 |

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ANNUAL TOTALS FOR YEAR 4

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.63 | 27696.900 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 8.050 | 29222.422 | 105.51 |
| RECIRCULATION INTO LAYER 5 | 0.001339 | 4.862 | 0.02 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0002 | 0.858 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.001339 | 4.862 | 0.02 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000003 | 0.011 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0046 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.003519 | 12.773 | 0.05 |
| CHANGE IN WATER STORAGE | -0.424 | -1538.926 | -5.56 |
| SOIL WATER AT START OF YEAR | 659.611 | 2394388.250 | |
| SOIL WATER AT END OF YEAR | 659.671 | 2394604.500 | |
| SNOW WATER AT START OF YEAR | 0.484 | 1755.166 | 6.34 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | -0.0001 | -0.226 | 0.00 |

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ANNUAL TOTALS FOR YEAR 5

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 9.02 | 32742.605 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.540 | 27371.637 | 83.60 |
| RECIRCULATION INTO LAYER 5 | 0.000533 | 1.935 | 0.01 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0001 | 0.341 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000533 | 1.935 | 0.01 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000003 | 0.010 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0018 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.003179 | 11.541 | 0.04 |
| CHANGE IN WATER STORAGE | 1.476 | 5359.257 | 16.37 |
| SOIL WATER AT START OF YEAR | 659.671 | 2394604.500 | |
| SOIL WATER AT END OF YEAR | 661.147 | 2399963.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.171 | 0.00 |

ANNUAL TOTALS FOR YEAR 6

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.98 | 28967.406 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 8.687 | 31532.771 | 108.86 |
| RECIRCULATION INTO LAYER 5 | 0.000212 | 0.770 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.136 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000212 | 0.770 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000003 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0007 | | |

| | | | |
|---|---|---|---|
| PERC./LEAKAGE THROUGH LAYER 10 | 0.002904 | 10.540 | 0.04 |
| CHANGE IN WATER STORAGE | -0.710 | -2576.272 | -8.89 |
| SOIL WATER AT START OF YEAR | 661.147 | 2399963.750 | |
| SOIL WATER AT END OF YEAR | 660.437 | 2397387.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0001 | 0.231 | 0.00 |

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ANNUAL TOTALS FOR YEAR 7

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.77 | 24575.102 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 5.688 | 20646.789 | 84.02 |
| RECIRCULATION INTO LAYER 5 | 0.000084 | 0.304 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.054 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000084 | 0.304 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000003 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0003 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.002669 | 9.690 | 0.04 |
| CHANGE IN WATER STORAGE | 1.080 | 3918.689 | 15.95 |
| SOIL WATER AT START OF YEAR | 660.437 | 2397387.500 | |
| SOIL WATER AT END OF YEAR | 661.517 | 2401306.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.121 | 0.00 |

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ANNUAL TOTALS FOR YEAR 8

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 5.21 | 18912.301 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 5.845 | 21217.352 | 112.19 |
| RECIRCULATION INTO LAYER 5 | 0.000032 | 0.117 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.021 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000032 | 0.117 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000003 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0001 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.002475 | 8.983 | 0.05 |
| CHANGE IN WATER STORAGE | -0.638 | -2314.169 | -12.24 |
| SOIL WATER AT START OF YEAR | 661.517 | 2401306.250 | |
| SOIL WATER AT END OF YEAR | 660.879 | 2398992.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.115 | 0.00 |

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ANNUAL TOTALS FOR YEAR 9

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.01 | 29076.297 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.509 | 27256.732 | 93.74 |
| RECIRCULATION INTO LAYER 5 | 0.000012 | 0.042 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.007 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000012 | 0.042 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000002 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.002293 | 8.324 | 0.03 |
| CHANGE IN WATER STORAGE | 0.499 | 1811.234 | 6.23 |

| | | | |
|---|---|---|---|
| SOIL WATER AT START OF YEAR | 660.879 | 2398992.000 | |
| SOIL WATER AT END OF YEAR | 661.378 | 2400803.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.001 | 0.00 |

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ANNUAL TOTALS FOR YEAR 10

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.80 | 24683.996 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 6.591 | 23926.658 | 96.93 |
| RECIRCULATION INTO LAYER 5 | 0.000003 | 0.012 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.002 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000003 | 0.012 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000002 | 0.009 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.002140 | 7.770 | 0.03 |
| CHANGE IN WATER STORAGE | 0.207 | 749.751 | 3.04 |
| SOIL WATER AT START OF YEAR | 661.378 | 2400803.250 | |
| SOIL WATER AT END OF YEAR | 661.585 | 2401553.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | -0.0001 | -0.185 | 0.00 |

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ANNUAL TOTALS FOR YEAR 11

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|

| | | | |
|---|---|---|---|
| PRECIPITATION | 7.13 | 25881.900 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 6.969 | 25297.482 | 97.74 |
| RECIRCULATION INTO LAYER 5 | 0.000000 | 0.001 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000000 | 0.001 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000001 | 0.005 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.001038 | 3.768 | 0.01 |
| CHANGE IN WATER STORAGE | 0.160 | 580.481 | 2.24 |
| SOIL WATER AT START OF YEAR | 661.585 | 2401553.000 | |
| SOIL WATER AT END OF YEAR | 661.745 | 2402133.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.168 | 0.00 |

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ANNUAL TOTALS FOR YEAR 12

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 5.05 | 18331.498 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 5.116 | 18569.332 | 101.30 |
| RECIRCULATION INTO LAYER 5 | 0.000000 | 0.000 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000000 | 0.000 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000000 | 0.000 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000000 | 0.000 | 0.00 |
| CHANGE IN WATER STORAGE | -0.065 | -237.731 | -1.30 |
| SOIL WATER AT START OF YEAR | 661.745 | 2402133.500 | |

| | | | |
|---|---|---|---|
| SOIL WATER AT END OF YEAR | 661.679 | 2401895.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.104 | 0.00 |

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ANNUAL TOTALS FOR YEAR 13

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.36 | 30346.803 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.782 | 28249.398 | 93.09 |
| RECIRCULATION INTO LAYER 5 | 0.000000 | 0.000 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000000 | 0.000 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000000 | 0.000 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000000 | 0.000 | 0.00 |
| CHANGE IN WATER STORAGE | 0.578 | 2097.264 | 6.91 |
| SOIL WATER AT START OF YEAR | 661.679 | 2401895.750 | |
| SOIL WATER AT END OF YEAR | 662.257 | 2403993.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.140 | 0.00 |

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ANNUAL TOTALS FOR YEAR 14

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.02 | 25482.598 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |

| | | | |
|---|---|---|---|
| EVAPOTRANSPIRATION | 5.715 | 20744.443 | 81.41 |
| RECIRCULATION INTO LAYER 5 | 0.000000 | 0.000 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000000 | 0.000 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000000 | 0.000 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000000 | 0.000 | 0.00 |
| CHANGE IN WATER STORAGE | 1.305 | 4738.453 | 18.59 |
| SOIL WATER AT START OF YEAR | 662.257 | 2403993.000 | |
| SOIL WATER AT END OF YEAR | 663.562 | 2408731.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | -0.0001 | -0.298 | 0.00 |

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ANNUAL TOTALS FOR YEAR 15

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 4.78 | 17351.398 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 5.287 | 19191.561 | 110.61 |
| RECIRCULATION INTO LAYER 5 | 0.000000 | 0.000 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000000 | 0.000 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000000 | 0.000 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000000 | 0.000 | 0.00 |
| CHANGE IN WATER STORAGE | -0.507 | -1840.258 | -10.61 |
| SOIL WATER AT START OF YEAR | 663.562 | 2408731.500 | |
| SOIL WATER AT END OF YEAR | 663.055 | 2406891.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |

| | | | |
|---|---|---|---|
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.097 | 0.00 |

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ANNUAL TOTALS FOR YEAR 16

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.20 | 29766.002 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.017 | 25471.768 | 85.57 |
| RECIRCULATION INTO LAYER 5 | 0.000000 | 0.000 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000000 | 0.000 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000000 | 0.000 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000000 | 0.000 | 0.00 |
| CHANGE IN WATER STORAGE | 1.183 | 4294.229 | 14.43 |
| SOIL WATER AT START OF YEAR | 663.055 | 2406891.250 | |
| SOIL WATER AT END OF YEAR | 664.238 | 2411185.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.005 | 0.00 |

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ANNUAL TOTALS FOR YEAR 17

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 5.88 | 21344.396 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 6.140 | 22288.566 | 104.42 |

| | | | |
|---|---|---|---|
| RECIRCULATION INTO LAYER 5 | 0.000000 | 0.000 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000000 | 0.000 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000000 | 0.000 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000000 | 0.000 | 0.00 |
| CHANGE IN WATER STORAGE | -0.260 | -944.279 | -4.42 |
| SOIL WATER AT START OF YEAR | 664.238 | 2411185.500 | |
| SOIL WATER AT END OF YEAR | 663.978 | 2410241.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.109 | 0.00 |

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ANNUAL TOTALS FOR YEAR 18

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.59 | 23921.701 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 6.381 | 23162.354 | 96.83 |
| RECIRCULATION INTO LAYER 5 | 0.000000 | 0.000 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000000 | 0.000 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000000 | 0.000 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000000 | 0.000 | 0.00 |
| CHANGE IN WATER STORAGE | 0.209 | 759.278 | 3.17 |
| SOIL WATER AT START OF YEAR | 663.978 | 2410241.250 | |
| SOIL WATER AT END OF YEAR | 664.187 | 2411000.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |

| | | | |
|---|---|---|---|
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.069 | 0.00 |

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ANNUAL TOTALS FOR YEAR 19

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.46 | 23449.803 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 5.465 | 19838.701 | 84.60 |
| RECIRCULATION INTO LAYER 5 | 0.000000 | 0.000 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000000 | 0.000 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000000 | 0.000 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000000 | 0.000 | 0.00 |
| CHANGE IN WATER STORAGE | 0.995 | 3611.167 | 15.40 |
| SOIL WATER AT START OF YEAR | 664.187 | 2411000.500 | |
| SOIL WATER AT END OF YEAR | 665.182 | 2414611.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.068 | 0.00 |

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ANNUAL TOTALS FOR YEAR 20

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.50 | 27224.996 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.411 | 26902.090 | 98.81 |
| RECIRCULATION INTO LAYER 5 | 0.000000 | 0.000 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.000 | 0.00 |

| | | | |
|---|---|---|---|
| RECIRCULATION FROM LAYER 7 | 0.000000 | 0.000 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000000 | 0.000 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000000 | 0.000 | 0.00 |
| CHANGE IN WATER STORAGE | 0.089 | 323.031 | 1.19 |
| SOIL WATER AT START OF YEAR | 665.182 | 2414611.500 | |
| SOIL WATER AT END OF YEAR | 665.271 | 2414934.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.125 | 0.00 |

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ANNUAL TOTALS FOR YEAR 21

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 4.95 | 17968.502 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 5.121 | 18589.002 | 103.45 |
| RECIRCULATION INTO LAYER 5 | 0.000000 | 0.000 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000000 | 0.000 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000000 | 0.000 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000000 | 0.000 | 0.00 |
| CHANGE IN WATER STORAGE | -0.171 | -620.583 | -3.45 |
| SOIL WATER AT START OF YEAR | 665.271 | 2414934.500 | |
| SOIL WATER AT END OF YEAR | 665.100 | 2414314.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.081 | 0.00 |

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ANNUAL TOTALS FOR YEAR 22

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.24 | 29911.195 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 6.553 | 23787.775 | 79.53 |
| RECIRCULATION INTO LAYER 5 | 0.000000 | 0.000 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000000 | 0.000 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000000 | 0.000 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000000 | 0.000 | 0.00 |
| CHANGE IN WATER STORAGE | 1.687 | 6123.409 | 20.47 |
| SOIL WATER AT START OF YEAR | 665.100 | 2414314.000 | |
| SOIL WATER AT END OF YEAR | 666.787 | 2420437.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.010 | 0.00 |

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ANNUAL TOTALS FOR YEAR 23

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.61 | 23994.301 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 6.650 | 24140.281 | 100.61 |
| RECIRCULATION INTO LAYER 5 | 0.000000 | 0.000 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000000 | 0.000 | 0.00 |

| | | | |
|---|---|---|---|
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000000 | 0.000 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000000 | 0.000 | 0.00 |
| CHANGE IN WATER STORAGE | -0.040 | -145.785 | -0.61 |
| SOIL WATER AT START OF YEAR | 666.787 | 2420437.500 | |
| SOIL WATER AT END OF YEAR | 666.747 | 2420291.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | -0.0001 | -0.196 | 0.00 |

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ANNUAL TOTALS FOR YEAR 24

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 5.96 | 21634.799 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 6.104 | 22159.035 | 102.42 |
| RECIRCULATION INTO LAYER 5 | 0.000000 | 0.000 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000000 | 0.000 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000000 | 0.000 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000000 | 0.000 | 0.00 |
| CHANGE IN WATER STORAGE | -0.144 | -524.205 | -2.42 |
| SOIL WATER AT START OF YEAR | 666.747 | 2420291.750 | |
| SOIL WATER AT END OF YEAR | 666.603 | 2419767.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.031 | 0.00 |

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ANNUAL TOTALS FOR YEAR 25

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.24 | 26281.201 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 6.430 | 23340.793 | 88.81 |
| RECIRCULATION INTO LAYER 5 | 0.000000 | 0.000 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000000 | 0.000 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000000 | 0.000 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000000 | 0.000 | 0.00 |
| CHANGE IN WATER STORAGE | 0.810 | 2940.291 | 11.19 |
| SOIL WATER AT START OF YEAR | 666.603 | 2419767.500 | |
| SOIL WATER AT END OF YEAR | 667.413 | 2422707.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.118 | 0.00 |

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ANNUAL TOTALS FOR YEAR 26

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.83 | 32052.902 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.910 | 28712.355 | 89.58 |
| RECIRCULATION INTO LAYER 5 | 0.000000 | 0.000 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000000 | 0.000 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000000 | 0.000 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0000 | | |

| | | | |
|---|---|---|---|
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000000 | 0.000 | 0.00 |
| CHANGE IN WATER STORAGE | 0.920 | 3340.646 | 10.42 |
| SOIL WATER AT START OF YEAR | 667.413 | 2422707.750 | |
| SOIL WATER AT END OF YEAR | 668.333 | 2426048.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | -0.099 | 0.00 |

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ANNUAL TOTALS FOR YEAR 27

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.32 | 22941.602 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 6.393 | 23206.342 | 101.15 |
| RECIRCULATION INTO LAYER 5 | 0.000000 | 0.000 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000000 | 0.000 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000000 | 0.000 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000000 | 0.000 | 0.00 |
| CHANGE IN WATER STORAGE | -0.073 | -264.761 | -1.15 |
| SOIL WATER AT START OF YEAR | 668.333 | 2426048.500 | |
| SOIL WATER AT END OF YEAR | 668.260 | 2425783.500 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.021 | 0.00 |

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ANNUAL TOTALS FOR YEAR 28

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 6.90 | 25047.002 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 5.856 | 21255.666 | 84.86 |
| RECIRCULATION INTO LAYER 5 | 0.000000 | 0.000 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000000 | 0.000 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000000 | 0.000 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000000 | 0.000 | 0.00 |
| CHANGE IN WATER STORAGE | 1.044 | 3791.294 | 15.14 |
| SOIL WATER AT START OF YEAR | 668.260 | 2425783.500 | |
| SOIL WATER AT END OF YEAR | 669.304 | 2429575.000 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.042 | 0.00 |

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ANNUAL TOTALS FOR YEAR 29

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 9.20 | 33396.008 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 9.202 | 33402.652 | 100.02 |
| RECIRCULATION INTO LAYER 5 | 0.000000 | 0.000 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000000 | 0.000 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000000 | 0.000 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000000 | 0.000 | 0.00 |

| | | | |
|---|---|---|---|
| CHANGE IN WATER STORAGE | -0.002 | -6.647 | -0.02 |
| SOIL WATER AT START OF YEAR | 669.304 | 2429575.000 | |
| SOIL WATER AT END OF YEAR | 669.303 | 2429568.250 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.000 | 0.00 |

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ANNUAL TOTALS FOR YEAR 30

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 8.05 | 29221.498 | 100.00 |
| RUNOFF | 0.000 | 0.000 | 0.00 |
| EVAPOTRANSPIRATION | 7.846 | 28479.928 | 97.46 |
| RECIRCULATION INTO LAYER 5 | 0.000000 | 0.000 | 0.00 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.0000 | 0.000 | 0.00 |
| RECIRCULATION FROM LAYER 7 | 0.000000 | 0.000 | 0.00 |
| PERC./LEAKAGE THROUGH LAYER 9 | 0.000000 | 0.000 | 0.00 |
| AVG. HEAD ON TOP OF LAYER 8 | 0.0000 | | |
| PERC./LEAKAGE THROUGH LAYER 10 | 0.000000 | 0.000 | 0.00 |
| CHANGE IN WATER STORAGE | 0.204 | 741.553 | 2.54 |
| SOIL WATER AT START OF YEAR | 669.303 | 2429568.250 | |
| SOIL WATER AT END OF YEAR | 669.507 | 2430309.750 | |
| SNOW WATER AT START OF YEAR | 0.000 | 0.000 | 0.00 |
| SNOW WATER AT END OF YEAR | 0.000 | 0.000 | 0.00 |
| ANNUAL WATER BUDGET BALANCE | 0.0000 | 0.016 | 0.00 |

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

| | JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|---|
| **PRECIPITATION** | | | | | | |
| TOTALS | 0.45 | 0.43 | 0.25 | 0.22 | 0.27 | 0.51 |
| | 1.35 | 1.00 | 1.25 | 0.70 | 0.40 | 0.41 |
| STD. DEVIATIONS | 0.42 | 0.48 | 0.23 | 0.27 | 0.28 | 0.49 |
| | 1.10 | 0.55 | 1.00 | 0.62 | 0.49 | 0.32 |
| **RUNOFF** | | | | | | |
| TOTALS | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| STD. DEVIATIONS | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| **EVAPOTRANSPIRATION** | | | | | | |
| TOTALS | 0.453 | 0.375 | 0.297 | 0.234 | 0.215 | 0.350 |
| | 1.163 | 1.053 | 1.168 | 0.647 | 0.440 | 0.392 |
| STD. DEVIATIONS | 0.378 | 0.348 | 0.217 | 0.215 | 0.217 | 0.331 |
| | 0.781 | 0.557 | 0.664 | 0.442 | 0.415 | 0.264 |
| **LATERAL DRAINAGE RECIRCULATED INTO LAYER 5** | | | | | | |
| TOTALS | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 |
| | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0001 | 0.0001 |
| **LATERAL DRAINAGE COLLECTED FROM LAYER 7** | | | | | | |
| TOTALS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **LATERAL DRAINAGE RECIRCULATED FROM LAYER 7** | | | | | | |
| TOTALS | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 |
| | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0001 | 0.0001 |
| **PERCOLATION/LEAKAGE THROUGH LAYER 9** | | | | | | |
| TOTALS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **PERCOLATION/LEAKAGE THROUGH LAYER 10** | | | | | | |
| TOTALS | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| STD. DEVIATIONS | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |

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AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

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DAILY AVERAGE HEAD ON TOP OF LAYER 8

| | | | | | | |
|---|---|---|---|---|---|---|
| AVERAGES | 0.0028 | 0.0027 | 0.0026 | 0.0025 | 0.0024 | 0.0024 |
| | 0.0023 | 0.0022 | 0.0021 | 0.0021 | 0.0020 | 0.0019 |
| STD. DEVIATIONS | 0.0077 | 0.0075 | 0.0073 | 0.0071 | 0.0069 | 0.0068 |
| | 0.0066 | 0.0065 | 0.0064 | 0.0062 | 0.0059 | 0.0057 |

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

| | INCHES | | CU. FEET | PERCENT |
|---|---|---|---|---|
| PRECIPITATION | 7.25 | ( 1.338) | 26311.5 | 100.00 |
| RUNOFF | 0.000 | ( 0.0000) | 0.00 | 0.000 |
| EVAPOTRANSPIRATION | 6.788 | ( 1.0700) | 24640.21 | 93.648 |
| DRAINAGE RECIRCULATED INTO LAYER 5 | 0.00068 | ( 0.00195) | 2.465 | 0.00937 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 7 | 0.00012 | ( 0.00034) | 0.435 | 0.00165 |
| DRAINAGE RECIRCULATED FROM LAYER 7 | 0.00068 | ( 0.00195) | 2.465 | 0.00937 |
| PERCOLATION/LEAKAGE THROUGH LAYER 9 | 0.00000 | ( 0.00000) | 0.004 | 0.00001 |
| AVERAGE HEAD ON TOP OF LAYER 8 | 0.002 | ( 0.007) | | |
| PERCOLATION/LEAKAGE THROUGH LAYER 10 | 0.00112 | ( 0.00163) | 4.060 | 0.01543 |
| CHANGE IN WATER STORAGE | 0.459 | ( 0.8146) | 1666.76 | 6.335 |

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 2.02 | 7332.600 |
| RUNOFF | 0.000 | 0.0000 |
| DRAINAGE RECIRCULATED INTO LAYER 5 | 0.00003 | 0.09272 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.00000 | 0.01636 |
| DRAINAGE RECIRCULATED FROM LAYER 7 | 0.00003 | 0.09272 |
| PERCOLATION/LEAKAGE THROUGH LAYER 9 | 0.000000 | 0.00005 |
| AVERAGE HEAD ON TOP OF LAYER 8 | 0.032 | |
| MAXIMUM HEAD ON TOP OF LAYER 8 | 0.064 | |
| LOCATION OF MAXIMUM HEAD IN LAYER 7 (DISTANCE FROM DRAIN) | 2.3 FEET | |
| PERCOLATION/LEAKAGE THROUGH LAYER 10 | 0.000015 | 0.05366 |
| SNOW WATER | 0.56 | 2033.9432 |

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.2012

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0440

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 30

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 0.0520 | 0.0130 |
| 2 | 1.4357 | 0.0798 |
| 3 | 0.7438 | 0.1240 |
| 4 | 0.8755 | 0.0730 |
| 5 | 594.7994 | 0.2555 |
| 6 | 69.6000 | 0.2900 |

| | | |
|---|---|---|
| 7 | 1.4880 | 0.0620 |
| 8 | 0.0000 | 0.0000 |
| 9 | 0.1800 | 0.7500 |
| 10 | 0.3325 | 0.0554 |
| SNOW WATER | 0.000 | |

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| | JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|---|
| **PRECIPITATION** | | | | | | |
| TOTALS | 0.45 | 0.43 | 0.25 | 0.22 | 0.27 | 0.51 |
| | 1.35 | 1.00 | 1.25 | 0.70 | 0.40 | 0.41 |
| STD. DEVIATIONS | 0.42 | 0.48 | 0.23 | 0.27 | 0.28 | 0.49 |
| | 1.10 | 0.55 | 1.00 | 0.62 | 0.49 | 0.32 |
| **RUNOFF** | | | | | | |
| TOTALS | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| STD. DEVIATIONS | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| **EVAPOTRANSPIRATION** | | | | | | |
| TOTALS | 0.453 | 0.375 | 0.297 | 0.234 | 0.215 | 0.350 |
| | 1.163 | 1.053 | 1.168 | 0.647 | 0.440 | 0.392 |
| STD. DEVIATIONS | 0.378 | 0.348 | 0.217 | 0.215 | 0.217 | 0.331 |
| | 0.781 | 0.557 | 0.664 | 0.442 | 0.415 | 0.264 |
| **LATERAL DRAINAGE RECIRCULATED INTO LAYER 5** | | | | | | |
| TOTALS | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 |
| | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0001 | 0.0001 |
| **LATERAL DRAINAGE COLLECTED FROM LAYER 7** | | | | | | |
| TOTALS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **LATERAL DRAINAGE RECIRCULATED FROM LAYER 7** | | | | | | |
| TOTALS | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 |
| | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0001 | 0.0001 |
| **PERCOLATION/LEAKAGE THROUGH LAYER 9** | | | | | | |
| TOTALS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **PERCOLATION/LEAKAGE THROUGH LAYER 10** | | | | | | |
| TOTALS | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| STD. DEVIATIONS | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 8

| | | | | | | |
|---|---|---|---|---|---|---|
| AVERAGES | 0.0028 | 0.0027 | 0.0026 | 0.0025 | 0.0024 | 0.0024 |
| | 0.0023 | 0.0022 | 0.0021 | 0.0021 | 0.0020 | 0.0019 |
| STD. DEVIATIONS | 0.0077 | 0.0075 | 0.0073 | 0.0071 | 0.0069 | 0.0068 |
| | 0.0066 | 0.0065 | 0.0064 | 0.0062 | 0.0059 | 0.0057 |

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

| | INCHES | CU. FEET | PERCENT |
|---|---|---|---|
| PRECIPITATION | 7.25 ( 1.338) | 26311.5 | 100.00 |
| RUNOFF | 0.000 ( 0.0000) | 0.00 | 0.000 |
| EVAPOTRANSPIRATION | 6.788 ( 1.0700) | 24640.21 | 93.648 |
| DRAINAGE RECIRCULATED INTO LAYER 5 | 0.00068 ( 0.00195) | 2.465 | 0.00937 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 7 | 0.00012 ( 0.00034) | 0.435 | 0.00165 |
| DRAINAGE RECIRCULATED FROM LAYER 7 | 0.00068 ( 0.00195) | 2.465 | 0.00937 |
| PERCOLATION/LEAKAGE THROUGH LAYER 9 | 0.00000 ( 0.00000) | 0.004 | 0.00001 |
| AVERAGE HEAD ON TOP OF LAYER 8 | 0.002 ( 0.007) | | |
| PERCOLATION/LEAKAGE THROUGH LAYER 10 | 0.00112 ( 0.00163) | 4.061 | 0.01543 |
| CHANGE IN WATER STORAGE | 0.459 ( 0.8146) | 1666.76 | 6.335 |

PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 2.02 | 7332.600 |
| RUNOFF | 0.000 | 0.0000 |
| DRAINAGE RECIRCULATED INTO LAYER 5 | 0.00003 | 0.09272 |
| DRAINAGE COLLECTED FROM LAYER 7 | 0.00000 | 0.01636 |
| DRAINAGE RECIRCULATED FROM LAYER 7 | 0.00003 | 0.09272 |
| PERCOLATION/LEAKAGE THROUGH LAYER 9 | 0.000000 | 0.00004 |
| AVERAGE HEAD ON TOP OF LAYER 8 | 0.032 | |
| MAXIMUM HEAD ON TOP OF LAYER 8 | 0.064 | |
| LOCATION OF MAXIMUM HEAD IN LAYER 7 (DISTANCE FROM DRAIN) | 2.3 FEET | |
| PERCOLATION/LEAKAGE THROUGH LAYER 10 | 0.000015 | 0.05367 |
| SNOW WATER | 0.56 | 2033.9432 |

| | |
|---|---|
| MAXIMUM VEG. SOIL WATER (VOL/VOL) | 0.2012 |
| MINIMUM VEG. SOIL WATER (VOL/VOL) | 0.0440 |

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 30

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 0.0520 | 0.0130 |
| 2 | 1.4357 | 0.0798 |
| 3 | 0.7438 | 0.1240 |
| 4 | 0.8755 | 0.0730 |
| 5 | 594.7994 | 0.2555 |
| 6 | 69.6000 | 0.2900 |

| | | |
|---|---|---|
| 7 | 1.4880 | 0.0620 |
| 8 | 0.0000 | 0.0000 |
| 9 | 0.1800 | 0.7500 |
| 10 | 0.3325 | 0.0554 |
| SNOW WATER | 0.000 | |

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# Appendix 3I - Attachment 2
# Pipe Deflection Calculations

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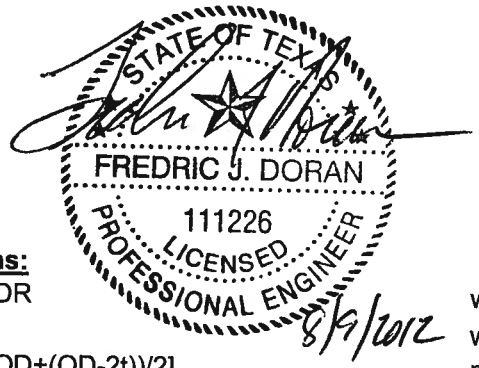
**Pipe Deflection Calculations**
**McCombs Landfill - 4/15/11 (SSK)**




6 inch pipe

**Equations:**

t = OD/SDR — wall thickness
$I = t^3/12$ — wall moment of inertia
R = 0.5[(OD+(OD-2t))/2] — mean radius
W = OD*[(6*120)+(120*66.7)]/144 — vertical stress
Wp = (W*12)/(12-($D_p$*N)) — modified vertical stress
$x = (D*K*W*R^3) / [(E*I) + (0.061*E'*R^3)]$ — deflection
Deflection % = x/(2*R)

Input Variables

| | | |
|---|---|---|
| **OD (in.) =** | 6.625 | |
| K = | 0.1 | pipe bedding constant (0.1) |
| D = | 1.0 | deflection lag factor (1.0) |
| E (psi) = | 133,000 | Pipe Mod of Elasticity |
| E' (psi) = | 3,000 | Soil Mod of Reaction |
| Soil Cover Depth (ft.) = | 8 | |
| Waste Depth (ft.) = | 264 | |
| Soil Cover Dens. (pcf) = | 120 | |
| Waste Dens. (pcf) = | 66.7 | |
| $D_p$ = | 0.5 | diameter of perforation (inches) |
| N = | 2.4 | number of perforations per foot |

Design Criteria

| | |
|---|---|
| Recommended Maximum Deflection | 5.0% |
| Allowable Maximum Deflection | 7.5% |

Deflection Calculations

| **SDR =** | **7.0** | **9.0** | **11.0** | **13.5** | **15.5** | **17.0** | **19.0** | **21.0** | **26.0** | **32.5** |
|---|---|---|---|---|---|---|---|---|---|---|
| t (in.) = | 0.946 | 0.736 | 0.602 | 0.491 | 0.427 | 0.390 | 0.349 | 0.315 | 0.255 | 0.204 |
| I ($in^3$) = | 0.071 | 0.033 | 0.018 | 0.010 | 0.007 | 0.005 | 0.004 | 0.003 | 0.001 | 0.001 |
| R (in) = | 2.839 | 2.944 | 3.011 | 3.067 | 3.099 | 3.118 | 3.138 | 3.155 | 3.185 | 3.211 |
| W (lbs/in.) = | 854.29 | 854.29 | 854.29 | 854.29 | 854.29 | 854.29 | 854.29 | 854.29 | 854.29 | 854.29 |
| Wp (lbs/in.) = | 949.22 | 949.22 | 949.22 | 949.22 | 949.22 | 949.22 | 949.22 | 949.22 | 949.22 | 949.22 |
| x (in.) = | 0.160 | 0.267 | 0.349 | 0.416 | 0.448 | 0.464 | 0.479 | 0.489 | 0.503 | 0.511 |
| **Deflection (%) =** | **2.816%** | **4.525%** | **5.801%** | **6.775%** | **7.222%** | **7.439%** | **7.630%** | **7.751%** | **7.898%** | **7.955%** |
| **Acceptability per Rec.** | **OK** | **OK** | **Try again** | **Try again** | **Try again** | **Try again** | **Try again** | **Try again** | **Try again** | **Try again** |
| **Acceptability per Allow.** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **Try again** | **Try again** | **Try again** | **Try again** |

**Pipe Deflection Calucations**
**McCombs Landfill - 4/15/11 (SSK)**

8 inch pipe

**Equations:**

| | |
|---|---|
| $t = OD/SDR$ | wall thickness |
| $I = t^3/12$ | wall moment of inertia |
| $R = 0.5[(OD+(OD-2t))/2]$ | mean radius |
| $W = OD*[(6*120)+(120*66.7)]/144$ | vertical stress |
| $Wp = (W*12)/(12-(D_p*N))$ | modified vertical stress |
| $x = (D*K*W*R^3) / [(E*I) + (0.061*E'*R^3)]$ | deflection |
| Deflection % = x/(2*R) | |

Input Variables

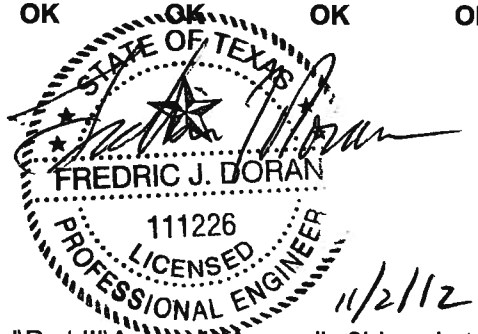
| | | |
|---|---|---|
| **OD (in.) =** | 8.625 | |
| K = | 0.1 | pipe bedding constant (0.1) |
| D = | 1.0 | deflection lag factor (1.0) |
| E (psi) = | 133,000 | Pipe Mod of Elasticity |
| E' (psi) = | 3,000 | Soil Mod of Reaction |
| Soil Cover Depth (ft.) = | 8 | |
| Waste Depth (ft.) = | 264 | |
| Soil Cover Dens. (pcf) = | 120 | |
| Waste Dens. (pcf) = | 66.7 | |
| $D_p$ = | 0.5 | diameter of perforation (inches) |
| N = | 2.4 | number of perforations per foot |

Design Criteria

| | |
|---|---|
| Recommended Maximum Deflection | 5.0% |
| Allowable Deflection | 7.5% |

Deflection Calculations

| **SDR =** | **7.0** | **9.0** | **11.0** | **13.5** | **15.5** | **17.0** | **19.0** | **21.0** | **26.0** | **32.5** |
|---|---|---|---|---|---|---|---|---|---|---|
| t (in.) = | 1.232 | 0.958 | 0.784 | 0.639 | 0.556 | 0.507 | 0.454 | 0.411 | 0.332 | 0.265 |
| I ($in^3$) = | 0.156 | 0.073 | 0.040 | 0.022 | 0.014 | 0.011 | 0.008 | 0.006 | 0.003 | 0.002 |
| R (in) = | 3.696 | 3.833 | 3.920 | 3.993 | 4.034 | 4.059 | 4.086 | 4.107 | 4.147 | 4.180 |
| W (lbs/in.) = | 1,112.19 | 1,112.19 | 1,112.19 | 1,112.19 | 1,112.19 | 1,112.19 | 1,112.19 | 1,112.19 | 1,112.19 | 1,112.19 |
| Wp (lbs/in.) = | 1,235.77 | 1,235.77 | 1,235.77 | 1,235.77 | 1,235.77 | 1,235.77 | 1,235.77 | 1,235.77 | 1,235.77 | 1,235.77 |
| x (in.) = | 0.208 | 0.347 | 0.455 | 0.541 | 0.583 | 0.604 | 0.623 | 0.637 | 0.655 | 0.665 |
| **Deflection (%) =** | **2.816%** | **4.525%** | **5.801%** | **6.775%** | **7.222%** | **7.439%** | **7.630%** | **7.751%** | **7.898%** | **7.955%** |
| **Acceptability per Rec.** | **OK** | **OK** | **Try again** | **Try again** | **Try again** | **Try again** | **Try again** | **Try again** | **Try again** | **Try again** |
| **Acceptability per Allow.** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **Try again** | **Try again** | **Try again** | **Try again** |




11/2/12

## Pipe Design by Compressive Ring Thrust Stress and Ring Deflection
**McCombs Landfill - 4/15/11 (SSK)**

**Compressive Ring Thrust Stress of 6" diameter perforated HDPE leachate collection pipe.**

SDR = 9 Design Value

$$VAF = 0.88 - 0.71 * \frac{S_a - 1}{S_a + 2.5}$$

VAF = Vertical Arching Factor

$S_a$ = Hoop Thrust Stiffness Ratio

$$S_a = \frac{1.43 * M_s * r_{CENT}}{EA}$$

$r_{CENT}$ = radius to centroidal axis of pipe, in

$M_s$ = one-dimensional modulus of soil, psi

E = apparent modulus of elasticity of pipe material, psi

A = profile wall average cross-sectional area, in2/in, or wall thickness (in) for DR pipe

Calculate Vertical Soil Stress = (depth * density)/144

| | | | |
|---|---|---|---|
| Waste Depth (ft.) $W_d$ = | 264 | ft | Design Value |
| Waste Dens. (pcf) = | 66.7 | pcf | Standard Parameter |
| Vertical Soil Stress = | 122.283 | psi | Calculated |

Use Table 2-14 in PPI PE Handbook, Chapter 6, Page 226 to determine $M_s$

| | | | |
|---|---|---|---|
| $M_s$ = | 3534.5 | psi | (assuming a 90% compaction.) |
| $r_{CENT}$ = | 3.3125 | in | |
| E = | 28,250 | psi | Standard Value for HDPE pipe, 50 year life (Table 2-6, Chapter 6, PE Handbook, p209) |
| A = | 0.736 | in | Minimum Wall thickness for SDR 9 pipe (Forrer Supply) |
| **$S_a$ =** | **0.805** | | Stiffness, Calculated |
| **VAF =** | **0.922** | | Arching Factor, Calculated |

| | | |
|---|---|---|
| Soil Cover Depth (ft.) $S_d$ = | 8 | Design Value |
| Waste Depth (ft.) $W_d$ = | 264 | Design Value |
| Soil Cover Dens. (pcf) = | 120 | Standard Parameter |
| Waste Dens. (pcf) = | 66.7 | Standard Parameter |

$$P_{rd} = VAF * [(S_d * S_{Density}) + (W_d + W_{Density})]$$

| | | | |
|---|---|---|---|
| $P_{rd}$ = | 17117.4105 | psf | Radial Directed Eart Pressure, Calculated |
| **$P_{rd}$ =** | **118.87** | **psi** | Radial Directed Eart Pressure, Calculated |

$$S = \frac{P_{rd} * D_o}{288 * A}$$

| | | | |
|---|---|---|---|
| **S =** | **535.00** | **psi** | Ring Compressive Stress, Calculated |
| | < | | |
| | 1000 | psi | Max Compressive Yield Strength for PE 3408 HDPE pipe (Handbook of Polyethylene Pipe, Appendix 3, pg 102) |

**OK**

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## Ring Deflection of Pipes Using Watkins-Gaube Graph

$$R_f = \frac{12 * E_s (SDR - 1)^3}{E}$$

$$E_s = M_S * \frac{(1+\mu)(1-2\mu)}{(1-\mu)}$$

| | | | |
|---|---|---|---|
| SDR = | 9 | | Design Factor |
| $E_s$ = | 2625.62857 | psi | Secant modulus of the soil, Calculated |
| E = | 28,250 | psi | Standard Value for HDPE pipe, 50 year life (Table 2-6, Chapter 6, PE Handbook, p209) |
| $D_m$ = | 5.89 | in | Mean Diameter ($D_o$ -t), Calculated |
| $D_o$ = | 6.63 | in | Standard Value for 6" HDPE pipe, outside diameter |
| t = | 0.736 | in | Standard Value for 6" SDR 9 HDPE pipe, min wall thickness |
| μ = | 0.3 | | Assumed Poisson Ratio |
| $R_f$ = | 571.04 | | Rigidity Factor, Calculated |
| $D_f$ = | 1.1 | | Deformation Factor taken from Figure 2-6, PE Handbook, Chapter 6, p230 |

$$\varepsilon_s = \frac{w * H}{144 * E_s}$$

**$\varepsilon_s$ = 4.91%** Soil Strain, Calculated

Percent Deflection = $\frac{\Delta X}{D_m}(100) = D_f * \varepsilon_S$

**Deflection = 5.40%** > 5.0% **Try Again**

| | |
|---|---|
| 5.0% | Recommended Max Deflection |
| 7.5% | Allowable Deflection |

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## Pipe Design by Compressive Ring Thrust Stress and Ring Deflection
**McCombs Landfill - 4/15/11 (SSK)**

**Compressive Ring Thrust Stress of 6" diameter perforated HDPE leachate collection pipe.**

SDR = 11 Design Value

$$VAF = 0.88 - 0.71 * \frac{S_a - 1}{S_a + 2.5}$$

VAF = Vertical Arching Factor

$S_a$ = Hoop Thrust Stiffness Ratio

$$S_a = \frac{1.43 * M_s * r_{CENT}}{EA}$$

$r_{CENT}$ = radius to centroidal axis of pipe, in

$M_s$ = one-dimensional modulus of soil, psi

E = apparent modulus of elasticity of pipe material, psi

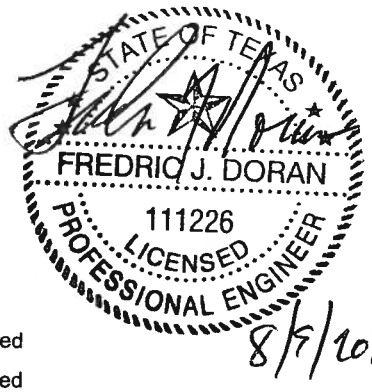
A = profile wall average cross-sectional area, in2/in, or wall thickness (in) for DR pipe

Calculate Vertical Soil Stress = (depth * density)/144

| | | |
|---|---|---|
| Waste Depth (ft.) $W_d$ = | 264 ft | Design Value |
| Waste Dens. (pcf) = | 66.7 pcf | Standard Parameter |
| Vertical Soil Stress = | 122.283 psi | Calculated |

Use Table 2-14 in PPI PE Handbook, Chapter 6, Page 226 to determine $M_s$

| | | |
|---|---|---|
| $M_s$ = | 3534.5 psi | (assuming a 90% compaction.) |
| $r_{CENT}$ = | 3.3125 in | |
| E = | 28,250 psi | Standard Value for HDPE pipe, 50 year life (Table 2-6, Chapter 6, PE Handbook, p209) |
| A = | 0.602 in | Minimum Wall thickness for SDR 11 pipe (Forrer Supply) |
| **$S_a$ =** | **0.984** | Stiffness, Calculated |
| **VAF =** | **0.883** | Arching Factor, Calculated |




8/9/2012

| | | |
|---|---|---|
| Soil Cover Depth (ft.) $S_d$ = | 8 | Design Value |
| Waste Depth (ft.) $W_d$ = | 264 | Design Value |
| Soil Cover Dens. (pcf) = | 120 | Standard Parameter |
| Waste Dens. (pcf) = | 66.7 | Standard Parameter |

$$P_{rd} = VAF * [(S_d * S_{Density}) + (W_d + W_{Density})]$$

| | | |
|---|---|---|
| $P_{rd}$ = | 16399.282 psf | Radial Directed Eart Pressure, Calculated |
| **$P_{rd}$ =** | **113.88 psi** | Radial Directed Eart Pressure, Calculated |

$$S = \frac{P_{rd} * D_o}{288 * A}$$

| | | |
|---|---|---|
| **S =** | **626.65 psi** | Ring Compressive Stress, Calculated |
| | < | |
| | 1000 psi | Max Compressive Yield Strength for PE 3408 HDPE pipe (Handbook of Polyethylene Pipe, Appendix 3, pg 102) |
| | **OK** | |

## Ring Deflection of Pipes Using Watkins-Gaube Graph

$$R_f = \frac{12 * E_s (SDR - 1)^3}{E}$$

$$E_s = M_S * \frac{(1+\mu)(1-2\mu)}{(1-\mu)}$$

| | | |
|---|---|---|
| SDR = | 11 | Design Factor |
| $E_s$ = | 2625.6286 psi | Secant modulus of the soil, Calculated |
| E = | 28,250 psi | Standard Value for HDPE pipe, 50 year life (Table 2-6, Chapter 6, PE Handbook, p209) |
| $D_m$ = | 6.02 in | Mean Diameter ($D_o$ -t), Calculated |
| $D_o$ = | 6.63 in | Standard Value for 6" HDPE pipe, outside diameter |
| t = | 0.602 in | Standard Value for 6" SDR 11 HDPE pipe, min wall thickness |
| μ = | 0.3 | Assumed Poisson Ratio |
| $R_f$ = | 1115.31 | Rigidity Factor, Calculated |
| $D_f$ = | 1.3 | Deformation Factor taken from Figure 2-6, PE Handbook, Chapter 6, p230 |

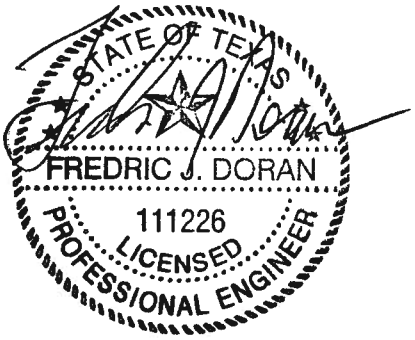
$$\varepsilon_s = \frac{w * H}{144 * E_s}$$

**$\varepsilon_s$ = 4.91%** Soil Strain, Calculated

Percent Deflection = $\frac{\Delta X}{D_m}(100) = D_f * \varepsilon_S$

**Deflection = 6.38%** > 5.0% **Try Again**

| | |
|---|---|
| 5.0% | Recommended Max Deflection |
| 7.5% | Allowable Deflection |



## Pipe Design by Compressive Ring Thrust Stress and Ring Deflection
**McCombs Landfill - 4/15/11 (SSK)**

**Compressive Ring Thrust Stress of 8" diameter perforated HDPE leachate collection pipe.**

SDR = 7.3 Design Value

$$VAF = 0.88 - 0.71 * \frac{S_a - 1}{S_a + 2.5}$$

VAF = Vertical Arching Factor

$S_a$ = Hoop Thrust Stiffness Ratio

$$S_a = \frac{1.43 * M_s * r_{CENT}}{EA}$$

$r_{CENT}$ = radius to centroidal axis of pipe, in

$M_s$ = one-dimensional modulus of soil, psi

E = apparent modulus of elasticity of pipe material, psi

A = profile wall average cross-sectional area, in2/in, or wall thickness (in) for DR pipe

Calculate Vertical Soil Stress = (depth * density)/144

| | | | |
|---|---|---|---|
| Waste Depth (ft.) $W_d$ = | 264 | ft | Design Value |
| Waste Dens. (pcf) = | 66.7 | pcf | Standard Parameter |
| Vertical Soil Stress = | 122.283 | psi | Calculated |

Use Table 2-14 in PPI PE Handbook, Chapter 6, Page 226 to determine $M_s$

| | | | |
|---|---|---|---|
| $M_s$ = | 3534.5 | psi | (assuming a 90% compaction.) |
| $r_{CENT}$ = | 3.3125 | in | |
| E = | 28,250 | psi | Standard Value for HDPE pipe, 50 year life (Table 2-6, Chapter 6, PE Handbook, p209) |
| A = | 1.182 | in | Minimum Wall thickness for SDR 7.3 pipe (Forrer Supply) |
| **$S_a$ =** | **0.501** | | Stiffness, Calculated |
| **VAF =** | **0.998** | | Arching Factor, Calculated |

8/9/2012

| | | | |
|---|---|---|---|
| Soil Cover Depth (ft.) $S_d$ = | 8 | | Design Value |
| Waste Depth (ft.) $W_d$ = | 264 | | Design Value |
| Soil Cover Dens. (pcf) = | 120 | | Standard Parameter |
| Waste Dens. (pcf) = | 66.7 | | Standard Parameter |

$$P_{rd} = VAF * [(S_d * S_{Density}) + (W_d + W_{Density})]$$

| | | | |
|---|---|---|---|
| $P_{rd}$ = | 18530.6795 | psf | Radial Directed Eart Pressure, Calculated |
| **$P_{rd}$ =** | **128.69** | **psi** | Radial Directed Eart Pressure, Calculated |

$$S = \frac{P_{rd} * D_o}{288 * A}$$

| | | | |
|---|---|---|---|
| **S =** | **469.78** | **psi** | Ring Compressive Stress, Calculated |
| | < | | |
| | 1000 | psi | Max Compressive Yield Strength for PE 3408 HDPE pipe (Handbook of Polyethylene Pipe, Appendix 3, pg 102) |

**OK**

## Ring Deflection of Pipes Using Watkins-Gaube Graph

$$R_f = \frac{12 * E_s (SDR - 1)^3}{E}$$

$$E_s = M_S * \frac{(1+\mu)(1-2\mu)}{(1-\mu)}$$

| | | |
|---|---|---|
| SDR = | 7.3 | Design Factor |
| $E_s$ = | 2625.62857 psi | Secant modulus of the soil, Calculated |
| E = | 28,250 psi | Standard Value for HDPE pipe, 50 year life (Table 2-6, Chapter 6, PE Handbook, p209) |
| $D_m$ = | 7.45 in | Mean Diameter ($D_o$ -t), Calculated |
| $D_o$ = | 8.63 in | Standard Value for 8" HDPE pipe, outside diameter |
| t = | 1.182 in | Standard Value for 8" SDR 9 HDPE pipe, min wall thickness |
| μ = | 0.3 | Assumed Poisson Ratio |
| $R_f$ = | 278.88 | Rigidity Factor, Calculated |
| $D_f$ = | 0.9 | Deformation Factor taken from Figure 2-6, PE Handbook, Chapter 6, p230 |

$$\varepsilon_s = \frac{w * H}{144 * E_s}$$

**$\varepsilon_s$ = 4.91%** Soil Strain, Calculated

Percent Deflection = $\frac{\Delta X}{D_m}(100) = D_f * \varepsilon_S$

**Deflection = 4.42% < 5.0% OK**

5.0% Recommended Max Deflection

7.5% Allowable Deflection

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## Pipe Design by Compressive Ring Thrust Stress and Ring Deflection
**McCombs Landfill - 4/15/11 (SSK)**

**Compressive Ring Thrust Stress of 8" diameter perforated HDPE leachate collection pipe.**

SDR = 9 Design Value

$$VAF = 0.88 - 0.71 * \frac{S_a - 1}{S_a + 2.5}$$

VAF = Vertical Arching Factor

$S_a$ = Hoop Thrust Stiffness Ratio

$$S_a = \frac{1.43 * M_s * r_{CENT}}{EA}$$

$r_{CENT}$ = radius to centroidal axis of pipe, in

$M_s$ = one-dimensional modulus of soil, psi

E = apparent modulus of elasticity of pipe material, psi

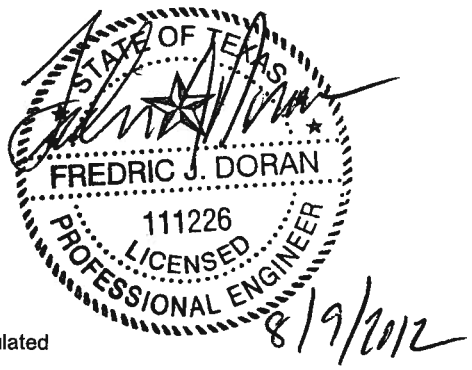
A = profile wall average cross-sectional area, in2/in, or wall thickness (in) for DR pipe

Calculate Vertical Soil Stress = (depth * density)/144

| | | | |
|---|---|---|---|
| Waste Depth (ft.) $W_d$ = | 264 | ft | Design Value |
| Waste Dens. (pcf) = | 66.7 | pcf | Standard Parameter |
| Vertical Soil Stress = | 122.283 | psi | Calculated |

Use Table 2-14 in PPI PE Handbook, Chapter 6, Page 226 to determine $M_s$

| | | | |
|---|---|---|---|
| $M_s$ = | 3534.5 | psi | (assuming a 90% compaction.) |
| $r_{CENT}$ = | 3.3125 | in | |
| E = | 28,250 | psi | Standard Value for HDPE pipe, 50 year life (Table 2-6, Chapter 6, PE Handbook, p209) |
| A = | 0.958 | in | Minimum Wall thickness for SDR 9 pipe (Forrer Supply) |
| **$S_a$ =** | **0.619** | | Stiffness, Calculated |
| **VAF =** | **0.967** | | Arching Factor, Calculated |




| | | | |
|---|---|---|---|
| Soil Cover Depth (ft.) $S_d$ = | 8 | | Design Value |
| Waste Depth (ft.) $W_d$ = | 264 | | Design Value |
| Soil Cover Dens. (pcf) = | 120 | | Standard Parameter |
| Waste Dens. (pcf) = | 66.7 | | Standard Parameter |

$$P_{rd} = VAF * [(S_d * S_{Density}) + (W_d + W_{Density})]$$

| | | | |
|---|---|---|---|
| $P_{rd}$ = | 17952.7325 | psf | Radial Directed Eart Pressure, Calculated |
| **$P_{rd}$ =** | **124.67** | **psi** | Radial Directed Eart Pressure, Calculated |

$$S = \frac{P_{rd} * D_o}{288 * A}$$

| | | | |
|---|---|---|---|
| **S =** | **561.22** | **psi** | Ring Compressive Stress, Calculated |
| | < | | |
| | 1000 | psi | Max Compressive Yield Strength for PE 3408 HDPE pipe (Handbook of Polyethylene Pipe, Appendix 3, pg 102) |

**OK**

## Ring Deflection of Pipes Using Watkins-Gaube Graph

$$R_f = \frac{12 * E_s (SDR - 1)^3}{E}$$

$$E_s = M_S * \frac{(1+\mu)(1-2\mu)}{(1-\mu)}$$

| | | | |
|---|---|---|---|
| SDR = | 9 | | Design Factor |
| $E_s$ = | 2625.62857 | psi | Secant modulus of the soil, Calculated |
| E = | 28,250 | psi | Standard Value for HDPE pipe, 50 year life (Table 2-6, Chapter 6, PE Handbook, p209) |
| $D_m$ = | 7.67 | in | Mean Diameter ($D_o$ -t), Calculated |
| $D_o$ = | 8.63 | in | Standard Value for 8" HDPE pipe, outside diameter |
| t = | 0.958 | in | Standard Value for 8" SDR 9 HDPE pipe, min wall thickness |
| μ = | 0.3 | | Assumed Poisson Ratio |
| $R_f$ = | 571.04 | | Rigidity Factor, Calculated |
| $D_f$ = | 1.1 | | Deformation Factor taken from Figure 2-6, PE Handbook, Chapter 6, p230 |

$$\varepsilon_s = \frac{w * H}{144 * E_s}$$

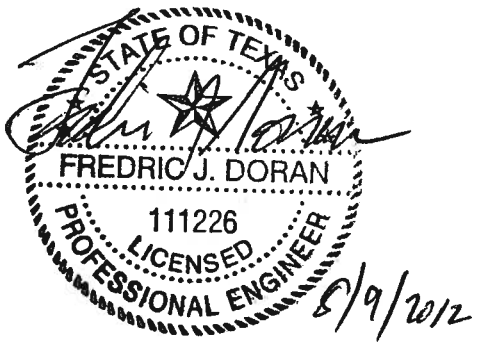
**$\varepsilon_s$ = 4.91%** Soil Strain, Calculated

Percent Deflection = $\frac{\Delta X}{D_m}(100) = D_f * \varepsilon_S$

**Deflection = 5.40%** > 5.0% **Try Again**

5.0% Recommended Max Deflection

7.5% Allowable Deflection



## Pipe Design by Compressive Ring Thrust Stress and Ring Deflection
**McCombs Landfill - 4/15/11 (SSK)**

**Compressive Ring Thrust Stress of 8" diameter perforated HDPE leachate collection pipe.**

SDR = 11 Design Value

$$VAF = 0.88 - 0.71 * \frac{S_a - 1}{S_a + 2.5}$$

VAF = Vertical Arching Factor

$S_a$ = Hoop Thrust Stiffness Ratio

$$S_a = \frac{1.43 * M_s * r_{CENT}}{EA}$$

$r_{CENT}$ = radius to centroidal axis of pipe, in

$M_s$ = one-dimensional modulus of soil, psi

E = apparent modulus of elasticity of pipe material, psi

A = profile wall average cross-sectional area, in2/in, or wall thickness (in) for DR pipe

Calculate Vertical Soil Stress = (depth * density)/144

| | | |
|---|---|---|
| Waste Depth (ft.) $W_d$ = | 264 ft | Design Value |
| Waste Dens. (pcf) = | 66.7 pcf | Standard Parameter |
| Vertical Soil Stress = | 122.283 psi | Calculated |

Use Table 2-14 in PPI PE Handbook, Chapter 6, Page 226 to determine $M_s$

| | | |
|---|---|---|
| $M_s$ = | 3534.5 psi | (assuming a 90% compaction.) |
| $r_{CENT}$ = | 3.3125 in | |
| E = | 28,250 psi | Standard Value for HDPE pipe, 50 year life (Table 2-6, Chapter 6, PE Handbook, p209) |
| A = | 0.784 in | Minimum Wall thickness for SDR 11 pipe (Forrer Supply) |
| **$S_a$ =** | **0.756** | Stiffness, Calculated |
| **VAF =** | **0.933** | Arching Factor, Calculated |

| | | |
|---|---|---|
| Soil Cover Depth (ft.) $S_d$ = | 8 | Design Value |
| Waste Depth (ft.) $W_d$ = | 264 | Design Value |
| Soil Cover Dens. (pcf) = | 120 | Standard Parameter |
| Waste Dens. (pcf) = | 66.7 | Standard Parameter |

$$P_{rd} = VAF * [(S_d * S_{Density}) + (W_d + W_{Density})]$$

| | | |
|---|---|---|
| $P_{rd}$ = | 17328.799 psf | Radial Directed Eart Pressure, Calculated |
| **$P_{rd}$ =** | **120.34 psi** | Radial Directed Eart Pressure, Calculated |

$$S = \frac{P_{rd} * D_o}{288 * A}$$

| | | |
|---|---|---|
| **S =** | **661.94 psi** | Ring Compressive Stress, Calculated |
| | < | |
| | 1000 psi | Max Compressive Yield Strength for PE 3408 HDPE pipe (Handbook of Polyethylene Pipe, Appendix 3, pg 102) |
| | **OK** | |

## Ring Deflection of Pipes Using Watkins-Gaube Graph

$$R_f = \frac{12 * E_s (SDR - 1)^3}{E}$$

$$E_s = M_S * \frac{(1+\mu)(1-2\mu)}{(1-\mu)}$$

| | | |
|---|---|---|
| SDR = | 11 | Design Factor |
| $E_s$ = | 2625.6286 psi | Secant modulus of the soil, Calculated |
| E = | 28,250 psi | Standard Value for HDPE pipe, 50 year life (Table 2-6, Chapter 6, PE Handbook, p209) |
| $D_m$ = | 7.84 in | Mean Diameter ($D_o$ -t), Calculated |
| $D_o$ = | 8.63 in | Standard Value for 8" HDPE pipe, outside diameter |
| t = | 0.784 in | Standard Value for 8" SDR 11 HDPE pipe, min wall thickness |
| μ = | 0.3 | Assumed Poisson Ratio |
| $R_f$ = | 1115.31 | Rigidity Factor, Calculated |
| $D_f$ = | 1.3 | Deformation Factor taken from Figure 2-6, PE Handbook, Chapter 6, p230 |

$$\varepsilon_s = \frac{w * H}{144 * E_s}$$

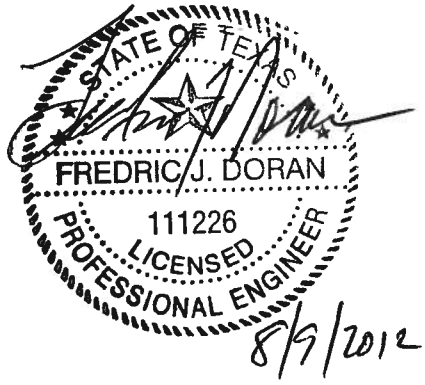
**$\varepsilon_s$ = 4.91%** Soil Strain, Calculated

Percent Deflection = $\frac{\Delta X}{D_m}(100) = D_f * \varepsilon_S$

**Deflection = 6.38%** > 5.0% **Try Again**

5.0% Recommended Max Deflection

7.5% Allowable Deflection



**Pipe Design by Wall Crushing and Wall Buckling**
**McCombs Landfill - 4/15/11 (SSK)**

**Compressive Stress of 6" diameter perforated HDPE leachate collection pipe.**

| | | |
|---|---|---|
| SDR = | 9 | Design Value |

**Find $P_t$**

| | | |
|---|---|---|
| Soil Cover Depth (ft.) $S_d$ = | 8 | Design Value |
| Waste Depth (ft.) $W_d$ = | 264 | Design Value |
| Soil Cover Dens. (pcf) = | 120 | Standard Parameter |
| Waste Dens. (pcf) = | 66.7 | Standard Parameter |

$$P_t = [(S_d * S_{Density}) + (W_d + W_{Density})]$$

| | | |
|---|---|---|
| $P_t$ = | 18568.8 PSF | Calculated |
| **$P_t$ =** | **128.95 PSI** | Calculated |

**Calculate $S_a$**

$$S_a = \frac{(SDR - 1)}{2} * P_t$$

| | | |
|---|---|---|
| **$S_a$ =** | **515.80 PSI** | Calculated |

**Determine Buckling Capacity of the Pipe**

$$P_{CB} = 0.8\sqrt{E'*P_C}$$

| | | |
|---|---|---|
| $P_{CB}$ = | Critical Buckling Soil Pressure at Top of Pipe, PSI | |
| E' = | Soil Modulus. Value based on soil type (ASTM D2312) and degree of compaction. | |
| E' = | 3000.00 | Calculated |
| $P_c$ = | Hydrostatic, Critical Collapse Differential Pressure (PSI) | |
| $P_c$ (Driscopipe)= | $\frac{2.32 * E}{(SDR)^3}$ | |
| E = | Stress and Time Dependent Tensile Modulus of Elasticity, PSI | |
| E = | 35,000 PSI | Standard Value |
| $P_c$ = | 111.39 | Calculated |
| **$P_{CB}$ =** | **462.45** | Calculated |
| SF = Safety Factor | | |
| **SF = $P_{CB}$ / $P_t$ =** | **3.59 > 2** | **OK** |

**Pipe Design by Wall Crushing and Wall Buckling**
**McCombs Landfill - 4/15/11 (SSK)**

**Compressive Stress of 6" diameter perforated HDPE leachate collection pipe.**

| | | |
|---|---|---|
| SDR = | 11 | Design Value |

**Find $P_t$**

| | | |
|---|---|---|
| Soil Cover Depth (ft.) $S_d$ = | 8 | Design Value |
| Waste Depth (ft.) $W_d$ = | 264 | Design Value |
| Soil Cover Dens. (pcf) = | 120 | Standard Parameter |
| Waste Dens. (pcf) = | 66.7 | Standard Parameter |

$$P_t = [(S_d * S_{Density}) + (W_d + W_{Density})]$$

| | | |
|---|---|---|
| $P_t$ = | 18568.8 PSF | Calculated |
| **$P_t$ =** | **128.95 PSI** | Calculated |

**Calculate $S_a$**

$$S_a = \frac{(SDR - 1)}{2} * P_t$$

| | | |
|---|---|---|
| **$S_a$ =** | **644.75 PSI** | Calculated |

**Determine Buckling Capacity of the Pipe**

$$P_{CB} = 0.8\sqrt{E'*P_C}$$

$P_{CB}$ = Critical Buckling Soil Pressure at Top of Pipe, PSI

E' = Soil Modulus. Value based on soil type (ASTM D2312) and degree of compaction.

| | | |
|---|---|---|
| E' = | 3000.00 | Calculated |

$P_c$ = Hydrostatic, Critical Collapse Differential Pressure (PSI)

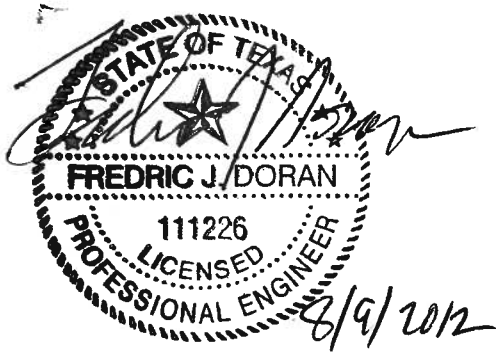
$P_c$ (Driscopipe)= $\frac{2.32 * E}{(SDR)^3}$

E = Stress and Time Dependent Tensile Modulus of Elasticity, PSI

| | | |
|---|---|---|
| E = | 35,000 PSI | Standard Value |
| $P_c$ = | 61.01 | Calculated |
| **$P_{CB}$ =** | **342.25** | Calculated |

SF = Safety Factor

| | | |
|---|---|---|
| **SF = $P_{CB}$ / $P_t$ =** | **2.65 > 2** | **OK** |



**Pipe Design by Wall Crushing and Wall Buckling**
**McCombs Landfill - 4/15/11 (SSK)**

**Compressive Stress of 8" diameter perforated HDPE leachate collection pipe.**

| | | |
|---|---|---|
| SDR = | 7.3 | Design Value |

**Find $P_t$**

| | | |
|---|---|---|
| Soil Cover Depth (ft.) $S_d$ = | 8 | Design Value |
| Waste Depth (ft.) $W_d$ = | 264 | Design Value |
| Soil Cover Dens. (pcf) = | 120 | Standard Parameter |
| Waste Dens. (pcf) = | 66.7 | Standard Parameter |

$$P_t = [(S_d * S_{Density}) + (W_d + W_{Density})]$$

| | | |
|---|---|---|
| $P_t$ = | 18568.8 PSF | Calculated |
| **$P_t$ =** | **128.95 PSI** | Calculated |

**Calculate $S_a$**

$$S_a = \frac{(SDR - 1)}{2} * P_t$$

| | | |
|---|---|---|
| **$S_a$ =** | **406.19 PSI** | Calculated |

**Determine Buckling Capacity of the Pipe**

$$P_{CB} = 0.8\sqrt{E'*P_C}$$

| | | |
|---|---|---|
| $P_{CB}$ = | Critical Buckling Soil Pressure at Top of Pipe, PSI | |
| E' = | Soil Modulus. Value based on soil type (ASTM D2312) and degree of compaction. | |
| E' = | 3000.00 | Calculated |
| $P_c$ = | Hydrostatic, Critical Collapse Differential Pressure (PSI) | |
| $P_c$ (Driscopipe)= | $\frac{2.32 * E}{(SDR)^3}$ | |
| E = | Stress and Time Dependent Tensile Modulus of Elasticity, PSI | |
| E = | 35,000 PSI | Standard Value |
| $P_c$ = | 208.73 | Calculated |
| **$P_{CB}$ =** | **633.06** | Calculated |

SF = Safety Factor

| | | |
|---|---|---|
| **SF = $P_{CB}$ / $P_t$ =** | **4.91 > 2** | **OK** |

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8/9/2012

**Pipe Design by Wall Crushing and Wall Buckling**
**McCombs Landfill - 4/15/11 (SSK)**

**Compressive Stress of 8" diameter perforated HDPE leachate collection pipe.**

| | | |
|---|---|---|
| SDR = | 9 | Design Value |

**Find $P_t$**

| | | |
|---|---|---|
| Soil Cover Depth (ft.) $S_d$ = | 8 | Design Value |
| Waste Depth (ft.) $W_d$ = | 264 | Design Value |
| Soil Cover Dens. (pcf) = | 120 | Standard Parameter |
| Waste Dens. (pcf) = | 66.7 | Standard Parameter |

$$P_t = [(S_d * S_{Density}) + (W_d + W_{Density})]$$

| | | | |
|---|---|---|---|
| $P_t$ = | 18568.8 | PSF | Calculated |
| **$P_t$ =** | **128.95** | **PSI** | Calculated |

**Calculate $S_a$**

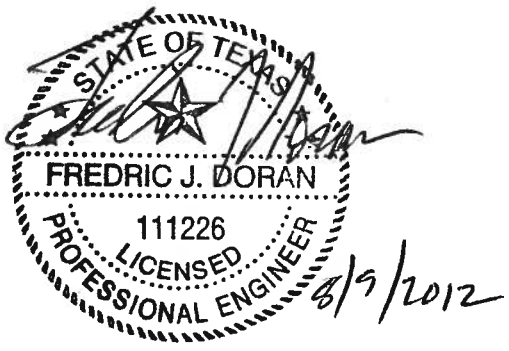
$$S_a = \frac{(SDR - 1)}{2} * P_t$$

| | | | |
|---|---|---|---|
| **$S_a$ =** | **515.80** | **PSI** | Calculated |

**Determine Buckling Capacity of the Pipe**

$$P_{CB} = 0.8\sqrt{E'*P_C}$$

| | | |
|---|---|---|
| $P_{CB}$ = | Critical Buckling Soil Pressure at Top of Pipe, PSI | |
| E' = | Soil Modulus. Value based on soil type (ASTM D2312) and degree of compaction. | |
| E' = | 3000.00 | Calculated |
| $P_c$ = | Hydrostatic, Critical Collapse Differential Pressure (PSI) | |
| $P_c$ (Driscopipe)= | $\frac{2.32 * E}{(SDR)^3}$ | |
| E = | Stress and Time Dependent Tensile Modulus of Elasticity, PSI | |
| E = | 35,000 PSI | Standard Value |
| $P_c$ = | 111.39 | Calculated |
| **$P_{CB}$ =** | **462.45** | Calculated |
| SF = Safety Factor | | |
| **SF = $P_{CB}$ / $P_t$ =** | **3.59 > 2** | **OK** |



**Pipe Design by Wall Crushing and Wall Buckling**
**McCombs Landfill - 4/15/11 (SSK)**

**Compressive Stress of 8" diameter perforated HDPE leachate collection pipe.**

| | | |
|---|---|---|
| SDR = | 11 | Design Value |

**Find $P_t$**

| | | |
|---|---|---|
| Soil Cover Depth (ft.) $S_d$ = | 8 | Design Value |
| Waste Depth (ft.) $W_d$ = | 264 | Design Value |
| Soil Cover Dens. (pcf) = | 120 | Standard Parameter |
| Waste Dens. (pcf) = | 66.7 | Standard Parameter |

$$P_t = [(S_d * S_{Density}) + (W_d + W_{Density})]$$

| | | |
|---|---|---|
| $P_t$ = | 18568.8 PSF | Calculated |
| **$P_t$ =** | **128.95 PSI** | Calculated |

**Calculate $S_a$**

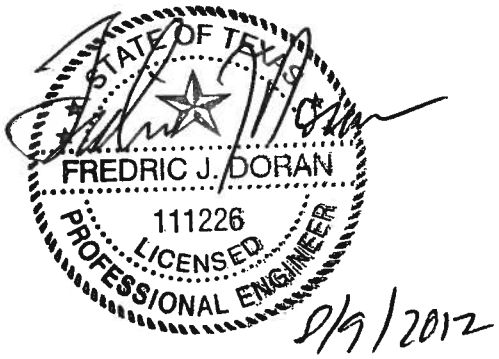
$$S_a = \frac{(SDR - 1)}{2} * P_t$$

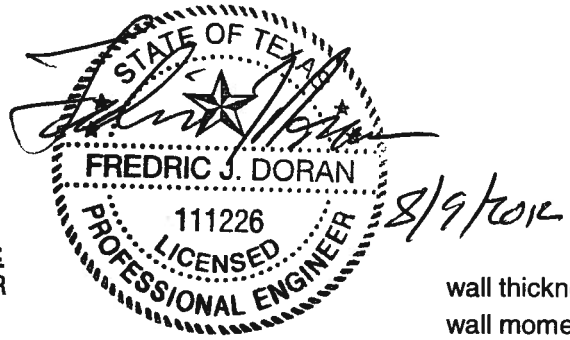
| | | |
|---|---|---|
| **$S_a$ =** | **644.75 PSI** | Calculated |

**Determine Buckling Capacity of the Pipe**

$$P_{CB} = 0.8\sqrt{E'*P_C}$$

| | | |
|---|---|---|
| $P_{CB}$ = | Critical Buckling Soil Pressure at Top of Pipe, PSI | |
| E' = | Soil Modulus. Value based on soil type (ASTM D2312) and degree of compaction. | |
| E' = | 3000.00 | Calculated |
| $P_c$ = | Hydrostatic, Critical Collapse Differential Pressure (PSI) | |
| $P_c$ (Driscopipe)= | $\frac{2.32 * E}{(SDR)^3}$ | |
| E = | Stress and Time Dependent Tensile Modulus of Elasticity, PSI | |
| E = | 35,000 PSI | Standard Value |
| $P_c$ = | 61.01 | Calculated |
| **$P_{CB}$ =** | **342.25** | Calculated |
| SF = Safety Factor | | |
| **SF = $P_{CB}$ / $P_t$ =** | **2.65 > 2** | **OK** |






8/9/2012

**Pipe Deflection Calculations**
**McCombs Landfill, Sector K - 05/10/12 (TLK)**

6 inch pipe

**Equations:**

| | |
|---|---|
| $t = OD/SDR$ | wall thickness |
| $I = t^3/12$ | wall moment of inertia |
| $R = 0.5[(OD+(OD-2t))/2]$ | mean radius |
| $W = OD*[(6*120)+(120*66.7)]/144$ | vertical stress |
| $Wp = (W*12)/(12-(D_p*N))$ | modified vertical stress |
| $x = (D*K*W*R^3) / [(E*I) + (0.061*E'*R^3)]$ | deflection |
| $Deflection\ \% = x/(2*R)$ | |

Input Variables

| | | |
|---|---|---|
| **OD (in.) =** | 6.625 | |
| K = | 0.1 | pipe bedding constant (0.1) |
| D = | 1.0 | deflection lag factor (1.0) |
| E (psi) = | 133,000 | Pipe Mod of Elasticity |
| E' (psi) = | 3,000 | Soil Mod of Reaction |
| Soil Cover Depth (ft.) = | 8 | |
| Waste Depth (ft.) = | 210 | |
| Soil Cover Dens. (pcf) = | 120 | |
| Waste Dens. (pcf) = | 66.7 | |
| $D_p$ = | 0.5 | diameter of perforation (inches) |
| N = | 2.4 | number of perforations per foot |

Design Criteria

| | |
|---|---|
| Recommended Maximum Deflection | 5.0% |
| Allowable Maximum Deflection | 7.5% |

Deflection Calculations

| **SDR =** | **7.0** | **9.0** | **11.0** | **13.5** | **15.5** | **17.0** | **19.0** | **21.0** | **26.0** | **32.5** |
|---|---|---|---|---|---|---|---|---|---|---|
| t (in.) = | 0.946 | 0.736 | 0.602 | 0.491 | 0.427 | 0.390 | 0.349 | 0.315 | 0.255 | 0.204 |
| I ($in^3$) = | 0.071 | 0.033 | 0.018 | 0.010 | 0.007 | 0.005 | 0.004 | 0.003 | 0.001 | 0.001 |
| R (in) = | 2.839 | 2.944 | 3.011 | 3.067 | 3.099 | 3.118 | 3.138 | 3.155 | 3.185 | 3.211 |
| W (lbs/in.) = | 688.59 | 688.59 | 688.59 | 688.59 | 688.59 | 688.59 | 688.59 | 688.59 | 688.59 | 688.59 |
| Wp (lbs/in.) = | 765.10 | 765.10 | 765.10 | 765.10 | 765.10 | 765.10 | 765.10 | 765.10 | 765.10 | 765.10 |
| x (in.) = | 0.129 | 0.215 | 0.282 | 0.335 | 0.361 | 0.374 | 0.386 | 0.394 | 0.406 | 0.412 |
| **Deflection (%) =** | **2.270%** | **3.648%** | **4.676%** | **5.461%** | **5.821%** | **5.996%** | **6.150%** | **6.248%** | **6.366%** | **6.412%** |
| **Acceptability per Rec.** | **OK** | **OK** | **OK** | **Try again** | **Try again** | **Try again** | **Try again** | **Try again** | **Try again** | **Try again** |
| **Acceptability per Allow.** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |

**Pipe Design by Wall Crushing and Wall Buckling**
**McCombs Landfill, Sector K - 05/10/12 (TLK)**

**Compressive Stress of 6" diameter perforated HDPE leachate collection pipe.**

| | | |
|---|---|---|
| SDR = | 11 | Design Value |

**Find $P_t$**

| | | |
|---|---|---|
| Soil Cover Depth (ft.) $S_d$ = | 8 | Design Value |
| Waste Depth (ft.) $W_d$ = | 210 | Design Value |
| Soil Cover Dens. (pcf) = | 120 | Standard Parameter |
| Waste Dens. (pcf) = | 66.7 | Standard Parameter |

$$P_t = [(S_d * S_{Density}) + (W_d + W_{Density})]$$

| | | |
|---|---|---|
| $P_t$ = | 14967 PSF | Calculated |
| **$P_t$ =** | **103.94 PSI** | Calculated |

**Calculate $S_a$**

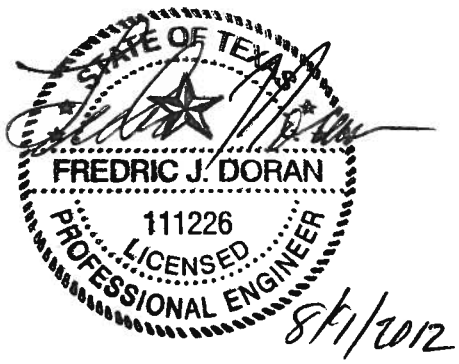
$$S_a = \frac{(SDR - 1)}{2} * P_t$$

| | | |
|---|---|---|
| **$S_a$ =** | **519.69 PSI** | Calculated |

**Determine Buckling Capacity of the Pipe**

$$P_{CB} = 0.8\sqrt{E' * P_C}$$

| | | |
|---|---|---|
| $P_{CB}$ = | Critical Buckling Soil Pressure at Top of Pipe, PSI | |
| E' = | Soil Modulus. Value based on soil type (ASTM D2312) and degree of compaction. | |
| E' = | 3000.00 | Calculated |
| $P_c$ = | Hydrostatic, Critical Collapse Differential Pressure (PSI) | |
| $P_c$ (Driscopipe)= | $\frac{2.32 * E}{(SDR)^3}$ | |
| E = | Stress and Time Dependent Tensile Modulus of Elasticity, PSI | |
| E = | 35,000 PSI | Standard Value |
| $P_c$ = | 61.01 | Calculated |
| **$P_{CB}$ =** | **342.25** | Calculated |
| SF = Safety Factor | | |
| **SF = $P_{CB}$ / $P_t$ =** | **3.29 > 2** | **OK** |



## Pipe Design by Compressive Ring Thrust Stress and Ring Deflection
**McCombs Landfill, Sector K - 05/10/12 (TLK)**

**Compressive Ring Thrust Stress of 6" diameter perforated HDPE leachate collection pipe.**

SDR = 11 Design Value

$$VAF = 0.88 - 0.71 * \frac{S_a - 1}{S_a + 2.5}$$

VAF = Vertical Arching Factor

$S_a$ = Hoop Thrust Stiffness Ratio

$$S_a = \frac{1.43 * M_s * r_{CENT}}{EA}$$

$r_{CENT}$ = radius to centroidal axis of pipe, in

$M_s$ = one-dimensional modulus of soil, psi

E = apparent modulus of elasticity of pipe material, psi

A = profile wall average cross-sectional area, in2/in, or wall thickness (in) for DR pipe

Calculate Vertical Soil Stress = (depth * density)/144

| | | | |
|---|---|---|---|
| Waste Depth (ft.) $W_d$ = | 210 | ft | Design Value |
| Waste Dens. (pcf) = | 66.7 | pcf | Standard Parameter |
| Vertical Soil Stress = | 97.271 | psi | Calculated |

Use Table 2-14 in PPI PE Handbook, Chapter 6, Page 226 to determine $M_s$

| | | | |
|---|---|---|---|
| $M_s$ = | 3534.5 | psi | (assuming a 90% compaction.) |
| $r_{CENT}$ = | 3.3125 | in | |
| E = | 28,250 | psi | Standard Value for HDPE pipe, 50 year life (Table 2-6, Chapter 6, PE Handbook, p209) |
| A = | 0.602 | in | Minimum Wall thickness for SDR 11 pipe (Forrer Supply) |
| **$S_a$ =** | **0.984** | | Stiffness, Calculated |
| **VAF =** | **0.883** | | Arching Factor, Calculated |

| | | | |
|---|---|---|---|
| Soil Cover Depth (ft.) $S_d$ = | 8 | | Design Value |
| Waste Depth (ft.) $W_d$ = | 210 | | Design Value |
| Soil Cover Dens. (pcf) = | 120 | | Standard Parameter |
| Waste Dens. (pcf) = | 66.7 | | Standard Parameter |

$$P_{rd} = VAF * [(S_d * S_{Density}) + (W_d + W_{Density})]$$

| | | | |
|---|---|---|---|
| $P_{rd}$ = | 13218.305 | psf | Radial Directed Eart Pressure, Calculated |
| **$P_{rd}$ =** | **91.79** | **psi** | Radial Directed Eart Pressure, Calculated |

$$S = \frac{P_{rd} * D_o}{288 * A}$$

| | | | |
|---|---|---|---|
| **S =** | **505.09** | **psi** | Ring Compressive Stress, Calculated |
| | < | | |
| | 1000 | psi | Max Compressive Yield Strength for PE 3408 HDPE pipe (Handbook of Polyethylene Pipe, Appendix 3, pg 102) |

**OK**

STATE OF TEXAS
FREDRIC J. DORAN
111226
LICENSED
PROFESSIONAL ENGINEER
8/9/2012

## Ring Deflection of Pipes Using Watkins-Gaube Graph

$$R_f = \frac{12 * E_s (SDR - 1)^3}{E}$$

$$E_s = M_S * \frac{(1+\mu)(1-2\mu)}{(1-\mu)}$$

| | | |
|---|---|---|
| SDR = | 11 | Design Factor |
| $E_s$ = | 2625.6286 psi | Secant modulus of the soil, Calculated |
| E = | 28,250 psi | Standard Value for HDPE pipe, 50 year life (Table 2-6, Chapter 6, PE Handbook, p209) |
| $D_m$ = | 6.02 in | Mean Diameter ($D_o$ -t), Calculated |
| $D_o$ = | 6.63 in | Standard Value for 6" HDPE pipe, outside diameter |
| t = | 0.602 in | Standard Value for 6" SDR 11 HDPE pipe, min wall thickness |
| μ = | 0.3 | Assumed Poisson Ratio |
| $R_f$ = | 1115.31 | Rigidity Factor, Calculated |
| $D_f$ = | 1.3 | Deformation Factor taken from Figure 2-6, PE Handbook, Chapter 6, p230 |

$$\varepsilon_s = \frac{w * H}{144 * E_s}$$

**$\varepsilon_s$ = 3.96%** Soil Strain, Calculated

Percent Deflection = $\frac{\Delta X}{D_m}(100) = D_f * \varepsilon_s$

**Deflection = 5.15%** > 5.0% **Try Again**

| | |
|---|---|
| 5.0% | Recommended Max Deflection |
| 7.5% | Allowable Deflection |

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8/9/2012

## Calculated Pipe Deflection from Equipment

McCombs Landfill - Created by: TLK 7-3-12, Checked by: FJD 7-3-12

Assumptions: Critical Load occurs when:

Scenario 1) Construction equipment (CAT 770 off-road) driven over pipe trench (2-foot min cover)

Scenario 2) Compactor (CAT 826) driven over pipe with minimum 6-feet of waste in place

Input Variables for 6-inch Pipe

Scenario 1

| | | |
|---|---|---|
| **OD (in.) =** | 6.625 | |
| K = | 0.1 | pipe bedding constant (0.1) |
| D = | 1.0 | deflection lag factor (1.0) |
| E (psi) = | 133,000 | Pipe Mod of Elasticity |
| E' (psi) = | 3,000 | Soil Mod of Reaction |
| Soil Cover Depth (ft.) = | 2 | |
| Soil Cover Dens. (pcf) = | 120 | |
| Equipment Maximum Weight (psi) = | 110 | |
| $D_p$ = | 0.5 | diameter of perforation (inches) |
| N = | 2.4 | number of perforations per foot |

**Equations:**

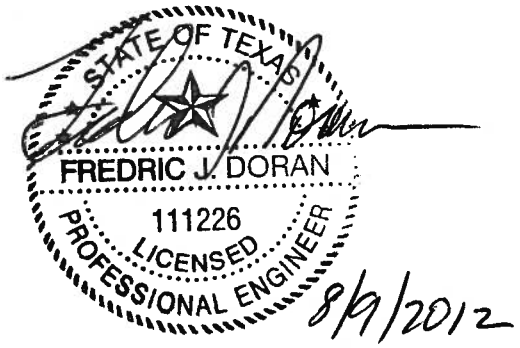
| | |
|---|---|
| t = OD/SDR | wall thickness |
| $I = t^3/12$ | wall moment of inertia |
| R = 0.5[(OD+(OD-2t))/2] | mean radius |
| W = OD*[(Soil PSI)+(EQ PSI)]/14 | vertical stress |
| $Wp = (W*12)/(12-(D_p*N))$ | modified vertical stress |
| $x = (D*K*W*R^3) / [(E*I) + (0.061*E'*R^3)]$ | deflection |
| Deflection % = x/(2*R) | |

Design Criteria

| | |
|---|---|
| Recommended Maximum Deflection | 5.0% |
| Allowable Maximum Deflection | 7.5% |

Deflection Calculations for Scenario 1

| **SDR =** | **7.0** | **9.0** | **11.0** | **13.5** | **15.5** | **17.0** | **19.0** | **21.0** | **26.0** | **32.5** |
|---|---|---|---|---|---|---|---|---|---|---|
| t (in.) = | 0.946 | 0.736 | 0.602 | 0.491 | 0.427 | 0.390 | 0.349 | 0.315 | 0.255 | 0.204 |
| I ($in^3$) = | 0.071 | 0.033 | 0.018 | 0.010 | 0.007 | 0.005 | 0.004 | 0.003 | 0.001 | 0.001 |
| R (in) = | 2.839 | 2.944 | 3.011 | 3.067 | 3.099 | 3.118 | 3.138 | 3.155 | 3.185 | 3.211 |
| W (lbs/in.) = | 16.10 | 16.10 | 16.10 | 16.10 | 16.10 | 16.10 | 16.10 | 16.10 | 16.10 | 16.10 |
| Wp (lbs/in.) = | 17.89 | 17.89 | 17.89 | 17.89 | 17.89 | 17.89 | 17.89 | 17.89 | 17.89 | 17.89 |
| x (in.) = | 0.003 | 0.005 | 0.006 | 0.007 | 0.008 | 0.008 | 0.008 | 0.008 | 0.009 | 0.009 |
| **Deflection (%) =** | **0.048%** | **0.077%** | **0.098%** | **0.115%** | **0.123%** | **0.126%** | **0.129%** | **0.131%** | **0.134%** | **0.135%** |
| **Acceptability per Rec.** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| **Acceptability per Allow.** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |



## Calculated Pipe Deflection from Equipment

McCombs Landfill - Created by: TLK 7-3-12, Checked by: FJD 7-3-12

Assumptions: Critical Load occurs when:

Scenario 1) Construction equipment (CAT 770 off-road) driven over pipe trench (2-foot min cover)

Scenario 2) Compactor (CAT 826) driven over pipe with minimum 6-feet of waste in place

Input Variables for 6-inch Pipe

Scenario 2

| | | |
|---|---|---|
| **OD (in.) =** | 6.625 | |
| K = | 0.1 | pipe bedding constant (0.1) |
| D = | 1.0 | deflection lag factor (1.0) |
| E (psi) = | 133,000 | Pipe Mod of Elasticity |
| E' (psi) = | 3,000 | Soil Mod of Reaction |
| Soil Cover Depth (ft.) = | 4 | |
| Soil Cover Dens. (pcf) = | 120 | |
| Waste Depth (ft.) = | 6 | |
| Waste Dens. (pcf) = | 67 | |
| Equipment Maximum Weight (psi) = | 50 | |
| $D_p$ = | 0.5 | diameter of perforation (inches) |
| N = | 2.4 | number of perforations per foot |

**Equations:**

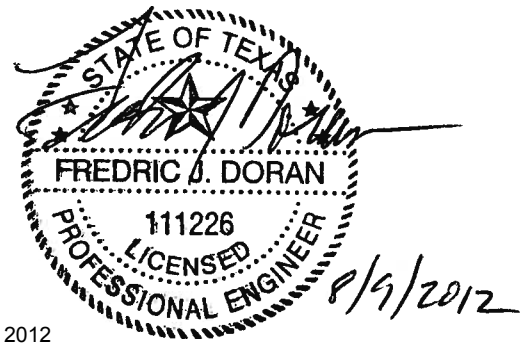
| | |
|---|---|
| t = OD/SDR | wall thickness |
| $I = t^3/12$ | wall moment of inertia |
| R = 0.5[(OD+(OD-2t))/2] | mean radius |
| W = OD*[(Soil PSI)+(EQ PSI)+(W | vertical stress |
| $Wp = (W*12)/(12-(D_p*N))$ | modified vertical stress |
| $x = (D*K*W*R^3) / [(E*I) + (0.061*E'*R^3)]$ | deflection |
| Deflection % = x/(2*R) | |

Design Criteria

| | |
|---|---|
| Recommended Maximum Deflection | 5.0% |
| Allowable Maximum Deflection | 7.5% |

Deflection Calculations for Scenario 2

| **SDR =** | **7.0** | **9.0** | **11.0** | **13.5** | **15.5** | **17.0** | **19.0** | **21.0** | **26.0** | **32.5** |
|---|---|---|---|---|---|---|---|---|---|---|
| t (in.) = | 0.946 | 0.736 | 0.602 | 0.491 | 0.427 | 0.390 | 0.349 | 0.315 | 0.255 | 0.204 |
| $I (in^3)$ = | 0.071 | 0.033 | 0.018 | 0.010 | 0.007 | 0.005 | 0.004 | 0.003 | 0.001 | 0.001 |
| R (in) = | 2.839 | 2.944 | 3.011 | 3.067 | 3.099 | 3.118 | 3.138 | 3.155 | 3.185 | 3.211 |
| W (lbs/in.) = | 42.88 | 42.88 | 42.88 | 42.88 | 42.88 | 42.88 | 42.88 | 42.88 | 42.88 | 42.88 |
| Wp (lbs/in.) = | 47.64 | 47.64 | 47.64 | 47.64 | 47.64 | 47.64 | 47.64 | 47.64 | 47.64 | 47.64 |
| x (in.) = | 0.007 | 0.012 | 0.016 | 0.019 | 0.020 | 0.021 | 0.022 | 0.022 | 0.023 | 0.023 |
| **Deflection (%) =** | **0.127%** | **0.204%** | **0.262%** | **0.306%** | **0.326%** | **0.336%** | **0.345%** | **0.350%** | **0.357%** | **0.359%** |
| **Acceptability per Rec.** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| **Acceptability per Allow.** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |




8/9/2012

## Calculated Pipe Deflection from Equipment

McCombs Landfill - Created by: TLK 7-3-12, Checked by: FJD 7-3-12

Assumptions: Critical Load occurs when:

Scenario 1) Construction equipment (CAT 770 off-road) driven over pipe trench (2-foot min cover)

Scenario 2) Compactor (CAT 826) driven over pipe with minimum 6-feet of waste in place

Input Variables for 8-inch Pipe

Scenario 1

| | | |
|---|---|---|
| **OD (in.) =** | 8.625 | |
| K = | 0.1 | pipe bedding constant (0.1) |
| D = | 1.0 | deflection lag factor (1.0) |
| E (psi) = | 133,000 | Pipe Mod of Elasticity |
| E' (psi) = | 3,000 | Soil Mod of Reaction |
| Soil Cover Depth (ft.) = | 2 | |
| Soil Cover Dens. (pcf) = | 120 | |
| Equipment Maximum Weight (psi) = | 110 | |
| $D_p$ = | 0.5 | diameter of perforation (inches) |
| N = | 2.4 | number of perforations per foot |

**Equations:**

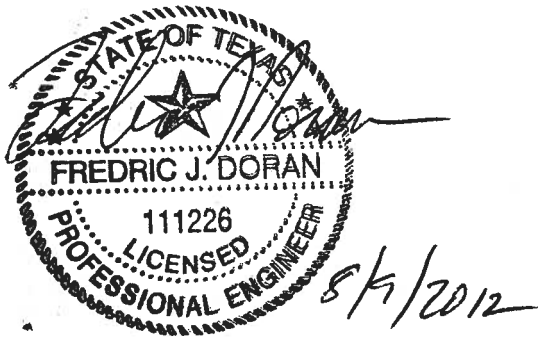
| | |
|---|---|
| t = OD/SDR | wall thickness |
| $I = t^3/12$ | wall moment of inertia |
| R = 0.5[(OD+(OD-2t))/2] | mean radius |
| W = OD*[(Soil PSI)+(EQ PSI)]/14 | vertical stress |
| $Wp = (W*12)/(12-(D_p*N))$ | modified vertical stress |
| $x = (D*K*W*R^3) / [(E*I) + (0.061*E'*R^3)]$ | deflection |
| Deflection % = x/(2*R) | |

Design Criteria

| | |
|---|---|
| Recommended Maximum Deflection | 5.0% |
| Allowable Maximum Deflection | 7.5% |

Deflection Calculations for Scenario 1

| **SDR =** | **7.0** | **9.0** | **11.0** | **13.5** | **15.5** | **17.0** | **19.0** | **21.0** | **26.0** | **32.5** |
|---|---|---|---|---|---|---|---|---|---|---|
| t (in.) = | 1.232 | 0.958 | 0.784 | 0.639 | 0.556 | 0.507 | 0.454 | 0.411 | 0.332 | 0.265 |
| I ($in^3$) = | 0.156 | 0.073 | 0.040 | 0.022 | 0.014 | 0.011 | 0.008 | 0.006 | 0.003 | 0.002 |
| R (in) = | 3.696 | 3.833 | 3.920 | 3.993 | 4.034 | 4.059 | 4.086 | 4.107 | 4.147 | 4.180 |
| W (lbs/in.) = | 20.96 | 20.96 | 20.96 | 20.96 | 20.96 | 20.96 | 20.96 | 20.96 | 20.96 | 20.96 |
| Wp (lbs/in.) = | 23.29 | 23.29 | 23.29 | 23.29 | 23.29 | 23.29 | 23.29 | 23.29 | 23.29 | 23.29 |
| x (in.) = | 0.004 | 0.006 | 0.008 | 0.009 | 0.010 | 0.010 | 0.011 | 0.011 | 0.011 | 0.011 |
| **Deflection (%) =** | **0.048%** | **0.077%** | **0.098%** | **0.115%** | **0.123%** | **0.126%** | **0.129%** | **0.131%** | **0.134%** | **0.135%** |
| **Acceptability per Rec.** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| **Acceptability per Allow.** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |



## Calculated Pipe Deflection from Equipment

McCombs Landfill - Created by: TLK 7-3-12, Checked by: FJD 7-3-12

Assumptions: Critical Load occurs when:

Scenario 1) Construction equipment (CAT 770 off-road) driven over pipe trench (2-foot min cover)

Scenario 2) Compactor (CAT 826) driven over pipe with minimum 6-feet of waste in place

Input Variables for 8-inch Pipe

Scenario 2

| | | |
|---|---|---|
| **OD (in.) =** | 8.625 | |
| K = | 0.1 | pipe bedding constant (0.1) |
| D = | 1.0 | deflection lag factor (1.0) |
| E (psi) = | 133,000 | Pipe Mod of Elasticity |
| E' (psi) = | 3,000 | Soil Mod of Reaction |
| Soil Cover Depth (ft.) = | 4 | |
| Soil Cover Dens. (pcf) = | 120 | |
| Waste Depth (ft.) = | 6 | |
| Waste Dens. (pcf) = | 67 | |
| Equipment Maximum Weight (psi) = | 50 | |
| $D_p$ = | 0.5 | diameter of perforation (inches) |
| N = | 2.4 | number of perforations per foot |

**Equations:**

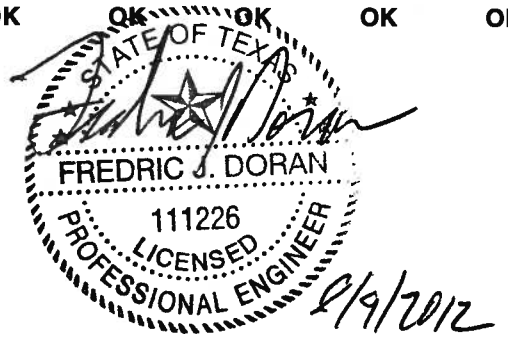
| | |
|---|---|
| t = OD/SDR | wall thickness |
| $I = t^3/12$ | wall moment of inertia |
| R = 0.5[(OD+(OD-2t))/2] | mean radius |
| W = OD*[(Soil PSI)+(EQ PSI)+(W | vertical stress |
| $Wp = (W*12)/(12-(D_p*N))$ | modified vertical stress |
| $x = (D*K*W*R^3) / [(E*I) + (0.061*E'*R^3)]$ | deflection |
| Deflection % = x/(2*R) | |

Design Criteria

| | |
|---|---|
| Recommended Maximum Deflection | 5.0% |
| Allowable Maximum Deflection | 7.5% |

Deflection Calculations for Scenario 2

| **SDR =** | **7.0** | **9.0** | **11.0** | **13.5** | **15.5** | **17.0** | **19.0** | **21.0** | **26.0** | **32.5** |
|---|---|---|---|---|---|---|---|---|---|---|
| t (in.) = | 1.232 | 0.958 | 0.784 | 0.639 | 0.556 | 0.507 | 0.454 | 0.411 | 0.332 | 0.265 |
| $I (in^3)$ = | 0.156 | 0.073 | 0.040 | 0.022 | 0.014 | 0.011 | 0.008 | 0.006 | 0.003 | 0.002 |
| R (in) = | 3.696 | 3.833 | 3.920 | 3.993 | 4.034 | 4.059 | 4.086 | 4.107 | 4.147 | 4.180 |
| W (lbs/in.) = | 55.82 | 55.82 | 55.82 | 55.82 | 55.82 | 55.82 | 55.82 | 55.82 | 55.82 | 55.82 |
| Wp (lbs/in.) = | 62.03 | 62.03 | 62.03 | 62.03 | 62.03 | 62.03 | 62.03 | 62.03 | 62.03 | 62.03 |
| x (in.) = | 0.009 | 0.016 | 0.021 | 0.024 | 0.026 | 0.027 | 0.028 | 0.029 | 0.030 | 0.030 |
| **Deflection (%) =** | **0.127%** | **0.204%** | **0.262%** | **0.306%** | **0.326%** | **0.336%** | **0.345%** | **0.350%** | **0.357%** | **0.359%** |
| **Acceptability per Rec.** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| **Acceptability per Allow.** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |



# Appendix 3I – Attachment 3
# Raba Kistner Leachate and Contaminated Water Plan

SAIC®

## Memorandum

To: TCEQ

From: Cami Van Abel, P.E.

Subject: Raba Kistner Leachate and Contaminated Water Plan

Date: March 15, 2013

The Leachate and Contaminated Water Plan prepared by Raba Kistner Consultants, Inc. and dated April 24, 2002 (Revision 1 – July 29, 2002) is provided in partial form to provide details for contaminated water management for the updated leachate and contaminated water plan. The calculations prepared by Raba Kistner are still relevant to current conditions at the site and they comply with 30 TAC §330.305 (b) and (c). Sections 2 through 10, Figures Att15-2 through Att15-4, and Appendices Atta15-B through Att15-G have been removed from the Raba Kistner plan as they have been updated throughout Permit No. 729B.

SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI

# Part III
# Site Development Plan
# Appendix 3I, Attachment 3
# Leachate and Contaminated Water Plan

## McCombs Landfill
## MSW Permit No. 729B
## City of El Paso
## El Paso County, Texas
## Revision 1 - July 29, 2002

The attached document was modified from its original form to modify the MSW Permit No. 729A to 729B. Portions of the original document that are still applicable to the MSW Permit Amendment 729B as described in the preceding memo have been included for reference.

# PART III
# SITE DEVELOPMENT PLAN
APPENDIX 3I, ATTACHMENT 3
# LEACHATE AND CONTAMINATED WATER PLAN

## McCOMBS LANDFILL
## MSW PERMIT NO. 729B
## CITY OF EL PASO
## EL PASO COUNTY, TEXAS

*Prepared by:*

Raba Kistner

STATE OF TEXAS
VALERIE A. JOOSTEN
89118
LICENSED PROFESSIONAL ENGINEER

APRIL 24, 2002
REVISION 1 - JULY 29, 2002

Valerie Joosten 8/7/02
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1.0 CONTAMINATED WATER ..... 1

### FIGURES

Control Berm at Working Face ..... Att15-1

### APPENDICES

Rainfall Frequency Maps ..... Att15-A

# LEACHATE AND CONTAMINATED WATER PLAN

## 1.0 CONTAMINATED WATER

Drainage and run-off from the active area that comes in direct contact with waste will be retained by temporary toe berms. These berms will be sized to hold the volume of water produced by the 24-hour, 25 year storm event assuming an active face of 250 ft x 250 ft (see Figure Att15-1). The assumed area of the active face is based on our experience for landfills with comparative waste disposal rates to the McCombs Landfill. The 24-hour, 25-year storm event maps from the Weather Bureau (NWS) Technical Paper 40, Rainfall Frequency Atlas of the United States can be found in Appendix Att15-A. Plate 1 of Appendix Att15-A displays a storm event map for the Central and Eastern United States, which includes the state of Texas. Plate 2 of Appendix Att15-A displays a storm event map with greater isopluvial detail for the area near the site. The two maps were compared with each other to obtain the 24-hour, 25-year storm event used in calculating the temporary toe berm and run-on berm sizes.

Calculations for sizing the temporary toe berms are as follows:

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VALERIE A. JOOSTEN
89118
LICENSED
PROFESSIONAL ENGINEER

Assumptions:

1. An active working face of 250 ft x 250 ft
2. Dikes/berms placed 50 ft down flow from active area
3. 24-hour, 25-year storm event = 3.0 inches = 0.25 ft
4. Active face 3:1 slope
5. Effective berm height = 2.0 ft (3.0 feet high minus 1.0 ft of freeboard)

Sample Calculation:

Maximum surface = 250 ft x (250 ft + 50 ft) = 75,000 ft²
Total rainfall volume = 75,000 ft² x .25 ft = 18,750 ft³
Volume retained by berm = 2 ft x (50 ft x 250 ft) + $\frac{2 \text{ ft} (3 \times 2 \text{ ft})}{2}$ x 250 ft = 26,500 ft³

26,500 ft³ retention volume/18,750 ft³ rainfall volume = 1.41 safety factor

Stormwater from areas with six (6) inches of daily cover and any area with alternate daily cover is considered contaminated. Inactive areas with six (6) inches of daily cover will be inspected weekly for erosion, ponded water, seeps, protruding waste or other conditions that may cause contaminated runoff from daily cover. After a period of 180 days, an additional six (6) inches of cover material will be placed over the daily cover for a total of not less than twelve (12) inches of cover. This 12-inch layer of cover material will be classified as "intermediate cover". Stormwater runoff from intermediate cover areas will be considered uncontaminated. Once the area becomes active again, the top six inches of intermediate cover material may be stripped off for use as daily cover in other areas.

Surface water run-on to the working face will be controlled with temporary run-on berms as shown on Figure Att15-1. Calculations for sizing the temporary run-on berms are as follows:

Assumptions:

1. 24-hour, 25 year storm event = 3.0 inches = 0.25 feet.
2. All surface water flow encountering run-on berms will be sheet flow.
3. Run-on berms are temporary with a maximum length of 300 ft centered on working face.
4. Berm height = 2.0 ft (24 in.)

Since flow to be handled by the run-on berm is sheet flow, the depth of water to be diverted will be 0.25 feet.

Sample calculation:

0.25 feet + 1.0 foot of freeboard = 1.25 feet (min.) berm height

2.0 feet (min.) constructed height/1.25 feet (min.) required height = 1.60 safety factor

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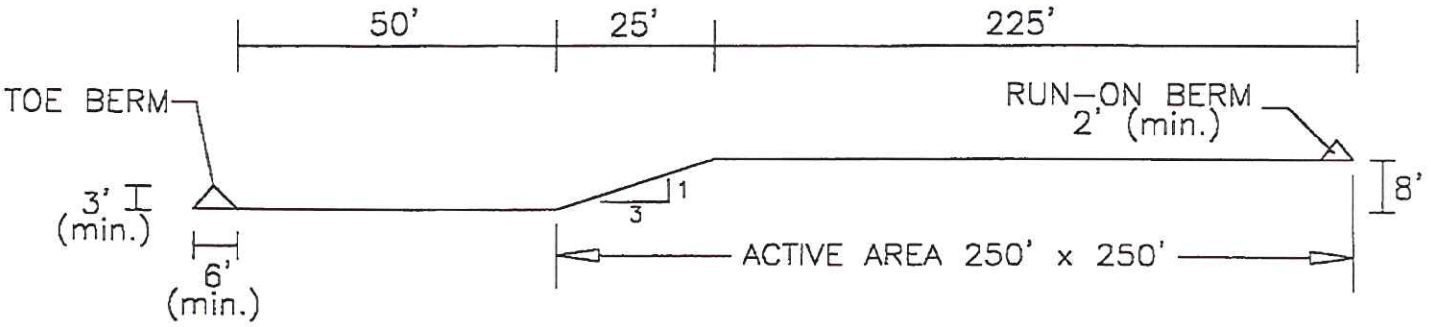
# FIGURES




TOE BERM CALCULATIONS

ASSUMPTIONS:

1. An active working face of 250' x 250'
2. Berms placed 50' download flow from active area
3. 24 hour–25 year storm event = 3" = 0.25 feet
4. Active face 3:1 slope
5. Effective berm height = 2' (24")
6. Berm height = 3' (36")(1.0' freeboard)

CALCULATIONS:

Max Surface = 250' x (250'+50') = 75,000 $ft^2$

Total rainfall volume = 75,000 $ft^2$ x .25' = 18,750 $ft^3$

Retention Volume

$$= 2'(50' \times 250') + \frac{2'(3' \times 2')}{2} \times 250' = 26{,}500\ ft^3$$

26,500 $ft^3$ retention volume/18,750 $ft^3$ rainfall volume = 1.41 Safety Factor

RUN–ON BERM CALCULATION

ASSUMPTIONS:

1. 24 hour–25 year storm event = 3" = 0.25 feet
2. All flows to run–on berms will be sheet flow
3. Run–on berms are temporary with a maximum length 300', centered on working face.
4. Berm 2.0' (24")

Since flows to be handled by the run–on berm are sheet flows, the depth of water to be diverted will be 0.25 feet.

CALCULATION:

0.25' + 1.0' freeboard = 1.25' (min) berm height

2' (min.) constructed height/1.25 (min.) required height = 1.60 Safety Factor

Valerie Joosten
4/25/02

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| REVISIONS | | | |
|---|---|---|---|
| NO. | BY | DATE | APPD |
| | | | |

Raba Kistner

Engineers, Geologists, Hygienists and Environmental Scientists

CONTROL BERM AT WORKING FACE
McCOMBS LANDFILL – MSW PERMIT No. 729B
EL PASO COUNTY, TEXAS

SCALE: N.T.S. PROJECT NO.: ASF02-045-00 FIGURE ATT15-1

DRAWN BY: IW CHK. BY: VJ APPD.: FC DATE: 4/05/02

# APPENDIX Att15-A

## Rainfall Frequency Maps

# Appendix 3J
# Liner Quality Control Plan

SAIC®

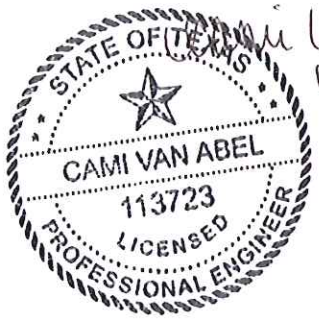
# McCombs Municipal Landfill
# El Paso County, Texas
# TCEQ MSW Permit No. 729B

## Part III
## Appendix 3J
## Liner Quality Control Plan

Prepared for

**City of El Paso**

Updated June 2013, Revision 2

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# Part III

# Appendix 3J – Liner Quality Control Plan

## City of El Paso

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# Appendix 3J
# LINER QUALITY CONTROL PLAN
30 TAC §330.63(d)(4)(G), §330.331, §330.335, §330.337, §330.339, §330.341

This Liner Quality Control Plan (LQCP) has been prepared in accordance with 30 TAC §330.339 and details construction quality practices that will be undertaken to assure compliance with the Texas Commission on Environmental Quality (TCEQ) Municipal Solid Waste Rules (MSWR). This LQCP has been prepared using regulatory guidance documents, standard industry practices and testing methods current as of the issuance of this report. Quality assurance and quality control (QA/QC) practices for construction projects should follow the most up to date technical guidelines of the executive director. This LQCP provides QA/QC guidelines for the design, construction, testing parameters and frequency, and documentation of the landfill liner and leachate collection system construction.

## 3J.1 Scope

This LQCP is intended for construction of the sanitary landfill liner for the City of El Paso, Texas, McCombs Landfill (Landfill). The LQCP is intended to address 3 types of liner construction scenarios at the Landfill. The design structure of the liner system scenarios are described below.

Scenario 1 addresses a prescriptive (i.e., current permitted) liner system, consisting of (in ascending order):

- 6-inch scarified and compacted subgrade;
- 6-inch compacted caliche;
- 60-mil high density polyethylene (HDPE) geomembrane liner;
- 24-inch sand protective layer; and,
- Waste.

Scenario 2 describes an alternative liner system to Scenario 1 to be used in instances where caliche is not available for cell construction or is not cost effective to obtain. This scenario design system consists of (in ascending order):

- 6-inch scarified and compacted subgrade;
- Geosynthetic Clay Liner (GCL);
- 60-mil HDPE geomembrane liner;
- 24-inch sand protective layer; and,
- Waste.

Scenario 3 addresses a ”piggy-backed” liner system for portions of the Landfill where liner construction occurs over existing unlined municipal solid waste (MSW) fill areas. This scenario provides for a component of geotechnical stability where the

liner system is being constructed over waste fill areas with the potential for non-uniform settlement. This design system consists of (in ascending order, beginning with the waste material present at the time of "piggy-back" cell construction):

- Inert construction and demolition (C&D) waste;
- 12-inch intermediate cover;
- 36-inch compacted onsite soil;
- 6-inch bedding sand;
- Primary uniaxial geogrid;
- Secondary uniaxial geogrid;
- GCL;
- 60 mil HDPE geomembrane liner;
- 24-inch sand protective layer, and;
- Waste.

As stated previously, Scenario 1 and Scenario 2 liner systems are presented as interchangeable liner design systems and the use of either liner system will be determined based on the availability of caliche. Scenario 3 liner system is specific to the areas of the Landfill where waste material is considered in the foundation of the liner system for the "piggy-back" cell development.

The Landfill cell will be sloped to drain liquid to leachate collection trenches along the centerline of each cell. The leachate collection trenches will include a perforated HDPE pipe backfilled with aggregate. The leachate collection system is described further in Section 3J.5.1 and detailed in Appendix 3I.

## 3J.2 Construction Quality Assurance Personnel

All quality assurance personnel associated with Landfill cell construction will be properly trained and qualified to test and inspect the components of cell construction in their respective areas of expertise.

The Construction Quality Assurance (CQA) Professional of Record (POR) will be responsible for all CQA activities associated with liner system construction. The POR will be licensed as a Professional Engineer in Texas. The POR will be experienced in geotechnical engineering and/or engineering geology with relation to landfill cell construction.

The POR representative will be responsible for the implementation of field inspection and testing activities under the direct supervision of the POR. The POR representative is responsible for the CQA monitoring and must be an engineering technician with a minimum of 4 years relevant experience, or an engineer or geologist with at least 1 year of relevant experience.

Any references to surveying contained within this LQCP shall be required to be performed by a professional land surveyor registered in the State of Texas.

# 3J.3 Site Geology

Site geological information is described in Section 3.5 of the permit report. The liner system is designed with separation distance of over 300 feet from the highest observed groundwater elevation at the Landfill. Therefore, de-watering efforts or uplift analysis and ballast support is not required for landfill cell construction.

# 3J.4 Location

The landfill is located at 13600 McCombs Road, on the northeast side of the City of El Paso, Texas.

# 3J.5 Leachate Collection System Design

The leachate collection system shall be constructed according to construction drawings provided in Appendix 3G and consists of:

- Collection Trenches (ascending order):
  - 8-ounce geotextile filter fabric;
  - 8-inch diameter HDPE leachate collection perforated and non-perforated pipes;
  - 12-inch thick layer of washed aggregate (maximum of 5% of calcium carbonate content);
  - 12-inch thick layer of pea gravel backfill (maximum of 5% of calcium carbonate content); and,
  - 24-inch thick layer of protective sand.
- Leachate collection sump (ascending order):
  - 8-ounce geotextile filter fabric;
  - 18-inch diameter HDPE leachate transfer pipe;
  - 12-inch thick layer of washed aggregate (maximum of 5% of calcium carbonate content);
  - 12-inch thick layer of pea gravel backfill (maximum of 5% of calcium carbonate content); and,
  - 24-inch thick layer of protective sand.

# 3J.6 Site Preparation and Slopes

## 3J.6.1 Grading

The cell footprint should be prepared to the required grade prior to the construction of the liner system. All necessary grading and fill placement including side slopes shall be performed according to construction drawings. Anchor trenches shall be built as detailed in the construction drawings.

### 3J.6.2 Slopes

The slope of excavation faces shall be proportioned according to construction drawings and shall be in accordance with Occupational Safety and Health Administration (OSHA) excavation and trenching regulations.

A slope stability analysis is provided in Appendix 3-G, Attachment 3. The analysis is valid for the conditions and design set forth in the calculations.

Construction slopes shall not be steeper than the final slopes. No construction activities which may present concentrated loadings or stress, such as heavy equipment storage or soil stockpiles shall not be placed within 100 feet of slope crests unless additional slope stability analysis are performed.

### 3J.6.3 Excavation Faces Protective Layer

A 24-inch thick protective sand layer will be placed over the geomembrane as described in Section 3J.8.6. The protective layer will also act as a drainage media, allowing the transport of leachate to the low-lying leachate collection sump area. The intended sand to be used as protective layer will be sampled for material conformance as detailed in Table 3J.1. The POR representative will review the analytical results to ensure compliance with project specifications. The protective sand shall be placed directly on top of the geomembrane using a backhoe or belt conveyor. No construction equipment will be allowed to operate on the geomembrane without at least 12-inches of soil in place over the geomembrane. The remainder of the protective sand layer shall be placed using a low ground pressure dozer (see Table 3J-2).

## 3J.7 Material Field and Laboratory Testing

The POR will be responsible for the implementation of field inspection and testing activities. The Contractor, with oversight by the POR representative, will obtain soil and geosynthetic samples for third-party analysis. Laboratory and field tests are identified in Table 3J.1. The table presents testing requirements for pre-construction borrow source acceptance, placement requirements and post-placement requirements, where applicable. Additional tests may be required or recommended by the POR and/or POR representative prior to material acceptance. Other tests and services normally provided by inspection and testing agencies may also be conducted as the POR and/or POR representative directs.

Table 3J.1
Laboratory and Field QA/QC Testing

| | Material | Test | Test Method | Minimum Test Frequency | Minimum Passing Requirements |
|---|---|---|---|---|---|
| 1. | SUBGRADE (IN-SITU SOIL) | | | Prior to Grading | |
| | | Particle Size Distribution | ASTM D 422 or ASTM D 1140 | 1 test/material type | ≥ 30% passing 200 sieve; 100% passing 1 in. screen |
| | | Standard Proctor Test | ASTM D 698 | 1 test/material type | NA |
| | | Moisture Content | ASTM D 2216 | 1 test/material type | NA |
| | | Soil Classification | ASTM D2487 | 1 test/material type | CL, CL-ML, CH |
| | | | | During Placement | |
| | | Field Density and Water Content (Nuclear Methods) | ASTM D 6938 | 1/8,000 $ft^2$ per 6 in. lift | ≥95% Maximum Dry Density ± 3% optimum moisture |
| | | Direct Shear (Subgrade/GCL) | ASTM D 5321 | 1/Material Type | Min 24 degrees[7] |
| 2. | SOIL LINER (6 IN. COMPACTED CALICHE) | | | Borrow Source | |
| | | Particle Size Distribution | ASTM D 422 or ASTM D 1140 | 1 test/material type | ≥ 30% passing 200 sieve; 100% passing 3/8 in. screen |
| | | Standard Proctor Test | ASTM D 698 | 1 test/material type | NA |
| | | Moisture Content | ASTM D 2216 | 1 test/material type | NA |
| | | Permeability | TAC Designated Methodology[1] | 1 test/material type | ≤ $1x10^{-7}$ cm/sec |
| | | Plasticity Index | ASTM D 4318 | 1 test/material type | ≥ 15 |
| | | Liquid Limit | ASTM D 4318 | 1 test/material type | ≥ 30 |
| | | Soil Classification | ASTM D2487 | 1 test/material type | CL, CL-ML, CH |
| | | | | During Placement | |
| | | Field Density and Water Content (Nuclear Methods) | ASTM D 6938 | 1/8,000 $ft^2$ per 6 in. lift Min 3 tests per 6 in. lift | ≥95% Maximum Dry Density ± 2% optimum moisture |
| | | Particle Size Distribution | ASTM D 422 or ASTM D 1140 | 1/100,000 $ft^2$ per 6 in. lift | ≥ 30% passing 200 sieve; 100% passing 3/8 in. screen |
| | | Plasticity Index | ASTM D 4318 | 1/100,000 $ft^2$ per 6 in. lift | ≥ 15 |
| | | Liquid Limit | ASTM D 4318 | 1/100,000 $ft^2$ per 6 in. lift | ≥ 30 |
| | | Permeability | TAC Designated | 1/100,000 $ft^2$ per 6 in. lift | ≤ $1x10^{-7}$ cm/sec |

Table 3J.1
Laboratory and Field QA/QC Testing

| | Material | Test | Test Method | Minimum Test Frequency | Minimum Passing Requirements |
|---|---|---|---|---|---|
| | | | Methodology[1] | | |
| | | Layer Thickness | Survey | 1 point/5,000 ft$^2$ | ≥ 6 inches |
| 3. | GEOSYNTHETIC CLAY LINER | | | Material Conformance | |
| | | Bentonite Swell Index[2] | ASTM D 5890 | 1 test/50 tons material | ≥ 24 mL/ 2g |
| | | Fluid Loss[2] | ASTM D 5891 | 1 test/50 tons material | ≥ 18 mL |
| | | Bentonite Mass/Area[3] | ASTM D 5993 | 1 test/40,000 ft$^2$ | 0.75 lbs./ ft$^2$ |
| | | GCL Grab Strength[4] | ASTM D 4632 | 1 test/200,000 ft$^2$ | 90 lbs. |
| | | GCL Peel Strength | ASTM D 4632 | 1 test/40,000 ft$^2$ | 15 lbs. |
| | | GCL Index Flux[5] | ASTM D 5887 | 1/100,000 ft$^2$ | 1x10$^{-8}$ m$^3$/m$^2$/sec |
| | | GCL Permeability[5] | ASTM D 5887 | 1/100,000 ft$^2$ | ≤ 5x10$^{-9}$ cm/sec |
| | | GCL Hydrated Internal Shear Strength[6] | ASTM D 5321 | 1/100,000 ft$^2$ | 500 lbs./ft$^2$ |
| | | Direct Shear (GCL/Geomembrane) | ASTM D 5321 | 1/Material Type | Min 24 degrees[7] |
| | | Cap Fabric (non-woven) | ASTM D5261 | 1/225,000 ft$^2$ | ≥ 5.8 oz/yd$^2$ |
| | | Carrier Fabric (woven) | ASTM D5261 | 1/225,000 ft$^2$ | ≥ 3.0 oz/yd$^2$ |
| | | Moisture Content | ASTM D5993 | 1/45,000 ft$^2$ | ≤ 35% |
| 4. | BUFFER SAND | | | Borrow Source | |
| | | Particle Size Distribution | ASTM D 422 | 1 test/5,000 yd$^3$ | ≤ 5% by weight passing through #200 sieve; 100% by weight passing through 3/8" sieve |
| | | Soil Classification | ASTM D 2487 | 1 test/2,000 yd$^3$ | SC, SM, SW-SM, SW-SC, SP-SM, SP-SC; Uniformity coefficient <6 |
| | | Permeability | ASTM D 2434 | 1 test/2,000 yd$^3$ | ≥ 1x10$^{-3}$ cm/sec |
| | | | | During Placement | |
| | | Permeability | ASTM D 2434 | 1 test/acre | ≥ 1x10$^{-3}$ cm/sec |
| 5. | UNIAXIAL GEOGRID | | | Material Conformance | |
| | | Mass/Unit Area | ASTM D 5261 | MARV based on 95% confidence level. | ≥ 11 oz/yd$^3$ |
| | | Aperture Size | ASTM D 1777 | MARV based on 95% confidence level. | ≥ 0.8 x 1.2 in. |

Table 3J.1
Laboratory and Field QA/QC Testing

| | Material | Test | Test Method | Minimum Test Frequency | Minimum Passing Requirements |
|---|---|---|---|---|---|
| | | % Open Area | CW022125 | MARV based on 95% confidence level. | ≥ 70% |
| | | Ultimate Wide Width Tensile Strength | ASTM D 6637 | MARV based on 95% confidence level. | ≥ 5,480 lbs./ft |
| | | Elongation at Break | ASTM D 6637 | MARV based on 95% confidence level. | 4 to 6% |
| 5. | UNIAXIAL GEOGRID | 100 Year Creep Limited Strength at 2% Strain | ASTM D 6992 | MARV based on 95% confidence level. | 1,150 lbs./ft |
| | | 100 Year Creep Limited Strength at 5% Strain | ASTM D 6992 | MARV based on 95% confidence level. | 3,616 lbs./ft |
| | | Allowable Design Strength at 5% | GRI GG4 | MARV based on 95% confidence level. | 3,389 lbs./ft |
| | | pH Resistance Range | ASTM D 5819 | MARV based on 95% confidence level. | 2 to 13 |
| 6. | GEOMEMBRANE (60 MIL HDPE TEXTURED) | | | Material Conformance[12] | |
| | | Sheet Thickness | ASTM D 5994 | 1/50,000 $ft^2$ and every resin lot | 60 mil ± 10% |
| | | Specific Gravity (Density) | ASTM D 1505 | 1/100,000 $ft^2$ and every resin lot | 0.935 to 0.95 $g/cm^3$ |
| | | Melt Flow Index | ASTM D1238 | 1/100,000 $ft^2$ and every resin lot | <1.0 g/10 min. |
| | | Asperity Height | ASTM D 7466 | 1/100,000 $ft^2$ and every resin lot | 10 mil |
| | | Tensile Strength Yield | ASTM D 6693 | 1/100,000 $ft^2$ and every resin lot | ≥ 126 lbs./in |
| | | Tensile Strength Break | ASTM D 6693 | 1/100,000 $ft^2$ and every resin lot | ≥ 90 lbs./in |
| | | Elongation at Break | ASTM D 6693 | 1/100,000 $ft^2$ and every resin lot | ≥ 100% |
| | | Elongation at Yield | ASTM D 6693 | 1/100,000 $ft^2$ and every resin lot | ≥ 12% |
| | | Carbon Black Content | ASTM D 1603 or 4218 | 1/100,000 $ft^2$ and every resin lot | 2.0 to 3.0% |
| | | Carbon Black Dispersion | ASTM D 5596 | 1/100,000 $ft^2$ and every resin lot | 9 as Category 1 or 2, 1 as Category 3 |
| | | Tear Resistance | ASTM D 1004 | 1/100,000 $ft^2$ and every resin lot | Min. 42 lbs.. |
| | | Puncture Resistance | ASTM D 4833 | 1/100,000 $ft^2$ and every resin lot | Min. 90 lbs.. |
| | | Direct Shear (HDPE/Protective Sand) | ASTM D 5321 | 1/Material Type | Min 24 degrees[7] |
| | | | | Seam | |
| | | Shear Strength | ASTM D 4437 | 1/500 feet of seam length | ≥ 120 lbs./in [8] |
| | | Peel Strength | ASTM D 4437 | 1/500 feet of seam length | ≥ 78 lbs./in (extrusion method) or 91 |

Table 3J.1
Laboratory and Field QA/QC Testing

| | Material | Test | Test Method | Minimum Test Frequency | Minimum Passing Requirements |
|---|---|---|---|---|---|
| | | | | | lbs./in (wedge method) [9] |
| | | | | As-Built Integrity | |
| | | Electric Conductance | ASTM D 6747 | Geomembrane Area | N/A |
| 7. | PROTECTIVE SAND LAYER | | | Borrow Source | |
| | | Particle Size Distribution | ASTM D 422 | 1 test/5,000 $yd^3$ | ≤ 5% by weight passing through #200 sieve; 100% by weight passing through 3/8" sieve |
| | | Soil Classification | ASTM D 2487 | 1 test/2,000 $yd^3$ | SC, SM, SW-SM, SW-SC, SP-SM, SP-SC; Uniformity coefficient <6 |
| | | Permeability | ASTM D 2434 | 1 test/2,000 $yd^3$ | ≥ $1x10^{-3}$ cm/sec |
| | | | | During Placement | |
| | | Permeability | ASTM D 2434 | 1 test/acre | ≥ $1x10^{-3}$ cm/sec |
| 8. | LEACHATE COLLECTION SYSTEM WASHED AGGREGATE | | | Borrow Source | |
| | | Particle Size Distribution | ASTM D 422 | 1 test/source | 100% passing 1½ in.; 0% passing ¾ in. Uniformity Coefficient ≤4 |
| | | Soil Classification | ASTM D 2487 | 1 test/source | GW, GP |
| | | Carbonate Content | JLT-S-105-e9 or ASTM D 3042[10] | 1 test/source | ≤ 5% |
| | | | | During Placement | |
| | | Particle Size Distribution | ASTM D 422 | 1 test/3,000 $yd^3$ | 100% passing 1½ in.; 0% passing ¾ in. |
| | | Carbonate Content | JLT-S-105-e9 or ASTM D 3042[10] | 1 test/3,000 $yd^3$ | ≤ 5% |
| 9. | LEACHATE COLLECTION SYSTEM WASHED PEA GRAVEL | | | Borrow Source | |
| | | Particle Size Distribution | ASTM D 422 | 1 test/source | Filter Criteria[11] |
| | | Soil Classification | ASTM D 2487 | 1 test/source | GW, GP |
| | | Carbonate Content | JLT-S-105-e9 or ASTM D 3042[10] | 1 test/source | ≤ 5% |
| | | | | During Placement | |
| | | Particle Size Distribution | ASTM D 422 | 1 test/3,000 $yd^3$ | Filter Criteria[11] |
| | | Carbonate Content | JLT-S-105-e9 or | 1 test/3,000 $yd^3$ | ≤ 5% |

Table 3J.1
Laboratory and Field QA/QC Testing

| Material | Test | Test Method | Minimum Test Frequency | Minimum Passing Requirements |
|---|---|---|---|---|
| | | ASTM D 3042[10] | | |

Notes:

N/A – Not Applicable
MARV – Minimum Average Roll Value
[1] Permeability testing methodology described in 30 TAC §330.339 (c).
[2] Bentonite property tests performed at processing facility before shipment to GCL production facilities.
[3] Bentonite mass/area reported at 0% moisture content.
[4] All tensile testing shall be performed in the machine direction, with results as minimum average roll values unless otherwise indicated.
[5] Index flux and permeability testing with desired distilled/de-ionized water at 80 lb/in$^2$ (551 kPa) tailwater pressure.
[6] Peak value measured at 200 lb/ft$^2$ (30 kPa) normal stress.
[7] Interface friction angles shall be tested between the Subgrade/GCL, GCL/Geomembrane, and Geomembrane/Protective Sand to comply with calculations in Appendix 3G, Attachment 3.
[8] Four of 5 tests from each sample must have a shear strength no less than 95% of the minimum yield sheet strength, with the minimum acceptable shear strength no less than 120 lb/in, regardless of seaming method.
[9] For seams performed using hot wedge methods, 4 of 5 tests from each sample must have a peel strength no less than 62% of the minimum yield sheet strength, with the minimum acceptable peel strength of no less than 91 lb/in. For seams performed using extrusion fillet methods, 4 of 5 tests from each sample must have a peel strength of no less than 72% of the minimum yield sheet strength, with the minimum acceptable peel strength no less than 78 lb/in.
[10]The ASTM D 3042 test shall use a HCL solution having a pH of no more than 5.
[11]The pea gravel will act as a filter medium between the protective sand layer and the aggregate. Based on the gradation results of the 3 drainage material, the following criteria shall be met between all layers:

1. Criterion 1: $D_{15\ (lower)}/D_{85\ (upper)} < 4$ to 5
2. Criterion 2: $D_{15\ (lower)}/D_{15\ (upper)} < 20$

[12]Material conformance documentation will be provided by the contractor or contractor's selected geomembrane manufacturer to the POR prior to material delivery to the site.

# 3J.8 Material Placement

## 3J.8.1 Subgrade

To prepare the subgrade for cell construction, the area will initially be proof-rolled with heavy, rubber-tired construction equipment to detect "soft" areas or otherwise unsuitable issues for cell liner construction. Soft areas will be excavated and replaced with suitable onsite general fill material and re-compacted. Debris, including roots and stumps will be removed from the construction area. Areas determined to be unsuitable for cell liner construction will be excavated to the extent necessary to attain suitable conditions. The excavated area will be backfilled with material deemed suitable (soil material meeting the characteristics of Materials 1 or 2 listed in Table 3J.1) for cell liner construction. The material will be placed in lifts not exceeding 8-inches in thickness and compacted until the designed subgrade elevations in the area are attained. The backfilled material will be "stair-stepped" laterally into the native material as shown in Detail 3J-2 below. The surface of each of the steps in the surrounding subgrade will be scarified to maximize bonding between the new and old sections.

The upper 6-inches of the subgrade will be scarified and roughened. Water will be added as necessary to provide a suitable firm subgrade so that optimum compaction density of not less than 95% of maximum density as determined by the standard proctor compaction test (ASTM D 698) is attained. The moisture content of the materials shall be uniform and within plus or minus 3% of optimum value as determined by ASTM D 2216. Required laboratory and field QA/QC tests, collection frequency and passing requirements are presented above in Table 3J.1. In place density and moisture testing will be conducted as described below in Section 3J.8.2. Construction will be sequenced in such a manner to maintain drainage and minimize the potential effects of precipitation on the construction area. Excavation activities will occur in strict adherence to OSHA regulations.

The POR representative will observe the subgrade preparation to ensure suitability for cell liner construction. The POR representative will verify the thickness of the subgrade through visual confirmation that the scarified and compacted in-situ soil is a minimum of 6-inches thick. Prior to the placement of the caliche (if used for the cell construction), the top of the finished subgrade will be surveyed for topographic elevations at a minimum rate of one survey point per 5,000 square feet of cell liner limits.

## 3J.8.2 Prescriptive Primary Liner – Caliche

Once the finished, compacted subgrade is confirmed to adhere with material specifications and is surveyed, caliche material shall be placed in one lift not to exceed 8-inches in loose depth and then compacted to the required density of not less than 95% of maximum density as determined by the Standard Proctor Compaction Test (ASTM D 698). In instances where caliche is already present within the proposed construction area, approximately 8-inches of caliche material will be scarified as "loose" material and compacted to attain the 6-inch thickness requirements. If an area

of the cell is determined to be unsuitable for in-situ liner construction, the identified area will be excavated to the extent necessary to attain suitable conditions. The excavated area will be backfilled with material deemed suitable (soil material meeting the characteristics of Material 2 listed in Table 3J.1) for cell liner construction. Excavations will be made in strict adherence to OSHA regulations. The backfill material will be placed in lifts not exceeding 8-inches in thickness and compacted until the designed subgrade elevations in the area are attained. The backfilled material will be "stair-stepped" laterally into the native material as shown in Detail 3J-2 below. The surface of each of the steps in the surrounding subgrade will be scarified to maximize bonding between the new and old sections.

Lift construction details are depicted in Figure 3J-1. The width of the lift construction will be dependent upon the cell area that will be constructed

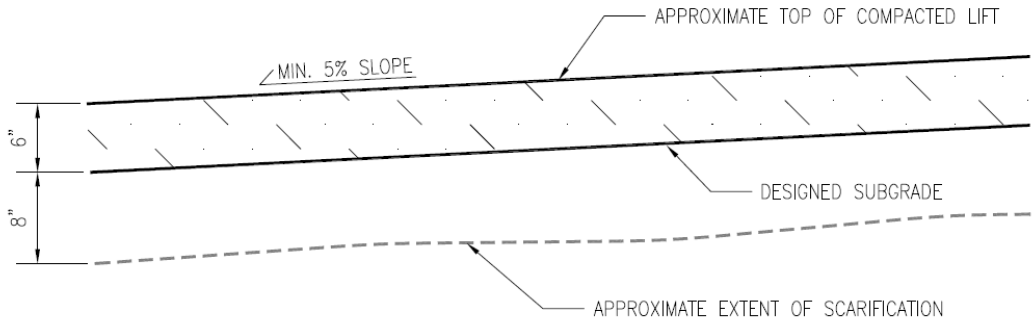


**Figure 3J-1: Detail for Overexcavation and Recompaction of In-Situ Soils**

The moisture content of the materials shall be uniform and within 2% of optimum value as determined by ASTM D 2216. Required laboratory and field QA/QC tests, collection frequency and passing requirements are presented above in Table 3J.1. Modeling of the alternative caliche (prescriptive) liner is provided in Appendix 3I, Attachment 2.

Compaction of the subgrade and the 6-inch caliche shall be performed with a pad-footed or prong-footed roller only. The soil liner shall not be compacted with a bulldozer, rubber-tired roller, flat-wheel roller, scraper or any tracked equipment unless it is used to pull a footed roller.

Determination of density and water content in the field shall be in accordance with the requirements of ASTM D 6938 (nuclear methods). Control of the soil placement shall consist of field inspection and testing to determine that the subgrade and the 6-inch caliche liner has been compacted to the required density and at the proper moisture content. Should any portion of a lift not conform to the density and moisture requirement, the lift shall be scarified, moisture conditioned as necessary, and re-compacted until the required density and moisture content are obtained.

Rocks and caliche clods greater than 1-inch in diameter shall total no more than 10% by weight. The caliche surface shall contain no material larger than 3/8-inches in diameter. The constructed subgrade and caliche shall be "stair-stepped" into an underlying formation of sufficient strength to ensure stability of the constructed liner

system. The surface of each of the steps in the "old" liner shall be scarified to maximize bonding between the "old" and "new" liner material. See Figure 3J-2 for depiction of the "stair-stepped" construction method. It should be noted that for the 6-inch caliche layer, there will only be one "stair-step".

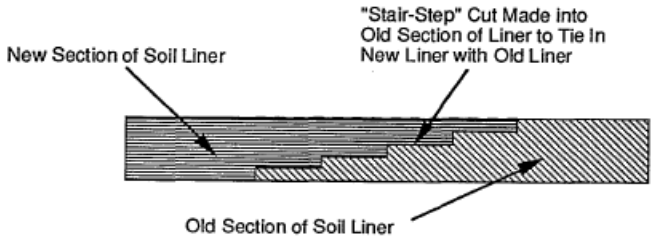


**Figure 3J-2: Tie-in of Soil Liner System (Typical)**
**Source of Figure: Figure 2.2, Quality Assurance and Quality Control for Waste Containment Facilities, EPA Technical Guidance Document 600/R-93/182, September 1993, p. 22**

The completed compacted caliche soil liner must be protected against material drying, desiccation, rutting, erosion and ponding water. Any areas of noted damage shall be re-worked, re-compacted and re-tested.

The thickness of the in-place caliche will be verified by standard survey methods, using the same grid pattern and frequency (1 survey point per 5,000 square feet of cell liner limits) as the subgrade survey to verify that a finished, compacted thickness of at least 6-inches of caliche are in place.

The surface of a constructed soil liner should be covered or otherwise protected within a period of six months to mitigate the effects of dessication, surface erosion, and rutting due to traffic. Liner surfaces not covered within six months shall be checked by the POR and/or POR representative, who shall then submit a letter report on the findings to the TCEQ. Required repairs shall be performed promptly. A new report shall be submitted on the new construction for all liners that need repair due to damage.

## 3J.8.3 Alternative Primary Liner – GCL

In instances where caliche material is not available (or not cost effective to obtain) for Landfill cell construction, GCL may be used. GCL is a manufactured hydraulic barrier consisting of clay bonded to layers of geosynthetics. The GCL shall be reinforced with a layer of sodium bentonite between a woven and a non-woven geotextile that are needle-punched together. Modeling of the alternative liner compared to the prescriptive liner utilizing the HELP model is provided in Appendix 3I, Attachment 1. Additionally, modeling of leachate migration using the Multimedia Exposure Assessment (Multimed) Model is provided in Appendix 3J, Attachment 1.

Quality control certificates shall be submitted by the GCL manufacturer and include: certificates of analysis for bentonite clay used in GCL production demonstrating compliance with the parameters swell index and fluid loss, and manufacturer's test data for finished GCL products of bentonite/mass area, GCL tensile strength, GCL peel strength, GCL index flux, permeability, and hydrated internal shear strength data demonstrating compliance with these specifications.

Handling of GCL rolls should be done to minimize potential damage. Procedures detailed in ASTM D-4873 (02), "Standard Guide for Identification, Storage and Handling of Geosynthetic Rolls and Samples" should be followed as applicable. Each roll shall be inspected during unloading to identify damage. Damaged rolls shall be set aside for further inspection. The GCL shall be stored in a level, dry and well-drained storage area, and shall be covered and protected from ultraviolet photodegradation and precipitation. Care will be taken during GCL roll loading and unloading so that not damage occurs to the GCL, its core or its protective wrapping. If any protective wrapping is damaged or stripped off the rolls, the wrapping will be repaired immediately or the roll moved to an enclosed facility until it may be repaired. If any of the clay material is found to be lost during transportation or handling, the outer layers of the GCL should be discarded until undamaged product is found. The reminder of the GCL roll will be re-wrapped in accordance with the manufacturer's instructions.

The GCL material physical property specifications are detailed Table 3J.1.

The minimum acceptable dimensions of full-size GCL panels shall be 150 feet in length and 15 feet in width. Short rolls (those manufactured to a length greater than 70 feet but less than a full-length roll) may be supplied at a rate no greater than 3 per truckload or 3 rolls every 36,000 square feet of GCL, whichever is less. A 6-inch overlap guideline shall be imprinted on both edges of the upper geotextile component of the GCL as a means for providing quality assurance of overlap dimension.

Installation shall not begin until the base has been properly prepared. The surface shall be maintained in a firm, clean, dry and smooth condition during liner installation. The GCL shall be oriented and installed with the non-woven side facing up. The panels shall lie flat on the underlying surface, with no wrinkles or folds, especially at the exposed edges of the panels. Equipment that could damage the GCL shall not be allowed to travel directly on the GCL, and the cover material (geomembrane) shall be placed immediately over the bentonite GCL.

As the GCL is installed, all overlapping panels shall be inspected to ensure that a minimum of 6-inch overlap exists. For any overlapping panels that are parallel to the slope, the upslope panel shall "single" over the downslope panel with a minimum of 24-inches of overlap. In addition, the GCL shall be inspected for any tears or punctures and repaired or replaced as deemed necessary by the POR.

## 3J.8.4 Geogrid and Bedding Sand

Scenario 3 described in Section 3J.1 includes 2 layers of uniaxial geogrid. Geogrids are reinforcement geosynthetics formed by adjoining longitudinal and transverse ribs. The geogrid layers are installed in areas of "piggy-back" Landfill development and underlie the GCL layer. A layer of free-draining bedding sand (buffer sand) no less than 6-inches thick will be placed between 36-inch compacted onsite soil and the primary uniaxial geogrid. The buffer sand will meet the specifications included in Table 3J.1. The buffer sand will be smooth-rolled and free of any rocks, debris or organic matter.

The POR or POR representative will inspect the delivered geogrid to verify it is the proper and intended material. The POR or POR representative will verify the geogrid

identification labels and coding and inspect the rib joining, thickness and aperture size. If the geogrid has a primary strength direction, it must be indicated on the material.

The geogrid shall have a minimum tensile strength of 3,500 pounds per foot at an allowable stress of 5% or less over 50 years. Material conformance specifications are included in Table 3J.1. The geogrid installation contractor will demonstrate experience of at least 3 projects of similar construction and scope. The geogrid will be stored, handled and installed as specified in the manufacturer's recommendations and current industry standards. At a minimum, the geogrid installation requirements will include:

- Deployment will occur from the top of the slope downward, so that the geogrid is taut before the GCL is placed.
- Reinforcement shall be placed side by side with no overlap.
- The geogrid will end in an anchor trench as shown on Drawing P3-29.
- The roll ends will be connected with Bodkin connection only.
- The geogrid material shall be restrained from moving out of alignment during and after placement. Alignment shall be maintained by securing each reinforcement strip to the ground with stakes or anchoring by hand placing a small quantity of fill on top of the reinforcement prior to placement of the GCL.
- The reinforcement strips shall be pulled taut to remove slack. Stakes should be driven through the reinforcement apertures, or fill should be placed on top of the strips.
- The construction schedule shall allow only the amount of geogrid needed to complete immediately pending work in order to minimize unnecessary exposure to reinforcement.
- Overlying GCL placement shall proceed from the bottom of the slope upward.
- Construction equipment will not be permitted to drive directly over the geogrid.
- Geogrid roll connections on the side slopes shall be avoided. Connections will be located as close to the bottom of the slope as possible.

The POR or POR representative will also oversee the installation of the geogrid and approve connection methods. If additional conformance testing is required, the POR or POR representative will oversee sample collection, frequency and testing methodology.

## 3J.8.5 Secondary Liner – 60 mil HDPE Geomembrane

The liner system consists of a primary (caliche or alternative GCL) liner and the overlying secondary liner, which will consist of a 60-mil HDPE geomembrane. The geomembrane will be textured on both sides to ensure structural stability. The POR and/or POR representative will provide continuous construction oversight during the deployment of the geomembrane and will directly oversee testing of trial welds, seams and repairs. Documentation retained during the installation of the geomembrane will be used in preparation of the soil and geomembrane liner evaluation report (SLER and GLER).

Material conformance documentation will be provided by the contractor or the contractor's selected geomembrane manufacturer to the POR prior to material delivery to the site. Documentation provided will be reviewed by the POR to ensure the proposed material meets the properties specified in Table 3J.1, along with any other material requirements listed in the construction project specifications. Once the intended geomembrane material is approved for use by the POR for the construction project, the geomembrane may be shipped to the construction site.

The geomembrane rolls shipped to the site will be handled, transported and stored in accordance with the geomembrane manufacturer's recommendations, standard industry practices and as designated in the construction project specifications. Each roll will be identified with the manufacturer's name, product identification, thickness, roll number, roll dimensions and the date manufactured. The POR or POR representative will inspect the delivered rolls and will be provided with a roll inventory from the contractor. The POR or POR representative will verify the geomembrane rolls are stored and handled in accordance with the manufacturer's recommendations and observe that:

- Designated equipment used to unload and store the rolls do not have the potential to damage the liner material.
- The rolls are stored in a suitable location and not stacked more than 5 rolls high.
- The rolls are protected from potential puncture, dirt, grease, water accumulation, moisture and excessive heat.

The contractor will submit the qualifications of their selected geomembrane installer to the POR for approval. Geomembrane installation contractor qualifications will be described in the construction project specifications. At a minimum, these qualifications shall include:

- Sufficient production capacity and qualified personnel to meet the demands of the work.
- Approval or licensing of the geomembrane installer by the geomembrane manufacturer.
- Proven qualification by personnel performing the seaming operation by successfully passing seaming tests.
- A minimum of 1 million square feet of experience seaming geomembrane using the same type of seaming apparatus to be used for this work by the "Master Seamer".

Once approved, and prior to the geomembrane deployment, a meeting will be held at the construction site with a minimum of the POR and/or POR representative, the contractor and the approved geomembrane installer in attendance. Installation methods, testing frequency, nonconformance procedures, deployment layout, schedule and personnel contact information will be discussed, at a minimum. Prior to geomembrane deployment, the geomembrane installer will inspect the prepared surface to ensure it is suitable for liner installation, and will certify it in a subgrade acceptance form. If caliche is used as the primary liner, it should be smooth drum rolled, free of irregularities, ruts, soft areas, loose soil, stones, protrusions or any objects that could damage the geomembrane. If GLC is used as the primary liner, the

material integrity will be inspected, and the surface should be clean, and kept free of irregularities or any debris or wind-blown material.

The POR or POR representative will observe geomembrane deployment procedures and facilitate sample collection and testing. Geomembrane rolls shall be deployed by equipment that will unroll the geomembrane without damaging, crimping or stretching the material and that will not damage the underlying material. The geomembrane will not be installed on frozen subgrade. If GCL is used in the liner design, deployment equipment will not be permitted to ride directly over the GCL. If the geomembrane panel must be adjusted once placed upon the GCL, the panel must be moved by hand or using a small pneumatic, tired lifting unit. Tire inflation pressure should be limited to 40 kPa (6 psi) or less over the GCL. If there are any folds, wrinkles or other undulations in the GCL, they will be removed prior to placement of the geomembrane.

The POR and/or POR representative will remain onsite during geomembrane installation. The panels will each be uniquely identified and the location of each panel recorded on a drawing. All panels must be anchored with sufficient ballast to prevent wind uplift. Restrictions will be placed on the liner installation personnel to minimize the potential for damage to the liner, such as smoking or wearing damaging shoes. No more panels will be deployed than can be seamed on the same day.

During geomembrane deployment, the POR and/or POR representative will:

- Observe handling, storage, and installation procedures used for geomembrane liner to verify conformance with manufacturer's instructions and construction specifications.
- Verify that equipment used in geomembrane installation and testing is operating properly.
- Verify that installer is performing trial seaming and field testing at the required frequencies.
- Inspect geomembrane during placement for defects and damage. Notify the contractor for repairs.
- Observation to ensure the unrolled geomembrane has adequate and appropriate ballast to prevent uplift from the wind without causing damage to the geomembrane.
- Observation of the weather conditions (i.e., temperature, humidity, precipitation and wind) to ensure they are acceptable for geomembrane placement and seaming.
- Inspect to ensure the leading edge excavation of the anchor trench excavation is rounded and the dimensions are as specified.
- Inspect to verify proper slack is incorporated into liner sheet installation to accommodate effects from temperature changes.
- Document the construction using field notes and photographs.
- Verify that the installer is documenting all necessary information. Make periodic reviews of installer's documentation.
- Locate, identify, and send seam and material samples to the testing agency for specified tests listed in Table 3J.1.

- Oversee field testing to verify proper procedures and quality construction. Testing frequencies are included in Table 3J.1.
- Review test results from laboratory and field tests. Passing criteria for laboratory and field tests are presented in Table 3J.1.

Panels that are not deployed in accordance with manufacturer's recommendations, standard industry practices and/or as specified in this LQCP or in the construction project specifications shall be marked by the POR representative and be repaired or be removed and replaced by the installer.

The QA/QC program for geomembrane seaming includes preparing trial seams prior to seaming each day as well as throughout the day, inspection and testing of field seams, and repairing seams that fail testing criteria.

Trial seams should be performed daily for each welding machine: before the day's field seaming begins, and once every 4 hours (a minimum of twice per day). Trial seam welds will be inspected by liner manufacturer's site personnel to allow for determination of the optimum welding process parameters based on the prevailing ambient conditions. Trial welds should be at least 5 feet long, and 1½-feet wide. Each trial weld should be marked with the date, time, ambient temperature, number of seaming unit, name of seamer, pass or fail designation, and peel and sheer strength values. The peel and sheer strength values are to be determined using the installer's supplied digital electronically operated tensiometer testing device operated by the installer's personnel and monitored by the POR and/or POR representative. Three peel tests will be performed on each trial seam weld and recorded on the trial seam. The results will be documented and filed on the report forms, and each trial seam will be stored onsite until the GLER is approved by the TCEQ.

The entire length of each field seam weld will be visually inspected immediately after production by the POR representative and the installer's representative. In addition, the entire length of each seam weld will be nondestructively tested and certified for continuity and water-tightness in the presence of the POR representative using air pressure or other appropriate methods. The results will be recorded daily on a Seam Testing Information form. Factory seams are subject to the same testing requirements as field seams.

The air channel that results between the dual bonded tracks will be inflated using a hypodermic needle and pressurized to approximately 200 kPa (30 pounds per square inch(psi)). The designated time period for the seam test shall be no less than 5 minutes. If an unacceptable drop in pressure (4 psi or more) occurs, a number of actions may be taken:

- The distance may be systematically halved until the leak is located.
- The section may be tested by some other leak detection method.
- An extrusion fillet weld may be placed over the entire edge.
- A cap strip may be seamed over the entire edge.

For non-destructive seam testing using a vacuum chamber or vacuum box will be performed by placing a transparent top over the seam. A soapy solution is placed over the seam. A vacuum of approximately 20 kPa (or 3 psi) is then applied. The top is held

over the seam for approximately 10 seconds. When a leak is encountered, the soapy solution shows bubbles, which reduces the observed vacuum. If the vacuum is held and no bubbles observed, the test is deemed acceptable. Vacuum box testing will only be applied in areas where a level testing surface is present. Vacuum box testing will not occur over areas of the leachate collection sumps, anchor trenches, pipe penetrations or any other locations where the vacuum box top will not be able to provide a seal over the test area.

Destructive seam testing may be performed per the construction project specification. The destructive test samples should be cut at least 3 feet in length and 1½-feet wide to provide 3 relatively equal samples: 1 for the independent laboratory to test in peel and shear; 1 for the installer to check in the field; and 1 for an archive sample. The seam should be field tested in peel at the time the sample is taken.

If the field test fails, the seam can either be reconstructed between the failed field test location and any previous passed seam location, or the installer can move to either side of the failed seam location (10-foot minimum), and take another sample for field testing. If the sample passes the field test, a destructive sample is taken from that location and sent for laboratory tests. If the laboratory sample passes the test, the seam is reconstructed between the 2 passing tests. If the laboratory tests fail, the process is repeated until both the field and laboratory samples pass the tests at a location. The seam is then reconstructed in this zone between 2 passed test reconstructed seams. All acceptable seams must be bound by 2 passed tests.

Any samples or in-place destructive testing of geomembrane will require that the area affected be repaired or replaced with material of equal or better quality. Such repair or replacement is subject to the same nondestructive testing as other geomembrane liner seams.

To meet the seaming requirement discussed above, field testing and inspection of geomembrane seaming will include:

- Observation to ensure the seaming materials and equipment are as specified.
- Observation to ensure a firm foundation is available for seaming.
- Observation to ensure the start-up seams prepared by the installer and their testing meet the requirements of the specifications prior to actual seaming.
- Observation to ensure the geomembrane is free from dirt, dust, and moisture.
- Inspection to ensure the overlap of the sheets composing the seam is in conformance with specifications.
- Measurement of the curing time between seaming and seam testing to ensure that it is as specified (when applicable).
- Observation to ensure that all seams are free from visible discontinuities in the seam or any other noticeable defects. Defective areas shall be marked on the liner and on the construction inspection form. All defective areas are required to be repaired in accordance with the specifications.
- Observation of air pressure or other appropriate methods of nondestructively testing field seams to ensure the testing is completed as specified.

- Observation of destructive test sampling to ensure samples are taken at the location and frequency specified.
- Observation of the repair and retesting of seams at failure points in accordance with the specifications to ensure the repaired seams meet the criteria specified.
- Walk-through inspection of the liner after placement of the geomembrane to ensure that equipment or personnel have not damaged the geomembrane during the seaming process.
- Completion of applicable inspection forms.

Repairs, installation and/or material defects in seams, failing destructive and/or non-destructive tests and destructive test sample locations shall be repaired by 1 of the following acceptable repair techniques:

- Patches – used to repair large holes, tears, defects and destructive test locations.
- Extrusion – used to repair small holes, tears, defects, holes from non-destructive tests and seam defects less than ½-inch in length or diameter.
- Capping – used to repair failed seams or seams where non-destructive testing can be performed.

Repairs will be performed in accordance with standard industry practices and will be inspected and logged by the POR representative. The surface of the repair area will be clean and dry. Patching material will be extended at least 6-inches beyond the defect area and, with beveled edges prior to extrusion welding.

Once the geomembrane has been inspected and deemed acceptable by the POR and/or POR representative, the top of the geomembrane liner will be surveyed using the same grid pattern and frequency (one survey point per 5,000 square feet of cell liner limits) as the subgrade if the GCL was used as the primary liner.

The geomembrane will be tested for potential holes and liner defects again after the protective sand layer has been placed over the geomembrane. The leak location detection testing will be performed in accordance with ASTM D 6747.

## 3J.8.6 Protective Sand Layer

A 24-inch thick protective sand layer will be placed over the geomembrane. The protective layer will also act as drainage media, allowing the transport of leachate to the low-lying leachate collection sump area. The intended sand to be used as protective layer will be sampled for material conformance as detailed in Table 3J.1. The POR representative will review the analytical results to ensure compliance with project specifications. The protective sand shall be placed directly on top of the geomembrane using a backhoe or belt conveyor. No construction equipment shall be allowed to operate on the geomembrane without a minimum thickness of 12-inches of sand in place over the geomembrane. The protective sand layer shall be placed using a low ground pressure dozer in accordance with the requirements in Table 3J-2.

Table 3J-2
Construction Equipment Requirements

| Maximum Allowable Equipment Ground Pressure (psi) | Thickness of Overlying Compacted Fill (ft) |
|---|---|
| < 4 | 1.0 |
| < 8 | 1.5 |
| <16 | 2.0 |
| >16 | 3.0 |

The POR representative will observe protective sand layer placement and document construction activities using field notes, surveys and photographs. The POR representative will observe material placement process to ensure the Contractor's equipment does not damage the geomembrane and that the minimum thickness of sand over the geomembrane is as specified for the type of equipment in use. The protective sand shall be placed from the haul road and spread in a manner to minimize wrinkles and stress in the underlying geosynthetics. The protective sand will be placed from the cell bottom to the top along the sideslopes. Any geosynthetic material that has been damaged by the installation of the protective sand layer must be repaired and re-tested using methods described in Section 3J.8.5.

The POR and/or POR representative will review the in-place laboratory testing results to ensure permeability specifications are attained.

Thickness verification of the protective sand layer shall be determined by standard survey methods. The base measurement will be either the top of the geomembrane (if GCL is used for the primary liner) or the top of the finished caliche. A survey of the top of the finished protective sand layer will be performed using the same grid pattern of one measurement per 5,000 square feet of lined area.

## 3J.8.7 Leachate Collection

The leachate collection trench design is described in Appendix 3I. All soil testing and evaluation of either in-situ soil or constructed soil liners shall be complete prior to installing the leachate collection system. An 8-ounce woven geotextile cushion will be placed along the leachate collection trench, on top of the HDPE geomembrane to protect the geomembrane from the overlying leachate collection pipe and drainage aggregate. The POR and/or POR representative will review the contractor material submittal to ensure the product is suitable for geomembrane protection. The leachate collection pipe will be overlain by 12-inches of washed aggregate. An additional 12-inches of washed pea gravel will be placed over the aggregate to act as a filter medium between the protective sand layer and the aggregate. The washed aggregate and pea gravel will meet the material specifications listed in Table 3J.1. The POR and/or POR representative will review the laboratory analytical data to ensure the intended aggregate and pea gravel are in conformance with the material specifications. Additional inspection activities that will be performed by the POR and/or POR representative for the leachate collection aggregate and pea gravel include:

- Field observation to ensure the geotextile cushion material is placed through the entire extent of the leachate collection trench, and the material used is the type and thickness specified.
- Field observation to ensure the filter material is of the type and gradation specified.
- Field observation to ensure the filter material placement follows the specified installation procedures, including the minimum thickness requirements.

The protective sand layer survey data will be used to verify that 2-feet total of aggregate and pea gravel have been placed over the leachate collection trench, along with field verification that each layer of filter material is 1-foot thick.

The leachate collection pipe shall be placed as shown on the design drawings. The pipe shall be joined in accordance with manufacturer and project construction specifications.

Construction equipment shall not be allowed to travel directly over the leachate collection pipes until adequate cover has been placed (see Table 3J-2).

The POR and/or POR representative will review material data sheets to ensure the intended pipe meets construction specifications. During the installation of the pipe, the POR and/or POR representative will:

- Inspect the condition of the pipes and note any defects. Any identified defective pipe must be replaced.
- Observe that construction equipment is operated in a manner to prevent damage to the pipe.
- Inspect the pipe perforations and pipe orientation to verify they are placed as detailed in the construction specifications.
- Observe that the pipes and fittings are joined in accordance with manufacturer and construction project specifications.
- Observe that the pipe is handled and placed in a manner to prevent materials (rocks, debris, vegetation, etc.) from entering the pipe.

## 3J.8.8 Reports

Three copies of prepared construction documentation reports will be submitted to the TCEQ Municipal Solid Waste Permits Section. The evaluated construction project will not be used for waste disposal until TCEQ approval is received. It is expected that TCEQ may respond to the permittee either verbally or by writing within 14 days from the date of submittal listed on the SLER and GLER. If no response is received within 14 days of the SLER and GLER submittal, the report shall be considered accepted and the permittee will begin waste disposal.

Each report will be signed and, where necessary, sealed by the individual performing the evaluation and countersigned by the permittee or authorized representative.

Permanent markers will be installed during the cell construction to identify the extent of permissible waste limits. Once the cell is approved for use, initial waste placement will proceed as detailed in Section 4.9.9.

Preparation and submission of the SLER and GLER shall be in accordance with TCEQ MSWD and will include necessary field reports, laboratory analytical reports and surveys to document the construction methods and test procedures are consistent with this LQCP, TCEQ rules and construction project specifications. At a minimum, the SLER and GLER shall contain the following:

- A schedule and summary of construction activities;
- A summary of all laboratory analytical and field test results;
- Observe that construction equipment is operated in a manner to prevent damage to the pipe;
- Location of field samples and test results;
- Statement of compliance with the LQCP and/or description of deviations from the LQCP and/or project construction specifications;
- Record drawings and surveys;
- Detailed description of temporary dewatering activities as necessary; and,
- Seal and signature of POR and, if applicable, POR representative, in accordance with the Texas Engineering Practice Act.

Any deviations from this LQCP shall receive prior written approval from the executive director.

# Appendix 3J – Attachment 1
# Multimed Modeling Results

SAIC®

# Appendix 3J, Attachment 1
# MultiMed Groundwater Fate and Transport Model for Alternative Landfill Liner Design

## Introduction

SAIC, on behalf of the City of El Paso, Texas has prepared a permit amendment for the vertical expansion of the McCombs Landfill. This vertical expansion within the currently permitted landfill footprint will increase the ultimate waste disposal capacity of the Landfill. In addition to the permit amendment for a vertical expansion, SAIC is proposing an alternative liner design utilizing a geocomposite liner (GCL) liner system. The Multimedia Exposure Assessment (MultiMed) model was completed as part of the alternative liner design to evaluate the potential impacts to groundwater associated with the landfill development and the alternative liner design and to ensure compliance with the contituents listed within Table 1 of 30 TAC §330.331.

## Landfill Liner

The McCombs Landfill currently uses an alternative liner design that was approved on July 10, 1995. The approved liner (referenced as "Scenaro 1") consists of (from bottom to top), 6-inches of compacted subgrade, 6-inches of caliche, 60-mil high density polyethylene (HDPE) geomembrane liner and 24-inches protective soil cover.

The proposed alternative liner design (referred to as"Scenaro 2") for the McCombs Landfill is as follows (from bottom to top):

- 6-inch compacted subgrade;
- GCL;
- 60-mil HDPE geomembrane liner;
- 24-inch protective cover; and
- Waste.

Based on the results of the HELP modeling, the combination of HDPE geomembrane liner with GCL provides a lower permeability barrier system with a leakage rate through the modeled barrier system subgrade of 0.000015 inch per day (in/d) or 1.39E-04 meters per year (m/y). [0.000015 in/d *0.0254m/in * 365d/y =0.000139 m/y].

The HELP model was run to evaluate several scenarios as part of the alternative liner approval and copies of the HELP model runs are provided in Appendix 3I, Attachment 1. Based the on various scenarios, HELP model runs were completed for this permit amendment. The peak daily percolation/leakage value predicted through the GCL subgrade layer of the alternative liner design for each scenario is 0.000015 inch, as depicted in the table below.

HELP Model Runs

McCombs Landfill Alternative Liner Design

Permit Amendment MSW 729B

| Alternative Liner Design | GCL Layer | Peak Leakage Values (inches/day) | Peak Daily Values for Years: | Appendix 3I, Attachment 1 (Page #) |
|---|---|---|---|---|
| Open Conditions: 10 ft MSW, 6" Daily Cover | Layer 7 | 0.000015 | 1 through 4 | 19 |
| Open Conditions: 264ft MSW, 12" Intermediate Cover | Layer 8 | 0.000015 | 1 through 20 | 40 |
| Closed Condition: Prescribed Final Cover | Layer 12 | 0.000015 | 1 through 30 | 72 |
| Closed Condition: Prescribed Final Cover (Sideslope) | Layer 12 | 0.000015 | 1 through 30 | 104 |
| Closed Condition: Final Cover_EVAP | Layer 11 | 0.000015 | 1 through 30 | 128 |
| Close Condition: Final Cover EVAP (Sideslope) | Layer 10 | 0.000015 | 1 through 30 | 156 |

## Site Geology and Hydrogeology

The McCombs Landfill is located on deposits of the Hueco Bolson, probably Camp Rice Formation. These deposits primarily consist of clay, sand, and gravel, with some caliche. The landfill site is underlain by Tertiary and Quaternary basin (Bolson) deposits, overlain by areas of gravel and caliche rimrock. Recent Quaternary alluvial deposits are also present in the Landfill vicinity in topographically low areas.

Boring logs for wells drilled on site to depths greater than 500 feet generally indicate deposits of:

- 0 – 50 feet Sand, and sand and gravel;
- 50-250 feet Sand, with some clay;
- 250-470 feet Sand and fine gravel mix; and
- 470-560 feet Sandy clay.

In general, the relatively clean sands are non-plastic, while sandy clay ranges from low to high plasticity. Permeability tests were not considered necessary based on the soil types encountered during the site characterization. Estimated coefficients of permeability are between 0.01 and 0.04 centimeters per second.

The regional groundwater system in the area primarily consists of the Hueco Bolson aquifers. The Hueco Bolson is divided into the City Artesian area, the Mesa area and the Lower Valley (Leggart, 1962). The Mesa area extends north of the City Artesian area into New Mexico and east to the Hueco Mountains. The Landfill is located within the Mesa area.

Two aquifers occur in these areas: an upper aquifer in the Rio Grande alluvium and a lower aquifer in the Hueco Bolson deposits. Since no known impermeable zone of regional extent separates these aquifers, the Rio Grande alluvium and the Hueco Bolson are considered to be, at least in part, hydrologically connected in the City Artesian and Lower Valley areas (Alvared and Buckner, 1980). The Mesa area primarily consists of Hueco Bolson deposits. Historic withdrawals of groundwater since 1906 for public water supply and irrigation have caused major declines in the water levels. The average water level decline in the Hueco Bolson from 1903 to 1980 is approximately 53 feet (White, 1987).

Locally, recharge to the aquifer occurs due to mountain front infiltration of precipitation from the surface and from the injection of treated sewage into the aquifer from the Hueco Bolson Recharge Project (White and Sladek, 1990). Numerous injection wells were constructed northeast of El Paso and water from the Fred Hervey Water Treatment Plant has been injected into the aquifer by El Paso Water Utilities (EPWU) since the mid-1980s. Since 1991, EPWU has been selling water to El Paso Electric Company for use as cooling water at the Newman Plant, thus less water has been injected into the aquifer (Sperka, 1993).

Based on available information, regional groundwater flow direction in the McCombs Landfill area is to the south-southeast. Groundwater movement in the area is generally less than 1.0 feet per day (White, 1987). EPWU groundwater data indicate that the static groundwater elevation in the area is between 3,670 and 3,675 feet MSL or approximately 370 to 390 feet below ground surface (EPWU, 1993).

Groundwater conditions at the site were determined using data from three groundwater monitoring wells constructed in 2003 around the landfill as part of the approved Subtitle D groundwater monitoring system. Water levels data from December 6, 2010 indicates ground water beneath the site occur approximately 390 to 398 feet below land surface, with corresponding elevations of 3,677 to 3,686 feet AMSI. Based on groundwater level measurements at the site, groundwater flow direction is S70° East or to the east-southeast. The site-specific groundwater flow direction correlates with regional groundwater flow direction within the Hueco Bolson aquifer.

Depth to groundwater in the area of McCombs Landfill is approximately 380 to 400 feet below ground surface. The Hueco Bolson aquifer generally contains fresh water in it upper portion and becomes saline at depth (Davis and Leggat, 1965). The Hueco Bolson aquifer is over 200 meters thick (USGS 2003).

## MultiMed Computer Model

MultiMed is groundwater fate and transport moded developed for the United States Environmental Protection Agency (US EPA) to assist in the evaluation of alternative landfill liner designs for Subtitle D landfills.

For this alternative liner design, MultiMed is used to evaluate the impact of landfill leachate seepage containing trichloroethylene (TCE) on groundwater at the point of compliance, approximately 30 feet or 10 meters from the waste limit boundary. The model can be run with seepage through the landfill liner system and the unsaturated zone to the water table, or, the model can be run as a saturated zone model only, evaluating seepage directly to the groundwater. This evaluation was run in both modes (saturated and unsaturated/saturated modes) and results compared.

Parameters may be input into the MultiMed model to reflect the site geology and hydrogeologic properties. The model is divided into seven parameter groups for data input:

- General parameters;
- Source parameters;
- Chemical parameters;
- Unsaturated zone flow parameters;
- Unsaturated zone transport parameters;
- Saturated zone parameters; and
- Well location and time parameters.

The following section documents the input parameters used within this model and the information source and/or assumptions used in this evaluation.

## MutilMed Model Data

### General Parameters

- Application Type - Subtitle D landfills.
- Run Type – The model was run in deterministic mode in which each parameter was assigned a unique value in accordance with the site conditions.
- Source Type – assumed continual steady state flux.
- Aquifer Source Plan Geometry – Gaussian: Treated as enriched along the center line, tapering to each side as in a Gaussian distribution.
- Active Modules – this was run in both Saturated Zone only and Unsaturated & Saturated Zone modules.

### Source Parameters

- Source Area – The source area evaluated was the proposed Section B waste disposal cell. This cell is 217.7 acres in area or 881,000 square meters. Since a source area was defined, the source length and wide was derived by the model.
- Source Infiltration Rate – This rate is generated from Hydrologic Evaluation of Landfill Performance (HELP) model completed for the landfill alternative liner design. The infiltration rate was taken as the seepage through both the HDPE synthetic liner and the GCL or the leakage through the composite liner system into the subsurface. The value used for this model was from an open landfill cell with

10 feet of waste in place and no cover system. The leakage rate for the liner was the peak daily average of 0.000015 inches per day*acre or 0.000139 meters per year (m/y). [0.000015 in/d * 0.025 m/in * 365d/y = 1.39E-4 m/y]

- Outside Recharge Rate – The outside recharge rate can also be derived from the HELP model. Given the arid environment of the El Paso area, the recharge rate was assumed to be near zero and a value of 1E-10 meters per year was used.
- Initial Concentration – This model, per TCEQ direction, was run only for the chemical trichloroethylene (TCE) at an assumed initial concentration of 1.3 milligrams per liter (mg/l).
- Initial Spread of Source – this is derived by the MultiMed model.

### Chemical Parameters

- Per TCEQ direction, trichloroethylene (TCE) was the only chemical evaluated with for this alternative liner design.
- Normalized Distribution Coefficient (Koc) – assumed to be zero (0.00) Dissolved Decay Coefficient – Derived by MultiMed Model.
- Sorbed Decay Coefficient – Derived by MultiMed Model.
- Overall Aquifer Decay Coefficient – Derived by MultiMed Model.
- Acid Hydrolysis Rate – Hydrolysis was assumed to be zero (0.00) or negligible since it is unlikely trichloroethylene would not undergo much hydrolysis unless the environment was very basic or acidic.
- Neutral Hydrolysis Rate – assumed to be zero (0.00).
- Base Hydrolysis Rate – assumed to be zero (0.00).
- Hydrolysis Reference Temperature – model default of 25 C.
- Aquifer Distribution Coefficient – Derived by MultiMed Model.

### Unsaturated Zone Flow

- Selected Flow Layer – One (1) was selected as the unconsolidated deposits beneath the landfill were assumed to one layer of sand.
- Flow Layer Thickness – The flow layer thickness value used was 100 meters. The thickness of unsaturated deposits beneath the lowest landfill liner base elevation (4,022 feet NGVD) and the water table (3,686 feet NGVD (336 feet or 102.4 meters)).
- Saturated Hydraulic Conductivity – 36 cm/hr ($1E10^{-2}$ cm/sec, 3,150 m/y) "Site Characterization and Monitoring Plan, McCombs Landfill, El Paso, Texas", prepared by PSC-The Carel Corporation and dated October 11, 1993, Revised: December 2012; Section 4.7.3 Groundwater Flow Gradient and Rate, pg 16-17. A copy of this document is provided in Appendix 3K, Attachment 1 (pages 20-21) of the Permit Modification, McCombs Landfill – MSW 729B.
- Effective Porosity – 0.30 "Site Characterization and Monitoring Plan, McCombs Landfill, El Paso, Texas", prepared by PSC-The Carel Corporation and dated

October 11, 1993, Revised: December 2012; Section 4.7.3 Groundwater Flow Gradient and Rate, pg 16-17. A copy of this document is provided in Appendix 3K, Attachment 1 (pages 20-21) of the Permit Modification, McCombs Landfill – MSW 729B.

- Air Entry Pressure Head – Assumed to be zero (0.0); this value is typically zero for coarser soils. (Texas Water Commission, Alternative Liner Design Handbook, Version 1, 1993).
- Residual Water Content – Default value for sand (0.43). Table D - Texas Water Commission, Alternative Liner Design Handbook, Version 1, 1993;
- vanGenuchten Alpha – Default value for sand (0.145). Table E - Texas Water Commission, Alternative Liner Design Handbook, Version 1, 1993;
- vanGenuchten Beta – Default value for sand (2.68). Table E - Texas Water Commission, Alternative Liner Design Handbook, Version 1, 1993.

### Unsaturated Zone Transport

- Select Transport Layer – Corresponds to Layer 1 of Unsaturated Zone Flow.
- Transport Layer Thickness - Corresponds to Layer 1 of Unsaturated Zone Flow.
- Longitudinal Dispersivity – Derived MultiMed Model.
- Percentage Organic Matter – assumed to be zero (0.00).
- Bulk Density – Default value for coarse sand (1.69). Table G - Texas Water Commission, Alternative Liner Design Handbook, Version 1, 1993.
- Biological Decay Coefficient – Assumed to be zero, i.e. no biological degradation is occurring in the unsaturated zone.

### Saturated Zone

- Aquifer thickness – Hueco Bolson aquifer is over 200 meters thick. For this model, an aquifer thickness of 100 meters was used.
- Mixing Zone Thickness – Derived by MultiMed Model.
- Effective Porosity – 0.30 "Site Characterization and Monitoring Plan, McCombs Landfill, El Paso, Texas", prepared by PSC-The Carel Corporation and dated October 11, 1993, Revised: December 2012; Section 4.7.3 Groundwater Flow Gradient and Rate, pg 16-17. A copy of this document is provided in Appendix 3K, Attachment 1 (pages 20-21) of the Permit Modification, McCombs Landfill – MSW 729B.
- Particle Diameter – Derived by MultiMed Model.
- Bulk Density – Default value for coarse sand (1.69). Table G - Texas Water Commission, Alternative Liner Design Handbook, Version 1, 1993.
- Saturated Hydraulic Conductivity – 3,150 m/y (36 cm/hr, $1E10^{-2}$ cm/sec) "Site Characterization and Monitoring Plan, McCombs Landfill, El Paso, Texas", prepared by PSC-The Carel Corporation and dated October 11, 1993, Revised: December 2012; Section 4.7.3 Groundwater Flow Gradient and Rate, pg 16-17. A

copy of this document is provided in Appendix 3K, Attachment 1 (pages 20-21) of the Permit Modification, McCombs Landfill – MSW 729B.

- Hydraulic Gradient – 0.0042 "Site Characterization and Monitoring Plan, McCombs Landfill, El Paso, Texas", prepared by PSC-The Carel Corporation and dated October 11, 1993, Revised: December 2012; Section 4.7.3 Groundwater Flow Gradient and Rate, pg 16-17. A copy of this document is provided in Appendix 3K, Attachment 1 (pages 20-21) of the Permit Modification, McCombs Landfill – MSW 729B.
- Seepage Velocity – Derived by MultiMed Model.
- Longitudinal Dispersivity – Derived by MultiMed Model.
- Transverse Dispersivity – Derived by MultiMed Model.
- Aquifer Temperature – Assumed 11°C.
- Aquifer pH – Assumed 7.2 standard pH units.
- Fraction Organic Carbon (foc) – assumed to be zero (0.00).
- Aquifer Retardation Factor – Derived by MultiMed Model.
- Aquifer Biological Decay Rate – No biological decay rate modeled.

### Well Location and Time

- Radial Distance to Well – Point of Compliance is approximately 30 feet (10 meters) from waste limit boundary.
- Angle off Plume Axis – For Subtitle D application Angle off Plume Axis is fixed at zero.
- Well Screen Fraction – For Subtitle D application Angle off Plume Axis is fixed at zero.

## Summary and Conclusion

The MultiMed model was run under the parameters and assumptions listed in the preceding section and in both the active model for unsaturated zone and saturated zone and with no retardation or degradation. The results of the SATURATED and SATURATED & UNSATURATED model runs are nearly the same in the predicted concentration at the point of compliance. The predicted concentration of trichloroethylene at the point of compliance, a monitoring point 10 meters directly downgradient of the waste limit boundary for the SATURATED & UNSATURATED model run is 3.265E-04 mg/l (0.0003265 mg/l). The SATURATED ONLY model run has a predicted concentration at the point of compliance of 3.269E-04 mg/l (0.0003269 mg/l). Both model results (0.0003265 mg/l and 0.0003269 mg/l) are below the established standard, US EPA maximum contaminant level (MCL) of 0.005 mg/l for trichloroethylene (TCE).

Based on the results of the MultiMed Model runs, the alternative liner proposed for the McCombs Landfill will meet the requirements of 30 TAC §330.331.

McCombs Landfill Permit Amendment
MultiMed Model Parameters
SATURATED MODEL RUN
Landfill Liner Scenario 2 (sarified&compacted subsurface/GCL/HDPE/Sand/Waste)
Revised May 27, 2013

| | | |
|---|---|---|
| **GENERAL** | | |
| Application | Subtitle D | MultiMed Determined |
| Run Type | Deterministic | MultiMed Determined |
| Source Type | Steady-State | MultiMed Determined |
| Aquifer Source Plane Geometry | Gaussian | MultiMed Determined |
| Active Modules | SATURATED | MultiMed Determined |
| Number of MC Iterations | NA | MultiMed Determined |
| MC Confidence Interval (%) | NA | MultiMed Determined |
| **SOURCE** | | |
| Source Area ($m^2$) | 881000 | Landfill Waste Unit Area |
| Source Length (m) | 1000 | |
| Source width (m) | 881 | |
| Source Infiltration Rate (m/yr) | 1.39E-04 | HELP Model Scenario 2 GCL/HDPE |
| Outside Recharge Rate (m/yr) | 1.00E-10 | assumed |
| Initial Conscentration (mg/l) | 1.3 | TCEQ Direction |
| Source Duration (yr) | NA | |
| Source Decay Coeff. (1/yr) | NA | |
| Initial Spread of Source (m) | Derived | MultiMed Determined |
| **CHEMICAL** | | |
| Trichloroethylene | | |
| Normalized Dist.Coeff. (KOC. mg/l) | 0 | Assume 0, Conservative |
| Dissolved Decay Coeff. (1/yr) | Derived | MultiMed Determined |
| Sorbed Decay Coeff. (1/yr) | Derived | MultiMed Determined |
| Overall Aquifer Decay Coeff. (1/yr) | Derived | MultiMed Determined |
| Acid Hydrolysis Rate (l-mole/yr) | 0 | Assume 0, Conservative |
| Neutral Hydrolysis Rate (1/yr) | 0 | Assume 0, Conservative |
| Base Hydrolysis Rate (l-mole/yr) | 0 | Assume 0, Conservative |
| Hydrolysis Ref Temp (deg C) | 25 | Assumed |
| Aquifer Distribution Coeff. (mg/l) | Derived | MultiMed Determined |
| **SATURATED ZONE** | | |
| Aquifer Thickness (m) | 100 | Assumed, Hueco Bolson aquifer >200 m in area |
| Mixing Zone Thickness (m) | Derived | MultiMed Determined |
| Effective Porosity | 0.3 | Site Characterization & Monitoring Plan (Revised 2012) |
| Particle Diameter (cm) | Derived | MultiMed Determined |
| Bulk Density ($g/cm^3$) | 1.69 | Alternative Liner Design Handbook (Table C) |
| Sat Hydraulic Conductivity (m/yr) | 3150 | Site Characterization & Monitoring Plan (Revised 2012) |
| Hydraulic Gradient | 0.0042 | Site Characterization & Monitoring Plan (Revised 2012) |
| Seepage Velocity (m/yr) | Derived | MultiMed Determined |
| Longitudinal Dispersivity (m) | Derived | MultiMed Determined |
| Transverse Dispersivity (m) | Derived | MultiMed Determined |
| Vertical Dispersivity (m) | Derived | MultiMed Determined |
| Aquifer Temperature (deg C) | 11 | assumed |
| Aquifer pH | 7.2 | assumed |
| Fraction Organic Carbon | 0 | Assume 0, Conservative |

**McCombs Landfill Permit Amendment**
**MultiMed Model Parameters**
**SATURATED MODEL RUN**
**Landfill Liner Scenario 2 (sarified&compacted subsurface/GCL/HDPE/Sand/Waste)**
**Revised May 27, 2013**

| Retardation Factor | Derived | MultiMed Determined |
|---|---|---|
| Aquifer Bio Decay Coeff. (1/yr) | 0 | Assume 0, Conservative |
| **WELL LOC and TIME** | | |
| Radial Distance to Well (m) | 10 | Distance to nearest POC |
| Angle off Plume Axis (deg) | 0 | Assume 0, Conservative |
| Well Screen Depth Fraction | 0 | Assume 0, Conservative |
| Time Step Option | NA | |
| Start Time (yrs) | NA | |
| End Time (yrs) | NA | |

MULTIMED V1.01 DATE OF CALCULATIONS: 5-JUN-2013 TIME: 16:52:17
Run Title: aMcCombs Landfill Permit Modification-Alternative Liner Design
MultiMed Trichloroethylene

| | |
|---|---|
| Chemical simulated: | Trichloroethylene |
| Simulation models included: | Saturated zone model |
| Simulation type: | Deterministic |
| Infiltration rate: | Specified By User: 1.390E-04 m/yr |
| Source term: | Steady-state |
| Saturated zone source plane: | Gaussian |
| Well distance from site: | 1.000E+01 m |

Predicted relative well concentration: 3.269E-04
DAF for this case is: 3.977E+03

MULTIMED V1.01 DATE OF CALCULATIONS: 5-JUN-2013 TIME: 16:52:17

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED (Version 1.50, 2005)

1
Run options
--- -------

aMcCombs Landfill Permit Modification-Alternative Liner Design

MultiMed Trichloroethylene
Chemical simulated is Trichloroethylene

Option Chosen Saturated zone model
Run was DETERMIN
Infiltration Specified By User: 1.390E-04 m/yr
Run was steady-state
Reject runs if Y coordinate outside plume
Reject runs if Z coordinate outside plume
Gaussian source used in saturated zone model
1
1

CHEMICAL SPECIFIC VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS MEAN | PARAMETERS STD DEV | LIMITS MIN | LIMITS MAX |
|---|---|---|---|---|---|---|
| Solid phase decay coefficient | 1/yr | DERIVED | -999. | -999. | -999. | -999. |
| Dissolved phase decay coefficient | 1/yr | DERIVED | -999. | -999. | -999. | -999. |
| Overall chemical decay coefficient | 1/yr | DERIVED | -999. | -999. | -999. | -999. |
| Acid catalyzed hydrolysis rate | l/M-yr | CONSTANT | 0.000 | -999. | -999. | -999. |
| Neutral hydrolysis rate constant | 1/yr | CONSTANT | 0.000 | -999. | -999. | -999. |
| Base catalyzed hydrolysis rate | l/M-yr | CONSTANT | 0.000 | -999. | -999. | -999. |
| Reference temperature | C | CONSTANT | 25.0 | -999. | -999. | -999. |
| Normalized distribution coefficient | ml/g | CONSTANT | 0.000 | -999. | -999. | -999. |
| Distribution coefficient | -- | DERIVED | -999. | -999. | -999. | -999. |
| Biodegradation coefficient (sat. zone) | 1/yr | CONSTANT | 0.000 | -999. | -999. | -999. |
| Air diffusion coefficient | cm2/s | CONSTANT | -999. | -999. | -999. | -999. |
| Reference temperature for air diffusion | C | CONSTANT | -999. | -999. | -999. | -999. |
| Molecular weight | g/M | CONSTANT | -999. | -999. | -999. | -999. |
| Mole fraction of solute | -- | CONSTANT | -999. | -999. | -999. | -999. |
| Vapor pressure of solute | mm Hg | CONSTANT | -999 | -999 | -999 | -999 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Henry`s law constant | atm-m^3/M | CONSTANT | -999. | -999. | -999. | -999. |
| Overall 1st order decay sat. zone | 1/yr | DERIVED | 0.000 | 0.000 | 0.000 | 1.00 |
| Not currently used | | CONSTANT | 0.000 | 0.000 | 0.000 | 0.000 |
| Not currently used | | CONSTANT | 0.000 | 0.000 | 0.000 | 0.000 |

1

SOURCE SPECIFIC VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS | | LIMITS | |
|---|---|---|---|---|---|---|
| | | | MEAN | STD DEV | MIN | MAX |
| Infiltration rate | m/yr | CONSTANT | 0.139E-03 | -999. | -999. | -999. |
| Area of waste disposal unit | m^2 | DERIVED | 0.915E+05 | -999. | -999. | -999. |
| Duration of pulse | yr | CONSTANT | -999. | -999. | -999. | -999. |
| Spread of contaminant source | m | DERIVED | -999. | -999. | -999. | -999. |
| Recharge rate | m/yr | CONSTANT | 0.100E-09 | -999. | -999. | -999. |
| Source decay constant | 1/yr | CONSTANT | 0.000 | 0.000 | 0.000 | 0.000 |
| Initial concentration at landfill | mg/l | CONSTANT | 1.30 | -999. | -999. | -999. |
| Length scale of facility | m | CONSTANT | 0.100E+04 | -999. | -999. | -999. |
| Width scale of facility | m | CONSTANT | 881. | -999. | -999. | -999. |
| Near field dilution | | DERIVED | 1.00 | 0.000 | 0.000 | 1.00 |

1

AQUIFER SPECIFIC VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS | | LIMITS | |
|---|---|---|---|---|---|---|
| | | | MEAN | STD DEV | MIN | MAX |
| Particle diameter | cm | CONSTANT | 0.250E-01 | -999. | -999. | -999. |
| Aquifer porosity | -- | DERIVED | 0.300 | -999. | -999. | -999. |
| Bulk density | g/cc | CONSTANT | 1.69 | -999. | -999. | -999. |
| Aquifer thickness | m | CONSTANT | 100. | -999. | -999. | -999. |
| Source thickness (mixing zone depth) | m | DERIVED | -999. | -999. | -999. | -999. |
| Conductivity (hydraulic) | m/yr | CONSTANT | 0.315E+04 | -999. | -999. | -999. |
| Gradient (hydraulic) | | CONSTANT | 0.420E-02 | -999. | -999. | -999. |
| Groundwater seepage velocity | m/yr | DERIVED | -999. | -999. | -999. | -999. |
| Retardation coefficient | -- | DERIVED | -999. | -999. | -999. | -999. |
| Longitudinal dispersivity | m | FUNCTION OF X | -999. | -999. | -999. | -999. |
| Transverse dispersivity | m | FUNCTION OF X | -999. | -999. | -999. | -999. |
| Vertical dispersivity | m | FUNCTION OF X | -999. | -999. | -999. | -999. |
| Temperature of aquifer | C | CONSTANT | 11.0 | -999. | -999. | -999. |
| pH | -- | CONSTANT | 7.20 | -999. | -999. | -999. |
| Organic carbon content (fraction) | | CONSTANT | 0.000 | -999. | -999. | -999. |
| Well distance from site | m | CONSTANT | 10.0 | -999. | -999. | -999. |
| Angle off center | degree | CONSTANT | 0.000 | 0.000 | 0.000 | 0.000 |
| Well vertical distance | m | CONSTANT | 0.000 | 0.000 | 0.000 | 0.000 |

CONCENTRATION AFTER SATURATED ZONE MODEL 0.3269E-03

McCombs Landfill Permit Amendment
MultiMed Model Parameters
UNSATURATED & SATURATED MODEL RUN
Landfill Liner Scenario 2 (sarified&compacted subsurface/GCL/HDPE/Sand/Waste)
Revised May 27, 2013

| | | |
|---|---|---|
| **GENERAL** | | |
| Application | Subtitle D | MultiMed Determined |
| Run Type | Deterministic | MultiMed Determined |
| Source Type | Steady-State | MultiMed Determined |
| Aquifer Source Plane Geometry | Gaussian | MultiMed Determined |
| Active Modules | Unsat & Sat | MultiMed Determined |
| Number of MC Iterations | NA | MultiMed Determined |
| MC Confidence Interval (%) | NA | MultiMed Determined |
| **SOURCE** | | |
| Source Area ($m^2$) | 881000 | Landfill Waste Unit Area |
| Source Length (m) | 1000 | |
| Source width (m) | 881 | |
| Source Infiltration Rate (m/yr) | 1.39E-04 | HELP Model Scenario 2 GCL/HDPE |
| Outside Recharge Rate (m/yr) | 1.00E-10 | assumed |
| Initial Conscentration (mg/l) | 1.3 | TCEQ Direction |
| Source Duration (yr) | NA | |
| Source Decay Coeff. (1/yr) | NA | |
| Initial Spread of Source (m) | Derived | MultiMed Determined |
| **CHEMICAL** | | |
| Trichloroethylene | | |
| Normalized Dist.Coeff. (KOC. mg/l) | 0 | Assume 0, Conservative |
| Dissolved Decay Coeff. (1/yr) | Derived | MultiMed Determined |
| Sorbed Decay Coeff. (1/yr) | Derived | MultiMed Determined |
| Overall Aquifer Decay Coeff. (1/yr) | Derived | MultiMed Determined |
| Acid Hydrolysis Rate (l-mole/yr) | 0 | Assume 0, Conservative |
| Neutral Hydrolysis Rate (1/yr) | 0 | Assume 0, Conservative |
| Base Hydrolysis Rate (l-mole/yr) | 0 | Assume 0, Conservative |
| Hydrolysis Ref Temp (deg C) | 25 | Assumed |
| Aquifer Distribution Coeff. (mg/l) | Derived | MultiMed Determined |
| **UNSAT ZONE FLOW** | | |
| Select Flow Layer | 1 | |
| Flow Layer Thickness | 100 | Thickness of unsaturated deposits in landfill area |
| Flow Material Number | 1 | |
| Sat Hydraulic Conductivity (cm/h) | 36 | Site Characterization & Monitoring Plan (Revised 2012) |
| Effective Porosity | 0.3 | Site Characterization & Monitoring Plan (Revised 2012) |
| Air Pressure Head (m) | 0 | |
| Residual Water Content | 0.43 | Alternative Liner Design Handbook (Table D) |
| van Genuchten Alpha (1/cm) | 0.145 | Alternative Liner Design Handbook (page 84) |
| van Genuchten Beta | 2.68 | Alternative Liner Design Handbook (page 84) |
| Brooks & Corey Exponent | NA | |

**McCombs Landfill Permit Amendment**
**MultiMed Model Parameters**
**UNSATURATED & SATURATED MODEL RUN**
**Landfill Liner Scenario 2 (sarified&compacted subsurface/GCL/HDPE/Sand/Waste)**
**Revised May 27, 2013**

| | | |
|---|---|---|
| **UNSAT ZONE TRANS** | | |
| Select Transport layer | 1 | |
| Transport Layer Thickness (m) | 100 | Unconsolidated deposits in landfill area >100 m |
| Longitudinal Dispersivity (m) | Derived | MultiMed Determined |
| Percent Organic Matter (%) | 0 | Assume 0, Conservative |
| Bulk Density ($g/cm^3$) | 1.69 | Alternative Liner Design Handbook (Table G) |
| Biologial Decay Coeff (1/yr) | 0 | Assume 0, Conservative |
| **SATURATED ZONE** | | |
| Aquifer Thickness (m) | 100 | Assumed, Hueco Bolson aquifer >200 m in area |
| Mixing Zone Thickness (m) | Derived | MultiMed Determined |
| Effective Porosity | 0.3 | Site Characterization & Monitoring Plan (Revised 2012) |
| Particle Diameter (cm) | Derived | MultiMed Determined |
| Bulk Density (g/cm3) | 1.69 | Alternative Liner Design Handbook (Table C) |
| Sat Hydraulic Conductivity (m/yr) | 3150 | Site Characterization & Monitoring Plan (Revised 2012) |
| Hydraulic Gradient | 0.0042 | Site Characterization & Monitoring Plan (Revised 2012) |
| Seepage Velocity (m/yr) | Derived | MultiMed Determined |
| Longitudinal Dispersivity (m) | Derived | MultiMed Determined |
| Transverse Dispersivity (m) | Derived | MultiMed Determined |
| Vertical Dispersivity (m) | Derived | MultiMed Determined |
| Aquifer Temperature (deg C) | 11 | assumed |
| Aquifer pH | 7.2 | assumed |
| Fraction Organic Carbon | 0 | Assume 0, Conservative |
| Retardation Factor | Derived | MultiMed Determined |
| Aquifer Bio Decay Coeff. (1/yr) | 0 | Assume 0, Conservative |
| **WELL LOC and TIME** | | |
| Radial Distance to Well (m) | 10 | Distance to nearest POC |
| Angle off Plume Axis (deg) | 0 | Assume 0, Conservative |
| Well Screen Depth Fraction | 0 | Assume 0, Conservative |
| Time Step Option | NA | |
| Start Time (yrs) | NA | |
| End Time (yrs) | NA | |

MULTIMED V1.01 DATE OF CALCULATIONS: 6-JUN-2013 TIME: 13:49:32
Run Title: aMcCombs Landfill Permit Modification-Alternative Liner Design
MultiMed Trichloroethylene

| | |
|---|---|
| Chemical simulated: | Trichloroethylene |
| Simulation models included: | Saturated and unsaturated zone models |
| Simulation type: | Deterministic |
| Infiltration rate: | Specified By User: 1.390E-04 m/yr |
| Source term: | Steady-state |
| Saturated zone source plane: | Gaussian |
| Well distance from site: | 1.000E+01 m |

Predicted relative well concentration: 3.265E-04
DAF for this case is: 3.982E+03

MULTIMED V1.01 DATE OF CALCULATIONS: 6-JUN-2013 TIME: 13:49:32

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.50, 2005)

1
Run options
--- -------

aMcCombs Landfill Permit Modification-Alternative Liner Design

MultiMed Trichloroethylene
Chemical simulated is Trichloroethylene

Option Chosen Saturated and unsaturated zone models
Run was DETERMIN
Infiltration Specified By User: 1.390E-04 m/yr
Run was steady-state
Reject runs if Y coordinate outside plume
Reject runs if Z coordinate outside plume
Gaussian source used in saturated zone model
1
1
UNSATURATED ZONE FLOW MODEL PARAMETERS
(input parameter description and value)

| | | |
|---|---|---|
| NP | - Total number of nodal points | 240 |
| NMAT | - Number of different porous materials | 1 |
| KPROP | - Van Genuchten or Brooks and Corey | 1 |
| IMSHGN | - Spatial discretization option | 1 |
| NVFLAYR | - Number of layers in flow model | 1 |

OPTIONS CHOSEN
------- ------
Van Genuchten functional coefficients
User defined coordinate system
1

Layer information
-----------------

| LAYER NO. | LAYER THICKNESS | MATERIAL PROPERTY |
|---|---|---|
| 1 | 100.00 | 1 |

DATA FOR MATERIAL 1

---- --- --------
VADOSE ZONE MATERIAL VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS MEAN | PARAMETERS STD DEV | LIMITS MIN | LIMITS MAX |
|---|---|---|---|---|---|---|
| Saturated hydraulic conductivity | cm/hr | CONSTANT | 3.60 | -999. | -999. | -999. |
| Unsaturated zone porosity | -- | CONSTANT | 0.340 | -999. | -999. | -999. |
| Air entry pressure head | m | CONSTANT | 0.000 | -999. | -999. | -999. |
| Depth of the unsaturated zone | m | CONSTANT | 100. | 0.000 | 0.000 | 0.000 |

DATA FOR MATERIAL 1
---- --- --------
VADOSE ZONE FUNCTION VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS MEAN | PARAMETERS STD DEV | LIMITS MIN | LIMITS MAX |
|---|---|---|---|---|---|---|
| Residual water content | -- | CONSTANT | 0.430 | -999. | -999. | -999. |
| Brook and Corey exponent,EN | -- | CONSTANT | -999. | -999. | -999. | -999. |
| ALFA coefficient | 1/cm | CONSTANT | 0.145 | -999. | -999. | -999. |
| Van Genuchten exponent, ENN | -- | CONSTANT | 2.68 | -999. | -999. | -999. |

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

| | | | |
|---|---|---|---|
| NLAY | - Number of different layers used | | 1 |
| NTSTPS | - Number of time values concentration calc | | 40 |
| DUMMY | - Not presently used | | 1 |
| ISOL | - Type of scheme used in unsaturated zone | | 2 |
| N | - Stehfest terms or number of increments | | 18 |
| NTEL | - Points in Lagrangian interpolation | | 3 |
| NGPTS | - Number of Gauss points | | 104 |
| NIT | - Convolution integral segments | | 2 |
| IBOUND | - Type of boundary condition | | 1 |
| ITSGEN | - Time values generated or input | | 1 |
| TMAX | - Max simulation time | -- | 0.0 |
| WTFUN | - Weighting factor | -- | 1.2 |

3J 1-18

OPTIONS CHOSEN
------- ------
Convolution integral approach
Nondecaying continuous source
Computer generated times for computing concentrations

1

DATA FOR LAYER 1

VADOSE TRANSPORT VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS MEAN | PARAMETERS STD DEV | LIMITS MIN | LIMITS MAX |
|---|---|---|---|---|---|---|
| Thickness of layer | m | CONSTANT | 100. | -999. | -999. | -999. |
| Longitudinal dispersivity of layer | m | DERIVED | -999. | -999. | -999. | -999. |
| Percent organic matter | -- | CONSTANT | 0.000 | -999. | -999. | -999. |
| Bulk density of soil for layer | g/cc | CONSTANT | 1.69 | -999. | -999. | -999. |
| Biological decay coefficient | 1/yr | CONSTANT | 0.000 | -999. | -999. | -999. |

1

CHEMICAL SPECIFIC VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS MEAN | PARAMETERS STD DEV | LIMITS MIN | LIMITS MAX |
|---|---|---|---|---|---|---|
| Solid phase decay coefficient | 1/yr | DERIVED | -999. | -999. | -999. | -999. |
| Dissolved phase decay coefficient | 1/yr | DERIVED | -999. | -999. | -999. | -999. |
| Overall chemical decay coefficient | 1/yr | DERIVED | -999. | -999. | -999. | -999. |
| Acid catalyzed hydrolysis rate | l/M-yr | CONSTANT | 0.000 | -999. | -999. | -999. |
| Neutral hydrolysis rate constant | 1/yr | CONSTANT | 0.000 | -999. | -999. | -999. |
| Base catalyzed hydrolysis rate | l/M-yr | CONSTANT | 0.000 | -999. | -999. | -999. |
| Reference temperature | C | CONSTANT | 25.0 | -999. | -999. | -999. |
| Normalized distribution coefficient | ml/g | CONSTANT | 0.000 | -999. | -999. | -999. |
| Distribution coefficient | -- | DERIVED | -999. | -999. | -999. | -999. |
| Biodegradation coefficient (sat. zone) | 1/yr | CONSTANT | 0.000 | -999. | -999. | -999. |
| Air diffusion coefficient | cm2/s | CONSTANT | -999. | -999. | -999. | -999. |
| Reference temperature for air diffusion | C | CONSTANT | -999. | -999. | -999. | -999. |
| Molecular weight | g/M | CONSTANT | -999. | -999. | -999. | -999. |
| Mole fraction of solute | -- | CONSTANT | -999. | -999. | -999. | -999. |
| Vapor pressure of solute | mm Hg | CONSTANT | -999. | -999. | -999. | -999. |
| Henry`s law constant | atm-m^3/M | CONSTANT | -999. | -999. | -999. | -999. |
| Overall 1st order decay sat. zone | 1/yr | DERIVED | 0.000 | 0.000 | 0.000 | 1.00 |
| Not currently used | | CONSTANT | 0.000 | 0.000 | 0.000 | 0.000 |
| Not currently used | | CONSTANT | 0.000 | 0.000 | 0.000 | 0.000 |

SOURCE SPECIFIC VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS MEAN | PARAMETERS STD DEV | LIMITS MIN | LIMITS MAX |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| Infiltration rate | m/yr | CONSTANT | 0.139E-03 | -999. | -999. | -999. |
| Area of waste disposal unit | m^2 | DERIVED | 0.915E+05 | -999. | -999. | -999. |
| Duration of pulse | yr | CONSTANT | -999. | -999. | -999. | -999. |
| Spread of contaminant source | m | DERIVED | -999. | -999. | -999. | -999. |
| Recharge rate | m/yr | CONSTANT | 0.100E-09 | -999. | -999. | -999. |
| Source decay constant | 1/yr | CONSTANT | 0.000 | 0.000 | 0.000 | 0.000 |
| Initial concentration at landfill | mg/l | CONSTANT | 1.30 | -999. | -999. | -999. |
| Length scale of facility | m | CONSTANT | 0.100E+04 | -999. | -999. | -999. |
| Width scale of facility | m | CONSTANT | 881. | -999. | -999. | -999. |
| Near field dilution | | DERIVED | 1.00 | 0.000 | 0.000 | 1.00 |

1

AQUIFER SPECIFIC VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS | | LIMITS | |
|---|---|---|---|---|---|---|
| | | | MEAN | STD DEV | MIN | MAX |
| Particle diameter | cm | CONSTANT | 0.250E-01 | -999. | -999. | -999. |
| Aquifer porosity | -- | CONSTANT | 0.300 | -999. | -999. | -999. |
| Bulk density | g/cc | CONSTANT | 1.69 | -999. | -999. | -999. |
| Aquifer thickness | m | CONSTANT | 100. | -999. | -999. | -999. |
| Source thickness (mixing zone depth) | m | DERIVED | -999. | -999. | -999. | -999. |
| Conductivity (hydraulic) | m/yr | CONSTANT | 0.315E+04 | -999. | -999. | -999. |
| Gradient (hydraulic) | | CONSTANT | 0.420E-02 | -999. | -999. | -999. |
| Groundwater seepage velocity | m/yr | DERIVED | -999. | -999. | -999. | -999. |
| Retardation coefficient | -- | DERIVED | -999. | -999. | -999. | -999. |
| Longitudinal dispersivity | m | FUNCTION OF X | -999. | -999. | -999. | -999. |
| Transverse dispersivity | m | FUNCTION OF X | -999. | -999. | -999. | -999. |
| Vertical dispersivity | m | FUNCTION OF X | -999. | -999. | -999. | -999. |
| Temperature of aquifer | C | CONSTANT | 11.0 | -999. | -999. | -999. |
| pH | -- | CONSTANT | 7.20 | -999. | -999. | -999. |
| Organic carbon content (fraction) | | CONSTANT | 0.000 | -999. | -999. | -999. |
| Well distance from site | m | CONSTANT | 10.0 | -999. | -999. | -999. |
| Angle off center | degree | CONSTANT | 0.000 | 0.000 | 0.000 | 0.000 |
| Well vertical distance | m | CONSTANT | 0.000 | 0.000 | 0.000 | 0.000 |

CONCENTRATION AFTER SATURATED ZONE MODEL 0.3265E-03

# MultiMed Model Results
# Point of Compliance (125’ from Waste Boundary)

MULTIMED V1.01 DATE OF CALCULATIONS: 9-AUG-2012 TIME: 13:25:38
Run Title: aMcCombs Landfill Permit Modification-Alternative Liner Design
MultiMed Trichloroethylene

| | |
|---|---|
| Chemical simulated: | Trichloroethylene |
| Simulation models included: | Saturated and unsaturated zone models |
| Simulation type: | Deterministic |
| Infiltration rate: | Specified By User: 3.140E-03 m/yr |
| Source term: | Steady-state |
| Saturated zone source plane: | Gaussian |
| Well distance from site: | 3.800E+01 m |

Predicted relative well concentration: 3.412E-03
DAF for this case is: 3.810E+02

MULTIMED V1.01 DATE OF CALCULATIONS: 9-AUG-2012 TIME: 13:25:38

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.50, 2005)

1
Run options
--- -------

aMcCombs Landfill Permit Modification-Alternative Liner Design

MultiMed Trichloroethylene
Chemical simulated is Trichloroethylene

Option Chosen Saturated and unsaturated zone models
Run was DETERMIN
Infiltration Specified By User: 3.140E-03 m/yr
Run was steady-state
Reject runs if Y coordinate outside plume
Reject runs if Z coordinate outside plume
Gaussian source used in saturated zone model
1
1
UNSATURATED ZONE FLOW MODEL PARAMETERS
(input parameter description and value)

| | | |
|---|---|---|
| NP | - Total number of nodal points | 240 |
| NMAT | - Number of different porous materials | 1 |
| KPROP | - Van Genuchten or Brooks and Corey | 1 |
| IMSHGN | - Spatial discretization option | 1 |
| NVFLAYR | - Number of layers in flow model | 1 |

OPTIONS CHOSEN
------- ------
Van Genuchten functional coefficients
User defined coordinate system
1

Layer information
-----------------

| LAYER NO. | LAYER THICKNESS | MATERIAL PROPERTY |
|---|---|---|
| 1 | 100.00 | 1 |

DATA FOR MATERIAL 1
---- --- --------
VADOSE ZONE MATERIAL VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS | | | |
|---|---|---|---|---|---|---|
| | | | MEAN | STD DEV | LIMITS MIN | MAX |
| Saturated hydraulic conductivity | cm/hr | CONSTANT | 29.7 | -999. | -999. | -999 |
| Unsaturated zone porosity | -- | CONSTANT | 0.340 | -999 | | |

```
-999.       -999.
            Air entry pressure head                    m          CONSTANT        0.000      -999.
-999.       -999.
            Depth of the unsaturated zone              m          CONSTANT         100.      0.000
0.000       0.000
```

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS MEAN | STD DEV | LIMITS MIN | MAX |
|---|---|---|---|---|---|---|
| Residual water content | -- | CONSTANT | 0.430 | -999. | -999. | -999. |
| Brook and Corey exponent,EN | -- | CONSTANT | -999. | -999. | -999. | -999. |
| ALFA coefficient | 1/cm | CONSTANT | 0.145 | -999. | -999. | -999. |
| Van Genuchten exponent, ENN | -- | CONSTANT | 2.68 | -999. | -999. | -999. |

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

| | | | |
|---|---|---|---|
| NLAY | - Number of different layers used | | 1 |
| NTSTPS | - Number of time values concentration calc | | 40 |
| DUMMY | - Not presently used | | 1 |
| ISOL | - Type of scheme used in unsaturated zone | | 2 |
| N | - Stehfest terms or number of increments | | 18 |
| NTEL | - Points in Lagrangian interpolation | | 3 |
| NGPTS | - Number of Gauss points | | 104 |
| NIT | - Convolution integral segments | | 2 |
| IBOUND | - Type of boundary condition | | 1 |
| ITSGEN | - Time values generated or input | | 1 |
| TMAX | - Max simulation time | -- | 0.0 |
| WTFUN | - Weighting factor | -- | 1.2 |

OPTIONS CHOSEN

Convolution integral approach
Nondecaying continuous source
Computer generated times for computing concentrations

1

DATA FOR LAYER 1

VADOSE TRANSPORT VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS MEAN | STD DEV | LIMITS MIN | MAX |
|---|---|---|---|---|---|---|
| Thickness of layer | m | CONSTANT | 100 | -999 | | |

-999. -999.

| | | | | | |
|---|---|---|---|---|---|
| | Longitudinal dispersivity of layer | m | DERIVED | -999. | -999. |
| -999. | -999. | | | | |
| | Percent organic matter | -- | CONSTANT | 0.110 | -999. |
| -999. | -999. | | | | |
| | Bulk density of soil for layer | g/cc | CONSTANT | 1.58 | -999. |
| -999. | -999. | | | | |
| | Biological decay coefficient | 1/yr | CONSTANT | 0.000 | -999. |
| -999. | -999. | | | | |

1

CHEMICAL SPECIFIC VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS | |
|---|---|---|---|---|
| | | | MEAN | STD |
| LIMITS | | | | |
| DEV MIN MAX | | | | |
| Solid phase decay coefficient | 1/yr | DERIVED | -999. | -999. |
| -999. -999. | | | | |
| Dissolved phase decay coefficient | 1/yr | DERIVED | -999. | -999. |
| -999. -999. | | | | |
| Overall chemical decay coefficient | 1/yr | DERIVED | -999. | -999. |
| -999. -999. | | | | |
| Acid catalyzed hydrolysis rate | l/M-yr | CONSTANT | 0.000 | -999. |
| -999. -999. | | | | |
| Neutral hydrolysis rate constant | 1/yr | CONSTANT | 0.000 | -999. |
| -999. -999. | | | | |
| Base catalyzed hydrolysis rate | l/M-yr | CONSTANT | 0.000 | -999. |
| -999. -999. | | | | |
| Reference temperature | C | CONSTANT | 25.0 | -999. |
| -999. -999. | | | | |
| Normalized distribution coefficient | ml/g | CONSTANT | 152. | -999. |
| -999. -999. | | | | |
| Distribution coefficient | -- | DERIVED | -999. | -999. |
| -999. -999. | | | | |
| Biodegradation coefficient (sat. zone) | 1/yr | CONSTANT | 0.000 | -999. |
| -999. -999. | | | | |
| Air diffusion coefficient | cm2/s | CONSTANT | -999. | -999. |
| -999. -999. | | | | |
| Reference temperature for air diffusion | C | CONSTANT | -999. | -999. |
| -999. -999. | | | | |
| Molecular weight | g/M | CONSTANT | -999. | -999. |
| -999. -999. | | | | |
| Mole fraction of solute | -- | CONSTANT | -999. | -999. |
| -999. -999. | | | | |
| Vapor pressure of solute | mm Hg | CONSTANT | -999. | -999. |
| -999. -999. | | | | |
| Henry`s law constant | atm-m^3/M | CONSTANT | -999. | -999. |
| -999. -999. | | | | |
| Overall 1st order decay sat. zone | 1/yr | DERIVED | 0.000 | 0.000 |
| 0.000 1.00 | | | | |
| Not currently used | | CONSTANT | 0.000 | 0.000 |
| 0.000 0.000 | | | | |
| Not currently used | | CONSTANT | 0.000 | 0.000 |
| 0.000 0.000 | | | | |

1

SOURCE SPECIFIC VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS | |
|---|---|---|---|---|
| | | | MEAN | STD |
| LIMITS | | | | |
| DEV MIN MAX | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Infiltration rate | m/yr | CONSTANT | 0.314E-02 | -999. | -999. |
| Area of waste disposal unit | m^2 | CONSTANT | 0.915E+05 | -999. | -999. |
| Duration of pulse | yr | CONSTANT | -999. | -999. | -999. |
| Spread of contaminant source | m | DERIVED | -999. | -999. | -999. |
| Recharge rate | m/yr | CONSTANT | 0.100E-09 | -999. | -999. |
| Source decay constant | 1/yr | CONSTANT | 0.000 | 0.000 | 0.000 |
| Initial concentration at landfill | mg/l | CONSTANT | 1.30 | -999. | -999. |
| Length scale of facility | m | DERIVED | -999. | -999. | -999. |
| Width scale of facility | m | DERIVED | -999. | -999. | -999. |
| Near field dilution | | DERIVED | 1.00 | 0.000 | 0.000 |

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AQUIFER SPECIFIC VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS MEAN | STD DEV | LIMITS MIN | MAX |
|---|---|---|---|---|---|---|
| Particle diameter | cm | CONSTANT | -999. | -999. | -999. | -999. |
| Aquifer porosity | -- | CONSTANT | 0.300 | -999. | -999. | -999. |
| Bulk density | g/cc | CONSTANT | 1.58 | -999. | -999. | -999. |
| Aquifer thickness | m | CONSTANT | 50.0 | -999. | -999. | -999. |
| Source thickness (mixing zone depth) | m | DERIVED | -999. | -999. | -999. | -999. |
| Conductivity (hydraulic) | m/yr | CONSTANT | 0.631E+04 | -999. | -999. | -999. |
| Gradient (hydraulic) | | CONSTANT | 0.420E-02 | -999. | -999. | -999. |
| Groundwater seepage velocity | m/yr | DERIVED | -999. | -999. | -999. | -999. |
| Retardation coefficient | -- | DERIVED | -999. | -999. | -999. | -999. |
| Longitudinal dispersivity | m | FUNCTION OF X | -999. | -999. | -999. | -999. |
| Transverse dispersivity | m | FUNCTION OF X | -999. | -999. | -999. | -999. |
| Vertical dispersivity | m | FUNCTION OF X | -999. | -999. | -999. | -999. |
| Temperature of aquifer | C | CONSTANT | 11.0 | -999. | -999. | -999. |
| pH | -- | CONSTANT | 6.80 | -999. | -999. | -999. |
| Organic carbon content (fraction) | | CONSTANT | 0.640E-01 | -999. | -999. | -999. |
| Well distance from site | m | CONSTANT | 38.0 | -999. | -999. | -999. |
| Angle off center | degree | CONSTANT | 0.000 | 0.000 | 0.000 | 0.000 |
| Well vertical distance | m | CONSTANT | 0.000 | 0.000 | 0.000 | 0.000 |

0.000 0.000

CONCENTRATION AFTER SATURATED ZONE MODEL 0.3412E-02

```
MULTIMED  V1.01   DATE OF CALCULATIONS:  9-AUG-2012  TIME: 13:26:54
Run Title:  aMcCombs Landfill Permit Modification-Alternative Liner Design
            MultiMed Trichloroethylene
Chemical simulated:                    Trichloroethylene
Simulation models included:            Saturated zone model
Simulation type:                       Deterministic
Infiltration rate:                     Specified By User: 3.140E-03 m/yr
Source term:                           Steady-state
Saturated zone source plane:           Gaussian
Well distance from site:               3.800E+01 m

Predicted relative well concentration: 3.412E-03
DAF for this case is: 3.810E+02
```

MULTIMED V1.01 DATE OF CALCULATIONS: 9-AUG-2012 TIME: 13:26:54

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED (Version 1.50, 2005)

1
Run options
--- -------

aMcCombs Landfill Permit Modification-Alternative Liner Design

MultiMed Trichloroethylene
Chemical simulated is Trichloroethylene

Option Chosen Saturated zone model
Run was DETERMIN
Infiltration Specified By User: 3.140E-03 m/yr
Run was steady-state
Reject runs if Y coordinate outside plume
Reject runs if Z coordinate outside plume
Gaussian source used in saturated zone model
1
1

CHEMICAL SPECIFIC VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS MEAN | PARAMETERS STD | LIMITS DEV | LIMITS MIN | LIMITS MAX |
|---|---|---|---|---|---|---|---|
| Solid phase decay coefficient | 1/yr | DERIVED | -999. | -999. | -999. | -999. | |
| Dissolved phase decay coefficient | 1/yr | DERIVED | -999. | -999. | -999. | -999. | |
| Overall chemical decay coefficient | 1/yr | DERIVED | -999. | -999. | -999. | -999. | |
| Acid catalyzed hydrolysis rate | l/M-yr | CONSTANT | 0.000 | -999. | -999. | -999. | |
| Neutral hydrolysis rate constant | 1/yr | CONSTANT | 0.000 | -999. | -999. | -999. | |
| Base catalyzed hydrolysis rate | l/M-yr | CONSTANT | 0.000 | -999. | -999. | -999. | |
| Reference temperature | C | CONSTANT | 25.0 | -999. | -999. | -999. | |
| Normalized distribution coefficient | ml/g | CONSTANT | 152. | -999. | -999. | -999. | |
| Distribution coefficient | -- | DERIVED | -999. | -999. | -999. | -999. | |
| Biodegradation coefficient (sat. zone) | 1/yr | CONSTANT | 0.000 | -999. | -999. | -999. | |
| Air diffusion coefficient | cm2/s | CONSTANT | -999. | -999. | -999. | -999. | |
| Reference temperature for air diffusion | C | CONSTANT | -999. | -999. | -999. | -999. | |
| Molecular weight | g/M | CONSTANT | -999. | -999. | -999. | -999. | |
| Mole fraction of solute | -- | CONSTANT | -999. | -999. | -999. | -999. | |

| | | | | | |
|---|---|---|---|---|---|
| | Vapor pressure of solute | mm Hg | CONSTANT | -999. | -999. |
| -999. | -999. | | | | |
| | Henry`s law constant | atm-m^3/M | CONSTANT | -999. | -999. |
| -999. | -999. | | | | |
| | Overall 1st order decay sat. zone | 1/yr | DERIVED | 0.000 | 0.000 |
| 0.000 | 1.00 | | | | |
| | Not currently used | | CONSTANT | 0.000 | 0.000 |
| 0.000 | 0.000 | | | | |
| | Not currently used | | CONSTANT | 0.000 | 0.000 |
| 0.000 | 0.000 | | | | |

1

SOURCE SPECIFIC VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS | | LIMITS | |
|---|---|---|---|---|---|---|
| | | | MEAN | STD | | |
| DEV | MIN | MAX | | | | |
| | Infiltration rate | m/yr | CONSTANT | 0.314E-02 | -999. | |
| -999. | -999. | | | | | |
| | Area of waste disposal unit | m^2 | CONSTANT | 0.915E+05 | -999. | |
| -999. | -999. | | | | | |
| | Duration of pulse | yr | CONSTANT | -999. | -999. | |
| -999. | -999. | | | | | |
| | Spread of contaminant source | m | DERIVED | -999. | -999. | |
| -999. | -999. | | | | | |
| | Recharge rate | m/yr | CONSTANT | 0.100E-09 | -999. | |
| -999. | -999. | | | | | |
| | Source decay constant | 1/yr | CONSTANT | 0.000 | 0.000 | |
| 0.000 | 0.000 | | | | | |
| | Initial concentration at landfill | mg/l | CONSTANT | 1.30 | -999. | |
| -999. | -999. | | | | | |
| | Length scale of facility | m | DERIVED | -999. | -999. | |
| -999. | -999. | | | | | |
| | Width scale of facility | m | DERIVED | -999. | -999. | |
| -999. | -999. | | | | | |
| | Near field dilution | | DERIVED | 1.00 | 0.000 | |
| 0.000 | 1.00 | | | | | |

1

AQUIFER SPECIFIC VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS | | LIMITS | |
|---|---|---|---|---|---|---|
| | | | MEAN | STD | | |
| DEV | MIN | MAX | | | | |
| | Particle diameter | cm | CONSTANT | -999. | -999. | |
| -999. | -999. | | | | | |
| | Aquifer porosity | -- | CONSTANT | 0.300 | -999. | |
| -999. | -999. | | | | | |
| | Bulk density | g/cc | CONSTANT | 1.58 | -999. | |
| -999. | -999. | | | | | |
| | Aquifer thickness | m | CONSTANT | 50.0 | -999. | |
| -999. | -999. | | | | | |
| | Source thickness (mixing zone depth) | m | DERIVED | -999. | -999. | |
| -999. | -999. | | | | | |
| | Conductivity (hydraulic) | m/yr | CONSTANT | 0.631E+04 | -999. | |
| -999. | -999. | | | | | |
| | Gradient (hydraulic) | | CONSTANT | 0.420E-02 | -999. | |
| -999 | -999 | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | Groundwater seepage velocity | m/yr | DERIVED | -999. | -999. |
| -999. | -999. | | | | |
| | Retardation coefficient | -- | DERIVED | -999. | -999. |
| -999. | -999. | | | | |
| | Longitudinal dispersivity | m | FUNCTION OF X | -999. | -999. |
| -999. | -999. | | | | |
| | Transverse dispersivity | m | FUNCTION OF X | -999. | -999. |
| -999. | -999. | | | | |
| | Vertical dispersivity | m | FUNCTION OF X | -999. | -999. |
| -999. | -999. | | | | |
| | Temperature of aquifer | C | CONSTANT | 11.0 | -999. |
| -999. | -999. | | | | |
| | pH | -- | CONSTANT | 6.80 | -999. |
| -999. | -999. | | | | |
| | Organic carbon content (fraction) | | CONSTANT | 0.640E-01 | -999. |
| -999. | -999. | | | | |
| | Well distance from site | m | CONSTANT | 38.0 | -999. |
| -999. | -999. | | | | |
| | Angle off center | degree | CONSTANT | 0.000 | 0.000 |
| 0.000 | 0.000 | | | | |
| | Well vertical distance | m | CONSTANT | 0.000 | 0.000 |
| 0.000 | 0.000 | | | | |

CONCENTRATION AFTER SATURATED ZONE MODEL 0.3412E-02

# MultiMed Model Results
# McCombs Landfill Waste Unit Boundary (1 meter)

MULTIMED V1.01 DATE OF CALCULATIONS: 9-AUG-2012 TIME: 13:27:47
Run Title: aMcCombs Landfill Permit Modification-Alternative Liner Design
MultiMed Trichloroethylene

| | |
|---|---|
| Chemical simulated: | Trichloroethylene |
| Simulation models included: | Saturated and unsaturated zone models |
| Simulation type: | Deterministic |
| Infiltration rate: | Specified By User: 3.140E-03 m/yr |
| Source term: | Steady-state |
| Saturated zone source plane: | Gaussian |
| Well distance from site: | 1.000E+00 m |

Predicted relative well concentration: 3.475E-03
DAF for this case is: 3.741E+02

MULTIMED V1.01 DATE OF CALCULATIONS: 9-AUG-2012 TIME: 13:27:47

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED (Version 1.50, 2005)

1
Run options
--- -------

aMcCombs Landfill Permit Modification-Alternative Liner Design

MultiMed Trichloroethylene
Chemical simulated is Trichloroethylene

Option Chosen Saturated and unsaturated zone models
Run was DETERMIN
Infiltration Specified By User: 3.140E-03 m/yr
Run was steady-state
Reject runs if Y coordinate outside plume
Reject runs if Z coordinate outside plume
Gaussian source used in saturated zone model
1
1
UNSATURATED ZONE FLOW MODEL PARAMETERS
(input parameter description and value)

| | | |
|---|---|---|
| NP | - Total number of nodal points | 240 |
| NMAT | - Number of different porous materials | 1 |
| KPROP | - Van Genuchten or Brooks and Corey | 1 |
| IMSHGN | - Spatial discretization option | 1 |
| NVFLAYR | - Number of layers in flow model | 1 |

OPTIONS CHOSEN
------- ------
Van Genuchten functional coefficients
User defined coordinate system
1

Layer information
-----------------

| LAYER NO. | LAYER THICKNESS | MATERIAL PROPERTY |
|---|---|---|
| 1 | 100.00 | 1 |

DATA FOR MATERIAL 1
---- --- --------
VADOSE ZONE MATERIAL VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS | | LIMITS | |
|---|---|---|---|---|---|---|
| | | | MEAN | STD DEV | MIN | MAX |
| Saturated hydraulic conductivity | cm/hr | CONSTANT | 29.7 | -999. | -999. | 999 |
| Unsaturated zone porosity | -- | CONSTANT | 0.340 | -999 | | |

-999. -999.
Air entry pressure head m CONSTANT 0.000 -999.
-999. -999.
Depth of the unsaturated zone m CONSTANT 100. 0.000
0.000 0.000

DATA FOR MATERIAL 1
---- --- --------
VADOSE ZONE FUNCTION VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS MEAN | STD DEV | LIMITS MIN | MAX |
|---|---|---|---|---|---|---|
| Residual water content | -- | CONSTANT | 0.430 | -999. | -999. | -999. |
| Brook and Corey exponent,EN | -- | CONSTANT | -999. | -999. | -999. | -999. |
| ALFA coefficient | 1/cm | CONSTANT | 0.145 | -999. | -999. | -999. |
| Van Genuchten exponent, ENN | -- | CONSTANT | 2.68 | -999. | -999. | -999. |

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

| | | | |
|---|---|---|---|
| NLAY | - Number of different layers used | | 1 |
| NTSTPS | - Number of time values concentration calc | | 40 |
| DUMMY | - Not presently used | | 1 |
| ISOL | - Type of scheme used in unsaturated zone | | 2 |
| N | - Stehfest terms or number of increments | | 18 |
| NTEL | - Points in Lagrangian interpolation | | 3 |
| NGPTS | - Number of Gauss points | | 104 |
| NIT | - Convolution integral segments | | 2 |
| IBOUND | - Type of boundary condition | | 1 |
| ITSGEN | - Time values generated or input | | 1 |
| TMAX | - Max simulation time | -- | 0.0 |
| WTFUN | - Weighting factor | -- | 1.2 |

OPTIONS CHOSEN
------- ------
Convolution integral approach
Nondecaying continuous source
Computer generated times for computing concentrations
1

DATA FOR LAYER 1
---- --- -----
VADOSE TRANSPORT VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS MEAN | STD DEV | LIMITS MIN | MAX |
|---|---|---|---|---|---|---|
| Thickness of layer | m | CONSTANT | 100. | 999. | | |

| | | | | | |
|---|---|---|---|---|---|
| -999. | -999. | | | | |
| | Longitudinal dispersivity of layer | m | DERIVED | -999. | -999. |
| -999. | -999. | | | | |
| | Percent organic matter | -- | CONSTANT | 0.110 | -999. |
| -999. | -999. | | | | |
| | Bulk density of soil for layer | g/cc | CONSTANT | 1.58 | -999. |
| -999. | -999. | | | | |
| | Biological decay coefficient | 1/yr | CONSTANT | 0.000 | -999. |
| -999. | -999. | | | | |

1

CHEMICAL SPECIFIC VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS | | LIMITS | |
|---|---|---|---|---|---|---|
| | | | MEAN | STD DEV | MIN | MAX |
| Solid phase decay coefficient | 1/yr | DERIVED | -999. | -999. | -999. | -999. |
| Dissolved phase decay coefficient | 1/yr | DERIVED | -999. | -999. | -999. | -999. |
| Overall chemical decay coefficient | 1/yr | DERIVED | -999. | -999. | -999. | -999. |
| Acid catalyzed hydrolysis rate | l/M-yr | CONSTANT | 0.000 | -999. | -999. | -999. |
| Neutral hydrolysis rate constant | 1/yr | CONSTANT | 0.000 | -999. | -999. | -999. |
| Base catalyzed hydrolysis rate | l/M-yr | CONSTANT | 0.000 | -999. | -999. | -999. |
| Reference temperature | C | CONSTANT | 25.0 | -999. | -999. | -999. |
| Normalized distribution coefficient | ml/g | CONSTANT | 152. | -999. | -999. | -999. |
| Distribution coefficient | -- | DERIVED | -999. | -999. | -999. | -999. |
| Biodegradation coefficient (sat. zone) | 1/yr | CONSTANT | 0.000 | -999. | -999. | -999. |
| Air diffusion coefficient | cm2/s | CONSTANT | -999. | -999. | -999. | -999. |
| Reference temperature for air diffusion | C | CONSTANT | -999. | -999. | -999. | -999. |
| Molecular weight | g/M | CONSTANT | -999. | -999. | -999. | -999. |
| Mole fraction of solute | -- | CONSTANT | -999. | -999. | -999. | -999. |
| Vapor pressure of solute | mm Hg | CONSTANT | -999. | -999. | -999. | -999. |
| Henry`s law constant | atm-m^3/M | CONSTANT | -999. | -999. | -999. | -999. |
| Overall 1st order decay sat. zone | 1/yr | DERIVED | 0.000 | 0.000 | 0.000 | 1.00 |
| Not currently used | | CONSTANT | 0.000 | 0.000 | 0.000 | 0.000 |
| Not currently used | | CONSTANT | 0.000 | 0.000 | 0.000 | 0.000 |

1

SOURCE SPECIFIC VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS | | LIMITS | |
|---|---|---|---|---|---|---|
| | | | MEAN | STD DEV | MIN | MAX |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Infiltration rate | m/yr | CONSTANT | 0.314E-02 | -999. | -999. |
| -999. | -999. | | | | | |
| | Area of waste disposal unit | m^2 | CONSTANT | 0.915E+05 | -999. | -999. |
| -999. | -999. | | | | | |
| | Duration of pulse | yr | CONSTANT | -999. | -999. | -999. |
| -999. | -999. | | | | | |
| | Spread of contaminant source | m | DERIVED | -999. | -999. | -999. |
| -999. | -999. | | | | | |
| | Recharge rate | m/yr | CONSTANT | 0.100E-09 | -999. | -999. |
| -999. | -999. | | | | | |
| | Source decay constant | 1/yr | CONSTANT | 0.000 | 0.000 | |
| 0.000 | 0.000 | | | | | |
| | Initial concentration at landfill | mg/l | CONSTANT | 1.30 | -999. | -999. |
| -999. | -999. | | | | | |
| | Length scale of facility | m | DERIVED | -999. | -999. | -999. |
| -999. | -999. | | | | | |
| | Width scale of facility | m | DERIVED | -999. | -999. | -999. |
| -999. | -999. | | | | | |
| | Near field dilution | | DERIVED | 1.00 | 0.000 | |
| 0.000 | 1.00 | | | | | |
| 1 | | | | | | |

AQUIFER SPECIFIC VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS | | LIMITS | |
|---|---|---|---|---|---|---|
| | | | MEAN | STD DEV | MIN | MAX |
| Particle diameter | cm | CONSTANT | -999. | -999. | -999. | -999. |
| Aquifer porosity | -- | CONSTANT | 0.300 | -999. | -999. | -999. |
| Bulk density | g/cc | CONSTANT | 1.58 | -999. | -999. | -999. |
| Aquifer thickness | m | CONSTANT | 50.0 | -999. | -999. | -999. |
| Source thickness (mixing zone depth) | m | DERIVED | -999. | -999. | -999. | -999. |
| Conductivity (hydraulic) | m/yr | CONSTANT | 0.631E+04 | -999. | -999. | -999. |
| Gradient (hydraulic) | | CONSTANT | 0.420E-02 | -999. | -999. | -999. |
| Groundwater seepage velocity | m/yr | DERIVED | -999. | -999. | -999. | -999. |
| Retardation coefficient | -- | DERIVED | -999. | -999. | -999. | -999. |
| Longitudinal dispersivity | m | FUNCTION OF X | -999. | -999. | -999. | -999. |
| Transverse dispersivity | m | FUNCTION OF X | -999. | -999. | -999. | -999. |
| Vertical dispersivity | m | FUNCTION OF X | -999. | -999. | -999. | -999. |
| Temperature of aquifer | C | CONSTANT | 11.0 | -999. | -999. | -999. |
| pH | -- | CONSTANT | 6.80 | -999. | -999. | -999. |
| Organic carbon content (fraction) | | CONSTANT | 0.640E-01 | -999. | -999. | -999. |
| Well distance from site | m | CONSTANT | 1.00 | -999. | -999. | -999. |
| Angle off center | degree | CONSTANT | 0.000 | 0.000 | 0.000 | 0.000 |
| Well vertical distance | m | CONSTANT | 0.000 | 0.000 | | |

0.000 0.000

CONCENTRATION AFTER SATURATED ZONE MODEL 0.3475E-02

# Appendix 3J – Attachment 2
# Alternative Liner Modeling ("Prescriptive Liner")

SAIC®

## Memorandum

To: TCEQ

From: Cami Van Abel, SAIC

Subject: Appendix 3J, Attachment 2 – Alternative Liner Modeling (Scenario 1)

Date: March 15, 2013

SAIC has reviewed the attached "Report of Study for Alternative Liner Design Using Single Flexible Membrane Liner, McCombs Landfill, Permit No. 729-A, El Paso, Texas, May 1995" and subsequent revisions dated June 22, 1995 and June 26, 1995. This report was submitted to and approved by the Texas Natural Resources Conservation Commission (TNRCC). The attached Report for the alternative liner modeling for caliche references TNRCC and MSW Permit No. 729A throughout. It should be noted that TNRRC is now Texas Commission of Environmental Quality (TCEQ) and the attached report and data are applicable to the major permit amendment for MSW Permit No. 729B.

Reference to MSW Permit No. 729A should be used synonymously with MSW Permit No. 729B, reference to TNRCC should be used synonymously with TCEQ, and reference to the maximum contaminate levels (Title 31 TAC 330.202) should be used synonymously with 30 TAC §330.331.

TLK

SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI

John Hall, *Chairman*
Pam Reed, *Commissioner*
R. B. "Ralph" Marquez, *Commissioner*
Dan Pearson, *Executive Director*

# TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

*Protecting Texas by Reducing and Preventing Pollution*

July 10, 1995

John D. Cordova, P.E.
City of El Paso
Two Civic Center Plaza
El Paso, Texas 79901-1196

Re: McCombs Municipal Solid Waste Landfill
MSW Permit No. 729A
Alternate Liner Design

Dear Mr. Cordova:

On June 1, 1995, the Texas Natural Resource Conservation Commission (TNRCC) Municipal Solid Waste (MSW) Permits Section received a request from the above referenced facility to use an alternate liner design (ALD) pursuant to 30 Texas Administrative Code (TAC) 330.202-Alternate Design. On June 27 and July 6, 1995, clarifications and additional information was submitted to the TNRCC. The proposed ALD consists of a single 60 mil HDPE underlain by a 6 inch compacted caliche on 6 inches of in-situ compacted subgrade. This alternate liner design proposes to replace the currently approved ALD consisting of a double flexible membrane liner with a leachate collection and a leachate detection system. The submitted ALD has been signed and sealed by Danny R. Anderson, P.E. (P.E. # 32062) in accordance with The Texas Engineering Practice Act.

Pursuant to 30 TAC §330.202, Alternate Design:

> Alternate liner designs may be authorized by the executive director if the owner or operator provides a demonstration by computerized modeling (for example, the "Help" and "Multi-Media" models) that show that the maximum contaminant levels detailed in §330.200 of this title (relating to Design Criteria), Table 1 will not be exceeded at the point of compliance. At the discretion of the executive director, a field demonstration may be required to prove the practicality and performance capabilities of an alternative design.

The TNRCC staff has reviewed the submitted ALD and supporting information and has determined that a HELP and Multimed model was submitted in accordance with 30 TAC §330.202. The results of the


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HELP and Multimed models which are based on the values selected by the consultant and input into the models, indicate that the maximum contaminant levels detailed in 330 TAC §330.200, Table 1 were not exceeded during the remaining active life and post-closure care period.

If you have any questions concerning this letter, please contact Mark Dollins, P.E. at (512) 239-6675.

Sincerely,

Ronald R. Pedde, P.E., Special Assistant
Office of Waste Management
Texas Natural Resource Conservation Commission

RRP/md

cc: Mark Dollins, P.E.
John C. Karlsruher, P.E.
Cardenas-Salcedo and Associates, Inc.
7500 Viscount
Suite 101
El Paso, Texas 79925



DEC 17 2001 12:11 FAX:512-239-6000 MSW SOLID WASTE P.13

# REPORT OF STUDY

# FOR

# ALTERNATE LINER DESIGN

# USING SINGLE FLEXIBLE MEMBRANE LINER

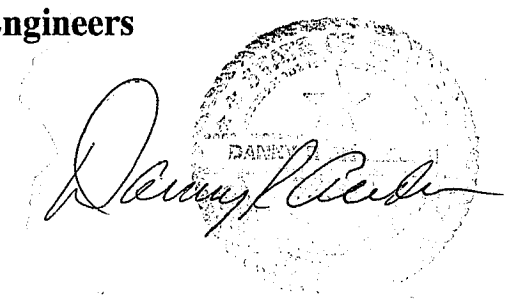
## McCOMBS LANDFILL

## PERMIT NO. 729-A

## EL PASO, TEXAS

**MAY 1995**

**DANNY R. ANDERSON CONSULTANTS, INC.**
**Geotechnical and Environmental Engineers**
**4601 Ripley Drive**
**El Paso, Texas 79922**



# ABSTRACT

A new alternate design liner has been proposed by the City of El Paso for the McCombs Landfill to replace the previous approved alternate design liner. These computer models were made to demonstrate the suitability of the new alternate design liner which consists of single flexible membrane liner (FML) with a leachate collection system. Most of the input data used were identical to the previous alternate design liner computer model which consists of double flexible membrane liner.

Two computerized models were utilized, HELP and MULTIMED, together with equations for leachate head over the liner. Two models of MultiMed programs which consist of Subtitle D and Generic Model were generated to determine the maximum contaminant level when it reached the groundwater. In Subtitle D, the groundwater table is assumed to be located at the bottom of landfill and in the Generic Model it is assumed to be at 1 inch below the bottom of landfill. These assumptions give a very conservative approach since the actual groundwater table is located approximately 106 meters (350 feet) below the ground surface as reported in the suitability study of the McCombs Sludge Disposal Landfill in 1987. Points of Compliance (P.O.C) are assumed to be located at the groundwater table level, 1 meter in down gradient direction from the landfill.



Page 1

The results of Subtitle D model shows the Dillution Attenuation Factor (DAF) of 575 which is far greater than 260 (the minimum value required by TNRCC). From the generic model, DAF value of 4630 is obtained. This value is the maximum value which is reached in the 120 years of landfill life.

Some conclusions have been drawn from this study.

1. The amount of leachate which is assumed to pass through the liner system does not have potential for contamination to the groundwater.

2. The depth of existing groundwater provides further protection from contamination.



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# 1. INTRODUCTION

The City of El Paso has decided to propose a new alternate design liner for the McCombs Landfill using single flexible membrane liner. As it is mentioned on the previous approved alternate design liner (ADL), the ADL was proposed due to the existing geologic and site condition of the surrounding landfll area. On site soils and the soil in the vicinity of the proposed landfill are unsuitable to be used as lining materials. The option of importing and processing suitable soils to the site will increase the cost of construction. This alternate design is in compliance with the Title 31 of the Texas Administrative Code (TAC), Section 330.202 which states the following:

Alternate liner designs may be authorized by the executive director if the owner or operator provides a demonstration by computerized design modeling (for example the "Help" and Multi-Media" models) that shows that the maximum contaminant levels detailed in §330.200 of this title (relating to Design Criteria), Table 1 will not be exceeded at the point of compliance. At the discretion of the executive director, a field demonstration may be required to prove the practicality and performance capabilities of an alternative design. Maximum Contaminant Level (MCL), Table 1, can be found on Page 6. The Hydrologic Evaluation of landfill performance (HELP) and Multi-Media Models are programs which model the landfills and the ground-water beneath them. The HELP model utilizes the properties of the soil layers in a landfill, landfill geometric parameters, and the climatic data specific of the area to calculate the amount of leachate



Page 4

in drainage layers of the landfill and the quantity of the leachate which could penetrate the bottom of the liner. The HELP Model also calculates the amount of leachate head on each of the confining soil layers in the landfill.

The Multi-Media Model utilizes the leachate quantity data, unsaturated zone soil parameters, the aquifer parameters, and the geometric landfill parameters to calculate a Dilution Attenuation Factor (DAF) at a specific point outside the landfill boundary. The point outside the landfill boundary may be selected by the modeler and is referred to as the point of compliance (POC). The DAF is the ratio of the initial contaminant concentration in the leachate to the contaminant concentration at the point of compliance.

This study was conducted to demonstrate that the new proposed alternate design liner using a single flexible membrane liner (FML) will provide sufficient protection of the groundwater.



Page 5

| CHEMICAL | MAXIMUM CONTAMINANT LEVEL (MCL) mg/L |
|---|---|
| Arsenic | 0.05 |
| Barium | 1.0 |
| Benzene | 0.005 |
| Cadmium | 0.01 |
| Carbon tetrachloride | 0.005 |
| Chromium (hexavalent) | 0.01 |
| 2,4-Dichlorophenoxy acetic acid | 0.01 |
| 1,4-Dichlorobenzene | 0.075 |
| 1,2-Dichloroethane | 0.005 |
| 1,1-Dichloroethylene | 0.007 |
| Endrin | 0.002 |
| Fluoride | 4 |
| Lindane | 0.004 |
| Lead | 0.05 |
| Mercury | 0.002 |
| Methoxychlor | 0.1 |
| Nitrate | 10 |
| Selenium | 0.01 |
| Silver | 0.05 |
| Toxaphene | 0.005 |
| 1,1,1-Trichloroethane | 0.02 |
| Trichloroethylene | 0.005 |
| 2,4,5-Trichlorophenoxy acetic acid | 0.01 |
| Vinyl Chloride | 0.002 |

This Table was obtained from ALTERNATE DESIGN HANDBOOK Version 8/93.

TABLE 1.1 MAXIMUM CONTAMINANT LEVEL (MCL)



Page 6

# 2. SITE INVESTIGATION

The site suitability study of the municipal sludge sanitary landfill, which was conducted in 1987, was used to provide data for the computer simulations. The above landfill is located beside the proposed Subtitle D landfill. The proposed site of Subtitle D landfill is shown on Figure 1. The summary of the above study is as follows:

## 2.1 CLIMATE AND PHYSIOGRAPHIC SETTING

El Paso lies within the Chihuahuan desert climate region which is characterized by small but variable precipitation, large annual and diurnal temperature ranges, low relative humidity, and abundant sunshine throughout the year.

High summer daytime temperatures, mild winter daytime temperature, low humidity, and moderate winds combine to create an average annual potential evapotranspiration of 79.7 inches.

The proposed landfill site lies on the broad lowland surface of the Hueco Bolson, on intermontane basin typical of the Mexican Highlands subsection of the Basin and Range Physiographic Province. The Hueco Bolson is a north-south trending tectonic trough with basin-fill deposits, extending from southernmost New Mexico through western Texas and into northern Chihuahua. The Hueco Bolson is bounded on the north by the Tularosa Basin (topographically indistinct but hydrologically separate), on the west by the Franklin



Page 7

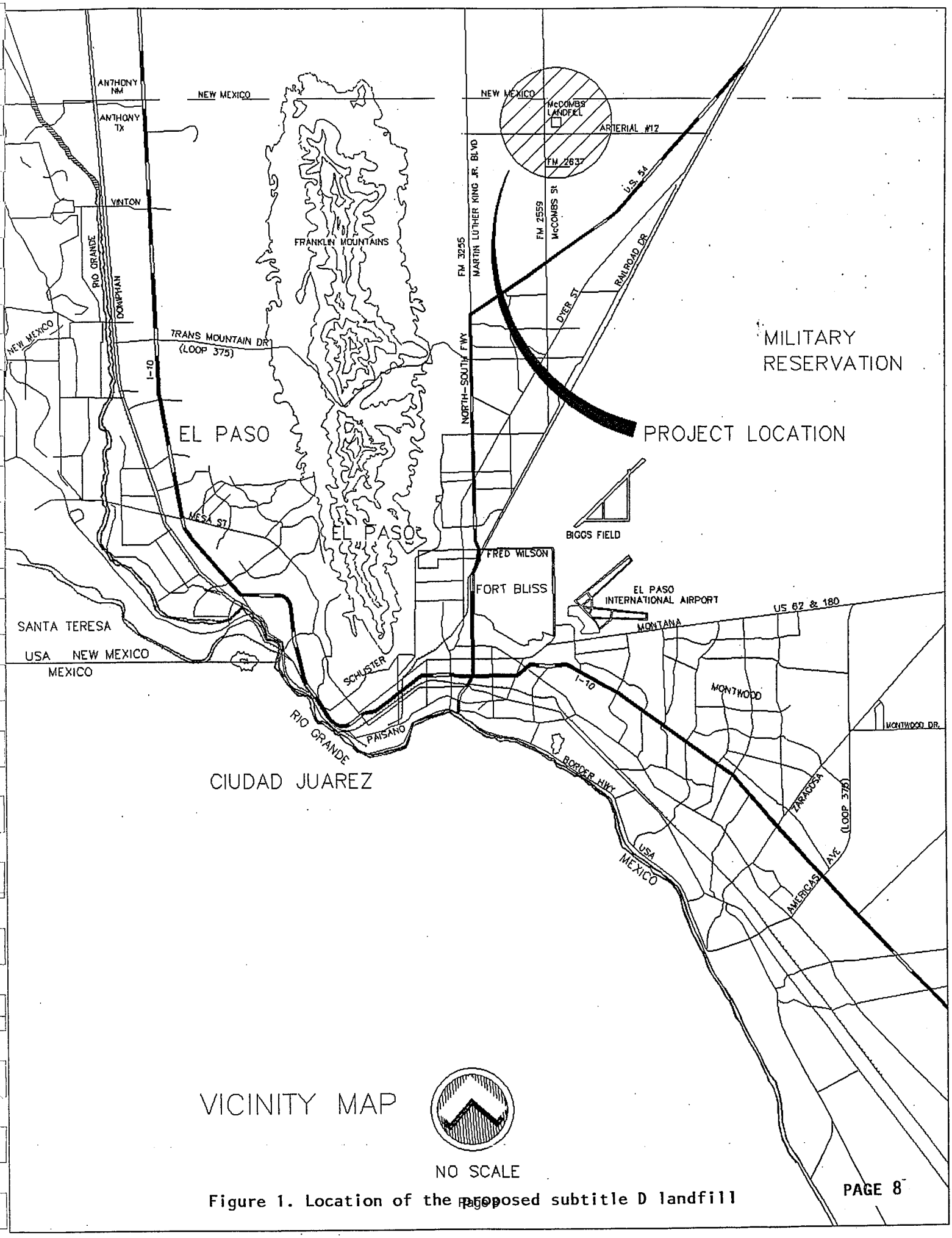


Figure 1. Location of the proposed subtitle D landfill

Mountains (a tilted fault block), on the east by the Hueco Mountains (limestone with some igneous intrusions), and on the south by mountain ranges of the Sierra Madre Occidental Massif.

Basin-fill deposits range up to 2740 meters (9000 feet) deep near the Franklin Mountains. The upper 430 meters (1400 feet) in this portion of the Bolson are predominantly alluvial sands and gravels, thinning to the east. Lacustrine deposits predominate below the fluvial sediments with basement rock of granite and limestone (Figure 2). Alluvial fan and eolian deposits interfinger with both dominant facies at depth and also comprise the more recent surficial deposits. Both facies are considered part of the Fort Hancock Formation, although some assign fluvial gravels in the upper facies as part of the Camp Rice Formation, distinct from piedmont slope alluvial deposits and the lower Lacustrine facies. When crossing the Hueco Bolson, one is aware of the ridge and swale topography which is also evident as aligned depressions on LANDSAT imagery, perhaps representing relict drainage features. Present-day drainage is primarily internal and non-integrated, with rare surface runoff accumulating briefly in playas or small depressions.

An Eastern Boundary Fault Zone (EBFZ) is proposed as separating the Franklin Mountains from the bolson deposits and would be buried under recent piedmont slope deposits and relict landslide blocks (Figure 2). Between 6100 and 7620 meters (20,000 and 25,000 feet) of vertical displacement is said to have occurred along this fault which



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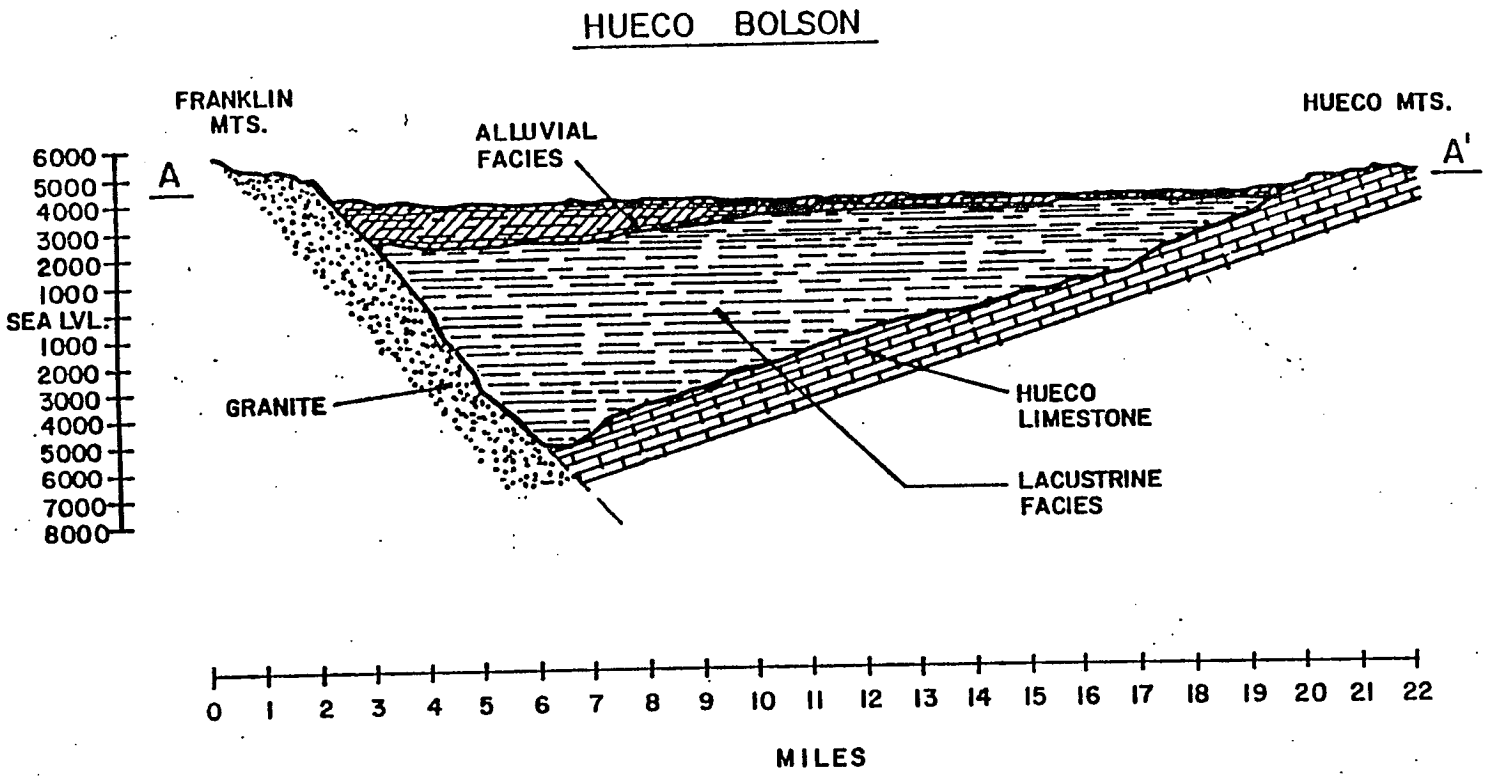


FIG. 2 A WEST - EAST GEOLOGIC CROSS-SECTION OF THE HUECO BOLSON.

dips 25° eastward, based on gravity and seismic data. Movement was initiated during the early Laramide, between 50 and 156 million years ago and has probably decreased ever since. Movement of 122 meters (400 feet) along the EBFZ is suspected since deposition of the upper portion of the Bolson-fill. Westward tilting of the bolson along this fault zone led in part to deposition of the Rio Grande fluvial sediments which thins to the east, (as mentioned earlier), and which today comprise the most productive regional aquifer. The westward tilting along the EBFZ also accounts for the decline in surface elevation of about 61 meters (200 feet) over 13 kilometers (8 miles) from east to west.

## 2.2 SITE CONDITIONS AND SUBSOIL PROFILE

2.2.1 The proposed construction site is located in the Hueco Bolson. The soils in this area are related to the Turney-Berino Association which is described as nearly level and gently sloping soils that have a clay loam subsoil and are moderately deep over soft caliche.

2.2.2 The large deficit between precipitation and potential evapotranspiration restricts vegetation in this region. The potential plant community is made up of grass decreasers as bush muhly, black grama perennial three-awns, plains bristle grass, mesa drop seed and sand drop seed, common invaders are mesquite, creosote bush and brown snake weed.



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2.2.3 Subsurface soils encountered from 5 test borings are reported in the Appendix. Predominantly three strata of soil material were encountered; silty sand, clayey sand and poorly graded sand. Silty clayey sand is found near the ground surface and extends from the elevation of 4030 feet to 3988 feet while poorly graded sand is found at the elevation of 3988 feet and extends to 3935 feet. Groundwater was not encountered at any of the test boring locations during the time of the investigation.

## 2.3 GROUNDWATER

### 2.3.1 Regional Distribution

Water bearing sediments in the Hueco Bolson are very lenticular in nature, consisting of mixed rounded sands and gravels (left by the ancestral Rio Grande), poorly graded piedmont slope sands and clays (derived locally from granitic outcrops), and well graded piedmont slope sands (derived locally from sandstone outcrops and eolian deposits). Hydrostatrigraphic units of lower permeability involve Lacustrine clays mixed with pebbles of chert (derived locally from outcrops of shale and limestone).

Groundwater is primarily unconfined beneath the broad lowland surface of the Hueco Bolson; this portion of the aquifer is known as the Mesa area. In the Rio Grande Valley between El Paso and Ysleta, groundwater in bolson deposits is semi-confined beneath discontinuous clay lenses left when the river had entrenched 60 to 80 meters (200 to 260 feet) beneath the current valley floor elevation; this portion of the Hueco Bolson aquifer



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is known as the City Artesian Area. The static water table in the Mesa Area generally ranges in depth below the land surface from 260 to 380 feet dated December 1986. Drawdown in the Mesa Area in the 20 year period, between 1964-1984 ranges from 10 feet in northeast El Paso to 60 feet in the El Paso International Airport, surrounding area (see Figure 3). Disregarding the City Artesian Area median well depth is 168 meters (550 feet) with 67 percent of wells between depths of 90-245 meters (300-800) feet (Figure 4).

2.3.2 Movement

The water table has a hydraulic gradient of about 0.0025 (13 feet per mile) towards a major cone of depression in the vicinity of El Paso International Airport. Groundwater surface contours are provided to illustrate flow directions (Figure 5). Recharge is restricted to deep percolation at the contact between bedrock and alluvium from precipitation of the east slope of the Franklin Mountains. Average annual recharge is estimated at 7.4 million cubic meters (6000 acre-feet), contrasted with 1980 pumpage requirements of 111.7 mcm (90,590 acre-feet). With projected increases in demand for Hueco Bolson groundwater, 75 percent of the volume in storage will be depleted between 1980 and 2030. Transmissivity of the Mesa Area aquifer ranges from 990 to 1980 $m^2$/day (80 to 160 gal/day/ft); vertical hydraulic conductivity is approximately 20 gal/day/$ft^2$; while horizontal hydraulic conductivity is approximately 200 gal/day/$ft^2$; storage coefficient (specific yield) ranges between 0.16 to 0.30; well yields average 9760 $m^3$/day



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(1.79 gal/min); specific capacity of wells averages 0.5$m^3$/day/m.

### 2.3.3 Quality

The quality of groundwater in the Mesa Area of the Hueco Bolson aquifer is characterized by steady increases in total dissolved solids (TDS) with increasing depth (Figure 3). The thickness of groundwater containing 300-500 mg/1 TDS reaches a maximum of 275 meters (900 feet); the thickness of groundwater with 300 to 2500 mg/l reaches a maximum of 305 meters (1000 feet).

### 2.3.4 Existing Well

The Texas ownership doctrine for groundwater allocation dictates that municipal water supply wells must be located within El Paso City limits or located where water rights have been acquired from the landowner. The ownership doctrine thereby accounts for the high density of wells in the Mesa Area portion of the Hueco Bolson aquifer beneath city land, as opposed to those located beneath Fort Bliss (Figure 5).

Several wells exist in the vicinity of the proposed landfill site (Figure 6). Well #314 is owned by El Paso Sand Products Company, a quarry operation which adjoins the proposed landfill site on the west. The well is drilled to a depth of 142 meters (465 feet). Static water level is approximately 116 meters (350 feet) below land surface. The well is slotted for the entire depth below static water level but no water quality analyses are



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available.

Hydraulically up-gradient and within a one-mile radius from the proposed landfill site are two existing wells (Well #310 was a USGS test well that was filled in). Well #213 is owned by the El Paso Electric Company and is not oriented along any flow line relative to the proposed landfill site. This well is drilled to a depth of 267 meters (875 feet). Static water level is approximately 102 meters (340 feet) below land surface. The well is slotted for the entire depth below 136 meters (445 feet), discharging water with 797 mg/l TDS (Jan. 15, 1976 measurement). Chloride was reported at a level of 350 mg/l, the only ion to exceed current EPA National Interim Primary Drinking Water Standards. Well #309 is an El Paso City municipal water supply well located 0.32 km (0.2 mile) distant as measured along flow lines. This well is drilled to a depth of 242 meters (795 feet). Static water level is at the elevation of 3689.31 feet approximately 102 meters (335 feet) below land surface (December 1986 measurement). The well is slotted between 155 and 168 meters (510 and 550 feet) and between 186 and 198 meters (610 and 650 feet) depth, discharging water with 505 mg/l TDS (Oct. 6, 1965 measurement). Hydraulically down-gradient and within the one-mile radius from the proposed landfill site are three city-owned wells. Well #305 is drilled to a depth of 184 meters (603 feet) and is 0.2 km (0.1 mile) distant as measured along flow lines. Static water level is approximately 104 meters (340 feet) below land surface. This well is screened between 114 and 152 meters (374 and 1199 feet) depth, discharging water with 436 mg/l TDS (Nov. 1, 1974



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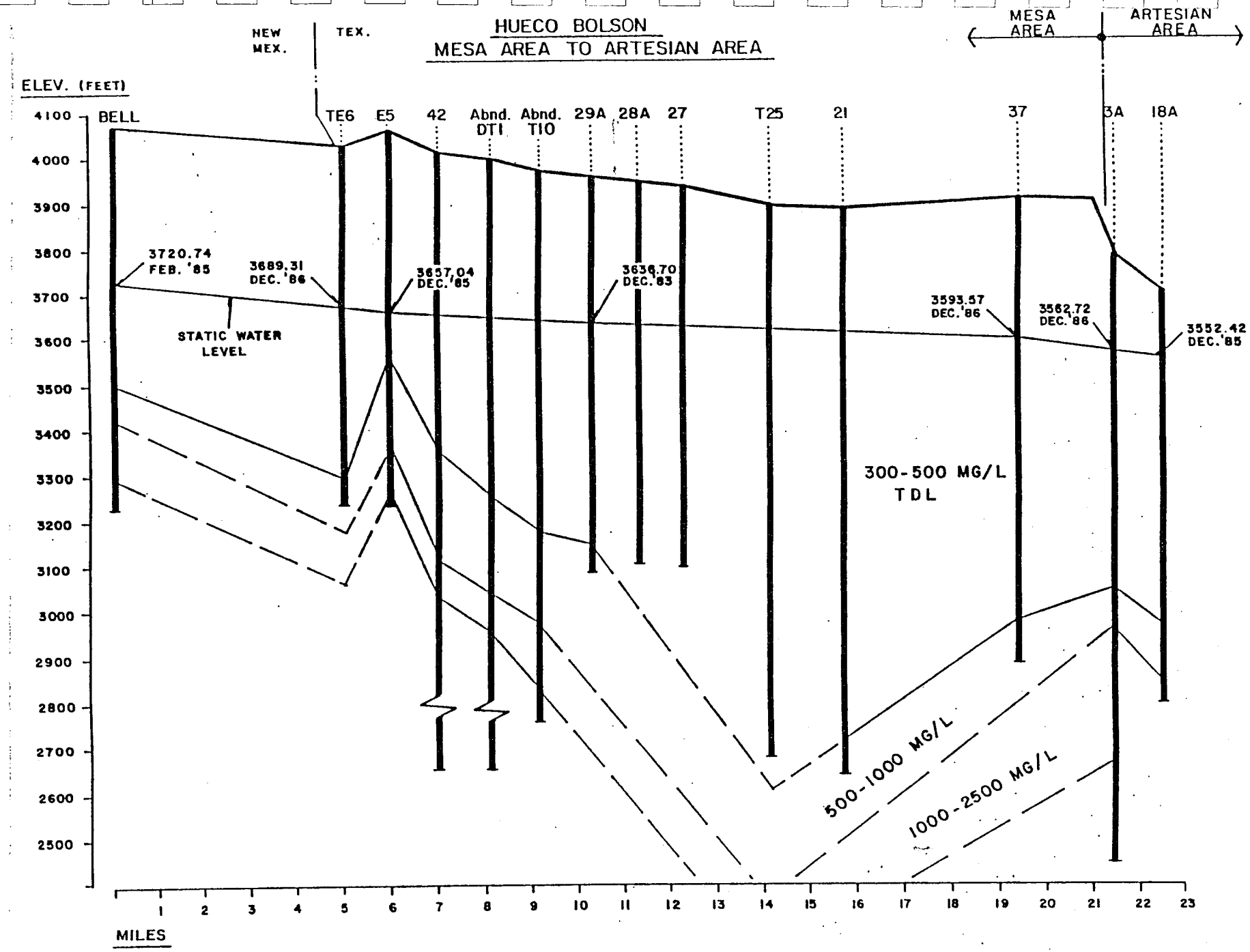


INFORMATION PROVIDED BY
ROGER SPERKA, EL PASO WATER UTILITIES

Abnd. = ABANDONED TDL = TOTAL DISSOLVED SOLID

DEC. 1986

FIG. 3

A NORTH-SOUTH CROSS-SECTION OF THE HUECO BOLSON ILLUSTRATING STATIC WATER LEVEL.
THE PROPOSED LANDFILL SITE IS LOCATED BETWEEN WELLS TE6 & E5.

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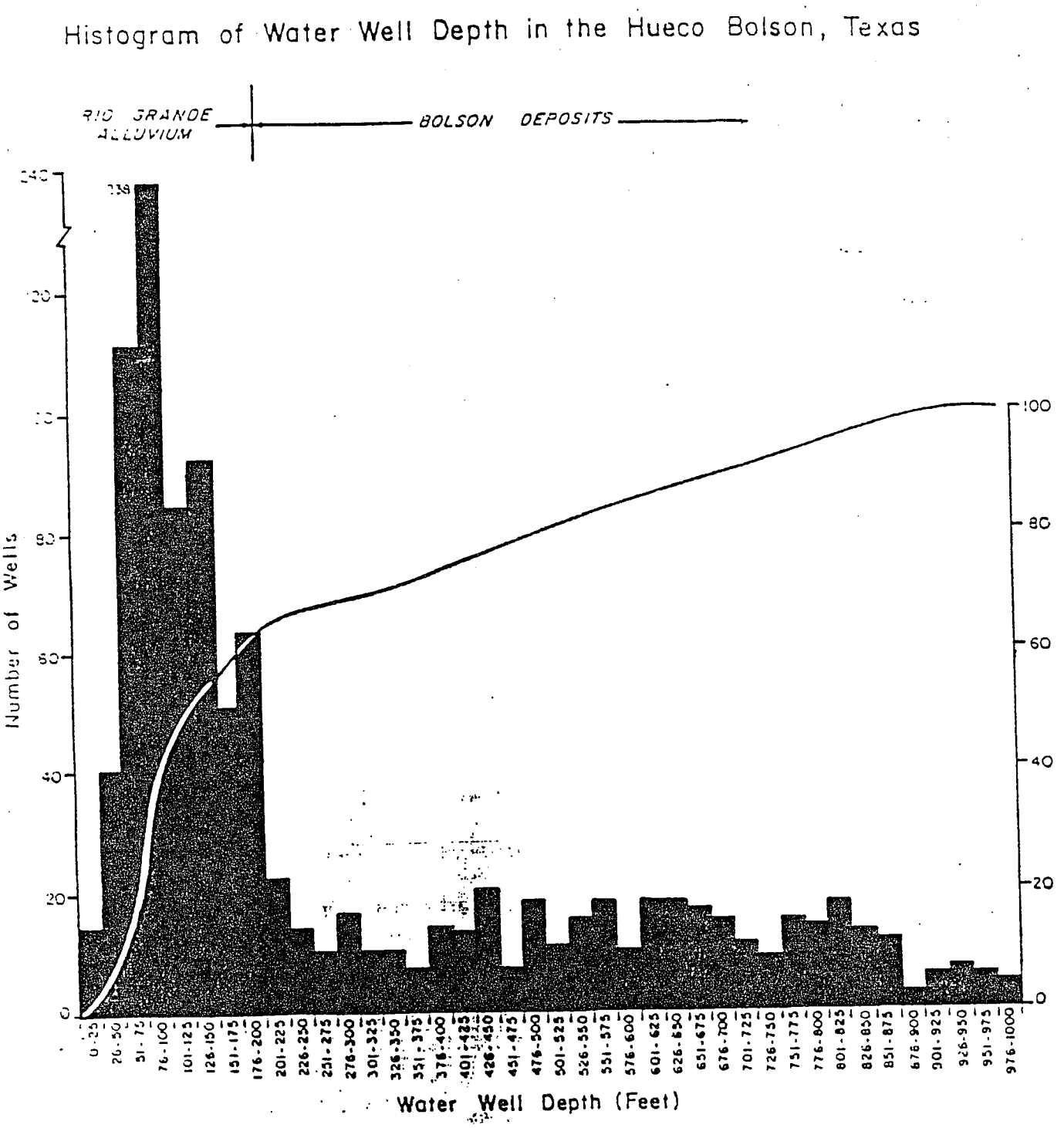


Figure 4. Histogram of water well depth in the Hueco Bolson, El Paso County, Texas. Wells of depth less than 79 meters (260 feet) depth are pumping water from the Rio Grande alluvium in the El Paso Valley. Wells of depth greater than 79 meters are pumping water from either the City Artesian Area (below the Rio Grande alluvium between El Paso and Ysleta) or the Mesa area.



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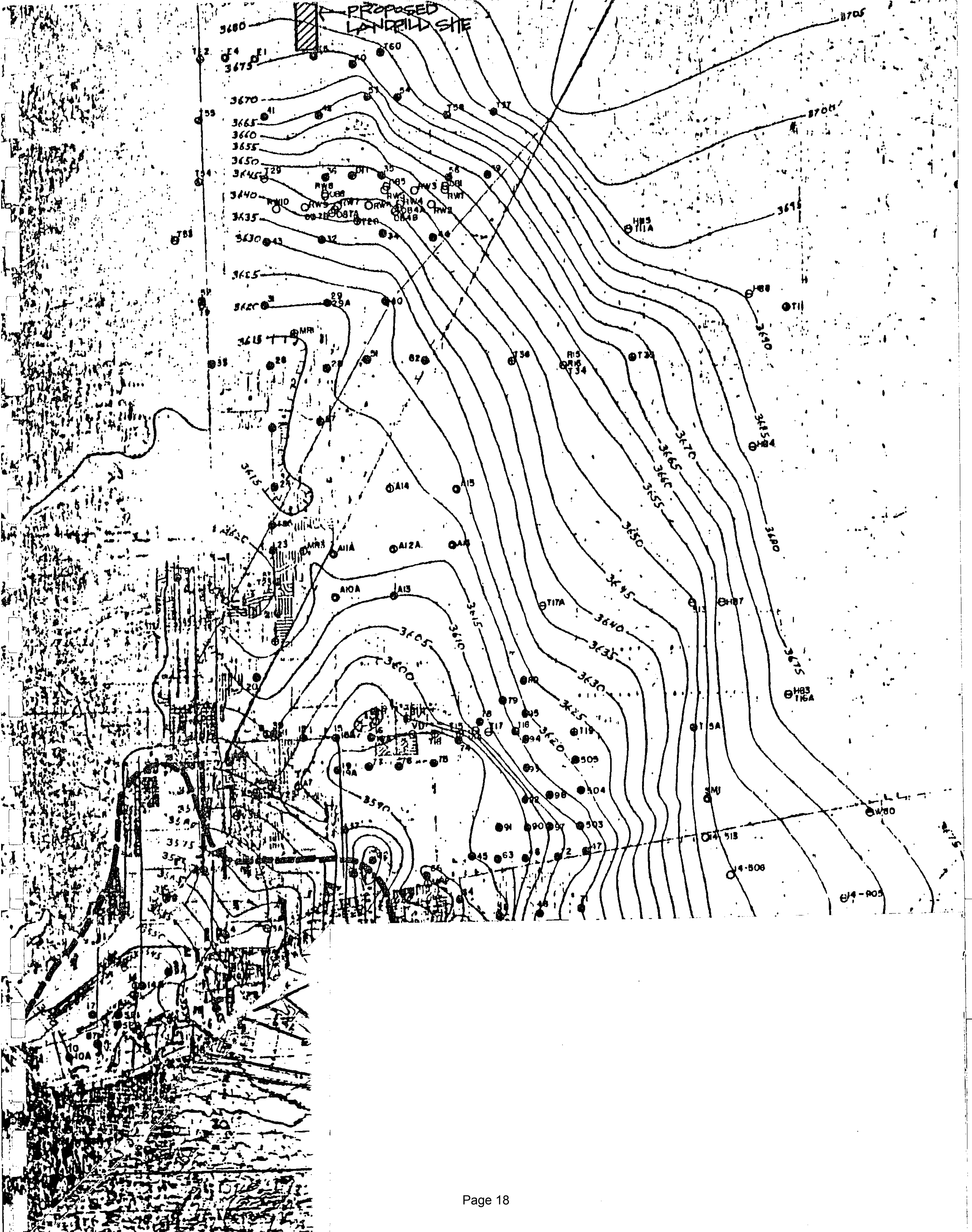
PROPOSED LANDFILL SITE
3680
3675
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3630
3625
3620
A14
A15
A11A
A12A
A10A
A13
T17A
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MR3
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14-505
505
504
503

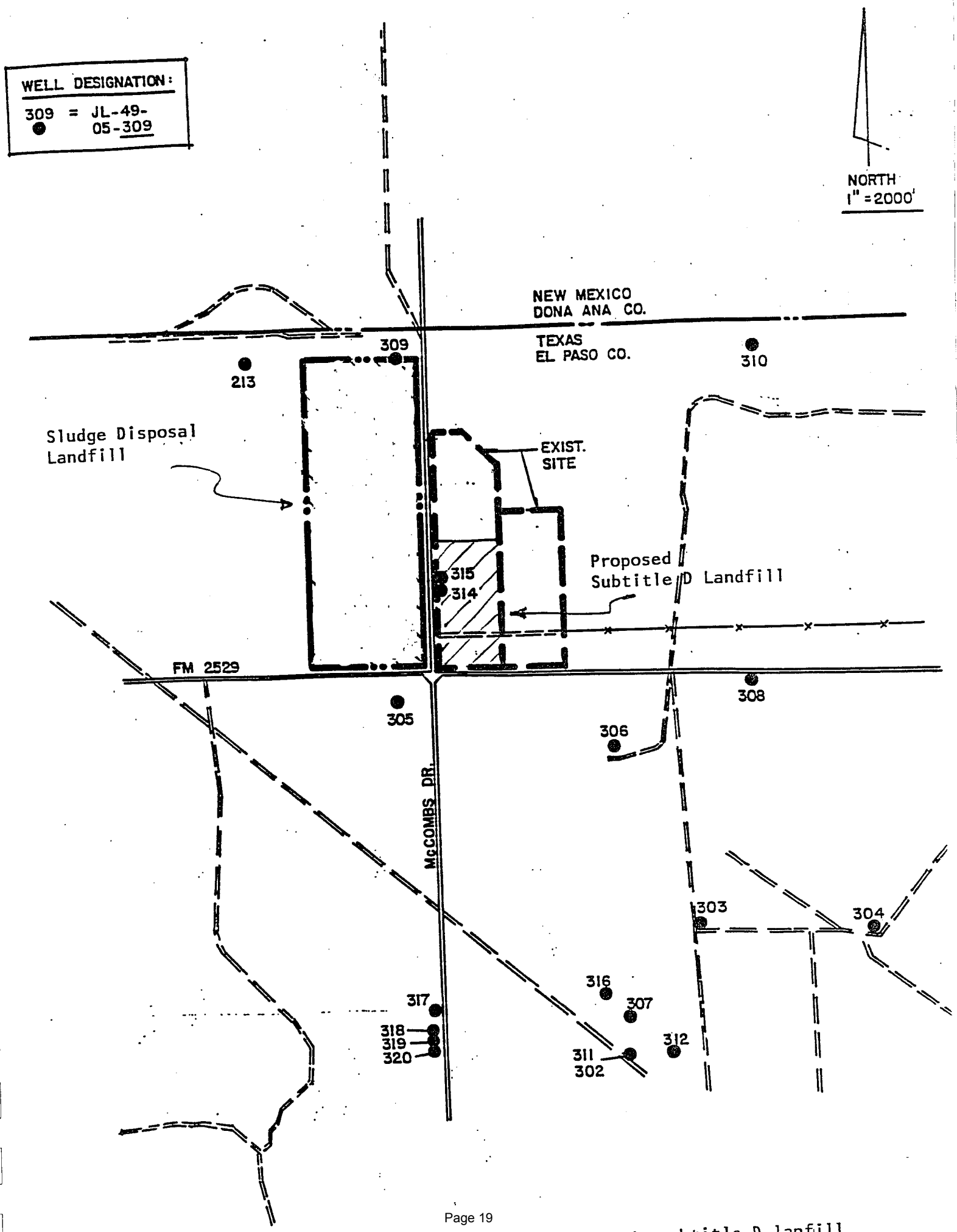




Figure 6. Existing wells on the proposed subtitle D lanfill and the existing sludge disposal landfill.

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measurement). Well #306 is drilled to a depth of 184 meters (603 feet) and is 0.5 km (0.3 mile) distant but not along any flow lines which cross the proposed landfill site. Static water level is approximately 116 meters (379 feet) below land surface. This well is screened for the entire depth below 119 meters (391 feet) depth, discharging water with 1459 mg/l TDS (July 5, 1965 measurement; the chloride and sulfate anions did not meet EPA standards. Well #301 is drilled to a depth of 205 meters (671 feet) and is 1.6 km (1 mile) distant as measured along a flow line. Static water level is approximately 109 meters (358 feet) below land surface (December 1985 measurement). This well is slotted from 98 to 154 meters (320 to 505 feet) and again below 155 meters (507 feet), discharging water with 400 mg/l TDS. Well #303 is owned by Prices Dairy and is not located along any flow lines which intersect the proposed landfill site. This well is drilled to a depth of 265 meters (870 feet) with static water level at approximately 116 meters (380 feet) below land surface (January 1987).

## 2.4 UNSATURATED AND SATURATED ZONE CHARACTERISTICS

### 2.4.1 Unsaturated Zone Characteristics

Subsurface soils encountered from five test borings and three wells (see Appendix A) indicate poorly graded silty sand and clayey sand with low to medium plasticity index are the dominant material in the unsaturated zone.



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2.4.2 Saturated Zone Characteristics

Static water table is between 102 and 110 meters (335 and 360 feet) below the land surface at the proposed landfill site. This represents a decline in water table elevation of 10 feet to 60 feet during the past twenty years, 1964 to 1984. The water table has a hydraulic gradient (i) of 0.0025, sloping SSW so that groundwater beneath the proposed landfill site moves NNE and SSW. The gradient and direction of the water table surface have also been modified from conditions in 1903, when i = 0.0009 sloping to the east. Within the one-mile radius study area, aquifer transmissivity is 170 $m^2$/day (140 gal/day/ft) for the upper 133 meters (440 feet) of the saturated zone; horizontal hydraulic conductivity is (250 gal/day/$ft^2$). The groundwater flow per unit width of aquifer will be $q_w$=KDi=Ti=(1740 $m^2$/day) (0.0025) = 4.35 $m^3$/day/m.

A standard thickness (d) of 133 meters (440 feet) is used since this is the local thickness of groundwater containing 300 to 2500 mg/l TDS.



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# 3. DATA AND MODELING CASES

## 3.1 DATA

The normal mean monthly precipitation and normal mean monthly temperature, during a period of 30 years (1961-1990), were used to run the simulation for the HELP program model. These climatological data were obtained from the National Weather Services in El Paso, Texas. The input parameters were summarized and reported on Page 26.

Input parameters for the Multi-Media program consists of two groups of data. The first group of data was used for Subtitle D Model and the second group of data was used for the Generic Model. These parameters were tabulated in Table 3.1 through Table 3.3 for the Subtitle D Model and Table 3.4 through Table 3.7 for the Generic Model. In order to simplify the simulation Model, the Unsaturated Zone layer is assumed to consist of one homogeneous layer (clean sands). As described in Section 2.2.3, the existing unsaturated layer consist of silty sand, clayey sand and poorly graded sand. Thus, it has a lower hydraulic conducitivity value than those of the assumed layer. Therefore, a conservative result will be obtained.

Since the silty clayey materials in the unsaturated zone will decrease, or prohibit the vertical movement of contaminant, the vertical hydraulic conductivity value will not be excessively higher than the horizontal hydraulic conductivity value.



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The saturated zone is also assumed to consist of one homogeneous layer of sand-coarse material. As indicated in Section 2.4.2, the hydraulic gradient and the thickness of the aquifer were taken as 0.0025 and 133 meters respectively.

The quantity of leachate assumed to be leaking through the liner, which must be estimated to provide the input data used in the Multi-Media Model, was calculated based on the leakage equations in the TNRCC Handbook. This equation has been modified to take into account the thin lining system. The equations used the amount of head on the liner to determine leakage rates. This head value was obtained from the HELP Model.

The above mentioned equations were obtained from the Johnson Ranch II Subtitle D cell, the alternate liner notebook from the City of Odessa, Texas. The alternate liner design was used by the City of Odessa for permit modification of the Johnson Ranch II - Subtitle D landfill on November 1993. The calculation of leachate rates is reported on Appendix C.

The Hydraulic Conductivity of the Flexible Membrane Liner (FML) was assumed to be 5 x 10E-9 cm/sec. This hydraulic conductivity value was estimated based on a study performed by Paula Estornall, a geotechnical engineer at Hart-Crowser Associates in Seattle, WA and Dr. David Daniel (a professor of civil engineering at the University of Texas at Austin) (see Appendix G).



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# INPUT PARAMETERS FOR HELP MODEL

| | |
|---|---|
| Years of Rainfall/Temperature Data: | 1961 - 1990 |
| Daily Temperature: | Default |
| Average Monthly Normal Temperature: | Average |
| Average Monthly Normal Precipitation: | Average |
| Solar Radiation: | Default for El Paso |
| Maximum Leaf Area Index: | 0.0 for bare ground |
| Evaporative Depth: | 18.00 inches |
| Override Default Run-Off Curve: | No |
| Is the Landfill Active or Uncovered: | Yes |
| Fraction of Run-Off Which is Available To Drain (only applicable for open/active landfill): | 0000 |
| Surface Area ($ft^2$): | 881,000 |

| | TEMPERATURE | PRECIPITATION |
|---|---|---|
| MONTH | AVERAGE | AVERAGE |
| JANUARY | 42.8 | 0.40 |
| FEBRUARY | 48.1 | 0.41 |
| MARCH | 55.1 | 0.29 |
| APRIL | 63.4 | 0.20 |
| MAY | 71.8 | 0.25 |
| JUNE | 80.4 | 0.67 |
| JULY | 82.3 | 1.54 |
| AUGUST | 80.1 | 1.58 |
| SEPTEMBER | 74.4 | 1.70 |
| OCTOBER | 64.0 | 0.76 |
| NOVEMBER | 52.4 | 0.44 |
| DECEMBER | 44.1 | 0.57 |



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| VARIABLE NAME | UNIT | MEAN | STANDARD DEVIATION | MIN. | MAX. | SOURCE/COMMENTS |
|---|---|---|---|---|---|---|
| Particle diameter | cm | 0.025 | - | - | - | Study 1987 |
| Aquifer porosity | - | - | - | - | - | Generated by MULTIMED model |
| Bulk density | g/cc | 1.73 | - | - | - | State Alternate Liner Handbook, Table G |
| Aquifer thickness | m | 133 | - | - | - | Study 1987 |
| Mixing zone depth | m | | - | - | - | Derived |
| Hydraulic conductivity | m/yr | 3741.5 | - | - | - | Study 1987 |
| Hydraulic gradient | - | 0.0025 | - | - | - | Report Study 1987 |
| Ground-water seepage velocity | m/yr | | - | - | - | Generated by MULTIMED model |
| Retardation coefficient | - | - | - | - | - | Generated by MULTIMED model |
| Longitudinal dispersivity | m | - | - | - | - | Generated by MULTIMED model |
| Transversal dispersivity | m | - | - | - | - | Generated by MULTIMED model |
| Vertical dispersivity | m | - | - | - | - | Generated by MULTIMED model |
| Temperature of the aquifer | °C | 25.0 | - | - | - | Assume |
| pH | - | 7.31 | - | - | - | Assume |
| Organic carbon content | % | 1.0E-5 | - | - | - | Assume conservative |
| Receptor distance from well | m | 1 | - | - | - | Assume conservative |
| Z-distance from watertable | - | - | - | - | - | Not allowed in Subtitle D application |

TABLE 3.1 AQUIFER SPECIFIC PARAMETERS FOR SUBTITLE D MODEL



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| VARIABLE NAME | UNITS | VALUE | SOURCE/COMMENTS |
|---|---|---|---|
| Solid phase decay coefficient | 1/yr | - | Derived |
| Dissolved phase decay coefficient | 1/yr | - | Derived |
| Overall chemical decay coefficient | 1/yr | - | Derived |
| Acid catalyst hydrolysis rate constant | L/m - yr | 0.00 | Derived |
| Neutral hydrolysis rate constant | 1/yr | 0.00 | Derived |
| Base catalyst hydrolysis constant | L/m - yr | 0.00 | Derived |
| Reference temperature | °C | 25 | Assume |
| Normalized distribution coefficient | mL/g | 0.00 | Derived |
| Distribution coefficient | - | - | Generated by MULTIMED Model |
| Biodegredation coefficient | 1/yr | - | Not allowed by TNRCC |

TABLE 3.2 CHEMICAL SPECIFIC PARAMETERS FOR SUBTITLE D MODEL

| VARIABLE NAME | UNITS | VALUE | SOURCE/COMMENTS |
|---|---|---|---|
| Infiltration Rate coefficient | m/yr | $0.698 \times 10^{-3}$ | From liner leakage equations, see calcs. |
| Area of waste disposal unit | $m^2$ | 881,000 | Area of proposed site |
| Spread of contaminant source | m | - | Generated by MULTIMED model |
| Recharge rate | m/yr | 0.00 | Assume |
| Initial concentration at landfill | mg/L | 1.0 | Specified by TNRCC |
| Length scale of facility | m | 1000 | |
| Width scale of facility | m | 881 | |

TABLE 3.3 SOURCE SPECIFIC PARAMETERS FOR SUBTITLE D MODEL



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| VARIABLE NAME | UNIT | MEAN | STANDARD DEVIATION | MIN. | MAX. | SOURCE/COMMENTS |
|---|---|---|---|---|---|---|
| Particle diameter | cm | 0.025 | - | - | - | Study 1987 |
| Aquifer porosity | - | - | - | - | - | Generated by MULTIMED model |
| Bulk density | g/cc | 1.73 | - | - | - | State Alternate Liner Handbook, Table G |
| Aquifer thickness | m | 133 | - | - | - | Study 1987 |
| Mixing zone depth | m | | - | - | - | Derived |
| Hydraulic conductivity | m/yr | 3741.5 | - | - | - | 1987 10.3 m/day |
| Hydraulic gradient | - | 0.0025 | - | - | - | Study 1987 |
| Ground-water seepage velocity | m/yr | | - | - | - | Generated by MULTIMED model |
| Retardation coefficient | - | - | - | - | - | Generated by MULTIMED model |
| Longitudinal dispersivity | m | - | - | - | - | Generated by MULTIMED model |
| Transversal dispersivity | m | - | - | - | - | Generated by MULTIMED model |
| Vertical dispersivity | m | - | - | - | - | Generated by MULTIMED model |
| Temperature of the aquifer | °C | 25.0 | - | - | - | Assume |
| pH | - | 7.31 | - | - | - | Assume |
| Organic carbon content | % | 1.0E-5 | - | - | - | Assume conservative |
| Receptor distance from well | m | 1 | - | - | - | Assumed |
| Z-distance from watertable | Fraction | 0.00 | - | - | - | POC on the water table |

TABLE 3.4 AQUIFER SPECIFIC PARAMETERS FOR TRANSIENT MODEL



Page 27

| VARIABLE NAME | UNITS | VALUE | SOURCE/COMMENTS |
|---|---|---|---|
| Solid phase decay coefficient | 1/yr | - | |
| Dissolved phase decay coefficient | 1/yr | - | |
| Overall chemical decay coefficient | 1/yr | - | |
| Acid catalyst hydrolysis rate constant | L/m - yr | - | |
| Neutral hydrolysis rate constant | 1/yr | - | |
| Base catalyst hydrolysis constant | L/m - yr | - | |
| Reference temperature | °C | 25 | Assume |
| Normalized distribution coefficient | mL/g | - | |
| Distribution coefficient | - | - | |
| Biodegredation coefficient | 1/yr | - | |

TABLE 3.2 CHEMICAL SPECIFIC PARAMETERS FOR TRANSIENT MODEL

| VARIABLE NAME | UNITS | VALUE | SOURCE/COMMENTS |
|---|---|---|---|
| Infiltration Rate coefficient | m/yr | $0.698 \times 10^{-3}$ | From liner leakage equations, see calcs. |
| Area of waste disposal unit | $m^2$ | 881,000 | Area of proposed site |
| Spread of contaminant source | m | - | Generated by MULTIMED model |
| Recharge rate | m/yr | 0.00 | Assume |
| Initial concentration at landfill | mg/L | 1.0 | Specified by TNRCC |
| Length scale of facility | m | 1000 | |
| Width scale of facility | m | 881 | |

TABLE 3.5 SOURCE SPECIFIC PARAMETERS FOR TRANSIENT MODEL



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| VARIABLE NAME | UNIT | MEAN | STANDARD DEVIATION | MIN. | MAX. | SOURCE/COMMENTS |
|---|---|---|---|---|---|---|
| Thickness Layer diameter | m | 1 | - | - | - | Assume (very conservative) |
| Longitudinal Dispersivity | m | - | - | - | - | Generated by MULTIMED model |
| Percent Organic Matter | % | 0.026 | - | - | - | Assume |
| Bulk Density of Soil Layer | g/cc | 1.69 | - | - | - | Alternate Design Handbook, pp 88 |
| Biological Decay | 1/yr | 0.005 | - | - | - | Assume |

TABLE 3.6 UNSATURATED ZONE TRANSPORT PARAMETERS FOR TRANSIENT MODEL

| VARIABLE NAME | UNIT | MEAN | STANDARD DEVIATION | MIN. | MAX. | SOURCE/COMMENTS |
|---|---|---|---|---|---|---|
| Saturated Hydraulic Conductivity | cm/hr | 29.7 | - | - | - | Alternate Design Handbook, pp. 80 (Table B) |
| Unsaturated Zone Porosity | - | 0.365 | - | - | - | Alternate Design Handbook, pp 81 (Table E) |
| Air Entry Pressure | - | 0.00 | - | - | - | Assume |
| Depth of Unsaturated Zone | - | 1.00 | - | - | - | Assume (very conservative) |
| Residual Water Content | - | 0.045 | - | - | - | Alternate Design Handbook, Table D |
| Brooks and Corey Exponent | - | 0.00 | - | - | - | Not used |
| Alta Van Gemuchten Coef. | 1/cm | 0.145 | - | - | - | Alternate Design Handbook, pp 84 |
| Beta Van Gemuchten Coef. | - | 2.68 | - | - | - | Alternate Design Handbook, pp.84 |

TABLE 3.7 UNSATURATED ZONE FLOW PARAMETERS IN TRANSIENT MODEL



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## 3.2 MODELING CASES

### 3.2.1 HELP Modeling Run

The proposed alternate design liner consists of 24″ of protective cover, a flexible membrane liner (60 mil HDPE) over 6″ of compacted caliche soil. In HELP Model, 24″ protective cover is functioned as a drainage layer and is underlain by barrier soil liner with flexible membrane liner. The protective cover layer is assumed to be consisting of sand layer with coefficient of permeability of $1 \times 10^{-3}$ cm/sec.

### 3.2.2 Multi-Media Modeling Run

Two models were generated in this program, the Subtitle D Model and the Generic Model. In the Subtitle D Model the program was run based on the steady-state mode. Where in the Generic Model the transient mode was used.

As was mentioned before the unsaturated layer in generic model is assumed consist of 1 m (3.3 feet). This will ensure that a very conservative result will be obtained. The contamination level at point of compliance was investigated in the time frame of 200 years. Where in the Subtitle D Model, the time factor is neglected because it is based on a steady state mode.



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The points of compliance are assumed to be located on the groundwater table level 1 meter away from the landfill in down gradient direction. The ground water table level is under the assumption that it is located on the bottom of landfill for Subtitle D Model and 1 meter below the bottom of landfill for the generic model.



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# 4. PRESENTATION OF RESULT

The leachate concentration levels at the point of compliance were calculated by dividing the leachate concentration by the DAF as recommended in the TNRCC Handbook and do not account for the background water quality. These results are reported on Page 34 and Page 35. The Dilution Attenuation Factor (DAF) is calculated by dividing initial concentration (TNRCC=1.0) with the concentration at the Point of Compliance. The location of the Point of Compliance, maximum leachate concentration at POC, and the Dilution Attenuation Factor (DAF) is tabulated in Table 4.1.

| MODEL GENERATED | LOCATION OF POC | CONCENTRATION | DAF |
|---|---|---|---|
| Subtitle D | Bottom of landfill 1 m in down gradient | 0.1738E-02 m | 575 |
| Generic | 1 m below the bottom of landfill, 1 m in down gradient | 0.2160E-03 | 4630 |

TABLE 4.1 CONCENTRATION AND DAF VALUE AT POINT OF COMPLIANCE

The results which were obtained from the Subtitle D Model shows that the DAF values are at the range of 575. This value is obtained at the steady state condition, which is very conservative because it requires that the water entering the flow system be balanced by the water leaving the system. This system also requires that the contaminant source have a sufficiently large mass to ensure that the downgradient concentration once reached will



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be maintained. Furthermore, it also required that the source contaminant be continuous and constant. This condition will hardly be achieved in the existing site condition.

The concentration level at point of compliance from the generic model shows the value of 4630. This value will be achieved after 120 years with the assumption that the landfill is an active landfill. The relationship between the concentration of leachate at point of compliance relative to time is shown in Figure 7.



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Contaminant Levels at Point of Compliance

MCCOMB LANDFILL WITH SINGLE FML
SUBTITLE D MODEL RESULTS

| Point of Compliance (POC) | | Bottom of Landfill, 1 M in down gradient | | | |
|---|---|---|---|---|---|
| Dillution Attenuation Factor (DAF) | | 575 | | | |
| # | CHEMICAL | Typical Leachate Conc.,mg/l | Contaminat Level at POC | Maximum Cont.Level (MCL)mg/l | POC level >MCL |
| 1 | Aresenic | 5.000 | 0.009 | 0.050 | No |
| 2 | Barium | 100.000 | 0.174 | 1.000 | No |
| 3 | Benzene | 0.814 | 0.001 | 0.005 | No |
| 4 | Cadmium | 1.000 | 0.002 | 0.010 | No |
| 5 | Carbon Tetrachloride | 0.500 | 0.001 | 0.005 | No |
| 6 | Chromium | 5.000 | 0.009 | 0.050 | No |
| 7 | 2,4-Dichlorophenoxy acetic acid | 10.000 | 0.017 | 0.100 | No |
| 8 | 1,4-Dichlororbenzene | 7.500 | 0.013 | 0.075 | No |
| 9 | 1,2-Dichloroethane | 0.500 | 0.001 | 0.005 | No |
| 10 | 1,1-Dichloroethylene | 0.700 | 0.001 | 0.007 | No |
| 11 | Endrin | 0.050 | 0.000 | 0.000 | No |
| 12 | Flouride | 1.190 | 0.002 | 4.000 | No |
| 13 | Lindane | 0.400 | 0.001 | 0.004 | No |
| 14 | Lead | 5.000 | 0.009 | 0.050 | No |
| 15 | Mercury | 0.200 | 0.000 | 0.002 | No |
| 16 | Methoxychlor | | | 0.100 | |
| 17 | Nitrate | | | 10.000 | |
| 18 | Selenium | 1.000 | 0.002 | 0.010 | No |
| 19 | Silver | 5.000 | 0.009 | 0.050 | No |
| 20 | Toxaphene | 0.500 | 0.001 | 0.005 | No |
| 21 | 1,1,1,-Trichloroethane | | | 0.200 | |
| 22 | Trichloroethylene | 1.300 | 0.002 | 0.005 | No |
| 23 | 2,4,5-Trichlorophenoxy acetic acid | 1.000 | 0.002 | 0.010 | No |
| 24 | Vinyl chloride | 0.200 | 0.000 | 0.002 | No |

Notes:
1. POC contaminant levels are calculated as recommended in the TNRCC Alternate Liner Design Handbook and do not account for background groundwater quality.
2. Leachate concentration levels were obtained from the TNRCC Alternate Liner Design Handbook
3. The flouride concentration was obtained from a Missouri Department of Natural Resources study.
4. No data is available on typical concentration of Methoxychlor, Nitrate, or 1,1,1-trichloroethane.



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Contaminant Levels at Point of Compliance

MCCOMB LANDFILL WITH SINGLE FML
GENERIC MODEL RESULTS

| Point of Compliance (POC) | 1 M below landfill, 1 M in down gradient | | | |
|---|---|---|---|---|
| Dillution Attenuation Factor (DAF) | 4630 | | | |
| # CHEMICAL | Typical Leachate Conc.,mg/l | Contaminat Level at POC | Maximum Cont.Level (MCL)mg/l | POC level >MCL |
| 1 Aresenic | 5.000 | 0.001 | 0.050 | No |
| 2 Barium | 100.000 | 0.022 | 1.000 | No |
| 3 Benzene | 0.814 | 0.000 | 0.005 | No |
| 4 Cadmium | 1.000 | 0.000 | 0.010 | No |
| 5 Carbon Tetrachloride | 0.500 | 0.000 | 0.005 | No |
| 6 Chromium | 5.000 | 0.001 | 0.050 | No |
| 7 2,4-Dichlorophenoxy acetic acid | 10.000 | 0.002 | 0.100 | No |
| 8 1,4-Dichlororbenzene | 7.500 | 0.002 | 0.075 | No |
| 9 1,2-Dichloroethane | 0.500 | 0.000 | 0.005 | No |
| 10 1,1-Dichloroethylene | 0.700 | 0.000 | 0.007 | No |
| 11 Endrin | 0.050 | 0.000 | 0.000 | No |
| 12 Flouride | 1.190 | 0.000 | 4.000 | No |
| 13 Lindane | 0.400 | 0.000 | 0.004 | No |
| 14 Lead | 5.000 | 0.001 | 0.050 | No |
| 15 Mercury | 0.200 | 0.000 | 0.002 | No |
| 16 Methoxychlor | | | 0.100 | |
| 17 Nitrate | | | 10.000 | |
| 18 Selenium | 1.000 | 0.000 | 0.010 | No |
| 19 Silver | 5.000 | 0.001 | 0.050 | No |
| 20 Toxaphene | 0.500 | 0.000 | 0.005 | No |
| 21 1,1,1,-Trichloroethane | | | 0.200 | |
| 22 Trichloroethylene | 1.300 | 0.000 | 0.005 | No |
| 23 2,4,5-Trichlorophenoxy acetic acid | 1.000 | 0.000 | 0.010 | No |
| 24 Vinyl chloride | 0.200 | 0.000 | 0.002 | No |

Notes:
1. POC contaminant levels are calculated as recommended in the TNRCC Alternate Liner Design Handbook and do not account for background groundwater quality.
2. Leachate concentration levels were obtained from the TNRCC Alternate Liner Design Handbook
3. The flouride concentration was obtained from a Missouri Department of Natural Resources study.
4. No data is available on typical concentration of Methoxychlor, Nitrate, or 1,1,1-trichloroethane.



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# GENERIC MODEL SIMULATION RESULT

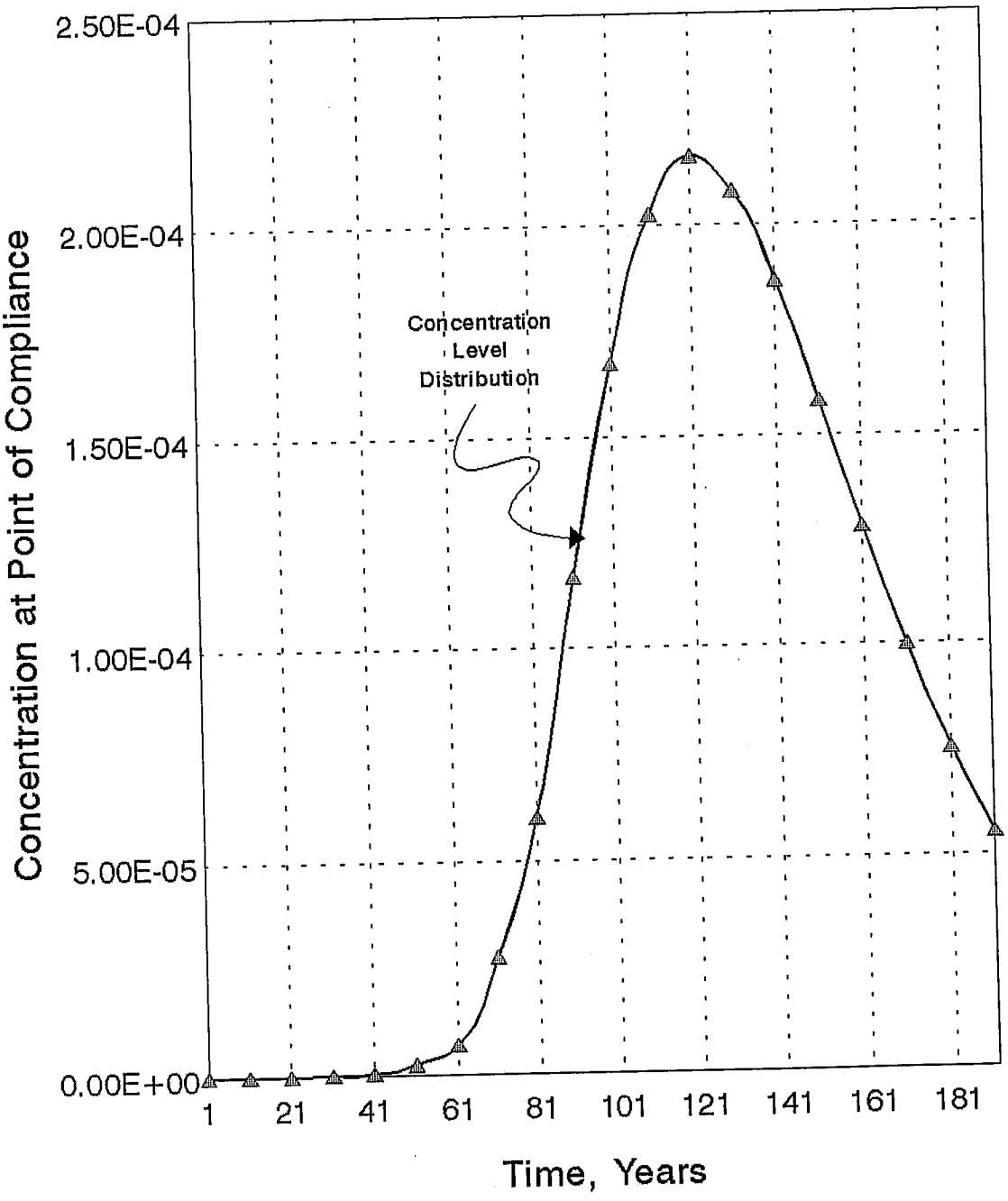


Figure 7. Concentration at Point of Compliance relative to Time



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# 5. DISCUSSION AND CONCLUSION

None of the concentration levels at the Point of Compliance exceeds the maximum concentration level, which is recommended by TNRCC. The Alternate Design Handbook on Page 24 and 25 indicates that the minimum Dilution Attenuation Factor (DAF) should be 260. Where in this study the minimum Dilution Attenuation Factor is approximately 575. This value far exceeds the above requirement.

The Generic Model result indicates the DAF value at P.O. C. is 4630. These results show that the contaminants have been diluted at least 575 times when it reaches the P.O.C.

The above results indicate that the amount of leachate which passes through the liner system is considered insignificant and it will take more than 200 years to reach the DAF of 575 at the POC, which is located at 1m in down gradient from the landfill and at a depth of 1 m below the bottom of landfill. That is, by assuming that the unsaturated layer consist only of clean sand layer. If the thickness of unsaturated zone increases, the longer the time that is needed by the leachate to penetrate the unsaturated zone.



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Based on this study, we recommend a construction of Subtitle D cell at McCombs Landfill using an alternate liner. The alternate liner design will consist of a single 60 mil Flexible Membrane Liner (FML) overlain by 24" of protective cover, with a leachate collection system. Consequently, we recommend that no further site specific soil sampling and testing be performed and ground water monitoring be waived.



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# APPENDIX A

TABLE I

WELL #JL-49-05-310

OWNER: U.S. GEOLOGICAL SURVEY

| | THICKNESS (feet) | DEPTH (feet) |
|---|---|---|
| Sand, fine caliche, and granules | 10 | 10 |
| Sand, fine, granules, and pebbles | 10 | 20 |
| Gravel | 10 | 30 |
| Gravel and sand, medium to coarse | 10 | 40 |
| Sand, medium to coarse, and gravel | 10 | 50 |
| Sand, fine to coarse, and gravel | 10 | 60 |
| Gravel, sand, and clay | 10 | 70 |
| Gravel, sand, fine, and clay | 10 | 80 |
| Sand, fine to coarse, and gravel | 20 | 100 |
| Sand, medium to coarse, and gravel | 70 | 170 |
| Sand, gray, fine to coarse, and gravel | 10 | 180 |
| Sand, gray, fine to medium, and gravel | 4 | 184 |
| Sand, fine to coarse, and gravel | 6 | 190 |
| Sand, fine to medium | 10 | 200 |
| Sand, fine to medium, and gravel | 10 | 210 |
| Sand, medium to coarse, and gravel | 10 | 220 |
| Sand, fine to coarse, and gravel | 20 | 240 |
| Sand, fine to coarse, gravel, and clay | 10 | 250 |
| Sand, fine to medium, and gravel | 10 | 260 |
| Sand, fine to coarse, gravel, and clay | 10 | 270 |
| Sand, fine to medium, some clay, and gravel | 10 | 300 |
| Sand, medium to very coarse | 10 | 310 |
| Sand, fine to coarse, some clay, and gravel | 10 | 320 |
| Sand, fine to coarse, and gravel | 10 | 330 |
| Sand, fine to coarse, and some gravel | 10 | 340 |
| Sand, fine to coarse, some gravel, and caliche | 10 | 350 |
| Sand, fine to very coarse | 20 | 370 |

TABLE II

WELL #JL-49-05-213

OWNER: EL PASO ELECTRIC COMPANY

| SOIL DESCRIPTION | DEPTH (feet) |
|---|---|
| Sand | 0 - 11 |
| Sand, calcareous | 11 - 16 |
| Sand and gravel | 16 - 35 |
| Sand and layers of clay | 35 - 50 |
| Sand | 50 - 102 |
| Clay | 102 - 118 |
| Sand | 118 - 140 |
| Sand, some clay | 140 - 162 |
| Sand | 162 - 181 |
| Clay | 181 - 184 |
| Sand some clay | 184 - 274 |
| Sand coarse | 274 - 276 |
| Clay soft | 276 - 289 |
| Sand | 289 - 297 |
| Clay sandy | 297 - 313 |
| Sand | 313 - 373 |
| Clay | 313 - 377 |
| Sand, clayey | 317 - 379 |
| Clay | 379 - 382 |
| Sand | 382 - 411 |
| Clay sandy | 411 - 416 |
| Clay | 416 - 424 |
| Sand, coarse, gravelly | 424 - 452 |
| Sand, clayey | 452 - 476 |
| Clay | 476 - 482 |
| Sand, medium, gravelly | 482 - 544 |
| Sand, clayey | 544 - 550 |
| Clay | 550 - 561 |
| Sand, clayey | 561 - 577 |
| Sand | 577 - 650 |
| Clay | 650 - 653 |
| Sand | 653 - 660 |
| Sand, some clay lenses | 660 - 681 |
| Sand | 681 - 688 |
| Clay | 688 - 691 |
| Sand and clay | 691 - 704 |
| Clay | 704 - 711 |
| Sand, clay lenses | 711 - 727 |
| Sand, loose | 727 - 752 |
| Sand, dense | 752 - 756 |
| Sand | 756 - 770 |
| Clay, sand | 770 - 776 |
| Sand | 776 - 788 |
| Clay, sandy | 788 - 792 |
| Sand | 792 - 809 |
| Clay, hard | 809 - 811 |
| Sand | 811 - 813 |
| Clay, hard | 813 - 814 |
| Sand, clayey | 814 - 824 |
| Clay, stiff | 824 - 830 |
| Sand | 830 - 839 |
| Clay, stiff | 839 - 843 |
| Sand | 843 - 851 |
| Clay | 851 - 856 |
| Sand, clayey | 856 - 874 |
| Clay | 874 - 884 |
| Sand and clay | 884 - 900 |
| Sand | 900 - 911 |
| Clay, sandy | 911 - 927 |
| Sand | 927 - 933 |
| Clay, hard | 933 - 940 |
| Sand | 940 - 952 |
| Clay | 952 - 956 |
| Sand, clay | 956 - 965 |
| Clay | 965 - 973 |
| Sand and clay | 973 - 981 |
| Clay | 981 - 987 |
| Sand, clayey | 987 - 1005 |
| Clay | 1005 - 1007 |
| Sand | 1007 - 1008 |
| Clay | 1008 - 1009 |
| Sand | 1009 - 1012 |
| Clay | 1012 - 1013 |
| Sand and clay | 1013 - 1015 |
| Clay sandy | 1015 - 1034 |
| Sand and clay | 1034 - 1036 |
| Clay sandy | 1036 - 1063 |
| Sand dense clayey | 1063 - 1070 |
| Clay | 1070 - 1075 |
| Sand medium dense, gravelly | 1075 - 1082 |
| Clay | 1082 - 1091 |

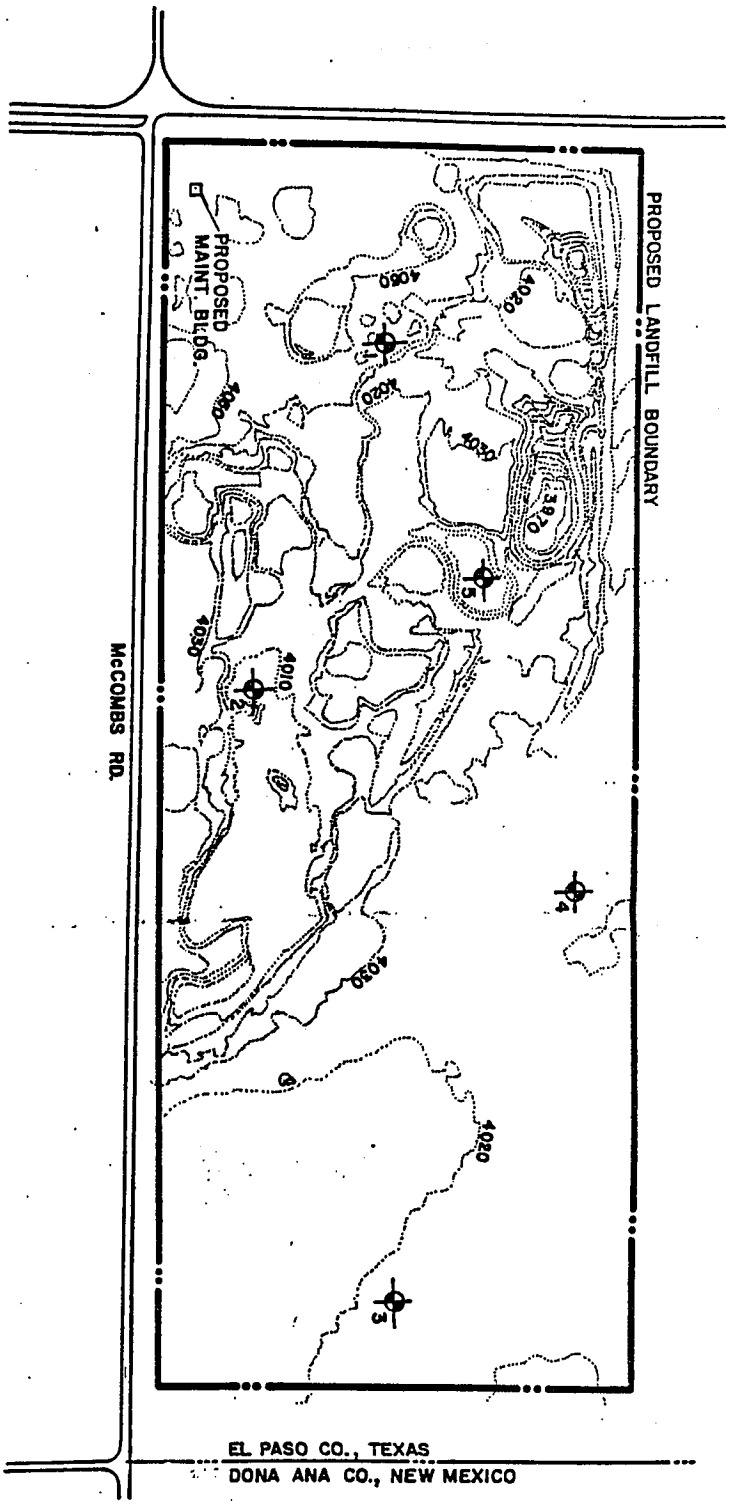
# TABLE III

## WELL #JL-49-05-315

## DRILLER: EL PASO SAND PRODUCTS

## OWNER: EL PASO PUBLIC SERVICE BOARD

| SOIL DESCRIPTION | DEPTH (feet) |
|---|---|
| | 0 - 10 |
| Top soil | 10 - 20 |
| Sand, clayey | 20 - 40 |
| Sand | 40 - 60 |
| Sand and gravel | 60 - 100 |
| Sand | 100 - 120 |
| Sand and gray clay | 120 - 140 |
| Sand gravelly | 140 - 160 |
| Sand and gray clay | 160 - 180 |
| Sand and gray clay | 180 - 200 |
| Sand | 200 - 220 |
| Clay (gray) | 220 - 260 |
| Sand and clay | 260 - 300 |
| Gray clay | 300 - 325 |
| Clay, sandy | 325 - 355 |
| Clay | 355 - 360 |
| Sand | 360 - 400 |
| Sand | 400 - 450 |
| Sand | 450 - 500 |
| Sand, clay | 500 - 550 |
| Sand | 550 - 600 |
| Sand | |




NORTH

SCALE: 1" = APPROX. 500'

BORING LOCATION & NUMBER

DANNY R. ANDERSON CONSULTANTS, INC.

| | | | |
|---|---|---|---|
| PROJECT TITLE | McCOMBS SLUDGE DISPOSAL LANDFILL | | |
| DRAWING TITLE | BORING PLAN | SHEET NO. | A-1 |
| REF | DRAWN BY D.E. | APPROVED BY | DRAWING NO. |
| | DATE OCT. 22, 1987 | DATE | A-4 |

# REPORT OF BORING NUMBER 1

PROJECT: McCombs Sludge Disposal Landfill
LOCATION: McCombs Road, El Paso, Texas

| DESCRIPTION OF MATERIALS | SYMBOL | DEPTH | CORES | STANDARD PENETRATION BLOWS PER SIX INCHES 1st | 2nd | 3rd | ELEV. | LIQUID | LIMIT | PLASTIC INDEX | MOISTURE CONTENT | SOIL CLASS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine to medium, silty, multicolored, red, brown, gray, poorly graded, loose, dry | | 1 | | | | | | | | | | |
| | | 2 | | | | | | | | | | |
| | | 3 | | | | | | | | | | |
| | | 4 | | | | | | | | | | |
| | | 5 | | | | | | | | | | |
| | | 6 | X | 5 | 5 | 5 | | | | | 7.3 | SP-SM |
| | | 7 | X | | | | | | | | | |
| | | 8 | | | | | | | | | | |
| | | 9 | | | | | | | | | | |
| | | 10 | | | | | | | | | | |
| SAND, fine, silty, brown, medium dense, dry | | 11 | X | 4 | 4 | 3 | | | | | | |
| | | 12 | X | | | | | | | | | |
| | | 13 | | | | | | | | | | |
| | | 14 | | | | | | | | | | |
| | | 15 | | | | | | | | | | |
| | | 16 | X | 6 | 8 | 9 | | | | | 8.0 | SM |
| | | 17 | X | | | | | | | | | |

TYPE AND MAKE OF DRILL: Mobile Drill Co. Model B52/61 with 8-1/2" O.D. Continuous flight hollow stem auger.

DATE BORING STARTED: 10-14-87
DATE BORING COMPLETED: 10-14-87
SURFACE ELEVATION: 4030'
GROUNDWATER ELEVATION: Not Encountered
REMARKS:

DRILLER: Jose De La Cruz
DRILLER: Gelacio Gutierrez
LOGGER: Patrick Shing

FILE NO. 87194
SHEET NO. A2

# REPORT OF BORING NUMBER 1

PROJECT: McCombs Sludge Disposal Landfill
LOCATION: McCombs Road, El Paso, Texas

| DESCRIPTION OF MATERIALS | SYMBOL | DEPTH | CORES | STANDARD PENETRATION BLOWS PER SIX INCHES 1st | 2nd | 3rd | ELEV. | LIQUID LIMIT | PLASTIC INDEX | MOISTURE CONTENT | SOIL CLASS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, silty, brown, medium dense, dry | | 18 | | | | | | | | | |
| | | 19 | | | | | | | | | |
| | | 20 | X | | | | | | | | |
| | | | X | 7 | 7 | 8 | | | | | |
| | | 21 | X | | | | | | | | |
| Boring Terminated at 21-1/2 feet | | 22 | | | | | | | | | |
| | | 23 | | | | | | | | | |
| | | 24 | | | | | | | | | |
| | | 25 | | | | | | | | | |
| | | 26 | | | | | | | | | |
| | | 27 | | | | | | | | | |
| | | 28 | | | | | | | | | |
| | | 29 | | | | | | | | | |
| | | 30 | | | | | | | | | |
| | | 31 | | | | | | | | | |
| | | 32 | | | | | | | | | |
| | | 33 | | | | | | | | | |
| | | 34 | | | | | | | | | |

TYPE AND MAKE OF DRILL: Mobile Drill Co. Model B52/61 with 8-1/2" O.D. Continuous flight hollow stem auger.

DATE BORING STARTED: 10-14-87 DRILLER: Jose De La Cruz
DATE BORING COMPLETED: 10-14-87 DRILLER: Gelacio Gutierrez
SURFACE ELEVATION: 4030' LOGGER: Patrick Shing
GROUNDWATER ELEVATION: Not Encountered
REMARKS:

FILE NO. 87194
SHEET NO. A3

# REPORT OF BORING NUMBER 2

PROJECT: McCombs Sludge Disposal Landfill
LOCATION: McCombs Road, El Paso, Texas

| DESCRIPTION OF MATERIALS | SYMBOL | DEPTH | CORES | STANDARD PENETRATION BLOWS PER SIX INCHES 1st | 2nd | 3rd | ELEV. | LIQUID LIMIT | PLASTIC INDEX | MOISTURE CONTENT | SOIL CLASS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, silty, reddish-brown, loose, dry to moist | : | 1 | | | | | | | | | |
| | : | 2 | | | | | | | | | |
| | : | 3 | | | | | | | | | |
| | : | 4 | | | | | | | | | |
| | : | 5 | | | | | | | | | |
| | : | 6 | X X X | 4 | 4 | 3 | | | | 6.1 | SM |
| | : | 7 | | | | | | | | | |
| | : | 8 | | | | | | | | | |
| | : | 9 | | | | | | | | | |
| | : | 10 | | | | | | | | | |
| | : | 11 | X X X | 4 | 2 | 2 | | | | 16.9 | SM |
| | : | 12 | | | | | | | | | |
| | : | 13 | | | | | | | | | |
| | : | 14 | | | | | | | | | |
| | : | 15 | | | | | | | | | |
| SAND, fine, multicolored, red, brown, gray, poorly graded, dense, dry | : | 16 | X X X | 14 | 28 | 36 | | | | | |
| | : | 17 | | | | | | | | | |

TYPE AND MAKE OF DRILL: Mobile Drill Co. Model B52/61 with 8-1/2" O.D. Continuous flight hollow stem auger.
DATE BORING STARTED: 10-14-87
DATE BORING COMPLETED: 10-14-87
SURFACE ELEVATION: 4003'
GROUNDWATER ELEVATION: Not Encountered
REMARKS:

DRILLER: Jose De La Cruz
DRILLER: Gelacio Gutierrez
LOGGER: Patrick Shing

FILE NO. 8719
SHEET NO. A4

# REPORT OF BORING NUMBER 2

PROJECT: McCombs Sludge Disposal Landfill
LOCATION: McCombs Road, El Paso, Texas

| DESCRIPTION OF MATERIALS | SYMBOL | DEPTH | CORES | STANDARD PENETRATION BLOWS PER SIX INCHES 1st | 2nd | 3rd | ELEV. | LIQUID LIMIT | PLASTIC INDEX | MOISTURE CONTENT | SOIL CLASS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, multicolored, red, brown, gray, poorly graded, very dense, dry | | 18 | | | | | | | | | |
| | | 19 | | | | | | | | | |
| | | 20 | X | | | | | | | | |
| | | 21 | X | 13 | 23 | 36 | | | | 3.7 | SP |
| Boring Terminated at 21-1/2 feet | | 22 | | | | | | | | | |
| | | 23 | | | | | | | | | |
| | | 24 | | | | | | | | | |
| | | 25 | | | | | | | | | |
| | | 26 | | | | | | | | | |
| | | 27 | | | | | | | | | |
| | | 28 | | | | | | | | | |
| | | 29 | | | | | | | | | |
| | | 30 | | | | | | | | | |
| | | 31 | | | | | | | | | |
| | | 32 | | | | | | | | | |
| | | 33 | | | | | | | | | |
| | | 34 | | | | | | | | | |

TYPE AND MAKE OF DRILL: Mobile Drill Co. Model B52/61 with 8-1/2" O.D. Continuous flight hollow stem auger.

DATE BORING STARTED: 10-14-87
DATE BORING COMPLETED: 10-14-87
SURFACE ELEVATION: 4003'
GROUNDWATER ELEVATION: Not Encountered
REMARKS:

DRILLER: Jose De La Cruz
DRILLER: Gelacio Gutierrez
LOGGER: Patrick Shing

FILE NO. 87194
SHEET NO. A5

# REPORT OF BORING NUMBER 3

PROJECT: McCombs Sludge Disposal Landfill
LOCATION: McCombs Road, El Paso, Texas

| DESCRIPTION OF MATERIALS | SYMBOL | DEPTH | CORES | STANDARD PENETRATION BLOWS PER SIX INCHES 1st | 2nd | 3rd | ELEV. | LIQUID LIMIT | PLASTICITY INDEX | MOISTURE CONTENT | SOIL CLASS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, silty, reddish-brown, loose, dry | | 1 | | | | | | | | | |
| | | 2 | | | | | | | | | |
| | | 3 | | | | | | | | | |
| | | 4 | | | | | | | | | |
| | | 5 | | | | | | | | | |
| | | 6 | X | 6 | 5 | 10 | | | | 6.7 | SM |
| | | 7 | X | | | | | | | | |
| | | 8 | | | | | | | | | |
| | | 9 | | | | | | | | | |
| SAND, fine, clayey, reddish-brown, dense, dry | | 10 | | | | | | | | | |
| | | 11 | X | 38 | 24 | 22 | | 31 | 16 | 7.2 | SC |
| | | 12 | X | | | | | | | | |
| | | 13 | | | | | | | | | |
| | | 14 | | | | | | | | | |
| | | 15 | | | | | | | | | |
| | | 16 | X | 25 | 23 | 22 | | 36 | 12 | 8.0 | SC |
| | | 17 | X | | | | | | | | |

TYPE AND MAKE OF DRILL: Mobile Drill Co. Model B52/61 with 8-1/2" O.D. Continuous flight hollow stem auger.

DATE BORING STARTED: 10-15-87
DATE BORING COMPLETED: 10-15-87
SURFACE ELEVATION: 4020'
GROUNDWATER ELEVATION: Not Encountered
REMARKS:

DRILLER: Jose De La Cruz
DRILLER: Gelacio Gutierrez
LOGGER: Patrick Shing

FILE NO. 87194
SHEET NO. A6

# REPORT OF BORING NUMBER 3

PROJECT: McCombs Sludge Disposal Landfill
LOCATION: McCombs Road, El Paso, Texas

| DESCRIPTION OF MATERIALS | SYMBOL | DEPTH | CORE | STANDARD PENETRATION BLOWS PER SIX INCHES 1st | 2nd | 3rd | ELEV. | LIQUID LIMIT | PLASTICITY INDEX | MOISTURE CONTENT | SOIL CLASS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, clayey, reddish brown, medium dense, dry | | 18 | | | | | | | | | |
| | | 19 | | | | | | | | | |
| | | 20 | X | | | | | | | | |
| | | | X | 12 | 14 | 17 | | | | | |
| | | 21 | X | | | | | | | | |
| | | 22 | | | | | | | | | |
| | | 23 | | | | | | | | | |
| | | 24 | | | | | | | | | |
| | | 25 | | | | | | | | | |
| Boring Terminated at 25 feet | | 26 | | | | | | | | | |
| | | 27 | | | | | | | | | |
| | | 28 | | | | | | | | | |
| | | 29 | | | | | | | | | |
| | | 30 | | | | | | | | | |
| | | 31 | | | | | | | | | |
| | | 32 | | | | | | | | | |
| | | 33 | | | | | | | | | |
| | | 34 | | | | | | | | | |

TYPE AND MAKE OF DRILL: Mobile Drill Co. Model B52/61 with 8-1/2" O.D. Continuous flight hollow stem auger.

DATE BORING STARTED: 10-15-87 DRILLER: Jose De La Cruz

DATE BORING COMPLETED: 10-15-87 DRILLER: Gelacio Gutierrez

SURFACE ELEVATION: 4020' LOGGER: Patrick Shing

GROUNDWATER ELEVATION: Not Encountered

REMARKS:

FILE NO. 87194

SHEET NO. A7

# REPORT OF BORING NUMBER 4

PROJECT: McCombs Sludge Disposal Landfill
LOCATION: McCombs Road, El Paso, Texas

| DESCRIPTION OF MATERIALS | SYMBOL | DEPTH | CORES | STANDARD PENETRATION BLOWS PER SIX INCHES 1st | 2nd | 3rd | ELEV. | LIQUID LIMIT | PLASTICITY INDEX | MOISTURE CONTENT | SOIL CLASS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, clayey, reddish brown, dense, dry | | 1 | | | | | | | | | |
| | | 2 | | | | | | | | | |
| | | 3 | | | | | | | | | |
| | | 4 | | | | | | | | | |
| | | 5 | | | | | | | | | |
| | | 6 | X | 16 | 23 | 25 | | | | | |
| | | 7 | X | | | | | | | | |
| | | 8 | | | | | | | | | |
| | | 9 | | | | | | | | | |
| | | 10 | | | | | | | | | |
| | | 11 | X | 14 | 14 | 17 | | 39 | 32 | 9.2 | SC |
| | | 12 | X | | | | | | | | |
| | | 13 | | | | | | | | | |
| | | 14 | | | | | | | | | |
| | | 15 | | | | | | | | | |
| | | 16 | X | 18 | 28 | 38 | | | | | |
| | | 17 | X | | | | | | | | |

TYPE AND MAKE OF DRILL: Mobile Drill Co. Model B52/61 with 8-1/2" O.D. Continuous flight hollow stem auger.

DATE BORING STARTED: 10-15-87
DATE BORING COMPLETED: 10-15-87
SURFACE ELEVATION: 4020'
GROUNDWATER ELEVATION: Not Encountered
REMARKS:

DRILLER: Jose De La Cruz
DRILLER: Gelacio Gutierrez
LOGGER: Patrick Shing

FILE NO. 87194
SHEET NO. A8

# REPORT OF BORING NUMBER 4

PROJECT: McCombs Sludge Disposal Landfill
LOCATION: McCombs Road, El Paso, Texas

| DESCRIPTION OF MATERIALS | SYMBOL | DEPTH | CORES | STANDARD PENETRATION BLOWS PER SIX INCHES 1st | 2nd | 3rd | ELEV. | LIQUID LIMIT | PLASTIC INDEX | MOISTURE CONTENT | SOIL CLASS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, clayey, reddish brown, dense, dry | | 18 | | | | | | | | | |
| | | 19 | | | | | | | | | |
| | | 20 | X | | | | | | | | |
| | | | X | 11 | 16 | 21 | | 38 | 20 | 8.0 | SC |
| | | 21 | X | | | | | | | | |
| | | 22 | | | | | | | | | |
| | | 23 | | | | | | | | | |
| | | 24 | | | | | | | | | |
| | | 25 | | | | | | | | | |
| Boring Terminated at 25 feet | | 26 | | | | | | | | | |
| | | 27 | | | | | | | | | |
| | | 28 | | | | | | | | | |
| | | 29 | | | | | | | | | |
| | | 30 | | | | | | | | | |
| | | 31 | | | | | | | | | |
| | | 32 | | | | | | | | | |
| | | 33 | | | | | | | | | |
| | | 34 | | | | | | | | | |

TYPE AND MAKE OF DRILL: Mobile Drill Co. Model B52/61 with 8-1/2" O.D. Continuous flight hollow stem auger.

DATE BORING STARTED: 10-15-87
DRILLER: Jose De La Cruz

DATE BORING COMPLETED: 10-15-87
DRILLER: Gelacio Gutierrez

SURFACE ELEVATION: 4020'
LOGGER: Patrick Shing

GROUNDWATER ELEVATION: Not Encountered

REMARKS:

FILE NO. 87194
SHEET NO. A9

# REPORT OF BORING NUMBER 5

PROJECT: McCombs Sludge Disposal Landfill
LOCATION: McCombs Road, El Paso, Texas

| DESCRIPTION OF MATERIALS | SYMBOL | DEPTH | CORES | STANDARD PENETRATION BLOWS PER SIX INCHES 1st | 2nd | 3rd | ELEV. | LIQUID | LIMIT | PLASTIC | INDEX | MOIST | CONTENT | SOIL | CLASS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, medium, brown, poorly graded medium dense, moist | :: | 1 | | | | | | | | | | | | | |
| | :: | 2 | | | | | | | | | | | | | |
| | :: | 3 | X | | | | | | | | | | | | |
| | :: | | X | 4 | 5 | 8 | | | | | | | | | |
| | :: | 4 | X | | | | | | | | | | | | |
| | :: | 5 | | | | | | | | | | | | | |
| | :: | | X | | | | | | | | | | | | |
| | :: | 6 | X | 15 | 17 | 47 | | | | | | | | | |
| SAND, medium, gravelly, brown, poorly graded, dense, dry | :: | | X | | | | | | | | | | | | |
| | :O | 7 | | | | | | | | | | | | | |
| | o: | | | | | | | | | | | | | | |
| | :: | 8 | | | | | | | | | | | | | |
| | :: | | | | | | | | | | | | | | |
| | :O | 9 | | | | | | | | | | | | | |
| | o: | | | | | | | | | | | | | | |
| | :: | 10 | | | | | | | | | | | | | |
| SAND, fine, brown, poorly graded, dense, dry | :: | | X | | | | | | | | | | 4.2 | | SP |
| | :: | 11 | X | 8 | 15 | 20 | | | | | | | | | |
| | :: | | X | | | | | | | | | | | | |
| | :: | 12 | | | | | | | | | | | | | |
| | :: | | | | | | | | | | | | | | |
| | :: | 13 | | | | | | | | | | | | | |
| | :: | | | | | | | | | | | | | | |
| | :: | 14 | | | | | | | | | | | | | |
| | :: | | | | | | | | | | | | | | |
| | :: | 15 | | | | | | | | | | | | | |
| | :: | | X | | | | | | | | | | | | |
| | :: | 16 | X | 11 | 19 | 23 | | | | | | | | | |
| | :: | | X | | | | | | | | | | | | |
| | :: | 17 | | | | | | | | | | | | | |
| | :: | | | | | | | | | | | | | | |

TYPE AND MAKE OF DRILL: Mobile Drill Co. Model B52/61 with 8-1/2" O.D. Continuous flight hollow stem auger.

DATE BORING STARTED: 10-21-87
DATE BORING COMPLETED: 10-21-87
SURFACE ELEVATION: 3965'
GROUNDWATER ELEVATION: Not Encountered
REMARKS:

DRILLER: Jose De La Cruz
DRILLER: Gelacio Gutierrez
LOGGER: Patrick Shing

FILE NO. 87194
SHEET NO. A10

# REPORT OF BORING NUMBER 5

PROJECT: McCombs Sludge Disposal Landfill
LOCATION: McCombs Road, El Paso, Texas

| DESCRIPTION OF MATERIALS | SYMBOL | DEPTH | CORES | STANDARD PENETRATION BLOWS PER SIX INCHES 1st | 2nd | 3rd | ELEV. | LIQUID LIMIT | PLASTIC INDEX | MOISTURE CONTENT | SOIL CLASS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, brown, poorly graded, dense, dry | | 18 | | | | | | | | | |
| | | 19 | | | | | | | | | |
| | | 20 | X | | | | | | | | |
| | | | X | 20 | 21 | 23 | | | | | |
| | | 21 | X | | | | | | | | |
| | | 22 | | | | | | | | | |
| | | 23 | | | | | | | | | |
| | | 24 | | | | | | | | | |
| | | 25 | | | | | | | | 4.7 | SP |
| | | 26 | | | | | | | | | |
| | | 27 | | | | | | | | | |
| | | 28 | | | | | | | | | |
| | | 29 | | | | | | | | | |
| | | 30 | | | | | | | | | |
| Boring Terminated at 30 feet | | 31 | | | | | | | | | |
| | | 32 | | | | | | | | | |
| | | 33 | | | | | | | | | |
| | | 34 | | | | | | | | | |

TYPE AND MAKE OF DRILL: Mobile Drill Co. Model B52/61 with 8-1/2" O.D. Continuous flight hollow stem auger.

DATE BORING STARTED: 10-21-87
DATE BORING COMPLETED: 10-21-87
SURFACE ELEVATION: 3965'
GROUNDWATER ELEVATION: Not Encountered
REMARKS:

DRILLER: Jose De La Cruz
DRILLER: Gelacio Gutierrez
LOGGER: Patrick Shing

FILE NO. 87194
SHEET NO. A11

# APPENDIX B

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MCCOMB LANFILL WITH SINGLE LINER
EL PASO, TEXAS
MAY 18, 1995

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LAYER 1

LATERAL DRAINAGE LAYER

| | | |
|---|---|---|
| THICKNESS | = | 24.00 INCHES |
| POROSITY | = | 0.3710 VOL/VOL |
| FIELD CAPACITY | = | 0.2215 VOL/VOL |
| WILTING POINT | = | 0.0539 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.1309 VOL/VOL |
| SATURATED HYDRAULIC CONDUCTIVITY | = | 0.001000000047 CM/SEC |
| SLOPE | = | 3.00 PERCENT |
| DRAINAGE LENGTH | = | 270.0 FEET |

LAYER 2

BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER

| | | |
|---|---|---|
| THICKNESS | = | 0.30 INCHES |
| POROSITY | = | 0.5200 VOL/VOL |
| FIELD CAPACITY | = | 0.4800 VOL/VOL |
| WILTING POINT | = | 0.3250 VOL/VOL |
| INITIAL SOIL WATER CONTENT | = | 0.4300 VOL/VOL |
| SATURATED HYDRAULIC CONDUCTIVITY | = | 0.000000005000 CM/SEC |
| LINER LEAKAGE FRACTION | = | 0.00010000 |

GENERAL SIMULATION DATA

| | | |
|---|---|---|
| SCS RUNOFF CURVE NUMBER | = | 83.00 |
| TOTAL AREA OF COVER | = | 881000. SQ FT |
| EVAPORATIVE ZONE DEPTH | = | 18.00 INCHES |
| POTENTIAL RUNOFF FRACTION | = | 0.000000 |
| UPPER LIMIT VEG. STORAGE | = | 6.6780 INCHES |
| INITIAL VEG. STORAGE | = | 2.3562 INCHES |
| INITIAL SNOW WATER CONTENT | = | 0.0000 INCHES |
| INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS | = | 3.2706 INCHES |

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

SYNTHETIC RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND SOLAR RADIATION FOR EL PASO TEXAS

| | | |
|---|---|---|
| MAXIMUM LEAF AREA INDEX | = | 0.00 |
| START OF GROWING SEASON (JULIAN DATE) | = | 81 |
| END OF GROWING SEASON (JULIAN DATE) | = | 315 |

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

| JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|
| 42.80 | 48.10 | 55.10 | 63.40 | 71.80 | 80.40 |
| 82.30 | 80.10 | 74.40 | 64.00 | 52.40 | 44.10 |

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

| | JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|---|
| PRECIPITATION | | | | | | |
| TOTALS | 0.22 | 0.38 | 0.35 | 0.19 | 0.29 | 0.75 |
| | 1.36 | 1.57 | 1.66 | 0.76 | 0.56 | 0.82 |
| STD. DEVIATIONS | 0.24 | 0.31 | 0.27 | 0.27 | 0.27 | 0.64 |
| | 0.80 | 0.91 | 1.35 | 0.47 | 0.53 | 0.78 |
| RUNOFF | | | | | | |
| TOTALS | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| STD. DEVIATIONS | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| EVAPOTRANSPIRATION | | | | | | |
| TOTALS | 0.532 | 0.265 | 0.289 | 0.241 | 0.218 | 0.539 |
| | 1.040 | 1.522 | 1.639 | 0.798 | 0.565 | 0.630 |
| STD. DEVIATIONS | 0.495 | 0.107 | 0.114 | 0.095 | 0.065 | 0.572 |
| | 0.871 | 1.088 | 1.043 | 0.579 | 0.460 | 0.412 |
| LATERAL DRAINAGE FROM LAYER 1 | | | | | | |
| TOTALS | 0.0538 | 0.0457 | 0.0483 | 0.0455 | 0.0453 | 0.0433 |
| | 0.0471 | 0.0506 | 0.0570 | 0.0605 | 0.0557 | 0.0563 |
| STD. DEVIATIONS | 0.0208 | 0.0143 | 0.0146 | 0.0136 | 0.0133 | 0.0128 |
| | 0.0149 | 0.0158 | 0.0122 | 0.0116 | 0.0107 | 0.0095 |
| PERCOLATION FROM LAYER 2 | | | | | | |
| TOTALS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

| | (INCHES) | | (CU. FT.) | PERCENT |
|---|---|---|---|---|
| PRECIPITATION | 8.93 | ( 2.380) | 655354. | 100.00 |
| RUNOFF | 0.000 | ( 0.000) | 0. | 0.00 |
| EVAPOTRANSPIRATION | 8.279 | ( 1.879) | 607819. | 92.75 |
| LATERAL DRAINAGE FROM LAYER 1 | 0.6092 | ( 0.1273) | 44727. | 6.82 |
| PERCOLATION FROM LAYER 2 | 0.0001 | ( 0.0000) | 8. | 0.00 |
| CHANGE IN WATER STORAGE | 0.038 | ( 1.187) | 2799. | 0.43 |

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 2.76 | 202630.0 |
| RUNOFF | 0.000 | 0.0 |
| LATERAL DRAINAGE FROM LAYER 1 | 0.0045 | 329.9 |
| PERCOLATION FROM LAYER 2 | 0.0000 | 0.1 |
| HEAD ON LAYER 2 | 15.0 | |
| SNOW WATER | 0.02 | 1468.3 |
| MAXIMUM VEG. SOIL WATER (VOL/VOL) | 0.2636 | |
| MINIMUM VEG. SOIL WATER (VOL/VOL) | 0.0532 | |

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FINAL WATER STORAGE AT END OF YEAR 20

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 3.90 | 0.1627 |
| 2 | 0.13 | 0.4300 |
| SNOW WATER | 0.00 | |

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# APPENDIX C

"HELP" CALCULATION (FLOW)

- Calculation of Leachate on Liners

$$Tmax = L \frac{\sqrt{4(e/k)+\tan^2(\beta)} - \tan(\beta)}{2\cos(\beta)}$$

(TNRCC Alternate Liner Design Handbook, page 9)

where:

Tmax = Maximum thickness of leachate in the leachate collection layer.

L = Length of horizontal projection of the leachate collection layer (meters).

e = Impingement rate (meters/sec).

k = Hydraulic conductivity of drainage layer (meter/sec).

ß = Slope angle of the base of the leachate collection layer (degrees).

e = 0.0045 inches/day = $114.3 \times 10^{-6}$ m/day

$$= \frac{114.3 \times 10^{-6} \text{ m/sec/sec}}{86400}$$

$$= 1.323 \times 10^{-9} \text{ m/sec}$$

L = 270 feet = 82 meters.

K = $10^{-3}$ m/sec = $10^{-5}$ m/sec.

ß = 3%

$$Tmax = 82 \left[\frac{\sqrt{4(1.323 \times 10^{-9}/10^{-5})+\tan^2(3°)}-\tan(3°)}{2\cos(3°)}\right]$$

$$= 82 \left[\frac{\sqrt{5.292 \times 10^{-4} + 274.66 \times 10^{-5}} - 0.0524077}{1.9973}\right]$$

$$= 82 \left[\frac{0.0572346 - 0.052407}{1.9973}\right]$$

$$= 82 \ (0.0024167)$$

$$= 0.1982 \text{ meter} = 0.6503 \text{ feet} = 7.803 \text{ inches}$$

Calculated T max = 7.8031 inches is less than the maximum value of 12 inches (TNRCC Handbook).

- Calculation of Infiltration Rate (Q)

  -assume that FML have a "Good Placement"

$$R = 0.26a^{0.05} \times H^{0.45} \times Ks^{-0.13} \left(\frac{\mu 25}{\mu 15}\right)$$

where

a = area of hole = 0.16 in² = $1 \times 10^{-4}$ m² (TNRCC, Alternate Design, Page 11).

H = Hydraulic head on top of geomembrane liner (meter). (HELP, YIELD - 15 inches) 15 inches = 0.381 meters.

Ks = Hydraulic Conductivity of low permeability soil underlying geomembrane = ($5 \times 10^{-9}$ cm/sec = $5 \times 10^{-11}$ m/s).

$\mu^{25}$ = Viscosity of water at 25°C = 0.000890 (N s/m²)

$\mu^{15}$ = Viscosity of water at 15°C = 0.001139 (N s/m²)

$$R = 0.26(1\times10^{-4})^{0.05} \times (0.381)^{0.45} \times (5\times10^{-11})^{-0.13} \left(\frac{0.000890}{0.001139}\right)$$

= 1.81297 inches

$$L \text{ avg.} = 1 + \frac{H}{2Hs \ \ln(R/Ro)}$$

H = Hydraulic head as top of Geomembrane = 0.381 meters.

Hs= Thickness of low permeability soil = 0.30" = 0.00762 m.

R = from Above = 1.81297 meters

Ro= Radius of imperfection = 0.226" = 0.00574m

$$L_{avg} = 1 + \frac{0.381}{2(0.00762)\ln\left(\frac{1.81297}{0.00574}\right)}$$

$$= 1 + \frac{0.381}{0.087710199}$$

$$= 5.343850594$$

$$Q = Ks\ L\ \pi\ R^2\ \left(\frac{\#defects}{acres}\right)(area) \rightarrow$$

area assume = 22 acres

$$Q = (5 \times 10^{-11})(5.343850594)(3.14)(1.81297)^2\left(\frac{7}{acre}\right)(22\ acres)$$

$$= 424.674 \times 10^{-9}\ m^3/sec.$$

$$Q = (424.674 \times 10^{-9}\ m^3/sec)\left(\frac{31536000\ sec}{year}\right)\left(\frac{1}{19182 m^2}\right)$$

$$= 698.182 \times 10^{-6}\ m/year \quad \text{(MULTIMED INPUT)}$$

$$\approx 0.698 \times 10^{-3}\ m/year$$

# APPENDIX D

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991

DANNY R. ANDERSON CONSULTANTS, INC

MCCOMB LANDFILL WITH SINGLE FLEXIBLE MEMBRANE LINER

MCCOMB, TEXAS

MAY 19, 1995

Run Options

Subtitle D Model

OPEN LANDFILL
Chemical simulated is DEFAULT CHEMICAL

| Option Chosen | Saturated zone model |
|---|---|
| Run was | DETERMIN |
| Infiltration input by user | |
| Run was steady-state | |
| Reject runs if Y coordinate outside plume | |
| Reject runs if Z coordinate outside plume | |
| Gaussian source used in saturated zone model | |

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CHEMICAL SPECIFIC VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS MEAN | PARAMETERS STD DEV | LIMITS MIN | LIMITS MAX |
|---|---|---|---|---|---|---|
| Solid phase decay coefficient | 1/yr | DERIVED | -999. | -999. | 0.000E+00 | 0.100E+11 |
| Dissolved phase decay coefficient | 1/yr | DERIVED | -999. | -999. | 0.000E+00 | 0.100E+11 |
| Overall chemical decay coefficient | 1/yr | DERIVED | -999. | -999. | 0.000E+00 | 0.100E+11 |
| Acid catalyzed hydrolysis rate | 1/M-yr | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | -999. |
| Neutral hydrolysis rate constant | 1/yr | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | -999. |
| Base catalyzed hydrolysis rate | 1/M-yr | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | -999. |
| Reference temperature | C | CONSTANT | 25.0 | -999. | 0.000E+00 | 100. |
| Normalized distribution coefficient | ml/g | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | -999. |
| Distribution coefficient | -- | DERIVED | -999. | -999. | 0.000E+00 | 0.100E+11 |
| Biodegradation coefficient (sat. zone) | 1/yr | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | -999. |
| Air diffusion coefficient | cm2/s | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | 10.0 |
| Reference temperature for air diffusion | C | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | 100. |
| Molecular weight | g/M | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | -999. |
| Mole fraction of solute | -- | CONSTANT | 0.000E+00 | -999. | 0.100E-08 | 1.00 |
| Vapor pressure of solute | mm Hg | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | 100. |
| Henry`s law constant | atm-m^3/M | CONSTANT | 0.000E+00 | -999. | 0.100E-09 | 1.00 |
| Overall 1st order decay sat. zone | 1/yr | DERIVED | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.00 |
| Not currently used | | CONSTANT | -999. | -999. | 0.000E+00 | 1.00 |
| Not currently used | | CONSTANT | -999. | -999. | 0.000E+00 | 1.00 |

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SOURCE SPECIFIC VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS MEAN | PARAMETERS STD DEV | LIMITS MIN | LIMITS MAX |
|---|---|---|---|---|---|---|
| Infiltration rate | m/yr | CONSTANT | 0.698E-03 | -999. | 0.100E-09 | 0.100E+11 |
| Area of waste disposal unit | m^2 | CONSTANT | 0.881E+06 | -999. | 0.100E-01 | -999. |
| Duration of pulse | yr | CONSTANT | -999. | -999. | 0.100E-08 | -999. |
| Spread of contaminant source | m | DERIVED | -999. | -999. | 0.100E-08 | 0.100E+11 |
| Recharge rate | m/yr | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | 0.100E+11 |
| Source decay constant | 1/yr | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | -999. |
| Initial concentration at landfill | mg/l | CONSTANT | 1.00 | -999. | 0.000E+00 | -999. |
| Length scale of facility | m | CONSTANT | 0.100E+04 | -999. | 0.100E-08 | 0.100E+11 |
| Width scale of facility | m | CONSTANT | 881. | -999. | 0.100E-08 | 0.100E+11 |
| Near field dilution | | DERIVED | 1.00 | 0.000E+00 | 0.000E+00 | 1.00 |

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AQUIFER SPECIFIC VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS MEAN | PARAMETERS STD DEV | LIMITS MIN | LIMITS MAX |
|---|---|---|---|---|---|---|
| Particle diameter | cm | CONSTANT | 0.250E-01 | -999. | 0.100E-08 | 100. |
| Aquifer porosity | -- | DERIVED | -999. | -999. | 0.100E-08 | 0.990 |
| Bulk density | g/cc | CONSTANT | 1.73 | -999. | 0.100E-01 | 5.00 |
| Aquifer thickness | m | CONSTANT | 133. | -999. | 0.100E-08 | 0.100E+06 |
| Source thickness (mixing zone depth) | m | DERIVED | -999. | -999. | 0.100E-08 | 0.100E+06 |
| Conductivity (hydraulic) | m/yr | CONSTANT | 0.374E+04 | -999. | 0.100E-06 | 0.100E+09 |
| Gradient (hydraulic) | | CONSTANT | 0.250E-02 | -999. | 0.100E-07 | -999. |
| Groundwater seepage velocity | m/yr | DERIVED | -999. | -999. | 0.100E-09 | 0.100E+09 |
| Retardation coefficient | -- | DERIVED | -999. | -999. | 1.00 | 0.100E+09 |
| Longitudinal dispersivity | m | FUNCTION OF X | -999. | -999. | -999. | -999. |
| Transverse dispersivity | m | FUNCTION OF X | -999. | -999. | -999. | -999. |
| Vertical dispersivity | m | FUNCTION OF X | -999. | -999. | -999. | -999. |
| Temperature of aquifer | C | CONSTANT | 25.0 | -999. | 0.000E+00 | 100. |
| pH | -- | CONSTANT | 7.31 | -999. | 0.300 | 14.0 |
| Organic carbon content (fraction) | | CONSTANT | 0.100E-04 | -999. | 0.100E-05 | 1.00 |
| Well distance from site | m | CONSTANT | 1.00 | -999. | 1.00 | -999. |
| Angle off center | degree | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | 360. |
| Well vertical distance | m | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | 1.00 |

CONCENTRATION AFTER SATURATED ZONE MODEL 0.1738E-02

# APPENDIX E

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

1
DANNY R. ANDERSON CONSULTANTS, INC

MCCOMB LANDFILL WITH SINGLE FLEXIBLE MEMBRANE LINER

MCCOMB, TEXAS

MAY 19, 1995

Run options
--- -------

GENERIC MODEL

OPEN LANDFILL
Chemical simulated is DEFAULT CHEMICAL

| | |
|---|---|
| Option Chosen | Saturated and unsaturated zone models |
| Run was | DETERMIN |
| Infiltration input by user | |
| Run was transient | |
| Reject runs if Y coordinate outside plume | |
| Do not reject runs if Z coordinate outside plume | |
| Gaussian source used in saturated zone model | |

1
1
UNSATURATED ZONE FLOW MODEL PARAMETERS
(input parameter description and value)

| | | |
|---|---|---|
| NP | - Total number of nodal points | 240 |
| NMAT | - Number of different porous materials | 1 |
| KPROP | - Van Genuchten or Brooks and Corey | 1 |
| IMSHGN | - Spatial discretization option | 1 |
| NVFLAYR | - Number of layers in flow model | 1 |

OPTIONS CHOSEN
------- ------
Van Genuchten functional coefficients
User defined coordinate system
1

Layer information

| LAYER NO. | LAYER THICKNESS | MATERIAL PROPERTY |
|---|---|---|
| 1 | 1.00 | 1 |

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS MEAN | PARAMETERS STD DEV | LIMITS MIN | LIMITS MAX |
|---|---|---|---|---|---|---|
| Saturated hydraulic conductivity | cm/hr | CONSTANT | 29.7 | -999. | 0.100E-10 | 0.100E+05 |
| Unsaturated zone porosity | -- | CONSTANT | 0.365 | -999. | 0.100E-08 | 0.990 |
| Air entry pressure head | m | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | -999. |
| Depth of the unsaturated zone | m | CONSTANT | 1.00 | -999. | 0.100E-08 | -999. |

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS MEAN | PARAMETERS STD DEV | LIMITS MIN | LIMITS MAX |
|---|---|---|---|---|---|---|
| Residual water content | -- | CONSTANT | 0.450E-01 | -999. | 0.100E-08 | 1.00 |
| Brook and Corey exponent,EN | -- | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | 10.0 |
| ALFA coefficient | 1/cm | CONSTANT | 0.145 | -999. | 0.000E+00 | 1.00 |
| Van Genuchten exponent, ENN | -- | CONSTANT | 2.68 | -999. | 1.00 | 5.00 |

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

| | | | |
|---|---|---|---|
| NLAY | - Number of different layers used | | 1 |
| NTSTPS | - Number of time values concentration calc | | 40 |
| DUMMY | - Not presently used | | 1 |
| ISOL | - Type of scheme used in unsaturated zone | | 1 |
| N | - Stehfest terms or number of increments | | 18 |
| NTEL | - Points in Lagrangian interpolation | | 3 |
| NGPTS | - Number of Gauss points | | 104 |
| NIT | - Convolution integral segments | | 2 |
| IBOUND | - Type of boundary condition | | 2 |
| ITSGEN | - Time values generated or input | | 1 |
| TMAX | - Max simulation time | -- | 0.0 |
| WTFUN | - Weighting factor | -- | 1.2 |

OPTIONS CHOSEN

Stehfest numerical inversion algorithm
Nondecaying pulse source
Computer generated times for computing concentrations

1

DATA FOR LAYER 1

VADOSE TRANSPORT VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS MEAN | PARAMETERS STD DEV | LIMITS MIN | LIMITS MAX |
|---|---|---|---|---|---|---|
| Thickness of layer | m | CONSTANT | 1.00 | -999. | 0.100E-08 | -999. |
| Longitudinal dispersivity of layer | m | DERIVED | -999. | -999. | 0.100E-02 | 0.100E+05 |
| Percent organic matter | -- | CONSTANT | 0.260E-01 | -999. | 0.000E+00 | 100. |
| Bulk density of soil for layer | g/cc | CONSTANT | 1.69 | -999. | 0.100E-01 | 5.00 |
| Biological decay coefficient | 1/yr | CONSTANT | 0.500E-02 | -999. | 0.000E+00 | -999. |

1

CHEMICAL SPECIFIC VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS MEAN | PARAMETERS STD DEV | LIMITS MIN | LIMITS MAX |
|---|---|---|---|---|---|---|
| Solid phase decay coefficient | 1/yr | DERIVED | -999. | -999. | 0.000E+00 | 0.100E+11 |
| Dissolved phase decay coefficient | 1/yr | DERIVED | -999. | -999. | 0.000E+00 | 0.100E+11 |
| Overall chemical decay coefficient | 1/yr | DERIVED | -999. | -999. | 0.000E+00 | 0.100E+11 |
| Acid catalyzed hydrolysis rate | 1/M-yr | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | -999. |
| Neutral hydrolysis rate constant | 1/yr | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | -999. |
| Base catalyzed hydrolysis rate | 1/M-yr | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | -999. |
| Reference temperature | C | CONSTANT | 25.0 | -999. | 0.000E+00 | 100. |
| Normalized distribution coefficient | ml/g | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | -999. |
| Distribution coefficient | -- | DERIVED | -999. | -999. | 0.000E+00 | 0.100E+11 |
| Biodegradation coefficient (sat. zone) | 1/yr | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | -999. |
| Air diffusion coefficient | cm2/s | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | 10.0 |
| Reference temperature for air diffusion | C | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | 100. |
| Molecular weight | g/M | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | 100. |
| Mole fraction of solute | -- | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | -999. |
| Vapor pressure of solute | mm Hg | CONSTANT | 0.000E+00 | -999. | 0.100E-08 | 1.00 |
| Henry`s law constant | atm-m^3/M | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | 100. |
| Overall 1st order decay sat. zone | 1/yr | DERIVED | 0.000E+00 | 0.000E+00 | 0.100E-09 | 1.00 |
| Not currently used | | CONSTANT | -999. | -999. | 0.000E+00 | 1.00 |
| Not currently used | | CONSTANT | -999. | -999. | 0.000E+00 | 1.00 |

1

SOURCE SPECIFIC VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS MEAN | PARAMETERS STD DEV | LIMITS MIN | LIMITS MAX |
|---|---|---|---|---|---|---|
| Infiltration rate | m/yr | CONSTANT | 0.698E-03 | -999. | 0.100E-09 | 0.100E+11 |
| Area of waste disposal unit | m^2 | CONSTANT | 0.881E+06 | -999. | 0.100E-01 | -999. |
| Duration of pulse | yr | CONSTANT | 20.0 | -999. | 0.100E-08 | -999. |
| Spread of contaminant source | m | DERIVED | -999. | -999. | 0.100E-08 | 0.100E+11 |
| Recharge rate | m/yr | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | 0.100E+11 |
| Source decay constant | 1/yr | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | -999. |
| Initial concentration at landfill | mg/l | CONSTANT | 1.00 | -999. | 0.000E+00 | -999. |
| Length scale of facility | m | CONSTANT | 0.100E+04 | -999. | 0.100E-08 | 0.100E+11 |
| Width scale of facility | m | CONSTANT | 881. | -999. | 0.100E-08 | 0.100E+11 |
| Near field dilution | | DERIVED | 1.00 | 0.000E+00 | 0.000E+00 | 1.00 |

1

AQUIFER SPECIFIC VARIABLES

| VARIABLE NAME | UNITS | DISTRIBUTION | PARAMETERS MEAN | PARAMETERS STD DEV | LIMITS MIN | LIMITS MAX |
|---|---|---|---|---|---|---|
| Particle diameter | cm | CONSTANT | 0.250E-01 | -999. | 0.100E-08 | 100. |
| Aquifer porosity | -- | DERIVED | -999. | -999. | 0.100E-08 | 0.990 |
| Bulk density | g/cc | CONSTANT | 1.73 | -999. | 0.100E-01 | 5.00 |
| Aquifer thickness | m | CONSTANT | 133. | -999. | 0.100E-08 | 0.100E+06 |
| Source thickness (mixing zone depth) | m | DERIVED | -999. | -999. | 0.100E-08 | 0.100E+06 |
| Conductivity (hydraulic) | m/yr | CONSTANT | 0.374E+04 | -999. | 0.100E-06 | 0.100E+09 |
| Gradient (hydraulic) | | CONSTANT | 0.250E-02 | -999. | 0.100E-07 | -999. |
| Groundwater seepage velocity | m/yr | DERIVED | -999. | -999. | 0.100E-09 | 0.100E+09 |
| Retardation coefficient | -- | DERIVED | -999. | -999. | 1.00 | 0.100E+09 |
| Longitudinal dispersivity | m | FUNCTION OF X | -999. | -999. | -999. | -999. |
| Transverse dispersivity | m | FUNCTION OF X | -999. | -999. | -999. | -999. |
| Vertical dispersivity | m | FUNCTION OF X | -999. | -999. | -999. | -999. |
| Temperature of aquifer | C | CONSTANT | 25.0 | -999. | 0.000E+00 | 100. |
| pH | -- | CONSTANT | 7.31 | -999. | 0.300 | 14.0 |
| Organic carbon content (fraction) | | CONSTANT | 0.100E-04 | -999. | 0.100E-05 | 1.00 |
| Well distance from site | m | CONSTANT | 1.00 | -999. | 1.00 | -999. |
| Angle off center | degree | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | 360. |
| Well vertical distance | m | CONSTANT | 0.000E+00 | -999. | 0.000E+00 | 1.00 |

1

| TIME | CONCENTRATION |
|---|---|
| 0.100E+01 | 0.00000E+00 |
| 0.110E+02 | 0.00000E+00 |
| 0.210E+02 | 0.00000E+00 |
| 0.310E+02 | 0.19917E-06 |
| 0.410E+02 | 0.48267E-06 |
| 0.510E+02 | 0.26381E-05 |
| 0.610E+02 | 0.70969E-05 |
| 0.710E+02 | 0.27734E-04 |
| 0.810E+02 | 0.60458E-04 |
| 0.910E+02 | 0.11681E-03 |
| 0.101E+03 | 0.16718E-03 |
| 0.111E+03 | 0.20239E-03 |
| 0.121E+03 | 0.21603E-03 |
| 0.131E+03 | 0.20777E-03 |
| 0.141E+03 | 0.18652E-03 |
| 0.151E+03 | 0.15802E-03 |
| 0.161E+03 | 0.12810E-03 |
| 0.171E+03 | 0.99984E-04 |
| 0.181E+03 | 0.75431E-04 |
| 0.191E+03 | 0.55486E-04 |

# APPENDIX F

Climatography of the United States No. 84

# Daily Normals of Temperature, Precipitation and Heating and Cooling Degree Days, 1961-1990

## Texas, El Paso WSO AP

# CLIMATOGRAPHY OF THE UNITED STATES NO. 84

## DAILY NORMALS OF TEMPERATURE, HEATING AND COOLING DEGREE DAYS, AND PRECIPITATION 1961-90

412797 EL PASO WSO AP  LATITUDE: 31 48N  LONGITUDE: 106 24W  ELEVATION: 3918 FT.

| DAILY | DECEMBER TEMPERATURE MAX | MIN | AVG | DEG HDD | DAY CDD | PCP | JANUARY TEMPERATURE MAX | MIN | AVG | DEG HDD | DAY CDD | PCP | FEBRUARY TEMPERATURE MAX | MIN | AVG | DEG HDD | DAY CDD | PCP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 61 | 34 | 47 | 18 | 0 | .02 | 55 | 29 | 42 | 23 | 0 | .02 | 59 | 31 | 45 | 20 | 0 | .01 |
| 2 | 61 | 33 | 47 | 18 | 0 | .02 | 55 | 29 | 42 | 23 | 0 | .02 | 59 | 31 | 45 | 20 | 0 | .01 |
| 3 | 60 | 33 | 47 | 18 | 0 | .02 | 55 | 29 | 42 | 23 | 0 | .02 | 59 | 32 | 46 | 19 | 0 | .01 |
| 4 | 60 | 33 | 46 | 19 | 0 | .02 | 55 | 29 | 42 | 23 | 0 | .02 | 59 | 32 | 46 | 19 | 0 | .01 |
| 5 | 60 | 33 | 46 | 19 | 0 | .02 | 55 | 29 | 42 | 23 | 0 | .02 | 60 | 32 | 46 | 19 | 0 | .01 |
| 6 | 59 | 32 | 46 | 19 | 0 | .02 | 55 | 29 | 42 | 23 | 0 | .02 | 60 | 32 | 46 | 19 | 0 | .02 |
| 7 | 59 | 32 | 46 | 20 | 0 | .02 | 55 | 29 | 42 | 23 | 0 | .02 | 60 | 32 | 46 | 19 | 0 | .02 |
| 8 | 59 | 32 | 45 | 20 | 0 | .02 | 55 | 29 | 42 | 23 | 0 | .01 | 61 | 33 | 47 | 18 | 0 | .02 |
| 9 | 59 | 32 | 45 | 20 | 0 | .02 | 55 | 29 | 42 | 23 | 0 | .01 | 61 | 33 | 47 | 18 | 0 | .02 |
| 10 | 58 | 32 | 45 | 20 | 0 | .02 | 55 | 29 | 42 | 23 | 0 | .01 | 61 | 33 | 47 | 18 | 0 | .02 |
| 11 | 58 | 31 | 45 | 20 | 0 | .02 | 55 | 29 | 42 | 23 | 0 | .01 | 62 | 33 | 48 | 17 | 0 | .02 |
| 12 | 58 | 31 | 44 | 21 | 0 | .02 | 55 | 29 | 42 | 23 | 0 | .01 | 62 | 34 | 48 | 17 | 0 | .02 |
| 13 | 58 | 31 | 44 | 21 | 0 | .02 | 55 | 29 | 42 | 23 | 0 | .01 | 62 | 34 | 48 | 17 | 0 | .02 |
| 14 | 58 | 31 | 44 | 21 | 0 | .02 | 56 | 29 | 42 | 23 | 0 | .01 | 62 | 34 | 48 | 17 | 0 | .02 |
| 15 | 57 | 31 | 44 | 21 | 0 | .02 | 56 | 29 | 42 | 23 | 0 | .01 | 63 | 34 | 48 | 17 | 0 | .02 |
| 16 | 57 | 30 | 44 | 21 | 0 | .02 | 56 | 29 | 43 | 22 | 0 | .01 | 63 | 34 | 49 | 16 | 0 | .02 |
| 17 | 57 | 30 | 44 | 21 | 0 | .02 | 56 | 29 | 43 | 22 | 0 | .01 | 63 | 35 | 49 | 16 | 0 | .02 |
| 18 | 57 | 30 | 43 | 22 | 0 | .02 | 56 | 29 | 43 | 22 | 0 | .01 | 63 | 35 | 49 | 16 | 0 | .01 |
| 19 | 57 | 30 | 43 | 22 | 0 | .02 | 56 | 29 | 43 | 22 | 0 | .01 | 64 | 35 | 49 | 16 | 0 | .01 |
| 20 | 56 | 30 | 43 | 22 | 0 | .02 | 56 | 29 | 43 | 22 | 0 | .01 | 64 | 35 | 50 | 15 | 0 | .01 |
| 21 | 56 | 30 | 43 | 22 | 0 | .02 | 57 | 29 | 43 | 22 | 0 | .01 | 64 | 35 | 50 | 15 | 0 | .01 |
| 22 | 56 | 30 | 43 | 22 | 0 | .02 | 57 | 30 | 43 | 22 | 0 | .01 | 64 | 36 | 50 | 15 | 0 | .01 |
| 23 | 56 | 29 | 43 | 22 | 0 | .02 | 57 | 30 | 44 | 21 | 0 | .01 | 65 | 36 | 50 | 15 | 0 | .01 |
| 24 | 56 | 29 | 43 | 22 | 0 | .02 | 57 | 30 | 44 | 21 | 0 | .01 | 65 | 36 | 51 | 14 | 0 | .01 |
| 25 | 56 | 29 | 43 | 22 | 0 | .02 | 57 | 30 | 44 | 21 | 0 | .01 | 65 | 36 | 51 | 14 | 0 | .01 |
| 26 | 56 | 29 | 43 | 23 | 0 | .01 | 58 | 30 | 44 | 21 | 0 | .01 | 66 | 37 | 51 | 14 | 0 | .01 |
| 27 | 56 | 29 | 42 | 23 | 0 | .01 | 58 | 30 | 44 | 21 | 0 | .01 | | | | | | |
| 28 | 56 | 29 | 42 | 23 | 0 | .01 | 58 | 31 | 44 | 21 | 0 | .01 | | | | | | |
| 29 | 55 | 29 | 42 | 23 | 0 | .01 | 58 | 31 | 45 | 20 | 0 | .01 | | | | | | |
| 30 | 55 | 29 | 42 | 23 | 0 | .01 | 59 | 31 | 45 | 20 | 0 | .02 | | | | | | |
| 31 | 55 | 29 | 42 | 23 | 0 | .01 | | | | | | | | | | | | |
| MONTHLY | 57.5 | 30.7 | 44.1 | 648 | 0 | .57 | 56.1 | 29.4 | 42.8 | 688 | 0 | .40 | 62.2 | 33.9 | 48.1 | 473 | 0 | .41 |
| WINTER | 58.5 | 31.3 | 44.9 | 1809 | 0 | 1.38 | | | | | | | | | | | | |
| ANNUAL | 77.5 | 49.0 | 63.2 | 2708 | 2094 | 8.81 | | | | | | | | | | | | |

NOTES: DEGREE DAYS BASE TEMPERATURE = 65 DEG F; TEMPERATURE UNITS = DEG F;
PRECIPITATION UNITS = INCHES; * = LESS THAN 1 BUT GREATER THAN 0

THE DAILY VALUES PRESENTED IN THESE TABLES ARE NOT SIMPLE MEANS OF OBSERVED VALUES. THEY ARE INTERPOLATED FROM THE MUCH LESS VARIABLE MONTHLY NORMALS BY USE OF THE NATURAL SPLINE FUNCTION. IN LEAP YEARS USE THE FEBRUARY 28TH VALUES FOR THE 29TH AND ADJUST THE DEGREE DAY MONTHLY TOTALS ACCORDINGLY. DAILY PRECIPITATION NORMALS HERE ALSO COMPUTED USING THE NATURAL SPLINE FUNCTION AND DO NOT EXHIBIT THE TYPICAL DAILY RANDOM PATTERNS. HOWEVER, THEY MAY BE USED TO COMPUTE NORMAL PRECIPITATION OVER TIME INTERVALS.

# CLIMATOGRAPHY OF THE UNITED STATES NO. 84

## DAILY NORMALS OF TEMPERATURE, HEATING AND COOLING DEGREE DAYS, AND PRECIPITATION 1961-90

412797 EL PASO WSO AP  LATITUDE: 31 48N  LONGITUDE: 106 24W  ELEVATION: 3918 FT.

| DAILY | MARCH TEMPERATURE MAX | MARCH TEMPERATURE MIN | MARCH TEMPERATURE AVG | MARCH DEG HDD | MARCH DAY CDD | MARCH PCP | APRIL TEMPERATURE MAX | APRIL TEMPERATURE MIN | APRIL TEMPERATURE AVG | APRIL DEG HDD | APRIL DAY CDD | APRIL PCP | MAY TEMPERATURE MAX | MAY TEMPERATURE MIN | MAY TEMPERATURE AVG | MAY DEG HDD | MAY DAY CDD | MAY PCP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 66 | 37 | 51 | 14 | 0 | .01 | 75 | 44 | 59 | 7 | 1 | .01 | 83 | 52 | 67 | 1 | 3 | .00 |
| 2 | 66 | 37 | 52 | 13 | 0 | .01 | 75 | 44 | 60 | 6 | 1 | .01 | 83 | 53 | 68 | 1 | 4 | .00 |
| 3 | 66 | 37 | 52 | 13 | 0 | .01 | 75 | 45 | 60 | 6 | 1 | .01 | 83 | 53 | 68 | 1 | 4 | .00 |
| 4 | 67 | 37 | 52 | 13 | 0 | .01 | 76 | 45 | 60 | 6 | 1 | .01 | 83 | 53 | 68 | 1 | 4 | .00 |
| 5 | 67 | 38 | 52 | 13 | 0 | .01 | 76 | 45 | 61 | 5 | 1 | .01 | 84 | 53 | 69 | 1 | 5 | .00 |
| 6 | 67 | 38 | 53 | 12 | 0 | .01 | 76 | 45 | 61 | 5 | 1 | .01 | 84 | 54 | 69 | 1 | 5 | .00 |
| 7 | 67 | 38 | 53 | 12 | 0 | .01 | 76 | 46 | 61 | 5 | 1 | .01 | 84 | 54 | 69 | 1 | 5 | .01 |
| 8 | 68 | 38 | 53 | 12 | 0 | .01 | 77 | 46 | 61 | 5 | 1 | .01 | 84 | 55 | 70 | 0 | 5 | .01 |
| 9 | 68 | 38 | 53 | 12 | 0 | .01 | 77 | 46 | 62 | 5 | 2 | .01 | 85 | 55 | 70 | 0 | 5 | .01 |
| 10 | 68 | 39 | 53 | 12 | 0 | .01 | 77 | 46 | 62 | 5 | 2 | .01 | 85 | 55 | 70 | 0 | 5 | .01 |
| 11 | 68 | 39 | 54 | 11 | 0 | .01 | 78 | 47 | 62 | 5 | 2 | .01 | 86 | 55 | 70 | 0 | 5 | .01 |
| 12 | 69 | 39 | 54 | 11 | 0 | .01 | 78 | 47 | 63 | 4 | 2 | .01 | 86 | 56 | 71 | 0 | 6 | .01 |
| 13 | 69 | 39 | 54 | 11 | 0 | .01 | 78 | 47 | 63 | 4 | 2 | .01 | 86 | 56 | 71 | 0 | 6 | .01 |
| 14 | 69 | 40 | 54 | 11 | 0 | .01 | 78 | 48 | 63 | 4 | 2 | .01 | 86 | 56 | 71 | 0 | 6 | .01 |
| 15 | 70 | 40 | 55 | 10 | 0 | .01 | 79 | 48 | 63 | 4 | 2 | .01 | 87 | 56 | 72 | 0 | 7 | .01 |
| 16 | 70 | 40 | 55 | 10 | 0 | .01 | 79 | 48 | 64 | 3 | 2 | .01 | 87 | 57 | 72 | 0 | 7 | .01 |
| 17 | 70 | 40 | 55 | 10 | 0 | .01 | 79 | 49 | 64 | 3 | 2 | .01 | 87 | 57 | 72 | 0 | 7 | .01 |
| 18 | 70 | 41 | 56 | 9 | 0 | .01 | 80 | 49 | 64 | 3 | 2 | .01 | 88 | 57 | 72 | 0 | 7 | .01 |
| 19 | 71 | 41 | 56 | 9 | 0 | .01 | 80 | 49 | 64 | 3 | 2 | .01 | 88 | 58 | 73 | 0 | 8 | .01 |
| 20 | 71 | 41 | 56 | 9 | 0 | .01 | 80 | 50 | 65 | 3 | 3 | .00 | 89 | 58 | 73 | 0 | 8 | .01 |
| 21 | 71 | 41 | 56 | 9 | 0 | .01 | 81 | 50 | 65 | 3 | 3 | .00 | 89 | 58 | 74 | 0 | 9 | .01 |
| 22 | 72 | 42 | 57 | 9 | 1 | .01 | 81 | 50 | 66 | 2 | 3 | .00 | 89 | 58 | 74 | 0 | 9 | .01 |
| 23 | 72 | 42 | 57 | 9 | 1 | .01 | 81 | 50 | 66 | 2 | 3 | .00 | 90 | 59 | 74 | 0 | 9 | .01 |
| 24 | 72 | 42 | 57 | 9 | 1 | .01 | 81 | 51 | 66 | 2 | 3 | .00 | 90 | 59 | 74 | 0 | 9 | .01 |
| 25 | 72 | 42 | 57 | 9 | 1 | .01 | 81 | 51 | 66 | 2 | 3 | .00 | 90 | 59 | 75 | 0 | 10 | .01 |
| 26 | 73 | 43 | 58 | 8 | 1 | .01 | 82 | 51 | 66 | 2 | 3 | .00 | 91 | 60 | 75 | 0 | 10 | .01 |
| 27 | 73 | 43 | 58 | 8 | 1 | .01 | 82 | 51 | 67 | 1 | 3 | .00 | 91 | 60 | 76 | 0 | 11 | .01 |
| 28 | 74 | 43 | 59 | 7 | 1 | .01 | 82 | 52 | 67 | 1 | 3 | .00 | 92 | 60 | 76 | 0 | 11 | .01 |
| 29 | 74 | 43 | 59 | 7 | 1 | .00 | 82 | 52 | 67 | 1 | 3 | .00 | 92 | 60 | 76 | 0 | 11 | .01 |
| 30 | 74 | 44 | 59 | 7 | 1 | .00 | | | | | | | 93 | 60 | 76 | 0 | 11 | .01 |
| 31 | 74 | 44 | 59 | 7 | 1 | .00 | | | | | | | | | | | | |
| MONTHLY | 69.9 | 40.2 | 55.1 | 316 | 10 | .29 | 78.7 | 48.0 | 63.4 | 110 | 62 | .20 | 87.1 | 56.5 | 71.8 | 7 | 217 | .25 |
| SPRING | 78.6 | 48.3 | 63.5 | 433 | 289 | .74 | | | | | | | | | | | | |
| ANNUAL | 77.5 | 49.0 | 63.2 | 2708 | 2094 | 8.81 | | | | | | | | | | | | |

NOTES: DEGREE DAYS BASE TEMPERATURE = 65 DEG F; TEMPERATURE UNITS = DEG F; PRECIPITATION UNITS = INCHES; * = LESS THAN 1 BUT GREATER THAN 0

THE DAILY VALUES PRESENTED IN THESE TABLES ARE NOT SIMPLE MEANS OF OBSERVED VALUES. THEY ARE INTERPOLATED FROM THE MUCH LESS VARIABLE MONTHLY NORMALS BY USE OF THE NATURAL SPLINE FUNCTION. IN LEAP YEARS USE THE FEBRUARY 28TH VALUES FOR THE 29TH AND ADJUST THE DEGREE DAY MONTHLY TOTALS ACCORDINGLY. DAILY PRECIPITATION NORMALS WERE ALSO COMPUTED USING THE NATURAL SPLINE FUNCTION AND DO NOT EXHIBIT THE TYPICAL DAILY RANDOM PATTERNS. HOWEVER, THEY MAY BE USED TO COMPUTE NORMAL PRECIPITATION OVER TIME INTERVALS.

# CLIMATOGRAPHY OF THE UNITED STATES NO. 84

## DAILY NORMALS OF TEMPERATURE, HEATING AND COOLING DEGREE DAYS, AND PRECIPITATION 1961-90

412797 EL PASO WSO AP  LATITUDE: 31 48N  LONGITUDE: 106 24W  ELEVATION: 3918 FT.

| DAILY | JUNE TEMPERATURE MAX | JUNE TEMPERATURE MIN | JUNE TEMPERATURE AVG | JUNE DEG HDD | JUNE DAY CDD | JUNE PCP | JULY TEMPERATURE MAX | JULY TEMPERATURE MIN | JULY TEMPERATURE AVG | JULY DEG HDD | JULY DAY CDD | JULY PCP | AUGUST TEMPERATURE MAX | AUGUST TEMPERATURE MIN | AUGUST TEMPERATURE AVG | AUGUST DEG HDD | AUGUST DAY CDD | AUGUST PCP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 93 | 61 | 77 | 0 | 12 | .01 | 97 | 67 | 82 | 0 | 17 | .04 | 95 | 68 | 82 | 0 | 17 | .05 |
| 2 | 93 | 61 | 77 | 0 | 12 | .01 | 97 | 67 | 82 | 0 | 17 | .04 | 95 | 68 | 82 | 0 | 17 | .05 |
| 3 | 94 | 61 | 78 | 0 | 13 | .01 | 97 | 68 | 82 | 0 | 17 | .04 | 95 | 68 | 82 | 0 | 17 | .05 |
| 4 | 94 | 62 | 78 | 0 | 13 | .01 | 97 | 68 | 82 | 0 | 17 | .04 | 95 | 68 | 81 | 0 | 16 | .05 |
| 5 | 94 | 62 | 78 | | | | 97 | 68 | 83 | 0 | 18 | .04 | 95 | 68 | 81 | 0 | 16 | .05 |
| 6 | 95 | 62 | 79 | 0 | 14 | .01 | 97 | 68 | 83 | 0 | 18 | .05 | 95 | 68 | 81 | 0 | 16 | .05 |
| 7 | 95 | 62 | 79 | 0 | 14 | .02 | 97 | 68 | 83 | 0 | 18 | .05 | 95 | 68 | 81 | 0 | 16 | .05 |
| 8 | 95 | 63 | 79 | 0 | 14 | .02 | 97 | 68 | 83 | 0 | 18 | .05 | 95 | 67 | 81 | 0 | 16 | .05 |
| 9 | 96 | 63 | 79 | 0 | 14 | .02 | 97 | 68 | 83 | 0 | 18 | .05 | 95 | 67 | 81 | 0 | 16 | .05 |
| 10 | 96 | 63 | 80 | 0 | 15 | .02 | 97 | 68 | 83 | 0 | 18 | .05 | 94 | 67 | 81 | 0 | 16 | .05 |
| 11 | 96 | 63 | 80 | 0 | 15 | .02 | 96 | 69 | 83 | 0 | 18 | .05 | 94 | 67 | 81 | 0 | 16 | .05 |
| 12 | 96 | 64 | 80 | 0 | 15 | .02 | 96 | 69 | 83 | 0 | 18 | .05 | 94 | 67 | 81 | 0 | 16 | .05 |
| 13 | 97 | 64 | 81 | 0 | 16 | .02 | 96 | 69 | 82 | 0 | 17 | .05 | 94 | 67 | 80 | 0 | 15 | .05 |
| 14 | 97 | 64 | 81 | 0 | 16 | .02 | 96 | 69 | 82 | 0 | 17 | .05 | 94 | 67 | 80 | 0 | 15 | .05 |
| 15 | 97 | 64 | 81 | | | | 96 | 69 | 82 | 0 | 17 | .05 | 94 | 67 | 80 | 0 | 15 | .05 |
| 16 | 97 | 65 | 81 | 0 | 16 | .02 | 96 | 69 | 82 | 0 | 17 | .05 | 93 | 66 | 80 | 0 | 15 | .05 |
| 17 | 97 | 65 | 81 | 0 | 16 | .02 | 96 | 69 | 82 | 0 | 17 | .05 | 93 | 66 | 80 | 0 | 15 | .05 |
| 18 | 97 | 65 | 81 | 0 | 16 | .02 | 96 | 69 | 82 | 0 | 17 | .05 | 93 | 66 | 80 | 0 | 15 | .05 |
| 19 | 98 | 65 | 81 | 0 | 17 | .03 | 96 | 69 | 82 | 0 | 17 | .05 | 93 | 66 | 79 | 0 | 14 | .05 |
| 20 | 98 | 65 | 82 | | | | 96 | 69 | 82 | 0 | 17 | .06 | 93 | 66 | 79 | 0 | 14 | .05 |
| 21 | 98 | 66 | 82 | 0 | 17 | .03 | 96 | 69 | 82 | 0 | 17 | .06 | 93 | 66 | 79 | 0 | 14 | .05 |
| 22 | 98 | 66 | 82 | 0 | 17 | .03 | 96 | 69 | 82 | 0 | 17 | .06 | 92 | 66 | 79 | 0 | 14 | .05 |
| 23 | 98 | 66 | 82 | 0 | 17 | .03 | 96 | 69 | 82 | 0 | 17 | .06 | 92 | 66 | 79 | 0 | 14 | .05 |
| 24 | 98 | 66 | 82 | 0 | 17 | .03 | 95 | 69 | 82 | 0 | 17 | .05 | 92 | 66 | 79 | 0 | 14 | .05 |
| 25 | 98 | 66 | 82 | | | | 95 | 69 | 82 | 0 | 17 | .05 | 92 | 65 | 79 | 0 | 14 | .05 |
| 26 | 98 | 67 | 82 | 0 | 17 | .03 | 95 | 68 | 82 | 0 | 17 | .05 | 92 | 65 | 79 | 0 | 14 | .05 |
| 27 | 98 | 67 | 82 | 0 | 17 | .03 | 95 | 68 | 82 | 0 | 17 | .05 | 92 | 65 | 78 | 0 | 13 | .06 |
| 28 | 98 | 67 | 82 | 0 | 17 | .04 | 95 | 68 | 82 | 0 | 17 | .05 | 91 | 65 | 78 | 0 | 13 | .06 |
| 29 | 98 | 67 | 82 | 0 | 17 | .04 | 95 | 68 | 82 | 0 | 17 | .05 | 91 | 65 | 78 | 0 | 13 | .06 |
| 30 | 98 | 67 | 82 | | | | | | | | | | | | | | | |
| 31 | | | | | | | | | | | | | | | | | | |
| MONTHLY | 96.5 | 64.3 | 80.4 | 0 | 462 | .67 | 96.1 | 68.4 | 82.3 | 0 | 536 | 1.54 | 93.5 | 66.6 | 80.1 | 0 | 468 | 1.58 |
| SUMMER | 95.4 | 66.5 | 81.0 | 0 | 1466 | 3.79 | | | | | | | | | | | | |
| ANNUAL | 77.5 | 49.0 | 63.2 | 2708 | 2094 | 8.81 | | | | | | | | | | | | |

NOTES: DEGREE DAYS BASE TEMPERATURE = 65 DEG F; TEMPERATURE UNITS = DEG F;
PRECIPITATION UNITS = INCHES; * = LESS THAN 1 BUT GREATER THAN 0

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# CLIMATOGRAPHY OF THE UNITED STATES NO. 84

## DAILY NORMALS OF TEMPERATURE, HEATING AND COOLING DEGREE DAYS, AND PRECIPITATION 1961-90

412797 EL PASO WSO AP LATITUDE: 31 48N LONGITUDE: 106 24W ELEVATION: 3918 FT.

| DAILY | SEPTEMBER TEMPERATURE MAX | MIN | AVG | DEG HDD | DAY CDD | PCP | OCTOBER TEMPERATURE MAX | MIN | AVG | DEG HDD | DAY CDD | PCP | NOVEMBER TEMPERATURE MAX | MIN | AVG | DEG HDD | DAY CDD | PCP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 91 | 65 | 78 | 0 | 13 | .06 | 83 | 56 | 70 | 0 | 5 | .04 | 72 | 43 | 58 | 7 | 0 | .01 |
| 2 | 90 | 65 | 78 | 0 | 13 | .06 | 83 | 56 | 69 | 1 | 5 | .04 | 72 | 43 | 57 | 8 | 0 | .01 |
| 3 | 90 | 65 | 78 | 0 | 13 | .06 | 83 | 55 | 69 | 1 | 5 | .04 | 71 | 43 | 57 | 8 | 0 | .01 |
| 4 | 90 | 65 | 77 | 0 | 12 | .06 | 82 | 55 | 69 | 1 | 5 | .04 | 71 | 42 | 57 | 8 | 0 | .01 |
| 5 | 90 | 64 | 77 | 0 | 12 | .06 | 82 | 54 | 68 | 1 | 4 | .04 | 70 | 42 | 56 | 9 | 0 | .01 |
| 6 | 89 | 64 | 77 | 0 | 12 | .06 | 82 | 54 | 68 | 1 | 4 | .03 | 70 | 41 | 56 | 9 | 0 | .01 |
| 7 | 89 | 64 | 77 | 0 | 12 | .06 | 82 | 53 | 67 | 1 | 3 | .03 | 70 | 41 | 55 | 10 | 0 | .01 |
| 8 | 89 | 64 | 76 | 0 | 11 | .06 | 81 | 53 | 67 | 1 | 3 | .03 | 69 | 41 | 55 | 10 | 0 | .01 |
| 9 | 89 | 64 | 76 | 0 | 11 | .06 | 81 | 53 | 67 | 1 | 3 | .03 | 69 | 40 | 55 | 10 | 0 | .01 |
| 10 | 88 | 63 | 76 | 0 | 11 | .06 | 81 | 52 | 67 | 1 | 3 | .03 | 68 | 40 | 54 | 11 | 0 | .01 |
| 11 | 88 | 63 | 76 | 0 | 11 | .06 | 80 | 52 | 66 | 1 | 2 | .03 | 68 | 40 | 54 | 11 | 0 | .01 |
| 12 | 88 | 63 | 76 | 0 | 11 | .06 | 80 | 51 | 66 | 1 | 2 | .03 | 68 | 39 | 54 | 11 | 0 | .01 |
| 13 | 88 | 63 | 75 | 0 | 10 | .06 | 80 | 51 | 65 | 2 | 2 | .03 | 67 | 39 | 53 | 12 | 0 | .01 |
| 14 | 88 | 62 | 75 | 0 | 10 | .06 | 79 | 50 | 65 | 2 | 2 | .02 | 67 | 39 | 53 | 12 | 0 | .01 |
| 15 | 87 | 62 | 75 | 0 | 10 | .06 | 79 | 50 | 64 | 2 | 1 | .02 | 66 | 38 | 52 | 13 | 0 | .01 |
| 16 | 87 | 62 | 75 | 0 | 10 | .06 | 79 | 49 | 64 | 2 | 1 | .02 | 66 | 38 | 52 | 13 | 0 | .02 |
| 17 | 87 | 62 | 74 | 0 | 9 | .06 | 78 | 49 | 63 | 3 | 1 | .02 | 66 | 38 | 51 | 14 | 0 | .02 |
| 18 | 87 | 61 | 74 | 0 | 9 | .06 | 78 | 49 | 63 | 3 | 1 | .02 | 65 | 37 | 51 | 14 | 0 | .02 |
| 19 | 86 | 61 | 74 | 0 | 9 | .06 | 78 | 48 | 63 | 3 | 1 | .02 | 65 | 37 | 51 | 14 | 0 | .02 |
| 20 | 86 | 61 | 73 | 0 | 8 | .06 | 77 | 48 | 62 | 4 | 1 | .02 | 64 | 37 | 50 | 15 | 0 | .02 |
| 21 | 86 | 60 | 73 | 0 | 8 | .05 | 77 | 47 | 62 | 4 | 1 | .02 | 64 | 36 | 50 | 15 | 0 | .02 |
| 22 | 86 | 60 | 73 | 0 | 8 | .05 | 76 | 47 | 62 | 4 | 1 | .02 | 64 | 36 | 50 | 15 | 0 | .02 |
| 23 | 85 | 60 | 72 | 0 | 7 | .05 | 76 | 47 | 62 | 4 | 1 | .02 | 63 | 36 | 49 | 16 | 0 | .02 |
| 24 | 85 | 59 | 72 | 0 | 7 | .05 | 76 | 46 | 61 | 4 | 0 | .02 | 63 | 35 | 49 | 16 | 0 | .02 |
| 25 | 85 | 59 | 72 | 0 | 7 | .05 | 75 | 46 | 61 | 4 | 0 | .02 | 62 | 35 | 49 | 16 | 0 | .02 |
| 26 | 84 | 58 | 71 | 0 | 6 | .05 | 75 | 45 | 60 | 5 | 0 | .02 | 62 | 35 | 48 | 17 | 0 | .02 |
| 27 | 84 | 58 | 71 | 0 | 6 | .05 | 74 | 45 | 60 | 5 | 0 | .02 | 62 | 35 | 48 | 17 | 0 | .02 |
| 28 | 84 | 57 | 71 | 0 | 6 | .05 | 74 | 45 | 59 | 6 | 0 | .01 | 62 | 34 | 48 | 17 | 0 | .02 |
| 29 | 84 | 57 | 70 | 0 | 5 | .05 | 73 | 44 | 59 | 6 | 0 | .01 | 61 | 34 | 48 | 17 | 0 | .02 |
| 30 | 83 | 57 | 70 | 0 | 5 | .04 | 73 | 44 | 58 | 7 | 0 | .01 | | | | | | |
| 31 | | | | | | | 73 | 44 | 58 | 7 | 0 | .01 | | | | | | |
| MONTHLY | 87.1 | 61.6 | 74.4 | 0 | 282 | 1.70 | 78.4 | 49.6 | 64.0 | 88 | 57 | .76 | 66.4 | 38.4 | 52.4 | 378 | 0 | .44 |
| AUTUMN | 77.4 | 49.9 | 63.7 | 466 | 339 | 2.90 | | | | | | | | | | | | |
| ANNUAL | 77.5 | 49.0 | 63.2 | 2708 | 2094 | 8.81 | | | | | | | | | | | | |

NOTES: DEGREE DAYS BASE TEMPERATURE = 65 DEG F; TEMPERATURE UNITS = DEG F;
PRECIPITATION UNITS = INCHES; * = LESS THAN 1 BUT GREATER THAN 0

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412797 - EL PASO WSO AP, TX

PROBABILITY THAT THE MONTHLY PRECIPITATION WILL BE
EQUAL TO OR LESS THAN THE INDICATED PRECIPITATION AMOUNT

MONTHLY PRECIPITATION (INCHES)

| PROB | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | ANN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .005 | .00 | .00 | .00 | .00 | .00 | .00 | .02 | .00 | .01 | .00 | .00 | .00 | 2.79 |
| .010 | .00 | .00 | .00 | .00 | .00 | .00 | .04 | .00 | .03 | .00 | .00 | .00 | 3.16 |
| .050 | .00 | .00 | .00 | .00 | .00 | .00 | .14 | .10 | .11 | .00 | .00 | .00 | 4.35 |
| .100 | .03 | .00 | .00 | .00 | .00 | .00 | .24 | .26 | .21 | .03 | .00 | .02 | 5.09 |
| .200 | .09 | .00 | .00 | .00 | .01 | .00 | .45 | .51 | .43 | .12 | .04 | .09 | 6.12 |
| .300 | .16 | .12 | .09 | .00 | .05 | .02 | .66 | .74 | .66 | .22 | .10 | .17 | 6.93 |
| .400 | .22 | .21 | .16 | .02 | .09 | .09 | .90 | .98 | .92 | .35 | .18 | .26 | 7.69 |
| .500 | .30 | .31 | .23 | .06 | .14 | .21 | 1.17 | 1.25 | 1.22 | .50 | .27 | .37 | 8.44 |
| .600 | .39 | .41 | .30 | .12 | .21 | .40 | 1.48 | 1.56 | 1.59 | .68 | .39 | .51 | 9.25 |
| .700 | .50 | .53 | .39 | .21 | .30 | .68 | 1.88 | 1.95 | 2.06 | .92 | .53 | .69 | 10.16 |
| .800 | .65 | .70 | .50 | .34 | .43 | 1.13 | 2.43 | 2.47 | 2.71 | 1.26 | .74 | .94 | 11.30 |
| .900 | .90 | .98 | .69 | .59 | .66 | 1.98 | 3.34 | 3.32 | 3.82 | 1.85 | 1.10 | 1.38 | 13.02 |
| .950 | 1.14 | 1.24 | .85 | .84 | .89 | 2.89 | 4.24 | 4.14 | 4.91 | 2.44 | 1.45 | 1.82 | 14.56 |
| .990 | 1.70 | 1.83 | 1.22 | 1.46 | 1.44 | 5.12 | 6.29 | 5.99 | 7.44 | 3.81 | 2.29 | 2.85 | 17.75 |
| .995 | 1.93 | 2.08 | 1.38 | 1.73 | 1.68 | 6.11 | 7.16 | 6.78 | 8.52 | 4.40 | 2.65 | 3.29 | 19.02 |

PRECIPITATION QUINTILES 1961-1990 (IN INCHES)

| LVL | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 < | .00 | .00 | .00 | .00 | .00 | .00 | .04 | .00 | .01 | .00 | .00 | .00 |
| 1 | .00 | .00 | .00 | .00 | .00 | .00 | .04 | .00 | .01 | .00 | .00 | .00 |
| | .09 | .00 | .00 | .00 | .01 | .00 | .45 | .51 | .43 | .12 | .04 | .09 |
| 2 | .10 | .00 | .00 | .00 | .02 | .00 | .46 | .52 | .44 | .13 | .05 | .10 |
| | .22 | .21 | .16 | .02 | .09 | .09 | .90 | .98 | .92 | .35 | .18 | .26 |
| 3 | .23 | .22 | .17 | .03 | .10 | .10 | .91 | .99 | .93 | .36 | .19 | .27 |
| | .39 | .41 | .30 | .12 | .21 | .40 | 1.48 | 1.56 | 1.59 | .68 | .39 | .51 |
| 4 | .40 | .42 | .31 | .13 | .22 | .41 | 1.49 | 1.57 | 1.60 | .69 | .40 | .52 |
| | .65 | .70 | .50 | .34 | .43 | 1.13 | 2.43 | 2.47 | 2.71 | 1.26 | .74 | .94 |
| 5 | .66 | .71 | .51 | .35 | .44 | 1.14 | 2.44 | 2.48 | 2.72 | 1.27 | .75 | .95 |
| | 1.23 | 1.69 | .99 | 1.42 | .83 | 3.18 | 5.53 | 5.57 | 6.68 | 3.12 | 1.63 | 2.87 |
| 6 > | 1.23 | 1.69 | .99 | 1.42 | .83 | 3.18 | 5.53 | 5.57 | 6.68 | 3.12 | 1.63 | 2.87 |

0=LESS THAN 30-YEAR MINIMUM
1=FIRST QUINTILE
2=SECOND QUINTILE
3=THIRD QUINTILE
4=FOURTH QUINTILE
5=FIFTH QUINTILE
6=MORE THAN 30-YEAR MAXIMUM

THESE VALUES WERE DETERMINED FROM THE INCOMPLETE GAMMA DISTRIBUTION.

# CLIMATOGRAPHY OF THE UNITED STATES NO. 84
## DAILY NORMALS OF TEMPERATURE, HEATING AND COOLING DEGREE DAYS, AND PRECIPITATION 1961-90

## PREFACE

This publication presents daily temperature, heating and cooling degree day, and precipitation normals for selected stations based on the 1961-90 record, adjusted to the present station location. The following elements are presented:

MAX = Maximum Temperature (°F)
MIN = Minimum Temperature (°F)
AVG = Average Temperature (°F)
HDD = Heating Degree Days (Standard Base of 65°F)
CDD = Cooling Degree Days (Standard Base of 65°F)
PCP = Precipitation (Inches)

The stations included in this publication are the National Weather Service Offices and Principal Climatological Stations included in Climatography of the United States No. 81 (1).

The daily values presented in these tables are not simple means of the observed daily values. They are interpolated from the much less variable monthly normals by use of the natural spline function as described by Greville (2). The procedure involved constructing a cumulative series of monthly sums from the monthly normals. The cumulative series was for a 24-month period (July, . . . December, January, . . . December, January, . . . June) so the interpolating function could adequately fit the end points of the annual series. This process was applied independently to all six elements. No normal values for February 29 are included here; in common practice the normal values for the 28th are used for the 29th in each leap year. Thus, for leap years, the February monthly total degree day values are calculated by adding the daily value for the 28th to the printed monthly total. The February temperature and precipitation monthly values are not adjusted for leap years.

The monthly heating and cooling degree day normals (base 65°F) are derived from the monthly normal temperatures using the technique developed by Thom (3), (4). An asterisk (*) for a daily degree day value indicates a daily normal of less than one degree day, but not equal to zero.

Environmental Information Summary C-28 has a more detailed discussion of the daily normals procedure and a discussion of the monthly precipitation probabilities and quintiles.

The EIS C-28 brochure and additional information about the climate of the city listed in this publication may be obtained from the NCDC, Federal Bldg., 37 Battery Park Avenue, Asheville, NC 28801-2733, or by calling 704-259-0682.

### References


1. Climatography of the United States No. 81, "Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days 1961-90."
2. Greville, T.N.E., "Spline Functions, Interpolation, and Numerical Quadrature," Mathematical Methods of Digital Computers, Volume 2 (edited by A. Ralston and H. S. Wilf). John Wiley and Sons, Inc., New York, 1967.
3. Thom, H.C.S., "The Rational Relationship Between Heating Degree Days and Temperature," Monthly Weather Review, Volume 82, No. 1, January 1954.
4. Thom, H.C.S., "Normal Degree Days Above Any Base by the Universal Truncation Coefficient," Monthly Weather Review, Volume 94, No. 7, July 1966.
5. Cover photo courtesy of Ruth Zirkle, Ute Pass Courier.

# APPENDIX G

# Hydraulic Conductivity of Three Geosynthetic Clay Liners

By Paula Estornell[1] and David E. Daniel[2]

Abstract: The hydraulic conductivity of three 2.9 $m^2$ (32 sq ft) geosynthetic clay liners (GCLs) was measured. Tests were performed on individual sheets of the GCLs, on overlapped pieces of GCLs, and on composite liners consisting of a punctured geomembrane overlying a GCL. Hydraulic conductivities of two of the GCLs were in the range of $10^{-10}$ to $10^{-8}$ cm/s. No flow was measured through the third GCL, but the conductivity was obviously very low ($<< 10^{-7}$ cm/s). The hydraulic conductivities of overlapped GCLs were about the same as those of the control samples with no overlap; an effective hydraulic seal developed along the overlaps in all of the materials tested. Performance of the punctured geomembrane-GCL composites varied—performance was best when the punctured geomembrane was placed directly against bentonite and no geotextile separated the punctured geomembrane from the bentonite. For those GCLs with geotextiles on both sides, problems with migration of bentonite into the underlying drainage layer were encountered when inadequate filtration was provided. However, with a suitable filtration layer separating the drainage layer from the GCL, problems with migration of bentonite were eliminated.

## Introduction

A layer of low-hydraulic-conductivity compacted soil is a required component of most liner and cover systems at waste-containment facilities. In the past few years, several thin, prefabricated, clay blankets, called geosynthetic clay liners (GCLs), have been developed and proposed as an alternative to compacted clay in liner and cover systems. Geosynthetic clay liners may supplement required components in waste-containment units or, as proposed by some, replace part or all of the low-hydraulic-conductivity compacted-soil liner (Daniel and Koerner 1991). Daniel and Estornell (1990), Eith et al. (1990), Grube (1991), and Grube and Daniel (1991) review advantages and disadvantages of GCLs for various waste-containment applications.

The research described in this paper was performed to develop technical information on the engineering properties of GCLs, to determine the hydraulic properties of GCLs and the overlapped seams, and to evaluate the composite behavior of geomembrane-GCL composite liners.

## Geosynthetic Clay Liners

Three geosynthetic clay liners (GCLs) were investigated: Bentomat, Claymax, and Paraseal/Gundseal. A fourth GCL, Bentofix (Scheu et al. 1990), manufactured in Germany, was not included in this study. The three GCLs investigated are shown in Fig. 1.

Bentomat is manufactured by the Colloid Environmental Technologies Co. (CETCO) in Villa Rica, Georgia. The material that was tested consisted of 4.9 kg/$m^2$ (1 lb/sq ft) of untreated, Volclay sodium bentonite ("CS" grade) sandwiched between woven and nonwoven geotextiles that are needle punched together (Fig. 1) to contain the bentonite and to enhance in-plane shear strength.

Claymax is manufactured by the James Clem Corp. in Fairmont, Georgia. The material that was tested consisted by 4.9 kg/$m^2$ (1 lb/sq ft) of sodium bentonite sandwiched between two woven geotextiles (Fig. 1). The lower geotextile is a lightweight, open-weave, spun-lace polyester with large openings. A water-soluble glue is mixed with the bentonite to hold the components together until the GCL has been installed.

Paraseal/Gundseal is manufactured by Gundle Lining Systems, Inc., and Paramount Technical Products, Inc., (see Appendix I) in Spearfish, South Dakota. The material that was tested consisted of 4.9 kg/$m^2$ (1 lb/sq ft) of sodium bentonite mixed with an adhesive and attached to a 0.5 mm (20 mil) thick high-density polyethylene (HDPE) geomembrane (Fig. 1). Material tested in this study was Paraseal, but Paraseal and Gundseal are functionally identical.

Geosynthetic clay liners are manufactured in panels with widths of 4–5 m (13–17 ft) and lengths of 25–60 m (80–200 ft). The panels are placed on rolls at the factory and unrolled at the time of installation. The panels are overlapped 75–225 mm (3–9 in.) during installation and are said to be self-sealing at the overlap. Fig. 2 shows a sketch of the overlap zones. In the case of Bentomat, additional sodium bentonite is placed along the overlap at a rate of 0.4 kg/m (0.25 lb/ft). The bentonite penetrates the pores

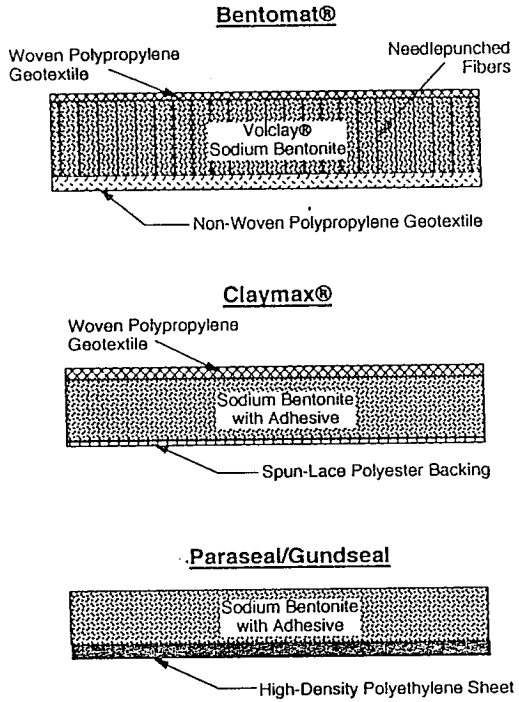


FIG. 1. Geosynthetic Clay Liners

[1]Geotech. Engr., Hart-Crowser Assoc., 1910 Fairview Ave. E., Seattle, WA 98102.
[2]Prof. of Civ. Engrg., Univ. of Texas, Austin, TX 78712.

Note. Discussion open until March 1, 1993. To extend the closing date one month, a written request must be filed with the ASCE Manager of Journals. The manuscript for this paper was submitted for review and possible publication on September 20, 1991. This paper is part of the *Journal of Geotechnical Engineering*, Vol. 118, No. 10, October, 1992. ©ASCE, ISSN 0733-9410/92/0010-1592/$1.00 + $.15 per page. Paper No. 2605.





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G-1

of the geotextiles, and the manufacturer says it causes the material to self-seam when the bentonite hydrates.

Claymax panels are normally placed with the open-weave, polyester backing facing downward (Fig. 2). When the bentonite hydrates, the manufacturer states that the bentonite oozes out through the openings in the geotextiles and causes the material to self-seal.

With Gundseal, the GCL can be placed with the bentonite facing upward or, as shown in Fig. 2, downward. The material is said to be self-sealing at the overlap. Although no mechanical joining of overlapped seams is necessary for any of the GCLs, the HDPE sheets in Gundseal can be welded together along the overlaps, if desired, but a thicker HDPE sheet than the usual 0.5-mm (20-mil) sheet would be required. Gundseal would be placed with the bentonite facing upward if a separate, conventional geomembrane lining is to be placed on top of the GCL.

More information about GCLs is available from the manufacturers and from Schubert (1987), Daniel and Estornell (1990), Shan (1990), Eith et al. (1990), Bruton (1991), Estornell (1991), Grube (1991), Grube and Daniel (1991), Shan and Daniel (1991), and Trauger (1991).

## Experimental Methods

Steel tanks, shown schematically in Fig. 3, were fabricated for bench-scale hydraulic conductivity tests. The tanks measured 2.4 m (8 ft) long, 1.2 m (4 ft) wide, and 0.9 m (3 ft) tall. A 13 mm (0.5 in.) diameter drainage

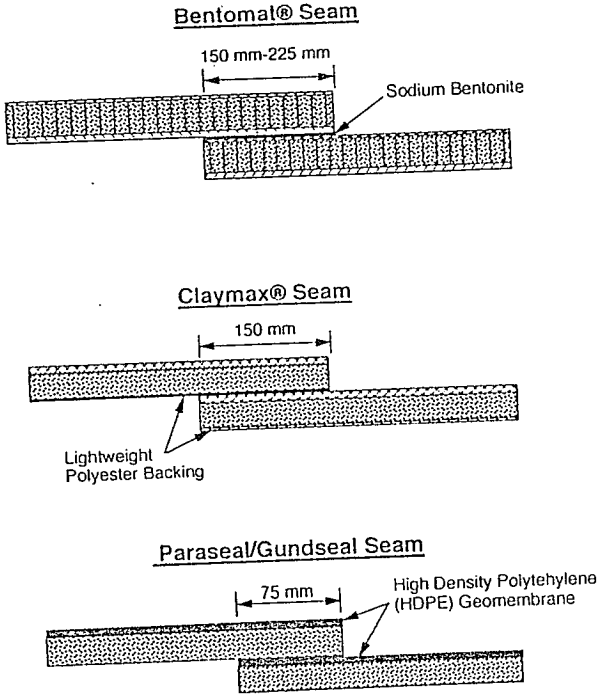


FIG. 2. Configuration of Overlapped Seams with Manufacturers' Minimum Recommended Overlap Width



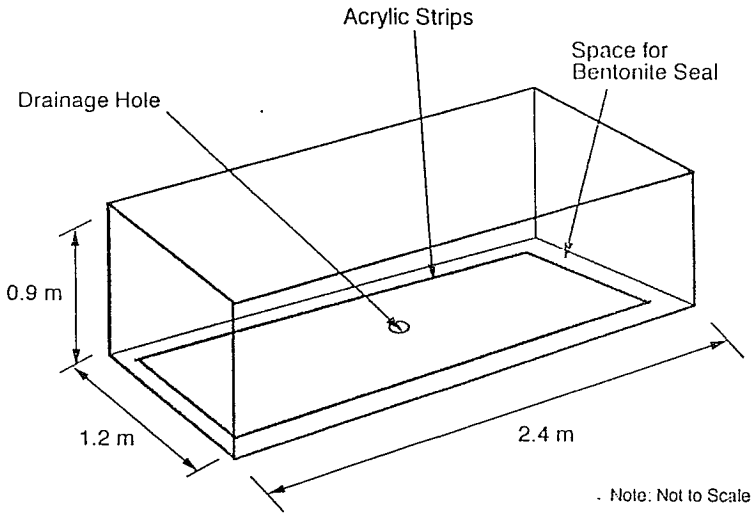


FIG. 3. Orthogonal View of Tank Used for Bench-Scale Hydraulic Conductivity Tests

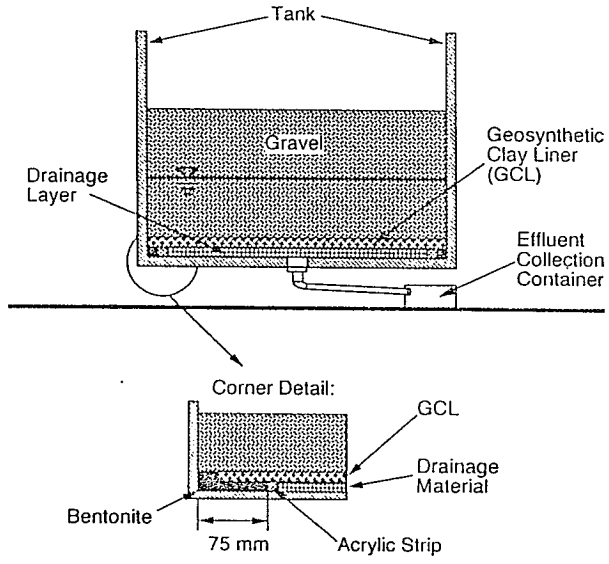


FIG. 4. Cross-Sectional View of Configuration of Materials in Tanks

hole was drilled in the center of the base (Fig. 3) of each tank. The inside walls of the tanks were coated with epoxy. The tanks were raised about 150 mm (6 in.) off the floor with wooden supports.

Acrylic fittings with PVC elbows and flexible plastic tubes were attached to the drainage holes at the bottom of each tank, as shown in Fig. 4. This outlet system provided a closed channel for effluent drainage. In addition, 6.4 mm by 6.4 mm (1/4 in. by 1/4 in.) acrylic strips were glued to the bottoms

of the tanks in a rectangular pattern, as shown in Fig. 3. The acrylic strips provided a 75 mm (3 in.) wide space around the edges of the tanks to retain bentonite that was placed to seal the GCLs against the edges of the tanks.

To conduct a test, a 2.3 m (7.5 ft) long by 1.1 m (3.5 ft) wide sheet of geotextile/geonet/geotextile composite (Gundnet) was centered and placed on the bottom surface of the tank. The Gundnet was cut smaller than the area of the tank to create a 75 mm (3 in.) wide space between the drainage material and edge of the tank to accommodate a bentonite seal (Fig. 4). The geotextile that separated the geonet from the GCLs was a 200 g/cm$^2$ (6 oz/sq yd), nonwoven geotextile with an apparent opening size of 0.15–0.25 mm.

Next, dry bentonite was placed in the space between the drainage material and the walls of the tank. A photograph of the seal and the drainage material is shown in Fig. 5. The GCL being tested was then placed over the drainage composite and bentonite edge seal, with the edges of the GCL either going to the edges of the steel tank (first test set) or within 25 mm (1 in.) of the edge of the tank (subsequent test sets). The spaces between the edges of the GCLs and the walls of the tank were filled with dry bentonite.

Next, a 300 or 600 mm (1 or 2 ft) thick layer of gravel was placed over the GCL with a front-end loader. The gravel had dry and saturated unit weights of 15.4 and 19.3 kN/m$^3$ (98 and 123 pcf), respectively, and a hydraulic conductivity of 5 cm/s (Estornell 1991). The tank was then slowly filled with water over a period of several days. The depth of water was then kept constant. The first set of tests was performed with a 300 mm (1 ft) thick gravel layer and 600 mm (2 ft) of water ponded on the GCLs. These conditions produced a calculated vertical effective stress of 3 kPa (0.4 psi) at the top of the GCL and 9 kPa (1.3 psi) at the bottom. The vertical effective stress was increased in the second and subsequent series of tests by increasing the thickness of gravel to 600 mm (2 ft) and decreasing the water depth to 300 mm (1 ft); the calculated effective stress acting on the top and bottom surface of the GCLs was 8 kPa (1.1 psi) and 10 kPa (1.5 psi), respectively.

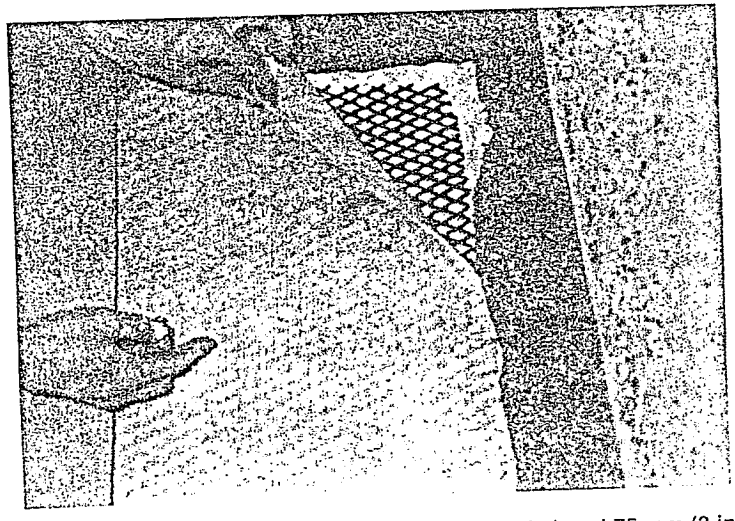

FIG. 5. Drainage Material (Geotextile/Geonet Composite) and 75 mm (3 in.) Wide Bentonitic Edge Seal



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Effluent water passing through the drainage hole was collected and weighed to determine the flux of water. Corrections were made to account for evaporation of water from collection pans. Tests were continued until the flux was steady. Except for Gundseal, steady flow was achieved after one to two and a half months, at which point outflow readings varied by no more than ±10%. For Gundseal, no outflow from any of the tanks occurred during more than five months of testing.

Hydraulic conductivity was calculated from Darcy's law for those GCLs that produced flow. It was assumed that the head loss was constant and that the pressure head was zero on the base of the GCL. The hydrated thicknesses of the GCLs (9.4 mm for Bentomat and 16–18 mm for Claymax), which were used to calculate hydraulic conductivity, were determined from laboratory swelling tests. Hydraulic gradient was typically in the range of 30–60.

Three types of tests were performed (Fig. 6). One type of test was a control test on individual sheets of GCL material that had no overlap. The second type of test was on overlapped sheets of GCL material. For Bentomat, sodium bentonite was placed along the overlap at the manufacturer's recommended rate, as shown in Fig. 7. Placement of Claymax overlaps is shown in Fig. 8. Placement of a Gundseal overlap is shown in Fig. 9 for the test with the HDPE facing upward.

At least one test was performed using the minimum overlap width rec-

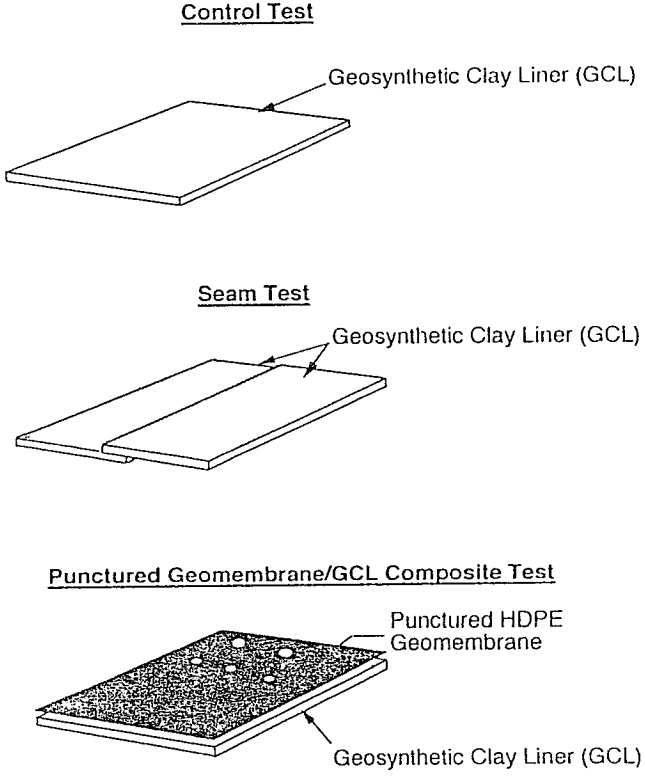


FIG. 6. Schematic Diagram of Types of Tests Performed in Tanks

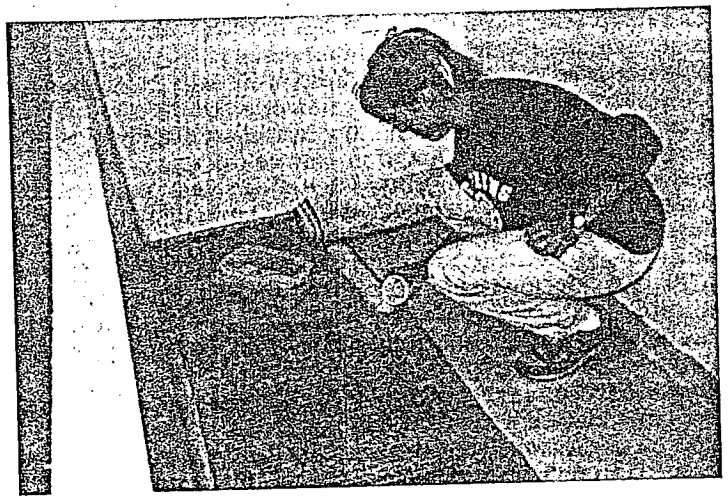

FIG. 7. Placement of Bentomat with Overlapped Seam (Note Spreading of Granular Bentonite along Overlapped Zone)

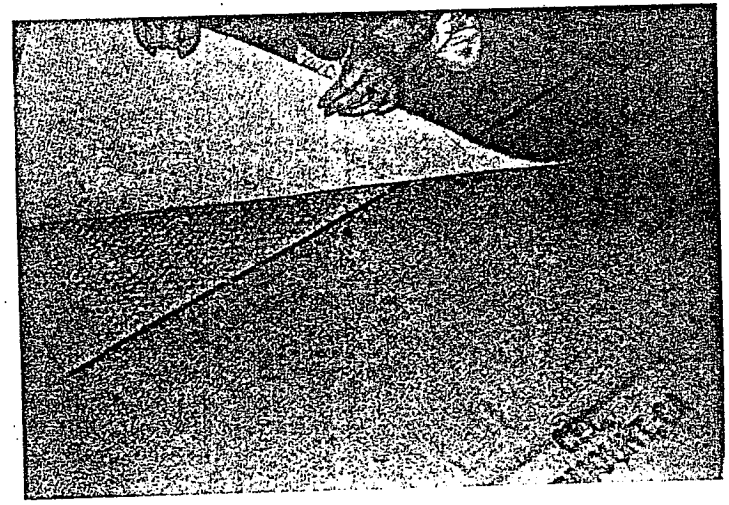

FIG. 8. Placement of Claymax with Overlapped Seam

ommended by the manufacturer [150 mm (6 in.) for Bentomat and Claymax, and 75 mm (3 in.) for Paraseal/Gundseal], and at least one test was conducted using half of the minimum recommended overlap width.

The third type of test (Fig. 6) involved a composite with the GCL overlain by a 1.5 mm (60 mil) HDPE geomembrane. Punctures that were made in the geomembrane included two 75 mm (3 in.) diameter holes, three 25 mm (1 in.) diameter holes, and three 600 mm (2 ft) long slits that were about 1 mm wide (Fig. 6).

Small-scale hydraulic conductivity tests were conducted on 100 mm (4 in.) diameter specimens. Flexible-wall permeameters were used, and pro-



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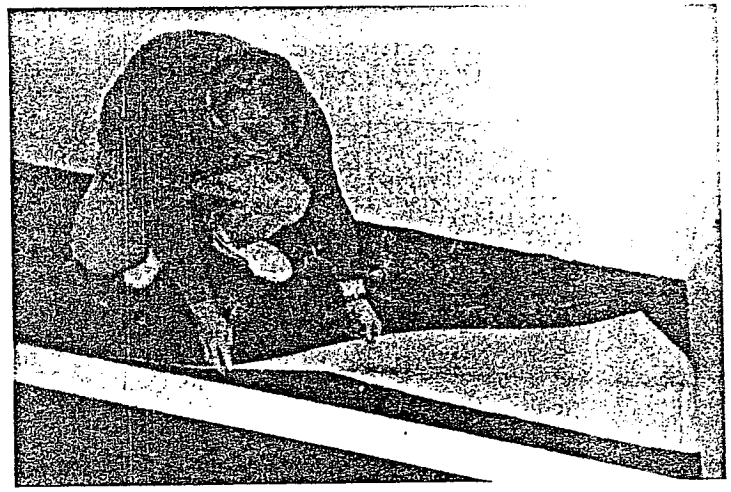

FIG. 9. Placement of Gundseal with Overlapped Seam

cedures outlined in ASTM method D5084 were generally followed. Only Bentomat was tested during this study. Tests on Claymax were performed by Shan (1990) and were not repeated. Hydraulic conductivity data for all the materials were obtained from sources cited in the next section.

## Results of Laboratory Hydraulic Conductivity Tests

The results of flexible-wall hydraulic conductivity tests on the three geosynthetic clay liners are shown in Table 1 and Fig. 10. Hydraulic conductivities of all three GCLs were in the range of $3 \times 10^{-10}$ to $6 \times 10^{-9}$ cm/s. Hydraulic conductivity has a tendency to decrease with increasing effective stress. Individuals who compare hydraulic conductivities of different materials should be careful to compare values measured at the same maximum effective stress.

## Results of Bench-Scale Tests

### Bentomat and Claymax: Tests on Control and Overlapped Samples

Two control tests (no overlapped seam) were performed on 1.2 m by 2.4 m (4 ft by 8 ft) samples. Hydraulic conductivities are summarized in Table 2. The hydraulic conductivity of Claymax measured in the bench-scale tanks compared reasonably well with results of flexible-wall hydraulic conductivity tests performed on small test specimens at similar effective stress. However, with Bentomat, the hydraulic conductivity in the bench-scale tanks was about 10 times lower than values measured in flexible-wall permeameters.

Possible sources of error in the tests on Bentomat were considered. In flexible-wall permeability tests, problems were initially encountered with loss of bentonite near the edges during preparation of test specimens, which led to high flow rates near edges. The problem was minimized by hydrating an oversized test specimen, trimming the moist specimen, and smearing the edge of the test specimen with additional bentonite paste. Despite these procedures, the edge seal may still have been imperfect.

TABLE 1. Results of Laboratory Hydraulic Conductivity Tests

| Material (1) | Source of information (2) | Maximum Effective Confining Stress | | Hydraulic conductivity (cm/s) (5) |
|---|---|---|---|---|
| | | kPa (3) | psi (4) | |
| Bentomat | GeoSyntec (1991a) | 35 | 5 | $1 \times 10^{-9}$ |
| | J&L Testing Co. (1990) | 56 | 8.2 | $6 \times 10^{-9}$ |
| | | 73 | 10.6 | $1 \times 10^{-9}$ |
| | | 91 | 13.2 | $1 \times 10^{-9}$ |
| | This study | 14 | 2 | $3 \times 10^{-9}$ |
| | | 34 | 5 | $3 \times 10^{-9}$ |
| | | 69 | 10 | $1 \times 10^{-9}$ |
| Claymax | Chen-Northern (1988) | 24 | 3.5 | $2 \times 10^{-9}$ |
| | Geoservices (1988) | 200 | 29 | $4 \times 10^{-10}$ |
| | Geoservices (1989) | 207 | 30 | $8 \times 10^{-10}$ |
| | | 207 | 30 | $3 \times 10^{-10}$ |
| | | 207 | 30 | $7 \times 10^{-10}$ |
| | Geoservices (1990) | 207 | 30 | $3 \times 10^{-10}$ |
| | GeoSyntec (1990) | 6.9 | 1 | $2 \times 10^{-9}$ |
| | GeoSyntec (1990) | 10.3 | 1.5 | $4 \times 10^{-9}$ |
| | Shan (1990) | 14 | 2 | $2 \times 10^{-9}$ |
| | | 34 | 5 | $1 \times 10^{-9}$ |
| | | 69 | 10 | $6 \times 10^{-10}$ |
| | | 138 | 20 | $3 \times 10^{-10}$ |
| Gundseal | GeoSyntec (1991b) | 14 | 2 | $2 \times 10^{-9}$ |
| | Shan and Daniel (1991) | 14 | 2 | $2 \times 10^{-9}$ |
| | GeoSyntec (1991c) | 34 | 5 | $1 \times 10^{-9}$ |

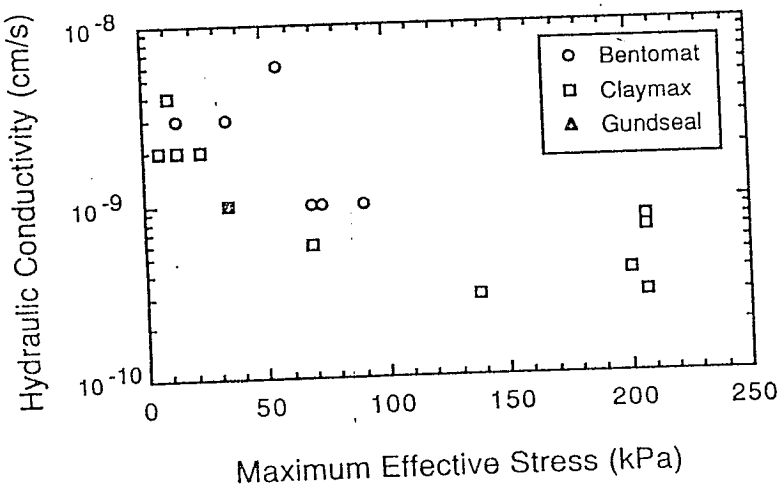


FIG. 10. Results of Flexible-Wall Hydraulic Conductivity Tests



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TABLE 2. Comparison of Hydraulic Conductivities Measured on Unseamed Pieces of Bentomat and Claymax

| Material (1) | RESULTS FROM BENCH-SCALE TANK TESTS | | | Hydraulic conductivity measured with flexible-wall permeameters (Fig. 10) (cm/s) (5) |
|---|---|---|---|---|
| | Average Effective Confining Stress | | Hydraulic conductivity (cm/s) (4) | |
| | kPa (2) | psi (3) | | |
| Bentomat | 6 | 0.9 | $4 \times 10^{-10}$ | $4 \times 10^{-9}$ |
| Bentomat | 9 | 1.3 | $4 \times 10^{-10}$ | $4 \times 10^{-9}$ |
| Claymax | 6 | 0.9 | $1 \times 10^{-8}$ | $3 \times 10^{-9}$ |
| Claymax | 6 | 0.9 | $8 \times 10^{-9}$ | $3 \times 10^{-9}$ |

TABLE 3. Hydraulic Conductivity of Overlapped Samples of Bentomat and Claymax

| Material (1) | Series (2) | Effective Stress (kPa) | | | Hydraulic Conductivity (cm/s) | |
|---|---|---|---|---|---|---|
| | | Top (3) | Bottom (4) | Control (no overlap) (5) | 150 mm (6 in.) overlap (6) | 75 mm (3 in.) overlap (7) |
| Bentomat | 1 | 8 | 10 | $4 \times 10^{-10}$ | $4 \times 10^{-10}$ | $1 \times 10^{-9}$ |
| | 2 | 8 | 10 | $4 \times 10^{-10a}$ | — | — |
| Claymax | 1 | 3 | 9 | $1 \times 10^{-8}$ | $3 \times 10^{-8}$ | $9 \times 10^{-8}$ |
| | 2 | 8 | 10 | $8 \times 10^{-9}$ | $9 \times 10^{-9}$ | $1 \times 10^{-8}$ |
| | 3 | 8 | 10 | $7 \times 10^{-9a}$ | — | — |

[a]Clay blanket underlain by Trevira 1135 geotextile filter.

In the tank tests on Bentomat, migration of bentonite out of the GCL and into the underlying materials may have reduced the flux of water through the GCL. When the first set of tests was dismantled, grey bentonite was visible in the geotextile/geonet/geotextile composite drainage material beneath both the Bentomat and the Claymax specimens. In the final series of tests, a thick, nonwoven geotextile was placed between the Bentomat and Claymax and the underlying Gundnet drainage composite. The geotextile was a Trevira 1135 fabric with a weight of 356 g/m$^2$ (10.5 oz/sq yd) and an apparent opening size of 0.13–0.21 mm. The thick geotextile filter stopped downward movement of bentonite from Bentomat and Claymax during the three-month testing period: bentonite could be seen on the upper surface of the geotextile filter but not in the bulk of the geotextile nor in the underlying drainage layer. However, with respect to the hydraulic conductivity anomalies, problems with bentonite migration were about the same for Bentomat and Claymax, and yet the comparison of results from tank tests and flexible-wall-permeameter tests was much different (Table 2). The writers were unable to isolate the cause for the discrepancy in hydraulic conductivity of Bentomat measured in flexible-wall permeameters and bench-scale tanks. Further investigation is recommended.

The results of tests on overlapped sheets of Bentomat and Claymax are summarized in Table 3. When the manufacturers' recommended minimum overlap width of 150 mm (6 in.) was maintained, the overall hydraulic conductivity of the overlapped panels was about the same as the hydraulic

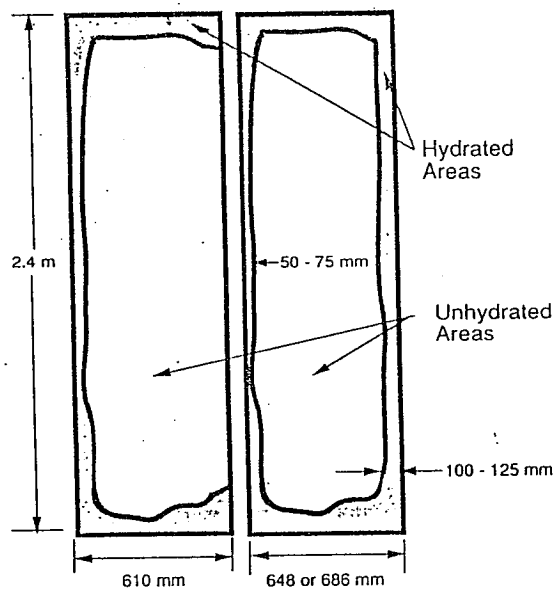


FIG. 11. Pattern of Wetting of Bentonite in Overlapped Gundseal when HDPE Faced Upward

conductivity of nonoverlapped, control panels. The GCLs self-sealed along the overlaps in these bench-scale tests.

When the overlap width for Claymax panels was reduced to half the minimum recommended value, the overall hydraulic conductivity of the overlapped panels was 1.2–9 times higher than the hydraulic conductivity of the control specimens, depending on the vertical stress applied to the specimens. For tests with effective stress greater than 7 kPa (1 psi), the performance of a narrow overlay of Claymax was better than for tests in which a lower effective stress was used. The differences between control and overlapped specimens may simply have been due to variations in the materials themselves; multiple tests for statistical purposes were infeasible due to the great time, effort, and expense associated with each of the tank tests. Intuitively, however, one would expect that the hydraulic integrity of the overlap might be more sensitive to the width of the overlap when the vertical stress is small. Overburden stress is probably needed for the Claymax seams to work because it appears that with little or no overburden, the bentonite simply expands unevenly when wetted and does not ooze through the openings of the geotextile and form a seal.

When the overlap width of Bentomat was reduced to half the minimum recommended value of 150 mm (6 in.), the hydraulic conductivity was 2.5 times greater than the value measured on the control sample with no overlap or the value measured on panels with the minimum 150-mm (6-in.) overlap (Table 3). Again, the difference may simply be the result of material variability. No tests were performed on Bentomat at the lower range of effective stress used for the first test series on Claymax.

### Gundseal: Tests on Control and Overlapped Samples

Five tests were performed on Gundseal. In the first series, the HDPE geomembrane faced upward, the calculated effective stress was between 3



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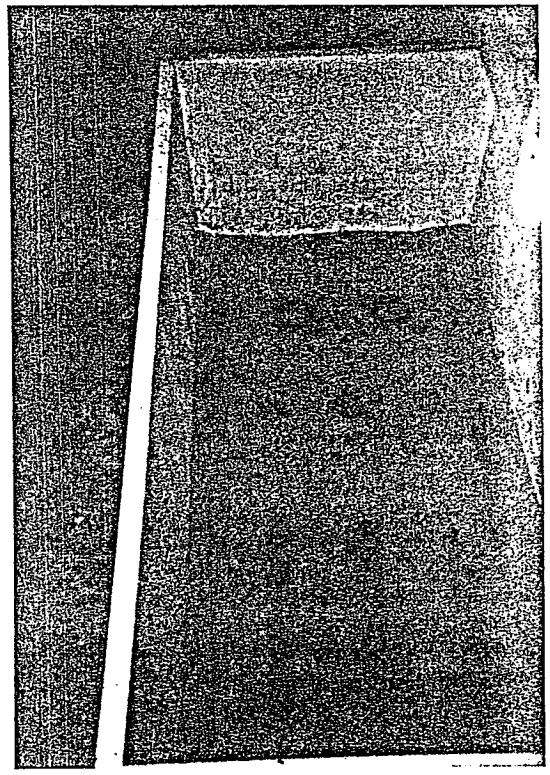

FIG. 12. Pattern of Wetting of Bentonite in Gundseal after Overlying Gravel and Punctured Geomembrane had been Removed from Tanks

TABLE 4. Results of Tests on Punctured Geomembrane/GCL Composites

| Material (1) | Hydraulic Conductivity (cm/s) | | Conductivity ratio: column 3 divided by column 2 (4) |
|---|---|---|---|
| | Control (no geomembrane) (2) | Composite (with punctured geomembrane) (3 | |
| Bentomat | $4 \times 10^{-10}$ | $6 \times 10^{-10}$ | 1.5 |
| Claymax | $7 \times 10^{-9}$ | $7 \times 10^{-9}$ | 1.0 |

and 9 kPa (0.4 and 1.3 psi), and the overlap widths were 75 mm (3 in.) and 38 mm (1.5 in.). A test on a control sample with no overlap was also performed. After five months of testing, no outflow was observed from any of the tanks. The tanks were dismantled, and it was found that the bentonite was wetted approximately 100–125 mm (4–5 in.) around the edges and 50–75 mm (2–3 in.) along the overlap (Fig. 11). Otherwise, the bentonite was not wetted. The tests on overlapped seams indicate that the minimum recommended overlap width contains a factor of safety under these test conditions.

In the second series, two tests were performed with the bentonite facing

upward. The calculated effective stress was between 8 and 10 kPa (1.1 and 1.5 psi), and the overlap width was 0 (control test) or 75 mm (3 in.). After five months, no outflow was detected. There was still some unhydrated bentonite in the overlapped areas at the end of the tests.

### Composite GCL/Punctured Geomembrane

The puncture pattern in the geomembranes that were placed on top of the GCLs is shown in Fig. 2. Vertical effective stress varied from 8–10 kPa (1.1–1.4 psi), and a pressure head of 300 mm (1 ft) of water was maintained on the materials tested.

With Gundseal, water penetrated the bentonite at the defects, but water migrated < 75 mm (3 in.) from the defects over the five-month testing period (Fig. 12). Effective composite action was obvious: the bentonite sealed off defects in the geomembrane and the GCL prevented outflow of water from the punctured geomembrane/GCL composite.

With tests involving Bentomat and Claymax, outflow did occur. An apparent hydraulic conductivity was calculated, assuming one-dimensional flow through the entire cross-sectional area of the GCL; results are shown in Table 4. Hydraulic conductivities of the punctured geomembrane/GCL composites were about the same as those of the GCLs alone. When the tests were dismantled after about three months of permeation, it was found that the bentonite was fully hydrated over the entire area of the Bentomat and Claymax sheets. It is assumed that water flowed through the punctures in the geomembranes, spread laterally through the geotextile that separated the bentonite from the geomembrane, and soaked the GCL. Once the bentonite was wetted, the high in-plane transmissivity of the geotextile that separated the punctured geomembrane from the bentonite provided an avenue for water to spread laterally from the punctures and permeate the GCLs. However, in-plane transmissivity of geotextiles tends to decrease with increasing vertical stress; the vertical stress used in these tests was low.

## Conclusions

Bench-scale hydraulic conductivity tests were performed on three geosynthetic clay liners (GCLs). The purpose of the tests was to determine: (1) Whether overlapped seams self-seal when the bentonite in the GCL is hydrated; and (2) whether the bentonite forms a seal against an overlying, punctured geomembrane. Conclusions drawn from this study are as follows:

1. The GCLs that were placed in large tanks self-sealed at overlaps when the bentonite was hydrated. Except for the case where low (< 7 kPa or 1 psi) vertical effective stress was employed, the hydraulic conductivities of overlapped materials were almost identical to values measured on control samples with no overlap.
2. For tests in which the minimum vertical effective stress was greater than 7 kPa (1 psi), the overlap width could be reduced as much as 50% below the minimum values recommended by the manufacturers without significantly increasing the overall hydraulic conductivity of overlapped panels. For the carefully controlled test conditions employed in this investigation, there was a factor of safety built into the manufacturers' minimum recommended overlap widths.
3. Bentonite was found to migrate vertically out of the two GCLs that contained bentonite between two geotextiles and into the underlying drainage layer when adequate filtration was not provided. Bentonite consistently migrated through a 200 g/m² (6 oz/sq yd), nonwoven, needle-punched geotextile with an apparent opening size of 0.15–0.25 mm and into an underlying geonet. However, bentonite migration was stopped during the three-month testing period by a 356 g/m² (10.5 oz/sq yd) nonwoven, needle-punched geotextile with an apparent opening size of 0.13–0.21 mm.
4. The effectiveness of composite action between a punctured geomembrane and the bentonite in the GCLs depended on whether a geotextile separated the punctured geomembrane from the bentonite. Good composite behavior was observed when the bentonite was in direct contact with the punctured geomembrane; liquid migrated laterally no more than about 75 mm (3 in.) from the punctures. Less effective composite action was observed when a geotextile separated the bentonite from the geomembrane.



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# Stress-Strain-Strength Responses of Compressible Chicago Glacial Clays

By Richard J. Finno,[1] Member ASCE, and Choong-Ki Chung[2]

ABSTRACT: The stress-strain-srength responses of compressible Chicago glacial clays are presented.These clays are lightly overconsolidated supra- or subglacial tills. Fixed piston and Shelby tube samples from various locations in the Chicago area were subjected to an extensive laboratory testing program, including index property, consolidation, direct shear, and $K_o$-consolidated, and undrained triaxial compression and extension tests. Results of the experimental program indicated the strengths of tills can be normalized when proper consideration is given to variations in natural water content. The different undrained strengths in compression and extension indicate that the clays exhibit stress-induced anisotropy. Initial undrained elastic moduli of the clays vary systematically with the overconsolidation ratio. Comparisons are made between strengths computed from relations based on normalized undrained strengths determined in the laboratory and those based on in-situ tests made at several locations. These data suggest that field vane strengths represent a conservative index of undrained shear strength for these Chicago clays.

## Introduction

This paper describes the laboratory behavior of compressible Chicago glacial clays. These clays are low-to-medium plastic clays, which are typical of many deposits in the Great Lakes area (Wu 1958). There is a dearth of published information concerning the shearing properties of these clays, which is surprising given the extensive developoment of this area. This paper reviews the geology of the compressible clays, describes the experimental program, and presents the results of conventional index, consolidation, and shear tests, as well as $K_o$-consolidated undrained ($CK_oU$) triaxial compression (TXC) and extension (TXE) tests. Results of these triaxial tests are expressed in terms of normalized soil parameters. Undrained shear strengths based on these normalized soil parameters are compared to results of in-situ tests conducted at the two sites where most of the specimens were obtained.

## Geology of Chicago Clays

The soils in the Chicago area are primarily glacially derived, and only the most recent advance of the continental glaciers left deposits in significant quantities. Bretz (1939) and Otto (1942) suggested that the soil was deposited in six fairly distinct till sheets during the Wisconsin stage of the Pleistocene epoch; in order of deposition, they are the Valparaiso, Tinley, Park Ridge, Deerfield, Blodgett, and Highland Park tills. Otto (1942) identified each till on the basis of water content and unconfined compression strength

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# Section 11

## Leachate Concentration Data

| Constituent | CAS No. | MCL mg/L | Recommended Input Conc. mg/L | Minimum Dilution Attenuation Factor |
|---|---|---|---|---|
| 2,4 - Dichlorophenoxy acetic acid | 94-75-7 | 0.1 | 10.0 | 100.0 |
| 1,4 - Dichlorobenzene | 106-46-7 | 0.075 | 7.5 | 100.0 |
| 1,2 - Dichloroethane | 107-06-2 | 0.005 | 0.5 | 100.0 |
| 1,1 - Dichloroethylene | 75-35-4 | 0.007 | 0.7 | 100.0 |
| Endrin | 72-20-8 | 0.0002 | 0.05 | 250.0 |
| Fluoride | | 4.0 | | |
| Lindane | 58-89-90 | 0.004 | 0.4 | 100.0 |
| Lead | 7439-92-1 | 0.05 | 5.0 | 100.0 |
| Mercury | 7439-97-6 | 0.002 | 0.2 | 100.0 |
| Methoxychlor | 72-43-5 | 0.1 | | 100.0 |
| Nitrate | | 10.0 | | |
| Selenium | 7782-49-2 | 0.01 | 1.0 | 100.0 |
| Silver | 7440-22-4 | 0.05 | 5.0 | 100.0 |
| Toxaphene | 8001-35-2 | 0.005 | 0.5 | 100.0 |
| 1,1,1 - Trichloromethane | | 0.2 | | |
| Trichloroethylene | 79-01-6 | 0.005 | 1.3 | 260.0 |
| 2,4,5- Trichlorophenoxy acetic acid | 93-72-1 | 0.01 | 1.0 | 100.0 |
| Vinyl Chloride | 75-01-4 | 0.002 | 0.2 | 100.0 |
| Benzene | 71-43-2 | 0.005 | 0.814 | 163.0 |

point of compliance, $C_p$.

$$DAF = \frac{C_o}{C_p}$$

Therefore, if $C_o$ is equivalent to 1, then with the calculation of the DAF, the predicted concentrations at the Point of Compliance will be dependent on the input leachate concentrations. The TWC has tabulated in Table 2 the recommended input concentrations for use in Multimed (or other fate and transport models) when site-specific-leachate data are not available. Values considered for recommended input concentrations were taken from USEPA's "Draft Background Document Summary of Data on Municipal Solid Waste Landfill Leachate Characteristics: July 1988, and the Toxicity Characteristic Leaching Procedure (TCLP) in 40 CFR §261.62. The greater of the values for each constituent is the recommended input concentration.

For concentrations used in the alternate design demonstration, the designer may:

1. Use the concentrations for the municipal solid waste landfills found in Table 2: or

2. Submit a proposal for a site characterization study for the alternate design.

Values in Table 2 will be revised as more leachate data become available. The designer should contact the TWC prior to commencing with design of a site to ensure the values listed are current or to obtain an updated list.

**Table 2**
**Leachate Evaluation**

| Constituent | CAS No. | MCL mg/L | Recommended Input Conc. mg/L | Minimum Dilution Attenuation Factor |
|---|---|---|---|---|
| Arsenic | 7440-38-2 | 0.05 | 5.0 | 100.0 |
| Barium | 7440-39-3 | 1.0 | 100.0 | 100.0 |
| Cadmium | 7440-43-9 | 0.01 | 1.0 | 100.0 |
| Carbon tetrachloride | 56-23-5 | 0.005 | 0.5 | 100.0 |
| Chromium (hexavalent) | 7440-47-3 | 0.05 | 5.0 | 100.0 |

# Texas Water Commission
# Alternate Liner Design Handbook
# A Performance Standard As Authorized By
# 31 Texas Administrative Code Section 330.202

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# LEACHATE CHARACTERISTICS FOR MISSOURI SANITARY LANDFILLS

Lee D. Tharp, P.E.[1]

## Abstract

Leachate management is a crucial issue that must be addressed during landfill design. To compile a detailed database of leachate chemical characteristics, the Missouri Department of Natural Resources (MDNR) ha in recent years required as permit conditions that sanitary landfills sample for and analyze semiannually certain metals and annually for hazardous waste characteristics, in accordance with 40 CFR Part 261. The original goal was to determine if sanitary landfill leachate is characteristically hazardous. The data indicates that it is not characteristically hazardous for the eight inorganic parameters specified in 40 CFR Part 261. The organic parameters required by TCLP for hazardous waste characterization are not included because of the lack of data.

Data from 13 sanitary landfills is provided with a total of 121 sampli events. One of the landfills is in the St. Louis area, although it is on the Illinois side of the Mississippi River. The sampling and analysis of the leachates were done by the individual landfills or the contracted private laboratories. The MDNR did not have requirements o laboratory QA/QC or sampling techniques. Data for two of the landfill was obtained from the local sewer district and was not a requirement o the individual landfill permits. All of the laboratory data is assume to be accurate, however it cannot be confirmed.

The data is presented along with ranges of values reported in the literature. For nearly all parameters the data is on the low side of the range reported in the literature. There is some question about wh methods should be used in sample preparation when analyzing for metals specifically with respect to filtering.

## Introduction

Until the early 1970s land disposal of municipal solid waste was unregulated and uncontrolled in comparison to today's standards.

---

[1]Chief, Landfill Permits Unit, Solid Waste Management Program, Missouri Department of Natural Resources

Presented at the Fourteenth Annual Madison Waste Conference, September 25-26, 1991, Department of Engineering Professional Development, University of Wisconsin-Madison.

Table 2
Leachate Sampling Results For 11
Sanitary Landfills

| Constituent | # of Samples | Low (mg/l) | High (mg/l) | Mean (mg/l) | Range Reported (mg/l)(1) |
|---|---|---|---|---|---|
| pH | 33 | 6.15 | 9.6 | 7.36 | 1.5-9.5 |
| BOD (mg/l) | 13 | 6.0 | 505 | 153.5 | 9-64,500 |
| COD (mg/l) | 16 | ND | 2400 | 798.9 | 0-97,900 |
| Arsenic (mg/l) | 33 | ND(0.001) | 0.13 | 0.0155 | ND-70.2 |
| Barium (mg/l) | 34 | ND(0.01) | 205 | 7.13 | ND-9.0 |
| Boron (mg/l) | 15 | 0.15/ND(10) | 6.9 | 2.07 | 0.42-70 |
| Cadmium (mg/l) | 39 | ND(0.001) | 0.10 | 0.02 | ND-1.16 |
| Chloride (mg/l) | 20 | 7.35 | 5031 | 1099.6 | 5-5,590 |
| Chromium (mg/l) | 37 | ND(0.005) | 0.2 | 0.022 | ND-22.5 |
| Copper (mg/l) | 24 | ND(0.005) | 0.08 | 0.019 | ND-9.9 |
| Fluoride (mg/l) | 13 | ND(0.05) | 6.47 | 1.19 | 0.1-1.3 |
| Lead (mg/l) | 37 | ND(0.003) | 0.654 | 0.039 | ND-6.6 |
| Mercury (mg/l) | 39 | ND(0.00001) | 0.032 | 0.0013 | ND-0.16 |
| Nickel (mg/l) | 28 | ND(0.01) | 0.74 | 0.078 | ND-3.3 |
| Potassium (mg/l) | 18 | 1.96 | 893 | 312.1 | 2-3,770 |
| Selenium (mg/l) | 31 | ND(0.001) | 0.012 | 0.0012 | ND-0.45 |
| Silver (mg/l) | 31 | ND(0.001) | 0.063 | 0.0027 | ND-0.24 |
| Sodium (mg/l) | 15 | 0.1 | 3610 | 673.3 | 0-8,000 |
| Sulfate (mg/l) | 19 | ND(5.0) | 471 | 60.0 | 0-84,000 |
| Zinc (mg/l) | 28 | ND(0.005) | 2.31 | 0.274 | 0-1,000 |
| Phosphorus (mg/l) | 10 | ND(0.04) | 5.4 | 1.38 | 0-130 |
| Iron (mg/l) | 14 | 0.427 | 248.42 | 31.71 | 0.06-42,000 |
| TKN (mg/l) | 14 | 1.43 | 447 | 153.9 | 2-1,850 |
| Ammonia (mg/l) | 11 | 0.13 | 457 | 135.0 | 0-1,250 |
| Nitrate (mg/l) | 17 | ND(0.001) | 81 | 6.9 | NR |
| Antimony (mg/l) | 2 | ND(0.005) | 0.2 | -- | ND-2.0 |
| Beryllium (mg/l) | 7 | ND(0.0005) | 0.02 | 0.003 | ND-0.08 |
| Manganese (mg/l) | 12 | 0.14 | 11.0 | 1.44 | ND-678 |
| Magnesium (mg/l) | 5 | 121.0 | 158.0 | 143.0 | 12-15,600 |
| TDS (mg/l) | 7 | 1180 | 10600 | 4881 | NR |
| TSS (mg/l) | 7 | 46 | 166 | 113.7 | 5-18,800 |

(1) Range reported in literature by Kmet and McGinley, 1982

ND(0.01) = nondetected (detection limit)
NR = not reported

TABLE 2. DEFAULT SOIL CHARACTERISTICS

| Soil Texture Class | | | MIR[d] | Porosity | Field Capacity | Wilting Point | Hydraulic Conductivity | CON[e] |
|---|---|---|---|---|---|---|---|---|
| HELP[a] | USDA[b] | USCS[c] | In/hr | Vol/Vol | Vol/Vol | Vol/Vol | in/hr | mm/day$^{0.5}$ |
| 1 | CoS | GS | 0.500 | 0.361 | 0.174 | 0.107 | 11.95 | 3.3 |
| 2 | CoSL | GP | 0.450 | 0.376 | 0.218 | 0.131 | 7.090 | 3.3 |
| 3 | S | SW | 0.400 | 0.389 | 0.199 | 0.066 | 6.620 | 3.3 |
| 4 | FS | SM | 0.390 | 0.371 | 0.172 | 0.050 | 5.400 | 3.3 |
| 5 | LS | SM | 0.380 | 0.430 | 0.16 | 0.060 | 2.780 | 3.4 |
| 6 | LFS | SM | 0.340 | 0.401 | 0.129 | 0.075 | 1.000 | 3.3 |
| 7 | LVFS | SM | 0.320 | 0.421 | 0.176 | 0.090 | 0.910 | 3.4 |
| 8 | SL | SM | 0.300 | 0.442 | 0.256 | 0.133 | 0.670 | 3.8 |
| 9 | FSL | SM | 0.250 | 0.458 | 0.223 | 0.092 | 0.550 | 4.5 |
| 10 | VFSL | MH | 0.250 | 0.511 | 0.301 | 0.184 | 0.330 | 5.0 |
| 11 | L | ML | 0.200 | 0.521 | 0.377 | 0.221 | 0.210 | 4.5 |
| 12 | SIL | ML | 0.170 | 0.535 | 0.421 | 0.222 | 0.110 | 5.0 |
| 13 | SCL | SC | 0.110 | 0.453 | 0.319 | 0.200 | 0.084 | 4.7 |
| 14 | CL | CL | 0.090 | 0.582 | 0.452 | 0.325 | 0.065 | 3.9 |
| 15 | SICL | CL | 0.070 | 0.588 | 0.504 | 0.355 | 0.041 | 4.2 |
| 16 | SC | CH | 0.060 | 0.572 | 0.456 | 0.378 | 0.065 | 3.6 |
| 17 | SIC | CH | 0.020 | 0.592 | 0.501 | 0.378 | 0.033 | 3.8 |
| 18 | C | CH | 0.010 | 0.680 | 0.607 | 0.492 | 0.022 | 3.5 |
| 19 | Waste | | 0.230 | 0.520 | 0.320 | 0.190 | 0.283 | 3.3 |
| 20 | Barrier Soil | | 0.002 | 0.520 | 0.450 | 0.360 | 0.000142 | 3.1 |
| 21 | Barrier Soil | | 0.001 | 0.520 | 0.480 | 0.400 | 0.0000142 | 3.1 |

[a] Soil classification system used in the HELP model (see discussion in text).

[b] Soil classification system used by the U.S. Department of Agriculture.

[c] The Unified Soil Classification System.

[d] MIR = Minimum Infiltration Rate.

[e] CON = Evaporation Coefficient (Transmissivity).

Report

# Major Permit Amendment – Part III: Volume II
# McCombs Municipal Landfill
# El Paso County, Texas
# TCEQ MSW Permit No. 729B

Prepared for: City of El Paso

Revised July 2013, Revision 6

SAIC®

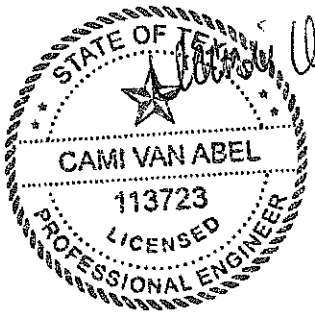
# McCombs Municipal Landfill
# El Paso County, Texas
# TCEQ MSW Permit No. 729B

# Major Permit Amendment Application
# Part III
# Volume II

Prepared for

**City of El Paso**

Updated July 2013, Revision 6

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Firm Registration No. 3823

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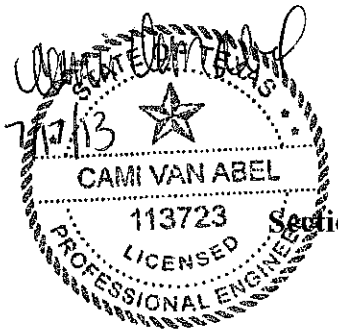

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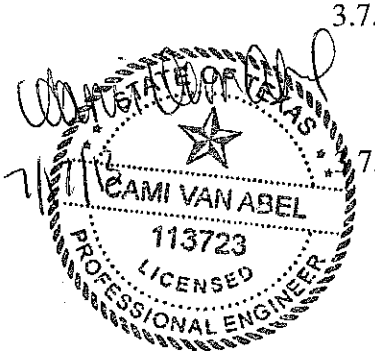

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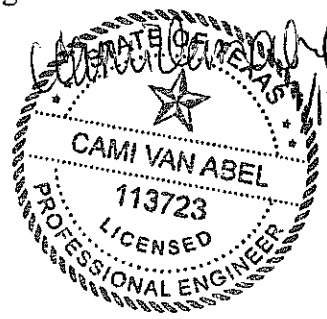


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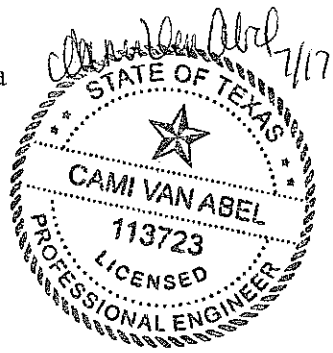

# Appendix 3K
# Geology

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# Appendix 3K – Attachment 1
# Site Characteristics and Monitoring Plan

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## Memorandum

SAIC

To: TCEQ

From: Cami A. Van Abel, SAIC

Subject: Appendix 3K, Attachment 1 – Site Characteristics and Monitoring Plan

Date: July 17, 2013

SAIC has reviewed the attached "Site Characterization and Monitoring Plan, McCombs Landfill, El Paso, Texas, October 11, 1993, updated and revised December 2012". The attached Report for the site characterization and monitoring references MSW Permit No. 729A throughout. It should be noted the attached report and data are applicable to the major permit amendment for MSW Permit No. 729B. Reference to MSW Permit No. 729A should be used synonymously with MSW Permit No. 729B.

CAV

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# SITE CHARACTERIZATION AND MONITORING PLAN

## McCOMBS LANDFILL
## EL PASO, TEXAS

**PREPARED FOR:**

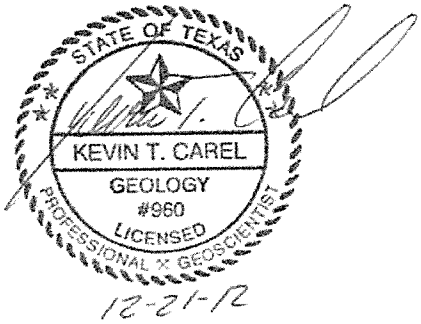
**CITY OF EL PASO**
**EL PASO, TEXAS**

**AND**

**TEXAS COMMISSION ON ENVIRONMENTAL QUALITY**
**AUSTIN, TEXAS**

**OCTOBER 11, 1993**

**REVISED: December 2012**



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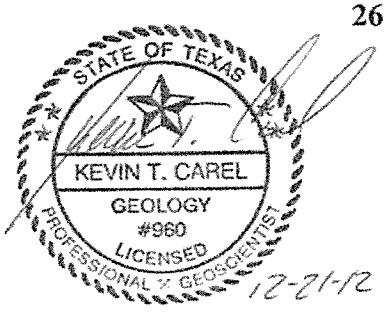

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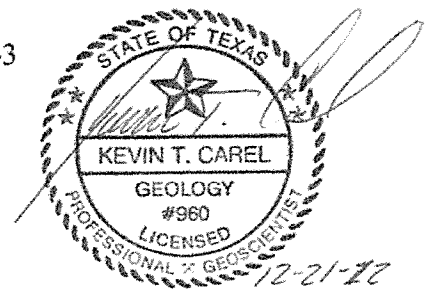

# EXECUTIVE SUMMARY

A hydrogeologic evaluation of the McCombs Sanitary Landfill was completed by SHB AGRA, Inc. (SHB) in 1993. The object of the evaluation was to develop a suitable groundwater monitoring plan at the subject site in order to comply with requirements set forth by the Texas Water Commission, now known as the Texas Commission on Environmental Quality (TCEQ), under Chapter 330 of the Texas Administrative Code. Parkhill, Smith & Cooper, Inc. and The Carel Corporation prepared modifications to comply with the 2006 revisions of Chapter 330.

The original evaluation program included a review of existing geotechnical, geological, hydrogeological and climatological data for the site. Groundwater data were obtained from federal, state and selected private entities. Details of daily operation were obtained from City of El Paso personnel familiar with the site.

Results of the SHB review indicate that the climate of the El Paso region is characterized by low average annual rainfall and high rates of evaporation. Groundwater is known to occur at depths exceeding 300 feet. These factors suggest an extremely low potential for leachate generation and migration to groundwater.

The original groundwater monitoring system consisted of the installation of three monitor wells at the facility. One located upgradient for background water quality determination, and two located downgradient to detect potential groundwater impacts based on regional groundwater flow direction data. A detailed Groundwater Sampling and Analysis Plan is included as a separate document.

The proposed groundwater monitoring system will be comprised of nine (9) monitoring wells: MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, MW-7, MW-8, and MW-9. This will be done by retaining existing wells MW-1, MW-2, and MW-3, converting existing piezometers PZ-4 and PZ-5 to MW-4 and MW-5, and installing new wells MW-6, MW-7, MW-8, and MW-9. It is proposed that monitoring wells MW-6 through MW-9 be installed within 180 days of the approval date of this permit modification. Five (5) additional monitoring wells (MW-10, MW-11, MW-12, MW-13, and MW-14) may also be added to the facility groundwater monitoring system in the event the landfill constructs cells in Sectors B, C, D, and E.

# 1 INTRODUCTION

## 1.1 Background

This report presents the results of a hydrogeologic evaluation of the McCombs Landfill in El Paso, Texas. The purpose of the study was to characterize the operational history of this municipal landfill and to study the geotechnical and hydrogeologic conditions of the site vicinity in order to evaluate the potential for a leachate migration and develop a groundwater monitoring system that would meet Texas Commission on Environmental Quality (TCEQ) requirements.

The TCEQ, formerly known as the Texas Natural Resource Conservation Commission, adopted Subtitle D as published by the United States Environmental Protection Agency (EPA) relating to municipal landfills. As adopted, the regulations required the development of a groundwater monitoring program for large municipal landfills. The State of Texas required submission of a groundwater and/or leachate migration monitoring plan based on a hydrogeologic evaluation of the landfill prior to implementation. The monitoring plan was required for all municipal landfills unless specifically exempted by the TCEQ Executive Director. This monitoring plan includes details concerning the number and location of monitor wells for the facility, construction of the wells, sampling procedures and frequency, and target parameters for chemical analyses.

The City of El Paso (City) contracted SHB AGRA, Inc. (SHB) to evaluate site specific hydrogeological and geotechnical conditions and develop the original monitoring plan for submission to the TCEQ. Subsequently, the City retained Parkhill, Smith & Cooper, Inc. and The Carel Corporation to prepare modifications to the original monitoring plan to comply with the 2006 revisions of Chapter 330.

## 1.2 Purpose & Scope

The objective of this study is to develop a groundwater monitoring plan for the McCombs Landfill within the regulatory framework of the 2006 revisions to Chapter 330 of the Texas Administrative Code (TAC) by the State of Texas and the TCEQ. SHB originally reviewed available background data on the hydrogeologic characteristics of the site area and previous geotechnical investigations completed at the site during the permitting process. On-site conditions and waste disposal practices were further evaluated during a site reconnaissance. A groundwater monitoring program was developed based on regulatory requirements and estimates of the groundwater characteristics at the site.

## 1.3 Project Location & Landfill Description

The McCombs Landfill is located approximately 20 miles northeast of downtown El Paso in Section 6, Block 80, Township 1, Texas and Pacific Surveys. The landfill is situated at the northeast corner of the intersection of McCombs Road and Farm Road 2529 (see Figure 1). The permitted landfill area encompasses approximately 327 acres, although only a portion has been landfilled at present. The City is the Owner and operator of the facility.

The McCombs Landfill was originally permitted as a municipal solid waste landfill on August 13, 1976 under Permit No. 729 for operation on 25 acres. A permit amendment was issued on May 30, 1984, which increased the total permitted area from 25 acres to 327 acres; however, the site development details were only provided for approximately 70 additional acres (landfill cells, Phases I-III) at the time since a quarry operation was active on the remaining acreage to the north and east of the existing landfill and Phases I-III. In 2002 the permit was modified to comply with Subtitle D requirements and to provide the site development details and landfill capacity of the remaining acreage (landfill cells, Sectors A-G). The site development plan allowed for the sand and gravel quarry to continue operating, but the quarry is scheduled to move towards the south and eventually east as Sectors A-G are developed.

Sector A was constructed in 2003 and has been filled since that time. The landfill was placed in an inactive status effective February 3, 2005 with only limited waste being disposed of since that time from a City of El Paso clean up project. The City of El Paso intends to re-open the McCombs Landfill at a later date.

The McCombs Landfill currently uses an alternate liner design that was approved on July 10, 1995. The approved alternate liner consists of a single 60-mil geomembrane liner overlain by a 24-inch protective soil cover. A 60-mil geomembrane is constructed over a 6-inch compacted caliche layer. This alternate liner design supercedes a previous alternative liner design (consisting of a double geomembrane liner separate by a geonet [leachate detection layer] and overlain by 24-inch leach collection system/protective cover with a minimum hydraulic conductivity of 1x10-2 cm/sec) that was approved on October 19, 1994. Landfill cells constructed prior to this time are presumably un-lined. The depth of the landfill cells at this facility are estimated to be approximately 40 to 50 feet deep. The elevation of the liner for Sectors A-G at the lowest points (leachate collection sumps) is approximately 4017 feet mean sea level (City Datum).

# 2 ASSESSMENT

## 2.1 Overview & Limitations

The scope of this project was limited to the review and analysis of available data for the McCombs Landfill. The discussions and recommendations of SHB are based on geotechnical, geological and hydrogeological conditions at the site, as described in published literature and available well records. No additional field exploration and/or testing was completed during this phase of the project. Based on past site history, climatological records, expected soil conditions and depth to groundwater, it appears very unlikely that leachate will impact groundwater. Locations for existing groundwater monitoring wells were selected on the basis of groundwater flow directions published in reviewed literature and evaluation of well data. After installation of monitor wells was complete, actual groundwater measurements on site indicated differing groundwater flow directions, necessitating installation of additional wells.

These and related limitations associated with the interpretation of results and data provided by other independent entities should be recognized in evaluating discussions and recommendations presented herein.

## 2.2 Regulatory Review

The TCEQ implemented new 30 TAC 330 Subchapter J rules governing groundwater monitoring and corrective action in 2006 (effective March 26, 2006). Per 30 TAC §330.401(b) *owners and operators of landfill units shall comply with the 2006 Revisions to this subchapter* [Subchapter J] *by applying for a permit modification with public notice in accordance with §305.70(l) of this title (relating to Municipal Solid Waste Permit and Registration Modifications) to revise any inconsistent provisions within two years from the effective date of the 2006 Revisions.* This plan has been modified to satisfy 30 TAC §330.403(a)(2), which states: *The point of compliance monitoring system must include monitoring wells installed to allow determination of the quality of groundwater passing the point of compliance as defined in §330.3 of this title and to ensure the detection of groundwater contamination in the uppermost aquifer. Monitoring well spacing for a municipal solid waste landfill unit shall not exceed 600 feet without an applicable site-specific technical demonstration that may be supplemented with a multi-dimensional fate and transport numerical flow model as set forth in subsection (e) of this section. The owner or operator of a municipal solid waste landfill unit must install a groundwater monitoring system at the point of compliance, as required by 40 Code of Federal Regulations §258.51(a)(2). When physical obstacles preclude installation of the groundwater monitoring wells at existing units,*

*the wells may be installed at the closest practicable distance to the point of compliance as defined in §330.3 of this title that will ensure detection of groundwater contamination of the uppermost aquifer.*

## 2.3 Review & Analysis of Available Data

Available information concerning the history of landfilling at the site, regional and local geology and hydrogeology was obtained and reviewed by SHB. The pertinent information is summarized in Section 4. Sources included federal, state and local agencies, as well as readily available private sector studies pertaining to local conditions and landfill operations in general. Information collected included:

- A time-lapse series of aerial photographs spanning the time from before commencement of landfilling operations at the site to the present.
- Site investigative report compiled by Danny R. Anderson Consultants (DRA), presented as part of the permit application in January, 1984 (DRA, 1984).[1]
- Documentation of permitting, inspection reporting and correspondence concerning landfilling operations received from the TDHR and the TCEQ.
- Published geologic and hydrogeologic mapping and literature available from public agencies and private/professional sources.
- Subtitle D section applicable to municipal landfills as outlined by the EPA, and the TCEQ's interpretation of the same (TAC Chapter 330).
- Data on water wells located within about 2 miles of the landfill site obtained from the Texas Water Development Board (TWDB), the TCEQ, and New Mexico State Engineers Office and the Interstate Stream Commission in New Mexico. This information included well location maps, water uses, depths to groundwater, well depths, well owners and drillers logs.
- Additional groundwater information was obtained from the Public Service Board (PSB), and the El Paso Water Utilities (EPWU).

Parkhill, Smith & Cooper, Inc. and The Carel Corporation reviewed additional data as part of the 2007 and 2012 modifications to this report. The new data from groundwater monitoring wells, groundwater contour maps, and groundwater sampling events is discussed in Section 4.7.

[1] References are listed at the end of this report.

## 2.4 Field Reconnaissance

SHB personnel completed multiple site visits during May, 1993. During the site reconnaissance, observations were made of site conditions, landfill operations, environmental conditions and general land use. Visible geologic, hydrogeologic and geotechnical conditions were studied in the open pit exposures. Groundwater wells and lysimeters on site were also visually located. Buildings, fenced areas, vegetation and land use on and around the subject site were also noted.

Parkhill, Smith & Cooper, Inc. and The Carel Corporation performed a site visit on July 16, 2007. During that reconnaissance, observations were made of current site conditions, on-site aggregate mining operations, water supply wells in the vicinity of the site and monitor wells located at the sludge disposal site, which is owned and operated by El Paso Water Utilities, located west of McCombs Road.

## 2.5 Groundwater Wells

Available information regarding groundwater wells in the site vicinity was originally reviewed and analyzed by SHB. Well information from TCEQ files was collected for wells located within a two-mile radius of the project site by Agency Information Consultants (AIC, 1993). Additional data was collected from El Paso Water Utilities (EPWU) and the New Mexico State Engineers Office (NMSEO). Many of the water wells in the project vicinity are EPWU public water supply and recharge wells. Groundwater flow maps and hydrographs of selected wells were constructed in an effort to analyze hydrologic conditions in the area. Regional hydrologic conditions and local well data are further discussed in Sections 4.5 and 4.6, respectively. Site-specific groundwater information in provided in Section 4.7.

# 3 REVIEW OF PREVIOUS INVESTIGATION

The initial permit application for the McCombs Landfill was completed by DRA on behalf of the City. The permit application addresses site characteristics, and includes discussions of the types of wastes to be accepted, and presents pertinent operational and maintenance criteria. Subsurface investigations completed on site were presented in a report that was appended to the permit application.

Certain limitations exist in the interpretation of results and data provided by other independent entities.

## 3.1 Geotechnical Investigation Data

This section primarily focuses on the subsurface investigations and the geotechnical profile of the soils underlying the site as described by DRA (1984).

- **Subsurface Drilling:** DRA completed 8 test borings west of the then existing landfill between September, 1982 and January, 1983, to depths between 30 and 50 feet below existing grades. Fifteen additional borings were drilled to 60 feet at locations to the east and north of the landfill. All drilling by DRA was completed using a Mobile B-52/61 and 8-inch diameter hollow stem auger. The geotechnical investigation report prepared by DRA also includes logs of 6 borings previously completed by Dickenson Laboratories to depths of 50 feet north of the landfill.

- **Geotechnical Profile:** The original 8 borings completed by DRA were drilled within an existing sand and gravel pit. The soils encountered predominantly were relatively clean sands, interbedded with lesser amounts of silty sands and occasional layers of clayey sands and sandy clays. Relatively clean sands with varying silt and gravel contents were noted in the 15 additional borings completed by DRA. The surface elevations of these 15 borings is unknown. In the 6 borings drilled by Dickenson, clayey sands were encountered to depths ranging between 13 and 25 feet, underlain by relatively clean sands. In one of the 6 borings, however, clean sands were encountered for the entire depth of the boring.

  In general, the relatively clean and silty sands are non-plastic, while the clayey soils range from low to high in plasticity. No groundwater was reported in any of the borings drilled. Permeability tests were not considered necessary, based on the soil types encountered. DRA estimated a coefficient of permeability to be between 0.01 and 0.04 cm/sec.

The report includes recommendations for temporary and permanent slopes, and for fill material to be used for site grading. Recommendations and specifications for other earthwork elements of the project were also addressed.

## 3.2 Permit Application Data

Pertinent information, including site characteristics and solid waste data was provided along with the permit application. Design criteria such as engineering considerations, land use, ground and surface water protection, etc. were also addressed. This information is briefly summarized below:

- **Solid Waste Data:** The landfill was located to serve the northeast parts of El Paso with an estimated population of approximately 77,500. The facility was designed to accept approximately 162 tons of non-hazardous industrial, municipal, commercial and domestic waste per day. Based on current estimates however, the landfill accepts about 220 tons of domestic waste per day. City personnel have indicated that the landfill does not accept industrial or commercial waste.

- **Site Location & Land Use:** The location of the site was defined as "...approximately 20 miles northeast of downtown El Paso in Section 6, Block 80, Township 1." Land use within a one mile radius included the existing landfill, a sand quarry, and some commercial operations. The nearest airfield reportedly was a privately owned sail plane airfield located approximately 2.3 miles from the site. The report states that "...an Eastern Boundary Fault Zone exists between the Franklin Mountains and the Hueco Bolson deposits.", and "...assuming continuous movement this (movement of the fault) would equate to approximately 0.005 inches per year" (DRA, 1984).

- **Groundwater Protection:** According to the DRA report attached to the permit application, unconfined groundwater occurs beneath the land surface of the Hueco Bolson at depths ranging between 260 and 360 feet. The water table reportedly has a hydraulic gradient of about 0.025 "...toward a major cone of depression in the vicinity of the El Paso International Airport." The report states that there is a steady increase in the total dissolved solids (TDS) with increasing depth. An inventory of existing water wells in the vicinity of the site also was completed.

  According the DRA report, the landfill would not pose a significant risk to groundwater underlying the site. The report states that "...soil moisture storage is always below available water holding capacity so gravity percolation is impossible." The report further states that the cemented soils and clay lenses underlying the site will also inhibit downward movement of leachate generated in the landfill units. The report points out that the then existing landfill had not caused a deterioration in groundwater quality, since important constituents from landfill leachate including BOD, COD, iron, manganese, chlorides, nitrates, hardness and trace elements were not detected in the wells located downgradient from the site.

- **Miscellaneous Information:** The DRA report addressed other subjects such as daily operational procedures, utility corridors within the site, surface water issues, and controlling methane generated in the landfill units. Discussions of site access were also included. These points are not further discussed herein.

# 4 SITE CONDITIONS & HISTORY

## 4.1 Site History

Available historical information was originally reviewed by SHB to assist in evaluating conditions on and in the vicinity of the site. The review included a brief evaluation of prior site usage. Particular attention was paid to past and current landfilling operations. Information reviewed included data available from federal, state, city and private agencies. Persons familiar with the site and landfilling operations were contacted for additional site information. Additional site history information has since been provided by the City of El Paso.

Prior to landfilling operations, the site was owned by Prices Producer, Inc. The City of El Paso purchased the property from Prices in September, 1954. The site was subsequently leased to El Paso Sand Products Inc. to be used for aggregate mining and was later leased to Jobe Concrete Products. Quarrying operations continued to date on site through a lease with Cemex.

The McCombs Landfill was first permitted as a Type I landfill by the Texas Department of Health Resources (TDHR) in August, 1976. According to City personnel, landfilling operations commenced in 1960. This initial permit was issued in 1976 for an area of 25 acres and a waste volume of approximately 400 tons per day. In May, 1984, the permit was amended to cover a total area of approximately 327 acres.

## 4.2 Climate

Weather information was collected from the National Oceanic and Atmospheric Administration (NOAA, 1993) by SHB. Based on this information, the climate of the El Paso region is characterized by an abundance of sunshine throughout the year, high daytime temperatures with very low humidity, scanty rainfall, and a relatively mild winter season typical of arid areas at low latitudes. Summer temperatures are high, frequently above 90 degrees and occasionally above 100 degrees. Humidity generally ranges between 10 and 25 percent. Winter daytime temperatures are mild, rising to 55 to 60 degrees on the average.

Rainfall throughout the year is light and generally insufficient for any plant growth except desert vegetation. Most of the precipitation occurs between July and September, from short but heavy thunderstorms. Small amounts of snowfall occur almost every year, but accumulations rarely exceed one inch, and snow seldom remains on the ground for more than a few hours. Average annual rainfall and snowfall are approximately 8.5 and 5.2 inches, respectively. Total annual precipitation varies from approximately 8 to 12 inches per year.

Wind velocities are not excessively high. Prevailing winds are from the north in the winter and south in summer, with the prevailing direction for the year north by a small margin.

## 4.3 Topography

The original topography of the site was presumably hilly. However, subsequent quarrying and landfilling operations have significantly modified the natural contours of the site. The present topography is now dominated by large depressions which are remnants of the old quarrying operations. These excavations range up to 50 feet in depth. The elevated landfilled areas are built-up to elevations in excess of 50 feet above grade. Earthen berms surrounding the landfill reduce the potential for run-on from adjacent properties.

## 4.4 Geologic Setting & Soil Profile

The McCombs Landfill lies within the Rio Grande Rift portion of the Mexican Highlands section of the Basin and Range Physiographic Province (Fenneman, 1931; Thornbury, 1965). Thornbury (1965) defines the Mexican Highlands Section as an area of variable geologic structure characterized by high desert valleys and mountain ranges. Hawley (1975) subdivided the Mexican Highlands Section into the Bolson and Rio Grande subsections. The Bolson Subsection covers a large area of southwestern New Mexico and portions of Texas, Chihuahua, Mexico and Arizona. This region is characterized by broad intermontane basins with internal drainage, called bolsons, that are bounded by fault-block mountain ranges.

The mountain ranges on the eastern side of the Bolson subsection trend in a general north-to-northwest direction and typically flank sizeable basins, including the Hueco Bolson in which the site is located (Thornbury, 1965). The Rio Grande Valley is incised into thick deposits of basin fill at the southern end of the Hueco Bolson typically ranging in age from Pliocene to Holocene. A broad alluvial plain with gently sloping terraces characterizes the valley of the Rio Grande River.

Tectonic adjustment initiating basin formation began in the region in the early Miocene. As the basins developed, erosion and subsequent deposition of Santa Fe Group sediments occurred (Gile and others, 1981; Strain, 1966). Renewed faulting in Late Miocene and Pliocene time, coupled with continued relative uplift, produced a series of en echelon grabens, such as the Mesilla and Hueco Bolsons, that characterize this section of the Rio Grande Rift Valley. These bolsons

regionally have received several thousand feet of sediments during the Late Cenozoic (Strain, 1966).

Basin fill was initially derived from the surrounding mountains. During the Pleistocene, the ancestral Rio Grande River flowed into closed basins in the area depositing thick sequences of sediments and forming an ephemeral lake (Strain, 1969). This basin fill has been correlated with similar deposits in other sections of the Rio Grande Rift and is named the Santa Fe Group by Hawley and others (1969). It has been proposed that the sediments of the Hueco Bolson be included in the Santa Fe Group, based on similar composition and depositional history.

The Hueco Bolson deposits have been divided into two rock stratigraphic units by Strain (1966), the Fort Hancock Formation and the Camp Rice Formation. The older Fort Hancock Formation is a massive unit composed of poorly consolidated clays, silts and fine grained sands ranging in color from grayish red to brown (Strain, 1966, 1980). The persistent and essentially horizontal bedding and fine texture of the Fort Hancock Formation indicates that it was deposited in lacustrine and playa environments. Goebel and others (1987) hypothesized deposition of the Fort Hancock Formation on a low-relief basin floor with a highly sinuous meandering river and ephemeral lakes.

In early Pleistocene time, adjacent basins had aggraded to levels sufficient to coalesce with the Hueco Bolson. Periods of moderately high precipitation resulted in the formation of a large ephemeral lake system which Strain (1966) named Lake Cabeza de Vaca. This ancient lake covered an area from Mesilla Bolson, more than 50 miles northwest of the site, to the Red Light Bolson, south of Sierra Blanca.

Deposition of fine grained sediments in the Hueco Bolson continued until an outlet to the southeast formed in early Pleistocene time. This outlet essentially breached Lake Cabeza de Vaca and changed the depositional environmental from predominantly lacustrine to fluvial (Strain, 1980). The Camp Rice Formation (Strain, 1966) records continued fluvial aggradation by the ancestral Rio Grande River in the Hueco Bolson.

The Camp Rice Formation unconformably overlies the Fort Hancock Formation. It is primarily composed of gravel, sand, silt and occasional discontinuous lenses of volcanic ash. Its color varies from very light gray to shades of pink, orange and light brown. The Camp Rice Formation is composed of two basic subdivisions, a fluvial and a piedmont facies (Gile and others, 1981). The fluvial facies is chiefly sandy to pebbly river-channel deposits with subordinate fine-grained overbank units. This facies thickens toward the bolson axes and commonly wedges out against the piedmont facies. The permitted area is probably underlain by fluvial deposits of the Camp Rice Formation (Seager and others, 1987).

Termination of Camp Rice deposition probably occurred as a result of spillover from the upper reaches of the Rio Grande River or stream capture by an arroyo system draining the Hueco Bolson. The upper reach of the Rio Grande River in the Mesilla Bolson was thus joined to the Rio Conchos through El Paso Canyon in mid-Pleistocene time (Strain 1970; Hawley and

Kottlowski, 1969). Integration of the upstream and downstream reaches of the Rio Grande River, re-establishing through-flowing drainage, was apparently the major cause of subsequent valley incision (Johnson and others, 1984).

The timing of this key shift from basin aggradation to incision is not precisely known, but can be estimated reasonably well from dated units within and overlying the Camp Rice Formation, and from subsequent development of geomorphic surfaces and soils (Gile and others, 1981; Machette, 1985). After the establishment of an integrated Rio Grande in mid-Pleistocene time, large-scale aggradation of the bolsons ceased. Several cycles of accelerated river downcutting followed, separated by periods of relative stability. This Quaternary history is expressed morphologically as a series of terrace, alluvial fan and pediment surfaces cut into or deposited upon the Santa Fe Group (Kottlowski, 1958). These surfaces are locally modified by recent sand deposits.

Numerous fault scarps of Quaternary age are present in the Hueco Bolson near the landfill. One inferred scarp apparently traverses the northeastern quadrant of the landfill permit area (SHB, 1993). This fault was not identified on the geologic map prepared by Harbour (1972). Insufficient information is available to confirm or refute the presence of a fault. Other north-south trending scarps are also apparent in the area. The age of faulting in Hueco Bolson has been dated as less than 0.5 m.y., based on offset in the Camp Rice Formation and in soils formed on the Camp Rice Formation (Seager, 1980). More precise dating of the faults has not been performed.

As noted previously, the McCombs Landfill is located on deposits of the Hueco Bolson, probably Camp Rice Formation. These deposits primarily consist of clay, sand and gravel, with some caliche (Bureau of Economic Geology, 1983). The landfill site is underlain by Tertiary and Quaternary basin (bolson) deposits, overlain by areas of gravel and caliche rimrock as presented in Figure 3 (Harbour, 1972). Recent Quaternary alluvial deposits are also present in the landfill vicinity in topographically low areas.

The caliche rimrock of Pleistocene age is commonly two to four feet thick, and consists of angular fragments of bedrock derived from the mountains and cemented by white caliche. The bolson deposits in the area were described by Harbour (1972) as "friable white sand with rounded volcanic pebbles". Bolson deposits of clay and sand with some gravel and caliche have been observed in water wells drilled east of the Franklin Mountains. The bolson deposits have been documented to extend to a depth of at least 4,920 feet below ground surface in a well drilled south of Newman, New Mexico, approximately five miles east of the landfill (Harbour, 1972).

A soil investigation was performed in 1983 by DRA. During the investigation, numerous soil borings were drilled on site to a depth of 60 feet below ground surface. According to boring logs generated during the investigation, the soils consist of an upper zone of variable thickness of silty sand, underlain by deposits of clean and gravelly sands. Stringers of clay which did not appear to be laterally extensive were observed in some of the soil borings. The sands and gravelly sands appear to be lenticular in nature, with little correlation across the site.

## 4.5 Regional Hydrogeology

Published information on the hydrogeology of the site area was reviewed to evaluate the factors influencing the groundwater system at the site. The regional groundwater system in the area primarily consists of the Hueco Bolson aquifers.

The Hueco Bolson has been divided into the City Artesian area, the Mesa area and the Lower Valley (Leggat, 1962). The City Artesian area underlies downtown El Paso and east El Paso as far as Ysleta. The Mesa area extends north of the City Artesian area into New Mexico and east to the Hueco Mountains. The Lower Valley area parallels the Rio Grande, and extends from Ysleta to beyond Tornillo. The McCombs Landfill is located in the Mesa area.

In general, the groundwater regimes of the City Artesian and the Lower Valley areas are essentially the same. Two aquifers occur in these areas: an upper aquifer in the Rio Grande alluvium and a lower aquifer in the Hueco Bolson deposits. Since no known impermeable zone of regional extent separates these aquifers, the Rio Grande alluvium and the Hueco Bolson are considered to be, at least in part, hydrologically connected in the City Artesian and Lower Valley areas (Alvarez and Buckner, 1980). Increased pumpage from public supply wells and lining of a portion of the Rio Grande River in the City Artesian area have affected the recharge-discharge relationships, and caused fluctuations in the direction of groundwater flow. In the Lower Valley area, recharge occurs from the Rio Grande Alluvial aquifer into the Hueco Bolson during times when the water level in the river is high, and from the Hueco Bolson into the Rio Grande alluvium when the water level in the river is lower.

The Mesa area primarily consists of Hueco Bolson deposits. Historic withdrawals of groundwater since 1906 for public water supply and irrigation have caused major declines in the water level. The average water level decline in the Hueco Bolson from 1903 to 1980 is approximately 53 feet (White, 1987).

Locally, recharge to the aquifer occurs due to mountain front infiltration of precipitation from the surface and from the injection of treated sewage into the aquifer from the Hueco Bolson Recharge Project (White and Sladek, 1990). Numerous injection wells have been constructed northeast of El Paso and water from the Fred Hervey Water Treatment Plant has been injected into the aquifer by El Paso Water Utilities (EPWU) since the mid-1980s. Over one billion gallons of treated water per year were injected into the Hueco Bolson between 1986 and 1991. The reinjection resulted in mounding of groundwater in the recharge project area, and has caused

some change in the groundwater flow regime. A slight mounding effect from the recharge project was observed on the EPWU 1993 Water Table Contour Map (EPWU, 1993). Since 1991, EPWU has been selling the reclaimed water to customers; thus, less water has been injected into the aquifer (Sperka, 1993) (Solis-Rojas, 2009). As of June 2009, over 60% of the reclaimed water produced at the Hervey Plant is sold to customers by the EPWU (Solis-Rojas, 2009). Selling the reclaimed water has produced a decline on water available for aquifer recharge. The recharge well nearest to the landfill is well RW11, located approximately one mile southwest of the landfill near well 49-05-214 (Solis-Rojas, 2009).

Based on available information regional groundwater flow in the McCombs Landfill area is generally to the south-southeast. However, more recent data indicates that site-specific groundwater flow is easterly as discussed in Section 4.7. Groundwater movement in the area is generally less than 1.0 feet per day (White, 1987). EPWU groundwater data indicate that the static groundwater elevation in the area is between 3670 and 3675 feet above mean sea level (msl), or approximately 370 to 390 feet below ground surface (EPWU, 1993). No evidence of perched aquifers in the area was noted during our research.

The Hueco Bolson generally contains fresh water in its upper portion and becomes saline at depth (Davis and Leggat, 1965). Groundwater quality in the landfill area is variable, with total dissolved solids (TDS) contents ranging from less than 500 ppm to greater than 1000 ppm (White, 1987). A localized plume of groundwater exhibiting elevated TDS and high nitrate values was observed in the vicinity of the former Price's Dairy Farm during the 1960s and 1970s. The Dairy was located approximately ¾-mile southwest of the permitted area. The plume probably occurred due to the leaching of salts into groundwater during excessive irrigation of crops in the area from 1956 to 1974 (White, 1987). Injection of high quality water from the Hueco Bolson Recharge Project has essentially diluted and dissipated the plume (Sperka, 1993).

## 4.6 Local Well Data

There are 41 wells located within the two-mile study area of the McCombs Landfill site according to well registration reports. The locations of the wells are shown in Figure 4. Available detailed well logs are presented in Appendix A. The wells range in total depth from 104 to 1483 feet below the local ground surface. Most of the wells are registered for public supply or industrial use. The registered wells were completed between 1940 to 2007.

Well records reviewed by SHB showed a wide range of measured groundwater depths. The variation in the recorded depths appears to be primarily due to the wide variation in measurement dates. Wells with earlier completion dates generally indicate shallower water depths than wells constructed at later dates. The location of the wells relative to the local recharge and pumping depression zones also affects the measured water depths. The recorded depth to water in the wells range from 296.6 to 385 feet below the ground surface (bgs). Depths to water in two original water wells for the quarry operations located directly west of the site were measured at 361 and 385 feet bgs. General contouring of the regional water table by SHB, considering time of measurements, is presented in Figures 5 through 8. Based on that information, groundwater

flow was originally believed to be southerly as illustrated in Figure 9. However, site specific water level data subsequently collected indicates that groundwater flow is easterly. Hydrographs of selected wells indicate a groundwater level decline in the area of approximately 20 feet in the past 20 years (Figures 10 through 13).

The nearest water wells currently used for public water supply are State Well Numbers JL-49-05-301 and JL-49-05-303 (EPWU wells 42 and 53, respectively) (Sperka, 1993). Well 303 is located approximately 1/2-mile southeast of the landfill and well 301 is located about 2/3-mile south of the site. Two wells are currently present directly adjacent to the site, State Well Numbers JL-49-05-315 located to the west and another well (CEMEX) whose State Well Number is unknown is located to the south. Both wells are owned and used by Cemex for quarrying operations. A former well, JL-49-05-314, was also located directly west of the site and was plugged and abandoned October 17, 2007. A copy of the plugging report is included in Appendix A.

## 4.7 Site Specific Groundwater Data

Supplemental site-specific hydrogeologic information was obtained and reviewed by Parkhill, Smith & Cooper, Inc. and The Carel Corporation. The supplemental information includes:

- The 2003 Groundwater Monitoring Well Installation Report by Raba Kistner. The aforementioned report details the installation activities for groundwater monitoring wells MW-1, MW-2, and MW-3.
- The geophysical logs for groundwater monitoring wells MW-1, MW-2, and MW-3 and El Paso Water Utilities wells EPWU-1, EPWU-2, EPWU-3.
- Water-level measurements were collected from groundwater monitoring wells MW-1, MW-2, and MW-3 from September 2003 to November 2007 by the City of El Paso.
- Water-level measurements from four (4) proximal groundwater monitoring wells collected by the City of El Paso in July and November 2007. The four (4) proximal groundwater monitoring wells were wells EPWU-1, EPWU-2, EPWU-3, and EPWU-4A.
- Well completion information for a water well (CEMEX) installed near the southeast corner of the site in the Spring 2007.
- Groundwater Monitoring Reports from June 2004 to July 2007.

### 4.7.1 Existing Groundwater Monitoring Wells

The existing groundwater monitoring system is comprised of monitor wells MW-1, MW-2, and

MW-3 and is illustrated in Figure 2. The boring logs for MW-1, MW-2, and MW-3 indicate the subsurface sediments are primarily composed of sand with some interbedded clay lenses and gravels. Most sands above a depth of 350 feet are described as being coarse grained and poorly sorted. Medium grained and fine grained sands appear to become more prevalent below 350 feet. The lower value of coefficient of permeability provided by Anderson (1983) is believed to be applicable to the medium and fine grained sands in the screen intervals.

The existing monitor wells have been constructed in accordance with 30 TAC §330.242, Monitor Well Construction Specifications. The logs and construction details of monitor wells MW-1 through MW-3 are provided in a December 18, 2003 Groundwater Monitoring System Installation Report by Raba Kistner (see Appendix B). Geophysical logs were also completed in monitor wells MW-1 through MW-3. The said geophysical logs are also provided in Appendix B.

### 4.7.2 September 2003 – July 2007 Water-Level Measurements

Water-levels were measured in wells MW-1, MW-2, and MW-3 from September 2003 to July 2007 by the City of El Paso. The recorded groundwater measurements are shown in the table below. Groundwater contour maps from September 2003 to July 2007 are provided in Appendix C.

**Water-Level Measurements**

| Monitor Well | MW-1 | | MW-2 | | MW-3 | |
|---|---|---|---|---|---|---|
| Top of Casing Elevation, ft msl | *4070.23* | | *4083.89* | | *4076.70* | |
| Total Well Depth from Top of Casing, ft | 475.88 | | 500.83 | | 498.02 | |
| **Measurement Date** | **WATER LEVEL DEPTH (FT) / *ELEVATION (FT MSL)*** | | | | | |
| 9/5/2003 | 396.15 | *3674.08* | 400.27 | *3683.62* | 397.71 | *3678.99* |
| 11/14/2003 | 396.29 | *3673.94* | 399.89 | *3684.00* | 391.52 | *3685.18* |
| 11/18/2003 | 396.03 | *3674.20* | 399.87 | *3684.02* | 391.25 | *3685.45* |
| 5/12/04 - 5/13/04 | 393.60 | *3676.63* | 400.58 | *3683.31* | 389.60 | *3687.10* |
| 9/27/04 - 9/28/04 | 394.10 | *3676.13* | 387.20 | *3696.69* | 390.00 | *3686.70* |
| 12/28/2004 | 394.10 | *3676.13* | 387.20 | *3696.69* | 390.00 | *3686.70* |
| 3/30/2005 | 393.00 | *3677.23* | 399.10 | *3684.79* | 389.10 | *3687.60* |
| 1/10/2006 | 393.40 | *3676.83* | 397.80 | *3686.09* | 388.90 | *3687.80* |
| 4/5/06-4/8/06 | 393.80 | *3676.43* | 397.70 | *3686.19* | 389.30 | *3687.40* |
| 7/20/2006 | 393.85 | *3676.38* | 399.02 | *3684.87* | 389.51 | *3687.19* |
| 10/31/06 - 11/2/06 | 394.65 | *3675.58* | 399.35 | *3684.54* | 390.45 | *3686.25* |
| 4/17/2007 | 394.30 | *3675.93* | 400.20 | *3683.69* | 389.90 | *3686.80* |
| 5/21/2007 | 394.10 | *3676.13* | 399.60 | *3684.29* | 389.50 | *3687.20* |
| 7/25/2007 | 394.10 | *3676.13* | 399.55 | *3684.34* | 389.70 | *3687.00* |
| 11/9/2007 | 393.74 | *3676.49* | 399.95 | *3683.94* | 389.75 | *3686.95* |
| 11/21/2007 | 393.70 | *3676.53* | 399.68 | *3684.21* | 389.86 | *3686.84* |

The above values were used to construct a hydrograph, Figure 14, to evaluate potential trends in the water-level data. The hydrograph indicates that MW-2 and MW-3 typically have comparable water-levels. The lowest groundwater elevation consistently occurred in MW-1. The initial water-levels were slightly depressed in each well; however, the elevations were stable with no major trends or fluctuations, except for the two anomalous measurements in MW-2. The anomalously high groundwater elevations recorded for MW-2 in September and December 2004 are believed to reflect an error in measurement due to the absence of a similar response in other on site monitor wells and the relatively consistent water-levels measured since that time.

Groundwater contour maps constructed from the three on site wells depict a uniformly sloping water table surface to the east-southeast as illustrated by Figure 1C through 14C in Appendix C. Review of available information revealed that four (4) additional groundwater monitoring wells exist within one-half mile west of the landfill: EPWU-1, EPWU-2, EPWU-3, and EPWU-4A. The four (4) wells were installed by the El Paso Water Utilities (EPWU) – Public Service Board to monitor a sludge disposal site located immediately west of McCombs Road and north of Stan Roberts Road. Their locations are illustrated on Figures 15, 16 and 17. Completion records and well logs are provided in Appendix A. Geophysical logs for wells EPWU-1, EPWU-2, EPWU-3 were also obtained and are included in Appendix A. Water-levels were measured in the four (4) EPWU wells on July 25, November 9, and November 21, 2007 in an effort to better define the groundwater flow direction in the vicinity of the landfill. Groundwater contour maps constructed using the July and November 2007 water-levels are provided as Figures 15, 16, and 17, respectively. These maps reveal an east to west trending low in the water table surface. According to Figures 15, 16, and 17, groundwater in the northern portion of the landfill flows southeasterly and flow in the southern portion of the site is to the northeast. Groundwater flow directions have been slightly modified following collection of additional water level measurements from August 2011 through July 2012 (see Section 4.8.1). Based on Figures 15, 16, and 17, each of the three (3) existing groundwater monitoring wells was determined to be positioned hydraulically upgradient of the landfill. However, groundwater flow data from August 2011 through July 2012 indicates existing wells MW-1 and MW-2 are downgradient of the landfill and MW-3 is upgradient of the landfill (see Section 4.8.1).

### 4.7.3 Groundwater Flow Gradient and Rate

Hydraulic gradients were estimated for the saturated zone for various points at the site from the water-level measurements recorded on November 9, 2007. The gradient for a particular part of the site is determined by calculating the difference between the groundwater contours (head difference) and dividing by the horizontal distance between the contours. The values are in ft/ft; multiply by 5,280 for the gradient in feet per mile. Minimum and maximum rates of groundwater movement were estimated using the groundwater velocity equation (Driscoll, 1986):

$v = 2{,}830Ki/ne$

Where:

v = groundwater velocity (ft/day);
K = hydraulic conductivity (cm/sec);
i = hydraulic gradient (ft/ft);
ne = effective porosity (percent); and
2,830 converts cm/sec to ft/day.

The hydraulic conductivity obtained from Anderson (1983) is estimated to be 1.0 x $10^{-2}$ cm/sec. Minimum and maximum hydraulic gradients were estimated for the saturated zone from Figure 16. Estimated hydraulic gradients range from a minimum of 0.0042 ft/ft in the south-central portion of the site, to a maximum of 0.0106 ft/ft in the southern portion of the site between MW-1 and MW-2. The average effective porosity is estimated to be 30 percent, based on values provided by Freeze and Cherry (1979).

$$v_{min} = \frac{2{,}830 \times 1.00\text{E-}02 \times 0.0042}{0.30}$$

$$v_{min} = 0.396 \text{ ft/day (easterly)}$$

and

$$v_{max} = \frac{2{,}830 \times 1.00\text{E-}02 \times 0.0106}{0.30}$$

$$v_{max} = 1.00 \text{ ft/day (northeasterly)}$$

### 4.7.4 Groundwater Quality

Groundwater monitoring results from nine groundwater sampling events conducted from May 2004 through May 2007 have been reviewed to determine if any potential groundwater impacts exist. The data indicate that of the 15 heavy metals listed in 30 TAC §330.419 only arsenic, barium and vanadium have been detected and all results for volatile organic compounds are non-detect. Some spatial variation does exist in the available data. Arsenic has been detected in MW-1 and MW-2 at concentrations below the primary drinking water standard of 10 µg/L and barium concentrations in MW-3 are elevated above those in MW-1 and MW-2. Neither arsenic or barium concentrations exhibit an increasing trend. Vanadium concentrations have been increasing in MW-2 and MW-3 since April 2005. Additionally, inorganic indicator constituents magnesium, calcium, potassium, chloride, sodium, and total dissolved solids occur at greater concentrations in MW-3 than MW-1 and MW-2. The occurrence of elevated heavy metals and inorganic indicator constituent in an upgradient well suggests that they are a natural phenomenon unrelated to the landfill. A summary of the existing groundwater analytical data for MW-1,

MW-2 and MW-3 is provided in Appendix D.

## 4.8 Piezometers PZ-4 and PZ-5

Piezometers PZ-4 and PZ-5 were installed at the McCombs Landfill in May – June, 2011 to aid in the determination of groundwater flow and to determine the extent of the point of compliance (POC). The installation report for PZ-4 and PZ-5 was submitted to the TCEQ on August 12, 2011 (PSC, 2011). Boring logs and well completion diagrams for PZ-4 and PZ-5 are provided in Appendix E. Subsurface sediments encountered during the drilling of PZ-4 and PZ-5 was primarily composed of sand with some interbedded clay lenses and gravels.

A geologic cross section trending west to east through PZ-4 and PZ-5 is included as Figure 18. Geophysical results for El Paso Water Utilities well EPWU-2 and McCombs Landfill wells MW-1 and MW-2 are also illustrated on Figure 18. Geophysical logging did not occur in PZ-4 or PZ-5. Given the interbedded nature of the sands and clays there is no discernable correlation of the stratigraphic units; however, similar variation exists in the lithologic logs and geophysical logs. The measured groundwater surface elevation on July 3, 2012 is also depicted on the geologic cross section. The groundwater surface elevation is generally level with a slight decreasing trend from EPWU-2 through MW-1. A noticeable decrease in groundwater surface elevation occurs between MW-1 and PZ-4. This observable decrease is likely due to drawdown induced by the extraction well (i.e. CEMEX well) located south of the facility and north of Stan Roberts Road.

### 4.8.1 August 2011 Through July 2012 Water Levels

Monthly water-levels were measured in El Paso Water Utilities wells EPWU-1, EPWU-2, EPU-3, and EPWU-4A; McCombs Landfill wells MW-1, MW-2, MW-3; and piezometers PZ-4 and PZ-5 from August 2011 through July 2012 by the City of El Paso. The recorded groundwater measurements are provided in Table 2. The values in Table 2 were used to construct a hydrograph, Figure 19, to evaluate potential trends in the water-level data. Groundwater elevations in all wells and each piezometer were generally stable from month to month aside from noticeable decreases in PZ-4 over the first two (2) months of measurements. The observable drawdown in PZ-4 was believed to be induced by the extraction well (i.e. CEMEX well) located south of the facility and north of Stan Roberts Road.

Groundwater contour maps from August 2011 through July 2012 are provided in Appendix F (Figures F1 through F12). These maps reveal a predominant easterly to southeasterly flow direction. A northwesterly component of groundwater flow is apparent in the southwest corner of the landfill; however, the flow changes to the east and southeast are believed to be due to drawdown induced by the extraction well (i.e. CEMEX well) located south of the facility and north of Stan Roberts Road. Based on the groundwater contour maps in Appendix F, MW-1 and

MW-2 are downgradient of the landfill and MW-3 is upgradient of the landfill.

# 5 CONCLUSIONS

Findings of the hydrogeologic evaluations of the McCombs Landfill are summarized below:

- According to information provided by a soil investigation report prepared by DRA, the soil underlying the site predominantly consists of sand with varying silt and gravel contents, and occasional layers of sandy clay. These soils typically are associated with the Pleistocene age Camp Rice Formation.

- Groundwater underlying the site occurs in the Hueco Bolson and Rio Grande Alluvial aquifers. Based on published information, the depth to groundwater at the landfill varies between 370 and 390 feet.

- Regional groundwater flow direction is generally toward the south-southeast.

- Climate in the El Paso region is characterized by an abundance of sunshine, low annual rainfall and high rates of evaporation.

- Climatic conditions indicate a low potential for leachate generation and migration to groundwater at the McCombs Landfill.

- The boring logs for MW-1, MW-2, and MW-3 indicate the subsurface sediments are primarily composed of sand with some interbedded clay lenses and gravels. Most sands above a depth of 350 feet are described as being coarse grained and poorly sorted. Medium grained and fine grained sands appear to become more prevalent below the 350 foot depth.

- Groundwater elevations recorded for the landfill since 2003 are stable and do not indicate any major trends or fluctuations.

- The estimated groundwater velocity for the uppermost water-bearing zone is about 1.0 feet per day.

- Spatial variability is apparent in the groundwater data with arsenic, barium, vanadium, magnesium, calcium, potassium, chloride, sodium, and total dissolved solids occurring at greater concentration in MW-3 than in MW-1 or MW-2.

- Groundwater flow at the McCombs Landfill is predominantly to the east/southeast. A northwesterly component of groundwater flow is apparent in the southwest corner of the landfill; however, the flow changes to the east and southeast likely due to the drawdown induced by the extraction well (i.e. CEMEX well) located south of the facility and north of Stan Roberts Road. MW-1 and MW-2 are downgradient of the landfill and MW-3 is upgradient of the landfill.

# 6 REVISED GROUNDWATER MONITORING SYSTEM

The TCEQ implemented new 30 TAC 330 Subchapter J rules governing groundwater monitoring and corrective action in 2006 (effective March 26, 2006). Per 30 TAC §330.401(b) *owners and operators of landfill units shall comply with the 2006 Revisions to this subchapter* [Subchapter J] *by applying for a permit modification with public notice in accordance with §305.70(l) of this title (relating to Municipal Solid Waste Permit and Registration Modifications) to revise any inconsistent provisions within two years from the effective date of the 2006 Revisions.*

## 6.1 Proposed Groundwater Monitoring System

The McCombs Landfill will comply with 30 TAC §330.403(a)(2) by modifying the ground water monitoring system appropriately. The McCombs Landfill will utilize the ground water monitoring system to monitor the uppermost groundwater in accordance with 30 TAC §§330.403-407 to protect human health and the environment.

The proposed groundwater monitoring system was based on the potentiometric surfaces illustrated on the groundwater contour maps provided in Appendix F. As previously discussed, the maps were constructed using water-level data collected from August 2011 to July 2012. The proposed groundwater monitoring system will be comprised of nine (9) monitoring wells: MW-1A, MW-2A, MW-3, MW-4, MW-5, MW-6, MW-7, MW-8, and MW-9. This will be done by plugging and abandoning existing wells MW-1 and MW-2, retaining existing well MW-3, converting existing piezometers PZ-4 and PZ-5 to MW-4 and MW-5, and installing new wells MW-1A, MW-2A, MW-6, MW-7, MW-8, and MW-9. It is proposed that monitoring wells MW-1A, MW-2A, and MW-6 through MW-9 be installed within 180 days of the approval date of this permit modification. Monitoring wells MW-1 and MW-2 will be plugged and abandoned, but will remain a part of the POC until background has been established in wells MW-1A and MW-2A, respectively. Five (5) additional monitoring wells (MW-10, MW-11, MW-12, MW-13, and MW-14) may also be added to the facility groundwater monitoring system in the event the landfill constructs cells in Sectors B, C, D, and E. Well MW-10 would be installed prior to acceptance of waste in Sector B. Wells MW-11 and MW-12 would be installed prior to acceptance of waste in Sector C. Wells MW-13 and MW-14 would be installed prior to waste acceptance in Sector D. If the sequence of landfill sector development changes, the phasing of well installations for MW-10, MW-11, MW-12, MW-13, and MW-14 will be adjusted accordingly as needed to ensure that POC wells will be in place before waste is accepted in a sector. Existing and proposed monitoring wells, the POC, and landfill Sectors are depicted on Figure 20.

Proposed wells MW-1A, MW-2A, MW-4, MW-5, MW-6, MW-7, MW-8, and MW-9 will be

located at the POC (*i.e.,* the vertical surface no more than 500 feet from the hydraulically downgradient limit of the waste management unit boundary, extending down through the uppermost ground water underlying the regulated units, and located on land owned or operated by the McCombs Landfill). Existing well MW-3 will be a background (i.e., upgradient well). Wells MW-10, MW-11, MW-12, MW-13, and MW-14 will also be located at the POC in the event their installation is required. If physical obstacles preclude installation of the groundwater monitoring wells at proposed locations in the existing sectors, the wells will be installed at the closest practical distance hydraulically downgradient from the relevant point of compliance that will ensure detection of groundwater contamination. The design of the monitoring system was based on site-specific technical information. Certification of the system is provided as Appendix G.

The proposed groundwater monitoring wells, with corresponding piezometer numbers (where applicable), and hydraulic gradient positions are listed in the following table.

**Proposed Groundwater Monitoring System**

| Monitoring Well ID | Status | Gradient Position | Latitude and Longitude* | Total Well Depth (ft)** | Top of PVC Casing Elevation (ft MSL)** | Screen Interval Depths (ft)** | Screen Interval Elevations (ft. MSL)** |
|---|---|---|---|---|---|---|---|
| MW-1 | Existing (To be plugged and abandoned) | POC | N 31°59'00.64" W 106°24'14.07" | 473 | 4,070.23 | 461 to 473 | 3,606.35 to 3,594.35 |
| MW-1A | New | POC | N 31°59'17.96" W 106°24'14.51" | 416 | 4,070 | 396 to 416 | 3,671 to 3,651 |
| MW-2 | Existing (To be plugged and abandoned) | POC | N 31°59'00.54" W 106°24'25.57" | 498 | 4,083.89 | 478 to 498 | 3,603.06 to 3,583.06 |
| MW-2A | New | POC | N 31°59'17.85" W 106°24'26.02" | 424 | 4,084 | 404 to 424 | 3,677 to 3,657 |
| MW-3 | Existing | Background | N 31°59'43.41" W 106°24'13.34" | 495 | 4,076.70 | 475 to 495 | 3,598.68 to 3,578.68 |
| PZ-4 | Existing (Convert to MW-4) | POC | N 31°59'18.82" W 106°24'07.71" | 465 | 4,049.64 | 413 to 463 | 3,634.28 to 3,584.28 |
| PZ-5 | Existing (Convert to MW-5) | POC | N 31°59'29.27" W 106°23'53.85" | 440 | 4,061.05 | 418 to 438 | 3,640.44 to 3,620.44 |
| MW-6 | New | POC | N 31°59'17.90" W 106°24'21.29" | 408 | 4,067 | 388 to 408 | 3,676 to 3,656 |

## Proposed Groundwater Monitoring System (continued)

| Monitoring Well ID | Status | Gradient Position | Latitude and Longitude* | Total Well Depth (ft)** | Top of PVC Casing Elevation (ft MSL)** | Screen Interval Depths (ft)** | Screen Interval Elevations (ft. MSL)** |
|---|---|---|---|---|---|---|---|
| MW-7 | New | POC | N 31°59'18.57" W 106°24'0.75" | 462 | 4,065 | 412 to 462 | 3,650 to 3,600 |
| MW-8 | New | POC | N 31°59'18.93" W 106°23'53.86" | 443 | 4,071 | 423 to 443 | 3,645 to 3,625 |
| MW-9 | New | POC | N 31°59'23.93" W 106°23'53.78" | 443 | 4,071 | 423 to 443 | 3,645 to 3,625 |
| MW-10 | Potential (Install if landfill expands to Sector B)*** | POC | N 31°59'35.15" W 106°23'53.83" | 446 | 4,080 | 426 to 446 | 3,651 to 3,631 |
| MW-11 | Potential (Install if landfill expands to Sector C)*** | POC | N 31°59'41.04" W 106°23'54.00" | 441 | 4,079 | 421 to 441 | 3,655 to 3,635 |
| MW-12 | Potential (Install if landfill expands to Sector C)*** | POC | N 31°59'46.93" W 106°23'54.00" | 433 | 4,076 | 413 to 433 | 3,660 to 3,640 |
| MW-13 | Potential (Install if landfill expands to Sector D)*** | POC | N 31°59'52.81" W 106°23'54.12" | 416 | 4,064 | 396 to 416 | 3,665 to 3,645 |
| MW-14 | Potential (Install if landfill expands to Sector D)*** | POC | N 31°59'58.70" W 106°23'54.16" | 406 | 4,059 | 386 to 406 | 3,670 to 3,650 |

* - Locations of new and potential wells may be adjusted based on site conditions at time of drilling. 600 foot spacing will be maintained.
** - Depths and elevations for new and potential wells are estimated.
*** - If the sequence of landfill sector development changes, the phasing of well installations will be adjusted accordingly as needed to ensure that POC wells will be in place before waste is accepted in a sector.

The new monitoring wells will be installed by a Texas licensed monitoring well driller in accordance with TCEQ monitoring well specifications. They will be completed in a manner not to introduce contaminants. The monitoring well installation and development be supervised by a geologist or engineer who is familiar with the area geology. Anticipated construction details for the new wells are provided in the table on the following page:

## Well Construction Specifications

| | |
|---|---|
| Well Depths | All wells approximately 25 feet into saturated zone, except MW-7. MW-7 installed approximately 55 feet into saturated zone to account for CEMEX well drawdown |
| Well Materials | 4" diameter sched. 80 PVC, flush threaded with screw joints, and o-rings. |
| Screen | MW-7 - Approximately 50 ft section, machine slotted with 0.010" slots.<br>All other wells - Approximately 20 ft section, machine slotted with 0.010" slots. |
| Filter Pack | Inert 10/20 silica sand extending approx. 2 ft above top of screen. |
| Annular Seal | 30 ft thick, composed of hydrated sodium bentonite pellets or granules. |
| Casing Seal | Bentonite grout or cement-bentonite grout placed from the annular seal to within approximately 2 ft. of the surface. |
| Concrete Pad | A 4' x 4' x 6" reinforced concrete pad extending to grout below surface. |
| Protective Casing and Bollards | Four-inch steel locking protective casing and two bollards placed outside of concrete pad. |

Note: Well depths may vary based on field conditions and the actual elevation of the groundwater producing interval encountered during drilling.

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# TABLES

# Table 1
## WATER WELL INVENTORY (2 mile radius)

| STATE WELL NUMBER | SURFACE ELEVATION | USE OF WELL | DRILL DATE | OWNER | TOTAL DEPTH | TDS | ANALYSES (Y/N) | CASING TYPE | CASING DIAMETER |
|---|---|---|---|---|---|---|---|---|---|
| 49-06-105 | 4059 | UNUSED | | PRICE'S DAIRY | 450 | 1,227 | Y | STEEL | |
| 49-05-201 | 4060 | IND | 1958 | CITY OF EL PASO | 631 | 414 | Y | STEEL | 24, 18, 12 |
| 49-05-202 | 4050.5 | IND | 1958 | CITY OF EL PASO | 625 | 389 | Y | | 24, 18, 12 |
| 49-05-203 | 4049.37 | DISPOSAL | | CITY OF EL PASO | 1483 | | | | |
| 49-05-204 | 4044.0 | PUBLIC | 1959 | CITY OF EL PASO | 515 | 487 | Y | STEEL | 24, 18 |
| 49-05-205 | 4042.39 | NOT USED | 1940 | CITY OF EL PASO | 1018 | | N | | 4 |
| 49-05-208 | 4063.99 | IND | 1962 | CITY OF EL PASO | 825 | 717 | Y | STEEL | 24, 18 |
| 49-05-212 | 4045 | IND | 1975 | EL PASO ELECTRIC | 839 | 437 | Y | STEEL | 24, 16 |
| 49-05-213 | 4030 | IND | 1975 | EL PASO ELECTRIC | 875 | 569 | Y | STEEL | 24, 16 |
| 49-05-214 | 4045 | RECHARGE | 1988 | CITY OF EL PASO | 685 | 619 | Y | STEEL | 16 |
| 49-05-224 | 4040 | RECHARGE | 2001 | EL PASO WATER | 420 | | N | | |
| 49-05-225 | 4040 | RECHARGE | 2001 | EL PASO WATER | 332 | | N | | |
| 49-05-226 | 4040 | RECHARGE | 2001 | EL PASO WATER | 167 | | N | | |
| 49-05-227 | 4040 | RECHARGE | 2001 | EL PASO WATER | 104 | | N | | |
| 49-05-301 | 4018 | | 1958 | CITY OF EL PASO | 671 | 624 | Y | | 24, 18, 12 |
| 49-05-302 | 4028 | UNUSED | 1947 | EPNG | 771 | | N | STEEL | 10 |
| 49-05-303 | 4044 | IRR | 1955 | PRICE'S DAIRY | 870 | 1049 | Y | | 24, 18, 12 |
| 49-05-304 | 4055 | | 1955 | PRICE'S DAIRY | 753 | 580 | Y | | 24, 18, 12 |
| 49-05-305 | 4055 | | 1965 | CITY OF EL PASO | 834 | 331 | Y | | 24, 28 |
| 49-05-306 | 4054 | | 1965 | CITY OF EL PASO | 603 | | N | STEEL | 24, 18 |
| 49-05-307 | | IND | 1958 | EPNG | 650 | 472 | Y | | 10, 12 |
| 49-05-308 | 4062 | OBSERV | 1965 | CITY OF EL PASO | 701 | | | | |
| 49-05-309 (EPWU-4A) | 4025 | OBSERV | 1965 | CITY OF EL PASO | 795 | 228 | Y | | 4 |
| 49-05-310 | PLUGGED | | | | | | | | |
| 49-05-311 | 4030 | IND | 1951 | EPNG | 750 | 567 | Y | STEEL | |

| STATE WELL NUMBER | SURFACE ELEVATION | USE OF WELL | DRILL DATE | OWNER | TOTAL DEPTH | TDS | ANALYSES (Y/N) | CASING TYPE | CASING DIAMETER |
|---|---|---|---|---|---|---|---|---|---|
| 49-05-312 | 4031 | IND | -- | EPNG | 630 | 768 | Y | | |
| 49-05-313 | PLUGGED | | | | | | | | |
| 49-05-314 | PLUGGED | IND | 1973 | EL PASO SAND PRODUCTS | 465 | | N | STEEL | 20, 16, 8½ |
| 49-05-315 | 4060 | IND | 1978 | EL PASO SAND PRODUCTS | 598 | | N | STEEL | 20, 12 |
| 49-05-316 | 4040 | IND | 1970 | EPNG | 625 | 368 | Y | STEEL | 26, 12 |
| 49-05-317 | 4008 | OBSERV | 1962 | CITY OF EL PASO | 500 | | N | STEEL | 5½ |
| 49-05-318 | 4009 | OBSERV | 1962 | CITY OF EL PASO | 500 | | N | STEEL | 5½ |
| 49-05-319 | 4008 | OBSERV | 1981 | CITY OF EL PASO | 500 | | N | STEEL | 5½ |
| 49-05-320 | 4007 | OBSERV | 1962 | CITY OF EL PASO | 500 | | N | STEEL | 5½ |
| 49-05-321 (EPWU-1) | 4054 | UNUSED | 1988 | CITY OF EL PASO | 500 | 1983 | Y | STEEL | 4 |
| 49-05-322 (EPWU-2) | 4050 | OBSERV | 1988 | CITY OF EL PASO | 500 | 318 | Y | STEEL | 4 |
| 49-05-323 (EPWU-3) | 4038 | OBSERV | 1988 | CITY OF EL PASO | 500 | 248 | Y | STEEL | 4 |
| CEMEX | 4050 | IND | 2007 | CEMEX INC. | 562 | | N | STEEL | 8 |
| 49-05-324 | 4040 | RECHARGE | | EL PASO WATER | 500 | | N | | |
| 49-05-325 | 4020 | RECHARGE | | EL PASO WATER | 500 | | N | | |
| RW11 | | RECHARGE | | EL PASO WATER | | | | | |
| New Mexico 1 | | IRR | 1959 | P.K. COLQUITT | 670 | | N | | 18 |
| New Mexico 2 | | DOMESTIC | 1960 | LAKE SECTION WATER COMPANY | 780 | | N | | 18 |

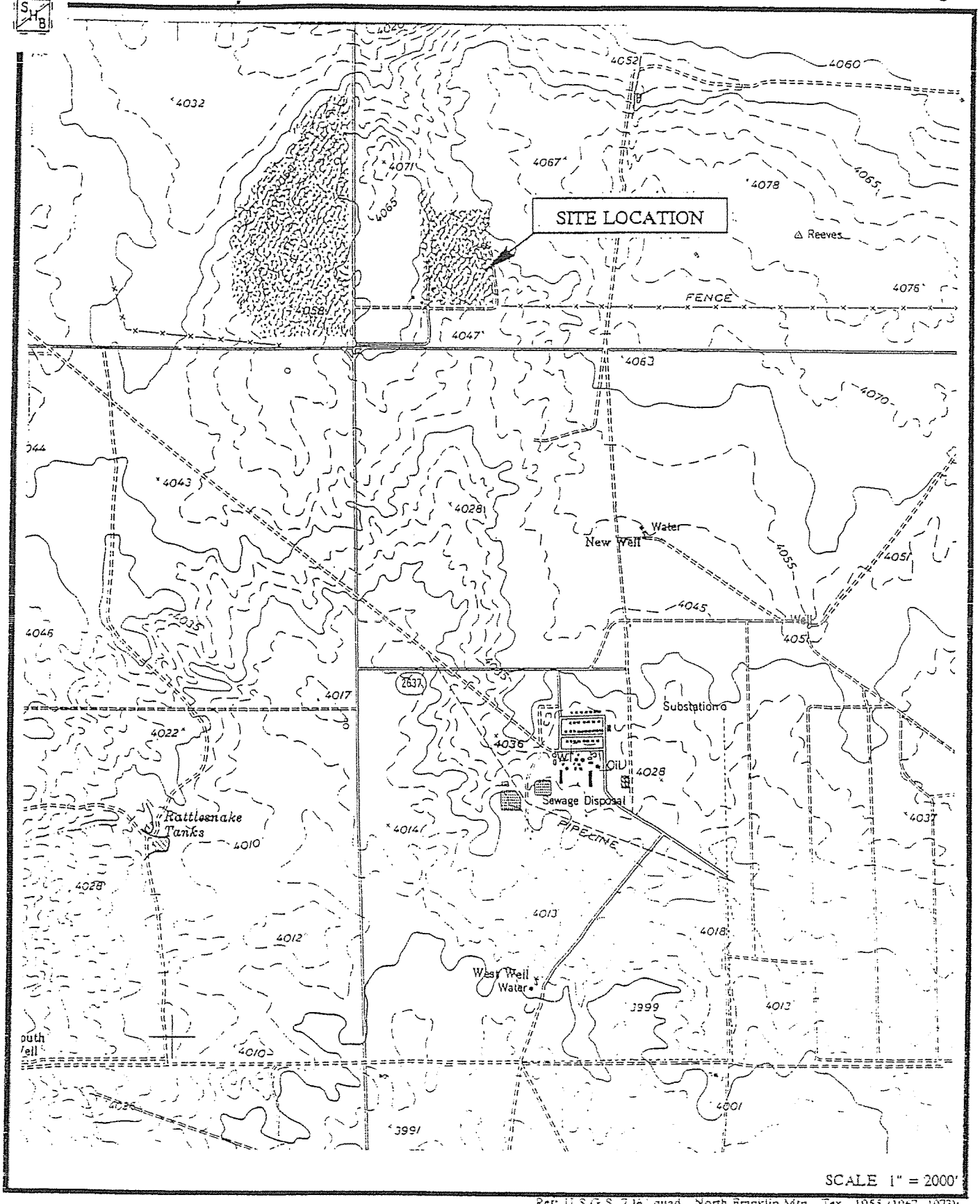
SUMMARY OF GROUNDWATER LEVEL DATA including PSB wells
City of El Paso, McCombs Landfill -- Permit No. MSW - 729A
El Paso County, Texas

# Table 2

| | McCombs Landfill Monitoring Wells | | | | | | | | | | El Paso Water Utilities - Sludge Monofil Monitoring Wells | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Monitor Well/Piezometer** | **MW-1** | | **MW-2** | | **MW-3** | | **PZ-4** | | **PZ-5** | | **EPWU-1** | | **EPWU-2** | | **EPWU-3** | | **EPWU-4A** | |
| Northing | 10738277.090 | | 10738321.600 | | 10742589.800 | | 10738330.520 | | 10739320.850 | | 10737372.220 | | 10738231.810 | | 10739959.120 | | 10742667.150 | |
| Easting | 415218.169 | | 414227.776 | | 415517.167 | | 415797.411 | | 417045.933 | | 413508.380 | | 411817.282 | | 411934.909 | | 413804.915 | |
| Top of Casing Elevation, ft msl | *4070.23* | | *4083.89* | | *4076.70* | | *4049.64* | | *4061.05* | | *4077.230* | | *4072.751* | | *4058.309* | | *4052.214* | |
| Total Well Depth from Top of Casing, ft | 475.88 | | 500.83 | | 498.02 | | 465.00 | | 440.00 | | Note 1 | | Note 1 | | Note 1 | | Note 1 | |
| **Measurement Date** | **WATER LEVEL DEPTH (FT) / *ELEVATION (FT MSL)*** | | | | | | | | | | | | | | | | | |
| 8/3/2011 | 393.50 | *3676.73* | 399.85 | *3684.04* | 390.70 | *3686.00* | 359.50 | *3690.14* | 406.80 | *3654.25* | 395.06 | *3682.17* | 388.17 | *3684.58* | 371.20 | *3687.11* | 357.95 | *3694.26* |
| 9/1/2011 | 393.55 | *3676.68* | 399.40 | *3684.49* | 390.60 | *3686.10* | 389.50 | *3660.14* | 406.90 | *3654.15* | 394.95 | *3682.28* | 388.72 | *3684.03* | 370.92 | *3687.39* | 358.01 | *3694.20* |
| 10/3/2011 | 393.85 | *3676.38* | 399.91 | *3683.98* | 391.55 | *3685.15* | 399.10 | *3650.54* | 407.45 | *3653.60* | 395.35 | *3681.88* | 388.50 | *3684.25* | 370.50 | *3687.81* | 358.15 | *3694.06* |
| 10/31/2011 | 394.00 | *3676.23* | 399.85 | *3684.04* | 391.90 | *3684.80* | 399.25 | *3650.39* | 407.51 | *3653.54* | 395.80 | *3681.43* | 388.25 | *3684.50* | 370.90 | *3687.41* | 358.20 | *3694.01* |
| 12/1/2011 | 393.80 | *3676.43* | 399.40 | *3684.49* | 391.55 | *3685.15* | 399.10 | *3650.54* | 407.30 | *3653.75* | 394.96 | *3682.27* | 387.99 | *3684.76* | 370.22 | *3688.09* | 357.99 | *3694.22* |
| 1/5/2012 | 394.10 | *3676.13* | 399.85 | *3684.04* | 391.80 | *3684.90* | 399.20 | *3650.44* | 407.55 | *3653.50* | 395.00 | *3682.23* | 388.05 | *3684.70* | 370.40 | *3687.91* | 357.80 | *3694.41* |
| 2/2/2012 | 394.20 | *3676.03* | 400.12 | *3683.77* | 391.50 | *3685.20* | 399.45 | *3650.19* | 407.63 | *3653.42* | 394.95 | *3682.28* | 387.90 | *3684.85* | 370.20 | *3688.11* | 357.50 | *3694.71* |
| 2/29/2012 | 394.00 | *3676.23* | 399.45 | *3684.44* | 391.45 | *3685.25* | 399.25 | *3650.39* | 407.80 | *3653.25* | 395.10 | *3682.13* | 388.30 | *3684.45* | 370.95 | *3687.36* | 358.25 | *3693.96* |
| 4/4/2012 | 394.40 | *3675.83* | 400.00 | *3683.89* | 392.15 | *3684.55* | 399.55 | *3650.09* | 408.00 | *3653.05* | 395.35 | *3681.88* | 388.35 | *3684.40* | 370.55 | *3687.76* | 358.50 | *3693.71* |
| 5/7/2012 | 394.60 | *3675.63* | 400.35 | *3683.54* | 392.50 | *3684.20* | 399.65 | *3649.99* | 408.10 | *3652.95* | 395.75 | *3681.48* | 388.75 | *3684.00* | 370.85 | *3687.46* | 358.55 | *3693.66* |
| 5/29/2012 | 394.80 | *3675.43* | 400.30 | *3683.59* | 392.35 | *3684.35* | 400.00 | *3649.64* | 408.50 | *3652.55* | 396.55 | *3680.68* | 389.15 | *3683.60* | 371.00 | *3687.31* | 358.70 | *3693.51* |
| 7/3/2012 | 395.15 | *3675.08* | 400.85 | *3683.04* | 392.85 | *3683.85* | 400.45 | *3649.19* | 408.70 | *3652.35* | 396.70 | *3680.53* | 390.00 | *3682.75* | 371.25 | *3687.06* | 358.60 | *3693.61* |

Notes:
1. EPWU - PSB wells have a screened interval of 300 - 500 ft

# FIGURES

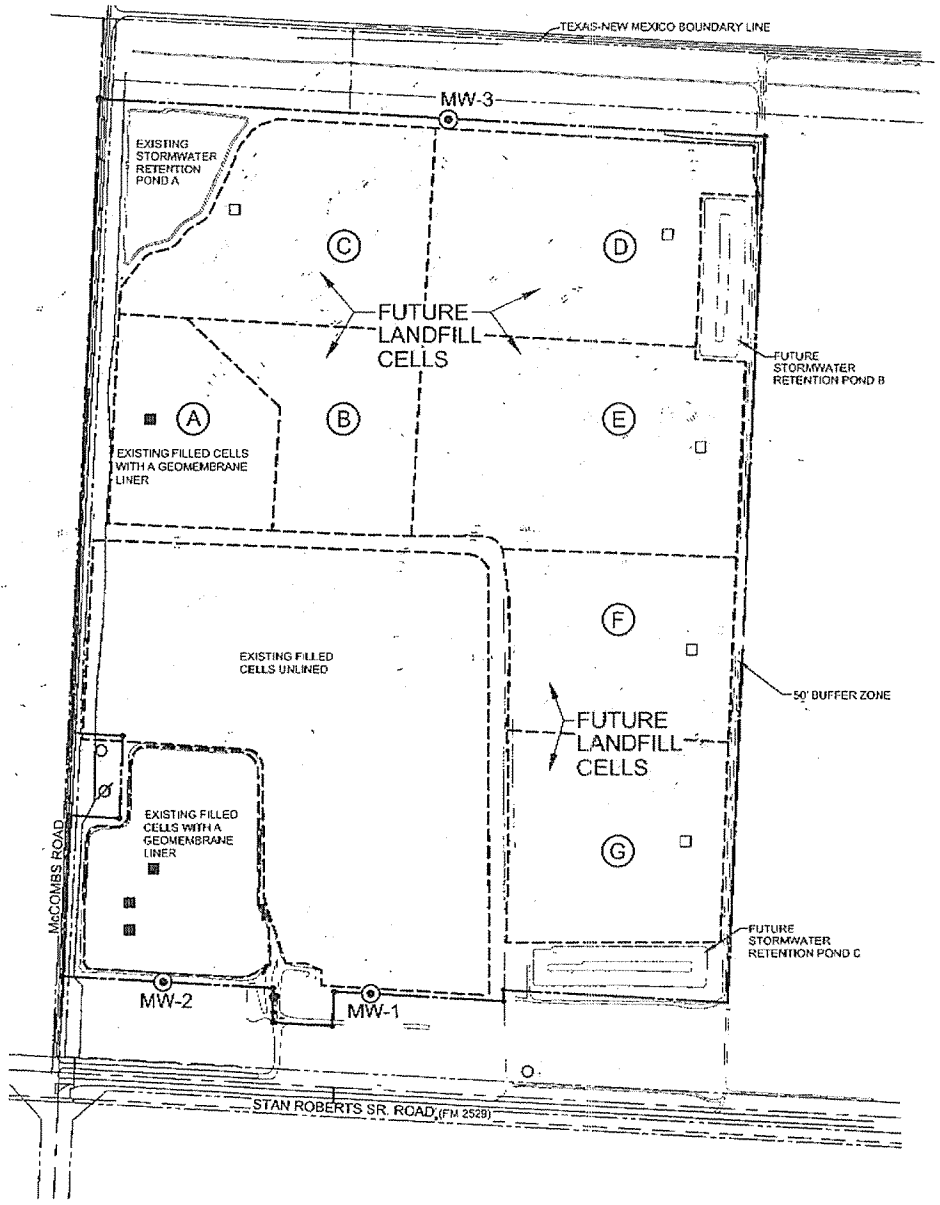



Ref: U.S.G.S. 7 ½' quad., North Franklin Mtn., Tex., 1955 (1967, 1973);

Existing Landfill Site Assessment
McCombs Landfill
El Paso, Texas
Job No. E93-4034

Figure 1
Site Location Map

AGRA
Earth & Environmental Group




STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
960
LICENSED
PROFESSIONAL GEOSCIENTIST

7-6-2009

PSC
PARKHILL SMITH & COOPER

The CAREL CORPORATION

136 Pecan Street, Keller, TX 76248

REGISTRATION NUMBER F-560

CAREL CORPORATION 50137

SCALE

0 300 600

FEET

**SITE PLAN**

THE CITY OF EL PASO TEXAS

**CITY OF EL PASO GROUNDWATER PERMIT MODIFICATIONS FOR McCOMBS LANDFILL**

7969 SAN PAULO DRIVE
EL PASO, TEXAS 79907

LEGEND:

- PROPERTY/PERMIT BOUNDARY
- EXISTING LEACHATE COLLETION SUMP
- FUTURE LEACHATE COLLETION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL
- LANDFILL SECTOR (CELL) DESIGNATION

N

| NO | DATE | DESCRIPTION |
|---|---|---|
| 1 | 7/6/2009 | TCEQ 1 RESPONSE |

ISSUING OFFICE: DFT PROJECT NO. 07-07-35

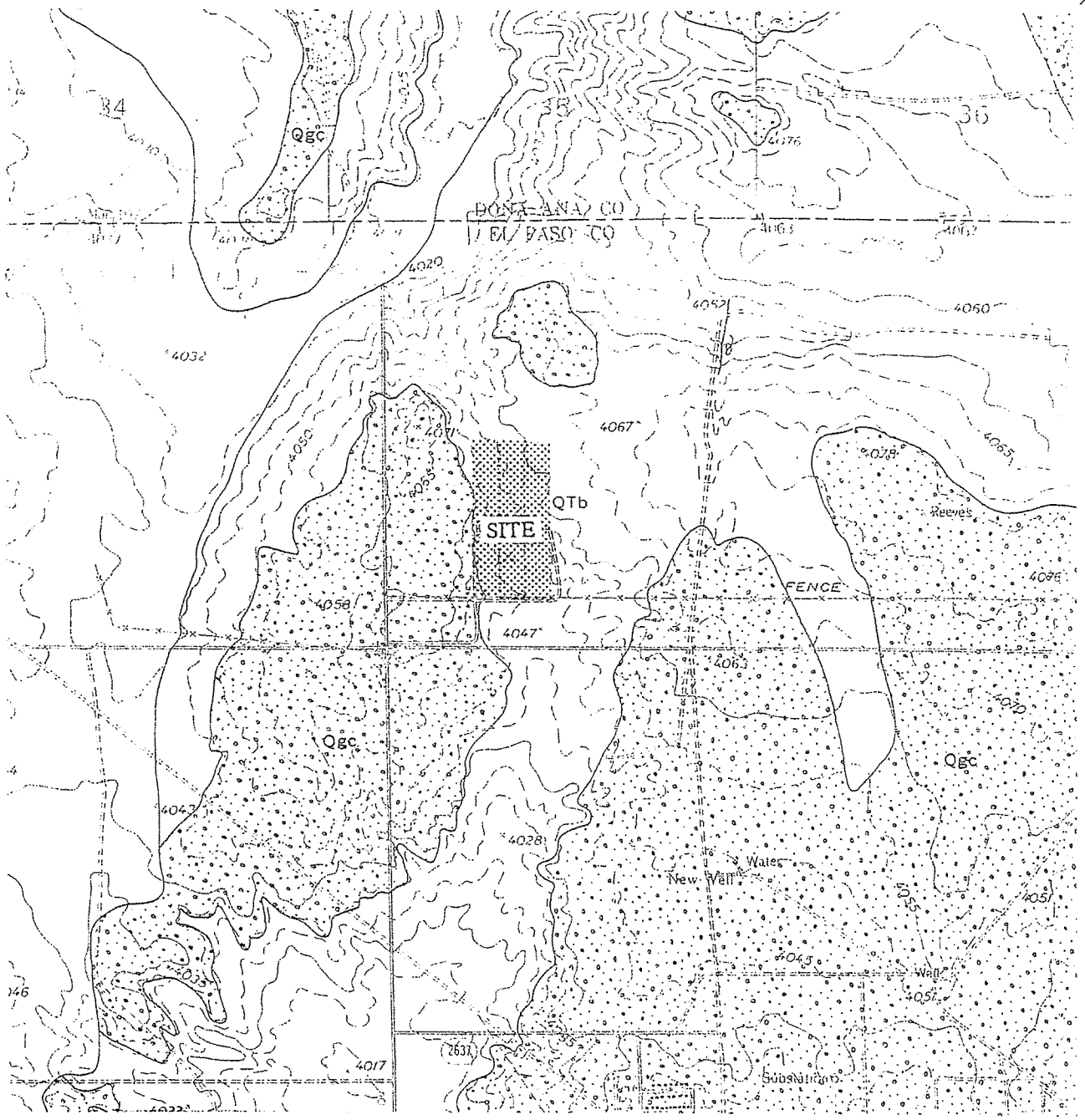
DATE DRAFTED: October 12, 2007

FILENAME:

DRAWN BY: FGK

DRAFTED BY: FGK

FIGURE: 2




## EXPLANATION

| | | |
|---|---|---|
| QUATERNARY | Qal<br>Alluvium | *Holocene* |
| | Qgc<br>Gravel and Caliche Rimrock | *Pleistocene* |
| TERTIARY & QUATERNARY | Qtb<br>Basin Deposits | *Pliocene* |

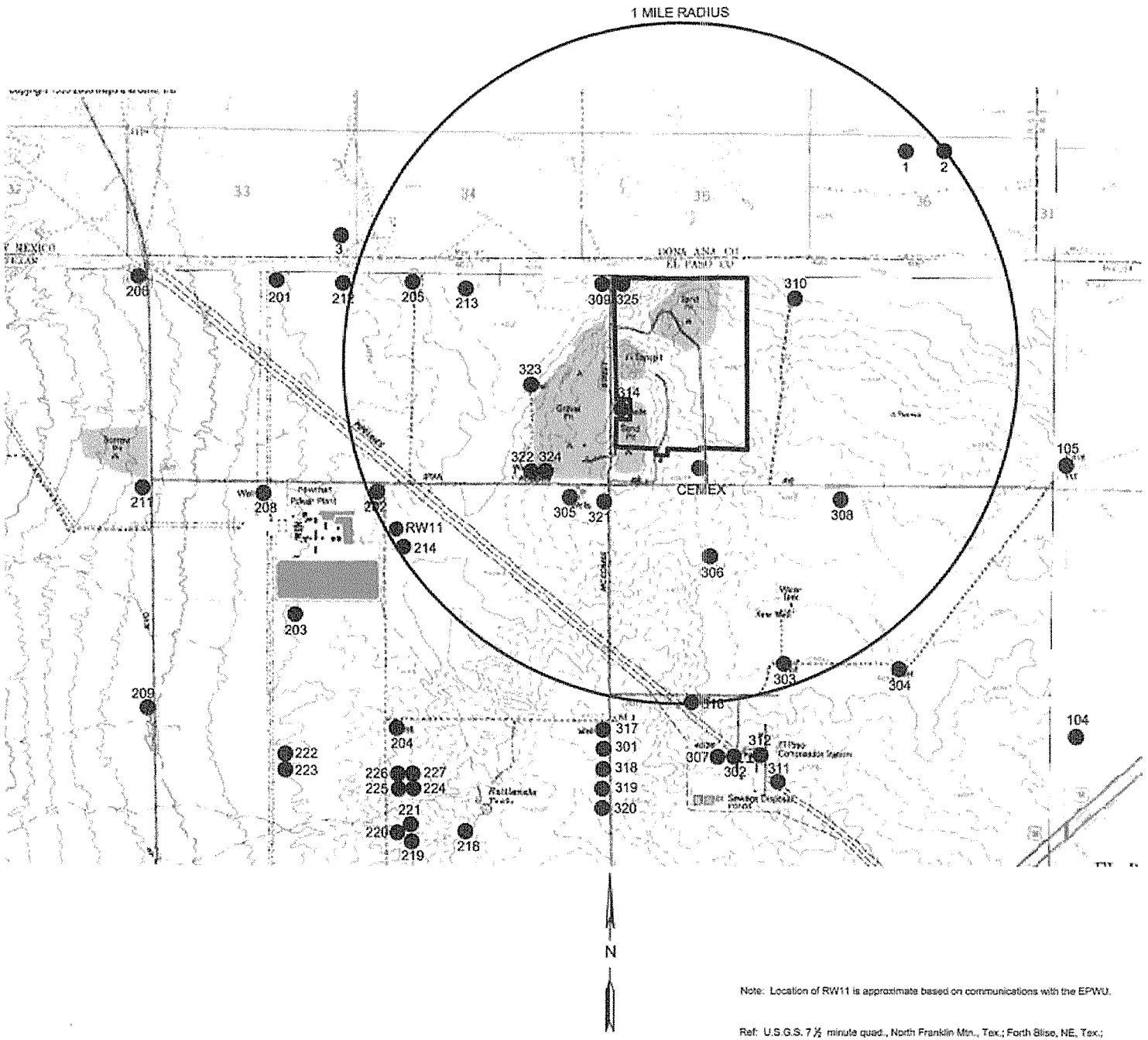
SCALE 1" = 2000'

Ref: "Geologic Map of the Northern Franklin Mountains, Texas and New Mexico
United States Dept. of Interior Geological Survey; Bulletin 1298

Existing Landfill Site Assessment
McCombs Landfill
El Paso, Texas
Job No. E93-4034

Figure 3
Geologic Map

AGRA
Earth & Environmental Group




Note: Location of RW11 is approximate based on communications with the EPWU.

Ref: U.S.G.S. 7 ½ minute quad., North Franklin Mtn., Tex.; Forth Bliss, NE, Tex.; Newman, New Mexico & Tex.; Newman, SW, New Mexico & Tex.; 1955 (1967, 1973)

PSC
PARKHILL, SMITH & COOPER

The CAREL CORPORATION

136 Pecan Street, Keller, TX 76248

REGISTRATION NUMBER F-560

CAREL CORPORATION 50137

SCALE
0 0.5 1
MILE

# WATER WELL SEARCH

CITY OF EL PASO
GROUNDWATER PERMIT
MODIFICATIONS FOR
McCOMBS LANDFILL

7969 SAN PAULO DRIVE
EL PASO, TEXAS 79907

LEGEND:

- WATER WELL
- 301 — STATE WELL NUMBER ABREVIATION
- CEMEX — WELL OWNER
- APPROXIMATE LANDFILL BOUNDARY

| NO | DATE | DESCRIPTION |
|---|---|---|
| 1 | 6/19/08 | ADDED SITE BOUNDARY AND 1 MILE BUFFER |

ISSUING OFFICE: CITY PROJECT NO: 07-07-35

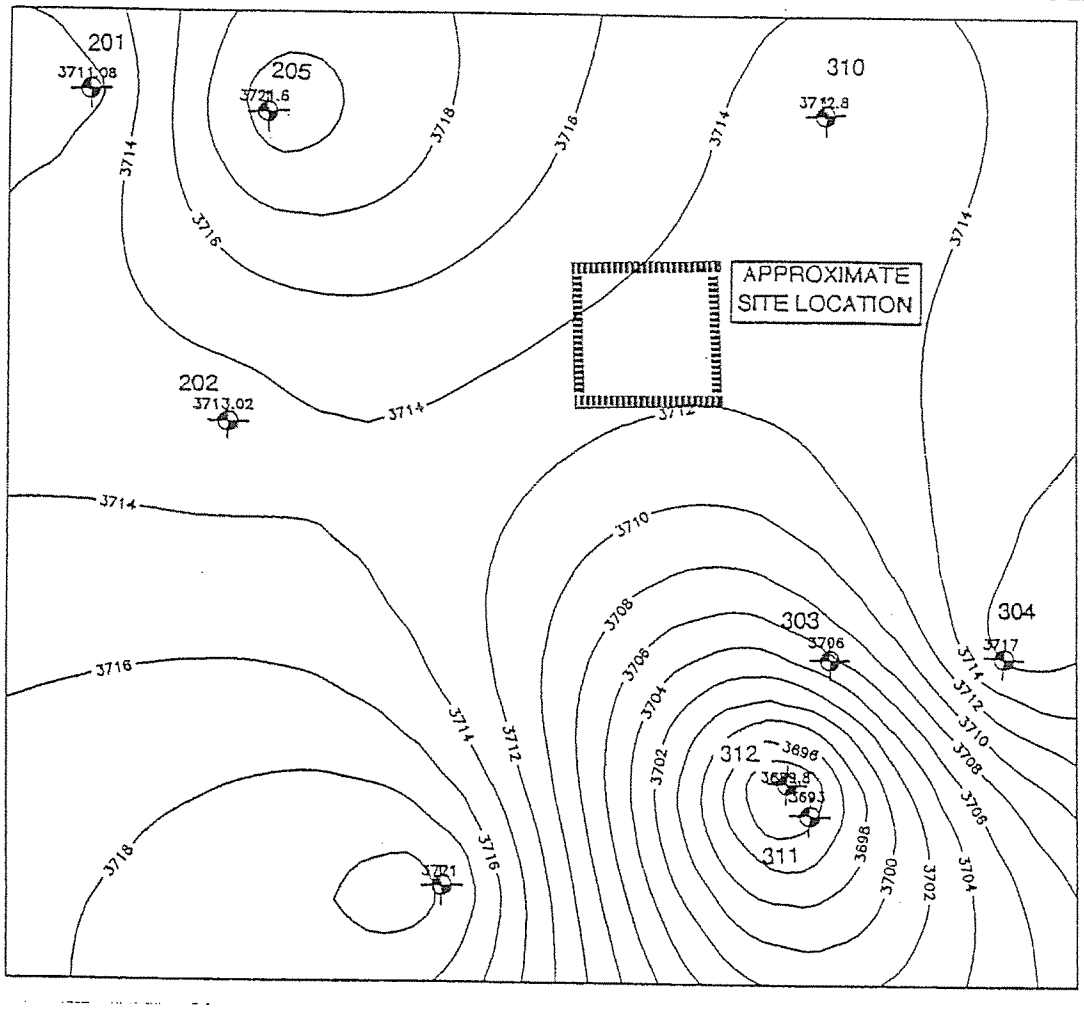
DATE DRAFTED: November 29, 2007

FILENAME: I:\TEXAS\McCombs\Figure 4.1.dwg

DRAWN BY: TDW

DRAFTED BY: TDW

FIGURE: 4

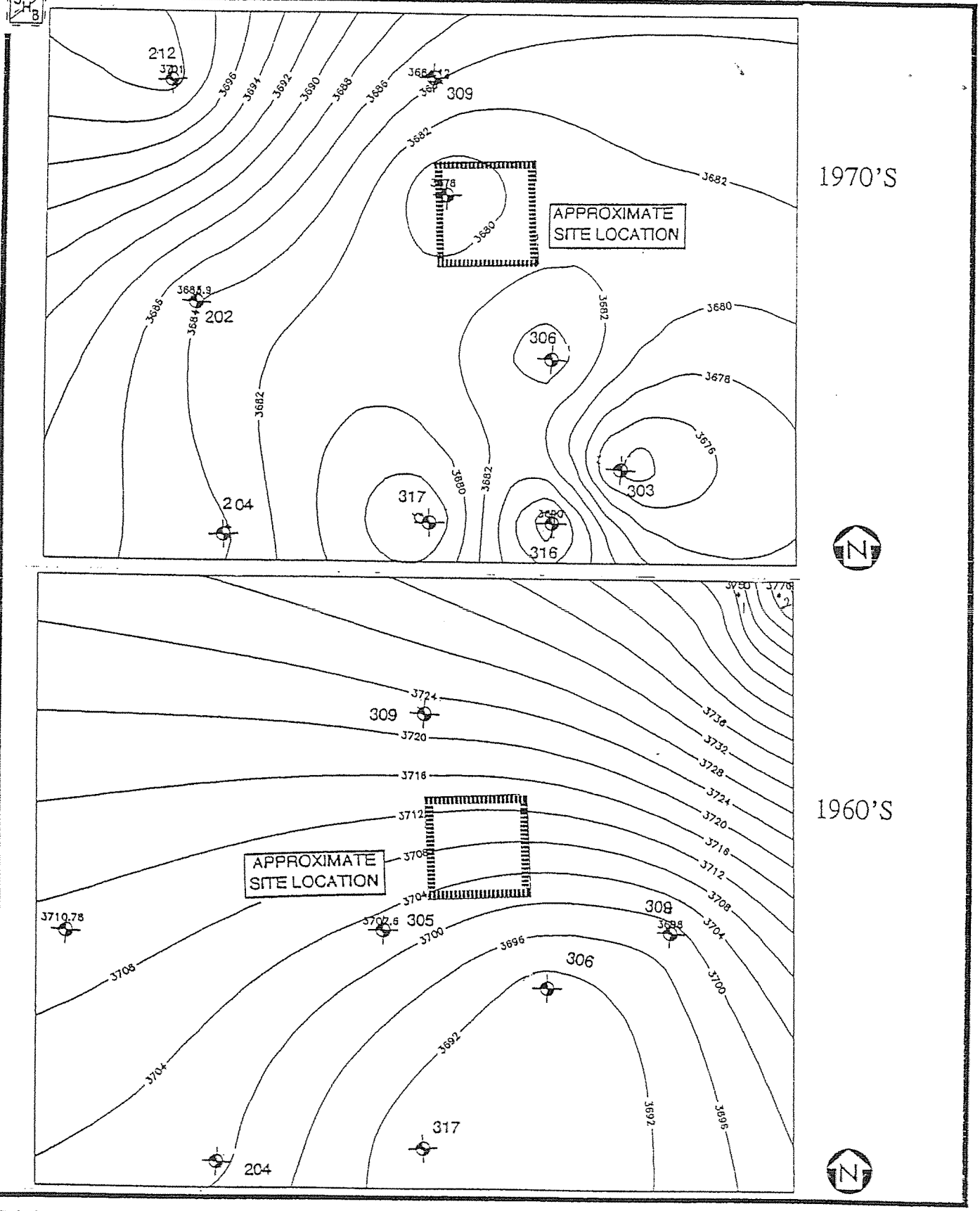



1950's

Existing Landfill Site Assessment
McCombs Landfill
El Paso, Texas
Job No. E93-4034

Figure 5
Groundwater Elevations

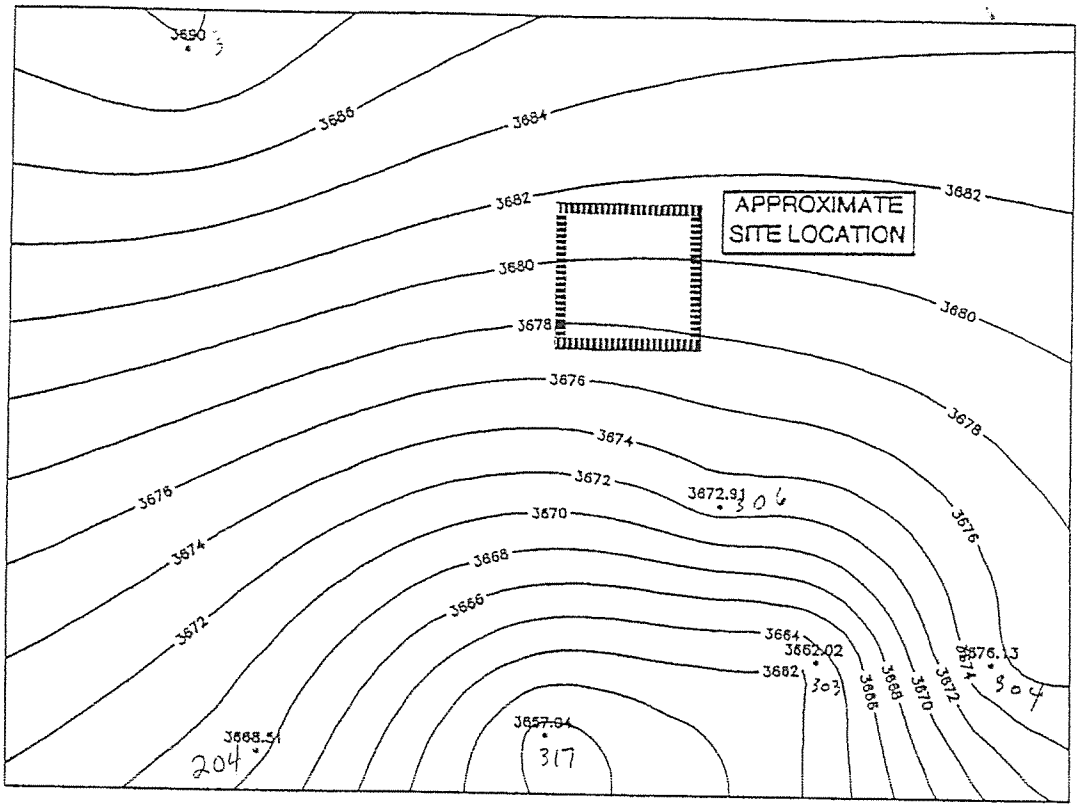
AGRA
Earth & Environmental Group

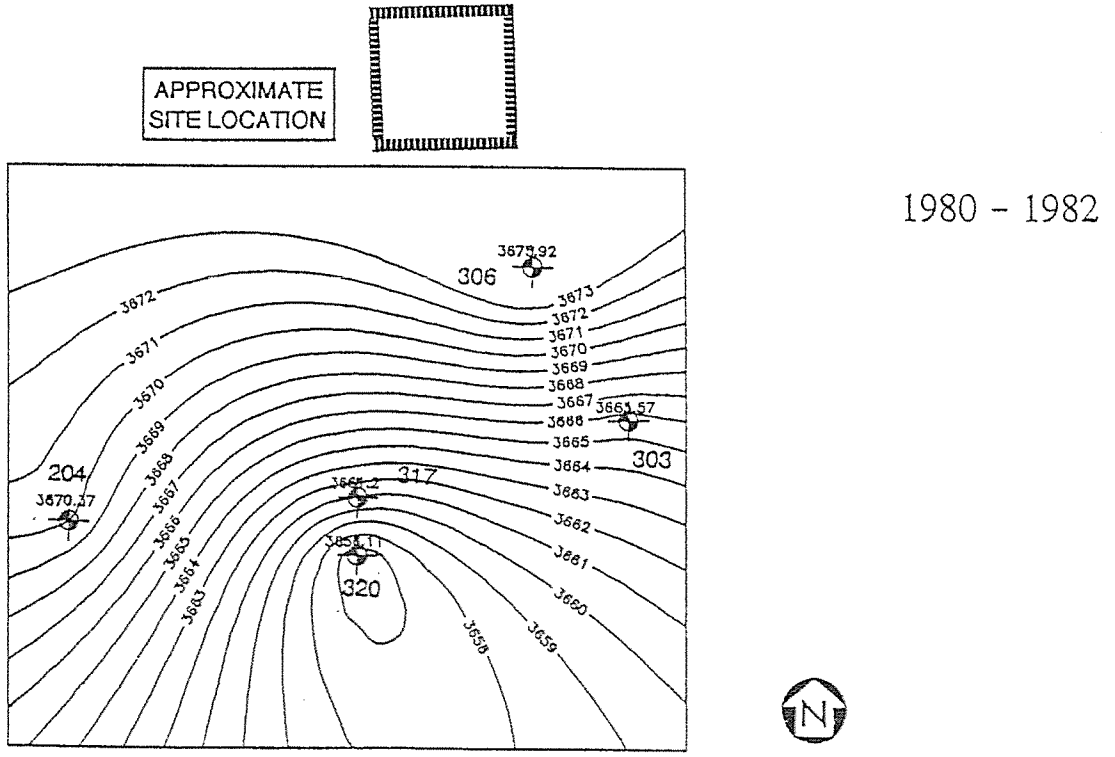



Existing Landfill Site Assessment
McCombs Landfill
El Paso, Texas
Job No. E93-4034

Figure 6
Groundwater Elevations

AGRA Earth & Environmental Group

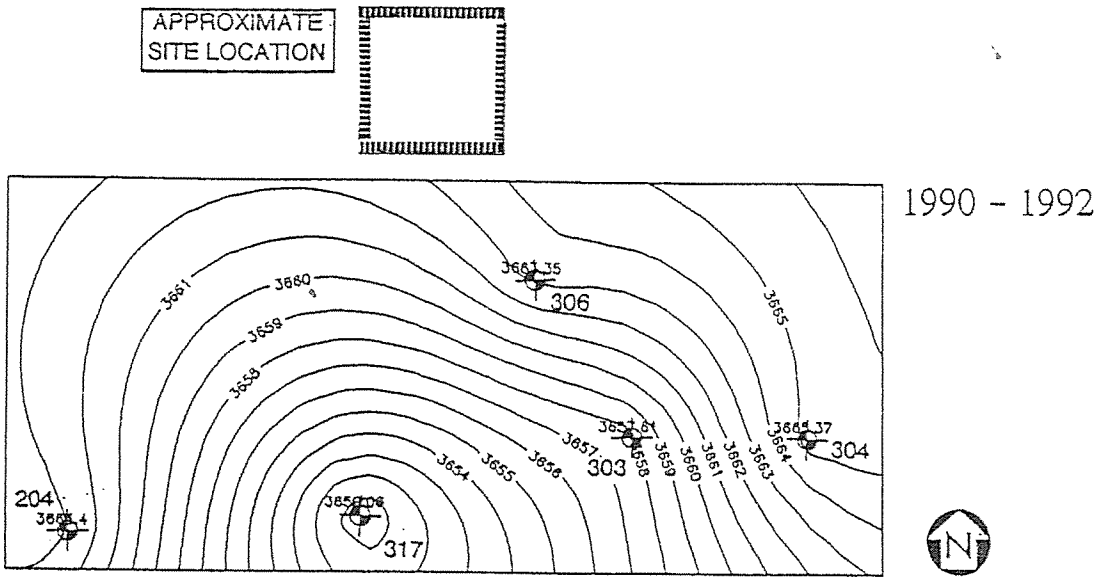


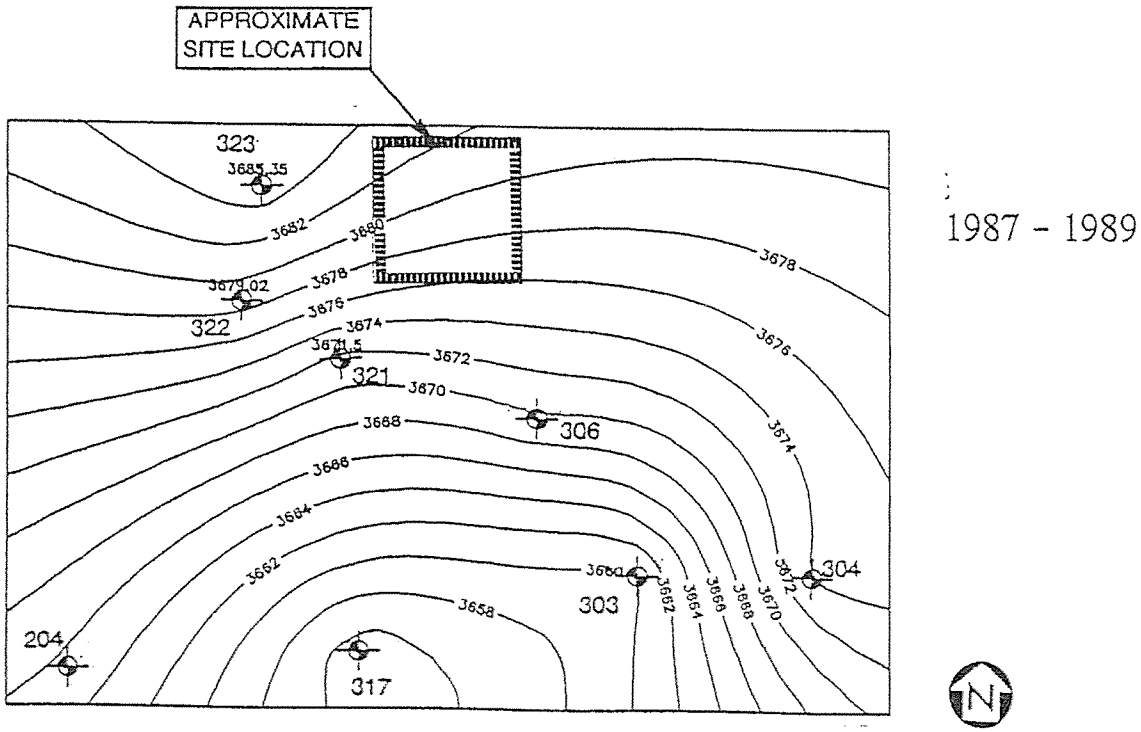




Existing Landfill Site Assessment
McCombs Landfill
El Paso, Texas
Job No. E93-4034

Figure 7
Groundwater Elevations

AGRA Earth & Environmental Group

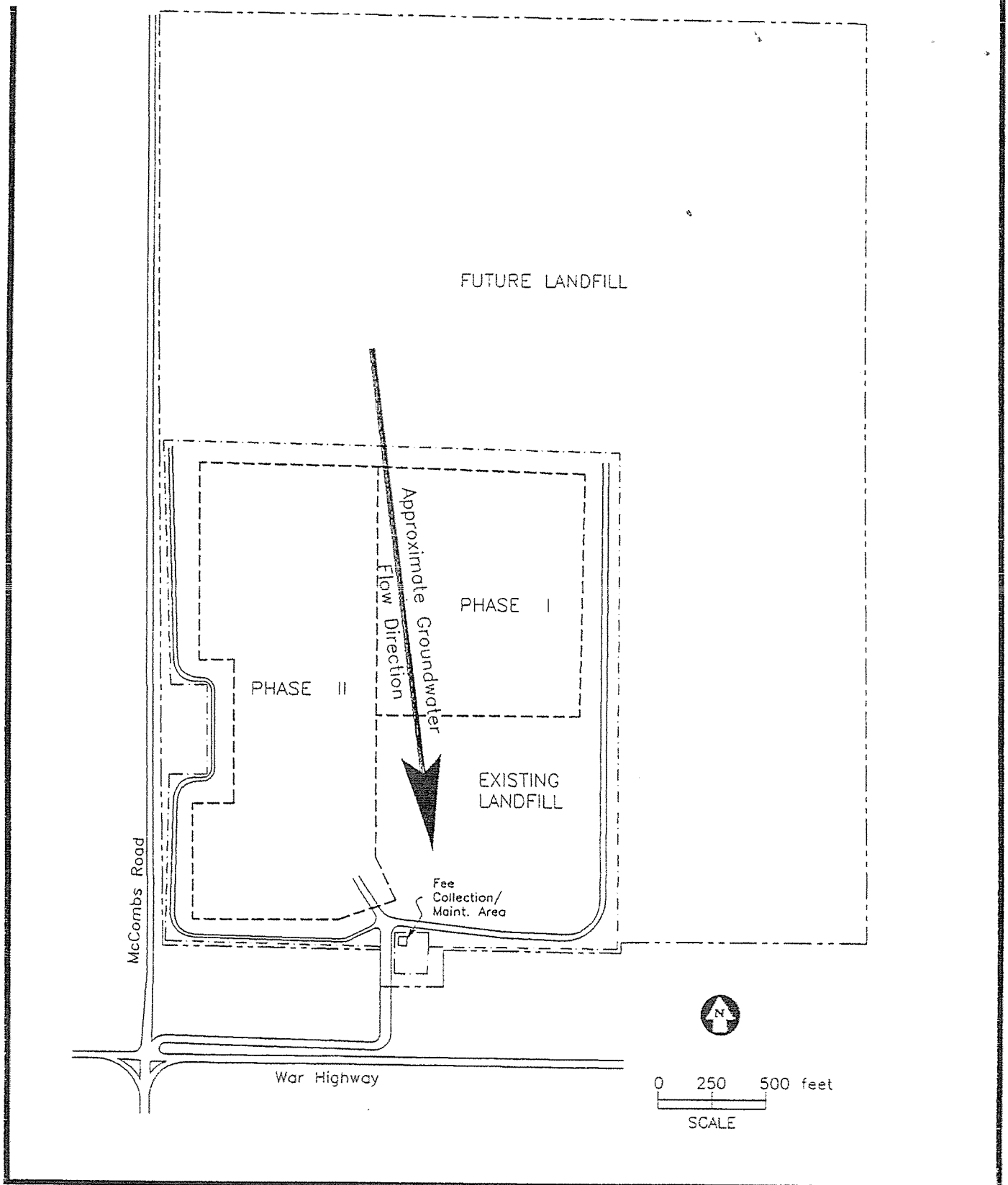



Existing Landfill Site Assessment
McCombs Landfill
El Paso, Texas
Job No. E93-4034

Figure 8
Groundwater Elevations

AGRA
Earth & Environmental Group



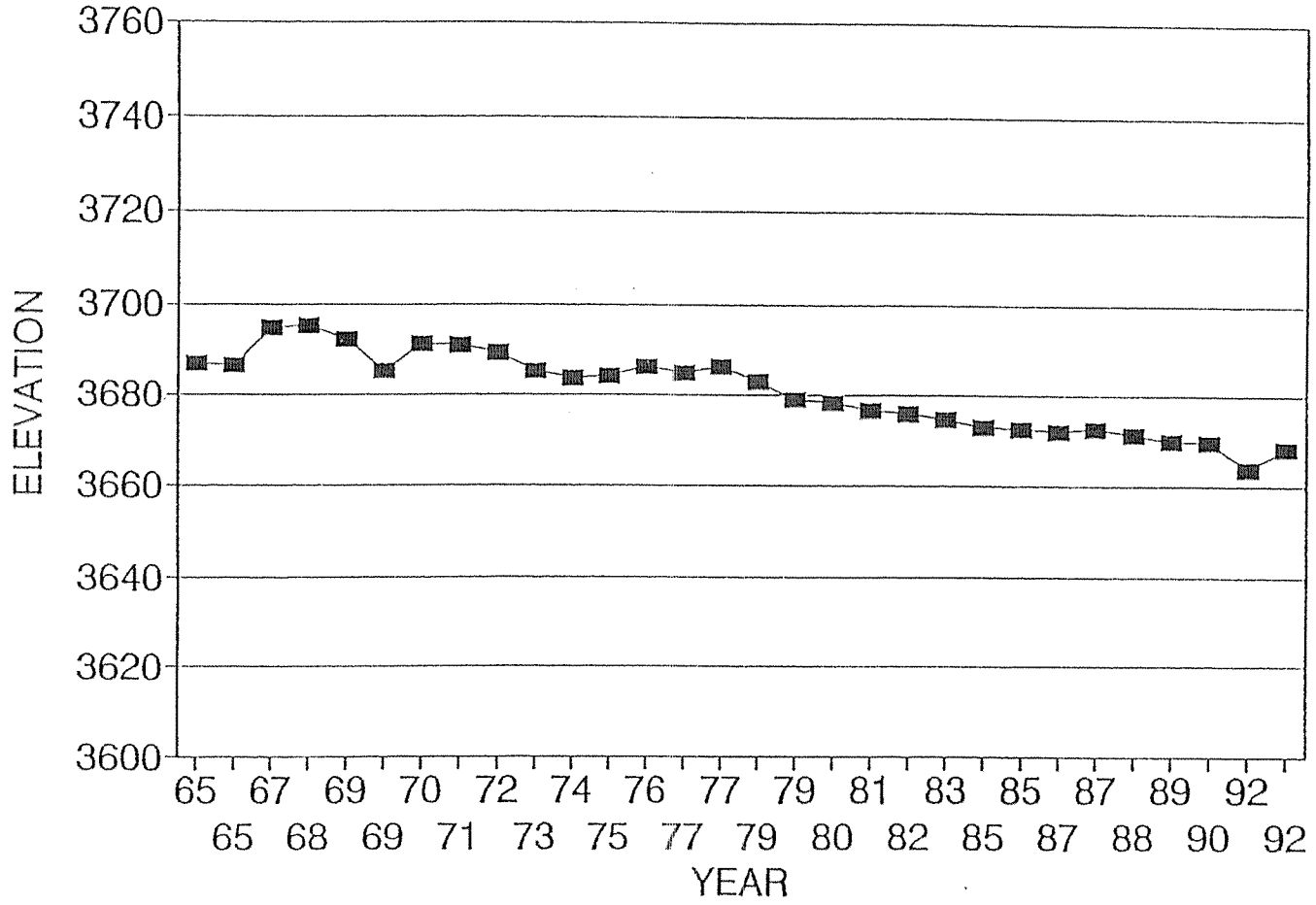

Ref.: "Northeast El Paso Landfill Completion Plan" by DRA, 4/83

Existing Landfill Site Assessement
McCombs Landfill
El Paso, Texas
Job No. E93-4034

Figure 9
Site Plan with Approximate Groundwater Flow Direction

AGRA Earth & Environmental Group

# GROUNDWATER ELEVATIONS
## MONITOR WELL 49-05-306




Existing Landfill Site Assessment
McCombs Landfill
SHB Job No. E93-4034

Figure 10

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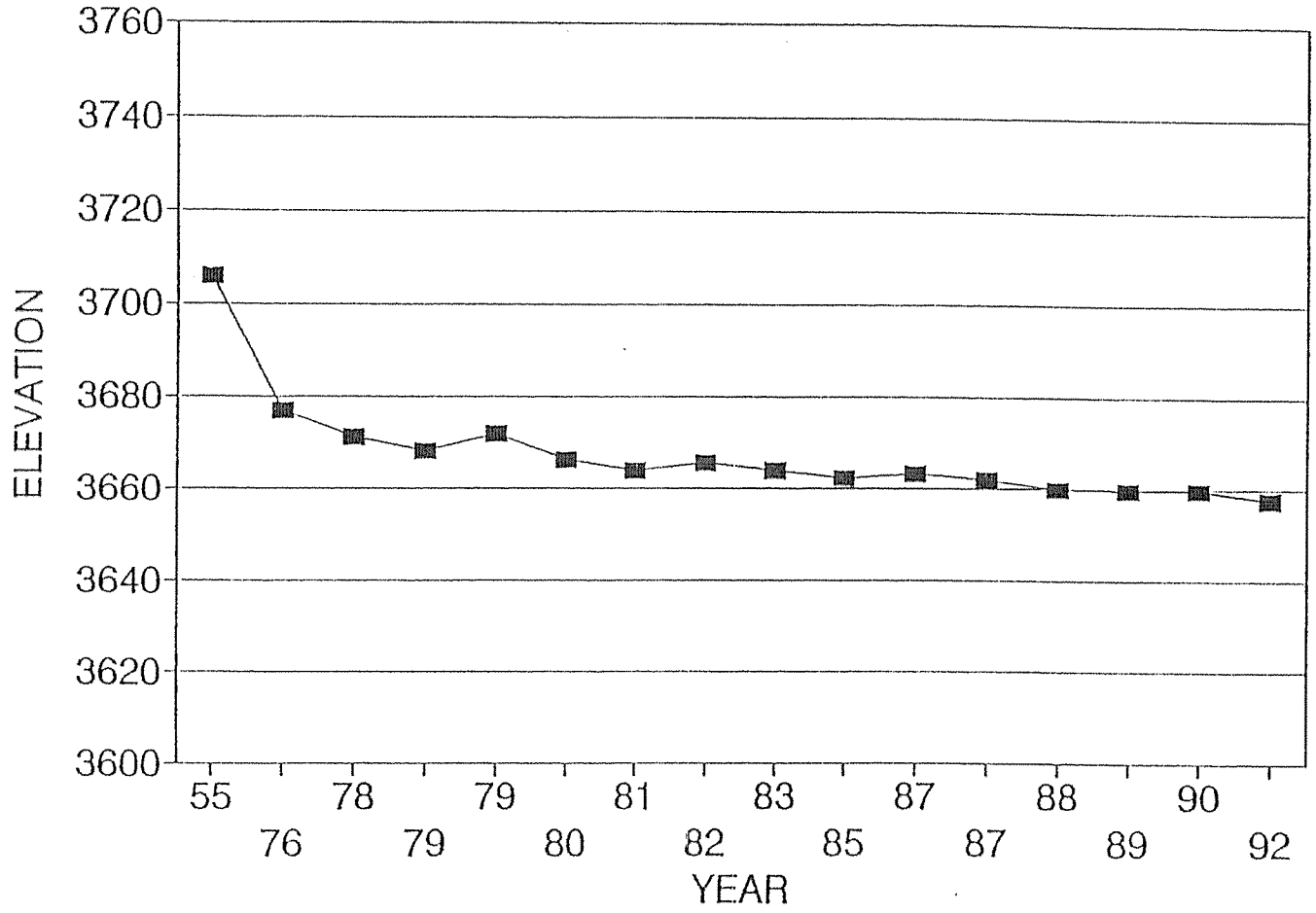
Earth & Environmental Group

# GROUNDWATER ELEVATIONS
## MONITOR WELL 49-05-303

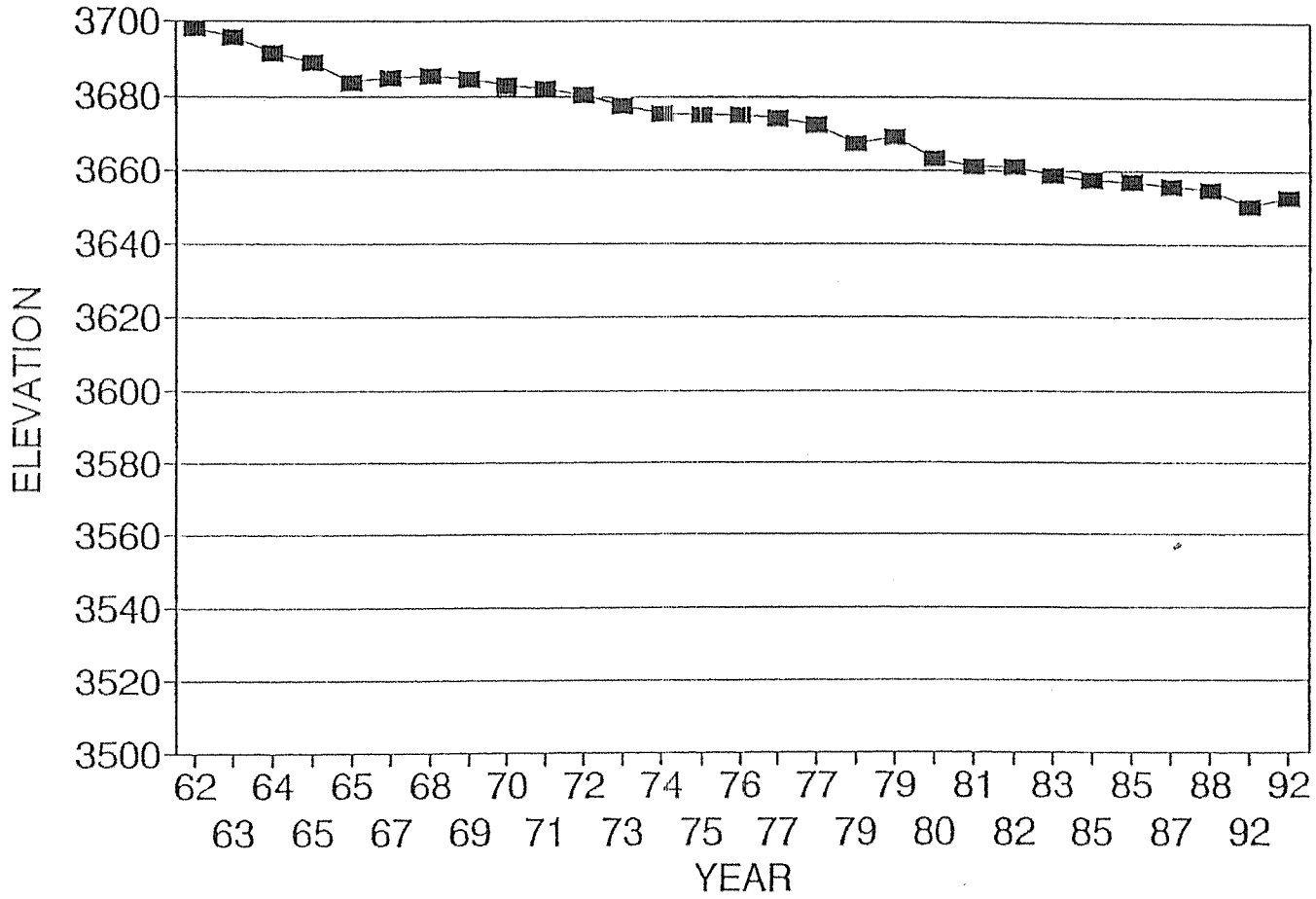



Existing Landfill Site Assessment
McCombs Landfill
SHB Job No. E93-4034

Figure 11

AGRA
Earth & Environmental Group

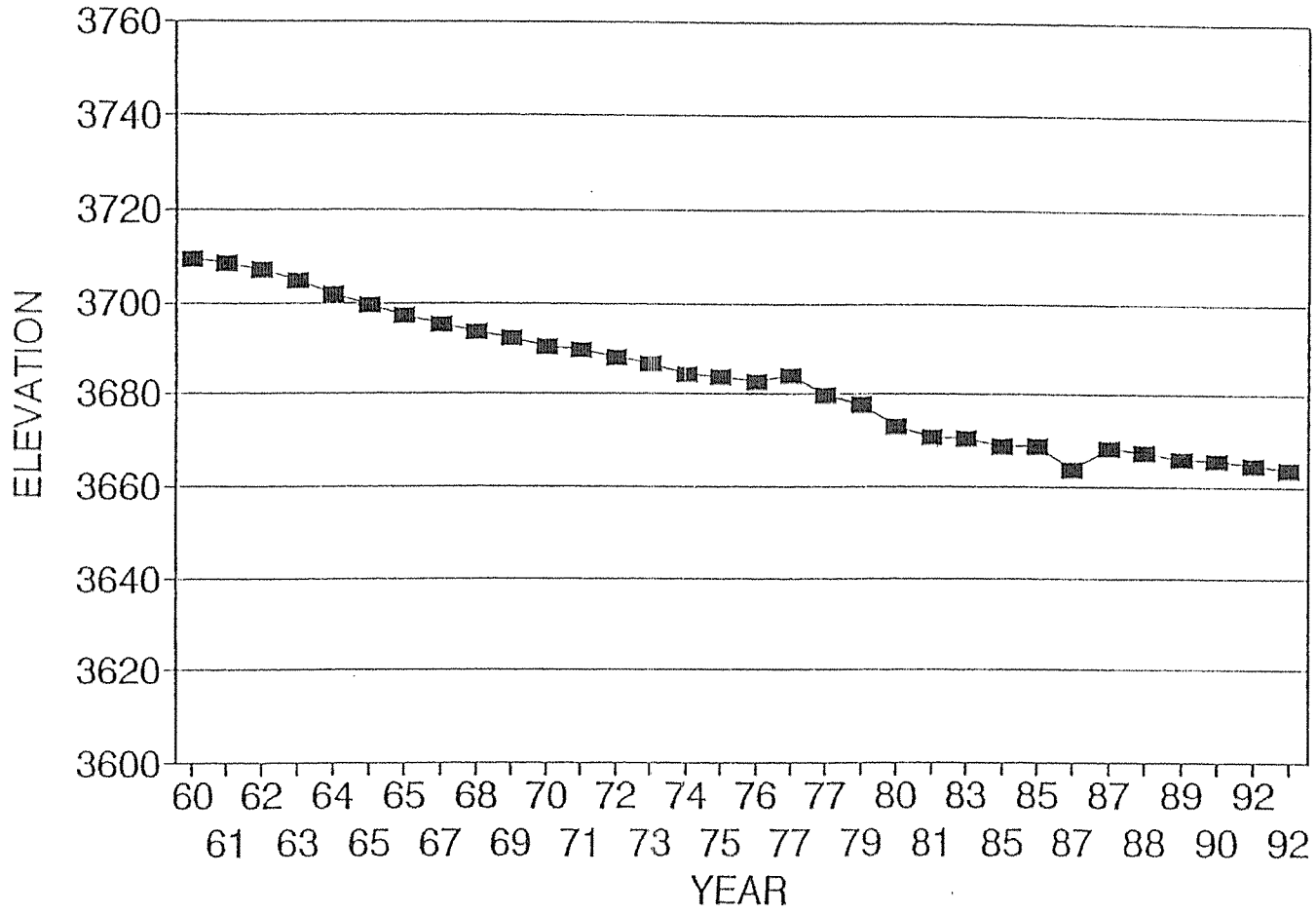
# GROUNDWATER ELEVATIONS
## MONITOR WELL 49-05-301




Existing Landfill Site Assessment
McCombs Landfill
SHB Job No. E93-4034

Figure 12

AGRA
Earth & Environmental Group

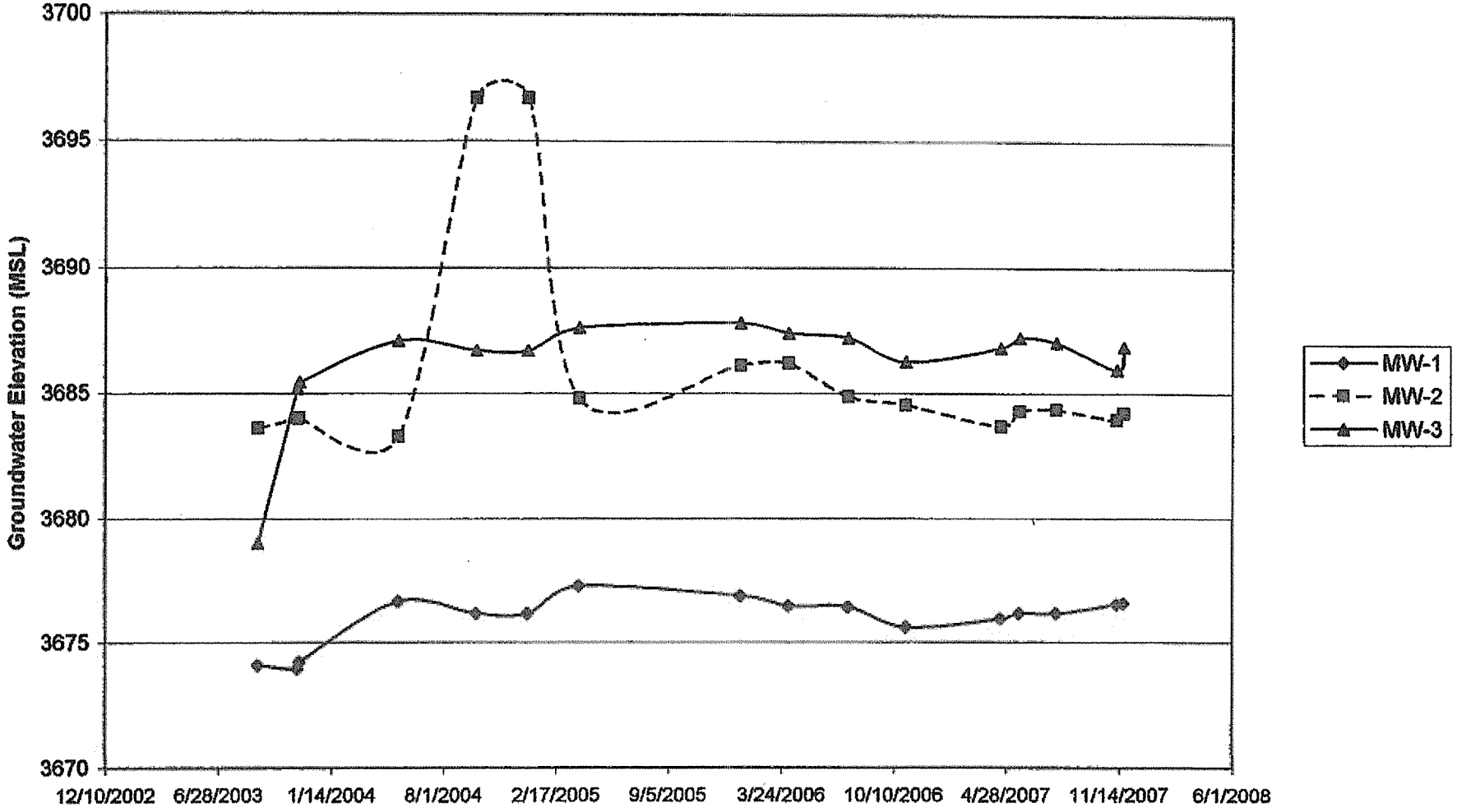


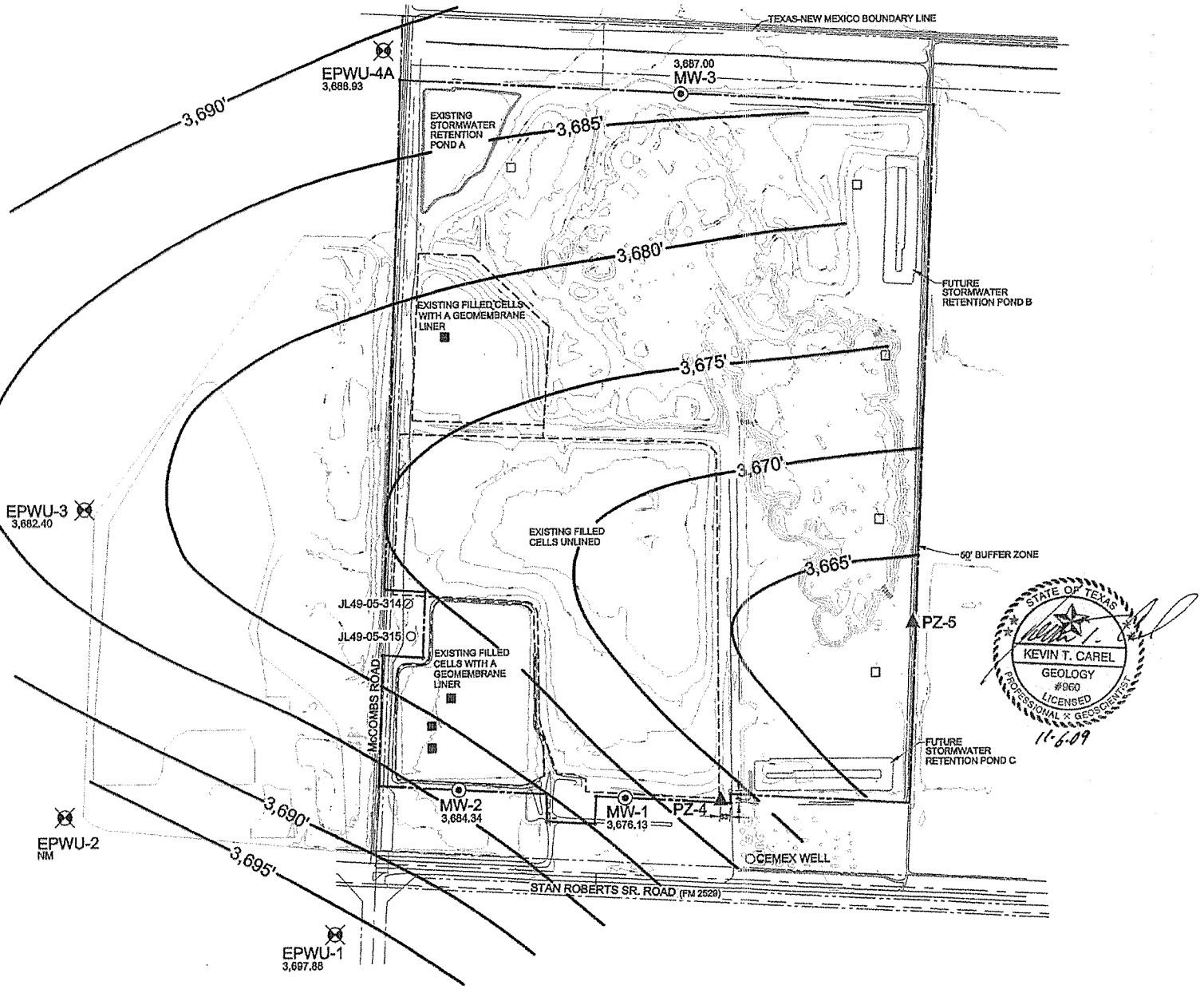

Existing Landfill Site Assessment
McCombs Landfill
SHB Job No. E93-4034

Figure 13

AGRA
Earth & Environmental Group

**Figure 14**
**Hydrograph McCombs Landfill**






Parkhill, Smith & Cooper, Inc.
Engineers • Architects • Planners
Lubbock El Paso Midland Amarillo Odessa

The CAREL CORPORATION

136 Pecan Street, Keller, TX 76248

**SCALE**

0 500 1000 FEET

**GROUNDWATER CONTOUR MAP JULY 25, 2007**

THE CITY OF EL PASO TEXAS

**CITY OF EL PASO GROUNDWATER PERMIT MODIFICATIONS FOR McCOMBS LANDFILL**

7969 SAN PAULO DRIVE
EL PASO, TEXAS 79907

**LEGEND:**

- PROPERTY/PERMIT BOUNDARY
- EXISTING LEACHATE COLLECTION SUMP
- FUTURE LEACHATE COLLECTION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- EPWU MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL
- NM NOT MEASURED/OBSTRUCTED
- PROPOSED 2009/2010 PIEZOMETER

N

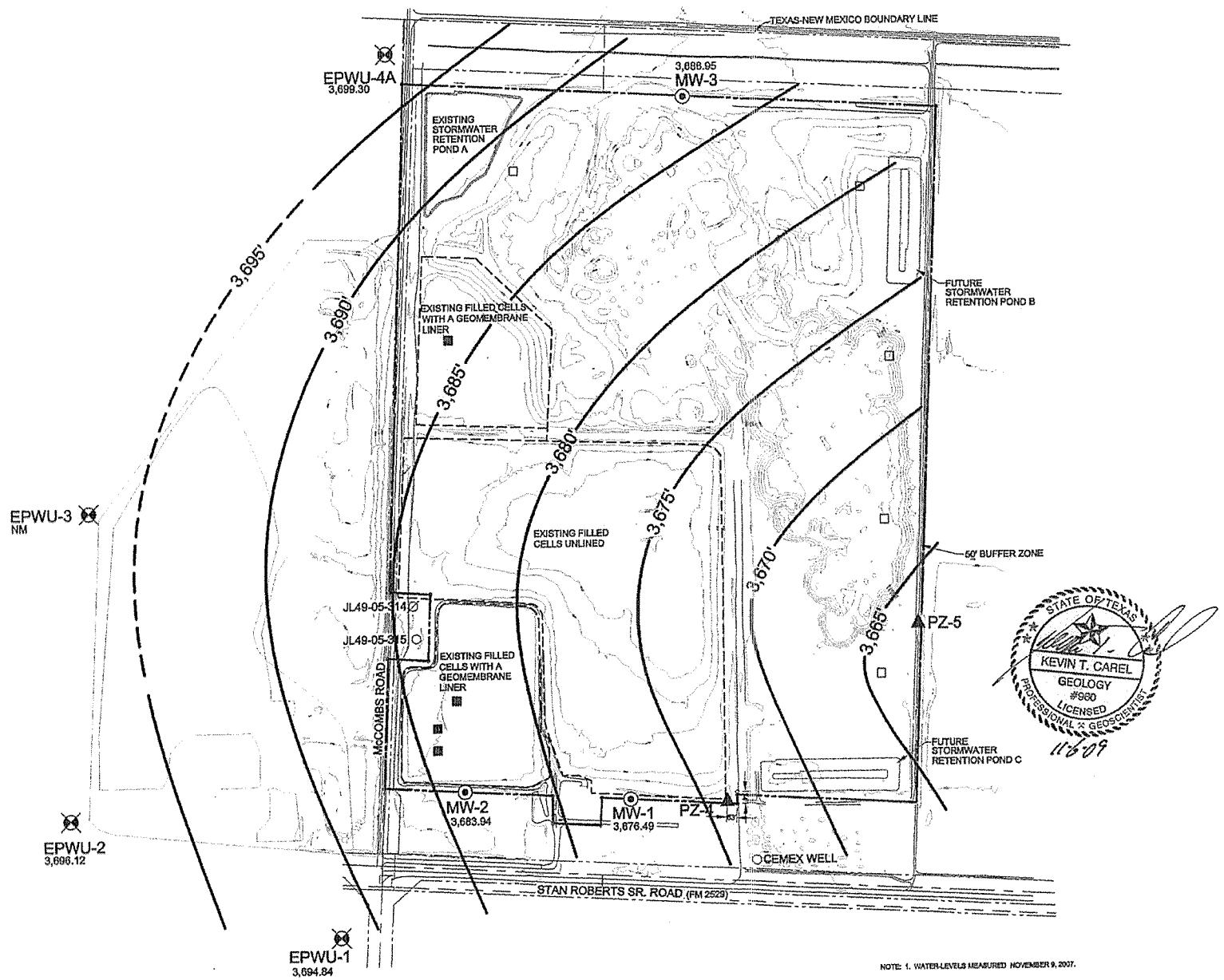
DATE DRAFTED: November 4, 2009

FILENAME: L:\TX\McCombs\2nd NOD\McCombspca.dwg

DRAWN BY: KTC

DRAFTED BY: TDW

FIGURE: 15





PBS
Parkhill, Smith & Cooper, Inc.
Engineers • Architects • Planners
Lubbock El Paso Midland Austin Odessa

The CAREL CORPORATION
136 Pecan Street, Keller, TX 76248


SCALE
0 300 600
FEET

# GROUNDWATER CONTOUR MAP NOVEMBER 9, 2007

CITY OF EL PASO
GROUNDWATER PERMIT
MODIFICATIONS FOR
McCOMBS LANDFILL

7999 SAN PAULO DRIVE
EL PASO, TEXAS 79907

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST
11-6-09

LEGEND:

- PROPERTY/PERMIT BOUNDARY
- EXISTING LEACHATE COLLECTION SUMP
- FUTURE LEACHATE COLLECTION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- EPWU MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL
- NM NOT MEASURED/OBSTRUCTED
- PROPOSED 2009/2010 PIEZOMETER

N

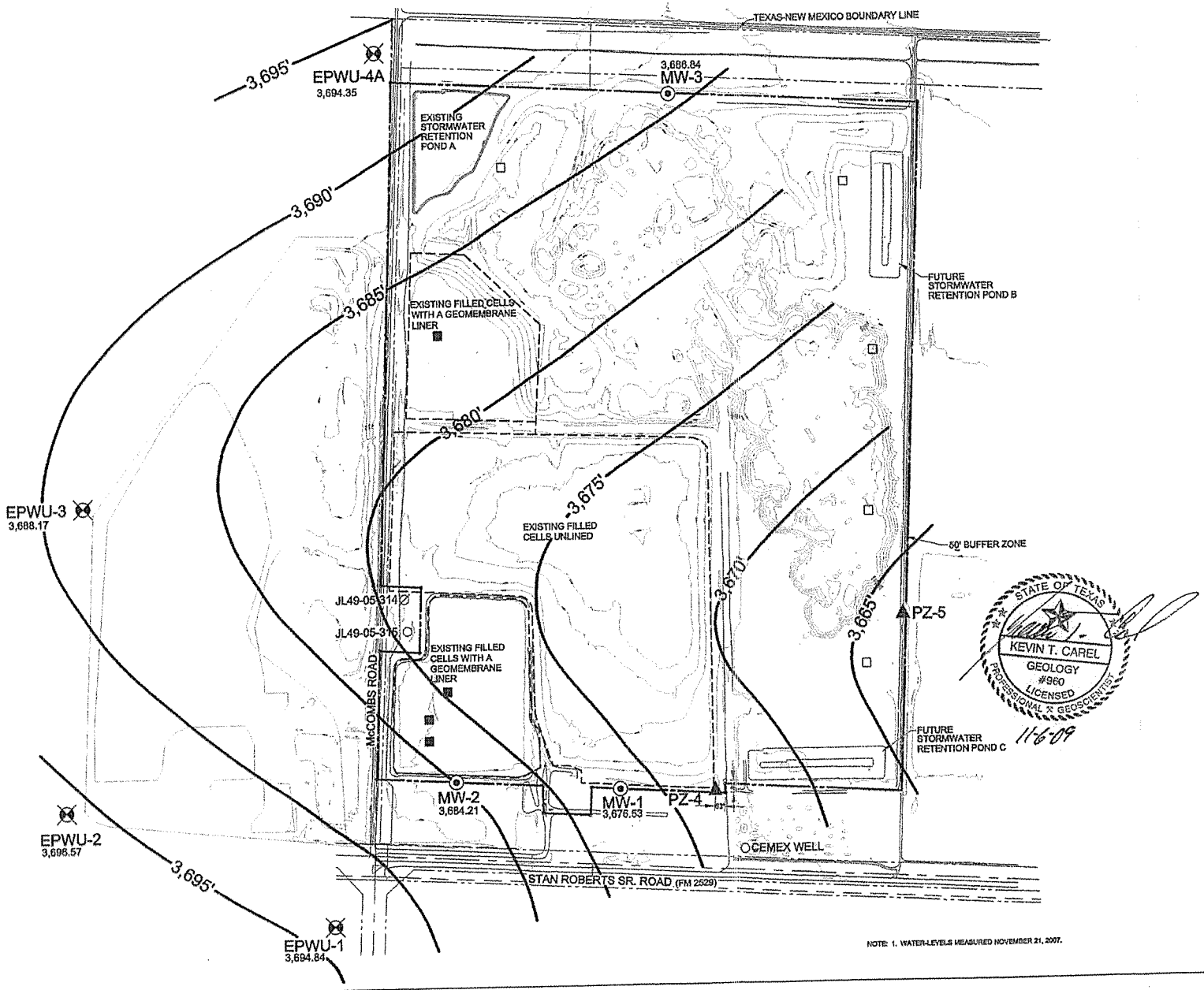
DATE DRAFTED: November 4, 2009

FILENAME: L:\TX\McCombs\Grd NOD\McCombpoc.dwg

DRAWN BY: KTC

DRAFTED BY: TDW

FIGURE: 16




Parkhill, Smith & Cooper, Inc.
Engineers • Architects • Planners

The CAREL CORPORATION

136 Pecan Street, Keller, TX 76248

**SCALE**

0 300 600
FEET

**GROUNDWATER CONTOUR MAP NOVEMBER 21, 2007**

THE CITY OF EL PASO TEXAS

**CITY OF EL PASO GROUNDWATER PERMIT MODIFICATIONS FOR McCOMBS LANDFILL**

7969 SAN PAULO DRIVE
EL PASO, TEXAS 79907

**LEGEND:**

- PROPERTY/PERMIT BOUNDARY
- EXISTING LEACHATE COLLECTION SUMP
- FUTURE LEACHATE COLLECTION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- EPWU MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL
- NM NOT MEASURED/OBSTRUCTED
- PROPOSED 2009/2010 PIEZOMETER

N

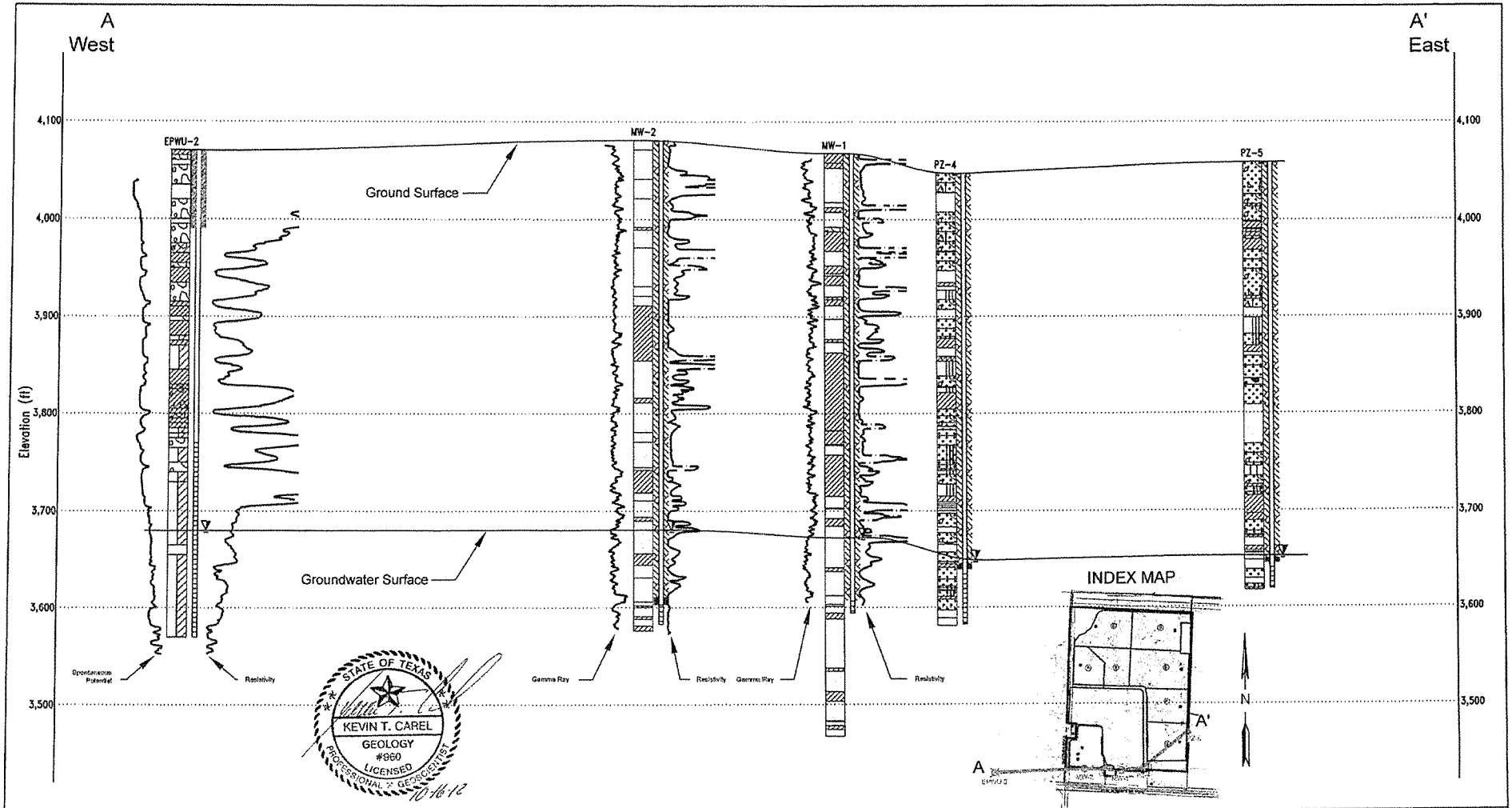
DATE DRAFTED: November 4, 2009

FILENAME: L:\TDW\McCombs\2nd HCOW\McCombspoc.dwg

DRAWN BY: KTC

DRAFTED BY: TDW

FIGURE: 17




The CAREL CORPORATION
136 Pecan Street, Keller, TX 76248

SCALE (feet)
100'
0
1,000'

LITHOLOGY GRAPHICS

LEGEND

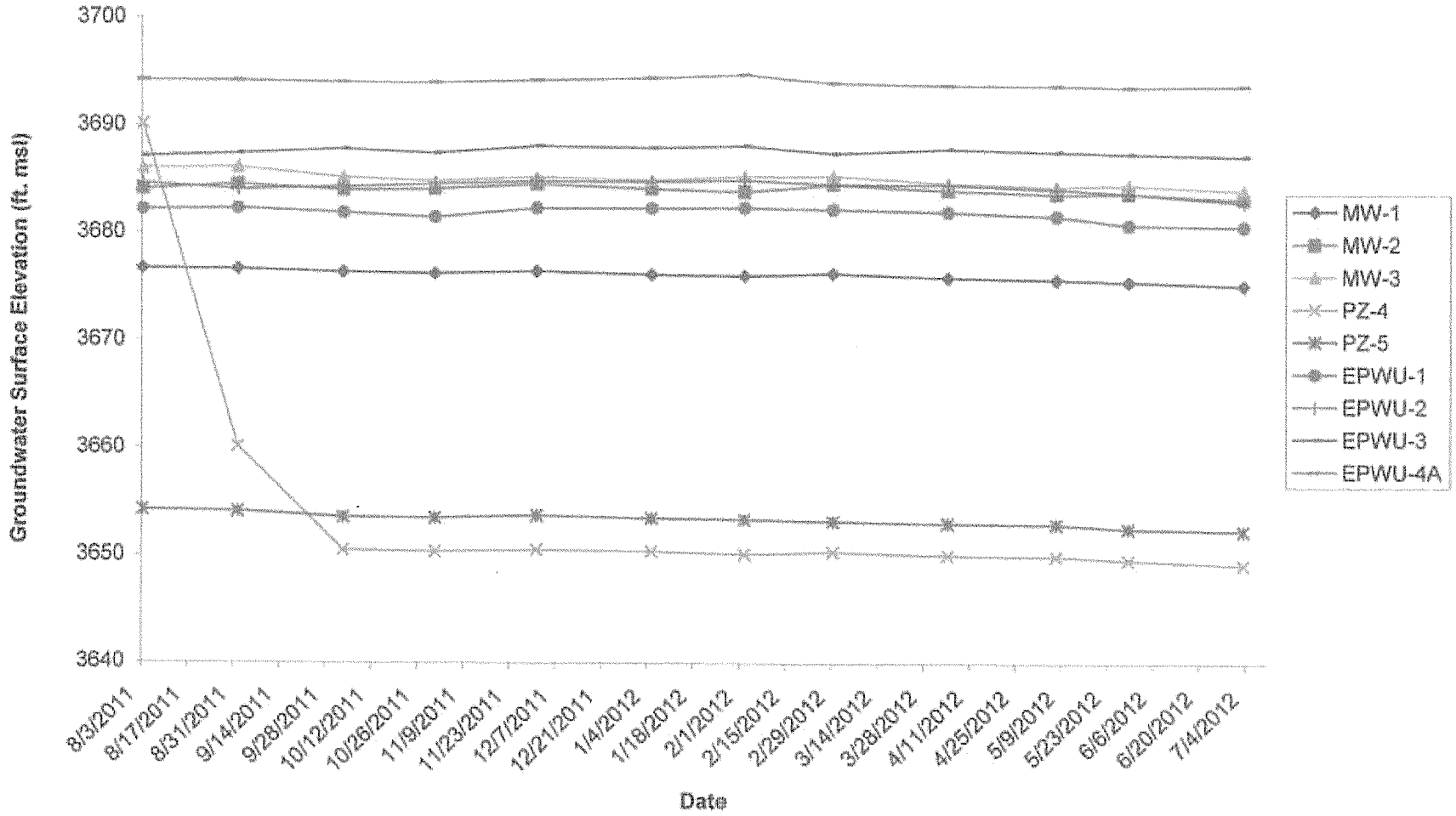
- USCS Low Plasticity Clay
- USCS Poorly-graded Sandy Gravel
- USCS Clayey Gravel
- USCS Low Plasticity Sandy Clay
- USCS Poorly-graded Gravelly Sand
- USCS Poorly-graded Sand with Clay
- USCS Poorly-graded Gravel
- Massive Sand or Sandstone
- USCS Well-graded Gravelly Sand
- USCS Poorly-graded Sand
- USCS Poorly-graded Sand with Silt
- USCS Low Plasticity Silty Clay
- Well-graded Gravelly Sand with Tuff
- USCS Low Plasticity Gravelly Clay
- USCS Well-graded Sand
- Water Level Measured July 3, 2012

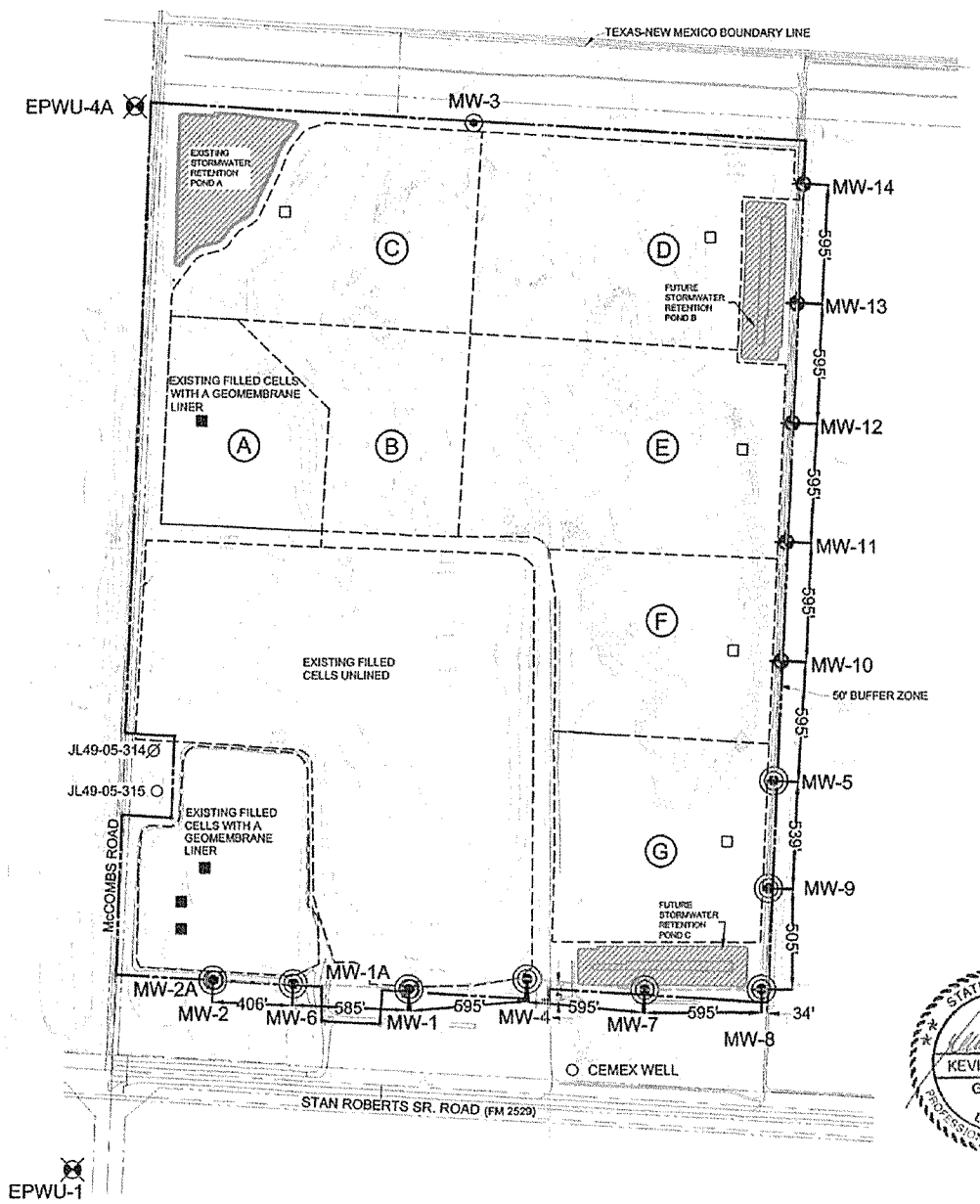
**GEOLOGIC CROSS SECTION A-A'**

MCCOMBS LANDFILL
El Paso, Texas

| | |
|---|---|
| DATE: September 17, 2012 | REV. NO: 2 |
| FILENAME: | |
| DESIGNED BY: KTC | FIGURE: 18 |
| DRAWN BY: SMG | |
| CHECKED BY: SJW | |
| APPROVED BY: KTC | |

**Figure 19**
**McCombs Landfill**
**Groundwater Surface Elevation Hydrograph**






Appendix 3K, Attachment 1, Page 58

Parkhill, Smith & Cooper, Inc.
Engineers • Architects • Planners

The CAREL CORPORATION
136 Pecan Street, Keller, TX 76248

**SCALE**
0 300 600
FEET

**PROPOSED GROUNDWATER MONITORNG NETWORK**

**CITY OF EL PASO GROUNDWATER PERMIT MODIFICATIONS FOR McCOMBS LANDFILL**

**7969 SAN PAULO DRIVE**
**EL PASO, TEXAS 79907**

LEGEND:

- PROPERTY/PERMIT BOUNDARY
- EXISTING LEACHATE COLLECTION SUMP
- FUTURE LEACHATE COLLECTION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- EPWU MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL
- MONITOR WELL TO BE PLUGGED AND ABANDONED
- NM NOT MEASURED/OBSTRUCTED
- PROPOSED GROUNDWATER MONITORING WELL
- FUTURE GROUNDWATER MONITORING WELL
- POINT OF COMPLIANCE
- POINT OF COMPLIANCE TURNING POINT
- (E) SECTOR DENOMINATION
- SECTOR BOUNDARY

N

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST
12-21-12

DATE DRAFTED: September 14,2012 | REV. # 2
FILENAME:
DRAWN BY: KTC | FIGURE: 20
DRAFTED BY: SMG

# APPENDICES

# APPENDIX A

# EL PASO WATER UTILITIES WELL REPORTS AND GEOPHYSICAL LOGS

EPWU-1

EPWU-2
EL PASO WATER UTILITIES
E-108
500
450
400
350
300
250
200
150
100
50

EPWU-3

# APPENDIX B

# GROUNDWATER MONITORING SYSTEM INSTALLATION REPORT AND GEOPHYSICAL LOGS

# Southwest Exploration Services, LLC

borehole geophysics & video services

| | |
|---|---|
| COMPANY | PARKHILL,SMITH&COOPER |
| WELL ID | MW-1 MSW PERMIT 729A |
| FIELD | McCOMBS LANDFILL |
| COUNTY | EL PASO STATE TEXAS |

**TYPE OF LOGS: NAT. GAMMA RAY**
**MORE: DUAL INDUCTION**

OTHER SERVICES
NONE

LOCATION
Lat N31 Deg 59' 17.9" Long W 106 Deg 24' 14.5"

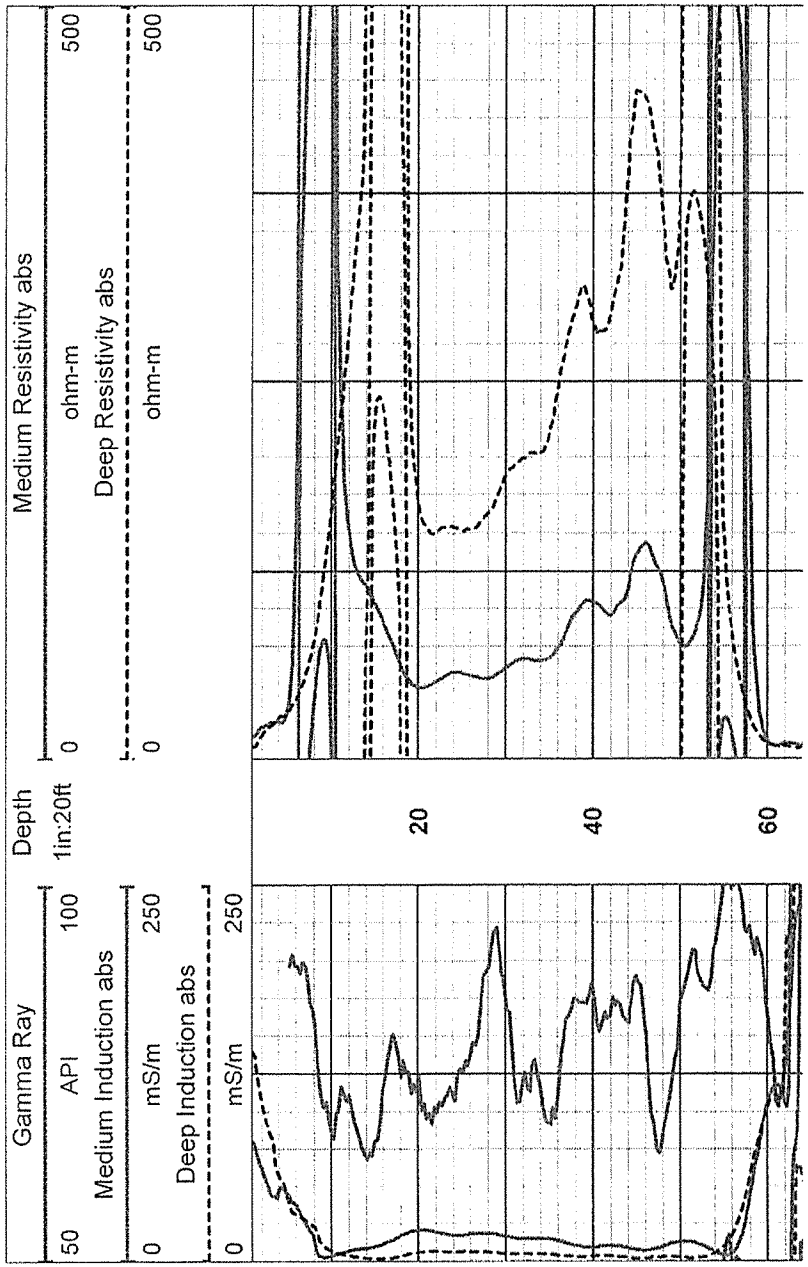
SEC TWP RGE

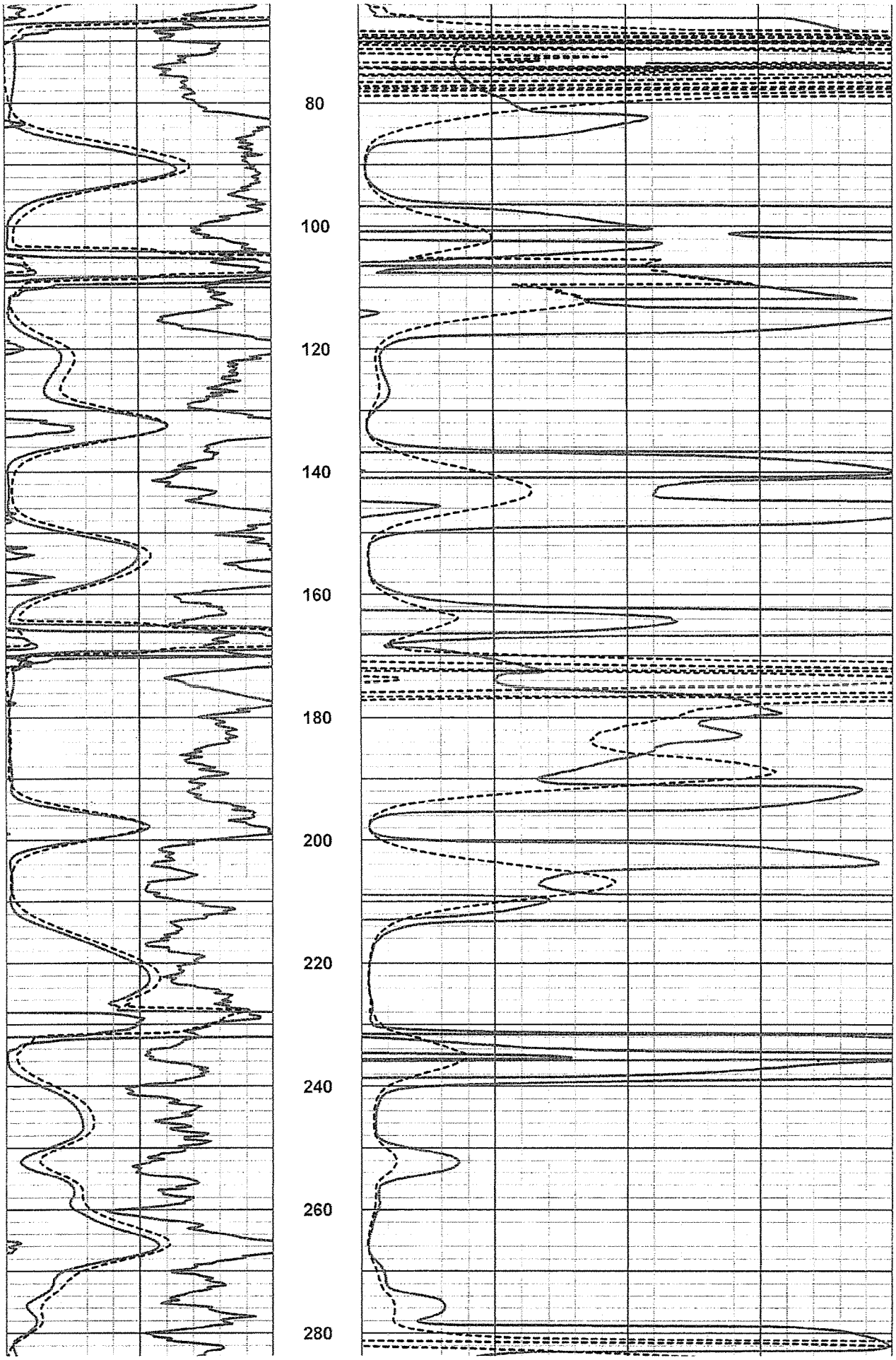
| | | | |
|---|---|---|---|
| PERMANENT DATUM | TOP OF CASING | ELEVATION 4070.23'MSL | K.B. |
| LOG MEAS. FROM | TOP OF CASING | ABOVE PERM. DATUM | D.F. |
| DRILLING MEAS. FROM | | | G.L. |

| | | | |
|---|---|---|---|
| DATE | 7-1-10, 7-12-10 | TYPE FLUID IN HOLE | FORMATION WATER |
| RUN No | 1,2 | SALINITY | |
| TYPE LOG | GAMMA-DIL | DENSITY | |
| DEPTH-DRILLER | 475 FT | LEVEL | APPROX. 394 FT SWL |
| DEPTH-LOGGER | 466 FT | MAX. REC. TEMP. | N/A |
| BTM LOGGED INTERVAL | 466 FT | IMAGE ORIENTED TO: | N/A |
| TOP LOGGED INTERVAL | SURFACE | SAMPLE INTERVAL | 0.2 FT |
| DRILLER / RIG# | N/A | LOGGING TRUCK | TRUCK #107 |
| RECORDED BY / Logging Eng. | D. JACOVITCH | TOOL STRING/SN | MSI GGRD, WR DIL |
| WITNESSED BY | PSC-MATT | LOG TIME:ON SITE/OFF SITE | 0830 1130 |

| RUN | BOREHOLE RECORD | | | CASING RECORD | | | |
|---|---|---|---|---|---|---|---|
| NO. | BIT | FROM | TO | SIZE | WGT. | FROM | TO |
| 1 | | | | 4" | PVC | SURFACE | 475 FT |
| 2 | | | | | | | |
| | | | | | | | |

COMMENTS:

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200
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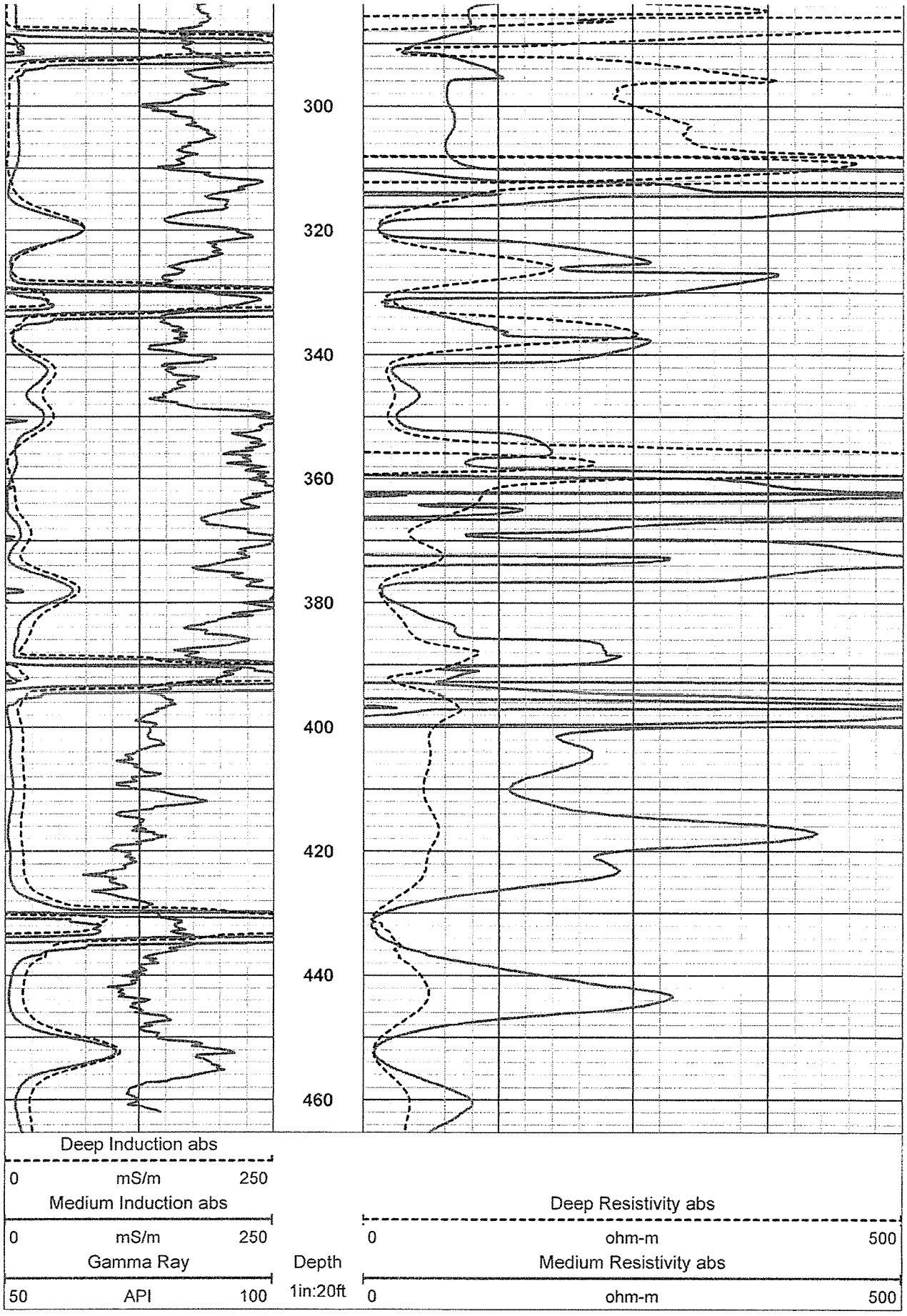
240
260
280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320
340
360
380
400
420
440
460
Deep Induction abs
0
mS/m
250
Medium Induction abs
0
mS/m
250
Gamma Ray
50
API
100
Depth
1in:20ft
Deep Resistivity abs
0
ohm-m
500
Medium Resistivity abs
0
ohm-m
500

# Southwest Exploration Services, LLC

borehole geophysics & video services

COMPANY PARKHILL,SMITH&COOPER
WELL ID MW-2 MSW PERMIT 729A
FIELD McCOMBS LANDFILL
COUNTY EL PASO STATE TEXAS

**TYPE OF LOGS: NAT. GAMMA RAY**
**MORE: DUAL INDUCTION**

LOCATION
Lat N 31 Deg 59' 0.5" Long W 106 Deg 24' 25.6"

SEC TWP RGE

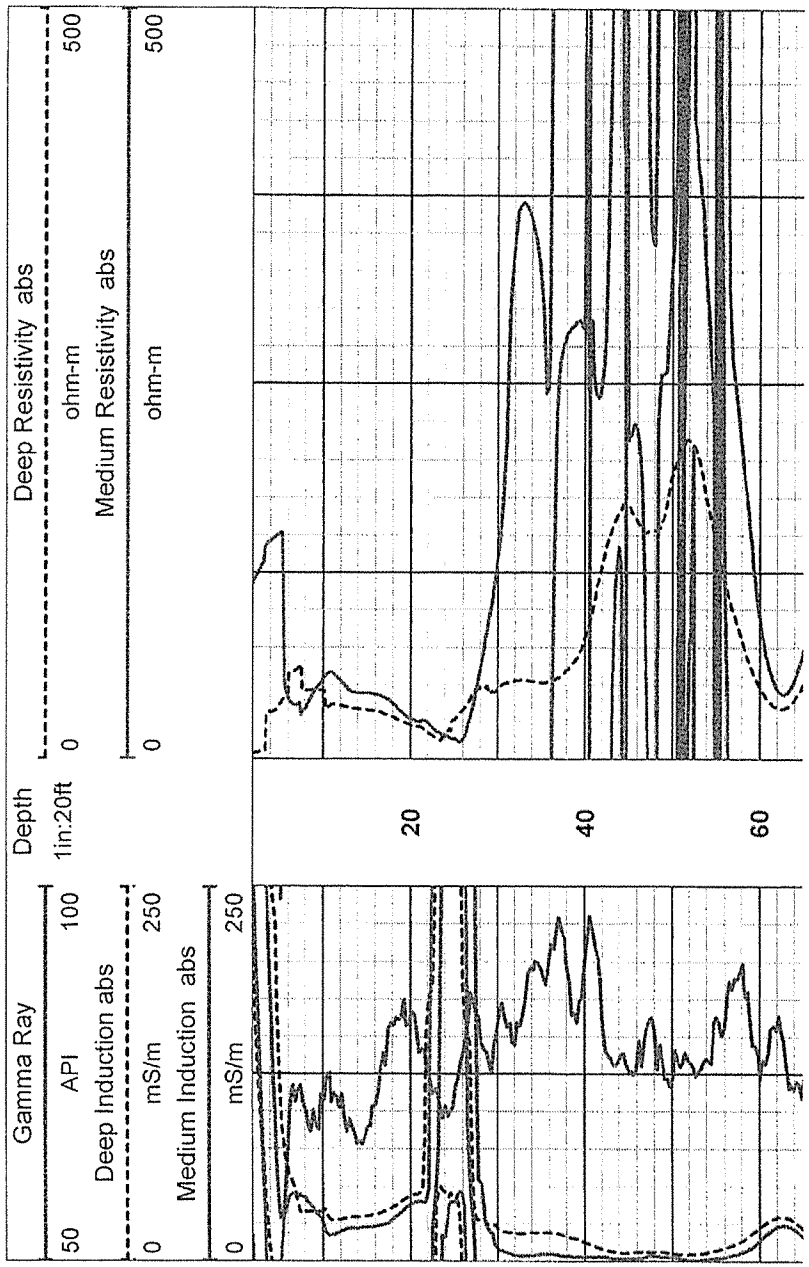
OTHER SERVICES
NONE

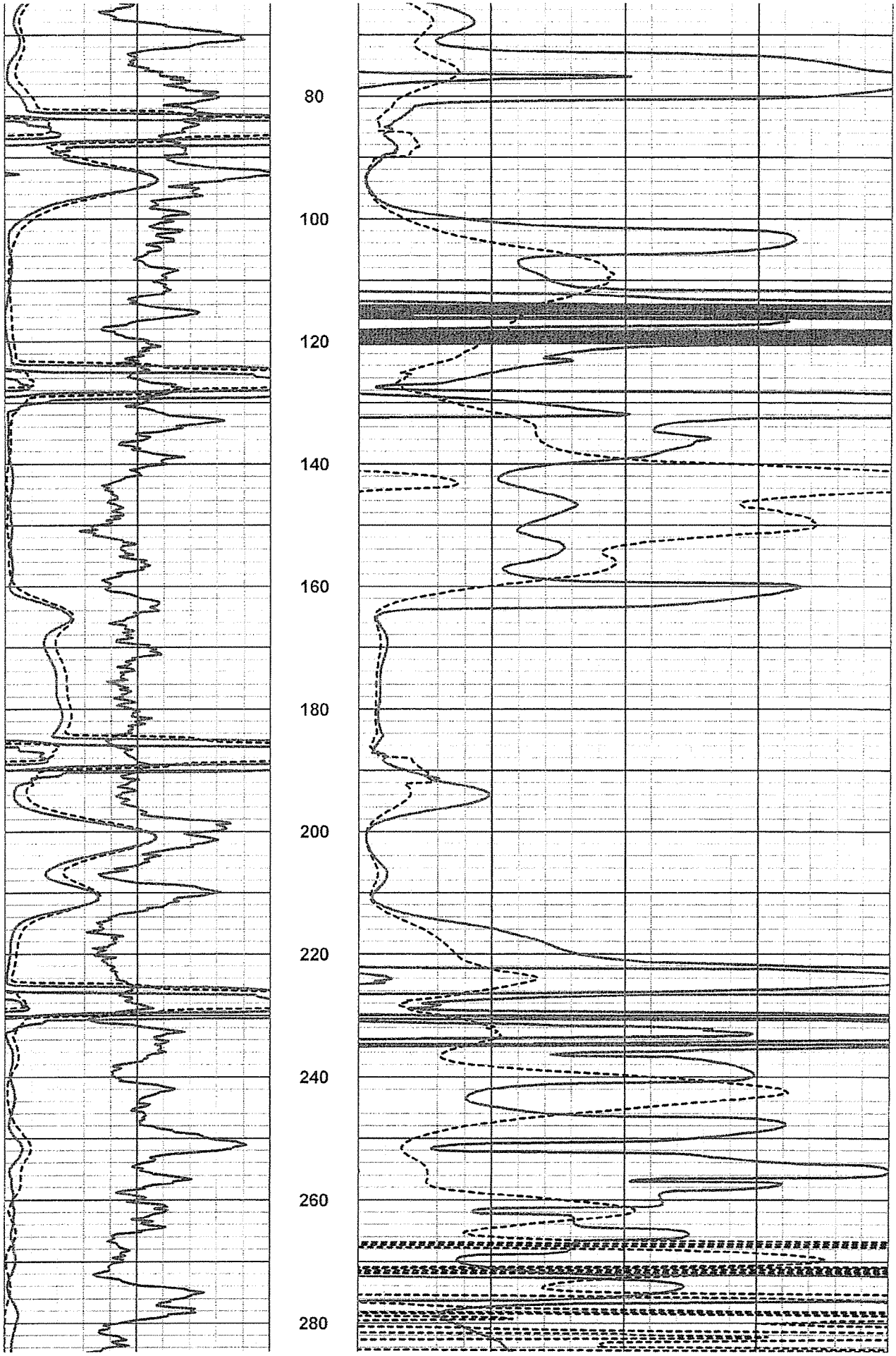
| | | | |
|---|---|---|---|
| PERMANENT DATUM | TOP OF CASING | ELEVATION 4083.89'MSL | K.B. |
| LOG MEAS. FROM | TOP OF CASING | ABOVE PERM. DATUM | D.F. |
| DRILLING MEAS. FROM | | | G.L. |

| | | | |
|---|---|---|---|
| DATE | 7-1-10, 7-12-10 | TYPE FLUID IN HOLE | FORMATION WATER |
| RUN No | 1,2 | SALINITY | |
| TYPE LOG | GAMMA-DIL | DENSITY | |
| DEPTH-DRILLER | 500 FT | LEVEL | APPROX. 399 FT SWL |
| DEPTH-LOGGER | 508 FT | MAX. REC. TEMP. | N/A |
| BTM LOGGED INTERVAL | 508 FT | IMAGE ORIENTED TO: | N/A |
| TOP LOGGED INTERVAL | SURFACE | SAMPLE INTERVAL | 0.2 FT |
| DRILLER / RIG# | N/A | LOGGING TRUCK | TRUCK #107 |
| RECORDED BY / Logging Eng. | D. JACOVITCH | TOOL STRING/SN | MSI GGRD, WR DIL |
| WITNESSED BY | PSC-MATT | LOG TIME:ON SITE/OFF SITE | 1230 11400 |

| RUN | BOREHOLE RECORD | | | CASING RECORD | | | |
|---|---|---|---|---|---|---|---|
| NO. | BIT | FROM | TO | SIZE | WGT. | FROM | TO |
| 1 | | | | 4" | PVC | SURFACE | 500 FT |
| 2 | | | | | | | |
| | | | | | | | |

COMMENTS:

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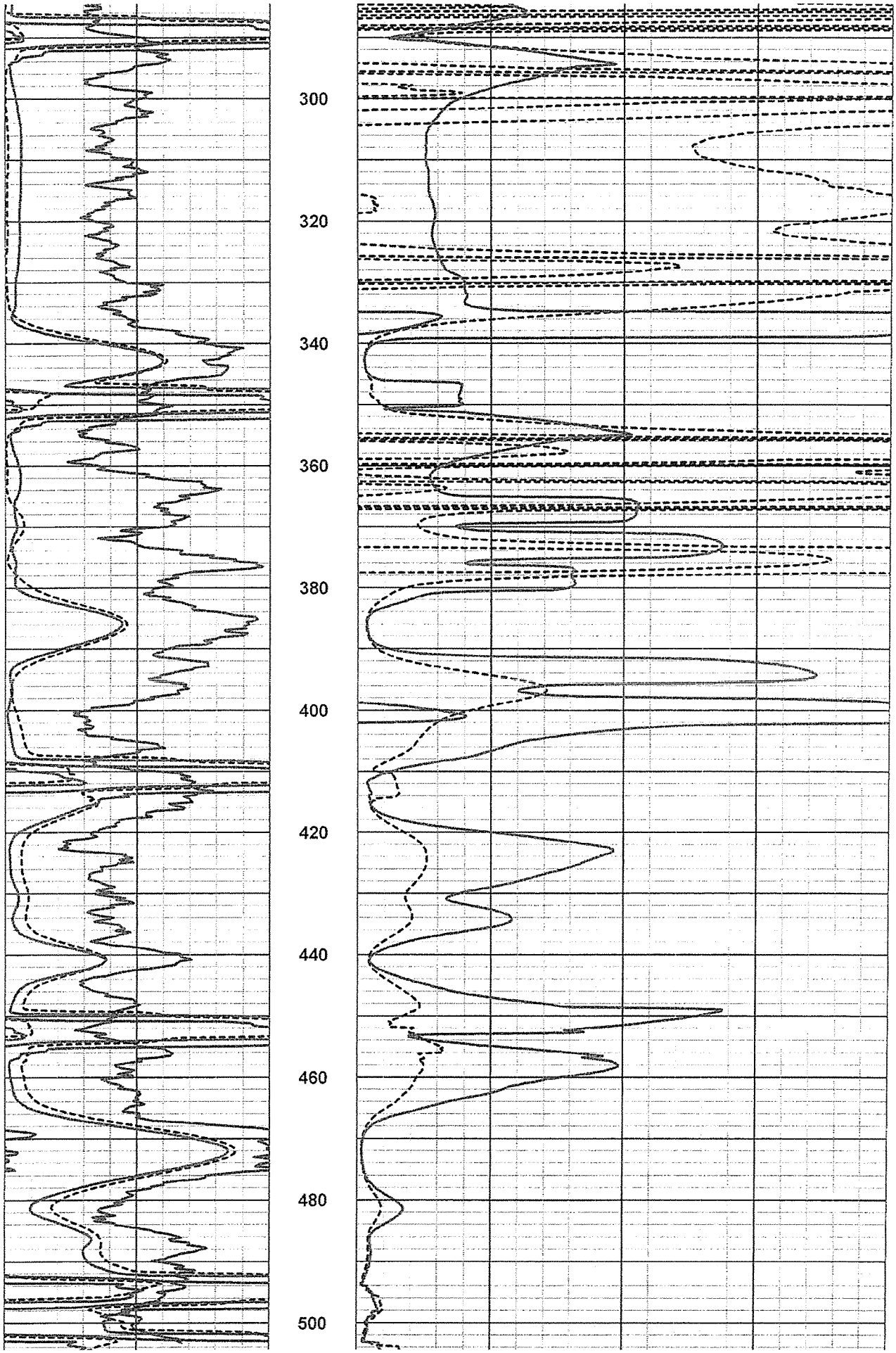
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420
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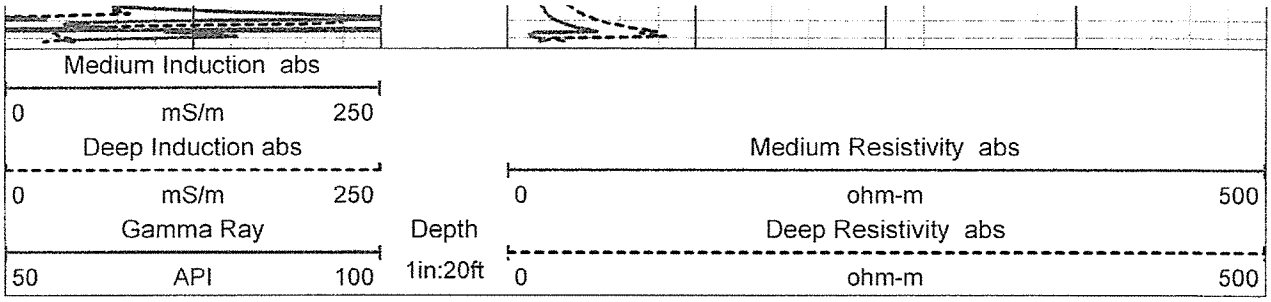
460
480
500


Medium Induction abs
0
mS/m
250
Deep Induction abs
0
mS/m
250
Gamma Ray
50
API
100
Depth
1in:20ft
Medium Resistivity abs
0
ohm-m
500
Deep Resistivity abs
0
ohm-m
500

# Southwest Exploration Services, LLC

borehole geophysics & video services

COMPANY PARKHILL,SMITH&COOPER
WELL ID MW-3 MSW PERMIT 729A
FIELD McCOMBS LANDFILL
COUNTY EL PASO STATE TEXAS

**TYPE OF LOGS: NAT. GAMMA RAY**
**MORE: DUAL INDUCTION**

LOCATION
Lat N 31 Deg 59' 43.4" Long W 106 Deg 24' 13.3"

SEC TWP RGE

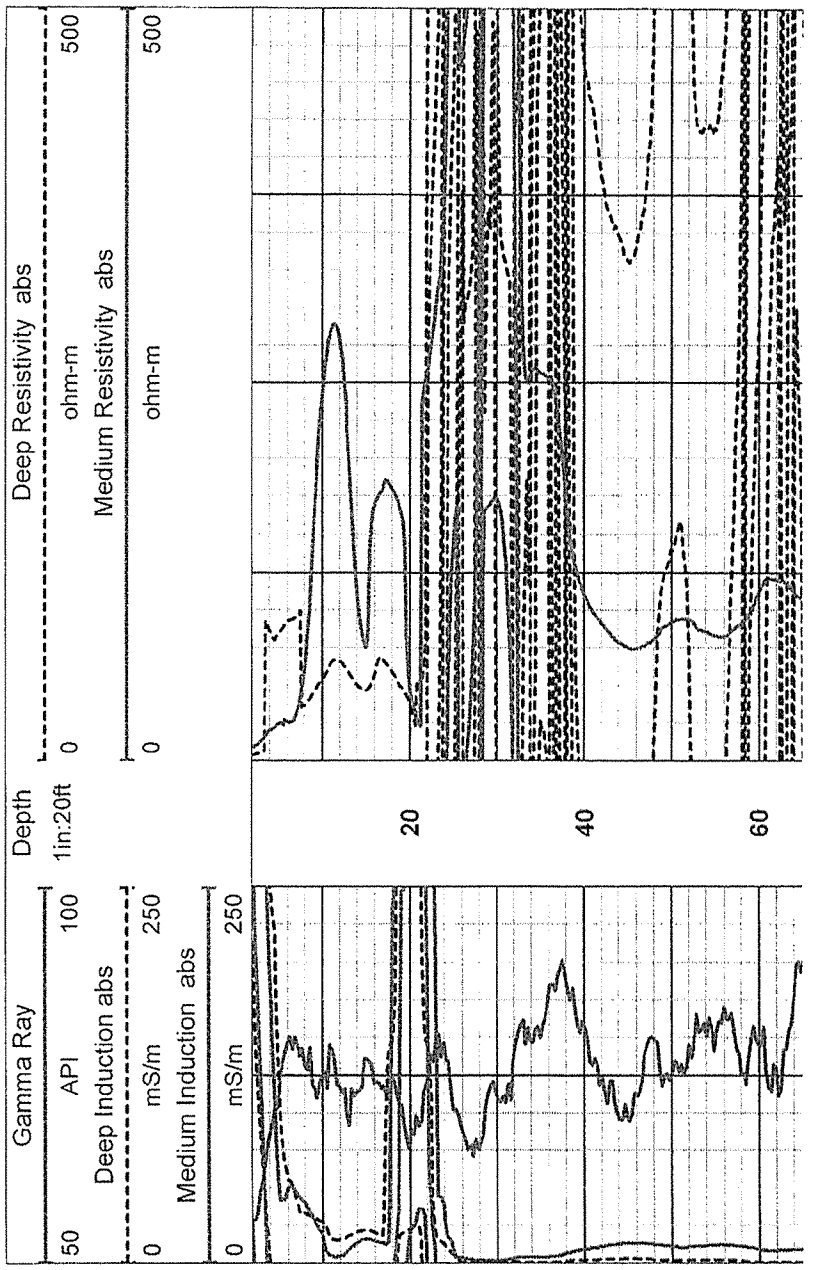
OTHER SERVICES
NONE

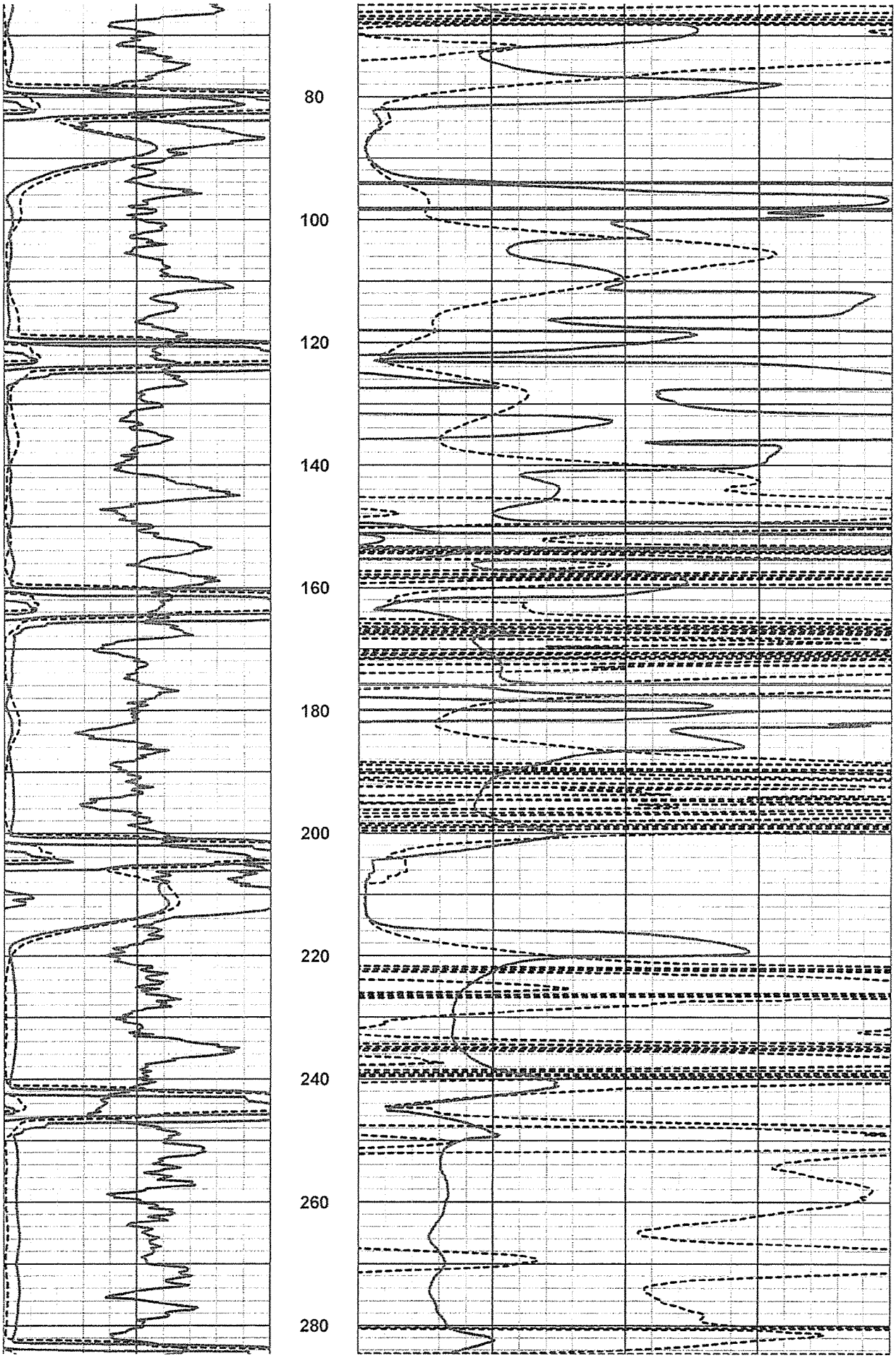
| | | | |
|---|---|---|---|
| PERMANENT DATUM | TOP OF CASING | ELEVATION 4076.70'MSL | K.B. |
| LOG MEAS. FROM | TOP OF CASING | ABOVE PERM. DATUM | D.F. |
| DRILLING MEAS. FROM | | | G.L. |

| | | | |
|---|---|---|---|
| DATE | 7-1-10, 7-12-10 | TYPE FLUID IN HOLE | FORMATION WATER |
| RUN No | 1,2 | SALINITY | |
| TYPE LOG | GAMMA-DIL | DENSITY | |
| DEPTH-DRILLER | 498 FT | LEVEL | APPROX. 392 FT SWL |
| DEPTH-LOGGER | 488 FT | MAX. REC. TEMP. | N/A |
| BTM LOGGED INTERVAL | 488 FT | IMAGE ORIENTED TO: | N/A |
| TOP LOGGED INTERVAL | SURFACE | SAMPLE INTERVAL | 0.2 FT |
| DRILLER / RIG# | N/A | LOGGING TRUCK | TRUCK #107 |
| RECORDED BY / Logging Eng. | D. JACOVITCH | TOOL STRING/SN | MSI GGRD, WR DIL |
| WITNESSED BY | PSC-MATT | LOG TIME:ON SITE/OFF SITE | 0830 1130 |

| RUN | BOREHOLE RECORD | | | CASING RECORD | | | |
|---|---|---|---|---|---|---|---|
| NO. | BIT | FROM | TO | SIZE | WGT. | FROM | TO |
| 1 | | | | 4" | PVC | SURFACE | 498 FT |
| 2 | | | | | | | |
| | | | | | | | |

COMMENTS:

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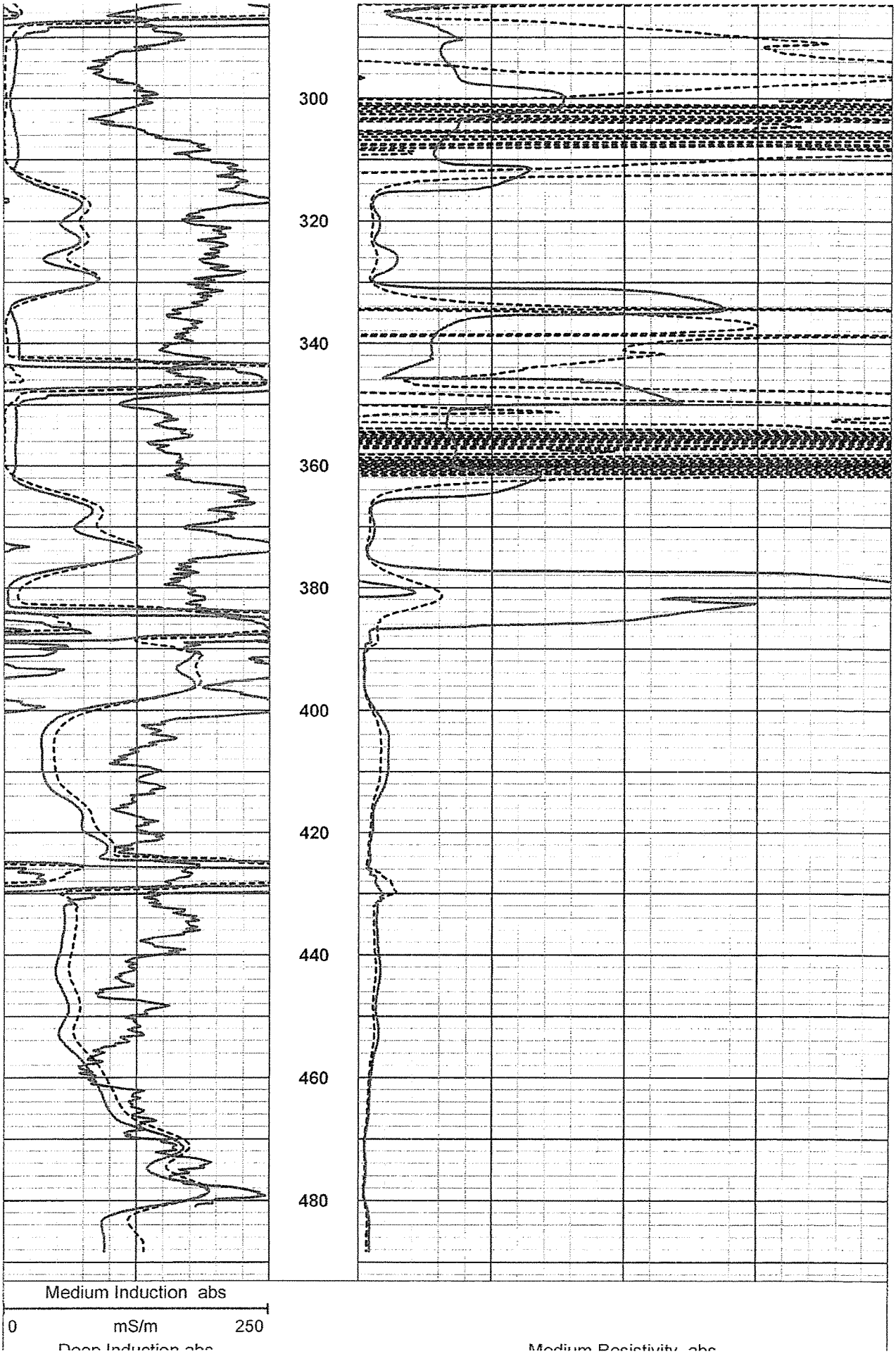
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380
400
420
440
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480
Medium Induction abs
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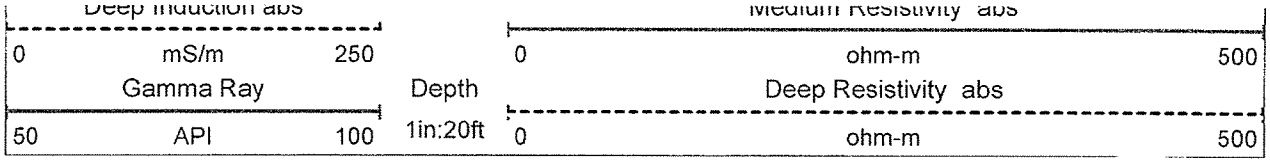
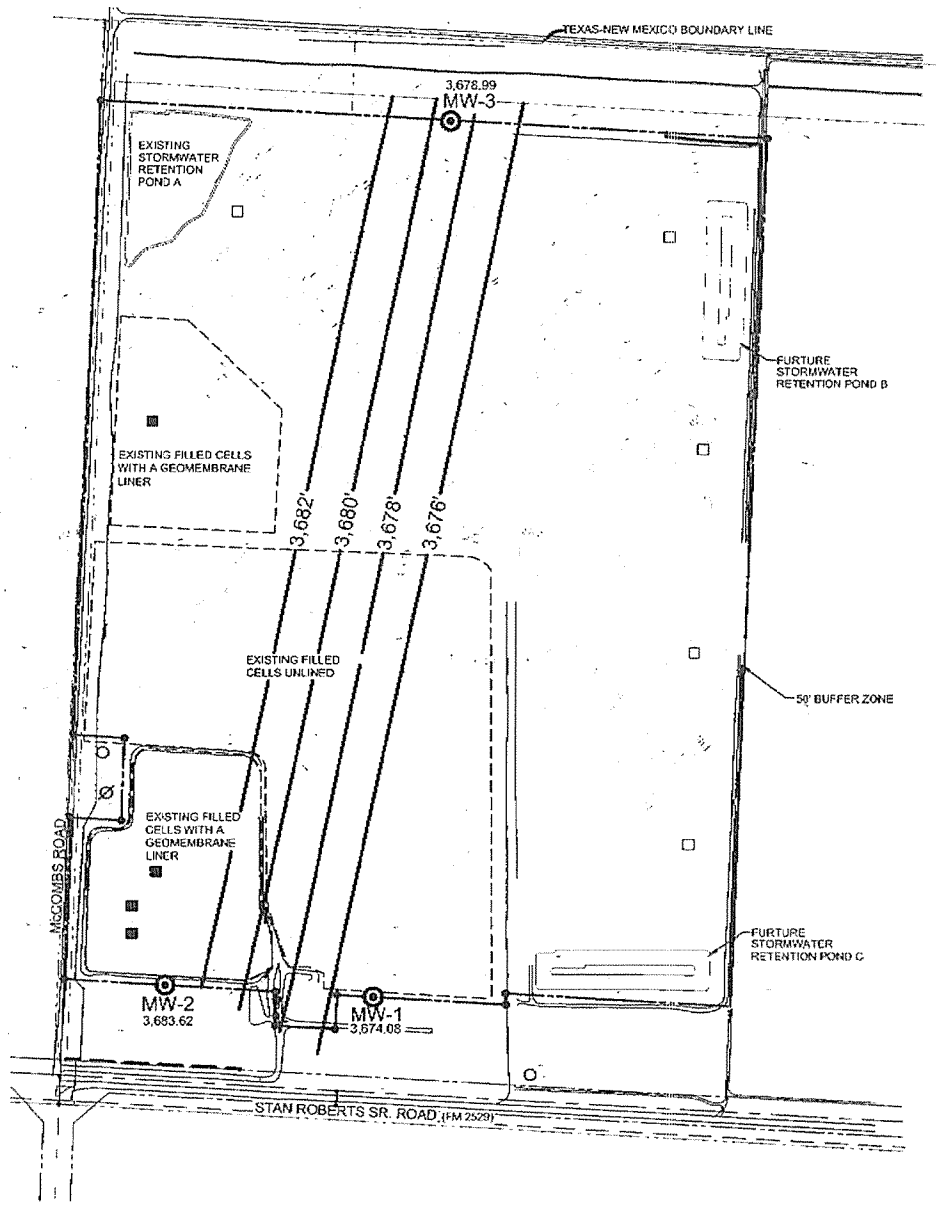
mS/m
250


Deep Induction abs
0
mS/m
250
Gamma Ray
50
API
100
Depth
1in:20ft
Medium Resistivity abs
0
ohm-m
500
Deep Resistivity abs
0
ohm-m
500

# APPENDIX C

# GROUNDWATER CONTOUR MAPS
# SEPTEMBER 2003 TO JULY 2007




STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
960
LICENSED
PROFESSIONAL GEOSCIENTIST

7-6-2009

PSC
PARKHILL SMITH & COOPER

The CAREL CORPORATION

136 Pecan Street, Keller, TX 76248

REGISTRATION NUMBER F-560

CAREL CORPORATION 50137

SCALE

0 300 900

FEET

# GROUNDWATER CONTOUR MAP SEPTEMBER 5, 2003

THE CITY OF EL PASO TEXAS

**CITY OF EL PASO GROUNDWATER PERMIT MODIFICATIONS FOR McCOMBS LANDFILL**

7969 SAN PAULO DRIVE
EL PASO, TEXAS 79907

LEGEND:

- PROPERTY/PERMIT BOUNDARY
- EXISTING LEACHATE COLLETION SUMP
- FURTURE LEACHATE COLLETION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL

N

| NO | DATE | DESCRIPTION |
|---|---|---|
| 1 | 7/6/2009 | WDD 1 RESPONSE |

COUNTY OFFICE/CITY PROJECT NO. 07-07-35

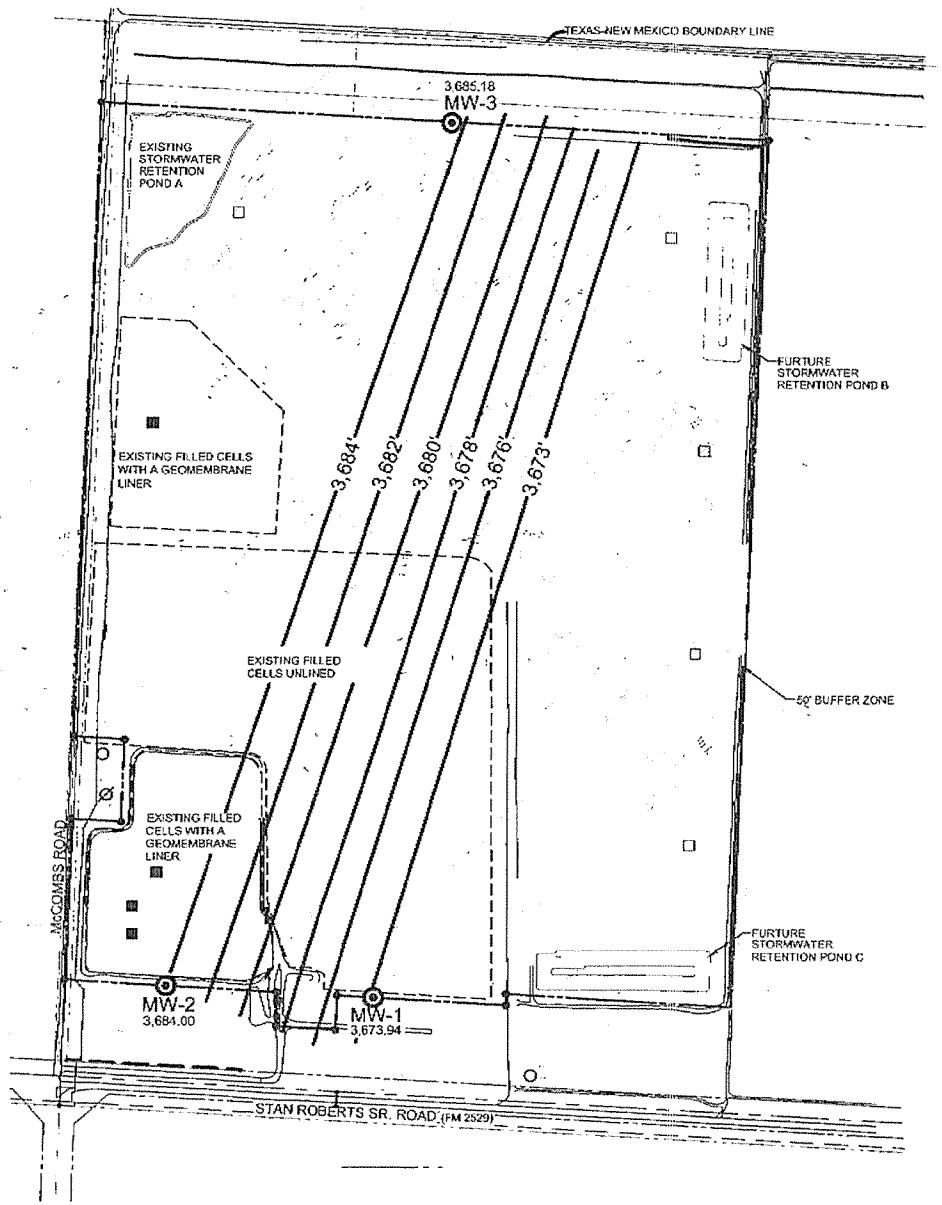
DATE DRAFTED: October 12, 2007

FILENAME: [illegible]

DRAWN BY: FGK

DRAFTED BY: FGK

FIGURE: 1C




STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
960
LICENSED
PROFESSIONAL GEOSCIENTIST

7-6-2009

PSC
PARKHILL SMITH & COOPER

The CAREL CORPORATION

136 Pecan Street, Keller, TX 76248

REGISTRATION NUMBER F-560

CAREL CORPORATION 50137

SCALE

0 300 600

FEET

# GROUNDWATER CONTOUR MAP NOVEMBER 14, 2003

THE CITY OF EL PASO TEXAS

CITY OF EL PASO
GROUNDWATER PERMIT
MODIFICATIONS FOR
McCOMBS LANDFILL

7969 SAN PAULO DRIVE
EL PASO, TEXAS 79907

LEGEND:

- PROPERTY/PERMIT BOUNDARY
- EXISTING LEACHATE COLLETION SUMP
- FURTURE LEACHATE COLLETION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL

N

| NO | DATE | DESCRIPTION |
|---|---|---|
| 1 | 7/6/2009 | MOD 1 RESPONSE |

ISSUING OFFICE: EPT PROJECT NO. 07-07-35

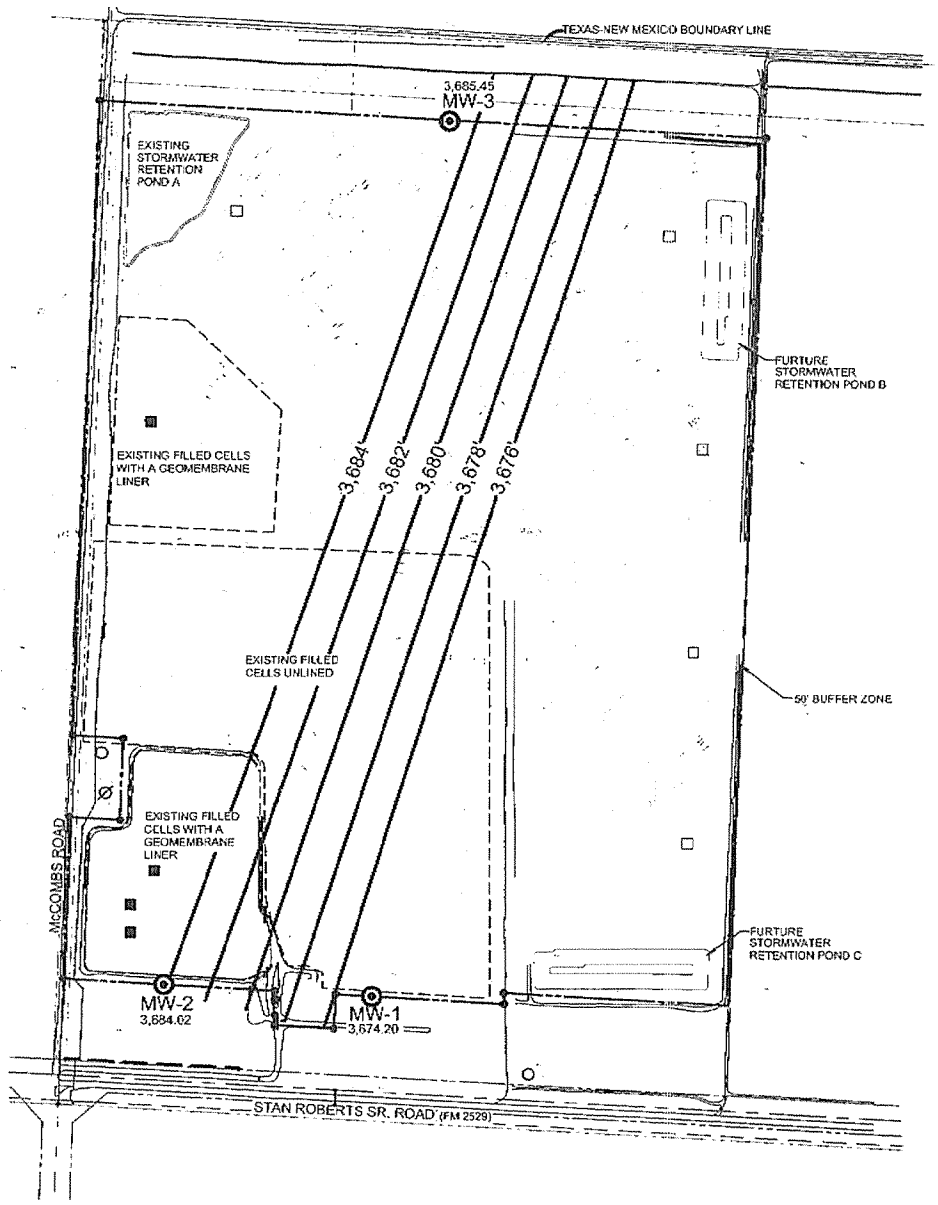
DATE DRAFTED: October 12, 2007

FILENAME: L:\TEXAS\Cal Comm\McCOMBS.mxd

DRAWN BY: FGK

DRAFTED BY: FGK

FIGURE: 2C

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PROFESSIONAL GEOSCIENTIST

7-6-2009

PSC PARKHILL SMITH & COOPER

CAREL CORPORATION

136 Pecan Street, Keller, TX 76248

REGISTRATION NUMBER F-560

CAREL CORPORATION 50137

SCALE

0 300 600

FEET

# GROUNDWATER CONTOUR MAP NOVEMBER 18, 2003

THE CITY OF EL PASO TEXAS

CITY OF EL PASO
GROUNDWATER PERMIT
MODIFICATIONS FOR
McCOMBS LANDFILL

7969 SAN PAULO DRIVE
EL PASO, TEXAS 79907

LEGEND:

- PROPERTY/PERMIT BOUNDARY
- EXISTING LEACHATE COLLETION SUMP
- FURTURE LEACHATE COLLETION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL

N

| NO | DATE | DESCRIPTION |
|---|---|---|
| 1 | 7/6/2009 | RTC 1 RESPONSE |
| DRAWING OFFICE, CITY | | PROJECT NO. 07-07-33 |

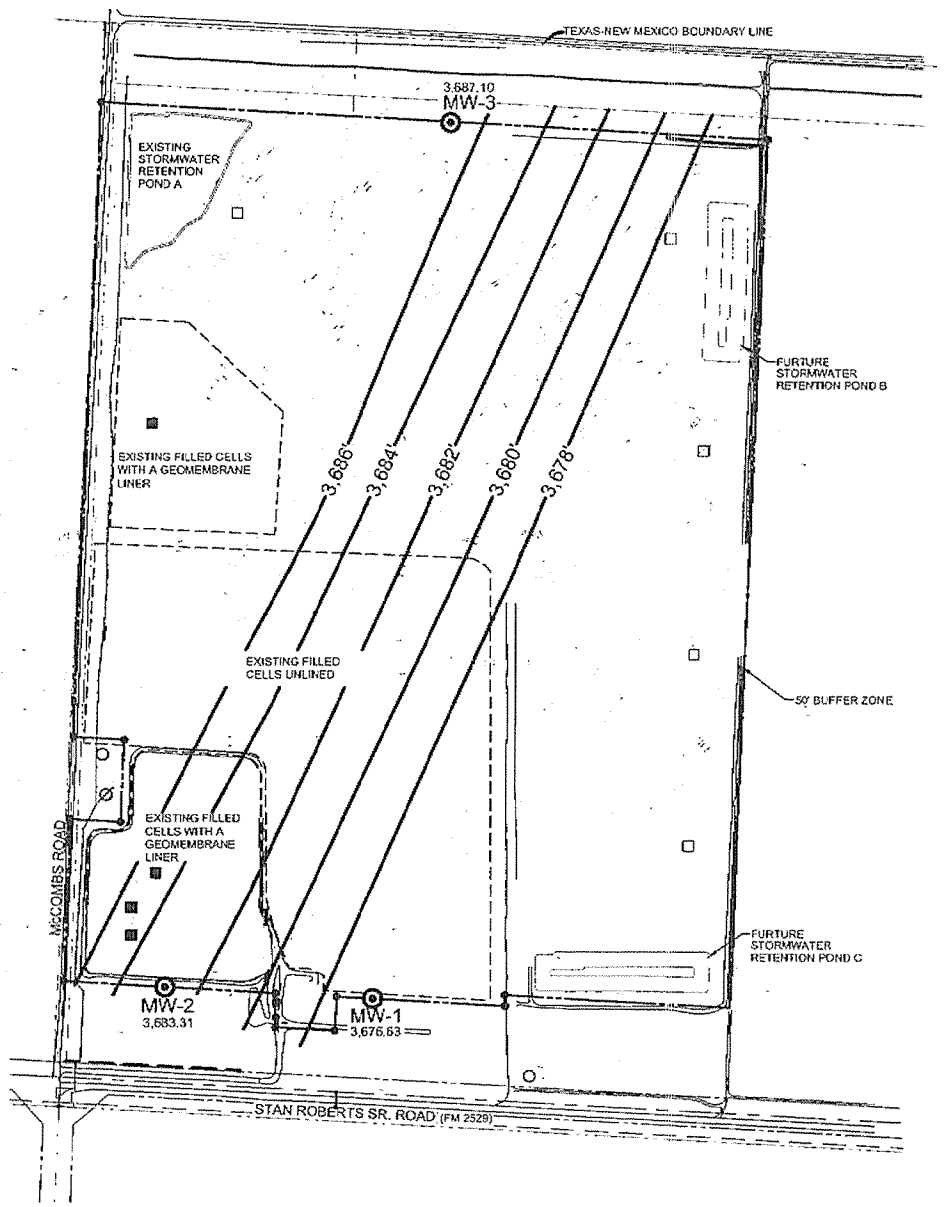
DATE DRAFTED: October 12, 2007

FILENAME: [illegible]

DRAWN BY: FGK

DRAFTED BY: FGK

FIGURE: 3C

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CAREL CORPORATION 50137

SCALE

0 300 600

FEET

# GROUNDWATER CONTOUR MAP MAY 12-13, 2004

THE CITY OF EL PASO TEXAS

CITY OF EL PASO
GROUNDWATER PERMIT
MODIFICATIONS FOR
McCOMBS LANDFILL

7909 SAN PAULO DRIVE
EL PASO, TEXAS 79907

LEGEND:

- PROPERTY/PERMIT BOUNDARY
- EXISTING LEACHATE COLLETION SUMP
- FURTURE LEACHATE COLLETION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL

N

| NO | DATE | DESCRIPTION |
|---|---|---|
| 1 | 7/5/2008 | ADD 1 RESPONSE |

GDLWG OFFICE/QTY PROJECT NO: 07-07-35

DATE DRAFTED: October 12, 2007

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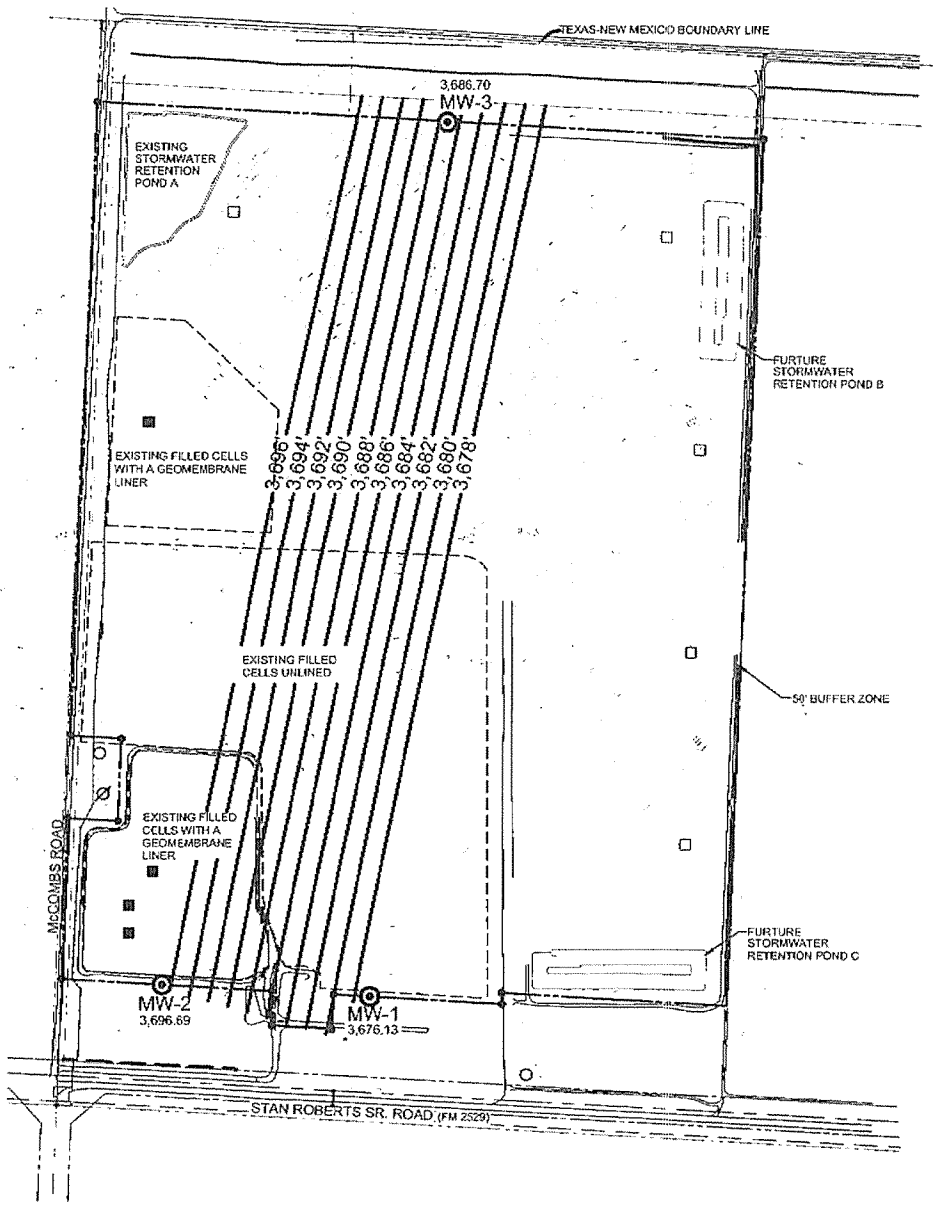
DRAFTED BY: FGK

FIGURE: 4C

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REGISTRATION NUMBER F-560

CAREL CORPORATION 50137

SCALE
0 300 600
FEET

# GROUNDWATER CONTOUR MAP SEPTEMBER 27-28, 2004

THE CITY OF EL PASO TEXAS

**CITY OF EL PASO GROUNDWATER PERMIT MODIFICATIONS FOR McCOMBS LANDFILL**

7969 SAN PAULO DRIVE
EL PASO, TEXAS 79907

LEGEND:

- PROPERTY/PERMIT BOUNDARY
- EXISTING LEACHATE COLLETION SUMP
- FURTURE LEACHATE COLLETION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL

N

| NO | DATE | DESCRIPTION |
|---|---|---|
| 1 | 7/6/2009 | MOD 1 RESPONSE |

COUNTY OFFICE CITY PROJECT NO: 07-07-35

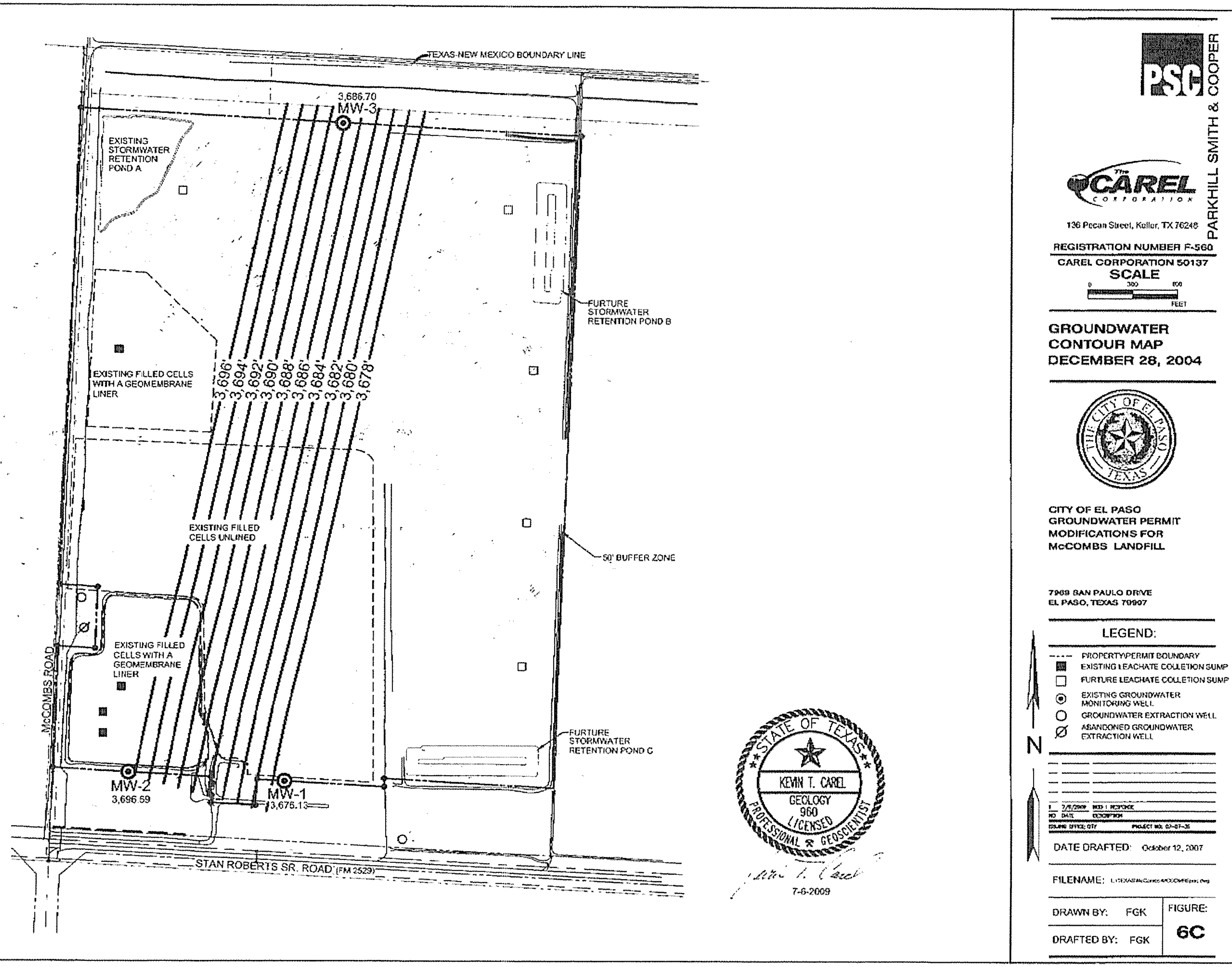
DATE DRAFTED: October 12, 2007

FILENAME: L:\TEXAS\McCombs\MCCOMB5.dwg

DRAWN BY: FGK

DRAFTED BY: FGK

FIGURE: 5C


TEXAS-NEW MEXICO BOUNDARY LINE
3,686.70
MW-3
EXISTING STORMWATER RETENTION POND A
EXISTING FILLED CELLS WITH A GEOMEMBRANE LINER
3,696'
3,694'
3,692'
3,690'
3,688'
3,686'
3,684'
3,682'
3,680'
3,678'
EXISTING FILLED CELLS UNLINED
EXISTING FILLED CELLS WITH A GEOMEMBRANE LINER
McCOMBS ROAD
MW-2
3,696.59
MW-1
3,675.13
STAN ROBERTS SR. ROAD (FM 2529)
FURTURE STORMWATER RETENTION POND B
50' BUFFER ZONE
FURTURE STORMWATER RETENTION POND C
STATE OF TEXAS
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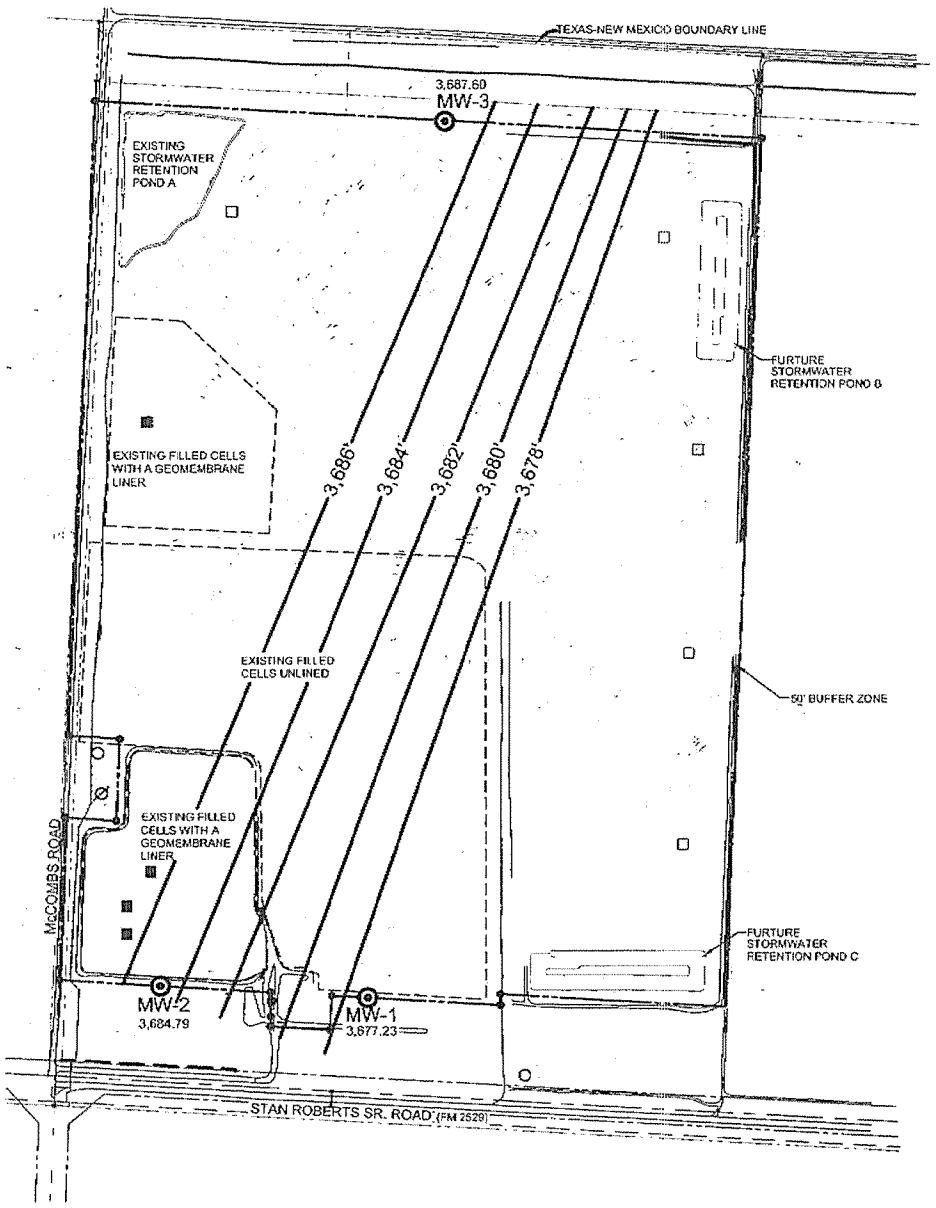
PSC
PARKHILL SMITH & COOPER
The CAREL CORPORATION
136 Pecan Street, Keller, TX 76248
REGISTRATION NUMBER F-560
CAREL CORPORATION 50137
SCALE
FEET
GROUNDWATER CONTOUR MAP
DECEMBER 28, 2004
THE CITY OF EL PASO TEXAS
CITY OF EL PASO
GROUNDWATER PERMIT
MODIFICATIONS FOR
McCOMBS LANDFILL
7969 SAN PAULO DRIVE
EL PASO, TEXAS 79907
LEGEND:
PROPERTY/PERMIT BOUNDARY
EXISTING LEACHATE COLLETION SUMP
FURTURE LEACHATE COLLETION SUMP
EXISTING GROUNDWATER MONITORING WELL
GROUNDWATER EXTRACTION WELL
ABANDONED GROUNDWATER EXTRACTION WELL
N
DATE DRAFTED: October 12, 2007
FILENAME:
DRAWN BY: FGK
DRAFTED BY: FGK
FIGURE:
6C

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REGISTRATION NUMBER F-660

CAREL CORPORATION 50137

SCALE

0 300 600

FEET

# GROUNDWATER CONTOUR MAP MARCH 30, 2005

THE CITY OF EL PASO TEXAS

CITY OF EL PASO
GROUNDWATER PERMIT
MODIFICATIONS FOR
McCOMBS LANDFILL

7969 SAN PAULO DRIVE
EL PASO, TEXAS 79907

LEGEND:

- PROPERTY/PERMIT BOUNDARY
- EXISTING LEACHATE COLLETION SUMP
- FURTURE LEACHATE COLLETION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL

N

| NO | DATE | DESCRIPTION |
|---|---|---|
| 1 | 7/8/2008 | RES. 1 RESPONSE |

CODING OFFICE: CITY PROJECT NO: 07-07-38

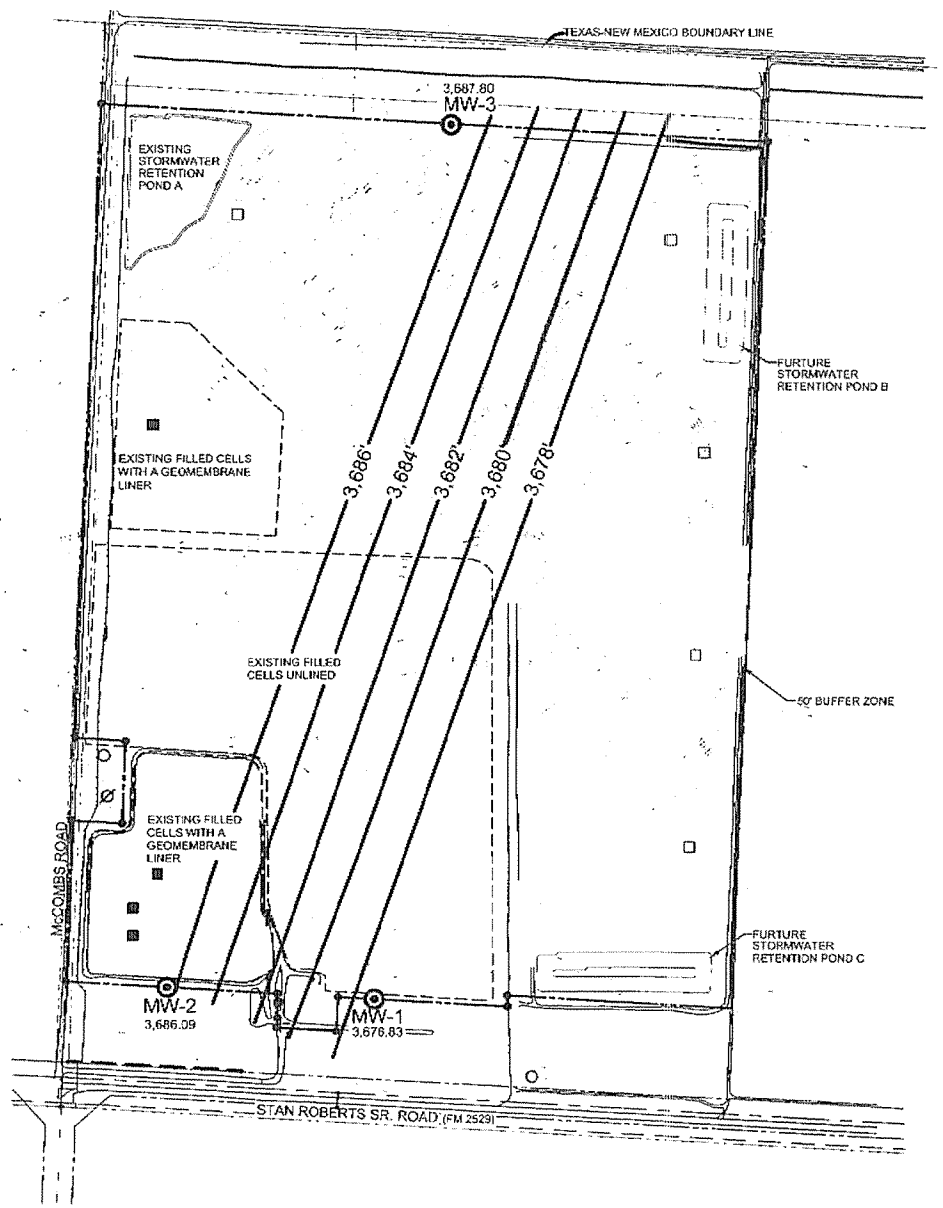
DATE DRAFTED: October 12, 2007

FILENAME: L:\TEXAS\McCombs\MCCOMBS.pcc.dwg

DRAWN BY: FGK

DRAFTED BY: FGK

FIGURE: 7C

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CAREL CORPORATION

136 Pecan Street, Keller, TX 76248

REGISTRATION NUMBER F-560

CAREL CORPORATION 50137

SCALE

0 300 600

FEET

# GROUNDWATER CONTOUR MAP JANUARY 10, 2006

THE CITY OF EL PASO TEXAS

**CITY OF EL PASO GROUNDWATER PERMIT MODIFICATIONS FOR McCOMBS LANDFILL**

7969 SAN PAULO DRIVE
EL PASO, TEXAS 79907

LEGEND:

- PROPERTY\PERMIT BOUNDARY
- EXISTING LEACHATE COLLETION SUMP
- FURTURE LEACHATE COLLETION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL

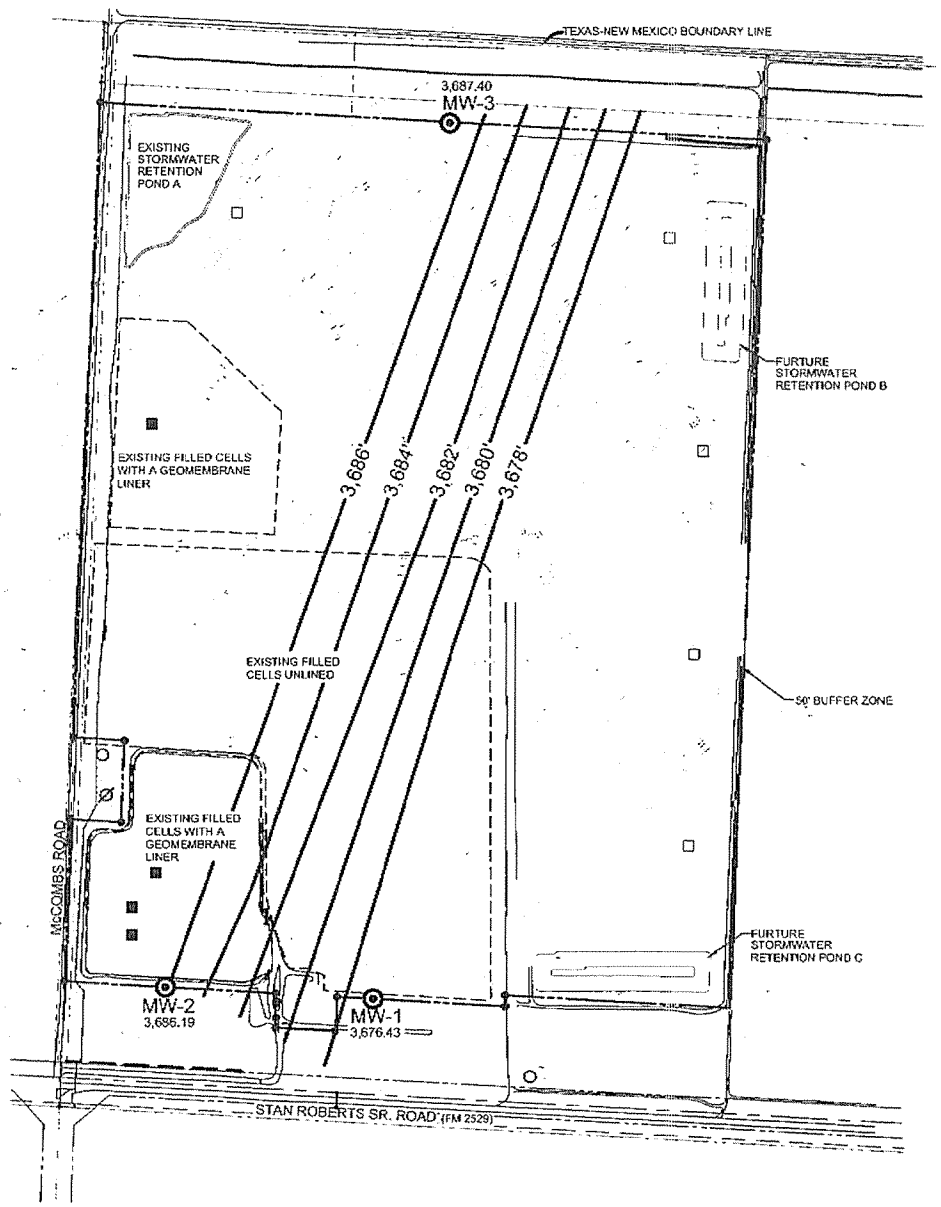
N

| NO | DATE | DESCRIPTION |
|---|---|---|
| 1 | 7/6/2009 | ADD 1 MORE |
| ISSUING OFFICE: CITY | | PROJECT #'S: 07-07-35 |

DATE DRAFTED: October 12, 2007

FILENAME: L:\TEXAS\Current\MCCOMB\doc.dwg

| DRAWN BY: FGK | FIGURE: |
|---|---|
| DRAFTED BY: FGK | 8C |

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REGISTRATION NUMBER F-560

CAREL CORPORATION 50137

SCALE

0 300 600

FEET

# GROUNDWATER CONTOUR MAP APRIL 5-8, 2006

THE CITY OF EL PASO TEXAS

CITY OF EL PASO
GROUNDWATER PERMIT
MODIFICATIONS FOR
McCOMBS LANDFILL

7969 SAN PAULO DRIVE
EL PASO, TEXAS 79907

LEGEND:

- PROPERTY/PERMIT BOUNDARY
- EXISTING LEACHATE COLLETION SUMP
- FURTURE LEACHATE COLLETION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL

N

| NO | DATE | DESCRIPTION |
|---|---|---|
| 1 | 7/6/2009 | MOD 1 RESPONSE |

ISSUING OFFICE: EPT PROJECT NO: 07-07-38

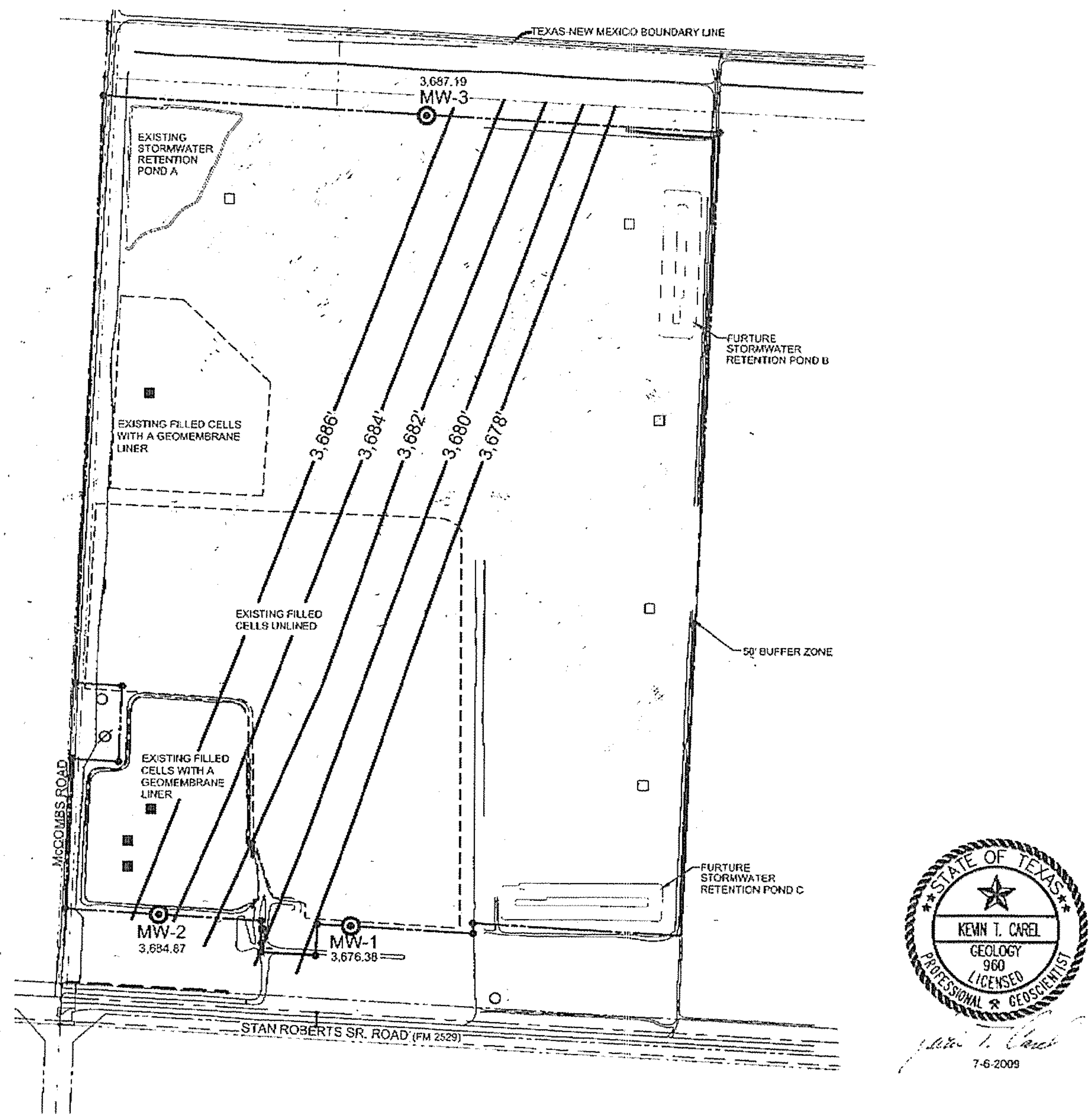
DATE DRAFTED: October 12, 2007

FILENAME: L:\TEXAS\Active\McCOMBS\Doc.dwg

DRAWN BY: FGK

DRAFTED BY: FGK

FIGURE: 9C

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REGISTRATION NUMBER F-560

CAREL CORPORATION 50137

SCALE

0 300 600 FEET

**GROUNDWATER CONTOUR MAP**
**JULY 20, 2006**

THE CITY OF EL PASO TEXAS

CITY OF EL PASO
GROUNDWATER PERMIT MODIFICATIONS FOR McCOMBS LANDFILL

7969 SAN PAULO DRIVE
EL PASO, TEXAS 79907

LEGEND:

- PROPERTY/PERMIT BOUNDARY
- EXISTING LEACHATE COLLETION SUMP
- FURTURE LEACHATE COLLETION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL

N

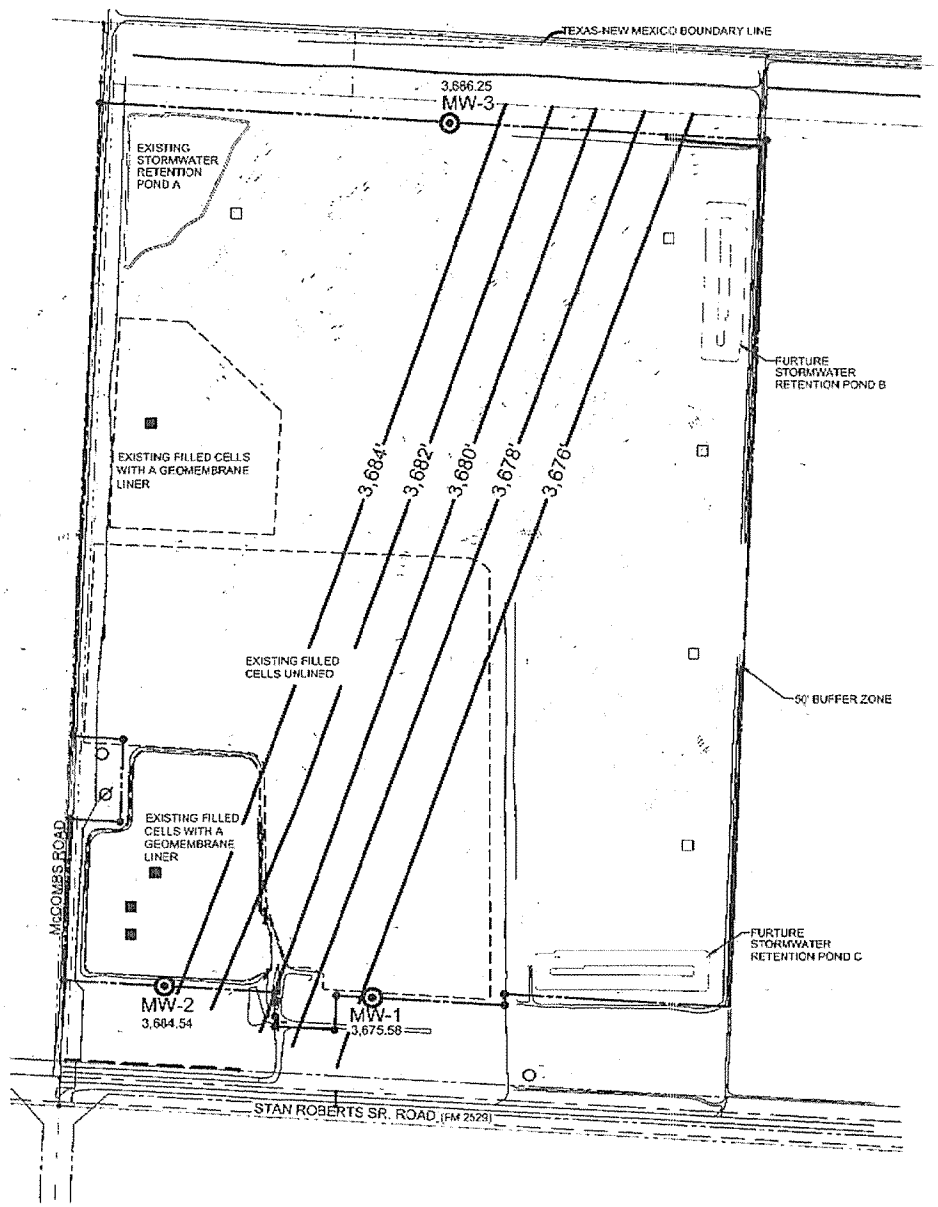
DATE DRAFTED: October 12, 2007

FILENAME:

DRAWN BY: FGK

DRAFTED BY: FGK

FIGURE: 10C

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REGISTRATION NUMBER F-560

CAREL CORPORATION 50137

SCALE

0 300 600

FEET

# GROUNDWATER CONTOUR MAP OCTOBER 31, 2006 - NOVEMBER 2, 2006

THE CITY OF EL PASO TEXAS

CITY OF EL PASO
GROUNDWATER PERMIT
MODIFICATIONS FOR
McCOMBS LANDFILL

7969 SAN PAULO DRIVE
EL PASO, TEXAS 79907

LEGEND:

- PROPERTY/PERMIT BOUNDARY
- EXISTING LEACHATE COLLETION SUMP
- FURTURE LEACHATE COLLETION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL

N

| NO | DATE | DESCRIPTION |
|---|---|---|
| 1 | 7/6/2009 | MOD 1 RESPONSE |

DRAWING OFFICE COPY — PROJECT No. 07-07-35

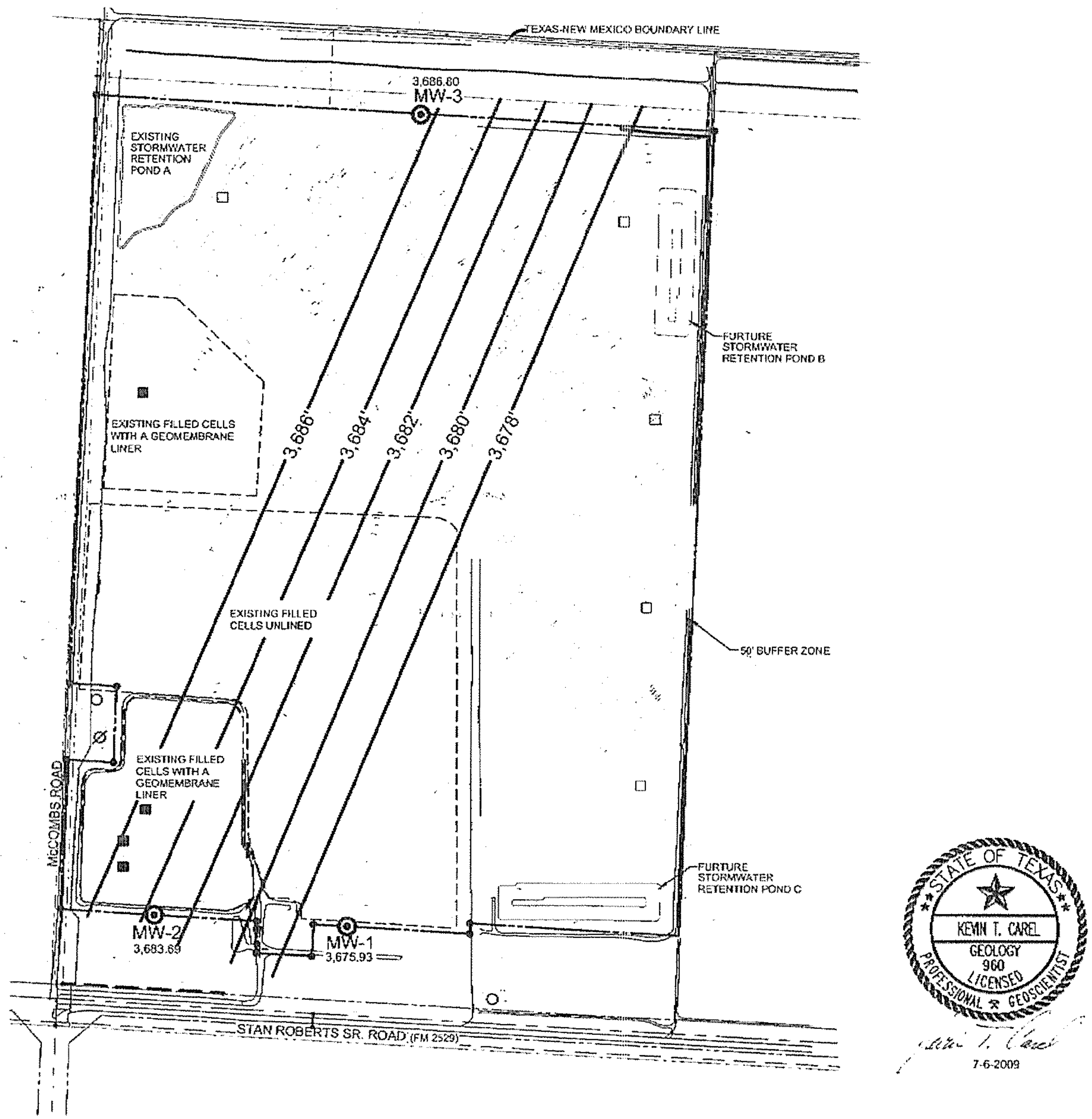
DATE DRAFTED: October 12, 2007

FILENAME: L:\TEXAS\McCOMBS\McCOMBS.dwg

DRAWN BY: FGK

DRAFTED BY: FGK

FIGURE: 11C

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REGISTRATION NUMBER F-560

CAREL CORPORATION 50137

SCALE

0 300 600 FEET

**GROUNDWATER CONTOUR MAP APRIL 17, 2007**

THE CITY OF EL PASO TEXAS

CITY OF EL PASO
GROUNDWATER PERMIT MODIFICATIONS FOR McCOMBS LANDFILL

7969 SAN PAULO DRIVE
EL PASO, TEXAS 79907

LEGEND:

- PROPERTY/PERMIT BOUNDARY
- EXISTING LEACHATE COLLETION SUMP
- FURTURE LEACHATE COLLETION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL

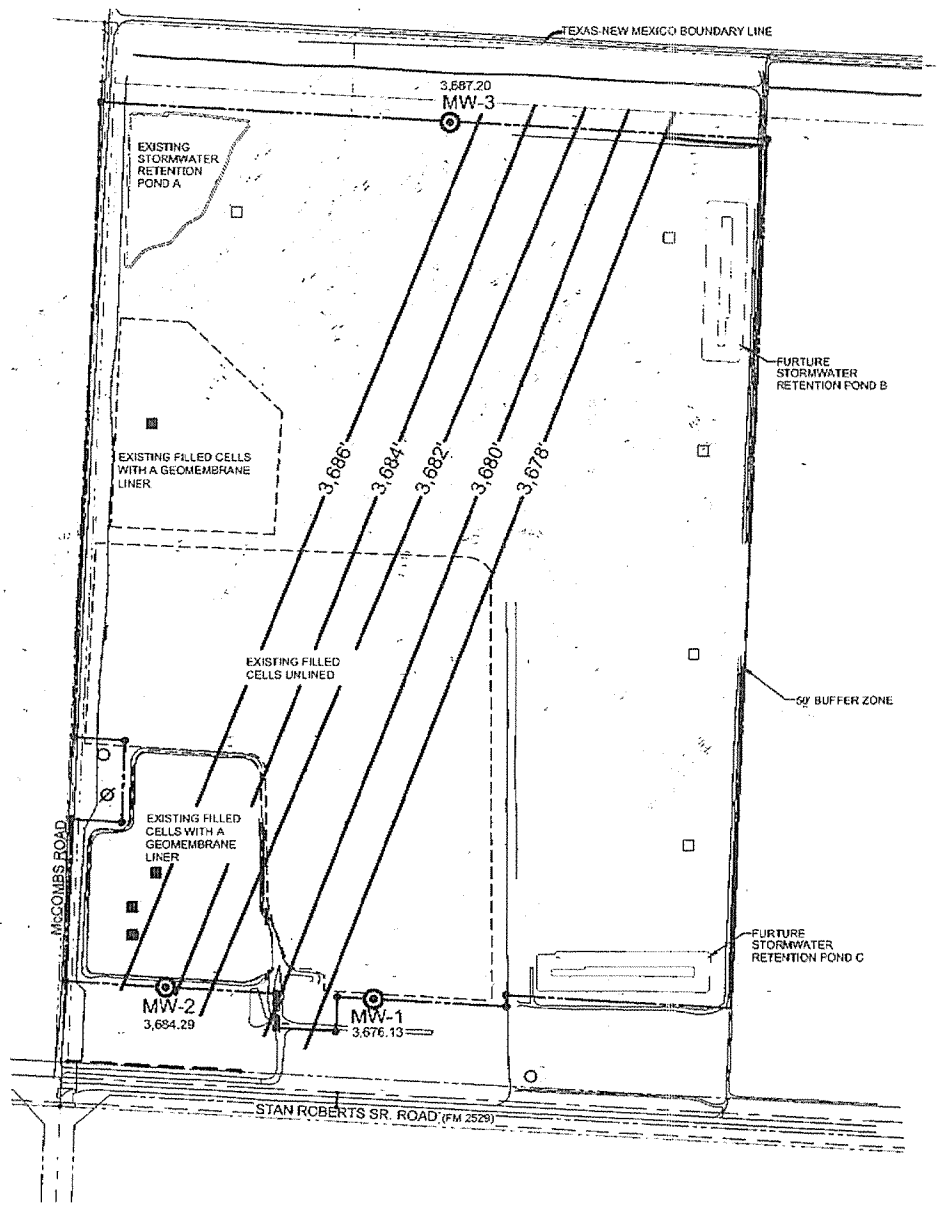
DATE DRAFTED: October 12, 2007

FILENAME:

DRAWN BY: FGK

DRAFTED BY: FGK

FIGURE: 12C

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REGISTRATION NUMBER F-560

CAREL CORPORATION 50137

SCALE

0 300 600
FEET

# GROUNDWATER CONTOUR MAP MAY 21, 2007

THE CITY OF EL PASO TEXAS

CITY OF EL PASO
GROUNDWATER PERMIT
MODIFICATIONS FOR
McCOMBS LANDFILL

7909 SAN PAULO DRIVE
EL PASO, TEXAS 79907

LEGEND:

- PROPERTY/PERMIT BOUNDARY
- EXISTING LEACHATE COLLETION SUMP
- FURTURE LEACHATE COLLETION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL

N

| NO | DATE | DESCRIPTION |
|---|---|---|
| 1 | 7/6/2009 | MOD 1 RESPONSE |

DRAWING OFFICE: CITY PROJECT NO. 07-07-35

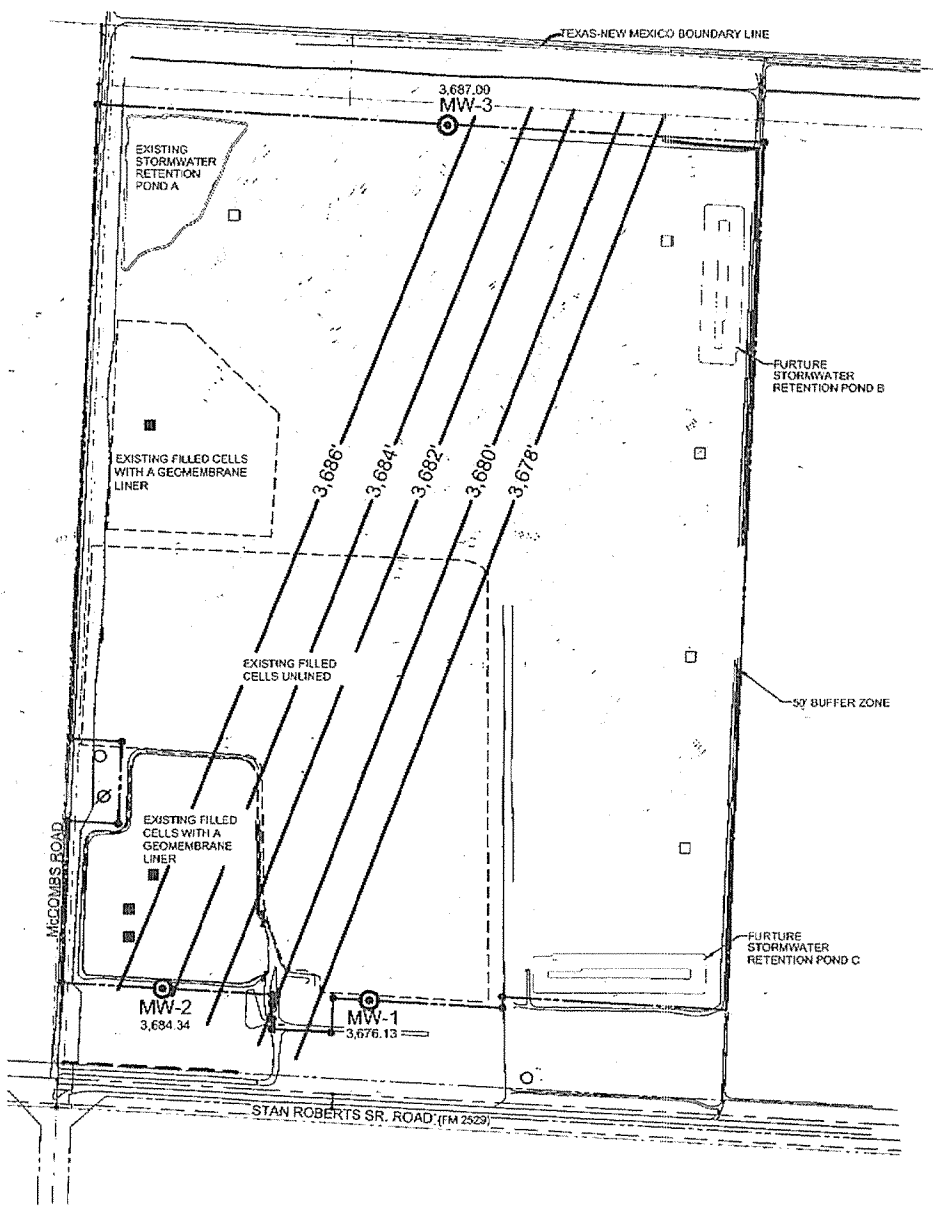
DATE DRAFTED: October 12, 2007

FILENAME: L:\TEXAS\McCombs\McCOMBS2.dwg

DRAWN BY: FGK

DRAFTED BY: FGK

FIGURE: 13C

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REGISTRATION NUMBER F-560

CAREL CORPORATION 50137

SCALE

0 300 600

FEET

# GROUNDWATER CONTOUR MAP JULY 25, 2007

THE CITY OF EL PASO TEXAS

CITY OF EL PASO
GROUNDWATER PERMIT
MODIFICATIONS FOR
McCOMBS LANDFILL

7969 SAN PAULO DRIVE
EL PASO, TEXAS 79907

LEGEND:

- PROPERTY/PERMIT BOUNDARY
- EXISTING LEACHATE COLLETION SUMP
- FURTURE LEACHATE COLLETION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL

N

| NO | DATE | DESCRIPTION |
|---|---|---|
| 1 | 7/8/2008 | MOD 1 RESPONSE |

EGING OFFICE, CITY — PROJECT NO. 07-07-30

DATE DRAFTED: October 12, 2007

FILENAME: L:\TEXAS\McCombs\PROCOMBS.pro.dwg

DRAWN BY: FGK

DRAFTED BY: FGK

FIGURE: 14C

# APPENDIX D

# SUMMARY OF GROUNDWATER ANALYTICAL DATA MW-1, MW-2 AND MW-3

SUMMARY OF GROUNDWATER ANALYTICAL DATA
City of El Paso, McCombs Landfill - Permit No. MSW 729A
El Paso County, Texas

| Well | Date | Antimony ug/l | Arsenic ug/l | Barium ug/l | Beryllium ug/l | Cadmium ug/l | Chromium ug/l | Cobalt ug/l | Copper ug/l | Lead ug/l | Nickel ug/l | Selenium ug/l | Silver ug/l | Thallium ug/l | Vanadium ug/l | Zinc ug/l | Iron ug/l | Manganese ug/l | Magnesium mg/l | Calcium mg/l | Potassium mg/l | Nitrate mg/l | Chloride mg/l | Sodium mg/l | Sulfate mg/l | Alkalinity, Total mg/l | Total Dissolved Solids mg/l | Ammonia mg/l | Specific Conductance (lab) (umhos/cm) | Specific Conductance (field) (umhos/cm) | pH (lab) | ph (field) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-1 | 9/13/2004 | <360 | <190 | 90 | <2.0 | <26 | <150 | <60 | <170 | <440 | <90 | <320 | <50 | <300 | <70 | <50 | 340 | <50 | 1.7 | <50 | 5.5 | 1.35 | 86.2 | 70 | <50 | 53.8 | 270 | <0.2 | 359 | 450 | 8.6 | 8.6 |
| MW-1 | 9/27/2004 | <360 | <190 | 100 | <2.0 | <26 | <150 | <60 | <170 | <440 | <90 | <320 | <100 | <300 | <70 | <50 | 560 | <60 | 2.5 | <50 | 5 | 1.4 | 78.3 | 57.7 | <50 | 63.4 | 267 | <0.2 | 415 | 446 | 8.6 | 8.6 |
| MW-1 | 12/30/2004 | <10 | <190 | 100 | <2.0 | <10 | <50 | <60 | <50 | <50 | <50 | <10 | <100 | N/A | <10.0 | <50 | 670 | <50 | 2.9 | <50 | 5.9 | 1.39 | 70 | 57.2 | <50 | 70.4 | 267 | <0.2 | 513 | 563 | 8.4 | 8.65 |
| MW-1 | 4/12/2005 | <5.0 | 8.8 | 112 | <2.0 | <5.0 | <50 | <2.0 | <50 | <50 | <50 | <5.0 | <50 | <2 | 20.2 | <50 | 363 | <50 | 2.97 | <50 | 5.16 | 1.26 | 98.7 | 59.4 | <50 | 179 | 269 | <0.2 | 463 | 464 | 8.2 | 8.3 |
| MW-1 | 1/10/2006 | <5.0 | 8.37 | 101 | <2.0 | <5.0 | <50 | <2.0 | <50 | <50 | <50 | <5.0 | <50 | <2 | 17.4 | <50 | 279 | <50 | 3.33 | <50 | 4.41 | 1.33 | 66.4 | 60.4 | <50 | 67.3 | 284 | <0.1 | 444 | 316 | 8.09 | 8.38 |
| MW-1 | 4/6/2006 | <5.0 | 8.89 | 102 | <2.0 | <5.0 | <50 | <2.0 | <50 | <50 | <50 | <5.0 | <50 | <2 | 19 | <50 | 291 | <50 | 3.27 | <50 | 4.66 | 1.71 | 84.1 | 59.6 | <50 | 60 | 269 | <0.1 | 462 | 495 | 8.14 | 8.42 |
| MW-1 | 7/25/2006 | <5.0 | 7.27 | 98.6 | <2.0 | <5.0 | <50 | <2.0 | <50 | <50 | <50 | <5.0 | <50 | <2 | 15.3 | <50 | 281 | <50 | 3.1 | <50 | 5.1 | 1.66 | 87.5 | 61.3 | <50 | 62 | 282 | 0.10J | 473 | 528 | 8.08 | 8.46 |
| MW-1 | 11/5/2006 | <5.0 | 5.8 | 111 | <2.0 | <5.0 | <50 | <2.0 | <50 | <50 | <50 | <5.0 | <50 | <2 | 18.6 | <50 | 99 | <50 | 3.67 | <50 | 5.42 | 1.8 | 85.9 | 66.7 | <50 | 78.5 | 284 | N/A | 471 | 495 | 8.1 | 8.6 |
| MW-1 | 5/24/2007 | <5.0 | 8 | 104 | <2.0 | <5.0 | <50 | <2.0 | <50 | <50 | <50 | <5.0 | <50 | <2 | 17.1 | <50 | 237 | <50 | 3.35 | <50 | 4.65 | 1.7 | 89.2 | 57.9 | <50 | 64.1 | 281 | <0.1 | 471 | 423 | 8.3 | 8.59 |
| MW-2 | 9/13/2004 | <360 | <190 | 100 | <2.0 | <26 | <150 | <60 | <170 | <440 | <90 | <320 | <50 | <300 | <70 | <50 | <50 | <50 | 3.7 | <50 | 4.5 | 1.25 | 84.7 | <50 | <50 | 80.7 | 256 | 0.2 | 356 | N/A | 7.9 | 7.9 |
| MW-2 | 9/25/2004 | <360 | <190 | 110 | <2.0 | <26 | <150 | <60 | <170 | <440 | <90 | <320 | <100 | <300 | <70 | 70 | 100 | <50 | 4.5 | <50 | 5 | 1.52 | 74.9 | 64.8 | <50 | 85.1 | 278 | <0.2 | 418 | 709 | 8.5 | 7.9 |
| MW-2 | 12/30/2004 | <10 | <190 | 100 | <2.0 | <10 | <50 | <60 | <50 | <50 | <50 | <10 | <100 | N/A | <10.0 | <50 | 290 | <50 | 4.2 | <50 | 6 | 1.37 | 75.8 | 57.8 | <50 | 83 | 255 | <0.2 | 500 | 569 | 7.9 | 7.9 |
| MW-2 | 4/5/2005 | <5.0 | 9.8 | 109 | <2.0 | <5.0 | <50 | <2.0 | <50 | <50 | <50 | <5.0 | <50 | <2 | 15.5 | <50 | <50 | <50 | 4.3 | <50 | <1.0 | 1.37 | 71.6 | 62.6 | <50 | 268 | 251 | <0.2 | 453 | 451 | 7.7 | 8.2 |
| MW-2 | 1/10/2006 | <5.0 | 9.39 | 96.3 | <2.0 | <5.0 | <50 | <2.0 | <50 | <50 | <50 | <5.0 | <50 | <2 | 15.9 | <50 | <50 | <50 | 4.55 | <50 | 4.74 | 1.41 | 66.4 | 61.3 | <50 | 86.6 | 276 | <0.1 | 427 | 211 | 7.85 | 8.08 |
| MW-2 | 4/7/2006 | <5.0 | 9.96 | 103 | <2.0 | <5.0 | <50 | <2.0 | <50 | <50 | <50 | <5.0 | <50 | <2 | 20 | <50 | 90 | <50 | 4.34 | <50 | 5.03 | 1.72 | 84.2 | 61.9 | <50 | 77 | 263 | <0.1 | 444 | 459 | 7.95 | 8.15 |
| MW-2 | 7/25/2006 | <5.0 | 8.54 | 96.5 | <2.0 | <5.0 | <50 | <2.0 | <50 | <50 | <50 | <5.0 | <50 | <2 | 16.7 | <50 | <50 | <50 | 4.2 | <50 | 5.54 | 1.66 | 87.2 | 63 | <50 | 79 | 256 | 0.11J | 449 | 511 --> | 7.89 | 8.23 |
| MW-2 | 11/5/2006 | <5.0 | 9 | 105 | <2.0 | <5.0 | <50 | <2.0 | <50 | <50 | <50 | <5.0 | <50 | <2.0 | 17.7 | <50 | <50 | <50 | 4.33 | <50 | 5.06 | 1.8 | 85.9 | 60.9 | <50 | 75.4 | 259 | N/A | 451 | 441 | 7.9 | 8.5 |
| MW-2 | 5/23/2007 | <5.0 | 9.6 | 106 | <2.0 | <5.0 | <50 | <2.0 | <50 | <50 | <50 | <5.0 | <50 | <2.0 | 21.3 | <50 | 79.3 | <50 | 4.18 | <50 | 5.49 | 1.7 | 89.1 | 59.3 | <50 | 75.8 | 280 | <0.1 | 455 | 474 | 8 | 8.39 |
| MW-3 | 9/12/2004 | <360 | <190 | 370 | <2.0 | <26 | <150 | <60 | <170 | <440 | <90 | <320 | <50 | <300 | <70 | <50 | 2560 | <50 | 16.7 | 122 | 10.7 | 0.74 | 705 | 377 | <50 | 51.8 | 1260 | 0.3 | 2120 | N/A | 7.8 | 7.5 |
| MW-3 | 9/29/2004 | <360 | <190 | 370 | <2.0 | <26 | <150 | <60 | <170 | <440 | <90 | <320 | <100 | <300 | <70 | <50 | 2560 | <50 | 19 | 121 | 14.3 | 0.77 | 718 | 393 | <50 | 57.4 | 1400 | <0.2 | 2300 | 2280 | 7.8 | 7.8 |
| MW-3 | 12/30/2004 | <10 | <190 | 370 | <2.0 | <10 | <50 | <60 | <170 | <50 | <50 | <10 | <100 | N/A | <10.0 | <50 | <70 | <50 | 15.7 | 104 | 10.8 | 0.62 | 691 | 281 | <50 | 52.5 | 1210 | <0.2 | 2440 | 2280 | 7.7 | 7.8 |
| MW-3 | 4/5/2005 | <5.0 | <5.0 | 378 | <2.0 | <5.0 | <50 | <2.0 | <50 | <50 | <50 | <5.0 | <50 | <2.0 | 8.2 | <50 | 309 | <50 | 16.9 | 120 | 12.5 | 0.66 | 189 | 302 | <50 | 203 | 1180 | <0.2 | 2340 | 2292 | 7.6 | 7.8 |
| MW-3 | 1/10/2006 | <5.0 | <5.0 | 383 | <2.0 | <5.0 | <50 | <2.0 | <50 | <50 | <50 | <5.0 | <50 | <2.0 | 8.7 | <50 | 1248 | <50 | 14.5 | 99.3 | 9.07 | 0.68 | 717 | 310 | <50 | 54.3 | 1160 | 0.15J | 2150 | 1108 | 7.69 | 7.76 |
| MW-3 | 4/6/2006 | <5.0 | <5.0 | 421 | <2.0 | <5.0 | <50 | <2.0 | <50 | <50 | <50 | <5.0 | <50 | <2.0 | 5 | <50 | 187 | <50 | 17.9 | 117 | 11.1 | 0.92 | 675 | 311 | <50 | 48 | 1180 | <0.1 | 2250 | 2282 | 7.62 | 7.89 |
| MW-3 | 7/25/2006 | <5.0 | <5.0 | 398 | <2.0 | <5.0 | <50 | <2.0 | <50 | <50 | <50 | <5.0 | <50 | <2.0 | 9.36 | <50 | 285 | <50 | 17.4 | 116 | 11.6 | 0.725 | 650 | 295 | <50 | 49 | 1310 | 0.16J | 2305 | 2578 | 7.66 | 7.88 |
| MW-3 | 11/5/2006 | <5.0 | <5.0 | 338 | <2.0 | <5.0 | <50 | <2.0 | <50 | <50 | <50 | <5.0 | <50 | <2.0 | 11.4 | <50 | <50 | <50 | 18.1 | 126 | 11.2 | 1.1 | 692 | 303 | <50 | 45.4 | 1690 | N/A | 2510 | 2331 | 7.7 | 8.16 |
| MW-3 | 5/22/2007 | <5.0 | <5.0 | 362 | <2.0 | <5.0 | <50 | <2.0 | <50 | <50 | <50 | <5.0 | <50 | <2.0 | 14.4 | <50 | 158 | <50 | 17.2 | 114 | 10.7 | 0.96 | 689 | 301 | <50 | 48.5 | 1530 | <0.1 | 2340 | 2495 | 7.8 | 8.09 |

## SUMMARY OF GROUNDWATER ANALYTICAL DATA
City of El Paso, McCombs Landfill - Permit No. MSW - 729A
El Paso County, Texas

| Well | Date | Acetone | Acrylonitrile | Benzene | Bromochloromethane | Bromodichloromethane | Bromoform | Carbon disulfide | Carbon tetrachloride | Chlorobenzene | Chloroethane | Chloroform | Dibromochloromethane | 1,2-Dibromo-3-chloropropane | 1,2-Dibromoethane | o-Dichlorobenzene | p-Dichlorobenzene | trans-1,4-Dichloro-2-butene | 1,1-Dichloroethane | 1,2-Dichloroethane | 1,1-Dichloroethylene | cis-1,2-Dichloroethylene | trans-1,2-Dichloroethylene | 1,2-Dichloropropane |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-1 | 5/13/2004 | <10.0 | <20.0 | <1.0 | NA | <1.0 | <1.0 | <5.0 | <1.0 | <1.0 | <5.0 | <1.0 | <1.0 | NA | <2.0 | <1.0 | <1.0 | NA | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-1 | 9/27/2004 | <10.0 | <20.0 | <1.0 | NA | <1.0 | <1.0 | <5.0 | <1.0 | <1.0 | <5.0 | <1.0 | <1.0 | NA | <2.0 | <1.0 | <1.0 | NA | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-1 | 12/30/2004 | <10.0 | <20.0 | <1.0 | NA | <1.0 | <1.0 | <5.0 | <1.0 | <1.0 | <5.0 | <1.0 | <1.0 | <2.0 | <2.0 | <1.0 | <1.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-1 | 4/1/2005 | <10.0 | <20.0 | <1.0 | <1.0 | <1.0 | <1.0 | <5.0 | <1.0 | <1.0 | <5.0 | <1.0 | <1.0 | <2.0 | <2.0 | <1.0 | <1.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-1 | 1/10/2006 | <10.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <1.0 | <2.0 | <2.0 | <1.0 | <1.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-1 | 4/6/2006 | <10.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <1.0 | <2.0 | <2.0 | <1.0 | <1.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-1 | 7/25/2006 | <10.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <1.0 | <2.0 | <2.0 | <1.0 | <1.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-1 | 11/5/2006 | <10.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <1.0 | <2.0 | <2.0 | <1.0 | <1.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-1 | 5/24/2007 | <10.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <1.0 | <2.0 | <2.0 | <1.0 | <1.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-2 | 5/13/2004 | <10.0 | <20.0 | <1.0 | NA | <1.0 | <1.0 | <5.0 | <1.0 | <1.0 | <5.0 | <1.0 | <1.0 | NA | <2.0 | <1.0 | <1.0 | NA | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-2 | 9/29/2004 | <10.0 | <20.0 | <1.0 | NA | <1.0 | <1.0 | <5.0 | <1.0 | <1.0 | <5.0 | <1.0 | <1.0 | NA | <2.0 | <1.0 | <1.0 | NA | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-2 | 12/30/2004 | <10.0 | <20.0 | <1.0 | NA | <1.0 | <1.0 | <5.0 | <1.0 | <1.0 | <5.0 | <1.0 | <1.0 | <2.0 | <2.0 | <1.0 | <1.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-2 | 4/5/2005 | <10.0 | <20.0 | <1.0 | <1.0 | <1.0 | <1.0 | <5.0 | <1.0 | <1.0 | <5.0 | <1.0 | <1.0 | <2.0 | <2.0 | <1.0 | <1.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-2 | 1/10/2006 | <10.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <1.0 | <2.0 | <2.0 | <1.0 | <1.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-2 | 4/7/2006 | <10.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <1.0 | <2.0 | <2.0 | <1.0 | <1.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-2 | 7/26/2006 | <10.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <1.0 | <2.0 | <2.0 | <1.0 | <1.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-2 | 11/5/2006 | <10.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <1.0 | <2.0 | <2.0 | <1.0 | <1.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-2 | 5/22/2007 | <10.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <1.0 | <2.0 | <2.0 | <1.0 | <1.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-3 | 5/12/2004 | <10.0 | <20.0 | <1.0 | NA | <1.0 | <1.0 | <5.0 | <1.0 | <1.0 | <5.0 | <1.0 | <1.0 | NA | <2.0 | <1.0 | <1.0 | NA | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-3 | 9/29/2004 | <10.0 | <20.0 | <1.0 | NA | <1.0 | <1.0 | <5.0 | <1.0 | <1.0 | <5.0 | <1.0 | <1.0 | NA | <2.0 | <1.0 | <1.0 | NA | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-3 | 12/30/2004 | <10.0 | <20.0 | <1.0 | NA | <1.0 | <1.0 | <5.0 | <1.0 | <1.0 | <5.0 | <1.0 | <1.0 | <2.0 | <2.0 | <1.0 | <1.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-3 | 4/5/2005 | <10.0 | <20.0 | <1.0 | <1.0 | <1.0 | <1.0 | <5.0 | <1.0 | <1.0 | <5.0 | <1.0 | <1.0 | <2.0 | <2.0 | <1.0 | <1.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-3 | 1/10/2006 | <10.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <1.0 | <2.0 | <2.0 | <1.0 | <1.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-3 | 4/5/2006 | <10.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <1.0 | <2.0 | <2.0 | <1.0 | <1.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-3 | 7/25/2006 | <10.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <1.0 | <2.0 | <2.0 | <1.0 | <1.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-3 | 11/6/2006 | <10.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <1.0 | <2.0 | <2.0 | <1.0 | <1.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MW-3 | 5/22/2007 | <10.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <1.0 | <2.0 | <2.0 | <1.0 | <1.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |

| Well | Date | cis-1,3-Dichloropropene | trans-1,3-Dichloropropene | Ethylbenzene | 2-Hexanone | Methyl bromide | Methyl chloride | Methylene bromide | Methylene chloride | Methyl Ethyl ketone | Methyl iodide | 4-Methyl-2-pentanone | Styrene | 1,1,1,2-Tetrachloroethane | 1,1,2,2-Tetrachloroethane | Tetrachloroethylene | Toluene | 1,1,1-Trichloroethane | 1,1,2-Trichloroethane | Trichloroethylene | Trichlorofluoromethane | 1,2,3-Trichloropropane | Vinyl acetate | Vinyl chloride | Xylenes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-1 | 5/13/2004 | <1.0 | <1.0 | <1.0 | <5.0 | <10.0 | <5.0 | <2.0 | <10.0 | <10.0 | NA | NA | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <5.0 | <1.0 | <10.0 | <5.0 | |
| MW-1 | 9/27/2004 | <1.0 | <1.0 | <1.0 | <5.0 | <10.0 | <5.0 | <2.0 | <10.0 | <10.0 | NA | NA | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <5.0 | <1.0 | <10.0 | <5.0 | |
| MW-1 | 12/30/2004 | <1.0 | <1.0 | <1.0 | <5.0 | <10.0 | <5.0 | <2.0 | <10.0 | <10.0 | NA | <5.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <5.0 | <1.0 | <10.0 | <5.0 | |
| MW-1 | 4/1/2005 | <1.0 | <1.0 | <1.0 | <5.0 | <10.0 | <5.0 | <2.0 | <10.0 | <10.0 | <5.0 | <5.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <5.0 | <1.0 | <10.0 | <5.0 | |
| MW-1 | 1/10/2006 | <1.0 | <1.0 | <1.0 | <2.0 | <2.5 | <2.5 | <2.0 | <2.0 | <10.0 | <2.0 | <2.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <10.0 | <2.0 | |
| MW-1 | 4/6/2006 | <1.0 | <1.0 | <1.0 | <2.0 | <2.5 | <2.5 | <2.0 | <2.0 | <10.0 | <2.0 | <2.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <10.0 | <2.0 | |
| MW-1 | 7/25/2006 | <1.0 | <1.0 | <1.0 | <2.0 | <2.5 | <2.5 | <2.0 | <2.0 | <10.0 | <2.0 | <2.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <10.0 | <2.0 | |
| MW-1 | 11/5/2006 | <1.0 | <1.0 | <1.0 | <2.0 | <2.5 | <2.5 | <2.0 | <2.0 | <10.0 | <2.0 | <2.0 | <1.0 | <1.0 | <1.0 | <1.0 | 3.4 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <10.0 | <2.0 | |
| MW-1 | 5/24/2007 | <1.0 | <1.0 | <1.0 | <2.0 | <2.5 | <2.5 | <2.0 | <2.0 | <10.0 | <2.0 | <2.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <10.0 | <2.0 | <3.0 |
| MW-2 | 5/13/2004 | <1.0 | <1.0 | <1.0 | <5.0 | <10.0 | <5.0 | <2.0 | <10.0 | <10.0 | NA | NA | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <5.0 | <1.0 | <10.0 | <5.0 | |
| MW-2 | 9/29/2004 | <1.0 | <1.0 | <1.0 | <5.0 | <10.0 | <5.0 | <2.0 | <10.0 | <10.0 | NA | NA | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <5.0 | <1.0 | <10.0 | <5.0 | |
| MW-2 | 12/30/2004 | <1.0 | <1.0 | <1.0 | <5.0 | <10.0 | <5.0 | <2.0 | <10.0 | <10.0 | NA | <5.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <5.0 | <1.0 | <10.0 | <5.0 | |
| MW-2 | 4/5/2005 | <1.0 | <1.0 | <1.0 | <5.0 | <10.0 | <5.0 | <2.0 | <10.0 | <10.0 | <5.0 | <5.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <5.0 | <1.0 | <10.0 | <5.0 | |
| MW-2 | 1/10/2006 | <1.0 | <1.0 | <1.0 | <2.0 | <2.5 | <2.5 | <2.0 | <2.0 | <10.0 | <2.0 | <2.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <10.0 | <2.0 | |
| MW-2 | 4/7/2006 | <1.0 | <1.0 | <1.0 | <2.0 | <2.5 | <2.5 | <2.0 | <2.0 | <10.0 | <2.0 | <2.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <10.0 | <2.0 | |
| MW-2 | 7/26/2006 | <1.0 | <1.0 | <1.0 | <2.0 | <2.5 | <2.5 | <2.0 | <2.0 | <10.0 | <2.0 | <2.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <10.0 | <2.0 | |
| MW-2 | 11/5/2006 | <1.0 | <1.0 | <1.0 | <2.0 | <2.5 | <2.5 | <2.0 | <2.0 | <10.0 | <2.0 | <2.0 | <1.0 | <1.0 | <1.0 | <1.0 | 2.8 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <10.0 | <2.0 | |
| MW-2 | 5/22/2007 | <1.0 | <1.0 | <1.0 | <2.0 | <2.5 | <2.5 | <2.0 | <2.0 | <10.0 | <2.0 | <2.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <10.0 | <2.0 | <3.0 |
| MW-3 | 5/12/2004 | <1.0 | <1.0 | <1.0 | <5.0 | <10.0 | <5.0 | <2.0 | <10.0 | <10.0 | NA | NA | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <5.0 | <1.0 | <10.0 | <5.0 | |
| MW-3 | 9/29/2004 | <1.0 | <1.0 | <1.0 | <5.0 | <10.0 | <5.0 | <2.0 | <10.0 | <10.0 | NA | NA | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <5.0 | <1.0 | <10.0 | <5.0 | |
| MW-3 | 12/30/2004 | <1.0 | <1.0 | <1.0 | <5.0 | <10.0 | <5.0 | <2.0 | <10.0 | <10.0 | NA | <5.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <5.0 | <1.0 | <10.0 | <5.0 | |
| MW-3 | 4/5/2005 | <1.0 | <1.0 | <1.0 | <5.0 | <10.0 | <5.0 | <2.0 | <10.0 | <10.0 | <5.0 | <5.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <5.0 | <1.0 | <10.0 | <5.0 | |
| MW-3 | 1/10/2006 | <1.0 | <1.0 | <1.0 | <2.0 | <2.5 | <2.5 | <2.0 | <2.0 | <10.0 | <2.0 | <2.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <10.0 | <2.0 | |
| MW-3 | 4/5/2006 | <1.0 | <1.0 | <1.0 | <2.0 | <2.5 | <2.5 | <2.0 | <2.0 | <10.0 | <2.0 | <2.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <10.0 | <2.0 | |
| MW-3 | 7/25/2006 | <1.0 | <1.0 | <1.0 | <2.0 | <2.5 | <2.5 | <2.0 | <2.0 | <10.0 | <2.0 | <2.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <10.0 | <2.0 | |
| MW-3 | 11/6/2006 | <1.0 | <1.0 | <1.0 | <2.0 | <2.5 | <2.5 | <2.0 | <2.0 | <10.0 | <2.0 | <2.0 | <1.0 | <1.0 | <1.0 | <1.0 | 2.8 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <10.0 | <2.0 | <3.0 |
| MW-3 | 5/22/2007 | <1.0 | <1.0 | <1.0 | <2.0 | <2.5 | <2.5 | <2.0 | <2.0 | <10.0 | <2.0 | <2.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <10.0 | <2.0 | <3.0 |

R:\TEXAS\McCombs\Groundwater Data.xls

# APPENDIX E

# PZ-4 AND PZ-5 BORING LOGS AND WELL COMPLETION DIAGRAMS

# LOG OF PIEZOMETER NO. PZ-4

Project Description: 2011 McCombs Landfill Piezometer Installations

CAREL CORPORATION

Location: McCombs Landfill
Top of PVC El.: 4049.64 feet MSL
Surface El.: 4047.28 feet MSL
Completion Depth: 466 feet
Date Boring Started: 5/26/2011
Date Boring Completed: 6/2/2011

Latitude: 31.988560
Longitude: 106.402142

| Depth, feet | Samples | Symbol/USCS | MATERIAL DESCRIPTION | Piezometer Construction Details | Piezometer Description |
|---|---|---|---|---|---|
| 0–5 | | | SAND, tan, well graded, subangular to angular, fine to cobble grained, dry, loose, some gravel, carbonate cement | | Concrete from surface to 2' bgs |
| 5–10 | | | | | |
| 10–15 | | | SAND, light grayish red brown, well graded, round to subangular, fine to pebble grained, dry, loose, some gravel, some volcanic rock fragments, quartz rich with mafic gravel and volcanic rocks, multicolored grains | | |
| 15–20 | | | | | |
| 20–25 | | | SAND, light reddish brown to brown, poorly graded, rounded, fine grained, dry, loose, quartz rich with mafic minerals, multicolored grains | | |
| 25–30 | | | | | |
| 30–35 | | | | | |
| 35–40 | | | | | |
| 40–45 | | | SANDY GRAVEL, light brown, well graded, round to angular, fine to gravel grained, dry, loose, quartz rich with mafic minerals, multicolored grains | | |
| 45–50 | | | | | |
| 50–55 | | | SAND, dark brown, well graded, fine to pebble grained, dry, loose, and gravel, iron oxide staining, quartz rich with multicolored grains | | |
| 55–60 | | | | | |
| 60–65 | | | SAND, light grayish brown, well graded, round to subangular, fine to pebble grained, dry, loose, and gravel, with volcanic rock fragments, with limestone, quartz rich with multicolored grains | | |
| 65–70 | | | | | |
| 70–75 | | | SAND, light brown, well graded, dry, loose, and gravel, quartz rich with mafic minerals, multicolored grains | | |
| 75–80 | | | | | |
| 80 | | | CLAY, reddish brown, dry | | |
| 80–85 | | | SAND, light brown, well graded, subrounded, fine to medium grained, dry, loose, iron oxide staining, quartz rich with mafic minerals, multicolored grains | | |
| 85–90 | | | | | |
| 90–95 | | | SAND, light brown, well graded, fine to pebble grained, dry, loose, and gravel, quartz rich with mafic minerals, multicolored grains | | |
| 95–100 | | | | | |

STATE OF TEXAS
KEVIN T. CAREL
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#960
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7-19-11

Drilling Contractor: WDC Exploration and Well's
Drilling Method: Air Rotary with Casing Advance
Sampling Method: Cuttings
Geologist: Michael J. Hull, P.G.
Project No.: 10-01-22

| Groundwater Observations | |
|---|---|
| Date | Elevation (ft. MSL) |
| 05/27/11 | 3633.28 |
| 05/31/11 | 3651.28 |
| 06/08/11 | 3650.81 |

Remarks: Speedstar 50K Drilling Rig. 10" diameter boring, 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface.

EL PASO PZS MCCOMBS.GPJ CAREL.GDT 07/19/11

LOG OF PIEZOMETER NO. PZ-4
PAGE 1 of 5

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▼ Water level after drilling.

## LOG OF PIEZOMETER NO. PZ-4

Project Description: 2011 McCombs Landfill Piezometer Installations

Location: McCombs Landfill
Top of PVC El.: 4049.64 feet MSL
Surface El.: 4047.28 feet MSL
Completion Depth: 466 feet
Date Boring Started: 5/26/2011
Date Boring Completed: 6/2/2011
Latitude: 31.988560
Longitude: 106.402142

| Depth, feet | Samples | Symbol/USCS | MATERIAL DESCRIPTION | Piezometer Construction Details | Piezometer Description |
|---|---|---|---|---|---|
| 105 | | | SAND, light reddish brown, poorly graded, rounded, fine grained, moist, loose, quartz rich with multicolored grains | | |
| 110 | | | | | |
| 115 | | | SANDY CLAY, reddish brown, slightly moist | | |
| 120 | | | SAND, light brown, poorly graded, rounded, fine grained, dry, loose, quartz rich with mafic minerals, multicolored grains | | |
| 125 | | | SILTY SAND, light brown, poorly graded, rounded, very fine grained, dry, loose | | |
| 130 | | | SAND, reddish brown, well graded, subangular to subrounded, fine to gravel grained, slightly moist, loose, quartz rich with mafic minerals, multicolored grains | | |
| 135 | | | | | |
| 140 | | | SAND, brown, poorly graded, well rounded, fine grained, dry, loose, quartz rich with mafic minerals, multicolored grains | | |
| 145 | | | | | |
| 150 | | | SAND, brown, well graded, subrounded, medium grained, slightly moist, loose, quartz rich with mafic minerals, multicolored grains | | |
| 155 | | | | | |
| 160 | | | SAND, brown, well graded, subrounded, medium grained, moist, loose, quartz rich with mafic minerals, multicolored grains | | |
| 165 | | | | | |
| 170 | | | CLAY, reddish brown, dry | | |
| 175 | | | SANDY CLAY, reddish brown, well graded, fine to medium grained, dry, loose, with clay lenses, quartz rich with mafic minerals, multicolored grains | | |
| 180 | | | SAND, light brown, poorly graded, rounded, fine grained, dry, loose, quartz rich with mafic minerals, multicolored grains | | |
| 185 | | | | | |
| 190 | | | SILTY CLAY, reddish brown, dry | | |
| 195 | | | SILTY SAND, reddish yellow brown, poorly graded, rounded, very fine grained, dry, loose, quartz rich | | |
| 200 | | | | | |

STATE OF TEXAS
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7-19-11

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary with Casing Advance
Sampling Method: Cuttings
Geologist: Michael J. Hull, P.G.
Project No.: 10-01-22

Groundwater Observations

| Date | Elevation (ft. MSL) |
|---|---|
| 05/27/11 | 3633.28 |
| 05/31/11 | 3651.28 |
| 06/08/11 | 3650.81 |

Remarks: Speedstar 50K Drilling Rig. 10" diameter boring. 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface.

EL PASO PZS MCCOMBS.GPJ CAREL.GDT 07/19/11



The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▼ Water level after drilling.

# LOG OF PIEZOMETER NO. PZ-4

Project Description: 2011 McCombs Landfill Piezometer Installations

Location: McCombs Landfill
Top of PVC El.: 4049.64 feet MSL
Surface El.: 4047.28 feet MSL
Completion Depth: 466 feet
Date Boring Started: 5/26/2011
Date Boring Completed: 6/2/2011
Latitude: 31.988560
Longitude: 106.402142

| Depth, feet | Samples | Symbol/USCS | MATERIAL DESCRIPTION | Piezometer Construction Details | Piezometer Description |
|---|---|---|---|---|---|
| 205 | | | SILTY SAND, reddish yellow brown, poorly graded, rounded, very fine grained, dry, loose, quartz rich | | |
| 210 | | | SANDY GRAVEL, light grayish brown, well graded, round to subangular, fine to pebble grained, dry, loose, quartz rich with mafic minerals, multicolored grains | | |
| 215 | | | | | |
| 220 | | | SANDY CLAY, reddish brown, dry | | |
| 225 | | | SILTY SAND, light brown, poorly graded, rounded, very fine grained, dry, loose | | |
| 230 | | | CLAY, reddish brown, slightly moist, with sand, and silt | | |
| 235 | | | | | |
| 240 | | | | | |
| 245 | | | SAND, light reddish brown, well graded, subangular to subrounded, fine to pebble grained, dry, loose, quartz rich with mafic minerals, multicolored grains | | |
| 250 | | | SAND, light reddish brown, well graded, subrounded to angular, medium to coarse grained, dry, loose, and gravel, with clay lenses, quartz rich with mafic minerals, multicolored grains | | Bentonite grout from 2' to 403' bgs |
| 255 | | | | | |
| 260 | | | | | |
| 265 | | | | | |
| 270 | | | SAND, light gray, well graded, rounded to subrounded, fine to medium grained, dry, loose, quartz rich with multicolored grains | | |
| 275 | | | | | |
| 280 | | | SAND, well graded, rounded, very fine to medium grained, dry, loose, and silt, quartz rich with mafic minerals, multicolored grains | | |
| 285 | | | | | |
| 290 | | | | | |
| 295 | | | thin red-brown clay lense at 295' bgs | | |
| 300 | | | | | |

STATE OF TEXAS
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7-19-11

| | |
|---|---|
| Drilling Contractor: | WDC Exploration and Wells |
| Drilling Method: | Air Rotary with Casing Advance |
| Sampling Method: | Cuttings |
| Geologist: | Michael J. Hull, P.G. |
| Project No.: | 10-01-22 |

| Groundwater Observations | |
|---|---|
| Date | Elevation (ft. MSL) |
| 05/27/11 | 3633.28 |
| 05/31/11 | 3651.28 |
| 06/08/11 | 3650.81 |

Remarks: Speedstar 50K Drilling Rig. 10" diameter boring. 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface.

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The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▼ Water level after drilling.

## LOG OF PIEZOMETER NO. PZ-4

Project Description: 2011 McCombs Landfill Piezometer Installations

CAREL CORPORATION

Location: McCombs Landfill
Top of PVC El.: 4049.64 feet MSL
Surface El.: 4047.28 feet MSL
Completion Depth: 466 feet
Date Boring Started: 5/26/2011
Date Boring Completed: 6/2/2011
Latitude: 31.988560
Longitude: 106.402142

| Depth, feet | Samples | Symbol/USCS | MATERIAL DESCRIPTION | Piezometer Construction Details | Piezometer Description |
|---|---|---|---|---|---|
| 305 | | | SAND, light brown, well graded, fine to pebble grained, dry, loose, with gravel, quartz rich with mafic minerals, multicolored grains | | |
| | | | CLAY, reddish brown, dry | | |
| 310 | | | SILTY SAND, light reddish brown, poorly graded, rounded, dry, loose | | |
| 315 | | | SAND, light grayish brown, well graded, subangular to subrounded, fine to pebble grained, dry, loose, with gravel, quartz rich with mafic minerals, multicolored grains | | |
| 320 | | | | | |
| 325 | | | SILTY SAND, light brown to light grayish brown, poorly graded, rounded, very fine grained, dry, loose, quartz rich | | |
| 330 | | | | | |
| 335 | | | SILTY CLAY, reddish brown, dry, hard, calcite cement | | |
| 340 | | | SAND, light reddish brown, poorly graded, rounded to subrounded, fine to medium grained, dry, loose, with clay lenses, iron oxide staining, quartz rich with multicolored grains | | |
| 345 | | | | | |
| 350 | | | SAND, light grayish brown, well graded, subangular to subrounded, fine to pebble grained, dry, loose, with gravel, quartz rich with mafic minerals, multicolored grains | | |
| 355 | | | | | |
| 360 | | | | | |
| 365 | | | ARKOSIC SAND, light grayish brown, poorly graded, rounded, fine grained, dry, loose, quartz rich with feldspar and mafic minerals, multicolored grains | | |
| 370 | | | ARKOSIC SAND, light grayish brown, well graded, subangular to subrounded, fine to pebble grained, dry, loose, with gravel, quartz rich with feldspar and mafic minerals, multicolored grains | | |
| 375 | | | | | |
| 380 | | | GRAVEL, grayish brown, well graded, dry, with volcanic rock fragments, with limestone, Volcanic | | |
| 385 | | | SAND, light grayish brown, poorly graded, rounded, fine grained, slightly moist, loose, quartz rich with mafic minerals, multicolored grains | | |
| 390 | | | SAND, light grayish brown, well graded, subrounded, medium grained, slightly moist, loose, quartz rich with mafic minerals, multicolored grains | | |
| 395 | | | moist at 399' bgs | | |
| 400 | | | | | |

STATE OF TEXAS
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7-19-11

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary with Casing Advance
Sampling Method: Cuttings
Geologist: Michael J. Hull, P.G.
Project No.: 10-01-22

| Groundwater Observations | |
|---|---|
| Date | Elevation (ft. MSL) |
| 05/27/11 | 3633.28 |
| 05/31/11 | 3651.28 |
| 06/08/11 | 3650.81 |

Remarks: Speedstar 50K Drilling Rig. 10" diameter boring. 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface.

EL PASO PZS MCCOMBS.GPJ CAREL.GDT 07/19/11

LOG OF PIEZOMETER NO. PZ-4
PAGE 4 of 5

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▼ Water level after drilling.

# LOG OF PIEZOMETER NO. PZ-4

Project Description: 2011 McCombs Landfill Piezometer Installations

CAREL CORPORATION

Location: McCombs Landfill
Top of PVC El.: 4049.64 feet MSL
Surface El.: 4047.28 feet MSL
Completion Depth: 466 feet
Date Boring Started: 5/26/2011
Date Boring Completed: 6/2/2011
Latitude: 31.988560
Longitude: 106.402142

| Depth, feet | Samples | Symbol/USCS | MATERIAL DESCRIPTION | Piezometer Construction Details | Piezometer Description |
|---|---|---|---|---|---|
| 405 | | | SAND, light reddish brown, fine to medium grained, dry, loose | | Hydrated bentonite seal from 403' to 408' bgs |
| | | | CLAY, reddish brown, moist | | |
| 410 | | | SAND, light reddish brown, well graded, subrounded, medium grained, dry, loose, quartz rich with multicolored grains<br>moist to slightly wet at 414' bgs | | 10/20 Silica sand from 408' to 466' bgs |
| 415 | | | Adding water to hole from 418' bgs to total depth | | |
| 420 | | | SAND, brown, well graded, subrounded, medium grained, wet, loose, quartz rich with mafic minerals, multicolored grains | | |
| 425 | | | SAND, brown, well graded, medium to gravel grained, wet, loose, and gravel, some clay lenses, quartz rich with mafic minerals, multicolored grains | | |
| 430 | | | SILTY SAND, light brown, well graded, rounded to subrounded, very fine to medium grained, wet, loose, quartz rich with mafic minerals, multicolored grains | | 0.01" Slotted screen from 413' to 463' bgs |
| 435 | | | CLAY, reddish brown | | |
| 440 | | | SAND, light brown, well graded, rounded to subrounded, fine to coarse grained, loose, iron oxide staining, quartz rich with mafic minerals, multicolored grains | | |
| 445 | | | SAND, light brown, poorly graded, rounded to subrounded, very fine to fine grained, loose, iron oxide staining, quartz rich with mafic minerals, multicolored grains | | |
| 450 | | | SAND, light brown to blue, poorly graded, subrounded, medium grained, wet, loose, iron oxide staining, quartz rich with mafic minerals, multicolored grains | | Two foot sediment trap |
| 455 | | | | | |
| 460 | | | | | |
| 465 | | | | | |
| 470 | | | | | |
| 475 | | | | | |
| 480 | | | | | |
| 485 | | | | | |
| 490 | | | | | |
| 495 | | | | | |
| 500 | | | | | |

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7-19-11

EL PASO PZS MCCOMBS GPJ CAREL GDT 07/19/11

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary with Casing Advance
Sampling Method: Cuttings
Geologist: Michael J. Hull, P.G.
Project No.: 10-01-22

| Groundwater Observations | |
|---|---|
| Date | Elevation (ft. MSL) |
| 05/27/11 | 3633.28 |
| 05/31/11 | 3651.28 |
| 06/08/11 | 3650.81 |

Remarks: Speedstar 50K Drilling Rig. 10" diameter boring. 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface.

LOG OF PIEZOMETER NO. PZ-4
PAGE 5 of 5

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▼ Water level after drilling.

# Monitor Well Data Sheet

Permittee or Site Name: McCombs Landfill
County: El Paso County
Date of Monitor Well Installation: June 1, 2011
Latitude: 31°59'18.81720" Longitude: 106°23'53.84750"
Monitor Well Groundwater Gradient Position:
Upgradient: _____ Downgradient: _____

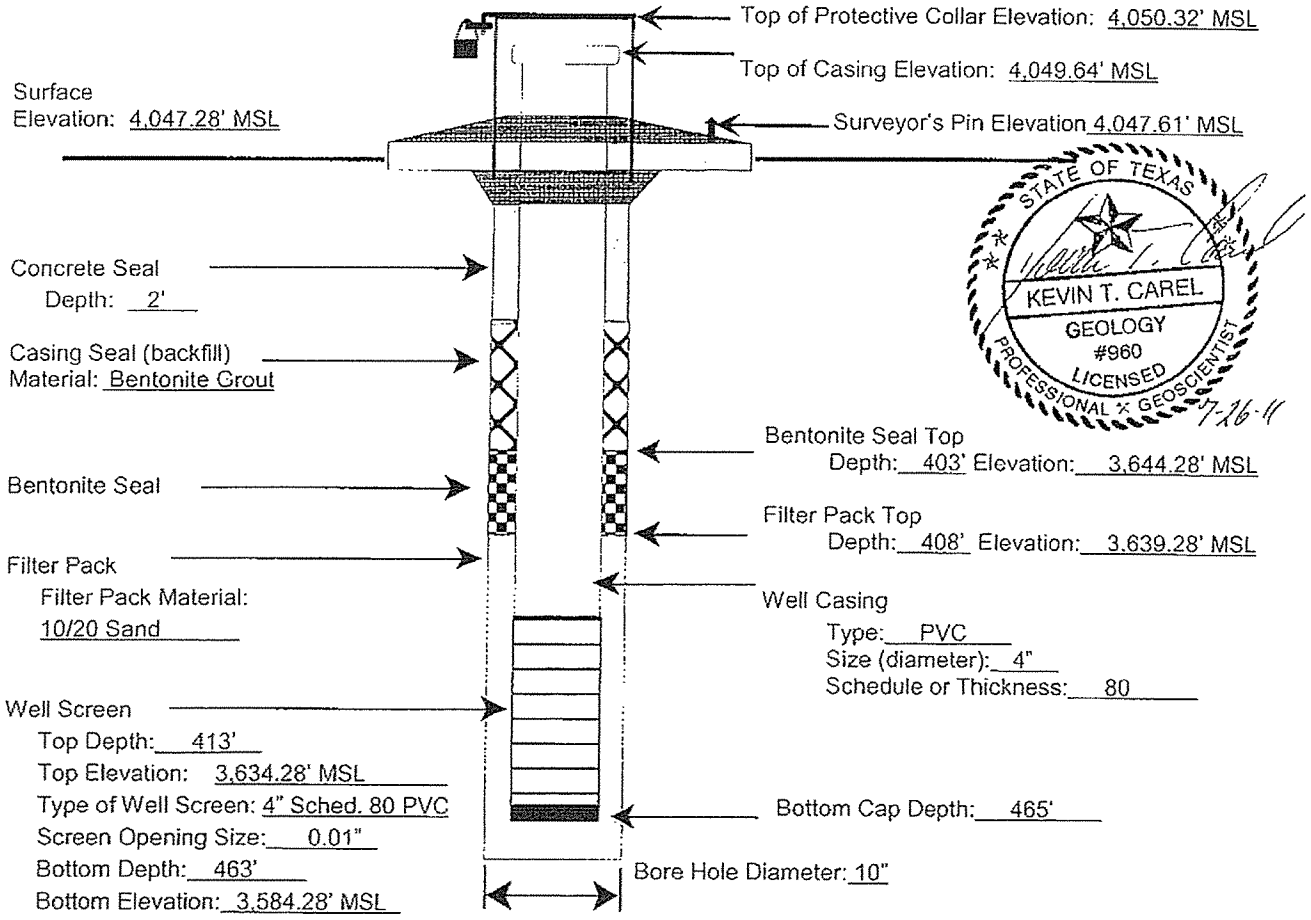
MSW Permit No.: 729A
Monitor Well I.D. No.: PZ-4
Date of Monitor Well Development: June 8, 2011
Monitor Well Driller
Name: William B. Bludworth
License No. 4885

NOTES:

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to nearest hundredth of a foot.
- Diameter of boring should be at least 4 inches larger than diameter of well casing.
- Use flush screw joint casing only, 2-inch diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommend).
- Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist, or Engineer Supervising Well Installation: Michael J. Hull, PG
Static Water Level Elevation (with respect to MSL) after Well Development: 3,650.81' MSL
Name of Geologic Formation(s) in which Well is completed: Hueco Bolson

Type of Locking Device: Pad Lock Type of Casing Protection: 6" x 6" x 5' Steel
Concrete Surface Pad (with steel reinforcement) Dimensions: 4' x 4' x 6"




TCEQ-10308

# LOG OF PIEZOMETER NO. PZ-5

Project Description: 2011 McCombs Landfill Piezometer Installations

CAREL CORPORATION

Location: McCombs Landfill
Top of PVC El.: 4061.05 feet MSL
Surface El.: 4058.44 feet MSL
Completion Depth: 441 feet
Date Boring Started: 5/23/2011
Date Boring Completed: 5/25/2011
Latitude: 31.991463
Longitude: 106.398291

| Depth, feet | Samples | Symbol/USCS | MATERIAL DESCRIPTION | Piezometer Construction Details | Piezometer Description |
|---|---|---|---|---|---|
| 0 | | | SAND, light reddish brown, well graded, subangular to subrounded, very fine to cobble grained, dry, loose, with gravel, quartz rich with feldspar and mafic minerals, multicolored grains | | Concrete from surface to 2' bgs |
| 40 | | | SAND, light reddish brown, well graded, coarse to cobble grained, dry, loose, with gravel, quartz rich with feldspar and mafic minerals, multicolored grains | | |
| 45 | | | SILTY CLAY, reddish brown, dry | | |
| 50 | | | SAND, light reddish brown, well graded, subangular to subrounded, fine to pebble grained, dry, loose, with gravel, iron oxide staining, quartz rich with feldspar and mafic minerals, multicolored grains | | |
| 60 | | | GRAVEL, brown, coarse to cobble grained, dry, loose | | |
| 65 | | | CLAY, light reddish brown, dry | | |
| 70 | | | SAND, light reddish brown, well graded, subangular to subrounded, fine to pebble grained, dry, loose | | |
| 75 | | | SAND, light reddish brown, well graded, subangular to subrounded, fine to coarse grained, dry, quartz rich, multicolored grains | | |
| 80 | | | SANDY CLAY, light reddish brown, dry, with silt | | |
| 85 | | | SAND, light brown, well graded, subrounded, fine to medium grained, dry, loose, iron oxide staining, quartz rich with feldspar and mafic minerals, multicolored grains | | |
| 90 | | | CLAY, dry | | |
| 95 | | | SAND, light grayish brown, well graded, subrounded, very fine to fine grained, dry, loose, iron oxide staining, quartz rich with feldspar and mafic minerals, multicolored grains | | |
| 100 | | | | | |

STATE OF TEXAS
KEVIN T. CAREL
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7-19-11

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary with Casing Advance
Sampling Method: Cuttings
Geologist: Michael J. Hull, P.G.
Project No.: 10-01-22

| Groundwater Observations | |
|---|---|
| Date | Elevation (ft. MSL) |
| 05/24/11 | 3652.44 |
| 06/07/11 | 3653.97 |

Remarks: Speedstar 50K Drilling Rig. 10" diameter boring, 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface. Casing hammer continuous from 44' bgs to total depth.

EL PASO PZS MCCOMBS GPJ CAREL GDT 07/19/11

LOG OF PIEZOMETER NO. PZ-5
PAGE 1 of 5

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

Water level at time of drilling.
Water level at end of drilling.
Water level after drilling.

# LOG OF PIEZOMETER NO. PZ-5

Project Description: 2011 McCombs Landfill Piezometer Installations

The CAREL Corporation

Location: McCombs Landfill
Top of PVC El.: 4061.05 feet MSL
Surface El.: 4058.44 feet MSL
Completion Depth: 441 feet
Date Boring Started: 5/23/2011
Date Boring Completed: 5/25/2011

Latitude: 31.991463
Longitude: 106.398291

| Depth, feet | Samples | Symbol/USCS | MATERIAL DESCRIPTION | Piezometer Construction Details | Piezometer Description |
|---|---|---|---|---|---|
| 105 | | | SAND, light brown, well graded, subrounded, fine to medium grained, dry, loose, quartz rich with mafic minerals, multicolored grains | | |
| 110 | | | | | |
| 115 | | | SAND, light gray, well graded, subangular to subrounded, fine to pebble grained, dry, loose, with gravel, quartz rich with mafic minerals, multicolored grains | | |
| 120 | | | | | |
| 125 | | | | | |
| 130 | | | | | |
| 135 | | | | | |
| 140 | | | CLAY, reddish brown, dry | | |
| 145 | | | SAND, light gray, well graded, subangular to subrounded, fine to pebble grained, dry, loose, with volcanic rock fragments, and limestone, quartz rich with mafic minerals and limestone gravel fragments, multicolored grains | | |
| 150 | | | SAND, light grayish brown, poorly graded, rounded, fine grained, dry, loose, quartz rich with mafic minerals, multicolored grains | | |
| 155 | | | | | |
| 160 | | | SILTY SAND, light grayish brown, poorly graded, rounded, fine grained, dry, loose, Quartz Sand | | |
| 165 | | | | | |
| 170 | | | | | |
| 175 | | | | | |
| 180 | | | SILTY SAND, reddish brown, well graded, round to subangular, very fine to cobble grained, dry, loose, with limestone, Quartz Sand with limestone gravel fragments | | |
| 185 | | | | | |
| 190 | | | CLAY, reddish brown, dry | | |
| 195 | | | | | |
| 200 | | | SAND, light reddish brown, poorly graded, subrounded, fine to medium grained, dry, loose, | | |

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST

7-19-11

EL PASO PZS-MCCOMBS.GPJ CAREL.GDT 07/19/11

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary with Casing Advance
Sampling Method: Cuttings
Geologist: Michael J. Hull, P.G.
Project No.: 10-01-22

| Groundwater Observations | |
|---|---|
| Date | Elevation (ft. MSL) |
| 05/24/11 | 3652.44 |
| 06/07/11 | 3653.97 |

Remarks: Speedstar 50K Drilling Rig. 10" diameter boring, 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface. Casing hammer continuous from 44' bgs to total depth.



The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▼ Water level after drilling.

# LOG OF PIEZOMETER NO. PZ-5

Project Description: 2011 McCombs Landfill Piezometer Installations

CAREL CORPORATION

Location: McCombs Landfill
Top of PVC El.: 4061.05 feet MSL
Surface El.: 4058.44 feet MSL
Completion Depth: 441 feet
Date Boring Started: 5/23/2011
Date Boring Completed: 5/25/2011
Latitude: 31.991463
Longitude: 106.398291

| Depth, feet | Samples | Symbol/USCS | MATERIAL DESCRIPTION | Piezometer Construction Details | Piezometer Description |
|---|---|---|---|---|---|
| 205 | | | quartz rich with mafic minerals, multicolored grains<br>SAND, reddish brown, well graded, subrounded, fine grained, slightly moist, loose, quartz rich with mafic minerals, multicolored grains | | |
| 210 | | | SAND, light grayish brown, well graded, fine to medium grained, dry, loose, Quartz Sand | | |
| 215 | | | | | |
| 220 | | | | | |
| 225 | | | SANDY GRAVEL, light grayish brown, well graded, subangular to well rounded, fine to pebble grained, dry, loose, with volcanic rock fragments, Quartz Sand | | |
| 230 | | | SAND, light grayish brown, well graded, subrounded, fine to medium grained, dry, loose, iron oxide staining, quartz rich with mafic minerals, multicolored grains | | |
| 235 | | | | | |
| 240 | | | | | |
| 245 | | | | | |
| 250 | | | SAND, light grayish brown, poorly graded, rounded, very fine to fine grained, dry, loose, quartz rich with mafic minerals, multicolored grains | | Bentonite grout from 2' to 408' bgs |
| 255 | | | | | |
| 260 | | | | | |
| 265 | | | | | |
| 270 | | | | | |
| 275 | | | | | |
| 280 | | | | | |
| 285 | | | | | |
| 290 | | | SAND, light brown, well graded, subrounded, fine to medium grained, dry, loose, Quartz Sand | | |
| 295 | | | | | |
| 300 | | | | | |

STATE OF TEXAS
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GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST
7-19-11

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary with Casing Advance
Sampling Method: Cuttings
Geologist: Michael J. Hull, P.G.
Project No.: 10-01-22

Groundwater Observations

| Date | Elevation (ft. MSL) |
|---|---|
| 05/24/11 | 3652.44 |
| 06/07/11 | 3653.97 |
| | |

Remarks: Speedstar 50K Drilling Rig. 10" diameter boring, 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface. Casing hammer continuous from 44' bgs to total depth.

EL PASO PZS MCCOMBS.GPJ CAREL.GDT 07/19/11

LOG OF PIEZOMETER NO. PZ-5
PAGE 3 of 5

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

Water level at time of drilling.
Water level at end of drilling.
Water level after drilling.

# LOG OF PIEZOMETER NO. PZ-5

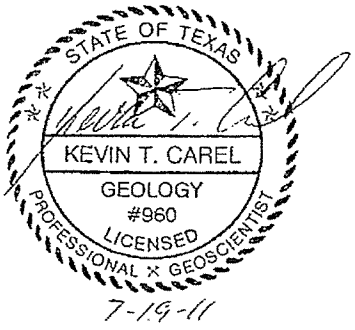
Project Description: 2011 McCombs Landfill Piezometer Installations

CAREL EXPLORATION

Location: McCombs Landfill
Top of PVC El.: 4061.05 feet MSL
Surface El.: 4058.44 feet MSL
Completion Depth: 441 feet
Date Boring Started: 5/23/2011
Date Boring Completed: 5/25/2011

Latitude: 31.991463
Longitude: 106.398291

| Depth, feet | Samples | Symbol/USCS | MATERIAL DESCRIPTION | Piezometer Construction Details | Piezometer Description |
|---|---|---|---|---|---|
| 305 | | | SAND, light brown, well graded, subangular to subrounded, fine to pebble grained, slightly moist, loose, and gravel, Quartz Sand with Limestone Gravel | | |
| 310 | | | SAND, reddish brown, poorly graded, very fine grained, dry, loose, Quartz Sand | | |
| 315 | | | SANDY SILT, light brown, poorly graded, rounded, very fine grained, dry, loose | | |
| 320 | | | | | |
| 325 | | | SAND, light grayish brown, well graded, subangular to subrounded, fine to pebble grained, dry, loose, and volcanic rock fragments, and limestone, Quartz Sand with limestone and granite gravel fragments | | |
| 330 | | | CLAY, reddish brown, dry | | |
| 335 | | | SILTY SAND, reddish brown, poorly graded, rounded, dry, loose, iron oxide staining, Quartz Sand | | |
| 340 | | | SAND, light tannish brown, well graded, fine to pebble grained, slightly moist, loose, with gravel, Quartz Sand | | |
| 345 | | | CLAY, reddish brown, dry, calcareous | | |
| 350 | | | | | |
| 355 | | | | | |
| 360 | | | | | |
| 365 | | | SANDY CLAY, reddish brown, dry | | |
| 370 | | | ARKOSIC SAND, light reddish brown, well graded, rounded to subrounded, very fine to fine grained, dry, loose, quartz rich with mafic minerals, multicolored grains | | |
| 375 | | | | | |
| 380 | | | SAND, light reddish brown, well graded, subangular to subrounded, very fine to coarse grained, dry, loose, quartz rich with feldspar and mafic minerals, multicolored grains | | |
| 385 | | | SILTY CLAY, reddish brown, moist | | |
| 390 | | | CLAY, reddish brown, dry | | |
| 395 | | | SAND, reddish brown, poorly graded, rounded, fine grained, dry, loose | | |
| 400 | | | CLAY, reddish brown, slightly moist | | |




7-19-11

| | |
|---|---|
| Drilling Contractor: | WDC Exploration and Wells |
| Drilling Method: | Air Rotary with Casing Advance |
| Sampling Method: | Cuttings |
| Geologist: | Michael J. Hull, P.G. |
| Project No.: | 10-01-22 |

Groundwater Observations

| Date | Elevation (ft. MSL) |
|---|---|
| 05/24/11 | 3652.44 |
| 06/07/11 | 3653.97 |

Remarks: Speedstar 50K Drilling Rig. 10" diameter boring, 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface. Casing hammer continuous from 44' bgs to total depth.

EL PASO PZS MCCOMBS.GPJ CAREL.GDT 07/19/11



The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▼ Water level after drilling.

# LOG OF PIEZOMETER NO. PZ-5

Project Description: 2011 McCombs Landfill Piezometer Installations

CAREL Corporation

Location: McCombs Landfill
Top of PVC El.: 4061.05 feet MSL
Surface El.: 4058.44 feet MSL
Completion Depth: 441 feet
Date Boring Started: 5/23/2011
Date Boring Completed: 5/25/2011

Latitude: 31.991463
Longitude: 106.398291

| Depth, feet | Samples | Symbol/USCS | MATERIAL DESCRIPTION | Piezometer Construction Details | Piezometer Description |
|---|---|---|---|---|---|
| 405 | | | SAND, reddish brown, poorly graded, rounded, fine grained, dry, loose, Quartz Sand | | |
| | | | CLAY, reddish brown, moist | | |
| 410 | | | SAND, reddish brown, poorly graded, rounded, fine grained, moist, loose wet at 406' bgs | | Hydrated bentonite seal from 408' to 413' bgs |
| 415 | | | SAND, brown, poorly graded, rounded, fine grained, wet, loose, quartz rich with mafic minerals, multicolored grains | | 10/20 Silica sand from 413' to 441' bgs |
| 420 | | | SAND, light brown, well graded, subrounded to angular, fine to coarse grained, wet, loose, quartz rich with mafic minerals, multicolored grains | | |
| 425 | | | | | 0.01" Slotted screen from 418' to 438' bgs |
| 430 | | | SAND, brown, poorly graded, rounded, fine grained, loose, Quartz Sand | | |
| 435 | | | SAND, brown, well graded, round to subangular, fine to pebble grained, loose, and volcanic rock fragments, and limestone, Quartz Sand with mafic minerals, limestone and granite gravel fragments, multicolored grains | | Two foot sediment trap |
| 440 | | | CLAY, reddish brown | | |
| 445 | | | | | |
| 450 | | | | | |
| 455 | | | | | |
| 460 | | | | | |
| 465 | | | | | |
| 470 | | | | | |
| 475 | | | | | |
| 480 | | | | | |
| 485 | | | | | |
| 490 | | | | | |
| 495 | | | | | |
| 500 | | | | | |

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST

7-19-11

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary with Casing Advance
Sampling Method: Cuttings
Geologist: Michael J. Huil, P.G.
Project No.: 10-01-22

| Groundwater Observations | |
|---|---|
| Date | Elevation (ft. MSL) |
| 05/24/11 | 3652.44 |
| 06/07/11 | 3653.97 |
| | |

Remarks: Speedstar 50K Drilling Rig. 10" diameter boring, 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface. Casing hammer continuous from 44' bgs to total depth.

'EL PASO PZS MCCOMBS.GPJ CAREL.GDT 07/19/11

LOG OF PIEZOMETER NO. PZ-5
PAGE 5 of 5

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▽ Water level after drilling.

# Monitor Well Data Sheet

Permittee or Site Name: McCombs Landfill
County: El Paso County
Date of Monitor Well Installation: May 25, 2011
Latitude: 31°59'29.26715" Longitude: 106°23'53.84750"
Monitor Well Groundwater Gradient Position:
Upgradient: _____ Downgradient: _____

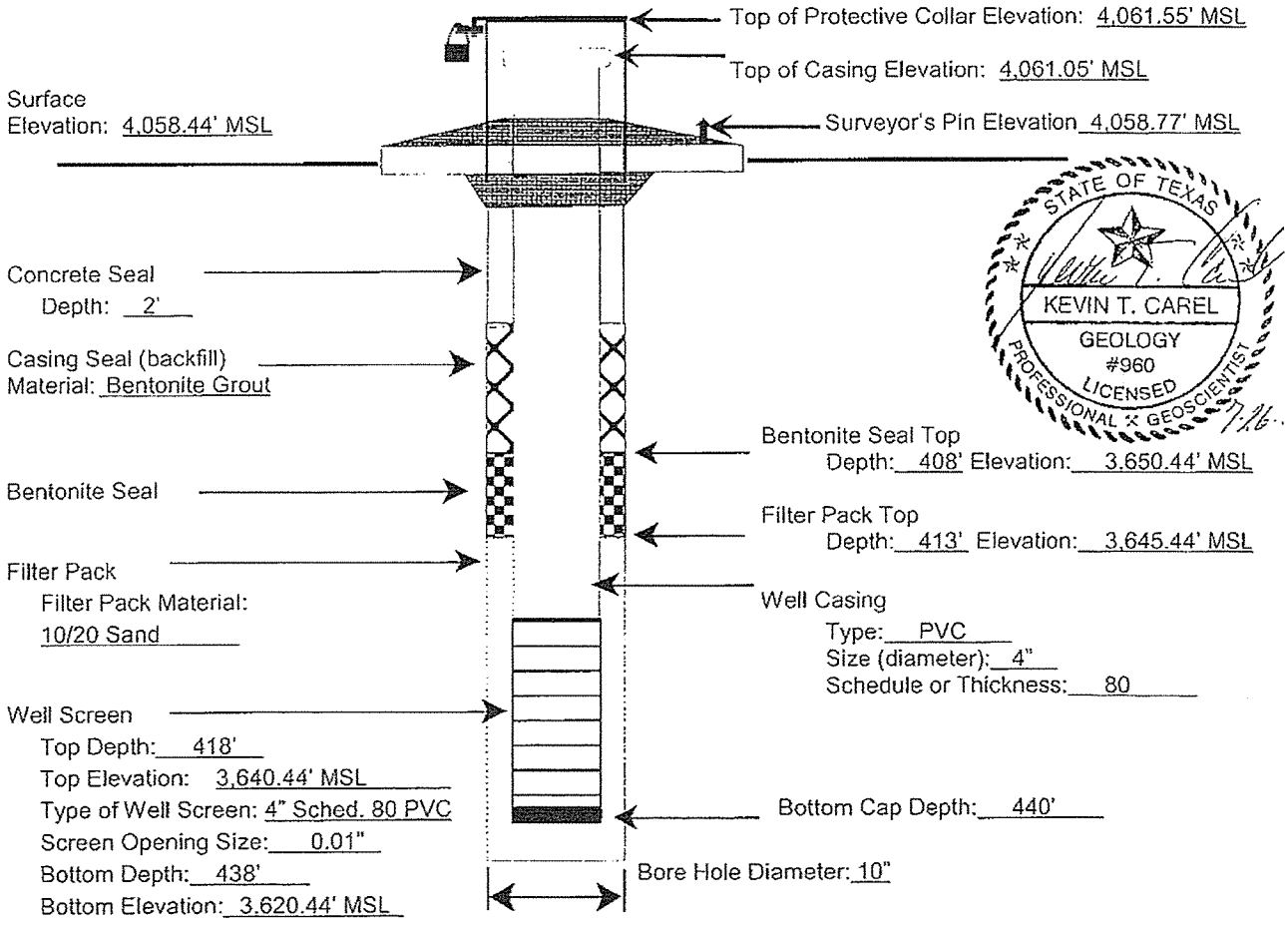
MSW Permit No.: 729A
Monitor Well I.D. No.: PZ-5
Date of Monitor Well Development: June 7, 2011
Monitor Well Driller
Name: William B. Bludworth
License No. 4885

NOTES:

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to nearest hundredth of a foot.
- Diameter of boring should be at least 4 inches larger than diameter of well casing.
- Use flush screw joint casing only, 2-inch diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommend).
- Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist, or Engineer Supervising Well Installation: Michael J. Hull, PG
Static Water Level Elevation (with respect to MSL) after Well Development: 3,653.97' MSL
Name of Geologic Formation(s) in which Well is completed: Hueco Bolson

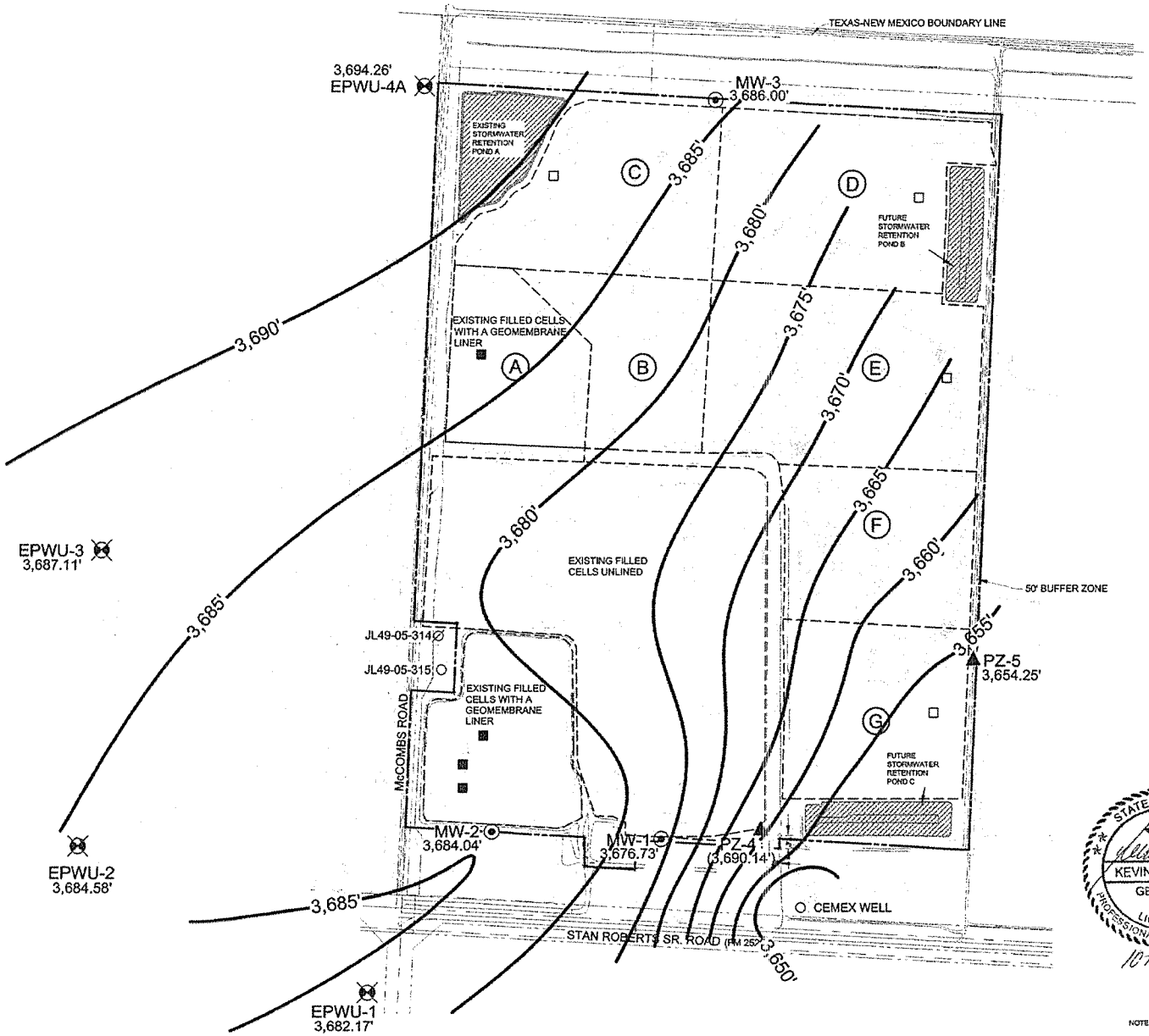
Type of Locking Device: Pad Lock Type of Casing Protection: 6" x 6" x 5' Steel
Concrete Surface Pad (with steel reinforcement) Dimensions: 4' x 4' x 6"




TCEQ-10308

# APPENDIX F

# GROUNDWATER CONTOUR MAPS, AUGUST 2011 TO JULY 2012

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SCALE
0 300 600
FEET

# GROUNDWATER CONTOUR MAP 08/03/2011

CITY OF EL PASO
GROUNDWATER PERMIT MODIFICATIONS FOR McCOMBS LANDFILL

7969 SAN PAULO DRIVE
EL PASO, TEXAS 79907

LEGEND:

- PROPERTY\PERMIT BOUNDARY
- EXISTING LEACHATE COLLECTION SUMP
- FUTURE LEACHATE COLLECTION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- EPWU MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL
- NM NOT MEASURED/OBSTRUCTED
- PIEZOMETER
- FUTURE GROUNDWATER MONITORING WELL
- (E) SECTOR DENOMINATION
- SECTOR BOUNDARY

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
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10/6/12

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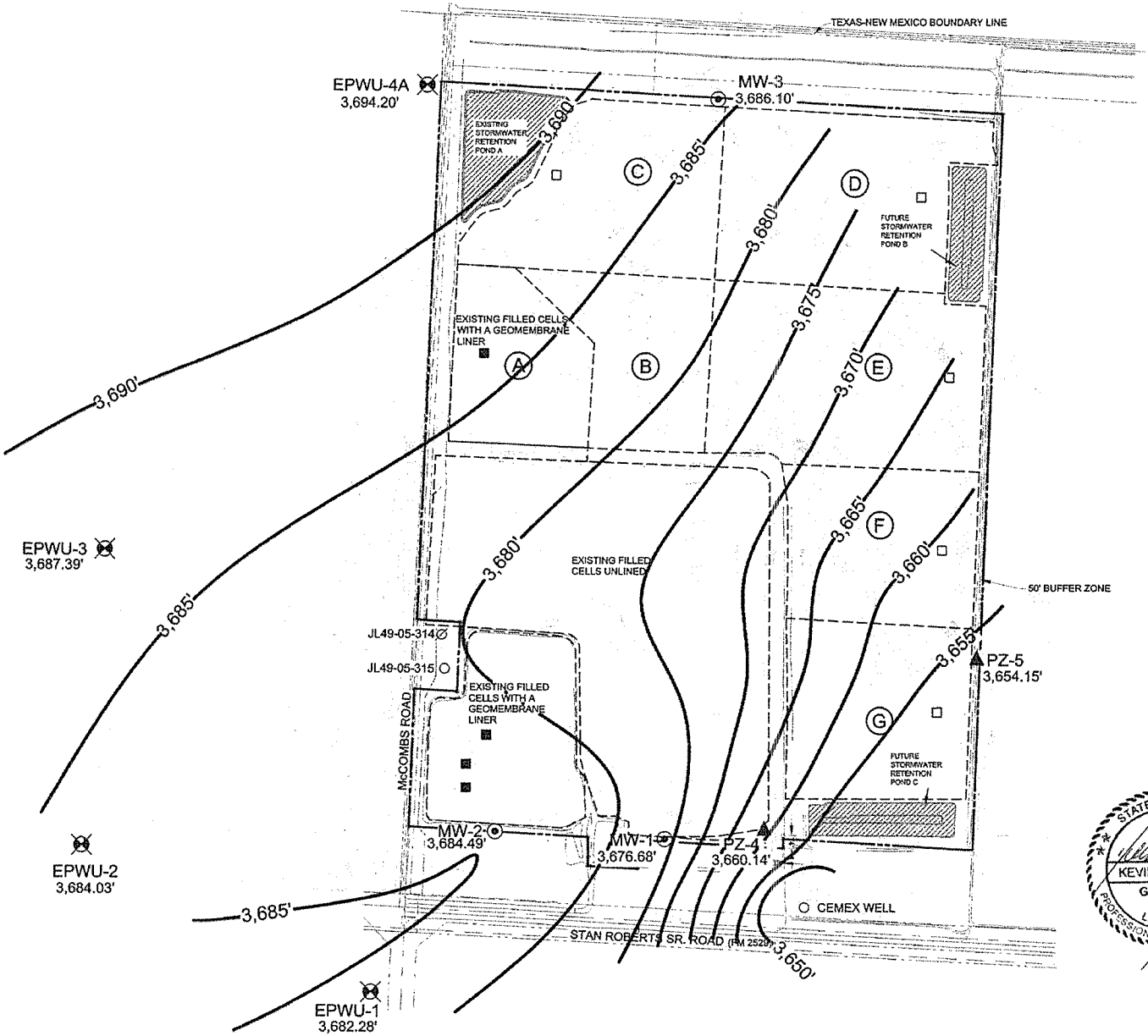
FIGURE: F-1

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**GROUNDWATER CONTOUR MAP 09/01/2011**

THE CITY OF EL PASO TEXAS

**CITY OF EL PASO GROUNDWATER PERMIT MODIFICATIONS FOR McCOMBS LANDFILL**

**7969 SAN PAULO DRIVE EL PASO, TEXAS 79907**

LEGEND:

- PROPERTY\PERMIT BOUNDARY
- EXISTING LEACHATE COLLECTION SUMP
- FUTURE LEACHATE COLLECTION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- EPWU MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL
- NM NOT MEASURED/OBSTRUCTED
- PIEZOMETER
- FUTURE GROUNDWATER MONITORING WELL
- (E) SECTOR DENOMINATION
- SECTOR BOUNDARY

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
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PROFESSIONAL GEOSCIENTIST
10/16/12

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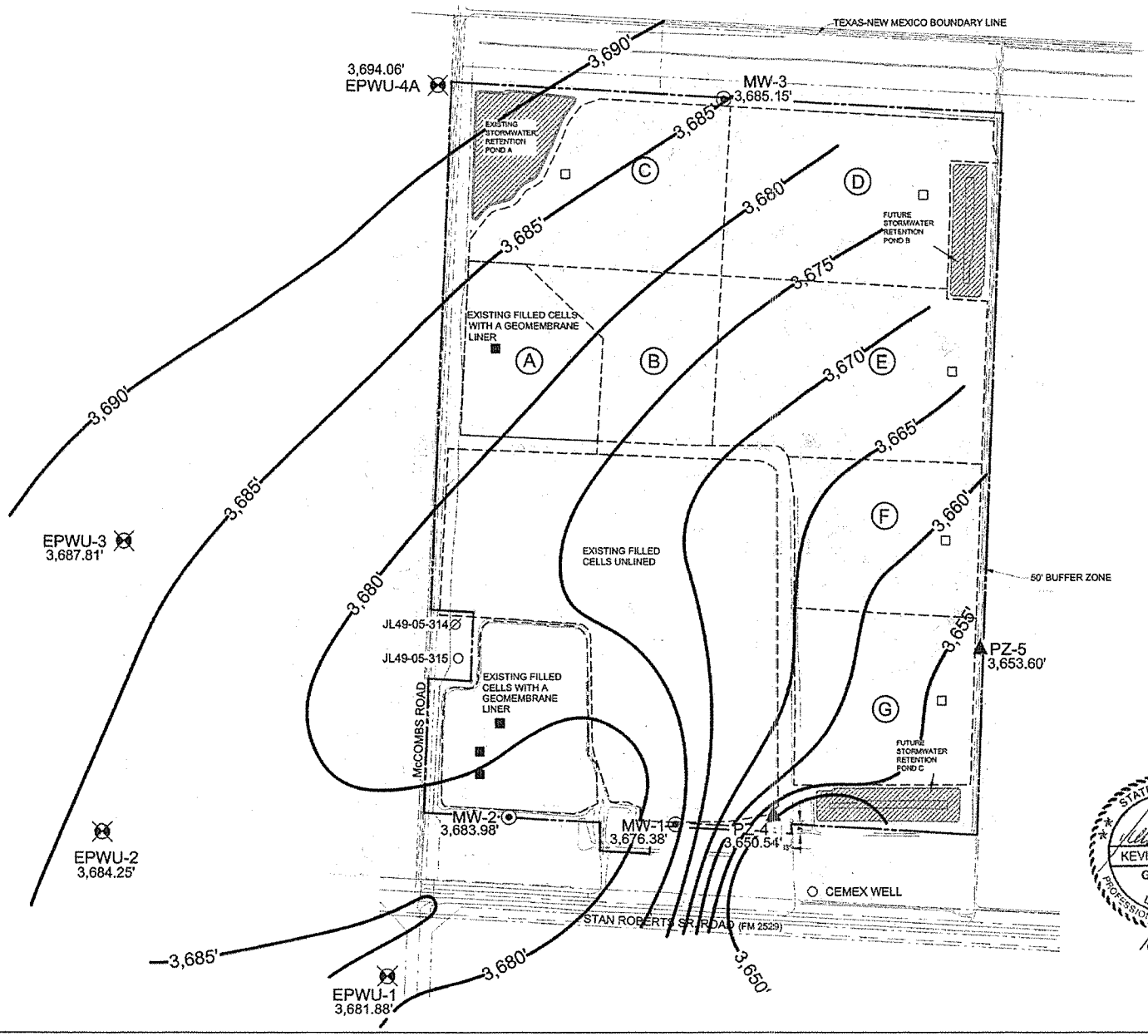
FIGURE: **F-2**





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# GROUNDWATER CONTOUR MAP 10/03/2011

THE CITY OF EL PASO TEXAS

**CITY OF EL PASO**
**GROUNDWATER PERMIT MODIFICATIONS FOR McCOMBS LANDFILL**

7969 SAN PAULO DRIVE
EL PASO, TEXAS 79907

LEGEND:

- PROPERTY\PERMIT BOUNDARY
- EXISTING LEACHATE COLLECTION SUMP
- FUTURE LEACHATE COLLECTION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- EPWU MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL
- NM NOT MEASURED/OBSTRUCTED
- PIEZOMETER
- FUTURE GROUNDWATER MONITORING WELL
- (E) SECTOR DENOMINATION
- SECTOR BOUNDARY

N

STATE OF TEXAS
KEVIN T. CAREL
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#960
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10/16/12

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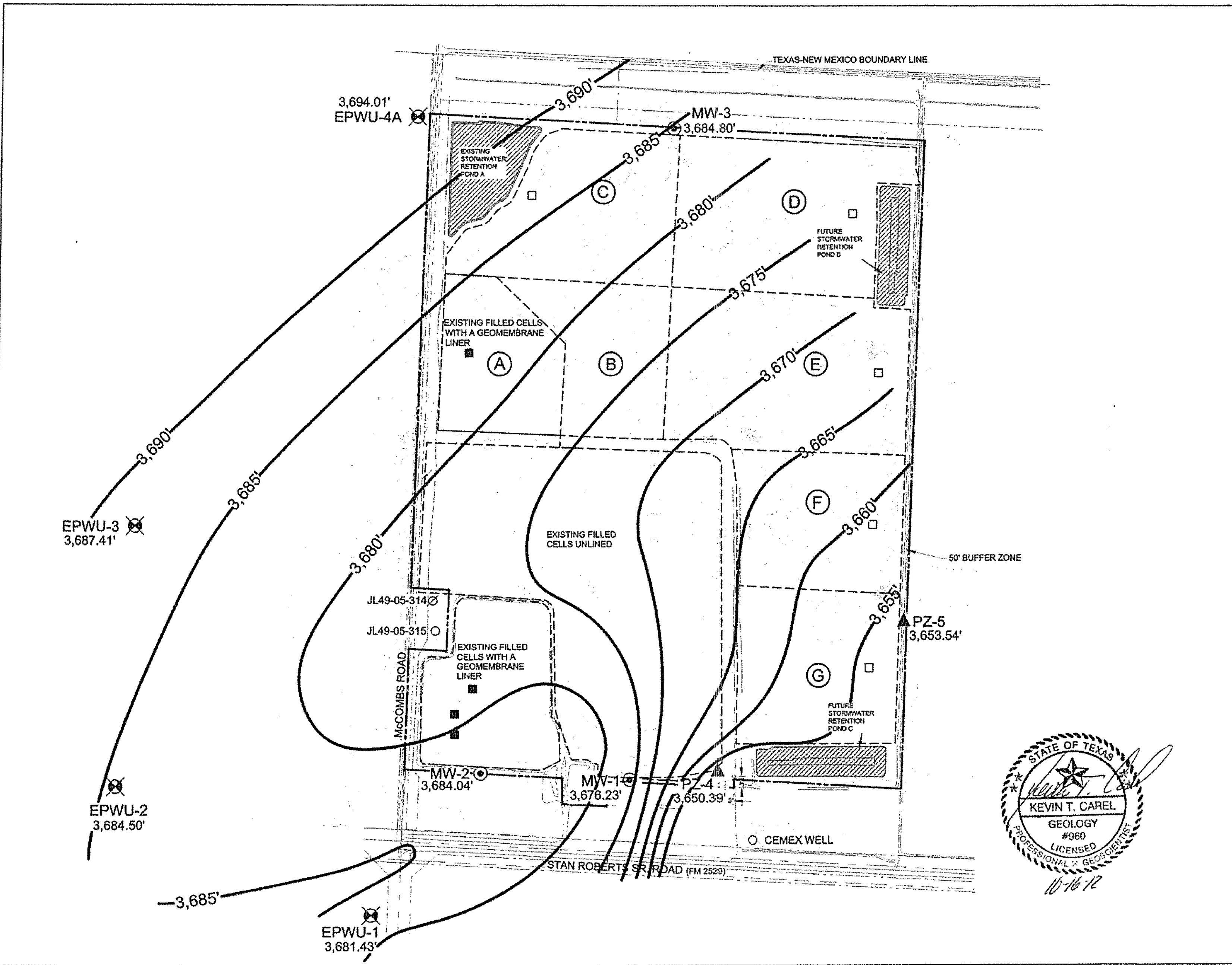


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**GROUNDWATER CONTOUR MAP**
**10/31/2011**

THE CITY OF EL PASO TEXAS

**CITY OF EL PASO GROUNDWATER PERMIT MODIFICATIONS FOR McCOMBS LANDFILL**

7969 SAN PAULO DRIVE
EL PASO, TEXAS 79907

**LEGEND:**

- PROPERTY/PERMIT BOUNDARY
- EXISTING LEACHATE COLLECTION SUMP
- FUTURE LEACHATE COLLECTION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- EPWU MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL
- NM NOT MEASURED/OBSTRUCTED
- PIEZOMETER
- FUTURE GROUNDWATER MONITORING WELL
- (E) SECTOR DENOMINATION
- SECTOR BOUNDARY

N

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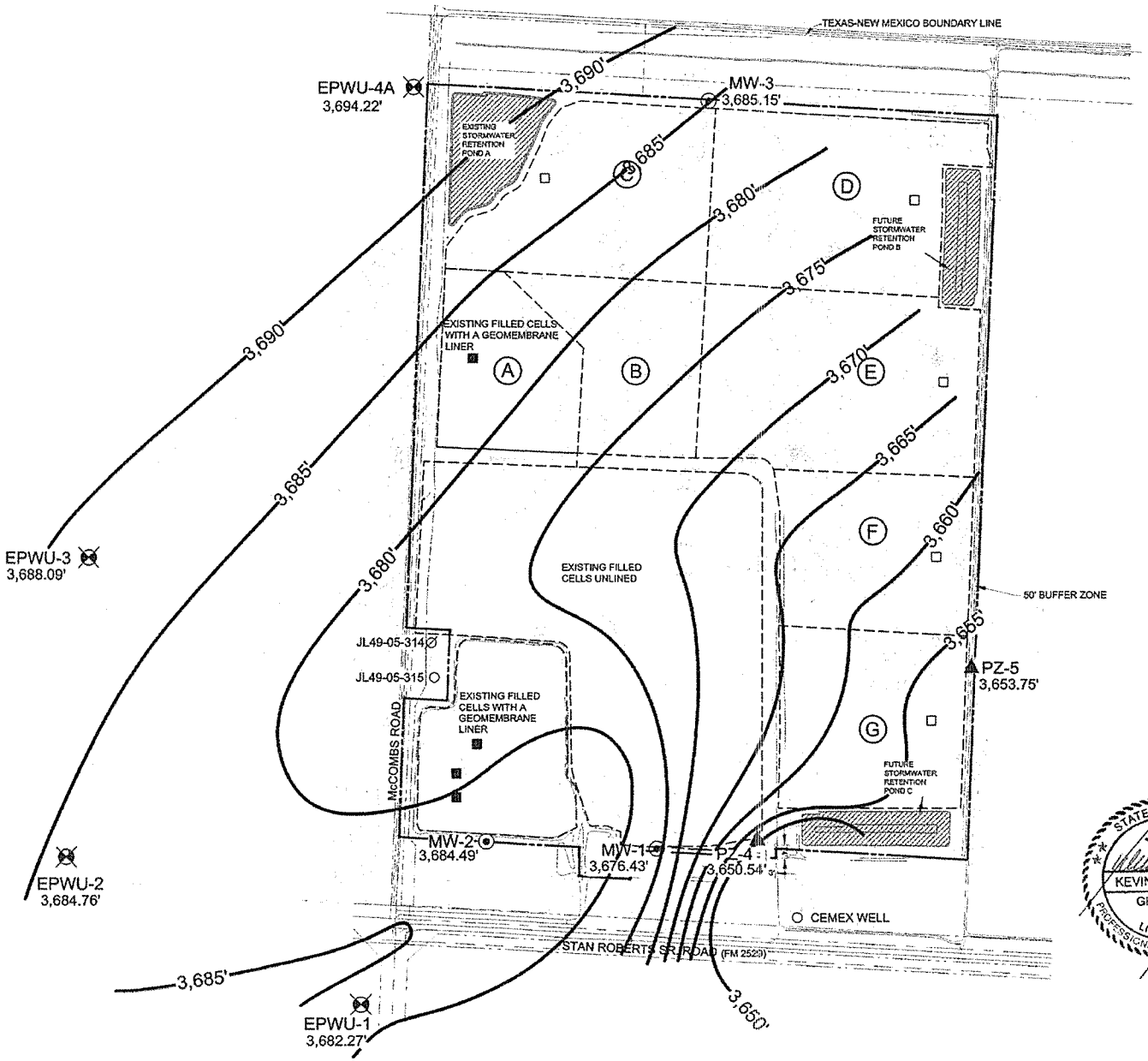



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**SCALE**

0 300 600
FEET

# GROUNDWATER CONTOUR MAP 12/01/2011

**CITY OF EL PASO GROUNDWATER PERMIT MODIFICATIONS FOR McCOMBS LANDFILL**

7969 SAN PAULO DRIVE
EL PASO, TEXAS 79907

LEGEND:

- PROPERTY/PERMIT BOUNDARY
- EXISTING LEACHATE COLLECTION SUMP
- FUTURE LEACHATE COLLECTION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- EPWU MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL
- NM NOT MEASURED/OBSTRUCTED
- PIEZOMETER
- FUTURE GROUNDWATER MONITORING WELL
- (E) SECTOR DENOMINATION
- SECTOR BOUNDARY

STATE OF TEXAS
KEVIN T. CAREL
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10.16.12

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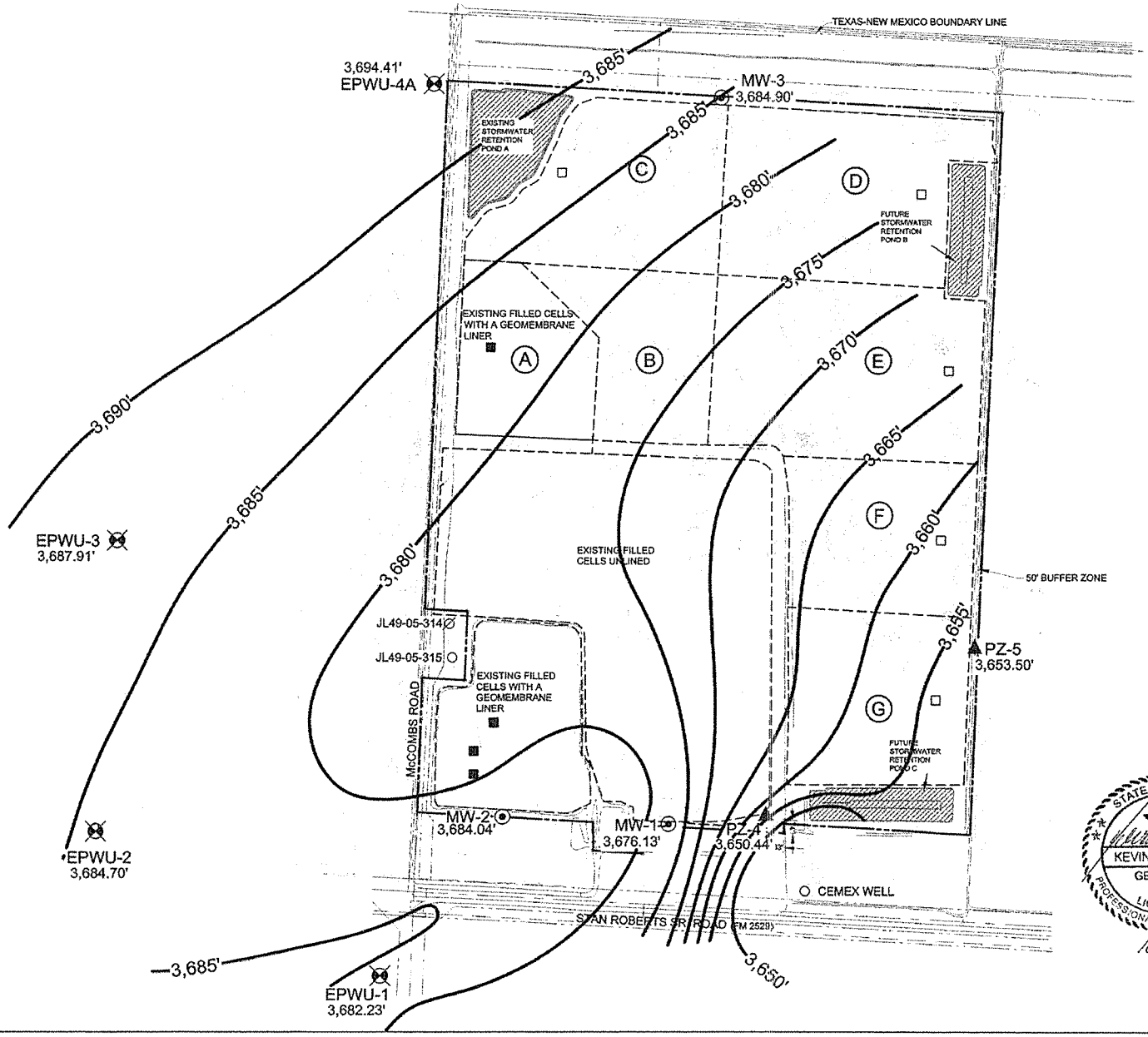


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**SCALE**

0 300 600
FEET

**GROUNDWATER CONTOUR MAP 01/05/2012**

**CITY OF EL PASO GROUNDWATER PERMIT MODIFICATIONS FOR McCOMBS LANDFILL**

**7969 SAN PAULO DRIVE**
**EL PASO, TEXAS 79907**

LEGEND:

- PROPERTY/PERMIT BOUNDARY
- EXISTING LEACHATE COLLECTION SUMP
- FUTURE LEACHATE COLLECTION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- EPWU MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL
- NM NOT MEASURED/OBSTRUCTED
- PIEZOMETER
- FUTURE GROUNDWATER MONITORING WELL
- (E) SECTOR DENOMINATION
- SECTOR BOUNDARY

DATE DRAFTED: August 14,2012 REV. # 2

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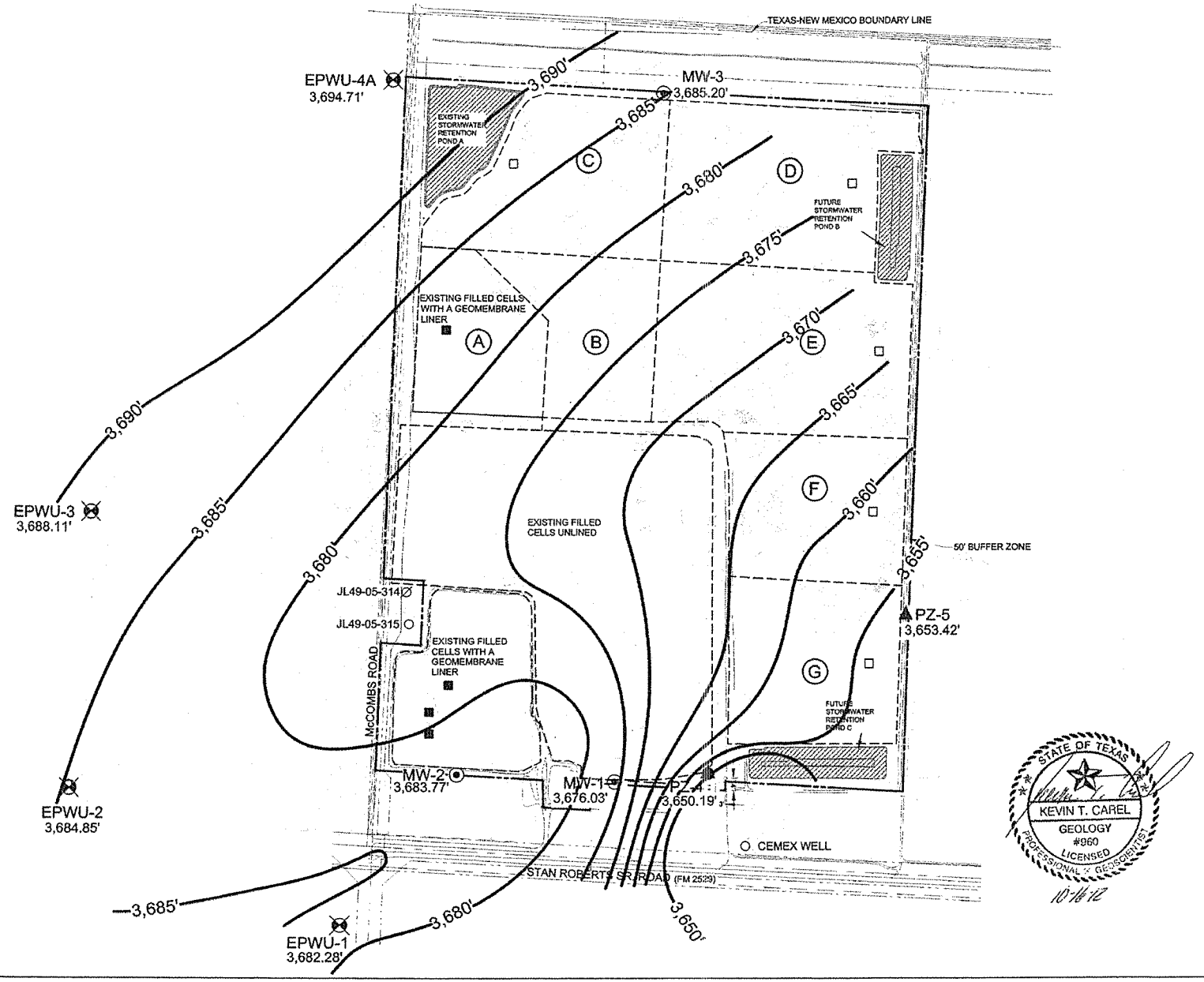


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**SCALE**
0 300 600
FEET

**GROUNDWATER CONTOUR MAP 02/02/2012**

**CITY OF EL PASO GROUNDWATER PERMIT MODIFICATIONS FOR McCOMBS LANDFILL**

**7909 SAN PAULO DRIVE EL PASO, TEXAS 79907**

LEGEND:

- PROPERTY/PERMIT BOUNDARY
- EXISTING LEACHATE COLLECTION SUMP
- FUTURE LEACHATE COLLECTION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- EPWU MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL
- NM NOT MEASURED/OBSTRUCTED
- PROPOSED GROUNDWATER MONITORING WELL
- FUTURE GROUNDWATER MONITORING WELL
- (E) SECTOR DENOMINATION
- SECTOR BOUNDARY

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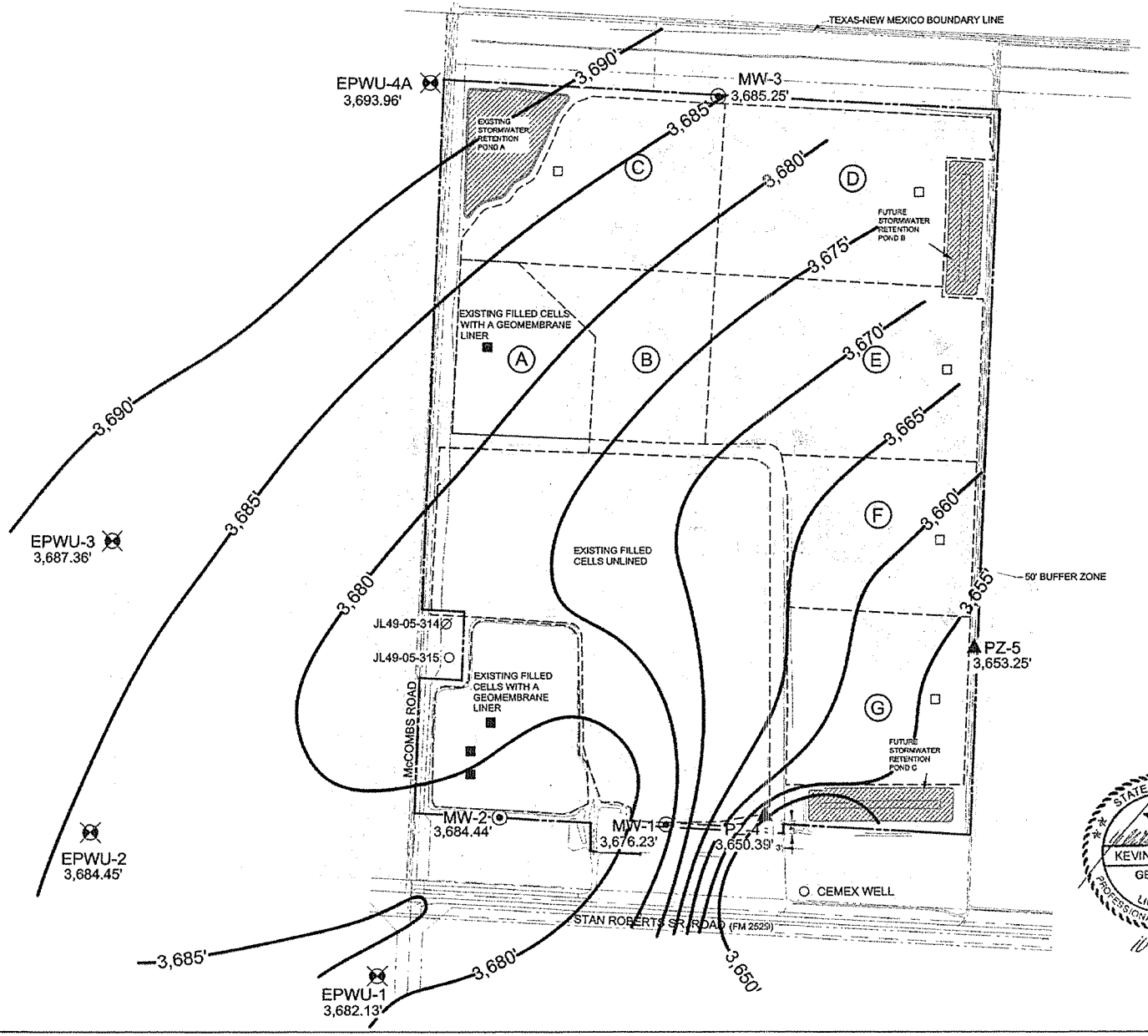


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Lubbock | Fort Milford Amarillo Odessa

The CAREL CORPORATION

136 Pecan Street, Keller, TX 76248

**SCALE**

0 300 600
FEET

**GROUNDWATER CONTOUR MAP 02/29/2012**

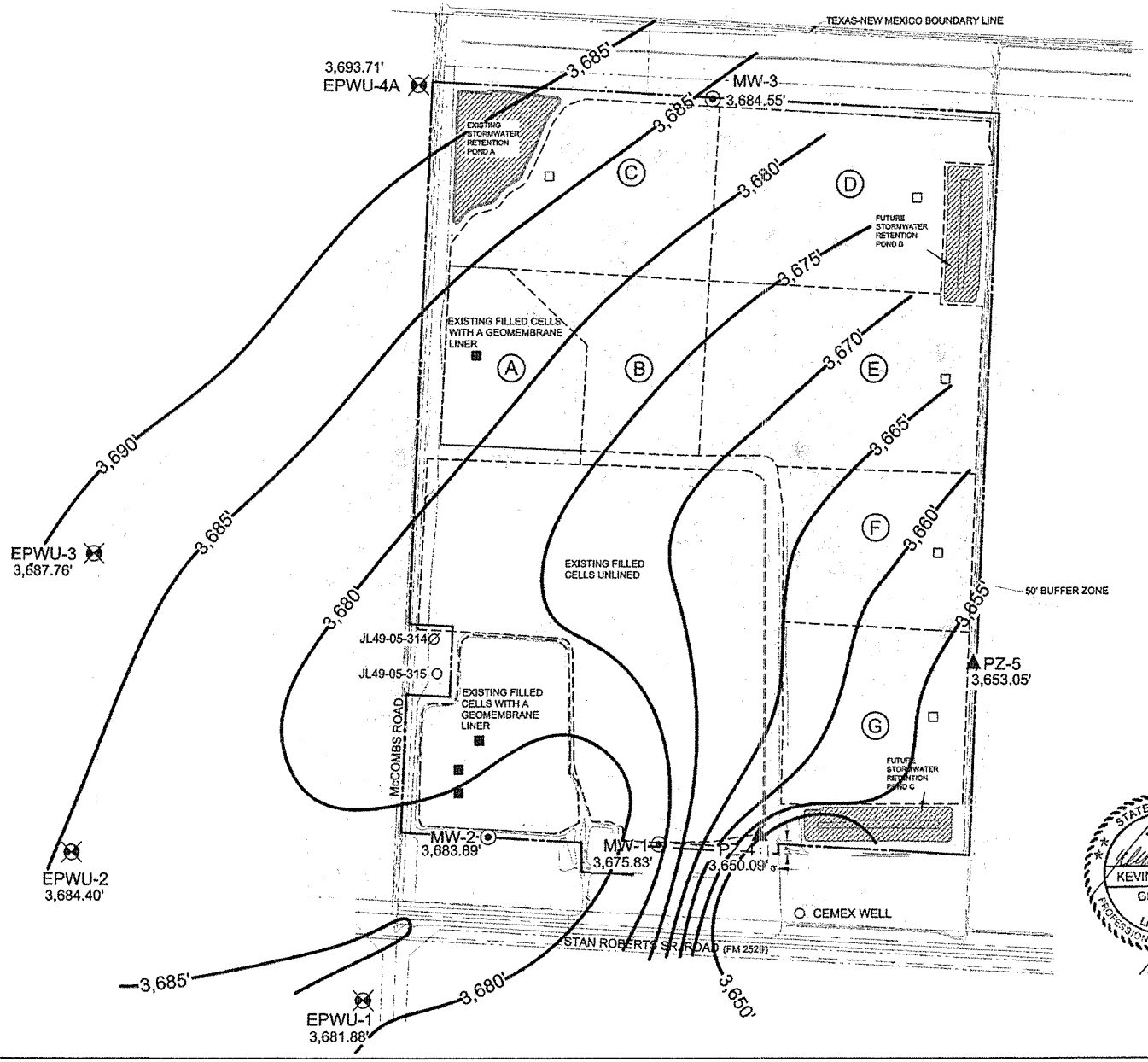
**CITY OF EL PASO GROUNDWATER PERMIT MODIFICATIONS FOR McCOMBS LANDFILL**

7969 SAN PAULO DRIVE
EL PASO, TEXAS 79907

**LEGEND:**

- PROPERTY\PERMIT BOUNDARY
- EXISTING LEACHATE COLLECTION SUMP
- FUTURE LEACHATE COLLECTION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- EPWU MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL
- NM NOT MEASURED/OBSTRUCTED
- PIEZOMETER
- FUTURE GROUNDWATER MONITORING WELL
- (E) SECTOR DENOMINATION
- SECTOR BOUNDARY

| | |
|---|---|
| DATE DRAFTED: August 14,2012 | REV. # 2 |
| FILENAME: | |
| DRAWN BY: KTC | FIGURE: F-8 |
| DRAFTED BY: SMG | |

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**SCALE**

0 300 600
FEET

**GROUNDWATER CONTOUR MAP 04/04/2012**

**CITY OF EL PASO GROUNDWATER PERMIT MODIFICATIONS FOR McCOMBS LANDFILL**

**7909 SAN PAULO DRIVE**
**EL PASO, TEXAS 79907**

LEGEND:

- PROPERTY\PERMIT BOUNDARY
- EXISTING LEACHATE COLLECTION SUMP
- FUTURE LEACHATE COLLECTION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- EPWU MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL
- NM NOT MEASURED/OBSTRUCTED
- PIEZOMETER
- FUTURE GROUNDWATER MONITORING WELL
- (E) SECTOR DENOMINATION
- SECTOR BOUNDARY

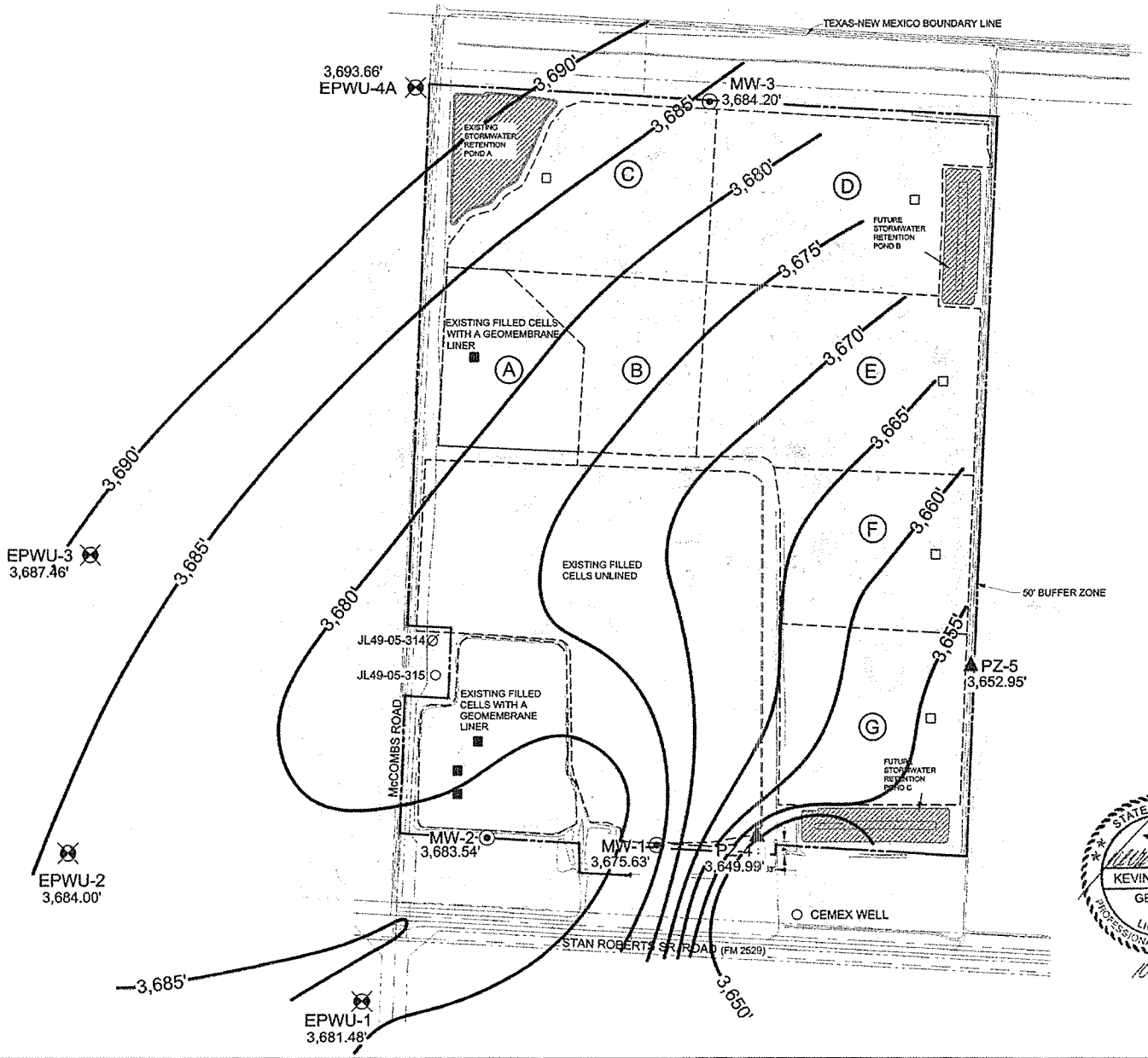
DATE DRAFTED: August 14,2012 REV. # 2

FILENAME: [illegible]

DRAWN BY: KTC

FIGURE: **F-9**

DRAFTED BY: SMG

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136 Pecan Street, Keller, TX 76248

**SCALE**

0 300 600
FEET

**GROUNDWATER CONTOUR MAP 05/07/2012**

**CITY OF EL PASO GROUNDWATER PERMIT MODIFICATIONS FOR McCOMBS LANDFILL**

**7969 SAN PAULO DRIVE EL PASO, TEXAS 79907**

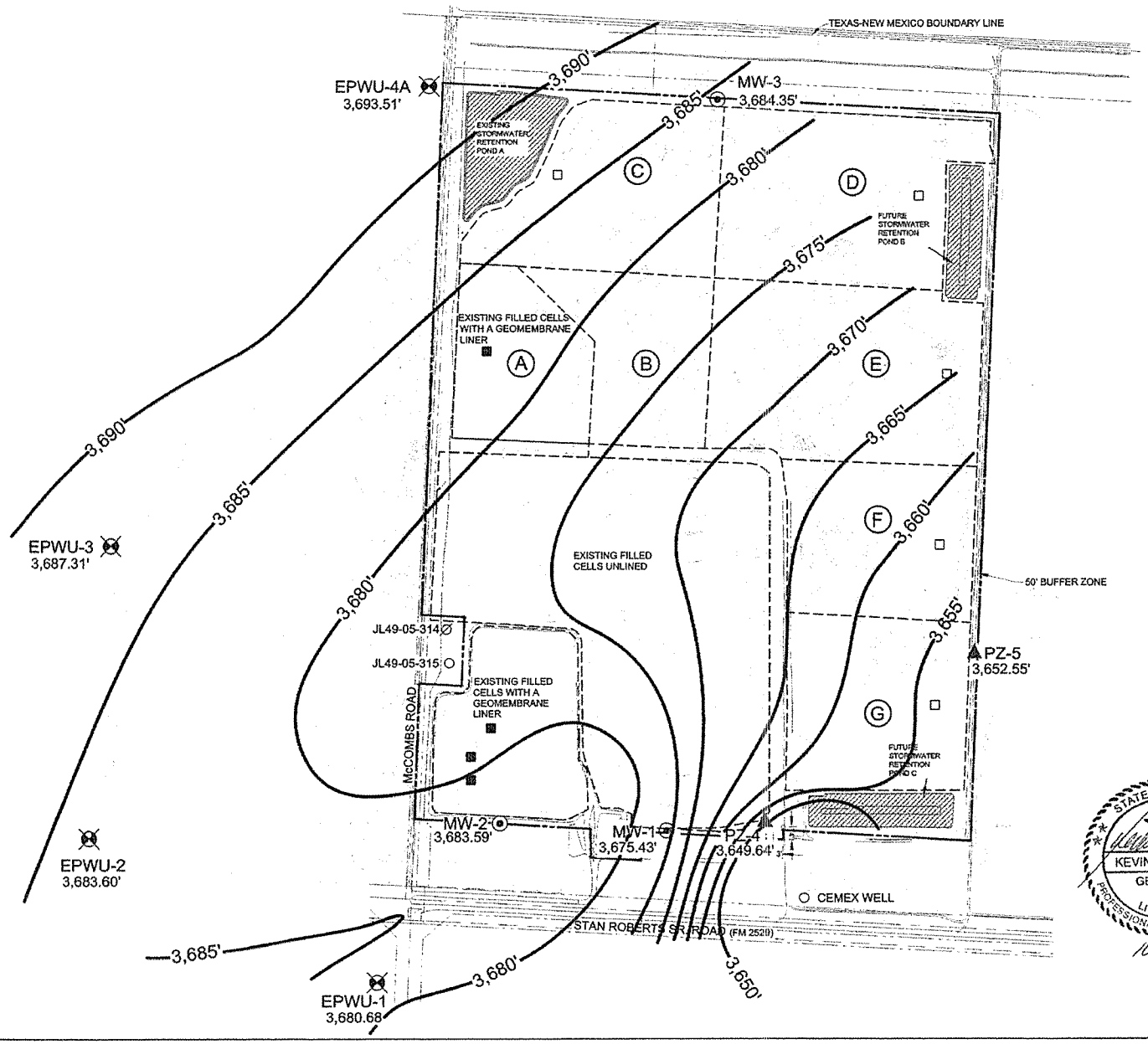
LEGEND:

- PROPERTY/PERMIT BOUNDARY
- EXISTING LEACHATE COLLECTION SUMP
- FUTURE LEACHATE COLLECTION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- EPWU MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL
- NM NOT MEASURED/OBSTRUCTED
- PIEZOMETER
- FUTURE GROUNDWATER MONITORING WELL
- (E) SECTOR DENOMINATION
- SECTOR BOUNDARY

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST

10/16/12

| | |
|---|---|
| DATE DRAFTED: August 14,2012 | REV. # 2 |
| FILENAME: | |
| DRAWN BY: KTC | FIGURE: F-10 |
| DRAFTED BY: SMG | |




Parkhill, Smith & Cooper, Inc.
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Lubbock El Paso Midland Amarillo Odessa

The CAREL CORPORATION

136 Pecan Street, Keller, TX 76248

**SCALE**

0 300 600
FEET

# GROUNDWATER CONTOUR MAP 05/29/2012

THE CITY OF EL PASO TEXAS

**CITY OF EL PASO**
**GROUNDWATER PERMIT MODIFICATIONS FOR McCOMBS LANDFILL**

**7969 SAN PAULO DRIVE**
**EL PASO, TEXAS 79907**

LEGEND:

- PROPERTY\PERMIT BOUNDARY
- EXISTING LEACHATE COLLECTION SUMP
- FUTURE LEACHATE COLLECTION SUMP
- EXISTING GROUNDWATER MONITORING WELL
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- PIEZOMETER
- FUTURE GROUNDWATER MONITORING WELL
- (E) SECTOR DENOMINATION
- SECTOR BOUNDARY

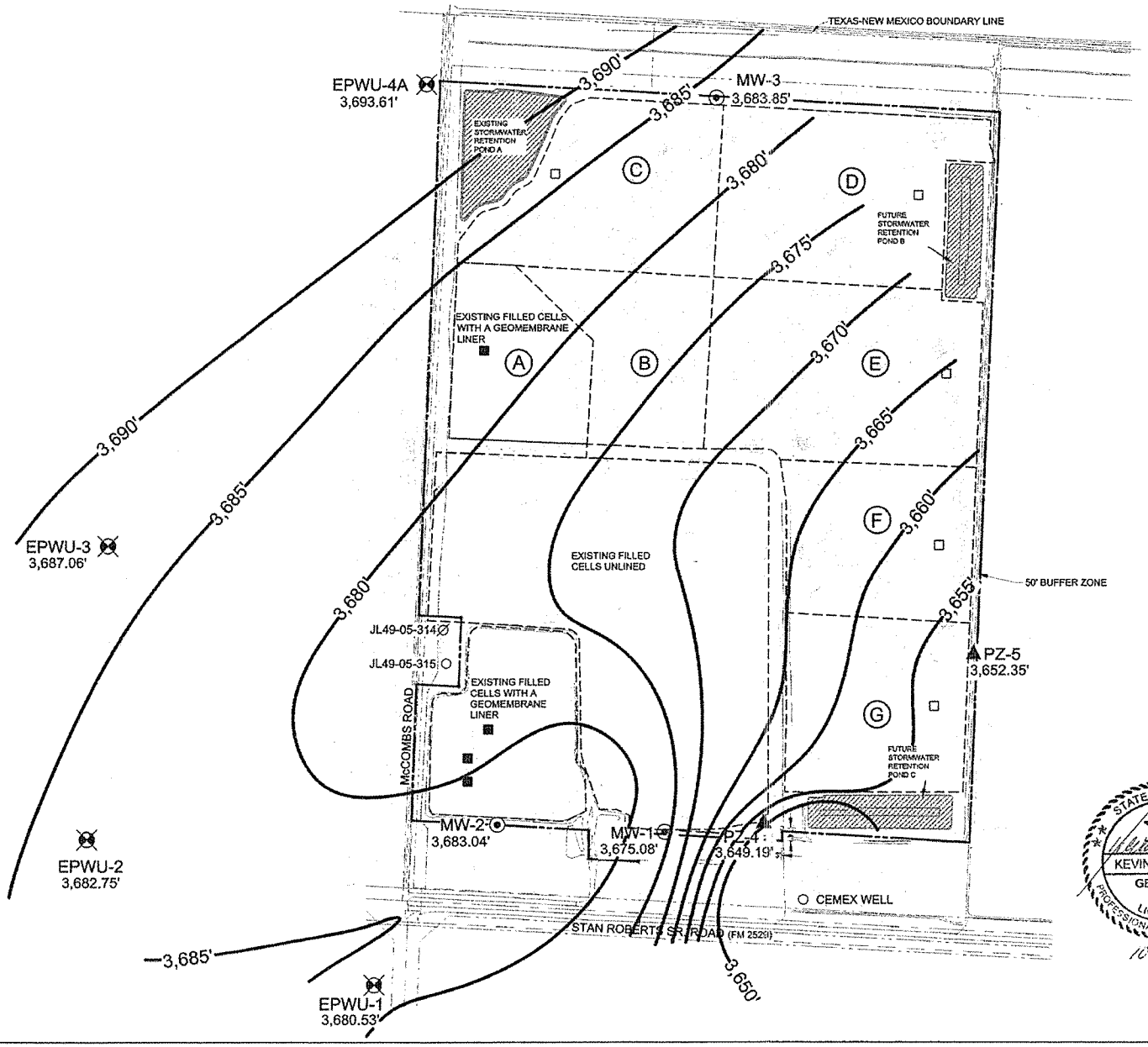
STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST
10-16-12

DATE DRAFTED: August 14,2012 | REV. # 2

FILENAME:

DRAWN BY: KTC | FIGURE: F-11

DRAFTED BY: SMG




Forkin, Smith & Cooper, Inc.
Engineers • Architects • Planners

The CAREL CORPORATION

136 Pecan Street, Keller, TX 76248

**SCALE**

0 300 600
FEET

**GROUNDWATER CONTOUR MAP 07/03/2012**

**CITY OF EL PASO GROUNDWATER PERMIT MODIFICATIONS FOR McCOMBS LANDFILL**

**7969 SAN PAULO DRIVE**
**EL PASO, TEXAS 79907**

LEGEND:

- PROPERTY/PERMIT BOUNDARY
- EXISTING LEACHATE COLLECTION SUMP
- FUTURE LEACHATE COLLECTION SUMP
- EXISTING GROUNDWATER MONITORING WELL
- EPWU MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ABANDONED GROUNDWATER EXTRACTION WELL
- NM NOT MEASURED/OBSTRUCTED
- PIEZOMETER
- FUTURE GROUNDWATER MONITORING WELL
- (E) SECTOR DENOMINATION
- SECTOR BOUNDARY

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST
10/16/12

DATE DRAFTED: August 14,2012 REV. # 2
FILENAME:
DRAWN BY: KTC FIGURE: F-12
DRAFTED BY: SMG

# APPENDIX G

# GROUNDWATER MONITORING SYSTEM DESIGN CERTIFICATION

# Appendix 3K – Attachment 2
# 2-Mile Water Wells

## Memorandum

SAIC

To: TCEQ

From: Randall J. Sippel, P.G., SAIC

Subject: Water Well Search

Date: July 9, 2012

SAIC Energy, Environment & Infrastructure, LLC has conducted a water well search for the McCombs Landfill located in El Paso County, El Paso, Texas in accordance with 30 TAC §330.63(e)(3)(J). The water well search was conducted utilizing the online Texas Water Development Board (TWDB) Water Information Integration and Dissemination (WIID) database. Site coordinate boundaries were entered into the database (buffer numbers 1 through 4) and a 2-mile boundary was placed on the buffer numbers (see attached figure). All scanned well logs located within the approximate 2-mile radius were downloaded from the TWDB website and are included as an attachment to this memo. The scanned quality of the documents is as they were located on the TWDB website and are considered the best version available. The wells located within the search radius include the following:

**Table 1**

**Water Well Search**

| | | | | |
|---|---|---|---|---|
| 4905201 | 4905202 | 4905203 | 4905204 | 4905205 |
| 4905208 | 4905212 | 4905213 | 4905214 | 4905215 |
| 4905216 | 4905217 | 4905218 | 4905219 | 4905220 |
| 4905221 | 4905222 | 4905223 | 4905224 | 4905225 |
| 4905226 | 4905227 | 4905301 | 4905302 | 4905303 |
| 4905304 | 4905305 | 4905306 | 4905307 | 4905308 |
| 4905309 | 4905310 | 4905311 | 4905312 | 4905313 |
| 4905314 | 4905315 | 4905316 | 4905317 | 4905318 |
| 4905319 | 4905320 | 4905321 | 4905322 | 4905323 |
| 4905324 | 4905325 | 4906102 | 4906104 | 4906105 |

This information was also provided to TCEQ in a letter from Parkhill, Smith & Cooper (PSC) dated July 6, 2009, responding to a TCEQ comment letter of May 4, 2009 regarding the permit modification of the groundwater monitoring system for the City of El Paso McCombs Municipal



SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI

Landfill, MSW Permit No. 729A. The Water Well Search map, Figure 4 and Water Well Inventory, Table 1, of that letter are also provided with the TWBD well logs. In addition to the wells listed above, well sealing and redrilling records for the Cemex replacement well (2007) is located in the attachment.

RJS

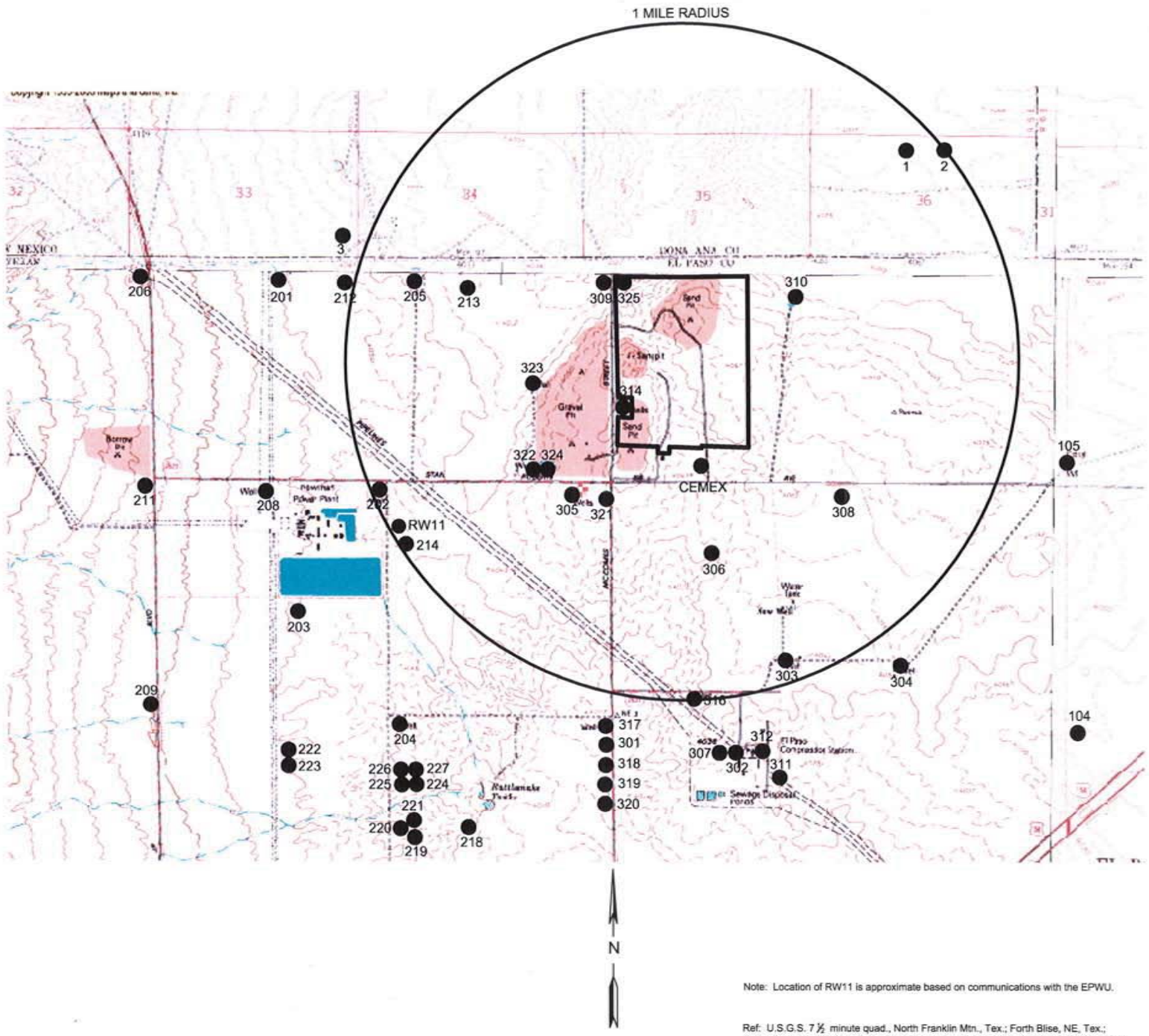


*SAIC Energy, Environment & Infrastructure, LLC*
*1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI*

# Table 1
# WATER WELL INVENTORY (2 mile radius)

| STATE WELL NUMBER | SURFACE ELEVATION | USE OF WELL | DRILL DATE | OWNER | TOTAL DEPTH | TDS | ANALYSES (Y/N) | CASING TYPE | CASING DIAMETER |
|---|---|---|---|---|---|---|---|---|---|
| 49-06-105 | 4059 | UNUSED | | PRICE'S DAIRY | 450 | 1,227 | Y | STEEL | |
| 49-05-201 | 4060 | IND | 1958 | CITY OF EL PASO | 631 | 414 | Y | STEEL | 24, 18, 12 |
| 49-05-202 | 4050.5 | IND | 1958 | CITY OF EL PASO | 625 | 389 | Y | | 24, 18, 12 |
| 49-05-203 | 4049.37 | DISPOSAL | | CITY OF EL PASO | 1483 | | | | |
| 49-05-204 | 4044.0 | PUBLIC | 1959 | CITY OF EL PASO | 515 | 487 | Y | STEEL | 24, 18 |
| 49-05-205 | 4042.39 | NOT USED | 1940 | CITY OF EL PASO | 1018 | | N | | 4 |
| 49-05-208 | 4063.99 | IND | 1962 | CITY OF EL PASO | 825 | 717 | Y | STEEL | 24, 18 |
| 49-05-212 | 4045 | IND | 1975 | EL PASO ELECTRIC | 839 | 437 | Y | STEEL | 24, 16 |
| 49-05-213 | 4030 | IND | 1975 | EL PASO ELECTRIC | 875 | 569 | Y | STEEL | 24, 16 |
| 49-05-214 | 4045 | RECHARGE | 1988 | CITY OF EL PASO | 685 | 619 | Y | STEEL | 16 |
| 49-05-224 | 4040 | RECHARGE | 2001 | EL PASO WATER | 420 | | N | | |
| 49-05-225 | 4040 | RECHARGE | 2001 | EL PASO WATER | 332 | | N | | |
| 49-05-226 | 4040 | RECHARGE | 2001 | EL PASO WATER | 167 | | N | | |
| 49-05-227 | 4040 | RECHARGE | 2001 | EL PASO WATER | 104 | | N | | |
| 49-05-301 | 4018 | | 1958 | CITY OF EL PASO | 671 | 624 | Y | | 24, 18, 12 |
| 49-05-302 | 4028 | UNUSED | 1947 | EPNG | 771 | | N | STEEL | 10 |
| 49-05-303 | 4044 | IRR | 1955 | PRICE'S DAIRY | 870 | 1049 | Y | | 24, 18, 12 |
| 49-05-304 | 4055 | | 1955 | PRICE'S DAIRY | 753 | 580 | Y | | 24, 18, 12 |
| 49-05-305 | 4055 | | 1965 | CITY OF EL PASO | 834 | 331 | Y | | 24, 28 |
| 49-05-306 | 4054 | | 1965 | CITY OF EL PASO | 603 | | N | STEEL | 24, 18 |
| 49-05-307 | | IND | 1958 | EPNG | 650 | 472 | Y | | 10, 12 |
| 49-05-308 | 4062 | OBSERV | 1965 | CITY OF EL PASO | 701 | | | | |
| 49-05-309 | 4025 | OBSERV | 1965 | CITY OF EL PASO | 795 | 228 | Y | | 4 |
| 49-05-310 | PLUGGED | | | | | | | | |
| 49-05-311 | 4030 | IND | 1951 | EPNG | 750 | 567 | Y | STEEL | |
| 49-05-312 | 4031 | IND | -- | EPNG | 630 | 768 | Y | | |

| STATE WELL NUMBER | SURFACE ELEVATION | USE OF WELL | DRILL DATE | OWNER | TOTAL DEPTH | TDS | ANALYSES (Y/N) | CASING TYPE | CASING DIAMETER |
|---|---|---|---|---|---|---|---|---|---|
| 49-05-313 | PLUGGED | | | | | | | | |
| 49-05-314 | 4062 | IND | | EL PASO SAND PRODUCTS | -- | | | | 20, 16, 8½ |
| 49-05-315 | PLUGGED | IND | 1978 | EL PASO SAND PRODUCTS | 598 | | N | STEEL | 20, 12 |
| 49-05-316 | 4040 | IND | 1970 | EPNG | 625 | 368 | Y | STEEL | 26, 12 |
| 49-05-317 | 4008 | OBSERV | 1962 | CITY OF EL PASO | 500 | | N | STEEL | 5½ |
| 49-05-318 | 4009 | OBSERV | 1962 | CITY OF EL PASO | 500 | | N | STEEL | 5½ |
| 49-05-319 | 4008 | OBSERV | 1981 | CITY OF EL PASO | 500 | | N | STEEL | 5½ |
| 49-05-320 | 4007 | OBSERV | 1962 | CITY OF EL PASO | 500 | | N | STEEL | 5½ |
| 49-05-321 | 4054 | UNUSED | 1988 | CITY OF EL PASO | 500 | 1983 | Y | STEEL | 4 |
| 49-05-322 | 4050 | OBSERV | 1988 | CITY OF EL PASO | 500 | 318 | Y | STEEL | 4 |
| 49-05-323 | 4038 | OBSERV | 1988 | CITY OF EL PASO | 500 | 248 | Y | STEEL | 4 |
| CEMEX | 4050 | IND | 2007 | CEMEX INC. | 562 | | N | STEEL | 8 |
| 49-05-324 | 4040 | RECHARGE | | EL PASO WATER | 500 | | N | | |
| 49-05-325 | 4020 | RECHARGE | | EL PASO WATER | 500 | | N | | |
| RW11 | | RECHARGE | | EL PASO WATER | | | | | |




Note: Location of RW11 is approximate based on communications with the EPWU.

Ref: U.S.G.S. 7 ½ minute quad., North Franklin Mtn., Tex.; Forth Blise, NE, Tex.; Newman, New Mexico & Tex.; Newman, SW, New Mexico & Tex.; 1955 (1967, 1973)



PSC PARKHILL SMITH & COOPER

The CAREL CORPORATION
136 Pecan Street, Keller, TX 76248
REGISTRATION NUMBER F-560

CAREL CORPORATION 50137

SCALE
0 0.5 1
MILE

# WATER WELL SEARCH

CITY OF EL PASO
GROUNDWATER PERMIT
MODIFICATIONS FOR
McCOMBS LANDFILL

7969 SAN PAULO DRIVE
EL PASO, TEXAS 79907

LEGEND:

- WATER WELL
- 301 — STATE WELL NUMBER ABREVIATION
- CEMEX — WELL OWNER
- APPROXIMATE LANDFILL BOUNDARY

| NO | DATE | DESCRIPTION |
|---|---|---|
| 1 | 5/19/09 | ADDED SITE BOUNDARY AND 1 MILE ENVELOPE |

ISSUING OFFICE: CITY PROJECT NO: 07-07-35

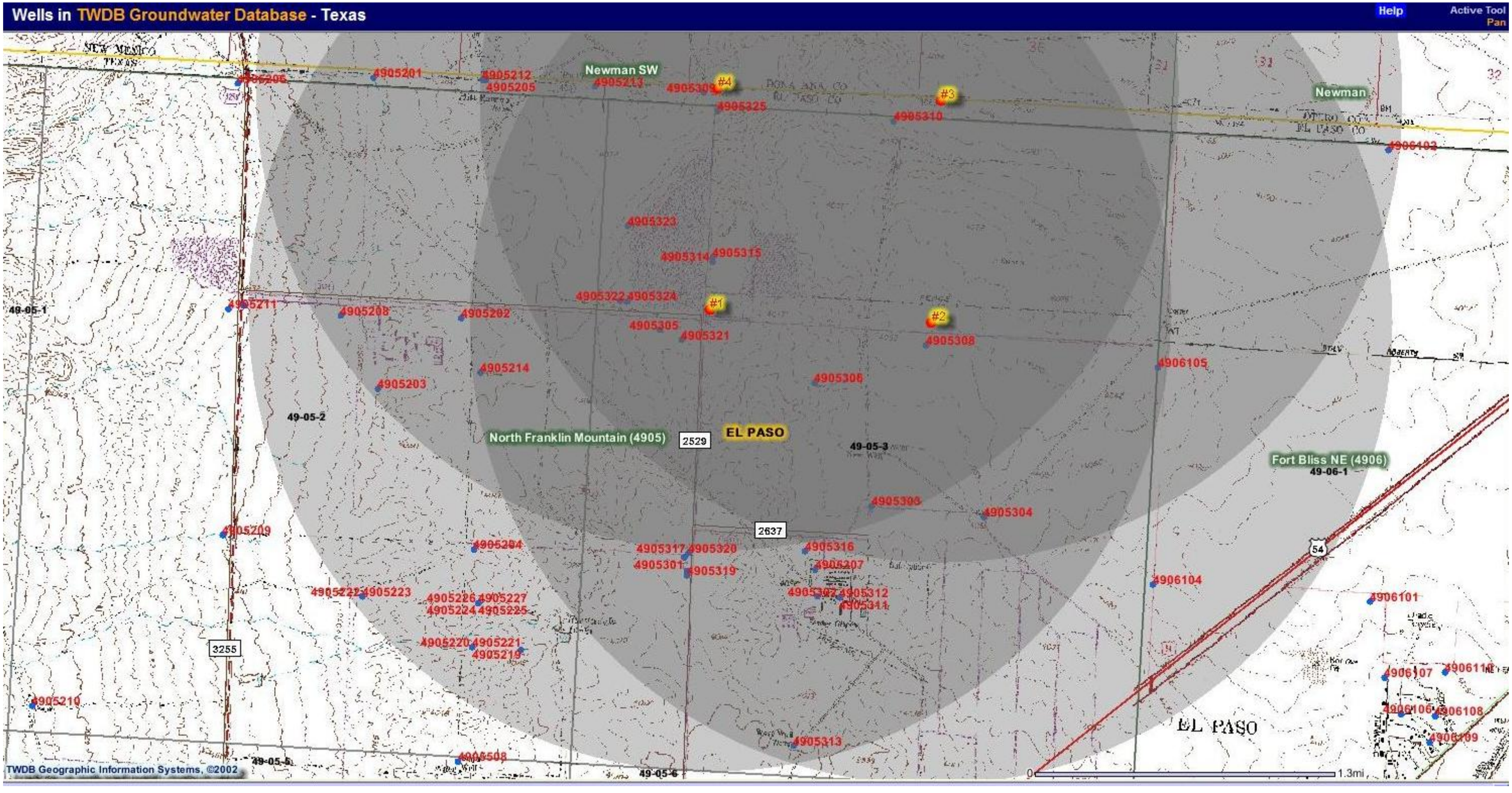
DATE DRAFTED: November 29, 2007

FILENAME: I:\TEXAS\McCombs\Figure 4.1.dwg

DRAWN BY: TDW

DRAFTED BY: TDW

FIGURE: 4


Wells in TWDB Groundwater Database - Texas
Help
Active Tool
Pan
Newman SW
Newman
#1
#2
#3
#4
4905201
4905212
4905205
4905213
4905309
4905325
4905310
4906103
4905323
4905314
4905315
4905322
4905324
4905211
4905208
4905202
4905305
4905321
4905308
4906105
4905214
4905306
4905203
49-05-1
49-05-2
49-05-3
North Franklin Mountain (4905)
2529
EL PASO
Fort Bliss NE (4906)
49-06-1
4905303
4905304
2637
4905209
4905204
4905317
4905320
4905301
4905319
4905316
4905207
4906104
4905222
4905223
4905226
4905227
4905224
4905225
4905307
4905312
4905311
4906101
4905220
4905221
4905219
3255
4905210
4906107
4906110
4906106
4906108
4906109
4905313
4905208
49-05-5
49-05-6
54
EL PASO
0
1.3mi
TWDB Geographic Information Systems, ©2002

# Attachment
# 2-Mile Water Well Logs

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer Hueco Bolson  Field No. E-3 R-78  State Well No. 49 05 201

Owner's Well No. _____  County El Paso

1. Location: NE 1/4, NW 1/4 Sec. 2, Block 81 Survey _____
NEC
31 59 52 N 106 26 10 1

2. Owner: City of El Paso  Address: _____

3. Tenant: El Paso Electric Co  Address: _____

Driller: City  Address: _____

3. Elevation of LSD is 4060 ft. above msl, determined by Topo

4. Drilled: 12 1958; Dug, Cable Tool, Rotary, _____

5. Depth: Rept. 631 ft. Meas. _____ ft.

6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed _____

7. Pump: Mfgr. Layne-Bowler Type turbine

No. Stages 11, Bowls Diam. _____ in., Setting 450 ft.

Column Diam. _____ in., Length Tailpipe _____ ft.

8. Motor: Fuel Elec Make & Model _____ HP. 200

9. Yield: Flow _____ gpm, Pump 1480 gpm, Meas., Rept., Est. 2/24/59

10. Performance Test: Date _____ Length of Test 24 Made by _____

Static Level _____ ft. Pumping Level _____ ft. Drawdown 48.8 ft.

Production 1480 gpm Specific Capacity SC 30.3 gpm/ft.

CASING & BLANK PIPE
Cemented From _____ ft. to _____ ft.

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 24 | Stl | | |
| 18 | " | | |
| 12 | " | 498 | bottom |
| | | | |

11. Water Level: 351.4 ft. rept. meas. 1/6 1957 above below top of meas'g pipe which is 2.5 ft. above below surface.

_____ ft. rept. meas. _____ 19__ above below which is _____ ft. above below surface.

_____ ft. rept. meas. _____ 19__ above below which is _____ ft. above below surface.

_____ ft. rept. meas. _____ 19__ above below which is _____ ft. above below surface.

12. Use: Dom., Stock, Public Supply, Ind., Irr., Waterflooding, Observation, Not Used, _____

13. Quality (Remarks on taste, odor, color, etc.) _____

Temp. ___ °F, Date sampled for analysis 2/25/59 Laboratory _____

Temp. ___ °F, Date sampled for analysis _____ Laboratory _____

Temp. ___ °F, Date sampled for analysis _____ Laboratory _____

14. Other data available as circled: Driller's Log, Radioactivity Log, Electric Log,

Formation Samples, Pumping Test, _____

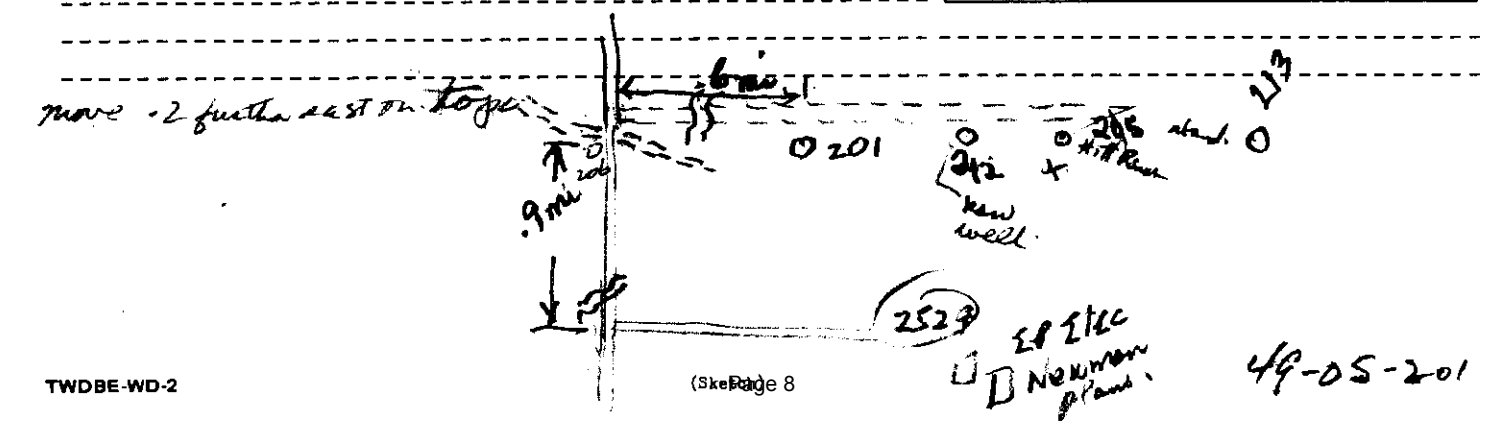
15. Record by: TWDB Date 7/20 1975

Source of Data USGS well sched (ERLeggat 12/16/58)

16. Remarks: _____

WELL SCREEN
Screen Openings _____

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 19" | m.11 slotted | 321 | 481 |
| | | | |
| | | | |
| | | | |



JL-49-05-201
E-3
6/11/90

# EL PASO WATER UTILITIES
## WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED | 06/11/90 | WELL NUMBER | E3 |
| DATE RECEIVED AT LABORATORY | 06/11/90 | LAB. NUMBER | C061190-3 |
| DATE ANALYSIS COMPLETED | 06/12/90 | LOCATION | |
| | | OWNER | |
| | | SAMPLE TAKER | T. CLIETT |
| | | DELIVERED BY | T. CLIETT |

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 2.00 | ****** | ****** |
| Total Alkalinity as CaCO3 | 145 | ****** | ****** |
| Carbonates as CO3 | 2.44 | .081325 | 7 |
| Bicarbonates as HCO3 | 172 | 2.81941 | 123 |
| Chlorides as Cl | 90 | 2.5389 | 193 |
| Sulfates as SO4 | 71 | 1.47822 | 109 |
| Fluorides as F | 0.90 | .047376 | ****** |
| Nitrates as NO3 LOD=0.10 | 6.90 | .111297 | 8 |
| Total Phosphates as PO4 LOD=.09 | 0.00 | 0 | ****** |
| Total Anions = | 343 | 7.07653 | 440 |

| CATIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Total Hardness as CaCO3 | 104 | ****** | ****** |
| Calcium as Ca | 30.5 | 1.52195 | 79 |
| Magnesium as Mg | 6.80 | .559368 | 26 |
| Sodium as Na | 112 | 4.872 | 238 |
| Potassium as K | 8.70 | .222459 | 16 |
| Total Cations = | 158 | 7.17578 | 359 |
| TDS BY EPWU METHOD (1)= | 501 | 14.2523 | 799 |
| TDS BY USGS METHOD (2)= | 434 | | |
| TDS BY TDH METHOD (3)= | 414 | | |

| | |
|---|---|
| Silica, SiO2 = | 20.00 |
| Chlorine Res. = | N/A |
| Turbidity,ntu = | 0.08 |
| Sample Temp(C)= | 25 |
| pH @ 25 | 8.34 |
| Lab E.C.@25C as umhos/cm = | 740 |
| Field E.C. @25C as umhos/cm = | N/A |
| pH Saturation = | 7.83 |
| Langelier Ind.= | 0.51 |
| Aggress. Index= | 12.52 |
| % Na of T Cat.= | 68 |

Remarks
LOD = LIMIT OF DETECTION

CHECKING CORRECTNESS OF ANALYSIS
Measured Diluted E.C. = 788
Calculated Diluted E.C.= 799
% Error = 1.38

(1) SUM OF IONS, NOT INCLUDING SILICA
(2) SUM OF IONS WITH CONVERSION OF HCO3 TO CO3, PLUS SILICA.
(3) SUM OF IONS, NOT INCLUDING SILICA WITH CONVERSION OF HCO3 TO CO3.

ANION-CATION BALANCE
Total Anions - Total Cations = SD = -0.46
+or-(0.1065+0.0155* T.ANIONS)
-.09925 < +or-1SD = +or- .216186 MAX. LIMIT

ANALYST Judith McBill

WATER SUPPLY MGR Douglas Patterson
PO BOX 511
EL PASO, TEXAS 79961

KEY PUNCHED

49-05-201

# EL PASO WATER UTILITIES
## WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED | 07-01-87 | WELL NUMBER | E-3 |
| DATE RECEIVED AT LABORATORY | 07-01-87 | LAB. NUMBER | C070187-16 |
| DATE ANALYSIS COMPLETED | 07-23-87 | LOCATION | NA |
| | | OWNER | |
| | | SAMPLE TAKER | R. SPERKA |
| | | DELIVERED BY | R. SPERKA |

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.00 | ****** | ****** |
| Total Alkalinity as CaCO3 | 140 | ****** | ****** |
| Carbonates as CO3 | 0.00 | 0 | 0 |
| Bicarbonates as HCO3 | 171 | 2.79941 | 122 |
| Chlorides as Cl | 74 | 2.08754 | 158 |
| Sulfates as SO4 | 59 | 1.22838 | 91 |
| Fluorides as F | 0.61 | .032110 | ****** |
| Nitrates as NO3 LOD=0.443 | 7.22 | .116459 | 8 |
| Total Phosphates as PO4 LOD=.09 | 0.00 | 0 | ****** |
| Total Anions = | 312 | 6.26390 | 380 |

| CATIONS | | | |
|---|---|---|---|
| Total Hardness as CaCO3 | 92 | ****** | ****** |
| Calcium as Ca | 30 | 1.497 | 78 |
| Magnesium as Mg | 4.13 | .339587 | 16 |
| Sodium as Na | 100 | 4.35 | 213 |
| Potassium as K | 9.12 | .233198 | 17 |
| Total Cations = | 143 | 6.41979 | 323 |
| TOTAL DISSOLVED SOLIDS = | 455 | 12.6837 | 703 |

| | |
|---|---|
| Silica, SiO2 = | 45.00 |
| Chlorine Res. = | NA |
| Turbidity,ntu = | 0.13 |
| Sample Temp(C)= | 22.00 |
| pH @ 22.00 | 8.03 |
| Lab E.C.@25C as umhos/cm = | 590 |
| Field E.C. @25C as umhos/cm = | 655 |
| pH Saturation = | 7.91 |
| Langelier Ind.= | 0.12 |
| Aggress. Index= | 12.14 |
| % Na of T Cat.= | 68 |

Remarks _____

LOD = LIMIT OF DETECTION

CHECKING CORRECTNESS OF ANALYSIS

| | |
|---|---|
| Measured Diluted E.C. = | 590 |
| Calculated Diluted E.C.= | 703 |
| % Error = | 1.88 |

ANION-CATION BALANCE

Total Anions - Total Cations =
+or-(0.1065+0.0155* T.ANIONS)
-.15588=<+or-1SD= +or- .203590 MAX. LIMIT

ANALYST Sylvia A. Pay for M. Sprester

P.O. BOX 511
El Paso, Texas 79961

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer Hueco Bolson  Field No. R-59 E-1  State Well No. 49 05 202

Owner's Well No. _____  County El Paso

1. Location: NE¼ 1/4 Sec. 11, Block 80 Survey T-1
315909 N 1062534.1

2. Owner: City of El Paso  Address: _____

Tenant: _____  Address: _____

Driller: City  Address: _____

3. Elevation of 4050.5 LSD is _____ ft. above msl, determined by _____

4. Drilled: 1 1958; Dug, Cable Tool, Rotary, _____

5. Depth: Rept. 725* ft. Meas. _____ ft.

6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed _____

7. Pump: Mfgr. _____ Type Turbine

No. Stages _____, Bowls Diam. _____ in., Setting _____ ft.

Column Diam. _____ in., Length Tailpipe _____ ft.

8. Motor: Fuel Electric Make & Model _____ HP. _____

9. Yield: Flow _____ gpm, Pump 1357 gpm, (Meas.) Rept., Est. 1/22/58

10. Performance Test: Date _____ Length of Test 24 hrs. Made by _____

Static Level _____ ft. Pumping Level _____ ft. Drawdown 45 ft.

Production 1357 gpm Specific Capacity 30.1 gpm/ft.

CASING & BLANK PIPE
Cemented From _____ ft. to _____ ft.

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 24 | | | |
| 18 | | | |
| 12 | | | |

11. Water Level: 337.38 ft. (meas) rept. 1/9 1958 (above) below top of 1" meas pipe which is 3.4 ft. (above) below surface.

363.1 ft. meas rept. Jan 1974 above (below) LSD which is _____ ft. above below surface.

_____ ft. meas rept. _____ 19__ above below which is _____ ft. above below surface.

_____ ft. meas rept. _____ 19__ above below which is _____ ft. above below surface.

12. Use: Dom., Stock, Public Supply, (Ind.), Irr., Waterflooding, Observation, Not Used, To supply EP Elec. Co. Sp. Cap. 30.1

13. Quality: (Remarks on taste, odor, color, etc.) Good

Temp. 81 °F, Date sampled for analysis _____ Laboratory City

Temp. ___ °F, Date sampled for analysis _____ Laboratory _____

Temp. ___ °F, Date sampled for analysis _____ Laboratory _____

WELL SCREEN
Screen Openings _____

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

14. Other data available as circled: Driller's Log, Radioactivity Log, (Electric Log),

Formation Samples, Pumping Test, _____

15. Record by: TWDB Date 2/20 1975

Source of Data USGS well sched (ER Leggat 12/3/57)

16. Remarks:
*Plugged back to 625'
Electric log indicates water with Cl < 250 ppm extends to depth of about 590'

ck w/ from shelf no wells here.

49-05-202

TWDBE-WD-2 (Sketch)

# WELL DATA

WELL NUMBER E-1

JL-49-05-202

## PUMP DATA

Make _____

Type _____

Stages _____

Tubing _____

Shaft _____

Column _____

Serial Number _____

Setting _____

O. D. Bowls _____

Capacity — GPM _____ / Feet Head _____

## MOTOR DATA

Make _____

Volts _____

Amps _____

Type _____

Motor H. P. _____

Speed _____

Cycles - Phase _____

Serial Number _____

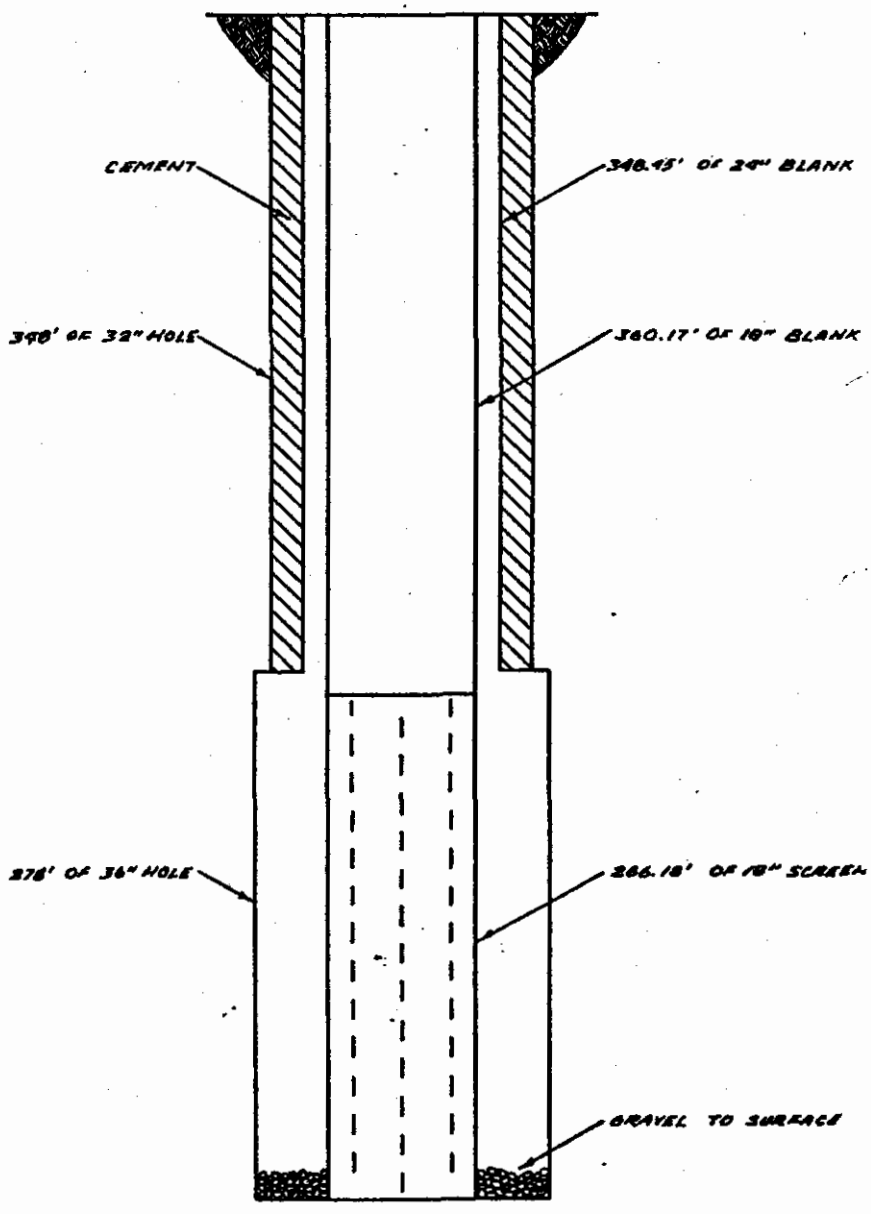
Date Installed _____

## SCALE

Vertical _____

Horizontal _____

## MATERIALS




T.D. 626'

E-1

49 05 202

JL-49-05-202

** NOV 22 1988 AT 36 NWIS 88.1 PROGRAM JWENTE TRANSACTION NO.: 1

BTF EDTLC #1 9/19/88

RECORD NO.: 98804212
SITE ID: 315909106253401 LAB ID NO.: 2860050 PROJECT: 46480020C3
STATION NAME: JL-49-05-202 STATE: 48
BEGIN DATE: 09-19-1988 AT 1315 END DATE: - - AT COUNTY: 141
GEOLOGIC UNIT: DATA TYPES:
STATUS: H SOURCE: 9 HYD. CONDITION: 9 TYPE: 9 HYD. EVENT: 9
MEDIUM: 6 REMARKS TO LAB:
SAMPLE COST: $64.65 REMARKS FROM LAB: EL PASO County
SCHEDULES USED: 1022
NO. PARAMETERS: 21 PROCESSING STATUS: R

| | CODE | PARAMETER NAME | UNITS | VALUE | REM | QA | MET | SIG |
|---|---|---|---|---|---|---|---|---|
| | 00010 | WATER TEMPERATURE | (DEGREES) | 27.5 | | A | | 3 |
| | 00027 | COLLECTING AGENCY | (CODE NUMBER) | 1028 | | A | | 4 |
| NEW--> | 00028 | ANALYZING AGENCY | (CODE NUMBER) | 80020 | | H | | 5 |
| | 00095 | SPECIFIC CONDUCTANCE | US/CM @ 25C | 698 | | A | | 3 |
| | 00400 | PH | (STANDARD UNITS) | 8.10 | | A | | 3 |
| ~~NEW -->~~ | ~~00403~~ | ~~PH LABORATORY~~ | ~~(UNITS)~~ | ~~8.10~~ | | H | A | 3 |
| | 00410 | ALKALINITY,WH,FET,F | (MG/L AS CACO3) | 116 | | A | | 3 |
| NEW--> | 00631 | NO2 + NO3 DISSOLVED | (MG/L AS N) | 1.80 | | H | B | 3 |
| COMPUTED | 00900 | HARDNESS TOTAL | (MG/L AS CAO3) | 100 | | | | |
| COMPUTED | 00902 | NONCARBONATE HARD. F | (MG/L AS CACO3) | 0 | | | | |
| NEW--> | 00915 | CALCIUM DISSOLVED | (MG/L AS CA) | 30 | | H | D | 2 |
| NEW--> | 00925 | MAGNESIUM DISSOLVED | (MG/L AS MG) | 6.9 | | H | C | 2 |
| NEW--> | 00930 | SODIUM DISSOLVED | (MG/L AS NA) | 94 | | H | C | 2 |
| COMPUTED | 00931 | SODIUM ADSORPTION R. | (RATIO) | 4 | | | | |
| COMPUTED | 00932 | SODIUM PERCENT | (PERCENT) | 65 | | | | |
| NEW--> | 00935 | POTASSIUM DISSOLVED | (MG/L AS K) | 8.2 | | H | B | 2 |
| NEW--> | 00940 | CHLORIDE DISSOLVED | (MG/L AS CL) | 100 | | H | E | 2 |
| NEW--> | 00945 | SULFATE DISSOLVED | (MG/L AS SO4) | 54 | | H | D | 2 |
| NEW--> | 00950 | FLUORIDE DISSOLVED | (MG/L AS F) | 0.60 | | H | B | 2 |
| NEW--> | 00955 | SILICA DISSOLVED | (MG/L AS SIO2) | 34 | | H | D | 2 |
| NEW--> | 01020 | BORON DISSOLVED | (UG/L AS B) | 100 | | H | B | 2 |
| COMPUTED | 70301 | DISSOLVED SOLIDS SUM | MG/L | 397 | | | | |
| | 72002 | DEPTH-TOP-WATER ZONE | FT | 360 | | A | | 3 |
| | 72003 | DEPTH-BOT.WATER ZONE | FT | 625 | | A | | 3 |
| | 72008 | DEPTH OF WELL IN FT. | FT | 625.00 | | A | | 3 |
| -NEW--> | 90095 | SPECIFIC CONDUCTANCE | MICROSIEMENS/CM | ~~674~~ | | H | A | 3 |

KEY PUNCHED

RECORD NUMBER: 804212

STATION ID: USGS 315909106253401

STATION NAME: JL-49-05-202

COLLECTION DATE: 09-19-1988 1315 - -

| CATIONS | (MG/L) | (MEQ/L) | ANIONS | (MG/L) | (MEQ/L) |
|---|---|---|---|---|---|
| CALCIUM, DISS. MG/L | 30.000 | 1.498 | CHLORIDE, DISS. MG/L | 100.001 | 2.822 |
| MAGNESIUM, DISS. MG/L | 6.901 | 0.568 | SULFATE, DISS. MG/L | 54.000 | 1.125 |
| SODIUM, DISS. MG/L | 94.000 | 4.090 | FLUORIDE, DISS. MG/L | 0.600 | 0.032 |
| POTASSIUM, DISS. MG/L | 8.201 | 0.210 | ALKALINITY, FET, FLD \| | 116.001 | 2.318 |
| | | | NO2 + NO3, DISS. AS N | 1.800 | 0.129 |
| | | --- | | | --- |
| TOTAL | | 6.364 | TOTAL | | 6.424 |

PERCENT DIFFERENCE = -0.46

KEY PUNCHED

MD

JL-49-05-202
6/28/88
EPIC # 1

EP 15 1988 AT 1323 NWIS 88.1 PROGRAM QWENTER TRANSACTION NO.: 1

KEY PUNCHED

RECORD NO.: 88804007
SITE ID: 315909106253401 LAB ID NO.: 1870263 PROJECT: 4648002C3
TATION NAME: JL-49-05-202 STATE: 48
BEGIN DATE: 06-23-1988 AT 1510 END DATE: - - AT COUNTY: 141
OLOGIC UNIT: DATA TYPES:
STATUS: H SOURCE: 9 HYD. CONDITION: 9 TYPE: 9 HYD. EVENT: 9
MEDIUM: 6 REMARKS TO LAB:
SAMPLE COST: $64.65 REMARKS FROM LAB:
EDULES USED: 1022
PARAMETERS: 22 PROCESSING STATUS: R

KEY PUNCHED EL PASO County

Requested Reruns 9/20/88 Ca = 31 Na = 95
Updated 10-11-88

| | CODE | PARAMETER NAME | UNITS | VALUE | REM | QA | MET | SIG |
|---|---|---|---|---|---|---|---|---|
| | 00010 | WATER TEMPERATURE | (DEGREES) | 27.5 | | A | | 3 |
| | 00027 | COLLECTING AGENCY | (CODE NUMBER) | 1028 | | A | | 4 |
| > | 00028 | ANALYZING AGENCY | (CODE NUMBER) | 80020 | | H | | 5 |
| | 00095 | SPECIFIC CONDUCTANCE | US/CM @ 25C | 715 | | A | | 3 |
| | 00400 | PH | (STANDARD UNITS) | 8.10 | | A | | 3 |
| > | 00403 | PH LABORATORY | (UNITS) | 8.00 | | H | A | 3 |
| | 00410 | ALKALINITY,WH,FET,F | (MG/L AS CACO3) | 120 | | A | | 3 |
| > | 00631 | NO2 + NO3 DISSOLVED | (MG/L AS N) | 1.80 | | H | B | 3 |
| D | 00900 | HARDNESS TOTAL | (MG/L AS CAO3) | 96 | | | | |
| D | 00902 | NONCARBONATE HARD. F | (MG/L AS CACO3) | 0 | | | | |
| > | 00915 | CALCIUM DISSOLVED | (MG/L AS CA) | 28 | | H | D | 2 |
| > | 00925 | MAGNESIUM DISSOLVED | (MG/L AS MG) | 6.3 | | H | C | 2 |
| > | 00930 | SODIUM DISSOLVED | (MG/L AS NA) | 90 | | H | C | 2 |
| D | 00931 | SODIUM ADSORPTION R. | (RATIO) | 4 | | | | |
| D | 00932 | SODIUM PERCENT | (PERCENT) | 65 | | | | |
| > | 00935 | POTASSIUM DISSOLVED | (MG/L AS K) | 7.8 | | H | B | 2 |
| > | 00940 | CHLORIDE DISSOLVED | (MG/L AS CL) | 99 | | H | E | 2 |
| > | 00945 | SULFATE DISSOLVED | (MG/L AS SO4) | 53 | | H | D | 2 |
| > | 00950 | FLUORIDE DISSOLVED | (MG/L AS F) | 0.60 | | H | B | 2 |
| > | 00955 | SILICA DISSOLVED | (MG/L AS SIO2) | 32 | | H | D | 2 |
| > | 01020 | BORON DISSOLVED | (UG/L AS B) | 100 | | H | B | 2 |
| D | 70301 | DISSOLVED SOLIDS SUM | MG/L | 389 | | | | |
| | 72002 | DEPTH-TOP-WATER ZONE | FT | 360 | | A | | 3 |
| | 72003 | DEPTH-BOT.WATER ZONE | FT | 625 | | A | | 3 |
| | 72004 | PUMP PERIOD (MIN) ) | MIN | 760 | | A | | 3 |
| | 72008 | DEPTH OF WELL IN FT. | FT | 625.00 | | A | | 5 |
| > | 90095 | SPECIFIC CONDUCTANCE | MICROSIEMENS/CM | 673 | | H | A | 3 |

JL-99-05-202
6/28/88

RECORD NUMBER: 93804007

STATION ID: USGS 315909106253401

STATION NAME: JL-99-05-202

LLECTION DATE: 06-28-1988 1510

KEY PUNCHED

| ATIONS | | (MG/L) | (MEQ/L) | ANIONS | | (MG/L) | (MEQ/L) |
|---|---|---|---|---|---|---|---|
| CALCIUM, | DISS. MG/L | 31 | 1.547 | CHLORIDE, | DISS. MG/L | 99.000 | 2.793 |
| MAGNESIUM, | DISS. MG/L | 6.300 | 0.519 | SULFATE, | DISS. MG/L | 53.000 | 1.104 |
| SODIUM, | DISS. MG/L | 95 | 4.132 | FLUORIDE, | DISS. MG/L | 0.600 | 0.032 |
| POTASSIUM, | DISS. MG/L | 7.800 | 0.200 | ALKALINITY, FET, FLD | | 120.001 | 2.398 |
| | | | | NO2 + NO3, | DISS. AS N | 1.800 | 0.129 |
| TOTAL | | | 6398 | TOTAL | | | 6.455 |

PERCENT DIFFERENCE = -.40

JL-49-05-202
[redacted] EPEC ww#1
4/7/89

Key Punched

** MAY 09 1989 AT 1451 NWIS 8d.1 PROGRAM QWENTER TRANSACTION NO.: 1

RECORD NO.: 98901633
SITE ID: 315904106253401 LAB IO NO.: 1030132 PROJECT: 4648002C3
STATION NAME: JL-49-05-202 STATE: 48
BEGIN DATE: 04-07-1989 AT 1247 END DATE: - - AT COUNTY: 141
GEOLOGIC UNIT: DATA TYPES:
STATUS: H SOURCE: 9 HYD. CONDITION: 9 TYPE: 9 HYD. EVENT: 9
MEDIUM: 6 REMARKS TO LAB:
SAMPLE COST: 464.75 REMARKS FROM LAB:
SCHEDULES USED: 1022
NO. PARAMETERS: 21 PROCESSING STATUS: R

| | CODE | PARAMETER NAME | UNITS | VALUE | REM | QA | MET | SIG |
|---|---|---|---|---|---|---|---|---|
| | 00010 | WATER TEMPERATURE | (DEGREES) | 22.0 | | A | | 3 |
| | 00027 | COLLECTING AGENCY | (CODE NUMBER) | 1026 | | A | | 4 |
| NEW--> | 00028 | ANALYZING AGENCY | (CODE NUMBER) | 90020 | | H | | 5 |
| | 00095 | SPECIFIC CONDUCTANCE | US/CM @ 25C | 684 | | A | | 5 |
| | 00400 | PH | (STANDARD UNITS) | 7.80 | | A | | 5 |
| NEW--> | [redacted] | PH LABORATORY | (UNITS) | 8.10 | | H | A | 3 |
| | 00410 | ALKALINITY,WH,FET,F | (MG/L AS CACO3) | 122 | | A | | 3 |
| NEW--> | 00631 | NO2 + NO3 DISSOLVED | (MG/L AS N) | 1.70 | | H | B | 3 |
| COMPUTED | 00900 | HARDNESS TOTAL | (MG/L AS CAO3) | 100 | | | | |
| COMPUTED | 00902 | NONCARBONATE HARD. F | (MG/L AS CACO3) | 0 | | | | |
| NEW--> | 00915 | CALCIUM DISSOLVED | (MG/L AS CA) | 29 | | H | D | 2 |
| NEW--> | 00925 | MAGNESIUM DISSOLVED | (MG/L AS MG) | 6.8 | | H | C | 2 |
| NEW--> | 00930 | SODIUM DISSOLVED | (MG/L AS NA) | 94 | | H | C | 2 |
| COMPUTED | 00931 | SODIUM ABSORPTION R. | (RATIO) | 4 | | | | |
| COMPUTED | 00932 | SODIUM, PERCENT | PERCENT | 65 | | | | |
| NEW--> | 00935 | POTASSIUM DISSOLVED | (MG/L AS K) | 3.0 | | H | B | 2 |
| NEW--> | 00940 | CHLORIDE DISSOLVED | (MG/L AS CL) | 99 | | H | E | 2 |
| NEW--> | 00945 | SULFATE DISSOLVED | (MG/L AS SO4) | 54 | | H | D | 2 |
| NEW--> | 00950 | FLUORIDE DISSOLVED | (MG/L AS F) | 0.70 | | H | B | 2 |
| NEW--> | 00955 | SILICA DISSOLVED | (MG/L AS SIO2) | 33 | | H | D | 2 |
| NEW--> | 01020 | BORON DISSOLVED | (UG/L AS B) | 100 | | H | B | 2 |
| COMPUTED | 70301 | DISSOLVED SOLIDS SUM | MG/L | 398 | | | | |
| | 72002 | DEPTH-TOP-WATER ZONE | FT | 360 | | A | | 3 |
| | 72003 | DEPTH-BOT.WATER ZONE | FT | 625 | | A | | 3 |
| | 72008 | DEPTH OF WELL IN FT. | FT | 625.00 | | A | | 5 |
| NEW--> | [redacted] | SPECIFIC CONDUCTANCE | MICROSIEMENS/CM | 687 | | H | A | 3 |

RECORD NUMBER: 93901633

STATION ID: USGS 315709106253401

STATION NAME: JL-49-05-202

COLLECTION DATE: 04-07-1993 1247

| CATIONS | | (MG/L) | (MEQ/L) | ANIONS | | (MG/L) | (MEQ/L) |
|---|---|---|---|---|---|---|---|
| CALCIUM, | DISS. MG/L | 29.000 | 1.446 | CHLORIDE, | DISS. MG/L | 99.000 | 2.793 |
| MAGNESIUM, | DISS. MG/L | 6.000 | 0.560 | SULFATE, | DISS. MG/L | 54.000 | 1.125 |
| SODIUM, | DISS. MG/L | 94.000 | 4.090 | FLUORIDE, | DISS. MG/L | 0.701 | 0.037 |
| POTASSIUM, | DISS. MG/L | 8.000 | 0.205 | ALKALINITY, FET, FLD | | 122.001 | 2.438 |
| | | | | NO2 + NO3, | DISS. AS N | 1.701 | 0.122 |
| | | | --- | | | | --- |
| | TOTAL | | 6.301 | | TOTAL | | 6.513 |

PERCENT DIFFFRENCE = -1.65

JM 48-05-202

# EL PASO WATER UTILITIES
## WATER ANALYSIS REPORT

DATE SAMPLE COLLECTED 05-21-87 WELL NUMBER E-1
DATE RECEIVED AT LABORATORY 05-21-87 LAB. NUMBER C052187-5
DATE ANALYSIS COMPLETED 05-22-87 LOCATION NE AREA
OWNER
SAMPLE TAKER R. SPERKA
DELIVERED BY R. SPERKA

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0 | ****** | ****** |
| Total Alkalinity as CaCO3 | 111 | ****** | ****** |
| Carbonates as CO3 | 0.00 | 0 | 0 |
| Bicarbonates as HCO3 | 135 | 2.21953 | 97 |
| Chlorides as Cl | 110 | 3.1031 | 236 |
| Sulfates as SO4 | 48 | .99936 | 74 |
| Fluorides as F | .63 | .033163 | ****** |
| Nitrates as NO3 LOD=.43 | 7.2 | .116136 | 8 |
| Total Phosphates as PO4 LOD=.09 | 0 | 0 | ****** |
| Total Anions = | 301 | 6.47129 | 414 |

| CATIONS | | | |
|---|---|---|---|
| Total Hardness as CaCO3 | 104 | ****** | ****** |
| Calcium as Ca | 31 | 1.5469 | 80 |
| Magnesium as Mg | 6.44 | .529356 | 25 |
| Sodium as Na | 100 | 4.35 | 213 |
| Potassium as K | 8.30 | .212231 | 15 |
| Total Cations = | 146 | 6.63849 | 333 |
| TOTAL DISSOLVED SOLIDS = | 447 | 13.1098 | 747 |

| | |
|---|---|
| Silica, SiO2 = | 32 |
| Chlorine Res. = | NA |
| Turbidity,ntu = | .11 |
| Sample Temp(C)= | 25 |
| pH @ 25 | 8.06 |
| Lab E.C.@25C as umhos/cm = | 685 |
| Field E.C. @25C as umhos/cm = | 660 |
| pH Saturation = | 7.93 |
| Langelier Ind.= | 0.13 |
| Aggress. Index= | 12.12 |
| % Na of T Cat.= | 66 |

Remarks _____
LOD = LIMIT OF DETECTION

CHECKING CORRECTNESS OF ANALYSIS
Measured Diluted E.C. = 730
Calculated Diluted E.C.= 747
% Error = 2.33

ANION-CATION BALANCE
Total Anions - Total Cations =
+or-(0.1065+0.0155* T.ANIONS)
-.16719=<+or-1SD= +or- .206805 MAX. LIMIT

ANALYST M Sprattler L Ray DOR
P.O. BOX 511
El Paso,Texas 79961

**EL Paso Electric Company**
P. O. BOX 982 - EL PASO, TEXAS

NEWMAN WATER WELLS

# WATER ANALYSIS DATA SHEET

| Well or Sample Number | E-1 | E-3 | E-4 | E-5 | E-6 | E-7 | | |
|---|---|---|---|---|---|---|---|---|
| Date Collected | 1-20-76 | 2-5-76 | 11-1-74 | 11-1-74 | 12-31-75 | 1-15-76 | | |
| | 49-05-202 | 201 | 208 | 305 | 211 | 213 | | |
| pH | 7.25 | 7.6 | 7.75 | 7.95 | 7.7 | 7.2 | | |
| Conductivity, micromhos | 775 | 675 | 950 | 580 | 750 | 1,225 | | |
| Total dissolved solids from conductivity | 620 | 540 | 760 | 460 | 600 | 980 | | |
| Total dissolved solids, calculated | 492 | 514 | 717 | 436 | 526 | 797 | | |
| Total Hardness as $CaCO_3$ | 120 | 102 | 164 | 116 | 144 | 176 | | |
| Phenol. Alkalinity as $CaCO_3$ | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Total Alkalinity as $CaCO_3$ | 126 | 150 | 152 | 112 | 102 | 68 | | |
| Carbonate Alkalinity as $CO_3$ | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Bicarbonate Alkalinity as $HCO_3$ | 153 | 183 | 185 | 136 | 124 | 83 | | |
| Sulphates as $SO_4$ | 60 | 60 | 100 | 50 | 50 | 60 | | |
| Chlorides as Cl | 100 | 85 | 164 | 84 | 162 | 350 | | |
| Calcium as Ca | 32 | 28 | 26 | 24 | 40 | 56 | | |
| Magnesium as Mg | 10 | 9 | 24 | 14 | 10 | 9 | | |
| Sodium, calculated as Na | 109 | 121 | 189 | 98 | 109 | 205 | | |
| Silica as $SiO_2$ | 28 | 28 | 31 | 30 | 30 | 33 | | |

**REMARKS:**

Well: _____

Depth: _____

Location: _____



49-05-202

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer Hueco Bolson  Field No. E-Dw-1 R-81  State Well No. 49-05-203

Owner's Well No. _____  County El Paso

Disposal well #1

1. Location: ___ 1/4, NE 1/4 Sec. 11, Block 81 Survey _____
   31 58 52 N 106 25 55.1
2. Owner: El Paso Electric Co Address: _____
   Tenant: _____ Address: _____
   Driller: City Address: _____
3. Elevation of 4049.37 CSD is _____ ft. above msl, determined by USGS
4. Drilled: _____ 19___; Dug, Cable Tool, Rotary, _____
5. Depth: Rept. 1483 ft. Meas. _____ ft.
6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed _____
7. Pump: Mfgr. _____ Type _____
   No. Stages _____, Bowls Diam. ___ in., Setting _____ ft.
   Column Diam. _____ in., Length Tailpipe _____ ft.
8. Motor: Fuel _____ Make & Model _____ HP. _____
9. Yield: Flow ___ gpm, Pump 528 gpm, Meas., Rept., Est. 10/29/57
10. Performance Test: Date _____ Length of Test ? 4 Made by _____
    Static Level ___ ft. Pumping Level ___ ft. Drawdown 71 ft. Sp. Cap: 8.1/24 hrs
    Production 528 gpm Specific Capacity _____ gpm/ft.
11. Water Level: 344.0 ft. rept. meas. 10/26 1959 above below meas pipe in temp pump which is 5.0 ft. above below surface.
    _____ ft. rept. meas. _____ 19___ above below which is ___ ft. above below surface.
    _____ ft. rept. meas. _____ 19___ above below which is ___ ft. above below surface.
    _____ ft. rept. meas. _____ 19___ above below which is ___ ft. above below surface.
12. Use: Dom., Stock, Public Supply, Ind., Irr., Waterflooding, Observation, Not Used, Disposal well
13. Quality: (Remarks on taste, odor, color, etc.) Salina : Cl = 6860
    Temp. 94 °F, Date sampled for analysis _____ Laboratory _____
    Temp. ___ °F, Date sampled for analysis _____ Laboratory _____
    Temp. ___ °F, Date sampled for analysis _____ Laboratory _____
14. Other data available as circled: Driller's Log, Radioactivity Log, Electric Log,
    Formation Samples, Pumping Test, _____
15. Record by: TWDB Date ?/20 1975
    Source of Data USGS well sched (ERleggat 9/15/59)
16. Remarks:
    Drilled for disposal of blow-off water
    Base of fresh water = 840

CASING & BLANK PIPE

Cemented From ___ ft. to ___ ft.

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| | | | 1188 |

WELL SCREEN

Screen Openings

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| | Stainless steel screen | 990 | 1188 |

TWDB-WD-2 (Sketch)

49-05-203

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer Hueco Bolson  Field No. R-84  State Well No. 49 05 204

Owner's Well No. 41  County El Paso

1. Location: ___ 1/4, ___ 1/4 Sec. ___, Block ___ Survey ___

2. Owner: City of El Paso  Address: ___

Tenant: ___  Address: ___

Driller: City  Address: ___

3. Elevation of 4044.0 is ___ ft. above msl, determined by ___

4. Drilled: Dec 1959; Dug, Cable Tool, Rotary, ___

5. Depth: Rept. 515 ft. Meas. ___ ft.

6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed

7. Pump: Mfgr. U.S. Pumps  Type turbine

No. Stages 13, Bowls Diam. ___ in., Setting ___ ft.

Column Diam. ___ in., Length Tailpipe ___ ft.

8. Motor: Fuel Elec.  Make & Model Louis-Allis  HP. 200

9. Yield: Flow ___ gpm, Pump ___ gpm, Meas., Rept., Est. ___

10. Performance Test: Date 1-26-60  Length of Test ___  Made by ___

Static Level ___ ft. Pumping Level ___ ft. Drawdown 7.1 ft.

Production 1400 gpm  Specific Capacity ___ gpm/ft.

CASING & BLANK PIPE

Cemented From 0 ft. to 345 ft.

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 24 | Steel | 0 | 345.04 |
| 18 | Steel | 0 | 358.73 |

11. Water Level: 335.08 ft. rept. meas. 1-5- 1960 above below mp which is 3.5 ft. above below surface.

357.48 ft. rept. meas. 1/7 1975 above below LSD which is ___ ft. above below surface.

___ ft. rept. meas. ___ 19__ above below which is ___ ft. above below surface.

___ ft. rept. meas. ___ 19__ above below which is ___ ft. above below surface.

12. Use: Dom., Stock, Public Supply, Ind., Irr., Waterflooding, Observation, Not Used, test well

13. Quality: (Remarks on taste, odor, color, etc.) ___

Temp. ___ °F, Date sampled for analysis ___ Laboratory ___

Temp. ___ °F, Date sampled for analysis ___ Laboratory ___

Temp. ___ °F, Date sampled for analysis ___ Laboratory ___

WELL SCREEN

Screen Openings ___

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 18 | Slotted | 358.73 | 515 |

14. Other data available as circled: Driller's Log, Radioactivity Log, Electric Log, Formation Samples, Pumping Test, ___

15. Record by: TWDB - El Paso  Date ___ 1972

Source of Data USGS well sched. by E. R. Leggett 12-6-59

16. Remarks:

Pump set at 40 ft. Base of freshwater = 620'.

Plugged back to 515'

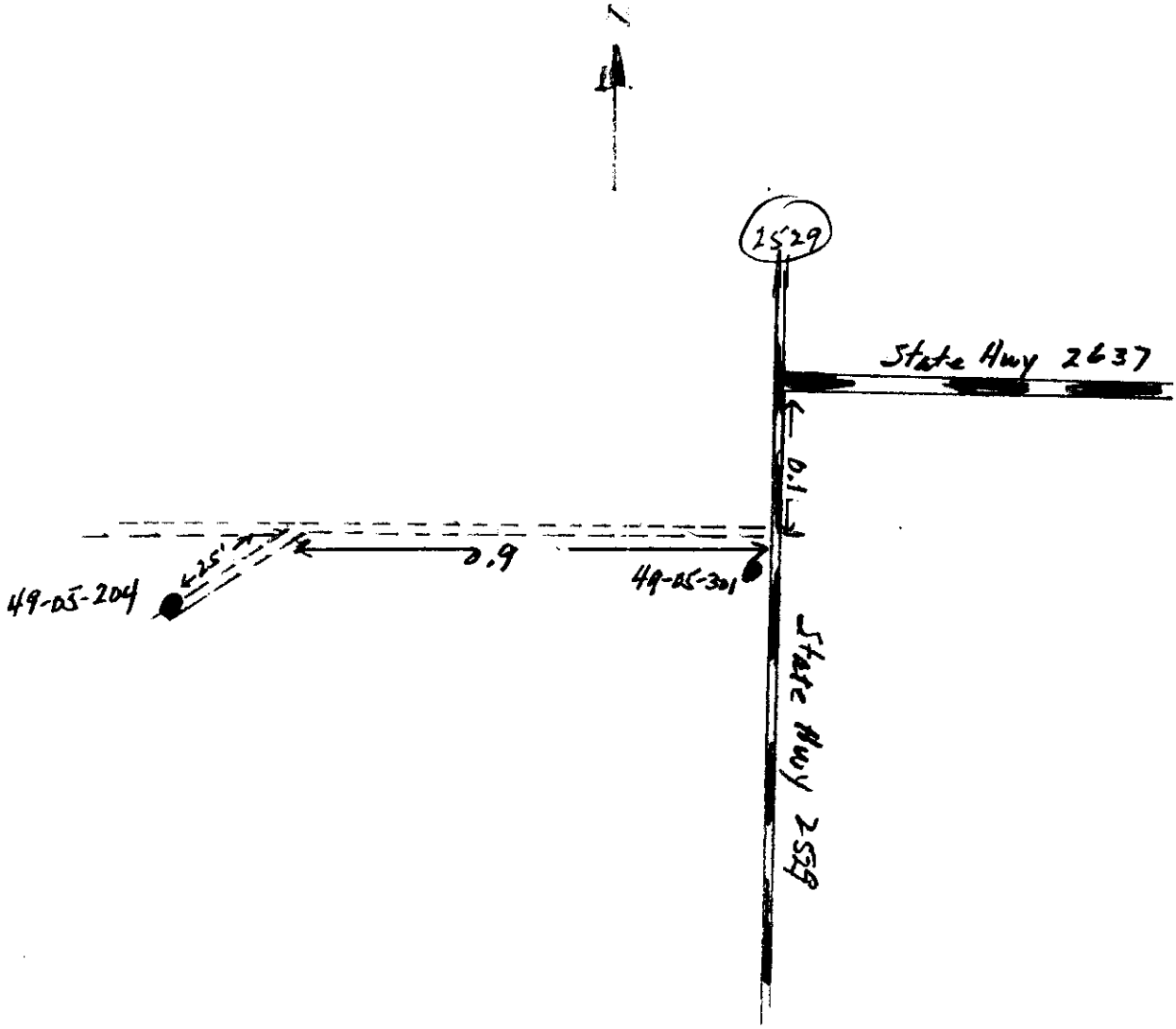
Electric log

Obs Well

TWDBE-WD-2  (Sketch)



49-05-204


1529
State Hwy 2637
0.1
0.9
49-05-204
49-05-301
State Hwy 2529

# WELL DATA

WELL NUMBER 41

JL-49-05-204

## PUMP DATA

Make U. S.

Type

Stages 13

Tubing

Shaft 1-15/16"

Column

Serial Number 26536

Setting

O. D. Bowls

Capacity — GPM

Capacity — Feet Head

## MOTOR DATA

Make LOUIS-ALLIS

Volts 440

Amps 232

Type COGOX

Motor H. P. 200

Speed 1180 RPM

Cycles - Phase 60 - 3 PHASE

Serial Number 587PTO

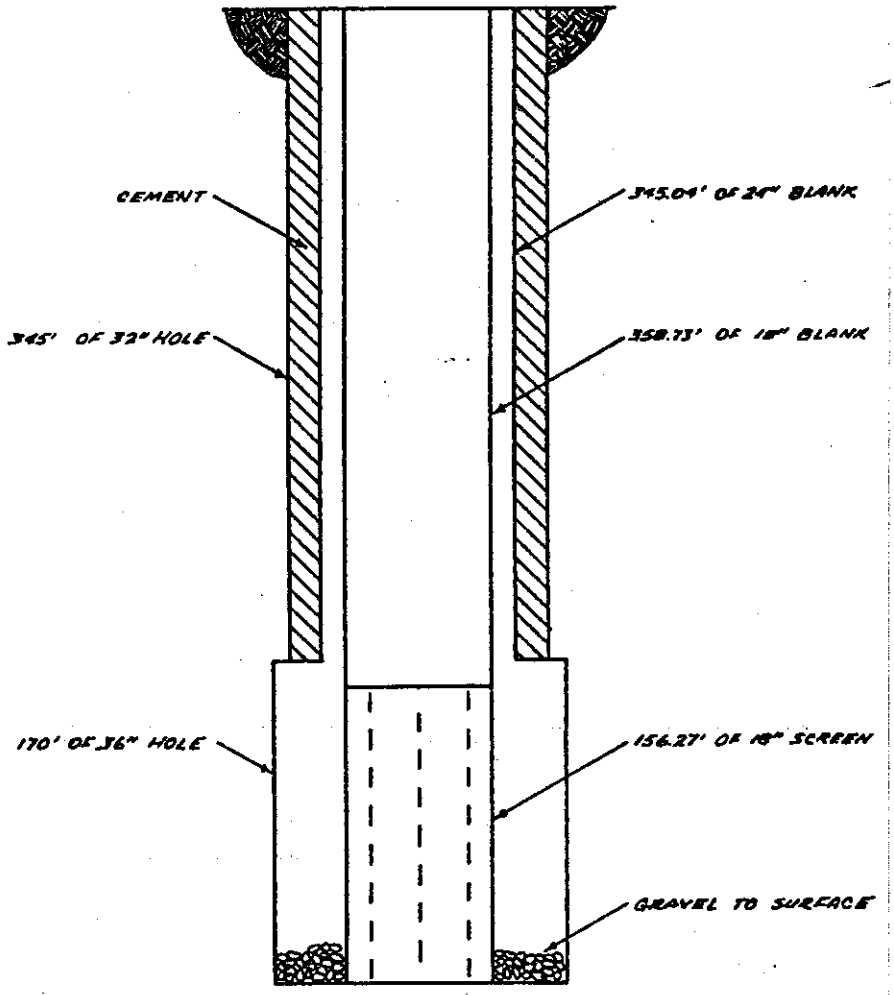
Date Installed

## SCALE

Vertical 1" = 100'

Horizontal ½" = 1'

## MATERIALS




T.D. 515'

41

49 05 204



R.S.A. FORM 2002 0665

JL-49-05-204

* SEP 06 1988 AT 0908 NWIS 88.1 PROGRAM QWENTEK TRANSACTION NO.: 457

Drop 5/23/88

RECORD NO.: 98802427
SITE ID: 315816106252701 LAB ID NO.: 1470041 PROJECT: 464800203
STATION NAME: JL-49-05-204 STATE: 48
BEGIN DATE: 05-23-1988 AT 1210 END DATE: - - AT COUNTY: 141
GEOLOGIC UNIT: DATA TYPES:
STATUS: H SOURCE: 9 HYD. CONDITION: 9 TYPE: 9 HYD. EVENT: 9
MEDIUM: 6 REMARKS TO LAB:
SAMPLE COST: $163.80 REMARKS FROM LAB: -- El Paso County
SCHEDULES USED:
NO. PARAMETERS: 10 PROCESSING STATUS: R

| | CODE | PARAMETER NAME | UNITS | VALUE | REM | QA | MET | SIG |
|---|---|---|---|---|---|---|---|---|
| | 00010 | WATER TEMPERATURE | (DEGREES) | 29.0 | | I | | 3 |
| DATE | 00028 | ANALYZING AGENCY | (CODE NUMBER) | 80020 | | H | | 5 |
| | 00095 | SPECIFIC CONDUCTANCE | US/CM @ 25C | 900 | | I | | 3 |
| | 00400 | PH | (STANDARD UNITS) | 7.90 | | I | | 3 |
| | 00610 | NITROGEN AMMONIA T. | (MG/L AS N) | 0.010 | 1 | H | B | 3 |
| | 00615 | NITROGEN,NITRITE T. | MG/L AS N | 0.010 | 1 | H | B | 3 |
| | 00625 | NITROGEN AMM+ORG TOT | (MG/L AS N) | 0.30 | | H | A | 2 |
| | 00630 | NO2 + NO3 TOTAL | (MG/L AS N) | 1.20 | | H | B | 3 |
| | 00665 | PHOSPHOROUS TOTAL | (MG/L AS P) | 0.010 | 1 | H | B | 3 |
| DATE | 82084 | NITROGEN 15/14 RATIO | RATIO PER MIL | 7.60 | | H | A | 3 |

KEY PUNCHED

JL-49-05-204
5/23/88
FPWA # 41

** JUN 15 1988 AT 1517 NWIS 88.1 PROGRAM QWENTER TRANSACTION NO.: 94

RLT

RECORD NO.: 98802427
SITE IO: 315816106252701 LAB ID NO.: 1470041 PROJECT: 464800203
STATION NAME: JL-49-05-204 STATE: 48
BEGIN DATE: 05-23-1988 AT 1210 END DATE: - - AT COUNTY: 141
GEOLOGIC UNIT: DATA TYPES:
STATUS: H SOURCE: 9 HYD. CONDITION: 9 TYPE: 9 HYD. EVENT: 9
MEDIUM: 6 REMARKS TO LAB:
SAMPLE COST: $37.45 REMARKS FROM LAB:
SCHEDULES USED: 1134
NO. PARAMETERS: 9 PROCESSING STATUS: R

| | CODE | PARAMETER NAME | UNITS | VALUE | REM | QA | MET | SIG |
|---|---|---|---|---|---|---|---|---|
| | 00010 | WATER TEMPERATURE | (DEGREES) | 29.0 ✓ | | I | | 3 |
| NEW--> | 00028 | ANALYZING AGENCY | (CODE NUMBER) | 80020 | | H | | 5 |
| | 00095 | SPECIFIC CONDUCTANCE | US/CM @ 25C | 900 ✓ | | I | | 3 |
| | 00400 | PH | (STANDARD UNITS) | 7.90 ✓ | | I | | 3 |
| NEW--> | 00610 | NITROGEN AMMONIA T. | (MG/L AS N) | 0.010* | 1 | H | B | 3 |
| NEW--> | 00615 | NITROGEN, NITRITE T. | MG/L AS N | 0.010* | 1 | H | B | 3 |
| NEW--> | 00625 | NITROGEN ~~AMMONIA~~ T. | (MG/L AS N) | 0.30* | | H | A | 2 |
| NEW--> | 00630 | NO2 + NO3 TOTAL | (MG/L AS N) | 1.20* | | H | B | 3 |
| NEW--> | 00665 | PHOSPHOROUS TOTAL | (MG/L AS P) | 0.010* | 1 | H | B | 3 |

KEY PUNCHED

JC-44-09-204
EPWU #41
12/27/89
JC-44-05-204

# EL PASO WATER UTILITIES
## WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED | 12/27/89 | WELL NUMBER | 41 |
| DATE RECEIVED AT LABORATORY | 12/27/89 | LAB. NUMBER | C122789-5 |
| DATE ANALYSIS COMPLETED | 12/29/89 | LOCATION | |
| | | OWNER | EPWU |
| | | SAMPLE TAKER | F. BROOKS |
| | | DELIVERED BY | F BROOKS |

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 1.00 | ****** | ****** |
| Total Alkalinity as CaCO3 | 134.7 | ****** | ****** |
| Carbonates as CO3 | 1.22 | .040663 | 3 |
| Bicarbonates as HCO3 | 162 | 2.65344 | 116 |
| Chlorides as Cl | 139.7 | 3.94094 | 299 |
| Sulfates as SO4 | 79.8 | 1.66144 | 123 |
| Fluorides as F | 1.00 | .05264 | ****** |
| Nitrates as NO3 | 5.57 | .08784 | 6 |
| Total Phosphates as PO4 LOD=.09 | 0.00 | | ****** |
| Total Anions = | 389 | 8.43894 | 547 |

| CATIONS | | | |
|---|---|---|---|
| Total Hardness as CaCO3 | 138 | ****** | ****** |
| Calcium as Ca | 40.1 | 2.00099 | 104 |
| Magnesium as Mg | 9.20 | .756792 | 35 |
| Sodium as Na | 122.1 | 5.31135 | 260 |
| Potassium as K | 8.70 | .222459 | 16 |
| Total Cations = | 180 | 8.29159 | 415 |
| TDS BY EPWU METHOD (1)= | 569 | 16.7306 | 762 |
| TDS BY USGS METHOD (2)= | 528 | | |
| TDS BY TDH METHOD (3)= | 487 | | |

| | |
|---|---|
| Silica, SiO2 = | 41.00 |
| Chlorine Res. = | N/A |
| Turbidity,ntu = | 0.48 |
| Sample Temp(C)= | 22.7 |
| pH @ 22.7 | 8.35 |
| Lab E.C.@25C as umhos/cm = | 852 |
| Field E.C. @25C as umhos/cm = | N/A |
| pH Saturation = | 7.80 |
| Langelier Ind.= | 0.55 |
| Aggress. Index= | 12.62 |
| % Na of T Cat.= | 64 |

Remarks
LOD = LIMIT OF DETECTION

Std. Dev. = 0.63

CHECKING CORRECTNESS OF ANALYSIS
Measured Diluted E.C. = 952
Calculated Diluted E.C.= 962
% Error = 1.04

(1) SUM OF IONS, NOT INCLUDING SILICA
(2) SUM OF IONS PLUS SILICA, PLUS CONVERSION OF HCO3 TO CO3.
(3) SUM OF IONS, NOT INCLUDING SILICA PLUS CONVERSION OF HCO3 TO CO3.

ANION-CATION BALANCE
Total Anions - Total Cations =
+or-(0.1065+0.0155* T.ANIONS)
.147371=<+or-1SD= +or- .237304 MAX. LIMIT

KEY PUNCHED

ANALYST Judith McBee

WATER SUPPLY MGR Douglas Rattman

PO BOX 511
EL PASO, TEXAS 79961

JL-49-05-204
WELL 41
5/23/88

# EL PASO WATER UTILITIES
## WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED | 05-23-88 | WELL NUMBER | WELL 41 |
| DATE RECEIVED AT LABORATORY | 05-23-88 | LAB. NUMBER | C052388- 10 |
| DATE ANALYSIS COMPLETED | 08-05-88 | LOCATION | MESA WELL FIELD |
| | | OWNER | EPWU |
| | | SAMPLE TAKER | M. SPRESTER |
| | | DELIVERED BY | M. SPRESTER |

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 1.00 | ****** | ****** |
| Total Alkalinity as CaCO3 | 127 | ****** | ****** |
| Carbonates as CO3 | 1.20 | .039996 | 3 |
| Bicarbonates as HCO3 | 153 | 2.49948 | 109 |
| Chlorides as Cl | 151 | 4.25971 | 323 |
| Sulfates as SO4 | 60 | 1.2492 | 92 |
| Fluorides as F | 0.74 | .038954 | ****** |
| Nitrates as NO3 LOD=0.443 | 6.06 | .097748 | 7 |
| Total Phosphates as PO4 LOD=.09 | 0.00 | 0 | ****** |
| Total Anions = | 372 | 8.18508 | 535 |

| CATIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Total Hardness as CaCO3 | 118 | ****** | ****** |
| Calcium as Ca | 37 | 1.8463 | 96 |
| Magnesium as Mg | 6.30 | .518238 | 24 |
| Sodium as Na | 111 | 4.8285 | 236 |
| Potassium as K | 0.00 | 0 | 0 |
| Total Cations = | 154 | 7.19304 | 356 |
| TOTAL DISSOLVED SOLIDS = | 526 | 15.3781 | 891 |

| | |
|---|---|
| Silica, SiO2 = | 48.5 |
| Chlorine Res. = | |
| Turbidity,ntu = | 0.1 |
| Sample Temp(C)= | 22. |
| pH @ 22.1= | 8.3 |
| Lab E.C.@25C as umhos/cm = | 81 |
| Field E.C. @25C as umhos/cm = | N |
| pH Saturation = | 7.8 |
| Langelier Ind.= | 0.5 |
| Aggress. Index= | 12.5 |
| % Na of T Cat.= | 6 |

Remarks
LOD = LIMIT OF DETECTION

TAG#- 560

Na & K calculated as Na

CHECKING CORRECTNESS OF ANALYSIS

| | |
|---|---|
| Measured Diluted E.C. = | 870 |
| Calculated Diluted E.C.= | 890 |
| % Error = | 2.30 |

KEY PUNCHED

ANION-CATION BALANCE
Total Anions - Total Cations =
+or-(0.1065+0.0155* T.ANIONS)
.992044=<+or-1SD= +or- .233369 MAX. LIMIT

ANALYST Maria L. Posada

WATER, SUPPLY MGR
PO BOX 511
EL PASO, TEXAS 79961

JL 98-05-264

8/22/86

# WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED | 07-22-86 | WELL NUMBER | 41 |
| DATE RECEIVED AT LABORATORY | 07-24-86 | LAB. NUMBER | C072586-7 |
| DATE ANALYSIS COMPLETED | 07-30-86 | LOCATION | NEVINS WELL FIELD |
| | | OWNER | |
| | | SAMPLE TAKER | FELIX |
| | | DELIVERED BY | FELIX |

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0 | ****** | ****** |
| Total Alkalinity as CaCO3 | 130 | ****** | ****** |
| Carbonates as CO3 | 0 | 0 | 0 |
| Bicarbonates as HCO3 | 159 | 2.60104 | 113 |
| Chlorides as Cl | 124 | 3.49804 | 266 |
| Sulfates as SO4 | 76 | 1.58232 | 117 |
| Fluorides as F | .84 | .044218 | ****** |
| Nitrates as NO3 LOD=4.43 | 5.2 | .083876 | 6 |
| Total Phosphates as PO4 LOD=.09 | 0 | 0 | ****** |
| Total Anions = | 365 | 7.80949 | 502 |

| CATIONS | | | |
|---|---|---|---|
| Total Hardness as CaCO3 | 108 | ****** | ****** |
| Calcium as Ca | 30 | 1.497 | 78 |
| Magnesium as Mg | 8.3 | .68309 | 32 |
| Sodium as Na | 124 | 5.394 | 264 |
| Potassium as K | 8.8 | .22528 | 16 |
| Total Cations = | 171.1 | 7.79937 | 390 |
| TOTAL DISSOLVED SOLIDS = | 536 | 15.6089 | 891 |

| | |
|---|---|
| Silica, SiO2 = | 33 |
| Chlorine Res. = | |
| Turbidity,ntu = | .16 |
| Sample Temp(C)= | 29 |
| pH @ 29 | 7.72 |
| Lab E.C.@25C as umhos/cm = | 812 |
| Field E.C. @25C as umhos/cm = | |
| pH Saturation = | 7.80 |
| Langelier Ind.= | -0.08 |
| Aggress. Index= | 11.87 |
| % Na of T Cat.= | 69 |

Remarks _____

LOD = LIMIT OF DETECTION

SAMPLE SENT TO NORTH-EAST PLANT FOR METALS. TAG #169

CHECKING CORRECTNESS OF ANALYSIS

Measured Diluted E.C. = 906

Calculated Diluted E.C.= 891

% Error = -1.6556

ANION-CATION BALANCE

Total Anions - Total Cations =

+or-(0.1065+0.0155* T.Cations)

.010124=<+or-ISO= +or- .227390 MAX. LIMIT

ANALYST S. Chávez DOH

EL PASO WATER UTILITIES
PUBLIC SERVICE BOARD

# WATER ANALYSIS REPORT

JL-19-05 ~~CH~~ 204

| | |
|---|---|
| DATE SAMPLE COLLECTED | 12/22/85 |
| DATE RECEIVED AT LABORATORY | 12/27/85 |
| DATE ANALYSIS COMPLETED | 12/31/85 |

Well Number 41
Lab. Number C.122785-
Location Texas Well Field
Owner
Sample Taker M. Spruce
Delivered By M. Spruce

**MILLIGRAMS PER LITER**

| | |
|---|---|
| TOTAL DISSOLVED SOLIDS | 555 |
| PHENOL ALKALINITY AS Ca $CO_3$ | 0 |
| TOTAL ALKALINITY AS Ca $CO_3$ | 122 |
| TOTAL HARDNESS AS Ca $CO_3$ | 122 |
| CHLORIDES AS Cl | 135 |
| SULFATES AS $SO_4$ | 85 |
| FLUORIDES AS F | 1.0 |
| SILICA as $SiO_2$ | 28 |
| NITRATE as $NO_3$ | 5.9 |
| TOTAL PHOSPHATES AS $PO_4$ | 0.12 |
| CALCIUM as Ca | 37 |
| MAGNESIUM as Mg | 7.2 |
| SODIUM as Na | 128 |
| POTASSIUM as K | 2.4 |

| | |
|---|---|
| CHLORINE RESIDUAL (Mg/l) | – |
| TURBIDITY (N.T.U.) | 0.08 |
| SAMPLE TEMPERATURE (°c) | 25 |
| pH | 7.88 |
| LAB ELECTRICAL CONDUCTIVITY as µmhos/cm @ 25°c | 828 |
| FIELD ELECTRICAL CONDUCTIVITY as µmhos/cm @ 25°c | – |
| LANGELIER INDEX | +0.0830 |
| AGGRESSIVITY INDEX | 12.0543 |
| % Na OF TOTAL CATIONS | 68 |

**CHECKING CORRECTNESS OF ANALYSIS**

| | |
|---|---|
| MEASURED DILUTED E.C. | 920 |
| CALCULATED DILUTED E.C. | 942 |
| % ERROR | +2.3 |

**ANION - CATION BALANCE**

| ANIONS | Mg/l | Meg/l |
|---|---|---|
| CARBONATES as $CO_3$ | 0 | 0.0000 |
| BICARNONATES as $HCO_3$ 149 | ~~122~~ | 2.4410 |
| CHLORIDES as Cl | 135 | 3.8070 |
| SULFATES as $SO_4$ | 85 | 1.7680 |
| FLUORIDES as F | 1.0 | 0.0526 |
| NITRATES as $NO_3$ | 5.9 | 0.0950 |
| PHOSPHATES as $PO_4$ | 0.12 | 0.0038 |
| | TOTAL | 8.1674 |
| **CATIONS** | **Mg/l** | **Meg/l** |
| CALCIUM as Ca | 37 | 1.8463 |
| MAGNESIUM as Mg | 7.2 | 0.5926 |
| SODIUM as Na | 128 | 5.5680 |
| POTASSIUM as K | 2.4 | 0.1894 |
| | TOTAL | 8.1963 |

TOTAL ANIONS – TOTAL CATIONS = ± 0.1065 + 0.0155 (TOTAL CATIONS)
-0.0289 = < ± ISD 0.2331

Remarks: Sample sent to Southeast plant for metal analyses.

Analyst D. Chávez



FORM 4571-0885

JL-49-05-204

# EL PASO WATER UTILITIES
## WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED | 08-12-87 | WELL NUMBER | WELL 41 |
| DATE RECEIVED AT LABORATORY | 08-12-87 | LAB. NUMBER | C081887-8 |
| DATE ANALYSIS COMPLETED | 08-19-87 | LOCATION | Nevins Field |
| | | OWNER | |
| | | SAMPLE TAKER | Michiko Sprester |
| | | DELIVERED BY | Michiko Sprester |

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.00 | ****** | ****** |
| Total Alkalinity as CaCO3 | 132 | ****** | ****** |
| Carbonates as CO3 | 0.00 | 0 | 0 |
| Bicarbonates as HCO3 | 161 | 2.63945 | 115 |
| Chlorides as Cl | 136 | 3.83656 | 291 |
| Sulfates as SO4 | 73 | 1.51986 | 112 |
| Fluorides as F | 0.97 | .051061 | ****** |
| Nitrates as NO3 LOD=0.443 | 5.41 | .087263 | 6 |
| Total Phosphates as PO4 LOD=.09 | 0.00 | 0 | ****** |
| Total Anions = | 376 | 8.13419 | 525 |

| | |
|---|---|
| Silica, SiO2 = | 32.00 |
| Chlorine Res. = | NA |
| Turbidity,ntu = | 0.10 |
| Sample Temp(C)= | 18.60 |
| pH @ 18.60 | 8.05 |
| Lab E.C.@25C as umhos/cm = | 825 |
| Field E.C. @25C as umhos/cm = | NA |
| pH Saturation = | 7.97 |
| Langelier Ind.= | 0.08 |
| Aggress. Index= | 12.24 |
| % Na of T Cat.= | 67 |

| CATIONS | | | |
|---|---|---|---|
| Total Hardness as CaCO3 | 118 | ****** | ****** |
| Calcium as Ca | 33 | 1.6467 | 86 |
| Magnesium as Mg | 8.62 | .709138 | 33 |
| Sodium as Na | 123 | 5.3505 | 262 |
| Potassium as K | 9.71 | .248285 | 18 |
| Total Cations = | 174 | 7.95462 | 398 |
| TOTAL DISSOLVED SOLIDS = | 551 | 16.0888 | 923 |

Remarks

LOD = LIMIT OF DETECTION

Sent to Austin for metal analysis on 08-25-87.

CHECKING CORRECTNESS OF ANALYSIS

| | |
|---|---|
| Measured Diluted E.C. = | 906 |
| Calculated Diluted E.C.= | 923 |
| % Error = | 1.88 |

ANION-CATION BALANCE

Total Anions - Total Cations =
+or-(0.1065+0.0155* T.ANIONS)
.179567=<+or-1SD= +or- .232580 MAX. LIMIT

ANALYST M. Sprester El Paso

P.O. BOX 511

EL PASO WATER UTILITIES PUBLIC SERVICE BOARD

# WATER ANALYSIS DATA SHEET

49-05-204

Well Number #41

WELL DATA:

LAB# 04683-8

| | |
|---|---|
| SAMPLE COLLECTED | 2-15-83 |
| RECEIVED AT LABORATORY | " |
| ANALYSIS COMPLETED | 2-17-83 |
| pH | * 7.66 |
| **MILIGRAMS PER LITER** | |
| TOTAL DISSOLVED SOLIDS | 518 |
| PHENOL ALKALINITY AS $Ca\ CO_3$ | — |
| TOTAL ALKALINITY AS $Ca\ CO_3$ | 131 |
| TOTAL HARDNESS AS $Ca\ CO_3$ | 102 |
| CHLORIDES AS Cl | 126 |
| SULFATES AS $SO_4$ | 64 |
| FLUORIDES AS F | 1.0 |
| SILICA AS $Si\ O_2$ | 35 |
| NITRATE AS N (as $NO_3$ <4.4) | <1.0 |
| TOTAL PHOSPHATES AS P (as $PO_4$ <0.03) | <0.01 |
| CALCIUM AS Ca | 30 |
| MAGNESIUM AS Mg | 6.6 |
| SODIUM | 124 |
| POTASSIUM | 7.0 |
| CHLORINE RESIDUAL | — |
| TURBIDITY, N. T.U. | 0.13 |
| TEMPERATURE (°C) | 29°C |
| **ORGANICS BY G.C.** | Mg/l |
| CHLOROFORM | |
| BROMODICHLOROMETHANE | |
| DIBROMOCHLOROMETHANE | |
| BROMOFORM | |
| TOTAL THM's | |
| **CHECKING CORRECTNESS OF ANALYSIS** | |
| MEASURED DILUTE E.C. | 870 |
| CALCULATED DILUTE E.C. | 861 |
| % ERROR | -1.0% |

Location:

| ELEMENT | SEWAGE LIMITS | POTABLE LIMITS | SAMPLE mg/l |
|---|---|---|---|
| ARSENIC | 1.0 | .05 | |
| BARIUM | 5.0 | 1.0 | |
| CADMIUM | .05 | .010 | — |
| CHROMIUM | 5.0 | .05 | — |
| COPPER | 1.0 | 1.0 | — |
| IRON | — | .30 | — |
| LEAD | 1.0 | .05 | — |
| MANGANESE | 5.0 | .05 | — |
| MERCURY | .005 | .002 | |
| NICKEL | 5.0 | — | — |
| SELENIUM | .02 | .01 | |
| SILVER | .10 | .05 | — |
| ZINC | 5.0 | 5.0 | — |
| LANGELIER INDEX * | | | -0.09 |
| AGGRESSIVITY INDEX * | | | 11.9 |
| % Na OF TOTAL CATIONS | | | 70.9 |

**ANION – CATION BALANCE**

| ANIONS | mg/l | Meq/l |
|---|---|---|
| ALKALINITY | 131 | 2.5765 |
| CHLORIDES | 126 | 3.5545 |
| FLUORIDES | 1.0 | 0.0526 |
| SULFATES | 64 | 1.3325 |
| NITRATES | <1.0 | — |
| PHOSPHATES | <0.01 | — |
| | TOTAL | 7.5161 |
| CATIONS | Mg/l | Meq/l |
| CALCIUM | 30 | 1.4970 |
| MAGNESIUM | 6.6 | 0.5431 |
| POTASSIUM | 7.0 | 0.1791 |
| SODIUM | 124 | 5.3940 |
| | TOTAL | 7.6132 |

Remarks: * Possible error in pH Reading

Collected By Brooks @ 0945

(-) Below Detectable Limits

$\Sigma$ANIONS - $\Sigma$CATIONS = ± (0.1065 + 0.0155 $\Sigma$ANIONS)

-0.0971 =< ± ISD = 0.2228

Analyst

Page 62

49-05-204

FORM 4519-1282

EL PASO WATER UTILITIES PUBLIC SERVICE BOARD

# WATER ANALYSIS DATA SHEET

JL-49-05-204

Plant Sample  Well Number 41  Location

| Sample Number | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Depth | | | | | | |
| Sample Collected | 9-16-81 | | | | | |
| Received at Laboratory | 9-16-81 | | | | | |
| Analysis Completed | 9-17-81 | | | | | |
| pH at 25°C | 7.83 | | | | | |
| E C | | | | | | |
| $CaCO_3$ Saturation Index | -0.02 | | | | | |
| Sodium Per Cent of Total Cations | 74.2 | | | | | |

MILLIGRAMS PER LITER

| | | | | | | |
|---|---|---|---|---|---|---|
| Total Dissolved Solids | 537 | | | | | |
| Phenol Alkalinity as $Ca\ CO_3$ | 0 | | | | | |
| Total Alkalinity as $Ca\ CO_3$ | 134 | | | | | |
| Total Hardness as $Ca\ CO_3$ | 102 | | | | | |
| Chlorides as Cl | 123 | | | | | |
| Sulfates as $SO_4$ | 76 | | | | | |
| Fluorides as F | 0.90 | | | | | |
| Silica as $SiO_2$ | 35 | | | | | |
| Nitrate as N | 1.1 | as $NO_3$ 4.9 | | | | |
| Total Phosphates as P | less than 0.01 | as $PO_4$ <0.03 | | | | |
| Calcium as Ca | 30 | | | | | |
| Magnesium as Mg | 6.3 | | | | | |
| Sodium Na & K calc. as Na | 133 | | | | | |
| Potassium | ------- | | | | | |
| Total Iron as Fe | less than 0.05 | | | | | |
| Manganese as Mn | less than 0.05 | | | | | |
| Chlorine Residual | 0.0 | | | | | |
| Turbidity, N.T.U. | 0.31 | | | | | |
| Aggressivity Index | 11.8 | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Checking Correctness of Analysis: | | | | | | |
| Measured Diluted E. C. | 890 | | | | | |
| Calculated Diluted E. C. | 888 | | | | | |
| % Error | -0.2 | | | | | |

Remarks: Sample taken by F. Brooks at 1030 hours.

JL-49-05-204

EL PASO WATER UTILITIES PUBLIC SERVICE BOARD

# WATER ANALYSIS DATA SHEET

49-05-204

Plant Sample  Well Number 41  Location

| Sample Number | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Depth | | | | | | |
| Sample Collected | 5-20-80 | | | | | |
| Received at Laboratory | 5-20-80 | | | | | |
| Analysis Completed | 5-21-80 | | | | | |
| pH 28° C | 7.98 | | | | | |
| E C | | | | | | |
| Ca $CO_3$ Saturation Index | +0.19 | | | | | |
| Sodium Per Cent of Total Cations | 77.2% | | | | | |

MILLIGRAMS PER LITER

| | | | | | | |
|---|---|---|---|---|---|---|
| Total Dissolved Solids | 507 | | | | | |
| Phenol Alkalinity as Ca $CO_3$ | 0 | | | | | |
| Total Alkalinity as Ca $CO_3$ | 130 | | | | | |
| Total Hardness as Ca $CO_3$ | 102 | | | | | |
| Chlorides as Cl | 113 | | | | | |
| Sulfates as $SO_4$ | 77 | | | | | |
| Fluorides as F | 0.93 | | | | | |
| Silica as $SiO_2$ | 38 | | | | | |
| Nitrate as N | 1.3 | as $NO_3$ 5.8 | | | | |
| Total Phosphates as P | <0.01 | as $PO_4$ <0.03 | | | | |
| Calcium as Ca | 29 | | | | | |
| Magnesium as Mg | 7.3 | | | | | |
| Sodium | 123 | | | | | |
| Potassium | | | | | | |
| Total Iron as Fe | <0.1 | | | | | |
| Manganese as Mn | <0.01 | | | | | |
| Chlorine Residual | 0 | | | | | |
| Turbidity, N.T.U. | 0.29 | | | | | |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Checking Correctness of Analysis: | | | | | | |
| Measured Diluted E. C. | | | | | | |
| Calculated Diluted E. C. | 834 | | | | | |
| % Error | | | | | | |

Remarks: Collected by Frank Brooks at

49-05-204



Elizabeth G Zeleny

# EL PASO WATER UTILITIES
# WATER ANALYSIS REPORT

Corrected Copy

JL-49-05-204

| | | | |
|---|---|---|---|
| **DATE COLLECTED:** | **012296** | **SAMPLE SOURCE:** | **WELL 41** |
| **TIME COLLECTED:** | **19:20** | **LAB NUMBER:** | **JC012396-3** |
| **DATE RECEIVED:** | **012396** | **LOCATION:** | |
| **TIME RECEIVED:** | **14:00** | **OWNER:** | **EPWU** |
| **DATE ANALYZED:** | **012496** | **COLLECTED BY:** | **Romero** |
| **DATE ANALYSIS COMPLETED:** | **012996** | **DELIVERED BY:** | **M. Villanueva** |

| **ANIONS** | mg/l | me/l | Dil E.C. | | |
|---|---|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.0 | | | Silica, SiO2 = | 36.0 |
| Total Alkalinity as CaCO3 | 120.0 | | | Chlorine Res. = | |
| Carbonates as CO3 | 0.0 | 0.0000 | 0 | Turbidity, NTU = | 0.26 |
| Bicarbonates as HCO3 | 146.4 | 2.4010 | 105 | Sample Temp (C) | 23.2 |
| Chlorides as Cl | 179.0 | 5.0489 | 383 | pH @ | 7.86 |
| Sulfates as SO4 | 120.0 | 2.4960 | 185 | Lab E.C. @ 25 C | |
| Flourides as F | 1.0 | 0.0500 | | as umhos/m = | 1047 |
| Nitrates as NO3 LOD= 0.1 | 12.8 ~~2.9~~ | 0.0461 | 3 | Field E.C. @ 25 C | |
| Total Phosphates LOD= 0.09 | 0.0 | 0.0003 | | as umhos/cm = | |
| **TOTAL ANIONS** | 449 | 10.0423 | 676 | pH Saturation = | 7.77 |
| | | | | Langelier Index | 0.09 |
| | | | | Aggress. Index | 12.13 |
| **CATIONS** | | | | % Na of T. Cat. = | 66 |
| Total Hardness as CaCO3 | 156 | | | Iron = | <.1 |
| Calcium as Ca | 47.3 | 2.3650 | 123 | Nitrite= | <.1 |
| Magnesium Mg | 9.2 | 0.7541 | 35 | | |
| Sodium as Na | 157.0 | 6.8291 | 334 | | |
| Potassium as K | 9.6 | 0.2455 | 18 | | |
| **TOTAL CATIONS** | 223 | 10.1937 | 510 | | |
| **TDS BY EPWU METHOD (1)=** | 681 ~~672~~ | 20.2360 | 1186 | | |
| **TDS BY USGS METHOD (2)=** | 634 | | | | |
| **TDS BY TDH METHOD (3)=** | 598 | | | | |
| **TDS BY EVAPORATION (4)=** | 612 | | | | |

**CHECKING CORRECTNESS OF ANALYSIS**

| | |
|---|---|
| Measured Diluted E.C. | 1175 |
| Calculated Diluted E.C. | 1186 |
| % Error | 0.94% |

1.- SUM OF IONS, NOT INCLUDING SILICA.
2.- SUM OF IONS WITH CONVERSION OF HCO3 TO CO3, PLUS SILICA.
3.- SUM OF IONS, NOT INCLUDING SILICA WITH CONVERSION OF HCO3 TO CO3.

**ANION - CATION BALANCE**

| | |
|---|---|
| Total Anions - Total Cations = | -0.1514 |
| + or - (0.1065 + 0.0155 * T. Anions) Maximum Limit +/- | 0.2622 |

~~SD= -0.55~~ SD= 0.06

Teresa T. Alcala
**Teresa T. Alcala, Chemist I**

Douglas Rittmann
**Douglas Rittmann, P.E.**
**Water Systems Div. Mgr.**

JL-49-05-204

# ANION-CATION BALANCE

*SM 1030 F*

*Standard Methods 19TH Edition*

*LABORATORY SERVICES - JR Laboratory*

Sampling Location: Mesa-Nevins

Requested By: R. Sperka

Sample Identification: J043098-13
Project: W.S.
Sampling Point: Well 41
Sampling Description: Grab

Date Collected: 05/30/98
Time Collected: 11:00
Date Reported: 06/04/98

| ANIONS | mg/L | me/L | Dil EC |
|---|---|---|---|
| p-Alkalinity (CaCO3) | ND | | |
| t-Alkalinity (CaCO3) | 120 | | |
| Carbonate | ~~0 ND~~ | 0 | 0 |
| Bicarbonate | 146 ~~150~~ | 2.46 | 107.25 |
| Chloride | 190 | 5.35921 | 406.6 |
| Sulfate | 110 | 2.288 | 169.4 |
| Fluoride | 0.94 | 0.04948 | |
| Nitrogen as NO3 | 14 | 0.22579 | 16.1 |
| Total phosphorous as PO4 | <0.03 | ND | 0 |
| *TOTAL ANIONS* | 464.9 | 10.3825 | 699.35 |

| CATIONS | mg/L | me/L | Dil EC |
|---|---|---|---|
| Calcium | 50.5 | 2.525 | 131.3 |
| Magnesium | 7.7 | 0.63115 | 29.414 |
| Sodium | 150 | 6.52458 | 319.5 |
| Potassium | 9.72 | 0.24859 | 17.8848 |
| *TOTAL CATIONS* | 217.9 | 9.92933 | 498.099 |

| | |
|---|---|
| Field pH | ND |
| Field Temperature | ND |
| Field EC | ND |
| pH | 7.88 |
| Temperature of analysis | 28.4 |
| Chlorine Residual | NA |
| pH Saturation | 7.63 |
| Langlier Index | 0.25 |
| TDS (EPWU method) | 680 |
| TDS (USGS method) | 640 |
| TDS (TDH method) | 610 |
| TDS (measured @ 180C) | 630 |
| TDS (calculated-SM 1030F) | 640 |
| Turbidity, NTU | 0.171 |
| Silica | 30 |
| %Na of Total Cations | 65.7% |
| Hardness as CaCO3 (titrated) | 160 |
| Hardness as CaCO3 (calc) | 160 |
| EC (measured) | 1100 |
| EC (calculated) | 1100 |
| Diluted EC (measured) | 1200 |
| Diluted EC (calculated) | 1200 |

***Scale Forming***

anions+cations, excluding silica

convert HCO3 to CO3, include silica

convert HCO3 to CO3, exclude silica

SD = 1.47

## CHECKING CORRECTNESS OF ANALYSIS

| | | | ACTION REQUIRED | LIMITS |
|---|---|---|---|---|
| *Anion/Cation balance (% diff)...* | -2.2% | *ACCEPTABLE* | *NONE* | +/-5.0% |
| *TDS Ratio.....* | 1.0 | *ACCEPTABLE* | *NONE* | 1.0-1.2 |
| *Conductivity ratio.....* | 1.0 | *ACCEPTABLE* | *NONE* | 0.9-1.1 |
| *Measured EC and anion sum....* | 1038 | *ACCEPTABLE* | *NONE* | (0.9-1.1)EC |
| *Measured EC and cation sum....* | 993 | *ACCEPTABLE* | *NONE* | (0.9-1.1)EC |
| *Calculated TDS to EC ratio.....* | 0.58 | *ACCEPTABLE* | *NONE* | 0.55-0.7 |
| *Measured TDS to EC ratio.....* | 0.57 | *ACCEPTABLE* | *NONE* | 0.55-0.7 |
| *Hardness relative % error.....* | 0.0% | *ACCEPTABLE* | *NONE* | +/-5.0% |

QA/QC: Teresa T. Tabeada DATE: 6-8-98

APPROVAL: Victoria Rodriguez DATE: 6-10-98

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer Hueco Bolson  Field No. R-2 T 30  State Well No. 49-05-205

Owner's Well No. test well 30  County El Paso

1. Location: ___ 1/4, ___ 1/4 Sec. ___, Block ___ Survey ___
31 57 59 N 106 25 29.1
2. Owner: City of El Paso  Address: ___
Tenant: ___  Address: ___
Driller: C R Jensen  Address: ___
3. Elevation of 4042.39 is ___ ft. above msl, determined by ___
4. Drilled: 5 1940; Dug, Cable Tool, Rotary, ___
5. Depth: Rept. 1013 ft. Meas. ___ ft.
6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed ___
7. Pump: Mfgr. none Type ___
No. Stages none, Bowls Diam. ___ in., Setting ___ ft.
Column Diam. ___ in., Length Tailpipe ___ ft.
8. Motor: Fuel none Make & Model ___ HP. ___
9. Yield: Flow ___ gpm, Pump ___ gpm, Meas., Rept., Est. ___
10. Performance Test: Date ___ Length of Test ___ Made by ___
Static Level ___ ft. Pumping Level ___ ft. Drawdown ___ ft.
Production ___ gpm Specific Capacity ___ gpm/ft.

CASING & BLANK PIPE
Cemented From ___ ft. to ___ ft.

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 4 | | | 520 |
| | | | |
| | | | |
| | | | |

11. Water Level: 318.91 ft. rept. meas. 5/17 1940 above/below top of 4" csg which is 1.2 ft. above/below surface.
318.4 ft. rept. meas. 1/7 19 54 above/below LSD which is ___ ft. above/below surface.
___ ft. rept. meas. ___ 19 ___ above/below which is ___ ft. above/below surface.
___ ft. rept. meas. ___ 19 ___ above/below which is ___ ft. above/below surface.
12. Use: Dom., Stock, Public Supply, Ind., Irr., Waterflooding, Observation, Not Used, ___
13. Quality: (Remarks on taste, odor, color, etc.) ___
Temp. ___ °F, Date sampled for analysis ___ Laboratory ___
Temp. ___ °F, Date sampled for analysis ___ Laboratory ___
Temp. ___ °F, Date sampled for analysis ___ Laboratory ___
14. Other data available as circled: Driller's Log, Radioactivity Log, Electric Log,
Formation Samples, Pumping Test, ___
15. Record by: TWDB Date 7/20 1975
Source of Data USGS well sched (Colvin 6/4/40)
16. Remarks: ___

WELL SCREEN
Screen Openings ___

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| | Slotted | 419 | 520 |
| | | | |
| | | | |
| | | | |

— 4-1-75 Could not locate

TWDBE-WD-2 (Sketch)



49-05-205 ✓

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer Bolson  Field No. E-4 ft.R-89  State Well No. 49-05-208

Owner's Well No. _____  County El Paso

1. Location: NE 1/4, NW 1/4 Sec. 11, Block 81 Survey Twn 1
31 59 08 N 106 26 06.1

2. Owner: City of El Paso  Address: _____
Tenant: El Paso Electric Co  Address: _____
Driller: City  Address: _____

3. Elevation of 4063.99 ft. above msl, determined by USGS

4. Drilled: June 19 62; Dug, Cable Tool, Rotary, _____

5. Depth: Rept. 825 ft. Meas. _____ ft.

6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed _____

7. Pump: Mfgr. _____ Type Layne T
No. Stages _____, Bowls Diam. _____ in., Setting _____ ft.
Column Diam. _____ in., Length Tailpipe _____ ft.

8. Motor: Fuel Elect Make & Model _____ HP. _____

9. Yield: Flow _____ gpm, Pump 1200 gpm, (Meas.), Rept., Est. 8/7/62

10. Performance Test: Date _____ Length of Test 6 Hr Made by _____
Static Level _____ ft. Pumping Level _____ ft. Drawdown 36.56 ft.
Production 1191-1227 gpm Specific Capacity _____ gpm/ft.

CASING & BLANK PIPE
Cemented From _____ ft. to _____ ft.

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 24 | GI-MS | 0 | 366 |
| 18 | blank | | 376 |
| | | | |
| | | | |
| | | | |

11. Water Level: 362.22 ft. rept. (meas.) 8/6 19 62 (above) below MP on pump which is 3.0 ft. (above) below surface.
_____ ft. rept. meas. _____ 19 _____ above below _____ which is _____ ft. above below surface.
_____ ft. rept. meas. _____ 19 _____ above below _____ which is _____ ft. above below surface.
_____ ft. rept. meas. _____ 19 _____ above below _____ which is _____ ft. above below surface.

12. Use: Dom., Stock, Public Supply (Ind), Irr., Waterflooding, Observation, Not Used, _____

13. Quality: (Remarks on taste, odor, color, etc.) _____
Temp. 81 °F, Date sampled for analysis 8/6/62 Laboratory City
Temp. ___ °F, Date sampled for analysis _____ Laboratory _____
Temp. ___ °F, Date sampled for analysis _____ Laboratory _____

WELL SCREEN
Screen Openings _____

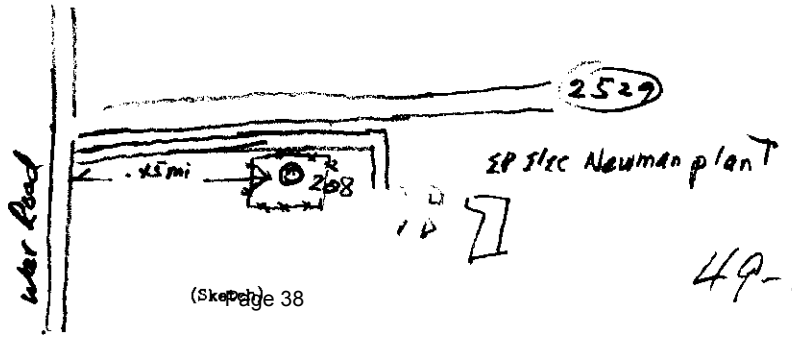
| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 18 | Slotted -150 Series | 376 | 665 |
| | | | |
| | | | |
| | | | |

14. Other data available as circled: Driller's Log, Radioactivity Log, Electric Log,
Formation Samples, Pumping Test, _____

15. Record by: TWDB Date 2/21 19 75
Source of Data USGS well sched (M. Davis 7/25/62)

16. Remarks:
Sp. Cap. = 366 @ 1200 gpm/6 hrs
PB 665
Base fresh water 740'
32" hole 0-376, 36" underream 376-665

ck w/ [illegible] driller's log




49-05-208 ✓

TWDBE-WD-2

(Sketch)

# WELL DATA

WELL NUMBER E-4

JL-49-05-208

## PUMP DATA

Make _____

Type _____

Stages _____

Tubing _____

Shaft _____

Column _____

Serial Number _____

Setting _____

O. D. Bowls _____

Capacity — GPM _____ / Feet Head _____

## MOTOR DATA

Make _____

Volts _____

Amps _____

Type _____

Motar H. P. _____

Speed _____

Cycles - Phase _____

Serial Number _____

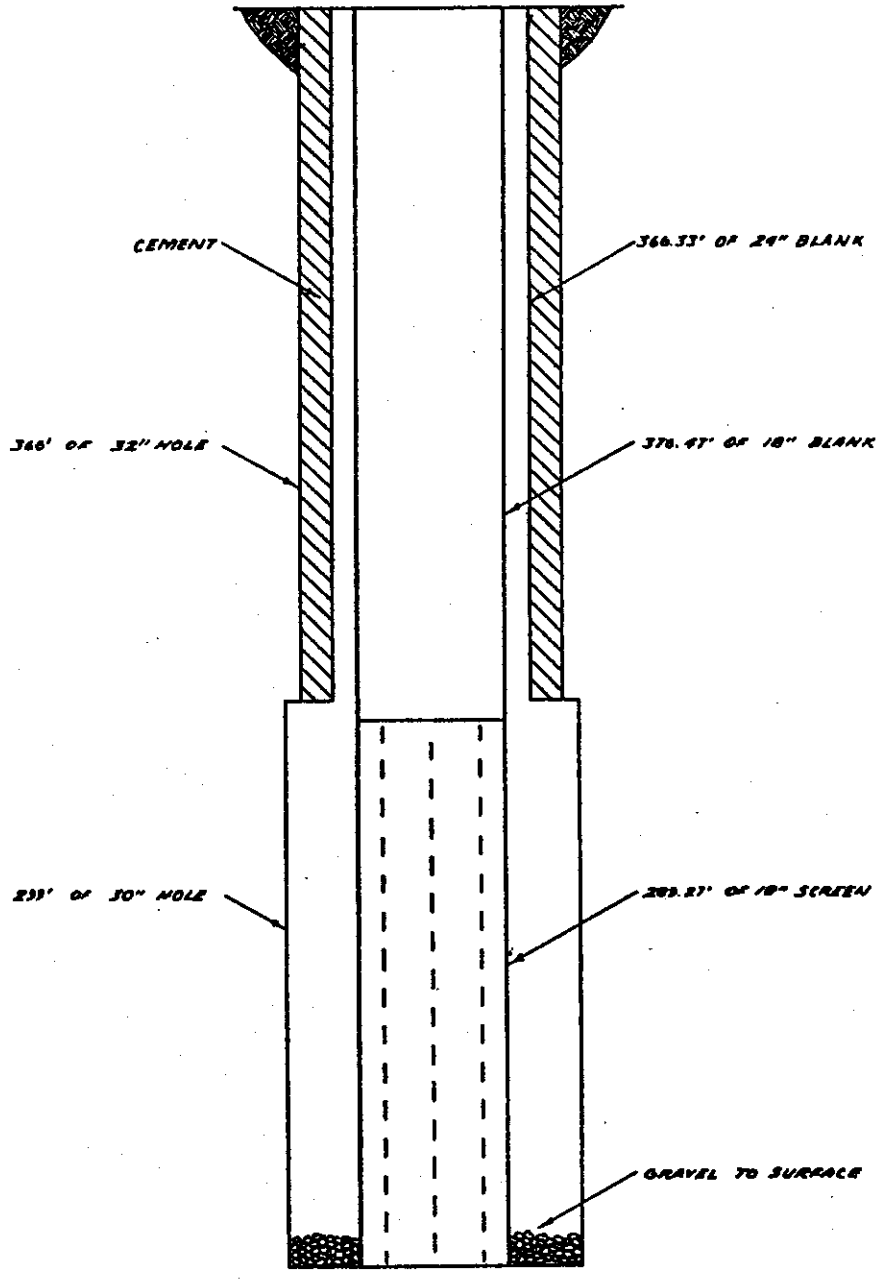
Date Installed _____

## SCALE

Vertical _____

Harizantal _____

## MATERIALS






49 05 208

P.S.B. FORM 2002 0665

JL-49-05-208

# EL PASO WATER UTILITIES
## WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED | 04-27-87 | WELL NUMBER | E-4 |
| DATE RECEIVED AT LABORATORY | 04-27-87 | LAB. NUMBER | C042787-6 |
| DATE ANALYSIS COMPLETED | 05-01-87 | LOCATION | NE AREA |
| | | OWNER | |
| | | SAMPLE TAKER | R. SPERKA |
| | | DELIVERED BY | R. SPERKA |

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0 | ****** | ****** |
| Total Alkalinity as CaCO3 | 137 | ****** | ****** |
| Carbonates as CO3 | 0.00 | 0 | 0 |
| Bicarbonates as HCO3 | 167 | 2.73942 | 119 |
| Chlorides as Cl | 177 | 4.99317 | 379 |
| Sulfates as SO4 | 82 | 1.70724 | 126 |
| Fluorides as F | 1 | .05264 | ****** |
| Nitrates as NO3 LOD=4.43 | 5.8 | .093554 | 7 |
| Total Phosphates as PO4 LOD=.09 | 0 | 0 | ****** |
| Total Anions = | 433 | 9.58603 | 631 |

| CATIONS | | | |
|---|---|---|---|
| Total Hardness as CaCO3 | 156 | ****** | ****** |
| Calcium as Ca | 45 | 2.2455 | 117 |
| Magnesium as Mg | 10.56 | .868944 | 40 |
| Sodium as Na | 142 | 6.177 | 302 |
| Potassium as K | 9.70 | .248029 | 18 |
| Total Cations = | 207 | 9.53947 | 477 |
| TOTAL DISSOLVED SOLIDS = | 640 | 19.1255 | 1108 |

| | |
|---|---|
| Silica, SiO2 = | 29 |
| Chlorine Res. = | NA |
| Turbidity,ntu = | .25 |
| Sample Temp(C)= | 27 |
| pH @ 27 | 7.89 |
| Lab E.C.@25C as umhos/cm = | 1090 |
| Field E.C. @25C as umhos/cm = | 1010 |
| pH Saturation = | 7.66 |
| Langelier Ind.= | 0.23 |
| Aggress. Index= | 12.22 |
| % Na of T Cat.= | 65 |

Remarks _____

LOD = LIMIT OF DETECTION

CHECKING CORRECTNESS OF ANALYSIS

| | |
|---|---|
| Measured Diluted E.C. = | 1084 |
| Calculated Diluted E.C.= | 1108 |
| % Error = | 2.21 |

ANION-CATION BALANCE

Total Anions - Total Cations =
+or-(0.1065+0.0155* T.ANIONS)
.046556=<+or-1SD= +or- .255083 MAX. LIMIT

ANALYST M Aguilera A Paz DDL

P.O. BOX 511
El Paso,Texas 79961

EL Paso Electric Company
P. O. BOX 982 - EL PASO, TEXAS

NEWMAN WATER WELLS

# WATER ANALYSIS DATA SHEET

| Well or Sample Number | E-1 | E-3 | E-4 | E-5 | E-6 | E-7 | | |
|---|---|---|---|---|---|---|---|---|
| Date Collected | 1-20-76 | 2-5-76 | 11-1-74 | 11-1-74 | 12-31-75 | 1-15-76 | | |
| | 49-05-202 | 201 | 208 | 305 | 212 | 213 | | |
| pH | 7.25 | 7.6 | 7.75 | 7.95 | 7.7 | 7.2 | | |
| Conductivity, micromhos | 775 | 675 | 950 | 580 | 750 | 1,225 | | |
| Total dissolved solids from conductivity | 620 | 540 | 760 | 460 | 600 | 980 | | |
| Total dissolved solids, calculated | 492 | 514 | 717 | 436 | 526 | 797 | | |
| Total Hardness as $CaCO_3$ | 120 | 102 | 164 | 116 | 144 | 176 | | |
| *Phenol. Alkalinity as* $CaCO_3$ | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Total Alkalinity as $CaCO_3$ | 126 | 150 | 152 | 112 | 102 | 68 | | |
| Carbonate Alkalinity as $CO_3$ | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Bicarbonate Alkalinity as $HCO_3$ | 153 | 183 | 185 | 136 | 124 | 83 | | |
| Sulphates as $SO_4$ | 60 | 60 | 100 | 50 | 50 | 60 | | |
| Chlorides as Cl | 100 | 85 | 164 | 84 | 162 | 350 | | |
| Calcium as Ca | 32 | 28 | 26 | 24 | 40 | 56 | | |
| Magnesium as Mg | 10 | 9 | 24 | 14 | 10 | 9 | | |
| Sodium, calculated as Na | 109 | 121 | 189 | 98 | 109 | 205 | | |
| Silica as $SiO_2$ | 28 | 28 | 31 | 30 | 30 | 33 | | |

**REMARKS:**

Well: _____

Depth: _____

Location: _____



49-05-208

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer Hueco Bolson  Field No. _____  State Well No. 49-05-212

Owner's Well No. #6  County El Paso

1. Location: 1/4, 1/4 Sec. _____, Block _____ Survey _____
320000N 1062534

2. Owner: El Paso Electric Co #6 Address: _____
Tenant: _____ Address: _____
Driller: C. by of ET Address: _____

3. Elevation of USD is 4045 ft. above msl, determined by Topo

4. Drilled: 1975; Dug, Cable Tool, (Rotary),

5. Depth: Rept. _____ ft. Meas. 839 ft.

6. Completion: Open Hole, Straight Wall, Underreamed, (Gravel Packed)

7. Pump: Mfgr. _____ Type T
No. Stages _____, Bowls Diam. _____ in., Setting _____ ft.
Column Diam. _____ in., Length Tailpipe _____ ft.

8. Motor: Fuel Elec Make & Model _____ HP. _____

9. Yield: Flow _____ gpm, Pump 1600 gpm, Meas., Rept., Est.

10. Performance Test: Date _____ Length of Test 24hrs Made by _____
Static Level _____ ft. Pumping Level _____ ft. Drawdown 28.07 ft.
Production _____ gpm Specific Capacity 57 gpm/ft.

11. Water Level: 346.00 ft. (rept.) meas. 2- 1975 above below USD which is _____ ft. above below surface.
_____ ft. rept. meas. _____ 19__ above below _____ which is _____ ft. above below surface.
_____ ft. rept. meas. _____ 19__ above below _____ which is _____ ft. above below surface.
_____ ft. rept. meas. _____ 19__ above below _____ which is _____ ft. above below surface.

12. Use: Dom., Stock, Public Supply, (Ind.), Irr., Waterflooding, Observation, Not Used, _____

13. Quality: (Remarks on taste, odor, color, etc.) _____
Temp. ___ °F, Date sampled for analysis 12/20/74 Laboratory BPWU
Temp. ___ °F, Date sampled for analysis _____ Laboratory _____
Temp. ___ °F, Date sampled for analysis _____ Laboratory _____

14. Other data available as circled: Driller's Log, Radioactivity Log, Electric Log, Formation Samples, Pumping Test, _____

15. Record by: TWDB Date 5/14 1975
Source of Data USGS well sched (D.E.White 4/3/75)

16. Remarks: _____
4/3/75 - Not yet equipped

CASING & BLANK PIPE
Cemented From _____ ft. to _____ ft.

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 24 | Steel | 0 | 360.75 Cemented |
| 16 | " | 0 | 463.33 Blank |

WELL SCREEN
Screen Openings _____

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 16 | Slotted Pipe | 463.33 | 839 |

Iron < 0.2
Sulfate 63
Chloride 155
Hard. 140
Sp Cond. 765

sketch over

TWDBE-WD-2

(Sketch)



49-05-212

# WELL DATA

WELL NUMBER E6

49-05-212

## PUMP DATA

Make _____

Type _____

Stages _____

Tubing _____

Shaft _____

Column _____

Serial Number _____

Setting _____

O. D. Bowls _____

Capacity — GPM _____

Capacity — Feet Head _____

## MOTOR DATA

Make _____

Volts _____

Amps _____

Type _____

Motor H. P. _____

Speed _____

Cycles - Phase _____

Serial Number _____

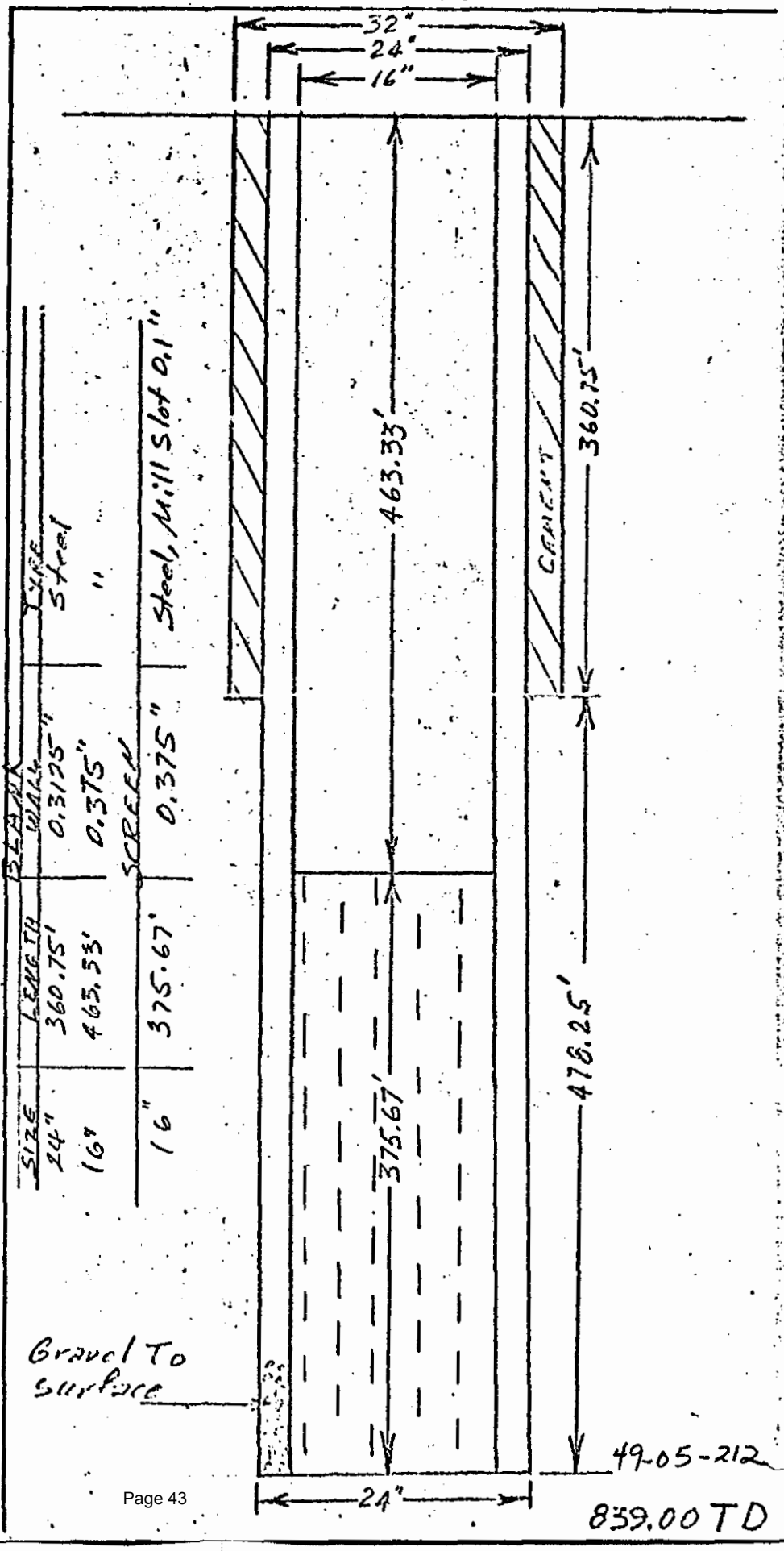
Date Installed _____

## SCALE

Vertical _____

Horizontal _____

## MATERIALS






P.S.D. FORM 2002 - 0665

JL-49-05-212
E-6
6/11/90

# EL PASO WATER UTILITIES
## WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED | 06/11/90 | WELL NUMBER | E6 |
| DATE RECEIVED AT LABORATORY | 06/11/90 | LAB. NUMBER | C061190-5 |
| DATE ANALYSIS COMPLETED | 06/12/90 | LOCATION | |
| | | OWNER | |
| | | SAMPLE TAKER | T. CLIETT |
| | | DELIVERED BY | T. CLIETT |

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 4.00 | ****** | ****** |
| Total Alkalinity as CaCO3 | 96 | ****** | ****** |
| Carbonates as CO3 | 4.88 | .162650 | 14 |
| Bicarbonates as HCO3 | 107 | 1.75963 | 77 |
| Chlorides as Cl | 170 | 4.7957 | 364 |
| Sulfates as SO4 | 40 | .8328 | 62 |
| Fluorides as F | 0.60 | .031584 | ****** |
| Nitrates as NO3 LOD=0.10 | 6.40 | .103232 | 7 |
| Total Phosphates as PO4 LOD=.09 | 0.00 | 0 | ****** |
| Total Anions = | 329 | 7.68560 | 523 |

| CATIONS | | | |
|---|---|---|---|
| Total Hardness as CaCO3 | 138 | ****** | ****** |
| Calcium as Ca | 41.7 | 2.08083 | 108 |
| Magnesium as Mg | 8.20 | .674532 | 31 |
| Sodium as Na | 106 | 4.611 | 225 |
| Potassium as K | 6.90 | .176433 | 13 |
| Total Cations = | 163 | 7.54280 | 378 |
| TDS BY EPWU METHOD (1)= | 492 | 15.2284 | 901 |
| TDS BY USGS METHOD (2)= | 476 | | |
| TDS BY TDH METHOD (3)= | 437 | | |

| | |
|---|---|
| Silica, SiO2 = | 39.00 |
| Chlorine Res. = | N/A |
| Turbidity,ntu = | 0.15 |
| Sample Temp(C)= | 25 |
| pH @ 25 | 8.39 |
| Lab E.C.@25C as umhos/cm = | 836 |
| Field E.C. @25C as umhos/cm = | N/A |
| pH Saturation = | 7.87 |
| Langelier Ind.= | 0.52 |
| Aggress. Index= | 12.51 |
| % Na of T Cat.= | 61 |

Remarks
LOD = LIMIT OF DETECTION

CHECKING CORRECTNESS OF ANALYSIS

| | |
|---|---|
| Measured Diluted E.C. = | 884 |
| Calculated Diluted E.C.= | 901 |
| % Error = | 1.89 |

(1) SUM OF IONS, NOT INCLUDING SILICA
(2) SUM OF IONS WITH CONVERSION OF HCO3 TO CO3, PLUS SILICA.
(3) SUM OF IONS, NOT INCLUDING SILICA WITH CONVERSION OF HCO3 TO CO3.

ANION-CATION BALANCE
Total Anions - Total Cations = SD=0.61
+or-(0.1065+0.0155* T.ANIONS)
.142802=<+or-1SD= +or- .225627 MAX. LIMIT

ANALYST Judith McBee

WATER SUPPLY MGR

PO BOX 511
EL PASO, TEXAS 79961

KEY PUNCHED

JL-49-05-212

EL PASO WATER UTILITIES
WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED | 05-20-87 | WELL NUMBER | E-6 |
| DATE RECEIVED AT LABORATORY | 05-20-87 | LAB. NUMBER | C052087-5 |
| DATE ANALYSIS COMPLETED | 05-27-87 | LOCATION | NE AREA |
| | | OWNER | |
| | | SAMPLE TAKER | R. SPERKA |
| | | DELIVERED BY | R. SPERKA |

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0 | ****** | ****** |
| Total Alkalinity as CaCO3 | 96 | ****** | ****** |
| Carbonates as CO3 | 0.00 | 0 | 0 |
| Bicarbonates as HCO3 | 117 | 1.91960 | 84 |
| Chlorides as Cl | 171 | 4.82391 | 366 |
| Sulfates as SO4 | 48 | .99936 | 74 |
| Fluorides as F | .6 | .031584 | ****** |
| Nitrates as NO3 LOD=4.43 | 6.6 | .106458 | 8 |
| Total Phosphates as PO4 LOD=.09 | 0 | 0 | ****** |
| Total Anions = | 343 | 7.88091 | 531 |

| CATIONS | | | |
|---|---|---|---|
| Total Hardness as CaCO3 | 146 | ****** | ****** |
| Calcium as Ca | 46 | 2.2954 | 119 |
| Magnesium as Mg | 7.53 | .619247 | 29 |
| Sodium as Na | 112 | 4.872 | 238 |
| Potassium as K | 7.20 | .184104 | 13 |
| Total Cations = | 173 | 7.97075 | 400 |
| TOTAL DISSOLVED SOLIDS = | 516 | 15.8517 | 931 |

| | |
|---|---|
| Silica, SiO2 = | 40 |
| Chlorine Res. = | NA |
| Turbidity,ntu = | .2 |
| Sample Temp(C)= | 25 |
| pH @ 25 | 8.2 |
| Lab E.C.@25C as umhos/cm = | 840 |
| Field E.C. @25C as umhos/cm = | 820 |
| pH Saturation = | 7.83 |
| Langelier Ind.= | 0.37 |
| Aggress. Index= | 12.35 |
| % Na of T Cat.= | 61 |

Remarks _____
LOD = LIMIT OF DETECTION

CHECKING CORRECTNESS OF ANALYSIS
Measured Diluted E.C. = 919
Calculated Diluted E.C.= 931
% Error = 1.31

ANION-CATION BALANCE
Total Anions - Total Cations =
+or-(0.1065+0.0155* T.ANIONS)
-.08984=<+or-1SD= +or- .228654 MAX. LIMIT

ANALYST M. Apsarta SA Pay DDR
P.O. BOX 514
El Paso,Texas 79961

EL PASO WATER UTILITIES PUBLIC SERVICE

# WATER ANALYSIS DATA SHEET

Tom Chett — 49-05-212

Plant Sample  Well Number E-6 Location

| SAMPLE NUMBER | -1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| DEPTH | 988-1008 | 776-796 | 615-635 | | | |
| SAMPLE COLLECTED | 11-22-74 | 11-22-74 | 11-22-74 | | | |
| RECEIVED AT LABORATORY | | | | | | |
| ANALYSIS COMPLETED | | | | | | |
| pH | 7.6 | 8.0 | 8.4 | | | |
| EC x $10^6$ @ $25^\circ$ | | | | | | |
| TASTE AND ODOR | | | | | | |
| SODIUM PER CENT OF TOTAL CATIONS | 79% | 73% | 80% | | | |

PARTS PER MILLION

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTAL DISSOLVED SOLIDS | 1995 | 850 | 430 | | | |
| PHENOL ALKALINITY AS $CaCO_3$ | 0 | 0 | 4 | | | |
| TOTAL ALKALINITY AS $CaCO_3$ | 63 | 66 | 113 | | | |
| TOTAL HARDNESS AS $CaCO_3$ | 380 | 202 | 72 | | | |
| CHLORIDES | 970 | 370 | 75 | | | |
| SULFATES | 109 | 44 | 75 | | | |
| CALCIUM | 121 | 66 | 21 | | | |
| MAGNESIUM | 18 | 9 | 5 | | | |
| TOTAL IRON | 0.10 | 0.11 | 0.08 | | | |
| FLUORIDES | 0.68 | 0.28 | 0.2 | | | |
| SODIUM & POTASSIUM (CALC. AS NA) | 537 | 199 | 103 | | | |
| SILICA, $SiO_2$ | — | — | — | | | |
| MANGANESE | <0.05 | <0.05 | <0.05 | | | |
| PHOSPHATES | <0.05 | <0.05 | <0.05 | | | |

THEORETICAL COMBINATIONS

| | | | | | | |
|---|---|---|---|---|---|---|
| SPECIFIC CONDUCTANCE | 3000 | 1340 | 620 | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Remarks: .....

.....

.....

Analyst 49-05-212



FORM 4518-0368

PUBLIC SERVICE BOARD — WATER ANALYSIS DATA SHEET

Plant Sample — Well or F6 Location — 49-05-212

| SAMPLE NUMBER | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| DEPTH | 839 | | | | | |
| SAMPLE COLLECTED | 12-20-74 | | | | | |
| RECEIVED AT LABORATORY | 12-20-74 | | | | | |
| ANALYSIS COMPLETED | 12-20-74 | | | | | |
| pH | 7.75 | | | | | |
| EC x $10^6$ @ 25° | | | | | | |
| TASTE AND ODOR | | | | | | |
| SODIUM PER CENT OF TOTAL CATIONS | 68.7 | | | | | |

PARTS PER MILLION

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTAL DISSOLVED SOLIDS | 532 | | | | | |
| PHENOL ALKALINITY AS $CaCO_3$ | 0 | | | | | |
| TOTAL ALKALINITY AS $CaCO_3$ | 100 | | | | | |
| TOTAL HARDNESS AS $CaCO_3$ | 140 | | | | | |
| CHLORIDES | 155 | | | | | |
| SULFATES | 63 | | | | | |
| CALCIUM | 43 | | | | | |
| MAGNESIUM | 8 | | | | | |
| TOTAL IRON | <.02 | | | | | |
| FLUORIDES | .37 | | | | | |
| SODIUM & POTASSIUM (CALC. AS Na) | 112 | | | | | |
| SILICA, $SiO_2$ | — | | | | | |
| MANGANESE | <.02 | | | | | |
| PHOSPHATES | <.05 | | | | | |

THEORETICAL COMBINATIONS

| | | | | | | |
|---|---|---|---|---|---|---|
| Specific Conductance | 765 | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Remarks: Production 1600 GPM.



D. L. Rittmann
Analyst

FORM 4518-0368

EL Paso Electric Company
P. O. BOX 982 · EL PASO, TEXAS

NEWMAN WATER WELLS

# WATER ANALYSIS DATA SHEET

| Well or Sample Number | E-1 | E-3 | E-4 | E-5 | E-6 | E-7 | | |
|---|---|---|---|---|---|---|---|---|
| Date Collected | 1-20-76 | 2-5-76 | 11-1-74 | 11-1-74 | 12-31-75 | 1-15-76 | | |
| | 49-35-202 | 201 | 208 | 305 | 212 | 213 | | |
| pH | 7.25 | 7.6 | 7.75 | 7.95 | 7.7 | 7.2 | | |
| Conductivity, micromhos | 775 | 675 | 950 | 580 | 750 | 1,225 | | |
| Total dissolved solids from conductivity | 620 | 540 | 760 | 460 | 600 | 980 | | |
| Total dissolved solids, calculated | 492 | 514 | 717 | 436 | 526 | 797 | | |
| Total Hardness as $CaCO_3$ | 120 | 102 | 164 | 116 | 144 | 176 | | |
| Phenol. Alkalinity as $CaCO_3$ | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Total Alkalinity as $CaCO_3$ | 126 | 150 | 152 | 112 | 102 | 68 | | |
| Carbonate Alkalinity as $CO_3$ | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Bicarbonate Alkalinity as $HCO_3$ | 153 | 183 | 185 | 136 | 124 | 83 | | |
| Sulphates as $SO_4$ | 60 | 60 | 100 | 50 | 50 | 60 | | |
| Chlorides as Cl | 100 | 85 | 164 | 84 | 162 | 350 | | |
| Calcium as Ca | 32 | 28 | 26 | 24 | 40 | 56 | | |
| Magnesium as Mg | 10 | 9 | 24 | 14 | 10 | 9 | | |
| Sodium, calculated as Na | 109 | 121 | 189 | 98 | 109 | 205 | | |
| Silica as $SiO_2$ | 28 | 28 | 31 | 30 | 30 | 33 | | |

**REMARKS:**

Well:_____

Depth:_____

Location:_____



49-05-212

JL-49-05-212

# EL PASO WATER UTILITIES
# WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| **DATE COLLECTED:** | **12/02/96** | **SAMPLE SOURCE:** | **Well E-6** |
| **TIME COLLECTED:** | **16:20** | **LAB NUMBER:** | **C120396-2** |
| **DATE RECEIVED:** | **12/03/96** | **LOCATION:** | **Northeast** |
| **TIME RECEIVED:** | **08:00** | **OWNER:** | **EPWU** |
| **DATE ANALYZED:** | **12/03/96** | **COLLECTED BY:** | **A. Castaneda** |
| **DATE ANALYSIS COMPLETED:** | **12/12/96** | **DELIVERED BY:** | **A. Castaneda** |

| **ANIONS** | mg/l | me/l | Dil E.C. | | |
|---|---|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.0 | | | Silica, SiO2 = | 37.0 |
| Total Alkalinity as CaCO3 | 92.0 | | | Chlorine Res. = | N/A |
| Carbonates as CO3 | 0.0 | 0.0000 | 0 | Turbidity, NTU = | 0.18 |
| Bicarbonates as HCO3 | 112.2 | 1.8407 | 80 | Sample Temp (C) | 16.2 |
| Chlorides as Cl | 155.0 | 4.3720 | 332 | pH @ | 8.15 |
| Sulfates as SO4 | 38.0 | 0.7904 | 59 | Lab E.C. @ 25 C | |
| Fluorides as F | 0.7 | 0.0346 | | as umhos/m = | 730 |
| Nitrates as NO3 LOD= 0.1 | 7.3 | 0.1185 | 8 | Field E.C. @ 25 C | |
| Total Phosphates LOD= 0.09 | 0.0 | 0.0005 | | as umhos/cm = | N/A |
| **TOTAL ANIONS** | 313 | 7.1567 | 479 | pH Saturation = | 8.02 |
| | | | | Langelier Index | 0.13 |
| | | | | Aggress. Index | 12.25 |
| **CATIONS** | | | | % Na of T. Cat. = | 58 |
| Total Hardness as CaCO3 | 136 | | | | |
| Calcium as Ca | 46.5 | 2.3250 | 121 | | |
| Magnesium Mg | 4.8 | 0.3934 | 18 | | |
| Sodium as Na | 100.0 | 4.3497 | 213 | | |
| Potassium as K | 7.1 | 0.1818 | 13 | | |
| **TOTAL CATIONS** | 158 | 7.2500 | 365 | | |

| | | |
|---|---|---|
| **TDS BY EPWU METHOD (1)=** | 472 | 14.4067 | 844 |
| **TDS BY USGS METHOD (2)=** | 452 | | |
| **TDS BY TDH METHOD (3)=** | 415 | | |
| **TDS BY EVAPORATION (4)=** | 443 | | |

**CHECKING CORRECTNESS OF ANALYSIS**

| | |
|---|---|
| Measured Diluted E.C. | 840 |
| Calculated Diluted E.C. | 844 |
| % Error | 0.50% |

**ANION - CATION BALANCE**

| | |
|---|---|
| Total Anions - Total Cations = | -0.0933 |
| + or - (0.1065 + 0.0155 * T. Anions) Maximum Limit +/- | 0.2174 |

1.- SUM OF IONS, NOT INCLUDING SILICA.
2.- SUM OF IONS WITH CONVERSION OF HCO3 TO CO3, PLUS SILICA.
3.- SUM OF IONS, NOT INCLUDING SILICA WITH CONVERSION OF HCO3 TO CO3.
4.-AT 180 DEGREES CELSIUS

SD = -0.41

Maria Molina, Chemist I

Douglas Rittmann, P.E.
Water Systems Div. Mgr.

05

JL-49-05-212

# EL PASO WATER UTILITIES
# WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| **DATE COLLECTED:** | **05/16/97** | **SAMPLE SOURCE:** | **Well E6** |
| **TIME COLLECTED:** | **08:00** | **LAB NUMBER:** | **C051697-31** |
| **DATE RECEIVED:** | **05/16/97** | **LOCATION:** | **Nevins** |
| **TIME RECEIVED:** | **13:30** | **OWNER:** | **EPWU** |
| **DATE ANALYZED:** | **05/16/97** | **COLLECTED BY:** | **N.A.** |
| **DATE ANALYSIS COMPLETED:** | **06/20/97** | **DELIVERED BY:** | **N.A.** |

| **ANIONS** | mg/l | me/l | Dil E.C. | | |
|---|---|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.0 | | | Silica, SiO2 = | 32.0 |
| Total Alkalinity as CaCO3 | 106.0 | | | Chlorine Res. = | N/A |
| Carbonates as CO3 | 0.0 | 0.0000 | 0 | Turbidity, NTU = | 0.11 |
| Bicarbonates as HCO3 | 129.3 | 2.1208 | 92 | Sample Temp (C) | 31.1 |
| Chlorides as Cl | 135.0 | 3.8079 | 289 | pH @ | 8.04 |
| Sulfates as SO4 | 40.0 | 0.8320 | 62 | Lab E.C. @ 25 C | |
| Fluorides as F | 0.6 | 0.0331 | | as umhos/m = | 740 |
| Nitrates as NO3 LOD= 0.1 | 6.3 | 0.1023 | 7 | Field E.C. @ 25 C | |
| Total Phosphates LOD= 0.09 | 0.0 | 0.0008 | | as umhos/cm = | N/A |
| **TOTAL ANIONS** | 311 | 6.8968 | 450 | pH Saturation = | 7.71 |
| | | | | Langelier Index | 0.33 |
| | | | | Aggress. Index | 12.17 |
| **CATIONS** | | | | % Na of T. Cat. = | 59 |
| Total Hardness as CaCO3 | 126 | | | | |
| Calcium as Ca | 40.9 | 2.0450 | 106 | | |
| Magnesium Mg | 5.8 | 0.4754 | 22 | | |
| Sodium as Na | 94.0 | 4.0887 | 200 | | |
| Potassium as K | 7.1 | 0.1821 | 13 | | |
| **TOTAL CATIONS** | 148 | 6.7912 | 342 | | |

| | | | |
|---|---|---|---|
| **TDS BY EPWU METHOD (1)=** | 459 | 13.6881 | 792 |
| **TDS BY USGS METHOD (2)=** | 425 | | |
| **TDS BY TDH METHOD (3)=** | 393 | | |
| **TDS BY EVAPORATION (4)=** | 411 | | |

**CHECKING CORRECTNESS OF ANALYSIS**

| | | |
|---|---|---|
| Measured Diluted E.C. | 780 | 1.- SUM OF IONS, NOT INCLUDING SILICA. |
| Calculated Diluted E.C. | 792 | 2.- SUM OF IONS WITH CONVERSION OF |
| % Error | 1.55% | HCO3 TO CO3, PLUS SILICA. |
| | | 3.- SUM OF IONS, NOT INCLUDING SILICA |
| **ANION - CATION BALANCE** | | WITH CONVERSION OF HCO3 TO CO3. |
| Total Anions - Total Cations = | 0.1056 | 4.-AT 180 DEGREES CELSIUS |
| + or - (0.1065 + 0.0155 * T. Anions) | | |
| Maximum Limit +/- | 0.2134 | SD = 0.49 |

Maria Molina
**Maria Molina, Chemist I**

Paul R. Rivas
**Paul R. Rivas, Chemist II**

JL-49-05-212

# ANION-CATION BALANCE

*SM 1030 F*

*Standard Methods 19TH Edition*

*CENTRAL LABORATORY*

Sampling Location: Mesa-Nevins

Requested By: R. Sperka

Sample Identification: K021198-2
Project: WS
Sampling Point: Well E6
Sampling Description: Grab

Date Collected: 02-10-98
Time Collected: 27:13
Date Reported: 02/24/98

| ANIONS | mg/L | me/L | Dil EC |
|---|---|---|---|
| p-Alkalinity (CaCO3) | 0.0 | | |
| t-Alkalinity (CaCO3) | 101 | | |
| Carbonate | 0 | 0.00 | 0.00 |
| Bicarbonate | 123 | 2.02 | 88.10 |
| Chloride | 138 | 3.89 | 295.32 |
| Sulfate | 43.9 | 0.91 | 67.61 |
| Fluoride | 0.64 | 0.03 | |
| Nitrogen as NO3 | 10.3 | 0.17 | 11.82 |
| Total phosphorous as PO4 | 0.00 | 0.00 | |
| *TOTAL ANIONS* | 316.0 | 7.03 | 462.85 |

| CATIONS | mg/L | me/L | Dil EC |
|---|---|---|---|
| Calcium | 41.7 | 2.09 | 108.42 |
| Magnesium | 4.8 | 0.39 | 18.34 |
| Sodium | 95 | 4.14 | 202.78 |
| Potassium | 7.1 | 0.18 | 13.03 |
| *TOTAL CATIONS* | 148.8 | 6.80 | 342.56 |

| | | |
|---|---|---|
| Field pH | ND | |
| Field Temperature | ND | |
| Field EC | ND | |
| pH | 8.02 | |
| Temperature of analysis | 18.7 | |
| Chlorine Residual | ND | |
| pH Saturation | 7.97 | |
| Langlier Index | 0.05 | ***Scale Forming*** |
| TDS (EPWU method) | 465 | anions+cations, excluding silica |
| TDS (USGS method) | 432 | convert HCO3 to CO3, include silica |
| TDS (TDH method) | 402 | convert HCO3 to CO3, exclude silica |
| TDS (measured @ 180C) | 414 | |
| TDS (calculated-SM 1030F) | 432 | SD= 1.08 |
| Turbidity, NTU | 0.36 | |
| Silica | 29 | |
| %Na of Total Cations | 60.9% | |
| Hardness as CaCO3 (titrated) | 124.0 | |
| Hardness as CaCO3 (calc) | 124.0 | |
| EC (measured) | 726 | |
| EC (calculated) | 747 | |
| Diluted EC (measured) | 790 | |
| Diluted EC (calculated) | 805 | |

## CHECKING CORRECTNESS OF ANALYSIS

| | | | ACTION REQUIRED | LIMITS |
|---|---|---|---|---|
| *Anion/Cation balance (% diff)...* | -1.6% | *ACCEPTABLE* | *NONE* | +/-2.0% |
| *TDS Ratio.....* | 1.0 | *ACCEPTABLE* | *NONE* | 1.0-1.2 |
| *Conductivity ratio.....* | 1.0 | *ACCEPTABLE* | *NONE* | 0.9-1.1 |
| *Measured EC and anion sum.....* | 703 | *ACCEPTABLE* | *NONE* | (0.9-1.1)EC |
| *Measured EC and cation sum....* | 680 | *ACCEPTABLE* | *NONE* | (0.9-1.1)EC |
| *Calculated TDS to EC ratio.....* | 0.59 | *ACCEPTABLE* | *NONE* | 0.55-0.7 |
| *Measured TDS to EC ratio.....* | 0.57 | *ACCEPTABLE* | *NONE* | 0.55-0.7 |
| *Hardness relative % error.....* | 0.0% | *ACCEPTABLE* | *NONE* | +/-5.0% |

CHEMIST: Eduardo Alcalá DATE: 2-26-98

QA/QC: [signature] DATE: 3-3-98

APPROVAL: [signature] DATE: MAR 04 1998

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer Hueco Bolson  Field No. _____  State Well No. 49-05-213

Owner's Well No. #7  County El Paso

1. Location: _____ 1/4, _____ 1/4 Sec. _____, Block _____ Survey _____
   32 00 01 N 106 25 02
2. Owner: El Paso Electric Co #7 Address: _____
   Tenant: _____ Address: _____
   Driller: City of El Paso Address: _____
3. Elevation of LSD is 4030 ft. above msl, determined by Todd
4. Drilled: 1975; Dug, Cable Tool, Rotary, (Jetted)
5. Depth: Rept. _____ ft. Meas. 875 ft.
6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed
7. Pump: Mfgr. _____ Type T
   No. Stages _____, Bowls Diam. _____ in., Setting _____ ft.
   Column Diam. _____ in., Length Tailpipe _____ ft.
8. Motor: Fuel Elect Make & Model _____ HP.
9. Yield: Flow _____ gpm, Pump 1800 gpm, Meas., Rept., Est. 2/75
10. Performance Test: Date _____ Length of Test 24hrs Made by _____
    Static Level _____ ft. Pumping Level _____ ft. Drawdown 33.60 ft.
    Production _____ gpm Specific Capacity 53.6 gpm/ft.
11. Water Level: 340.10 ft. rept. meas. 2-1975 above (below) LSD which is _____ ft. above (below) surface.
    _____ ft. rept. meas. _____ 19__ above (below) _____ which is _____ ft. above (below) surface.
    _____ ft. rept. meas. _____ 19__ above (below) _____ which is _____ ft. above (below) surface.
    _____ ft. rept. meas. _____ 19__ above (below) _____ which is _____ ft. above (below) surface.
12. Use: Dom., Stock, Public Supply, (Ind), Irr., Waterflooding, Observation, Not Used, _____
13. Quality: (Remarks on taste, odor, color, etc.) _____
    Temp. ___ °F, Date sampled for analysis 2/6/75 Laboratory EPWU
    Temp. ___ °F, Date sampled for analysis _____ Laboratory _____
    Temp. ___ °F, Date sampled for analysis _____ Laboratory _____
14. Other data available as circled: Driller's Log, Radioactivity Log, Electric Log,
    Formation Samples, Pumping Test, _____
15. Record by: TWDB Date 5/14 1975
    Source of Data USGS well sched (D.E. White 4/3/75)
16. Remarks: _____
    4/3/75 not yet equipped

CASING & BLANK PIPE
Cemented From _____ ft. to _____ ft.

| Diam. (in.) | Type | Setting, ft. from | to | |
|---|---|---|---|---|
| 24 | Steel | 0 | 363.57 | (cemented) |
| 16 | Steel | 0 | 444.60 | (blank) |

WELL SCREEN
Screen Openings _____

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 16 | Slotted Perf | 444.60 | 825. |

Iron 0.075
Sulfate 50
Chloride 400
Hard 206

sketch on 212

TWDBE-WD-2 (Sketch)



49-05-213

# WELL DATA

WELL NUMBER E7

49-05-213

## PUMP DATA

Make _____

Type _____

Stages _____

Tubing _____

Shaft _____

Column _____

Serial Number _____

Setting _____

O. D. Bowls _____

Capacity — GPM _____ / Feet Head _____

## MOTOR DATA

Make _____

Volts _____

Amps _____

Type _____

Motor H. P. _____

Speed _____

Cycles - Phose _____

Serial Number _____

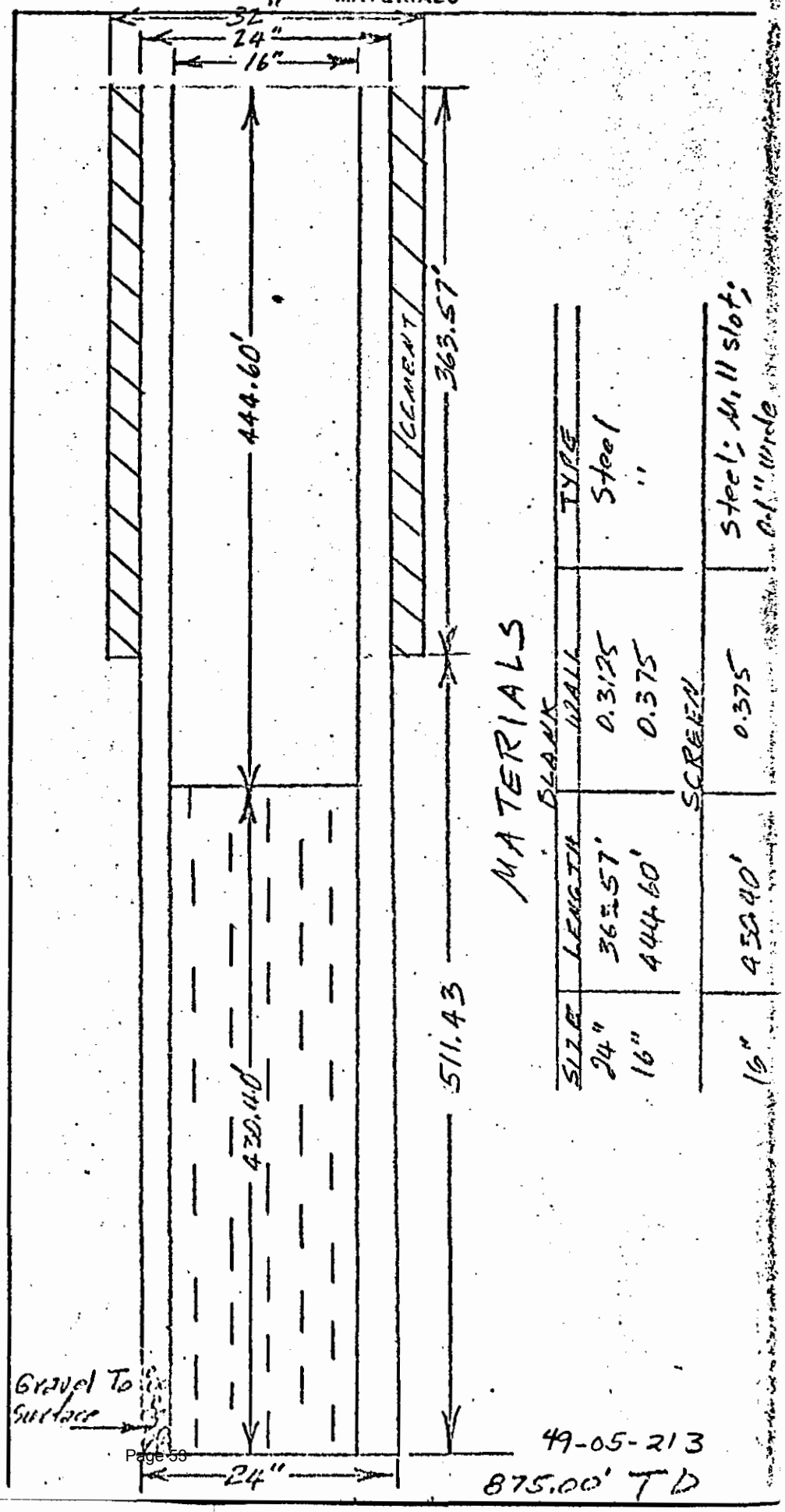
Date Installed _____

## SCALE

Vertical _____

Horizontal _____

## MATERIALS




| SIZE | LENGTH | BLANK WALL | SCREEN | TYPE |
|---|---|---|---|---|
| 24" | 36.57' | 0.3125 | 0.375 | Steel |
| 16" | 444.60' | 0.375 | | " |
| 16" | 420.40' | | | Steel; M, 11 slot; 0.1" wide |



P.A.D. FORM 2002 0668

JL-48-05-213
E-7
6/11/90

# EL PASO WATER UTILITIES
## WATER ANALYSIS REPORT

DATE SAMPLE COLLECTED 06/11/90
DATE RECEIVED AT LABORATORY 06/11/90
DATE ANALYSIS COMPLETED 06/12/90

WELL NUMBER E7
LAB. NUMBER C061190-6
LOCATION
OWNER
SAMPLE TAKER T. CLIETT
DELIVERED BY T. CLIETT

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 4.00 | ****** | ****** |
| Total Alkalinity as CaCO3 | 76 | ****** | ****** |
| Carbonates as CO3 | 4.88 | .162650 | 14 |
| Bicarbonates as HCO3 | 83 | 1.35971 | 59 |
| Chlorides as Cl | 262 | 7.39102 | 561 |
| Sulfates as SO4 | 38 | .79116 | 58 |
| Fluorides as F | 0.70 | .036848 | ****** |
| Nitrates as NO3 LOD=0.10 | 6.60 | .106458 | 8 |
| Total Phosphates as PO4 LOD=.09 | 0.00 | 0 | ****** |
| Total Anions = | 395 | 9.84785 | 700 |

| | |
|---|---|
| Silica, SiO2 = | 35.00 |
| Chlorine Res. = | N/A |
| Turbidity,ntu = | 0.09 |
| Sample Temp(C)= | 22 |
| pH @ 22 | 8.60 |
| Lab E.C.@25C as umhos/cm = | 1090 |
| Field E.C. @25C as umhos/cm = | N/A |
| pH Saturation = | 8.04 |
| Langelier Ind.= | 0.56 |
| Aggress. Index= | 12.61 |
| % Na of T Cat.= | 71 |

Remarks _____
LOD = LIMIT OF DETECTION

| CATIONS | | | |
|---|---|---|---|
| Total Hardness as CaCO3 | 134 | ****** | ****** |
| Calcium as Ca | 42.5 | 2.12075 | 110 |
| Magnesium as Mg | 6.80 | .559368 | 26 |
| Sodium as Na | 162 | 7.047 | 345 |
| Potassium as K | 5.10 | .130407 | 9 |
| Total Cations = | 216 | 9.85753 | 490 |
| TDS BY EPWU METHOD (1)= | 612 | 19.7054 | 1190 |
| TDS BY USGS METHOD (2)= | 604 | | |
| TDS BY TDH METHOD (3)= | 569 | | |

CHECKING CORRECTNESS OF ANALYSIS
Measured Diluted E.C. = 1176
Calculated Diluted E.C.= 1190
% Error = 1.18

(1) SUM OF IONS, NOT INCLUDING SILICA
(2) SUM OF IONS WITH CONVERSION OF HCO3 TO CO3, PLUS SILICA.
(3) SUM OF IONS, NOT INCLUDING SILICA WITH CONVERSION OF HCO3 TO CO3.

ANION-CATION BALANCE
Total Anions - Total Cations = SD=-0.03
+or-(0.1065+0.0155* T.ANIONS)
-.00967=<+or-1SD= +or- .259142 MAX. LIMIT

ANALYST Judith McBee

WATER SUPPLY MGR D.D. Rittenhouse

PO BOX 511
EL PASO, TEXAS 79961

KEY PUNCHED

JL-49-05-213

# EL PASO WATER UTILITIES
## WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED | 05-20-87 | WELL NUMBER | E-7 |
| DATE RECEIVED AT LABORATORY | 05-20-87 | LAB. NUMBER | C052087-6 |
| DATE ANALYSIS COMPLETED | 05-22-87 | LOCATION | NE AREA |
| | | OWNER | |
| | | SAMPLE TAKER | R. SPERKA |
| | | DELIVERED BY | R. SPERKA |

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0 | ****** | ****** |
| Total Alkalinity as CaCO3 | 77 | ****** | ****** |
| Carbonates as CO3 | 0.00 | 0 | 0 |
| Bicarbonates as HCO3 | 94 | 1.53968 | 67 |
| Chlorides as Cl | 170 | 4.7957 | 364 |
| Sulfates as SO4 | 20 | .4164 | 31 |
| Fluorides as F | .66 | .034742 | ****** |
| Nitrates as NO3 LOD=4.43 | 7.2 | .116136 | 8 |
| Total Phosphates as PO4 LOD=.09 | 0 | 0 | ****** |
| Total Anions = | 292 | 6.90266 | 470 |

| CATIONS | | | |
|---|---|---|---|
| Total Hardness as CaCO3 | 92 | ****** | ****** |
| Calcium as Ca | 30 | 1.497 | 78 |
| Magnesium as Mg | 4.13 | .339587 | 16 |
| Sodium as Na | 113 | 4.9155 | 240 |
| Potassium as K | 5.30 | .135521 | 10 |
| Total Cations = | 152 | 6.88761 | 344 |
| TOTAL DISSOLVED SOLIDS = | 444 | 13.7903 | 814 |

| | |
|---|---|
| Silica, SiO2 = | 25 |
| Chlorine Res. = | NA |
| Turbidity,ntu = | .17 |
| Sample Temp(C)= | 25 |
| pH @ 25 | 8.21 |
| Lab E.C.@25C as umhos/cm = | 715 |
| Field E.C. @25C as umhos/cm = | 695 |
| pH Saturation = | 8.10 |
| Langelier Ind.= | 0.11 |
| Aggress. Index= | 12.06 |
| % Na of T Cat.= | 71 |

Remarks _____

LOD = LIMIT OF DETECTION

CHECKING CORRECTNESS OF ANALYSIS

| | |
|---|---|
| Measured Diluted E.C. = | 792 |
| Calculated Diluted E.C.= | 814 |
| % Error = | 2.78 |

ANION-CATION BALANCE

Total Anions - Total Cations =
+or-(0.1065+0.0155* T.ANIONS)
.015047=<+or-1SD= +or- .213491 MAX. LIMIT

ANALYST M. Sperka de Paz DDR

P.O. BOX 511
El Paso,Texas 79961

EL Paso Electric Company
P. O. BOX 982 · EL PASO, TEXAS

NEWMAN WATER WELLS

# WATER ANALYSIS DATA SHEET

| Well or Sample Number | E-1 | E-3 | E-4 | E-5 | E-6 | E-7 | | |
|---|---|---|---|---|---|---|---|---|
| Date Collected | 1-20-76 | 2-5-76 | 11-1-74 | 11-1-74 | 12-31-75 | 1-15-76 | | |
| | 49-05-202 | 201 | 208 | 305 | 212 | 213 | | |
| pH | 7.25 | 7.6 | 7.75 | 7.95 | 7.7 | 7.2 | | |
| Conductivity, micromhos | 775 | 675 | 950 | 580 | 750 | 1,225 | | |
| Total dissolved solids from conductivity | 620 | 540 | 760 | 460 | 600 | 980 | | |
| Total dissolved solids, calculated | 492 | 514 | 717 | 436 | 526 | 797 | | |
| Total Hardness as $CaCO_3$ | 120 | 102 | 164 | 116 | 144 | 176 | | |
| Phenol. Alkalinity as $CaCO_3$ | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Total Alkalinity as $CaCO_3$ | 126 | 150 | 152 | 112 | 102 | 68 | | |
| Carbonate Alkalinity as $CO_3$ | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Bicarbonate Alkalinity as $HCO_3$ | 153 | 183 | 185 | 136 | 124 | 83 | | |
| Sulphates as $SO_4$ | 60 | 60 | 100 | 50 | 50 | 60 | | |
| Chlorides as Cl | 100 | 85 | 164 | 84 | 162 | 350 | | |
| Calcium as Ca | 32 | 28 | 26 | 24 | 40 | 56 | | |
| Magnesium as Mg | 10 | 9 | 24 | 14 | 10 | 9 | | |
| Sodium, calculated as Na | 109 | 121 | 189 | 98 | 109 | 205 | | |
| Silica as $SiO_2$ | 28 | 28 | 31 | 30 | 30 | 33 | | |

**REMARKS:**

Well: _____

Depth: _____

Location: _____



49-05-213

EL PASO WATER UTILITIES PUBLIC SERVICE BOARD

# WATER ANALYSIS DATA SHEET

49-05-213

Plant Sample 1400 Ft/m Well number E-7 Location El Paso Electric Company

| SAMPLE NUMBER | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| DEPTH | 875' | | | | | |
| SAMPLE COLLECTED | 2-6-75 | | | | | |
| RECEIVED AT LABORATORY | 2-7-75 | | | | | |
| ANALYSIS COMPLETED | 2-10-75 | | | | | |
| pH | 7.9 | | | | | |
| EC x $10^6$ @ $25^0$ | | | | | | |
| TASTE AND ODOR | | | | | | |
| SODIUM PER CENT OF TOTAL CATIONS | 73.2% | | | | | |

PARTS PER MILLION

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTAL DISSOLVED SOLIDS | 834 | | | | | |
| PHENOL ALKALINITY AS $CaCO_3$ | 0 | | | | | |
| TOTAL ALKALINITY AS $CaCO_3$ | 63 | | | | | |
| TOTAL HARDNESS AS $CaCO_3$ | 222 | | | | | |
| CHLORIDES | 405 | | | | | |
| SULFATES | 52 | | | | | |
| CALCIUM | 66 | | | | | |
| MAGNESIUM | 13 | | | | | |
| TOTAL IRON | .075 | | | | | |
| FLUORIDES | 0.57 | | | | | |
| SODIUM & POTASSIUM (CALC. AS Na) | 216 | | | | | |
| SILICA, $SiO_2$ | — | | | | | |
| MANGANESE | L.05 | | | | | |
| PHOSPHATES | 0.09 | | | | | |

THEORETICAL COMBINATIONS

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Remarks:.....

.....

.....



D. L. Rittenhouse
Analyst

49-05-213

# ANALYSIS DATA SH

49-05-213

TD 859
E-6
369'
Gravel
360

1600 gpm
57 sec cap
20.00

T= 128,000 24hr
300,000
80,000 (15) 24hr
130,000

T= L-12

Location E7

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| | 1072-1092 | 946-966 | | | | |
| | 1-10-75 | 1-10-75 | | | | |
| | 1-13-75 | 1-13-75 | | | | |
| | 1-13-75 | 1-13-75 | | | | |
| | 7.2 | 7.45 | | | | |
| | | | | | | |
| | | | | | | |
| | 74.7% | 81.6% | | | | |

PARTS PER MILLION

| | | | | | | |
|---|---|---|---|---|---|---|
| | 1952 | 1845 | | | | |
| | 0 | 0 | | | | |
| | 45 | 51 | | | | |
| | 420 | 330 | | | | |
| | 1005 | 920 | | | | |
| | 263 | 173 | | | | |
| | 134 | 112 | | | | |
| MAGNESIUM | 21 | 12 | | | | |
| TOTAL IRON | .02 | .025 | | | | |
| FLUORIDES | .57 | .37 | | | | |
| SODIUM & POTASSIUM (CALC. AS NA) | 457 | 551 | | | | |
| SILICA, $SiO_2$ | — | — | | | | |
| MANGANESE | <.02 | <.02 | | | | |
| PHOSPHATES | <.05 | <.05 | | | | |

THEORETICAL COMBINATIONS

| | 1 | 2 | | | | |
|---|---|---|---|---|---|---|
| Specific Conductance | 3600 | 3200 | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Remarks:.....

.....

.....



D.O. Kittrell 49-05-213
Analyst

J2-49-05-213

# EL PASO WATER UTILITIES
# WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| **DATE COLLECTED:** | **12/02/96** | **SAMPLE SOURCE:** | **Well E-7** |
| **TIME COLLECTED:** | **16:30** | **LAB NUMBER:** | **C120396-3** |
| **DATE RECEIVED:** | **12/03/96** | **LOCATION:** | **Northeast** |
| **TIME RECEIVED:** | **08:00** | **OWNER:** | **EPWU** |
| **DATE ANALYZED:** | **12/03/96** | **COLLECTED BY:** | **A. Castaneda** |
| **DATE ANALYSIS COMPLETED:** | **12/12/96** | **DELIVERED BY:** | **A. Castaneda** |

| **ANIONS** | mg/l | me/l | Dil E.C. | | |
|---|---|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 1.0 | | | Silica, SiO2 = | 35.0 |
| Total Alkalinity as CaCO3 | 64.0 | | | Chlorine Res. = | N/A |
| Carbonates as CO3 | 1.2 | 0.0400 | 3 | Turbidity, NTU = | 0.69 |
| Bicarbonates as HCO3 | 75.6 | 1.2405 | 54 | Sample Temp (C) | 16.4 |
| Chlorides as Cl | 210.0 | 5.9233 | 449 | pH @ | 8.33 |
| Sulfates as SO4 | 32.0 | 0.6656 | 49 | Lab E.C. @ 25 C | |
| Fluorides as F | 0.7 | 0.0372 | | as umhos/m = | 840 |
| Nitrates as NO3 LOD= 0.1 | 7.9 | 0.1269 | 9 | Field E.C. @ 25 C | |
| Total Phosphates LOD= 0.09 | 0.0 | 0.0005 | | as umhos/cm = | N/A |
| **TOTAL ANIONS** | 327 | 8.0340 | 565 | pH Saturation = | 8.24 |
| | | | | Langelier Index | 0.09 |
| | | | | Aggress. Index | 12.19 |
| **CATIONS** | | | | % Na of T. Cat. = | 69 |
| Total Hardness as CaCO3 | 114 | | | | |
| Calcium as Ca | 40.1 | 2.0050 | 104 | | |
| Magnesium Mg | 3.3 | 0.2705 | 13 | | |
| Sodium as Na | 129.0 | 5.6111 | 275 | | |
| Potassium as K | 5.2 | 0.1317 | 9 | | |
| **TOTAL CATIONS** | 178 | 8.0183 | 401 | | |

| | | | |
|---|---|---|---|
| **TDS BY EPWU METHOD (1)=** | 505 | 16.0524 | 966 |
| **TDS BY USGS METHOD (2)=** | 502 | | |
| **TDS BY TDH METHOD (3)=** | 467 | | |
| **TDS BY EVAPORATION (4)=** | 492 | | |

**CHECKING CORRECTNESS OF ANALYSIS**

| | |
|---|---|
| Measured Diluted E.C. | 950 |
| Calculated Diluted E.C. | 966 |
| % Error | 1.72% |

**ANION - CATION BALANCE**

| | |
|---|---|
| Total Anions - Total Cations = | 0.0157 |
| + or - (0.1065 + 0.0155 * T. Anions) Maximum Limit +/- | 0.2310 |

1.- SUM OF IONS, NOT INCLUDING SILICA.
2.- SUM OF IONS WITH CONVERSION OF HCO3 TO CO3, PLUS SILICA.
3.- SUM OF IONS, NOT INCLUDING SILICA WITH CONVERSION OF HCO3 TO CO3.
4.-AT 180 DEGREES CELSIUS

SD = 0.07

Maria Molina
**Maria Molina, Chemist I**

Douglas Rittmann
**Douglas Rittmann, P.E.**
**Water Systems Div. Mgr.**

06

JL-49-05-213

# EL PASO WATER UTILITIES
# WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| **DATE COLLECTED:** | **05/16/97** | **SAMPLE SOURCE:** | **Well E7** |
| **TIME COLLECTED:** | **08:15** | **LAB NUMBER:** | **C051697-32** |
| **DATE RECEIVED:** | **05/16/97** | **LOCATION:** | **Nevins** |
| **TIME RECEIVED:** | **13:30** | **OWNER:** | **EPWU** |
| **DATE ANALYZED:** | **05/16/97** | **COLLECTED BY:** | **N.A.** |
| **DATE ANALYSIS COMPLETED:** | **06/20/97** | **DELIVERED BY:** | **N.A.** |

| **ANIONS** | mg/l | me/l | Dil E.C. | | |
|---|---|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.0 | | | Silica, SiO2 = | 31.0 |
| Total Alkalinity as CaCO3 | 76.0 | | | Chlorine Res. = | N/A |
| Carbonates as CO3 | 0.0 | 0.0000 | 0 | Turbidity, NTU = | 0.12 |
| Bicarbonates as HCO3 | 92.7 | 1.5206 | 66 | Sample Temp (C) | 31.0 |
| Chlorides as Cl | 265.0 | 7.4747 | 567 | pH @ | 8.13 |
| Sulfates as SO4 | 36.0 | 0.7488 | 55 | Lab E.C. @ 25 C | |
| Fluorides as F | 0.7 | 0.0346 | | as umhos/m = | 1090 |
| Nitrates as NO3 LOD= 0.1 | 6.7 | 0.1073 | 8 | Field E.C. @ 25 C | |
| Total Phosphates LOD= 0.09 | 0.0 | 0.0004 | | as umhos/cm = | N/A |
| **TOTAL ANIONS** | 401 | 9.8863 | 696 | pH Saturation = | 7.78 |
| | | | | Langelier Index | 0.35 |
| | | | | Aggress. Index | 12.17 |
| **CATIONS** | | | | % Na of T. Cat. = | 68 |
| Total Hardness as CaCO3 | 144 | | | | |
| Calcium as Ca | 49.7 | 2.4850 | 129 | | |
| Magnesium Mg | 4.8 | 0.3934 | 18 | | |
| Sodium as Na | 157.0 | 6.8291 | 334 | | |
| Potassium as K | 5.4 | 0.1391 | 10 | | |
| **TOTAL CATIONS** | 217 | 9.8466 | 492 | | |

| | | | |
|---|---|---|---|
| **TDS BY EPWU METHOD (1)=** | 618 | 19.7330 | 1188 |
| **TDS BY USGS METHOD (2)=** | 602 | | |
| **TDS BY TDH METHOD (3)=** | 571 | | |
| **TDS BY EVAPORATION (4)=** | 636 | | |

**CHECKING CORRECTNESS OF ANALYSIS**

| | |
|---|---|
| Measured Diluted E.C. | 1200 |
| Calculated Diluted E.C. | 1188 |
| % Error | -0.96% |

**ANION - CATION BALANCE**

| | |
|---|---|
| Total Anions - Total Cations = | 0.0397 |
| + or - (0.1065 + 0.0155 * T. Anions) | |
| Maximum Limit +/- | 0.2597 |

1.- SUM OF IONS, NOT INCLUDING SILICA.
2.- SUM OF IONS WITH CONVERSION OF HCO3 TO CO3, PLUS SILICA.
3.- SUM OF IONS, NOT INCLUDING SILICA WITH CONVERSION OF HCO3 TO CO3.
4.-AT 180 DEGREES CELSIUS

SD = 0.18

Maria Molina
**Maria Molina, Chemist I**

**Paul R. Rivas, Chemist II**

JL-49-05-213

# ANION-CATION BALANCE

*SM 1030 F*

*Standard Methods 19TH Edition*

*CENTRAL LABORATORY*

Sampling Location: Mesa-Nevins

Requested By: R. Sperka

Sample Identification: J022798-6
Project: W.S.
Sampling Point: Well E7
Sampling Description: Grab

Date Collected: 02/26/98
Time Collected: ~~02/27/98~~
Date Reported: 03/18/98

| ANIONS | mg/L | me/L | Dil EC |
|---|---|---|---|
| p-Alkalinity (CaCO3) | 0.0 | | |
| t-Alkalinity (CaCO3) | 70 | | |
| Carbonate | 0 | 0.00 | 0.00 |
| Bicarbonate | 85 | 1.40 | 61.06 |
| Chloride | 291 | 8.21 | 622.74 |
| Sulfate | 30.3 | 0.63 | 46.66 |
| Fluoride | 0.66 | 0.03 | |
| Nitrogen as NO3 | 10.7 | 0.17 | 12.28 |
| Total phosphorous as PO4 < 0.03 | 0.00 | 0.00 | |
| *TOTAL ANIONS* | 418.0 | 10.45 | 742.75 |

| CATIONS | mg/L | me/L | Dil EC |
|---|---|---|---|
| Calcium | 52.9 | 2.65 | 137.54 |
| Magnesium | 5.8 | 0.48 | 22.16 |
| Sodium | 163 | 7.09 | 347.19 |
| Potassium | 5.6 | 0.14 | 10.36 |
| *TOTAL CATIONS* | 227.3 | 10.35 | 517.25 |

| | | |
|---|---|---|
| Field pH | ND | |
| Field Temperature | ND | |
| Field EC | ND | |
| pH | 8.24 | |
| Temperature of analysis | 20.7 | |
| Chlorine Residual | ND | |
| pH Saturation | 8.01 | |
| Langlier Index | 0.23 | *Scale Forming* |
| TDS (EPWU method) | 645 | anions+cations, excluding silica |
| TDS (USGS method) | 631 | convert HCO3 to CO3, include silica |
| TDS (TDH method) | 602 | convert HCO3 to CO3, exclude silica |
| TDS (measured @ 180C) | 666 | |
| TDS (calculated-SM 1030F) | 631 | SD=0.34 |
| Turbidity, NTU | 0.12 | |
| Silica | 29 | |
| %Na of Total Cations | 68.5% | |
| Hardness as CaCO3 (titrated) | 156.0 | |
| Hardness as CaCO3 (calc) | 156.1 | |
| EC (measured) | 1140 | |
| EC (calculated) | 1153 | |
| Diluted EC (measured) | 1240 | |
| Diluted EC (calculated) | 1260 | |

## CHECKING CORRECTNESS OF ANALYSIS

| | | | ACTION REQUIRED | LIMITS |
|---|---|---|---|---|
| *Anion/Cation balance (% diff)...* | -0.4% | *ACCEPTABLE* | *NONE* | +/-5.0% |
| *TDS Ratio.....* | 1.1 | *ACCEPTABLE* | *NONE* | 1.0-1.2 |
| *Conductivity ratio.....* | 1.0 | *ACCEPTABLE* | *NONE* | 0.9-1.1 |
| *Measured EC and anion sum.....* | 1045 | *ACCEPTABLE* | *NONE* | (0.9-1.1)EC |
| *Measured EC and cation sum....* | 1035 | *ACCEPTABLE* | *NONE* | (0.9-1.1)EC |
| *Calculated TDS to EC ratio.....* | 0.55 | *ACCEPTABLE* | *NONE* | 0.55-0.7 |
| *Measured TDS to EC ratio.....* | 0.58 | *ACCEPTABLE* | *NONE* | 0.55-0.7 |
| *Hardness relative % error.....* | 0.1% | *ACCEPTABLE* | *NONE* | +/-5.0% |

CHEMIST: _____ DATE: 3-26-98

QA/QC: _____ DATE: 3-31-98

APPROVAL: _____ DATE: APR 01 1998

R12, C11

We JL-49-05-214

FORM 9-1642
(DEC 68)

# WELL SCHEDULE

U. S. DEPT. OF THE INTERIOR — GEOLOGICAL SURVEY — WATER RESOURCES DIVISION

RW-11

DWS ± ROGER SPENCE

1:62,500

## MASTER CARD

Record by A. F. White Source of data F. Pwu Date 8/23/88 Map ± North Franklin

State Tex 49 County (or town) El Paso JL 4½

Latitude: 31 58 58 N (deg, min, sec) Longitude: 106 25 29 (degrees, min, sec) Sequential number: 1

Lat-long accuracy: T. S, R W, Sec 12 SW¼ NW¼ NW¼ BLK 81 TSP 1 B & M

Local well number: JL-49-05-214 Other number:

Local use: Owner or name: El Paso County

Owner or name: CITY OF EL PASO Address: Utilities

Ownership: (C) County, (F) Fed Gov't, (M) Mun, (N) Corp or Co, (P) Private, (S) State Agency, (W) Water Dist

Use of water: (A) Air cond, (B) Bottling, (C) Comm, (D) Dewater, (E) Power, (F) Fire, (H) Irr, (I) Ind, (M) Med, (N) P S, (P) Rec, (R) Stock, (S) Inactit, (T) Unused, (U) Repressure, (V) Recharge, (W) Desal-P S, (X) Desal-other, (Z) Other HERD WELL

Use of well: (A) Anode, (D) Drain, (G) Seismic, (H) Heat Res, (O) Obs, (P) Oil-gas, (R) Recharge, (T) Test, (U) Unused, (W) Withdraw, (X) Waste, (Z) Destroyed

DATA AVAILABLE: Well data Freq. W/L meas.: Field aquifer char.

Hyd. lab. data:

Qual. water data; type:

Freq. sampling: OCCR Pumpage inventory: yes / no, period:

Aperture cards: yes

Log data: E PWU E LOG 20-758'

## WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD Depth well: 685.12 ft 685 Meas. rept accuracy

Depth cased; (first perf.) 295 ft 276 Casing type: S ; Diam. 16 in 16

Finish: (C) porous concrete, (F) gravel w. (perf.), (G) gravel w. (screen), (H) horiz. gallery, (O) open end, (P) perf., (S) screen, (T) sd. pt., (W) shored, (X) open hole, (Z) other

Method Drilled: (A) air rot, (B) bored, (C) cable, (D) dug, (H) hyd rot., (J) jetted, (P) air percussion, (R) reverse rotary, (T) trenching, (V) driven, (W) drive wash, (Z) other

Date Drilled: JUNE 1988 Pump intake setting: ft

Driller: E Pwu name address

Lift (type): (A) air, (B) bucket, (C) cent, (J) jet, (L) multiple (cent.), (M) multiple (turb.), (N) none, (P) piston, (R) rot, (S) submerg, (T) turb, (Z) other Deep Shallow

Power (type): diesel, elec, gas, gasoline, hand, gas, wind; nat LP H.P. Trans. or meter no.

Descrip. MP ft above below LSD, Alt. MP

Alt. LSD: 4045 4045 Accuracy: (source) E Log - 7½ Min

Water Level ft above below MP; Ft above below LSD Accuracy:

Date meas: Yield: gpm Method determined

Drawdown: ft Accuracy: Pumping period hrs

QUALITY OF WATER DATA: Iron ppm Sulfate ppm Chloride ppm Hard. ppm

Sp. Conduct K x $10^6$ Temp. °F Date sampled

Taste, color, etc.

WR-11 No.



49-05-214

Well No. JL-~~HG~~-05-214

Latitude-longitude 31 58 58 N / 106 25 29 1

HYDROGEOLOGIC CARD

SAME AS ON MASTER CARD

Physiographic Province: BASIN & RG [22] Section: MEX HIGHLAND [D]

Drainage Basin: RIO GRANDE [57 H] Subbasin: [ ]

Topo of well site: (D) depression, (C) stream channel, (E) dunes, (F) flat, (H) hilltop, (K) sink, (L) swamp, (0) offshore, (P) pediment, (S) hillside, (T) terrace, (U) undulating, (V) valley flat [ ]

MAJOR AQUIFER: TERT-QUAT PLIO-PLEIST [RQ] HUECO BOLSON [BN]
system, series, aquifer, formation, group

Lithology: ______ [ ] Origin: ______ [ ] Aquifer Thickness: ______ ft

[ ] Length of well open to: 279.45' ft [ ] Depth to top of: ______ ft [ ]

MINOR AQUIFER: ______, ______ [ ] ______ [ ]
system, series, aquifer, formation, group

Lithology: ______ [ ] Origin: ______ [ ] Aquifer Thickness: ______ ft

[ ] Length of well open to: ______ ft [ ] Depth to top of: ______ ft [ ]

Intervals Screened: 275.67-376.11, 416.11-475.72, 495.72-555.67, 625.67-685.12

Depth to consolidated rock: ______ ft [ ] Source of data: ______ [ ]

Depth to basement: ______ ft [ ] Source of data: ______ [ ]

Surficial material: ______ [ ] Infiltration characteristics: ______ [ ]

Coefficient Trans: ______ gpd/ft [ ] Coefficient Storage: ______ [ ]

Coefficient Perm: ______ $gpd/ft^2$; Spec cap: ______ gpm/ft; Number of geologic cards: ______ [ ]

SEE COMPLETION DIAGRAM & LOCATION MAP

INTERVAL SAMPLE 712-732'
619 MG/L DS -- BETTER QUAL.
THAN "E" LOG INDICATES --
MAY NOT BE A REPRESENTATIVE SAMPLE.

Well No.

GPO : 1972 O - 475-840



49-05-214

# WELL DATA

WELL NUMBER RW-11

JL-49-05-214

## PUMP DATA

Make _____

Type _____

Stages _____

Tubing _____

Shaft _____

Column _____

Serial Number _____

Setting _____

O. D. Bowls _____

Capacity: GPM _____ / Feet Head _____

## MOTOR DATA

Make _____

Volts _____

Amps _____

Type _____

Motor H. P. _____

Speed _____

Cycles - Phase _____

Serial Number _____

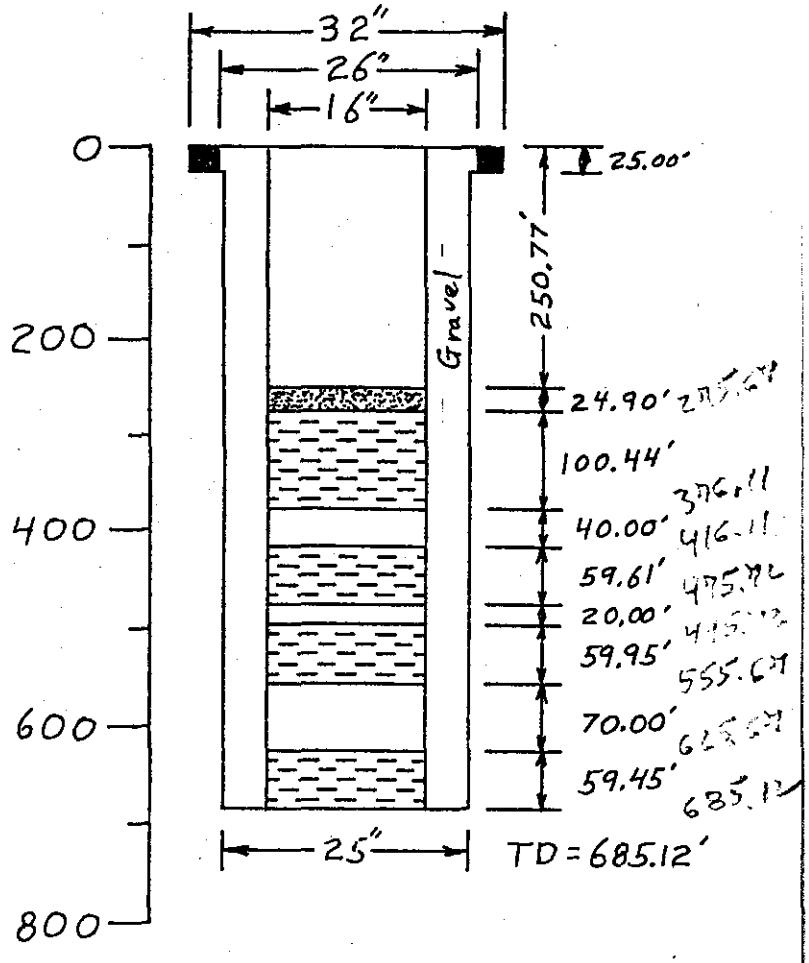
Date Installed _____

## SCALE

Vertical 1" = 200'

Horizontal 1" = 20"

## MATERIALS




### Materials

| Size | Length | Wall | Type |
|---|---|---|---|
| 26" | 25.00' | 0.281" | Steel |
| 16" | 380.77' | 0.281" | Steel |
| 16" | 24.90' | 0.281" | Galv. Steel |

### Screen

| | | | |
|---|---|---|---|
| 16" | 279.45' | 35 lbs/ft | Galv. Steel Wire-Wrapped; Slot = 0.1" |



49-05-214

R-11 JL-4 05-214
712-732' 6/24/88
2 SAMPLE

DATE SAMPLE COLLECTED: NA
DATE RECEIVED AT LAB: 24 JUNE 1988
DATE ANALYSIS COMPLETED: 6 JULY 1988
SAMPLE IDENTIFICATION: RW-11
OWNER: EPWU
DEPTH OF WELL: 712'-732'
LABORATORY #: C062188-3

KEY PUNCHED

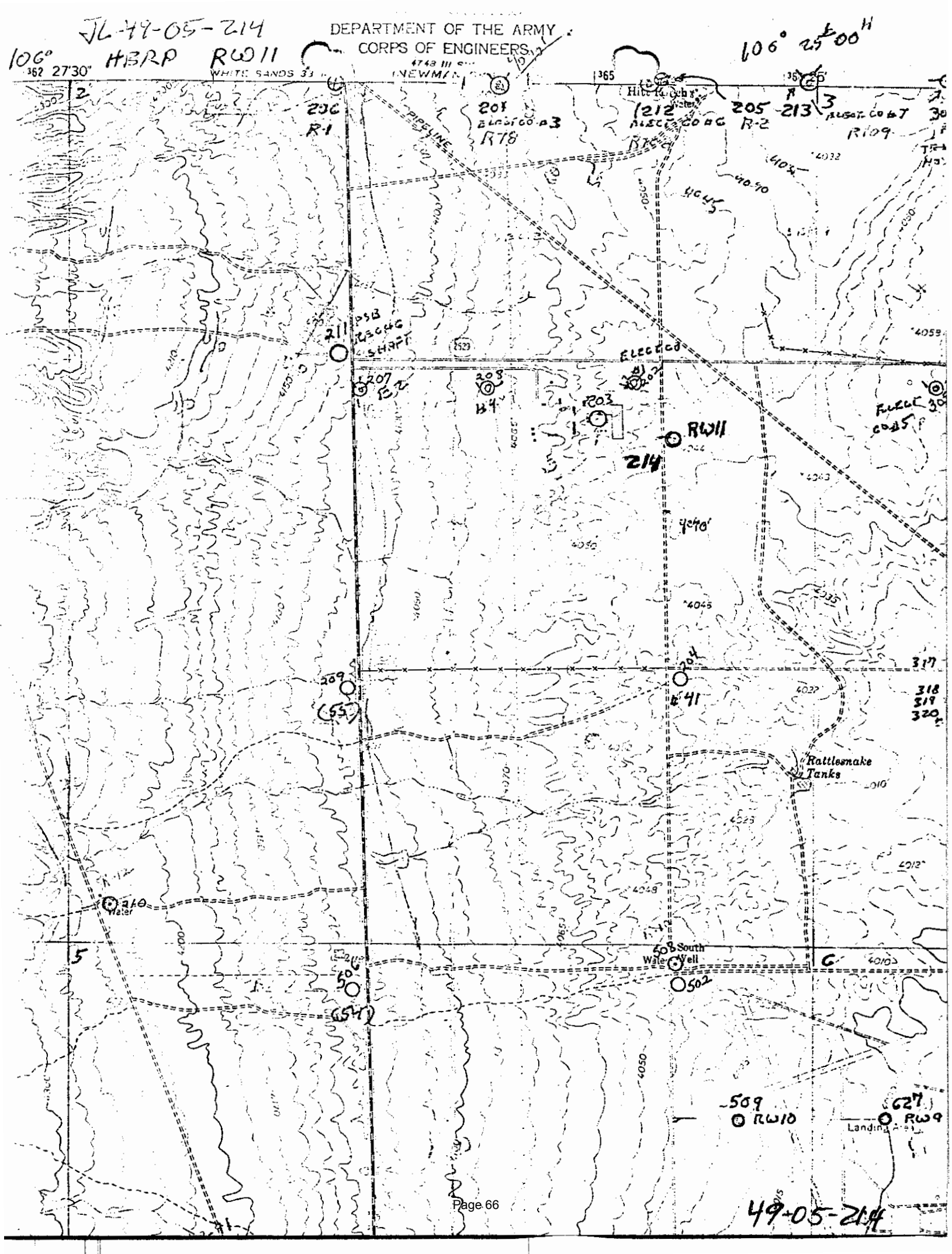
| ANIONS | mg/L | me/L | DIL E.C. |
|---|---|---|---|
| p-ALK (CaCO3) | 0.00 | ********** | |
| t-ALK (CaCO3) | 83.70 | ********** | |
| CARBONATES AS CO3 | 0.00 | 0.00 | 0.00 |
| BICARBONATES AS HCO3 | 102.11 | 1.67 | 73.01 |
| CHLORIDES AS Cl | 290.00 | 8.18 | 620.60 |
| SULFATES AS SO4 | 38.79 | 0.81 | 59.74 |
| FLOURIDES AS F | 0.72 | 0.04 | ********* |
| NITRATES AS NO3 | 3.93 | 0.06 | 4.52 |
| TOTAL PHOSPHATES AS PO4 | 0.21 | 0.01 | ********* |
| TOTAL ANIONS | 435.76 | 10.77 | 757.87 |
| CATIONS | | | |
| t-HARDNESS AS CaCO3 | 50.00 | ********** | |
| CALCIUM AS Ca | 26.80 | 1.34 | 69.68 |
| MAGNESIUM AS Mg | 6.50 | 0.53 | 24.83 |
| SODIUM AS Na | 195.00 | 8.48 | 415.35 |
| POTASSIUM AS K | 13.40 | 0.34 | 24.66 |
| TOTAL CATIONS | 241.70 | 10.69 | 534.52 |

| | | | |
|---|---|---|---|
| E. COND | 1131.00 | pH: | 8.10 |
| TDS | 619.00 | TURBIDITY | 110 NTU |
| THEORETICAL TDS | 677.46 | SiO4: | 30.00 |
| | | CL2 RES: | NA |
| CHECKING CORRECTNESS OF ANALYSIS | | TEMP OF ANALYSIS: | 24 C |
| MEASURED DILUTED E.C. | 1296.00 | pH SATUR: | 8.46 |
| CALCULATED DILUTED E,C, | 1292.38 | LANG IND: | -0.36 |
| % ERROR | -0.28% | AGGR IND: | 11.72 |
| | | FIELD E.C.: | 1100.00 |
| ANION/CATION BALANCE | | %NA OF T. CAT.: | 79.3% |
| t-ANIONS - t-CATIONS= | 0.08 | | |
| THEORETICAL LIMIT | 0.27 | | |

ANALYST: Sylvia Luna
CHEMIST: _____



49-05-214


JL-49-05-214
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
106° 25' 00"
106° 27'30"
HBRP RW11
WHITE SANDS 33
NEWMAN
Hitt Ranch Water
206 R-1
201 ELECTRIC CO #3 RT8
212 ELECTRIC CO #6 RT6
205 R-2
213
3
RW09
PIPELINE
211 DSB ELECTRIC SHAFT
207 RT7
208 B4
203
RW11
214
ELECTRIC CO #5
209 (55)
204
641
317
318
319
320
Rattlesnake Tanks
240 Water
508 South Well Water
502
50
(54)
509
RW10
627
RW9
Landing Area
49-05-214

JL-49-05-214

# EL PASO WATER UTILITIES
# WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| **DATE COLLECTED:** | **11/22/96** | **SAMPLE SOURCE:** | **Well 58** |
| **TIME COLLECTED:** | **18:00** | **LAB NUMBER:** | **C112596-1** |
| **DATE RECEIVED:** | **11/25/96** | **LOCATION:** | **Nevins** |
| **TIME RECEIVED:** | **08:00** | **OWNER:** | **EPWU** |
| **DATE ANALYZED:** | **11/25/96** | **COLLECTED BY:** | **R. Alvarez** |
| **DATE ANALYSIS COMPLETED:** | **12/05/96** | **DELIVERED BY:** | **R. Alvarez** |

| **ANIONS** | mg/l | me/l | Dil E.C. | | |
|---|---|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.0 | | | Silica, SiO2 = | 35.0 |
| Total Alkalinity as CaCO3 | 106.0 | | | Chlorine Res. = | N/A |
| Carbonates as CO3 | 0.0 | 0.0000 | 0 | Turbidity, NTU = | 0.12 |
| Bicarbonates as HCO3 | 129.3 | 2.1208 | 92 | Sample Temp (C) | 21.0 |
| Chlorides as Cl | 215.0 | 6.0644 | 460 | pH @ | 7.91 |
| Sulfates as SO4 | 126.0 | 2.6208 | 194 | Lab E.C. @ 25 C | |
| Fluorides as F | 0.6 | 0.0322 | | as umhos/m = | 1120 |
| Nitrates as NO3 LOD= 0.1 | 10.9 | 0.1757 | 13 | Field E.C. @ 25 C | |
| Total Phosphates LOD= 0.09 | 0.0 | 0.0005 | | as umhos/cm = | N/A |
| **TOTAL ANIONS** | 482 | 11.0144 | 759 | pH Saturation = | 7.73 |
| | | | | Langelier Index | 0.18 |
| | | | | Aggress. Index | 12.27 |
| **CATIONS** | | | | % Na of T. Cat. = | 57 |
| Total Hardness as CaCO3 | 218 | | | | |
| Calcium as Ca | 66.6 | 3.3300 | 173 | | |
| Magnesium Mg | 12.5 | 1.0246 | 48 | | |
| Sodium as Na | 146.0 | 6.3506 | 311 | | |
| Potassium as K | 9.9 | 0.2535 | 18 | | |
| **TOTAL CATIONS** | 235 | 10.9586 | 550 | | |

| | | | |
|---|---|---|---|
| **TDS BY EPWU METHOD (1)=** | 717 | 21.9731 | 1309 |
| **TDS BY USGS METHOD (2)=** | 686 | | |
| **TDS BY TDH METHOD (3)=** | 651 | | |
| **TDS BY EVAPORATION (4)=** | 659 | | |

**CHECKING CORRECTNESS OF ANALYSIS**

| | |
|---|---|
| Measured Diluted E.C. | 1300 |
| Calculated Diluted E.C. | 1309 |
| % Error | 0.71% |

**ANION - CATION BALANCE**

| | |
|---|---|
| Total Anions - Total Cations = | 0.0558 |
| + or - (0.1065 + 0.0155 * T. Anions) Maximum Limit +/- | 0.2772 |

1.- SUM OF IONS, NOT INCLUDING SILICA.
2.- SUM OF IONS WITH CONVERSION OF HCO3 TO CO3, PLUS SILICA.
3.- SUM OF IONS, NOT INCLUDING SILICA WITH CONVERSION OF HCO3 TO CO3.
4.-AT 180 DEGREES CELSIUS

SD = 0.22

Teresa T. Alcala
**Teresa Alcala, Chemist I**

Douglas Rittmann
**Douglas Rittmann, P.E.**
**Water Systems Div. Mgr.**

JL-49-05-214

# EL PASO WATER UTILITIES
# WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| **DATE COLLECTED:** | **05/16/97** | **SAMPLE SOURCE:** | **Well 58** |
| **TIME COLLECTED:** | **08:30** | **LAB NUMBER:** | **C051697-30** |
| **DATE RECEIVED:** | **05/16/97** | **LOCATION:** | **Nevins** |
| **TIME RECEIVED:** | **13:30** | **OWNER:** | **EPWU** |
| **DATE ANALYZED:** | **05/16/97** | **COLLECTED BY:** | **N.A.** |
| **DATE ANALYSIS COMPLETED:** | **06/19/97** | **DELIVERED BY:** | **N.A.** |

| **ANIONS** | mg/l | me/l | Dil E.C. | | |
|---|---|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.0 | | | Silica, SiO2 = | 30.0 |
| Total Alkalinity as CaCO3 | 112.0 | | | Chlorine Res. = | N/A |
| Carbonates as CO3 | 0.0 | 0.0000 | 0 | Turbidity, NTU = | 0.09 |
| Bicarbonates as HCO3 | 136.6 | 2.2409 | 98 | Sample Temp (C) | 31.8 |
| Chlorides as Cl | 195.0 | 5.5002 | 417 | pH @ | 7.86 |
| Sulfates as SO4 | 98.0 | 2.0384 | 151 | Lab E.C. @ 25 C | |
| Fluorides as F | 0.6 | 0.0335 | | as umhos/m = | 1040 |
| Nitrates as NO3 LOD= 0.1 | 7.3 | 0.1182 | 8 | Field E.C. @ 25 C | |
| Total Phosphates LOD= 0.09 | 0.0 | 0.0005 | | as umhos/cm = | N/A |
| **TOTAL ANIONS** | 438 | 9.9317 | 674 | pH Saturation = | 7.57 |
| | | | | Langelier Index | 0.29 |
| | | | | Aggress. Index | 12.15 |
| **CATIONS** | | | | % Na of T. Cat. = | 60 |
| Total Hardness as CaCO3 | 175 | | | | |
| Calcium as Ca | 53.7 | 2.6850 | 140 | | |
| Magnesium Mg | 9.9 | 0.8115 | 38 | | |
| Sodium as Na | 138.0 | 6.0026 | 294 | | |
| Potassium as K | 9.6 | 0.2463 | 18 | | |
| **TOTAL CATIONS** | 211 | 9.7454 | 489 | | |

| | | | |
|---|---|---|---|
| **TDS BY EPWU METHOD (1)=** | 649 | 19.6770 | 1163 |
| **TDS BY USGS METHOD (2)=** | 609 | | |
| **TDS BY TDH METHOD (3)=** | 579 | | |
| **TDS BY EVAPORATION (4)=** | 593 | | |

**CHECKING CORRECTNESS OF ANALYSIS**

| | |
|---|---|
| Measured Diluted E.C. | 1160 |
| Calculated Diluted E.C. | 1163 |
| % Error | 0.30% |

**ANION - CATION BALANCE**

| | |
|---|---|
| Total Anions - Total Cations = | 0.1863 |
| + or - (0.1065 + 0.0155 * T. Anions) | |
| Maximum Limit +/- | 0.2604 |

1.- SUM OF IONS, NOT INCLUDING SILICA.
2.- SUM OF IONS WITH CONVERSION OF HCO3 TO CO3, PLUS SILICA.
3.- SUM OF IONS, NOT INCLUDING SILICA WITH CONVERSION OF HCO3 TO CO3.
4.-AT 180 DEGREES CELSIUS

SD = 0.72

Maria Molina
**Maria Molina, Chemist I**

**Paul R. Rivas, Chemist II**

JL-49-05-214

# ANION-CATION BALANCE

SM 1030 F

*Standard Methods 19TH Edition*

CENTRAL LABORATORY

Sampling Location: Mesa-Nevins

Requested By: R. Sperka

Sample Identification: J021198-7
Project: WS
Sampling Point: Well 58
Sampling Description: Grab

Date Collected: 02/10/98
Time Collected: 16:52
Date Reported: 02/24/98

| ANIONS | mg/L | me/L | Dil EC |
|---|---|---|---|
| p-Alkalinity (CaCO3) | 0.0 | | |
| t-Alkalinity (CaCO3) | 108 | | |
| Carbonate | 0 | 0.00 | 0.00 |
| Bicarbonate | 132 | 2.16 | 94.21 |
| Chloride | 207 | 5.84 | 442.98 |
| Sulfate | 123.0 | 2.56 | 189.42 |
| Fluoride | 0.65 | 0.03 | |
| Nitrogen as NO3 | 11.7 | 0.19 | 13.40 |
| Total phosphorous as PO4 | 0.00 | 0.00 | |
| *TOTAL ANIONS* | 474.1 | 10.78 | 740.01 |

| CATIONS | mg/L | me/L | Dil EC |
|---|---|---|---|
| Calcium | 61.8 | 3.09 | 160.68 |
| Magnesium | 9.6 | 0.79 | 36.67 |
| Sodium | 142 | 6.18 | 302.46 |
| Potassium | 9.9 | 0.25 | 18.25 |
| *TOTAL CATIONS* | 223.3 | 10.31 | 518.06 |

| | |
|---|---|
| Field pH | ND |
| Field Temperature | ND |
| Field EC | ND |
| pH | 7.85 |
| Temperature of analysis | 18.6 |
| Chlorine Residual | ND |
| pH Saturation | 7.80 |
| Langlier Index | 0.05 |
| TDS (EPWU method) | 697 |
| TDS (USGS method) | 660 |
| TDS (TDH method) | 630 |
| TDS (measured @ 180C) | 646 |
| TDS (calculated-SM 1030F) | 660 |
| Turbidity, NTU | 0.09 |
| Silica | 30 |
| %Na of Total Cations | 59.9% |
| Hardness as CaCO3 (titrated) | 194.0 |
| Hardness as CaCO3 (calc) | 194.1 |
| EC (measured) | 1100 |
| EC (calculated) | 1120 |
| Diluted EC (measured) | 1260 |
| Diluted EC (calculated) | 1258 |

***Scale Forming***

anions+cations, excluding silica

convert HCO3 to CO3, include silica

convert HCO3 to CO3, exclude silica

SD = 1.77

## CHECKING CORRECTNESS OF ANALYSIS

| | | | ACTION REQUIRED | LIMITS |
|---|---|---|---|---|
| *Anion/Cation balance (% diff)...* | -2.2% | *ACCEPTABLE* | *NONE* | +/-5.0% |
| *TDS Ratio.....* | 1.0 | *ACCEPTABLE* | *NONE* | 1.0-1.2 |
| *Conductivity ratio.....* | 1.0 | *ACCEPTABLE* | *NONE* | 0.9-1.1 |
| *Measured EC and anion sum.....* | 1078 | *ACCEPTABLE* | *NONE* | (0.9-1.1)EC |
| *Measured EC and cation sum....* | 1031 | *ACCEPTABLE* | *NONE* | (0.9-1.1)EC |
| *Calculated TDS to EC ratio.....* | 0.60 | *ACCEPTABLE* | *NONE* | 0.55-0.7 |
| *Measured TDS to EC ratio.....* | 0.59 | *ACCEPTABLE* | *NONE* | 0.55-0.7 |
| *Hardness relative % error.....* | 0.0% | *ACCEPTABLE* | *NONE* | +/-5.0% |

CHEMIST: Teresa T. Alcalá DATE: 2-26-98

QA/QC: Victoria Cobey DATE: 3-3-98

APPROVAL: [signature] DATE: MAR 04 1998

# Texas Water Development Board

## Well Schedule

State Well Number 49052151 Previous Well Number _____ County El Paso 141

River Basin 23 Zone 1 Latitude 315755 Longitude 1062515 Coordinates Accuracy 0

Owner's well No. _____ Location: _____ 1/4 , _____ 1/4 , Section _____ Block _____ Survey _____

Owner El Paso Water Utilities M-1A Driller Layne-Christensen

Address _____ Tenant/Oper. _____

Date Drilled 04272000 Depth 409 Source of Depth A Altitude 402 Source of Alt. Data M

Aquifer 112ACBL Aquifer ID 01 Well Type R User _____

**Well Construction** Const Method _____ Casing Material _____ Completion Method _____ Screen Material _____

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (S)
Open Hole (O)
Cemented from ___ to ___

| | Diam. (in.) | Interval of C.S, or O. From | To |
|---|---|---|---|
| 1 | S | 370 | 409 |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |

**Lift Data** Pump Mfr. _____ Type of Lift _____ Pump Depth Setting (ft) _____ ft.

Motor Mfg _____ Power _____ H.P. _____

**Yield** Flow Rate _____ Pump Rate _____ GPM (Circle how rate was determined: Meas Rept Est) Date of Test _____

**Performance Test** Length of test _____ hr Production Rate _____ GPM (Circle how rate was determined: Meas Rept Est) Date of Test _____

Static Level _____ ft. Pumping Level _____ ft. Amount of Drawdown _____ ft. Specific Capacity _____ GPM/ft.

**Water Use** Primary _____ Secondary _____ Tertiary _____

**Water Quality** (Remarks: _____

**Other Data Available** Water Level M Water Quality M Logs _____ Other Data _____

**Water Levels**

| | Date | Meas. | Remarks | M.P. + - |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

Recorded by D R Jones Date Record Collected or Information Updated 11022011 Reporting Agency 02

Remarks 1 Well is part of EPWU's recharge
2 Study.
3
4
5
6

Aquifer

49-05-215

Well Number

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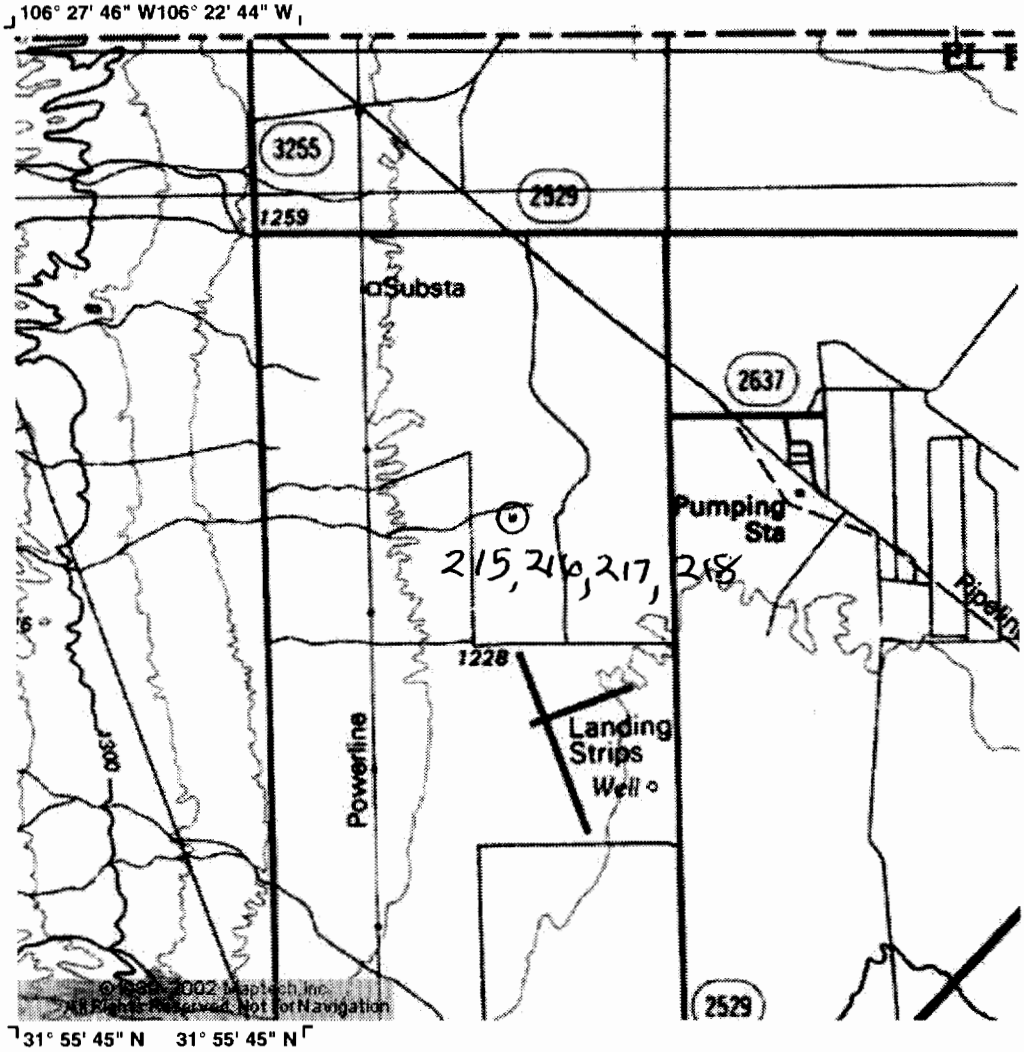


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49-05-215
216
217
218

# Texas Water Development Board

## Well Schedule

State Well Number 49 05 216 Previous Well Number County El Paso 141

River Basin 23 Zone i Latitude 31 57 55 Longitude 106 25 15 Coordinates Accuracy 0

Owner's well No. _____ Location: _____ 1/4 , _____ 1/4 , Section _____ Block _____ Survey _____

Owner El Paso Water Utilities PSB M-1B

Driller Layne-Christensen

Address _____ Tenant/Oper. _____

Date Drilled 04 27 2001 Depth 330 Source of Depth A Altitude 402 Source of Alt. Data M

Aquifer 112HCBL Aquifer ID 01 Well Type R User

**Well Construction**

Const Method _____ Casing Material _____

Completion Method _____ Screen Material _____

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (S)
Open Hole (O)
Cemented from ___ to ___

| | Diam. (in.) | Interval of C.S. or O. From | To |
|---|---|---|---|
| 1 | S | 310 | 330 |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
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| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |

**Lift Data** Pump Mfr. _____ Type of Lift _____ Pump Depth Setting (ft) _____ ft.

Motor Mfg _____ Power _____ H.P. _____

**Yield** Flow Rate _____ Pump Rate _____ GPM (Circle how rate was determined: Meas Rept Est) Date of Test _____

**Performance Test** Length of test _____ hr Production Rate _____ GPM (Circle how rate was determined: Meas Rept Est) Date of Test _____

Static Level _____ ft. Pumping Level _____ ft. Amount of Drawdown _____ ft. Specific Capacity _____ GPM/ft.

**Water Use** Primary _____ Secondary _____ Tertiary _____

**Water Quality** (Remarks: _____

**Other Data Available** Water Level N Water Quality N Logs _____ Other Data _____

**Water Levels**

Date _____ Meas. _____ Remarks _____ M.P. + - _____

Date _____ Meas. _____ Remarks _____

Date _____ Meas. _____ Remarks _____

Recorded by D R Jones Date Record Collected or Information Updated 11 02 2001 Reporting Agency 02

Remarks
1 Well is part of EPWU's recharge
2 Study.
3
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5
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_____
**Aquifer**

49-05-216
**Well Number**

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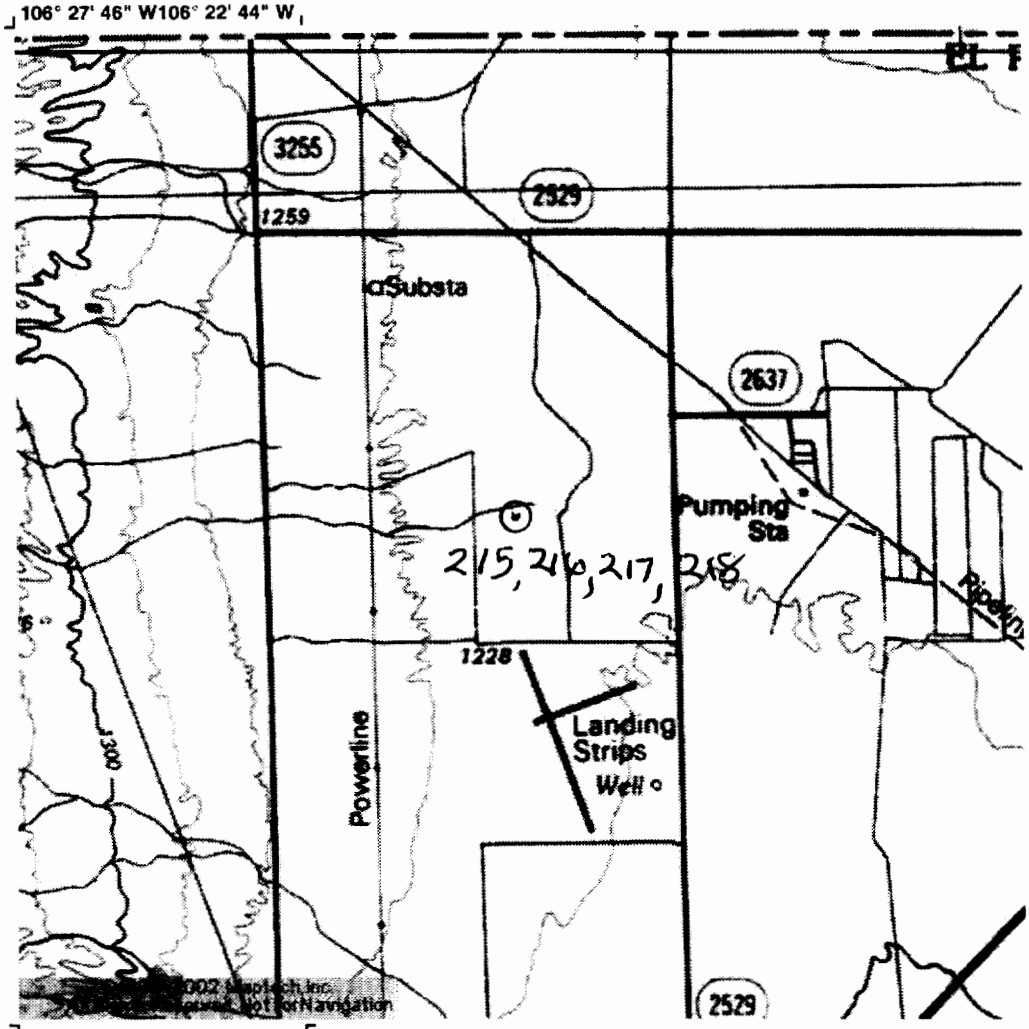


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49.05.215
216
217
218

# Texas Water Development Board

## Well Schedule

State Well Number 49052117 Previous Well Number _____ County El Paso 141

River Basin 23 Zone i Latitude 315755 Longitude 1062515 Coordinates Accuracy 0

Owner's well No. _____ Location: _____ 1/4 , _____ 1/4 , Section _____ Block _____ Survey _____

Owner El Paso Water Utilities PSB Driller Layne-Christensen

Address _____ Tenant/Oper. _____

Date Drilled 04272000 Depth 204 Source of Depth A Altitude 402 Source of Alt. Data M

Aquifer 112HCBL Aquifer ID 01 _____ Well Type R User _____

**Well Construction**

Const Method _____ Casing Material _____

Completion Method _____ Screen Material _____

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (S)
Open Hole (O)
Cemented from ___ to ___

| | Diam. (in.) | Interval of C.S. or O. From | To |
|---|---|---|---|
| 1 | S | 184 | 204 |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |

**Lift Data** Pump Mfr. _____ Type of Lift _____ Pump Depth Setting (ft) _____ ft.

Motor Mfg _____ Power _____ H.P. _____

**Yield** Flow Rate _____ Pump Rate _____ GPM Circle how rate was determined: Meas Rept Est Date of Test _____

**Performance Test** Length of test _____ hr Production Rate _____ GPM Circle how rate was determined: Meas Rept Est Date of Test _____

Static Level _____ ft. Pumping Level _____ ft. Amount of Drawdown _____ ft. Specific Capacity _____ GPM/ft.

**Water Use** Primary _____ N Secondary _____ N Tertiary _____

**Water Quality** (Remarks: _____

**Other Data Available** Water Level Y Water Quality N Logs _____ Other Data _____

**Water Levels**

| | Date | Meas. | Remarks | M.P. + - |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |

Recorded by D R Jones Date Record Collected or Information Updated 11022001 Reporting Agency 02

Remarks: Well is part of EPWU's recharge Study.

Aquifer

49-05-217

Well Number

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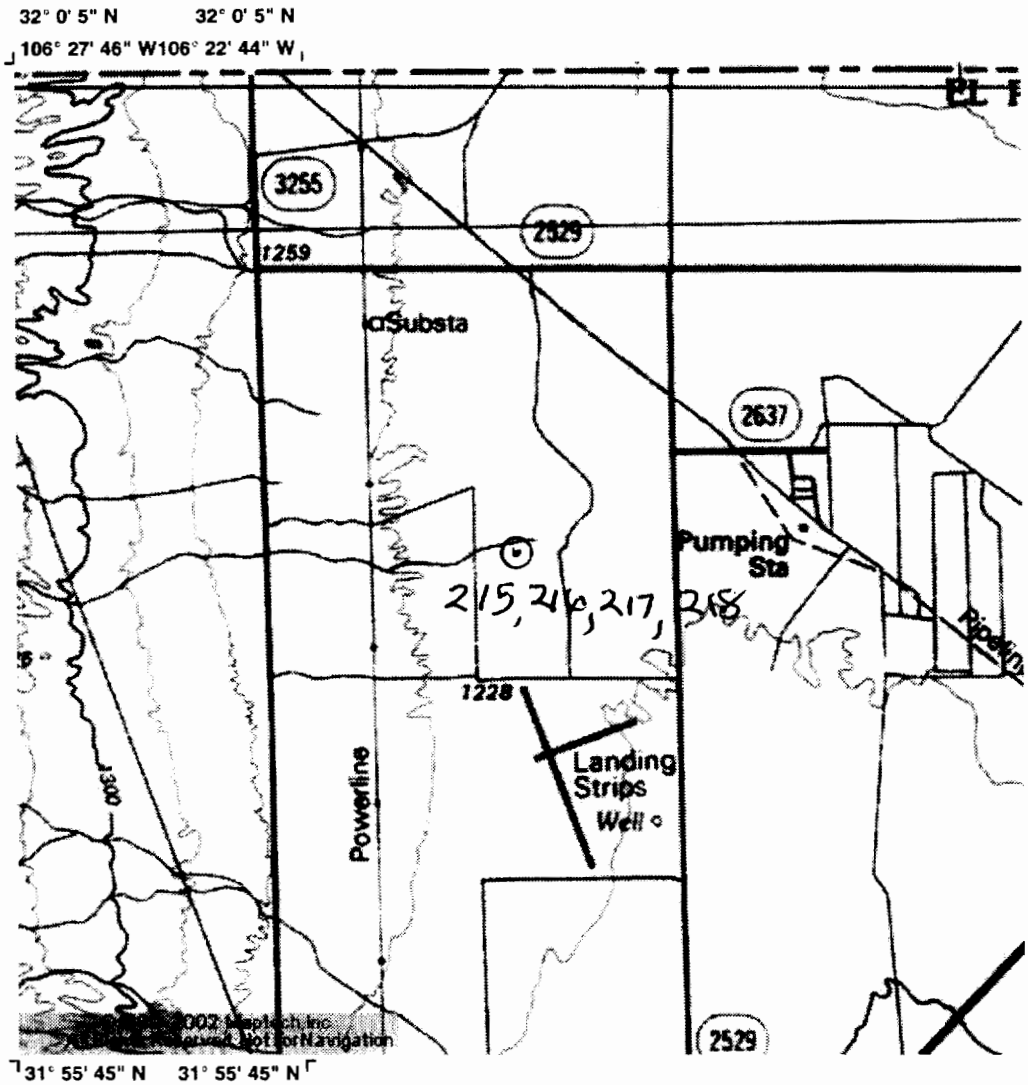


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49.05-215
216
217
218

# Texas Water Development Board

## Well Schedule

State Well Number 49052118 Previous Well Number _____ County El Paso 141

River Basin 23 Zone i Latitude 315755 Longitude 1062515 Coordinates Accuracy 0

Owner's well No. _____ Location: _____ 1/4 , _____ 1/4 , Section _____ Block _____ Survey _____

Owner El Paso Water Utilities PSB M-1D

Driller Layne-Christensen

Address _____ Tenant/Oper. _____

Date Drilled 04272000 Depth 120 Source of Depth A Altitude 402 Source of Alt. Data M

Aquifer 112HCBL Aquifer ID 01 Well Type R User _____

**Well Construction**

Const Method _____ Casing Material _____

Completion Method _____ Screen Material _____

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (S)
Open Hole (O)
Cemented from ___ to ___

| | Diam. (in.) | Interval of C.S. or O From | To |
|---|---|---|---|
| 1 | S | 100 | 120 |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |

**Lift Data** Pump Mfr. _____ Type of Lift _____ Pump Depth Setting (ft) _____ ft.

Motor Mfg _____ Power _____ H.P. _____

**Yield** Flow Rate _____ Pump Rate _____ GPM (Circle how rate was determined: Meas Rept Est) Date of Test _____

**Performance Test** Length of test _____ hr Production Rate _____ GPM (Circle how rate was determined: Meas Rept Est) Date of Test _____

Static Level _____ ft. Pumping Level _____ ft. Amount of Drawdown _____ ft. Specific Capacity _____ GPM/ft.

**Water Use** Primary _____ Secondary _____ Tertiary _____

**Water Quality** (Remarks: _____

**Other Data Available** Water Level Y Water Quality N Logs _____ Other Data _____

**Water Levels**

| | Date | Meas. | Remarks | M.P. + - |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |

Recorded by D R Jones Date Record Collected or Information Updated 11022011 Reporting Agency 02

Remarks 1 Well is part of EPWU's recharge
2 Study.
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Aquifer

49-05-218

Well Number



Form at: V:/HEMon/Share/forms/WellSchedule

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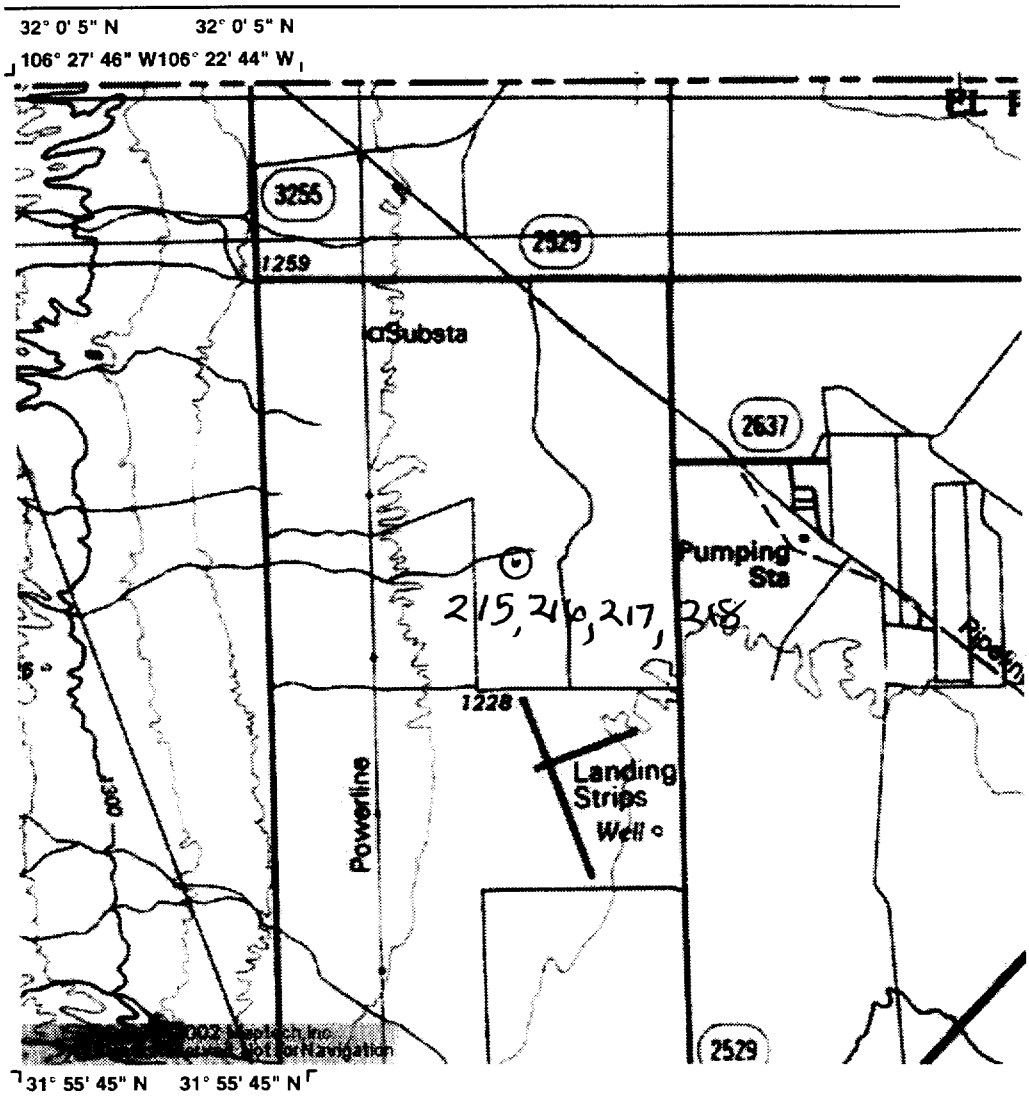


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49.05-215
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217
218

# Texas Water Development Board
## Well Schedule

State Well Number 49052219 Previous Well Number _____ County El Paso 141

River Basin 23 Zone i Latitude 315755 Longitude 1062528 Coordinates Accuracy 0

Owner's well No. _____ Location: _____ 1/4, _____ 1/4, Section _____ Block _____ Survey _____

Owner El Paso Water Utilities M-2A

Driller Layne-Christensen

Address _____ Tenant/Oper. _____

Date Drilled 04182000 Depth 101 Source of Depth A Altitude 403 Source of Alt. Data M

Aquifer 124CBL Aquifer ID 01 _____ Well Type R User _____

**Well Construction**
Const Method _____ Casing Material _____
Completion Method _____ Screen Material _____

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (S)
Open Hole (O)
Cemented from ___ to ___

| | Diam. (in.) | Interval of C.S, or O. From | To |
|---|---|---|---|
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |

**Lift Data** Pump Mfr. _____ Type of Lift _____ Pump Depth Setting (ft) _____ ft.
Motor Mfg _____ Power _____ H.P. _____

**Yield** Flow Rate _____ Pump Rate _____ GPM (Circle how rate was determined: Meas Rept Est) Date of Test _____

**Performance Test** Length of test _____ hr Production Rate _____ GPM (Circle how rate was determined: Meas Rept Est) Date of Test _____
Static Level _____ ft. Pumping Level _____ ft. Amount of Drawdown _____ ft. Specific Capacity _____ GPM/ft.

**Water Use** Primary _____ Secondary _____ Tertiary _____

**Water Quality** (Remarks: _____

**Other Data Available** Water Level N Water Quality N Logs _____ Other Data _____

**Water Levels**
Date _____ Meas. _____ Remarks _____ M.P. + - _____
Date _____ Meas. _____ Remarks _____
Date _____ Meas. _____ Remarks _____

Recorded by D R Jones Date Record Collected or Information Updated 11023001 Reporting Agency 02

Remarks
1 well is part of EPWU's recharge
2 study.
3
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Aquifer

49-05-219

Well Number

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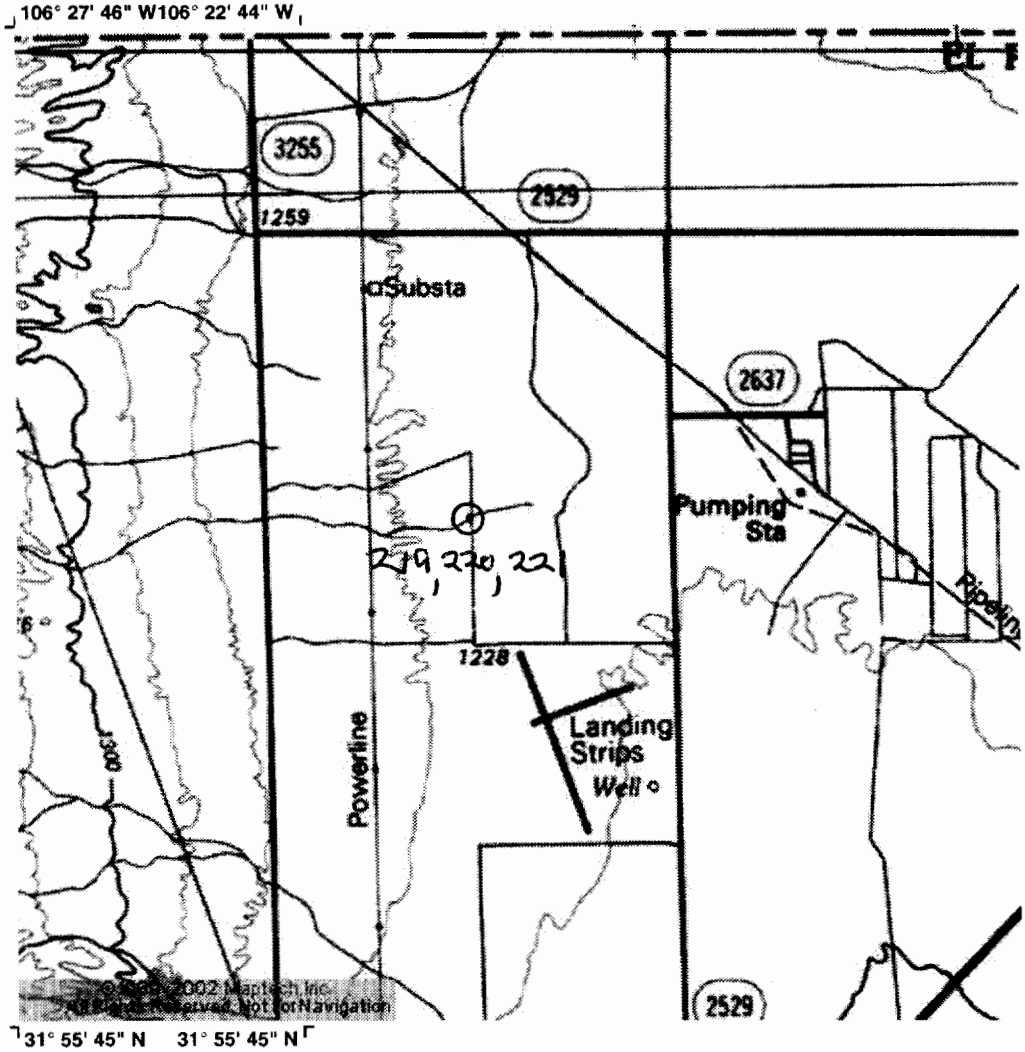


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# Texas Water Development Board
## Well Schedule

State Well Number 49052220 Previous Well Number _____ County El Paso 141

River Basin 23 Zone 1 Latitude 315755 Longitude 1062528 Coordinates Accuracy 0

Owner's well No. _____ Location: _____ 1/4, _____ 1/4, Section _____ Block _____ Survey _____

Owner El Paso Water Utilities M-2B Driller Layne-Christensen

Address _____ Tenant/Oper. _____

Date Drilled 04182000 Depth 49 Source of Depth A Altitude 403 Source of Alt. Data M

Aquifer _____ Aquifer ID _____ Well Type R User _____

**Well Construction**
Const Method _____ Casing Material _____
Completion Method _____ Screen Material _____

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (S)
Open Hole (O)
Cemented from _____ to _____

| | Diam. (in.) | Interval of C.S. or O. From | To |
|---|---|---|---|
| 1 | 5 | 44 | 49 |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |

**Lift Data** Pump Mfr. _____ Type of Lift _____ Pump Depth Setting (ft) _____ ft.
Motor Mfg _____ Power _____ H.P. _____

**Yield** Flow Rate _____ Pump Rate _____ GPM (Circle how rate was determined: Meas Rept Est) Date of Test _____

**Performance Test** Length of test _____ hr Production Rate _____ GPM (Circle how rate was determined: Meas Rept Est) Date of Test _____
Static Level _____ ft. Pumping Level _____ ft. Amount of Drawdown _____ ft. Specific Capacity _____ GPM/ft.

**Water Use** Primary _____ Secondary _____ Tertiary _____

**Water Quality** (Remarks: _____

**Other Data Available** Water Level N Water Quality N Logs _____ Other Data _____

**Water Levels**
Date _____ Meas. _____ Remarks _____ M.P. + - _____
Date _____ Meas. _____ Remarks _____
Date _____ Meas. _____ Remarks _____

Recorded by D R Jones Date Record Collected or Information Updated 11023001 Reporting Agency 02

Remarks: well is part of EPWU's recharge study.

Aquifer

49-05-220

Well Number

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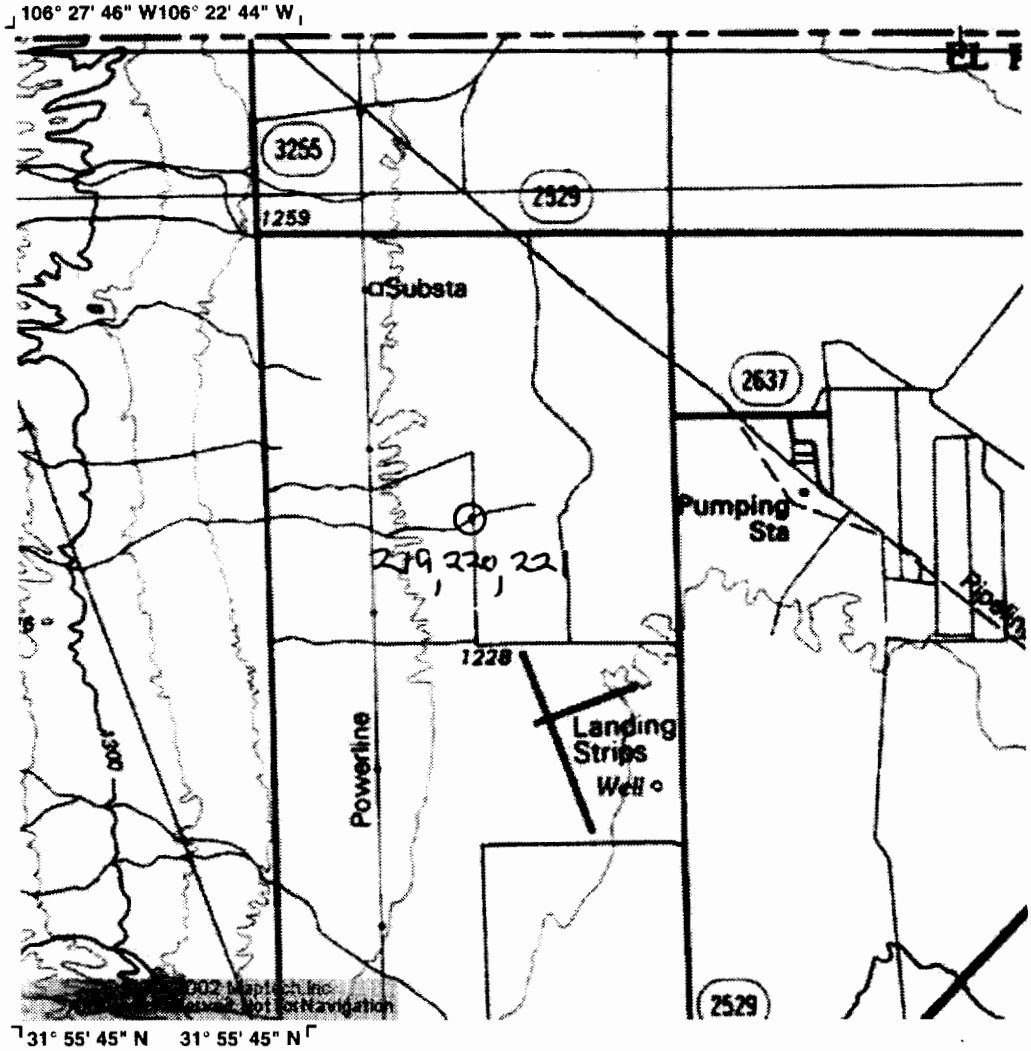
32° 0' 5" N 32° 0' 5" N
106° 27' 46" W106° 22' 44" W




31° 55' 45" N 31° 55' 45" N
106° 27' 46" W106° 22' 44" W

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49.05. 219
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# Texas Water Development Board
## Well Schedule

State Well Number: 49 05 221 | Previous Well Number: | County: El Paso 141

River Basin: 23 | Zone: 1 | Latitude: 31 57 55 | Longitude: 106 25 28 | Coordinates Accuracy: 0

Owner's well No. _____ | Location: _____ 1/4, _____ 1/4, | Section _____ | Block _____ | Survey _____

Owner: El Paso Water Utilities M-2C | Driller: Layne-Christensen

Address _____ | Tenant/Oper. _____

Date Drilled: 04 18 2000 | Depth: 14 | Source of Depth: A | Altitude: 403 | Source of Alt. Data: M

Aquifer _____ | Aquifer ID | Well Type: R | User

**Well Construction**
Const Method _____ | Casing Material _____
Completion Method _____ | Screen Material _____

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (S)
Open Hole (O)
Cemented from ___ to ___

| | Diam. (in.) | Interval of C.S. or O. From | To |
|---|---|---|---|
| 1 | 5 | 9 | 14 |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
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| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |

**Lift Data**
Pump Mfr. _____ | Type of Lift _____ | Pump Depth Setting (ft) _____ ft.
Motor Mfg _____ | Power _____ | H.P.

**Yield**
Flow Rate _____ | Pump Rate _____ GPM | Circle how rate was determined: Meas Rept Est | Date of Test _____

**Performance Test**
Length of test _____ hr | Production Rate _____ GPM | Circle how rate was determined: Meas Rept Est | Date of Test _____

Static Level _____ ft | Pumping Level _____ ft. | Amount of Drawdown _____ ft. | Specific Capacity _____ GPM/ft.

**Water Use**
Primary _____ | Secondary _____ | Tertiary _____

**Water Quality** (Remarks: _____

**Other Data Available**
Water Level: N | Water Quality: N | Logs | Other Data

**Water Levels**

| | Date | Meas. | Remarks | M.P. + - |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |

Recorded by: D R Jones | Date Record Collected or Information Updated: 11 02 2001 | Reporting Agency: 02

Remarks:
1 Well is part of EPWU's recharge
2 Study.
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Aquifer

49-05-221

Well Number



Form at: V:/HEMon/Shareforms/WellSchedule

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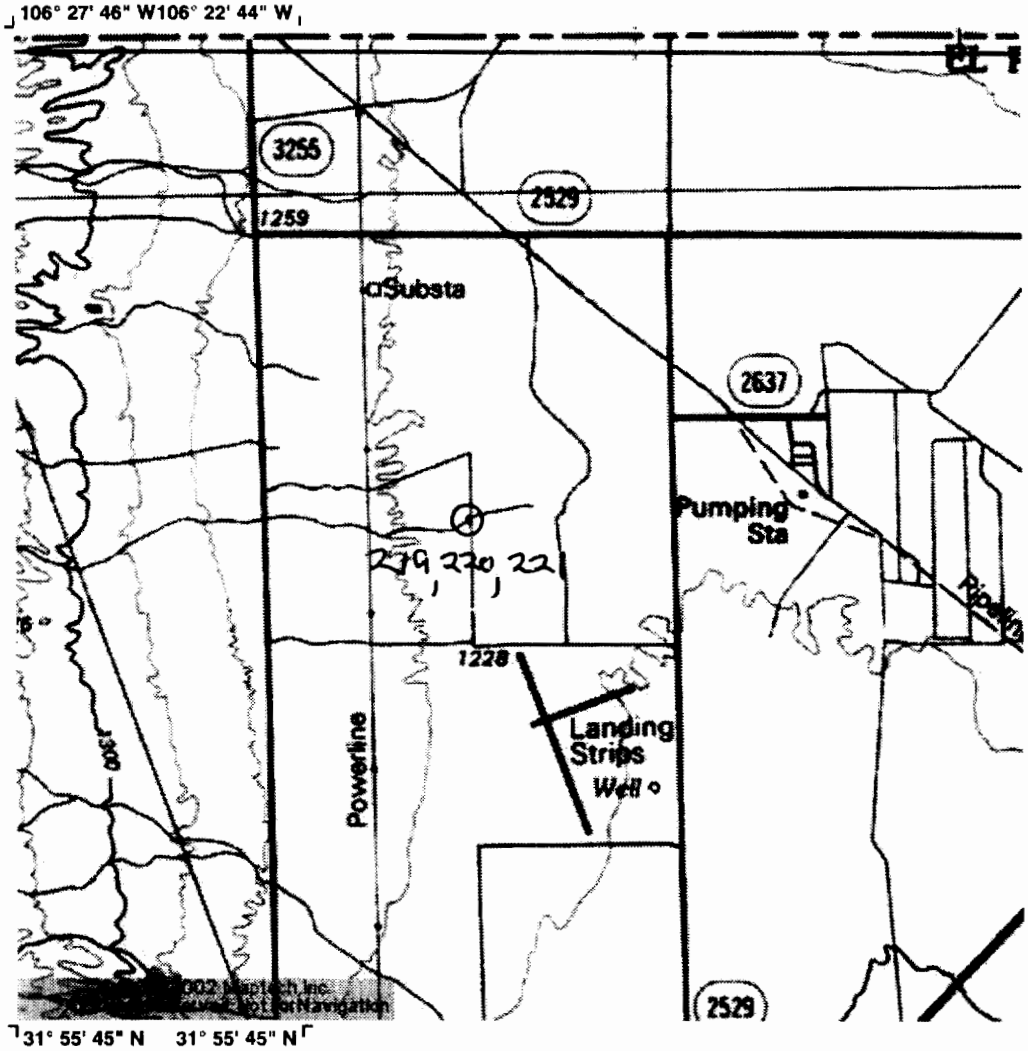


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220
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# Texas Water Development Board
## Well Schedule

State Well Number 49052222 Previous Well Number _____ County El Paso 141

River Basin 23 Zone i Latitude 315805 Longitude 1062558 Coordinates Accuracy 0

Owner's well No. _____ Location: _____ 1/4 , _____ 1/4 , Section _____ Block _____ Survey _____

Owner El Paso Water Utilities M-3A Driller Layne-Christensen

Address _____ Tenant/Oper. _____

Date Drilled 04192000 Depth 102 Source of Depth A Altitude 404 Source of Alt. Data M

Aquifer _____ Aquifer ID _____ Well Type R User _____

**Well Construction**
Const Method _____ Casing Material _____
Completion Method _____ Screen Material _____

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (S)
Open Hole (O)
Cemented from _____ to _____

| | Diam. (in.) | Interval of C.S. or O. From | To |
|---|---|---|---|
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
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| 7 | | | |
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| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |

**Lift Data** Pump Mfr. _____ Type of Lift _____ Pump Depth Setting (ft) _____ ft.
Motor Mfg _____ Power _____ H.P. _____

**Yield** Flow Rate _____ Pump Rate _____ GPM (Circle how rate was determined: Meas Rept Est) Date of Test _____

**Performance Test** Length of test _____ hr Production Rate _____ GPM (Circle how rate was determined: Meas Rept Est) Date of Test _____
Static Level _____ ft. Pumping Level _____ ft. Amount of Drawdown _____ ft. Specific Capacity _____ GPM/ft.

**Water Use** Primary _____ Secondary _____ Tertiary _____

**Water Quality** (Remarks: _____

**Other Data Available** Water Level N Water Quality N Logs _____ Other Data _____

**Water Levels**
Date _____ Meas. _____ Remarks _____ M.P. + - _____
Date _____ Meas. _____ Remarks _____
Date _____ Meas. _____ Remarks _____

Recorded by D R Jones Date Record Collected or Information Updated 11023001 Reporting Agency 02

Remarks
1 Well is part of EPWU's recharge
2 study.
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_____
**Aquifer**

49-05-222
**Well Number**

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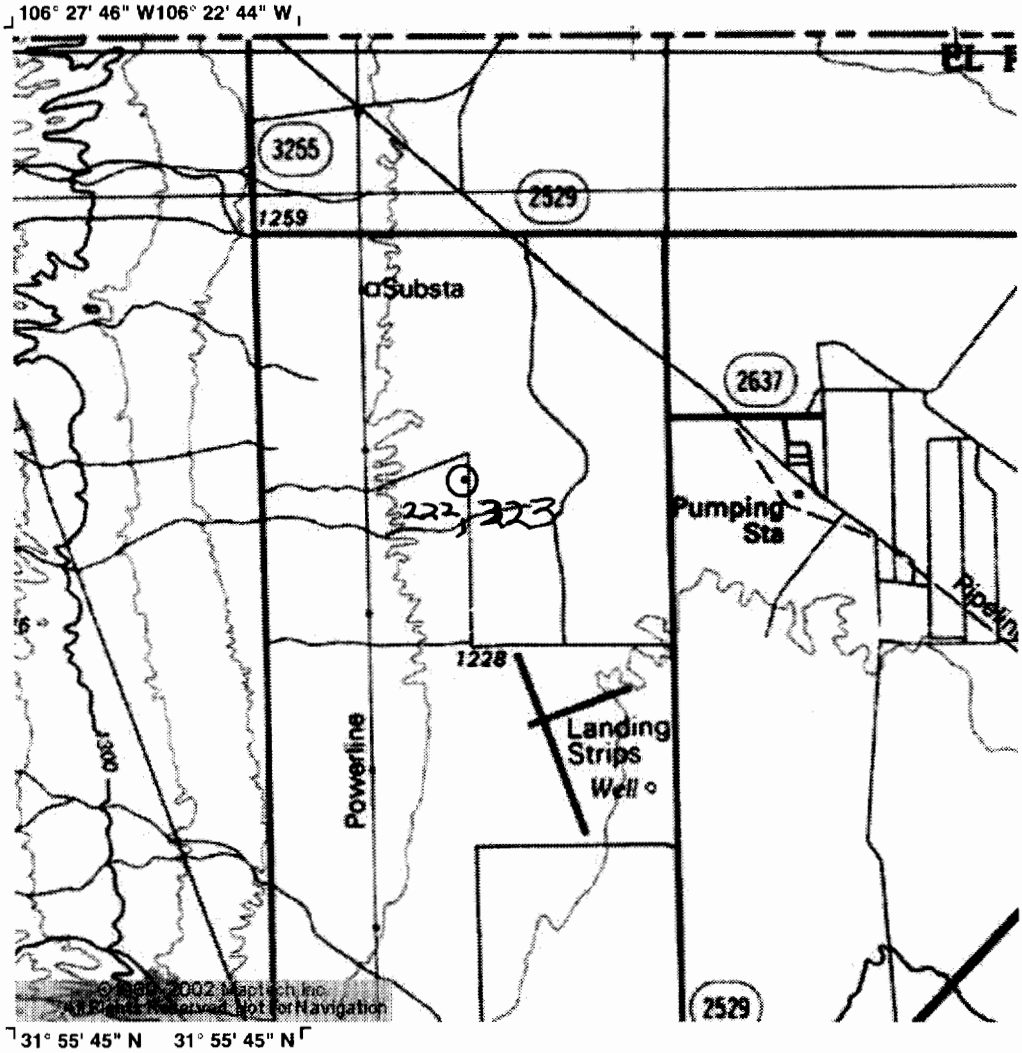


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49-05- 222
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# Texas Water Development Board
## Well Schedule

State Well Number 49 05 223 Previous Well Number _____ County El Paso 141

River Basin 23 Zone i Latitude 31 58 05 Longitude 106 25 28 Coordinates Accuracy 0

Owner's well No. _____ Location: _____ 1/4 , _____ 1/4 , Section _____ Block _____ Survey _____

Owner El Paso Water Utilities M-3B Driller Layne-Christensen

Address _____ Tenant/Oper. _____

Date Drilled 04 19 2000 Depth 42 Source of Depth A Altitude 404 Source of Alt. Data M

Aquifer _____ Aquifer ID _____ Well Type R User _____

**Well Construction**
Const Method _____ Casing Material _____
Completion Method _____ Screen Material _____

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (S)
Open Hole (O)
Cemented from _____ to _____

| | Diam. (in.) | Interval of C.S. or O. From | To |
|---|---|---|---|
| 1 | S | 37 | 42 |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
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| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |

**Lift Data** Pump Mfr. _____ Type of Lift _____ Pump Depth Setting (ft) _____ ft.
Motor Mfg _____ Power _____ H.P. _____

**Yield** Flow Rate _____ Pump Rate _____ GPM (Circle how rate was determined: Meas Rept Est) Date of Test _____

**Performance Test** Length of test _____ hr Production Rate _____ GPM (Circle how rate was determined: Meas Rept Est) Date of Test _____
Static Level _____ ft. Pumping Level _____ ft. Amount of Drawdown _____ ft. Specific Capacity _____ GPM/ft.

**Water Use** Primary _____ Secondary _____ Tertiary _____

**Water Quality** (Remarks: _____

**Other Data Available** Water Level N Water Quality N Logs _____ Other Data _____

**Water Levels**
Date _____ Meas. _____ Remarks _____ M.P. + - _____
Date _____ Meas. _____ Remarks _____
Date _____ Meas. _____ Remarks _____

Recorded by D R Jones Date Record Collected or Information Updated 11 02 2001 Reporting Agency 102

Remarks
1 well is part of EPWU's recharge
2 study.
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Aquifer

49-05-223

Well Number

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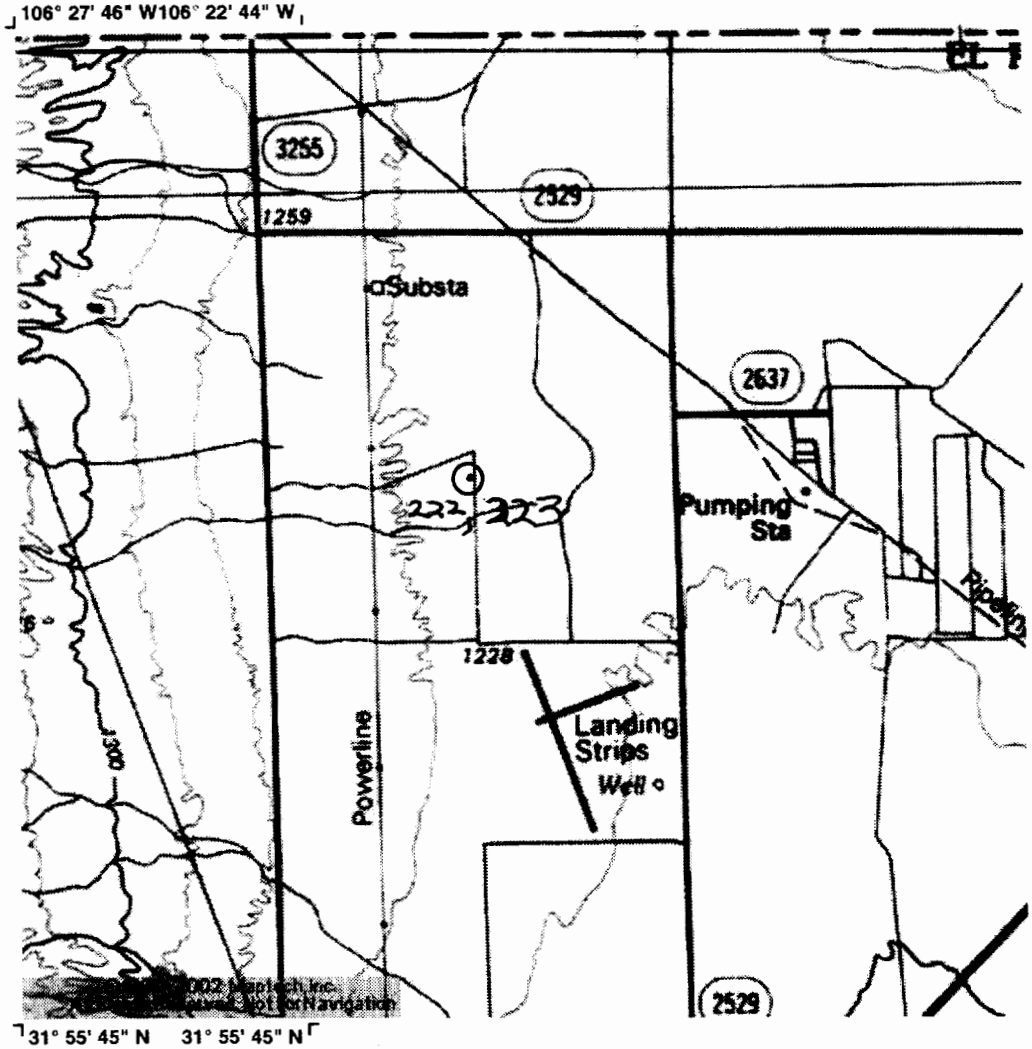


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49-05-222
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# Texas Water Development Board
## Well Schedule

State Well Number: 49 05 224 | Previous Well Number: | County: El Paso 141

River Basin: 23 | Zone: 1 | Latitude: 31 58 05 | Longitude: 106 25 27 | Coordinates Accuracy: 0

Owner's well No. | Location: 1/4, 1/4, Section | Block | Survey

Owner: El Paso Water Utilities PM-4A | Driller: Layne-Christensen

Address | Tenant/Oper.

Date Drilled: 02 02 2001 | Depth: 420 | Source of Depth: A | Altitude: 404 | Source of Alt. Data: M

Aquifer | Aquifer ID | Well Type: R | User

**Well Construction**: Const Method | Casing Material | Completion Method | Screen Material

**Lift Data**: Pump Mfr. | Type of Lift | Pump Depth Setting (ft) ft. | Motor Mfg | Power | H.P.

**Yield**: Flow Rate | Pump Rate GPM (Circle how rate was determined: Meas Rept Est) | Date of Test

**Performance Test**: Length of test hr | Production Rate GPM (Meas Rept Est) | Date of Test

Static Level ft. | Pumping Level ft. | Amount of Drawdown ft. | Specific Capacity GPM/ft.

**Water Use**: Primary | Secondary | Tertiary

**Water Quality** (Remarks:

**Other Data Available**: Water Level: N | Water Quality: N | Logs | Other Data

**Water Levels**: Date | Meas. | Remarks | M.P. +/-

Date | Meas. | Remarks

Date | Meas. | Remarks

Recorded by: D R Jones | Date Record Collected or Information Updated: 11 02 2001 | Reporting Agency: 02

Remarks: Well is part of EPWU's recharge study.

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (S)
Open Hole (O)
Cemented from ___ to ___

| | Diam. (in.) | Interval of C,S, or O. From | To |
|---|---|---|---|
| 1 | 5 | 375 | 415 |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |

Aquifer

49-05-224

Well Number



Form at: V:/HEMon/Share/forms/WellSchedule

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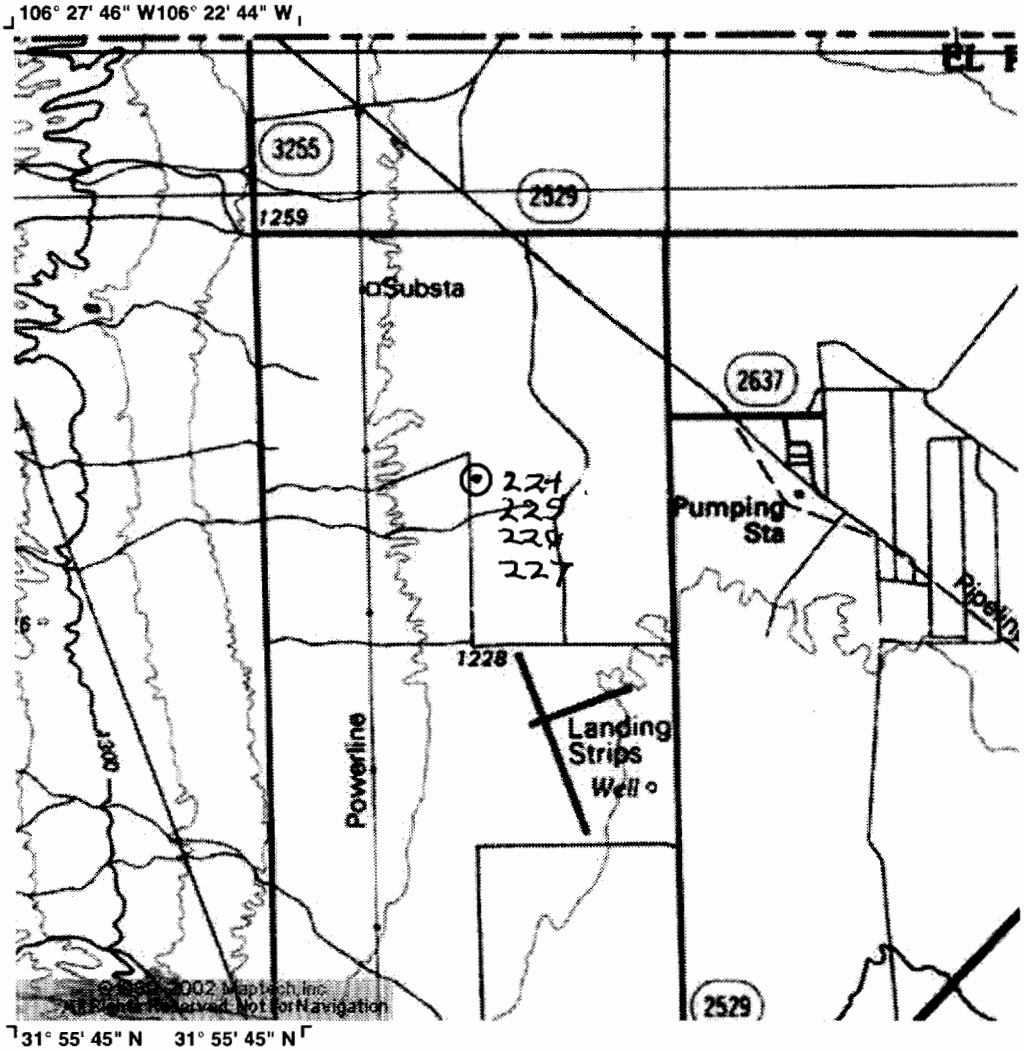
32° 0' 5" N 32° 0' 5" N

106° 27' 46" W106° 22' 44" W




31° 55' 45" N 31° 55' 45" N

106° 27' 46" W106° 22' 44" W

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49.05.224
225
226
227

# Texas Water Development Board
## Well Schedule

State Well Number 49 05 225 Previous Well Number _____ County El Paso 141

River Basin 23 Zone 1 Latitude 31 58 05 Longitude 106 25 27 Coordinates Accuracy 0

Owner's well No. _____ Location: _____ 1/4 , _____ 1/4 , Section _____ Block _____ Survey _____

Owner El Paso Water Utilities M-48 Driller Layne-Christensen

Address _____ Tenant/Oper. _____

Date Drilled 02 07 2001 Depth 332 Source of Depth A Altitude 4044 Source of Alt. Data M

Aquifer _____ Aquifer ID _____ Well Type R User _____

**Well Construction**
Const Method _____ Casing Material _____
Completion Method _____ Screen Material _____

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (S)
Open Hole (O)
Cemented from ___ to ___

| | Diam. (in.) | Interval of C.S. or O. From | To |
|---|---|---|---|
| 1 | S | 312 | 332 |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |

**Lift Data** Pump Mfr. _____ Type of Lift _____ Pump Depth Setting (ft) _____ ft.
Motor Mfg _____ Power _____ H.P. _____

**Yield** Flow Rate _____ Pump Rate _____ GPM (Circle how rate was determined: Meas Rept Est) Date of Test _____

**Performance Test** Length of test _____ hr Production Rate _____ GPM (Circle how rate was determined: Meas Rept Est) Date of Test _____
Static Level _____ ft. Pumping Level _____ ft. Amount of Drawdown _____ ft. Specific Capacity _____ GPM/ft.

**Water Use** Primary _____ Secondary _____ Tertiary _____

**Water Quality** (Remarks: _____

**Other Data Available** Water Level N Water Quality N Logs _____ Other Data _____

**Water Levels**
Date _____ Meas. _____ Remarks _____ M.P. + - _____
Date _____ Meas. _____ Remarks _____
Date _____ Meas. _____ Remarks _____

Recorded by D R Jones Date Record Collected or Information Updated 11 02 2001 Reporting Agency 02

Remarks
1 well is part of EPWU's recharge
2 study.
3
4
5
6

Aquifer

49.05.225
Well Number

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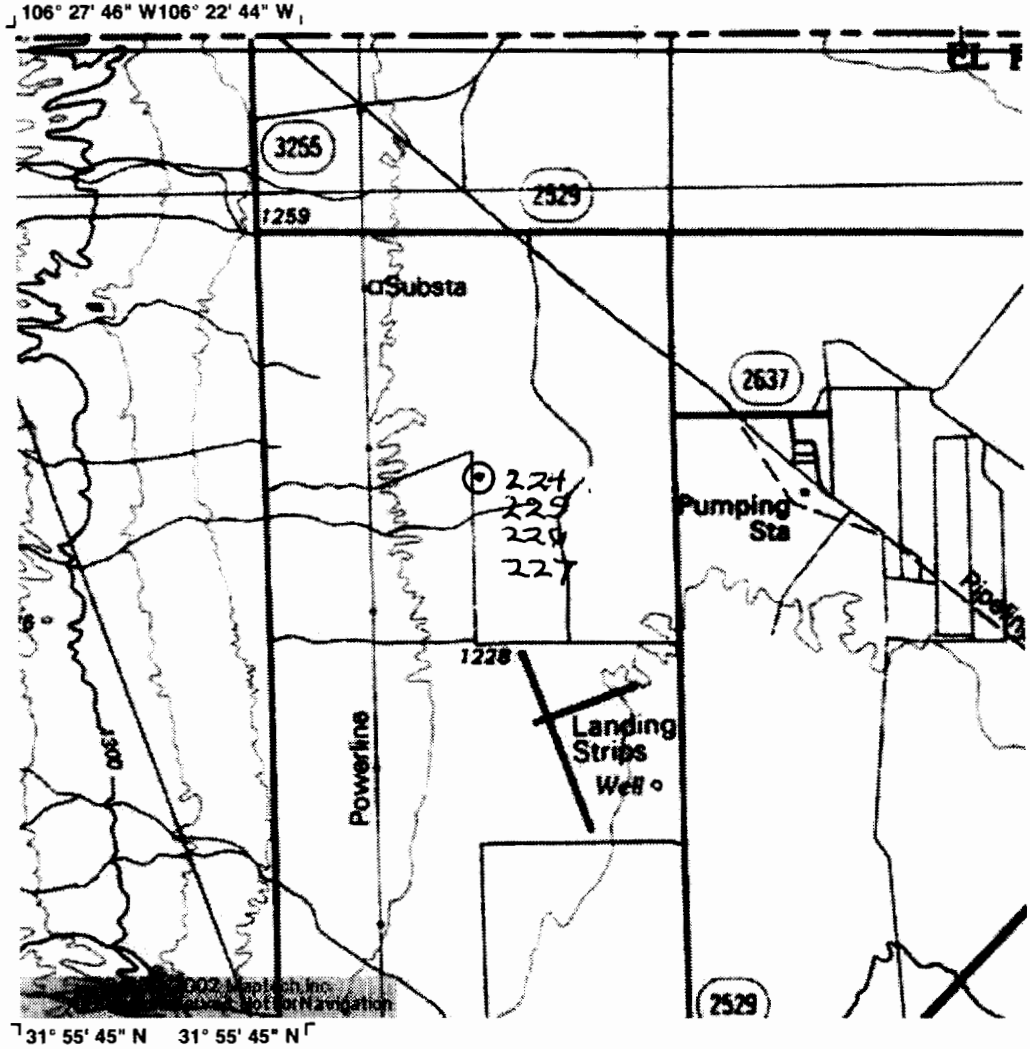


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49 05. 224
225
226
227

# Texas Water Development Board
## Well Schedule

State Well Number 49d5226 Previous Well Number _____ County El Paso 141

River Basin _____ 23 Zone i Latitude 315805 Longitude 1062527 Coordinates Accuracy 0

Owner's well No. _____ Location: _____ 1/4, _____ 1/4, Section _____ Block _____ Survey _____

Owner El Paso Water Utilities M-4C Driller Layne-Christensen

Address _____ Tenant/Oper. _____

Date Drilled 02022001 Depth 167 Source of Depth A Altitude 404 Source of Alt. Data M

Aquifer _____ Aquifer ID _____ Well Type R User _____

**Well Construction**
Const Method _____ Casing Material _____
Completion Method _____ Screen Material _____

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (S)
Open Hole (O)
Cemented from _____ to _____

| | Diam. (in.) | Interval of C.S. or O. From | To |
|---|---|---|---|
| 1 | 5 | 147 | 167 |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |

**Lift Data** Pump Mfr. _____ Type of Lift _____ Pump Depth Setting (ft) _____ ft.
Motor Mfg _____ Power _____ H.P. _____

**Yield** Flow Rate _____ Pump Rate _____ GPM (Circle how rate was determined: Meas Rept Est) Date of Test _____

**Performance Test** Length of test _____ hr Production Rate _____ GPM (Circle how rate was determined: Meas Rept Est) Date of Test _____
Static Level _____ ft. Pumping Level _____ ft. Amount of Drawdown _____ ft. Specific Capacity _____ GPM/ft.

**Water Use** Primary _____ Secondary _____ Tertiary _____

**Water Quality** (Remarks: _____

**Other Data Available** Water Level N Water Quality N Logs _____ Other Data _____

**Water Levels**
Date _____ Meas. _____ Remarks _____ M.P. + - _____
Date _____ Meas. _____ Remarks _____
Date _____ Meas. _____ Remarks _____

Recorded by D R Jones Date Record Collected or Information Updated 11022001 Reporting Agency 02

Remarks
1 well is part of EPWU's recharge
2 study.
3
4
5
6

Aquifer

49-05-226

Well Number

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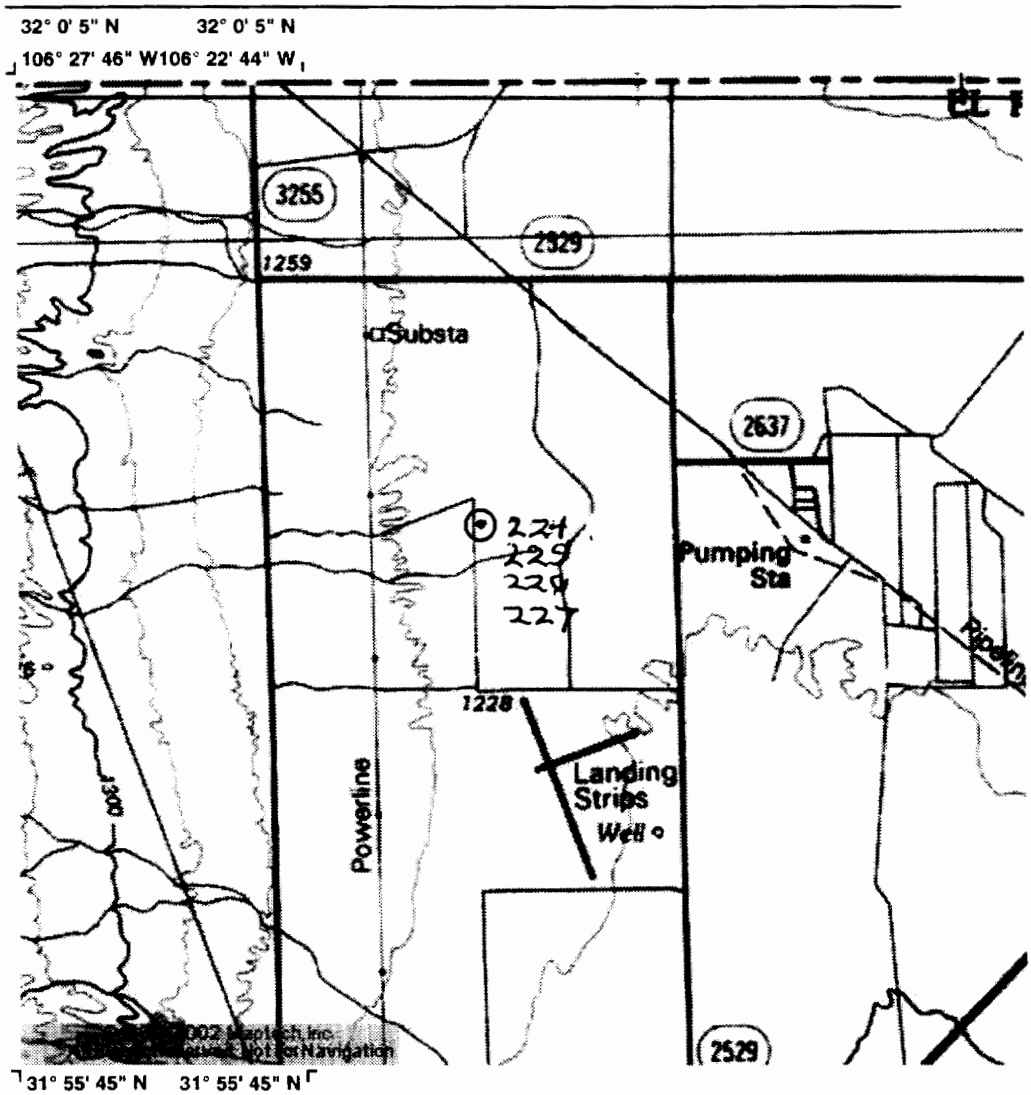


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49 05. 224
225
226
227

# Texas Water Development Board
## Well Schedule

State Well Number 49 05 227 Previous Well Number _____ County El Paso 141

River Basin _____ 23 Zone 1 Latitude 31 58 05 Longitude 106 35 27 Coordinates Accuracy 0

Owner's well No. _____ Location: _____ 1/4, _____ 1/4, Section _____ Block _____ Survey _____

Owner El Paso Water Utilities M-40 Driller Layne-Christensen

Address _____ Tenant/Oper. _____

Date Drilled 02 02 2001 Depth 104 Source of Depth A Altitude 4014 Source of Alt. Data M

Aquifer _____ Aquifer ID _____ Well Type R User _____

**Well Construction**
Const Method _____ Casing Material _____
Completion Method _____ Screen Material _____

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (S)
Open Hole (O)
Cemented from ___ to ___

| | Diam. (in.) | Interval of C,S, or O. From | To |
|---|---|---|---|
| 1 | 5 | 89 | 104 |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |

**Lift Data** Pump Mfr. _____ Type of Lift _____ Pump Depth Setting (ft) _____ ft.
Motor Mfg _____ Power _____ H.P. _____

**Yield** Flow Rate _____ Pump Rate _____ GPM (Circle how rate was determined: Meas Rept Est) Date of Test _____

**Performance Test** Length of test _____ hr Production Rate _____ GPM (Circle how rate was determined: Meas Rept Est) Date of Test _____
Static Level _____ ft. Pumping Level _____ ft. Amount of Drawdown _____ ft. Specific Capacity _____ GPM/ft.

**Water Use** Primary _____ Secondary _____ Tertiary _____

**Water Quality** (Remarks: _____

**Other Data Available** Water Level N Water Quality N Logs _____ Other Data _____

**Water Levels**
Date _____ Meas. _____ Remarks _____ M.P. + - _____
Date _____ Meas. _____ Remarks _____
Date _____ Meas. _____ Remarks _____

Recorded by D R Jones Date Record Collected or Information Updated 11 03 2001 Reporting Agency 02

Remarks
1 well is part of EPWU's recharge
2 study.
3
4
5
6

Aquifer

49-05-227
Well Number

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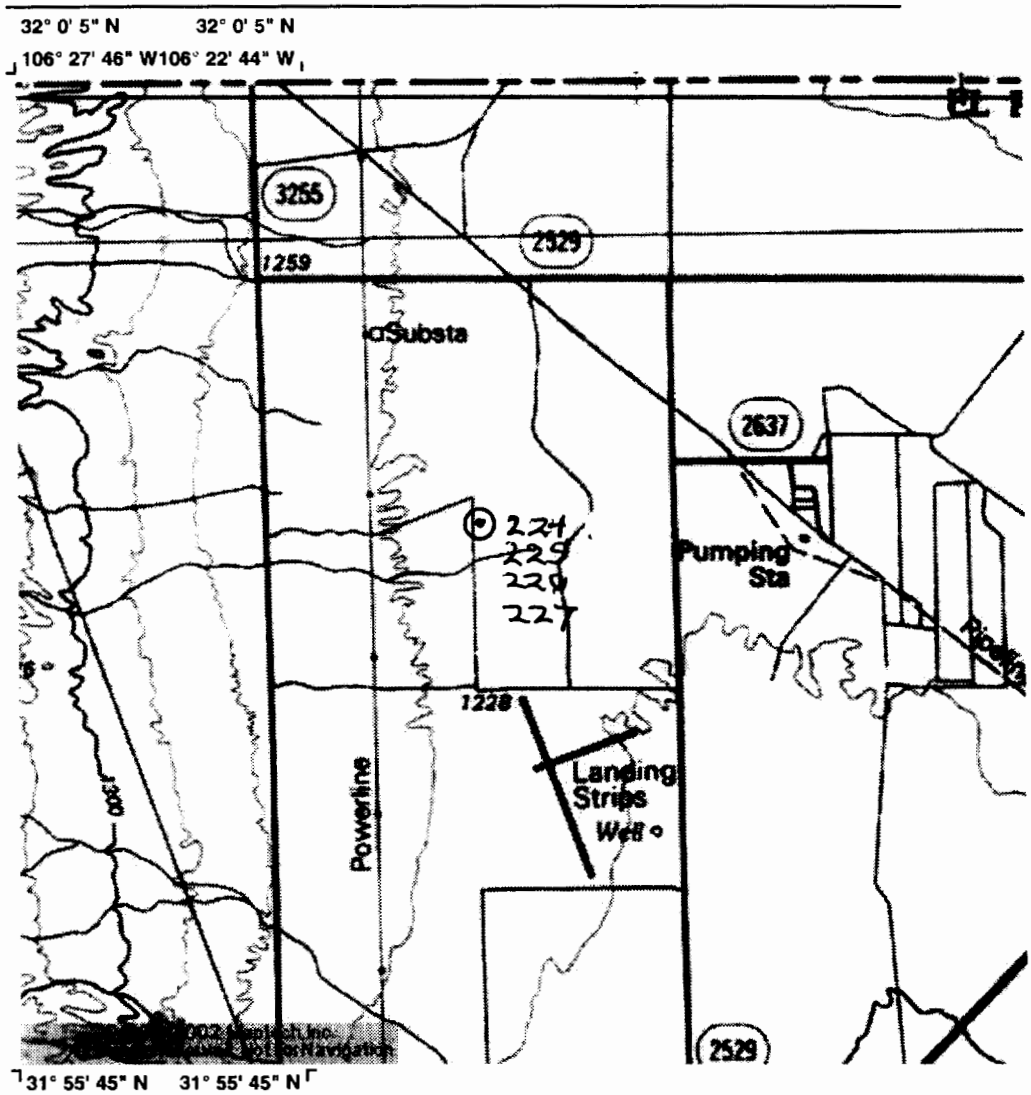


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49 05. 224
225
226
227

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer Hueco Bolson  Field No. R-72  State Well No. 49-05-301

Owner's Well No. 42  County El Paso

1. Location: ___ 1/4, ___ 1/4 Sec. ___, Block ___ Survey ___

2. Owner: City of El Paso  Address: ___

Tenant: ___  Address: ___

Driller: City  Address: ___

3. Elevation of 4017.5 is ___ ft. above msl, determined by ___

4. Drilled: April 1958; Dug, Cable Tool, Rotary

5. Depth: Rept. 670.87 ft. Meas. ___ ft.

6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed

7. Pump: Mfgr. U.S. Pumps  Type turbine

No. Stages 12, Bowls Diam. 14 in., Setting 420 ft.

Column Diam. ___ in., Length Tailpipe ___ ft.

8. Motor: Fuel Elec  Make & Model Allis-Chalmers  HP. 250

9. Yield: Flow ___ gpm, Pump 1250 gpm, Meas., Rept., Est.

10. Performance Test: Date 6/16/60  Length of Test 8 hrs  Made by ___

Static Level ___ ft. Pumping Level ___ ft. Drawdown 365 ft.

Production 1600 gpm  Specific Capacity ___ gpm/ft.

CASING & BLANK PIPE
Cemented From 0 ft. to 314 ft.

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 24 | Steel | 0 | 314 |
| 18 | Steel | 0 | 319.66 |
| Swage | | 504.83 | 507.33 |
| | | | |

11. Water Level: 319.4 ft. rept. meas. 6/13 1960 above below Meas pipe which is 3.0 ft. above below surface.

340.27 ft. rept. meas. 1/7 1975 above below USD which is ___ ft. above below surface.

___ ft. rept. meas. ___ 19__ above below ___ which is ___ ft. above below surface.

___ ft. rept. meas. ___ 19__ above below ___ which is ___ ft. above below surface.

12. Use: Dom., Stock, Public Supply, Ind., Irr., Waterflooding, Observation, Not Used, Test well

13. Quality: (Remarks on taste, odor, color, etc.) ___

Temp. ___ °F, Date sampled for analysis ___ Laboratory ___

Temp. ___ °F, Date sampled for analysis ___ Laboratory ___

Temp. ___ °F, Date sampled for analysis ___ Laboratory ___

WELL SCREEN
Screen Openings 0.105"

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 18 | Slotted | 319.66 | 504.83 |
| 12 | " | 507.33 | 670.87 |
| | | | |
| | | | |

14. Other data available as circled: Driller's Log, Radioactivity Log, Electric Log, Formation Samples, Pumping Test, ___

15. Record by: TWDB - El Paso  Date ___ 1972

Source of Data USGS well sched. by E.R. Leggett 4/25/58

16. Remarks:

Redrilled as production well. Depth 670'

24" surface 0-314

18" screen 322-507

12 3/4 screen 507-670 0.105 openings

See Sketch on 49-05-204

Obs Well

TWDBE-WD-2

(Sketch)



49-05-301

# WELL DATA

WELL NUMBER 42

JL-49-05-301

## PUMP DATA

Make U. S.

Type

Stages 12

Tubing

Shaft

Column 10" x 3" x 1-15/16"

Serial Number 27734

Setting 420'

O. D. Bowls 14"

Capacity — GPM 1250

Capacity — Feet Head 500

## MOTOR DATA

Make ALLIS-CHALMERS

Volts 440

Amps 290

Type HSO

Motor H. P. 250

Speed 1185 RPM

Cycles - Phase 60 - 3 PHASE

Serial Number 15160-52321-1-1

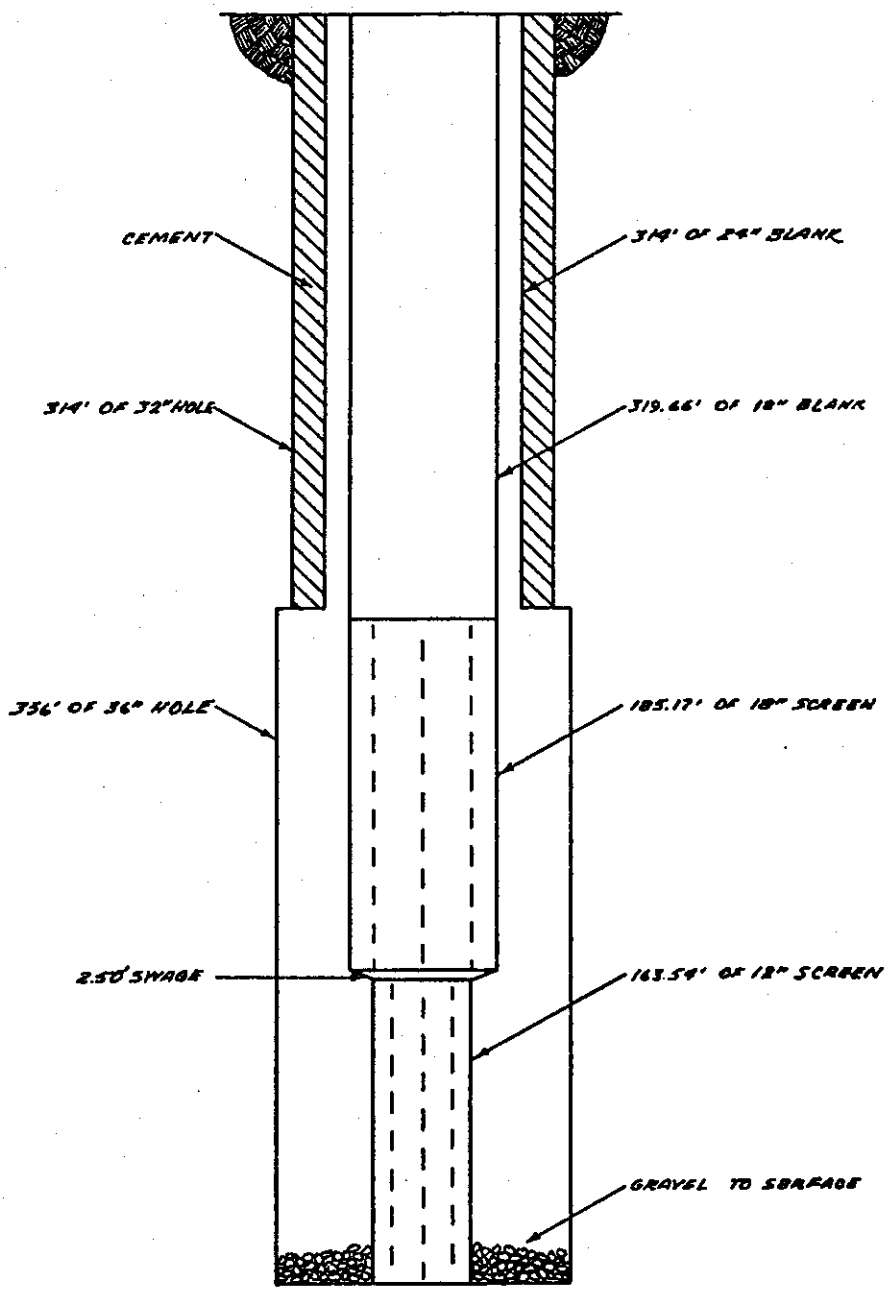
Date Installed

## SCALE

Vertical 1" = 100'

Horizontal ½" = 1'

## MATERIALS






49 05 301

P.S.B. FORM 2002 0665

VL-49-05-301
RDWA #42
12/19/89
JC-49-05-301

# EL PASO WATER UTILITIES
## WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED | 12/19/89 | WELL NUMBER | 42 |
| DATE RECEIVED AT LABORATORY | 12/19/89 | LAB. NUMBER | C121989-7 |
| DATE ANALYSIS COMPLETED | 12/22/89 | LOCATION | |
| | | OWNER | EPWU |
| | | SAMPLE TAKER | F. BROOKS |
| | | DELIVERED BY | F. BROOKS |

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 2.00 | ****** | ****** |
| Total Alkalinity as CaCO3 | 120.6 | ****** | ****** |
| Carbonates as CO3 | 2.44 | .081325 | 7 |
| Bicarbonates as HCO3 | 142 | 2.33151 | 102 |
| Chlorides as Cl | 85 | 2.39785 | 182 |
| Sulfates as SO4 | 49.03 | 1.02080 | 75 |
| Fluorides as F | 0.84 | .044210 | ****** |
| Nitrates as NO3 | 7.92 | .127750 | 9 |
| Total Phosphates as PO4 LOD=.09 | 0.00 | 0 | ****** |
| Total Anions = | 287 | 6.00346 | 375 |

| CATIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Total Hardness as CaCO3 | 107 | ****** | ****** |
| Calcium as Ca | 34.1 | 1.70159 | 88 |
| Magnesium as Mg | 5.30 | .435973 | 20 |
| Sodium as Na | 82.4 | 3.5844 | 175 |
| Potassium as K | 6.11 | .156233 | 11 |
| Total Cations = | 128 | 5.87820 | 295 |
| TDS BY EPWU METHOD (1)= | 413 | 11.8817 | 670 |
| TDS BY USGS METHOD (2)= | 381 | | |
| TDS BY TDH METHOD (3)= | 343 | | |

| | |
|---|---|
| Silica, SiO2 = | 38.00 |
| Chlorine Res. = | N/A |
| Turbidity,ntu = | 0.32 |
| Sample Temp(C)= | 22.7 |
| pH @ 22.7 | 8.55 |
| Lab E.C.@25C as umhos/cm = | 359 |
| Field E.C. @25C as umhos/cm = | N/A |
| pH Saturation = | 7.90 |
| Langelier Ind.= | 0.65 |
| Aggress. Index= | 12.66 |
| % Na of T Cat.= | 61 |

Remarks
LOD = LIMIT OF DETECTION

Std. Dev. = 0.61

CHECKING CORRECTNESS OF ANALYSIS

| | |
|---|---|
| Measured Diluted E.C. = | 660 |
| Calculated Diluted E.C.= | 670 |
| % Error = | 1.52 |

(1) SUM OF IONS, NOT INCLUDING SILICA
(2) SUM OF IONS PLUS SILICA, PLUS CONVERSION OF HCO3 TO CO3.
(3) SUM OF IONS, NOT INCLUDING SILICA PLUS CONVERSION OF HCO3 TO CO3.

ANION-CATION BALANCE
Total Anions - Total Cations =
+or-(0.1065+0.0155* T.ANIONS)
.125257=<+or-1SD +or- .199554 MAX. LIMIT

KEY PUNCHED

ANALYST Judith McBride

WATER SUPPLY MGR Douglas Hartman

PO BOX 511
EL PASO, TEXAS 79961

EL PASO WATER UTILITIES PUBLIC SERVICE BOARD

# WATER ANALYSIS DATA SHEET

49-05-301

Plant Sample  Well Number 42  Location

| Sample Number | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Depth | | | | | | |
| Sample Collected | 5-20-80 | | | | | |
| Received at Laboratory | 5-20-80 | | | | | |
| Analysis Completed | 5-21-80 | | | | | |
| pH @ 28° C | 7.98 | | | | | |
| E C | | | | | | |
| $Ca\ CO_3$ Saturation Index | +0.14 | | | | | |
| Sodium Per Cent of Total Cations | 69.6% | | | | | |

MILLIGRAMS PER LITER

| | | | | | | |
|---|---|---|---|---|---|---|
| Total Dissolved Solids | 383 | | | | | |
| Phenol Alkalinity as $Ca\ CO_3$ | 0 | | | | | |
| Total Alkalinity as $Ca\ CO_3$ | 119 | | | | | |
| Total Hardness as $Ca\ CO_3$ | 99 | | | | | |
| Chlorides as Cl | 68 | | | | | |
| Sulfates as $SO_4$ | 55 | | | | | |
| Fluorides as F | 0.64 | | | | | |
| Silica as $SiO_2$ | 35 | | | | | |
| Nitrate as N | 1.6 | as $NO_3$ 7.1 | | | | |
| Total Phosphates as P | < 0.01 | as $PO_4$ <0.03 | | | | |
| Calcium as Ca | 28 | | | | | |
| Magnesium as Mg | 7.0 | | | | | |
| Sodium | 80 | | | | | |
| Potassium | | | | | | |
| Total Iron as Fe | < 0.1 | | | | | |
| Manganese as Mn | <0.01 | | | | | |
| Chlorine Residual | 0 | | | | | |
| Turbidity, N.T.U. | 0.29 | | | | | |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Checking Correctness of Analysis: | | | | | | |
| Measured Diluted E. C. | | | | | | |
| Calculated Diluted E. C. | 600 | | | | | |
| % Error | | | | | | |

Remarks: Sample Collected by Frank Brooks

49-05-301

JL-49-05-301
Fepwu # 42
5/24/88

Key P.

# EL PASO WATER UTILITIES
## WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED | 05/24/88 | WELL NUMBER | WELL 49 |
| DATE RECEIVED AT LABORATORY | 05/24/88 | LAB. NUMBER | C052488-7 |
| DATE ANALYSIS COMPLETED | 07/04/88 | LOCATION | A.P. mc Rae |
| | | OWNER | EPWU |
| | | SAMPLE TAKER | M. Apuster |
| | | DELIVERED BY | M. Apuster |

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.00 | ****** | ****** |
| Total Alkalinity as CaCO3 | 131 | ****** | ****** |
| Carbonates as CO3 | 0.00 | 0 | 0 |
| Bicarbonates as HCO3 | 160 | 2.61945 | 114 |
| Chlorides as Cl | 171 | 4.82391 | 366 |
| Sulfates as SO4 | 105 | 2.1861 | 162 |
| Fluorides as F | 0.60 | .031584 | ****** |
| Nitrates as NO3 LOD=0.443 | 6.00 | .09678 | 7 |
| Total Phosphates as PO4 LOD=.09 | 0.00 | 0 | ****** |
| Total Anions = | 442 | 9.75782 | 649 |

| CATIONS | | | |
|---|---|---|---|
| Total Hardness as CaCO3 | 226 | ****** | ****** |
| Calcium as Ca | 58 | 2.8942 | 150 |
| Magnesium as Mg | 19.90 | 1.63697 | 76 |
| Sodium as Na | 104 | 4.524 | 221 |
| Potassium as K CALCULATED AS NA | 0.00 | 0 | 0 |
| Total Cations = | 182 | 9.05517 | 448 |
| TOTAL DISSOLVED SOLIDS = | 624 | 18.8130 | 1097 |

| | |
|---|---|
| Silica, SiO2 = | ——— |
| Chlorine Res. = | |
| Turbidity,ntu = | 0.1 |
| Sample Temp(C)= | 22. |
| pH @ 22.1= | 8.1 |
| Lab E.C.@25C as | ——— |
| umhos/cm = | |
| Field E.C. @25C | ——— |
| as umhos/cm = | |
| pH Saturation = | 7.6 |
| Langelier Ind.= | 0.5 |
| Aggress. Index= | 12.6 |
| % Na of T Cat.= | 5 |

Remarks _____

LOD = LIMIT OF DETECTION

TAG#-561

CHECKING CORRECTNESS OF ANALYSIS
Measured Diluted E.C. = 1180
Calculated Diluted E.C.= 1097
% Error = -7.03

ANION-CATION BALANCE
Total Anions - Total Cations =
+or-(0.1065+0.0155* T.ANIONS)
.702650=<+or-1SD= +or- .257746 MAX. LIMIT

KEY PUNCHED

ANALYST Maria L. Posada

WATER SUPPLY MGR Douglas Rattman
PO BOX 511
EL PASO, TEXAS 79961

EL PASO WATER UTILITIES PUBLIC SERVICE BOARD

# WATER ANALYSIS DATA SHEET

JL-49-05-301

Plant Sample  Well Number 42  Location

| Sample Number | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Depth | | | | | | |
| Sample Collected | 9-17-81 | | | | | |
| Received at Laboratory | 9-17-81 | | | | | |
| Analysis Completed | 9-21-81 | | | | | |
| pH at 26°C | 7.88 | | | | | |
| E C | | | | | | |
| Ca $CO_3$ Saturation Index | +0.06 | | | | | |
| Sodium Per Cent of Total Cations | 65.5 | | | | | |

MILLIGRAMS PER LITER

| | | | | | | |
|---|---|---|---|---|---|---|
| Total Dissolved Solids | 411 | | | | | |
| Phenol Alkalinity as Ca $CO_3$ | 0 | | | | | |
| Total Alkalinity as Ca $CO_3$ | 119 | | | | | |
| Total Hardness as Ca $CO_3$ | 100 | | | | | |
| Chlorides as Cl | 78 | | | | | |
| Sulfates as $SO_4$ | 52 | | | | | |
| Fluorides as F | 0.62 | | | | | |
| Silica as $SiO_2$ | 33 | | | | | |
| Nitrate as N | 2.3 | as $NO_3$ 10.2 | | | | |
| Total Phosphates as P | less than <0.01 | as $PO_4$ <0.03 | | | | |
| Calcium as Ca | 33 | | | | | |
| Magnesium as Mg | 4.4 | | | | | |
| Sodium Na & K calc. as Na | 88 | | | | | |
| Potassium | ------- | | | | | |
| Total Iron as Fe | less than <0.05 | | | | | |
| Manganese as Mn | less than <0.05 | | | | | |
| Chlorine Residual | -------- | | | | | |
| Turbidity, N.T.U. | 0.21 | | | | | |
| Aggressivity Index | 11.9 | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Checking Correctness of Analysis: | | | | | | |
| Measured Diluted E. C. | 650 | | | | | |
| Calculated Diluted E. C. | 652 | | | | | |
| % Error | +0.3 | | | | | |

Remarks: Sample taken by F. Brooks at 1030 hours.

JL-49-05-301



Douglas A. Hallmark

EL PASO WATER UTILITIES PUBLIC SERVICE BOARD

# WATER ANALYSIS DATA SHEET

JL-49-05-301

Well Number #42

WELL DATA:

LAB# 12283-6

| | |
|---|---|
| SAMPLE COLLECTED | 5-2-83 |
| RECEIVED AT LABORATORY | " |
| ANALYSIS COMPLETED | 5-4-83 |
| pH | 8.00 |
| **MILIGRAMS PER LITER** | |
| TOTAL DISSOLVED SOLIDS | 381 |
| PHENOL ALKALINITY AS Ca $CO_3$ | — |
| TOTAL ALKALINITY AS Ca $CO_3$ | 102 |
| TOTAL HARDNESS AS Ca $CO_3$ | 102 |
| CHLORIDES AS Cl | 92 |
| SULFATES AS $SO_4$ | 34 |
| FLUORIDES AS F | 0.62 |
| SILICA AS Si $O_2$ | 31 |
| NITRATE AS $NO_3$ | 10.2 |
| TOTAL PHOSPHATES AS $PO_4$ | 0.06 |
| CALCIUM AS Ca | 30 |
| MAGNESIUM AS Mg | 6.5 |
| SODIUM | 77 |
| POTASSIUM | 6.2 |
| CHLORINE RESIDUAL | — |
| TURBIDITY, N. T.U. | 0.18 |
| TEMPERATURE (°C) | 25°C |
| **ORGANICS BY G.C.** | Mg/l |
| CHLOROFORM | |
| BROMODICHLOROMETHANE | |
| DIBROMOCHLOROMETHANE | |
| BROMOFORM | |
| TOTAL THM's | |
| **CHECKING CORRECTNESS OF ANALYSIS** | |
| MEASURED DILUTE E.C. | 628 |
| CALCULATED DILUTE E.C. | 635 |
| % ERROR | -1.11 |

Location:

| ELEMENT | SEWAGE LIMITS | POTABLE LIMITS | SAMPLE mg/l |
|---|---|---|---|
| ARSENIC | 1.0 | .05 | |
| BARIUM | 5.0 | 1.0 | |
| CADMIUM | .05 | .010 | — |
| CHROMIUM | 5.0 | .05 | — |
| COPPER | 1.0 | 1.0 | — |
| IRON | — | .30 | — |
| LEAD | 1.0 | .05 | — |
| MANGANESE | 5.0 | .05 | -- |
| MERCURY | .005 | .002 | |
| NICKEL | 5.0 | — | — |
| SELENIUM | .02 | .01 | |
| SILVER | .10 | .05 | — |
| ZINC | 5.0 | 5.0 | — |
| LANGELIER INDEX | | | +0.05 |
| AGGRESSIVITY INDEX | | | 12.0 |
| % Na OF TOTAL CATIONS | | | 60.5 |

**ANION – CATION BALANCE**

| ANIONS | mg/l | Meq/l |
|---|---|---|
| ALKALINITY | 102 | 2.0396 |
| CHLORIDES | 92 | 2.5953 |
| FLUORIDES | 0.62 | 0.0326 |
| SULFATES | 34 | 0.7079 |
| NITRATES | 10.2 | 0.1645 |
| PHOSPHATES | 0.06 | 0.0019 |
| | TOTAL | 5.5418 |
| CATIONS | Mg/l | Meq/l |
| CALCIUM | 30 | 1.4970 |
| MAGNESIUM | 6.5 | 0.5349 |
| POTASSIUM | 6.2 | 0.1586 |
| SODIUM | 77 | 3.3495 |
| | TOTAL | 5.5400 |

Remarks: COLLECTED BY GRIFFIN @ 1430

(-) BELOW DETECTABLE LIMITS.

Analyst

Page 102

$\Sigma$ANIONS - $\Sigma$CATIONS = ± (0.1065 + 0.0155 $\Sigma$ANIONS)

+0.0018 =< ± ISD = 0.1924

49-05-301

FORM 4514-1282

EL PASO WATER UTILITIES PUBLIC SERVICE BOARD

49-05-301

# WATER ANALYSIS DATA SHEET

Well Number: #42 Lab. Number: #03084-6 Location:

| | |
|---|---|
| DATE SAMPLE COLLECTED | 1-31-84 |
| DATE RECEIVED AT LABORATORY | " |
| DATE ANALYSIS COMPLETED | 2-2-84 |

**MILLIGRAMS PER LITER**

| | |
|---|---|
| TOTAL DISSOLVED SOLIDS | 399 |
| PHENOL ALKALINITY AS $Ca\ CO_3$ | — |
| TOTAL ALKALINITY AS $Ca\ CO_3$ | 117 |
| TOTAL HARDNESS AS $Ca\ CO_3$ | 101 |
| CHLORIDES AS Cl | 75 |
| SULFATES AS $SO_4$ | 45 |
| FLUORIDES AS F | 0.62 |
| SILICA AS $Si\ O_2$ | 42 |
| NITRATE AS $NO_3$ | 11 |
| TOTAL PHOSPHATES AS $PO_4$ | <0.03 |
| CALCIUM AS Ca | 30 |
| MAGNESIUM AS Mg | 6.3 |
| SODIUM AS Na | 83 |
| POTASSIUM AS K | 5.7 |

| | |
|---|---|
| CHLORINE RESIDUAL (Mg/l) | — |
| ~~TURBIDITY (N.T.U.)~~ | 0.13 |
| TEMPERATURE (°c) | 23.9 |
| pH | 7.97 |

**ORGANICS BY G.C. (Mg/l)**

| | |
|---|---|
| CHLOROFORM | |
| BROMODICHLOROMETHANE | |
| DIBROMOCHLOROMETHANE | |
| BROMOFORM | |
| TOTAL THM's | |
| LINDANE | |
| ENDRIN | |
| METHOXYCHLOR | |
| 2, 4 - D | |
| SILVEX | |
| TOXAPHENE | |

**CHECKING CORRECTNESS OF ANALYSIS**

| | |
|---|---|
| MEASURED DILUTED E.C. | 630 |
| CALCULATED DILUTED E.C. | 633 |
| % ERROR | +0.54 |

| ELEMENT | SEWAGE LIMITS | POTABLE LIMITS | SAMPLE (Mg/l) |
|---|---|---|---|
| ARSENIC | 1.0 | 0.05 | |
| BARIUM | 5.0 | 1.0 | |
| CADMIUM | 0.05 | 0.010 | <0.01 |
| CHROMIUM | 5.0 | 0.05 | <0.01 |
| COPPER | 1.0 | 1.0 | <0.01 |
| IRON | — | 0.30 | <0.01 |
| LEAD | 1.0 | 0.05 | <0.01 |
| MANGANESE | 5.0 | 0.05 | <0.01 |
| MERCURY | 0.005 | 0.002 | |
| NICKEL | 5.0 | — | <0.01 |
| SELENIUM | 0.02 | 0.01 | |
| SILVER | 0.10 | 0.05 | <0.01 |
| ZINC | 5.0 | 5.0 | <0.01 |

| | |
|---|---|
| LANGELIER INDEX | +0.03 |
| AGGRESSIVITY INDEX | 12.0 |
| % Na OF TOTAL CATIONS | 62.6 |
| TOTAL ORGANIC CARBONS (Mg/l) | |
| TOTAL INORGANIC CARBONS (Mg/l) | |
| ~~TOTAL CARBONS (Mg/l)~~ | |

**ANION - CATION BALANCE**

| ANIONS | Mg/l | Meg/l |
|---|---|---|
| PHENOL ALKALINITY | 117 | — |
| TOTAL ALKALINITY | 75 | 2.3409 |
| CHLORIDES | 45 | 2.1150 |
| SULFATES | 0.62 | 0.9360 |
| FLUORIDES | | 0.0326 |
| NITRATES | 11 | 0.1771 |
| PHOSPHATES | <0.03 | — |
| | TOTAL | 5.6016 |
| **CATIONS** | **Mg/l** | **Meg/l** |
| CALCIUM | 30 | 1.4970 |
| MAGNESIUM | 63 | 0.5185 |
| SODIUM | 83 | 3.6105 |
| POTASSIUM | 5.7 | 0.1459 |
| | TOTAL | 5.7719 |

TOTAL ANIONS – TOTAL CATIONS = ± 0.1065 + 0.0155 (TOTAL ANIONS)

−0.1703 =< ± ISD = 0.1933

Remarks: Collected By Scott @ 1400



Analyst [signature] 49-05-301

FORM 4518-0883

JL-49-05-301

# WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED | 05-06-86 | WELL NUMBER | 42 |
| DATE RECEIVED AT LABORATORY | 05-06-86 | LAB. NUMBER | C050686-10 |
| DATE ANALYSIS COMPLETED | 05-08-86 | LOCATION | NEVINS WELL FIELD |
| | | OWNER | |
| | | SAMPLE TAKER | M. SPRESTER |
| | | DELIVERED BY | M. SPRESTER |

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0 | ****** | ****** |
| Total Alkalinity as CaCO3 | 110 | ****** | ****** |
| Carbonates as CO3 | 0 | 0 | 0 |
| Bicarbonates as HCO3 | 134 | 2.20088 | 96 |
| Chlorides as Cl | 86 | 2.42606 | 184 |
| Sulfates as SO4 | 48 | .99936 | 74 |
| Fluorides as F | .57 | .030005 | ****** |
| Nitrates as NO3 LOD=4.43 | 7.8 | .125814 | 9 |
| Total Phosphates as PO4 LOD=.09 | 0 | 0 | ****** |
| Total Anions = | 277 | 5.78212 | 363 |

| CATIONS | | | |
|---|---|---|---|
| Total Hardness as CaCO3 | 104 | ****** | ****** |
| Calcium as Ca | 31 | 1.5469 | 80 |
| Magnesium as Mg | 6.3 | .51849 | 24 |
| Sodium as Na | 82 | 3.567 | 174 |
| Potassium as K | 6.4 | .16384 | 12 |
| Total Cations = | 125.7 | 5.79623 | 291 |
| TOTAL DISSOLVED SOLIDS = | 402 | 11.5783 | 654 |

| | |
|---|---|
| Silica, SiO2 = | 33 |
| Chlorine Res. = | |
| Turbidity,ntu = | .07 |
| Sample Temp(C)= | 29 |
| pH @ 29 | 7.75 |
| Lab E.C.@25C as umhos/cm = | 590 |
| Field E.C. @25C as umhos/cm = | |
| pH Saturation = | 7.85 |
| Langelier Ind.= | -0.10 |
| Aggress. Index= | 11.81 |
| % Na of T Cat.= | 62 |

Remarks

LOD = LIMIT OF DETECTION

SAMPLE SENT TO NORTH-EAST PLANT FOR METALS ANALYSIS.
TAG #76

CHECKING CORRECTNESS OF ANALYSIS

| | |
|---|---|
| Measured Diluted E.C. = | 646 |
| Calculated Diluted E.C.= | 654 |
| % Error = | 1.23839 |

ANION-CATION BALANCE

Total Anions - Total Cations =
+or-(0.1065+0.0155* T.Cations)
-.01411=<+or-1SD= +or- .196342 MAX. LIMIT

ANALYST M. Chávez DDR

VL-78-05-301

# WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED | 02-19-87 | WELL NUMBER | WELL 42 |
| DATE RECEIVED AT LABORATORY | 02-19-87 | LAB. NUMBER | C021987-9 |
| DATE ANALYSIS COMPLETED | 03-04-87 | LOCATION | NEVINS WELL FIELD |
| | | OWNER | |
| | | SAMPLE TAKER | R. SPERKA |
| | | DELIVERED BY | R. SPERKA |

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0 | ****** | ****** |
| Total Alkalinity as CaCO3 | 116 | ****** | ****** |
| Carbonates as CO3 | 0.00 | 0 | 0 |
| Bicarbonates as HCO3 | 142 | 2.31951 | 101 |
| Chlorides as Cl | 76 | 2.14396 | 153 |
| Sulfates as SO4 | 46 | .95772 | 71 |
| Fluorides as F | .64 | .033690 | ****** |
| Nitrates as NO3 LOD=4.43 | 8.4 | .135492 | 10 |
| Total Phosphates as PO4 LOD=.09 | 0 | 0 | ****** |
| Total Anions = | 273 | 5.55037 | 344 |

| CATIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Total Hardness as CaCO3 | 104 | ****** | ****** |
| Calcium as Ca | 30 | 1.497 | 78 |
| Magnesium as Mg | 7.04 | .579015 | 27 |
| Sodium as Na | 78 | 3.393 | 166 |
| Potassium as K | 5.3 | .161091 | 12 |
| Total Cations = | 121 | 5.63011 | 282 |
| TOTAL DISSOLVED SOLIDS = | 394 | 11.2205 | 627 |

| | |
|---|---|
| Silica, SiO2 = | 32 |
| Chlorine Res. = | |
| Turbidity,ntu = | .07 |
| Sample Temp(C)= | 18 |
| pH @ 18 | 8.05 |
| Lab E.C.@25C as umhos/cm = | 576 |
| Field E.C. @25C as umhos/cm = | |
| pH Saturation = | 9.06 |
| Langelier Ind.= | -0.01 |
| Aggress. Index= | 12.13 |
| % Na of T Cat.= | 60 |

Remarks _____

LOD = LIMIT OF DETECTION

SAMPLE SENT TO AUSTIN FOR METAL ANALYSIS

CHECKING CORRECTNESS OF ANALYSIS

Measured Diluted E.C. = 642

Calculated Diluted E.C.= 627

% Error = -2.34

ANION-CATION BALANCE

Total Anions - Total Cations =

+or-(0.1065+0.0155* T.ANIONS)

-.03973=<+or-.193= +or- .193151 MAX. LIMIT

ANALYST Michelle Sprecher

EL PASO WATER UTILITIES PUBLIC SERVICE BOARD

# WATER ANALYSIS DATA SHEET

JL-49-05-301

Plant Sample  Well Number 42  Location

| Sample Number | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Depth | | | | | | |
| Sample Collected | 9-15-81 | | | | | |
| Received at Laboratory | 9-15-81 | | | | .. | |
| Analysis Completed | 9-17-81 | | | | | |
| pH at 25°C | 7.80 | | | | | |
| E C | | | | | | |
| Ca $CO_3$ Saturation Index | -0.09 | | | | | |
| Sodium Per Cent of Total Cations | 64.6 | | | | | |

MILLIGRAMS PER LITER

| | | | | | | |
|---|---|---|---|---|---|---|
| Total Dissolved Solids | 406 | | | | | |
| Phenol Alkalinity as Ca $CO_3$ | 0 | | | | | |
| Total Alkalinity as Ca $CO_3$ | 118 | | | | | |
| Total Hardness as Ca $CO_3$ | 102 | | | | | |
| Chlorides as Cl | 80 | | | | | |
| Sulfates as $SO_4$ | 52 | | | | | |
| Fluorides as F | 0.58 | | | | | |
| Silica as $SiO_2$ | 30 | | | | | |
| Nitrate as N | 1.5 | as $NO_3$ 6.6 | | | | |
| Total Phosphates as P | less than 0.01 | as $PO_4$ <0.03 | | | | |
| Calcium as Ca | 30 | | | | | |
| Magnesium as Mg | 6.8 | | | | | |
| Sodium Na & K calc. as Na | 86 | | | | | |
| Potassium | ------- | | | | | |
| Total Iron as Fe | less than 0.05 | | | | | |
| Manganese as Mn | less than 0.05 | | | | | |
| Chlorine Residual | 0.0 | | | | | |
| Turbidity, N.T.U. | 0.35 | | | | | |
| Aggressivity Index | 11.7 | | | | | |

| Checking Correctness of Analysis: | | | | | | |
|---|---|---|---|---|---|---|
| Measured Diluted E. C. | 650 | | | | | |
| Calculated Diluted E. C. | 649 | | | | | |
| % Error | -0.1 | | | | | |

Remarks: Sample taken by R. Sperka at 1100 hours.

JL-49-05-301



Douglas D. Patterson

# EL PASO WATER UTILITIES
# WATER ANALYSIS REPORT

Corrected Copy
JL-HG-05-301

| | | | |
|---|---|---|---|
| **DATE COLLECTED:** | **112895** | **SAMPLE SOURCE:** | **WELL 42** |
| **TIME COLLECTED:** | **12:10** | **LAB NUMBER:** | **JC112895-7** |
| **DATE RECEIVED:** | **112895** | **LOCATION:** | |
| **TIME RECEIVED:** | **16:00** | **OWNER:** | **EPWU** |
| **DATE ANALYZED:** | **112895** | **COLLECTED BY:** | **J. Zamora** |
| **DATE ANALYSIS COMPLETED:** | **120495** | **DELIVERED BY:** | **J. Zamora** |

| **ANIONS** | mg/l | me/l | Dil E.C. | | |
|---|---|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.0 | | | Silica, SiO2 = | 32.0 |
| Total Alkalinity as CaCO3 | 107.0 | | | Chlorine Res. = | |
| Carbonates as CO3 | 0.0 | 0.0000 | 0 | Turbidity, NTU = | 0.30 |
| Bicarbonates as HCO3 | 130.5 | 2.1409 | 93 | Sample Temp (C) | 18.8 |
| Chlorides as Cl | 88.0 | 2.4822 | 188 | pH @ | 8.05 |
| Sulfates as SO4 | 41.3 | 0.8590 | 64 | Lab E.C. @ 25 C | |
| Flourides as F | 0.8 | 0.0395 | | as umhos/m = | 598 |
| Nitrates as NO3 LOD= 0.1 | 21,3 ~~4.8~~ | 0.0774 | 6 | Field E.C. @ 25 C | |
| Total Phosphates LOD= 0.09 | 0.0 | 0.0003 | | as umhos/cm = | 630 |
| **TOTAL ANIONS** | 265 | 5.5993 | 351 | pH Saturation = | 8.10 |
| | | | | Langelier Index | -0.05 |
| **CATIONS** | | | | Aggress. Index | 12.12 |
| Total Hardness as CaCO3 | 109 | | | % Na of T. Cat. = | 58 |
| Calcium as Ca | 29.0 | 1.4500 | 75 | Iron = | <.1 |
| Magnesium Mg | 8.7 | 0.7131 | 33 | Nitrites = | <.1 |
| Sodium as Na | 79.0 | 3.4363 | 168 | | |
| Potassium as K | 7.0 | 0.1790 | 13 | | |
| **TOTAL CATIONS** | 124 | 5.7784 | 290 | | |
| **TDS BY EPWU METHOD (1)=** | 405 ~~389~~ | 11.3777 | 641 | | |
| **TDS BY USGS METHOD (2)=** | 355 | | | | |
| **TDS BY TDH METHOD (3)=** | 323 | | | | |
| **TDS BY EVAPORATION (4)=** | 362 | | | | |

**CHECKING CORRECTNESS OF ANALYSIS**

| | |
|---|---|
| Measured Diluted E.C. | 641 |
| Calculated Diluted E.C. | 641 |
| % Error | -0.13% |

1.- SUM OF IONS, NOT INCLUDING SILICA.
2.- SUM OF IONS WITH CONVERSION OF HCO3 TO CO3, PLUS SILICA.
3.- SUM OF IONS, NOT INCLUDING SILICA WITH CONVERSION OF HCO3 TO CO3.

**ANION - CATION BALANCE**

| | |
|---|---|
| Total Anions - Total Cations = | -0.1792 |
| + or - (0.1065 + 0.0155 * T. Anions) Maximum Limit +/- | 0.1933 |

~~SD=-0.92~~ SD=0.45

**Teresa T. Macias, Chemist I**

**Douglas Rittmann, P.E.**
**Water Systems Div. Mgr.**

JL-49-03-301

# EL PASO WATER UTILITIES
# WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| **DATE COLLECTED:** | **10/11/96** | **SAMPLE SOURCE:** | **Well 42** |
| **TIME COLLECTED:** | **18:50** | **LAB NUMBER:** | **C101496-9** |
| **DATE RECEIVED:** | **10/14/96** | **LOCATION:** | |
| **TIME RECEIVED:** | **08:00** | **OWNER:** | **EPWU** |
| **DATE ANALYZED:** | **10/14/96** | **COLLECTED BY:** | **R. Alvarez** |
| **DATE ANALYSIS COMPLETED:** | **10/28/96** | **DELIVERED BY:** | **R. Alvarez** |

| **ANIONS** | mg/l | me/l | Dil E.C. | | |
|---|---|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.0 | | | Silica, SiO2 = | 35.0 |
| Total Alkalinity as CaCO3 | 108.0 | | | Chlorine Res. = | N/A |
| Carbonates as CO3 | 0.0 | 0.0000 | 0 | Turbidity, NTU = | 0.17 |
| Bicarbonates as HCO3 | 131.8 | 2.1609 | 94 | Sample Temp (C) | 25.4 |
| Chlorides as Cl | 85.0 | 2.3975 | 182 | pH @ | 8.10 |
| Sulfates as SO4 | 45.0 | 0.9360 | 69 | Lab E.C. @ 25 C | |
| Fluorides as F | 0.7 | 0.0383 | | as umhos/m = | 566 |
| Nitrates as NO3 LOD= 0.1 | 6.9 | 0.1112 | 8 | Field E.C. @ 25 C | |
| Total Phosphates LOD= 0.09 | 0.0 | 0.0002 | | as umhos/cm = | N/A |
| **TOTAL ANIONS** | 269 | 5.6440 | 353 | pH Saturation = | 7.93 |
| | | | | Langelier Index | 0.17 |
| | | | | Aggress. Index | 12.12 |
| **CATIONS** | | | | % Na of T. Cat. = | 61 |
| Total Hardness as CaCO3 | 98 | | | | |
| Calcium as Ca | 30.9 | 1.5450 | 80 | | |
| Magnesium Mg | 5.0 | 0.4098 | 19 | | |
| Sodium as Na | 81.0 | 3.5233 | 173 | | |
| Potassium as K | 6.4 | 0.1629 | 12 | | |
| **TOTAL CATIONS** | 123 | 5.6410 | 284 | | |

| | | | |
|---|---|---|---|
| **TDS BY EPWU METHOD (1)=** | 393 | 11.2850 | 637 |
| **TDS BY USGS METHOD (2)=** | 361 | | |
| **TDS BY TDH METHOD (3)=** | 326 | | |
| **TDS BY EVAPORATION (4)=** | 355 | | |

**CHECKING CORRECTNESS OF ANALYSIS**

| | |
|---|---|
| Measured Diluted E.C. | 626 |
| Calculated Diluted E.C. | 637 |
| % Error | 1.76% |

**ANION - CATION BALANCE**

| | |
|---|---|
| Total Anions - Total Cations = | 0.0030 |
| + or - (0.1065 + 0.0155 * T. Anions) Maximum Limit +/- | 0.1940 |

1.- SUM OF IONS, NOT INCLUDING SILICA.
2.- SUM OF IONS WITH CONVERSION OF HCO3 TO CO3, PLUS SILICA.
3.- SUM OF IONS, NOT INCLUDING SILICA WITH CONVERSION OF HCO3 TO CO3.
4.-AT 180 DEGREES CELSIUS

SD = 0.02

Teresa T. Alcala
**Teresa Alcala, Chemist I**

Douglas Rittmann
**Douglas Rittmann, P.E.**
**Water Systems Div. Mgr.**

05

J2-49-05-301

# EL PASO WATER UTILITIES
# WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| **DATE COLLECTED:** | **05/16/97** | **SAMPLE SOURCE:** | **Well 42** |
| **TIME COLLECTED:** | **08:45** | **LAB NUMBER:** | **C051697-28** |
| **DATE RECEIVED:** | **05/16/97** | **LOCATION:** | **Nevins** |
| **TIME RECEIVED:** | **13:30** | **OWNER:** | **EPWU** |
| **DATE ANALYZED:** | **05/16/97** | **COLLECTED BY:** | **N.A.** |
| **DATE ANALYSIS COMPLETED:** | **06/19/97** | **DELIVERED BY:** | **N.A.** |

| **ANIONS** | mg/l | me/l | Dil E.C. | | |
|---|---|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.0 | | | Silica, SiO2 = | 30.0 |
| Total Alkalinity as CaCO3 | 118.0 | | | Chlorine Res. = | N/A |
| Carbonates as CO3 | 0.0 | 0.0000 | 0 | Turbidity, NTU = | 0.08 |
| Bicarbonates as HCO3 | 144.0 | 2.3609 | 103 | Sample Temp (C) | 31.2 |
| Chlorides as Cl | 85.0 | 2.3975 | 182 | pH @ | 8.04 |
| Sulfates as SO4 | 44.0 | 0.9152 | 68 | Lab E.C. @ 25 C | |
| Fluorides as F | 0.7 | 0.0367 | | as umhos/m = | 597 |
| Nitrates as NO3 LOD= 0.1 | 7.7 | 0.1244 | 9 | Field E.C. @ 25 C | |
| Total Phosphates LOD= 0.09 | 0.0 | 0.0004 | | as umhos/cm = | N/A |
| **TOTAL ANIONS** | 281 | 5.8352 | 361 | pH Saturation = | 7.77 |
| | | | | Langelier Index | 0.27 |
| | | | | Aggress. Index | 12.10 |
| **CATIONS** | | | | % Na of T. Cat. = | 61 |
| Total Hardness as CaCO3 | 98 | | | | |
| Calcium as Ca | 31.3 | 1.5650 | 81 | | |
| Magnesium Mg | 4.8 | 0.3934 | 18 | | |
| Sodium as Na | 83.0 | 3.6103 | 177 | | |
| Potassium as K | 6.5 | 0.1657 | 12 | | |
| **TOTAL CATIONS** | 126 | 5.7344 | 288 | | |

| | | | |
|---|---|---|---|
| **TDS BY EPWU METHOD (1)=** | 407 | 11.5697 | 650 |
| **TDS BY USGS METHOD (2)=** | 364 | | |
| **TDS BY TDH METHOD (3)=** | 334 | | |
| **TDS BY EVAPORATION (4)=** | 342 | | |

**CHECKING CORRECTNESS OF ANALYSIS**

| | |
|---|---|
| Measured Diluted E.C. | 638 |
| Calculated Diluted E.C. | 650 |
| % Error | 1.86% |

**ANION - CATION BALANCE**

| | |
|---|---|
| Total Anions - Total Cations = | 0.1008 |
| + or - (0.1065 + 0.0155 * T. Anions) Maximum Limit +/- | 0.1969 |

1.- SUM OF IONS, NOT INCLUDING SILICA.
2.- SUM OF IONS WITH CONVERSION OF HCO3 TO CO3, PLUS SILICA.
3.- SUM OF IONS, NOT INCLUDING SILICA WITH CONVERSION OF HCO3 TO CO3.
4.-AT 180 DEGREES CELSIUS

SD = 0.52

Maria Molina
**Maria Molina, Chemist I**

**Paul R. Rivas, Chemist II**

JL-49-05-301

# ANION-CATION BALANCE

SM 1030 F

*Standard Methods 19TH Edition*

CENTRAL LABORATORY

Sampling Location: Mesa-Nevins

Requested By: R. Sperka

Sample Identification: J021198-5
Project: WS
Sampling Point: Well 42
Sampling Description: Grab

Date Collected: 02/10/98
Time Collected: 14:40
Date Reported: 02/24/98

| ANIONS | mg/L | me/L | Dil EC |
|---|---|---|---|
| p-Alkalinity (CaCO3) | 0.0 | | |
| t-Alkalinity (CaCO3) | 111 | | |
| Carbonate | 0 | 0.00 | 0.00 |
| Bicarbonate | 135 | 2.22 | 96.83 |
| Chloride | 89 | 2.50 | 189.82 |
| Sulfate | 35.4 | 0.74 | 54.52 |
| Fluoride | 0.71 | 0.04 | |
| Nitrogen as NO3 | 9.7 | 0.16 | 11.16 |
| Total phosphorous as PO4 | 0.00 | 0.00 | |
| *TOTAL ANIONS* | 269.9 | 5.65 | 352.31 |

| CATIONS | mg/L | me/L | Dil EC |
|---|---|---|---|
| Calcium | 31.3 | 1.57 | 81.38 |
| Magnesium | 4.3 | 0.35 | 16.43 |
| Sodium | 82 | 3.57 | 174.66 |
| Potassium | 6.6 | 0.17 | 12.18 |
| *TOTAL CATIONS* | 124.2 | 5.65 | 284.65 |

| | | |
|---|---|---|
| Field pH | ND | |
| Field Temperature | ND | |
| Field EC | ND | |
| pH | 8.04 | |
| Temperature of analysis | 18.9 | |
| Chlorine Residual | ND | |
| pH Saturation | 8.04 | |
| Langlier Index | 0.00 | ***Water is Balanced*** |
| TDS (EPWU method) | 394 | anions+cations, excluding silica |
| TDS (USGS method) | 355 | convert HCO3 to CO3, include silica |
| TDS (TDH method) | 325 | convert HCO3 to CO3, exclude silica |
| TDS (measured @ 180C) | 348 | |
| TDS (calculated-SM 1030F) | 355 | SD=0.02 |
| Turbidity, NTU | 0.43 | |
| Silica | 29 | |
| %Na of Total Cations | 63.1% | |
| Hardness as CaCO3 (titrated) | 96.0 | |
| Hardness as CaCO3 (calc) | 96.0 | |
| EC (measured) | 603 | |
| EC (calculated) | 598 | |
| Diluted EC (measured) | 650 | |
| Diluted EC (calculated) | 637 | |

## CHECKING CORRECTNESS OF ANALYSIS

| | | ACTION REQUIRED | LIMITS |
|---|---|---|---|
| *Anion/Cation balance (% diff)...* | 0.0% | ACCEPTABLE | NONE | +/-2.0% |
| *TDS Ratio.....* | 1.0 | ACCEPTABLE | NONE | 1.0-1.2 |
| *Conductivity ratio.....* | 1.0 | ACCEPTABLE | NONE | 0.9-1.1 |
| *Measured EC and anion sum.....* | 565 | ACCEPTABLE | NONE | (0.9-1.1)EC |
| *Measured EC and cation sum....* | 565 | ACCEPTABLE | NONE | (0.9-1.1)EC |
| *Calculated TDS to EC ratio.....* | 0.59 | ACCEPTABLE | NONE | 0.55-0.7 |
| *Measured TDS to EC ratio.....* | 0.58 | ACCEPTABLE | NONE | 0.55-0.7 |
| *Hardness relative % error.....* | 0.0% | ACCEPTABLE | NONE | +/-5.0% |

CHEMIST: [signature] DATE: 2-26-98

QA/QC: [signature] DATE: 3-3-98

APPROVAL: [signature] DATE: MAR 04 1998

JL-49-05-301

# ANION-CATION BALANCE

*SM 1030 F*

*Standard Methods 19TH Edition*

*LABORATORY SERVICES - JR Laboratory*

Sampling Location: Nevins

Requested By: T. T. Alcala, Chemist I

Sample Identification: J021999-12
Project: Well Sample
Sampling Point: Well 42
Sampling Description: Grab

Date Collected: 02/19/99
Time Collected: 13:45
Date Reported: 03/18/99

| ANIONS | mg/L | me/L | Dil EC |
|---|---|---|---|
| p-Alkalinity (CaCO3) | ND | | |
| t-Alkalinity (CaCO3) | 110 | | |
| Carbonate | ND | 0 | 0 |
| Bicarbonate | 134.2 ~~130~~ | 2.132 | 92.95 |
| Chloride | 85 | 2.39754 | 181.9 |
| Sulfate | 46 | 0.9568 | 70.84 |
| Fluoride | 0.7 | 0.03685 | |
| Nitrogen as NO3 | 8.9 | 0.14354 | 10.235 |
| Total phosphorous as PO4 | 0.003 | 0.00009 | |
| *TOTAL ANIONS* | 270.6 | 5.66682 | 355.925 |

| CATIONS | mg/L | me/L | Dil EC |
|---|---|---|---|
| Calcium | 29.7 | 1.485 | 77.22 |
| Magnesium | 5.4 | 0.44262 | 20.628 |
| Sodium | 79.9 | 3.47543 | 170.187 |
| Potassium | 6.77 | 0.17315 | 12.4568 |
| Iron | 0.05 | | |
| *TOTAL CATIONS* | 121.8 | 5.5762 | 280.492 |

| | | |
|---|---|---|
| Field pH | ND | |
| Field Temperature | ND | |
| Field EC | ND | |
| pH | 7.99 | |
| Temperature of analysis | 25.6 | |
| Chlorine Residual | ND | |
| pH Saturation | 7.93 | |
| Langlier Index | 0.06 | ***Scale Forming*** |
| TDS (EPWU method) | 390 | anions+cations, excluding silica |
| TDS (USGS method) | 350 | convert HCO3 to CO3, include silica |
| TDS (TDH method) | 330 | convert HCO3 to CO3, exclude silica |
| TDS (measured @ 180C) | 360 | |
| TDS (calculated-SM 1030F) | 360 | SD= 0.82 |
| Turbidity, NTU | 0.77 | |
| Silica | 28 | |
| %Na of Total Cations | 62.3% | |
| Hardness as CaCO3 (titrated) | 94 | |
| Hardness as CaCO3 (calc) | 96 | |
| EC (measured) | 590 | |
| EC (calculated) | 600 | |
| Diluted EC (measured) | 630 | |
| Diluted EC (calculated) | 640 | |

## CHECKING CORRECTNESS OF ANALYSIS

| | | | ACTION REQUIRED | LIMITS |
|---|---|---|---|---|
| *Anion/Cation balance (% diff)...* | -0.8% | *ACCEPTABLE* | *NONE* | +/-2.0% |
| *TDS Ratio.....* | 1.0 | *ACCEPTABLE* | *NONE* | 1.0-1.2 |
| *Conductivity ratio.....* | 1.0 | *ACCEPTABLE* | *NONE* | 0.9-1.1 |
| *Measured EC and anion sum.....* | 567 | *ACCEPTABLE* | *NONE* | (0.9-1.1)EC |
| *Measured EC and cation sum.....* | 558 | *ACCEPTABLE* | *NONE* | (0.9-1.1)EC |
| *Calculated TDS to EC ratio.....* | 0.61 | *ACCEPTABLE* | *NONE* | 0.55-0.7 |
| *Measured TDS to EC ratio.....* | 0.61 | *ACCEPTABLE* | *NONE* | 0.55-0.7 |
| *Hardness relative % error.....* | 2.1% | *ACCEPTABLE* | *NONE* | +/-5.0% |

QA/QC: Teresita T. Alcala DATE: 031899

APPROVAL: Antonio Cabig DATE: 031879

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer _____ Field No. M-304 R-8 State Well No. 49-05-302

Owner's Well No. #1 County El Paso

1. Location: NW 1/4, NE 1/4 Sec. 18, Block 80 Survey T-1

31 58 11 N 106 23 55.1

2. Owner: El Paso Natural Gas Co. Address: _____

Tenant: _____ Address: _____

Driller: Folk & Bassett Address: _____

3. Elevation of CSD is 4078 ft. above msl, determined by Topo

4. Drilled: Jan or Feb 19 47; Dug, Cable Tool, Rotary, _____

5. Depth: Rept. 771 ft. Meas. _____ ft.

6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed _____

7. Pump: Mfgr. Pomona Type Turbine

No. Stages _____, Bowls Diam. _____ in., Setting _____ ft. Capacity 850 gpm

Column Diam. _____ in., Length Tailpipe _____ ft.

8. Motor: Fuel Elect Make & Model _____ HP. 25

9. Yield: Flow _____ gpm, Pump _____ gpm, Meas., Rept., Est. _____

10. Performance Test: Date _____ Length of Test _____ Made by _____

Static Level _____ ft. Pumping Level _____ ft. Drawdown _____ ft.

Production _____ gpm Specific Capacity _____ gpm/ft.

CASING & BLANK PIPE

Cemented From _____ ft. to _____ ft.

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 10 | Steel | | |

11. Water Level: _____ ft. rept. meas. _____ 19__ above below _____ which is _____ ft. above below surface.

_____ ft. rept. meas. _____ 19__ above below _____ which is _____ ft. above below surface.

_____ ft. rept. meas. _____ 19__ above below _____ which is _____ ft. above below surface.

_____ ft. rept. meas. _____ 19__ above below _____ which is _____ ft. above below surface.

12. Use: Dom., Stock, Public Supply, Ind., Irr., Waterflooding, Observation, Not Used, None

13. Quality: (Remarks on taste, odor, color, etc.) _____

Temp. ___ °F, Date sampled for analysis _____ Laboratory _____

Temp. ___ °F, Date sampled for analysis _____ Laboratory _____

Temp. ___ °F, Date sampled for analysis _____ Laboratory _____

14. Other data available as circled: Driller's Log, Radioactivity Log, Electric Log,

Formation Samples, Pumping Test, _____

15. Record by: _____ Date _____ 19__

Source of Data _____

16. Remarks:

Unused - pumps sand.

WELL SCREEN

Screen Openings _____

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| | | | |

4/10/75 Still unused.

Ran check w Dave Kelly

(Sketch)

49-05-302 ✓

Central Records
Texas Dept. of Water Resources

RECEIVED
AUG 17 1978

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer Hueco Bolson Sand & Gravel 380-860 Field No. Office No. R-66 State Well No. 49-05-303

Owner's Well No. #1 County El Paso

1. Location: SE 1/4, SE 1/4 Sec. 7, Block 80 Survey TSP-1
31583.2N 106 23 42.1

2. Owner: Price's Dairy #1 Address:

Tenant: Address:

Driller: Layne-Texas Co Address:

3. Elevation of Ground is 4044 ft. above msl, determined by topo 7½'

4. Drilled: 4 1955; Dug, Cable Tool, Rotary,

5. Depth: Rept. 1012 ft. Meas. ft.

6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed

7. Pump: Mfgr. Type T

No. Stages 8, Bowls Diam. 17 in., Setting 450 ft.

Column Diam. in., Length Tailpipe ft.

8. Motor: Fuel Electric Make & Model HP. 300

9. Yield: Flow gpm, Pump 1300 gpm, Meas., (Rept.), Est. 5/16/55

10. Performance Test: Date Length of Test 24 Made by

Static Level ft. Pumping Level ft. Drawdown 62 ft.

Production 1300-2146 gpm Specific Capacity gpm/ft.

CASING & BLANK PIPE

Cemented From ft. to ft.

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 24 | | | |
| 18 | | | |
| 12 | | | |
| | | | |

11. Water Level: 338 ft. rept. meas. 5/16 1955 above below reported by driller which is ft. above below surface.

363.72 ft. rept. meas. 5/16 1963 above below (R-67 pumping which is ft. above below surface.

357 ft. rept. (meas.) 1961 above below by Layne-Texas which is ft. above below surface.

ft. rept. meas. 19 above below which is ft. above below surface.

12. Use: Dom., Stock, Public Supply, Ind., (Irr.), Waterflooding, Observation, Not Used,

13. Quality: (Remarks on taste, odor, color, etc.)

Temp. °F, Date sampled for analysis 4/3/75 Laboratory

Temp. °F, Date sampled for analysis Laboratory

Temp. °F, Date sampled for analysis Laboratory

WELL SCREEN

Screen Openings

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

14. Other data available as circled: Driller's Log, Radioactivity Log, (Electric Log),

Formation Samples, Pumping Test,

15. Record by: TWDB Date 2/21 1925

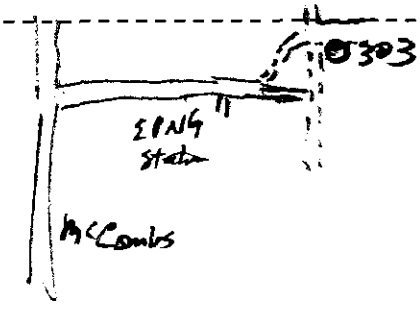
Source of Data USGS well sched (ERLeggat 3/4/57)

16. Remarks:

Cement plug 870-902

Base of fresh water 603

5/61 PL 387', SL 357' after 1hr (Layne-Texas)




(Sketch)

TWDBE-WD-2



49-05-303 ✓

# WELL DATA

WELL NUMBER 53

JL-49-05-303

## PUMP DATA

Make _____

Type _____

Stages _____

Tubing _____

Shaft _____

Column _____

Serial Number _____

Setting _____

O. D. Bowls _____

Capacity: GPM _____ / Feet Head _____

## MOTOR DATA

Make _____

Volts _____

Amps _____

Type _____

Motor H. P. _____

Speed _____

Cycles - Phase _____

Serial Number _____

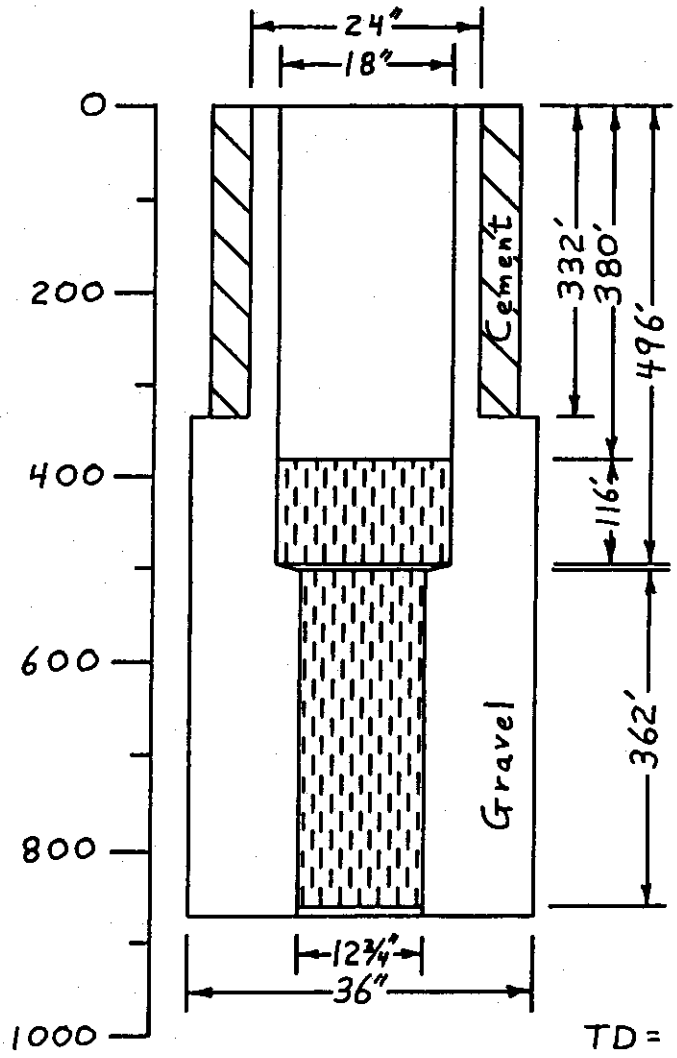
Date Installed _____

## SCALE

Vertical 1" = 200'

Horizontal 1" = 20"

## MATERIALS




Materials:

332' 24" OD 3/8" wall, 94.63 #/ft. casing with Baker float shoe

380' 18" OD 3/8" wall, 70.59 #/ft. blank liner

116' 18" OD 3/8" wall torch slot, galv. screen ¼" ga.

2' 18" OD x 12-¾" O.D. swage

362' 12-¾" OD 3/8" wall mill slot galv. screen

8' 12-¾" OD galvanized blank

2' 12-¾" OD pen pointed nipple, wood wash plug & back pressure valve

32' Cement plug

49 05 303



R.E.B. FORM 3002 0855

# Curtis Laboratories

W. W. CURTIS
ESTABLISHED 1926
ANALYTICAL AND CONSULTING CHEMISTS
PHONE OX. 4-6371
3922 MAIN STREET
HOUSTON 22, TEXAS

El Paso County
49-05-303

April 7, 1955.

Layne Texas Company
Dallas, Texas

2527-54.

SAMPLE OF: Water RECEIVED: April 5, 1955.
MARKED: Price Dairy, 20 miles north of El Paso, 2 miles west of Highway 54, Well No. 1, Sample No. 1, screen 442-443, static head 337, taken 4-2-55 after 10 hours pumping with air at 5 ..P.M. Albert Ehren.

CERTIFICATE OF ANALYSIS
Parts per Million:

| | |
|---|---|
| Calcium Bicarbonate | 77 |
| Magnesium Bicarbonate | 18 |
| Sodium Bicarbonate | 51 |
| Sodium Carbonate | 11 |
| Sodium Sulfate | 44 |
| Sodium Chloride | 106 |
| Silica | 18 |
| Iron Oxide | 0 |
| Aluminium Oxide | 3 |
| Volatile & Organic Matter | 26 |
| Total Solids | 354 |

RECEIVED
APR 16 '80
C R

| | |
|---|---|
| Total Hardness as Calcium Carbonate | 60 |
| Phenolphthalein Alkalinity | 5 |
| Methyl Orange Alkalinity | 100 |
| Free Carbon Dioxide | 0 |
| pH | 8.37 |

IONS:

| | | | |
|---|---|---|---|
| Calcium | 19 | Bicarbonate | 110 |
| Magnesium | 3 | Carbonate | 6 |
| Sodium (Diff.) | 75 | Sulfate | 30 |
| Iron (Fe) (Filt.) | 0.0 | Chloride | 64 |
| Iron (Fe) (Unfilt.) | 0.8 | | |

Appearance: Quite turbid (Whitish). Analysis on filtered water.

Respectfully submitted,

CURTIS LABORATORIES

W. W. Curtis

Report No. 9-1505.
Sent: Layne Texas Co., El Paso, Texas
Sent: Layne Texas Co., Houston, Texas

49-05-303

# Curtis Laboratories

W. W. CURTIS

ESTABLISHED 1926
ANALYTICAL AND CONSULTING CHEMISTS
PHONE OX. 4-6371
3922 HAIN STREET
HOUSTON 22, TEXAS


April 10, 1955.

Layne Texas Company
El Paso, Texas

2527-54.

SAMPLE OF: Water RECEIVED: April 8, 1955.
MARKED: Price's Dairy, 20 miles north of El Paso and 2 miles west of Highway 54, El Paso, Texas. Well No. 1, Sample No. 2, screen 602-622, static head 338, cone packer at 598, taken 4-6-55 after 8 hours pumping with air at 5 G.P.M. T. P. Bryant.

CERTIFICATE OF ANALYSIS
Parts per Million:

| | |
|---|---|
| Calcium Bicarbonate | 210 |
| Magnesium Bicarbonate | 72 |
| Sodium Bicarbonate | 92 |
| Sodium Carbonate | 42 |
| Sodium Sulfate | 186 |
| Sodium Chloride | 416 |
| Silica | 17 |
| Iron Oxide | 0.3 |
| Aluminium Oxide | 1.7 |
| Volatile & Organic Matter | 30. |
| Total Solids | 1067. |

| | |
|---|---|
| Total Hardness as Calcium Carbonate | 180 |
| Phenolphthalein Alkalinity | 20 |
| Methyl Orange Alkalinity | 274 |
| Free Carbon Dioxide | 0 |
| pH | 8.55 |

IONS:

| | | | |
|---|---|---|---|
| Calcium | 52 | Bicarbonate | 285 |
| Magnesium | 12 | Carbonate | 24 |
| Sodium (Diff.) | 267 | Sulfate | 126 |
| Iron (Fe) (Filt.) | 0.2 | Chloride | 252 |
| Iron (Fe) (Unfilt) | 1.8 | | |

Appearance: Quite turbid (light yellowish). Analysis on filtered water.

Respectfully submitted,

CURTIS LABORATORIES

C. W. Curtis

Report No. 9-1569.
Cc: Layne Texas Company, Dallas



49-05-303

# Curtis Laboratories

ESTABLISHED 1928
ANALYTICAL AND CONSULTING CHEMISTS
PHONE OX 4-6371
3922 HAIN STREET
HOUSTON 22, TEXAS

April 16, 1955.

Layne Texas Company
El Paso, Texas

2527-54.

SAMPLES OF: Two Waters RECEIVED: April 15, 1955.
MARKED: Price's Dairy, 20 miles North of El Paso, Texas and 2 miles West of Highway 54, Well No. 1.

## CERTIFICATE OF ANALYSIS
Parts per Million:

| Sample No. | #3 4-11-55 | #4 4-13-55 |
|---|---|---|
| Screen | 726-746 | 836-857 |
| Static head | 342 | 294 |
| Cone Packer set at | 724 | 834 |
| Pumped with air | 8 hrs. at 5 CFM | 5 hrs. at 12 PSI |
| Taken by | L. P. Bryant | Albert Caren |
| Calcium Bicarbonate | 124 | 154 |
| Calcium Carbonate | 10 | 10 |
| Calcium Sulfate | 105 | 121 |
| Calcium Chloride | 50 | 42 |
| Magnesium Chloride | 63 | 78 |
| Sodium Chloride | 826 | 1338 |
| Silica | 18 | 24 |
| Iron Oxide | 0.1 | 0.1 |
| Aluminium Oxide | 3.9 | 2.9 |
| Volatile & Organic Matter | 39. | 48. |
| Total Solids | 1239. | 1818. |
| Total Hardness as Calcium Carbonate | 276 | 315 |
| Phenolphthalein Alkalinity | 5 | 5 |
| Methyl Orange Alkalinity | 86 | 105 |
| Free Carbon Dioxide | 0 | 0 |
| pH | 7.90 | 8.10 |
| IONS: | | |
| Calcium | 84 | 93 |
| Magnesium | 16 | 20 |
| Sodium (Diff.) | 325 | 527 |
| Bicarbonate | 93 | 116 |
| Carbonate | 6 | 6 |
| Sulfate | 74 | 85 |
| Chloride | 580 | 896 |
| Iron (Fe) | 0.1 | 0.1 |

Appearance: Both samples quite turbid. Analyses on filtered water.

Respectfully submitted,

CURTIS LABORATORIES

C. C. Curtis

49-05-303

Report No. 2-1501.
Cc: Layne Texas Co., Houston

Curtis Laboratories
ESTABLISHED 1925
ANALYTICAL AND CONSULTING CHEMISTS
PHONE OX. 4-6371
3922 HAIN STREET
HOUSTON 22, TEXAS

W. W. CURTIS

April 18, 1955.

[illegible] Texas Company
El Paso, Texas

2527-5h.

[illegible]: Water RECEIVED: April 17, 1955.
[illegible]: Price's Dairy, 20 miles North of El Paso, Texas and 2 miles West of [illegible] Ch. Well No. 5, Sample No. 5, screen 900-922, static head 338, cone [illegible] at 927, taken 4-13-55 after 6 hours pumping with air at 20 C.P.M.
[illegible] Upper.

CHEMICAL OR ANALYSIS
Parts per Million:

| | |
|---|---|
| Calcium Bicarbonate | 105 |
| Calcium Carbonate | 10 |
| Calcium Sulfate | 247 |
| Calcium Chloride | 33 |
| Magnesium Chloride | 78 |
| Sodium Chloride | 1460 |
| Silica | 17 |
| Iron Oxide | 0.1 |
| Aluminum Oxide | 2.9 |
| Volatile & Organic matter | 44. |
| Total Solids | 1994. |

[illegible] Number as Calcium Carbonate — 366
[illegible] Phthalein Alkalinity — 5
[illegible] range Alkalinity — 75
[illegible] Dioxide — 0
[illegible] — 8.00

[illegible]:

| | | | |
|---|---|---|---|
| [illegible] | 113 | Bicarbonate | 79 |
| [illegible] | 19 | Carbonate | 6 |
| [illegible] (Na) — | 57 | Sulfate | 174 |
| Iron (Fe) (Diss.) — | 0.05 | Chloride | 960 |
| Iron (Fe) (Unfilt.) — | [illegible] | | |

[illegible]: Split Sample. Analysis on filtered water.

Respectfully submitted,

CURTIS LABORATORIES,

C. C. Curtis

[illegible] No. 8-1503.
[illegible]: Byron Harris Co., Houston
[illegible]: Byron Weber Co., Dallas

49-05-303

W. W. CURTIS

# Curtis Laboratories

ESTABLISHED 1924
ANALYTICAL AND CONSULTING CHEMISTS
PHONE OX. 4-6371
3922 HAIN STREET
HOUSTON 22, TEXAS

May 20, 1955.

ayne Texas Company
l Paso, Texas

2527-5h.

AMPLE OF: Four Waters RECEIVED: May 19, 1955.
ARKED: Price's Dairy, 20 miles N. E. of El Paso, Texas. Completed Well No. 1, erton 361-860, static head 336, Turbine Pump. Sample No. 2 taken by A. Ehren, ect by T. P. Bryant.

## CERTIFICATE OF ANALYSIS
Parts per Million:

| Sample Number | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Date Taken | 5-16 | 5-16 | 5-17 | 5-17 |
| Pumping Rate, G.P.M. | 1300 | 1650 | 1845 | 2146 |
| Pumping Hours | 6 hrs. | 6 hrs. | 6 hrs. | 5 hrs. |
| Pumping Level | 369 | 379 | 389 | 400 |
| Calcium Bicarbonate | 133 | 133 | 133 | 133 |
| Calcium Sulfate | 47 | 43 | 43 | 43 |
| Calcium Chloride | 3 | 8 | 11 | 11 |
| Magnesium Chloride | 39 | 39 | 39 | 39 |
| Sodium Chloride | 437 | 442 | 442 | 445 |
| Silica | 24 | 20 | 17 | 21 |
| Iron Oxide | 0.1 | 0.1 | 0.1 | 0.1 |
| Aluminum Oxide | 2.9 | 1.9 | 1.9 | 1.9 |
| Volatile & Organic Matter | 29 | 28 | 25 | 22 |
| Total Solids | 715 | 715 | 712 | 716 |
| Total Hardness as Calcium Carbonate | 161 | 164 | 166 | 166 |
| Phenolphthalein Alkalinity as $CaCO_3$ (to pH 8.3) | 0 | 0 | 0 | 0 |
| Methyl Orange Alkalinity | 82 | 82 | 82 | 82 |
| Free Carbon Dioxide | Trace | Trace | Trace | Trace |
| pH | 8.20 | 8.20 | 8.20 | 8.20 |
| ION: | | | | |
| Calcium | 48 | 49 | 50 | 50 |
| Magnesium | 10 | 10 | 10 | 10 |
| Sodium (Diff.) | 162 | 174 | 174 | 175 |
| Bicarbonate | 100 | 100 | 100 | 100 |
| Carbonate | 0 | 0 | 0 | 0 |
| Sulfate | 33 | 30 | 30 | 30 |
| Chloride | 305 | 302 | 304 | 305 |
| Iron (Fe) | 0.07 | 0.07 | 0.07 | 0.07 |
| Appearance: | Faintly Turbid | Clear & Colorless | Clear & Colorless | Clear & Colorless |

Respectfully submitted,

CURTIS LABORATORIES

W. W. Curtis

49-05-303

EL PASO WATER UTILITIES PUBLIC SERVICE BOARD

# WATER ANALYSIS DATA SHEET

JL-49-05-303

Plant Sample  Well Number #53  Location OLD PRICE #1 WELL

| SAMPLE NUMBER | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| DEPTH | | | | | | |
| SAMPLE COLLECTED | 6-2-82 | | | | | |
| RECEIVED AT LABORATORY | " | | | | | |
| ANALYSIS COMPLETED | 6-11-82 | | | | | |
| pH @ 26°C. | 7.85 | | | | | |
| E C L.I. | +0.01 | | | | | |
| $CaCO_3$ SATURATION INDEX A.I. | 12.1 | | | | | |
| SODIUM PER CENT OF TOTAL CATIONS | 66.3 | | | | | |

MILLIGRAMS PER LITER

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTAL DISSOLVED SOLIDS | 797 | | | | | |
| PHENOL ALKALINITY AS $Ca\ CO_3$ | -0- | | | | | |
| TOTAL ALKALINITY AS $Ca\ CO_3$ | 61 | | | | | |
| TOTAL HARDNESS AS $Ca\ CO_3$ | 224 | | | | | |
| CHLORIDES AS Cl | 417 | | | | | |
| SULFATES AS $SO_4$ | 20 | | | | | |
| FLUORIDES AS F | 0.31 | | | | | |
| SILICA AS $SiO_2$ | 34 | | | | | |
| NITRATE AS N | 5.1 | as $NO_3$ 22.6 | | | | |
| TOTAL PHOSPHATES AS P | 0.08 | as $PO_4$ 0.25 | | | | |
| CALCIUM AS Ca | 69 | | | | | |
| MAGNESIUM AS Mg | 13 | | | | | |
| SODIUM | 204 | | | | | |
| POTASSIUM | | | | | | |
| TOTAL IRON AS Fe | <0.05 | | | | | |
| MANGANESE AS Mn | <0.02 | | | | | |
| CHLORINE RESIDUAL | | | | | | |
| TURBIDITY, N.T.U. | 0.20 | | | | | |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| CHECKING CORRECTNESS OF ANALYSIS: | | | | | | |
| MEASURED DILUTED E. C. | 1625 | | | | | |
| CALCULATED DILUTED E. C. | 1646 | | | | | |
| % ERROR | +1.29 | | | | | |

Remarks: SAMPLE COLLECTED BY PENOYER.

EL PASO WATER UTILITIES PUBLIC SERVICE BOARD

# WATER ANALYSIS DATA SHEET 48-49-05-303

Plant Sample  Well Number 53 (P-1) Location

| SAMPLE NUMBER | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| DEPTH | | | | | | |
| SAMPLE COLLECTED | 10-16-81 | | | | | |
| RECEIVED AT LABORATORY | 10-16-81 | | | | | |
| ANALYSIS COMPLETED | 11-2-81 | | | | | |
| pH at 23°C | 7.87 | | | | | |
| XXX Aggressivity Index | 12.0 | | | | | |
| $CaCO_3$ SATURATION INDEX | +0.07 | | | | | |
| SODIUM PER CENT OF TOTAL CATIONS | 67.7 | | | | | |

MILLIGRAMS PER LITER

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTAL DISSOLVED SOLIDS | 981 | | | | | |
| PHENOL ALKALINITY AS $Ca\ CO_3$ | 0 | | | | | |
| TOTAL ALKALINITY AS $Ca\ CO_3$ | 62 | | | | | |
| TOTAL HARDNESS AS $Ca\ CO_3$ | 264 | | | | | |
| CHLORIDES AS Cl | 510 | | | | | |
| SULFATES AS $SO_4$ | 36 | | | | | |
| FLUORIDES AS F | 0.56 | | | | | |
| SILICA AS $SiO_2$ | 36 | | | | | |
| NITRATE AS N | 1.2 | as $NO_3$ 5.3 | | | | |
| TOTAL PHOSPHATES AS P | less than < 0.01 | as $PO_4$ < 0.03 | | | | |
| CALCIUM AS CA | 85 | | | | | |
| MAGNESIUM AS MG | 13 | | | | | |
| SODIUM | 256 | | | | | |
| POTASSIUM | ------- | | | | | |
| TOTAL IRON AS FE | less than < 0.05 | | | | | |
| MANGANESE AS MN | less than < 0.05 | | | | | |
| CHLORINE RESIDUAL | ------- | | | | | |
| TURBIDITY, N.T.U. | 0.11 | | | | | |
| | | | | | | |

| CHECKING CORRECTNESS OF ANALYSIS: | | | | | | |
|---|---|---|---|---|---|---|
| MEASURED DILUTED E. C. | 2030 | | | | | |
| CALCULATED DILUTED E. C. | 2024 | | | | | |
| % ERROR | -0.3 | | | | | |

Remarks: Sample taken by F. Brooks at 10:45 hours

48-05-303

Analyst



FORM 4548-8/80

EL PASO WATER WORKS PUBLIC SERVICE BOARD

# WATER ANALYSIS DATA SHEET

49-05-303

Plant Sample Well Number 53 Location

| SAMPLE NUMBER | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| DEPTH | | | | | | |
| SAMPLE COLLECTED | 6-4-80 | | | | | |
| RECEIVED AT LABORATORY | 6-5-80 | | | | | |
| ANALYSIS COMPLETED | 6-9-80 | | | | | |
| pH @ 29° | 8.14 | | | | | |
| E C | | | | | | |
| Ca $CO_3$ SATURATION INDEX | + 0.41 | | | | | |
| SODIUM PER CENT OF TOTAL CATIONS | 72.6% | | | | | |
| | MILLIGRAMS PER LITER | | | | | |
| TOTAL DISSOLVED SOLIDS | 793 | | | | | |
| PHENOL ALKALINITY AS Ca $CO_3$ | 0 | | | | | |
| TOTAL ALKALINITY AS Ca $CO_3$ | 65 | | | | | |
| TOTAL HARDNESS AS Ca $CO_3$ | 212 | | | | | |
| CHLORIDES AS Cl | 393 | | | | | |
| SULFATES AS $SO_4$ | 39 | | | | | |
| FLUORIDES AS F | 0.56 | | | | | |
| SILICA AS $SiO_2$ | 26 | | | | | |
| NITRATE AS N | 2.8 | 12.4 as $NO_3$ | | | | |
| TOTAL PHOSPHATES AS P | <0.01 | | | | | |
| CALCIUM AS Ca | 64 | | | | | |
| MAGNESIUM AS Mg | 13 | | | | | |
| SODIUM | 205 | | | | | |
| POTASSIUM | | | | | | |
| TOTAL IRON AS Fe | <0.1 | | | | | |
| MANGANESE AS Mn | <0.01 | | | | | |
| CHLORINE RESIDUAL | 0 | | | | | |
| TURBIDITY, N.T.U. | 0.09 | | | | | |
| | | | | | | |

| CHECKING CORRECTNESS OF ANALYSIS: | | | | | | |
|---|---|---|---|---|---|---|
| MEASURED DILUTED E. C. | 1650 | | | | | |
| CALCULATED DILUTED E. C. | 1610 | | | | | |
| % ERROR | 2.4% | | | | | |

Remarks: Sample Collected by F. Brooks.

49-05-303



Elizabeth G. Zufan
Analyst

FORM 4518 - 0879

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CENTRAL LABORATORY, SALT LAKE CITY, UTAH

WATER QUALITY ANALYSIS
LAB ID # 288167 RECORD # 9772

9-17-74

SAMPLE LOCATION: JL 49 ~~04~~ 05 303
STATION ID: 315832106234201 LAT.LONG.SEQ.: 315832 1062342 01
DATE OF COLLECTION: BEGIN--740917 END-- TIME--
COUNTY CODE: 141 PROJECT IDENTIFICATION: 01103
DATA TYPE: 2 SOURCE: GROUND WATER GEOLOGIC UNIT: 120BLSN
COMMENTS:
EL PASO CO OWNER PRICES DAIRY WELL NO 1 (R66) USE IRR SLOTTED 380-
850 COLL TOM CLIETT FIELD VALUE USED FOR PH BICARB CARBONATE & COND

| | | | | | |
|---|---|---|---|---|---|
| BICARBONATE | MG/L | 90 | NO2+NO3 AS N DISS | MG/L | 1.8 |
| CALCIUM DISS | MG/L | 91 | PH | | 7.6 |
| CARBONATE | MG/L | 0 | POTASSIUM DISS | MG/L | 9.5 |
| CHLORIDE DISS | MG/L | 500 | RESIDUE DIS CALC SUM | MG/L | 1040 |
| CONDUCTIVITY | | 2000 | RESIDUE DIS TON/AFT | | 1.41 |
| DEPTH(FT.FR.SURFACE) | | ~~870~~ | SAR | | 6.6 |
| FLUORIDE DISS | MG/L | 0.6 | SILICA DISSOLVED | MG/L | 33 |
| HARDNESS NONCARB | MG/L | 220 | SODIUM DISS | MG/L | 260 |
| HARDNESS TOTAL | MG/L | 300 | SODIUM PERCENT | | 65 |
| MAGNESIUM DISS | MG/L | 17 | SULFATE DISS | MG/L | 81 |

| CATIONS | (MG/L) | (MEQ/L) | ANIONS | (MG/L) | (MEQ/L) |
|---|---|---|---|---|---|
| CALCIUM DISS | 91 | 4.541 | BICARBONATE | 90 | 1.476 |
| MAGNESIUM DISS | 17 | 1.399 | CARBONATE | 0 | 0.000 |
| POTASSIUM DISS | 9.5 | 0.243 | CHLORIDE DISS | 500 | 14.105 |
| SODIUM DISS | 260 | 11.310 | FLUORIDE DISS | 0.6 | 0.032 |
| | | | SULFATE DISS | 81 | 1.687 |
| | | | NO2+NO3 AS N D | 1.8 | 0.129 |
| TOTAL | | 17.492 | TOTAL | | 17.427 |

PERCENT DIFFERENCE = 0.19

TL 49-05-303



49-05-303

JL-49-05-303

EL PASO WATER UTILITIES PUBLIC SERVICE BOARD

# WATER ANALYSIS DATA SHEET

Well Number: 53 Lab. Number: 16885-7 Location: EL PASO

| | |
|---|---|
| DATE SAMPLE COLLECTED | 6-17-85 |
| DATE RECEIVED AT LABORATORY | 6-17-85 |
| DATE ANALYSIS COMPLETED | 7-02-85 |

MILLIGRAMS PER LITER

| | |
|---|---|
| TOTAL DISSOLVED SOLIDS | 1049 |
| PHENOL ALKALINITY AS $Ca\ CO_3$ | 0 |
| TOTAL ALKALINITY AS $Ca\ CO_3$ | 59 |
| TOTAL HARDNESS AS $Ca\ CO_3$ | 283 |
| CHLORIDES AS Cl | 547 |
| SULFATES AS $SO_4$ | 38 |
| FLUORIDES AS F | .58 |
| SILICA AS $Si\ O_2$ | 30 |
| NITRATE AS $NO_3$ | 7.5 |
| TOTAL PHOSPHATES AS $PO_4$ | <0.03 |
| CALCIUM AS Ca | 84 |
| MAGNESIUM AS Mg | 17 |
| SODIUM AS Na | 274 |
| POTASSIUM AS K | 8.8 |

| | |
|---|---|
| CHLORINE RESIDUAL (Mg/l) | — |
| TURBIDITY (N.T.U.) | .14 |
| TEMPERATURE (°c) | 30.0 |
| pH | 7.94 |

ORGANICS BY G.C. (Mg/l)

| | |
|---|---|
| CHLOROFORM | |
| BROMODICHLOROMETHANE | |
| DIBROMOCHLOROMETHANE | |
| BROMOFORM | |
| TOTAL THM's | |
| LINDANE | |
| ENDRIN | |
| METHOXYCHLOR | |
| 2, 4 - D | |
| SILVEX | |
| TOXAPHENE | |

CHECKING CORRECTNESS OF ANALYSIS

| | |
|---|---|
| MEASURED DILUTED E.C. | 2210 |
| CALCULATED DILUTED E.C. | 2,171 |
| % ERROR | -1.74 |

| ELEMENT | SEWAGE LIMITS | POTABLE LIMITS | SAMPLE (Mg/l) |
|---|---|---|---|
| ARSENIC | 1.0 | 0.05 | |
| BARIUM | 5.0 | 1.0 | |
| CADMIUM | 0.05 | 0.010 | |
| CHROMIUM | 5.0 | 0.05 | |
| COPPER | 1.0 | 1.0 | |
| IRON | — | 0.30 | |
| LEAD | 1.0 | 0.05 | |
| MANGANESE | 5.0 | 0.05 | |
| MERCURY | 0.005 | 0.002 | |
| NICKEL | 5.0 | — | |
| SELENIUM | 0.02 | 0.01 | |
| SILVER | 0.10 | 0.05 | |
| ZINC | 5.0 | 5.0 | |

| | |
|---|---|
| LANGELIER INDEX | 0.2810 |
| AGGRESSIVITY INDEX | 12.1591 |
| % Na OF TOTAL CATIONS | 67 |
| TOTAL ORGANIC CARBONS (Mg/l) | |
| TOTAL INORGANIC CARBONS (Mg/l) | |
| TOTAL CARBONS (Mg/l) | |

ANION - CATION BALANCE

| ANIONS | Mg/l | Meg/l |
|---|---|---|
| PHENOL ALKALINITY | 0 | 0.0000 |
| TOTAL ALKALINITY | 59 | 1.1805 |
| CHLORIDES | 547 | 15.4254 |
| SULFATES | 38 | 0.7904 |
| FLUORIDES | .58 | 0.0305 |
| NITRATES | 7.5 | 0.1208 |
| PHOSPHATES | <0.03 | 0.0000 |
| | TOTAL | 17.5475 |
| CATIONS | Mg/l | Meg/l |
| CALCIUM | 84 | 4.1916 |
| MAGNESIUM | 17 | 1.3991 |
| SODIUM | 274 | 11.9190 |
| POTASSIUM | 8.8 | 0.2253 |
| | TOTAL | 17.7350 |

TOTAL ANIONS — TOTAL CATIONS = ± 0.1065 + 0.0155 (TOTAL ANIONS)

0.1875 = < ± ISD = 0.3785

Remarks: KEY PUNCHED

Analyst M. Sprute DDL

Geological Survey

128440

UNITED STATES DEPARTMENT OF THE INTERIOR
Ground Water Analysis

Water Resources Division
Austin, Texas

State: Texas 49 (Well No. R-66) County: El Paso

JL Well No. | Latitude 315832N | Longitude 1062342 | Seq. No. .1 | Date M 07 D 09 Y 70 | Sampling Depth | Type H

Local Well No JL-49-05-303 Location Near El Paso, north (Irrigation Well)

Owner: Prices Dairy Date drilled: 4/1955 Depth 1,012 WBF Prod. intervals Water level

Sampled after pumping Yield GPM Pt. of coll. Appearance Use Collector W.R.Meyer

42-05-303

K x $10^6$ R KCl 224 R sample 184 1220

Temperature °C 74

Density at 20°C | mg/l | me/l

$SiO_2$ ml A sample

Al ml A 0.00250 mg .00625 mg .0125 mg .025 mg Sample mg/l

Fe A 0.025 mg ml Sample Total mg/l ml Sample Diss. mg/l

Mn Total mg/l Dissolved mg/l

Ca 25 ml 53 2.64 (2.65)

Mg 9.5 / 9.4 94 9.4 .77

Na Na + K Calc.

K

Percent error Total cations

| | mg/l | me/l |
|---|---|---|
| $HCO_3$ 2.25 — 25 ml; Total Alk as $CO_3$ | 90 | 1.48 |
| $CO_3$ 25 ml | 0 | .00 |
| $SO_4$ 10 ml; Blk; Std; Sample 2.08 | 42 | .87 |
| Cl 10 ml; 6.20 | 310 | 8.75 |
| Source; Card No. Q | | |
| F ml; A 1.00 mg/l; 2.00 mg/l; A sample | | |
| $NO_3$ ml std.; A sample; A ml std; A ml std; Factor | | |
| $NO_2$ ml; A 0.01 mg; .02 mg; .05 mg; Sample | | |
| $PO_4$ ml Ortho Total; A 0.0050 mg; .0100 mg; .0250 mg; .0500 mg; Sample | | |
| Total anions | | |

Milliequivalents per liter

Na+K — Cl

Ca — $HCO_3+CO_3$

Mg — $SO_4$

a A mg; mg; mg; mg ml

Al Fe Mn

Cu Pb Zn

Dissolved solids: Determined Calculated

Hardness ml me/l Ca + Mg 7.41 me/l Alk 1.48 me/l NCH 1.93

Ca+Mg 170 NCH 6

Color Card No. R

Br I

Alk. as $CaCO_3$ Free $CO_2$

Percent Na SAR RSC 0.0

MEAS $NO_2$ Card No. S

Analyst ALVIN M. PICKARD Checked by MARILYN HARPER

Date begun Completed

| Transmittals | Date |
|---|---|
| Records processing---- | |
| Collector---------- | AUG 18 1970 |
| Owner---------- | |

AO R-66

Recorded by: Punched by: Date:

# Curtis Laboratories

ESTABLISHED 1928
ANALYTICAL AND CONSULTING CHEMISTS
PHONE OX. 4-6971
3922 HAIN STREET
HOUSTON 22, TEXAS

W. W. CURTIS


May 20, 1955.

ayne Texas Company
l Paso, Texas

2527-54.

AMPLES OF: Four Waters RECEIVED: May 19, 1955.
ARKED: Price's Dairy, 20 miles N. E. of El Paso, Texas. Completed Well No. 1, creen 381-860, static head 336, Turbine Pump. Sample No. 2 taken by A. Ehren, est by T. P. Bryant.

## CERTIFICATE OF ANALYSIS
### Parts per Million:

| Sample Number | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Date Taken | 5-16 | 5-16 | 5-17 | 5-17 |
| Pumping Rate, G.P.M. | 1300 | 1650 | 1845 | 2146 |
| Pumping Hours | 6 hrs. | 6 hrs. | 6 hrs. | 5 hrs. |
| Pumping Level | 369 | 379 | 389 | 400 |
| Calcium Bicarbonate | 133 | 133 | 133 | 133 |
| Calcium Sulfate | 47 | 43 | 43 | 43 |
| Calcium Chloride | 3 | 8 | 11 | 11 |
| Magnesium Chloride | 39 | 39 | 39 | 39 |
| Sodium Chloride | 437 | 442 | 442 | 445 |
| Silica | 24 | 20 | 17 | 21 |
| Iron Oxide | 0.1 | 0.1 | 0.1 | 0.1 |
| Aluminium Oxide | 2.9 | 1.9 | 1.9 | 1.9 |
| Volatile & Organic Matter | 29 | 28 | 25 | 22 |
| Total Solids | 715 | 715 | 712 | 716 |
| Total Hardness as Calcium Carbonate | 161 | 164 | 166 | 166 |
| Phenolphthalein Alkalinity as $CaCO_3$ (to pH 8.3) | 0 | 0 | 0 | 0 |
| Methyl Orange Alkalinity | 82 | 82 | 82 | 82 |
| Free Carbon Dioxide | Trace | Trace | Trace | Trace |
| pH | 8.20 | 8.20 | 8.20 | 8.20 |
| ION: | | | | |
| Calcium | 48 | 49 | 50 | 50 |
| Magnesium | 10 | 10 | 10 | 10 |
| Sodium (Diff.) | 162 | 174 | 174 | 175 |
| Bicarbonate | 100 | 100 | 100 | 100 |
| Carbonate | 0 | 0 | 0 | 0 |
| Sulfate | 33 | 30 | 30 | 30 |
| Chlorides | 306 | 302 | 304 | 306 |
| Iron (Fe) | 0.07 | 0.07 | 0.07 | 0.07 |
| Appearance: | Faintly Turbid | Clear & Colorless | Clear & Colorless | Clear & Colorless |

Respectfully submitted,

CURTIS LABORATORIES

W. W. Curtis

49-05-303

Curtis Laboratories

W. W. CURTIS

ESTABLISHED 1926
ANALYTICAL AND CONSULTING CHEMISTS
PHONE OX. 4-6371
3922 HAIN STREET
HOUSTON 22, TEXAS

April 18, 1955.

[illegible] Texas Company
[illegible] Paso, Texas

2527-5h.

[illegible]: Water RECEIVED: April 17, 1955.
[illegible]: Price's Dairy, 20 miles North of El Paso, Texas and 2 miles West of Highway 54. Well No. 4, Sample No. 5, screen 900-922, static head 338, cone setting at 997, taken 4-11-55 after 6 hours pumping with air at 20 G.P.M.
[illegible] report.

CERTIFICATE OF ANALYSIS
Parts per Million:

| | |
|---|---|
| Calcium Bicarbonate | 105 |
| Calcium Carbonate | 10 |
| Calcium Sulfate | 217 |
| Calcium Chloride | 33 |
| Magnesium Chloride | 78 |
| Sodium Chloride | 1460 |
| Silica | 17 |
| Iron Oxide | 0.1 |
| Aluminum Oxide | 2.9 |
| Volatile & Organic Matter | 45. |
| Total Solids | 1994. |

| | |
|---|---|
| [illegible] Hardness as Calcium Carbonate | 366 |
| [illegible] Calcium Alkalinity | 5 |
| [illegible] Range Alkalinity | 73 |
| [illegible] Sodium Bicarbonate | 0 |
| [illegible] p.H | 8.00 |

[illegible]:

| | | | |
|---|---|---|---|
| [illegible] Calcium | 115 | Bicarbonate | 79 |
| [illegible] Magnesium | 19 | Carbonate | 6 |
| [illegible] (D.C.) | 57 | Sulfate | 171 |
| Iron (Fe) (Wolt.) | 0.05 ✓ | Chloride | 960 |
| Iron (Fe) (Unfilt.) | [illegible] | | |

[illegible]: Solids Turbid. Analysis on filtered water.

Respectfully submitted,

CURTIS LABORATORIES,

W. W. Curtis

[illegible] No. 4-1503.
[illegible]: Texas Co., Houston
[illegible]: Texas Co., Dallas

49-05-303

# Curtis Laboratories

ESTABLISHED 1928

ANALYTICAL AND CONSULTING CHEMISTS

PHONE OX 4-6371

3922 HAIN STREET

HOUSTON 22, TEXAS


April 16, 1955.

Layne Texas Company
El Paso, Texas

2527-54.

SAMPLES OF: Two Waters RECEIVED: April 15, 1955.
MARKED: Price's Dairy, 20 miles North of El Paso, Texas and 2 miles West of Highway 54, Well No. 1.

CERTIFICATE OF ANALYSIS
Parts per Million:

| Sample No. | #3 4-11-55 | #4 4-13-55 |
|---|---|---|
| Screen | 726-746 | 836-857 |
| Static head | 342 | 294 |
| Cone Packer set at | 724 | 834 |
| Pumped with air | 8 hrs. at 5 CFM | 5 hrs. at 12 PSI |
| Taken by | L. P. Bryant | Albert Caren |
| Calcium Bicarbonate | 124 | 154 |
| Calcium Carbonate | 10 | 10 |
| Calcium Sulfate | 105 | 121 |
| Calcium Chloride | 50 | 42 |
| Magnesium Chloride | 63 | 78 |
| Sodium Chloride | 826 | 1338 |
| Silica | 18 | [illegible] |
| Iron Oxide | 0.1 | 0.1 |
| Aluminium Oxide | 3.9 | 2.9 |
| Volatile & Organic Matter | 39. | 48. |
| Total Solids | 1239. | 1818. |
| Total Hardness as Calcium Carbonate | 276 | 315 |
| Phenolphthalein Alkalinity | 5 | 5 |
| Methyl Orange Alkalinity | 86 | 105 |
| Free Carbon Dioxide | 0 | 0 |
| pH | 7.90 | 8.10 |
| IONS: | | |
| Calcium | 84 | 93 |
| Magnesium | 16 | 20 |
| Sodium (Diff.) | 325 | 527 |
| Bicarbonate | 93 | 116 |
| Carbonate | 6 | 6 |
| Sulfate | 74 | 85 |
| Chloride | 580 | 896 |
| Iron (Fe) | 0.1 | 0.1 |

Appearance: Both samples quite turbid. Analyses on filtered water.

Respectfully submitted,

CURTIS LABORATORIES

C. W. Curtis

Report No. 2-1571.
Log: Layne Texas Co., Houston
Loc: Layne Texas Co., [illegible]

49-05-303

# Curtis Laboratories

W. W. CURTIS

ESTABLISHED 1928
ANALYTICAL AND CONSULTING CHEMISTS
PHONE OX. 4-6371
3922 HAIN STREET
HOUSTON 22, TEXAS


April 10, 1955.

Layne Texas Company
El Paso, Texas

2527-54.

SAMPLE OF: Water RECEIVED: April 8, 1955.
MARKED: Price's Dairy, 20 miles north of El Paso and 2 miles west of highway 54, El Paso, Texas. Well No. 1, Sample No. 2, screen 602-622, static head 338, cone packer at 598, taken 4-6-55 after 8 hours pumping with air at 5 O.P.M. T. P. Bryant.

## CERTIFICATE OF ANALYSIS
Parts per Million:

| | |
|---|---|
| Calcium Bicarbonate | 210 |
| Magnesium Bicarbonate | 72 |
| Sodium Bicarbonate | 92 |
| Sodium Carbonate | 42 |
| Sodium Sulfate | 186 |
| Sodium Chloride | 416 |
| Silica | 17 |
| Iron Oxide | 0.3 |
| Aluminium Oxide | 1.7 |
| Volatile & Organic Matter | 30. |
| Total Solids | 1067. |

| | |
|---|---|
| Total Hardness as Calcium Carbonate | 180 |
| Phenolphthalein Alkalinity | 20 |
| Methyl Orange Alkalinity | 274 |
| Free Carbon Dioxide | 0 |
| pH | 8.55 |

IONS:

| | | | |
|---|---|---|---|
| Calcium | 52 | Bicarbonate | 285 |
| Magnesium | 12 | Carbonate | 24 |
| Sodium (Diff.) | 267 | Sulfate | 126 |
| Iron (Fe) (Filt.) | 0.2 | Chloride | 252 |
| Iron (Fe) (Unfilt) | 1.8 | | |

Appearance: Quite turbid (light yellowish). Analysis on filtered water.

Respectfully submitted,

CURTIS LABORATORIES

C. W. Curtis

Report No. 9-1509.
Rec: Layne Texas Company, Dallas

49 05-303

El Paso Office

# Curtis Laboratories

W. W. CURTIS

ESTABLISHED 1926
ANALYTICAL AND CONSULTING CHEMISTS
PHONE OX. 4-6371
3922 HAIN STREET
HOUSTON 22, TEXAS

April 7, 1955.

Layne Texas Company
Dallas, Texas

2527-54.

SAMPLE OF: Water RECEIVED: April 5, 1955.
MARKED: Price Dairy, 20 miles north of El Paso, 2 miles west of Highway 54, Well No. 1, Sample No. 1, screen 422-443, static head 337, taken 4-2-55 after 10 hours pumping with air at 5 .P.M. Albert Ehren.

CERTIFICATE OF ANALYSIS
Parts per Million:

| | |
|---|---|
| Calcium Bicarbonate | 77 |
| Magnesium Bicarbonate | 18 |
| Sodium Bicarbonate | 51 |
| Sodium Carbonate | 11 |
| Sodium Sulfate | 44 |
| Sodium Chloride | 106 |
| Silica | 18 |
| Iron Oxide | 0 |
| Aluminium Oxide | 3 |
| Volatile & Organic Matter | 26 |
| Total Solids | 354 |

| | |
|---|---|
| Total Hardness as Calcium Carbonate | 60 |
| Phenolphthalein Alkalinity | 5 |
| Methyl Orange Alkalinity | 100 |
| Free Carbon Dioxide | 0 |
| pH | 8.37 |

IONS:

| | | | |
|---|---|---|---|
| Calcium | 19 | Bicarbonate | 110 |
| Magnesium | 3 | Carbonate | 6 |
| Sodium (Diff.) | 75 | Sulfate | 30 |
| Iron (Fe) (Filt.) | 0.0 | Chloride | 64 |
| Iron (Fe) (Unfilt.) | 0.8 | | |

Appearance: Quite turbid (Whitish). Analysis on filtered water.

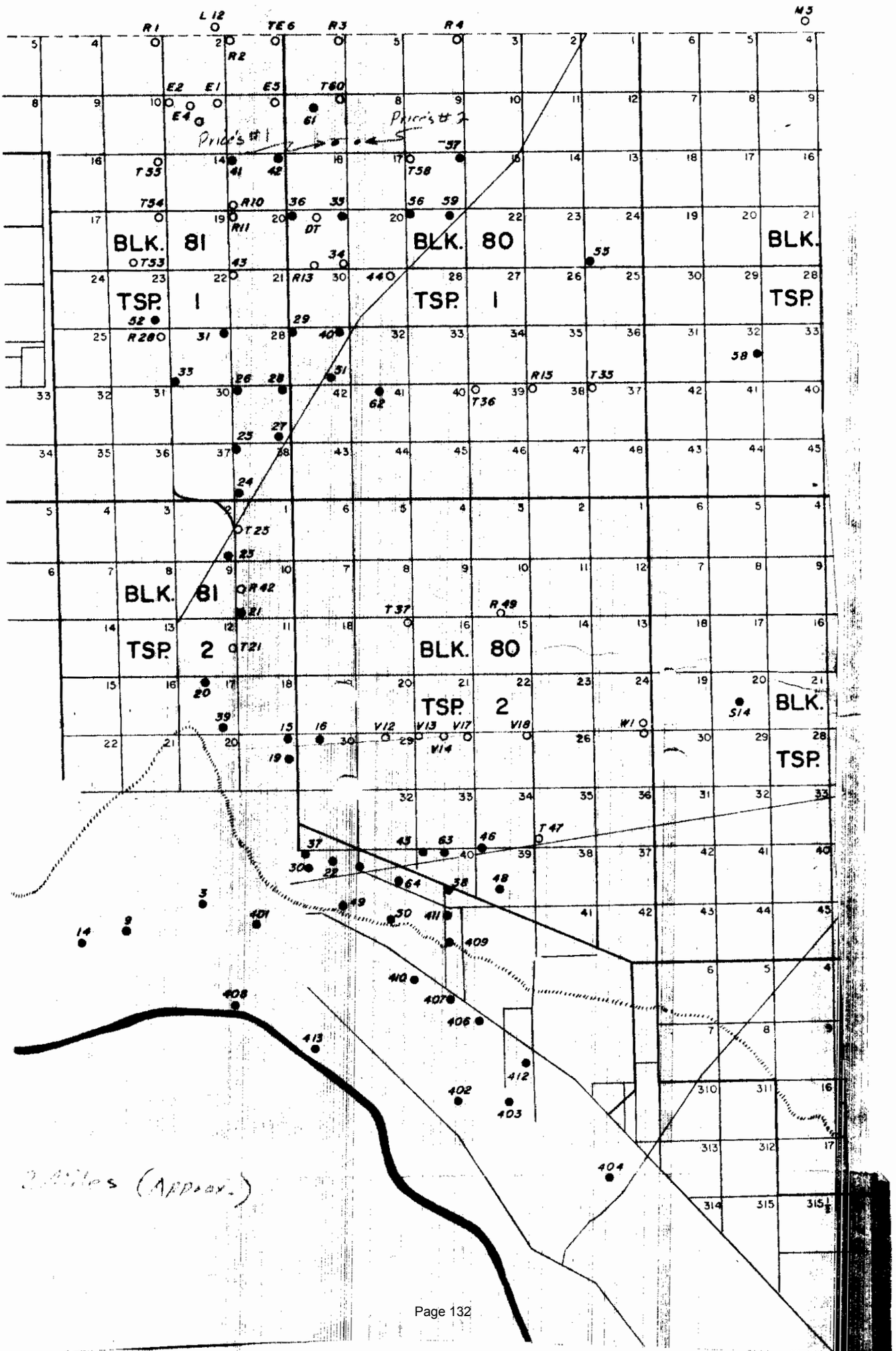
Respectfully submitted,

CURTIS LABORATORIES

W. W. Curtis

Report No. 9-1505.
Scc: Layne Texas Co., El Paso, Texas
Scc: Layne Texas Co., Houston, Texas

49-05-303


BLK. 81
TSP. 1
BLK. 80
TSP. 1
BLK.
TSP.
BLK. 81
TSP. 2
BLK. 80
TSP. 2
BLK.
TSP.
Price's #1
Price's #2
R1
L12
TE6
R3
R4
M3
R2
E2
E1
E5
T60
E4
61
T55
41
42
T58
T54
R10
36
35
56
59
R11
DT
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55
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R13
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52
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R28
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R15
T35
62
T36
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T25
23
R42
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T37
R49
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S14
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16
V12
V13
V17
V18
W1
V14
19
37
43
63
46
T47
30
22
64
38
48
3
49
401
411
14
9
409
410
408
407
406
413
412
402
403
404
2 Miles (Approx.)

JL-49-05-303

# EL PASO WATER UTILITIES
# WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| **DATE COLLECTED:** | **01/21/97** | **SAMPLE SOURCE:** | **Well 53** |
| **TIME COLLECTED:** | **15:37** | **LAB NUMBER:** | **C012297-1** |
| **DATE RECEIVED:** | **01/21/97** | **LOCATION:** | **Nevins** |
| **TIME RECEIVED:** | **08:00** | **OWNER:** | **EPWU** |
| **DATE ANALYZED:** | **01/22/97** | **COLLECTED BY:** | **R. Alvarez** |
| **DATE ANALYSIS COMPLETED:** | **02/05/97** | **DELIVERED BY:** | **R. Alvarez** |

| **ANIONS** | mg/l | me/l | Dil E.C. | | |
|---|---|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.0 | | | Silica, SiO2 = | 35.0 |
| Total Alkalinity as CaCO3 | 60.0 | | | Chlorine Res. = | N/A |
| Carbonates as CO3 | 0.0 | 0.0000 | 0 | Turbidity, NTU = | 0.13 |
| Bicarbonates as HCO3 | 73.2 | 1.2005 | 52 | Sample Temp (C) | 20.1 |
| Chlorides as Cl | 560.0 | 15.7956 | 1198 | pH @ | 7.99 |
| Sulfates as SO4 | 29.0 | 0.6032 | 45 | Lab E.C. @ 25 C | |
| Fluorides as F | 0.5 | 0.0277 | | as umhos/m = | 2000 |
| Nitrates as NO3 LOD= 0.1 | 5.5 | 0.0888 | 6 | Field E.C. @ 25 C | |
| Total Phosphates LOD= 0.09 | 0.0 | 0.0000 | | as umhos/cm = | N/A |
| **TOTAL ANIONS** | 668 | 17.7158 | 1302 | pH Saturation = | 7.81 |
| | | | | Langelier Index | 0.18 |
| | | | | Aggress. Index | 12.28 |
| **CATIONS** | | | | % Na of T. Cat. = | 61 |
| Total Hardness as CaCO3 | 326 | | | | |
| Calcium as Ca | 105.1 | 5.2550 | 273 | | |
| Magnesium Mg | 15.4 | 1.2623 | 59 | | |
| Sodium as Na | 254.0 | 11.0483 | 541 | | |
| Potassium as K | 8.9 | 0.2263 | 16 | | |
| **TOTAL CATIONS** | 383 | 17.7919 | 889 | | |

| | | | |
|---|---|---|---|
| **TDS BY EPWU METHOD (1)=** | 1052 | 35.5077 | 2191 |
| **TDS BY USGS METHOD (2)=** | 1049 | | |
| **TDS BY TDH METHOD (3)=** | 1014 | | |
| **TDS BY EVAPORATION (4)=** | 1353 | | |

**CHECKING CORRECTNESS OF ANALYSIS**

| | |
|---|---|
| Measured Diluted E.C. | 2200 |
| Calculated Diluted E.C. | 2191 |
| % Error | -0.40% |

**ANION - CATION BALANCE**

| | |
|---|---|
| Total Anions - Total Cations = | -0.0762 |
| + or - (0.1065 + 0.0155 * T. Anions) Maximum Limit +/- | 0.3811 |

1.- SUM OF IONS, NOT INCLUDING SILICA.
2.- SUM OF IONS WITH CONVERSION OF HCO3 TO CO3, PLUS SILICA.
3.- SUM OF IONS, NOT INCLUDING SILICA WITH CONVERSION OF HCO3 TO CO3.
4.-AT 180 DEGREES CELSIUS

SD = -0.19

Maria Molina
**Maria Molina, Chemist I**

Douglas Rittmann
**Douglas Rittmann, P.E.**
**Water Systems Div. Mgr.**

JL-49-05-303

# ANION-CATION BALANCE

SM 1030 F

*Standard Methods 19TH Edition*

CENTRAL LABORATORY

Sampling Location: Mesa-Nevins

Requested By: R. Sperka

Sample Identification: J121597-3
Project: Well Sample
Sampling Point: Well 53
Sampling Description: Grab

Date Collected: 12/11/97
Time Collected: 15:54
Date Reported: 01/07/98

| ANIONS | mg/L | me/L | Dil EC |
|---|---|---|---|
| p-Alkalinity (CaCO3) | 0.0 | | |
| t-Alkalinity (CaCO3) | 60 | | |
| Carbonate | 0 | 0.00 | 0.00 |
| Bicarbonate | 73 | 1.20 | 52.34 |
| Chloride | 749 | 21.13 | 1602.86 |
| Sulfate | 36.4 | 0.76 | 56.06 |
| Fluoride | 0.51 | 0.03 | |
| Nitrogen as NO3 | 13.2 | 0.21 | 15.18 |
| Total phosphorous as PO4 | 0.01 | 0.00 | |
| *TOTAL ANIONS* | 872.3 | 23.32 | 1726.43 |

| CATIONS | mg/L | me/L | Dil EC |
|---|---|---|---|
| Calcium | 135.5 | 6.78 | 352.30 |
| Magnesium | 18.8 | 1.54 | 71.82 |
| Sodium | 336 | 14.62 | 715.68 |
| Potassium | 10.7 | 0.27 | 19.69 |
| *TOTAL CATIONS* | 501.0 | 23.20 | 1159.48 |

| | | |
|---|---|---|
| Field pH | ND | |
| Field Temperature | ND | |
| Field EC | ND | |
| pH | 7.80 | |
| Temperature of analysis | 14.9 | |
| Chlorine Residual | NA | |
| pH Saturation | 7.83 | |
| Langlier Index | -0.03 | ***NON Scale Forming*** |
| TDS (EPWU method) | 1373 | anions+cations, excluding silica |
| TDS (USGS method) | 1364 | convert HCO3 to CO3, include silica |
| TDS (TDH method) | 1336 | convert HCO3 to CO3, exclude silica |
| TDS (measured @ 180C) | 1659 | |
| TDS (calculated-SM 1030F) | 1364 | SD=0.27 |
| Turbidity, NTU | 0.12 | |
| Silica | 28 | |
| %Na of Total Cations | 63.0% | |
| Hardness as CaCO3 (titrated) | 416.0 | |
| Hardness as CaCO3 (calc) | 416.2 | |
| EC (measured) | 2485 | |
| EC (calculated) | 2484 | |
| Diluted EC (measured) | 2900 | |
| Diluted EC (calculated) | 2886 | |

## CHECKING CORRECTNESS OF ANALYSIS

| | | | ACTION REQUIRED | LIMITS |
|---|---|---|---|---|
| *Anion/Cation balance (% diff)...* | -0.3% | *ACCEPTABLE* | *NONE* | +/-5.0% |
| *TDS Ratio.....* | 1.2 | *ACCEPTABLE* | *NONE* | 1.0-1.2 |
| *Conductivity ratio.....* | 1.0 | *ACCEPTABLE* | *NONE* | 0.9-1.1 |
| *Measured EC and anion sum.....* | 2332 | *ACCEPTABLE* | *NONE* | (0.9-1.1)EC |
| *Measured EC and cation sum....* | 2320 | *ACCEPTABLE* | *NONE* | (0.9-1.1)EC |
| *Calculated TDS to EC ratio.....* | 0.55 | *ACCEPTABLE* | *NONE* | 0.55-0.7 |
| *Measured TDS to EC ratio.....* | 0.67 | *ACCEPTABLE* | *NONE* | 0.55-0.7 |
| *Hardness relative % error.....* | 0.0% | *ACCEPTABLE* | *NONE* | +/-5.0% |
| *Diluted EC % difference*.....* | -0.5% | *ACCEPTABLE* | *NONE* | -2.0-1.5% |
| *Anions/Cations balance*.....* | 0.12 | *ACCEPTABLE* | *NONE* | 0.47 |

*Standard Methods 13th Edition

CHEMIST: Teresa Tafoya DATE: 1-14-98

QA/QC: Victoria Cobos DATE: 1-16-98

APPROVAL: RWA DATE: JAN 20 1998

JL-49-05-303

# ANION-CATION BALANCE

*SM 1030 F*

*Standard Methods 19TH Edition*

*CENTRAL LABORATORY*

Sampling Location: Mesa-Nevins

Requested By: R. Sperka

Sample Identification: J021198-6
Project: WS
Sampling Point: Well 53
Sampling Description: Grab

Date Collected: 02/10/98
Time Collected: 17:00
Date Reported: 02/24/98

| ANIONS | mg/L | me/L | Dil EC |
|---|---|---|---|
| p-Alkalinity (CaCO3) | 0.0 | | |
| t-Alkalinity (CaCO3) | 60 | | |
| Carbonate | 0 | 0.00 | 0.00 |
| Bicarbonate | 73 | 1.20 | 52.34 |
| Chloride | 513 | 14.47 | 1097.82 |
| Sulfate | 27.7 | 0.58 | 42.66 |
| Fluoride | 0.52 | 0.03 | |
| Nitrogen as NO3 | 9.3 | 0.15 | 10.70 |
| Total phosphorous as PO4 | 0.00 | 0.00 | |
| *TOTAL ANIONS* | 623.7 | 16.42 | 1203.51 |

| CATIONS | mg/L | me/L | Dil EC |
|---|---|---|---|
| Calcium | 97.0 | 4.85 | 252.20 |
| Magnesium | 13.2 | 1.08 | 50.42 |
| Sodium | 236 | 10.27 | 502.68 |
| Potassium | 8.9 | 0.23 | 16.30 |
| *TOTAL CATIONS* | 355.1 | 16.42 | 821.61 |

| | | |
|---|---|---|
| Field pH | ND | |
| Field Temperature | ND | |
| Field EC | ND | |
| pH | 7.93 | |
| Temperature of analysis | 18.6 | |
| Chlorine Residual | ND | |
| pH Saturation | 7.88 | |
| Langlier Index | 0.05 | ***Scale Forming*** |
| TDS (EPWU method) | 979 | anions+cations, excluding silica |
| TDS (USGS method) | 971 | convert HCO3 to CO3, include silica |
| TDS (TDH method) | 942 | convert HCO3 to CO3, exclude silica |
| TDS (measured @ 180C) | 1170 | |
| TDS (calculated-SM 1030F) | 971 | SD=0,01 |
| Turbidity, NTU | 0.09 | |
| Silica | 29 | |
| %Na of Total Cations | 62.5% | |
| Hardness as CaCO3 (titrated) | 297.0 | |
| Hardness as CaCO3 (calc) | 296.9 | |
| EC (measured) | 1740 | |
| EC (calculated) | 1797 | |
| Diluted EC (measured) | 2040 | |
| Diluted EC (calculated) | 2025 | |

## CHECKING CORRECTNESS OF ANALYSIS

| | | | ACTION REQUIRED | LIMITS |
|---|---|---|---|---|
| *Anion/Cation balance (% diff)...* | 0.0% | *ACCEPTABLE* | *NONE* | +/-5.0% |
| *TDS Ratio.....* | 1.2 | *ACCEPTABLE* | *NONE* | 1.0-1.2 |
| *Conductivity ratio.....* | 1.0 | *ACCEPTABLE* | *NONE* | 0.9-1.1 |
| *Measured EC and anion sum.....* | 1642 | *ACCEPTABLE* | *NONE* | (0.9-1.1)EC |
| *Measured EC and cation sum....* | 1642 | *ACCEPTABLE* | *NONE* | (0.9-1.1)EC |
| *Calculated TDS to EC ratio.....* | 0.56 | *ACCEPTABLE* | *NONE* | 0.55-0.7 |
| *Measured TDS to EC ratio.....* | 0.67 | *ACCEPTABLE* | *NONE* | 0.55-0.7 |
| *Hardness relative % error.....* | 0.0% | *ACCEPTABLE* | *NONE* | +/-5.0% |

CHEMIST: _____ DATE: 2-26-98

QA/QC: _____ DATE: 3-3-98

APPROVAL: _____ DATE: MAR 04 1998

JL-49-05-303

# ANION-CATION BALANCE

## SM 1030 F

*Standard Methods 19TH Edition*

## LABORATORY SERVICES - JR Laboratory

Sampling Location: Nevins

Requested By: T. T. Alcala, Chemist I

Sample Identification: J022299-11
Project: Well Sample
Sampling Point: Well 53
Sampling Description: Grab

Date Collected: 02/19/99
Time Collected: 18:45
Date Reported: 03/19/99

| ANIONS | mg/L | me/L | Dil EC |
|---|---|---|---|
| p-Alkalinity (CaCO3) | ND | | |
| t-Alkalinity (CaCO3) | 62 | | |
| Carbonate | ND | 0 | 0 |
| Bicarbonate | 75.64 ~~76~~ | 1.2464 | 54.34 |
| Chloride | 510 | 14.3852 | 1091.4 |
| Sulfate | 30 | 0.624 | 46.2 |
| Fluoride | 0.52 | 0.02737 | |
| Nitrogen as NO3 | 8.4 | 0.13548 | 9.66 |
| Total phosphorous as PO4 | 0.003 | 0.00009 | |
| *TOTAL ANIONS* | 624.9 | 16.4186 | 1201.6 |

| CATIONS | mg/L | me/L | Dil EC |
|---|---|---|---|
| Calcium | 96.2 | 4.81 | 250.12 |
| Magnesium | 14.5 | 1.18852 | 55.39 |
| Sodium | 232 | 10.0914 | 494.16 |
| Potassium | 8.85 | 0.22634 | 16.284 |
| Iron | <.05 | | |
| *TOTAL CATIONS* | 351.6 | 16.3162 | 815.954 |

| | | |
|---|---|---|
| Field pH | ND | |
| Field Temperature | ND | |
| Field EC | ND | |
| pH | 7.96 | |
| Temperature of analysis | 21.3 | |
| Chlorine Residual | ND | |
| pH Saturation | 7.81 | |
| Langlier Index | 0.15 | ***Scale Forming*** |
| TDS (EPWU method) | 980 | anions+cations, excluding silica |
| TDS (USGS method) | 960 | convert HCO3 to CO3, include silica |
| TDS (TDH method) | 940 | convert HCO3 to CO3, exclude silica |
| TDS (measured @ 180C) | 1190 | |
| TDS (calculated-SM 1030F) | 960 | SD= 0.29 |
| Turbidity, NTU | 0.122 | |
| Silica | 26 | |
| %Na of Total Cations | 61.8% | |
| Hardness as CaCO3 (titrated) | 300 | |
| Hardness as CaCO3 (calc) | 300 | |
| EC (measured) | 1700 | |
| EC (calculated) | 1800 | |
| Diluted EC (measured) | 2000 | |
| Diluted EC (calculated) | 2000 | |

## CHECKING CORRECTNESS OF ANALYSIS

| | | | ACTION REQUIRED | LIMITS |
|---|---|---|---|---|
| *Anion/Cation balance (% diff)...* | -0.3% | *ACCEPTABLE* | *NONE* | +/-5.0% |
| *TDS Ratio.....* | 1.2 | *ACCEPTABLE* | *NONE* | 1.0-1.2 |
| *Conductivity ratio.....* | 1.1 | *ACCEPTABLE* | *NONE* | 0.9-1.1 |
| *Measured EC and anion sum.....* | 1642 | *ACCEPTABLE* | *NONE* | (0.9-1.1)EC |
| *Measured EC and cation sum.....* | 1632 | *ACCEPTABLE* | *NONE* | (0.9-1.1)EC |
| *Calculated TDS to EC ratio.....* | 0.56 | *ACCEPTABLE* | *NONE* | 0.55-0.7 |
| *Measured TDS to EC ratio.....* | 0.70 | *ACCEPTABLE* | *NONE* | 0.55-0.7 |
| *Hardness relative % error.....* | 0.0% | *ACCEPTABLE* | *NONE* | +/-5.0% |

QA/QC: Teresita T. Alcala DATE: 031999

APPROVAL: Victoria Cabuyao DATE: 3/22/99

○ Maybe on tape ○ already on tape

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Hueco Bolson

Aquifer Sand & gravel 583-746 Field No. offset #47 State Well No. 49-05-304

Owner's Well No. #2 County El Paso

1. Location: 1/4, SW 1/4 Sec. 8, Block 80 Survey
31 58 31 N 106 23 17.1 1 mile NE of EPNG Station: 20 mi. NE of El Paso
2. Owner: Price's Dairy #2 Address:
Tenant: Address:
Driller: Layne-Texas Co Address:
3. Elevation of ~~3999 topo~~ is 4055 ft. above msl, determined by 7½ Topo
4. Drilled: ~~b~~ 1955; Dug, Cable Tool, Rotary,
5. Depth: Rept. 875 ft. Meas. ft.
6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed
7. Pump: Mfgr. Type turbine
No. Stages 8, Bowls Diam. 17 in., Setting ft.
Column Diam. in., Length Tailpipe ft.
8. Motor: Fuel Electric Make & Model HP. 300
9. Yield: Flow gpm, Pump 1200 gpm, Meas., Rept., Est. 7/1/55
10. Performance Test: Date Length of Test 24 Made by
Static Level ft. Pumping Level ft. Drawdown 61 ft.
Production 1350-2146 gpm Specific Capacity gpm/ft.

CASING & BLANK PIPE
Cemented From ft. to ft.

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 24 | | | |
| 18 | | | |
| 12 | | | |
| | | | |

11. Water Level: 338 ft. rept. meas. 7/15 1955 above below Reptd which is ft. above below surface.
ft. rept. meas. 19 above below which is ft. above below surface.
ft. rept. meas. 19 above below which is ft. above below surface.
ft. rept. meas. 19 above below which is ft. above below surface.
12. Use: Dom., Stock, Public Supply, Ind., (Irr.), Waterflooding, Observation, Not Used,
13. (Quality) (Remarks on taste, odor, color, etc.)
Temp. 79 °F, Date sampled for analysis 8/3/66 Laboratory Curtis
Temp. °F, Date sampled for analysis Laboratory
Temp. °F, Date sampled for analysis Laboratory
14. Other data available as circled: Driller's Log, Radioactivity Log, (Electric Log),
Formation Samples, Pumping Test,
15. Record by: TWDB Date 2/21 1975
Source of Data USGS well sched (ER Leggat 3/4/57)
16. Remarks:
Cement plug 753-850' Base of fresh water: 570'

WELL SCREEN
Screen Openings

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| | Slotted | | |
| | | | |
| | | | |
| | | | |



49-05-304

# WELL DATA

WELL NUMBER P2 (54)

JL-49-05-304

## PUMP DATA

Make _____

Type _____

Stages _____

Tubing _____

Shaft _____

Column _____

Serial Number _____

Setting _____

O. D. Bowls _____

Capacity: GPM _____ / Feet Head _____

## MOTOR DATA

Make _____

Volts _____

Amps _____

Type _____

Motor H.P. _____

Speed _____

Cycles - Phase _____

Serial Number _____

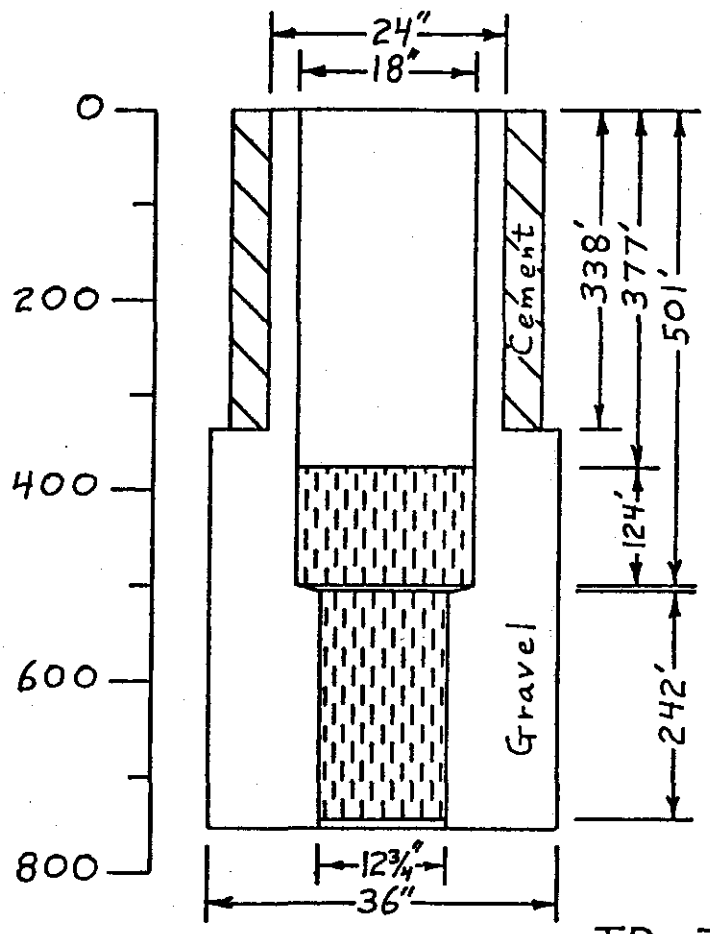
Date Installed _____

## SCALE

Vertical 1" = 200'

Horizontal 1" = 20"

## MATERIALS




TD = 753'

Materials:

339' 24" OD surface casing, 94.62 #/ft with Layne Texas float shoe on bottom

377' 18" OD blank 3/8" wall liner 70.59 #/ft

124' 18" OD galvanized torch slotted screen

3' 18" OD x 12-¾" OD swage

242' 12-¾" OD mill slotted screen

4.5' 12-¾" OD blank galv. pipe 49.56 #/ft

2.5' 12-¾" OD pen pointed nipple with B.P. valve and W.W. plug

~47' Cement plug



49 05 304

49-05-304

UNITED STATES DEPARTMENT OF THE INTERIOR
Geological Survey — Ground Water Analysis — Water Resources Division, Austin

Texas 49 | County: El Paso | JL | Well No. 3158311N | Latitude | Longitude 1062312 | Seq. No. 1 | Date M D Y 08 05 66 | Sampling Depth | Type C

Well No. R-67 Owner #2 | Location 1 mi. NE of El Paso Gas Pumping Station | Resample

Price's Dairy-El Paso | Date drilled: 6/55 | Depth: 875 | WBP Bolson Deposits | Prod. intervals 503-746 | Water level stat. 360 blw LSD

Flow after pumping Indefinite | Yield 3300 meas. | Pt. of coll. discharge pipe | Appearance clear | Use stock, irr. | Collector M.E. Davis

49-05-304

R KCl .357 | R sample 174 | 1160

pH 7.2 | Temperature °F 79

| | ml | ppm | epm |
|---|---|---|---|
| Conductivity at 20°C | | | |
| $O_2$ A sample 1154 | 5 ml | 3.0 | |
| A 0.00250 mg | ml | ppm | |
| .00625 mg | | | |
| .0125 mg | | | |
| .025 mg | | | |
| Sample | | | |
| A 0.025 mg | | | |
| 25 ml 0.000 Sample Total | | 0.00 ppm | |
| 25 ml 0.000 Sample Dis. | | 0.00 ppm | |
| 1.3 Total | | 0.01 ppm | |
| 2.04 Dissolved | | 2.1 ppm | |
| | ml | 168 | 3.37 |
| 68.2 | | | |
| epm Ca + Mg | | 116 | 1.32 |
| epm Ca | | | |
| epm Mg | | 16.00 | |
| 1→10 | | 2714 | 11.72 |
| Na + K Calc. | | | |
| 22.43 | | | |
| | | 718 | 2.01 |
| 2.75 | | | |

| | ml | ppm | epm |
|---|---|---|---|
| $HCO_3$ | 50 ml 3.95 N | 771 | 1.26 |
| Total Alk as $CO_3$ 38 | | | |
| $CO_3$ | 50 ml | 0 | 0.00 |
| $SO_4$ | 10 ml | 129 | |
| Blk | | | |
| Std | | | |
| Sample 1.47 | | | |
| Cl | 10 ml | 5217 | 15.0 |
| 10.65 | | | |
| Source 79 | Card No. 80 Q | | |
| F | 10 ml | 0.7 | |
| A 1.00 ppm | | | |
| 2.00 ppm | | | |
| A sample 1.198 | | | |
| $NO_3$ | 0.90 ml std. 10 ml | 45 | |
| A sample | | | |
| A ml std 5.1 ml | | | |
| A ml std Factor | | | |
| $NO_2$ | ml | ppm | |
| A 0.01 mg | | | |
| .02 mg | | | |
| .05 mg | | | |
| Sample | | | |
| $PO_4$ ml Ortho Total | | | |
| A 0.0050 mg | | | |
| .0100 mg | | | |
| .0250 mg | | | |
| .0500 mg | | | |
| Sample | | | |
| 21.96 Total anions | | | |

Equivalents per million

Na+K — Cl
Ca — $HCO_3+CO_3$
Mg — $SO_4$

B A 5 ml 0.06 | mg | mg | mg | Sample mg 0.12 0.00301

| | | | |
|---|---|---|---|
| Al | Fe | Mn | |
| Cu | Pb | Zn | |

Dissolved solids: Determined | Calculated 1010

Hardness ml | epm Ca + Mg 1.32 | epm Alk 1.26 | epm NCH 2.50 | Ca+Mg 1238 | NCH 1175

Color 0 | Card No. Q

Br | I

Alk. as $CaCO_3$ | Free $CO_2$

Percent Na 71 | SAR 7.7 | RSC 0.00

MEAS | $NO_2$ | Card No. S

Analyst HELEN CONNELL | Checked by C.C.K.

Date begun AUG 2 4 1966 | Completed AUG 31 1966

| Transmittals | Date |
|---|---|
| Records processing | |
| Collector | SEP 22 |
| Owner | |

1.20

R-67

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Geological Survey El Paso Cont. Program (R-67)

UNITED STATES DEPARTMENT OF THE INTERIOR
Ground Water Analysis

Water Resources Division
Austin, Texas

State: Texas 49 County: El Paso Well No. JL 315831N Latitude 1058231 Longitude 106231 2 Seq. No. .1 Date M D Y 07 09 70 Sampling Depth Type C

49-05-304

Local Well No. JL-49-05-304 Location Near El Paso (Irrigation Well)

Owner: Prices Dairy Date drilled: June 1955 Depth: 875 WRF 128441 Prod. intervals Water level

Sampled after pumping Yield GPM Pt. of coll. Appearance Use Collector W. R. Meyer

K x $10^6$ R KCl 223 R sample 120 1860

Temperature °C 75

Density at 20°C

| | ml | mg/l | me/l |
|---|---|---|---|
| $SiO_2$ | 5 ml, A sample 1.124 O.D. F=26 | 31 | |
| Al | A 0.00250 mg; .00625 mg; .0125 mg; .025 mg; Sample | | |
| Fe | A 0.025 mg .506; 25 ml .000 Sample Diss. .00 mg/l | Total mg/l | |
| Mn | | Dissolved mg/l | |
| Ca | 25 ml | 180 | 3.99 |
| Na | 13.7 / 13.6 / 13.6 | 14 | 1.15 |
| Na | 10→200 | 262 | 11.40 |
| Na + K Calc. | 13.0 / 13.1 | | |
| K | 3.0 / 3.5 / 3.51 × 1.100 = 3.9 | 78 | .20 |
| Percent error +.1 | Total cations | | 16.74 |

| | ml | mg/l | me/l |
|---|---|---|---|
| $HCO_3$ | 25 ml, 2.00 | 80 | |
| Total Alk as $CO_3$ | 39 | | 1.31 |
| $CO_3$ | 25 ml | 0 | .00 |
| $SO_4$ | 10 ml, Blk, Std, Sample 1.59 | 32 | .67 |
| Cl | 10 ml, 10.35 | 518 | 14.61 |
| Source 79 | Card No. 80 Q | | |
| F | 10 ml, A 1.00 mg/l, 2.00 mg/l, A sample .61 mg/l | 6 | .03 |
| $NO_3$ | Brucine ml std. 5 ml, A sample 1.12 mg/l N O.D. = .501, A ml std, A ml std, Factor 4.4267 | 49 | .08 |
| $NO_2$ | ml mg/l, A 0.01 mg, .02 mg, .05 mg, Sample | | |
| $PO_4$ | ml Ortho Total, A 0.0050 mg, .0100 mg, .0250 mg, .0500 mg, Sample | | |
| Total anions | | | 16.70 |

Milliequivalents per liter

Na+K — Cl

Ca — $HCO_3+CO_3$

Mg — $SO_4$

B A .229 mg .0010; .562 mg .0025; 1.093 mg .0050; .079 mg — 5 ml 200 × .00035 — 07

Al Fe Mn

Cu Pb Zn

Dissolved solids: Determined Calculated 989

Hardness ml Ca+Mg 257

me/l Ca + Mg

me/l Alk 1.31

me/l NCH 3.93 NCH 1942

Color 0 Card No. FR

Br I

Alk. as $CaCO_3$ Free $CO_2$

Percent Na .68 SAR 71 RSC 06

MBAS $NO_2$ Card No. S

Analyst ALVIN M. PICKARD Checked by

Date begun JUL 24 1970 Completed JUL 29 1970

| Transmittals | Date |
|---|---|
| Records processing | |
| Collector | AUG 19 70 |
| Owner | |

1.00 / 33.44 = .04 Vino

R-67

Recorded by: Punched by: Date:

Curtis Laboratories
ESTABLISHED 1926
ANALYTICAL AND CONSULTING CHEMISTS
PHONE CA. 4-6371
3922 MAIN STREET
HOUSTON 22, TEXAS

E. W. CURTIS

El Paso County
49-05-304

June 11, 1955.

Coyne Texas Company
El Paso, Texas

2533-55.

SAMPLE OF: Water RECEIVED: June 10, 1955.
MARKED: Prices Dairy, 20 miles north of El Paso, Texas (near Newman) Well No. 2, Sample #1, screen 540-560, static head 334, cone packer at 535. Taken 6-?-55 after 5 hours pumping with air at 25 .P.A. E. L. Bryson.

CERTIFICATE OF ANALYSIS
Parts per Million:

| | |
|---|---|
| Calcium Bicarbonate | 117 |
| Calcium Carbonate | 10 |
| Calcium Sulfate | 14 |
| Magnesium Sulfate | 13 |
| Magnesium Chloride | 12 |
| Sodium Chloride | 368 |
| Silica | 22 |
| Iron Oxide | 0.3 |
| Aluminium Oxide | 3.? |
| Volatile & Organic Matter | 21 |

Total Dissolved Solids-580.

| | |
|---|---|
| Total Hardness as Calcium Carbonate | 117 |
| Phenolphthalein Alkalinity as Calcium Carbonate (to pH 8.3) | 5 |
| Methyl Orange Alkalinity as Calcium Carbonate | 82 |
| Free Carbon Dioxide | 0 |
| pH | 8.50 |

IONS:

| | | | |
|---|---|---|---|
| Calcium | 37 | Bicarbonate | 88 |
| Magnesium | 6 | Carbonate | 6 |
| Sodium (Calc.) | 145 | Sulfate | 20 |
| Iron (Fe) | 0.2 | Chloride | 232 |

Appearance: Faintly turbid.

Respectfully submitted,

CURTIS LABORATORIES

E. W. Curtis

RECEIVED
APR 16 '80

Report No. 2-1630.

49-05-304

HOUSTON 22, TEXAS

July 6, 1955.

Layne Texas Company
El Paso, Texas

2533-S.

SAMPLE OF: Water RECEIVED: July 5, 1955.
MARKED: Price's Dairy, Newman Ranch 20 miles N. E. of El Paso, El Paso County, Texas. Well No. 2, Completed. Screen 377-845, static head 336, pumping level 399. Taken 7-2-55 after 24 hours pumping at 2160 G.P.M. with Test Pump. Clear and no sand. T. P. Bryant.

CERTIFICATE OF ANALYSIS
Parts per Million:

| | |
|---|---|
| Calcium Bicarbonate | 130 |
| Calcium Sulfate | 30 |
| Calcium Chloride | 28 |
| Magnesium Chloride | 31 |
| Sodium Chloride | 520 |
| Silica | 14 |
| Iron Oxide | 0.1 |
| Aluminium Oxide | 1.9 |
| Volatile & Organic Matter | 27. |
| Total Dissolved Solids | 782. |
| Residue on Evaporation at 105°C. | 730 |
| ½ Bicarbonate | 49 |
| Estimated Total Solids | 779 |

| | |
|---|---|
| Total Hardness as Calcium Carbonate | 160 |
| Phenolphthalein Alkalinity as Calcium Carbonate (to pH 8.3) | 0 |
| Methyl Orange Alkalinity as Calcium Carbonate | 80 |
| Free Carbon Dioxide | 2 |
| pH | 8.00 |

IONS:

| | | | |
|---|---|---|---|
| Calcium | 51 | Bicarbonate | 98 |
| Magnesium | 8 | Carbonate | 0 |
| Sodium (Calc.) | 205 | Sulfate | 21 |
| Iron (Fe) | 0.05 | Chloride | 356 |

Appearance: Clear and colorless with slight trace white sediment.

Respectfully submitted,

CURTIS LABORATORIES

C. C. Curtis

Report No. 9-1663.
Sec: Layne Texas Co., Dallas
Loc: Layne Texas Co., Houston

49-05-304



LAYNE TEXAS CO.

Typewrite (Black ribbon) or Print Plainly
(soft pencil or black ink)
Do not use ball point pen

Texas Department of Health Laboratories
1100 West 49th Street
Austin, Texas 78756

TDWR ONLY
Organization No. _____ Lab No. 02
Work No. _____

# CHEMICAL WATER ANALYSIS REPORT

County 071
State Well No. 49-05-304
_____ Well No. _____
Date Collected 08-05-66

Send report to:

Data Collection and Evaluation Section
Texas Department of Water Resources
P.O. Box 13087
Austin, Texas 78711

Owner _____ Send copy to owner Sample No. _____ By _____
Address _____ Well Location _____
Date Drilled _____ Depth _____ ft. WBF _____ Source (type of well) _____
Producing intervals _____ Water level _____ ft. Sample depth _____ ft.
Sampled after pumping _____ hrs. Yield _____ GPM meas. est. Temperature _____ °F _____ °C
Point of collection _____ Appearance ☐ clear ☐ turbid ☐ colored ☐ other
Use _____ Remarks _____

(FOR LABORATORY USE ONLY)

## CHEMICAL ANALYSIS

Laboratory No. _____ Date Received _____ KEY PUNCHED Date Reported _____

| | | MG/L | ME/L |
|---|---|---|---|
| Silica | 00955 | 30 | |
| Calcium | 00910 | 68 | |
| Magnesium | 00920 | 16 | |
| Sodium | 00929 | 274 | |
| | Total | | |
| ☒ Potassium | 00937 | 7.8 | |
| [3] ☐ Manganese | 01055 | . | %Na _____ |
| ☒ Boron | 01022 | .06 | SAR _____ |
| [3] ☒ Total Iron | 01045 | .00 | RSC _____ |
| ☐ (other) _____ | | MG/L | |

| | | MG/L | ME/L |
|---|---|---|---|
| Carbonate | 00445 | 0 | |
| Bicarbonate | 00440 | 77 | |
| Sulfate | 00945 | 29 | |
| Chloride | 00940 | 532 | |
| Fluoride | 00951 | .7 | |
| Nitrate | 71850 | 4.50 | |
| pH | 00403 | 7.2 | Total |
| [1] Dissolved Solids (residue at 180°C) | 70300 | 1000 | |
| Phenolphthalein Alkalinity as $CaCO_3$ | 00415 | | |
| Total Alkalinity as $CaCO_3$ | 00410 | | |
| Total Hardness as $CaCO_3$ | 00900 | 238 | |
| [2] Nitrogen Cycle | | | |
| Ammonia - N | 00610 | | |
| Nitrite - N | 00615 | | |
| Nitrate - N | 00620 | | |
| Organic Nitrogen | 00605 | | |

Specific Conductance (micromhos/cm³) 00095 _____
Diluted Conductance (micromhos/cm³): _____ x _____ = 1940

" ☐ " items will be analyzed if checked.

[1] The bicarbonate reported in this analysis can be converted by computation (multiplying by 0.4917) to an equivalent amount of carbonate, and the carbonate figure used in the computation of dissolved solids.
[2] Nitrogen cycle requires separate sample.
[3] Total Iron and Manganese require separate sample.



TDWR-0148 (Rev. 9-26-83)

Analyst _____ Checked By _____

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CENTRAL LABORATORY, SALT LAKE CITY, UTAH

WATER QUALITY ANALYSIS
LAB ID # 288164 RECORD # 9766

9-17-77

SAMPLE LOCATION: JL 49 05 304
STATION ID: 315831106231201 LAT.LONG.SEQ.: 315831 1062312 01
DATE OF COLLECTION: BEGIN--740917 END-- TIME--
COUNTY CODE: 141 PROJECT IDENTIFICATION: 01103
DATA TYPE: 2 SOURCE: GROUND WATER GEOLOGIC UNIT: 120BLSN
COMMENTS:
EL PASO CO OWNER PRICES DAIRY WELL NO 2 (R67) USE IRR SLOTTED
377 746 COLL TOM CLIETT FIELD VALUE USED FOR PH BICARB CARBONATE
AND CONDUCTIVITY

| | | | | | |
|---|---|---|---|---|---|
| BICARBONATE | MG/L | 80 | NO2+NO3 AS N DISS | MG/L | 1.2 |
| CALCIUM DISS | MG/L | 81 | PH | | 7.7 |
| CARBONATE | MG/L | 0 | POTASSIUM DISS | MG/L | 9.3 |
| CHLORIDE DISS | MG/L | 580 | RESIDUE DIS CALC SUM | MG/L | 1100 |
| CONDUCTIVITY | | 2000 | RESIDUE DIS TON/AFT | | 1.50 |
| DEPTH(FT.FR.SURFACE) | | 875 | SAR | | 8.0 |
| FLUORIDE DISS | MG/L | 0.6 | SILICA DISSOLVED | MG/L | 34 |
| HARDNESS NONCARB | MG/L | 200 | SODIUM DISS | MG/L | 300 |
| HARDNESS TOTAL | MG/L | 270 | SODIUM PERCENT | | 70 |
| MAGNESIUM DISS | MG/L | 16 | SULFATE DISS | MG/L | 32 |

| CATIONS | (MG/L) | (MEQ/L) | ANIONS | (MG/L) | (MEQ/L) |
|---|---|---|---|---|---|
| CALCIUM DISS | 81 | 4.042 | BICARBONATE | 80 | 1.312 |
| MAGNESIUM DISS | 16 | 1.317 | CARBONATE | 0 | 0.000 |
| POTASSIUM DISS | 9.3 | 0.238 | CHLORIDE DISS | 580 | 16.362 |
| SODIUM DISS | 300 | 13.050 | FLUORIDE DISS | 0.6 | 0.032 |
| | | | SULFATE DISS | 32 | 0.667 |
| | | | NO2+NO3 AS N D | 1.2 | 0.086 |
| TOTAL | | 18.646 | TOTAL | | 18.456 |

PERCENT DIFFERENCE = 0.51



49-05-304

Typewrite (Black ribbon) or Print Plainly
(soft pencil or black ink)
Do not use ball point pen

Texas Department of Health Laboratories
1100 West 49th Street
Austin, Texas 78756

TDWR ONLY
Organization No. _____ Lab No. 02
Work No. _____

# CHEMICAL WATER ANALYSIS REPORT

County 071
State Well No. 49-05-304
Well No. _____
Date Collected 09-17-77

Send report to:

Data Collection and Evaluation Section
Texas Department of Water Resources
P.O. Box 13087
Austin, Texas 78711

Owner _____ ☐ Send copy to owner Sample No. ☐ By _____
Address _____ Well Location _____
Date Drilled _____ Depth _____ ft. WBF _____ Source (type of well) _____
Producing intervals _____ Water level _____ ft. Sample depth _____ ft.
Sampled after pumping _____ hrs. Yield _____ GPM meas. est. Temperature _____ °F _____ °C
Point of collection _____ Appearance ☐ clear ☐ turbid ☐ colored ☐ other
Use _____ Remarks _____

(FOR LABORATORY USE ONLY)

## CHEMICAL ANALYSIS

KEY PUNCHED

Laboratory No. _____ Date Received _____ Date Reported _____

| | | MG/L | ME/L |
|---|---|---|---|
| Silica | 00955 | 34 | |
| Calcium | 00910 | 81 | |
| Magnesium | 00920 | 16 | |
| Sodium | 00929 | 300 | |
| | Total | | |
| ☐ Potassium | 00937 | 9.3 | |
| [3] ☐ Manganese | 01055 | . | %Na _____ |
| ☐ Boron | 01022 | . | SAR _____ |
| [3] ☐ Total Iron | 01045 | . | RSC _____ |
| ☐ (other) _____ | | MG/L | |

Specific Conductance (micromhos/cm3) 00095 _____
Diluted Conductance (micromhos/cm3): _____ x = 2000

" ☐ " items will be analyzed if checked.

| | | MG/L | ME/L |
|---|---|---|---|
| Carbonate | 00445 | 0 | |
| Bicarbonate | 00440 | 80 | |
| Sulfate | 00945 | 32 | |
| Chloride | 00940 | 580 | |
| Fluoride | 00951 | .6 | |
| Nitrate | 71850 | 5.31 | |
| pH | 00403 | 7.7 | Total |
| [1] Dissolved Solids (residue at 180°C) | 70300 | | 1100 |
| Phenolphthalein Alkalinity as $CaCO_3$ | 00415 | | 0 |
| Total Alkalinity as $CaCO_3$ | 00410 | | 66 |
| Total Hardness as $CaCO_3$ | 00900 | | 270 |
| [2] Nitrogen Cycle | | | |
| Ammonia - N | 00610 | | |
| Nitrite - N | 00615 | | |
| Nitrate - N | 00620 | | |
| Organic Nitrogen | 00605 | | |

[1] The bicarbonate reported in this analysis can be converted by computation (multiplying by 0.4917) to an equivalent amount of carbonate, and the carbonete figure used in the computation of dissolved solids.
[2] Nitrogen cycle requires seperate sample.
[3] Total Iron and Manganese require separate sample.

TDWR-0148 (Rev. 9-26-83)



Analyst _____ Checked By _____

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Hueco

Aquifer Bolson 374-499 Field No. R-101 office No E-5 State Well No. 49-05-305

Owner's Well No. _____ County El Paso

1. Location: NE 1/4, NE 1/4 Sec. 12, Block 81 Survey _____
315909N1062435.1

2. Owner: City of El Paso Address: _____

Tenant: _____ Address: _____

Driller: City Address: _____

3. Elevation of 4055 is _____ ft. above msl, determined by _____

4. Drilled: 8 1965; Dug, Cable Tool, Rotary, _____

5. Depth: Rept. 834 ft. Meas. _____ ft.

6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed _____

7. Pump: Mfgr. _____ Type turbine

No. Stages _____, Bowls Diam. _____ in., Setting _____ ft.

Column Diam. _____ in., Length Tailpipe _____ ft.

8. Motor: Fuel Electric Make & Model _____ HP. _____

9. Yield: Flow _____ gpm, Pump 1200 gpm, (Meas.) Rept., Est. 9/23/65

10. Performance Test: Date _____ Length of Test 7½ Made by _____

Static Level _____ ft. Pumping Level _____ ft. Drawdown 538 ft.

Production 1200 gpm Specific Capacity _____ gpm/ft.

CASING & BLANK PIPE

Cemented From _____ ft. to _____ ft.

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 24 | | 0 | 364 |
| 18 | | 1 | 399 |
| | | | |
| | | | |

11. Water Level: 355.4 ft. rept. (meas.) 9/23 1965 above (below) top MP which is 3.0 ft. (above) below surface.

_____ ft. rept. meas. _____ 19__ above below which is _____ ft. above below surface.

_____ ft. rept. meas. _____ 19__ above below which is _____ ft. above below surface.

_____ ft. rept. meas. _____ 19__ above below which is _____ ft. above below surface.

12. Use: Dom., Stock, Public Supply, (Ind.), Irr., Waterflooding, Observation, Not Used, for EP Elec Co.

13. (Quality) (Remarks on taste, odor, color, etc.) _____

Temp. 79 °F, Date sampled for analysis 8/1/66 Laboratory City

Temp. ___ °F, Date sampled for analysis _____ Laboratory _____

Temp. ___ °F, Date sampled for analysis _____ Laboratory _____

WELL SCREEN

Screen Openings _____

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 18 | Screen | 374 | 499 |
| | | | |
| | | | |
| | | | |

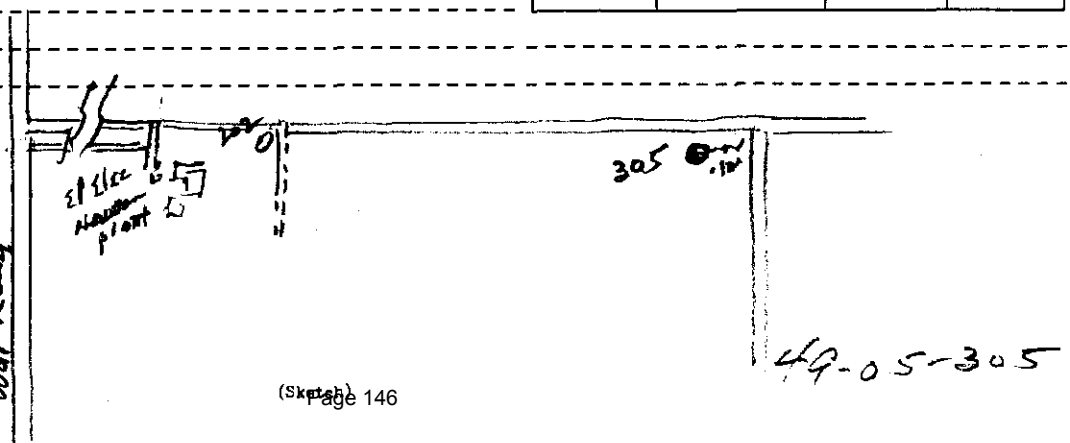
14. Other data available as circled: Driller's Log, Radioactivity Log, (Electric Log),

Formation Samples, Pumping Test, _____

15. Record by: TWDB Date 2/21 1975

Source of Data USGS well sched (ME Davis 8/3/65)

16. Remarks: _____




49-05-305

TWDBE-WD-2

# WELL DATA

WELL NUMBER E5

JL-49-05-305

## PUMP DATA

Make _____

Type _____

Stages _____

Tubing _____

Shaft _____

Column _____

Serial Number _____

Setting _____

O. D. Bowls _____

Capacity: GPM _____ / Feet Head _____

## MOTOR DATA

Make _____

Volts _____

Amps _____

Type _____

Motor H. P. _____

Speed _____

Cycles - Phase _____

Serial Number _____

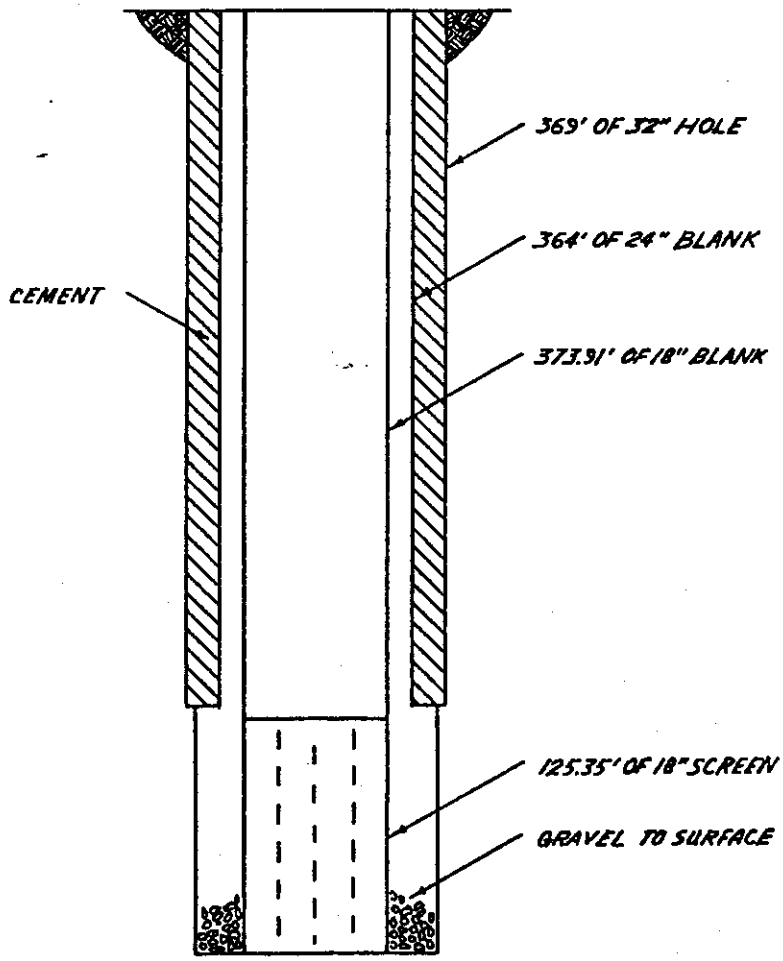
Date Installed _____

## SCALE

Vertical 1" = 100'

Horizontal 1/2" = 1'

## MATERIALS




T.D. 499.26'

49 05 305

49-05-305

Geological Survey — 01057 — UNITED STATES DEPARTMENT OF THE INTERIOR — Ground Water Analysis — HF — Water Resources Division

State: Texas 48 | County: El Paso | J L | Well No. | Latitude 315909N | Longitude 1062435 | Seq. No. 1 | Date 080166 | Sampling Depth | Type C

Well No. R-101, city/E-5 Location 1 mi. S of Tex.-New Mex. state line on McCombs Rd. NE ¼ sec. 12 Blk 91 TWP 1

Owner: City of El Paso — Date drilled: 8/65 — Depth: 834 — WBF Bolson Deposits — Prod. intervals 374-499 — Water level stat. 352.4 blw LSD

Sampled after pumping indef. — Yield 200 (400 meas.) GPM — Pt. of coll. faucet on pump — Appearance clear — Use ind. — Collector M.E. Davis

| Field | Value | ppm | epm |
|---|---|---|---|
| K × 10⁶ KCl | 359; K sample 630 | 571 | |
| pH | 7.2 | | |
| Temperature °F | | 79 | |
| Density at 20°C | | | |
| $SiO_2$ | 5 ml; A sample 1.720 | 31 | |
| Al | A 0.00250 mg; .00625 mg; .0125 mg; .025 mg; Sample | | |
| Fe | A 0.025 mg; 25 ml 0.018 Sample Total 0.01 ppm; 25 ml 0.000 Sample Diss. 0.00 ppm | | |
| Mn | Total 0.05 ppm | | 0.00 |
| Sr | Dissolved 0.83 ppm | | 0.02 |
| Ca | 100 ml 27.4 6.05 | 130 | 1.30 |
| Mg | epm Ca + Mg; epm Ca; epm Mg 5.57 | 5.4 | 0.46 |
| Na | 76.2 | 76 | 3.31 |
| Na + K Calc. | | | |
| K | | 4.7 | 0.12 |
| Percent error 4.27 × 1.10 = 10.2 | Total cations | | 5.21 |

| Field | Value | ppm | epm |
|---|---|---|---|
| $HCO_3$ | 50 ml 6.60; Total Alk as $CO_3$ 6.5 | 129 | 2.11 |
| $CO_3$ | 50 ml | 0 | 0.00 |
| $SO_4$ | 10 ml; Blk; Std; Sample 2.06 | 41 | 0.85 |
| Cl | 25 ml; 320 4.10 | 82 | 2.31 |
| Source 79 | Card No. 80 [8] | | |
| F | 10 ml; A 1.00 ppm; 2.00 ppm; A sample 1.208 | 0.7 | |
| $NO_3$ | 0.95 ml std. 10 ml; A sample; A ml std; A ml std Factor | 4.8 | 0.08 |
| $NO_2$ | ml ppm; A 0.01 mg; .02 mg; .05 mg; Sample | | |
| $PO_4$ | ml Ortho Total; A 0.0050 mg; .0100 mg; .0250 mg; .0500 mg; Sample | | |
| 0.21/10.50 | Total anions | | 5.39 |

Equivalents per million: Na+K — Cl; Ca — $HCO_3$+$CO_3$; Mg — $SO_4$

| Field | Value |
|---|---|
| B | A 0.001 mg 0.208, 0.0025 mg 0.504, mg, Sample mg 0.072 — 0.012; 5 ml; 0.08 |
| Al | |
| Fe | 0.04 |
| Mn | 0.05 |
| Cu | |
| Pb | |
| Zn | |
| Dissolved solids: Determined | |
| Calculated | 340 |
| Hardness | ml; epm Ca + Mg 1.98; epm Alk 2.11; epm NCH |
| Ca+Mg | 99 |
| NCH | 0 |
| Color | 0 |
| Card No. | 8 |
| Br | |
| I | |
| Alk. as $CaCO_3$ | |
| Free $CO_2$ | |
| Percent Na | 61 |
| SAR | 3.3 |
| RSC | 0.13 |
| MBAS | |
| $NO_2$ | |
| Card No. | 5 |

Analyst HELEN CONNELL — Checked by C.H.K.

Date begun AUG 1 6 1966 — Completed AUG 2 4 1966

| Transmittals | Date |
|---|---|
| Records processing | |
| Collector | SEP 2 3 1966 |
| Owner | |

1.53

R-101

Recorded by: ______ Punched by: ______ Date: ______

Jk-49-05-305
E-5
6/11/90

EL PASO WATER UTILITIES
WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED | 06/11/90 | WELL NUMBER | E5 |
| DATE RECEIVED AT LABORATORY | 06/11/90 | LAB. NUMBER | C061190-5 |
| DATE ANALYSIS COMPLETED | 06/12/90 | LOCATION | |
| | | OWNER | |
| | | SAMPLE TAKER | T. CLIETT |
| | | DELIVERED BY | T. CLIETT |

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 4.00 | ****** | ****** |
| Total Alkalinity as CaCO3 | 98 | ****** | ****** |
| Carbonates as CO3 | 4.88 | .162650 | 14 |
| Bicarbonates as HCO3 | 110 | 1.79962 | 78 |
| Chlorides as Cl | 95 | 2.67995 | 203 |
| Sulfates as SO4 | 45 | .9369 | 69 |
| Fluorides as F | 0.70 | .036848 | ****** |
| Nitrates as NO3 LOD=0.10 | 8.10 | .130653 | 9 |
| Total Phosphates as PO4 LOD=.09 | 0.00 | 0 | ****** |
| Total Anions = | 263 | 5.74662 | 374 |

| CATIONS | | | |
|---|---|---|---|
| Total Hardness as CaCO3 | 94 | ****** | ****** |
| Calcium as Ca | 31.3 | 1.56187 | 81 |
| Magnesium as Mg | 3.80 | .312588 | 15 |
| Sodium as Na | 83 | 3.6105 | 177 |
| Potassium as K | 5.50 | .140635 | 10 |
| Total Cations = | 124 | 5.62559 | 282 |
| TDS BY EPWU METHOD (1)= | 387 | 11.3722 | 657 |
| TDS BY USGS METHOD (2)= | 369 | | |
| TDS BY TDH METHOD (3)= | 331 | | |

| | |
|---|---|
| Silica, SiO2 = | 38.00 |
| Chlorine Res. = | N/A |
| Turbidity,ntu = | 0.09 |
| Sample Temp(C)= | 23 |
| pH @ 23 | 8.52 |
| Lab E.C.@25C as umhos/cm = | 599 |
| Field E.C. @25C as umhos/cm = | N/A |
| pH Saturation = | 8.01 |
| Langelier Ind.= | 0.51 |
| Aggress. Index= | 12.48 |
| % Na of T Cat.= | 64 |

Remarks
LOD = LIMIT OF DETECTION

CHECKING CORRECTNESS OF ANALYSIS

| | |
|---|---|
| Measured Diluted E.C. = | 644 |
| Calculated Diluted E.C.= | 656 |
| % Error = | 1.83 |

(1) SUM OF IONS, NOT INCLUDING SILICA
(2) SUM OF IONS WITH CONVERSION OF HCO3 TO CO3, PLUS SILICA.
(3) SUM OF IONS, NOT INCLUDING SILICA WITH CONVERSION OF HCO3 TO CO3.

ANION-CATION BALANCE
Total Anions - Total Cations = SD = 0.64
+or-(0.1065+0.0155* T.ANIONS)
.121030=<+or-1SD= +or- .195573 MAX. LIMIT

ANALYST Judith McBill

WATER SUPPLY MGR Douglas Wilson

PO BOX 511
EL PASO, TEXAS 79960

PUMPED

-49-05-305

EL PASO WATER UTILITIES
WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED | 04-27-87 | WELL NUMBER | E-5 |
| DATE RECEIVED AT LABORATORY | 04-27-87 | LAB. NUMBER | C042787-5 |
| DATE ANALYSIS COMPLETED | 05-04-87 | LOCATION | NE AREA |
| | | OWNER | |
| | | SAMPLE TAKER | R. SPERKA |
| | | DELIVERED BY | R. SPERKA |

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0 | ****** | ****** |
| Total Alkalinity as CaCO3 | 99 | ****** | ****** |
| Carbonates as CO3 | 0.00 | 0 | 0 |
| Bicarbonates as HCO3 | 121 | 1.97958 | 86 |
| Chlorides as Cl | 88 | 2.48248 | 188 |
| Sulfates as SO4 | 31 | .64542 | 48 |
| Fluorides as F | .63 | .033163 | ****** |
| Nitrates as NO3 LOD=4.43 | 8.1 | .130653 | 9 |
| Total Phosphates as PO4 LOD=.09 | 0 | 0 | ****** |
| Total Anions = | 249 | 5.27130 | 332 |

| | |
|---|---|
| Silica, SiO2 = | 27 |
| Chlorine Res. = | NA |
| Turbidity,ntu = | .12 |
| Sample Temp(C)= | 25 |
| pH @ 25 | 8.05 |
| Lab E.C.@25C as umhos/cm = | 620 |
| Field E.C. @25C as umhos/cm = | 580 |
| pH Saturation = | 7.98 |
| Langelier Ind.= | 0.07 |
| Aggress. Index= | 12.04 |
| % Na of T Cat.= | 59 |

| CATIONS | | | |
|---|---|---|---|
| Total Hardness as CaCO3 | 98 | ****** | ****** |
| Calcium as Ca | 30 | 1.497 | 78 |
| Magnesium as Mg | 5.59 | .459441 | 21 |
| Sodium as Na | 69 | 3.0015 | 147 |
| Potassium as K | 5.00 | .12785 | 9 |
| Total Cations = | 110 | 5.08579 | 255 |
| TOTAL DISSOLVED SOLIDS = | 358 | 10.3571 | 587 |

Remarks _____

LOD = LIMIT OF DETECTION

CHECKING CORRECTNESS OF ANALYSIS

| | |
|---|---|
| Measured Diluted E.C. = | 579 |
| Calculated Diluted E.C.= | 587 |
| % Error = | 1.38 |

ANION-CATION BALANCE
Total Anions - Total Cations =
+or-(0.1065+0.0155* T.ANIONS)
.185509=<+or-1SD= +or- .188205 MAX. LIMIT

ANALYST M. Sperka & G Ray DOR
P.O. BOX 511
El Paso,Texas 79961

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CENTRAL LABORATORY DENVER, COLORADO

JL-49-05-305

WATER QUALITY ANALYSIS
LAB-ID # 1174015 RECORD-# 57180

SAMPLE LOCATION: JL-49-05-305
STATION ID: 315909106243501 LAT.LONG.SEQ.: 315909 1062435 01
DATE OF COLLECTION: BEGIN--810606 END-- TIME--1018
STATE CODE: 48 COUNTY CODE: 141 PROJECT IDENTIFICATION: 464801103
DATA TYPE: 2 SOURCE: GROUND WATER GEOLOGIC UNIT: RLSN
COMMENTS: UNIQUE-#:
EL PASO ELECTRIC, NEWMAN PLANT WELL NO 5.

| | | | | | |
|---|---|---|---|---|---|
| ALK TOT FIELD CACO3 | MG/L | 100 | PH FIELD | UNITS | 8.0 |
| ANALYZING AGENCY | | 80020 | POTASSIUM-40, DISS. | PCI/L | 4.0 |
| CALCIUM, DISSOLV. | MG/L | 31 | POTASSIUM, DISSOLVED | MG/L | 5.3 |
| CHLORIDE, DISSOLVED | MG/L | 110 | RESIDUE DIS CALC SUM | MG/L | 376 |
| DEPTH LOC VERT IN FT | | 499 | SILICA, DIS. | MG/L | 32 |
| FLUORIDE, DISSOLVED | MG/L | 0.5 | SODIUM, ABSORP RATIO | | 3.5 |
| HARDNESS | MG/L | 100 | SODIUM, DIS. | MG/L | 82 |
| HARDNESS NONCARB FLD | MG/L | 2 | SODIUM, PERCENT | % | 62 |
| MAGNESIUM, DISSOLV. | MG/L | 6.0 | SP. CONDUCTANCE FLD | UMHOS | 610 |
| NITR DIS NO2+NO3 -N | MG/L | 1.9 | SP. CONDUCTANCE LAB | UMHOS | 629 |
| PH (LABORATORY) | UNITS | 8.0 | SULFATE, DISSOLVED | MG/L | 41 |
| | | | WATER TEMPERATURE | DEG C | 25.5 |

| CATIONS | (MG/L) | (MEQ/L) | ANIONS | (MG/L) | (MEQ/L) |
|---|---|---|---|---|---|
| CALCIUM, DISSO | 31 | 1.547 | ALK TOT FIELD | 100 | 1.998 |
| MAGNESIUM, DIS | 6.0 | 0.494 | CHLORIDE, DISS | 110 | 3.103 |
| POTASSIUM, DIS | 5.3 | 0.136 | FLUORIDE, DISS | 0.5 | 0.026 |
| SODIUM, DIS. | 82 | 3.567 | SULFATE, DISSO | 41 | 0.854 |
| | | | NITR DIS NO2+N | 1.9 | 0.136 |
| TOTAL | | 5.743 | as $NO_3$ TOTAL | | 6.117 |

PERCENT DIFFERENCE = -3.15



JL 49-05-305

Typewrite (Black ribbon) or Print Plainly
(soft pencil or black ink)
Do not use ball point pen

Texas Department of Health Laboratories
1100 West 49th Street
Austin, Texas 78756

TDWR ONLY

Organization No. _____ Lab No. 99

Work No. _____

# CHEMICAL WATER ANALYSIS REPORT

County 071

State Well No. 49-05-305

Well No. ~

Date Collected 04-22-74

Send report to:

Data Collection and Evaluation Section
Texas Department of Water Resources
P.O. Box 13087
Austin, Texas 78711

Owner _____ Send copy to owner Sample No. _____ By _____

Address _____ Well Location _____

Date Drilled _____ Depth _____ ft. WBF _____ Source (type of well) _____

Producing intervals _____ Water level _____ ft. Sample depth _____ ft.

Sampled after pumping _____ hrs. Yield _____ GPM meas. est. Temperature _____ °F _____ °C

Point of collection _____ Appearance ☐ clear ☐ turbid ☐ colored ☐ other

Use _____ Remarks _____

(FOR LABORATORY USE ONLY)

## CHEMICAL ANALYSIS KEY PUNCHED

Laboratory No. _____ Date Received _____ Date Reported _____

| | | MG/L | ME/L |
|---|---|---|---|
| Silica | 00955 | 31 | |
| Calcium | 00910 | 176 | |
| Magnesium | 00920 | 76 | |
| Sodium | 00929 | 115 | |
| | Total | | |
| ☐ Potassium | 00937 | | |
| [3] ☐ Manganese | 01055 | | |
| ☐ Boron | 01022 | | |
| [3] ☐ Total Iron | 01045 | | |
| ☐ (other) _____ | | | |

%Na _____

SAR _____

RSC _____

Specific Conductance (micromhos/cm3) 00095 _____

Diluted Conductance (micromhos/cm3): _____ x _____ = 1004

" ☐ " items will be analyzed if checked.

| | | MG/L | ME/L |
|---|---|---|---|
| Carbonate | 00445 | 0 | |
| Bicarbonate | 00440 | 101 | |
| Sulfate | 00945 | 140 | |
| Chloride | 00940 | 192 | |
| Fluoride | 00951 | .5 | |
| Nitrate | 71850 | | |
| pH | 00403 | 7.6 | |
| | Total | | |
| [1] Dissolved Solids (residue at 180°C) | 70300 | 670 | |
| Phenolphthalein Alkalinity as C $aCO_3$ | 00415 | 0 | |
| Total Alkalinity as C $aCO_3$ | 00410 | 83 | |
| Total Hardness as C $aCO_3$ | 00900 | 252 | |
| [2] Nitrogen Cycle | | | |
| Ammonia - N | 00610 | | |
| Nitrite - N | 00615 | | |
| Nitrate - N | 00620 | | |
| Organic Nitrogen | 00605 | | |

[1] The bicarbonate reported in this analysis can be converted by computation (multiplying by 0.4917) to an equivalent amount of carbonate, and the carbonate figure used in the computation of dissolved solids.
[2] Nitrogen cycle requires separate sample.
[3] Total Iron and Manganese require separate sample.

Analyst _____ Checked By _____



TDWR-0148 (Rev. 9-26-83)

Typewrite (Black ribbon) or Print Plainly
(soft pencil or black ink)
Do not use ball point pen

Texas Department of Health Laboratories
1100 West 49th Street
Austin, Texas 78756

**TDWR ONLY**

Organization No. _____ Lab No. 02

Work No. _____

# CHEMICAL WATER ANALYSIS REPORT

County 071

State Well No. 49-05-305

_____ Well No. _____

Date Collected 08-01-66

Send report to:

**Data Collection and Evaluation Section**
**Texas Department of Water Resources**
**P.O. Box 13087**
**Austin, Texas 78711**

Owner _____ ___ Send copy to owner Sample No. ___ By _____

Address _____ Well Location _____

Date Drilled _____ Depth _____ ft. WBF _____ Source (type of well) _____

Producing intervals _____ Water level _____ ft. Sample depth ____ ft.

Sampled after pumping _____ hrs. Yield _____ GPM meas. / est. Temperature ____ °F ____ °C

Point of collection _____ Appearance ☐ clear ☐ turbid ☐ colored ☐ other

Use PS Remarks _____

**(FOR LABORATORY USE ONLY)**

## CHEMICAL ANALYSIS

Laboratory No. _____ Date Received _____ KEY PUNCHED Date Reported _____

| | | MG/L | ME/L |
|---|---|---|---|
| Silica | 00955 | 31 | |
| Calcium | 00910 | 30 | |
| Magnesium | 00920 | 6 | |
| Sodium | 00929 | 76 | |
| | Total | | |
| ☑ Potassium | 00937 | 4.7 | |
| [3] ☐ Manganese | 01055 | . | %Na _____ |
| ☒ Boron | 01022 | .08 | SAR _____ |
| [3] ☐ Total Iron | 01045 | . | RSC _____ |
| ☐ (other) _____ | | MG/L | |

| | | MG/L | ME/L |
|---|---|---|---|
| Carbonate | 00445 | 0 | |
| Bicarbonate | 00440 | 129 | |
| Sulfate | 00945 | 41 | |
| Chloride | 00940 | 82 | |
| Fluoride | 00951 | .7 | |
| Nitrate | 71850 | 4.80 | |
| pH | 00403 | 7.2 | Total |
| [1] Dissolved Solids (residue at 180°C) | 70300 | | 340 |
| Phenolphthalein Alkalinity as $CaCO_3$ | 00415 | | |
| Total Alkalinity as $CaCO_3$ | 00410 | | |
| Total Hardness as $CaCO_3$ | 00900 | | 99 |
| [2] Nitrogen Cycle | | | |
| Ammonia - N | 00610 | | |
| Nitrite - N | 00615 | | |
| Nitrate - N | 00620 | | |
| Organic Nitrogen | 00605 | | |

Specific Conductance (micromhos/cm3) 00095 _____

Diluted Conductance (micromhos/cm3): _____ x _____ = 570

" ☐ " items will be analyzed if checked.

[1] The bicarbonate reported in this analysis can be converted by computation (multiplying by 0.4917) to an equivalent amount of carbonate, and the carbonate figure used in the computation of dissolved solids.
[2] Nitrogen cycle requires separate sample.
[3] Total Iron and Manganese require separate sample.



Analyst _____ Checked By _____

TDWR-0148 (Rev. 9-26-83)

EL Paso Electric Company
P. O. BOX 982 - EL PASO, TEXAS

NEWMAN WATER WELLS

# WATER ANALYSIS DATA SHEET

| Well or Sample Number | E-1 | E-3 | E-4 | E-5 | E-6 | E-7 | | |
|---|---|---|---|---|---|---|---|---|
| Date Collected | 1-20-76 | 2-5-76 | 11-1-74 | 11-1-74 | 12-31-75 | 1-15-76 | | |
| | 49-05-202 | 201 | 208 | 305 | 212 | 213 | | |
| pH | 7.25 | 7.6 | 7.75 | 7.95 | 7.7 | 7.2 | | |
| Conductivity, micromhos | 775 | 675 | 950 | 580 | 750 | 1,225 | | |
| Total dissolved solids from conductivity | 620 | 540 | 760 | 460 | 600 | 980 | | |
| Total dissolved solids, calculated | 492 | 514 | 717 | 436 | 526 | 797 | | |
| Total Hardness as $CaCO_3$ | 120 | 102 | 164 | 116 | 144 | 176 | | |
| Phenol. Alkalinity as $CaCO_3$ | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Total Alkalinity as $CaCO_3$ | 126 | 150 | 152 | 112 | 102 | 68 | | |
| Carbonate Alkalinity as $CO_3$ | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Bicarbonate Alkalinity as $HCO_3$ | 153 | 183 | 185 | 136 | 124 | 83 | | |
| Sulphates as $SO_4$ | 60 | 60 | 100 | 50 | 50 | 60 | | |
| Chlorides as Cl | 100 | 85 | 164 | 84 | 162 | 350 | | |
| Calcium as Ca | 32 | 28 | 26 | 24 | 40 | 56 | | |
| Magnesium as Mg | 10 | 9 | 24 | 14 | 10 | 9 | | |
| Sodium, calculated as Na | 109 | 121 | 189 | 98 | 109 | 205 | | |
| Silica as $SiO_2$ | 28 | 28 | 31 | 30 | 30 | 33 | | |

**REMARKS:**

Well: _____

Depth: _____

Location: _____



49-05-305

# EL PASO WATER UTILITIES
# WATER ANALYSIS REPORT

JL-49-05-305

| | | | |
|---|---|---|---|
| DATE COLLECTED: | 081695 | SAMPLE SOURCE: | WELL E 5 |
| TIME COLLECTED: | 15:10 | LAB NUMBER: | JC082195-5 |
| DATE RECEIVED: | 082195 | LOCATION: | |
| TIME RECEIVED: | 10:35 | OWNER: | EPWU |
| DATE ANALYZED: | 082195 | COLLECTED BY: | |
| DATE ANALYSIS COMPLETED: | 082595 | DELIVERED BY: | J. Zamora |

| ANIONS | mg/l | me/l | Dil E.C. | | |
|---|---|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.0 | | | Silica, SiO2 = | 33.8 |
| Total Alkalinity as CaCO3 | 106.0 | | | Chlorine Res. = | |
| Carbonates as CO3 | 0.0 | 0.0000 | 0 | Turbidity, NTU = | 0.80 |
| Bicarbonates as HCO3 | 129.3 | 2.1208 | 92 | Sample Temp (C) | 25.0 |
| Chlorides as Cl | 90.0 | 2.5386 | 193 | pH @ | 7.82 |
| Sulfates as SO4 | 42.8 | 0.8902 | 66 | Lab E.C. @ 25 C | |
| Flourides as F | 0.8 | 0.0400 | | as umhos/m = | 565 |
| Nitrates as NO3 LOD= 0.1 | 4.3 | 0.0700 | 5 | Field E.C. @ 25 C | |
| Total Phosphates LOD= 0.09 | < 0.09 | 0.0000 | | as umhos/cm = | |
| TOTAL ANIONS | 267 | 5.6597 | 356 | pH Saturation = | 8.03 |
| | | | | Langelier Index | -0.21 |
| CATIONS | | | | Aggress. Index | 11.80 |
| Total Hardness as CaCO3 | 90 | | | % Na of T. Cat. = | 64 |
| Calcium as Ca | 25.7 | 1.2825 | 67 | Iron = | 0.2 |
| Magnesium Mg | 6.3 | 0.5164 | 24 | Nitrite = | <.1 |
| Sodium as Na | 83.4 | 3.6277 | 178 | | |
| Potassium as K | 4.6 | 0.1171 | 8 | | |
| TOTAL CATIONS | 120 | 5.5437 | 277 | | |

| | | | |
|---|---|---|---|
| TDS BY EPWU METHOD (1)= | 387 | 11.2034 | 633 |
| TDS BY USGS METHOD (2)= | 355 | | |
| TDS BY TDH METHOD (3)= | 321 | | |
| TDS BY EVAPORATION (4)= | 376 | | |

**CHECKING CORRECTNESS OF ANALYSIS**

| | |
|---|---|
| Measured Diluted E.C. | 640 |
| Calculated Diluted E.C. | 633 |
| % Error | -1.13% |

1.- SUM OF IONS, NOT INCLUDING SILICA.
2.- SUM OF IONS WITH CONVERSION OF HCO3 TO CO3, PLUS SILICA.
3.- SUM OF IONS, NOT INCLUDING SILICA WITH CONVERSION OF HCO3 TO CO3.

**ANION - CATION BALANCE**

| | |
|---|---|
| Total Anions - Total Cations = | 0.1160 |
| + or - (0.1065 + 0.0155 * T. Anions) | |
| Maximum Limit +/- | 0.1942 |

SD = 0.59

Teresa T. Macias, Chemist I

Douglas Rittmann, P.E.
Water Systems Div. Mgr.

JL-49-05-305

# EL PASO WATER UTILITIES
# WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| **DATE COLLECTED:** | **12/02/96** | **SAMPLE SOURCE:** | **Well E-5** |
| **TIME COLLECTED:** | **16.45** | **LAB NUMBER:** | **C120396-1** |
| **DATE RECEIVED:** | **12/03/96** | **LOCATION:** | **Northeast** |
| **TIME RECEIVED:** | **08:00** | **OWNER:** | **EPWU** |
| **DATE ANALYZED:** | **12/03/96** | **COLLECTED BY:** | **A. Castaneda** |
| **DATE ANALYSIS COMPLETED:** | **12/12/96** | **DELIVERED BY:** | **A. Castaneda** |

| **ANIONS** | mg/l | me/l | Dil E.C. | | |
|---|---|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.0 | | | Silica, SiO2 = | 32.0 |
| Total Alkalinity as CaCO3 | 98.0 | | | Chlorine Res. = | N/A |
| Carbonates as CO3 | 0.0 | 0.0000 | 0 | Turbidity, NTU = | 0.28 |
| Bicarbonates as HCO3 | 119.6 | 1.9608 | 85 | Sample Temp (C) | 16.6 |
| Chlorides as Cl | 75.0 | 2.1155 | 161 | pH @ | 8.22 |
| Sulfates as SO4 | 34.0 | 0.7072 | 52 | Lab E.C. @ 25 C | |
| Fluorides as F | 0.7 | 0.0368 | | as umhos/m = | 480 |
| Nitrates as NO3 LOD= 0.1 | 7.4 | 0.1192 | 9 | Field E.C. @ 25 C | |
| Total Phosphates LOD= 0.09 | 0.0 | 0.0005 | | as umhos/cm = | N/A |
| **TOTAL ANIONS** | 237 | 4.9400 | 307 | pH Saturation = | 8.21 |
| | | | | Langelier Index | 0.01 |
| | | | | Aggress. Index | 12.13 |
| **CATIONS** | | | | % Na of T. Cat. = | 64 |
| Total Hardness as CaCO3 | 82 | | | | |
| Calcium as Ca | 26.5 | 1.3250 | 69 | | |
| Magnesium Mg | 3.8 | 0.3115 | 15 | | |
| Sodium as Na | 75.7 | 3.2927 | 161 | | |
| Potassium as K | 4.8 | 0.1225 | 9 | | |
| **TOTAL CATIONS** | 111 | 5.0517 | 253 | | |

| | | | |
|---|---|---|---|
| **TDS BY EPWU METHOD (1)=** | 347 | 9.9918 | 560 |
| **TDS BY USGS METHOD (2)=** | 319 | | |
| **TDS BY TDH METHOD (3)=** | 287 | | |
| **TDS BY EVAPORATION (4)=** | 308 | | |

**CHECKING CORRECTNESS OF ANALYSIS**

| | | |
|---|---|---|
| Measured Diluted E.C. | 550 | 1.- SUM OF IONS, NOT INCLUDING SILICA. |
| Calculated Diluted E.C. | 560 | 2.- SUM OF IONS WITH CONVERSION OF |
| % Error | 1.88% | HCO3 TO CO3, PLUS SILICA. |
| | | 3.- SUM OF IONS, NOT INCLUDING SILICA |
| **ANION - CATION BALANCE** | | WITH CONVERSION OF HCO3 TO CO3. |
| Total Anions - Total Cations = | -0.1117 | 4.-AT 180 DEGREES CELSIUS |
| + or - (0.1065 + 0.0155 * T. Anions) | | |
| Maximum Limit +/- | 0.1831 | SD = −0.60 |

Maria Molina
**Maria Molina, Chemist I**

Douglas Rittmann
**Douglas Rittmann, P.E.**
**Water Systems Div. Mgr.**

DS

JL-49-05-305

# EL PASO WATER UTILITIES
# WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| **DATE COLLECTED:** | **05/19/97** | **SAMPLE SOURCE:** | **Well E5** |
| **TIME COLLECTED:** | **19:00** | **LAB NUMBER:** | **C051997-10** |
| **DATE RECEIVED:** | **05/20/97** | **LOCATION:** | **Nevins** |
| **TIME RECEIVED:** | **08:00** | **OWNER:** | **EPWU** |
| **DATE ANALYZED:** | **05/16/97** | **COLLECTED BY:** | **R. McLellan** |
| **DATE ANALYSIS COMPLETED:** | **06/20/97** | **DELIVERED BY:** | **R. McLellan** |

| **ANIONS** | mg/l | me/l | Dil E.C. | | |
|---|---|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.0 | | | Silica, SiO2 = | 32.0 |
| Total Alkalinity as CaCO3 | 102.0 | | | Chlorine Res. = | N/A |
| Carbonates as CO3 | 0.0 | 0.0000 | 0 | Turbidity, NTU = | 0.07 |
| Bicarbonates as HCO3 | 124.4 | 2.0408 | 89 | Sample Temp (C) | 24.5 |
| Chlorides as Cl | 73.0 | 2.0591 | 156 | pH @ | 8.13 |
| Sulfates as SO4 | 38.0 | 0.7904 | 59 | Lab E.C. @ 25 C | |
| Fluorides as F | 0.7 | 0.0353 | | as umhos/m = | 513 |
| Nitrates as NO3 LOD= 0.1 | 7.6 | 0.1228 | 9 | Field E.C. @ 25 C | |
| Total Phosphates LOD= 0.09 | 0.0 | 0.0006 | | as umhos/cm = | N/A |
| **TOTAL ANIONS** | 244 | 5.0489 | 312 | pH Saturation = | 8.02 |
| | | | | Langelier Index | 0.11 |
| | | | | Aggress. Index | 12.04 |
| **CATIONS** | | | | % Na of T. Cat. = | 63 |
| Total Hardness as CaCO3 | 80 | | | | |
| Calcium as Ca | 27.3 | 1.3650 | 71 | | |
| Magnesium Mg | 2.9 | 0.2377 | 11 | | |
| Sodium as Na | 74.0 | 3.2188 | 158 | | |
| Potassium as K | 5.1 | 0.1302 | 9 | | |
| **TOTAL CATIONS** | 109 | 4.9517 | 249 | | |

| | | | |
|---|---|---|---|
| **TDS BY EPWU METHOD (1)=** | 353 | 10.0005 | 562 |
| **TDS BY USGS METHOD (2)=** | 322 | | |
| **TDS BY TDH METHOD (3)=** | 290 | | |
| **TDS BY EVAPORATION (4)=** | 304 | | |

**CHECKING CORRECTNESS OF ANALYSIS**

| | | |
|---|---|---|
| Measured Diluted E.C. | 554 | 1.- SUM OF IONS, NOT INCLUDING SILICA. |
| Calculated Diluted E.C. | 562 | 2.- SUM OF IONS WITH CONVERSION OF |
| % Error | 1.36% | HCO3 TO CO3, PLUS SILICA. |
| | | 3.- SUM OF IONS, NOT INCLUDING SILICA |
| **ANION - CATION BALANCE** | | WITH CONVERSION OF HCO3 TO CO3. |
| Total Anions - Total Cations = | 0.0972 | 4.-AT 180 DEGREES CELSIUS |
| + or - (0.1065 + 0.0155 * T. Anions) | | |
| Maximum Limit +/- | 0.1848 | SD = 0.54 |

Maria Molina

**Maria Molina, Chemist I**

**Paul R. Rivas, Chemist II**

JL-49-05-305

# ANION-CATION BALANCE

*SM 1030 F*

*Standard Methods 19TH Edition*

*LABORATORY SERVICES - JR Laboratory*

Sampling Location: Nevins

Requested By: Teresa T. Alcala, Chemist I

Sample Identification: J111198-3
Project: Well Sample
Sampling Point: Well E5
Sampling Description: Grab

Date Collected: 11/10/98
Time Collected: 18:00
Date Reported: 11/18/98

| ANIONS | mg/L | me/L | Dil EC |
|---|---|---|---|
| p-Alkalinity (CaCO3) | ND | | |
| t-Alkalinity (CaCO3) | 100 | | |
| Carbonate | ND | 0 | 0 |
| Bicarbonate | 122 ~~120~~ | 1.968 | 85.8 |
| Chloride | 89 | 2.51037 | 190.46 |
| Sulfate | 50 | 1.04 | 77 |
| Fluoride | 0.6 | 0.03158 | |
| Nitrogen as NO3 | 12 | 0.19354 | 13.8 |
| Total phosphorous as PO4 | 0.043 | 0.00136 | |
| *TOTAL ANIONS* | 271.6 | 5.74484 | 367.06 |

| CATIONS | mg/L | me/L | Dil EC |
|---|---|---|---|
| Calcium | 31.7 | 1.585 | 82.42 |
| Magnesium | 4.6 | 0.37705 | 17.572 |
| Sodium | 79.1 | 3.44063 | 168.483 |
| Potassium | 5.02 | 0.12839 | 9.2368 |
| Iron | <0.1 | | |
| *TOTAL CATIONS* | 120.4 | 5.53107 | 277.712 |

| | |
|---|---|
| Field pH | ND |
| Field Temperature | ND |
| Field EC | ND |
| pH | 8.09 |
| Temperature of analysis | 21.5 |
| Chlorine Residual | ND |
| pH Saturation | 8.03 |
| Langlier Index | 0.06 |
| TDS (EPWU method) | 390 |
| TDS (USGS method) | 360 |
| TDS (TDH method) | 330 |
| TDS (measured @ 180C) | 350 |
| TDS (calculated-SM 1030F) | 360 |
| Turbidity, NTU | 0.104 |
| Silica | 29 |
| %Na of Total Cations | 62.2% |
| Hardness as CaCO3 (titrated) | 98 |
| Hardness as CaCO3 (calc) | 98 |
| EC (measured) | 590 |
| EC (calculated) | 600 |
| Diluted EC (measured) | 640 |
| Diluted EC (calculated) | 640 |

***Scale Forming***
anions+cations, excluding silica
convert HCO3 to CO3, include silica
convert HCO3 to CO3, exclude silica

SD = 1.27

## CHECKING CORRECTNESS OF ANALYSIS

| | | | ACTION REQUIRED | LIMITS |
|---|---|---|---|---|
| *Anion/Cation balance (% diff)...* | -1.9% | *ACCEPTABLE* | *NONE* | +/-2.0% |
| *TDS Ratio.....* | 1.0 | *ACCEPTABLE* | *NONE* | 1.0-1.2 |
| *Conductivity ratio.....* | 1.0 | *ACCEPTABLE* | *NONE* | 0.9-1.1 |
| *Measured EC and anion sum....* | 574 | *ACCEPTABLE* | *NONE* | (0.9-1.1)EC |
| *Measured EC and cation sum....* | 553 | *ACCEPTABLE* | *NONE* | (0.9-1.1)EC |
| *Calculated TDS to EC ratio.....* | 0.61 | *ACCEPTABLE* | *NONE* | 0.55-0.7 |
| *Measured TDS to EC ratio.....* | 0.59 | *ACCEPTABLE* | *NONE* | 0.55-0.7 |
| *Hardness relative % error.....* | 0.0% | *ACCEPTABLE* | *NONE* | +/-5.0% |

QA/QC: Teresa T. Alcala DATE: 11-19-98

APPROVAL: Victor Cabuyao DATE: 11-19-98

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer Hueco Bolson  Field No. R-100  State Well No. 49 05 306

Owner's Well No. 61  County El Paso

1. Location: ___ 1/4, ___ 1/4 Sec. ___, Block ___ Survey ___

2. Owner: City of El Paso  Address: ___

Tenant: ___  Address: ___

Driller: City  Address: ___

3. Elevation of 4053.5 is ___ ft. above msl, determined by TW2-TOPO

4. Drilled: May 19 65; Dug, Cable Tool, (Rotary)

5. Depth: Rept. 603 ft. Meas. ___ ft.

6. Completion: Open Hole, Straight Wall, (Underreamed), (Gravel Packed)

7. Pump: Mfgr. ___ Type Turbine

No. Stages ___, Bowls Diam. ___ in., Setting ___ ft.

Column Diam. ___ in., Length Tailpipe ___ ft.

8. Motor: Fuel Elec Make & Model ___ HP. ___

9. Yield: Flow ___ gpm, Pump ___ gpm, Mess., Rept., Est.

10. Performance Test: Date 8/4/65 Length of Test 12 hrs Made by ___

Static Level ___ ft. Pumping Level 444 ft. Drawdown 77.45 ft.

Production 1200 gpm Specific Capacity ___ gpm/ft.

11. Water Level: 367.02 ft. (rept.) (meas.) 8/5 1965 (above) below Top of M.P. which is 3.0 ft. (above) below surface.

359.7 ft. rept. meas. 1-20 1970 above (below) LSD which is ___ ft. above below surface.

366.75 ft. rept. meas. 1/6 1975 above (below) LSD which is ___ ft. above below surface.

___ ft. rept. meas. 19___ above below which is ___ ft. above below surface.

12. Use: Dom., Stock, (Public Supply), Ind., Irr., Waterflooding, Observation, Not Used, ___

13. Quality: (Remarks on taste, odor, color, etc.) ___

Temp. ___ °F, Date sampled for analysis ___ Laboratory ___

Temp. ___ °F, Date sampled for analysis ___ Laboratory ___

Temp. ___ °F, Date sampled for analysis ___ Laboratory ___

14. Other data available as circled: Driller's Log, Radioactivity Log, (Electric Log),

Formation Samples, Pumping Test, ___

15. Record by: TWDB-El Paso  Date ___ 1972

Source of Data USGS well schedule by M.E. Davis 5/18/65

16. Remarks: ___

Electric log

4/4/75 Could not locate

Report 153 gives original depth of 1100 feet

CASING & BLANK PIPE

Cemented From 0 ft. to 370.37 ft.

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 24 | Steel | 0 | 370.37 |
| 18 | Steel | 0 | 390.94 |

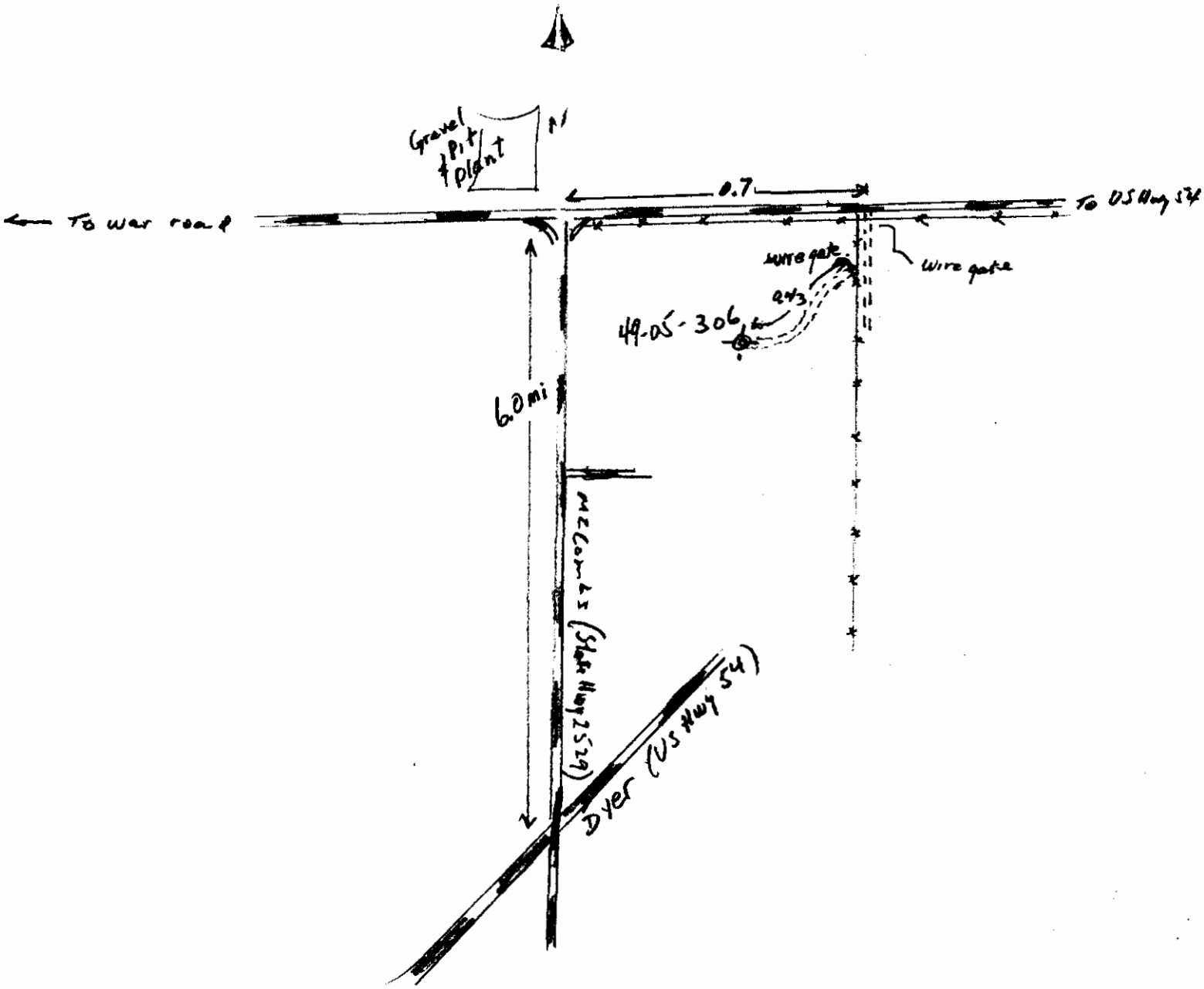
WELL SCREEN

Screen Openings ___

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 18 | Slotted | 390.94 | 603 |

(Sketch) sketch on back

Obs Well


Gravel pit + plant
0.7
To US Hwy 54
To war road
wire gate
Wire gate
49-05-306
6.0 mi
McCombs (State Hwy 2529)
Dyer (US Hwy 54)

# WELL DATA

WELL NUMBER 61

JL-49-05-306

## PUMP DATA

Make _____

Type _____

Stages _____

Tubing _____

Shaft _____

Column _____

Serial Number _____

Setting _____

O. D. Bowls _____

Capacity: GPM _____ / Feet Head _____

## MOTOR DATA

Make _____

Volts _____

Amps _____

Type _____

Motor H. P. _____

Speed _____

Cycles - Phase _____

Serial Number _____

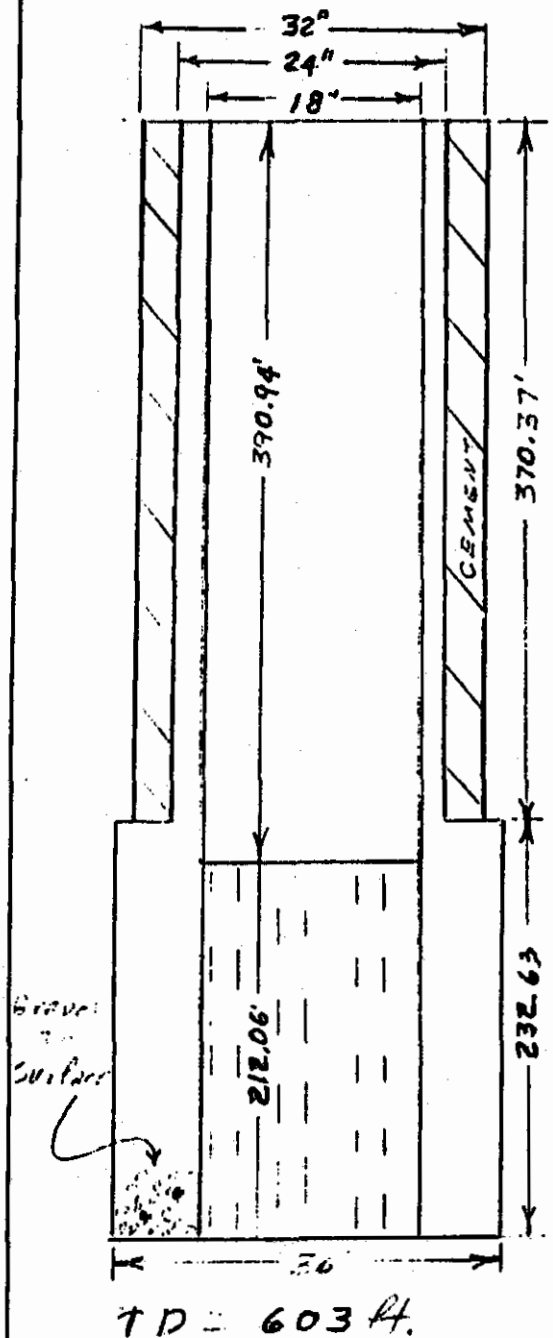
Date Installed _____

## SCALE

Vertical _____

Horizontal _____

## MATERIALS




| Size | Length | Wall | |
|---|---|---|---|
| 15" OD | 370.94' | O. 375" | C. Steel |
| 24" OD | 370.37' | O. 375" | C. Steel |
| | 212.06' | O. 375" | C. Steel |

Blank Liner

Slotted: O. 156"



49 05 306

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

West well

Aquifer Hueco Bolson  Field No. 5 off. no. R-75  State Well No. 49-05-307

Owner's Well No. _____  County El Paso

1. Location: ___ 1/4, ___ 1/4 Sec. _____, Block _____ Survey _____
31 58 14 N 10 62 35 6

2. Owner: El Paso Natural Gas Co  Address: _____

Tenant: _____  Address: _____

Driller: Layne-Texas Co. Ltd.  Address: _____

3. Elevation of _____ is _____ ft. above msl, determined by _____

4. Drilled: 6 19 58; Dug, Cable Tool, Rotary, _____

5. Depth: Rept. 650 ft. Meas. _____ ft.

6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed _____

7. Pump: Mfgr. _____ Type T

No. Stages _____, Bowls Diam. ___ in., Setting _____ ft.

Column Diam. _____ in., Length Tailpipe _____ ft.

8. Motor: Fuel Elec  Make & Model _____ HP. _____

9. Yield: Flow ___ gpm, Pump _____ gpm, Meas., Rept., Est. _____

10. Performance Test: Date _____ Length of Test _____ Made by _____

Static Level ___ ft. Pumping Level ___ ft. Drawdown ___ ft.

Production _____ gpm  Specific Capacity _____ gpm/ft.

CASING & BLANK PIPE

Cemented From _____ ft. to _____ ft.

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 20 | | | |
| 12 | | | |
| | | | |
| | | | |

11. Water Level: _____ ft. rept. meas. _____ 19 __ above below _____ which is _____ ft. above below surface.

_____ ft. rept. meas. _____ 19 __ above below _____ which is _____ ft. above below surface.

_____ ft. rept. meas. _____ 19 __ above below _____ which is _____ ft. above below surface.

_____ ft. rept. meas. _____ 19 __ above below _____ which is _____ ft. above below surface.

12. Use: Dom., Stock, Public Supply, (Ind.), Irr., Waterflooding, Observation, Not Used, _____

13. Quality (Remarks on taste, odor, color, etc.) _____

Temp. ___ °F, Date sampled for analysis _____ Laboratory City

Temp. ___ °F, Date sampled for analysis _____ Laboratory _____

Temp. ___ °F, Date sampled for analysis _____ Laboratory _____

WELL SCREEN

Screen Openings _____

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| | Screen | 423 | 650 |
| | | | |
| | | | |
| | | | |

14. Other data available as circled: Driller's Log, Radioactivity Log, Electric Log,

Formation Samples, Pumping Test, _____

15. Record by: TWDB  Date 2/21 1975

Source of Data USGS well sched (ER Leggat 8/27/58)

16. Remarks: _____

ck w/ Dave Kelly

Make file for 302, 307, 311, 312

TWDBE-WD-2

(Sketch)



49-05-307 ✓

EL PASO WATER UTILITIES PUBLIC SERVICE BOARD

EPWU #5 NE

# WATER ANALYSIS DATA SHEET

JL-49-05-307

JL 49-05-307

Well Number: Lab. Number: 16885-11

Location:

| | |
|---|---|
| DATE SAMPLE COLLECTED | 6-17-85 |
| DATE RECEIVED AT LABORATORY | 6-17-85 |
| DATE ANALYSIS COMPLETED | 7-02-85 |

MILLIGRAMS PER LITER

| | |
|---|---|
| TOTAL DISSOLVED SOLIDS | 459 |
| PHENOL ALKALINITY AS Ca $CO_3$ | 0 |
| TOTAL ALKALINITY AS Ca $CO_3$ | 74 |
| TOTAL HARDNESS AS Ca $CO_3$ | 166 |
| CHLORIDES AS Cl | 175 |
| SULFATES AS $SO_4$ | 35 |
| FLUORIDES AS F | .50 |
| SILICA AS $Si O_2$ | 33 |
| NITRATE AS $NO_3$ | 6.4 |
| TOTAL PHOSPHATES AS $PO_4$ | < 0.03 |
| CALCIUM AS Ca | 48 |
| MAGNESIUM AS Mg | 11 |
| SODIUM AS Na | 86 |
| POTASSIUM AS K | 7.0 |

| | |
|---|---|
| CHLORINE RESIDUAL (Mg/l) | — |
| TURBIDITY (N.T.U.) | .11 |
| TEMPERATURE (°c) | 32.0 |
| pH | 8.17 |

ORGANICS BY G.C. (Mg/l)

| | |
|---|---|
| CHLOROFORM | |
| BROMODICHLOROMETHANE | |
| DIBROMOCHLOROMETHANE | |
| BROMOFORM | |
| TOTAL THM's | |
| LINDANE | |
| ENDRIN | |
| METHOXYCHLOR | |
| 2, 4 - D | |
| SILVEX | |
| TOXAPHENE | |

CHECKING CORRECTNESS OF ANALYSIS

| | |
|---|---|
| MEASURED DILUTED E.C. | — |
| CALCULATED DILUTED E.C. | 863 |
| % ERROR | — |

| ELEMENT | SEWAGE LIMITS | POTABLE LIMITS | SAMPLE (Mg/l) |
|---|---|---|---|
| ARSENIC | 1.0 | 0.05 | |
| BARIUM | 5.0 | 1.0 | |
| CADMIUM | 0.05 | 0.010 | |
| CHROMIUM | 5.0 | 0.05 | |
| COPPER | 1.0 | 1.0 | |
| IRON | — | 0.30 | |
| LEAD | 1.0 | 0.05 | |
| MANGANESE | 5.0 | 0.05 | |
| MERCURY | 0.005 | 0.002 | |
| NICKEL | 5.0 | — | |
| SELENIUM | 0.02 | 0.01 | |
| SILVER | 0.10 | 0.05 | |
| ZINC | 5.0 | 5.0 | |

| | |
|---|---|
| LANGELIER INDEX | 0.4522 |
| AGGRESSIVITY INDEX | 12.2587 |
| % Na OF TOTAL CATIONS | 52 |
| TOTAL ORGANIC CARBONS (Mg/l) | |
| TOTAL INORGANIC CARBONS (Mg/l) | |
| TOTAL CARBONS (Mg/l) | |

ANION - CATION BALANCE

| ANIONS | Mg/l | Meg/l |
|---|---|---|
| PHENOL ALKALINITY | 0 | 0.0000 |
| TOTAL ALKALINITY | 74 | 1.4806 |
| CHLORIDES | 175 | 4.9350 |
| SULFATES | 35 | 0.7280 |
| FLUORIDES | .50 | 0.0263 |
| NITRATES | 6.4 | 0.1030 |
| PHOSPHATES | <0.03 | 0.0000 |
| | TOTAL | 7.2729 |
| CATIONS | Mg/l | Meg/l |
| CALCIUM | 48 | 2.3952 |
| MAGNESIUM | 11 | 0.9053 |
| SODIUM | 86 | 3.7410 |
| POTASSIUM | 7.0 | 0.1792 |
| | TOTAL | 7.2207 |

TOTAL ANIONS — TOTAL CATIONS = ± 0.1065 + 0.0155 (TOTAL ANIONS)

0.0522 = < ± ISD = 0.2192

Remarks: Collected by Don White (USGS), delivered by Roger Sparks

SC = 775 µmhos/cm

Analyst Michiko Spruce

FORM 4518-0883

EPNG # 5 WW
NEWMAN STA.

UNITED STATES DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY WRO
CENTRAL LABORATORY, DENVER, COLORADO

JL-49-05-307
9/1/84

LABORATORY ANALYTICAL SHEET FOR LAB-ID 4262074 RECORD-# 117440

STATION_ID: 315737106235901 COLLECTED: BEGIN DATE 840901 TIME 1740 END DATE TIME LAT-LONG-SEQ#: 315737 1062359 01
NAME: JL-49-05-307 STATE: 48 USER CODE: 48 TEXAS COUNTY: 141 GEO.UNIT:
SAMPLE MEDIUM: 6 STATUS: H SOURCE: 9 HYD.CONDITION: SAMPLE TYPE: 9 HYD.EVENT: PROJECT/ACCT-#: 464800203 COST: 53.30
COMMENTS: (* INDICATES LAB-CODE CHANGE)
UNIQUE NUMBER REQUESTED SCHEDULES USED 1022 0 0 0 TOTAL PARAMETERS 22
WATSTORE STORAGE REQUESTED. STATION HEADER DATA WAS SUBSTITUED. PLEASE CHECK NAME, STATE CODE, COUNTY, AND LAT_LONG_SEQ-#.
PRINTED ON 11/09/84 FIRST RETREIVAL "LABPRIM" 11/09/84 EL PASO NAT. GAS, NEWMAN PLANT WELL NO. 5.

| NAME | RMK/VALUE | UNITS | METHOD | W-CODE | LC |
|---|---|---|---|---|---|
| ALK TOT FIELD CACO3 | 79 | MG/L | - - | 410 | 2 |
| ANALYZING AGENCY | 80020 | | - - | 28 | 91 |
| CALCIUM, DISSOLVED | 50 | MG/L | I-1472-79 | 915 | 659* |
| CENTRAL LAB-ID-# | 4262074 | | - - | 99998 | 1500 |
| CHLORIDE, DISSOLVED | 170 | MG/L | I-2188-83 | 940 | 1213* |
| COLLECTION AGENCY | 1028 | | - - | 27 | 83 |
| DEPTH OF WELL IN FT. | 650 | | - - | 72008 | 308 |
| DEPTH-BOT.WATER ZONE | 650.0 | | - - | 72003 | 340 |
| DEPTH-TOP-WATER ZONE | 423.0 | | - - | 72002 | 339 |
| FLUORIDE, DISSOLVED | 0.6 | MG/L | I-2327-78 | 950 | 31 |
| MAGNESIUM, DISSOLVED | 10 | MG/L | I-1472-79 | 925 | 663* |
| Hardness | 170 | MG/L | | | |

| NAME | RMK/VALUE | UNITS | METHOD | W-CODE | LC |
|---|---|---|---|---|---|
| NCH | 87 | MG/L | | | |
| NITR DIS NO2+NO3 -N | 2.2 | MG/L | I-2545-78 | 631 | 228 |
| ~~PH (LABORATORY)~~ | ~~8.2~~ | ~~UNITS~~ | ~~I-2587-81~~ | ~~403~~ | ~~66~~ |
| PH FIELD | 7.9 | UNITS | I-1586-77 | 400 | 51 |
| POTASSIUM, DISSOLVED | 6.1 | MG/L | I-1630-78 | 935 | 54 |
| RESIDUE DIS CALC SUM | 472 | MG/L | I-1751-78 | 70301 | 28 |
| SILICA, DISSOLVED | 32 | MG/L | I-1472-79 | 955 | 667* |
| SODIUM, DISSOLVED | 90 | MG/L | I-1472-79 | 930 | 675* |
| SP. CONDUCTANCE FLD | 830 | UMHOS | I-1780-77 | 95 | 21 |
| ~~SP. CONDUCTANCE LAB~~ | ~~818~~ | ~~UMHOS~~ | ~~I-2781-81~~ | ~~90095~~ | ~~69~~ |
| SULFATE, TURB. DIS. | 56 | MG/L | - - | 945 | 1200 |
| WATER TEMPERATURE | 27.0 | DEG C | - - | 10 | 64 |
| Sodium, Percent | | | | | |

| CATIONS | (MG/L) | (MEQ/L) |
|---|---|---|
| POTASSIUM, DISSOLVED | 6.1 | 0.156 |
| CALCIUM, DISSOLVED | 50 | 2.495 |
| MAGNESIUM, DISSOLVED | 10 | 0.823 |
| SODIUM, DISSOLVED | 90 | 3.915 |
| TOTAL | | 7.389 |

| ANIONS | (MG/L) | (MEQ/L) |
|---|---|---|
| ALK TOT FIELD CACO3 | 79 | 1.578 |
| FLUORIDE, DISSOLVED | 0.6 | 0.032 |
| NITR DIS NO2+NO3 -N | 2.2 | 0.157 |
| SULFATE, TURB. DIS. | 56 | 1.166 |
| CHLORIDE, DISSOLVED | 170 | 4.796 |
| TOTAL | | 7.729 |

PERCENT DIFFERENCE = -2.25

JL-49-05-307

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CENTRAL LABORATORY DENVER, COLORADO

WATER QUALITY ANALYSIS
LAB-ID # 174013 RECORD-# 57176

SAMPLE LOCATION: JL-49-05-307
STATION ID: 315737106235901 LAT.LONG.SEQ.: 315737 1062359 01
DATE OF COLLECTION: BEGIN--810606 END-- TIME--1210
STATE CODE: 48 COUNTY CODE: 141 PROJECT IDENTIFICATION: 464801103
DATA TYPE: 2 SOURCE: GROUND WATER GEOLOGIC UNIT: 8LSN
COMMENTS: UNIQUE-#:
EL PASO NAT GAS, NEWMAN PLANT WELL NO. 5.

| | | | | | |
|---|---|---|---|---|---|
| ALK TOT FIELD CACO3 | MG/L | 77 | PH FIELD | UNITS | 7.8 |
| ANALYZING AGENCY | | 80020 | POTASSIUM-40, DISS. | PCI/L | 5.4 |
| CALCIUM, DISSOLV. | MG/L | 89 | POTASSIUM, DISSOLVED | MG/L | 7.3 |
| CHLORIDE, DISSOLVED | MG/L | 250 | RESIDUE DIS CALC SUM | MG/L | 699 |
| DEPTH LOC VERT IN FT | | 650 | SILICA, DIS. | MG/L | 32 |
| FLUORIDE, DISSOLVED | MG/L | 0.4 | SODIUM, ABSORP RATIO | | 3.1 |
| HARDNESS | MG/L | 290 | SODIUM, DIS. | MG/L | 120 |
| HARDNESS NONCARB FLD | MG/L | 220 | SODIUM, PERCENT | % | 46 |
| MAGNESIUM, DISSOLV. | MG/L | 17 | SP. CONDUCTANCE FLD | UMHOS | 1150 |
| NITR DIS NO2+NO3 -N | MG/L | 3.9 | ~~SP. CONDUCTANCE LAB~~ | ~~UMHOS~~ | ~~1200~~ |
| ~~PH (LABORATORY)~~ | ~~UNITS~~ | ~~7.5~~ | SULFATE, DISSOLVED | MG/L | 120 |
| | | | WATER TEMPERATURE | DEG C | 26.5 |

| CATIONS | (MG/L) | (MEQ/L) | ANIONS | (MG/L) | (MEQ/L) |
|---|---|---|---|---|---|
| CALCIUM, DISSO | 89 | 4.441 | ALK TOT FIELD | 77 | 1.538 |
| MAGNESIUM, DIS | 17 | 1.398 | CHLORIDE, DISS | 250 | 7.053 |
| POTASSIUM, DIS | 7.3 | 0.187 | FLUORIDE, DISS | 0.4 | 0.021 |
| SODIUM, DIS. | 120 | 5.220 | SULFATE, DISSO | 120 | 2.498 |
| | | | NITR DIS NO2+N | 3.9 | 0.278 |
| TOTAL | | 11.246 | 17 as $NO_3$ TOTAL | | 11.389 |

PERCENT DIFFERENCE = -0.63



JL-49-05-307

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPANY
SOUTHERN DIVISION LABORATORY
WATER ANALYSIS

J-C-49-05-314
J-49-05-314
J-49-05-307

Location El Paso

Date May 2, 1974

Date Sample Taken April 22, 1974

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | #2 | #4 | #5 |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | | | |
| pH | | | | | | | | | | | | 7.8 | 7.8 | 7.6 |
| P Alkalinity as $CaCO_3$ | | | | | | | | | | | | 0 | 0 | 0 |
| Total Alkalinity as $CaCO_3$ | | | | | | | | | | | | 70 | 80 | 83 |
| Chloride as Cl | | | | | | | | | | | | 213 | 174 | 192 |
| Sulfate as $SO_4$ | | | | | | | | | | | | 208 | 92.5 | 140 |
| Total Hardness as $CaCO_3$ | | | | | | | | | | | | 252 | 210 | 252 |
| Calcium as $CaCO_3$ | | | | | | | | | | | | 184 | 152 | 176 |
| Magnesium as $CaCO_3$ | | | | | | | | | | | | 68 | 58 | 76 |
| Sodium as Na | | | | | | | | | | | | 152 | 97 | 115 |
| Silica as $SiO_2$ | | | | | | | | | | | | 19.2 | 30 | 31.4 |
| Iron as Fe | | | | | | | | | | | | .01 | .003 | .003 |
| Fluoride as F | | | | | | | | | | | | 0.5 | 0.55 | 0.52 |
| Potassium as K | | | | | | | | | | | | | | |
| Treatment | | | | | | | | | | | | | | |
| PPM | | | | | | | | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | 768 | 567 | 670 |
| Specific Conductance; Micromhos | | | | | | | | | | | | 1073 | 915 | 1004 |

*— All results expressed as ppm or micromhos —*

Remarks:

Louise Bartlett
Analyst

Engineer

Date



49-05-307

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPAN
SOUTHERN DIVISION LABORATORY
WATER ANALYSIS

JL-49-05-307 JL-49-05-307

Location El Paso

Date July 19, 1974

Date Sample Taken July 16, 1974

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | #4 | #5 | |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | | | |
| pH | | | | | | | | | | | | 7.9 | 7.6 | |
| P Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 0 | 0 | |
| Total Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 80 | 80 | |
| Chloride as Cl | | | | | | | | | | | | 210 | 192 | |
| Sulfate as $SO_4$ | | | | | | | | | | | | | | |
| Total Hardness as Ca $CO_3$ | | | | | | | | | | | | 270 | 270 | |
| Calcium as Ca $CO_3$ | | | | | | | | | | | | 180 | 180 | |
| Magnesium as Ca $CO_3$ | | | | | | | | | | | | | | |
| [illegible]ium as Na | | | | | | | | | | | | | | |
| Silica as $SiO_2$ | | | | | | | | | | | | | | |
| Iron as Fe | | | | | | | | | | | | | | |
| Fluoride as F | | | | | | | | | | | | | | |
| Potassium as K | | | | | | | | | | | | | | |
| Treatment | | | | | | | | | | | | | | |
| PPM | | | | | | | | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | | | |
| Specific Conductance, Micromhos | | | | | | | | | | | | 1079 | 1043 | |

*– All results expressed as ppm or micromhos –*

Remarks:

Louise Bartlett
Analyst

Engineer

Date

49-05-307

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPANY
SOUTHERN DIVISION LABORATORY
WATER ANALYSIS

Location El Paso

Date July 16, 1975

Date Sample Taken July 14, 1975

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | #4 | #5 | |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | | | |
| pH | | | | | | | | | | | | 8.1 | 8.1 | |
| P Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 0 | 0 | |
| Total Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 88 | 75 | |
| Chloride as Cl | | | | | | | | | | | | 236 | 256 | |
| Sulfate as $SO_4$ | | | | | | | | | | | | | | |
| Total Hardness as Ca $CO_3$ | | | | | | | | | | | | 310 | 340 | |
| Calcium as Ca $CO_3$ | | | | | | | | | | | | 210 | 240 | |
| Magnesium as Ca $CO_3$ | | | | | | | | | | | | | | |
| Sodium as Na | | | | | | | | | | | | | | |
| Silica as $SiO_2$ | | | | | | | | | | | | | | |
| Iron as Fe | | | | | | | | | | | | | | |
| Fluoride as F | | | | | | | | | | | | | | |
| Potassium as K | | | | | | | | | | | | | | |
| Treatment | | | | | | | | | | | | | | |
| PPM | | | | | | | | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | | | |
| Specific Conductance, Micromhos | | | | | | | | | | | | 1184 | 1271 | |

*– All results expressed as ppm or micromhos –*

Remarks:

Louise Bartlett
Analyst

Engineer

Date



49-05-307

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPAN

SOUTHERN DIVISION LABORATORY

# WATER ANALYSIS

Location El Paso

Date November 5, 1975

Date Sample Taken October 14, 1975

JC-49-05-311

JC-49-05-307

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | #4 | #5 | |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | | | |
| pH | | | | | | | | | | | | 7.5 | 7.7 | |
| P Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 0 | 0 | |
| Total Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 85 | 78 | |
| Chloride as Cl | | | | | | | | | | | | 121 | 118 | |
| Sulfate as $SO_4$ | | | | | | | | | | | | 120 | 135 | |
| Total Hardness as Ca $CO_3$ | | | | | | | | | | | | 330 | 320 | |
| Calcium as Ca $CO_3$ | | | | | | | | | | | | 274 | 252 | |
| Magnesium as Ca $CO_3$ | | | | | | | | | | | | 56 | 68 | |
| Sodium as Na | | | | | | | | | | | | 23 | 53 | |
| Silica as $SiO_2$ | | | | | | | | | | | | 26.4 | 26.4 | |
| Iron as Fe | | | | | | | | | | | | .01 | .01 | |
| Fluoride as F | | | | | | | | | | | | .34 | .50 | |
| Potassium as K | | | | | | | | | | | | | | |
| Treatment | | | | | | | | | | | | | | |
| PPM | | | | | | | | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | 617 | 547 | |
| Specific Conductance, Micromhos | | | | | | | | | | | | 1266 | 1234 | |

*– All results expressed as ppm or micromhos –*

Remarks:

Joe Barnett/Jim Anderson
Analyst

Engineer

Date



49-05-307

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPANY

SOUTHERN DIVISION LABORATORY

WATER ANALYSIS

49-05-307

Location El Paso

Date January 19, 1976

Date Sample Taken January 14, 1976

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | #4 | #5 | |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | | | |
| pH | | | | | | | | | | | | 7.7 | 7.8 | |
| P Alkalinity as $CaCO_3$ | | | | | | | | | | | | 0 | 0 | |
| Total Alkalinity as $CaCO_3$ | | | | | | | | | | | | 80 | 80 | |
| Chloride as Cl | | | | | | | | | | | | 242 | 242 | |
| Sulfate as $SO_4$ | | | | | | | | | | | | | | |
| Total Hardness as $CaCO_3$ | | | | | | | | | | | | 340 | 336 | |
| Calcium as $CaCO_3$ | | | | | | | | | | | | 252 | 248 | |
| Magnesium as $CaCO_3$ | | | | | | | | | | | | | | |
| [illegible]um as Na | | | | | | | | | | | | | | |
| Silica as $SiO_2$ | | | | | | | | | | | | | | |
| Iron as Fe | | | | | | | | | | | | | | |
| Fluoride as F | | | | | | | | | | | | | | |
| Potassium as K | | | | | | | | | | | | | | |
| Treatment | | | | | | | | | | | | | | |
| PPM | | | | | | | | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | | | |
| Specific Conductance, Micromhos | | | | | | | | | | | | 1262 | 1271 | |

*– All results expressed as ppm or micromhos –*

Remarks:

Louise Bartlett
Analyst

Engineer

Date



49-05-307

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMP
SOUTHERN DIVISION LABORATORY
WATER ANALYSIS

Location El Paso

Date July 22, 1976

49-05-307 49-05-307

Date Sample Taken July 19, 1976

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | "C" BOILER | SOFT | BLEND | RAW | #4 | $5 |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | | |
| pH | 7.4 | 7.9 | 7. | 7.8 | 8.5 | 7.9 | 8.4 | 8.5 | 8.4 | | | 7.6 | 7.7 |
| P Alkalinity as $CaCO_3$ | 0 | 0 | | 0 | 5 | 0 | 3 | 130 | 3 | | | 0 | 0 |
| Total Alkalinity as $CaCO_3$ | 35 | 53 | | 238 | 460 | 155 | 498 | 3510 | 90 | | | 95 | 80 |
| Chloride as Cl | 1804 | 2300 | | 242 | 228 | 250 | 306 | | 135 | | | 256 | 264 |
| Sulfate as $SO_4$ | | | | | | | | | | | | | |
| Total Hardness as $CaCO_3$ | 2360 | 3020 | | 80 | 136 | 106 | 258 | 0 | 8 | | | 492 | 348 |
| Calcium as $CaCO_3$ | 1790 | 2260 | | 58 | 88 | 78 | 174 | | 0 | | | 372 | 272 |
| Magnesium as $CaCO_3$ | | | | | | | | | | | | | |
| 'ium as Na | | | | | | | | | | | | | |
| Silica as $SiO_2$ | | | | | | | | | | | | | |
| Iron as Fe | | | | | | | | | | | | | |
| Fluoride as F | | | | | | | | | | | | | |
| Potassium as K | | | | | | | | | | | | | |
| Treatment | Nalco 360 | Nalco 360 | | Drb 517 | Drb 517 | Drb 517 | Drb 517 | | | | | | |
| PPM | 39.5 | 35.2 | | 870 | 1215 | 548 | 1275 | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | | |
| Specific Conductance, Micromhos | 6846 | 8753 | | 1956 | | 1648 | | | 782 | | | 1628 | 1291 |

*– All results expressed as ppm or micromhos –*

Remarks: "C" AMB-freezing point 40° minus zero
51.5% amb Fl

Louise Bartlett
Analyst

Engineer

Date



49-05-307

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMP
SOUTHERN DIVISION LABORATOR
WATER ANALYSIS

JL-4-05-30

Location El Paso

Date April 30, 1976

Date Sample Taken April 27, 1976

| SYSTEM | OPEN | | | CLOSED | | | | "C" | STORAGE | | | WELLS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | ~~XXXXXX~~ AMB. | SOFT | ~~XXXXX~~ | RAW | #4 | #5 |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | Soft ~~XXX XXXXX~~ | RAW | | |
| pH | 7.4 | | | 7.6 | 8.2 | 7.7 | 7.6 | 8.5 | 7.6 | 8.3 | | 7.4 | 7.7 |
| P Alkalinity as $CaCO_3$ | 0 | | | 0 | 0 | 0 | 0 | 80 | 0 | 0 | | 0 | 0 |
| Total Alkalinity as $CaCO_3$ | 30 | | | 305 | 500 | 210 | 475 | 3620 | 80 | 95 | | 80 | 80 |
| Chloride as Cl | 952 | | | 242 | 228 | 256 | 256 | | 270 | 136 | | 328 | 256 |
| Sulfate as $SO_4$ | | | | | | | | | | | | 190 | 185 |
| Total Hardness as $CaCO_3$ | 1270 | | | 84 | 120 | 106 | 260 | 0 | 368 | 2 | | 432 | 348 |
| Calcium as $CaCO_3$ | 950 | | | 58 | 80 | 72 | 182 | | 272 | 0 | | 320 | 252 |
| Magnesium as $CaCO_3$ | | | | | | | | | | | | 112 | 96 |
| Sodium as Na | | | | | | | | | | | | 143 | 133 |
| Silica as $SiO_2$ | | | | | | | | | | | | 27.2 | 24.2 |
| Iron as Fe | | | | | | | | | | | | 0 | .002 |
| Fluoride as F | | | | | | | | | | | | 0.54 | 0.445 |
| Potassium as K | | | | | | | | | | | | | |
| Treatment | Nalco 360 | | | Drb 517 | Drb 517 | Drb 517 | Drb 517 | | | | | | |
| PPM | 31.75 | | | 1125 | 1380 | 750 | 1230 | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | 941 | 819 |
| Specific Conductance, Micromhos | 3956 | | | 2151 | | 1825 | | | 1310 | 786 | | 1479 | 1236 |

*— All results expressed as ppm or micromhos —*

Remarks: "C"-40 degrees minus zero
51.5% glycol

Louise Bartlett
Analyst

Engineer

Date



49-05-307

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPANY
SOUTHERN DIVISION LABORATOR
WATER ANALYSIS

Location El Paso

Date October 18, 1976

Date Sample Taken October 15, 1976

JV-49-05-3

JV-49-05-1

| FORAGE | | WELLS | | |
|---|---|---|---|---|
| BLEND | RAW | #4 | #5 | |
| DIS-TILLED | RAW | | | |
| | | 7.5 | 7.7 | |
| | | 0 | 0 | |
| | | 88 | 78 | |
| | | 338 | 256 | |
| | | | | |
| | | 464 | 352 | |
| | | 348 | 268 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | 1516 | 1253 | |

Louise Bartlett
Analyst

Engineer



49-05-307

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPANY

SOUTHERN DIVISION LABORATORY

# WATER ANALYSIS

Location El Paso

Date

Date Sample Taken January 17, 77

J-49-05-307

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | #5 | | |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | | | |
| pH | | | | | | | | | | | | 7.6 | | |
| P Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 0 | | |
| Total Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 76 | | |
| Chloride as Cl | | | | | | | | | | | | 255 | | |
| Sulfate as $SO_4$ | | | | | | | | | | | | | | |
| Total Hardness as Ca $CO_3$ | | | | | | | | | | | | 338 | | |
| Calcium as Ca $CO_3$ | | | | | | | | | | | | 252 | | |
| Magnesium as Ca $CO_3$ | | | | | | | | | | | | | | |
| Sodium as Na | | | | | | | | | | | | | | |
| Silica as $SiO_2$ | | | | | | | | | | | | | | |
| Iron as Fe | | | | | | | | | | | | | | |
| Fluoride as F | | | | | | | | | | | | | | |
| Potassium as K | | | | | | | | | | | | | | |
| Treatment | | | | | | | | | | | | | | |
| PPM | | | | | | | | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | | | |
| Specific Conductance, Micromhos | | | | | | | | | | | | 1285 | | |

*– All results expressed as ppm or micromhos –*

Remarks:

Analyst

Engineer

Date



49-05-307

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPANY

SOUTHERN DIVISION LABORATORY

# WATER ANALYSIS

Location El Paso

Date April 20, 1977

Date Sample Taken April 15, 1977

JL-49-05-

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | #4 | #5 |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | | |
| pH | | | | | | | | | | | | 8.0 | 8.0 |
| P Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 0 | 0 |
| Total Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 75 | 75 |
| Chloride as Cl | | | | | | | | | | | | 250 | 250 |
| Sulfate as $SO_4$ | | | | | | | | | | | | 166 | 166 |
| Total Hardness as Ca $CO_3$ | | | | | | | | | | | | 328 | 334 |
| Calcium as Ca $CO_3$ | | | | | | | | | | | | 250 | 230 |
| Magnesium as Ca $CO_3$ | | | | | | | | | | | | 78 | 104 |
| Sodium as Na | | | | | | | | | | | | 80 | 77 |
| Silica as $SiO_2$ | | | | | | | | | | | | 30 | 30.8 |
| Iron as Fe | | | | | | | | | | | | 0 | 0 |
| Fluoride as F | | | | | | | | | | | | .56 | .44 |
| Potassium as K | | | | | | | | | | | | | |
| Treatment | | | | | | | | | | | | | |
| PPM | | | | | | | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | 738 | 734 |
| Specific Conductance, Micromhos | | | | | | | | | | | | 1232 | 1232 |

*– All results expressed as ppm or micromhos –*

Remarks:

Richard Bowen
Analyst

Engineer

Date



49-05-307

rm 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPANY
SOUTHERN DIVISION LABORATORY
WATER ANALYSIS

JL-49-05-34

JL-49-05-307

ition El Paso

Date July 19, 1977

ate Sample Taken July 15, 1977

| SYSTEM | OPEN | CLOSED | STORAGE | WELLS | | |
|---|---|---|---|---|---|---|
| | | | | #4 | #5 | |
| | | | | | | |
| | | | | 7.4 | 7.4 | |
| | | | | 0 | 0 | |
| | | | | 85 | 65 | |
| | | | | 203 | 306 | |
| | | | | | | |
| | | | | 592 | 396 | |
| | | | | 444 | 308 | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
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| | | | | | | |
| | | | | | | |
| | | | | 1858 | 1417 | |

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neer



49-05-307

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPANY

SOUTHERN DIVISION LABORATORY

WATER ANALYSIS

JL-49-05-31

JL-49-05-307

Location El Paso

Date October 19, 1977

Date Sample Taken October 14, 1977

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | #4 | #5 | |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | | | |
| pH | | | | | | | | | | | | 7.4 | 7.4 | |
| P Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 0 | 0 | |
| Total Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 85 | 68 | |
| Chloride as Cl | | | | | | | | | | | | 398 | 270 | |
| Sulfate as $SO_4$ | | | | | | | | | | | | | | |
| Total Hardness as Ca $CO_3$ | | | | | | | | | | | | 596 | 368 | |
| Calcium as Ca $CO_3$ | | | | | | | | | | | | 436 | 28– | |
| Magnesium as Ca $CO_3$ | | | | | | | | | | | | | | |
| [illegible]ium as Na | | | | | | | | | | | | | | |
| Silica as $SiO_2$ | | | | | | | | | | | | | | |
| Iron as Fe | | | | | | | | | | | | | | |
| Fluoride as F | | | | | | | | | | | | | | |
| Potassium as K | | | | | | | | | | | | | | |
| Treatment | | | | | | | | | | | | | | |
| PPM | | | | | | | | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | | | |
| Specific Conductance, Micromhos | | | | | | | | | | | | 1854 | 1320 | |

*– All results expressed as ppm or micromhos –*

Remarks:

Louise Bartlett
Analyst

Engineer

Date



49-05-307

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPANY
SOUTHERN DIVISION LABORATORY
WATER ANALYSIS

JL-49-05-311 JL-49-05-307

Location El Paso

Date January 18, 1978

Date Sample Taken January 17, 1978

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | #4 | #5 | |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | | | |
| pH | | | | | | | | | | | | 8.0 | 8.0 | |
| P Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 0 | 0 | |
| Total Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 73 | 73 | |
| Chloride as Cl | | | | | | | | | | | | 253 | 249 | |
| Sulfate as $SO_4$ | | | | | | | | | | | | | | |
| Total Hardness as Ca $CO_3$ | | | | | | | | | | | | 352 | 348 | |
| Calcium as Ca $CO_3$ | | | | | | | | | | | | 252 | 252 | |
| Magnesium as Ca $CO_3$ | | | | | | | | | | | | | | |
| [illegible]dium as Na | | | | | | | | | | | | | | |
| Silica as $SiO_2$ | | | | | | | | | | | | | | |
| Iron as Fe | | | | | | | | | | | | | | |
| Fluoride as F | | | | | | | | | | | | | | |
| Potassium as K | | | | | | | | | | | | | | |
| Treatment | | | | | | | | | | | | | | |
| PPM | | | | | | | | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | | | |
| Specific Conductance, Micromhos | | | | | | | | | | | | 1239 | 1239 | |

*— All results expressed as ppm or micromhos —*

Remarks:

Louise Bartlett
Analyst

Engineer

Date



49-05-307

Form 3-46 (Rev. 9-64)

EL PASO NATURAL GAS COMPANY
SOUTHERN DIVISION LABORATORY
WATER ANALYSIS

Location El Paso

Date April 20, 1978

Date Sample Taken April 18, 1978

Jl-49-05-307

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | #4 | #5 | |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | | | |
| pH | | | | | | | | | | | | 7.7 | 7.6 | |
| P Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 0 | 0 | |
| Total Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 70 | 70 | |
| Chloride as Cl | | | | | | | | | | | | 242 | 242 | |
| Sulfate as $SO_4$ | | | | | | | | | | | | 110 | 100 | |
| Total Hardness as Ca $CO_3$ | | | | | | | | | | | | 340 | 320 | |
| Calcium as Ca $CO_3$ | | | | | | | | | | | | 240 | 240 | |
| Magnesium as Ca $CO_3$ | | | | | | | | | | | | 100 | 80 | |
| Sodium as Na | | | | | | | | | | | | 85 | 90 | |
| Silica as $SiO_2$ | | | | | | | | | | | | 35.6 | 35.6 | |
| Iron as Fe | | | | | | | | | | | | .1 | .05 | |
| Floride as F | | | | | | | | | | | | .45 | .43 | |
| Potassium as K | | | | | | | | | | | | | | |
| Treatment | | | | | | | | | | | | | | |
| PPM | | | | | | | | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | 678 | 669 | |
| Specific Conductance, Micromhos | | | | | | | | | | | | 1235 | 1235 | |

*– All results expressed as ppm or micromhos –*

Remarks:

Louise Bartlett
Analyst

Engineer

Date



49-05-307

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer Hueco Bolson  Field No. R-99  State Well No. 49-05-308

Owner's Well No. City 60  County El Paso

1. Location: 1/4, 1/4 Sec., Block, Survey
31 59 09 N 106 23 30.1
2. Owner: City of El Paso  Address:
Tenant:  Address:
Driller: City  Address:
3. Elevation of LSD is 4062 ft. above msl, determined by 7½ TOPO
4. Drilled: 4 1965; Dug, Cable Tool, Rotary,
5. Depth: Rept. 701 ft. Meas. ft.
6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed
7. Pump: Mfgr. Type
No. Stages, Bowls Diam. in., Setting ft.
Column Diam. none in., Length Tailpipe ft.
8. Motor: Fuel / Make & Model HP.
9. Yield: Flow gpm, Pump gpm, Meas., Rept., Est.
10. Performance Test: Date Length of Test Made by
Static Level ft. Pumping Level ft. Drawdown ft.
Production gpm Specific Capacity gpm/ft.

CASING & BLANK PIPE
Cemented From ft. to ft.

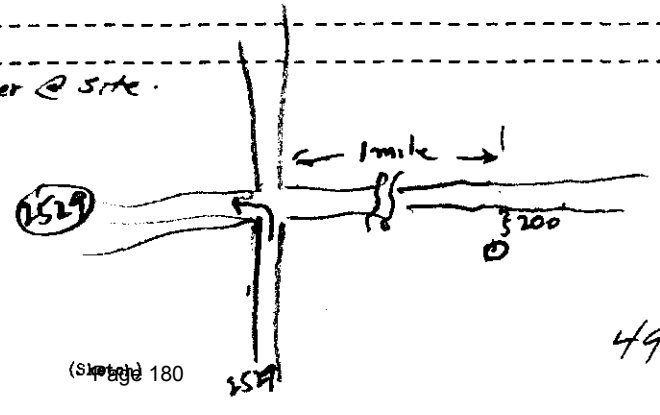
| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| | none | | |

11. Water Level: 367 ft. rept. meas. 4/28 1965 above below which is ft. above below surface.
ft. rept. meas. 19 above below which is ft. above below surface.
ft. rept. meas. 19 above below which is ft. above below surface.
ft. rept. meas. 19 above below which is ft. above below surface.
12. Use: Dom., Stock, Public Supply, Ind., Irr., Waterflooding, Observation, Not Used, test hole
13. Quality: (Remarks on taste, odor, color, etc.)
Temp. °F, Date sampled for analysis Laboratory
Temp. °F, Date sampled for analysis Laboratory
Temp. °F, Date sampled for analysis Laboratory
14. Other data available as circled: Driller's Log, Radioactivity Log, (Electric Log)
Formation Samples, Pumping Test,
15. Record by: TWDB  Date 2/21 1975
Source of Date USGS well sched (ME Davis 5/17/65)
16. Remarks:

WELL SCREEN
Screen Openings

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| | | | |

Corrugated steel (barrel-like) marker @ site.




49-05-308

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer Hueco. Bolson deposits  Field No. R-102 Hueco E-6  State Well No. 49-05-309

Owner's Well No. _____  County El Paso

1. Location: NE 1/4, NE 1/4 Sec. 1, Block 81 Survey Twn 2
320002N 1062433.1

2. Owner: City of El Paso  Address: _____

Tenant: _____  Address: _____

Driller: City (Gill)  Address: _____

3. Elevation of LSD is 4025 ft. above msl, determined by Nilo Topo.

4. Drilled: 10 1965; Dug, Cable Tool, Rotary, _____

5. Depth: Rept. 795 ft. Meas. _____ ft.

6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed _____

7. Pump: Mfgr. Jensen Bros Type piston

No. Stages _____, Bowls Diam. _____ in., Setting _____ ft.

Column Diam. _____ in., Length Tailpipe _____ ft.

8. Motor: Fuel Butane Make & Model Wisconsin HP. _____

9. Yield: Flow _____ gpm, Pump _____ gpm, Meas., Rept., Est. _____

10. Performance Test: Date _____ Length of Test _____ Made by _____

Static Level _____ ft. Pumping Level _____ ft. Drawdown _____ ft.

Production _____ gpm Specific Capacity _____ gpm/ft.

CASING & BLANK PIPE
Cemented From _____ ft. to _____ ft.

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 4" | | | 660 |
| | | | |
| | | | |
| | | | |
| | | | |

11. Water Level: 315.89 ft. rept. meas. 12/29 1965 above below Top of Csg which is 3.0 ft. above below surface.

✓ 315 ft. rept. meas. 10/15 1965 above below " which is " ft. above below surface.

350.88 ft. rept. meas. Jan 1974 above below LSD which is _____ ft. above below surface.

_____ ft. rept. meas. 19__ above below which is _____ ft. above below surface.

12. Use: Dom., Stock, Public Supply, Ind., Irr., Waterflooding, Observation, Not Used, _____

13. Quality (Remarks on taste, odor, color, etc.) _____

Temp. ___ °F, Date sampled for analysis _____ Laboratory _____

Temp. ___ °F, Date sampled for analysis _____ Laboratory _____

Temp. ___ °F, Date sampled for analysis _____ Laboratory _____

14. Other data available as circled: Driller's Log, Radioactivity Log, Electric Log,

Formation Samples, Pumping Test, _____

15. Record by: TWDB Date 2/21 1975

Source of Data USGS well sched (ME Davis 10/7/65)

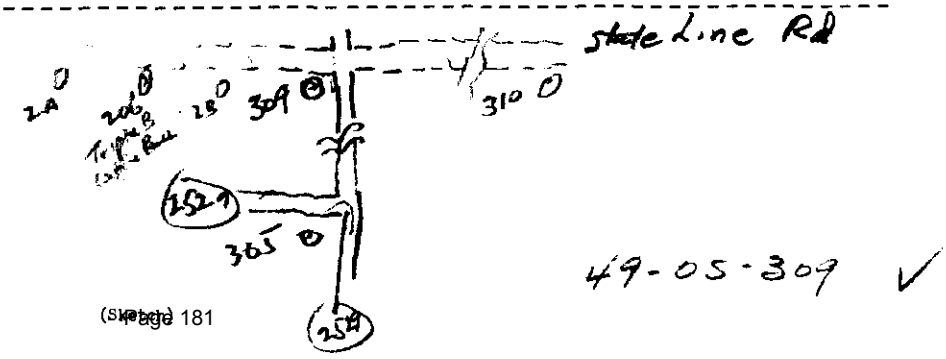
16. Remarks:

Fresh water base 715

4/3/75 pumping (Supplying Triple B Cattle Co. Ranch House & Stables)

WELL SCREEN
Screen Openings _____

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| | slotted | 510 | 550 |
| | | 610 | 650 |
| | | | |
| | | | |
| | | | |




49-05-309 ✓

JL-49-05-309
LF4
4/17/91

# EL PASO WATER UTILITIES
## WATER ANALYSIS REPORT

DATE SAMPLE COLLECTED: 04-17-91
DATE RECEIVED AT LABORATORY: 04-17-91
DATE ANALYSIS COMPLETED: 05-01-91

WELL NUMBER: LF4
LAB NUMBER:
LOCATION: LANDFILL 4
OWNER:
SAMPLE TAKER: SPERKA
DELIVERED BY: SPERKA

| ANIONS | mg/L | me/L | DIL E.C. |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.0 | ********** | |
| Total Alkalinity as CaCO3 | 77.1 | ********** | |
| Carbonates as CO3 | 0.0 | 0.0000 | 0 |
| Bicarbonates as HCO3 | 94.1 | 1.5426 | 67 |
| Chlorides as Cl | 50.0 | 1.4103 | 107 |
| Sulfates as SO4 | 23.8 | 0.4950 | 37 |
| Fluorides as F | 0.6 | 0.0320 | ******* |
| Nitrates as NO3 LOD=0.1 | 1.8 | 0.0290 | 2 |
| Total Phosphates as PO4 LOD=0.09 | 0.0 | 0.0000 | ******* |
| TOTAL ANIONS | 170 | 3.5090 | 213 |
| **CATIONS** | | | |
| Total Hardness as CaCO3 | 72 | ********** | |
| Calcium as Ca | 24.1 | 1.2050 | 63 |
| Magnesium Mg | 2.8 | 0.2295 | 11 |
| Sodium as Na | 48.8 | 2.1227 | 104 |
| Potassium as K | 2.3 | 0.0596 | 4 |
| TOTAL CATIONS | 78 | 3.6168 | 182 |
| TDS BY EPWU METHOD (1)= | 248 | 7.1258 | 395 |
| TDS BY USGS METHOD (2)= | 230 | | |
| TDS BY TDH METHOD (3)= | 200 | | |

| | |
|---|---|
| Silica, SiO2 = | 30.00 |
| Chlorine Res. = | N/A |
| Turbidity, NTU= | 31.00 |
| Sample Temp(C)= | 23.60 |
| pH @ 23.60 | 8.24 |
| Lab E.C.@25C as umhos/cm = | 381 |
| Field E.C. @25C as umhos/cm = | 410 |
| pH Saturation = | 8.20 |
| Langelier Index | 0.04 |
| Aggress. Index= | 11.98 |
| % Na of T.Cat.= | 57 |

CHECKING CORRECTNESS OF ANALYSIS

| | |
|---|---|
| Measured Diluted E.C. | 405 |
| Calculated Diluted E.C. | 395 |
| % Error | -2.58% |

ANION-CATION BALANCE
Total Anions - Total Cations = -0.1078
+or-(0.1065+0.0155*T.Anions)
Maximum Limit +/- 0.1609

KEY PUNCHED

ANALYST Rosa Aguirre

WATER SUPPLY MGR Douglas Williams
P.O. BOX 511
EL PASO, TEXAS 79961

(1) SUM OF IONS, NOT INCLUDING SILICA
(2) SUM OF IONS WITH CONVERSION OF HCO3 TO CO3, PLUS SILICA.
(3) SUM OF IONS, NOT INCLUDING SILICA WITH CONVERSION OF HCO3 TO CO3.

JL-49-05-309
LF # 4
4/18/91

# METAL ANALYSIS REPORT

LAB. NUMBER: 041891-20
SOURCE NAME: LANDFILL #4
SAMPLE TYPE: GRAB
COLLECT DATE: 04/18/91
COLLECT TIME: 13:00
REQUEST BY: ROGER SPERKA
DATE REPORTED: JULY 1, 1991

| METAL | SYMBOL | METHOD | RESULT (mg/L) | DETECTION LIMIT | ANALYST | DATE ANALYSED |
|---|---|---|---|---|---|---|
| Arsenic | As | EPA 206.2 | <0.0100 | .0100 | VR | 06/24/91 |
| Barium | Ba | EPA 208.2 | 0.1085 | .0100 | VR | 06/24/91 |
| Boron | B | | 0.12 | .10 | VR | 06/25/91 |
| Cadmium | Cd | EPA 213.2 | 0.0010 | .0005 | VR | 06/21/91 |
| Calcium | Ca | EPA 215.1 | 24.82 | 10.00 | VR | 06/11/91 |
| Chromium | Cr | EPA 218.2 | <0.0100 | .0100 | VR | 06/21/91 |
| Copper | Cu | EPA 220.2 | <0.0100 | .0100 | VR | 06/21/91 |
| Iron | Fe | EPA 236.1 | <0.100 | .100 | VR | 05/31/91 |
| Lead | Pb | EPA 239.2 | 0.0093 | .0050 | VR | 06/21/91 |
| Lithium | Li | | 0.022 | .010 | VR | 05/31/91 |
| Magnesium | Mg | EPA 242.1 | 4.14 | 2.00 | VR | 06/11/91 |
| Manganese | Mn | EPA 243.1 | <0.050 | .050 | VR | 05/31/91 |
| Mercury | Hg | EPA 245.1 | <0.0010 | .0010 | VR | 06/18/91 |
| Nickel | Ni | EPA 249.2 | <0.0100 | .0100 | VR | 07/01/91 |
| Phosphorus | P | | <1.00 | 1.00 | VR | 05/31/91 |
| Potassium | K | EPA 258.1 | <5.00 | 5.00 | VR | 06/11/91 |
| Selenium | Se | EPA 270.2 | <0.0100 | .0100 | VR | 06/24/91 |
| Silver | Ag | EPA 272.2 | <0.0010 | .0010 | VR | 06/24/91 |
| Sodium | Na | EPA 273.1 | 50.8 | 50.0 | VR | 06/11/91 |
| Zinc | Zn | EPA 289.1 | 0.253 | .100 | VR | 05/31/91 |

KEY PUNCHED

APPROVED
JUL 01 1991
BY: Victoria Rodriguez

JL-44-00-501
LF-4 309
4/19/90

# EL PASO WATER UTILITIES
## WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED | 04/19/90 | WELL NUMBER | LF-4 |
| DATE RECEIVED AT LABORATORY | 04/19/90 | LAB. NUMBER | C041990-5 |
| DATE ANALYSIS COMPLETED | 05/02/90 | LOCATION | |
| | | OWNER | EPWU |
| | | SAMPLE TAKER | R. SPERKA |
| | | DELIVERED BY | R. SPERKA |

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 2.00 | ****** | ****** |
| Total Alkalinity as CaCO3 | 84 | ****** | ****** |
| Carbonates as CO3 | 2.44 | .081325 | 7 |
| Bicarbonates as HCO3 | 98 | 1.59966 | 70 |
| Chlorides as Cl | 55 | 1.55155 | 118 |
| Sulfates as SO4 | 26.8 | .557976 | 41 |
| Fluorides as F | 0.70 | .036848 | ****** |
| Nitrates as NO3 | 8.30 | .133879 | 10 |
| Total Phosphates as PO4 LOD=.09 | 0.00 | 0 | ****** |
| Total Anions = | 191 | 3.96124 | 245 |

| CATIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Total Hardness as CaCO3 | 72 | ****** | ****** |
| Calcium as Ca | 26.5 | 1.32235 | 69 |
| Magnesium as Mg | 1.41 | .115987 | 5 |
| Sodium as Na | 55 | 2.3925 | 117 |
| Potassium as K | 3.39 | .086682 | 6 |
| Total Cations = | 86 | 3.91752 | 197 |
| TDS BY EPWU METHOD (1)= | 277 | 7.87876 | 443 |
| TDS BY USGS METHOD (2)= | 260 | | |
| TDS BY TDH METHOD (3)= | 228 | | |

| | |
|---|---|
| Silica, SiO2 = | 32.00 |
| Chlorine Res. = | N/A |
| Turbidity,ntu = | 19.00 |
| Sample Temp(C)= | 22 |
| pH @ 22 | 8.41 |
| Lab E.C.@25C as umhos/cm = | 360 |
| Field E.C. @25C as umhos/cm = | 400 |
| pH Saturation = | 8.16 |
| Langelier Ind.= | 0.25 |
| Aggress. Index= | 12.19 |
| % Na of T Cat.= | 61 |

Remarks
LOD = LIMIT OF DETECTION

CHECKING CORRECTNESS OF ANALYSIS

| | |
|---|---|
| Measured Diluted E.C. = | 438 |
| Calculated Diluted E.C.= | 442 |
| % Error = | 0.90 |

(1) SUM OF IONS, NOT INCLUDING SILICA
(2) SUM OF IONS WITH CONVERSION OF HCO3 TO CO3, PLUS SILICA.
(3) SUM OF IONS, NOT INCLUDING SILICA WITH CONVERSION OF HCO3 TO CO3.

ANION-CATION BALANCE
Total Anions - Total Cations = SD: 0.30
+or-(0.1065+0.0155* T.ANIONS)
.043723=<+or-1SD= +or- .167899 MAX. LIMIT

ANALYST Juan McBee

WATER SUPPLY MGR

PO BOX 511
EL PASO, TEXAS 79961

KEY PUNCHED

(SEE SHARPED CHANGES)
ADDED PERFORATIONS IN JULY 1988
330-360' 30 ft SO CALLED LANDFILL WELL LF-4
OVER 370-400' 30
420-450' 30
= 90'

JL-49-05-309
7/18/89

EL PASO WATER UTILITIES
WATER ANALYSIS REPORT

OLD TE-6 ORIG SCRD INTERVAL
510-550 } 40
610-650 } 40
280'

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED | 07/13/89 | WELL NUMBER | LF-4 |
| DATE RECEIVED AT LABORATORY | 07/13/89 | LAB. NUMBER | C071389- 5 |
| DATE ANALYSIS COMPLETED | 08/07/89 | LOCATION | SURFACE |
| | | OWNER | EPWU |
| | | SAMPLE TAKER | R. SPERKA |
| | | DELIVERED BY | R. SPERKA |

WTR TABLE SAMPLE

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.00 | ****** | ****** |
| Total Alkalinity as CaCO3 | 66 | ****** | ****** |
| Carbonates as CO3 | 0.00 | 0 | 0 |
| Bicarbonates as HCO3 | 81 | 1.31972 | 58 |
| Chlorides as Cl | 55 | 1.55155 | 118 |
| Sulfates as SO4 | 25.6 | .532992 | 39 |
| Fluorides as F | 0.66 | .034637 | ****** |
| Nitrates as NO3 LOD=0.443 | 10.05 | .162107 | 12 |
| Total Phosphates as PO4 LOD=.09 | 0.00 | 0 | ****** |
| Total Anions = | 172 | 3.60101 | 226 |

| | |
|---|---|
| Silica, SiO2 = | N/A |
| Chlorine Res. = | N/A |
| Turbidity,ntu = | 0.82 |
| Sample Temp(C)= | 25 |
| pH @ 25 | 7.66 |
| Lab E.C.@25C as umhos/cm = | 398 |
| Field E.C. @25C as umhos/cm = | 410 |
| pH Saturation = | 8.17 |
| Langelier Ind.= | -0.51 |
| Aggress. Index= | 11.36 |
| % Na of T Cat.= | 58 |

| CATIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Total Hardness as CaCO3 | 76 | ****** | ****** |
| Calcium as Ca | 28.05 | 1.39970 | 73 |
| Magnesium as Mg | 1.45 | .119277 | 6 |
| Sodium as Na | 47.9 | 2.08365 | 102 |
| Potassium as K CALCULATED AS NA | 0.00 | 0 | 0 |
| Total Cations = | 77 | 3.60262 | 180 |
| TOTAL DISSOLVED SOLIDS = | 249 | 7.20363 | 406 |

Remarks ______________
LOD = LIMIT OF DETECTION

TAG#-

CHECKING CORRECTNESS OF ANALYSIS
Measured Diluted E.C. = 410
Calculated Diluted E.C.= 406
% Error = -0.98

ANION-CATION BALANCE
Total Anions - Total Cations =
+or-(0.1065+0.0155* T.ANIONS)
-.00161=<+or-1SD= +or- .162316 MAX. LIMIT

ANALYST J. McGill

KEY PUNCHED

WATER SUPPLY MGR Douglas Rittmann
PO BOX 511
EL PASO, TEXAS 79961

JL-49-05-389
LF-4
11/13/89

DATE SAMPLE COLLECTED: 07-13-89
DATE RECEIVED AT LAB: 07-14-89
DATE ANALYSIS COMPLETED: 07-20-89
SAMPLE IDENTIFICATION: LF-4
OWNER: EPWU
DEPTH OF WELL:
LABORATORY #: 071489-1

| ANIONS | mg/L | me/L | DIL E.C. |
|---|---|---|---|
| p-ALK (CaCO3) | | ********** | |
| t-ALK (CaCO3) | 82.00 | ********** | |
| CARBONATES AS CO3 | 0.00 | 0.00 | 0.00 |
| BICARBONATES AS HCO3 | 100.04 | 1.64 | 71.53 |
| CHLORIDES AS Cl | 59.30 | 1.67 | 126.90 |
| SULFATES AS SO4 | 36.00 | 0.54 | 40.04 |
| FLOURIDES AS F | 0.70 | 0.04 | ********* |
| NITRATES AS NO3 | 7.13 | 0.11 | 8.20 |
| TOTAL PHOSPHATES AS PO4 | | 0.00 | ********* |
| TOTAL ANIONS | 193.17 | 4.01 | 246.67 |
| CATIONS | | | |
| t-HARDNESS AS CaCO3 | 71.02 | ********** | |
| CALCIUM AS Ca | 23.20 | 1.16 | 60.32 |
| MAGNESIUM AS Mg | 3.16 | 0.26 | 12.07 |
| SODIUM AS Na | 52.20 | 2.27 | 111.19 |
| POTASSIUM AS K | 3.56 | 0.09 | 6.55 |
| TOTAL CATIONS | 82.12 | 3.78 | 190.13 |

| | | | |
|---|---|---|---|
| E. COND | | pH: | 8.20 |
| TDS AT 103 C | 260.00 | TURBIDITY | |
| CALCULATED TDS | 275.29 | SiO4: | |
| | | Cl2 RES: | |
| CHECKING CORRECTNESS OF ANALYSIS | | TEMP OF ANALYSIS: | |
| MEASURED DILUTED E.C. | | pH SATUR: | 8.51 |
| CALCULATED DILUTED E.C. | 436.80 | LANG IND: | -0.31 |
| % ERROR | ERR | AGGR IND: | 11.97 |
| ANION/CATION BALANCE | | FIELD | |
| t-ANIONS - t-CATIONS= | 0.23 | F.C.: | 410.00 |
| MAXIMUM LIMIT +/- | 0.17 | %NA OF T. CAT.: | 60.1% |

KEY PUNCHED

ANALYST: _____

CHEMIST: _____

APPROVED

OCT 13 1989

BY: _____

EL PASO WATER UTILITIES PUBLIC SERVICE BOARD

# WATER ANALYSIS DATA SHEET TL-49-05-309

Plant Sample Well Number 6 Location R-102

| SAMPLE NUMBER | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| DEPTH | | | CITY PULLED PUMP & | | | |
| SAMPLE COLLECTED | 3-13-80 | | JETTED. | | | |
| RECEIVED AT LABORATORY | 3-14-80 | | SLTD 510 - 550 | | | |
| ANALYSIS COMPLETED | 3-27-80 | | | 610 - 650 | | |
| pH @ 23° C | 8.0 | | | | | |
| EC | 390 | | | | | |
| $CaCO_3$ SATURATION INDEX | -.2 | | | | | |
| SODIUM PER CENT OF TOTAL CATIONS | 70% | | | | | |

MILLIGRAMS PER LITER

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTAL DISSOLVED SOLIDS | ~~261~~ | 270 ppm | | | | |
| PHENOL ALKALINITY AS $Ca\ CO_3$ | 0 | | | | | |
| TOTAL ALKALINITY AS $Ca\ CO_3$ | 78 | | | | | |
| TOTAL HARDNESS AS $Ca\ CO_3$ | 68 | | | | | |
| CHLORIDES AS Cl | 64 | | | | | |
| SULFATES AS $SO_4$ | 18 | | | | | |
| FLUORIDES AS F | .46 | | | | | |
| SILICA AS $SiO_2$ | 25 | | | | | |
| NITRATE AS N | 2.0 | | | | | |
| TOTAL PHOSPHATES AS P less than | <.02 | | | | | |
| CALCIUM AS Ca | 22 | | | | | |
| MAGNESIUM AS Mg | 2.9 | | | | | |
| SODIUM | 59 | | | | | |
| POTASSIUM | --- | | | | | |
| TOTAL IRON AS Fe less than | <0.1 | | | | | |
| MANGANESE AS MN | .04 | | | | | |
| CHLORINE RESIDUAL | --- | | | | | |
| TURBIDITY, N.T.U. | 3.4 | | | | | |
| | | | | | | |

| CHECKING CORRECTNESS OF ANALYSIS: | | | | | | |
|---|---|---|---|---|---|---|
| MEASURED DILUTED E. C. | 430 | | | | | |
| CALCULATED DILUTED E. C. | 435 | | | | | |
| % ERROR | +1.2% | | | | | |

Remarks: Sample collected by jetting after cleaning out the well. Collected by Roger Sperka.

49-05-309

Douglas D. Mittman
Analyst

FORM 4518 - 0879

Geological Survey

Remarks: DST #3

UNITED STATES DEPARTMENT OF THE INTERIOR
Ground Water Analysis

Water Resources Division
Austin, Texas

State: Texas 4 9 | County: El Paso J L | Well No. | Latitude 3 2 0 0 0 2 N | Longitude 1 0 6 2 4 3 3 | Seq. No. 1 | Date M D Y 1 0 6 6 5 | Sampling Depth | Type

Well No. R-102 E-6 Location McCombs Road and Texas-New Mexico State Line. NE ¼ sec 1 Blk 81 Township 2. Type of well: test
Owner: City of El Paso Date drilled: 10/1965 Depth: 795 WBF Bolson Deposits Prod. intervals 691 to 716 Water level 315
Sampled after pumping 4 hours Yield 20 gpm. jet. pump Pt. of coll. discharge pipe Appearance clear Use Test Collector M. E. Davis

$10^6$ R KCl 36.8 R sample 106. 1016

pH 6.7 Temperature °F 79

| Density at 20°C | ppm | epm |
|---|---|---|
| $SiO_2$ 5 ml, A sample 1.292, Factor 26 | 34. | |
| Al ml, A 0.00250 mg, .00625 mg, .0125 mg, .025 mg, Sample | ppm | |
| Fe ml, A 0.025 mg, Sample | Total ppm, Dissolved ppm | |
| Mn ml, A 0.05 mg, .10 mg, .25 mg, .50 mg, Sample | Total ppm, Dissolved ppm | |
| 50 ml, 4.50 | 145 | 2.25 |
| epm Ca + Mg 2.72, epm Ca 2.25, epm Mg 0.47 | 57 | 0.47 |
| Na .18 .72 / 46 x 23 = 32 6 | Na + K Calc. 1216 | 5.46 |
| K | | |
| Percent error | Total cations | 2.73 |

| | ppm | epm |
|---|---|---|
| $HCO_3$ 50 ml 3.65, Total Alk as $CO_3$ 36 | 173 | 1.20 |
| $CO_3$ 50 ml | 0 | 0.00 |
| $SO_4$ 10 ml, Blk, Std, Sample 1.76 | 1351 | 0.73 |
| Cl 25 ml 10.90 | 2158 | 6.15 |
| Source, No. | | |
| F 10 ml, A 0.00 ppm 1.500, 1.00 ppm, 2.00 ppm, A sample 1.254 | 0.6 | 0.03 |
| $NO_3$ ml std. 10 ml, A sample .197, A ml std, A ml std, Factor | 4.5 | 0.07 |
| $NO_2$ ml, A 0.01 mg, .02 mg, .05 mg, Sample | ppm | |
| $PO_4$ ml, Ortho, Total, A 0.0050 mg, .0100 mg, .0250 mg, .0500 mg, Sample | | |
| | Total anions | |

B ml, A mg, mg, mg

Al, Fe, Mn

Cu, Pb, Zn

Dissolved solids: Determined, Calculated 505

Hardness 50 ml 6.80, epm Ca + Mg 2.72, epm Alk 1.20, epm NCH 1.52

Color, No.

Br, I

Alk. as $CaCO_3$, Free $CO_2$

Percent Na 67, SAR 4.7, RSC 0.0

MRAS, No.

Analyst A. J. DUPUY Checked by
Date begun DEC 6 Completed DEC 10 1965

| Transmittals | Date |
|---|---|
| Records processing---- | |
| Collector---- | |
| Owner---- | |

R-102

Recorded by: Punched by: Date:

Geological Survey

UNITED STATES DEPARTMENT OF THE INTERIOR
Ground Water Analysis

Water Resources Division
Austin, Texas

Remarks: DST #2

State: Texas 49 | County: El Paso | JL | Well No. 320002N | Latitude | 1062433 | Longitude | Seq. No. 1 | Date M 10 D 16 Y 65 | Sampling Depth | Type

Owner's Well No. R-102 E-6 Location McCombs Road and Texas-New Mexico State line. NE ¼ sec 1 Blk 81 Township 2. Type of well: test

Owner: City of El Paso Date drilled: 10/1965 Depth: 795 WBF Bolson Deposits Prod. intervals 595 to 620 Water level 315

Sampled after pumping 3 hours Yield 20 GPM Ft. of coll. discharge pipe Appearance clear Use Test Collector M. E. Davis

$10^6$ R KCl 36.8 R sample 510 — 7.20

pH 6.91 — Temperature °F 79

| Density at 20°C | ppm | epm |
|---|---|---|
| $O_2$ 5 ml, A sample 1.364, Factor 26 | 33. | |
| Al ml, A 0.00250 mg, .00625 mg, .0125 mg, .025 mg, Sample | ppm | |
| Fe ml, A 0.025 mg, Sample | Total ppm, Dissolved ppm | |
| Mn ml, A 0.05 mg, .10 mg, .25 mg, .50 mg, Sample | Total ppm, Dissolved ppm | |
| Ca 100 ml, 6.20 | 311 | 1.55 |
| Mg epm Ca + Mg 1.88, epm Ca 1.55, epm Mg 0.33 | 40. | 0.33 |
| Na 66 81. 1.78×23 = 118 | | |
| Na + K Calc. | 110. | 4.78 |
| K | | |
| Percent error | Total cations | 6.66 |

| | ppm | epm |
|---|---|---|
| $HCO_3$ 80 ml, 4.90, Total Alk as $CO_3$ 48 | 491 | 1.61 |
| $CO_3$ 0 ml | 0 | 0.00 |
| $SO_4$ 10 ml (25→100), Blk, Std, Sample 0.50 | 480 | 0.83 |
| Cl 25 ml, 7.30 | 1410 | 4.12 |
| Source 79, No. 80 | | |
| F 10 ml, A 0.00 ppm 1.500, 1.00 ppm, 2.00 ppm, A sample 1.224 | 17 | 0.04 |
| $NO_3$ ml std. 10 ml, A sample 1.54, A ml std, A ml std, Factor 23 | 35. | 0.06 |
| $NO_2$ ml, A 0.01 mg, .02 mg, .05 mg, Sample | ppm | |
| $PO_4$ ml Ortho Total, A 0.0050 mg, .0100 mg, .0250 mg, .0500 mg, Sample | | |
| 097204 | | |
| Total anions | | 6.66 |

| | |
|---|---|
| B ml, A mg, mg, mg | |
| Al | Fe, Mn |
| Cu | Pb, Zn |
| Dissolved solids: Determined | Calculated 416 |
| Hardness 100 ml, epm Ca + Mg 1.88, epm Alk 1.61, epm NCB 0.27 | 9.70 — 194 |
| Color | No. |
| Br | I |
| Alk. as $CaCO_3$ | Free $CO_2$ |
| Percent Na 72 | SAR 4.9 — RSC .00 |
| MBAS | No. |

Analyst A. J. DUPUY Checked by HC

Date begun DEC 6 1965 Completed DEC 10 1965

| Transmittals | Date |
|---|---|
| Records processing---- | |
| Collector---- | |
| Owner---- | |

R-102

Recorded by: Punched by: Date:

Page 189

49-05-309

Geological Survey — UNITED STATES DEPARTMENT OF THE INTERIOR — Ground Water Analysis — Water Resources Division, Austin, Texas

Remarks: DST #1

State: Texas 49 (1-2) County: El Paso JL (3-4) Well No. Latitude 320002N (5-11) Longitude 1062433 (12-18) Seq. No. 1 (19) Date M D Y 10 15 65 (20-25) Sampling Depth (26-29) Type (30)

Well No. R-102 E-6 Location McCombs Road and Texas and New Mexico State line. NE ¼ sec 1, Blk 81, Township 2. Type well: test

Owner: City of El Paso Date drilled: 10/1965 Depth: 795 WBF Bolson Deposits Prod. intervals 490 to 515 Water level 315

Sampled after pumping 2 hours Yield: 20 GPM Pt. of coll. Discharge pipe Appearance clear Use Test Collector M. E. Davis

$10^6$ R KCl 366 R sample 861 — 4217 (31-35)

| | | ppm | epm |
|---|---|---|---|
| pH 7.21 (36-38) | Temperature °F 78 (39-41) | | |
| Density at 20°C | | ppm | epm |
| $SiO_2$ 5 ml; A sample 1.308 Factor 36 — 34 (42-44) | | | |
| Al ml; A 0.00250 mg; .00625 mg; .0125 mg; .025 mg; Sample | | ppm | |
| Fe ml; A 0.025 mg; Sample; Total ppm; Dissolved ppm | | | |
| Mn ml; A 0.05 mg; .10 mg; .25 mg; .50 mg; Sample; Total ppm; Dissolved ppm | | | |
| Ca 100 ml; 4.70 — 124 (45-49) | | | 1.198 |
| Mg epm Ca + Mg 1.380; epm Ca 1.198; epm Mg 0.182 — 22 (50-53) | | | 0.182 |
| Na 100 / 330 / 720 × 23 = 69 — 54 (54-58) | | | |
| | Na + K Calc. — 63 (59-61) | | 2.720 |
| K | | | |
| $HCO_3$ ml 5.50 — 110 (62-65) | | | 1.803 |
| Total Alk as $CO_3$ 54 | | | |
| $CO_3$ 50 ml — 0 (66-67) | | | 0.000 |
| $SO_4$ 10 ml (50→100); Blk; Std; Sample 1.102 — 41 (68-72) | | | 0.854 |
| Cl 50 ml 4.60 / 4.50 — 46 (73-76) | | | 1.27 |
| Source 79; No. 80 | | | |
| F 10 ml; A 0.00 ppm 1.500; 1.00 ppm; 2.00 ppm; A sample 1.176 — 05 (26-28) | | | 0.05 |
| $NO_3$ ml std. 10 ml; A sample 2.8; A ml std .112; A 1.0 ml std 2.3 Factor 23 — 64 (29-32) | | | 0.103 |
| $NO_2$ ml; A 0.01 mg; .02 mg; .05 mg; Sample | | ppm | |
| $PO_4$ ml Ortho Total; A 0.0050 mg; .0100 mg; .0250 mg; .0500 mg; Sample (33-35) | | | |

097203

B ml; A mg; mg; mg — (36-38)

Al (39-41) Fe (42-45) Mn (46-49)

Cu (50-52) Pb (53-54) Zn (55-57)

Dissolved solids: Determined (58-63) Calculated 2711 (64-69)

Hardness 100 ml; epm Ca + Mg 1.380; epm Alk 1.803; epm NCH 0.000 — 69 (42-45) — 6.90 — (46-49)

Color (62-64) No. (80)

Br (26-28) I (29-31)

Alk. as $CaCO_3$ (32-35) Free $CO_2$ (36-38)

Percent Na SAR 3.3 (39-41) RSC 4.2 (42-44)

MBAS (45-47) No. (80)

Analyst S. J. DUPUY Checked by

Date begun DEC Completed DEC 10 1965

| Transmittals | Date |
|---|---|
| Records processing---- | |
| Collector---- | |
| Owner---- | |

R-102

Page 100

EL PASO WATER UTILITIES PUBLIC SERVICE BOARD

# WATER ANALYSIS DATA SHEET

JL-49-05-309
3/13/80

Plant Sample  Well Number TE 6  Location

| Sample Number | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Depth | 510-550 610-650 | | TD = 597' @ 14 Jul 88 | | | |
| Sample Collected | 3-13-80 | | i. sample jetted from | | | |
| Received at Laboratory | 3-14-80 | | the 510-550 interval. | | | |
| Analysis Completed | 3-27-80 | | | | | |
| pH @ 23° C | 8.0 | | | | | |
| E C | 390 | | | | | |
| Ca $CO_3$ Saturation Index | -.2 | | | | | |
| Sodium Per Cent of Total Cations | 70% | | | | | |

MILLIGRAMS PER LITER

| | | | | | | |
|---|---|---|---|---|---|---|
| Total Dissolved Solids | ~~261~~ | 270 D/D/C | | | | |
| Phenol Alkalinity as Ca $CO_3$ | 0 | | | | | |
| Total Alkalinity as Ca $CO_3$ | 78 | | | | | |
| Total Hardness as Ca $CO_3$ | 68 | | | | | |
| Chlorides as Cl | 64 | | | | | |
| Sulfates as $SO_4$ | 18 | | | | | |
| Fluorides as F | .46 | | | | | |
| Silica as $SiO_2$ | 25 | | | | | |
| Nitrate as N | 2.0 | as $NO_3$ 8.9 | | | | |
| Total Phosphates as P less than | <.02 | as PO4 <0.06 | | | | |
| Calcium as Ca | 22 | | | | | |
| Magnesium as Mg | 2.9 | | | | | |
| Sodium | 59 | | | | | |
| Potassium | --- | | | | | |
| Total Iron as Fe less than | <0.1 | | | | | |
| Manganese as Mn | .04 | | | | | |
| Chlorine Residual | --- | | | | | |
| Turbidity, N.T.U. | 3.4 | | | | | |
| | | | | | | |

| Checking Correctness of Analysis: | | | | | | |
|---|---|---|---|---|---|---|
| Measured Diluted E. C. | 430 | | | | | |
| Calculated Diluted E. C. | 435 | | | | | |
| % Error | +1.2% | | | | | |

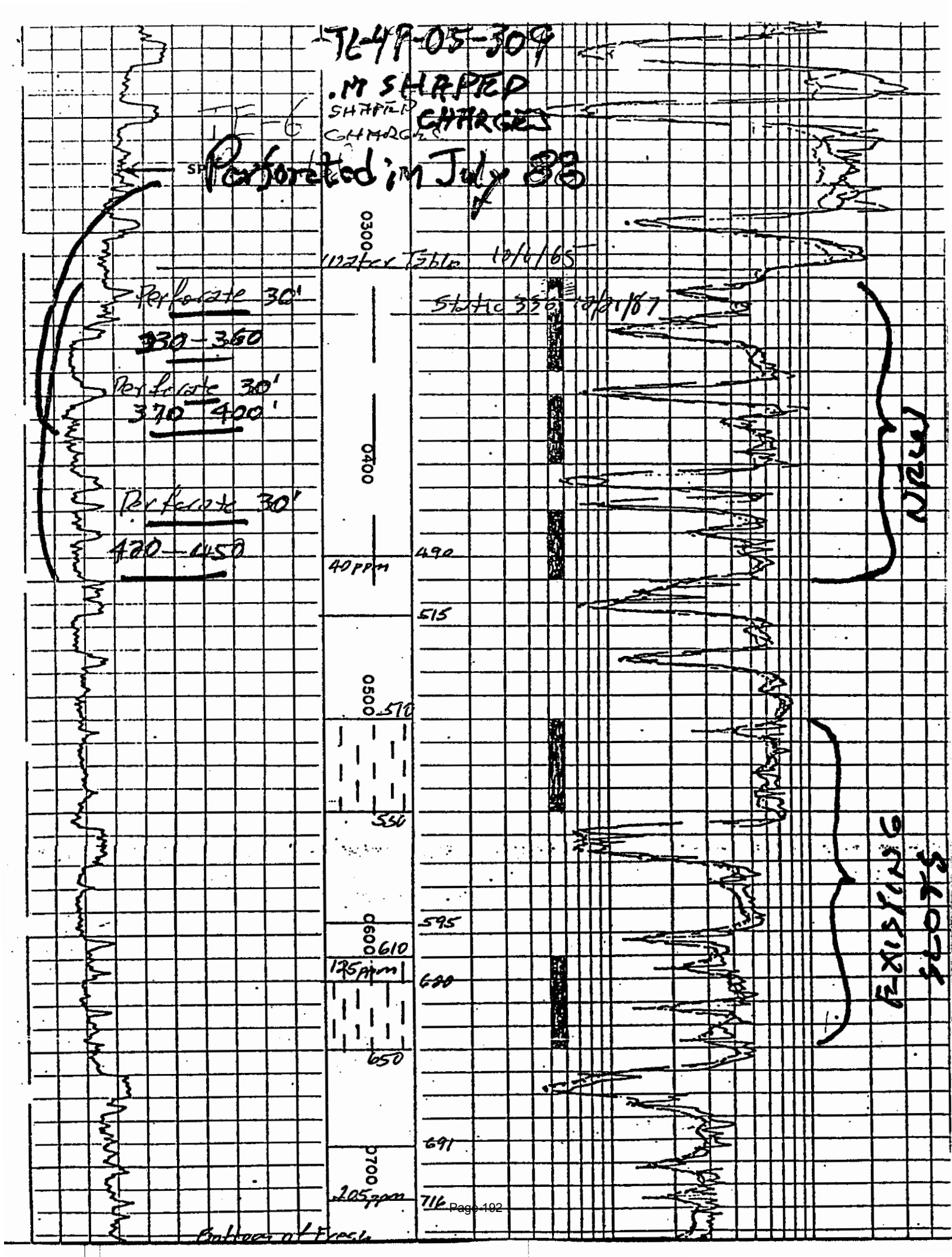
Remarks: Sample collected by jetting after cleaning out the well. Collected by Roger Sperka.

KEY PUNCHED

Douglas D. Rathman
Analyst



FORM 4518 - 0879


TC-49-05-309
.M SHAPED
SHAPED CHARGES
Perforated in July 88
0300
Water Table 10/6/65
Perforate 30'
330-360
Static 320 10/21/87
Perforate 30'
370-400'
0400
Perforate 30'
420-450
40 ppm
490
515
0500
570
550
595
0600
610
175 ppm
620
650
691
0700
205 ppm
716
Existing
New
Page 102

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Do not use ball point pen

Texas Department of Health Laboratories
1100 West 49th Street
Austin, Texas 78756

TDWR ONLY
Organization No. _____ Lab No. 02
Work No. _____

# CHEMICAL WATER ANALYSIS REPORT

County 071
State Well No. 49-05-309
Well No. _____
Date Collected 10-05-65

Send report to:

Data Collection and Evaluation Section
Texas Department of Water Resources
P.O. Box 13087
Austin, Texas 78711

Owner _____ Send copy to owner Sample No. _____ By _____
Address _____ Well Location _____
Date Drilled _____ Depth _____ ft. WBF _____ Source (type of well) _____
Producing intervals _____ Water level _____ ft. Sample depth 015 ft.
Sampled after pumping _____ hrs. Yield _____ GPM meas. est. Temperature _____ °F _____ °C
Point of collection _____ Appearance ☐ clear ☐ turbid ☐ colored ☐ other
Use _____ Remarks _____

(FOR LABORATORY USE ONLY)

## CHEMICAL ANALYSIS

Laboratory No. _____ Date Received _____ KEY PUNCHED Date Reported _____

| | | MG/L | ME/L |
|---|---|---|---|
| Silica | 00955 | 34 | |
| Calcium | 00910 | 24 | |
| Magnesium | 00920 | 2 | |
| Sodium | 00929 | 63 | |
| | Total | | |
| ☐ Potassium | 00937 | | |
| [3] ☐ Manganese | 01055 | | |
| ☐ Boron | 01022 | | |
| [3] ☐ Total Iron | 01045 | | |
| ☐ (other) _____ | | MG/L | |

%Na _____
SAR _____
RSC _____

Specific Conductance (micromhos/cm[3]) 00095 _____
Diluted Conductance (micromhos/cm[3]): _____ x _____ = 427

" ☐ " items will be analyzed if checked.

| | | MG/L | ME/L |
|---|---|---|---|
| Carbonate | 00445 | 0 | |
| Bicarbonate | 00440 | 110 | |
| Sulfate | 00945 | 41 | |
| Chloride | 00940 | 46 | |
| Fluoride | 00951 | .8 | |
| Nitrate | 71850 | 6.40 | |
| pH | 00403 | | |
| | Total | | |
| [1] Dissolved Solids (residue at 180°C) | 70300 | 271 | |
| Phenolphthalein Alkalinity as $CaCO_3$ | 00415 | | |
| Total Alkalinity as $CaCO_3$ | 00410 | | |
| Total Hardness as $CaCO_3$ | 00900 | | 69 |

[2] Nitrogen Cycle

| | | |
|---|---|---|
| Ammonia - N | 00610 | |
| Nitrite - N | 00615 | |
| Nitrate - N | 00620 | |
| Organic Nitrogen | 00605 | |

[1] The bicarbonate reported in this analysis can be converted by computation (multiplying by 0.4917) to an equivalent amount of carbonate, and the carbonate figure used in the computation of dissolved solids.
[2] Nitrogen cycle requires separate sample.
[3] Total Iron and Manganese require separate sample.



Analyst _____ Checked By _____

TDWR-0148 (Rev. 9-26-83)

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(soft pencil or black ink)
Do not use ball point pen

Texas Department of Health Laboratories
1100 West 49th Street
Austin, Texas 78756

TDWR ONLY
Organization No. _____ Lab No. 02
Work No. _____

# CHEMICAL WATER ANALYSIS REPORT

County 071
State Well No. 49-05-309
Well No. _____
Date Collected 10-06-65

Send report to:

Data Collection and Evaluation Section
Texas Department of Water Resources
P.O. Box 13087
Austin, Texas 78711

Owner _____ ___ Send copy to owner Sample No. 2 By _____
Address _____ Well Location _____
Date Drilled _____ Depth _____ ft. WBF _____ Source (type of well) _____
Producing intarvals _____ Water level _____ ft. Sample depth 0716 ft.
Sampled after pumping _____ hrs. Yield _____ GPM meas. est. Temperature ___°F ___°C
Point of collection _____ Appearance ☐ clear ☐ turbid ☐ colored ☐ other
Use _____ Remarks _____

(FOR LABORATORY USE ONLY)

## CHEMICAL ANALYSIS

KEY PUNCHED

Laboratory No. _____ Date Received _____ Date Reported _____

| | | MG/L | ME/L |
|---|---|---|---|
| Silica | 00955 | 34 | |
| Calcium | 00910 | 45 | |
| Magnesium | 00920 | 6 | |
| Sodium | 00929 | 126 | |
| | Total | | |
| ☐ Potassium | 00937 | | |
| [3] ☐ Manganese | 01055 | | |
| ☐ Boron | 01022 | | |
| [3] ☐ Total Iron | 01045 | | |
| ☐ (other) _____ | | | |

%Na _____
SAR _____
RSC _____

| | | MG/L | ME/L |
|---|---|---|---|
| Carbonate | 00445 | 0 | ? |
| Bicarbonate | 00440 | 73 | |
| Sulfate | 00945 | 35 | |
| Chloride | 00940 | 218 | |
| Fluoride | 00951 | 6 | |
| Nitrate | 71850 | 4.50 | |
| pH | 00403 | | |
| | Total | | |
| [1] Dissolved Solids (residue at 180°C) | 70300 | | 505 |
| Phenolphthalein Alkalinity as $CaCO_3$ | 00415 | | |
| Total Alkalinity as $CaCO_3$ | 00410 | | |
| Total Hardness as $CaCO_3$ | 00900 | | 136 |

[2] Nitrogen Cycle

| | | |
|---|---|---|
| Ammonia - N | 00610 | |
| Nitrite - N | 00615 | |
| Nitrate - N | 00620 | |
| Organic Nitrogen | 00605 | |

Specific Conductance (micromhos/cm3) 00095 _____
Diluted Conductance (micromhos/cm3): _____ x _____ = 906

" ☐ " items will be analyzed if checked.

[1] The bicarbonate reported in this analysis can be converted by computation (multiplying by 0.4917) to an equivalent amount of carbonate, and the carbonate figure used in the computation of dissolved solids.
[2] Nitrogen cycle requires separate sample.
[3] Total Iron and Manganese require separate sample.

TDWR-0148 (Rev. 9-26-83)


Analyst _____ Checked By _____

Typewrite (Black ribbon) or Print Plainly
(soft pencil or black ink)
Do not use ball point pen

Texas Department of Health Laboratories
1100 West 49th Street
Austin, Texas 78756

TDWR ONLY
Organization No. _____ Lab No. 02
Work No. _____

# CHEMICAL WATER ANALYSIS REPORT

Send report to:

Data Collection and Evaluation Section
Texas Department of Water Resources
P.O. Box 13087
Austin, Texas 78711

County 071
State Well No. 49-05-309
_____ Well No. _____
Date Collected 10-06-65

Owner _____ Send copy to owner Sample No. 1 By _____
Address _____ Well Location _____
Date Drilled _____ Depth _____ ft. WBF _____ Source (type of well) _____
Producing intervals _____ Water level _____ ft. Sample depth 0620 ft.
Sampled after pumping _____ hrs. Yield _____ GPM meas. est. Temperature °F °C
Point of collection _____ Appearance ☐ clear ☐ turbid ☐ colored ☐ other
Use _____ Remarks _____

(FOR LABORATORY USE ONLY)

## CHEMICAL ANALYSIS

Laboratory No. _____ Date Received _____ KEY PUNCHED Date Reported _____

| | | MG/L | ME/L |
|---|---|---|---|
| Silica | 00955 | 33 | |
| Calcium | 00910 | 31 | |
| Magnesium (.33) | 00920 | < 1 | |
| Sodium | 00929 | 110 | |
| | Total | | |
| ☐ Potassium | 00937 | | |
| [3] ☐ Manganese | 01055 | | %Na _____ |
| ☐ Boron | 01022 | | SAR _____ |
| [3] ☐ Total Iron | 01045 | | RSC _____ |
| ☐ (other) _____ | | MG/L | |

Specific Conductance (micromhos/cm3) 00095 _____
Diluted Conductance (micromhos/cm3): _____ x _____ = 722

" ☐ " items will be analyzed if checked.

| | | MG/L | ME/L |
|---|---|---|---|
| Carbonate | 00445 | 0 | |
| Bicarbonate | 00440 | 98 | |
| Sulfate | 00945 | 40 | |
| Chloride | 00940 | 146 | |
| Fluoride | 00951 | 7 | |
| Nitrate | 71850 | 3.50 | |
| pH | 00403 | | |
| | Total | | |
| [1] Dissolved Solids (residue at 180°C) | 70300 | 416 | |
| Phenolphthalein Alkalinity as $CaCO_3$ | 00415 | | |
| Total Alkalinity as $CaCO_3$ | 00410 | | |
| Total Hardness as $CaCO_3$ | 00900 | 94 | |
| [2] Nitrogen Cycle | | | |
| Ammonia - N | 00610 | | |
| Nitrite - N | 00615 | | |
| Nitrate - N | 00620 | | |
| Organic Nitrogen | 00605 | | |

[1] The bicarbonate reported in this analysis can be converted by computation (multiplying by 0.4917) to an equivalent amount of carbonate, and the carbonate figure used in the computation of dissolved solids.
[2] Nitrogen cycle requires separate sample.
[3] Total Iron and Manganese require separate sample.



Analyst _____ Checked By _____

TDWR-0148 (Rev. 9-26-83)

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer Hueco Bolson  Field No. T-2 Zone No. R-3  State Well No. 49 05 310

Owner's Well No. _____  County El Paso

1. Location: NE corner 1/4, _____ 1/4 Sec. 6, Block 80 Survey T-1-S

31 59 59 N 106 23 42.1

2. Owner: USGS  Address: _____

Tenant: _____  Address: _____

Driller: B & W Drilling Co of Texas  Address: _____

3. Elevation of 4060.8 LSD is _____ ft. above msl, determined by 7½ topo.

4. Drilled: _____ 5 1953 ; Dug, Cable Tool, Rotary, _____

5. Depth: Rept. 950 ft. Meas. _____ ft.

6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed _____

7. Pump: Mfgr. _____ Type _____

No. Stages _____, Bowls Diam. _____ in., Setting _____ ft.

Column Diam. none in., Length Tailpipe _____ ft.

8. Motor: Fuel none Make & Model _____ HP. _____

9. Yield: Flow _____ gpm, Pump _____ gpm, Meas., Rept., Est. _____

10. Performance Test: Date _____ Length of Test _____ Made by _____

Static Level _____ ft. Pumping Level _____ ft. Drawdown _____ ft.

Production _____ gpm Specific Capacity _____ gpm/ft.

11. Water Level: 3472 ft. rept. meas. 5/16 1953 above below LSD which is _____ ft. above below surface.

_____ ft. rept. meas. _____ 19 _____ above below _____ which is _____ ft. above below surface.

_____ ft. rept. meas. _____ 19 _____ above below _____ which is _____ ft. above below surface.

_____ ft. rept. meas. _____ 19 _____ above below _____ which is _____ ft. above below surface.

12. Use: Dom., Stock, Public Supply, Ind., Irr., Waterflooding, Observation, Not Used, test filled.

13. Quality: (Remarks on taste, odor, color, etc.) _____

Temp. _____ °F, Date sampled for analysis _____ Laboratory _____

Temp. _____ °F, Date sampled for analysis _____ Laboratory _____

Temp. _____ °F, Date sampled for analysis _____ Laboratory _____

14. Other data available as circled: Driller's Log, Radioactivity Log, Electric Log, Formation Samples, Pumping Test, sample log

15. Record by: TWDB  Date 3/21 1975

Source of Data USGS well sched (DBK 3/16/54)

16. Remarks:

DST: 444-484, 555-595, 740-783

plugged:

Elec. log and DST's indicate fresh-water sands extend to 380'.

could not locate.

CASING & BLANK PIPE

Cemented From _____ ft. to _____ ft.

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| none | | | |

WELL SCREEN

Screen Openings _____

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| | | | |

(Sketch)

49-05-310 ✓

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer Hueco Bolson  Field No. M-22-6 Office R-6  State Well No. 49-05-311

Owner's Well No. _____  County El Paso

1. Location: NW 1/4, NE 1/4 Sec. 18, Block 80 Survey T-1-S

31 58 11 N 106 23 49.1

2. Owner: El Paso Nat. Gas Co  Address: _____

Tenant: _____  Address: _____

Driller: Geo. McKenzie  Address: _____

3. Elevation of 4030.3 USD is _____ ft. above msl, determined by Hilltop

4. Drilled: Jan 19 51; Dug, Cable Tool, Rotary, _____

5. Depth: Rept. 750 ft. Meas. _____ ft.

6. Completion: Open Hole, Straight Wall, Underreamed, (Gravel Packed)

7. Pump: Mfgr. Pomona Type Turbine

No. Stages _____, Bowls Diam. _____ in., Setting 540 ft.

Column Diam. _____ in., Length Tailpipe _____ ft.

8. Motor: Fuel Electric Make & Model _____ HP. 25

9. Yield: Flow _____ gpm, Pump 150 gpm, Meas., (Rept.), Est.

10. Performance Test: Date _____ Length of Test _____ Made by _____

Static Level _____ ft. Pumping Level _____ ft. Drawdown _____ ft.

Production _____ gpm Specific Capacity _____ gpm/ft.

CASING & BLANK PIPE

Cemented From _____ ft. to _____ ft.

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| | Steel | | |

11. Water Level: 340 ft. (rept.) meas. 10/2 1951 (above) below pump block which is 3.0 ft. (above) below surface.

_____ ft. rept. meas. _____ 19__ above below _____ which is _____ ft. above below surface.

_____ ft. rept. meas. _____ 19__ above below _____ which is _____ ft. above below surface.

_____ ft. rept. meas. _____ 19__ above below _____ which is _____ ft. above below surface.

12. Use: Dom., Stock, Public Supply, (Ind.), Irr., Waterflooding, Observation, Not Used, _____

13. Quality: (Remarks on taste, odor, color, etc.) _____

Temp. ___ °F, Date sampled for analysis _____ Laboratory _____

Temp. ___ °F, Date sampled for analysis _____ Laboratory _____

Temp. ___ °F, Date sampled for analysis _____ Laboratory _____

WELL SCREEN

Screen Openings _____

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| | Screen | | |

14. Other data available as circled: Driller's Log, Radioactivity Log, Electric Log,

Formation Samples, Pumping Test, _____

15. Record by: TWDB Date 7/21 1975

Source of Data USGS well sched (JW Hood 10/3/51)

16. Remarks:

PL = 349 on 10/2/51

Shelter on 30²

49-05-311 ✓

TWDBE-WD-2

(Sketch)

tm 5-46 (3-69)

TOWR
co pits

EL PASO NATURAL GAS COMPANY
SOUTHERN DIVISION LABORATORY
WATER ANALYSIS

JL-49-05-311

Location El Paso Compressor Station Well No. 4 Date April 3, 1974
Depth 605' NW/4 NE/4, Sec. 18, Blk. 80, T-1, T&P R.R.
Date Sample Taken

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | | | |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | 12-12 1969 | 4-29 1970 | 6-4 1971 | 4-18 1972 | 4-16 1973 |
| ,H | | | | | | | | | | 7.8 | 7.2 | 7.5 | 7.8 | 7.9 |
| Alkalinity s Ca $CO_3$ | | | | | | | | | | 0 | 0 | 0 | 0 | 0 |
| otal Alkalinity s Ca $CO_3$ | | | | | | | | | | 93 | 85 | 100 | 95 | 85 |
| hloride as Cl | | | | | | | | | | 96 | 121 | 71 | 99 | 170 |
| ulfate as $SO_4$ | | | | | | | | | | 53 | 50 | 37.5 | 69.5 | 104 |
| otal Hardness s Ca $CO_3$ | | | | | | | | | | 108 | 116 | 88 | 124 | 208 |
| alcium s Ca $CO_3$ | | | | | | | | | | 72 | 88 | 60 | 80 | 148 |
| agnesium s Ca $CO_3$ | | | | | | | | | | 36 | 28 | 28 | 44 | 60 |
| odium as Na | | | | | | | | | | | | | | |
| ilica as $SiO_2$ | | | | | | | | | | 80 | 31 | 25.4 | 29.2 | 31.2 |
| on as Fe | | | | | | | | | | .015 | 0.12 | 0 | 0 | .09 |
| Flouride as F | | | | | | | | | | | | | | |
| otassium s K | | | | | | | | | | | | | | |
| reatment | | | | | | | | | | | | | | |
| PM | | | | | | | | | | | | | | |
| otal Dissolved olids | | | | | | | | | | 407 | 434 | 356 | 442 | 583 |
| pecific Conductance, icromhos | | | | | | | | | | 611 | 660 | 513 | 640 | 904 |

*— All results expressed as ppm or micromhos —*

Remarks:

Analyst

Engineer

Date



49-05-311

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPANY
SOUTHERN DIVISION LABORATORY
WATER ANALYSIS

Location El Paso

Date May 2, 1974

Date Sample Taken April 22, 1974

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | #2 | #4 | #5 |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | | | |
| pH | | | | | | | | | | | | 7.8 | 7.8 | 7.6 |
| P Alkalinity as $CaCO_3$ | | | | | | | | | | | | 0 | 0 | 0 |
| Total Alkalinity as $CaCO_3$ | | | | | | | | | | | | 70 | 80 | 83 |
| Chloride as Cl | | | | | | | | | | | | 213 | 174 | 192 |
| Sulfate as $SO_4$ | | | | | | | | | | | | 208 | 92.5 | 140 |
| Total Hardness as $CaCO_3$ | | | | | | | | | | | | 252 | 210 | 252 |
| Calcium as $CaCO_3$ | | | | | | | | | | | | 184 | 152 | 176 |
| Magnesium as $CaCO_3$ | | | | | | | | | | | | 68 | 58 | 76 |
| [illegible]ium as Na | | | | | | | | | | | | 152 | 97 | 115 |
| Silica as $SiO_2$ | | | | | | | | | | | | 19.2 | 30 | 31.4 |
| Iron as Fe | | | | | | | | | | | | .01 | .003 | .003 |
| Fluoride as F | | | | | | | | | | | | 0.5 | 0.55 | 0.52 |
| Potassium as K | | | | | | | | | | | | | | |
| Treatment | | | | | | | | | | | | | | |
| PPM | | | | | | | | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | 768 | 567 | 670 |
| Specific Conductance; Micromhos | | | | | | | | | | | | 1073 | 915 | 1004 |

*— All results expressed as ppm or micromhos —*

Remarks:

Louise Bartlett
Analyst

Engineer

Date



49-05-311

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPAN
SOUTHERN DIVISION LABORATORY
WATER ANALYSIS

JL-49-05-311

Location El Paso

Date July 19, 1974

Date Sample Taken July 16, 1974

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | #4 | #5 | |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | | | |
| pH | | | | | | | | | | | | 7.9 | 7.6 | |
| P Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 0 | 0 | |
| Total Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 80 | 80 | |
| Chloride as Cl | | | | | | | | | | | | 210 | 192 | |
| Sulfate as $SO_4$ | | | | | | | | | | | | | | |
| Total Hardness as Ca $CO_3$ | | | | | | | | | | | | 270 | 270 | |
| Calcium as Ca $CO_3$ | | | | | | | | | | | | 180 | 180 | |
| Magnesium as Ca $CO_3$ | | | | | | | | | | | | | | |
| Sodium as Na | | | | | | | | | | | | | | |
| Silica as $SiO_2$ | | | | | | | | | | | | | | |
| Iron as Fe | | | | | | | | | | | | | | |
| Fluoride as F | | | | | | | | | | | | | | |
| Potassium as K | | | | | | | | | | | | | | |
| Treatment | | | | | | | | | | | | | | |
| PPM | | | | | | | | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | | | |
| Specific Conductance, Micromhos | | | | | | | | | | | | 1029 | 1043 | |

*– All results expressed as ppm or micromhos –*

Remarks:

Louise Bartlett
Analyst

Engineer

Date



49-05-311

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPANY
SOUTHERN DIVISION LABORATORY
WATER ANALYSIS

JC-49-05-311
DC-49-05-307

Location El Paso

Date July 16, 1975

Date Sample Taken July 14, 1975

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | #4 | #5 | |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | | | |
| pH | | | | | | | | | | | | 8.1 | 8.1 | |
| P Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 0 | 0 | |
| Total Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 88 | 75 | |
| Chloride as Cl | | | | | | | | | | | | 236 | 256 | |
| Sulfate as $SO_4$ | | | | | | | | | | | | | | |
| Total Hardness as Ca $CO_3$ | | | | | | | | | | | | 310 | 340 | |
| Calcium as Ca $CO_3$ | | | | | | | | | | | | 210 | 240 | |
| Magnesium as Ca $CO_3$ | | | | | | | | | | | | | | |
| Sodium as Na | | | | | | | | | | | | | | |
| Silica as $SiO_2$ | | | | | | | | | | | | | | |
| Iron as Fe | | | | | | | | | | | | | | |
| Fluoride as F | | | | | | | | | | | | | | |
| Potassium as K | | | | | | | | | | | | | | |
| Treatment | | | | | | | | | | | | | | |
| PPM | | | | | | | | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | | | |
| Specific Conductance, Micromhos | | | | | | | | | | | | 1184 | 1271 | |

*– All results expressed as ppm or micromhos –*

Remarks:

Louise Bartlett
Analyst

Engineer

Date



49-05-311

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPANY
SOUTHERN DIVISION LABORATORY
WATER ANALYSIS

Location El Paso

Date November 5, 1975

Date Sample Taken October 14, 1975

49-05-311

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | #4 | #5 | |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | | | |
| pH | | | | | | | | | | | | 7.5 | 7.7 | |
| P Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 0 | 0 | |
| Total Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 85 | 78 | |
| Chloride as Cl | | | | | | | | | | | | 121 | 118 | |
| Sulfate as $SO_4$ | | | | | | | | | | | | 120 | 135 | |
| Total Hardness as Ca $CO_3$ | | | | | | | | | | | | 330 | 320 | |
| Calcium as Ca $CO_3$ | | | | | | | | | | | | 274 | 252 | |
| Magnesium as Ca $CO_3$ | | | | | | | | | | | | 56 | 68 | |
| Sodium as Na | | | | | | | | | | | | 23 | 53 | |
| Silica as $SiO_2$ | | | | | | | | | | | | 26.4 | 26.4 | |
| Iron as Fe | | | | | | | | | | | | .01 | .01 | |
| Fluoride as F | | | | | | | | | | | | .34 | .50 | |
| Potassium as K | | | | | | | | | | | | | | |
| Treatment | | | | | | | | | | | | | | |
| PPM | | | | | | | | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | 617 | 547 | |
| Specific Conductance, Micromhos | | | | | | | | | | | | 1266 | 1234 | |

*– All results expressed as ppm or micromhos –*

Remarks:

Joe Barnett/Jim Anderson
Analyst

Engineer

Date



49-05-311

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPANY
SOUTHERN DIVISION LABORATORY
WATER ANALYSIS

Location El Paso

Date January 19, 1976

Date Sample Taken January 14, 1976

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | #4 | #5 | |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | | | |
| pH | | | | | | | | | | | | 7.7 | 7.8 | |
| P Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 0 | 0 | |
| Total Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 80 | 80 | |
| Chloride as Cl | | | | | | | | | | | | 242 | 242 | |
| Sulfate as $SO_4$ | | | | | | | | | | | | | | |
| Total Hardness as Ca $CO_3$ | | | | | | | | | | | | 340 | 336 | |
| Calcium as Ca $CO_3$ | | | | | | | | | | | | 252 | 248 | |
| Magnesium as Ca $CO_3$ | | | | | | | | | | | | | | |
| [illegible]ium as Na | | | | | | | | | | | | | | |
| Silica as $SiO_2$ | | | | | | | | | | | | | | |
| Iron as Fe | | | | | | | | | | | | | | |
| Fluoride as F | | | | | | | | | | | | | | |
| Potassium as K | | | | | | | | | | | | | | |
| Treatment | | | | | | | | | | | | | | |
| PPM | | | | | | | | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | | | |
| Specific Conductance, Micromhos | | | | | | | | | | | | 1262 | 1271 | |

*– All results expressed as ppm or micromhos –*

Remarks:

Louise Bartlett
Analyst

Engineer

Date



49-05-311

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPANY
SOUTHERN DIVISION LABORATORY
WATER ANALYSIS

JL-49-05-311

Location El Paso

Date April 30, 1976

Date Sample Taken April 27, 1976

| SYSTEM | OPEN | | | CLOSED | | | | "C" | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | ~~XXXXX~~ AMB. | SOFT | ~~XXXX~~ | RAW | #4 | #5 | |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | Soft ~~XXXX~~ | RAW | | | |
| pH | 7.4 | | | 7.6 | 8.2 | 7.7 | 7.6 | 8.5 | 7.6 | 8.3 | | 7.4 | 7.7 | |
| P Alkalinity as Ca $CO_3$ | 0 | | | 0 | 0 | 0 | 0 | 80 | 0 | 0 | | 0 | 0 | |
| Total Alkalinity as Ca $CO_3$ | 30 | | | 305 | 500 | 210 | 475 | 3620 | 80 | 95 | | 80 | 80 | |
| Chloride as Cl | 952 | | | 242 | 228 | 256 | 256 | | 270 | 136 | | 328 | 256 | |
| Sulfate as $SO_4$ | | | | | | | | | | | | 190 | 185 | |
| Total Hardness as Ca $CO_3$ | 1270 | | | 84 | 120 | 106 | 260 | 0 | 368 | 2 | | 432 | 348 | |
| Calcium as Ca $CO_3$ | 950 | | | 58 | 80 | 72 | 182 | | 272 | 0 | | 320 | 252 | |
| Magnesium as Ca $CO_3$ | | | | | | | | | | | | 112 | 96 | |
| S[illegible]m as Na | | | | | | | | | | | | 143 | 133 | |
| Silica as $SiO_2$ | | | | | | | | | | | | 27.2 | 24.2 | |
| Iron as Fe | | | | | | | | | | | | 0 | .002 | |
| Fluoride as F | | | | | | | | | | | | 0.54 | 0.445 | |
| Potassium as K | | | | | | | | | | | | | | |
| Treatment | Nalco 360 | | | Drb 517 | Drb 517 | Drb 517 | Drb 517 | | | | | | | |
| PPM | 31.75 | | | 1125 | 1380 | 750 | 1230 | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | 941 | 819 | |
| Specific Conductance, Micromhos | 3956 | | | 2151 | | 1825 | | | 1310 | 786 | | 1479 | 1236 | |

*– All results expressed as ppm or micromhos –*

Remarks: "C"-40 degrees minus zero
51.5% glycol

Louise Bartlett
Analyst

Engineer

Date



49-05-311

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPANY

SOUTHERN DIVISION LABORATORY

WATER ANALYSIS

JJ-49-05-311 JZ-49-05-294

Location El Paso

Date July 22, 1976

Date Sample Taken July 19, 1976

| SYSTEM | OPEN | | | CLOSED | | | | "C" | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | #4 | $5 | |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | | | |
| pH | 7.4 | 7.9 | 7. | 7.8 | 8.5 | 7.9 | 8.4 | 8.5 | 8.4 | | | 7.6 | 7.7 | |
| P Alkalinity as Ca $CO_3$ | 0 | 0 | | 0 | 5 | 0 | 3 | 130 | 3 | | | 0 | 0 | |
| Total Alkalinity as Ca $CO_3$ | 35 | 53 | | 238 | 460 | 155 | 498 | 3510 | 90 | | | 95 | 80 | |
| Chloride as Cl | 1804 | 2300 | | 242 | 228 | 250 | 306 | | 135 | | | 256 | 264 | |
| Sulfate as $SO_4$ | | | | | | | | | | | | | | |
| Total Hardness as Ca $CO_3$ | 2360 | 3020 | | 80 | 136 | 106 | 258 | 0 | 8 | | | 492 | 348 | |
| Calcium as Ca $CO_3$ | 1790 | 2260 | | 58 | 88 | 78 | 174 | | 0 | | | 372 | 272 | |
| Magnesium as Ca $CO_3$ | | | | | | | | | | | | | | |
| 'ium as Na | | | | | | | | | | | | | | |
| Silica as $SiO_2$ | | | | | | | | | | | | | | |
| Iron as Fe | | | | | | | | | | | | | | |
| Fluoride as F | | | | | | | | | | | | | | |
| Potassium as K | | | | | | | | | | | | | | |
| Treatment | Nalco 360 | Nalco 360 | | Drb 517 | Drb 517 | Drb 517 | Drb 517 | | | | | | | |
| PPM | 39.5 | 35.2 | | 870 | 1215 | 548 | 1275 | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | | | |
| Specific Conductance, Micromhos | 6846 | 8753 | | 1956 | | 1648 | | | 782 | | | 1628 | 1291 | |

*– All results expressed as ppm or micromhos –*

Remarks: "C" AMB-freezing point 40° minus zero
51.5% amb Fl

Louise Bartlett
Analyst

Engineer

Date



49-05-311

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPANY

SOUTHERN DIVISION LABORATORY

WATER ANALYSIS

JL-49-05-311

JL-49-05-307

Location El Paso

Date October 18, 1976

Date Sample Taken October 15, 1976

| FORAGE | | WELLS | | |
|---|---|---|---|---|
| BLEND | RAW | #4 | #5 | |
| DIS-TILLED | RAW | | | |
| | | 7.5 | 7.7 | |
| | | 0 | 0 | |
| | | 88 | 78 | |
| | | 338 | 256 | |
| | | | | |
| | | 464 | 352 | |
| | | 348 | 268 | |
| | | | | |
| | | | | |
| | | | | |
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| | | | | |
| | | | | |
| | | | | |
| | | 1516 | 1253 | |

Louise Barthelt

Analyst

Engineer



49-05-311

-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPANY
SOUTHERN DIVISION LABORATORY
WATER ANALYSIS

Location El Paso District

Date June 15, 1977

SL-49-05-311

Date Sample Taken June 15, 1977

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | #4 | | |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | | | |
| pH | | | | | | | | | | | | 7.9 | | |
| P Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 0 | | |
| Total Alkalinity as Ca $CO_3$ | | | | | | | | | | | | ~~175~~ | | |
| Chloride as Cl | | | | | | | | | | | | ~~206~~ | | |
| Sulfate as $SO_4$ | | | | | | | | | | | | ~~160~~ | | |
| Total Hardness as Ca $CO_3$ | | | | | | | | | | | | ~~260~~ | | |
| Calcium as Ca $CO_3$ | | | | | | | | | | | | ~~148~~ | | |
| Magnesium as Ca $CO_3$ | | | | | | | | | | | | ~~112~~ | | |
| [illegible]ium as Na | | | | | | | | | | | | ~~173~~ | | |
| Silica as $SiO_2$ | | | | | | | | | | | | ~~70~~ | | |
| Iron as Fe | | | | | | | | | | | | ~~.25~~ | | |
| Fluoride as F | | | | | | | | | | | | ~~1.5~~ | | |
| Potassium as K | | | | | | | | | | | | | | |
| Treatment | | | | | | | | | | | | | | |
| PPM | | | | | | | | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | ~~912~~ | | |
| Specific Conductance, Micromhos | | | | | | | | | | | | ~~1271~~ | | |

*– All results expressed as ppm or micromhos –*

Remarks: Believe this to be Station No. 3-Well 4
Richard Molder

Louise Bartlett
Analyst

Engineer

Date

49-05-311

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPAN

SOUTHERN DIVISION LABORATORY

# WATER ANALYSIS

Location El Paso

Date April 20, 1977

Date Sample Taken April 15, 1977

49-05-311

49-05-311

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | #4 | #5 | |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | | | |
| pH | | | | | | | | | | | | 8.0 | 8.0 | |
| P Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 0 | 0 | |
| Total Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 75 | 75 | |
| Chloride as Cl | | | | | | | | | | | | 250 | 250 | |
| Sulfate as $SO_4$ | | | | | | | | | | | | 166 | 166 | |
| Total Hardness as Ca $CO_3$ | | | | | | | | | | | | 328 | 334 | |
| Calcium as Ca $CO_3$ | | | | | | | | | | | | 250 | 230 | |
| Magnesium as Ca $CO_3$ | | | | | | | | | | | | 78 | 104 | |
| Sodium as Na | | | | | | | | | | | | 80 | 77 | |
| Silica as $SiO_2$ | | | | | | | | | | | | 30 | 30.8 | |
| Iron as Fe | | | | | | | | | | | | 0 | 0 | |
| Fluoride as F | | | | | | | | | | | | .56 | .44 | |
| Potassium as K | | | | | | | | | | | | | | |
| Treatment | | | | | | | | | | | | | | |
| PPM | | | | | | | | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | 738 | 734 | |
| Specific Conductance, Micromhos | | | | | | | | | | | | 1232 | 1232 | |

*– All results expressed as ppm or micromhos –*

Remarks:

Richard Bowen
Analyst

Engineer

Date



49-05-311

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPANY
SOUTHERN DIVISION LABORATORY
WATER ANALYSIS

SL-4-05-311

SL-4-05-304

( ition El Paso

Date July 19, 1977

Date Sample Taken July 15, 1977

| SYSTEM | OPEN | CLOSED | STORAGE | WELLS | | |
|---|---|---|---|---|---|---|
| | | | | #4 | #5 | |
| | | | | | | |
| | | | | 7.4 | 7.4 | |
| | | | | 0 | 0 | |
| | | | | 85 | 65 | |
| | | | | 203 | 306 | |
| | | | | | | |
| | | | | 592 | 396 | |
| | | | | 444 | 308 | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
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| | | | | | | |
| | | | | 1858 | 1417 | |

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49-05-311

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPANY
SOUTHERN DIVISION LABORATORY
WATER ANALYSIS

JL-49-05-311 JC-49-05-307

Location El Paso

Date October 19, 1977

Date Sample Taken October 14, 1977

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | #4 | #5 | |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | | | |
| pH | | | | | | | | | | | | 7.4 | 7.4 | |
| P Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 0 | 0 | |
| Total Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 85 | 68 | |
| Chloride as Cl | | | | | | | | | | | | 398 | 270 | |
| Sulfate as $SO_4$ | | | | | | | | | | | | | | |
| Total Hardness as Ca $CO_3$ | | | | | | | | | | | | 596 | 368 | |
| Calcium as Ca $CO_3$ | | | | | | | | | | | | 436 | 28– | |
| Magnesium as Ca $CO_3$ | | | | | | | | | | | | | | |
| [illegible]ium as Na | | | | | | | | | | | | | | |
| Silica as $SiO_2$ | | | | | | | | | | | | | | |
| Iron as Fe | | | | | | | | | | | | | | |
| Fluoride as F | | | | | | | | | | | | | | |
| Potassium as K | | | | | | | | | | | | | | |
| Treatment | | | | | | | | | | | | | | |
| PPM | | | | | | | | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | | | |
| Specific Conductance, Micromhos | | | | | | | | | | | | 1854 | 1320 | |

*– All results expressed as ppm or micromhos –*

Remarks:

Louise Bartlett
Analyst

Engineer

Date



49-05-311

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPANY
SOUTHERN DIVISION LABORATORY
WATER ANALYSIS

JL-49-05-311

Location El Paso

Date January 18, 1978

Date Sample Taken January 17, 1978

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | #4 | #5 | |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | | | |
| pH | | | | | | | | | | | | 8.0 | 8.0 | |
| P Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 0 | 0 | |
| Total Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 73 | 73 | |
| Chloride as Cl | | | | | | | | | | | | 253 | 249 | |
| Sulfate as $SO_4$ | | | | | | | | | | | | | | |
| Total Hardness as Ca $CO_3$ | | | | | | | | | | | | 352 | 348 | |
| Calcium as Ca $CO_3$ | | | | | | | | | | | | 252 | 252 | |
| Magnesium as Ca $CO_3$ | | | | | | | | | | | | | | |
| dium as Na | | | | | | | | | | | | | | |
| Silica as $SiO_2$ | | | | | | | | | | | | | | |
| Iron as Fe | | | | | | | | | | | | | | |
| Fluoride as F | | | | | | | | | | | | | | |
| Potassium as K | | | | | | | | | | | | | | |
| Treatment | | | | | | | | | | | | | | |
| PPM | | | | | | | | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | | | |
| Specific Conductance, Micromhos | | | | | | | | | | | | 1239 | 1239 | |

*– All results expressed as ppm or micromhos –*

Remarks:

Louise Bartlett
Analyst

Engineer

Date



49-05-311

Form 5-46 (Rev. 9-64)

EL PASO NATURAL GAS COMPANY
SOUTHERN DIVISION LABORATORY
WATER ANALYSIS

Jt-49-05-311 Jt-49-05-304

Location El Paso

Date April 20, 1978

Date Sample Taken April 18, 1978

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | #4 | #5 | |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | | | |
| pH | | | | | | | | | | | | 7.7 | 7.6 | |
| P Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 0 | 0 | |
| Total Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 70 | 70 | |
| Chloride as Cl | | | | | | | | | | | | 242 | 242 | |
| Sulfate as $SO_4$ | | | | | | | | | | | | 110 | 100 | |
| Total Hardness as Ca $CO_3$ | | | | | | | | | | | | 340 | 320 | |
| Calcium as Ca $CO_3$ | | | | | | | | | | | | 240 | 240 | |
| Magnesium as Ca $CO_3$ | | | | | | | | | | | | 100 | 80 | |
| Sodium as Na | | | | | | | | | | | | 85 | 90 | |
| Silica as $SiO_2$ | | | | | | | | | | | | 35.6 | 35.6 | |
| Iron as Fe | | | | | | | | | | | | .1 | .05 | |
| Floride as F | | | | | | | | | | | | .45 | .43 | |
| Potassium as K | | | | | | | | | | | | | | |
| Treatment | | | | | | | | | | | | | | |
| PPM | | | | | | | | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | 678 | 669 | |
| Specific Conductance, Micromhos | | | | | | | | | | | | 1235 | 1235 | |

*— All results expressed as ppm or micromhos —*

Remarks:

Louise Bartlett
Analyst

Engineer

Date



49-05-311

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer Hueco Bolson  Field No. M-203 office no. R-7  State Well No. 49-05-312

Owner's Well No. #2  County El Paso

1. Location: NW 1/4, NE 1/4 Sec. 18, Block 80 Survey T-1

31 58 11 N 106 23 49.2

2. Owner: El Paso Nat. Gas Co. Address:

Tenant: Address:

Driller: Address:

3. Elevation of 4031.2 est 50 ft. above msl, determined by 7½ TOPO

4. ~~Drilled~~: 19 ; Dug, Cable Tool, Rotary,

5. Depth: Rept. ± 630 ft. Meas. ft.

6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed T

7. Pump: Mfgr. Pomona Type

No. Stages , Bowls Diam. in., Setting ft.

Column Diam. in., Length Tailpipe ft.

8. Motor: Fuel Elect Make & Model HP.

9. Yield: Flow gpm, Pump 150 gpm, Meas., (Rept.) Est.

10. Performance Test: Date Length of Test Made by

Static Level ft. Pumping Level ft. Drawdown ft.

Production gpm Specific Capacity gpm/ft.

CASING & BLANK PIPE

Cemented From ft. to ft.

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

11. Water Level: 340.2 ft. rept. meas. 6/1/1953 above (below) LSD which is ft. above (below) surface.

ft. rept. meas. 19 above (below) which is ft. above (below) surface.

ft. rept. meas. 19 above (below) which is ft. above (below) surface.

ft. rept. meas. 19 above (below) which is ft. above (below) surface.

12. Use: Dom., Stock, Public Supply, (Ind.) Irr., Waterflooding, Observation, Not Used,

13. Quality: (Remarks on taste, odor, color, etc.)

Temp. °F, Date sampled for analysis Laboratory

Temp. °F, Date sampled for analysis Laboratory

Temp. °F, Date sampled for analysis Laboratory

14. Other data available as circled: Driller's Log, Radioactivity Log, Electric Log,

Formation Samples, Pumping Test,

15. Record by: TWDB Date 2/21 1975

Source of Data USGS well sched (J.W. Hood 10/3/51)

16. Remarks:

Can't get tape down 21-24 36-47 (owner)

WELL SCREEN

Screen Openings

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| | Slotted | 405 | 435 |
| | | 474 | 504 |
| | | 555 | 585 |
| | | 585 | 615 |
| | | | |
| | | | |

check w/ Dave Kelly for WL.

340

49-05-312

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPANY
SOUTHERN DIVISION LABORATORY
WATER ANALYSIS

JC-49-05-312
JC-49-05-314
JC-49-05-387

Location El Paso

Date May 2, 1974

Date Sample Taken April 22, 1974

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | #2 | #4 | #5 |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | | | |
| pH | | | | | | | | | | | | 7.8 | 7.8 | 7.6 |
| P Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 0 | 0 | 0 |
| Total Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 70 | 80 | 83 |
| Chloride as Cl | | | | | | | | | | | | 213 | 174 | 192 |
| Sulfate as $SO_4$ | | | | | | | | | | | | 208 | 92.5 | 140 |
| Total Hardness as Ca $CO_3$ | | | | | | | | | | | | 252 | 210 | 252 |
| Calcium as Ca $CO_3$ | | | | | | | | | | | | 184 | 152 | 176 |
| Magnesium as Ca $CO_3$ | | | | | | | | | | | | 68 | 58 | 76 |
| Sodium as Na | | | | | | | | | | | | 152 | 97 | 115 |
| Silica as $SiO_2$ | | | | | | | | | | | | 19.2 | 30 | 31.4 |
| Iron as Fe | | | | | | | | | | | | .01 | .003 | .003 |
| Fluoride as F | | | | | | | | | | | | 0.5 | 0.55 | 0.52 |
| Potassium as K | | | | | | | | | | | | | | |
| Treatment | | | | | | | | | | | | | | |
| PPM | | | | | | | | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | 768 | 567 | 670 |
| Specific Conductance; Micromhos | | | | | | | | | | | | 1073 | 915 | 1004 |

*– All results expressed as ppm or micromhos –*

Remarks:

Louise Bartlett
Analyst

Engineer

Date



49-05-312

Form 5-45 (Rev. 9-64)

EL PASO NATURAL GAS COMPANY
SOUTHERN DIVISION LABORATORY
WATER ANALYSIS

JL-49-05-312

Location El Paso Compressor Station Well No. 2 Date April 3, 1974
Depth 630' NW/4 NE/4, Sec. 15, Blk. 80, T-1, T&P R.R.
Date Sample Taken

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | | | |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | 12-12 1969 | 4-29 1970 | 6-4 1971 | 4-18 1972 | 4-16 1973 |
| H | | | | | | | | | | 7.6 | 7.7 | 7.5 | 7.6 | 7.8 |
| Alkalinity s Ca $CO_3$ | | | | | | | | | | 0 | 0 | 0 | 0 | 0 |
| otal Alkalinity s Ca $CO_3$ | | | | | | | | | | 60 | 53 | 40 | 60 | 70 |
| hloride as Cl | | | | | | | | | | 210 | 324 | 426 | 462 | 468 |
| ulfate as $SO_4$ | | | | | | | | | | 155 | 265 | 430 | 380 | 425 |
| otal Hardness s Ca $CO_3$ | | | | | | | | | | 290 | 500 | 728 | 804 | 852 |
| alcium s Ca $CO_3$ | | | | | | | | | | 224 | 404 | 564 | 612 | 652 |
| agnesium s Ca $CO_3$ | | | | | | | | | | 66 | 96 | 164 | 192 | 200 |
| odium as Na | | | | | | | | | | | | | | |
| lica as $SiO_2$ | | | | | | | | | | 32 | 27 | 30.4 | 28 | 28.6 |
| on as Fe | | | | | | | | | | .025 | 0 | .5 | .3 | .09 |
| loride as F | | | | | | | | | | | | | | |
| otassium s K | | | | | | | | | | | | | | |
| reatment | | | | | | | | | | | | | | |
| PM | | | | | | | | | | | | | | |
| otal Dissolved olids | | | | | | | | | | 678 | 999 | 1367 | 1373 | 1466 |
| ecific Con- ductance, icromhos | | | | | | | | | | 1114 | 1650 | 2110 | 2300 | 2426 |

*— All results expressed as ppm or micromhos —*

emarks:

P4 M68

Analyst

Engineer

Date



49-05-312

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPANY
SOUTHERN DIVISION LABORATORY
WATER ANALYSIS

Location El Paso

Date February 6, 1975

Date Sample Taken January 17, 1975

49-05-312

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | 2 | | |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | | | |
| pH | | | | | | | | | | | | 7.7 | | |
| P Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 0 | | |
| Total Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 160 | | |
| Chloride as Cl | | | | | | | | | | | | 604 | | |
| Sulfate as $SO_4$ | | | | | | | | | | | | 290 | | |
| Total Hardness as Ca $CO_3$ | | | | | | | | | | | | 890 | | |
| Calcium as Ca $CO_3$ | | | | | | | | | | | | 660 | | |
| Magnesium as Ca $CO_3$ | | | | | | | | | | | | 230 | | |
| Sodium as Na | | | | | | | | | | | | 193 | | |
| Silica as $SiO_2$ | | | | | | | | | | | | 28.4 | | |
| Iron as Fe | | | | | | | | | | | | 0 | | |
| Fluoride as F | | | | | | | | | | | | 0.26 | | |
| Potassium as K | | | | | | | | | | | | | | |
| Treatment | | | | | | | | | | | | | | |
| PPM | | | | | | | | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | 1630 | | |
| Specific Conductance, Micromhos | | | | | | | | | | | | 2868 | | |

*– All results expressed as ppm or micromhos –*

Remarks:

Louise Bartlett
Analyst

Engineer

Date



49-05-312

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Hueco Bolson

R-9

Aquifer from 340'  Field No. 214  State Well No. 49 05 313

Owner's Well No.  County El Paso

1. Location: 1/4, 1/4 Sec. 18, Block  Survey
31 57 37 N 106 23 59.1

2. Owner: Price's Dairy  Address:

Tenant:  Address:

Driller:  Address:

3. Elevation of 4007.5 LSD is  ft. above msl, determined by Nile Topo.

4. Drilled: Old. 19 ; Dug, Cable Tool, Rotary,

5. Depth: Rept. 360 ft. Meas. ft.

6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed

7. Pump: Mfgr. Type

No. Stages , Bowls Diam. in., Setting ft.

Column Diam. in., Length Tailpipe ft.

8. Motor: Fuel Windmill Make & Model HP.

9. Yield: Flow gpm, Pump gpm, Meas., Rept., Est.

10. Performance Test: Date Length of Test Made by

Static Level ft. Pumping Level ft. Drawdown ft.

Production gpm Specific Capacity gpm/ft.

CASING & BLANK PIPE

Cemented From ft. to ft.

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 5 | | | |

11. Water Level: 296.6 ft. rept. meas. 8/9 1935 above (below) top of lift pipe which is 5 ft. (above) below surface.

298.1 ft. rept. meas. 1/7 1954 above (below) LSD which is ft. above (below) surface.

ft. rept. meas. 19 above below which is ft. above below surface.

ft. rept. meas. 19 above below which is ft. above below surface.

12. Use: Dom., (Stock) Public Supply, Ind., Irr., Waterflooding, Observation, Not Used,

13. Quality: (Remarks on taste, odor, color, etc.)

Temp. °F, Date sampled for analysis Laboratory

Temp. °F, Date sampled for analysis Laboratory

Temp. °F, Date sampled for analysis Laboratory

WELL SCREEN

Screen Openings

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| | | | |

14. Other data available as circled: Driller's Log, Radioactivity Log, Electric Log,

Formation Samples, Pumping Test,

15. Record by: TWDB Date 7/21 1975

Source of Data USGS well sched (ANS 8/9/35)

16. Remarks:

Water pipe stuck in well. Measured through water pipe

4/4/75 Windmill destroyed

Well filled.



49-05-313 V

# Texas Water Development Board
## Well Schedule

**State Well Number** 4905314 **Previous Well Number** **County** El Paso 141

**River Basin** 23 Rio Grande **GMA** 5 **Latitude** 315925 **Longitude** 1062430 **Source of Coords** 1

**Owner's Well No.** _____ **Location** _____

**Owner**
Cemex Const. Material South, LLC

**Driller**
- -

**Address** _____ **Tenant/Oper.** _____

**Date Drilled** 06/ /1973 **Depth** 465 **Source of Depth** **Altitude** 4062 **Source of Alt.** M

**Well Type** W **User** 262550

**WELL CONSTRUCTION**

**Const-Method** blank

**Completion** blank

**Casing Material** Steel

**Screen Material** Steel

**Casing or Blank Pipe (C) Well Screen or Slotted Zone (S) or Open Hole (O) Cemented from____to____**

| | | | |
|---|---|---|---|
| C | 20 | 0 | 20 |
| C | 16 | 0 | 185 |
| C | 8 | 0 | 465 |
| S | 8 | 385 | 465 |

**LIFT DATA - Pump Mfr. -** _____ **Type -** TURBINE PUMP **No. Stages** _____

**Bowls Diam -** _____ **in.** **Setting -** _____ **ft.** **Column Diam. -** _____ **in.**

**Motor Mfr. -** _____ **Fuel or Power -** ELECTRIC MOTOR **Horsepower -** 75.0

**YIELD Flow-** _____ **GPM** **Pump-** _____ **GPM** **Meas.,Rept.,Est.-** _____ **Date-** _____

**WATER USE** **Primary -** INDUSTRIAL **Secondary -** blank **Tertiary -** blank

**OTHER DATA AVAILABLE** **Water Levels -** M **Quality -** N **Logs -** D **Other Data -**

**WATER LEVELS** 1 measurement
1973
-385

**Recorded By** _____ **Date Record Collected or Updated -** 04/02/1975

**Reporting Agency** 01

**REMARKS -**
Company Contact: Octavio Holguin

**Aquifer -** 112HCBL **ID -** 1

HUECO
BOLSON

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer Hueco Bolson  Field No. _____  State Well No. 49-05-314

Owner's Well No. _____  County El Paso

1. Location: ____ 1/4, ____ 1/4 Sec. _____, Block _____ Survey _____
Located inside sand and gravel pit (west side)
2. Owner: El Paso Sand Products CO Address: El Paso 1045 Humble
Tenant: _____ Address: _____
Driller: _____ Address: _____
3. Elevation of LSD is 4060 ft. above msl, determined by TM 250 QQ
4. Drilled: 6 1973; Dug, Cable Tool, Rotary, _____
5. Depth: Rept. 465 ft. Meas. _____ ft.
6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed _____
7. Pump: Mfgr. Johnston Type T
No. Stages _____, Bowls Diam. ____ in., Setting _____ ft.
Column Diam. _____ in., Length Tailpipe _____ ft.
8. Motor: Fuel Elec Make & Model GE HP. 75
9. Yield: Flow _____ gpm, Pump _____ gpm, Meas., Rept., Est. _____
10. Performance Test: Date _____ Length of Test _____ Made by _____
Static Level ____ ft. Pumping Level ____ ft. Drawdown _____ ft.
Production _____ gpm Specific Capacity _____ gpm/ft.

CASING & BLANK PIPE

Cemented From _____ ft. to _____ ft.

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 20 | Steel | 0 | 20 |
| 16 | Steel | 0 | 185 |
| 8 1/4 | " | 0 | 465 |
| | | | |
| | | | |
| | | | |

11. Water Level: _____ ft. rept. meas. _____ 19__ above below UTM no access for tape which is ____ ft. above below surface.
385 ft. rept. meas. 6/4 1973 above below which is ____ ft. above below surface.
_____ ft. rept. meas. _____ 19__ above below which is ____ ft. above below surface.
_____ ft. rept. meas. _____ 19__ above below which is ____ ft. above below surface.
12. Use: Dom., Stock, Public Supply (Ind), Irr., Waterflooding, Observation, Not Used, _____
13. Quality: (Remarks on taste, odor, color, etc.) _____
Temp. ___ °F, Date sampled for analysis _____ Laboratory _____
Temp. ___ °F, Date sampled for analysis _____ Laboratory _____
Temp. ___ °F, Date sampled for analysis _____ Laboratory _____
14. Other data available as circled: Driller's Log, Radioactivity Log, Electric Log,
Formation Samples, Pumping Test, _____
15. Record by: TWDB RR Date 4/3 1975
Source of Data OBS
16. Remarks: _____
6" disch.

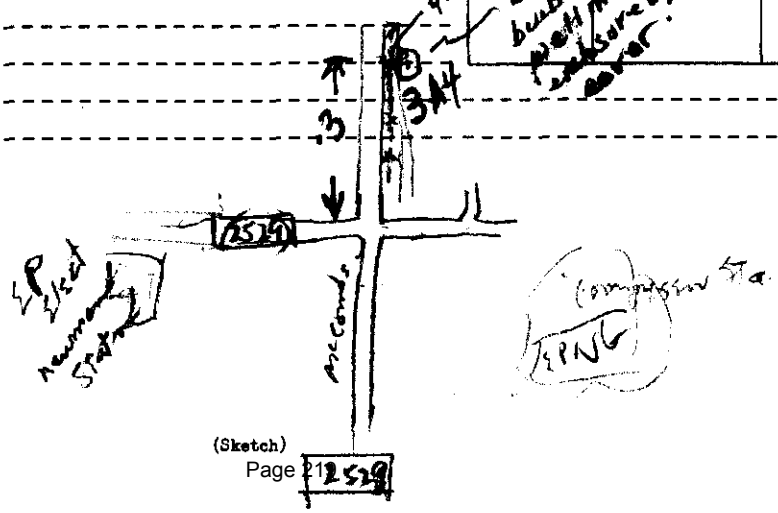
WELL SCREEN

Screen Openings _____

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 8 1/4 | mill slotted | 385 | 465 |
| | | | |
| | | | |
| | | | |

Behind built-up road path in fenced enclosure by metal cover.

For information call Joe Tirre @ El Paso Sand Products 565-4681




(Sketch)

TWDBE-WD-2



49-05-314

EL PASO ELECTRIC
Pat J. LaCo
ALLEN DRILLING CO
JL 49-05-314

463 to 465 red clay

Remarks:

20ft. of 20" surface pipe was cemented from top to bottom w/ 3½ yards cement. 185' 16" casing was set to seal off caving hole--It could not be pulled when completed. 20 yards of pea gravel was placed around 8¼ Mill slotted screen, Also fill back up to the bottom of 16" casing. The hole was bailed aprox. 30 hrs, until water was free of drilling mud and sand.

RECEIVED
JUL 18 1973
TEXAS WATER DEVELOPMENT BOARD

RECEIVED
SEP 14 1973
Central Records
Texas Water Development Board

# Texas Water Development Board
## Well Schedule

**State Well Number** 4905315 **Previous Well Number** **County** El Paso 141

**River Basin** 23 Rio Grande **GMA** 5 **Latitude** 315926 **Longitude** 1062430 **Source of Coords** 1

**Owner's Well No.** _____ **Location** _____

**Owner**
Cemex Const. Material South, LLC

**Driller**
Joe Bradford

**Address** _____ **Tenant/Oper.** _____

**Date Drilled** 07/ /1978 **Depth** 598 **Source of Depth** **Altitude** 4060 **Source of Alt.** M

**Well Type** T **User**

**WELL CONSTRUCTION**

**Const-Method** blank

**Completion** blank

**Casing Material** Steel

**Screen Material** Steel

**Casing or Blank Pipe (C) Well Screen or Slotted Zone (S) or Open Hole (O) Cemented from_____to_____**

| | | | |
|---|---|---|---|
| C | 20 | 0 | 354 |
| C | 13 | 0 | 595 |

**LIFT DATA -** **Pump Mfr. -** _____ **Type -** TURBINE PUMP **No. Stages** _____

**Bowls Diam -** _____ **in.** **Setting -** _____ **ft.** **Column Diam. -** _____ **in.**

**Motor Mfr. -** _____ **Fuel or Power -** ELECTRIC MOTOR **Horsepower -** 55.0

**YIELD Flow-** _____ **GPM** **Pump-** _____ **GPM** **Meas.,Rept.,Est.-** _____ **Date-** _____

**WATER USE** **Primary -** INDUSTRIAL **Secondary -** blank **Tertiary -** blank

**OTHER DATA AVAILABLE** **Water Levels -** N **Quality -** Y **Logs -** D **Other Data -**

**WATER LEVELS**

**Recorded By** _____ **Date Record Collected or Updated -** 06/13/1979

**Reporting Agency** 02

**REMARKS -**
Conpany Contact: Octavio Holguin

**Aquifer -** 112HCBL **ID -** 1

HUECO
BOLSON

TEXAS DEPARTMENT OF WATER RESOURCES

WELL SCHEDULE

Aquifer(s) Hueco Bolson  Project No. _____  State Well No. 49-05-315

_____  Field No./Owner's Well No. _____  County El Paso

1. Location: ___ ¼, ___ ¼, Section ___, Block ___, Survey _____, Lat. 31 59 20, Long. 106 24 28

2. Owner: El Paso Seed Products  Address: El Paso, TX 1045 Humble

Tenant (other): _____  Address: _____

Driller: Jae Bradford  Address: El Paso

3. Land Surface Elevation: 4060 ft. above msl determined by topo

4. Drilled: July 1978; Dug, Cable Tool, (Rotary), Air, _____

5. Depth: Rept. 598 ft. Meas. _____ ft.

6. Borehole Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed

7. Pump: Mfr. _____ Type _____

No. Stages _____, Bowls Diam. _____ in., Setting _____ ft.

Column Diam. _____ in., Length Tailpipe _____ ft.

8. Motor: Mfr. Elec  Fuel _____ HP. 55

9. Yield: Flow _____ gpm, Pump _____ gpm, Meas., Rept., Est. _____ Date _____

10. Performance Test: Date _____ Length of Test _____ Made by _____

Static Level 361 ft. Pumping Level _____ ft. Drawdown _____ ft.

Production _____ gpm  Specific Capacity _____ gpm/ft.

11. Quality: (Remarks on taste, odor, color, etc.) _____

Analyses

Date _____ Laboratory _____ TDS _____ Sp Cond _____

Date _____ Laboratory _____ TDS _____ Sp Cond _____

12. Other data available (as circled): Pumping Test, Power & Yield Test, Drillers Log, Formation Samples, Geophysical Log(s) E-log (type)

CASING, BLANK PIPE & WELL SCREEN
Cemented From _____ ft. to _____ ft.

| Diam. (in.) | Type | Setting (feet) from | to |
|---|---|---|---|
| 20 | Steel | 0 | 354 |
| 12¾ | " | 0 | 596 |
| mill slotted 1/8 | | 200 | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

13. Water Level(s): _____ ft. rept. meas. _____ 19___ above/below _____ which is ___ ft. above/below Land Surface

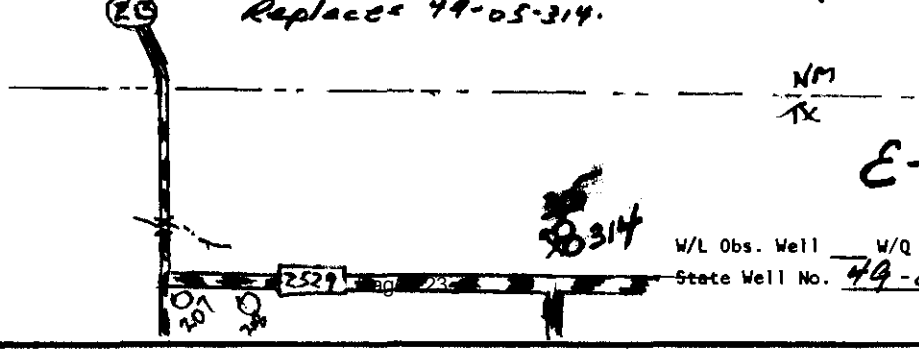
_____ ft. rept. meas. _____ 19___ above/below _____ which is ___ ft. above/below Land Surface

14. Use: Dom., Stock, Public Supply, (Ind.), Irr., Observation, Other (Test Hole, Oil Test, etc.) test hole

15. Recorded by: R. Rees  Source of data: D. E. White (USGS)  Date: 6/13/79

16. Remarks: 7-7-78, drilled test hole 150' north of existing well 49-05-314. Set about 333' of surface casing & reamed 19 inch hole. Dropped screen as they were lowering it. Recovered screen and completed @ 595'. Replaces 49-05-314.

17. Location or Sketch:




TDWR-0308

W/L Obs. Well ___  W/Q Obs. Well ___

State Well No. 49-05-315

RECEIVED
MAR 8 1979
DEPT. OF WATER RESOURCES

nd original copy by
rtified mail to the
xas Water Development Board
O. Box 12386
itin, Texas 78711

State of Texas

WATER WELL REPORT

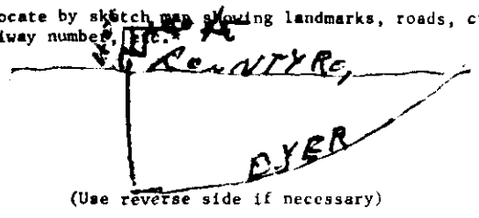
For TWDB use only
Well No. 49-05-38
Located on map
Received: 3-9-79

OWNER:
Person having well drilled El Paso Sand Products (Name) Address (Street or RFD) (City) (State)

Landowner El Paso Public Service Board (Name) Address (Street or RFD) (City) (State)

LOCATION OF WELL:
County El Paso, miles in direction from (N.E., S.W., etc.) (Town)

Locate by sketch map showing landmarks, roads, creeks, hiway numbers, etc.




(Use reverse side if necessary)

or Give legal location with distances and directions from adjacent sections or survey lines.

Labor League

Block Survey

Abstract No.

(NW¼ NE¼ SW¼ SE¼) of Section

TYPE OF WORK (Check): New Well ✓ Deepening Reconditioning Plugging

4) PROPOSED USE (Check): Domestic Industrial ✓ Municipal Irrigation Test Well Other

5) TYPE OF WELL (Check): Rotary ✓ Driven Dug Cable Jetted Bored

WELL LOG:
Diameter of hole in. Depth drilled ft. Depth of completed well ft. Date drilled

All measurements made from ft. above ground level.

| From (ft.) | To (ft.) | Description and color of formation material |
|---|---|---|
| 0 | 10 | Top Soil |
| 10 | 20 | Caliche |
| 20 | 40 | Sand |
| 40 | 60 | Sand & Gravel |
| 60 | 100 | Sand |
| 100 | 120 | Sand & Gray Clay |
| 120 | 140 | Sand & Gravel |
| 140 | 160 | Sand & Gray Clay |
| 160 | 180 | " " " |
| 180 | 200 | Sand |
| 200 | 220 | Clay (Gray) |

(Use reverse side if necessary) (Good)

9) Casing:
Type: Old New ✓ Steel ✓ Plastic Other
Cemented from 380' ft. to Surface ft.

| Diameter (inches) | Setting From (ft.) | To (ft.) | Gage |
|---|---|---|---|
| 20 in | 0' | 380' | 308 |
| ~~12 3/4~~ | ~~0~~ | ~~677~~ | ~~250~~ |

10) SCREEN:
Type Mill Slotted
Perforated Slotted ✓

| Diameter (inches) | Setting From (ft.) | To (ft.) | Slot Size |
|---|---|---|---|
| 12 3/4 | 0 | 691 | 1/8 80 PER FT |

COMPLETION (Check):
Straight wall Gravel packed Other
Under reamed Open Hole

11) WELL TESTS:
Was a pump test made? Yes No ✓ If yes, by whom?
Yield: 0 gpm with 0 ft. drawdown after 0 hrs.
Bailer test 0 gpm with 0 ft. drawdown after 0 hrs.
Artesian flow 0 gpm
Temperature of water 0

WATER LEVEL:
Static level 361 ft. below land surface Date 12-27-78
Artesian pressure lbs. per square inch Date
Depth to pump bowls, cylinder, jet, etc., See ft. below land surface.

12) WATER QUALITY:
Was a chemical analysis made? Yes No ✓
Did any strata contain undesirable water? Yes No ✓
Type of water? Sweet depth of strata 770

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief.

NAME J B Bradford (Type or Print) Water Well Drillers Registration No. 1281

ADDRESS 2001 Norton (Street or RFD) El Paso (City) Texas 79904 (State)

Signed J B Bradford (Water Well Driller) Brad Drilling (Company Name)

Please attach electric log, chemical analysis, and other pertinent information, if available. JL 49-05-315

Additional instructions on reverse side.

TWDB-GW-53

2)LOCATION OF WELL:

The sketch showing the well location must be as accurate as possible, showing [illegible], in such a manner that the well may be plotted on a General Highway Map of the county in which the well is located.

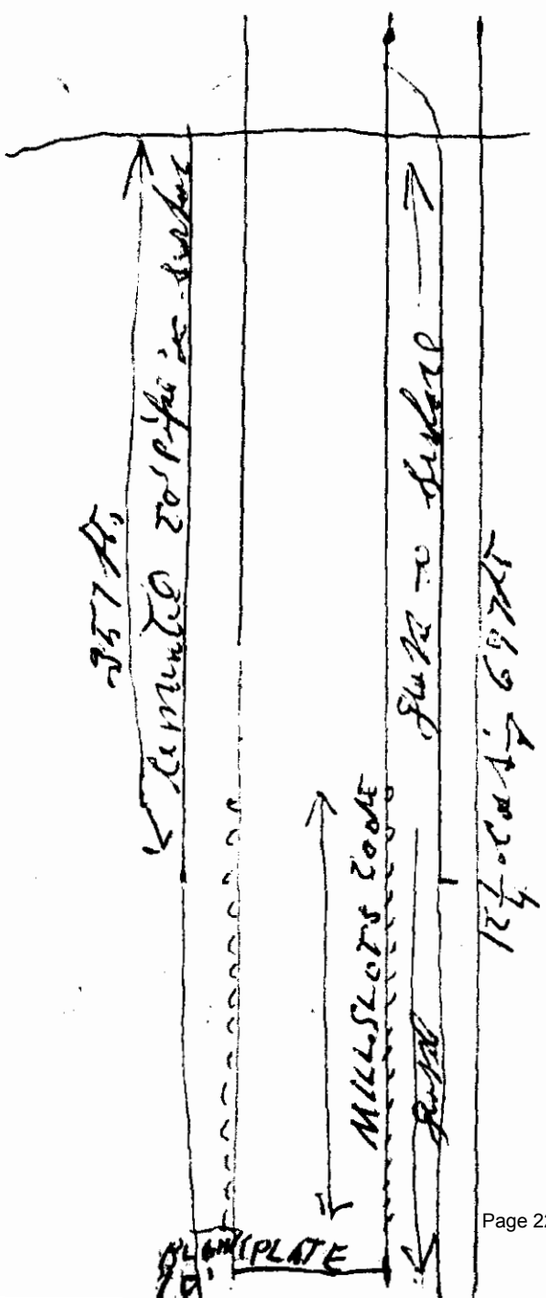
Reference points from which distances are measured and directions given should be some permanent landmark such as intersections, center of towns, river and creek bridges, railroad crossings, etc. The distance and direction from the nearest town should always be indicated.

When giving a legal description include a sketch showing location of the well within the described [illegible].

Information furnished in Section 2) of the TWDBE-GW-53 is very important. Unless the well can be [illegible] the value of the other data contained in the Report is greatly reduced.

220 - 260 Sandy & clay
260 - 300 clay gray
300 - 325 clay - sandy
325 - 355 clay - gray
355 - 360 water sand
360 400 sand
400 450 sand
450 500 sandy clay
500 550 sand
550 600 sand

JL 49-05-315



TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer Hueco Bolson  Field No. _____  State Well No. 49-05-316

Owner's Well No. 6  County _____

1. Location: ___ 1/4, ___ 1/4 Sec. _____, Block _____ Survey 31° 58' 21" 106° 23' 59"
North Franklin 7½ min topo, 3000' SW of plant, 150' S of FM 2637
2. Owner: El Paso Natural Gas  Address: El Paso, TX
Tenant: _____ Address: _____
Driller: Layne-Western  Address: El Paso
3. Elevation of LS is 4040 ft. above msl, determined by 7½ min. Topo
4. Drilled: 4-3 1970; Dug, Cable Tool, Rotary, _____
5. Depth: Rept. 625 ft. Meas. _____ ft.
6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed Gravel-wall
7. Pump: Mfgr. Johnson  Type Turbine
No. Stages _____, Bowls Diam. ____ in., Setting _____ ft.
Column Diam. _____ in., Length Tailpipe _____ ft.
8. Motor: Fuel electric  Make & Model _____ HP. 75
9. Yield: Flow ____ gpm, Pump 365 gpm, Meas., (Rept.), Est. _____
10. Performance Test: Date _____ Length of Test _____ Made by _____
Static Level ___ ft. Pumping Level ___ ft. Drawdown ____ ft.
Production _____ gpm Specific Capacity _____ gpm/ft.
11. Water Level: 350 ft. rept. meas. _____ 1970 (above) below LS which is ____ ft. above below surface.
_____ ft. rept. meas. _____ 19__ above below _____ which is ____ ft. above below surface.
_____ ft. rept. meas. _____ 19__ above below _____ which is ____ ft. above below surface.
_____ ft. rept. meas. _____ 19__ above below _____ which is ____ ft. above below surface.
12. Use: Dom., Stock, Public Supply, (Ind.), Irr., Waterflooding, Observation, Not Used, _____
13. Quality: (Remarks on taste, odor, color, etc.) _____
Temp. ___ °F, Date sampled for analysis _____ Laboratory _____
Temp. ___ °F, Date sampled for analysis _____ Laboratory _____
Temp. ___ °F, Date sampled for analysis _____ Laboratory _____
14. Other data available as circled: Driller's Log, Radioactivity Log, Electric Log,
Formation Samples, Pumping Test, _____
15. Record by: D. E. White & Layne 1x Files Date 11-16 1973
Source of Data _____
16. Remarks: 877 ft NW of well #5 49-05-307

CASING & BLANK PIPE
Cemented From _____ ft. to _____ ft.

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 26 | Steel | 0 | 104 |
| 12¾ | Steel | 0 | 625 |

WELL SCREEN
Screen Openings _____

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 12 | Mill Slot Screen | 422 | 624 |

TWDBE-WD-2

(Sketch)

49-05-316

Send original copy by certified mail to the Texas Water Development Board
P. O. Box 12386
Austin, Texas 78711

State of Texas

WATER WELL REPORT

For TWDB use only
Well No. 49-05-3A
Located on map yes
Received: 20

1) OWNER:
Person having well drilled EL PASO NAT. GAS Co Address EL PASO TEXAS
(Name) (Street or RFD) (City) (State)
Landowner [illegible]
(Name) (Street or RFD) (City) (State)

2) LOCATION OF WELL:
County EL PASO, ________ miles in ________ direction from ________
(N.E., S.W., etc.) (Town)

Locate by sketch map showing landmarks, roads, creeks, hiway number, etc.*

See attached map

North

(See reverse side if necessary)

OR

Give legal location with distances and directions from adjacent sections or survey lines.

Labor ________ League ________
Block ________ Survey ________
Abstract No. ________
(NW, NE, SW, SE) of Section ________

3) TYPE OF WORK (Check):
New Well Reopening
Reconditioning Plugging

4) PROPOSED USE (Check):
Domestic Industrial Municipal
Irrigation Test Well Other

5) TYPE OF WELL (Check):
Rotary Driven Dug
Cable Jetted Bored

6) WELL LOG:
Diameter of hole ________ in. Depth drilled ________ ft. Depth of completed well ________ ft. Date drilled ________
All measurements made from ________ ft. above ground level.

| From (ft.) | To (ft.) | Description and color of formation material |
|---|---|---|
| | | See Completion Report |

(See reverse side if necessary)

9) Casing:
Type: Old New Steel Plastic Other
Cemented from ________ ft. to ________ ft.

| Diameter (inches) | Setting From (ft.) | Setting To (ft.) | Gage |
|---|---|---|---|
| | | | |

10) SCREEN:
Type
Perforated Slotted

| Diameter (inches) | Setting From (ft.) | Setting To (ft.) | Slot Size |
|---|---|---|---|
| | | | |

7) COMPLETION (Check):
Straight wall Gravel packed Other
Under reamed Open Hole

8) WATER LEVEL:
Static level ________ ft. below land surface Date ________
Artesian pressure ________ lbs. per square inch Date ________
Depth to pump bowls, cylinder, jet, etc., ________ ft. below land surface.

11) WELL TESTS:
Was a pump test made? Yes No If yes, by whom?
Yield: ________ gpm with ________ ft. drawdown after ________ hrs.
Bailer test ________ gpm with ________ ft. drawdown after ________ hrs.
Artesian flow ________ gpm
Temperature of water ________

12) WATER QUALITY:
Was a chemical analysis made? Yes No
Did any strata contain undesirable water? Yes No
Type of water? ________ depth of strata ________

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief.

NAME WALLACE H. CLAYPOOL Water Well Drillers Registration No. 027
(Type or Print)
ADDRESS P.O. Box 8469 Houston Texas
(Street or RFD) (City) (State)
(Signed) Wallace H Claypool Layne Texas Co
(Water Well Driller) (Company Name)

Please attach electric log, chemical analysis, and other pertinent information, if available.

*Additional instructions on reverse side.

TDWR-GW-33

49-05-3A

Form No. 30

Tate

# LAYNE TEXAS MPA. Y.

HOUSTON -:- DALLAS

Rec'd [illegible] 232[illegible]

PAGE 1 of 1

FILE NO. 3435

DATE 4/16/70

## WELL LOG

### CUSTOMER LOCATION

FOR El Paso Natural Gas Company

LOCATION WELL El Paso Station

SURVEY FIELD

COUNTY El Paso STATE Texas

OTHER LAND MARKS 3000' S.W. of Plant, 150' S. of F.M. 2637

### WELL DATA

NAME WELL WELL NO. 6

ELEVATION DATUM

ST C SE

TEST HOLE SIZE 12¼" TD 625'

DATE STARTED DRILLING 3-30-70

DATE FINISHED DRILLING 4- 3-70

DRILLER V. Matus RIG NO. 6

TYPE MUD Gel NO. SACKS [illegible]

ELECTRIC LOG No TYPE

SURVEY No TYPE

OTHER

| DEPTH STRATA | EACH STRATUM | DESCRIPTION FORMATION | SAMPLES DEPTH | SAMPLES TYPE | SAMPLES NUMBER |
|---|---|---|---|---|---|
| 0 | | Surface | | | |
| 5 | 5 | Top soil, sand & caliche | | | |
| 33 | 28 | Fine gravel & sand | | | |
| 58 | 25 | Coarse gravel (large) | | | |
| 82 | 24 | Coarse gravel | | | |
| 98 | 16 | Gravel & clay streaks | | | |
| 111 | 13 | Clay | | | |
| 123 | 12 | Clay & gravel | | | |
| 133 | 10 | Gravel & sand (cut rough) | | | |
| 143 | 10 | Clay (cut hard) | | | |
| 174 | 31 | Gravel, sand & few clay breaks | | | |
| 182 | 8 | Clay & few gravel breaks | | | |
| 199 | 17 | Gravel & layers of clay (cut good) | | | |
| 217 | 18 | Clay (cut hard), few gravel brks. | | | |
| 267 | 50 | Clay & gravel breaks | | | |
| 318 | 51 | Sand & clay breaks | | | |
| 328 | 10 | Sand, gravel & few clay brks. | | | |
| 338 | 10 | Clay & sandy streaks | | | |
| 359 | 21 | Sand & clay breaks | | | |
| 379 | 20 | Clay & sand breaks | | | |
| 389 | 10 | Sand | | | |
| 409 | 20 | Sand, gravel & clay breaks | | | |
| 430 | 21 | Clay, gravel & sand | | | |
| 481 | 51 | Hard sand & layers of clay | | | |
| 490 | 9 | Clay & few sand breaks | | | |
| 513 | 23 | Hard sand, gravel & clay | | | |
| 522 | 9 | Clay & sand layers | | | |
| 554 | 32 | Sand & clay breaks | | | |
| 585 | 31 | Sand (cut hard), Layers of clay | | | |
| 606 | 21 | Clay, sand & gravel | | | |
| 625 | 19 | Hard sand & clay breaks | | | |
| Total depth 625 ft. | | | | | |

LAYNE TEXAS COMPANY

HOUSTON -:- DALLAS

PAGE 1 of

FILE NO. 2435

DATE 4/28/70

# WATER WELL TEST

## CUSTOMER LOCATION

TEST FOR El Paso Natural Gas Company

LOCATION OF WELL El Paso Station

SURVEY FIELD

COUNTY El Paso STATE Texas

DESCRIPTION OF LAND RIGHTS 3000' S.W. of Plant, 150' S. of F.M. 2637

## WELL DATA

NAME WELL WELL NO. 6

ELEVATION DATUM

WELL SIZE 26" & 12-3/4" 24" ream

TOTAL DEPTH 625' TOP SCREEN

GRAVEL WALL Yes STRAIGHT WALL

TYPE SCREEN Mill slot GAGE 3/16"

TEMPERATURE OF WATER

WATER CONDITION Clear

## WATER MEASURING DEVICE

ORIFICE SIZE 6"x5" LENGTH 24'

OTHER

## TEST PUMP DATA

DEPTH SETTING TOP OF BOWL 440'

LENGTH AIR LINE 440' SIZE 1/4"

TYPE BOWL 10" NO. STAGES 11

LENGTH BOWL SUCTION LT.

SAND CONTENT Trace OZ. PER 100 GAL.

WATER SAMPLE TAKEN Yes NO. SAMPLES 2

BACTERIOLOGICAL SAMPLE TAKEN

DRAWDOWN SPECIFIC CAPACITY

ACTIVE STATIC HEAD AFTER PUMP STOPPED

5 MIN. 365 FT. 20 MIN. 364 FT.

10 MIN. 364 FT. 25 MIN. FT.

15 MIN. 364 FT. 30 MIN. FT.

S.L. before start 365 ft.

| DATE HOUR | AIR LINE GAGE | PUMPING LEVEL | DISCH. PRESS. | HEAD ON ORIFICE INCHES | GPM | RPM | OPERATOR | REMARKS |
|---|---|---|---|---|---|---|---|---|
| 4/23/70 | - Started 24 Hr. step test at 4:00 P.M. | | | | | | | |
| 5:00PM | | 381 | | 11 | 412 | | | |
| 6:00 | | 381 | | 11 | 412 | | | |
| 7:00 | | 381 | | 11 | 412 | | | |
| 8:00 | | 381 | | 11 | 412 | | | |
| 9:00 | | 381 | | 11 | 412 | | | |
| 10:00 | | 381 | | 11 | 412 | | Step up engines | 500 GPM |
| 11:00 | | 386 | | 16¼ | 499 | | | |
| 12:00M | | 386 | | 16¼ | 499 | | 4/24/70 | |
| 1:00AM | | 386 | | 16¼ | 503 | | | |
| 2:00 | | 386 | | 16¼ | 503 | | | |
| 3:00 | | 386 | | 16¼ | 503 | | | |
| 4:00 | | 387 | | 17 | 510 | | Step up engine | to 600 GPM |
| 5:00 | | 391 | | 25 | 608 | | | |
| 6:00 | | 393 | | 25 | 608 | | | |
| 7:00 | | 393 | | 25 | 608 | | | |
| 8:00 | | 393¼ | | 25¼ | 614 | | | |
| 9:00 | | 393 | | 25 | 608 | | | |
| 10:00 | | 393 | | 25 | 608 | | Step engines | up to 700 GPM |
| 11:00 | | 397 | | 36 | 737 | | | |
| 12:00 M | | 396 | | 34½ | 720 | | | |
| 1:00PM | | 397 | | 36 | 737 | | | |
| 2:00 | | 396 | | 34½ | 720 | | | |
| 3:00 | | 396 | | 34½ | 720 | | | |
| 4:00 | | 395 | | 34 | 715 | | End of 24 hr. | Step test |

OBSERVERS

THE LAYNE TEXAS COMPANY, LTD.
HOUSTON -:- DALLAS

REPORT NO. 8373
P. O. 2328-70
PAGE 1 OF 1
FILE NO. 3435
DATE 4/28/70

# MATERIAL SETTING

**CUSTOMER LOCATION**

FOR El Paso Natural Gas Company

LOCATION WELL El Paso Station

SURVEY FIELD

COUNTY El Paso STATE Texas

OTHER LAND MARKS 3000' S.W. of Plant, 150' S. of F.M. 2637

**WELL DATA**

NAME WELL WELL NO. 6

ELEVATION DATUM

TYPE WELL Gravel-wall

SURFACE CASING CEMENTED Yes NO. SACKS 129

SIZE HOLE UNDERREAMED 24" DEPTH 625'

GRAVEL TYPE 112-113 NO. CU. YDS. 53

TYPE SCREEN Mill sot SLOT 3/16

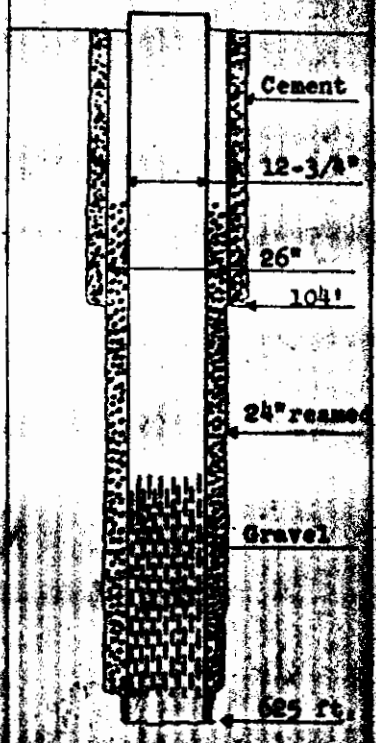
DRILLER V. Matus RIG NO. 6

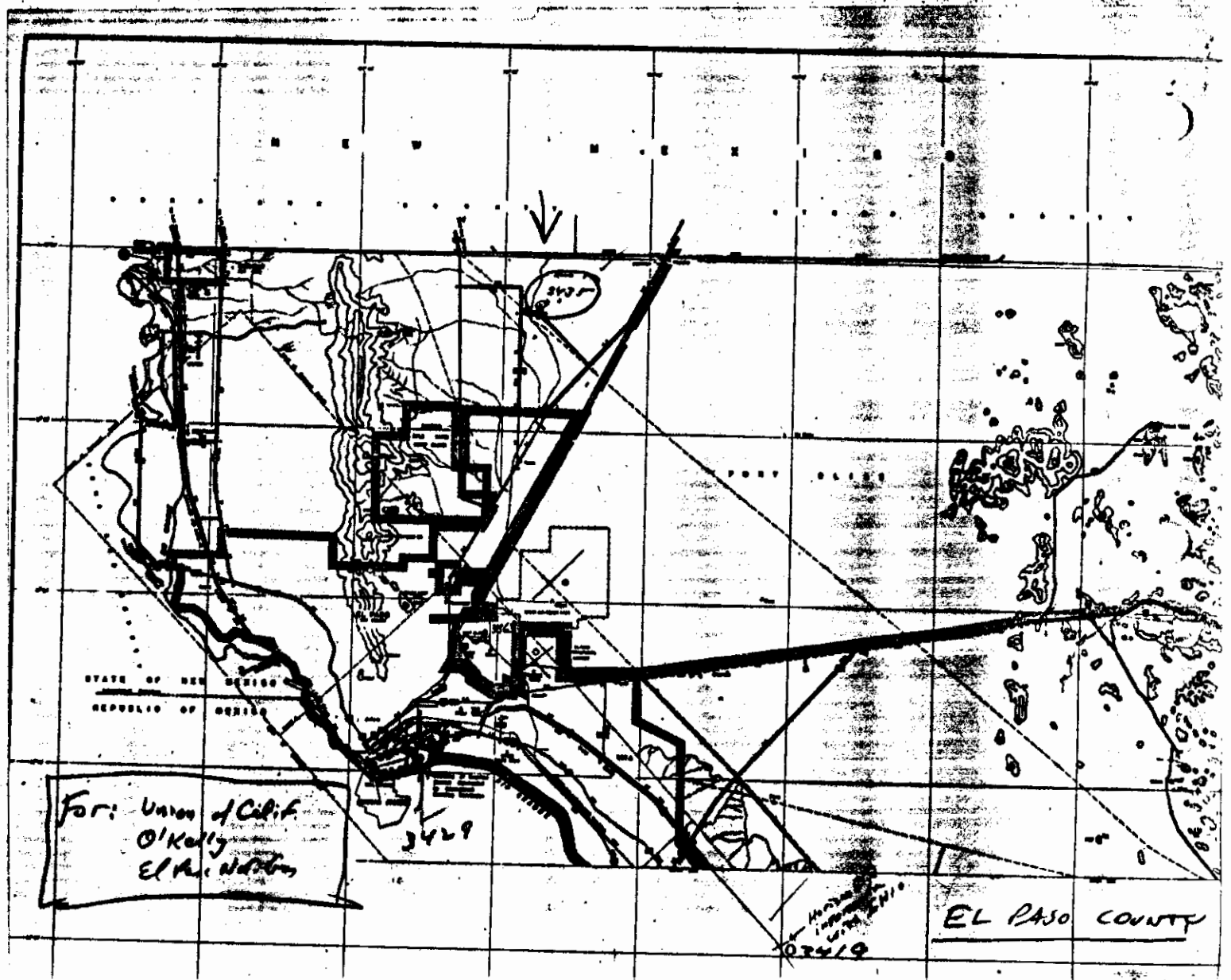
OTHER H. Thompson.

| DEPTH | LENGTH | SIZE, KIND, WEIGHT, MATERIAL |
|---|---|---|
| +2' | | 12-3/4" O.D. blank liner .312 |
| 0 | | Surface |
| 104' | 104' | 26" O.D. surface casing .291 |
| 423' | 421' | 12-3/4" O.D. blank liner .312 |
| 619' | 196' | 12-3/4" O.D. mill slot screen 3/16" ga. |
| 625' | 6' | 12-3/4" O.D. blank liner (open end) |

Total depth 625 ft.

SKETCH




For: Union of Calif
O'Kelly
El Paso Natural
EL PASO COUNTY

EP NO #6

EL PASO WATER UTILITIES PUBLIC SERVICE BOARD

# WATER ANALYSIS DATA SHEET

JL-49-05-316

JL 4905-316

Well Number: Lab. Number: 16885-10

Location:

| | |
|---|---|
| DATE SAMPLE COLLECTED | 6-17-85 |
| DATE RECEIVED AT LABORATORY | 6-17-85 |
| DATE ANALYSIS COMPLETED | 7-02-85 |

MILLIGRAMS PER LITER

| | |
|---|---|
| TOTAL DISSOLVED SOLIDS | 368 |
| PHENOL ALKALINITY AS $Ca\ CO_3$ | 0 |
| TOTAL ALKALINITY AS $Ca\ CO_3$ | 83 |
| TOTAL HARDNESS AS $Ca\ CO_3$ | 120 |
| CHLORIDES AS Cl | 93 |
| SULFATES AS $SO_4$ | 50 |
| FLUORIDES AS F | .60 |
| SILICA AS $Si\ O_2$ | 28 |
| NITRATE AS $NO_3$ | 6.4 |
| TOTAL PHOSPHATES AS $PO_4$ | <0.03 |
| CALCIUM AS Ca | 26 |
| MAGNESIUM AS Mg | 13 |
| SODIUM AS Na | 72 |
| POTASSIUM AS K | 5.8 |

| | |
|---|---|
| CHLORINE RESIDUAL (Mg/l) | — |
| TURBIDITY (N.T.U.) | .28 |
| TEMPERATURE (°c) | 32.0 |
| pH | 8.15 |

ORGANICS BY G.C. (Mg/l)

| | |
|---|---|
| CHLOROFORM | |
| BROMODICHLOROMETHANE | |
| DIBROMOCHLOROMETHANE | |
| BROMOFORM | |
| TOTAL THM's | |
| LINDANE | |
| ENORIN | |
| METHOXYCHLOR | |
| 2, 4 - D | |
| SILVEX | |
| TOXAPHENE | |

CHECKING CORRECTNESS OF ANALYSIS

| | |
|---|---|
| MEASURED DILUTED E.C. | |
| CALCULATED DILUTED E.C. | 637 |
| % ERROR | |

| ELEMENT | SEWAGE LIMITS | POTABLE LIMITS | SAMPLE (Mg/l) |
|---|---|---|---|
| ARSENIC | 1.0 | 0.05 | |
| BARIUM | 5.0 | 1.0 | |
| CADMIUM | 0.05 | 0.010 | |
| CHROMIUM | 5.0 | 0.05 | |
| COPPER | 1.0 | 1.0 | |
| IRON | — | 0.30 | |
| LEAD | 1.0 | 0.05 | |
| MANGANESE | 5.0 | 0.05 | |
| MERCURY | 0.005 | 0.002 | |
| NICKEL | 5.0 | — | |
| SELENIUM | 0.02 | 0.01 | |
| SILVER | 0.10 | 0.05 | |
| ZINC | 5.0 | 5.0 | |

| | |
|---|---|
| LANGELIER INDEX | 0.2254 |
| AGGRESSIVITY INDEX | 12.1449 |
| % Na OF TOTAL CATIONS | 55 |
| TOTAL ORGANIC CARBONS (Mg/l) | |
| TOTAL INORGANIC CARBONS (Mg/l) | |
| TOTAL CARBONS (Mg/l) | |

ANION - CATION BALANCE

| ANIONS | Mg/l | Meg/l |
|---|---|---|
| PHENOL ALKALINITY | 0 | 0.0000 |
| TOTAL ALKALINITY | 83 | 1.6607 |
| CHLORIDES | 93 | 2.6226 |
| SULFATES | 50 | 1.0400 |
| FLUORIDES | .60 | 0.0316 |
| NITRATES | 6.4 | 0.1030 |
| PHOSPHATES | <0.03 | 0.0000 |
| | TOTAL | 5.4579 |
| CATIONS | Mg/l | Meg/l |
| CALCIUM | 26 | 1.2974 |
| MAGNESIUM | 13 | 1.0699 |
| SODIUM | 72 | 3.1320 |
| POTASSIUM | 5.8 | 0.1485 |
| | TOTAL | 5.6478 |

TOTAL ANIONS — TOTAL CATIONS = ± 0.1065 + 0.0155 (TOTAL ANIONS)

0.1899 =< ± ISD = 0.1911

Remarks: Collected by Don White (USGS), delivered by Roger Spikes

SC = 553 µmhos/cm

Analyst Michiko Spicer

FORM 4518-0883

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CENTRAL LABORATORY DENVER, COLORADO

JL-49-05-31E
TEPNG #.6
SAMPLED 6-6-81

WATER QUALITY ANALYSIS
LAB-ID # 174012 RECORD-# 57174

SAMPLE LOCATION: JL-49-05-316
STATION ID: 315821106235901 LAT.LONG.SEQ.: 315821 1062359 01
DATE OF COLLECTION: BEGIN--810606 END-- TIME--1130
STATE CODE: 48 COUNTY CODE: 141 PROJECT IDENTIFICATION: 464801103
DATA TYPE: 2 SOURCE: GROUND WATER GEOLOGIC UNIT: BLSN
COMMENTS: UNIQUE-#:
EL PASO NAT. GAS, NEWMAN PLANT WELL NO.6

| | | | | | |
|---|---|---|---|---|---|
| ALK TOT FIELD CACO3 | MG/L | 94 | PH FIELD | UNITS | 8.1 |
| ANALYZING AGENCY | | 80020 | POTASSIUM-40, DISS. | PCI/L | 3.7 |
| CALCIUM, DISSOLV. | MG/L | 24 | POTASSIUM, DISSOLVED | MG/L | 4.9 |
| CHLORIDE, DISSOLVED | MG/L | 78 | RESIDUE DIS CALC SUM | MG/L | 311 |
| DEPTH LOC VERT IN FT | | 625 | SILICA, DIS. | MG/L | 31 |
| FLUORIDE, DISSOLVED | MG/L | 0.6 | SODIUM, ABSORP RATIO | | 3.3 |
| HARDNESS | MG/L | 81 | SODIUM, DIS. | MG/L | 68 |
| HARDNESS NONCARB FLD | MG/L | 0 | SODIUM, PERCENT | % | 63 |
| MAGNESIUM, DISSOLV. | MG/L | 5.1 | SP. CONDUCTANCE FLD | UMHOS | 510 |
| NITR DIS NO2+NO3 -N | MG/L | 1.9 | SP. CONDUCTANCE LAB | UMHOS | 532 |
| PH (LABORATORY) | UNITS | 7.9 | SULFATE, DISSOLVED | MG/L | 34 |
| | | | WATER TEMPERATURE | DEG C | 26.0 |

1.36 × 62.008 = 8.4 $NO_3$

| CATIONS | (MG/L) | (MEQ/L) | ANIONS | (MG/L) | (MEQ/L) |
|---|---|---|---|---|---|
| CALCIUM, DISSO | 24 | 1.198 | ALK TOT FIELD | 94 | 1.87 |
| MAGNESIUM, DIS | 5.1 | 0.420 | CHLORIDE, DISS | 78 | 2.20 |
| POTASSIUM, DIS | 4.9 | 0.125 | FLUORIDE, DISS | 0.6 | 0.03 |
| SODIUM, DIS. | 68 | 2.958 | SULFATE, DISSO | 34 | 0.70 |
| | | | NITR DIS NO2+N | 1.9 | 0.13 |
| TOTAL | | 4.700 | TOTAL | | 4.95 |

PERCENT DIFFERENCE = -2.62



49-05-316

Form 5-46 (Rev. 6-71)

EL PASO NATURAL GAS COMPAN
SOUTHERN DIVISION LABORATORY
WATER ANALYSIS

JL-49-05-316

Location El Paso

Date August 16, 1974

Date Sample Taken August 14, 1974

| SYSTEM | OPEN | | | CLOSED | | | | | STORAGE | | | WELLS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINLINE | A TOWER | B TOWER | C TOWER | A JACKET | A OIL | B JACKET | B OIL | BOILER | SOFT | BLEND | RAW | | | |
| TURBINE | AIR WASHER 1 | AIR WASHER 2 | AIR WASHER 3 | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | OIL | AJAX | SOFT | DIS-TILLED | RAW | #6 | | |
| pH | | | | | | | | | | | | 8.1 | | |
| P Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 0 | | |
| Total Alkalinity as Ca $CO_3$ | | | | | | | | | | | | 100 | | |
| Chloride as Cl | | | | | | | | | | | | 64 | | |
| Sulfate as $SO_4$ | | | | | | | | | | | | 38 | | |
| Total Hardness as Ca $CO_3$ | | | | | | | | | | | | 84 | | |
| Calcium as Ca $CO_3$ | | | | | | | | | | | | 56 | | |
| Magnesium as Ca $CO_3$ | | | | | | | | | | | | 28 | | |
| [illegible]ium as Na | | | | | | | | | | | | 67 | | |
| Silica as $SiO_2$ | | | | | | | | | | | | 32 | | |
| Iron as Fe | | | | | | | | | | | | 0 | | |
| Fluoride as F | | | | | | | | | | | | 0.82 | | |
| Potassium as K | | | | | | | | | | | | | | |
| Treatment | | | | | | | | | | | | | | |
| PPM | | | | | | | | | | | | | | |
| Total Dissolved Solids | | | | | | | | | | | | 352 | | |
| Specific Conductance, Micromhos | | | | | | | | | | | | 497 | | |

*– All results expressed as ppm or micromhos –*

Remarks:

Louise Bartlett
Analyst

Engineer

Date



49-05-316

TEXAS DEPARTMENT OF WATER RESOURCES

WELL SCHEDULE OW. #1

RGA

Aquifer(s) Hueco Bolson  Project No. _____  State Well No. 49-05-317

Field No./Owner's CITY Well No. R-72a  County JL / El Paso

1. Location: ___ ‡, ___ ‡, Section ___, Block ___, Survey ___, Lat. 315819 N, Long. 1062430
300' NORTH OF CITY WELL #42 (JL 49-05-301)

JAN 21 1982

2. Owner: CITY OF EL PASO  Address: _____

Tenant (other): _____  Address: CR/TDWR

Driller: _____  Address: _____

3. Land Surface Elevation: 4008 ft. above msl determined by 7 1/2'

4. Drilled: SEPT 19 62; Dug, Cable Tool, Rotary, Air, ___

5. Depth: Rept. 500 ft. Meas. _____ ft.

6. Borehole Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed

7. Pump: Mfr. _____ Type _____

No. Stages ___, Bowls Diam. ___ in., Setting ___ ft.

Column Diam. ___ in., Length Tailpipe ___ ft.

8. Motor: Mfr. _____ Fuel _____ HP. ___

9. Yield: Flow ___ gpm, Pump ___ gpm, Meas., Rept., Est. ___ Date ___

10. Performance Test: Date ___ Length of Test ___ Made by ___

Static Level ___ ft. Pumping Level ___ ft. Drawdown ___ ft.

Production ___ gpm Specific Capacity ___ gpm/ft.

11. Quality: (Remarks on taste, odor, color, etc.) _____

Analyses

Date ___ Laboratory ___ TDS ___ Sp Cond ___

Date ___ Laboratory ___ TDS ___ Sp Cond ___

12. Other data available (as circled): Pumping Test, Power & Yield Test, Drillers Log, Formation Samples, Geophysical Log(s) _____ (type)

CASING, BLANK PIPE & WELL SCREEN Cemented From ___ ft. to ___ ft.

| Diam. (in.) | Type | Setting (feet) from | to |
|---|---|---|---|
| 5 1/2" | S | 0 | 450 |
| 5 1/2" | SLTD | 450 | 500 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

13. Water Level(s): 364.6 ft. rept. meas. DEC 7 19 81 above below _____ which is ___ ft. above below Land Surface

___ ft. rept. meas. ___ 19 ___ above below _____ which is ___ ft. above below Land Surface

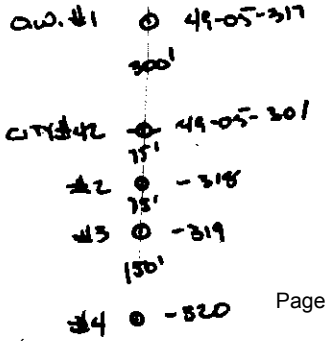
14. Use: Dom., Stock, Public Supply, Ind., Irr., Observation Other (Test Hole, Oil Test, etc.) _____

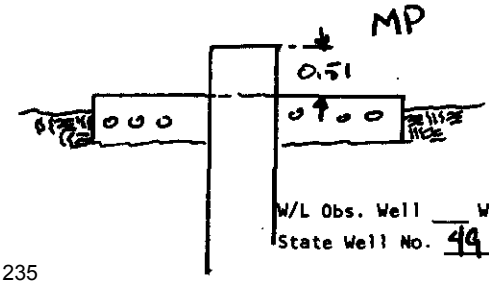
15. Recorded by: R. ZUBIA Source of data: USGS well sched. (DE. WHITE) Date: 12/28/81

16. Remarks: SEE NOTES ON 1962 RECHARGE TEST

SOMETHING DEAD IN WELL 12/7/81

17. Location or Sketch: See attached detailed sketch




W/L Obs. Well ___ W/Q Obs. Well ___

State Well No. 49-05-317

TDWR-0308

ATTACHMENT

JL 49-05-317

TEXAS DEPARTMENT OF WATER RESOURCES

RGA

WELL SCHEDULE O.W. 2

Aquifer(s) Hueco Bolson  Project No. _____  State Well No. 49 - 05 - 318

Field No./Owner's Well No. R-726  County JL / El Paso

1. Location: ___ ¼, ___ ¼, Section ___, Block ___, Survey _____, Lat. 315815 N, Long. 1062430
75' SOUTH OF CITY WELL #42 / JL 49-05-301

2. Owner: CITY OF EL PASO  Address: _____
Tenant (other): _____  Address: _____
Driller: _____  Address: _____

3. Land Surface Elevation: 4009 ft. above msl determined by 7 1/2'

4. Drilled: SEPT 1962; Dug, Cable Tool, Rotary, Air, _____

5. Depth: Rept. 500 ft. Meas. _____ ft.

6. Borehole Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed

7. Pump: Mfr. _____ Type _____
No. Stages _____, Bowls Diam. _____ in., Setting _____ ft.
Column Diam. _____ in., Length Tailpipe _____ ft.

8. Motor: Mfr. _____ Fuel _____ HP. _____

9. Yield: Flow _____ gpm, Pump _____ gpm, Meas., Rept., Est. _____ Date _____

10. Performance Test: Date _____ Length of Test _____ Made by _____
Static Level _____ ft. Pumping Level _____ ft. Drawdown _____ ft.
Production _____ gpm Specific Capacity _____ gpm/ft.

11. Quality: (Remarks on taste, odor, color, etc.) _____
Analyses
Date _____ Laboratory _____ TDS _____ Sp Cond _____
Date _____ Laboratory _____ TDS _____ Sp Cond _____

12. Other data available (as circled): Pumping Test, Power & Yield Test, Drillers Log, Formation Samples, Geophysical Log(s) _____ (type)

CASING, BLANK PIPE & WELL SCREEN
Cemented From ____ ft. to ____ ft.

| Diam. (in.) | Type | Setting (feet) from | to |
|---|---|---|---|
| 5½" | S | 0 | 450 |
| 5½" | SLTD | 450 | 500 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

13. Water Level(s): 4TM ft. rept. meas. 12/7 1962 above below _____ which is ___ ft. above below Land Surface
_____ ft. rept. meas. _____ 19___ above below _____ which is ___ ft. above below Land Surface

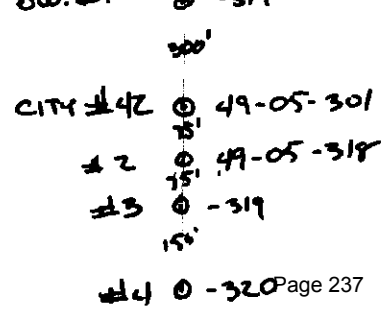
14. Use: Dom., Stock, Public Supply, Ind., Irr. (Observation) Other (Test Hole, Oil Test, etc.) _____

15. Recorded by: R. ZUBIA  Source of data: USGS well card (DE White)  Date: 12/28/81

16. Remarks: CAP WELDED ON CSG
SEE NOTES ON 1962 RECHARGE TEST

17. Location or Sketch:

See sketch with 49-05-317




ATTACHMENT

TDWR-0308

W/L Obs. Well ___ W/Q Obs. Well ___
State Well No. 49 -05- 318

15

# EL PASO WATER UTILITIES
# WATER ANALYSIS REPORT

450'-500'

| | | | |
|---|---|---|---|
| DATE COLLECTED: | 08/21/97 | SAMPLE SOURCE: | JL-49-05-318 (OW2) |
| TIME COLLECTED: | 16:20 | LAB NUMBER: | U082597-16 |
| DATE RECEIVED: | 08/25/97 | LOCATION: | JL-49-05-318 (OW2) |
| TIME RECEIVED: | 10:00 | OWNER: | |
| DATE ANALYZED: | 08/25/97 | COLLECTED BY: | USGS |
| DATE ANALYSIS COMPLETED: | 09/30/97 | DELIVERED BY: | R. Sperka |

| ANIONS | mg/l | me/l | Dil E.C. | | |
|---|---|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.0 | | | Silica, SiO2 = | 30.0 |
| Total Alkalinity as CaCO3 | 146.0 | | | Chlorine Res. = | N.A. |
| Carbonates as CO3 | 0.0 | 0.0000 | 0 | Turbidity, NTU = | 20.00 |
| Bicarbonates as HCO3 | 178.1 | 2.9212 | 127 | Sample Temp (C) | 22.9 |
| Chlorides as Cl | 75.0 | 2.1155 | 161 | pH @ | 7.91 |
| Sulfates as SO4 | 84.0 | 1.7472 | 129 | Lab E.C. @ 25 C | |
| Fluorides as F | 0.7 | 0.0368 | | as umhos/m = | 664 |
| Nitrates as NO3 LOD= 0.1 | 8.0 | 0.1283 | 9 | Field E.C. @ 25 C | |
| Total Phosphates LOD= 0.09 | 0.0 | 0.0005 | | as umhos/cm = | N.A. |
| TOTAL ANIONS | 346 | 6.9495 | 426 | pH Saturation = | 7.76 |
| | | | | Langelier Index | 0.15 |
| | | | | Aggress. Index | 12.16 |
| CATIONS | | | | % Na of T. Cat. = | 60 |
| Total Hardness as CaCO3 | 122 | | | | |
| Calcium as Ca | 39.3 | 1.9650 | 102 | | |
| Magnesium Mg | 6.3 | 0.5164 | 24 | | |
| Sodium as Na | 97.0 | 4.2192 | 207 | | |
| Potassium as K | 6.6 | 0.1698 | 12 | | |
| TOTAL CATIONS | 149 | 6.8704 | 345 | | |

| | | | |
|---|---|---|---|
| TDS BY EPWU METHOD (1)= | 495 | 13.8199 | 771 |
| TDS BY USGS METHOD (2)= | 434 | | |
| TDS BY TDH METHOD (3)= | 404 | | |
| TDS BY EVAPORATION (4)= | 411 | | |

| CHECKING CORRECTNESS OF ANALYSIS | | |
|---|---|---|
| Measured Diluted E.C. | 770 | 1.- SUM OF IONS, NOT INCLUDING SILICA. |
| Calculated Diluted E.C. | 771 | 2.- SUM OF IONS WITH CONVERSION OF |
| % Error | 0.19% | HCO3 TO CO3, PLUS SILICA. |
| | | 3.- SUM OF IONS, NOT INCLUDING SILICA |
| ANION - CATION BALANCE | | WITH CONVERSION OF HCO3 TO CO3. |
| Total Anions - Total Cations = | 0.0790 | 4.-AT 180 DEGREES CELSIUS |
| + or - (0.1065 + 0.0155 * T. Anions) | | |
| Maximum Limit +/- | 0.2142 | SD = 0.39 |

Maria Molina, Chemist I

Paul R. Rivas Chemist II

49-05-318

05

EL PASO WATER UTILITIES PUBLIC SERVICE BOARD

# ANALYTICAL REPORT

CENTRAL LABORATORY
11700 RAILROAD DRIVE
TELEPHONE (915) 594-5725 FAX (915) 821-3116

| | |
|---|---|
| SAMPLING LOCATION: | JL-49-05-318(OW2) |
| REQUESTED BY: | ROGER SPERKA, GEOLOGIST I<br>1154 HAWKINS BLVD, 79925<br>EL PASO, TEXAS |

| | | | |
|---|---|---|---|
| SAMPLE IDENTIFICATION: | U082597-16 | DATE COLLECTED: | 082197 |
| PROJECT: | WS | TIME COLLECTED: | 1620 |
| SAMPLING POINT: | JL-49-05-318(OW2) | DATE REPORTED: | 102897 |
| SAMPLE DESCRIPTION: | Grab | | |

| ANALYSIS | ANALYTICAL METHOD | RESULT | DETECTION LIMIT | UNITS | DATE OF ANALYSIS | ANALYST |
|---|---|---|---|---|---|---|
| Aluminum,Total | EPA 200.7 | ND | 0.050 | mg/L | 101497 | MSV |
| Arsenic, Total | EPA 200.9 | 0.0037 | 0.0020 | mg/L | 101697 | MSV |
| Barium, Total | EPA 200.7 | 0.070 | 0.010 | mg/L | 100997 | MSV |
| Boron, Total | EPA 200.7 | 0.114 | 0.020 | mg/L | 101497 | MSV |
| Cadmium, Total | EPA 213.2 | ND | 0.0005 | mg/L | 101597 | MSV |
| Chromium, Total | EPA 218.2 | 0.0090 | 0.0050 | mg/L | 101597 | MSV |
| Copper, Total | EPA 220.2 | ND | 0.0050 | mg/L | 101397 | MSV |
| Iron, Total | EPA 200.7 | 0.095 | 0.010 | mg/L | 100997 | MSV |
| Lead, Total | EPA 200.9 | ND | 0.0050 | mg/L | 101697 | MSV |
| Lithium, Total | EPA 200.7 | 0.042 | 0.020 | mg/L | 100997 | MSV |
| Manganese, Total | EPA 200.7 | ND | 0.010 | mg/L | 100997 | MSV |
| Mercury, Total | EPA 245.2 | ND | 0.0005 | mg/L | 092497 | MSV |
| Molybdenum, Total | EPA 200.7 | ND | 0.020 | mg/L | 100997 | MSV |
| Nickel, Total | EPA 249.2 | ND | 0.0050 | mg/L | 101497 | MSV |
| Selenium, Total [1] | EPA 200.9 | ND | 0.0100 | mg/L | 101597 | MSV |
| Silver, Total [2] | EPA 272.2 | ND | 0.0010 | mg/L | 102097 | MSV |
| Strontium, Total | EPA 200.7 | 0.950 | 0.020 | mg/L | 100997 | MSV |
| Vanadium, Total | EPA 200.7 | ND | 0.020 | mg/L | 100997 | MSV |
| Zinc, Total | EPA 200.7 | 0.143 | 0.010 | mg/L | 100997 | MSV |

Comments:
[1] Matrix Spike Recovery is outside acceptable limits. All other associated QC within acceptable limits.
[2] Matrix Spike Duplicate is outside acceptable limits. All other associated QC within acceptable limits.

Laboratory analyses were performed on samples utilizing procedures published in Standard Methods for the Examination of Water and Wastewater, 18th Edition 1992, or in EPA Methods for the Determination of Metals in Environmental Samples [EPA-600/4-91-010], June 1991 and the latest promulgated updates. ND, where noted, indicates Not Detected, with the detection limit listed.

QC/QA Reviewed

Approved

49-05-318

OCT 30 1997

TEXAS DEPARTMENT OF WATER RESOURCES

WELL SCHEDULE O.W. 3

Aquifer(s) 2GA Hueco Bolson Project No. _____ State Well No. 49-05-319

Field No./Owner's Well No. R-72-5 County EL PASO

1. Location: ___ ¼, ___ ¼, Section ___, Block ___, Survey _____, Lat. _____, Long. _____
150' SOUTH OF CITY #42 / JL 49-05-301

2. Owner: CITY OF EL PASO Address: _____
Tenant (other): _____ Address: _____
Driller: _____ Address: _____

3. Land Surface Elevation: 4005± ft. above msl determined by _____

4. Drilled: SEPT 1951; Dug, Cable Tool, Rotary, Air, _____

5. Depth: Rept. 500 ft. Meas. _____ ft.

6. Borehole Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed

7. Pump: Mfr. _____ Type _____
No. Stages _____, Bowls Diam. ___ in., Setting _____ ft.
Column Diam. _____ in., Length Tailpipe _____ ft.

8. Motor: Mfr. _____ Fuel _____ HP. _____

9. Yield: Flow _____ gpm, Pump _____ gpm, Meas., Rept., Est. _____ Date _____

10. Performance Test: Date _____ Length of Test _____ Made by _____
Static Level ___ ft. Pumping Level ___ ft. Drawdown _____ ft.
Production _____ gpm Specific Capacity _____ gpm/ft.

11. Quality: (Remarks on taste, odor, color, etc.) _____
Analyses
Date _____ Laboratory _____ TDS ___ Sp Cond _____
Date _____ Laboratory _____ TDS ___ Sp Cond _____

12. Other data available (as circled): Pumping Test, Power & Yield Test, Drillers Log, Formation Samples, Geophysical Log(s) _____ (type)

CASING, BLANK PIPE & WELL SCREEN
Cemented From ___ ft. to ___ ft.

| Diam. (in.) | Type | Setting (feet) from | to |
|---|---|---|---|
| 5½" | S | 0 | 450 |
| " | SLTD | 450 | 500 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

13. Water Level(s): 353.82 ft. rept. meas. 12/7 19 51 above/below _____ which is ___ ft. above/below Land Surface
_____ ft. rept. meas. _____ 19 ___ above/below _____ which is ___ ft. above/below Land Surface

14. Use: Dom., Stock, Public Supply, Ind., Irr., (Observation) Other (Test Hole, Oil Test, etc.) _____

15. Recorded by: R. ZUBIA Source of data: USGS Well Sched. (White) Date: 12/28/51

16. Remarks: NO CSG ON CSG
See notes on Experimental Recharge Test 1962

17. Location or Sketch:

O.W. #1 ⊙ -317

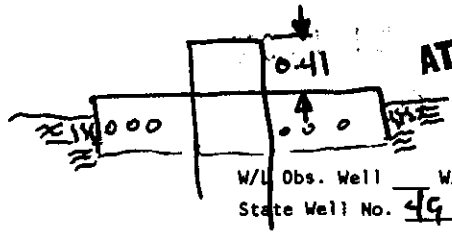
See sketch with 49-05-317

CITY #42 ⊙ 49-05-301

#2 ⊙ 318

#3 ⊙ 49-05-319

#4 ⊙ 319




ATTACHMENT

W/L Obs. Well ___ W/Q Obs. Well ___
State Well No. 49-05-319

TDWR-0308

TEXAS DEPARTMENT OF WATER RESOURCES

WELL SCHEDULE OW #4

RGA

Aquifer(s) Hueco Bolson Project No. _____ State Well No. 49-05-320

_____ Field No./Owner's Well No. R-72d County El Paso / HL

1. Location: ___¼, ___¼, Section ____, Block ____, Survey _____, Lat. 315813 N, Long. 1062450
300' SOUTH OF CITY WELL #42 / HL 49-05-301

2. Owner: CITY OF EL PASO Address: _____

Tenant (other): _____ Address: _____

Driller: _____ Address: _____

3. Land Surface Elevation: 4007 ft. above msl determined by 7½'

4. Drilled: SEPT 19 62; Dug, Cable Tool, Rotary, Air, _____

5. Depth: Rept. 500 ft. Meas. _____ ft.

6. Borehole Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed

7. Pump: Mfr. _____ Type _____

No. Stages _____, Bowls Diam. ____ in., Setting _____ ft.

Column Diam. _____ in., Length Tailpipe _____ ft.

8. Motor: Mfr. _____ Fuel _____ HP. ____

9. Yield: Flow ____ gpm, Pump ____ gpm, Meas., Rept., Est. ____ Date ___

10. Performance Test: Date _____ Length of Test ____ Made by _____

Static Level ____ ft. Pumping Level ____ ft. Drawdown ____ ft.

Production _____ gpm Specific Capacity _____ gpm/ft.

11. Quality: (Remarks on taste, odor, color, etc.) _____

Analyses

Date _____ Laboratory _____ TDS ____ Sp Cond ____

Date _____ Laboratory _____ TDS ____ Sp Cond ____

12. Other data available (as circled): Pumping Test, Power & Yield Test, Drillers Log, Formation Samples, Geophysical Log(s) _____

CASING, BLANK PIPE & WELL SCREEN
Cemented From ____ ft. to ____ ft.

| Diam. (in.) | Type | Setting (feet) from | to |
|---|---|---|---|
| 5½" | S | 0 | 450 |
| 11 | SLTD | 450 | 500 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

13. Water Level(s): 353.89 ft. rept. meas. 12/7 19__ (type) above below _____ which is ____ ft. above below Land Surface

_____ ft. rept. meas. _____ 19__ above below _____ which is ____ ft. above below Land Surface

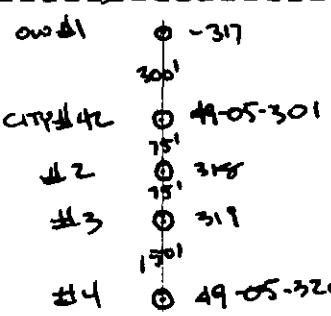
14. Use: Dom., Stock, Public Supply, Ind., Irr. (Observation) Other (Test Hole, Oil Test, etc.) _____

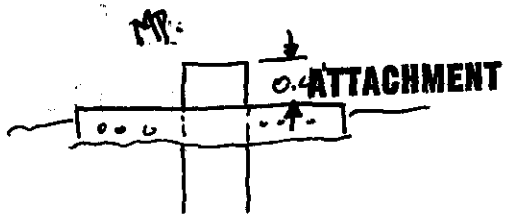
15. Recorded by: P. ZUBIA Source of data: USGS Well Schedule (E. White) Date: 12/28/81

16. Remarks: No cap on casing

See notes on recharge test 1962

17. Location or Sketch: See Sketch with 49-05-317




W/L Obs. Well ___ W/Q Obs. Well ___

State Well No. 49-05-320

TDWR-0308

FORM 9-1842B
(DEC. 68)

Well TL-49-05-321

# WELL SCHEDULE NE. LANDFILL OW #1

U. S. DEPT. OF THE INTERIOR — GEOLOGICAL SURVEY — WATER RESOURCES DIVISION

OBS-
ROGER
SEWAGE PIT SLUDGE

## MASTER CARD

Record by D.E. WHITE Source of data SPERKA Date 11/22/88 Map NORTH FRANKLIN 7½

State TEX 49 County (or town) EL PASO JL

Latitude: 31 59 07 N (deg, min, sec) Longitude: 106 24 35 (degrees, min, sec) Sequential number: 1

Lat-long Accuracy: T. ____ S, R ____ W, Sec ____, ____ ¼, ____ ¼, ____ ¼ ____

Local well number: JL-49-05-321 Other number: OW #1 B & M

Local use: ____ Owner or name: CITY OF EL PASO EPWU.

Owner or name: CITY OF EL PASO Address: ____

Ownership: (C) County, (F) Fed Gov't, (M) City, (N) Corp or Co, (P) Private, (S) Agency, (W) Water Dist ____ M

Use of water: (A) Air cond, (B) Bottling, (C) Com, (D) Dewater, (E) Power, (F) Fire, (H) Dom, (I) Irr, (M) Ind, (N) P S, (P) Rec, (S) Stock, (T) Instit, (U) Unused, (V) Repressure, (W) Recharge, (X) Desal-P S, (Y) Desal-other, (Z) Other ____ W

Use of well: (A) Anode, (D) Drain, (G) Seismic, (H) Heat Res, (O) Obs, (P) Oil-gas, (R) Recharge, (T) Test, (U) Unused, (W) Withdraw, (X) Waste, (Z) Destroyed Ø

DATA AVAILABLE: Well data ____ Freq. W/L meas.: ____ Field aquifer char. ____

Hyd. lab. data: ____

Qual. water data; type: ____

Freq. sampling: ____ Pumpage inventory: yes / no, period: ____

Aperture cards: ____ yes

Log data: EPWU E-LOG. 30-518' FR & TEMPLOG

## WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD Depth well: 500 ft 500 Meas. Sepa accuracy ____

Depth cased: (first perf.) 300 ft 300 Casing type: S ; Diam. 4½ in 4

Finish: (C) porous concrete, (F) gravel w. (perf.), (G) gravel w. (screen), (H) horiz. gallery, (O) open end, (P) perf., screen, sd. pt., (S) shored, (T) open hole, (Z) other ____

Method Drilled: (A) air rot, (B) bored, (C) cable, (D) dug, (H) hyd rot., (J) jetted, (P) air percussion, (R) reverse rotary, (T) trenching, (V) driven, (W) drive wash, (Z) other ____

Date Drilled: OCT 1988 9 8 8 Pump intake setting: — ft

Driller: COLE DRILLING CO. EL PASO (name, address)

Lift (type): (A) air, (B) bucket, (C) cent, (J) jet, (L) multiple (cent.), (M) multiple (turb.), (N) none, (P) piston, (R) rot, submerg, (S) turb, (T) other ____ Deep ____ Shallow ____

Power (type): diesel, elec, gas (nat, LP), gasoline, hand, wind; H.P. ____ Irrig. or water no. ____

Descrip. MP TOP OF CSG ft above / below LSD, Alt. MP ____

Alt. LSD: 4054 4054 Accuracy (source): 7½ MIL TOPO

Water Level 353.50 ft above / below MP; Ft above / below LSD ____ Accuracy: ____

Date meas: 10/14/88 Yield: ____ gpm Method determined ____

Drawdown: ____ ft Accuracy: ____ Pumping period ____ hrs

QUALITY OF WATER DATA: Iron ____ ppm Sulfate ____ ppm Chloride ____ ppm Hard. ____ ppm

Sp. Conduct ____ K x $10^6$ Temp. ____ °F Date sampled ____

Taste, color, etc. ____

WELL NO.

Well No. JL-005-321

Latitude-longitude 31 d 59 m 07 s / 106 d 24 m 35 s /

## HYDROGEOLOGIC CARD

SAME AS ON MASTER CARD (1–19) Physiographic Province: BASIN & RG (20–21) Section: NEX

HGHLD (22) Drainage Basin: RIO GRANDE (23–25) Subbasin: _____ (26)

Topo of well site: (D) depression, (C) stream channel, (E) dunes, (F) flat, (H) hilltop, (K) sink, (L) swamp, (0) offshore, (P) pediment, (S) hillside, (T) terrace, (U) undulating, (V) valley flat _____ (27)

MAJOR AQUIFER: TERT-QUAT. (system) PLIO-PLEIST (series) AQ (28–29) _____ (aquifer, formation, group) (30–31)

Lithology: _____ (32–33) Origin: _____ (34) Aquifer Thickness: _____ ft

(35–37) Length of well open to: 200 ft (38–40) Depth to top of: _____ ft (41–43)

MINOR AQUIFER: _____ (system), _____ (series) (44–45) _____ (aquifer, formation, group) (46–47)

Lithology: _____ (48–49) Origin: _____ (50) Aquifer Thickness: _____ ft

(51–53) Length of well open to: _____ ft (54–56) Depth to top of: _____ ft (57–59)

Intervals screened: WIRE WRAP 300-500'

Depth to consolidated rock: _____ ft (60–62) Source of data: _____ (64)

Depth to basement: _____ ft (65–68) Source of data: _____ (69)

Surficial material: _____ (70–71) Infiltration characteristics: _____ (72)

Coefficient Trans: _____ gpd/ft (73–75) Coefficient Storage: _____ (76–78)

Coefficient Perm: _____ $gpd/ft^2$; Spec cap: _____ gpm/ft; Number of geologic cards: _____ (79)

Well No.

GPO : 1972 O - 473-840

...ed origi... by
...rtified ma...
...xas Department of Water Resources
O. Box 13087
...stin, Texas 78711

# State of T...
# WATER WELL REPORT

For TDWR use only
Well No. 49-05-3
Located on map
Received:

1) OWNER El Paso Water Utilities Public Service Board (Name) Address P.O. Box 511 (Street or RFD) El Paso (City) Texas (State) 79961 (Zip)

2) LOCATION OF WELL: County El Paso, 2 miles in N (N.E., S.W., etc.) direction from El Paso (Town)

...iller must complete the legal description to the right ...th distance and direction from two intersecting sec... ...n or survey lines, or he must locate and identify the ...ll on an official Quarter- or Half-Scale Texas County ...neral Highway Map and attach the map to this form.

☒ Legal description: Section No. 12 Block No. 81 Township 1
Abstract No. ____ Survey Name ____
Distance and direction from two intersecting section or survey lines NE¼, NE¼, NE¼
☒ See attached map. On Back.

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☐ Domestic ☐ Industrial ☐ Public Supply ☐ Irrigation ☐ Test Well ☒ Other Well #1 Observation

5) DRILLING METHOD (Check): ☒ Mud Rotary ☐ Air Hammer ☐ Driven ☐ Bored ☐ Air Rotary ☐ Cable Tool ☐ Jetted ☐ Other ____

6) WELL LOG: Date drilled 09/23/88

DIAMETER OF HOLE

| Dia. (in.) | From (ft.) | To (ft.) |
|---|---|---|
| 12¼ | Surface | 500 |
| | | |
| | | |

7) BOREHOLE COMPLETION: ☐ Open Hole ☐ Straight Wall ☐ Undereamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 80 ft. to 500 ft.

| From (ft.) | To (ft.) | Description and color of formation material |
|---|---|---|
| 0 | 15 | Little Clay, Sand & Gravel |
| 15 | 45 | Sand & Gravel |
| 45 | 50 | Gravel |
| 50 | 55 | Sand & Gravel |
| 55 | 60 | Sand |
| 60 | 65 | Sand & Gravel |
| 65 | 70 | Sand, Gravel, & Little Clay |
| 70 | 80 | Sand & Gravel |
| 80 | 90 | Sand |
| 90 | 115 | Sand & Clay |
| 115 | 130 | Sand & Little Clay |
| 130 | 140 | Sand & Clay |
| 140 | 170 | Sand |
| 170 | 180 | Sand & Little Clay |
| 180 | 185 | Sand & Clay |
| 185 | 190 | Sand, Garvel, & Clay |
| 190 | 195 | Clay |
| 195 | 205 | Clay & Little Sand |
| 205 | 215 | Clay |
| 215 | 230 | Clay & Little Sand |
| 230 | 285 | Sand & Clay |
| 285 | 290 | Sand |

(Use reverse side if necessary) (Continued)

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

| Dia. (in.) | New or Used | Steel, Plastic, etc. Perf., Slotted, etc. Screen Mgf., if commercial | Setting (ft.) From | Setting (ft.) To | Gage Casing Screen |
|---|---|---|---|---|---|
| 4 | N | WESCO Wound Rod Screen .080 Slot | 500 | 300 | .250 |
| 4 | N | Galvanized | 300 | +1 | .250 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

CEMENTING DATA
Cemented from 0 ft. to 80 ft.
Method used Pressure Cemented
Cemented by Cole Drilling Company (Company or Individual)

9) WATER LEVEL: Static level 372 ft. below land surface Date 09/23/88
Artesian flow ____ gpm. Date ____

10) PACKERS: Type Depth

11) TYPE PUMP: ☐ Turbin ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other ____
Depth to pump bowls, cylinder, jet, etc., ____ ft.

12) WELL TESTS: ☐ Type Test: ☐ Pump ☐ Bailer ☒ Jetted ☐ Estimated
Yield: ____ gpm with ____ ft. drawdown after ____ hrs.

RECEIVED
OCT 7 1988
TEXAS WATER COMMISSION

13) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable water? ☐ Yes ☒ No
If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ____ Depth of strata ____
Was a chemical analysis made? ☐ Yes ☒ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief.

NAME James Cole (Type or Print) Water Well Drillers Registration No. 285

ADDRESS 9516 Gairloch (Street or RFD) El Paso (City) Texas (State) 79925 (Zip)

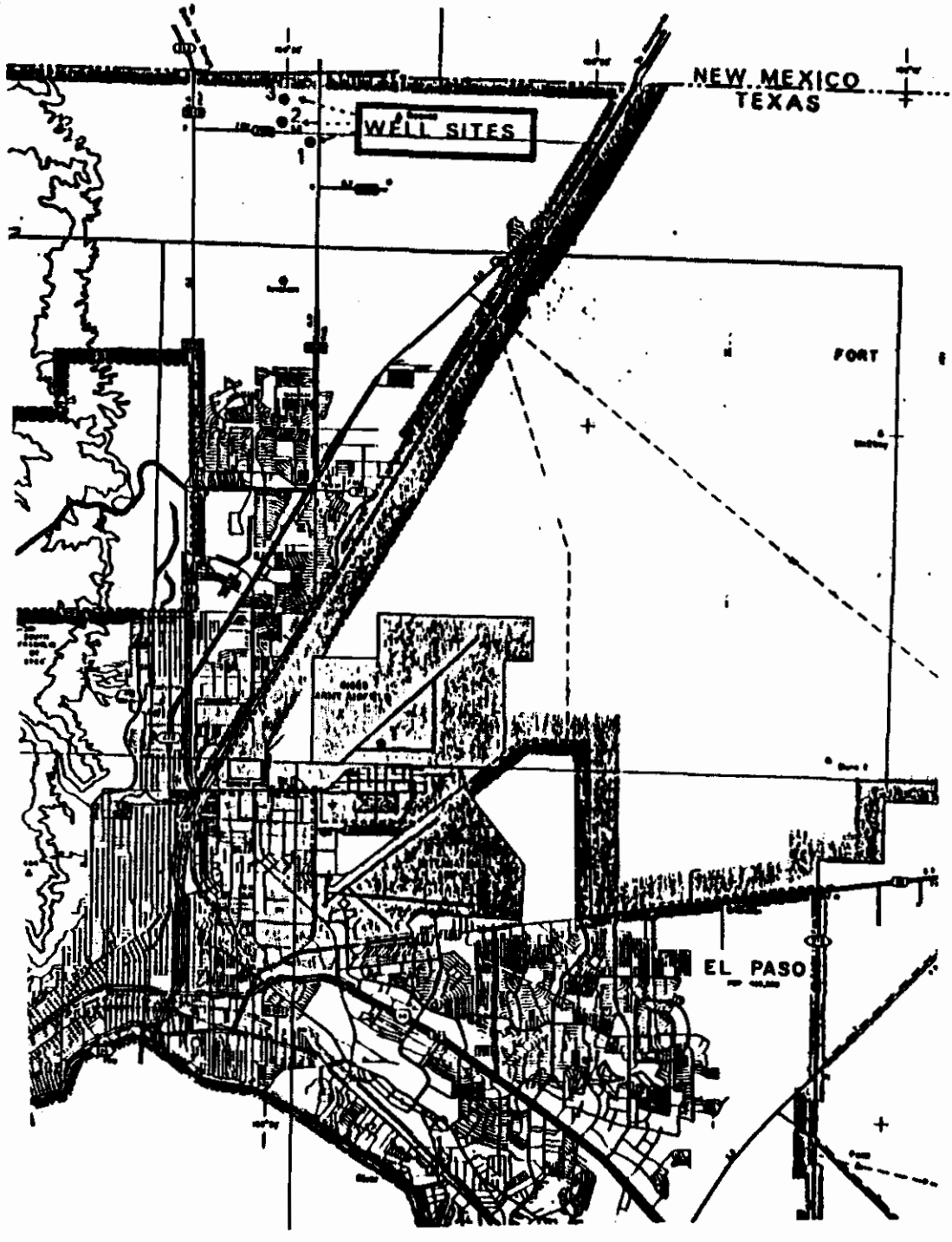
(Signed) James M Cole (Water Well Driller) Cole Drilling Company (Company Name)

Please attach electric log, chemical analysis, and other pertinent information, if available.

*Additional instructions on reverse side.
OWR-0382

49-05-321 X

| | | |
|---|---|---|
| 290 | 305 | Sand & Little Clay |
| 305 | 335 | Sand & Cl[illegible] |
| 335 | [illegible]85 | Sand & Lit[illegible]e Clay |
| 385 | [illegible]25 | Sand & Clay |
| 425 | 430 | Sand & Little Clay |
| 430 | 500 | Sand & Clay |




49-05-321

EL PASO WATER UTILITIES
WATER ANALYSIS REPORT

LF-1 4/17/90 49.05-321

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED | 04/17/90 | WELL NUMBER | LF-1 |
| DATE RECEIVED AT LABORATORY | 04/17/90 | LAB. NUMBER | C041790-8 |
| DATE ANALYSIS COMPLETED | 05/02/90 | LOCATION | |
| | | OWNER | EPWU |
| | | SAMPLE TAKER | R. SPERKA |
| | | DELIVERED BY | R. SPERKA |

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.00 | ****** | ****** |
| Total Alkalinity as CaCO3 | 111 | ****** | ****** |
| Carbonates as CO3 | 0.00 | 0 | 0 |
| Bicarbonates as HCO3 | 135 | 2.21953 | 97 |
| Chlorides as Cl | 320 | 9.0272 | 685 |
| Sulfates as SO4 | 884 | 18.4049 | 1360 |
| Fluorides as F | 1.12 | .058957 | ****** |
| Nitrates as NO3 | 57.90 | .933927 | 66 |
| Total Phosphates as PO4 LOD=.09 | 0.00 | 0 | ****** |
| Total Anions = | 1398 | 30.6445 | 2208 |

| CATIONS | | | |
|---|---|---|---|
| Total Hardness as CaCO3 | 584 | ****** | ****** |
| Calcium as Ca | 169 | 8.4331 | 439 |
| Magnesium as Mg | 39.30 | 3.23282 | 151 |
| Sodium as Na | 432 | 18.792 | 919 |
| Potassium as K | 13.30 | .340081 | 24 |
| Total Cations = | 654 | 30.7980 | 1533 |
| TDS BY EPWU METHOD (1)= | 2052 | 61.4425 | 3741 |
| TDS BY USGS METHOD (2)= | 2017 | | |
| TDS BY TDH METHOD (3)= | 1983 | | |

| | |
|---|---|
| Silica, SiO2 = | 34.00 |
| Chlorine Res. = | N/A |
| Turbidity,ntu = | 54.00 |
| Sample Temp(C)= | 22 |
| pH @ 22 | 7.61 |
| Lab E.C.@25C as umhos/cm = | 2620 |
| Field E.C. @25C as umhos/cm = | 2800 |
| pH Saturation = | 7.34 |
| Langelier Ind.= | 0.27 |
| Aggress. Index= | 12.42 |
| % Na of T Cat.= | 61 |

Remarks
LOD = LIMIT OF DETECTION

CHECKING CORRECTNESS OF ANALYSIS
Measured Diluted E.C. = 3660
Calculated Diluted E.C.= 3741
% Error = 2.17

(1) SUM OF IONS, NOT INCLUDING SILICA
(2) SUM OF IONS WITH CONVERSION OF HCO3 TO CO3, PLUS SILICA.
(3) SUM OF IONS, NOT INCLUDING SILICA WITH CONVERSION OF HCO3 TO CO3.

ANION-CATION BALANCE
Total Anions - Total Cations =
+or-(0.1065+0.0155* T.ANIONS)
-.15350=<+or-1SD= +or- .581490 MAX. LIMIT

ANALYST Judith McBee

WATER SUPPLY MGR D.D. Hutchinson

PO BOX 511
EL PASO, TEXAS 79961

KEY PUNCHED

JL-49-05-321

9/25/88

DATE SAMPLE COLLECTED: 9/25/88
DATE RECEIVED AT LAB: 9/25/88
DATE ANALYSIS COMPLETED: 9/30/88
SAMPLE IDENTIFICATION: Landfill #1
OWNER: EPWU
DEPTH OF WELL:
LABORATORY #: 92588-1

KqP.

| ANIONS | mg/L | me/L | DIL E.C. | |
|---|---|---|---|---|
| p-ALK (CaCO3) | 5.00 | ********** | | |
| t-ALK (CaCO3) | 122.60 | ********** | | |
| CARBONATES AS CO3 | 6.00 | 0.20 | 16.92 | |
| BICARBONATES AS HCO3 | 137.37 | 2.25 | 98.22 | |
| CHLORIDES AS Cl | 66.00 | 1.86 | 141.24 | |
| SULFATES AS SO4 | 68.00 | 1.41 | 104.72 | |
| FLOURIDES AS F | 0.91 | 0.05 | ********* | |
| NITRATES AS NO3 | 8.95 | 0.14 | 10.29 | |
| TOTAL PHOSPHATES AS PO4 | | 0.00 | ********* | LOD < 0.2 |
| TOTAL ANIONS | 287.23 | 5.92 | 371.39 | |
| CATIONS | | | | |
| t-HARDNESS AS CaCO3 | 30.23 | ********** | | |
| CALCIUM AS Ca | 8.30 | 0.42 | 21.58 | |
| MAGNESIUM AS Mg | 2.30 | 0.19 | 8.79 | |
| SODIUM AS Na | 103.00 | 4.48 | 219.39 | |
| POTASSIUM AS K | 4.80 | 0.12 | 8.83 | |
| TOTAL CATIONS | 118.40 | 5.21 | 258.59 | |

| | | | |
|---|---|---|---|
| E. COND | 341.00 | pH: | 8.40 |
| TDS AT 103 C | 452.00 | TURBIDITY | 60.00 |
| CALCULATED TDS | 405.63 | SiO4: | |
| | | Cl2 RES: | NA |
| CHECKING CORRECTNESS OF ANALYSIS | | TEMP OF ANALYSIS: | 26.00 |
| MEASURED DILUTED E.C. | 557.20 | pH SATUR: | 8.25 |
| CALCULATED DILUTED E.C. | 629.98 | LANG IND: | 0.15 |
| % ERROR | 13.06% | AGGR IND: | 11.97 |
| ANION/CATION BALANCE | | FIELD E.C.: | 615.00 |
| t-ANIONS - t-CATIONS= | 0.71 | %NA OF T. CAT.: | 86.1% |
| MAXIMUM LIMIT +/- | 0.20 | | |

KEY PUNCHED

ANALYST:
CHEMIST:

APPR.
JAN 30 1989
BY:

JL-49-05-321

LF1 4/17/91

# EL PASO WATER UTILITIES
# WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| ATE SAMPLE COLLECTED: | 04-17-91 | WELL NUMBER: | LF1 |
| ATE RECEIVED AT LABORATORY: | 04-17-91 | LAB NUMBER: | |
| ATE ANALYSIS COMPLETED: | 05-01-91 | LOCATION: | LAND FILL 1 |
| | | OWNER: | |
| | | SAMPLE TAKER: | SPERKA |
| | | DELIVERED BY: | SPERKA |

| ANIONS | mg/L | me/L | DIL E.C. |
|---|---|---|---|
| henol Alkalinity as CaCO3 | 0.0 | ********** | |
| otal Alkalinity as CaCO3 | 104.0 | ********** | |
| arbonates as CO3 | 0.0 | 0.0000 | 0 |
| icarbonates as HCO3 | 126.9 | 2.0808 | 91 |
| hlorides as Cl | 320.0 | 9.0260 | 685 |
| ulfates as SO4 | 944.0 | 19.6352 | 1454 |
| luorides as F | 1.1 | 0.0579 | ******* |
| itrates as NO3 LOD=0.1 | 9.6 | 0.1545 | 11 |
| otal Phosphates as PO4 LOD=0.09 | 0.0 | 0.0000 | ******* |
| TOTAL ANIONS | 1402 | 30.9545 | 2240 |
| CATIONS | | | |
| otal Hardness as CaCO3 | 584 | ********** | |
| alcium as Ca | 167.6 | 8.3800 | 436 |
| agnesium Mg | 40.1 | 3.2869 | 153 |
| odium as Na | 434.0 | 18.8778 | 924 |
| otassium as K | 14.4 | 0.3683 | 26 |
| TOTAL CATIONS | 656 | 30.9130 | 1540 |
| DS BY EPWU METHOD (1)= | 2058 | 61.8674 | 3780 |
| DS BY USGS METHOD (2)= | 2022 | | |
| DS BY TDH METHOD (3)= | 1993 | | |

| | |
|---|---|
| Silica, SiO2 = | 29.00 |
| Chlorine Res. = | N/A |
| Turbidity, NTU= | 18.20 |
| Sample Temp(C)= | 22.30 |
| pH @ 22.30 | 7.79 |
| Lab E.C.@25C as umhos/cm = | 2890 |
| Field E.C. @25C as umhos/cm = | 2900 |
| pH Saturation = | 7.36 |
| Langelier Index | 0.43 |
| Aggress. Index= | 12.57 |
| % Na of T.Cat.= | 60 |

HECKING CORRECTNESS OF ANALYSIS

| | |
|---|---|
| easured Diluted E.C. | 3810 |
| alculated Diluted E.C. | 3780 |
| Error | -0.78% |

NION-CATION BALANCE

| | |
|---|---|
| otal Anions - Total Cations = | 0.0415 |
| or-(0.1065+0.0155*T.Anions) Maximum Limit +/- | 0.5863 |

SD = 0.13

KEY PUNCHED

NALYST Rosa Aguirre

ATER SUPPLY MGR Douglas Miller

.O. BOX 511
L PASO, TEXAS 79961

(1) SUM OF IONS, NOT INCLUDING SILICA
(2) SUM OF IONS WITH CONVERSION OF HCO3 TO CO3, PLUS SILICA.
(3) SUM OF IONS, NOT INCLUDING SILICA WITH CONVERSION OF HCO3 TO CO3.

JL-49-05-321
LF #1
4/17/91

# METAL ANALYSIS REPORT

LAB. NUMBER: 041791-21
SOURCE NAME: LANDFILL #1
SAMPLE TYPE: GRAB
COLLECT DATE: 04/17/91
COLLECT TIME: 10:45
REQUEST BY: ROGER SPERKA
DATE REPORTED: JULY 1, 1991

| METAL | SYMBOL | METHOD | RESULT (mg/L) | DETECTION LIMIT | ANALYST | DATE ANALYSED |
|---|---|---|---|---|---|---|
| Arsenic | As | EPA 206.2 | <0.0100 | .0100 | VR | 06/24/91 |
| Barium | Ba | EPA 208.2 | 0.0364 | .0100 | VR | 06/24/91 |
| Boron | B | | 1.82 | .10 | VR | 06/25/91 |
| Cadmium | Cd | EPA 213.2 | <0.0005 | .0005 | VR | 06/21/91 |
| Calcium | Ca | EPA 215.1 | 175.70 | 10.00 | VR | 06/11/91 |
| Chromium | Cr | EPA 218.2 | <0.0100 | .0100 | VR | 06/21/91 |
| Copper | Cu | EPA 220.2 | <0.0100 | .0100 | VR | 06/21/91 |
| Iron | Fe | EPA 236.1 | <0.100 | .100 | VR | 05/31/91 |
| Lead | Pb | EPA 239.2 | <0.0050 | .0050 | VR | 06/21/91 |
| Lithium | Li | | 0.108 | .010 | VR | 05/31/91 |
| Magnesium | Mg | EPA 242.1 | 47.40 | 2.00 | VR | 06/11/91 |
| Manganese | Mn | EPA 243.1 | <0.050 | .050 | VR | 05/31/91 |
| Mercury | Hg | EPA 245.1 | <0.0010 | .0010 | VR | 06/18/91 |
| Nickel | Ni | EPA 249.2 | <0.0100 | .0100 | VR | 07/01/91 |
| Phosphorus | P | | <1.00 | 1.00 | VR | 05/31/91 |
| Potassium | K | EPA 258.1 | 12.30 | 5.00 | VR | 06/11/91 |
| Selenium | Se | EPA 270.2 | 0.0290 | .0100 | VR | 06/24/91 |
| Silver | Ag | EPA 272.2 | <0.0010 | .0010 | VR | 06/24/91 |
| Sodium | Na | EPA 273.1 | 454.0 | 50.0 | VR | 06/11/91 |
| Zinc | Zn | EPA 289.1 | 0.226 | .100 | VR | 05/31/91 |

KEY PUNCHED

APPROVED
JUL 0 1 1991
BY: Victoria Rodriguez

JL-48-05-321
4/10/89
CWTR TABLE

# EL PASO WATER UTILITIES
## WATER ANALYSIS REPORT K.P.

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED | 04/10/89 | WELL NUMBER | LF-1 |
| DATE RECEIVED AT LABORATORY | 04/10/89 | LAB. NUMBER | C041089- 2 |
| DATE ANALYSIS COMPLETED | 05/25/89 | LOCATION | SURFACE |
| | | OWNER | EPWU |
| | | SAMPLE TAKER | R. SPERKA |
| | | DELIVERED BY | R. SPERKA |

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.00 | ****** | ****** |
| Total Alkalinity as CaCO3 | 109 | ****** | ****** |
| Carbonates as CO3 | 0.00 | 0 | 0 |
| Bicarbonates as HCO3 | 133 | 2.17954 | 95 |
| Chlorides as Cl | 320 | 9.0272 | 685 |
| Sulfates as SO4 | 950 | 19.779 | 1462 |
| Fluorides as F | 1.15 | .060536 | ****** |
| Nitrates as NO3 LOD=0.443 | 1.65 | .026615 | 2 |
| Total Phosphates as PO4 LOD=.09 | 0.00 | 0 | ****** |
| Total Anions = | 1406 | 31.0729 | 2244 |

| CATIONS | | | |
|---|---|---|---|
| Total Hardness as CaCO3 | 628 | ****** | ****** |
| Calcium as Ca | 200 | 9.98 | 519 |
| Magnesium as Mg | 31.00 | 2.55006 | 119 |
| Sodium as Na | 424 | 18.444 | 902 |
| Potassium as K CALCULATED AS NA | 0.00 | 0 | 0 |
| Total Cations = | 655 | 30.9741 | 1540 |
| TOTAL DISSOLVED SOLIDS = | 2061 | 62.0470 | 3783 |

| | |
|---|---|
| Silica, SiO2 | =N/A |
| Chlorine Res. = | N/ |
| Turbidity,ntu = | 41.0 |
| Sample Temp(C)= | 2 |
| pH @ 22.1= | 7.5 |
| Lab E.C.@25C as umhos/cm = | 306 |
| Field E.C. @25C as umhos/cm = | 300 |
| pH Saturation = | 7.2 |
| Langelier Ind.= | 0.2 |
| Aggress. Index= | 12.3 |
| % Na of T Cat.= | 6 |

Remarks
LOD = LIMIT OF DETECTION

TAG#-

CHECKING CORRECTNESS OF ANALYSIS
Measured Diluted E.C. = 3800
Calculated Diluted E.C.= 3784
% Error = -0.42

ANION-CATION BALANCE
Total Anions - Total Cations =
+or-(0.1065+0.0155* T.ANIONS)
.098833=<+or-1SD= +or- .588130 MAX. LIMIT

ANALYST J McGill

WATER SUPPLY MGR

PO BOX 511
EL PASO, TEXAS 79961

FORM 9-1642B
(OEC. 68)

Well JL-49-05-322

# WELL SCHEDULE NE. LANDFILL OW #2

U. S. DEPT. OF THE INTERIOR — GEOLOGICAL SURVEY — WATER RESOURCES DIVISION

SEWAGE PLANT SLUDGE

## MASTER CARD

OBS — ROGER SPERRY

Record by D.F.WHITE Source of data Date 11/22/88 Map NORTH FRANKLIN 7½

State TEX 49 County (or town) EL PASO JL

Latitude: 31 deg 59 min 15 sec N/S Longitude: 106 degrees 24 min 51 sec Sequential number: 1

Lat-long Accuracy: N/E T. S, R w, Sec , k, k, k

Local well number: JL-49-05-322 Other number: OW #2 B & H

Local use: Owner or name: CITY OF EL PASO

Owner or name: CITY OF EL PASO Address: EPWU.

Ownership: (C) County, (F) Fed Gov't, (M) City, (N) Corp or Co, (P) Private, (S) State Agency, (W) Water Dist — M

Use of water: (A) Air cond, (B) Bottling, (C) Comm, (D) Domestic, (E) Power, (F) Fire, (H) Irr, (M) Mnd, (N) Ind, (P) P S, (R) Rec, (S) Stock, (T) Instit, (U) Unused, (V) Repressure, (W) Recharge, (X) Dasal-P S, (Y) Dasal-other, (Z) Other — U

Use of well: (A) Anode, (D) Drain, (G) Seismic, (H) Heat Exs, (O) Observ, (P) Oil-gas, (R) Recharge, (T) Test, (U) Unused, (W) Withdraw, (X) Waste, (Z) Destroyed — O

DATA AVAILABLE: Well data Freq. W/L meas.: Field aquifer char.

Hyd. lab. data:

Qual. water data; type:

Freq. sampling: Pumpage inventory: yes/no, period:

Aperture cards: yes

Log data: EPWU E LOG 30-58' FR & TEMP

## WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD Depth well: 500 ft 500 Meas. ep accuracy

Depth cased: (first perf.) 300 ft 300 Casing type: S ; Diam. 4½ in 44

Finish: (C) porous concrete, (F) gravel w. (perf.), (G) gravel w. (screen), (H) horiz. gallery, (O) open end, (P) perf., screen, sd. pt., (S) shored, (T) open hole, (Z) other — G

Method Drilled: (A) air rot, (B) bored, (C) cable, (D) dug, (H) hyd rot., (J) jetted, (P) air percussion, (R) reverse rotary, (T) trenching, (V) driven, (W) drive wash, (Z) other — H

Date Drilled: SEPT 1988 9 8 8 Pump intake setting: ft

Driller: CONT. ORLG. CO. name EL PASO address

Lift (type): (A) air, (B) bucket, (C) cent, (J) jet, (L) multiple (cent.), (M) multiple (turb.), (N) none, (P) piston, (R) rot, (S) submerg, (T) turb, (Z) other Deep Shallow

Power (type): diesel, elec, gas, gasoline, hand, nat gas, LP gas, wind; H.P. Trans. or meter no.

Descrip. MP TOP OF CSG. ft above/below LSD, Alt. MP

Alt. LSD: 4050 4050 Accuracy: (source) 7½ MIN TOPO

Water Level 372.98 ft above/below MP; Ft above/below LSD Accuracy:

Date meas: 10/11/88 Yield: gpm Method determined

Drawdown: ft Accuracy: Pumping period hrs

QUALITY OF WATER DATA: Iron ppm Sulfate ppm Chloride ppm Hard. ppm

Sp. Conduct K x $10^6$ Temp. °F Date sampled

Taste, color, etc.

Well No.

Well No. JL-05-322

Latitude-longitude 31° 59' 15" s 106° 24' 51" w

## HYDROGEOLOGIC CARD

SAME AS ON MASTER CARD (1–19) Physiographic Province: BASIN & RG (20–21) Section: REX.

HIGHLAND (23) Drainage Basin: RIO GRANDE (23–25) Subbasin: _____ (26)

Topo of well site: (D) depression, (C) stream channel, (E) dunes, (F) flat, (H) hilltop, (K) sink, (L) swamp, (O) offshore, (P) pediment, (S) hillside, (T) terrace, (U) undulating, (V) valley flat _____ (27)

MAJOR AQUIFER: TE-3-QUAT. (system) PLIO-PLEIST (series) (28–29) HUECO BOLSON (aquifer, formation, group) (30–31)

Lithology: _____ (32–33) Origin: _____ (34) Aquifer Thickness: _____ ft

(35–37) Length of well open to: 200' ft (38–40) Depth to top of: _____ ft (41–43)

MINOR AQUIFER: _____ system, _____ series (44–45) _____ aquifer, formation, group (46–47)

Lithology: _____ (48–49) Origin: _____ (50) Aquifer Thickness: _____ ft

(51–53) Length of well open to: _____ ft (54–56) Depth to top of: _____ ft (57–59)

Intervals screened: 10"/12" GRAV 320-500'

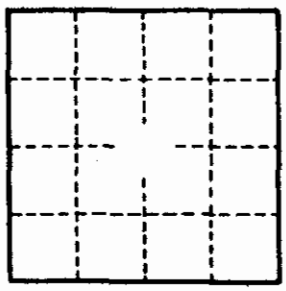
Depth to consolidated rock: _____ ft (60–63) Source of data: _____ (64)

Depth to basement: _____ ft (65–68) Source of data: _____ (69)

Surficial material: _____ (70–71) Infiltration characteristics: _____ (72)

Coefficient Trans: _____ gpd/ft (73–75) Coefficient Storage: _____ (76–78)

Coefficient Perm: _____ gpd/ft²; Spec cap: _____ gpm/ft; Number of geologic cards: _____ (79)



WELL NO.

GPO : 1972 O - 475-860

nd origin[al] ...y
rtified m...
...as Department of Water Resources
O. Box 13087
...stin, Texas 78711

# State of ...
# WATER WELL REPORT

For TDWR use only
Well No. 49-05-2
Located on map
Received:

1) OWNER El Paso Water Utilities Public Service Board (Name) Address P.O. Box 511 (Street or RFD) El Paso (City) Texas (State) 79961 (Zip)

2) LOCATION OF WELL:
County El Paso, 2 miles in N (N.E., S.W., etc.) direction from El Paso (Town)

...riller must complete the legal description to the right ...th distance and direction from two intersecting sec... or survey lines, or he must locate and identify the ...ell on an official Quarter- or Half-Scale Texas County ...eneral Highway Map and attach the map to this form.

☒ Legal description:
Section No. 1 Block No. 81 Township 1
Abstract No. ____ Survey Name ____
Distance and direction from two intersecting section or survey lines SE¼, SW¼, SE¼
☒ See attached map. On Back.

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):
☐ Domestic ☐ Industrial ☐ Public Supply ☐ Irrigation ☐ Test Well ☒ Other Well #2 Observation

5) DRILLING METHOD (Check):
☒ Mud Rotary ☐ Air Hammer ☐ Driven ☐ Bored ☐ Air Rotary ☐ Cable Tool ☐ Jetted ☐ Other ____

6) WELL LOG:
Date drilled 09/09/88

DIAMETER OF HOLE

| Dia. (in.) | From (ft.) | To (ft.) |
|---|---|---|
| 12¼ | Surface | 500 |

7) BOREHOLE COMPLETION:
☐ Open Hole ☐ Straight Wall ☐ Undereamed
☒ Gravel Packed ☐ Other ____
If Gravel Packed give interval ... from 80 ft. to 500 ft.

| From (ft.) | To (ft.) | Description and color of formation material |
|---|---|---|
| 0 | 5 | Clay, Sand & Lime |
| 5 | 10 | Gravel & Sand |
| 10 | 15 | Sand |
| 15 | 35 | Gravel & Sand |
| 35 | 50 | Sand |
| 50 | 70 | Gravel & Sand |
| 70 | 75 | Sand |
| 75 | 95 | Gravel & Sand |
| 95 | 105 | Gravel & Clay |
| 105 | 115 | Clay & Sand |
| 115 | 120 | Gravel & Sand |
| 120 | 135 | Clay |
| 135 | 155 | Gravel & Sand |
| 155 | 160 | Clay |
| 160 | 170 | Clay, Sand & Little Gravel |
| 170 | 175 | Sand, Gravel & Clay |
| 175 | 190 | Clay |
| 190 | 195 | Sand & Little Clay |
| 195 | 200 | Clay & Sand |
| 200 | 225 | Sand & Little Clay |
| 225 | 240 | Clay |
| 240 | 245 | Clay & Gravel |

(Use reverse side if necessary) (Continued)

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

| Dia. (in.) | New or Used | Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfr., if commercial | Setting (ft.) From | Setting (ft.) To | Gage Casing Screen |
|---|---|---|---|---|---|
| 4 | N | WESCO Wound Rod Screen .080 Slot | 500 | 300 | .250 |
| 4 | N | Galvanized | 300 | +1 | .250 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

CEMENTING DATA
Cemented from 0 ft. to 80 ft.
Method used Pressure Cemented
Cemented by Cole Drilling Company (Company or Individual)

9) WATER LEVEL:
Static level 362 ft. below land surface Date 09/09/88
Artesian flow ____ gpm. Date ____

10) PACKERS: Type Depth

11) TYPE PUMP:
☐ Turbin ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other ____
Depth to pump bowls, cylinder, jet, etc., ____ ft.

12) WELL TESTS:
☐ Type Test: ☐ Pump ☐ Bailer ☒ Jetted ☐ Estimated
Yield: ____ gpm with ____ ft. drawdown after ____ hrs.

13) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable water? ☐ Yes ☒ No
If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ____ Depth of strata ____
Was a chemical analysis made? ☐ Yes ☒ No

RECEIVED
OCT 7 1988
TEXAS WATER COMMISSION

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief.

NAME James Cole (Type or Print) Water Well Drillers Registration No. 285

ADDRESS 9516 Gairloch (Street or RFD) El Paso (City) Texas (State) 79925 (Zip)

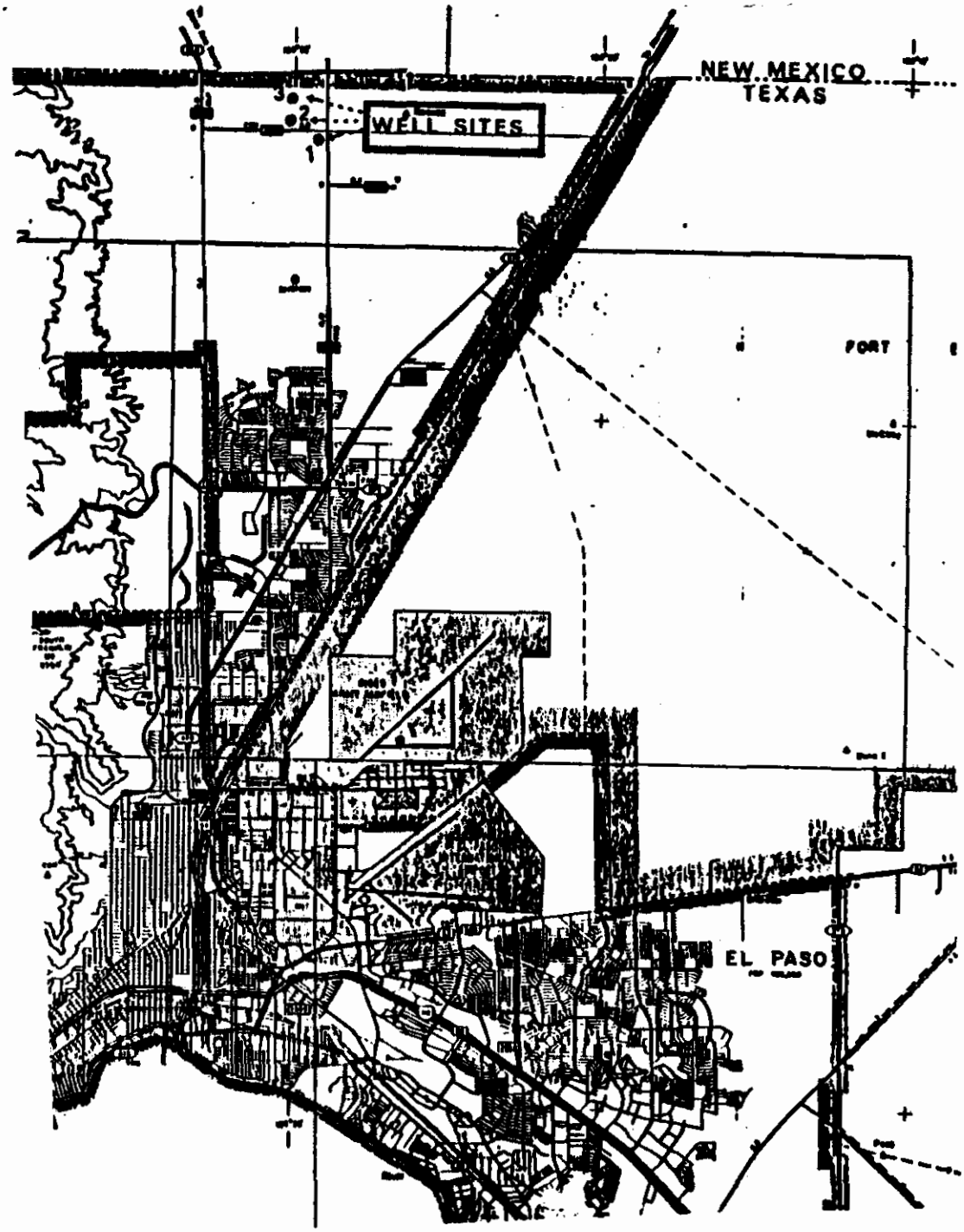
(Signed) James M. Cole (Water Well Driller) Cole Drilling Company (Company Name)

Please attach electric log, chemical analysis, and other pertinent information, if available.

*Additional instructions on reverse side.
DWR-6397

49-05-322 X

| | | |
|---|---|---|
| 245 | 265 | Gravel & C[illegible] |
| 265 | [illegible]0 | Clay |
| 270 | [illegible]5 | Gravel & Little Clay |
| 275 | [illegible]80 | Sand, Clay & Gravel |
| 280 | 285 | Clay |
| 285 | 290 | Sand & Clay |
| 290 | 295 | Sand & Little Clay |
| 295 | 305 | Gravel, Sand & Little Clay |
| 305 | 320 | Sand & Little Clay |
| 320 | 330 | Sand, Gravel & Little Clay |
| 330 | 340 | Sand & Little Clay |
| 340 | 405 | Sand & Clay |
| 405 | 415 | Sand |
| 415 | 500 | Sand & Little Clay |




49-05322

JL-49-05-32c
LF-2
4/18/90

# EL PASO WATER UTILITIES
## WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED | 04/18/90 | WELL NUMBER | LF-2 |
| DATE RECEIVED AT LABORATORY | 04/18/90 | LAB. NUMBER | C041990- 2 |
| DATE ANALYSIS COMPLETED | 05/02/90 | LOCATION | |
| | | OWNER | EPWU |
| | | SAMPLE TAKER | R. SPERKA |
| | | DELIVERED BY | R. SPERKA |

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.00 | ****** | ****** |
| Total Alkalinity as CaCO3 | 94 | ****** | ****** |
| Carbonates as CO3 | 0.00 | 0 | 0 |
| Bicarbonates as HCO3 | 115 | 1.87961 | 82 |
| Chlorides as Cl | 124 | 3.49804 | 266 |
| Sulfates as SO4 | 11.4 | .237348 | 18 |
| Fluorides as F | 0.80 | .042112 | ****** |
| Nitrates as NO3 LOD=0.1 | 0.00 | 0 | 0 |
| Total Phosphates as PO4 LOD=.09 | 0.00 | 0 | ****** |
| Total Anions = | 251 | 5.65711 | 365 |

| CATIONS | | | |
|---|---|---|---|
| Total Hardness as CaCO3 | 76 | ****** | ****** |
| Calcium as Ca | 19.2 | .95808 | 50 |
| Magnesium as Mg | 6.81 | .560191 | 26 |
| Sodium as Na | 95 | 4.1325 | 202 |
| Potassium as K | 4.08 | .104326 | 8 |
| Total Cations = | 125 | 5.75510 | 286 |
| TDS BY EPWU METHOD (1)= | 376 | 11.4122 | 651 |
| TDS BY USGS METHOD (2)= | 322 | | |
| TDS BY TDH METHOD (3)= | 318 | | |

| | |
|---|---|
| Silica, SiO2 = | 4.00 |
| Chlorine Res. = | N/A |
| Turbidity,ntu = | 34.00 |
| Sample Temp(C)= | 22 |
| pH @ 22 | 8.03 |
| Lab E.C.@25C as umhos/cm = | 578 |
| Field E.C. @25C as umhos/cm = | 610 |
| pH Saturation = | 8.26 |
| Langelier Ind.= | -0.23 |
| Aggress. Index= | 11.88 |
| % Na of T Cat.= | 72 |

Remarks
LOD = LIMIT OF DETECTION

CHECKING CORRECTNESS OF ANALYSIS

| | |
|---|---|
| Measured Diluted E.C. = | 646 |
| Calculated Diluted E.C.= | 655 |
| % Error = | 1.37 |

(1) SUM OF IONS, NOT INCLUDING SILICA
(2) SUM OF IONS WITH CONVERSION OF HCO3 TO CO3, PLUS SILICA.
(3) SUM OF IONS, NOT INCLUDING SILICA WITH CONVERSION OF HCO3 TO CO3.

ANION-CATION BALANCE
Total Anions - Total Cations = SIC -0.46
+or-(0.1065+0.0155* T.ANIONS)
-.09799=<+or-1SD= +or- .194185 MAX. LIMIT

ANALYST Judith McBee

KEY PUNCHED

WATER SUPPLY MGR

PO BOX 511
EL PASO, TEXAS 79961

VL-49-05-322
LF-2
7/13/89
@ WTR TABLE

# EL PASO WATER UTILITIES
## WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED | 07/13/89 | WELL NUMBER | LF-2 |
| DATE RECEIVED AT LABORATORY | 07/13/89 | LAB. NUMBER | C071389-4 |
| DATE ANALYSIS COMPLETED | 08/07/89 | LOCATION | SURFACE |
| | | OWNER | EPWU |
| | | SAMPLE TAKER | R. SPERKA |
| | | DELIVERED BY | R. SPERKA |

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.00 | ****** | ****** |
| Total Alkalinity as CaCO3 | 84 | ****** | ****** |
| Carbonates as CO3 | 0.00 | 0 | 0 |
| Bicarbonates as HCO3 | 102 | 1.67965 | 73 |
| Chlorides as Cl | 74.97 | 2.11490 | 161 |
| Sulfates as SO4 | 83.3 | 1.73431 | 128 |
| Fluorides as F | 0.84 | .043954 | ****** |
| Nitrates as NO3 LOD=0.443 | 7.00 | .11291 | 8 |
| Total Phosphates as PO4 LOD=.09 | 0.00 | 0 | ****** |
| Total Anions = | 269 | 5.68572 | 370 |

| CATIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Total Hardness as CaCO3 | 90 | ****** | ****** |
| Calcium as Ca | 28.05 | 1.39970 | 73 |
| Magnesium as Mg | 4.85 | .398961 | 19 |
| Sodium as Na | 89.4 | 3.8889 | 190 |
| Potassium as K CALCULATED AS NA | 0.00 | 0 | 0 |
| Total Cations = | 122 | 5.68756 | 282 |
| TOTAL DISSOLVED SOLIDS = | 391 | 11.3733 | 651 |

| | |
|---|---|
| Silica, SiO2 = | N/A |
| Chlorine Res. = | N/A |
| Turbidity,ntu = | 7.40 |
| Sample Temp(C)= | 25 |
| pH @ 25 | 7.31 |
| Lab E.C.@25C as umhos/cm = | 608 |
| Field E.C. @25C as umhos/cm = | 620 |
| pH Saturation = | 8.09 |
| Langelier Ind.= | -0.78 |
| Aggress. Index= | 11.19 |
| % Na of T Cat.= | 68 |

Remarks _____

LOD = LIMIT OF DETECTION

TAG#-

CHECKING CORRECTNESS OF ANALYSIS

| | |
|---|---|
| Measured Diluted E.C. = | 656 |
| Calculated Diluted E.C.= | 651 |
| % Error = | -0.76 |

ANION-CATION BALANCE

Total Anions - Total Cations =
+or-(0.1065+0.0155* T.ANIONS)
-.00183=<+or-1SD= +or- .194629 MAX. LIMIT

KEY PUNCHED

ANALYST J. McGill

WATER SUPPLY MGR Douglas Kittleman
PO BOX 511
EL PASO, TEXAS 79961

JL-48-05-322
9/21/88

DATE SAMPLE COLLECTED: 9/21/88
DATE RECEIVED AT LAB: 9/21/88
DATE ANALYSIS COMPLETED: 9/27/88
SAMPLE IDENTIFICATION: Landfill #2
OWNER:
DEPTH OF WELL:
LABORATORY #: 92188-1

| ANIONS | mg/L | me/L | DIL E.C. | |
|---|---|---|---|---|
| p-ALK (CaCO3) | 6.00 | ********** | | |
| t-ALK (CaCO3) | 79.40 | ********** | | |
| CARBONATES AS CO3 | 7.20 | 0.24 | 20.30 | |
| BICARBONATES AS HCO3 | 82.23 | 1.35 | 58.79 | |
| CHLORIDES AS Cl | 297.00 | 8.38 | 635.58 | |
| SULFATES AS SO4 | 69.00 | 1.44 | 106.26 | |
| FLOURIDES AS F | 0.44 | 0.02 | ********* | |
| NITRATES AS NO3 | 4.74 | 0.08 | 5.45 | |
| TOTAL PHOSPHATES AS PO4 | 0.00 | 0.00 | ********* | LOD < 0.2 |
| TOTAL ANIONS | 460.61 | 11.50 | 826.39 | |
| CATIONS | | | | |
| t-HARDNESS AS CaCO3 | 155.64 | ********** | | |
| CALCIUM AS Ca | 46.60 | 2.33 | 121.16 | |
| MAGNESIUM AS Mg | 9.50 | 0.78 | 36.29 | |
| SODIUM AS Na | 110.00 | 4.78 | 234.30 | |
| POTASSIUM AS K | 11.60 | 0.30 | 21.34 | |
| TOTAL CATIONS | 177.70 | 8.19 | 413.09 | |

| | | | |
|---|---|---|---|
| E. COND | 1043.00 | pH: | 8.20 |
| TDS AT 103 C | 708.00 | TURBIDITY | 49.00 |
| CALCULATED TDS | 638.31 | SiO4: | |
| | | Cl2 RES: | NA |
| CHECKING CORRECTNESS OF ANALYSIS | | TEMP OF ANALYSIS: | 26.00 |
| MEASURED DILUTED E.C. | 1111.00 | pH SATUR: | 7.70 |
| CALCULATED DILUTED E.C. | 1239.48 | LANG IND: | 0.50 |
| % ERROR | 11.56% | AGGR IND: | 12.29 |
| ANION/CATION BALANCE | | FIELD E.C.: | 1130.00 |
| t-ANIONS - t-CATIONS= | 3.31 | %NA OF T. CAT.: | 58.4% |
| MAXIMUM LIMIT +/- | 0.28 | | |

KEY PUNCHED

ANALYST: _____
CHEMIST: _____

APPROVED
JAN 24 1989
BK.

49-05-322
LF-2
7/13/89

DATE SAMPLE COLLECTED: 07-13-89
DATE RECEIVED AT LAB: 07-14-89
DATE ANALYSIS COMPLETED: 07-20-89
SAMPLE IDENTIFICATION: LF-2
OWNER: FPWU
DEPTH OF WELL:
LABORATORY #: 071489-2

| ANIONS | mg/l | me/l | DIL E.C. |
|---|---|---|---|
| p-ALK (CaCO3) | | ********** | |
| t-ALK (CaCO3) | 112.00 | ********** | |
| CARBONATES AS CO3 | 0.00 | 0.00 | 0.00 |
| BICARBONATES AS HCO3 | 136.64 | 2.24 | 97.70 |
| CHLORIDES AS Cl | 72.90 | 2.06 | 156.01 |
| SULFATES AS SO4 | 77.00 | 1.60 | 118.58 |
| FLOURIDES AS F | 0.90 | 0.05 | ********* |
| NITRATES AS NO3 | 1.55 | 0.02 | 1.78 |
| TOTAL PHOSPHATES AS PO4 | | 0.00 | ********* |
| TOTAL ANIONS | 288.99 | 5.97 | 374.07 |
| **CATIONS** | | | |
| t-HARDNESS AS CaCO3 | 82.38 | ********** | |
| CALCIUM AS Ca | 25.60 | 1.28 | 66.56 |
| MAGNESIUM AS Mg | 4.46 | 0.37 | 17.04 |
| SODIUM AS Na | 90.60 | 3.94 | 192.98 |
| POTASSIUM AS K | 5.22 | 0.13 | 9.60 |
| TOTAL CATIONS | 125.88 | 5.72 | 286.18 |

| | | | |
|---|---|---|---|
| E. COND | | pH: | 8.00 |
| TDS AT 103 C | 355.00 | TURBIDITY | |
| CALCULATED TDS | 414.87 | SiO4: | |
| | | Cl2 RES: | |
| CHECKING CORRECTNESS OF ANALYSIS | | TEMP OF ANALYSIS: | |
| MEASURED DILUTED E.C. | | pH SATUR: | 8.34 |
| CALCULATED DILUTED E.C. | 660.25 | LANG IND: | -0.34 |
| % ERROR | ERR | AGGR IND: | 11.97 |
| ANION/CATION BALANCE | | FIELD E.C.: | |
| t-ANIONS - t-CATIONS= | 0.25 | %NA OF T. CAT.: | 68.9% |
| MAXIMUM LIMIT +/- | 0.20 | | |

ANALYST:

CHEMIST:

KEY PUNCHED

APPROVED

OCT 13 1989

BY:

JL-49-05-322
LF 2
4/16/91

# EL PASO WATER UTILITIES
## WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED: | 4/16/91 | WELL NUMBER: | LF2 |
| DATE RECEIVED AT LABORATORY: | 4/16/91 | LAB NUMBER: | |
| DATE ANALYSIS COMPLETED: | 6/13/91 | LOCATION: | LANDFILL 2 |
| | | OWNER: | |
| | | SAMPLE TAKER: | SPERKA |
| | | DELIVERED BY: | SPERKA |

| ANIONS | mg/L | me/L | DIL E.C. |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 2.0 | ********** | |
| Total Alkalinity as CaCO3 | 95.4 | ********** | |
| Carbonates as CO3 | 2.4 | 0.0800 | 7 |
| Bicarbonates as HCO3 | 111.5 | 1.8287 | 80 |
| Chlorides as Cl | 110.0 | 3.1027 | 235 |
| Sulfates as SO4 | 39.0 | 0.8112 | 60 |
| Fluorides as F | 0.8 | 0.0426 | ******* |
| Nitrates as NO3 LOD=0.1 | 0.0 | 0.0000 | 0 |
| Total Phosphates as PO4 LOD=0.09 | 0.0 | 0.0000 | ******* |
| TOTAL ANIONS | 264 | 5.8653 | 382 |
| **CATIONS** | | | |
| Total Hardness as CaCO3 | 40 | ********** | |
| Calcium as Ca | 12.8 | 0.6400 | 33 |
| Magnesium Mg | 1.9 | 0.1557 | 7 |
| Sodium as Na | 117.0 | 5.0892 | 249 |
| Potassium as K | 4.9 | 0.1258 | 9 |
| TOTAL CATIONS | 137 | 6.0107 | 299 |
| TDS BY EPWU METHOD (1)= | 400 | 11.8760 | 681 |
| TDS BY USGS METHOD (2)= | 352 | | |
| TDS BY TDH METHOD (3)= | 344 | | |

| | |
|---|---|
| Silica, SiO2 = | 8.00 |
| Chlorine Res. = | N/A |
| Turbidity, NTU= | 155.00 |
| Sample Temp(C)= | 23.90 |
| pH @ 23.90 | 9.03 |
| Lab E.C.@25C as umhos/cm = | 615 |
| Field E.C. @25C as umhos/cm = | 640 |
| pH Saturation = | 8.40 |
| Langelier Index | 0.63 |
| Aggress. Index= | 12.61 |
| % Na of T.Cat.= | 83 |

CHECKING CORRECTNESS OF ANALYSIS

| | |
|---|---|
| Measured Diluted E.C. | 650 |
| Calculated Diluted E.C. | 681 |
| % Error | 4.73% |

ANION-CATION BALANCE

Total Anions - Total Cations = -0.1455

+or-(0.1065+0.0155*T.Anions)

Maximum Limit +/- 0.1974

-0.73

KEY PUNCHED

ANALYST Rosa Cisneros

WATER SUPPLY MGR Douglas R. Thurman

P.O. BOX 511
EL PASO, TEXAS 79961

(1) SUM OF IONS, NOT INCLUDING SILICA
(2) SUM OF IONS WITH CONVERSION OF HCO3 TO CO3, PLUS SILICA.
(3) SUM OF IONS, NOT INCLUDING SILICA WITH CONVERSION OF HCO3 TO CO3.

JL-49-05-322
LF #2
4/16/91

# METAL ANALYSIS REPORT

LAB. NUMBER: 041691-28
SOURCE NAME: LANDFILL #2
SAMPLE TYPE: GRAB
COLLECT DATE: 04/16/91
COLLECT TIME: 12:30
REQUEST BY: ROGER SPERKA
DATE REPORTED: JULY 1, 1991

| METAL | SYMBOL | METHOD | RESULT (mg/L) | DETECTION LIMIT | ANALYST | DATE ANALYSED |
|---|---|---|---|---|---|---|
| Arsenic | As | EPA 206.2 | <0.0100 | .0100 | VR | 06/24/91 |
| Barium | Ba | EPA 208.2 | 0.0265 | .0100 | VR | 06/24/91 |
| Boron | B | | 0.20 | .10 | VR | 06/25/91 |
| Cadmium | Cd | EPA 213.2 | <0.0005 | .0005 | VR | 06/21/91 |
| Calcium | Ca | EPA 215.1 | 12.90 | 10.00 | VR | 06/11/91 |
| Chromium | Cr | EPA 218.2 | <0.0100 | .0100 | VR | 06/21/91 |
| Copper | Cu | EPA 220.2 | <0.0100 | .0100 | VR | 06/21/91 |
| Iron | Fe | EPA 236.1 | <0.100 | .100 | VR | 05/31/91 |
| Lead | Pb | EPA 239.2 | <0.0050 | .0050 | VR | 06/21/91 |
| Lithium | Li | | 0.025 | .010 | VR | 05/31/91 |
| Magnesium | Mg | EPA 242.1 | 2.98 | 2.00 | VR | 06/11/91 |
| Manganese | Mn | EPA 243.1 | <0.050 | .050 | VR | 05/31/91 |
| Mercury | Hg | EPA 245.1 | <0.0010 | .0010 | VR | 06/18/91 |
| Nickel | Ni | EPA 249.2 | <0.0100 | .0100 | VR | 07/01/91 |
| Phosphorus | P | | <1.00 | 1.00 | VR | 05/31/91 |
| Potassium | K | EPA 258.1 | <5.00 | 5.00 | VR | 06/11/91 |
| Selenium | Se | EPA 270.2 | <0.0100 | .0100 | VR | 06/24/91 |
| Silver | Ag | EPA 272.2 | <0.0010 | .0010 | VR | 06/24/91 |
| Sodium | Na | EPA 273.1 | 118.4 | 50.0 | VR | 06/11/91 |
| Zinc | Zn | EPA 289.1 | <0.100 | .100 | VR | 05/31/91 |

KEY PUNCHED

APPROVED
JUL 1 1991
BY: Victoria Rodriguez

ORIG

FORM 9-1642B (DEC 68)

Well JL-49-05-323

# WELL SCHEDULE N.E. LANDFILL OW #3

U. S. DEPT. OF THE INTERIOR GEOLOGICAL SURVEY WATER RESOURCES DIVISION

SEWAGE PLT SLUDGE

## MASTER CARD

Record by DE WHITE Source of data ORS - ROGER SPERKA Date 11/23/83 Map NORTH FRANKLIN 7½

State TEX 49 County (or town) EL PASO JL

Latitude: 31 deg 59 min 32 sec N/S Longitude: 106 degrees 24 min 51 sec W Sequential number: 1

Lat-long accuracy: T. N, S, R W, Sec , , ,

Local well number: JL-49-05-323 Other number: OW#3 B & M

Local use: Owner of name: CITY OF EL PASO

Owner or name: CITY OF EL PASO Address: EPWU

Ownership: (C) County, (F) Fed Gov't, (M) City, (N) Corp or Co, (P) Private, (S) State Agency, (W) Water Dist — M

Use of water: (A) Air cond, (B) Bottling, (C) Comm, (D) Dewater, (E) Power, (F) Fire, (H) Dom, (I) Irr, (M) Mnd, (N) Ind, (P) P S, (R) Rec, (S) Stock, (T) Instit, (U) Unused, (V) Repressure, (W) Recharge, (X) Desal-P S, (Y) Desal-other, (Z) Other — U

Use of well: (A) Anode, (D) Drain, (G) Seismic, (H) Heat Res, (O) Obs, (Q) Oil-gas, (R) Recharge, (T) Test, (U) Unused, (W) Withdraw, (X) Waste, (Z) Destroyed — O

DATA AVAILABLE: Well data Freq. W/L meas.: Field aquifer char.

Hyd. lab. data:

Qual. water data; type:

Freq. sampling: Pumpage inventory: yes / no, period:

Aperture cards: yes

Log data: EPWU E LOG 20-510', F.R. & TEMP LOG

## WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD Depth well: 500 ft 500 Meas. (est)

Depth cased (first perf.): 300 ft 300 Casing type: C ; Diam. 4½ accuracy in 4

Finish: (C) porous concrete, (F) gravel w. (perf.), (G) gravel w. (screen), (H) horiz. gallery, (O) open end, (P) perf., (S) screen, (T) sd. pt., (W) shored, (X) open hole, (Z) other

Method Drilled: (A) air rot, (B) bored, cable, (C) dug, (D) Hyd rot., (H) jetted, (J) air percussion, (P) reverse rotary, (R) trenching, (T) driven, (V) drive wash, (W) other

Date Drilled: SEPTMBR 9 8 8 Pump intake setting: NONE ft

Driller: COLE DRLG CO. name EL PASO address

Lift (type): (A) air, (B) bucket, (C) cent, (J) jet, (L) multiple, (cent.), (M) multiple, (turb.), (N) none, (P) piston, (R) rot, (S) submerg, (T) turb, (Z) other Deep Shallow

Power (type): diesel, elec, gas, gasoline, hand, nat gas, LP gas, wind; H.P. Trans. or meter no.

Descrip. MP TOP OF CSG. ft above below LSD, Alt. MP

Alt. LSD: 4038 4038 Accuracy: (source) 7½ MIN

Water Level 354.65 ft above below MP; Ft above below LSD Accuracy:

Date meas: 10/11/88 Yield: gpm Method determined

Drawdown: ft Accuracy: Pumping period hrs

QUALITY OF WATER DATA: Iron ppm Sulfate ppm Chloride ppm Hard. ppm

Sp. Conduct K x 10⁶ Temp. °F Date sampled

Taste, color, etc.

Well No.

Well No. JL-Y-05-323

Latitude-longitude 31 59 32 S 106 24 57 -1
d m s d m s

## HYDROGEOLOGIC CARD

SAME AS ON MASTER CARD [1 19] Physiographic Province: BASIN & RG [20 21] Section: NEW MEX HIGHLAND [22] Drainage Basin: RIO GRANDE [23 25] Subbasin: [26]

Topo of well site: (D) depression, (C) stream channel, (E) dunes, (F) flat, (H) hilltop, (K) sink, (L) swamp, (O) offshore, (P) pediment, (S) hillside, (T) terrace, (U) undulating, (V) valley flat [27]

MAJOR AQUIFER: TERT-QUAT. system [28 29] PLIO-PLEIST. series [30 31] HUECO BOLSON aquifer, formation, group [32 33]

Lithology: [34 35] Origin: [36] Aquifer Thickness: ft

[37 39] Length of well open to: 200 ft [40 42] Depth to top of: ft [43 45]

MINOR AQUIFER: system, series [46 47] aquifer, formation, group [48 49]

Lithology: [50 51] Origin: [52] Aquifer Thickness: ft

[53 55] Length of well open to: ft [56 58] Depth to top of: ft [59 61]

Intervals Screened: WIRE WRAP 300-500'

Depth to consolidated rock: ft [62 65] Source of data: [66]

Depth to basement: ft [67 70] Source of data: [71]

Surficial material: [72 73] Infiltration characteristics: [74]

Coefficient Trans: gpd/ft [75 77] Coefficient Storage: [78 80]

Coefficient Perm: gpd/ft$^2$; Spec cap: gpm/ft; Number of geologic cards: [81]

Well No.

GPO : 1978 O - 473-840

nd original
rtified mail t
xas Department of Water Resources
O. Box 13087
ustin, Texas 78711

# State of Te:
# WATER WELL REPORT

For TDWR use only
Well No. 49-05-2
Located on map
Received:

1) OWNER El Paso Water Utilities Public Service Board (Name) Address P.O. Box 511 (Street or RFD) El Paso (City) Texas (State) 79961 (Zip)

2) LOCATION OF WELL: County El Paso 2 miles in N (N.E., S.W., etc.) direction from El Paso (Town)

Driller must complete the legal description to the right with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☒ Legal description:
Section No. 1 Block No. 81 Township 1
Abstract No. Survey Name
Distance and direction from two intersecting section or survey lines
Center E½, NW¼, SE¼
☒ See attached map. On Back.

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):
☐ Domestic ☐ Industrial ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Other Well #3 Observation

5) DRILLING METHOD (Check):
☒ Mud Rotary ☐ Air Hammer ☐ Driven ☐ Bored ☐ Air Rotary ☐ Cable Tool ☐ Jetted ☐ Other

6) WELL LOG:
Date drilled 09/18/88

DIAMETER OF HOLE

| Dia. (in.) | From (ft.) | To (ft.) |
|---|---|---|
| 12¼ | Surface | 500 |
| | | |
| | | |

7) BOREHOLE COMPLETION:
☐ Open Hole ☐ Straight Wall ☐ Underreamed
☒ Gravel Packed ☐ Other
If Gravel Packed give interval . . . from 80 ft. to 500 ft.

| From (ft.) | To (ft.) | Description and color of formation material |
|---|---|---|
| 0 | 15 | Clay |
| 15 | 20 | Gravel |
| 20 | 30 | Gravel & Sand |
| 30 | 45 | Gravel |
| 45 | 50 | Clay & Gravel |
| 50 | 55 | Gravel & Sand |
| 55 | 60 | Clay |
| 60 | 75 | Little Clay & Sand |
| 75 | 80 | Little Clay, Sand & Gravel |
| 80 | 90 | Sand |
| 90 | 100 | Gravel & Sand |
| 100 | 115 | Sand |
| 115 | 120 | Sandy Clay |
| 120 | 125 | Clay |
| 125 | 135 | Sandy Clay |
| 135 | 145 | Sand |
| 145 | 150 | Sandy Clay |
| 150 | 155 | Clay |
| 155 | 160 | Clay & Sand |
| 160 | 165 | Gravel & Sand |
| 165 | 175 | Clay & Sand |
| 175 | 190 | Clay |

(Use reverse side if necessary) (Continued)

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

| Dia. (in.) | New or Used | Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfr., if commercial | Setting (ft.) From | Setting (ft.) To | Gage Casing | Gage Screen |
|---|---|---|---|---|---|---|
| 4 | N | .080 Slot WESCO Wound Rod Screen | 500 | 300 | | .250 |
| 4 | N | Galvanized | 300 | +1 | | .250 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

CEMENTING DATA
Cemented from 0 ft. to 80 ft.
Method used Pressure Cemented
Cemented by Cole Drilling Company (Company or Individual)

9) WATER LEVEL:
Static level 362 ft. below land surface Date 09/18/88
Artesian flow gpm. Date

10) PACKERS: Type Depth

11) TYPE PUMP:
☐ Turbin ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc., ft.

12) WELL TESTS:
☐ Type Test: ☐ Pump ☐ Bailer ☒ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

13) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable water? ☐ Yes ☒ No
If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☒ No

RECEIVED
OCT 7 1988
TEXAS WATER COMMISSION

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief.

NAME James Cole (Type or Print) Water Well Drillers Registration No. 285

ADDRESS 9516 Gairloch (Street or RFD) El Paso (City) Texas (State) 79925 (Zip)

(Signed) James M. Cole (Water Well Driller) Cole Drilling Company (Company Name)

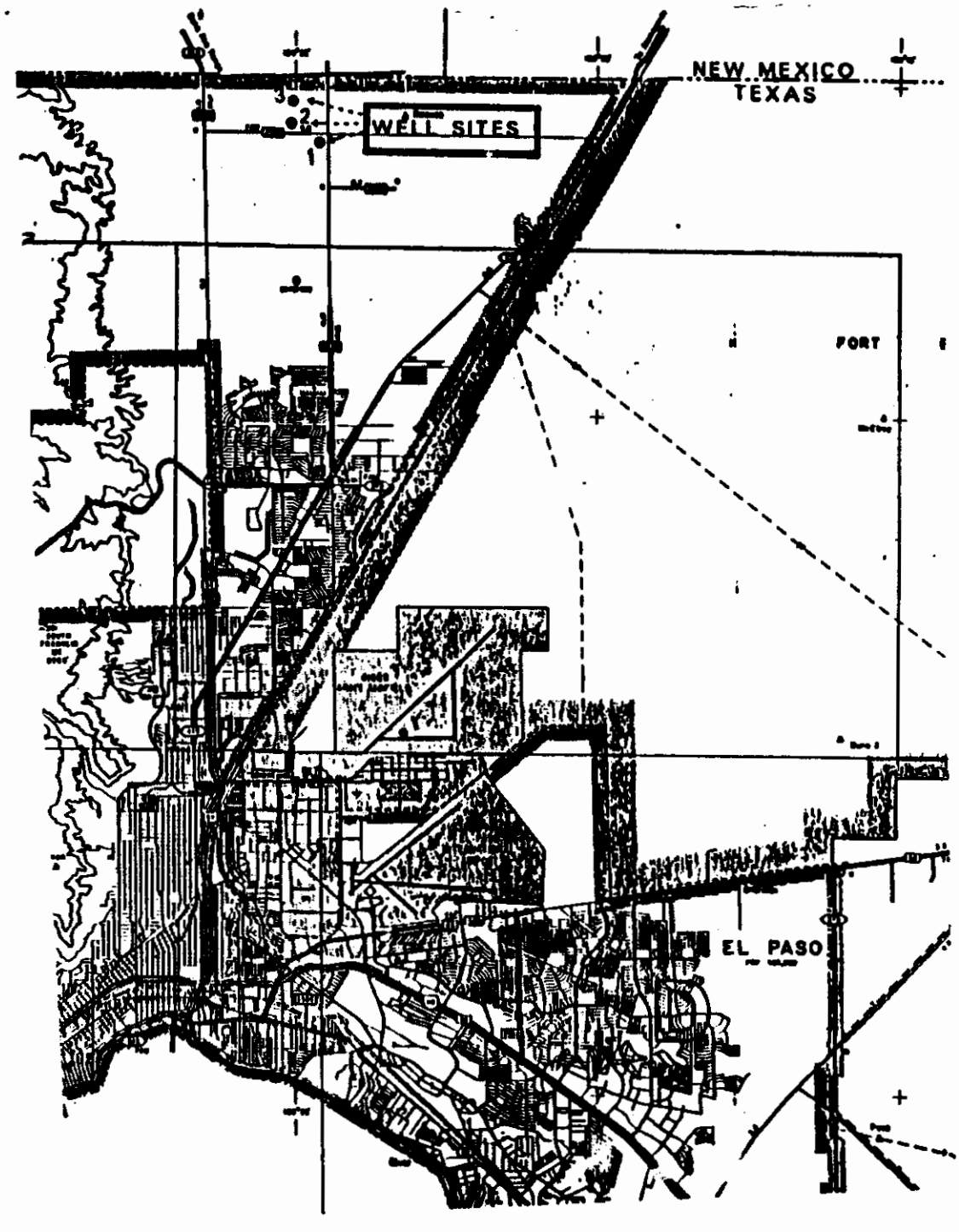
Please attach electric log, chemical analysis, and other pertinent information, if available.

*Additional instructions on reverse side.

OWR-0382

49-05-323 X

| | | |
|---|---|---|
| 190 | 195 | Little Gra & Clay |
| 195 | 215 | Clay |
| 215 | 235 | Clay & Sand |
| 235 | 245 | Sand |
| 245 | 265 | Little Clay & Sand |
| 265 | 280 | Sandy Clay |
| 280 | 285 | Clay & Limestone |
| 285 | 290 | Clay & Sand |
| 290 | 295 | Clay |
| 295 | 315 | Little Clay & Sand |
| 315 | 320 | Clay |
| 320 | 400 | Little Clay & Sand |
| 400 | 500 | Clay & Sand |



JL-49-05-323
LF 3
4/14/91

# EL PASO WATER UTILITIES
## WATER ANALYSIS REPORT

DATE SAMPLE COLLECTED: 04-17-91 WELL NUMBER: LF3
DATE RECEIVED AT LABORATORY: 04-17-91 LAB NUMBER:
DATE ANALYSIS COMPLETED: 06-13-91 LOCATION:
OWNER:
SAMPLE TAKER: SPERKA
DELIVERED BY: SPERKA

| ANIONS | mg/L | me/L | DIL E.C. |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.0 | ********** | |
| Total Alkalinity as CaCO3 | 95.0 | ********** | |
| Carbonates as CO3 | 0.0 | 0.0000 | 0 |
| Bicarbonates as HCO3 | 115.9 | 1.9008 | 83 |
| Chlorides as Cl | 43.0 | 1.2129 | 92 |
| Sulfates as SO4 | 54.0 | 1.1232 | 83 |
| Fluorides as F | 0.9 | 0.0483 | ******* |
| Nitrates as NO3 LOD=0.1 | 0.2 | 0.0035 | 0 |
| Total Phosphates as PO4 LOD=0,09 | 0.0 | 0.0000 | ******* |
| TOTAL ANIONS | 214 | 4.2886 | 258 |
| **CATIONS** | | | |
| Total Hardness as CaCO3 | 56 | ********** | |
| Calcium as Ca | 17.6 | 0.8800 | 46 |
| Magnesium Mg | 2.9 | 0.2377 | 11 |
| Sodium as Na | 69.2 | 3.0100 | 147 |
| Potassium as K | 3.6 | 0.0921 | 7 |
| TOTAL CATIONS | 93 | 4.2198 | 211 |
| TDS BY EPWU METHOD (1)= | 307 | 8.5084 | 469 |
| TDS BY USGS METHOD (2)= | 264 | | |
| TDS BY TDH METHOD (3)= | 248 | | |

| | |
|---|---|
| Silica, SiO2 = | 16.00 |
| Chlorine Res. = | N/A |
| Turbidity, NTU= | 119.00 |
| Sample Temp(C)= | 22.80 |
| pH @ 22.80 | 7.54 |
| Lab E.C.@25C as umhos/cm = | 422 |
| Field E.C. @25C as umhos/cm = | 460 |
| pH Saturation = | 8.27 |
| Langelier Index | -0.73 |
| Aggress. Index= | 11.27 |
| % Na of T.Cat.= | 70 |

CHECKING CORRECTNESS OF ANALYSIS

| | |
|---|---|
| Measured Diluted E.C. | 450 |
| Calculated Diluted E.C. | 469 |
| % Error | 4.26% |

ANION-CATION BALANCE

| | |
|---|---|
| Total Anions - Total Cations = | 0.0689 |
| +or-(0.1065+0.0155*T.Anions) Maximum Limit +/- | 0.1730 |

SO=0,40

KEY PUNCHED

ANALYST Rosa Aguirre

WATER SUPPLY MGR Douglas Hallman
P.O. BOX 511
EL PASO, TEXAS 79961

(1) SUM OF IONS, NOT INCLUDING SILICA
(2) SUM OF IONS WITH CONVERSION OF HCO3 TO CO3, PLUS SILICA.
(3) SUM OF IONS, NOT INCLUDING SILICA WITH CONVERSION OF HCO3 TO CO3.

JL-49-05-323
LF # 3
4/17/91

# METAL ANALYSIS REPORT

LAB. NUMBER: 041791-24
SOURCE NAME: LANDFILL #3
SAMPLE TYPE: GRAB
COLLECT DATE: 04/17/91
COLLECT TIME: 13:30
REQUEST BY: ROGER SPERKA
DATE REPORTED: JULY 1, 1991

| METAL | SYMBOL | METHOD | RESULT (mg/L) | DETECTION LIMIT | ANALYST | DATE ANALYSED |
|---|---|---|---|---|---|---|
| Arsenic | As | EPA 206.2 | <0.0100 | .0100 | VR | 06/24/91 |
| Barium | Ba | EPA 208.2 | 0.0352 | .0100 | VR | 06/24/91 |
| Boron | B | | 0.19 | .10 | VR | 06/25/91 |
| Cadmium | Cd | EPA 213.2 | <0.0005 | .0005 | VR | 06/21/91 |
| Calcium | Ca | EPA 215.1 | 18.58 | 10.00 | VR | 06/11/91 |
| Chromium | Cr | EPA 218.2 | <0.0100 | .0100 | VR | 06/21/91 |
| Copper | Cu | EPA 220.2 | <0.0100 | .0100 | VR | 06/21/91 |
| Iron | Fe | EPA 236.1 | <0.100 | .100 | VR | 05/31/91 |
| Lead | Pb | EPA 239.2 | <0.0050 | .0050 | VR | 06/21/91 |
| Lithium | Li | | 0.024 | .010 | VR | 05/31/91 |
| Magnesium | Mg | EPA 242.1 | 4.18 | 2.00 | VR | 06/11/91 |
| Manganese | Mn | EPA 243.1 | 0.319 | .050 | VR | 05/31/91 |
| Mercury | Hg | EPA 245.1 | <0.0010 | .0010 | VR | 06/18/91 |
| Nickel | Ni | EPA 249.2 | <0.0100 | .0100 | VR | 07/01/91 |
| Phosphorus | P | | <1.00 | 1.00 | VR | 05/31/91 |
| Potassium | K | EPA 258.1 | <5.00 | 5.00 | VR | 06/11/91 |
| Selenium | Se | EPA 270.2 | <0.0100 | .0100 | VR | 06/24/91 |
| Silver | Ag | EPA 272.2 | <0.0010 | .0010 | VR | 06/24/91 |
| Sodium | Na | EPA 273.1 | 68.8 | 50.0 | VR | 06/11/91 |
| Zinc | Zn | EPA 289.1 | 0.321 | .100 | VR | 05/31/91 |

KEY PUNCHED

APPROVED
JUL 0 1 1991
BY: Victoria Rodriguez

JL-49-05-323
LF-3
4/18/90

# EL PASO WATER UTILITIES
## WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED | 04/18/90 | WELL NUMBER | LF-3 |
| DATE RECEIVED AT LABORATORY | 04/18/90 | LAB. NUMBER | C041990-3 |
| DATE ANALYSIS COMPLETED | 05/02/90 | LOCATION | |
| | | OWNER | EPWU |
| | | SAMPLE TAKER | R. SPERKA |
| | | DELIVERED BY | R. SPERKA |

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 0.00 | ****** | ****** |
| Total Alkalinity as CaCO3 | 112 | ****** | ****** |
| Carbonates as CO3 | 0.00 | 0 | 0 |
| Bicarbonates as HCO3 | 137 | 2.23953 | 98 |
| Chlorides as Cl | 45 | 1.26945 | 96 |
| Sulfates as SO4 | 56.4 | 1.17425 | 87 |
| Fluorides as F | 1.00 | .05264 | ****** |
| Nitrates as NO3 | 5.50 | .088715 | 6 |
| Total Phosphates as PO4 LOD=.09 | 0.00 | 0 | ****** |
| Total Anions = | 245 | 4.82458 | 287 |

| CATIONS | | | |
|---|---|---|---|
| Total Hardness as CaCO3 | 68 | ****** | ****** |
| Calcium as Ca | 20.8 | 1.03792 | 54 |
| Magnesium as Mg | 3.90 | .320814 | 15 |
| Sodium as Na | 78 | 3.393 | 166 |
| Potassium as K | 3.65 | .093331 | 7 |
| Total Cations = | 106 | 4.84506 | 242 |
| TDS BY EPWU METHOD (1)= | 351 | 9.66965 | 529 |
| TDS BY USGS METHOD (2)= | 301 | | |
| TDS BY TDH METHOD (3)= | 281 | | |

| | |
|---|---|
| Silica, SiO2 = | 20.00 |
| Chlorine Res. = | N/A |
| Turbidity,ntu = | 76.00 |
| Sample Temp(C)= | 22 |
| pH @ 22 | 8.05 |
| Lab E.C.@25C as umhos/cm = | 449 |
| Field E.C. @25C as umhos/cm = | 470 |
| pH Saturation = | 8.15 |
| Langelier Ind.= | -0.10 |
| Aggress. Index= | 11.93 |
| % Na of T Cat.= | 70 |

Remarks
LOD = LIMIT OF DETECTION

CHECKING CORRECTNESS OF ANALYSIS

| | |
|---|---|
| Measured Diluted E.C. = | 518 |
| Calculated Diluted E.C.= | 529 |
| % Error = | 2.08 |

(1) SUM OF IONS, NOT INCLUDING SILICA
(2) SUM OF IONS WITH CONVERSION OF HCO3 TO CO3, PLUS SILICA.
(3) SUM OF IONS, NOT INCLUDING SILICA WITH CONVERSION OF HCO3 TO CO3.

ANION-CATION BALANCE
Total Anions - Total Cations = CD= -0.08
+or-(0.1065+0.0155* T.ANIONS)
-.02048=<+or-1SD= +or- .181281 MAX. LIMIT

ANALYST Judith McDill

WATER SUPPLY MGR. D. D. Matthews

PO BOX 511
EL PASO, TEXAS 79961

KEY PUNCHED

JL-49-05-323
9/20/88

DATE SAMPLE COLLECTED: 9/20/88
DATE RECEIVED AT LAB: 9/21/88
DATE ANALYSIS COMPLETED: 9/27/88
SAMPLE IDENTIFICATION: Landfill #3
OWNER: EPWU
DEPTH OF WELL:
LABORATORY #: 92188-2

| ANIONS | mg/L | me/L | DIL E.C. | |
|---|---|---|---|---|
| p-ALK (CaCO3) | 4.00 | ********** | | |
| t-ALK (CaCO3) | 121.60 | ********** | | |
| CARBONATES AS CO3 | 4.80 | 0.16 | 13.54 | |
| BICARBONATES AS HCO3 | 138.59 | 2.27 | 99.09 | |
| CHLORIDES AS Cl | 63.00 | 1.78 | 134.82 | |
| SULFATES AS SO4 | 20.00 | 0.42 | 30.80 | |
| FLOURIDES AS F | 0.93 | 0.05 | ********* | |
| NITRATES AS NO3 | 8.95 | 0.14 | 10.29 | |
| TOTAL PHOSPHATES AS PO4 | 0.00 | 0.00 | ********* | LOD < 0.2 |
| TOTAL ANIONS | 236.27 | 4.82 | 288.54 | |
| CATIONS | | | | |
| t-HARDNESS AS CaCO3 | 55.91 | ********** | | |
| CALCIUM AS Ca | 16.10 | 0.81 | 41.86 | |
| MAGNESIUM AS Mg | 3.80 | 0.31 | 14.52 | |
| SODIUM AS Na | 98.20 | 4.27 | 209.17 | |
| POTASSIUM AS K | 7.00 | 0.18 | 12.88 | |
| TOTAL CATIONS | 125.10 | 5.57 | 278.42 | |

| | | | |
|---|---|---|---|
| E. COND | 539.00 | pH: | 8.30 |
| TDS AT 103 C | 402.00 | TURBIDITY | 84.00 |
| CALCULATED TDS | 361.37 | SiO4: | |
| | | Cl2 RES: | NA |
| CHECKING CORRECTNESS OF ANALYSIS | | TEMP OF ANALYSIS: | 26.00 |
| MEASURED DILUTED E.C. | 573.10 | pH SATUR: | 7.96 |
| CALCULATED DILUTED E.C. | 566.96 | LANG IND: | 0.34 |
| % ERROR | -1.07% | AGGR IND: | 12.13 |
| ANION/CATION BALANCE | | FIELD E.C.: | 585.00 |
| t-ANIONS - t-CATIONS= | -0.75 | %NA OF T. CAT.: | 76.7% |
| MAXIMUM LIMIT +/- | 0.18 | | |

ANALYST: _____
CHEMIST: _____

KEY PUNCHED

APPROVED
JAN 24 1989
BY: _____

IC-469-05-323
4/11/89
@ WTP
TABLE

K.P.

# EL PASO WATER UTILITIES
## WATER ANALYSIS REPORT

| | | | |
|---|---|---|---|
| DATE SAMPLE COLLECTED | 04/11/89 | WELL NUMBER | LF-3 |
| DATE RECEIVED AT LABORATORY | 04/11/89 | LAB. NUMBER | C041189- 4 |
| DATE ANALYSIS COMPLETED | 05/25/89 | LOCATION | SURFACE |
| | | OWNER | EPWU |
| | | SAMPLE TAKER | R. SPERKA |
| | | DELIVERED BY | R. SPERKA |

| ANIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Phenol Alkalinity as CaCO3 | 4.00 | ****** | ****** |
| Total Alkalinity as CaCO3 | 106 | ****** | ****** |
| Carbonates as CO3 | 4.88 | .162650 | 14 |
| Bicarbonates as HCO3 | 120 | 1.95959 | 85 |
| Chlorides as Cl | 42 | 1.18482 | 90 |
| Sulfates as SO4 | 49 | 1.02018 | 75 |
| Fluorides as F | 0.19 | .010002 | ****** |
| Nitrates as NO3 LOD=0.443 | 0.00 | 0 | 0 |
| Total Phosphates as PO4 LOD=.09 | 0.11 | .003475 | ****** |
| Total Anions = | 216 | 4.34072 | 265 |

| CATIONS | MG/L | ME/L | DIL EC |
|---|---|---|---|
| Total Hardness as CaCO3 | 80 | ****** | ****** |
| Calcium as Ca | 19 | .9481 | 49 |
| Magnesium as Mg | 7.80 | .641628 | 30 |
| Sodium as Na | 63 | 2.7405 | 134 |
| Potassium as K CALCULATED AS NA | 0.00 | 0 | 0 |
| Total Cations = | 90 | 4.33023 | 213 |
| TOTAL DISSOLVED SOLIDS = | 306 | 8.67094 | 478 |

| | |
|---|---|
| Silica, SiO2 | =N/A |
| Chlorine Res. | = N/ |
| Turbidity,ntu | = 93.0 |
| Sample Temp(C) | = 2 |
| pH @ 22.1 | = 8.5 |
| Lab E.C.@25C as umhos/cm | = 47 |
| Field E.C. @25C as umhos/cm | = 50 |
| pH Saturaticn | = 8.2 |
| Langelier Ind. | = 0.3 |
| Aggress. Index | = 12.4 |
| % Na of T Cat. | = 6 |

Remarks
LOD = LIMIT OF DETECTION

TAG#-

CHECKING CORRECTNESS OF ANALYSIS
Measured Diluted E.C. = 480
Calculated Diluted E.C. = 478
% Error = -0.42

ANION-CATION BALANCE
Total Anions - Total Cations =
+or-(0.1065+0.0155* T.ANIONS)
.010487=<+or-1SD= +or- .173781 MAX. LIMIT

ANALYST J. McGill

WATER SUPPLY MGR
PO BOX 511
EL PASO, TEXAS 79961

JL-49-05-321, 322 & 323

32°00'00"

49-05

81°57'30"






49-05-321

# Texas Water Development Board
## Well Schedule

State Well Number 49 05 324 Previous Well Number _____ County El Paso 141

River Basin _____ 23 Zone 1 Latitude 31 59 15 Longitude 106 24 52 Coordinates Accuracy 0

Owner's well No. _____ Location: _____ 1/4, _____ 1/4, Section _____ Block _____ Survey _____

Owner El Paso Water Utilities LF-2A

Driller Layne-Christensen

Address _____ Tenant/Oper. _____

Date Drilled _____ Depth 500 Source of Depth A Altitude 404 Source of Alt. Data M

Aquifer _____ 112HCBK Aquifer ID 01 _____ Well Type 0 User _____

**Well Construction**
Const Method _____ Casing Material _____
Completion Method _____ Screen Material _____

**Lift Data**
Pump Mfr. _____ Type of Lift _____ Pump Depth Setting (ft) _____ ft.
Motor Mfg _____ Power _____ H.P. _____

**Yield**
Flow Rate _____ Pump Rate _____ GPM Circle how rate was determined: Meas Rept Est Date of Test _____

**Performance Test**
Length of test _____ hr Production Rate _____ GPM Circle how rate was determined: Meas Rept Est Date of Test _____
Static Level _____ ft. Pumping Level _____ ft. Amount of Drawdown _____ ft. Specific Capacity _____ GPM/ft.

**Water Use**
Primary _____ Secondary _____ Tertiary _____

**Water Quality**
(Remarks: _____

**Other Data Available**
Water Level N Water Quality N Logs _____ Other Data _____

**Water Levels**
Date _____ Meas. _____ Remarks _____ M.P. + - _____
Date _____ Meas. _____ Remarks _____
Date _____ Meas. _____ Remarks _____

Recorded by DR Jones Date Record Collected or Information Updated 11 02 2001 Reporting Agency 03

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (S)
Open Hole (O)
Cemented from _____ to _____

| | Diam. (in.) | Interval of C,S, or O. From | To |
|---|---|---|---|
| 1 | S | 300 | 500 |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |

Remarks
1 Well is a monitoring well for
2 El Paso's McCombs landfill.
3
4
5
6

_____ Aquifer

49-05-324 Well Number



Form at: V:/HEMon/Share1orms/WellSchedule

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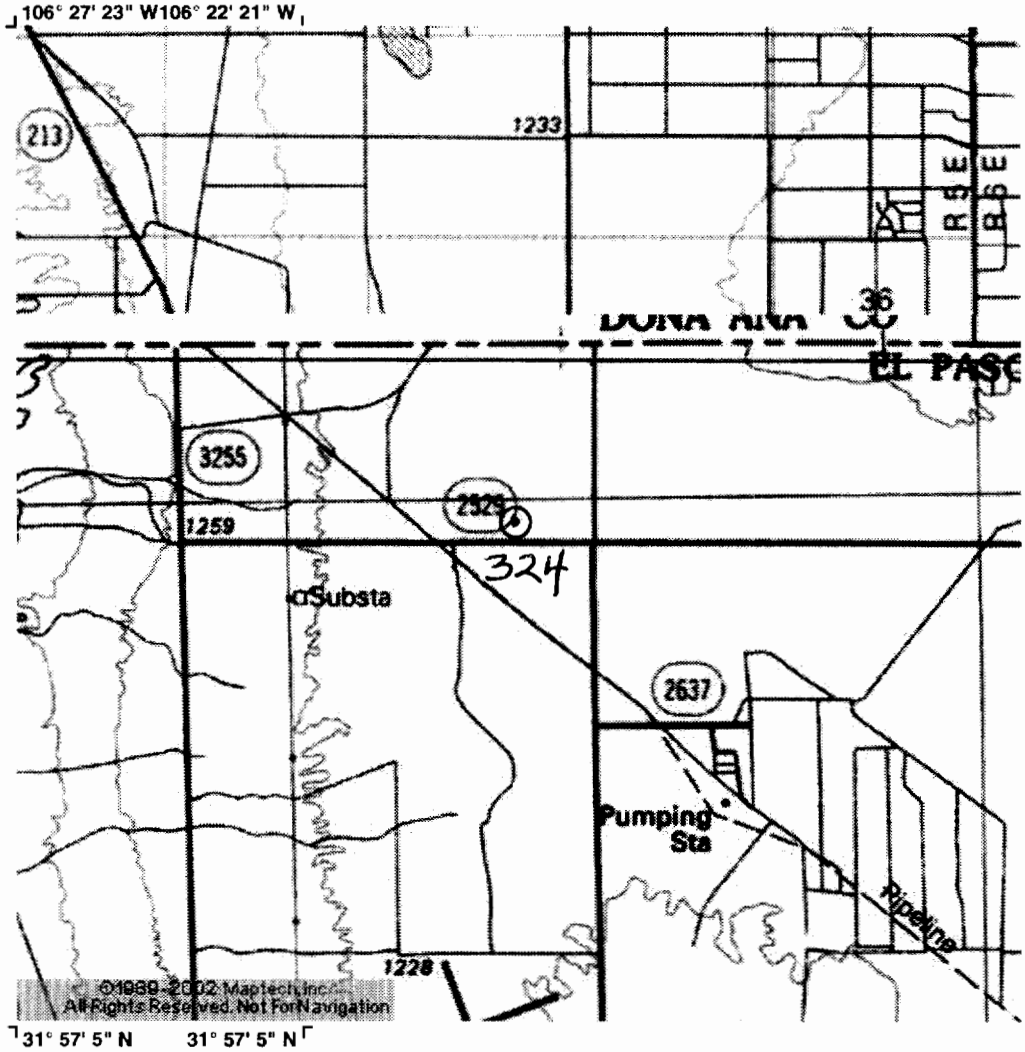


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49-05-324

# Texas Water Development Board
## Well Schedule

State Well Number 49 05 325 Previous Well Number _____ County El Paso 141

River Basin _____ 23 Zone i Latitude 31 59 59 Longitude 106 24 31 Coordinates Accuracy 0

Owner's well No. _____ Location: _____ 1/4, _____ 1/4, Section _____ Block _____ Survey _____

Owner El Paso Water Utilities LF-4A

Driller Layne-Christensen

Address _____ Tenant/Oper. _____

Date Drilled _____ Depth 500 Source of Depth A Altitude 402 Source of Alt. Data M

Aquifer 1 1 2 H C B L Aquifer ID 0 1 _____ Well Type 0 User _____

**Well Construction**
Const Method _____ Casing Material _____
Completion Method _____ Screen Material _____

**Lift Data**
Pump Mfr. _____ Type of Lift _____ Pump Depth Setting (ft) _____ ft.
Motor Mfg _____ Power _____ H.P. _____

**Yield**
Flow Rate _____ Pump Rate _____ GPM (Circle how rate was determined) Meas Rept Est Date of Test _____

**Performance Test**
Length of test _____ hr Production Rate _____ GPM (Circle how rate was determined) Meas Rept Est Date of Test _____
Static Level _____ ft. Pumping Level _____ ft. Amount of Drawdown _____ ft. Specific Capacity _____ GPM/ft.

**Water Use**
Primary _____ Secondary _____ Tertiary _____

**Water Quality** (Remarks: _____

**Other Data Available**
Water Level N Water Quality N Logs _____ Other Data _____

**Water Levels**
Date _____ Meas. _____ Remarks _____ M.P. + - _____
Date _____ Meas. _____ Remarks _____
Date _____ Meas. _____ Remarks _____

Recorded by DR Jones Date Record Collected or Information Updated 11 02 2001 Reporting Agency 02

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (S)
Open Hole (O)
Cemented from ___ to ___

| | Diam. (in.) | Interval of C.S. or O. From | To |
|---|---|---|---|
| 1 | 5 | 300 | 500 |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |

Remarks
1 Well is a monitoring well for
2 El Paso's McCamb landfill.
3
4
5
6

Aquifer

49-05-325
Well Number



Form at: V:/HEMon/Share/forms/WellSchedule

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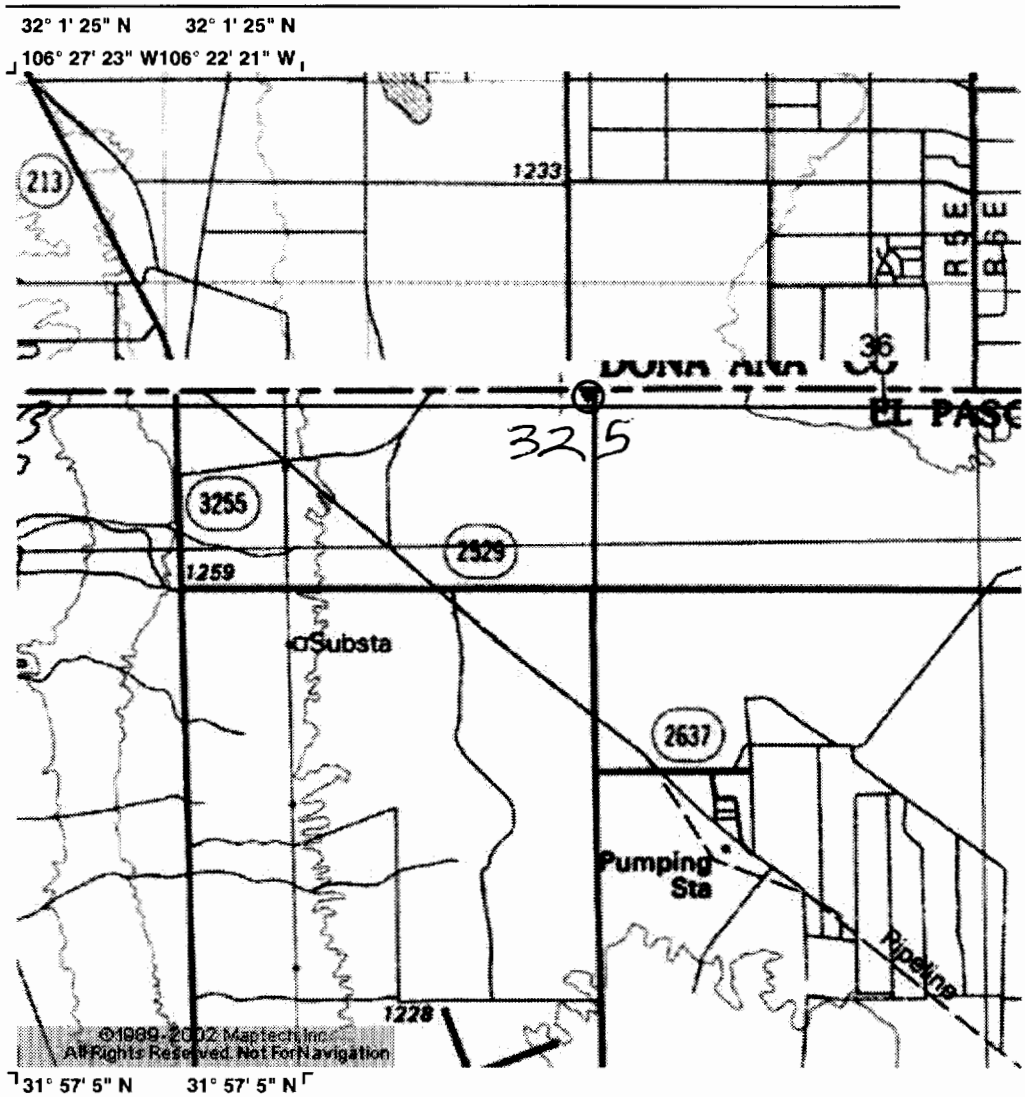


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49-05325

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer Hueco Bolson  Field No. R-4  State Well No. 49-06-102

Owner's Well No.  County El Paso

1. Location: NEC 1/4, 1/4 Sec. 4, Block 80 Survey T S P. I-S

2. Owner: PRICE'S DAIRY (USGS) Address:

Tenant: Address:

Driller: B & W Drilling Co. Address:

3. Elevation of 4047.5± is ft. above msl, determined by

4. Drilled: MAY 1953; Dug, Cable Tool, Rotary.

5. Depth: Rept. 825 ft. Meas. ft.

6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed

7. Pump: Mfgr. NONE Type

No. Stages, Bowls Diam. in., Setting ft.

Column Diam. in., Length Tailpipe ft.

8. Motor: Fuel Make & Model HP.

9. Yield: Flow gpm, Pump gpm, Meas., Rept., Est.

10. Performance Test: Date Length of Test Made by

Static Level ft. Pumping Level ft. Drawdown ft.

Production gpm Specific Capacity gpm/ft.

CASING & BLANK PIPE

Cemented From ft. to ft.

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 3 | | 0 | 520 |

11. Water Level: 332.65 ft. rept. meas. 1-7-1954 above below Top of 3" csg which is 1.5 ft. above below surface.

344.22 ft. rept. meas. 1/22/1976 above below LSD which is ft. above below surface.

ft. rept. meas. 19 above below which is ft. above below surface.

ft. rept. meas. 19 above below which is ft. above below surface.

12. Use: Dom., Stock, Public Supply, Ind., Irr., Waterflooding, Observation, Not Used, TEST

13. Quality: (Remarks on taste, odor, color, etc.)

Temp. °F, Date sampled for analysis Laboratory

Temp. °F, Date sampled for analysis Laboratory

Temp. °F, Date sampled for analysis Laboratory

14. Other data available as circled: Driller's Log, Radioactivity Log, Electric Log,

Formation Samples, Pumping Test,

WELL SCREEN

Screen Openings

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| 3 | Slotted | 500 | 520 |

15. Record by: TWDB - El Paso Date 19 72

Source of Data USGS well schedule by D.B.K. 3/14/54

16. Remarks:

Slotted 500-520

Water Sample 500-510, DST: 457-500, 542-586, 677-725, 752-798

Elect. Log & Sample Log

TEST WELL

4/9/75 OTM - Cap rusted on csg. - could not remove

move west on map

Elect. log & DST's indicate fresh-water sands extend to 430'

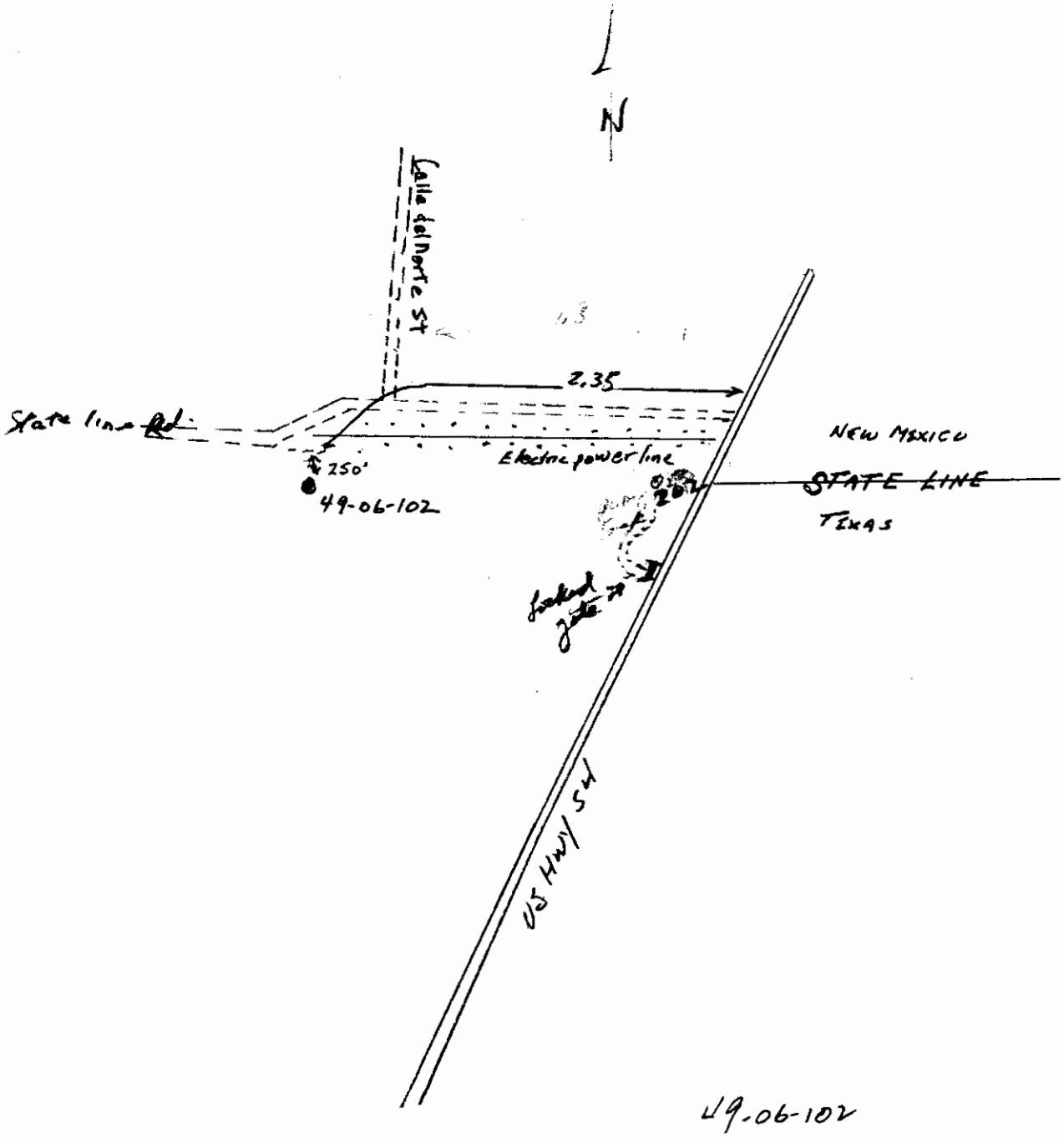
Obs Well

✓

TWDBE-WD-2

(Stage) 275

49-06-102


N
Calle del Norte St
2,35
State line Rd
250'
49-06-102
Electric power line
NEW MEXICO
STATE LINE
TEXAS
locked gate
US HWY 54
49-06-102

Typewrite (Black ribbon) or Print Plainly
(soft pencil or black ink)
Do not use ball point pen

Texas Department of Health Laboratories
1100 West 49th Street
Austin, Texas 78756

TDWR ONLY
Organization No. _____ Lab No. 02
Work No. _____

# CHEMICAL WATER ANALYSIS REPORT

County 071
State Well No. 49-06-102
Well No. _____
Date Collected 06-10-53

Send report to:

Data Collection and Evaluation Section
Texas Department of Water Resources
P.O. Box 13087
Austin, Texas 78711

Owner _____ Send copy to owner Sample No. _____ By _____
Address _____ Well Location _____
Date Drilled _____ Depth _____ ft. WBF _____ Source (type of well) _____
Producing intervals _____ Water level _____ ft. Sample depth _____ ft.
Sampled after pumping _____ hrs. Yield _____ GPM meas. est. Temperature _____ °F _____ °C
Point of collection _____ Appearance ☐ clear ☐ turbid ☐ colored ☐ other
Use _____ Remarks _____

(FOR LABORATORY USE ONLY)

## CHEMICAL ANALYSIS

KEY PUNCHED

Laboratory No. _____ Date Received _____ Date Reported _____

| | | MG/L | ME/L |
|---|---|---|---|
| Silica | 00955 | 33 | |
| Calcium | 00910 | 113 | |
| Magnesium | 00920 | 27 | |
| Sodium | 00929 | 330 | |
| | Total | | |
| ☐ Potassium | 00937 | 11.0 | |
| [3] ☐ Manganese | 01055 | . | %Na _____ |
| ☐ Boron | 01022 | .09 | SAR _____ |
| [3] ☐ Total Iron | 01045 | .04 | RSC _____ |
| ☐ (other) _____ | | MG/L | |

| | | MG/L | ME/L |
|---|---|---|---|
| Carbonate | 00445 | 0 | |
| Bicarbonate | 00440 | 60 | |
| Sulfate | 00945 | 11 | |
| Chloride | 00940 | 795 | |
| Fluoride | 00951 | .0 | |
| Nitrate | 71850 | 5.40 | |
| pH | 00403 | 7.5 | |
| | Total | | |
| [1] Dissolved Solids (residue at 180°C) | 70300 | 1380 | |
| Phenolphthalein Alkalinity as $CaCO_3$ | 00415 | | |
| Total Alkalinity as $CaCO_3$ | 00410 | | |
| Total Hardness as $CaCO_3$ | 00900 | 443 | |
| [2] Nitrogen Cycle | | | |
| Ammonia - N | 00610 | | |
| Nitrite - N | 00615 | | |
| Nitrate - N | 00620 | | |
| Organic Nitrogen | 00605 | | |

Specific Conductance (micromhos/cm³) 00095 _____
Diluted Conductance (micromhos/cm³): _____ x _____ = 2700

" ☐ " items will be analyzed if checked.

[1] The bicarbonate reported in this analysis can be converted by computation (multiplying by 0.4917) to an equivalent amount of carbonate, and the carbonate figure used in the computation of dissolved solids.
[2] Nitrogen cycle requires separate sample.
[3] Total Iron and Manganese require separate sample.

TDWR-0148 (Rev. 9-26-83)



Analyst _____ Checked By _____

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer Hueco Bolson  Field No. R-97  State Well No. 49-06-104

Owner's Well No. City 58  County El Paso

1. Location: 1/4, NW 1/4 Sec. 16, Block 80 Survey T-1
31 58 18 N 106 23 26.1

2. Owner: City of El Paso  Address:

Tenant:  Address:

Driller: City  Address:

3. Elevation of LSD is 4032 ft. above msl, determined by Topo

4. Drilled: 3 1965; Dug, Cable Tool, Rotary,

5. Depth: Rept. 949 ft. Meas. ft.

6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed

7. Pump: Mfgr. Type

No. Stages none, Bowls Diam. in., Setting ft.

Column Diam. in., Length Tailpipe ft.

8. Motor: Fuel Make & Model HP.

9. Yield: Flow gpm, Pump gpm, Meas., Rept., Est.

10. Performance Test: Date Length of Test Made by

Static Level ft. Pumping Level ft. Drawdown ft.

Production gpm Specific Capacity gpm/ft.

CASING & BLANK PIPE

Cemented From ft. to ft.

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| none | | | |

11. Water Level: 338 ft. rept. meas. 3/9 1965 above (below) LSD which is ft. above below surface.

ft. rept. meas. 19 above below which is ft. above below surface.

ft. rept. meas. 19 above below which is ft. above below surface.

ft. rept. meas. 19 above below which is ft. above below surface.

12. Use: Dom., Stock, Public Supply, Ind., Irr., Waterflooding, Observation, Not Used, test

13. Quality: (Remarks on taste, odor, color, etc.)

Temp. 79 °F, Date sampled for analysis Laboratory

Temp. °F, Date sampled for analysis Laboratory

Temp. °F, Date sampled for analysis Laboratory

WELL SCREEN

Screen Openings

| Diam. (in.) | Type | Setting, ft. from | to |
|---|---|---|---|
| | | | |

14. Other data available as circled: Driller's Log, Radioactivity Log, (Electric Log),

Formation Samples, Pumping Test,

15. Record by: TWDB  Date 2/20 1975

Source of Data USGS well sched (ME Davis 3/15/65)

16. Remarks:

DST 428-453

Elect. log & DST indicate no fresh water <250 ✓

could not locate
no evidence of well.

TWDBE-WD-2

(Sketch)



49-06-104 ✓

PUBLIC SERVICE BOARD - EL PASO WATER UTILITIES

El Paso Co.
City of El Paso

# WATER ANALYSIS DATA SHEET

49-06-104

Plant Sample ..... Well Number T-58 ..... Location .....

| SAMPLE NUMBER | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| DEPTH | 428-453 | | | | | |
| SAMPLE COLLECTED | 4-15-65 | | | | | |
| RECEIVED AT LABORATORY | | | | | | |
| ANALYSIS COMPLETED | 4-17-65 | | | | | |
| pH | 8.1 | | | | | |
| EC x $10^6$ @ $25^0$ | | | | | | |
| TASTE AND ODOR | | | | | | |
| SODIUM PER CENT OF TOTAL CATIONS | | | | | | |

PARTS PER MILLION

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTAL DISSOLVED SOLIDS | 786 | | | | | |
| PHENOL ALKALINITY AS $CaCO_3$ | 0 | | | | | |
| TOTAL ALKALINITY AS $CaCO_3$ | 60 | | | | | |
| TOTAL HARDNESS AS $CaCO_3$ | 158 | | | | | |
| CHLORIDES | 315 | | | | | |
| SULFATES | 236 | | | | | |
| CALCIUM | 59 | | | | | |
| MAGNESIUM | 3 | | | | | |
| TOTAL IRON | .04 | | | | | |
| FLUORIDES | .05 | | | | | |
| SODIUM & POTASSIUM (CALC. AS NA) | | | | | | |
| SILICA, $SiO_2$ | | | | | | |

THEORETICAL COMBINATIONS

| | | | | | | |
|---|---|---|---|---|---|---|
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Remarks: .....

.....

.....

not in report



....Oscar Estrada.....
Analyst

P.S.B. FORM 4518-0462

PUBLIC SERVICE BOARD - EL PASO WATER UTILITIES

# WATER ANALYSIS DATA SHEET

49-06-104

Plant Sample ..... Well Number 58 Location .....

| SAMPLE NUMBER | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| DEPTH | 428-453 | | | | | |
| SAMPLE COLLECTED | 4-15-65 | | | | | |
| RECEIVED AT LABORATORY | | | | | | |
| ANALYSIS COMPLETED | 4-17-65 | | | | | |
| pH | 8.1 | | | | | |
| EC x $10^6$ @ $25^0$ | | | | | | |
| TASTE AND ODOR | | | | | | |
| SODIUM PER CENT OF TOTAL CATIONS | | | | | | |

PARTS PER MILLION

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTAL DISSOLVED SOLIDS | 786 | | | | | |
| PHENOL ALKALINITY AS $CaCO_3$ | 0 | | | | | |
| TOTAL ALKALINITY AS $CaCO_3$ | 60 | | | | | |
| TOTAL HARDNESS AS $CaCO_3$ | 158 | | | | | |
| CHLORIDES | 315 | | | | | |
| SULFATES | 236 | | | | | |
| CALCIUM | 59 | | | | | |
| MAGNESIUM | 3 | | | | | |
| TOTAL IRON | .04 | | | | | |
| FLUORIDES | .05 | | | | | |
| SODIUM & POTASSIUM (CALC. AS Na) | | | | | | |
| SILICA, $SiO_2$ | | | | | | |

THEORETICAL COMBINATIONS

| | | | | | | |
|---|---|---|---|---|---|---|
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| | | | | | | |

Remarks: .....

.....

.....



Oscar Estrada ..... 49-06-104

Analyst

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

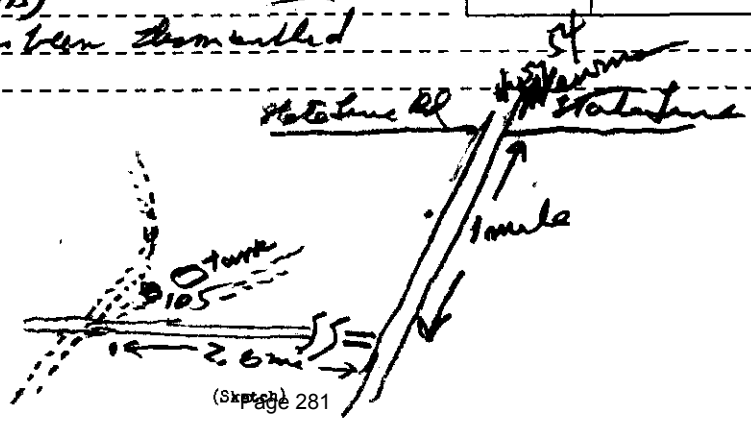
Aquifer Hueco Bolson  Field No. M-247 R-5  State Well No. 49-06-105

Owner's Well No. _____  County El Paso

1. Location: ___ 1/4, ___ 1/4 Sec. ___, Block ___ Survey ___
   31 59 07 N 106 22 28.1  1.9 miles NE of Compressor Station
2. Owner: Price's Dairy  Address: ___
   Tenant: ___  Address: ___
   Driller: ___  Address: ___
3. Elevation of 4059.3 LSD is ___ ft. above msl, determined by ___
4. Drilled: ___ 19___; Dug, Cable Tool, Rotary, ___
5. Depth: Rept. 450 ft. Meas. ___ ft.
6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed ___
7. Pump: Mfgr. ___ Type C
   No. Stages ___, Bowls Diam. ___ in., Setting ___ ft.
   Column Diam. None in., Length Tailpipe ___ ft.
8. Motor: Fuel Wind  Make & Model ___ HP. ___
9. Yield: Flow ___ gpm, Pump ___ gpm, Meas., Rept., Est. ___
10. Performance Test: Date ___ Length of Test ___ Made by ___
    Static Level ___ ft. Pumping Level ___ ft. Drawdown ___ ft.
    Production ___ gpm  Specific Capacity ___ gpm/ft.
11. Water Level: 580.3 ft. rept. meas. 4/10 19 75 above below Temp 65?  which is -8 ft. above below surface.
    ___ ft. rept. meas. ___ 19___ above below  which is ___ ft. above below surface.
    ___ ft. rept. meas. ___ 19___ above below  which is ___ ft. above below surface.
    ___ ft. rept. meas. ___ 19___ above below  which is ___ ft. above below surface.
12. Use: Dom., Stock, Public Supply, Ind., Irr., Waterflooding, Observation, Not Used  Abandoned
13. Quality (Remarks on taste, odor, color, etc.) ___
    Temp. ___ °F, Date sampled for analysis ___ Laboratory ___
    Temp. ___ °F, Date sampled for analysis ___ Laboratory ___
    Temp. ___ °F, Date sampled for analysis ___ Laboratory ___
14. Other data available as circled: Driller's Log, Radioactivity Log, Electric Log,
    Formation Samples, Pumping Test, ___
15. Record by: TWDB  Date 2/20 19 75
    Source of Data USGS well sched.
16. Remarks:
    no longer used - dropped some pipe in hole and can't get it out (per foreman as of 4/10/75)
    Windmill derrick has been dismantled

| CASING & BLANK PIPE | | | |
|---|---|---|---|
| Cemented From ___ ft. to ___ ft. | | | |
| Diam. (in.) | Type | Setting, ft. from | to |
| 6 | Steel | | 350 |
| 4 | | | 450 |
| | | | |
| | | | |

| WELL SCREEN | | | |
|---|---|---|---|
| Screen Openings ___ | | | |
| Diam. (in.) | Type | Setting, ft. from | to |
| 4 | | | |
| | | | |
| | | | |
| | | | |



(Sketch)

TWDBE-WD-2



49-06-105

49-06-105

PUBLIC SERVICE BOARD - EL PASO WATER UTILITIES

# WATER ANALYSIS DATA SHEET

Plant Sample ..... Well Number Price Dairy Location N. of Newman Road

| SAMPLE NUMBER | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| DEPTH | | | | | | |
| SAMPLE COLLECTED | | | | | | |
| RECEIVED AT LABORATORY | | | | | | |
| ANALYSIS COMPLETED | 4/7/65 | | | | | |
| pH | 8.25 | | | | | |
| EC x $10^5$ @ $25^0$ | | | | | | |
| TASTE AND ODOR | | | | | | |
| SODIUM PER CENT OF TOTAL CATIONS | | | | | | |

PARTS PER MILLION

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTAL DISSOLVED SOLIDS | 1227 | | | | | |
| PHENOL ALKALINITY AS $CaCO_3$ | 7 | | | | | |
| TOTAL ALKALINITY AS $CaCO_3$ | 83 | | | | | |
| TOTAL HARDNESS AS $CaCO_3$ | 232 | | | | | |
| CHLORIDES | 560 | | | | | |
| SULFATES | 325 | | | | | |
| CALCIUM | 80 | | | | | |
| MAGNESIUM | 8 | | | | | |
| TOTAL IRON | .02 | | | | | |
| FLUORIDES | | | | | | |
| SODIUM & POTASSIUM (CALC. AS NA) | | | | | | |
| SILICA, $SiO_2$ | | | | | | |

THEORETICAL COMBINATIONS

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
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| | | | | | | |

Remarks: North Of Newman Rd. (Windmill West)

Oscar Estrada
Analyst



P.S.B. FORM 4516-0462

49-06-105

Typewrite (Black ribbon) or Pri... ainly
(soft pencil or black ink)
Do not use ball point pen

Texas State Department of Health Laboratories
1100 West 49th Street
Austin, Texas 78756

**TWDBE-GW ONLY**

Program No. _____

Proj. No. _____

## CHEMICAL WATER ANALYSIS REPORT

Send report to:

Ground Water Data and Protection Division
Texas Water Development Board
P.O. Box 13087
Austin, Texas 78711

County _____

State Well No. _____

USGS Well No. R-6

Date Collected 04-07-65

By _____

Location N of Newman Road

Source (type of well) Windmill Owner Price Dairy

Date Drilled _____ Depth _____ ft. WBF _____

Producing intervals _____ Water level _____ ft.

Sampled after pumping _____ hrs. Yield _____ GPM meas. est. Temperature _____ °F _____ °C

Point of collection _____ Appearance ☐ clear ☐ turbid ☐ colored ☐ other

Use _____ Remarks _____

**(FOR LABORATORY USE ONLY)**

## CHEMICAL ANALYSIS

Laboratory No. _____ Date Received _____ Date Reported _____

| | MG/L | ME/L |
|---|---|---|
| Silica | | |
| Calcium | 80 | |
| Magnesium | 8 | |
| Sodium | | |
| Total | | |
| ☐ Potassium | | |
| ☐ Manganese | | |
| ☐ Boron | | |
| 3/ ☐ Total Iron | .02 | |
| ☐ (other) _____ | | |
| Specific Conductance (micromhos/cm³) | | |
| Diluted Conductance (micromhos/cm³) | X | |

%Na _____

SAR _____

SC _____

| | MG/L | ME/L |
|---|---|---|
| Carbonate | | |
| Bicarbonate | | |
| Sulfate | 325 | |
| Chloride | 560 | |
| Fluoride | | |
| Nitrate | | |
| pH | 8.3 | |
| Total | | |
| 1/ Dissolved Solids (sum in MG/L) | | |
| Phenolphthalein Alkalinity as C $aCO_3$ | 7 | |
| Total Alkalinity as C $aCO_3$ | 83 | |
| Total Hardness as C $aCO_3$ | 232 | |
| 2/ Nitrogen Cycle | | |
| Ammonia - N | | |
| Nitrite - N | | |
| Nitrate - N | | |
| Organic Nitrogen | | |

"☐" items will be analyzed if checked.

1/ The bicarbonate reported in this analysis is converted by computation (multiplying by 0.4917) to an equivalent amount of carbonate, and the carbonate figure is used in the computation of this sum.

2/ Nitrogen cycle requires separate sample.

3/ Total Iron requires separate sample.

Analyst _____ Checked By _____

TWDBE-WD-1 (Rev. 1-25-72)



49-06-105

# Texas Department of License and Regulation

Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department within 30 days following the plugging of the well.

## PLUGGING REPORT

### A. WELL IDENTIFICATION AND LOCATION DATA

**1) OWNER**

| Name | Address | City | State | Zip |
|---|---|---|---|---|
| Cemex Inc. | # 1 MCKelligon CAnyon Rd | El Paso | Tx | 79930 |

**2) WELL LOCATION**

| County | Physical Address | City | State | Zip |
|---|---|---|---|---|
| EL Paso | 6101 Stan Roberts DR | El Paso | Tx | 79934 |

| 3) Owner's Well No. | Long. | Lat. | Grid # |
|---|---|---|---|
| | | | |

4) Type of Well ☒ Water ☐ Monitor ☐ Injection ☐ De-Watering

5) NT

Drill, Pump Installer, or Landowner performing the plugging operations must locate and identify the location of the well within a specific grid on a full scale gridded map available from Texas Natural Resource Information Service. The location of the well should be denoted within the grid by placing a corresponding dot in the square to the right. The legal description is optional.

### B) HISTORICAL DATA ON WELL TO BE PLUGGED (if available)

6) Driller Unkown License No.

7) Drilled / / 8) Diameter of hole Inches 9) Total depth of well 442 feet.

### C. CURRENT PLUGGING DATA

10) Date well plugged / /

12) Name of Driller/Pump Installer or Well Owner performing the plugging
Stan Hargraves

License No. 3298-WI

13) CASING AND CEMENTING DATA RELATIVE TO THE PLUGGING OPERATIONS.

**CASING LEFT IN WELL**

| DIAMETER (inches) | FROM (feet) | TO (feet) |
|---|---|---|
| 12 | 0 | 442 |
| | | |
| | | |
| | | |

**CEMENT/BENTONITE PLUG(S) PLACES IN WELL**

| FROM (feet) | TO (feet) | SACKS |
|---|---|---|
| 0 | 442 | 400 |
| | | |
| | | |
| | | |

**11) REMOVE ALL REMOVEABLE CASING**
Please check box beside the method of plugging used

- ☐ Tremmie pipe cement from bottom to top.
- ☐ Tremmie pipe bentonite from bottom to 2 feet from From surface, cement top 2 feet.
- ☐ Pour in 3/8 bentonite chips when standing water in well is less than 100 feet depth, cement top 2 feet.
- ☒ Large diameter well filled with clay material from top to bottom, cement

**COMMENTS**

### D. VALIDATION OF INFORMATION INCLUDED IN FORM

I certify that I plugged this well (or the well was plugged under my supervision) and that all of the statements herein are true and correct. I understand that failure to complete items 1 through 13 will result in the report(s) being returned for completion and resubmitted.

Company or individual's Name (type or print) Stan Hargraves

| Address | City | State | Zip |
|---|---|---|---|
| 2545 N Hadley | Las CRuces N | N.M. | 88007 |

| Signature Licensed Driller/Pump Installer | Date | Signature Apprentice | Date |
|---|---|---|---|
| | 10/17/07 | | / / |

TDLR FORM a004WWD White - TDLR Yellow - Owner Pink - Driller/Pump Installer

## Facsimile

| | | | |
|---|---|---|---|
| **To:** | Manny Grado | **From:** | Octavio "Sonny" Holguin, Jr. |
| **Date:** | 05/25/07 | **Pages:** | 2 (including cover) |
| **Fax:** | (915) 621-6711 | **Fax:** | (915) 564-3680 |
| **Re:** | McCombs Quarry – Well Report | **Phone:** | (915) 564-1653 / cell (915) 227-3949 |

This facsimile is intended only for use of the addressee(s) named herein and may contain legally privileged and/or confidential information. If you are not the intended recipient of this facsimile, you are hereby notified that any dissemination, distribution or copying of this facsimile is strictly prohibited.

The following attached fax is the well report for the installation of the replacement well at the McCombs quarry.

Thanks.

#1 MCKELLIGON CANYON ROAD
EL PASO, TEXAS 79930
915-565-4681 TEL 915-562-6218 FAX

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087 — Please use black ink.

ATTENTION OWNER: Confidentiality Privilege Notice on Reverse Side

# State of Texas WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER CEMEX INC (Name) ADDRESS 1 McKelligon RD. El Paso (Street or RFD) TX (City) 79930 (State) (Zip)

2) ADDRESS OF WELL: County El Paso Stan Roberts DR. El Paso TX 79930 (Street, RFD or other) (City) (State) (Zip) GRID # ____

3) TYPE OF WORK (Check): [X] New Well [ ] Deepening [ ] Reconditioning [ ] Plugging

4) PROPOSED USE (Check): [ ] Monitor [ ] Environmental Soil Boring [ ] Domestic [X] Industrial [ ] Irrigation [ ] Injection [ ] Public Supply [ ] De-watering [ ] Testwell
If Public Supply well, were plans submitted to the TNRCC? [ ] Yes [ ] No

5)

6) WELL LOG:
Date Drilling:
Started 4-16 19 07
Completed 4-20 19 07

DIAMETER OF HOLE

| Dia. (in.) | From (ft.) | To (ft.) |
|---|---|---|
| 12¼ | Surface | 560 |
| | | |
| | | |

7) DRILLING METHOD (Check): [ ] Driven [ ] Air Rotary [X] Mud Rotary [ ] Bored [ ] Air Hammer [ ] Cable Tool [ ] Jetted [ ] Other ____

N

| From (ft.) | To (ft.) | Description and color of formation material |
|---|---|---|
| 0 | 30 | top soil and and sand |
| 30 | 45 | sand and gracel |
| 45 | 250 | sand some small clay STRK |
| 250 | 470 | sand and fine gravel mix |
| 470 | 560 | sandy clay and small sand streaks |

(Use reverse side if necessary)

8) Borehole Completion (Check): [ ] Open Hole [ ] Straight Wall [ ] Underreamed [X] Gravel Packed [ ] Other ____
If Gravel Packed give interval ... from 560 ft. to 10 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

| Dia. (in.) | New or Used | Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial | Setting (ft.) From | Setting (ft.) To | Gage Casing Screen |
|---|---|---|---|---|---|
| 8 | new | screen | 500 | 562 | .025 |
| 8 | new | steel | 0 | 500 | .322 |
| | | | | | |
| | | | | | |

9) CEMENTING DATA (Rule 338.44(1))
Cemented from 10 ft. to 0 ft. No. of sacks used 15
____ ft. to ____ ft. No. of sacks used ____
Method used gravity
Cemented by Stan Hargraves
Distance to septic system field lines or other concentrated contamination ____ ft.
Method of verification of above distance N/A

10) SURFACE COMPLETION
[ ] Specified Surface Slab Installed (Rule 338.44(2)(A))
[X] Specified Steel Sleeve Installed (Rule 338.44(3)(A))
[ ] Pitless Adapter Used (Rule 338.44(3)(b))
[ ] Approved Alternative Procedure Used (Rule 338.71)

11) WATER LEVEL:
Static level 399 ft. below land surface Date 4-23-2007
Artesian flow ____ gpm. Date ____

12) PACKERS: Type ____ Depth ____

13) TYPE PUMP:
[ ] Turbine [ ] Jet [X] Submersible [ ] Cylinder
[ ] Other ____
Depth to pump bowls, cylinder, jet, etc., ____ ft.

14) WELL TESTS:
Type test: [ ] Pump [ ] Bailer [ ] Jetted [X] Estimated
Yield: 150 gpm with ____ ft. drawdown after ____ hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
[ ] Yes [X] No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ____ Depth of strata ____
Was a chemical analysis made? [ ] Yes [ ] No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME HARGRAVES Drilling (Type or print) WELL DRILLER'S LICENSE NO. 3298 W.I.

ADDRESS 2545 W. Hadley (Street or RFD) LAS Cruces (City) NM (State) 88007 (Zip)

(Signed) ____ (Licensed Well Driller)

(Signed) ____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0160 (Rev. 11-01-94)

TNRCC COPY

ENVIRONMENTAL SERVICES
2007 MAR 21 A 8:09

March 19, 2007

*VIA CERTIFIED MAIL*
*RETURN RECEIPT NO. 7004 1350 0003 5374 2248*

Ellen A. Smyth, P.E., Director of Environmental Services
Environmental Services
7969 San Paulo Drive
El Paso, Texas 79907

RE: Replacement of Groundwater Well
McCombs Quarry
6101 Stan Roberts
El Paso, Texas 79934

Dear Ms. Smyth:

Cemex would like to inform the City of El Paso and the El Paso Water Utilities of a new location of a ground water well in order to replace the groundwater well located within the McCombs Landfill property boundary which collapsed and is no longer operable (see attached aerial photo).

According to the 2003 lease agreement between the El Paso Water Utilities, the City of El Paso, and Cemex (formerly Jobe), in the "Lease of Wells" section (Attached) it states the installation of a replacement well is the responsibility of the LESSEE. Cemex would like to install the replacement well in the 12.1754 acre parcel where the material center is currently located. The replacement well will be identical to the previous well located on the western boundary of the McCombs Landfill. The replacement well will be drilled 560 feet below ground level. The new four inch pump to be installed will produce the same capacity as the one being replaced (175 to 200 gallons per minute). The well will be installed approximately 212 feet north of Stan Roberts Sr. Avenue and approximately 71 feet east of the McCombs Landfill fence line. Cemex is scheduling the work to start during the week of March 26, 2007.

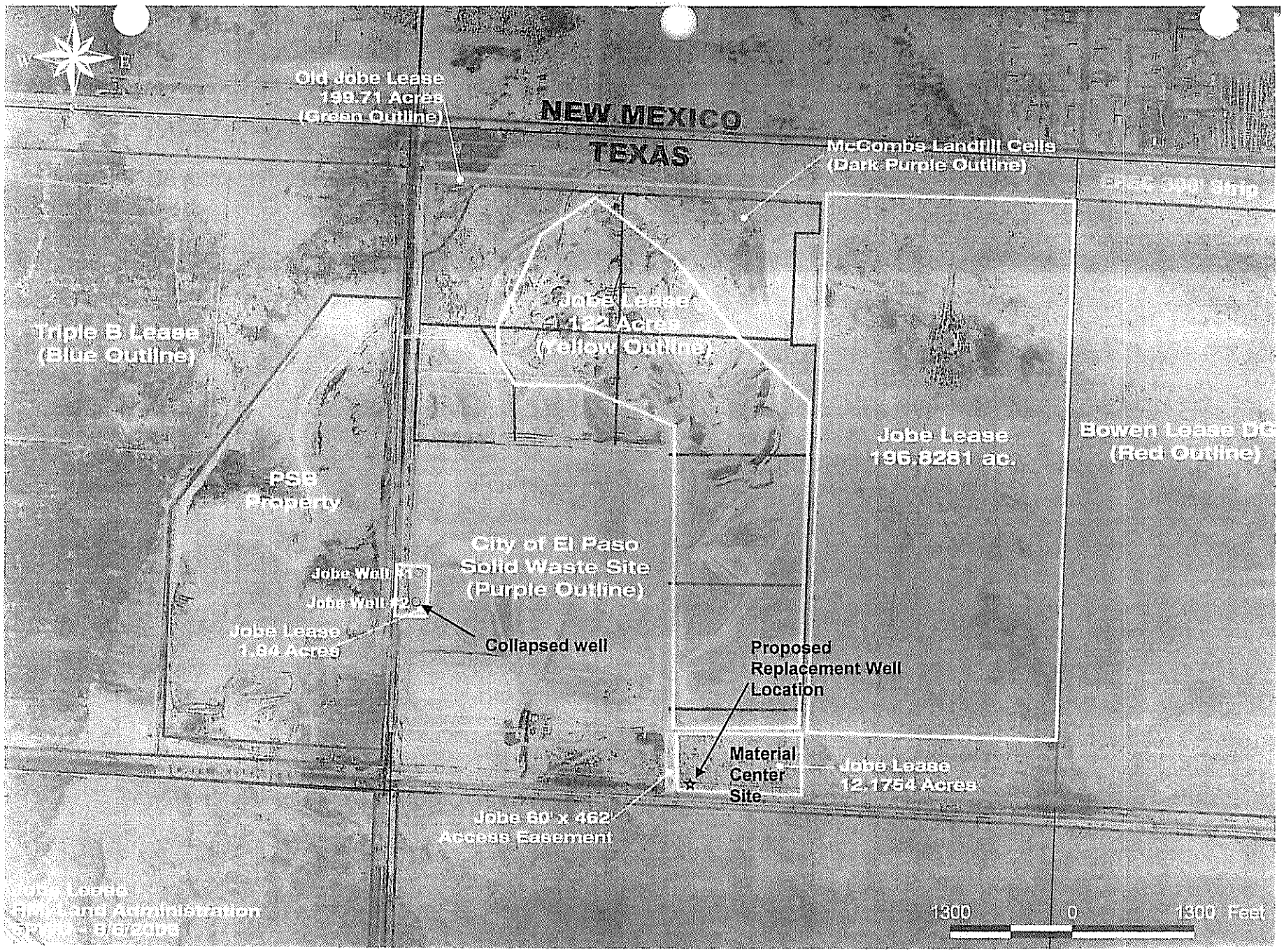
If you have any questions or need additional information, please do not hesitate to call me at (915) 564-1653.

Fax 564-3680
octavio.holguin jr@
cemex.com

Sincerely,

Octavio Holguin, Jr.
Environmental Manager

CC: Said Larbi-Cherif, P.E., Assistant Director, City of El Paso Environmental Services
David Brosman, P.E., Chief Operations Officer, El Paso Water Utilities
**Via Certified Mail *RETURN RECEIPT NO. 7004 1350 0003 5374 2255***
Alwyn Thorpe, Operations Director, Aggregates Division, Cemex

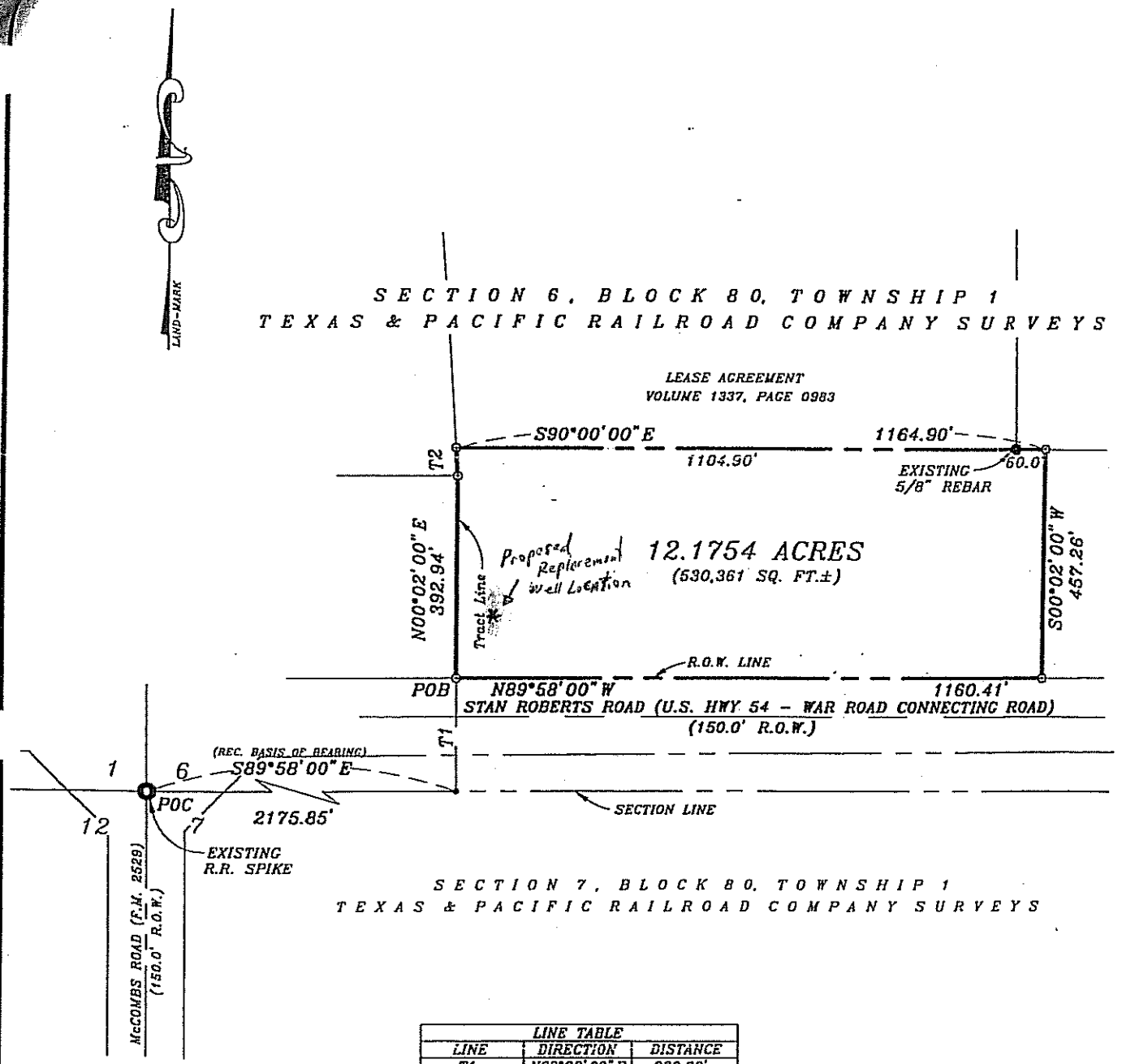

Old Jobe Lease
139.71 Acres
(Green Outline)
NEW MEXICO
TEXAS
McCombs Landfill Cells
(Dark Purple Outline)
Jobe Lease
2.122 Acres
(Yellow Outline)
Triple B Lease
(Blue Outline)
Jobe Lease
196.8281 ac.
Bowen Lease
(Red Outline)
PSB
Property
City of El Paso
Solid Waste Site
(Purple Outline)
Jobe Well #1
Jobe Well #2
Jobe Lease
1.84 Acres
Collapsed well
Proposed
Replacement Well
Location
Material
Center
Site
Jobe Lease
12.1754 Acres
Jobe 60' x 462'
Access Easement
1300
0
1300 Feet

for Materials removed during the month of March, shall be due and payable 15 days after the needed indexes are published.

4. **Lease of Wells**

In addition to Parcels I, II and III, described above, LESSOR also leases by this agreement to LESSEE a tract of land shown on Exhibit "D" attached hereto and identified as containing the LESSEE wells, which tract contains approximately 1.84 acres more or less and is the location site of two wells owned by LESSOR, which LESSOR hereby leases to LESSEE (hereinafter the "Well Site") described in Exhibit "D-2). LESSEE acknowledges the water produced from the wells shall only be used by it at its quarry operations upon other property leased. The discharge lines from such wells shall be metered and LESSOR shall bill LESSEE monthly on the amount of water used by LESSEE. For water use from the date of commencement of this lease through the end of December of 2003, LESSEE shall pay to LESSOR the sum of $0.48 per CCF. For the years 2004 through 2010, the price shall be calculated in accordance with the schedule attached hereto as Exhibit "E". The prices during the term of this lease will be pursuant to the schedule attached. In addition, LESSEE shall own the well pumping equipment and the transmission lines necessary for transporting such water from the wells to LESSEE's operations and shall have full responsibility for the maintenance and repairs of all well pumping equipment, transmission lines, and other appurtenances relating to such water wells. LESSEE shall also bear the cost for the electric bill or other energy cost associated for the pumping of such wells. If either or both of such wells shall fail, cave in or otherwise cease to be useable for the purposes anticipated herein, then LESSEE at its own expense, shall have the right to drill a new replacement well on either the 12.1754 acre parcel described in Exhibit "C" attached hereto, or on a site on Parcel II or its choosing, for purposes of providing the water required hereunder. If LESSEE should drill a new well, it shall bear all cost and expense of the drilling of such well and equipment the same, but shall not relieved of its obligation to pay LESSOR the fee per CCF of water pumped, as described hereinabove.

LESSOR and EPSW shall grant to LESSEE an new easement for a pipeline from the two wells described above, to provide a means whereby LESSEE can take the water by pipeline from those wells to its operating site. The route of such easement will be shown on Exhibit "D" attached hereto, and will be generally in a southerly direction from the wells, immediately adjacent to the west boundary of LESSOR/EPSW property, proceeding south toward Stan Roberts Avenue, until the landfill operation has been cleared, and then proceeding east, parallel to Stan Roberts Avenue, until it reaches LESSEE's property identified as Parcel III.




| LINE TABLE | | |
|---|---|---|
| LINE | DIRECTION | DISTANCE |
| T1 | N00°02'00"E | 220.00' |
| T2 | N04°00'00"W | 63.81' |

Copyright © 2002 by
Land-Mark Professional Surveying, Inc.

I hereby certify that the foregoing boundary survey was made by me or under my supervision and is true and correct to the best of my knowledge and belief.

Larry L. Drewes, R.P.L.S.
Texas 4869 N.M. 11402

# Plat of Survey

A PORTION OF
SECTION 6, BLOCK 80, TOWNSHIP 1,
TEXAS AND PACIFIC RAILROAD
COMPANY SURVEYS,
EL PASO COUNTY, TEXAS.

*See Attached Metes and Bounds Description*

Land-Mark Professional Surveying, Inc.
1405 Vanderbilt Drive, Suite 'A',
El Paso, Texas 79935

email: lnsurvey@swbell.net
"Serving Texas and New Mexico"

Job No. 02-02-15768B | Scale: 1" = 300' | Date: December 3, 2002

# Appendix 3K – Attachment 3
# Borings

## Memorandum

SAIC

To: TCEQ

From: Randall J. Sippel, P.G., SAIC RJS

Subject: Appendix 3K, Attachment 3 – Boring Logs

Date: July 9, 2012

SAIC Energy, Environment & Infrastructure, LLC (SAIC) has included the site boring logs completed by Danny R Anderson, Consultants (DRA) in May 1983 and November 1983 for TCEQ information. The boring information provided is considered adequate and generally conforms to 30 TAC § 330.63(e).

This permit application is related to a vertical expansion of the permitted landfill, therefore, the originally permitted landfill footprint will remain the same. There is no change in the base grades nor is there any lateral expansion of the permitted waste disposal area. Discussion with TCEQ staff prior to starting work on this permit modification and during the subsequent permit application review and comment period indicate that no additional geologic site characterization is necessary since there is not a horizontal expansion of the landfill. As per these discussions with TCEQ staff, an updated geology report is not necessary unless requesting a lateral expansion of the permitted waste disposal area.

SAIC has reviewed the reports related to the regional and site specific geology completed for the previous permit application and subsequent modifications and finds the reports adequate for the existing landfill.

RJS



SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI

Danny
R
Anderson, Consultants

GEOTECHNICAL ENGINEERS
2525 EAST YANDELL DR
EL PASO, TEXAS 79903
(915) 532-7566

January 6, 1983

Mr. David W. Harned, P.E.
City Engineer
City of El Paso
P.O. Box 1919
El Paso, Texas 79950

Re: Northeast Sanitary Landfill
El Paso, Texas
File No. 82182

Dear Mr. Harned:

In response to a request from the Texas Department of Health, we include the following addendum to our soils report dated May 3, 1983. Please attach this to all copies of our soil report so it may be considered a part of said report.

Begin Addendum No. 1:

We have completed fifteen additional borings to a depth of sixty feet in the area making the balance of 327 acres from the initially proposed 75 acre site.

Also enclosed, information for the area immediately north of the existing landfill from a subsurface investigation conducted by Dickinson Laboratories, Inc., in June of 1976.

The locations of the borings are as shown on Sheet A1 in the Appendix of this report. The soils encountered are shown on the attached Log of Boring Sheets A1/1 through A1/27.

End Addendum No. 1.

Should you require further information, please call us.

Sincerely,

Danny R. Anderson, P.E.

DRA/aco
Enclosures

Danny R Anderson, Consultants

GEOTECHNICAL ENGINEERS
2525 EAST YANDELL DR
EL PASO, TEXAS 79903
(915) 532-7566

# REPORT OF BORING NUMBER TR1

PROJECT City of El Paso Northeast Landfill

LOCATION McCombs Road and FM 2529, El Paso, Texas

| Description of Materials | Symbol | Depth, feet | Cores | Elevation | Standard Penetration Blows per 6 inches 1st | 2nd | 3rd | Liquid Limit | Plasticity Index | Moisture Content | Unified Soil Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, silty, brown, poorly graded, medium dense to dense, dry | | | | | 15 | 19 | 22 | | | | |
| SAND, fine, silty, slightly calcareous, light brown to brown, poorly graded, very dense, dry | | 10 | | | 17 | 22 | 34 | | | | |
| | | | | | 21 | 29 | 40 | | | | |
| | | 20 | | | 102 (15") | | | | | | |
| | | | | | 100 (16") | | | | | | |
| | | 30 | | | 100 (12") | | | | | | |
| SAND, fine to coarse, slightly gravelly, tan, black, brown, multicolored, very dense, dry | | | | | 17 | 22 | 34 | | | | |
| | | 40 | | | 120 (16") | | | | | | |
| | | | | | 23 | 32 | 45 | | | | |
| | | 50 | | | 100 (16½") | | | | | | |
| | | | | | 12 | 24 | 41 | | | | |
| | | 60 | | | 13 | 28 | 53 | | | | |

Type and make of drill Mobile B 52/61 8" o.d. Hollow stem auger

Driller Xavier Martinez

Logger Albert Tarin

REMARKS

Date boring started 10/25/83

Date boring completed 10/28/83

Surface elevation

Groundwater elevation Not encountere



FILE NO 82182

Sheet A1/1

IPT 4

Danny R Anderson, Consultants

GEOTECHNICAL ENGINEERS
2525 EAST YANDELL DR
EL PASO, TEXAS 79903
(915) 532-7566

# REPORT OF BORING NUMBER 2R1

PROJECT City of El Paso Northeast Landfill

LOCATION McCombs Road and FM 2529, El Paso, Texas

| Description of Materials | Symbol | Depth, feet | Cores | Elevation | Standard Penetration Blows per 6 inches 1st | 2nd | 3rd | Liquid Limit | Plasticity Index | Moisture Content | Unified Soil Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, silty, brown, poorly graded, medium dense, moist (1) | | | | * | | | | | | | |
| SAND, fine, silty, calcareous, slightly gravelly, light brown, dense to very dense, dry (Clay lenses from 20' to 29' depth) (2) | | 10 | | | 11 | 21 | 24 | | | | |
| | | | | | 100 ($12\frac{1}{2}$") | | | | | | |
| | | | | | 27 | 22 | 20 | | | | |
| | | 20 | | | 100 ($10\frac{1}{2}$") | | | | | | |
| | | | | | 17 | 26 | 28 | | | | |
| SAND, fine to coarse, slightly gravelly, tan, black, brown, multi-colored, poorly graded, dense to very dense, dry (Clay lenses from 29' to 60' depth) (3) | | 30 | | | 10 | 15 | 23 | | | | |
| | | | | | 16 | 28 | 32 | | | | |
| | | 40 | | | 16 | 25 | 28 | | | | |
| | | | | | 9 | 22 | 31 | | | | |
| | | 50 | | | 11 | 22 | 35 | | | | |
| | | | | | 20 | 35 | 45 | | | | |
| | | 60 | | | 19 | 26 | 42 | | | | |

Type and make of drill Mobile B 52/61 8" o.d. Hollow stem auger

Driller Xavier Martinez

Logger Albert Tarin

REMARKS *Grab Sample

Date boring started 10/28/83

Date boring completed 10/31/83

Surface elevation

Groundwater elevation Not encountered

Danny R Anderson, Consultants

GEOTECHNICAL ENGINEERS
3525 EAST YANDELL DR
EL PASO, TEXAS 79903
(915) 532-7566

# REPORT OF BORING NUMBER 3R1

PROJECT City of El Paso Northeast Landfill

LOCATION McCombs Road and FM 2529, El Paso, Texas

| Description of Materials | Symbol | Depth, feet | Cores | Elevation | Standard Penetration Blows per 6 inches 1st | 2nd | 3rd | Liquid Limit | Plasticity Index | Moisture Content | Unified Soil Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, silty, brown, gap graded, loose, moist | | | | | | | | | | | |
| SAND, fine, silty, gravelly, light tan, gap graded, dense, dry | | | | | | | | | | | |
| SAND, fine, gravelly, light tan, black, white, multicolored, gap graded, dense, dry | | 10 | | | | | | | | | |
| | | 20 | | | | | | | | | |
| | | 30 | | | | | | | | | |
| SAND, medium coarse, gravelly, black, tan, white, multicolored, poorly graded, dense, dry | | | | | | | | | | | |
| SAND, fine, silty, light tan, poorly graded, dense, dry | | 40 | | | | | | | | | |
| SAND, fine, tan, poorly graded, dense, dry | | | | | | | | | | | |
| SAND, fine, silty, gravelly, light tan, gap graded, medium dense, dry | | 50 | | | | | | | | | |
| | | 60 | | | | | | | | | |

Type and make of drill Mobile B 52/61 8" o.d. Hollow stem auger

Driller Richard Facio

Logger Danny R. Anderson

REMARKS

Date boring started 11/16/83

Date boring completed 11/16/83

Surface elevation

Groundwater elevation Not encountered

Danny R Anderson, Consultants

GEOTECHNICAL ENGINEERS
2525 EAST YANDELL DR
EL PASO, TEXAS 79903
(915) 532-7566

# REPORT OF BORING NUMBER 4R1

PROJECT City of El Paso Northeast Landfill

LOCATION McCombs Road and FM 2529, El Paso, Texas

| Description of Materials | Symbol | Depth, feet | Cores | Elevation | Standard Penetration Blows per 6 inches 1st | 2nd | 3rd | Liquid Limit | Plasticity Index | Moisture Content | Unified Soil Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, silty, gravelly, brown poorly graded, loose, moist | | | | | | | | | | | |
| SAND, fine, silty, gravelly, light tan, poorly graded, dense, dry | | | | | | | | | | | |
| SAND, fine, gravelly, tan, gap graded, dense, dry | | 10 | | | | | | | | | |
| | | 20 | | | | | | | | | |
| SAND, fine, silty, light tan, poorly graded, medium dense, dry | | | | | | | | | | | |
| SAND, fine, gravelly, tan, gap graded, dense, dry | | 30 | | | | | | | | | |
| SAND, fine, silty, light tan, poorly graded, dry | | 40 | | | | | | | | | |
| SAND, fine, tan, white, black, multicolored, poorly graded, dense, dry | | 50 | | | | | | | | | |
| | | 60 | | | | | | | | | |

Type and make of drill Mobile B 52/61 8" o.d. Hollow stem auger

Driller Richard Facio

Logger Danny R. Anderson

REMARKS

Date boring started 11/16/83

Date boring completed 11/16/83

Surface elevation

Groundwater elevation Not encountered

Danny R Anderson, Consultants

GEOTECHNICAL ENGINEERS
2525 EAST YANDELL DR
EL PASO TEXAS 79903
(915) 532-7566

# REPORT OF BORING NUMBER 5R1

PROJECT City of El Paso Northeast Landfill

LOCATION McCombs Road and FM 2529, El Paso, Texas

| Description of Materials | Symbol | Depth, feet | Cores | Elevation | Standard Penetration Blows per 6 inches 1st | 2nd | 3rd | Liquid Limit | Plasticity Index | Moisture Content | Unified Soil Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, silty, brown, poorly graded, loose, moist | | | | * | | | | | | | |
| SAND, fine, silty, calcareous, light brown, poorly graded, medium dense, dry | | | | | 9 | 8 | 9 | | | | |
| SAND, fine, slightly gravelly, tan, black, brown, multicolored, poorly graded, medium dense, dry | | 10 | | | 4 | 8 | 12 | | | | |
| SAND, fine, to coarse, gravelly, tan, black, brown, multicolored, poorly graded, medium dense to dense, dry | | | | | 5 | 7 | 10 | | | | |
| | | 20 | | | 7 | 9 | 13 | | | | |
| | | | | | 10 | 19 | 25 | | | | |
| | | 30 | | | 12 | 19 | 26 | | | | |
| | | | | | 16 | 26 | 34 | | | | |
| (2" clay lense at 40' depth) | | 40 | | | 19 | 39 | 42 | | | | |
| | | | | | 23 | 33 | 39 | | | | |
| SAND, fine, slightly gravelly, tan, black, brown, multicolored, poorly graded, very dense, dry | | 50 | | | 100 ($11\frac{1}{2}$") | | | | | | |
| | | | | | 14 | 30 | 50 | | | | |
| | | 60 | | | 11 | 18 | 36 | | | | |

Type and make of drill Mobile B 52/61 8" o.d. Hollow stem auger

Driller Xavier Martinez

Logger Albert Tarin

REMARKS *Grab Sample

Date boring started 11/1/83

Date boring completed 11/2/83

Surface elevation

Groundwater elevation Not encountere

Danny R Anderson, Consultants

GEOTECHNICAL ENGINEERS
2525 EAST YANDELL DR
EL PASO, TEXAS 79903
(915) 532-7566

# REPORT OF BORING NUMBER 6R1

PROJECT City of El Paso Northeast Landfill

LOCATION McCombs Road and FM 2529, El Paso, Texas

| Description of Materials | Symbol | Depth, feet | Cores | Elevation | Standard Penetration Blows per 6 inches 1st | 2nd | 3rd | Liquid Limit | Plasticity Index | Moisture Content | Unified Soil Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, silty, brown, poorly graded, loose, dry | | | | | | | | | | | |
| SAND, fine, silty, calcareous, light brown, dense to very dense, dry | | | | | 100(12") | | | | | | |
| | | 10 | | | 13 | 17 | 19 | | | | |
| | | | | | 12 | 19 | 19 | | | | |
| | | 20 | | | 9 | 13 | 16 | | | | |
| SAND, fine to coarse, gravelly, tan, black, brown, multicolored, medium dense to very dense, dry | | | | | 8 | 10 | 13 | | | | |
| | | 30 | | | 8 | 12 | 17 | | | | |
| | | | | | 8 | 11 | 15 | | | | |
| | | 40 | | | 8 | 8 | 12 | | | | |
| | | | | | 16 | 24 | 33 | | | | |
| | | 50 | | | 18 | 28 | 43 | | | | |
| | | | | | 18 | 24 | 32 | | | | |
| | | 60 | | | 12 | 23 | 34 | | | | |

Type and make of drill Mobile B 52/61 8" o.d. Hollow stem auger

Driller Xavier Martinez

Logger Albert Tarin

REMARKS

Date boring started 11/2/83

Date boring completed 11/2/83

Surface elevation

Groundwater elevation Not encountere

Danny R Anderson, Consultants

GEOTECHNICAL ENGINEERS
2525 EAST YANDELL DR
EL PASO, TEXAS 79903
(915) 532-7566

# REPORT OF BORING NUMBER 7R1

PROJECT City of El Paso Northeast Landfill

LOCATION McCombs Road and FM 2529, El Paso, Texas

| Description of Materials | Symbol | Depth, feet | Cores | Elevation | Standard Penetration Blows per 6 inches 1st | 2nd | 3rd | Liquid Limit | Plasticity Index | Moisture Content | Unified Soil Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, silty, brown, poorly graded, loose, dry | | | | * | | | | | | | |
| SAND, fine, silty, calcareous, light brown, dense, dry | | | | | 17 | 22 | 24 | | | | |
| | | 10 | | | 19 | 24 | 22 | | | | |
| | | | | | 13 | 17 | 19 | | | | |
| SAND, fine to coarse, gravelly, tan, black, brown, multicolored, poorly graded, dense to very dense, dry | | 20 | | | 12 | 32 | 52 | | | | |
| | | | | | 8 | 13 | 17 | | | | |
| | | 30 | | | 10 | 15 | 25 | | | | |
| | | | | | 9 | 19 | 21 | | | | |
| (2" clay lense at 40' depth) | | 40 | | | 16 | 28 | 38 | | | | |
| SAND, fine to medium, slightly gravelly, tan, black, brown, multicolored, poorly graded, dense to very dense, dry | | | | | 13 | 32 | 55 | | | | |
| | | 50 | | | 10 | 20 | 29 | | | | |
| | | | | | 13 | 23 | 29 | | | | |
| (1" clay lense at 60' depth) | | 60 | | | 13 | 27 | 39 | | | | |

Type and make of drill Mobile B 52/61 8" o.d. Hollow stem auger

Driller Xavier Martinez

Logger Albert Tarin

Date boring started 11/3/83

Date boring completed 11/4/83

Surface elevation

Groundwater elevation Not encountere

REMARKS *Grab Sample

Danny R Anderson, Consultants

GEOTECHNICAL ENGINEERS
2525 EAST YANDELL DR
EL PASO TEXAS 79903
(915) 532-7566

# REPORT OF BORING NUMBER 8R1

PROJECT City of El Paso Northeast Landfill

LOCATION McCombs Road and FM 2529, El Paso, Texas

| Description of Materials | Symbol | Depth, feet | Cores | Elevation | Standard Penetration Blows per 6 inches 1st | 2nd | 3rd | Liquid Limit | Plasticity Index | Moisture Content | Unified Soil Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, silty, brown, poorly graded, medium dense, dry | | | | * | | | | | | | |
| CLAY, slightly calcareous, brown, hard, dry | | | | | 16 | 21 | 25 | | | | |
| SAND, fine, silty, brown, poorly graded, medium dense, dry | | 10 | | | 9 | 11 | 17 | | | | |
| SAND, fine, tan, black, brown, multicolored, poorly graded, dense, dry (occasional gravel) | | | | | 7 | 16 | 21 | | | | |
| SAND, fine to coarse, slightly gravelly, tan, black, brown multicolored, poorly graded, dense to very dense, dry | | 20 | | | 8 | 13 | 24 | | | | |
| | | | | | 14 | 20 | 38 | | | | |
| | | 30 | | | 100(17") | | | | | | |
| | | | | | 100(15") | | | | | | |
| | | 40 | | | 100(16½") | | | | | | |
| | | | | | 100(14") | | | | | | |
| | | 50 | | | 17 | 62 | 21 | | | | |
| | | | | | 21 | 33 | 34 | | | | |
| | | 60 | | | 22 | 28 | 33 | | | | |

Type and make of drill Mobile B 52/61 8" o.d. Hollow stem auger

Driller Xavier Martinez

Logger Albert Tarin

REMARKS *Grab Sample

Date boring started 11/17/83

Date boring completed 11/17/83

Surface elevation

Groundwater elevation Not encountered

Danny R Anderson, Consultants

GEOTECHNICAL ENGINEERS
2525 EAST YANDELL DR
EL PASO, TEXAS 79903
(915) 532-7566

# REPORT OF BORING NUMBER 9R1

PROJECT City of El Paso Northeast Landfill

LOCATION McCombs Road and FM 2529, El Paso, Texas

| Description of Materials | Symbol | Depth, feet | Cores | Elevation | Standard Penetration Blows per 6 inches 1st | 2nd | 3rd | Liquid Limit | Plasticity Index | Moisture Content | Unified Soil Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, silty, brown, poorly graded, loose, moist | | | | | | | | | | | |
| SAND, fine, silty, light tan, poorly graded, dense, dry. 1.0" gravel at 8 feet. | | | | | | | | | | | |
| SAND, fine, tan, white, black, multicolored, gap graded, dense, dry | | 10 | | | | | | | | | |
| | | 20 | | | | | | | | | |
| | | 30 | | | | | | | | | |
| | | 40 | | | | | | | | | |
| SAND, fine, silty, clayey, tan, gap graded, dense, dry | | 50 | | | | | | | | | |
| | | 60 | | | | | | | | | |

Type and make of drill Mobile B 52/61 8" o.d. Hollow stem auger

Driller Richard Facio

Logger Danny R. Anderson

REMARKS

Date boring started 11/16/83

Date boring completed 11/16/83

Surface elevation

Groundwater elevation Not encountered

Danny R Anderson, Consultants

GEOTECHNICAL ENGINEERS
2525 EAST YANDELL DR
EL PASO, TEXAS 79903
(915) 532-7566

# REPORT OF BORING NUMBER 10R1

PROJECT City of El Paso Northeast Landfill

LOCATION McCombs Road and FM 2529, El Paso, Texas

| Description of Materials | Symbol | Depth, feet | Cores | Elevation | Standard Penetration Blows per 6 inches 1st | 2nd | 3rd | Liquid Limit | Plasticity Index | Moisture Content | Unified Soil Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, silty, brown, poorly graded, loose, dry (visible plant material) | | | | * | | | | | | | |
| SAND, fine, silty, calcareous, light brown, dense, dry | | | | | 16 | 19 | 21 | | | | |
| SAND, fine, silty, calcareous, gravelly medium dense, dry | | 10 | | | 7 | 10 | 14 | | | | |
| | | | | | 9 | 10 | 18 | | | | |
| | | 20 | | | 7 | 11 | 20 | | | | |
| SAND, fine to coarse, gravelly, tan, black, brown, multicolored, poorly graded, dense to very dense, dry | | | | | 14 | 23 | 28 | | | | |
| (Clay lenses from 35' to 35½' depth) | | 30 | | | 17 | 31 | 43 | | | | |
| | | | | | 100 (15") | | | | | | |
| | | 40 | | | 100 (15") | | | | | | |
| | | | | | 100 (16") | | | | | | |
| | | 50 | | | 100 (14") | | | | | | |
| | | | | | 100 (13") | | | | | | |
| | | 60 | | | 100 (13") | | | | | | |

Type and make of drill Mobile B 52/61 8" o.d. Hollow stem auger

Driller Xavier Martinez

Logger Albert Tarin

Date boring started 11/21/83

Date boring completed 11/21/83

Surface elevation

Groundwater elevation Not encountered

REMARKS

*Grab Sample

Danny R Anderson, Consultants

GEOTECHNICAL ENGINEERS
2525 EAST YANDELL DR
EL PASO, TEXAS 79903
(915) 532-7566

# REPORT OF BORING NUMBER 11R1

PROJECT City of El Paso Northeast Landfill

LOCATION McCombs Road and FM 2529, El Paso, Texas

| Description of Materials | Symbol | Depth, feet | Cores | Elevation | Standard Penetration Blows per 6 inches 1st | 2nd | 3rd | Liquid Limit | Plasticity Index | Moisture Content | Unified Soil Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, silty, brown, poorly graded, loose, moist | | | | | | | | | | | |
| SAND, fine, silty, light tan, poorly graded, dense, dry | | | | | | | | | | | |
| SAND, fine, gravelly, tan, white, multicolored, gap graded, dense, dry | | 10 | | | | | | | | | |
| | | 20 | | | | | | | | | |
| | | 30 | | | | | | | | | |
| SAND, fine, silty, light tan, poorly graded, dense, dry (1.0" clay lenses at 40 feet) | | 40 | | | | | | | | | |
| SAND, fine, silty, tan, poorly graded, dense, dry (1.0" clay lense at 45 feet) | | | | | | | | | | | |
| SAND, fine, gravelly, tan, white, multicolored, gap graded, dense, dry | | 50 | | | | | | | | | |
| | | 60 | | | | | | | | | |

Type and make of drill Mobile B 52/61 8" o.d. Hollow stem auger

Driller Richard Facio

Logger Danny R. Anderson

REMARKS

Date boring started 11/15/83

Date boring completed 11/16/83

Surface elevation

Groundwater elevation Not encountere

Danny R Anderson, Consultants

GEOTECHNICAL ENGINEERS
2525 EAST YANDELL DR
EL PASO, TEXAS 79903
(915) 532-7566

# REPORT OF BORING NUMBER 12R1

PROJECT City of El Paso Northeast Landfill

LOCATION McCombs Road and FM 2529, El Paso, Texas

| Description of Materials | Depth, feet | Elevation | Standard Penetration Blows per 6 inches 1st | 2nd | 3rd | Liquid Limit | Plasticity Index | Moisture Content | Unified Soil Classification |
|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, silty, brown, poorly graded, loose, dry (visible plant material) | | | | | | | | | |
| SAND, fine, silty, calcareous, light brown, poorly graded, medium dense, dry | | | 5 | 9 | 7 | | | | |
| SAND, fine, tan, black, brown, mulit-colored, poorly graded, medium dense to dense, dry | 10 | | 5 | 7 | 10 | | | | |
| | | | 9 | 16 | 25 | | | | |
| | 20 | | 11 | 21 | 29 | | | | |
| SAND, fine to coarse, tan, black, brown, multicolored, poorly graded, dense to very dense, dry | | | 10 | 16 | 21 | | | | |
| (Clay lenses from 35' to 36' depth) | 30 | | 17 | 29 | 37 | | | | |
| | | | 100(15") | | | | | | |
| | 40 | | 100(16") | | | | | | |
| | | | 100(16") | | | | | | |
| | 50 | | 100(16") | | | | | | |
| | | | 19 | 49 | 32 | | | | |
| | 60 | | 100(14") | | | | | | |

Type and make of drill Mobile B 52/61 8" o.d. Hollow stem auger

Driller Xavier Martinez

Logger Albert Tarin

REMARKS

Date boring started 11/22/83

Date boring completed 11/22/83

Surface elevation

Groundwater elevation Not encountere

Danny R Anderson, Consultants

GEOTECHNICAL ENGINEERS
2525 EAST YANDELL DR
EL PASO, TEXAS 79903
(915) 532-7566

# REPORT OF BORING NUMBER 13R1

PROJECT City of El Paso Northeast Landfill

LOCATION McCombs Road and FM 2529, El Paso, Texas

| Description of Materials | Symbol | Depth, feet | Cores | Elevation | Standard Penetration Blows per 6 inches 1st | 2nd | 3rd | Liquid Limit | Plasticity Index | Moisture Content | Unified Soil Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, silty, brown, poorly graded, loose to medium dense, moist | | | | | | | | | | | |
| SAND, fine, silty, gravelly, light tan, poorly graded, medium dense, dry | | | | | | | | | | | |
| SAND, fine, gravelly, light tan, white, black, multicolored, gap graded, medium dense, dry | | 10 20 30 | | | | | | | | | |
| SAND, fine, tan, poorly graded, dense, dry | | 40 | | | | | | | | | |
| SAND, fine, clayey, tan, poorly graded, dense, dry | | 50 60 | | | | | | | | | |

Type and make of drill Mobile B 52/61 8" o.d. Hollow stem auger

Driller Richard Facio

Logger Danny R. Anderson

REMARKS

Date boring started 11/14/83

Date boring completed 11/14/83

Surface elevation

Groundwater elevation Not encountered

Danny R Anderson, Consultants

GEOTECHNICAL ENGINEERS
2525 EAST YANDELL DR
EL PASO, TEXAS 79903
(915) 532-7566

# REPORT OF BORING NUMBER 14R1

PROJECT City of El Paso Northeast Landfill

LOCATION McCombs Road and FM 2529, El Paso, Texas

| Description of Materials | Symbol | Depth, feet | Cores | Elevation | Standard Penetration Blows per 6 inches 1st | 2nd | 3rd | Liquid Limit | Plasticity Index | Moisture Content | Unified Soil Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, silty, brown, poorly graded, loose, dry (visible plant material) | | | | | | | | | | | |
| SAND, fine, silty, calcareous, light brown, poorly graded, medium dense, dry | | | | | 100 (16½") | | | | | | |
| SAND, fine to coarse, tan, black, brown, multicolored, poorly graded, medium dense to very dense, dry | | 10 | | | 100 (17") | | | | | | |
| | | | | | 17 | 25 | 37 | | | | |
| | | 20 | | | 100 (15") | | | | | | |
| | | | | | 100 (13") | | | | | | |
| | | 30 | | | 100 (13") | | | | | | |
| | | | | | 7 | 9 | 11 | | | | |
| | | 40 | | | 9 | 11 | 14 | | | | |
| CLAY, slightly calcareous, brown, hard, dry | | | | | 8 | 11 | 12 | | | | |
| SAND, fine, silty, slightly calcareous, brown, poorly graded, very dense, dry | | 50 | | | 10 | 20 | 37 | | | | |
| SAND, fine, tan, black, brown, multicolored, poorly graded, very dense, dry | | | | | 13 | 19 | 30 | | | | |
| | | 60 | | | 14 | 20 | 30 | | | | |

Type and make of drill Mobile B 52/61 8" o.d. Hollow stem auger

Driller Xavier Martinez

Logged by Albert Tarin

Date boring started 11/23/83

Date boring completed 11/23/83

Surface elevation

Groundwater elevation Not encountere



FILE NO 82182

Danny R Anderson, Consultants

GEOTECHNICAL ENGINEERS
2525 EAST YANDELL DR
EL PASO, TEXAS 79903
(915) 532-7566

# REPORT OF BORING NUMBER 15R1

PROJECT City of El Paso Northeast Landfill

LOCATION McCombs Road and FM 2529, El Paso, Texas

| Description of Materials | Symbol | Depth, feet | Cores | Elevation | Standard Penetration Blows per 6 inches 1st | 2nd | 3rd | Liquid Limit | Plasticity Index | Moisture Content | Unified Soil Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, silty, brown, poorly graded, loose, moist | | | | | | | | | | | |
| SAND, fine, silty, gravelly, light tan, poorly graded, dense, dry. Caliche at 8 feet | | 10 | | | | | | | | | |
| SAND, fine, gravelly, light tan, white, multicolored, gap graded, dense, dry clay lenses at 16 feet deep | | 20 | | | | | | | | | |
| | | 30 | | | | | | | | | |
| | | 40 | | | | | | | | | |
| SAND, fine, light tan, poorly graded, dense, dry. Clay lenses at 46 feet (3") | | | | | | | | | | | |
| SAND, fine, gravelly, light tan, poorly graded, dense, dry | | 50 | | | | | | | | | |
| | | 60 | | | | | | | | | |

Type and make of drill Mobile B 52/61 8" o.d. Hollow stem auger

Driller Richard Facio

Logger Danny R. Anderson

REMARKS

Date boring started 11/13/83

Date boring completed 11/13/83

Surface elevation

Groundwater elevation Not encountered



RPT 4

FILE NO 82182

Sheet A1/15

PROJECT McCombs Landfill

JOB NO. DATE 6/29/76

# LOG OF TEST BORING NO. 1

RIG TYPE CME 55

BORING TYPE 6 1/2 H. S. A.

SURFACE ELEV.

DATUM

| Depth in Feet | Continuous Penetration Resistance | Graphical Log | Sample | Sample Type | Blows per foot 140 Lb. 30" Free-Fall Drop Hammer | Liquid Limit | Pasticity Index | Moisture Content Per Cent of Dry Wt. | Unified Soil Classification | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | X | S | 14 | | | | SP | Slightly Damp Medium Dense | Sand, fine grained with little gravel & lime. Low Plasticity Index. Tan. |
| 5 | | | X | S | 29 | | | | SP | Damp Medium Dense | Sand with gravel. Low Plasticity Index. Tan to Grey. |
| 10 | | | X | S | 45 | | | | SP | Damp Dense | |
| 15 | | | X | S | 41 | | | | SP | | |
| 20 | | | X | S | 32 | | | | SP | | |
| 25 | | | | | | | | | | | |

GROUND WATER

SAMPLE TYPE

DICKINSON LABORATORIES, INC

PROJECT McCombs Landfill

JOB NO. _____ DATE 6/29/76

# LOG OF TEST BORING NO. 1 (cont'

RIG TYPE CME 55

BORING TYPE 6 1/2 H. S. A.

SURFACE ELEV. _____

DATUM _____

| Depth in Feet | Continuous Penetration Resistance | Graphical Log | Sample | Sample Type | Blows per foot 140 Lb. 30" Free-Fall Drop Hammer | Liquid Limit | Pasticity Index | Moisture Content Per Cent of Dry Wt. | Unified Soil Classification | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | | | X | S | 44 | | | | SP | Damp<br>Dense | Sand with gravel. Low Plasticity Index. Tan. |
| 30 | | | X | S | 48 | | | | SP | | |
| 35 | | | X | S | 56 | | | | SP | Damp<br>Very Dense | |
| 40 | | | X | S | 64 | | | | SP | | |
| 45 | | | X | S | 68 | | | | SP | | |
| 50 | | | X | S | 72 | | | | SP | | |

GROUND WATER

SAMPLE TYPE

DICKINSON LABORATORIES, INC

PROJECT McCombs Landfill

JOB NO. _____ DATE 6/26/76

# LOG OF TEST BORING NO. 2

RIG TYPE CME 55

BORING TYPE 6 1/2 H. S. A.

SURFACE ELEV. _____

DATUM _____

| Depth in Feet | Continuous Penetration Resistance | Graphical Log | Sample | Sample Type | Blows per foot 140 Lb. 30" Free-Fall Drop Hammer | Liquid Limit | Pasticity Index | Moisture Content Per Cent of Dry Wt. | Unified Soil Classification | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | X | S | 23 | | | | SC | Slightly Damp Medium Dense | Clayey sand with lime. Medium Plasticity Index. Tan to White |
| 5 | | | X | S | 36 | | | | SC | Slightly Damp Dense | |
| 10 | | | X | S | 44 | | | | SC | | |
| 15 | | | X | S | 39 | | | | SP | Slightly Damp Dense | Sand with gravel. Low Plasticity Index. Tan to Grey. |
| 20 | | | X | S | 31 | | | | SP | | |
| 25 | | | | | | | | | | | |

GROUND WATER

SAMPLE TYPE

DICKINSON LABORATORIES, INC.

PROJECT McCombs Landfill

JOB NO. DATE 6/29/76

# LOG OF TEST BORING NO. 2 (cont'd.

RIG TYPE CME 55

BORING TYPE 6 1/2 H. S. A.

SURFACE ELEV.

DATUM

| Depth in Feet | Continuous Penetration Resistance | Graphical Log | Sample | Sample Type | Blows per foot 140 Lb. 30" Free-Fall Drop Hammer | Liquid Limit | Pasticity Index | Moisture Content Per Cent of Dry Wt. | Unified Soil Classification | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | | | | S | 47 | | | | SP | Dry<br>Dense | Sand with gravel. Low Plasticity Index. Tan to Grey. |
| 30 | | | | S | 41 | | | | SP | | |
| 35 | | | | S | 40 | | | | SP | | |
| 40 | | | | S | 58 | | | | SP | Dry<br>Very Dense | |
| 45 | | | | S | 61 | | | | SP | | |
| 50 | | | | S | 37 | | | | CH | Slightly Damp<br>Hard | Silty clay. High Plasticity Index. Brown. |

GROUND WATER

SAMPLE TYPE

DICKINSON LABORATORIES, INC.

PROJECT McCombs Landfill

JOB NO. DATE 6/28/76

# LOG OF TEST BORING NO. 3

RIG TYPE CME 55

BORING TYPE 6 1/2 H. S. A.

SURFACE ELEV.

DATUM

| Depth in Feet | Continuous Penetration Resistance | Graphical Log | Sample | Sample Type | Blows per foot 140 Lb. 30" Free-Fall Drop Hammer | Liquid Limit | Plasticity Index | Moisture Content Per Cent of Dry Wt. | Unified Soil Classification | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | X | S | 26 | | | | SC | Slightly Damp Medium Dense | Clayey sand with lime. Medi Plasticity Index. Tan to White. |
| 5 | | | X | S | 33 | | | | SC | Slightly Damp Dense | |
| 10 | | | X | S | 51 | | | | SC | | |
| 15 | | | X | S | 44 | | | | SC | | |
| 20 | | | X | S | 28 | | | | SP | Slightly Damp Medium Dense | Sand with gravel. Low Plasticity Index. Tan to Grey. |
| 25 | | | | | | | | | | | |

GROUND WATER

SAMPLE TYPE

DICKINSON LABORATORIES, INC.

PROJECT McCombs Landfill

JOB NO. _____ DATE 6/28/76

# LOG OF TEST BORING NO. 3 (cont'

RIG TYPE CME 55

BORING TYPE 6 1/2 H. S. A.

SURFACE ELEV. _____

DATUM _____

| Depth in Feet | Continuous Penetration Resistance | Graphical Log | Sample | Sample Type | Blows per foot 140 Lb. 30" Free-Fall Drop Hammer | Liquid Limit | Pasticity Index | Moisture Content Per Cent of Dry Wt. | Unified Soil Classification | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | | | | S | 28 | | | | SP | Dry<br>Medium Dense | Sand with gravel. Low Plasticity Index. Tan to Grey. |
| 30 | | | | S | 46 | | | | SP | Dry<br>Dense | |
| 35 | | | | S | 56 | | | | SP | Dry<br>Very Dense | |
| 40 | | | | S | 68 | | | | SP | | |
| 45 | | | | S | 51 | | | | SP | | |
| | | | | S | 33 | | | | | | |
| 50 | | | | | | | | | CH | Slightly Damp<br>Hard | Silty clay. High Plasticity Index. Brown. |

GROUND WATER _____ SAMPLE TYPE _____ DICKINSON LABORATORIES, INC.

PROJECT McCombs Landfill

JOB NO. _____ DATE 6/28/76

# LOG OF TEST BORING NO. 4

RIG TYPE CME 55

BORING TYPE 6 1/2 H. S. A.

SURFACE ELEV. _____

DATUM _____

| Depth in Feet | Continuous Penetration Resistance | Graphical Log | Sample | Sample Type | Blows per foot 140 Lb. 30" Free-Fall Drop Hammer | Liquid Limit | Pasticity Index | Moisture Content Per Cent of Dry Wt. | Unified Soil Classification | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | X | S | 12 | | | | SP | Slightly Damp Medium Dense | Silty sand. Low Plasticity Index. Tan. |
| | | | | | | | | | | Slightly Damp Medium Dense | Clayey sand with lime. Medium Plasticity Index. T to White. |
| 5 | | | X | S | 28 | | | | SC | | |
| 10 | | | X | S | 52 | | | | SC | Slightly Damp Very Dense | |
| 15 | | | X | S | 28 | | | | SC | Slightly Damp Medium Dense | |
| 20 | | | X | S | 33 | | | | SC | Slightly Damp Dense | |
| 25 | | | | | | | | | | | |

GROUND WATER

SAMPLE TYPE

DICKINSON LABORATORIES, INC.

PROJECT McCombs Landfill

JOB NO. _____ DATE 6/28/76

# LOG OF TEST BORING NO. 4 (cont'd

RIG TYPE CME 55

BORING TYPE 6 1/2 H. S. A.

SURFACE ELEV. _____

DATUM _____

| Depth in Feet | Continuous Penetration Resistance | Graphical Log | Sample | Sample Type | Blows per foot 140 Lb. 30" Free-Fall Drop Hammer | Liquid Limit | Pasticity Index | Moisture Content Per Cent of Dry Wt. | Unified Soil Classification | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | | | X | S | 44 | | | | SP | Dry<br>Dense | Sand with gravel. Low Plasticity Index. Tan to Grey. |
| 30 | | | X | S | 56 | | | | SP | Dry<br>Very Dense | |
| 35 | | | X | S | 68 | | | | SP | | |
| 40 | | | X | S | 72 | | | | SP | Slightly Damp<br>Very Dense | Sand with gravel with thin layer of clay. Low Plastic Index. Tan to Grey. |
| 45 | | | X | S | 74 | | | | SP | Slighty Damp<br>Very Dense | Sand with gravel. Low Plasticity Index. Tan to Grey. |
| 50 | | | X | S | 68 | | | | SP | | |

GROUND WATER

SAMPLE TYPE

DICKINSON LABORATORIES, INC.

PROJECT McCombs Landfill

JOB NO. _____ DATE 6/29/76

# LOG OF TEST BORING NO. 5

RIG TYPE CME 55

BORING TYPE 6 1/2 H. S. A.

SURFACE ELEV. _____

DATUM _____

| Depth in Feet | Continuous Penetration Resistance | Graphical Log | Sample | Sample Type | Blows per foot 140 Lb. 30" Free-Fall Drop Hammer | Liquid Limit | Plasticity Index | Moisture Content Per Cent of Dry Wt. | Unified Soil Classification | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | X | S | 22 | | | | SC | Slightly Damp Medium Dense | Clayey sand with lime. Medium Plasticity Index. Tan to White. |
| 5 | | | X | S | 34 | | | | SC | | |
| 10 | | | X | S | 48 | | | | SC | Slightly Damp Dense | |
| 15 | | | X | S | 36 | | | | SC | | |
| 20 | | | X | S | 38 | | | | SP | Slightly Damp Dense | Sand with gravel. Low Plasticity Index. Tan to Grey. |
| 25 | | | | | | | | | | | |

GROUND WATER

SAMPLE TYPE

DICKINSON LABORATORIES, INC.

PROJECT McCombs Landfill

JOB NO. _____ DATE 6/29/76

# LOG OF TEST BORING NO. 5 (cont'd.)

RIG TYPE CME 55

BORING TYPE 6 1/2 H. S. A.

SURFACE ELEV. _____

DATUM _____

| Depth in Feet | Continuous Penetration Resistance | Graphical Log | Sample | Sample Type | Blows per foot 140 Lb. 30" Free-Fall Drop Hammer | Liquid Limit | Plasticity Index | Moisture Content Per Cent of Dry Wt. | Unified Soil Classification | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | | | X | S | 42 | | | | SP | Dry<br>Dense | Sand with gravel. Low Plasticity Index. Tan to Grey. |
| 30 | | | X | S | 46 | | | | SP | | |
| 35 | | | X | S | 58 | | | | SP | Dry<br>Very Dense | |
| 40 | | | X | S | 62 | | | | SP | | |
| 45 | | | X | S | 64 | | | | SP | | |
| 50 | | | X | S | 72 | | | | SP | | |

GROUND WATER

SAMPLE TYPE

DICKINSON LABORATORIES, INC.

PROJECT McCombs Landfill

JOB NO. _____ DATE 6/29/76

# LOG OF TEST BORING NO. 6

RIG TYPE CME 55

BORING TYPE 6 1/2 H. S. A.

SURFACE ELEV. _____

DATUM _____

| Depth in Feet | Continuous Penetration Resistance | Graphical Log | Sample | Sample Type | Blows per foot 140 Lb. 30" Free-Fall Drop Hammer | Liquid Limit | Pasticity Index | Moisture Content Per Cent of Dry Wt. | Unified Soil Classification | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | X | S | 15 | | | | SC | Slightly Damp Medium Dense | Clayey sand with lime. Mediu Plasticity Index. Tan to White. |
| 5 | | | X | S | 31 | | | | SC | Slightly Damp Dense | |
| 10 | | | X | S | 47 | | | | SC | | |
| 15 | | | X | S | 45 | | | | SP | Slightly Damp Dense | Sand with gravel. Low Plasticity Index. Tan to Grey. |
| 20 | | | X | S | 36 | | | | SP | | |
| 25 | | | | | | | | | | | |

GROUND WATER

SAMPLE TYPE

DICKINSON LABORATORIES, INC.

PROJECT McCombs Landfill

JOB NO. DATE 6/29/76

# LOG OF TEST BORING NO. 6 (cont'd.)

RIG TYPE CME 55

BORING TYPE 6 1/2 H. S. A.

SURFACE ELEV.

DATUM

| Depth in Feet | Continuous Penetration Resistance | Graphical Log | Sample | Sample Type | Blows per foot 140 Lb. 30" Free-Fall Drop Hammer | Liquid Limit | Plasticity Index | Moisture Content Per Cent of Dry Wt. | Unified Soil Classification | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | | | X | S | 41 | | | | SP | Dry<br>Dense | Sand with gravel. Low Plasticity Index. Tan to Grey. |
| 30 | | | X | S | 48 | | | | SP | | |
| 35 | | | X | S | 54 | | | | SP | Dry<br>Very Dense | |
| 40 | | | X | S | 59 | | | | SP | | |
| 45 | | | X | S | 62 | | | | SP | | |
| 50 | | | X | S | 64 | | | | SP | | |

GROUND WATER

SAMPLE TYPE

DICKINSON LABORATORIES, INC.

Danny
R
Anderson, Consultants

GEOTECHNICAL ENGINEERS
2525 EAST YANDELL DR.
EL PASO, TEXAS 79903
(915) 532-7566

May 3, 1983

Mr. David W. Harned, P.E.
City Engineer
City of El Paso
P.O. Box 1919
El Paso, Texas 79950

Re: Northeast El Paso Sanitary Landfill
El Paso, Texas
File No. 82192

Dear Mr. Harned:

We have completed a geotechnical investigation at the above named site. The attached report describes the investigation techniques and the data obtained, together with our engineering recommendations for landfill design and site preparation.

We are pleased to assist you on this phase of your project, and look forward to serving you in the future. If we may be of further assistance, please call us.

Sincerely,

Danny R. Anderson, P.E.

DRA/aco

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APPENDIX


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|---|---|
| Boring Plan | Sheet A1 |
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| Key to Soils Classifications and Symbols | Sheet A47 |




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## 1. INTRODUCTION

We were authorized by the City of El Paso to perform a geotechnical investigation at the site of the proposed Northeast El Paso Sanitary Landfill Expansion. The 327 acre site is located in northeast El Paso in Section 6, Block 80, Township 1. It is situated in the northeast corner of the intersection of McCombs Road and FM2529. The proposed expansion will be to the north, west and east of the existing sanitary landfill operated by the City of El Paso.

The proposed site has been set aside as a mineral resource area, and will continue to be quarried for sand and mineral deposits. The area immediately west of the existing landfill is a pit which remains as a result of this operation.

The purpose of our geotechnical investigation was to determine the types of soils present at the site and their physical properties which relate to permeability, slope stability, and subgrade for roads.

## 2. INVESTIGATION

2.1 Subsurface soil strata and conditions at the site were determined by visual inspection of materials recovered from eight 8 inch O.D., hollow stem auger borings. The locations of the borings are as shown on Sheet A1 of the Appendix of this report.

Continuous sampling of subsurface soils was provided by the auger as well as split spoon samples which were recovered through the hollow



PT 8

stem. A two inch O.D., split tube sampler was used in obtaining disturbed samples and in determining standard penetration values of all soil strata. Samples were field extracted and classified, identified according to boring number and depth, and placed in moisture-proof containers for transportation to the laboratory for tests and further study. The soils encountered are shown on the Log of Boring Sheets A2 through A9 in the Appendix. Symbols and classifications shown on the logs are based on the Unified Soil Classification System. A key to the classification symbols is shown on Sheet A47.

2.2 All samples of subsurface materials from the borings were examined and classified in the laboratory. Atterberg Limits and grain size determinations were performed on typical samples to establish index properties and aid in proper classification of soil strata. The results of thirty-seven grain size determinations are shown on Sheet A10 through A46. Index properties are shown on the boring logs adjacent to the depth at which the sample was recovered.

## 3. SITE CONDITIONS AND SUBSOIL PROFILE

3.1 The proposed landfill site is located on the broad lowland surface of the Hueco Bolson. The soils of the site are predominantly alluvial sands and gravels.

3.2 The site is located on a high point sloping north, west, and south. The average rate of drop away from this high point is approximately 1.5%.



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3.3 The site has sparse vegetation with primary growth consisting of desert dropseed grasses and woody plants of creosotebush and mesquite.

3.4 The soils at the site are predominantely poorly graded sands, either gravelly sands (SP group, Unified Soil Classification), or clayey sands (SC group). The SP and SC group materials exhibit low and medium plasticity respectively. A layer of clay is reported at depths of 44 to 49 feet (Boring Number 2), 24 to 28 feet (Boring Number 3), and 30 to 32 feet (Boring Number 7), all in the proposed landfill area. Elsewhere, thin clay lenses are reported below 20 feet.

3.5 The groundwater table was not encountered in any of the test borings. Based on information obtained from several wells that exist in the vicinity of the proposed landfill, we would expect the groundwater table to be encountered at approximately three hundred and fifty feet below existing grade.

## 4. DISCUSSION AND RECOMMENDATIONS

4.1 We understand that landfill operations wil start on the first 70 acres made available by the sand and gravel operator. Part of this area will include the existing pit, with depths of 50 to 60 feet and approximately 1:1 slopes (1 horizontal to 1 vertical). We recommend these slopes and future ones to be shaped according to the requirements of Section 4.3 of this report.



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The material for cover, for the proposed landfill will be obtained from the overburden of mining operations. If this material has not been stockpiled by the sand and gravel operator, it will be removed directly from its natural location.

We understand that the State Health Department requirements are such that all finish slopes shall be a minimum of 4 to 1 (4 horizontal to 1 vertical). In order to maximize the fill volumes available, temporary cut and/or fill slopes should be as steep as safety will allow.

We understand that the State Health Department requires that a natural and/or artificial lining be present at the base of the landfill cells to prevent leachate migration. Where natural soils deposits exist, the premeability coefficient of the material shall be less than $1 \times 10^{-7}$ (cm/sec).

4.2 Due to the nature of the materials at the site, laboratory permability tests were not deemed necessary for this project. The materials are predominately clean uniform sands with a coefficient of permeability much higher than that required for a cell liner. By emperical methods, we predict the coefficient of permeability to be 0.01 to 0.04 cm/sec.

4.3 Clean, dry sands are stable regardless of their height, provided the slopes do not exceed their angle of internal friction. Therefore, we recommend that all cut and/or fill slopes required to construct the



T 8

fill cells be 1 1/2 to 1 (1 1/2 horizontal to 1 vertical). This will provide a factor of safety against a sliding failure of 1.0 which we consider adequate for temporary slopes.

All permanent slopes, other than those connected to the landfill and required to be 4 to 1, shall have a minimum slope of 2 horizontal to 1 vertical.

4.4 Fill material for site grading for permanent facilities shall be free of any organic or deleterious substance and shall not contain rocks or lumps over four inches in greatest dimension and, in addition, shall not consist of more than 60 percent by weight of rock larger than No. 4 sieve, and not more than 40 percent passing No. 200 sieve. The fill shall show low shrinkage or swelling when subjected to changes in moisture content and its plasticity index shall not exceed twelve. Grain size analysis, text for liquid limit, for plastic limit, shrinkage limit and computation of the plasticity index shall be performed in accordance with ASTM D422, D423, D424, and D427 respectively.

Prior to placing any backfill, all fill materials should be sampled, tested and approved by the geotechnical engineer. The surface on which the material is to be placed shall be scarified to a depth of six inches, watered to add the amount of moisture required for optimum compaction, then compacted to the required density.



PT 8

The fill material shall be placed in lifts not to exceed six inches in depth and then compacted. The moisture content of the materials shall be uniform and within plus or minus two percent of the optimum value as determined by ASTM D1557.

Compaction of the fill material shall be performed with approved types of power, vibratory, pneumatic or tamping equipment. Each lift of fill shall be compacted to a relative compaction which is not less than 95 percent of maximum density as determined by ASTM D1557. Determination of density in the field shall be in accordance with the requirements of ASTM D1556 or D2922.

Control of the backfilling shall consist of field inspection and testing to determine that each lift of fill has been compacted to the required density. Should any lift or portion of a lift not conform to the density requirements, the lift shall be scarified and recompacted until the required density is obtained.

Fill for the landfill operation shall have a quality and placement requirement as specified on the plans.

4.5 · We recommend that the pavement structure throughout the project area consist of one and one half inches of HMAC, four inches of crushed stone base on twelve inches of compacted subgrade. Where heavy truck traffic is expected, we recommend that we be notified to provide additional recommendations. Subgrade soils shall be excavated to the

required grade and compacted as stated previously in this report. Base course shall meet the requirements for Type "B", Grade 2 material according to Item 248, Flexible Base, Texas Highway Department, 1982 Standard Specifications for Construction of Highways, Streets, and Bridges. All other requirements of this document shall be met except where density is specified, the density shall be not less than 100% as determined by ASTM D1556 and D2922. The surface course shall meet the requirements for Type "C" coarse mix paving mixture according to Item 340, Hot Mix Asphaltic Concrete Pavement (Class A) of the above referenced standard. All other requirements of this document shall be met except density and stability shall be determined by the Marshall Method. The Marshall stability of the mix shall be not less than 1200 pounds when compacted at 75 blows, and have a flow between 8 and 16.

## 5. INSPECTION

We recommend that all site grading and fill operations be inspected by Danny R. Anderson, Consultants, Inc. Test of fill material should be made at the following rates:

(1) Two field densities per each lift or 1 per 10,000 square feet of fill, according to ASTM D2922 or ASTM D1556.

(2) One moisture density curve for each type of material used, according to ASTM D1557.

(3) One sieve analysis and one plasticity index for each type of imported material used, according to ASTM D422, 423, and 424.



T 8

## 6. LIMITATIONS

We have made every reasonable effort to properly evaluate the subsurface conditions and the physical properties of the subsoils as revealed by the samples recovered from the borings and the laboratory test results. It must be recognized that the conclusions reached in this report were based on conditions in the eight test borings drilled at the site. Our professional services were performed, our findings obtained, and our recommendations prepared in accordance with generally accepted engineering principles and practices. Should any unusual site conditions exist which appear to vary from those reported herein, we request immediate notification so that further investigations and supplemental recommendations can be made.

APPENDIX

McCombs Road Right of Way, 60' Wide

War Highway and U.S. Highway No.54 Connecting Road

Existing Pit

Top of Slope

Existing Landfill

300' El Paso Electric Co. Easement

Boundary Line

El Paso County, Texas
Dona Ana County, New Mexico

SYMBOLS:

- Boring Location and Number per DRA, Consultants (May, 1983)
- Boring Location and Number per DRA, Consultants (November, 1983)
- Boring Location and Number per Dickinson Laboratories (June, 1976)

NORTH

SCALE: 1" = 400'



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(915) 532-7466

Danny R Anderson, Consultants

DRAWING NO. 82182 - 143 - M

SHEET NO. A-1

APPROVED BY D.R.A.
DATE 4-83

DRAWN BY R.M.
DATE 4-83

REF. 1 2 3 4

PROJECT TITLE
NORTHEAST EL PASO SANITARY LANDFILL

DRAWING TITLE
BORING PLAN

Danny R Anderson, Consultants

GEOTECHNICAL ENGINEERS
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# REPORT OF BORING NUMBER 1

PROJECT City of El Paso Northeast Landfill

LOCATION McCombs and FM 2529

| Description of Materials | Symbol | Depth, feet | Cores | Elevation | Standard Penetration Blows per 6 inches 1st | 2nd | 3rd | Liquid Limit | Plasticity Index | Moisture Content | Unified Soil Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, silty, slightly gravelly, tan, poorly graded, medium dense to very dense, dry | | | | | 6 | 11 | 11 | | | 6.5 | SP-SM |
| | | 10 | | | 11 | 33 | 24 | | | 4.2 | |
| | | | | | 10 | 18 | 20 | | | 6.8 | SM |
| | | 20 | | | 3 | 10 | 16 | | | 3.8 | |
| | | | | | 11 | 24 | 30 | | | 4.2 | SP-SM |
| | | 30 | | | 7 | 14 | 20 | | | 2.5 | |
| | | | | | 12 | 25 | 39 | | | 1.5 | SP |
| | | 40 | | | 7 | 23 | 36 | | | 4.6 | |
| | | | | | 10 | 22 | 50 | | | 3.2 | SP-SM |
| | | 50 | | | | | | | | | |
| | | 60 | | | | | | | | | |

Type and make of drill Mobile B52/61 8" o.d. hollow stem auger

Driller Richard Facio, Raul Esqueda

Logger Richard Facio

REMARKS

Date boring started 9/24/82

Date boring completed 9/24/82

Surface elevation 4033

Groundwater elevation not encountered



FILE NO 82182

Danny R Anderson, Consultants

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# REPORT OF BORING NUMBER 2

PROJECT City of El Paso Northeast Landfill

LOCATION McCombs and FM 2529

| Description of Materials | Symbol | Depth, feet | Cores | Elevation | Standard Penetration Blows per 6 inches 1st | 2nd | 3rd | Liquid Limit | Plasticity Index | Moisture Content | Unified Soil Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, gravelly, tan, poorly graded, medium dense to very dense, dry | | | | | 8 | 10 | 12 | | | 4.6 | |
| | | 10 | | | 9 | 17 | 29 | | | 2.7 | SP |
| | | | | | 7 | 11 | 22 | | | 2.3 | |
| | | 20 | | | 11 | 18 | 21 | | | 2.0 | SP |
| | | | | | 7 | 14 | 19 | | | 7.2 | |
| SAND, fine, silty, gravelly, tan, poorly graded, loose to very dense, dry | | 30 | | | 9 | 15 | 22 | | | 5.6 | SP-SM |
| | | | | | 17 | 59 | 24 | | | 7.0 | |
| | | 40 | | | 4 | 5 | 7 | | | 7.3 | |
| CLAY, brown, stiff to very stiff, moist | | | | | 3 | 8 | 4 | 56 | 33 | 19.7 | CH |
| | | | | | 15 | 19 | 53 | | | | |
| SAND, fine, silty, tan, poorly graded, dense, dry | | 50 | | | 11 | 17 | 23 | | | 4.4 | SM |
| | | 60 | | | | | | | | | |

Type and make of drill Mobile B52/61 8" o.d. hollow stem auger

Driller Richard Facio, Raul Esqueda

Logger Richard Facio

REMARKS

Date boring started 9/24/82

Date boring completed 9/24/82

Surface elevation 4029

Groundwater elevation not encountered



FILE NO 82182

Danny R Anderson, Consultants

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# REPORT OF BORING NUMBER 3

PROJECT City of El Paso Northeast Landfill

LOCATION McCombs and FM 2529

| Description of Materials | Symbol | Depth, feet | Cores | Elevation | Standard Penetration Blows per 6 inches 1st | 2nd | 3rd | Liquid Limit | Plasticity Index | Moisture Content | Unified Soil Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine gravelly, tan, poorly graded, medium dense to very dense, dry, slightly calcareous. | | | | | 11 | 18 | 20 | | | 6.1 | |
| | | 10 | | | 7 | 17 | 36 | NP | NP | 3.8 | SP |
| | | | | | 11 | 10 | 14 | | | 5.5 | |
| SAND, fine, clayey, tan, poorly graded, dense, moist | | 20 | | | 7 | 15 | 29 | 24 | 9 | 13.3 | SC |
| CLAY, brown, very stiff, moist | | | | * | 8 | 7 | 15 | 56 | 33 | 22.9 | CH |
| SAND, fine, silty, tan, poorly graded, medium dense, dry | | 30 | | | 14 | 19 | 29 | NP | NP | 2.8 | SM |
| | | 40 | | | | | | | | | |
| | | 50 | | | | | | | | | |
| | | 60 | | | | | | | | | |

Type and make of drill Mobile B52/61 8" o.d. hollow stem auger

Driller Richard Facio, Raul Esqueda

Logger Richard Facio

REMARKS *No recovery

Date boring started 9/24/82

Date boring completed 9/24/82

Surface elevation 4023

Groundwater elevation not encountered



FILE NO 82182

Danny R Anderson, Consultants

GEOTECHNICAL ENGINEERS
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# REPORT OF BORING NUMBER 4

PROJECT City of El Paso Northeast Landfill

LOCATION McCombs and FM 2529

| Description of Materials | Symbol | Depth, feet | Cores | Elevation | Standard Penetration Blows per 6 inches 1st | 2nd | 3rd | Liquid Limit | Plasticity Index | Moisture Content | Unified Soil Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, silty, gravelly, tan to reddish color, poorly graded, loose to very dense, dry | | | | | 4 | 4 | 3 | | | 4.0 | SM |
| | | 10 | | | 3 | 5 | 5 | | | 3.4 | |
| | | | | | 2 | 4 | 3 | NP | NP | 2.2 | SP-SM |
| | | 20 | | | 13 | 11 | 23 | | | 2.5 | |
| | | | | | 16 | 25 | 28 | NP | NP | 7.0 | SM |
| (clay lense at 35') | | 30 | | | 20 | 37 | 43 | | | 1.5 | |
| | | | | | 14 | 16 | 34 | NP | NP | 1.4 | SP-SM |
| | | 40 | | | 28 | 57 | 15 | | | 0.6 | |
| | | | | | 16 | 27 | 50 | NP | NP | 2.8 | SP-SM |
| | | 50 | | | 15 | 22 | 37 | | | 1.7 | |
| | | 60 | | | | | | | | | |

Type and make of drill Mobile B52/61 8" o.d. hollow stem auger

Driller Richard Facio, Raul Esqueda

Logger Richard Facio

REMARKS

Date boring started 10/5/82

Date boring completed 10/5/82

Surface elevation 4045

Groundwater elevation not encountered



FILE NO 82182

Danny R Anderson, Consultants

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# REPORT OF BORING NUMBER 5

PROJECT City of El Paso Northeast Landfill

LOCATION McCombs and FM 2529

| Description of Materials | Symbol | Depth, feet | Cores | Elevation | Standard Penetration Blows per 6 inches 1st | 2nd | 3rd | Liquid Limit | Plasticity Index | Moisture Content | Unified Soil Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, silty, gravelly, tan, poorly graded, loose to very dense, dry | | | | | 4 | 3 | 5 | | | | |
| | | 10 | | | 2 | 3 | 3 | NP | NP | 3.6 | SP-SM |
| | | | | | 2 | 3 | 3 | | | | |
| | | 20 | | | 2 | 2 | 4 | | | 4.3 | SM |
| | | | | | 14 | 20 | 28 | | | | |
| | | 30 | | | 16 | 23 | 44 | NP | NP | 1.9 | SP |
| | | | | | 16 | 29 | 30 | | | | |
| Clay lenses at 40' to 50' | | 40 | | | 23 | 29 | 48 | (14½") | | 4.6 | SM |
| | | | | | 12 | 23 | 60 | (17 3/4") | | | |
| | | 50 | | | 22 | 26 | 47 | | | | |
| | | 60 | | | | | | | | | |

Type and make of drill Mobile B52/61 8" o.d. hollow stem auger

Driller Richard Facio, Raul Esqueda

Logger Richard Facio

REMARKS

Date boring started 10/5/82

Date boring completed 10/5/82

Surface elevation 4046

Groundwater elevation not encountered



FILE NO 82182

Sheet A6

Danny R Anderson, Consultants

GEOTECHNICAL ENGINEERS
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(915) 532-7566

# REPORT OF BORING NUMBER 6

PROJECT Northeast Landfill

LOCATION Corner of 2529 Farm Road and McCombs, El Paso, Texas

| Description of Materials | Depth, feet | Elevation | Standard Penetration Blows per 6 inches (1st / 2nd / 3rd) | Liquid Limit | Plasticity Index | Moisture Content | Unified Soil Classification |
|---|---|---|---|---|---|---|---|
| SAND, fine, light tan, black, white, multicolored, poorly graded, dense, dry | | * | 9 / 19 / 26 | | | 1.8 | SP |
| SAND, fine, clayey, light tan, black, white, multicolored, poorly graded, dense to very dense, dry | 10 | | 14 / 15 / 15 | 66 | 50 | 9.0 | SC |
| | | | 17 / 45 / 38 | (15.5 in.) | | | |
| SAND, fine, light tan, black, white, multicolored, poorly graded, very dense, dry | 20 | | 12 / 23 / 35 | | | 1.0 | SP |
| | | | 15 / 22 / 63 | (17 in.) | | | |
| | 30 | | 13 / 24 / 26 | | | 2.3 | SP |
| | | | 7 / 13 / 17 | | | | |
| SAND, fine, silty, light tan, black, white, multicolored, very dense, dry | 40 | | 11 / 31 / 58 | NP (16 in.) | NP | 3.6 | SP-SM |
| | | | 18 / 24 / 58 | (17 in.) | | | |
| | 50 | | | | | | |
| | 60 | | | | | | |

Type and make of drill Mobile B52/61 8" o.d. hollow stem auger

Driller Richard Facio, Raul Esqueda

Logger Rafael Munoz

REMARKS *Grab Sample

Date boring started 1/6/83

Date boring completed 1/6/83

Surface elevation 4027

Groundwater elevation Not encountered



FILE NO 82182

Danny R Anderson, Consultants

GEOTECHNICAL ENGINEERS
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EL PASO, TEXAS 79903
(915) 532-7566

# REPORT OF BORING NUMBER 7

PROJECT Northeast Landfill

LOCATION Corner of 2529 Farm Road and McCombs, El Paso, Texas

| Description of Materials | Depth, feet | Elevation | Standard Penetration Blows per 6 inches 1st | 2nd | 3rd | Liquid Limit | Plasticity Index | Moisture Content | Unified Soil Classification |
|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, gravelly, brown, gap graded, medium dense, moist | | | | | | | | | |
| SAND, fine, silty, light tan, poorly graded, medium dense to dense dry | | | 5 | 9 | 13 | | | 3.5 | SP-SM |
| | 10 | | 11 | 19 | 26 | | | 2.1 | SP |
| | | | 9 | 17 | 21 | | | | |
| SAND, fine, silty, light brown, poorly graded, medium dense, dry | 20 | | 8 | 8 | 11 | NP | NP | 6.5 | SP-SM |
| | | | 10 | 12 | 13 | | | | |
| CLAY, brown, very stiff, moist | 30 | | 5 | 8 | 14 | 53 | 33 | 19.0 | CH |
| SAND, fine, silty, tan, poorly graded, loose to medium dense, dry, clay lenses from 33 feet to 35 feet. | | | 4 | 5 | 14 | | | | |
| SAND, fine, tan, black, poorly graded, very dense, dry | 40 | | 12 | 24 | 46 | | | 2.0 | SP |
| | 50 | | | | | | | | |
| | 60 | | | | | | | | |

Type and make of drill Mobile B52/61 8" o.d. hollow stem auger

Driller Richard Facio, Raul Esqueda

Logger Rafael Munoz

REMARKS

Date boring started 1/11/83

Date boring completed 1/11/83

Surface elevation 4036

Groundwater elevation Not encountered



FILE NO 82182

Danny R Anderson, Consultants

GEOTECHNICAL ENGINEERS
2525 EAST YANDELL DR
EL PASO, TEXAS 79903
(915) 532-7566

# REPORT OF BORING NUMBER 8

PROJECT Northeast Landfill

LOCATION Corner of 2529 Farm Road and McCombs, El Paso, Texas

| Description of Materials | Symbol | Depth, feet | Cores | Elevation | Standard Penetration Blows per 6 inches 1st | 2nd | 3rd | Liquid Limit | Plasticity Index | Moisture Content | Unified Soil Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAND, fine, light tan, poorly graded, medium dense to very dense, dry | | | | * | 7 | 12 | 23 | | | 2.7 | SP |
| | | 10 | | | 7 | 10 | 19 | | | 5.5 | SP |
| | | | | | 11 | 27 | 54 | | | | |
| SAND, fine, gravelly, tan, poorly graded, very dense, dry, clay lenses from 20 to 22 feet | | 20 | | | 11 | 26 | 34 | 51 | 35 | 9.7 | SC |
| SAND, fine, light tan, white, red, black, multicolored, poorly graded, medium dense to dense, dry | | | | | 5 | 12 | 11 | | | | |
| | | | | | 5 | 16 | 22 | | | | |
| SAND, fine, light tan, poorly graded, very dense, dry | | 30 | | | 12 | 25 | 41 | | | 5.0 | SP |
| | | | | ** | | | | | | | |
| SAND, fine, silty, clayey, tan, poorly graded, very dense, dry | | | | | 12 | 27 | 56 | | | | |
| SAND, fine, gravelly, light tan, black, white, red, multicolored, poorly graded, very dense, dry | | 40 | | | 15 | 42 | 43 | NP (16 in.) | NP | 2.5 | |
| | | | | | 6 | 24 | 53 | | | | |
| | | 50 | | | | | | | | | |
| | | 60 | | | | | | | | | |

Type and make of drill Mobile B52/61 8" o.d. hollow stem auger

Driller Richard Facio, Raul Esqueda

Logger Rafael Munoz

REMARKS *Grab Sample
**No sample taken

Date boring started 1/7/83

Date boring completed 1/7/83

Surface elevation 4033

Groundwater elevation Not encountere



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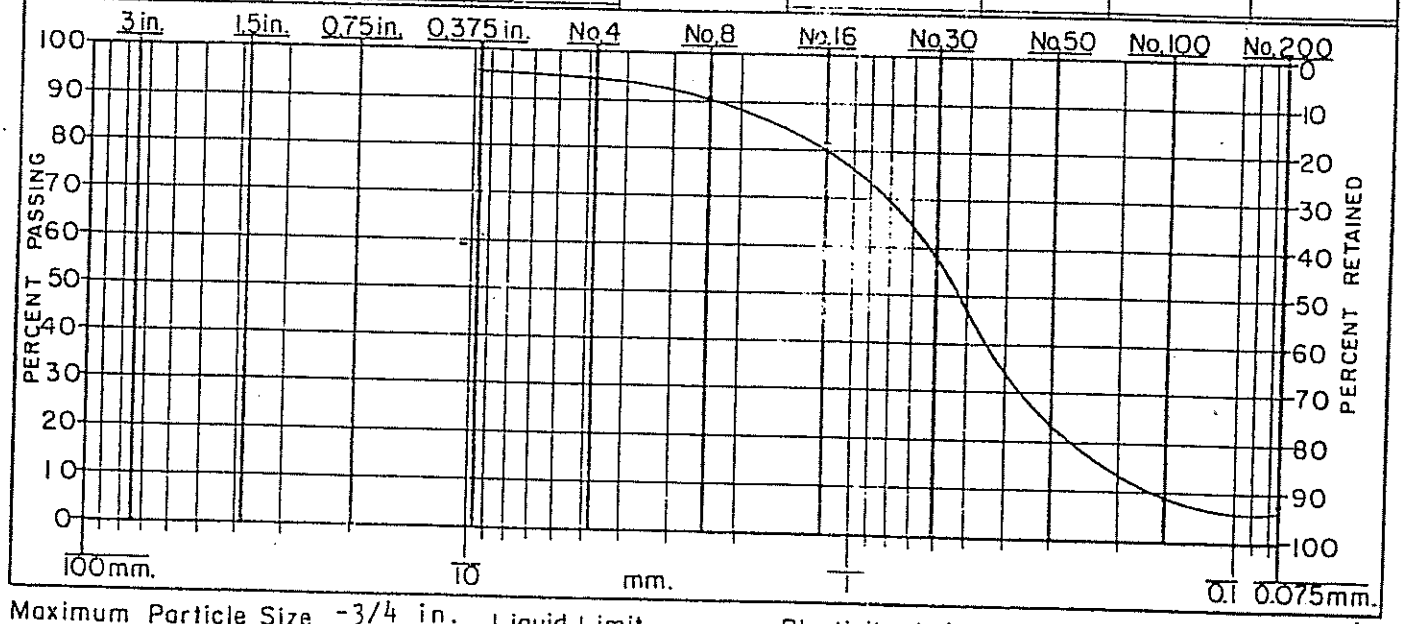
PROJECT Northeast Landfill

REPORT OF TEST ON SAND, poorly graded, SAND, silty

RECEIVED FROM Boring Number 1 at 5 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | | | |
| 9.5 (0.375) | 18.1 | 96 | 4.1 |
| 4.75 (No. 4) | 24.[illegible] | 95 | 5.[illegible] |
| 2.36 (No. 8) | 41.1 | 91 | 9.4 |
| 1.18mm (No.16) | 78.5 | 82 | 17.9 |
| 0.60 (No.30) | 182.3 | 58 | 41.7 |
| 0.30 (No.50) | 335.7 | 23 | 76.8 |
| 0.15 (No.100) | 400.8 | 8 | 91.7 |
| 0.075 (No.200) | 408.7 | 7 | 93.5 |




Maximum Particle Size -3/4 in. Liquid Limit _____ Plasticity Index _____ Moisture Content 6.5

This report covers laboratory procedures in accordance with ASTM D 2487, D 2217, D422, D423, D424 & D2216.

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PROJECT Northeast Landfill

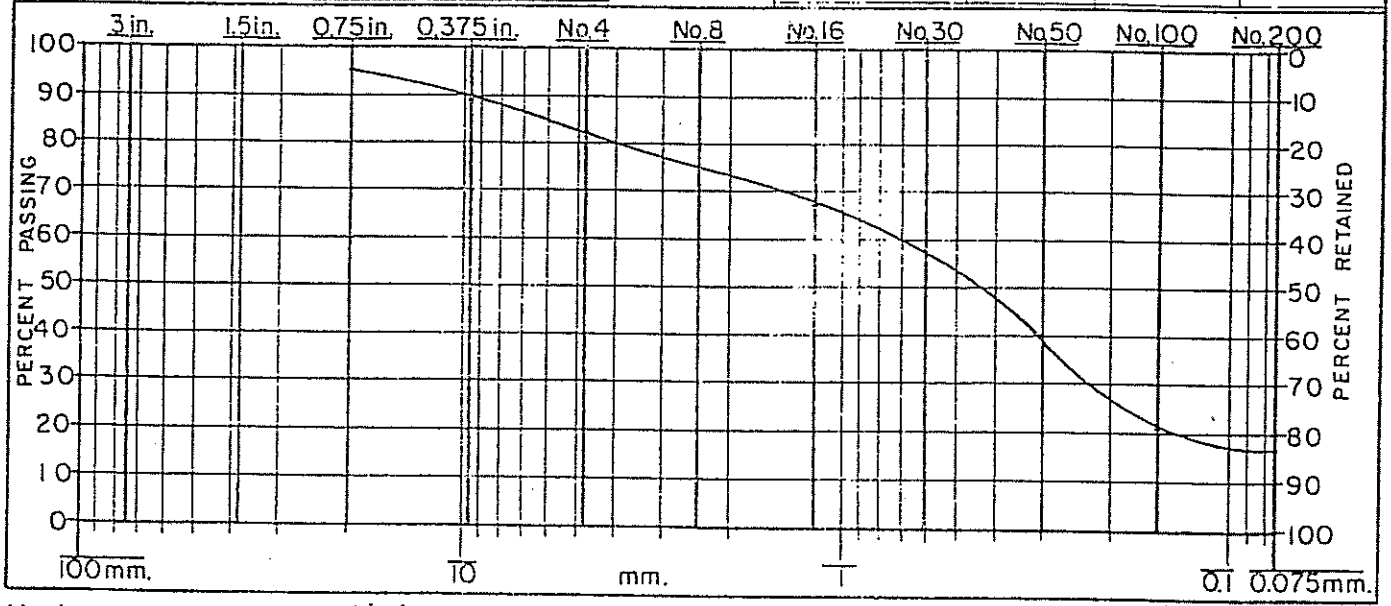
REPORT OF TEST ON SAND, silty

RECEIVED FROM Boring Number 1 at 15 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | 21.2 | 95 | 4.6 |
| 9.5 (0.375) | 52.0 | 89 | 11.4 |
| 4.75 (No. 4) | 80.5 | 82 | 17.7 |
| 2.36 (No. 8) | 114.1 | 75 | 25.1 |

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 1.18 mm (No. 16) | 150.3 | 67 | 33.1 |
| 0.60 (No. 30) | 194.9 | 57 | 43.0 |
| 0.30 (No. 50) | 273.6 | 40 | 60.3 |
| 0.15 (No. 100) | 359.2 | 21 | 79.2 |
| 0.075 (No. 200) | 378.8 | 17 | 83.5 |




Maximum Particle Size -1½ in. Liquid Limit _____ Plasticity Index _____ Moisture Content 6.8

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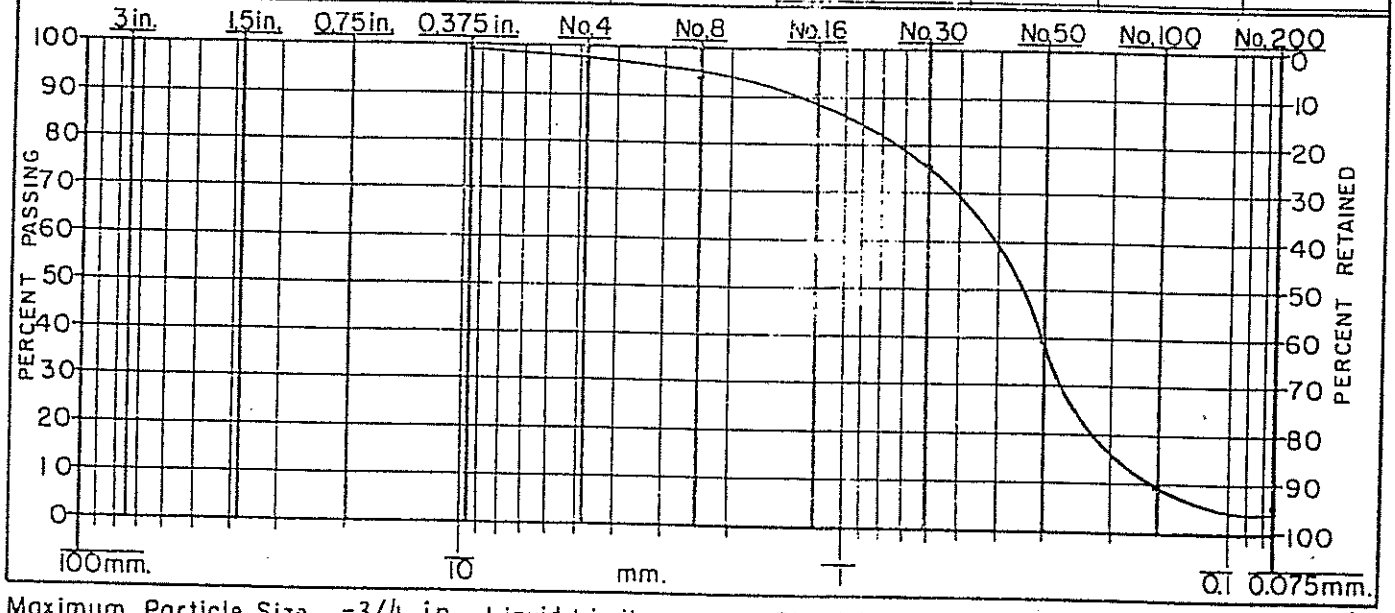
PROJECT Northeast Landfill

REPORT OF TEST ON SAND, poorly graded, SAND, silty

RECEIVED FROM Boring Number 1 at 25 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | | | |
| 9.5 (0.375) | 4.1 | 99 | 1.0 |
| 4.75 (No. 4) | 13.5 | 97 | 3.3 |
| 2.36 (No. 8) | 24.2 | 94 | 5.9 |
| 1.18 mm. (No. 16) | 37.7 | 91 | 9.3 |
| 0.60 (No. 30) | 95.6 | 76 | 23.6 |
| 0.30 (No. 50) | 246.8 | 39 | 61.0 |
| 0.15 (No. 100) | 366.6 | 9 | 90.7 |
| 0.075 (No. 200) | 381.0 | 6 | 94.2 |




Maximum Particle Size -3/4 in. Liquid Limit _____ Plasticity Index _____ Moisture Content 4.2

This report covers laboratory procedures in accordance with ASTM D 2487, D 2217, D 422, D 423, D 424 & D 2216.

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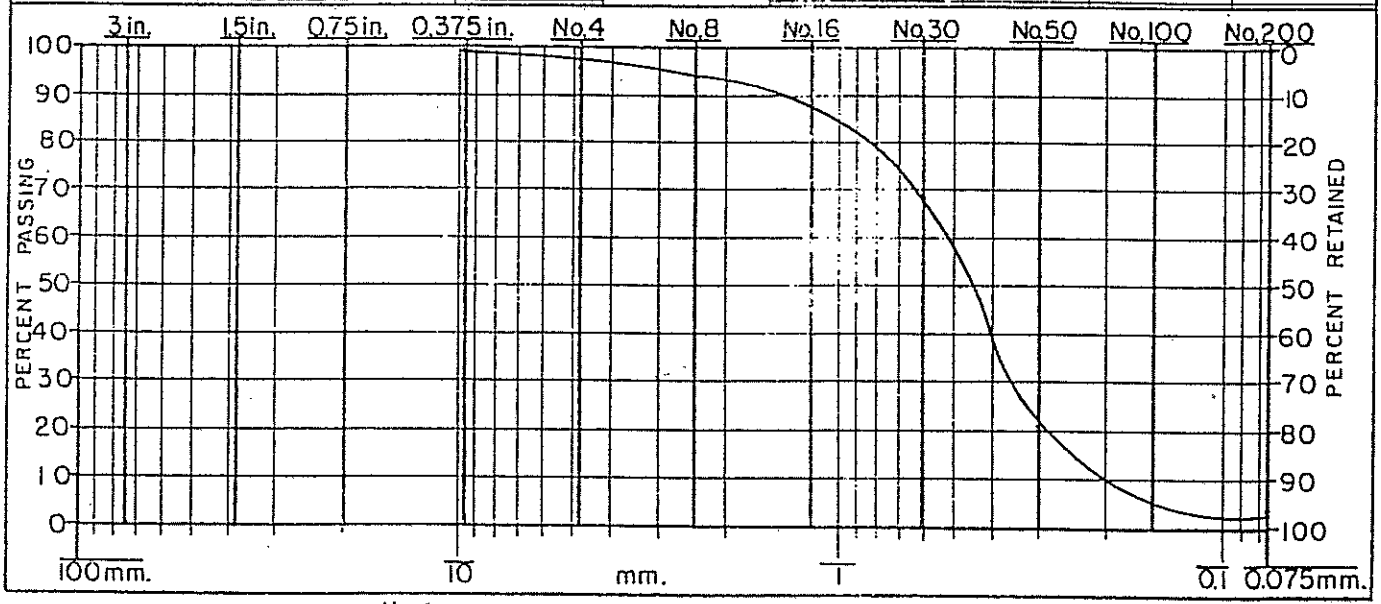
PROJECT Northeast Landfill

REPORT OF TEST ON SAND, poorly graded

RECEIVED FROM Boring Number 1 at 35 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | | | |
| 9.5 (0.375) | 5.1 | 99 | 1.3 |
| 4.75 (No. 4) | 16.0 | 96 | 4.3 |
| 2.36 (No.8) | 23.5 | 94 | 6.4 |
| 1.18mm. (No.16) | 39 | 89 | 10.6 |
| 0.60 (No.30) | 116.7 | 68 | 31.8 |
| 0.30 (No.50) | 289.1 | 21 | 78.8 |
| 0.15 (No.100) | 351.3 | 4 | 95.7 |
| 0.075 (No.200) | 356.8 | 3 | 97.2 |




Maximum Particle Size -3/4 in. Liquid Limit _____ Plasticity Index _____ Moisture Content 1.5

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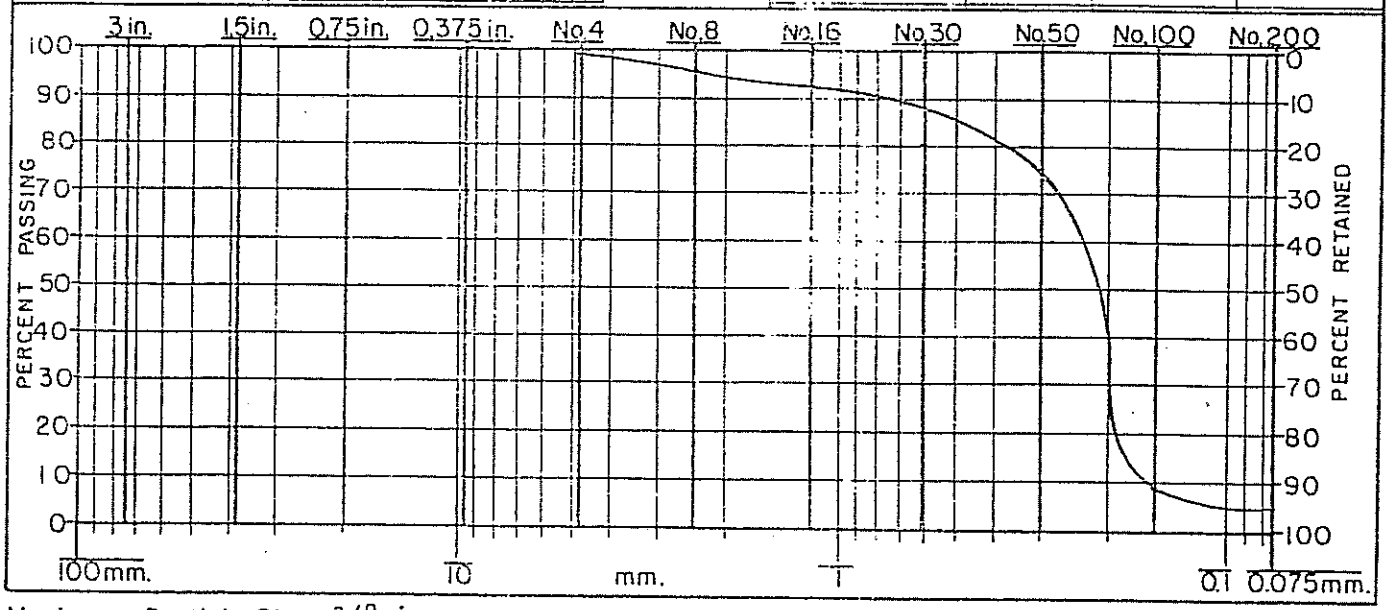
PROJECT Northeast Landfill

REPORT OF TEST ON SAND, poorly graded, SAND, silty

RECEIVED FROM Boring Number 1 at 45 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5) | | | |
| 19.0 (0.75) | | | |
| 9.5 (0.375) | | | |
| 4.75 (No. 4) | 5.0 | 98.8 | 1.2 |
| 2.36 (No. 8) | 15.5 | 96.4 | 3.6 |
| 1.18 mm (No. 16) | 30.7 | 92.9 | 7.1 |
| 0.60 (No. 30) | 85.5 | 80.1 | 19.9 |
| 0.30 (No. 50) | 277.8 | 35.4 | 64.6 |
| 0.15 (No. 100) | 395.6 | 8.0 | 92.0 |
| 0.075 (No. 200) | 407.6 | 5.2 | 94.8 |




Maximum Particle Size 3/8 in. Liquid Limit _____ Plasticity Index _____ Moisture Content 3.2

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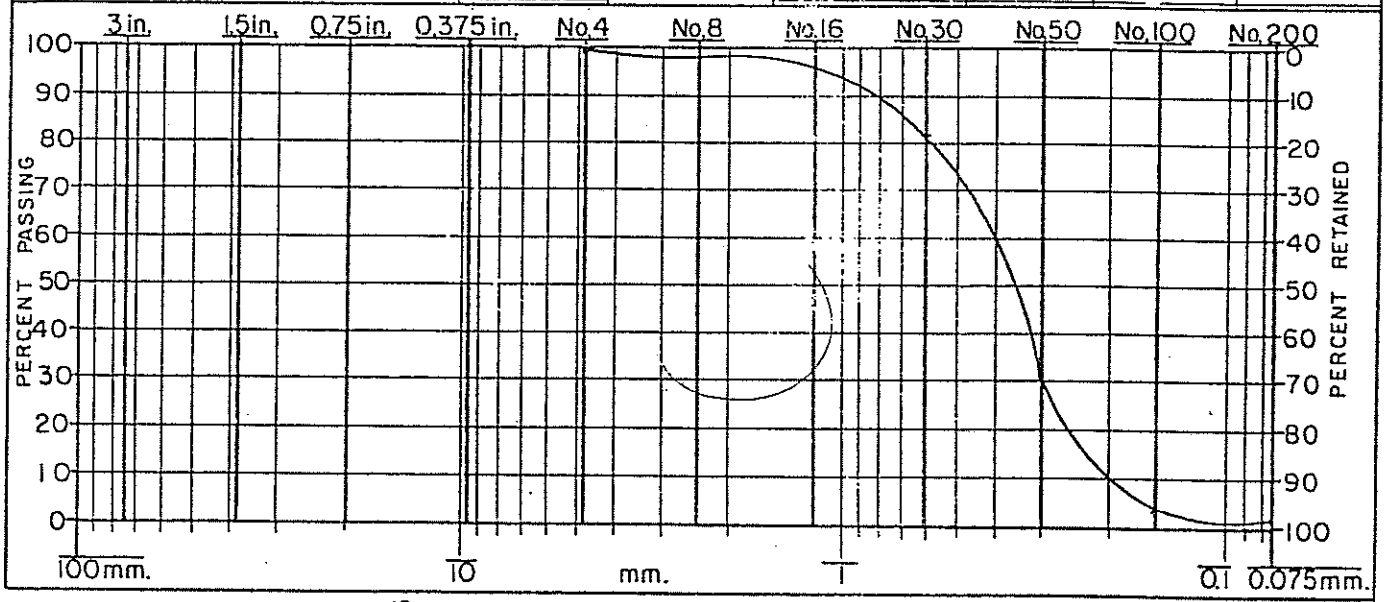
PROJECT Northeast Landfill

REPORT OF TEST ON SAND, poorly graded

RECEIVED FROM Boring Number 2 at 10 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | | | |
| 9.5 (0.375) | | | |
| 4.75 (No. 4) | 2.8 | 99 | .7 |
| 2.36 (No. 8) | 6.4 | 98 | 1.6 |
| 1.18mm (No.16) | 16.2 | 96 | 4.1 |
| 0.60 (No.30) | 70.6 | 82 | 17.9 |
| 0.30 (No.50) | 271.0 | 31 | 68.8 |
| 0.15 (No.100) | 380.7 | 3 | 96.6 |
| 0.075 (No.200) | 386.7 | 2 | 98.2 |




Maximum Particle Size -3/8 in. Liquid Limit _____ Plasticity Index _____ Moisture Content 2.7

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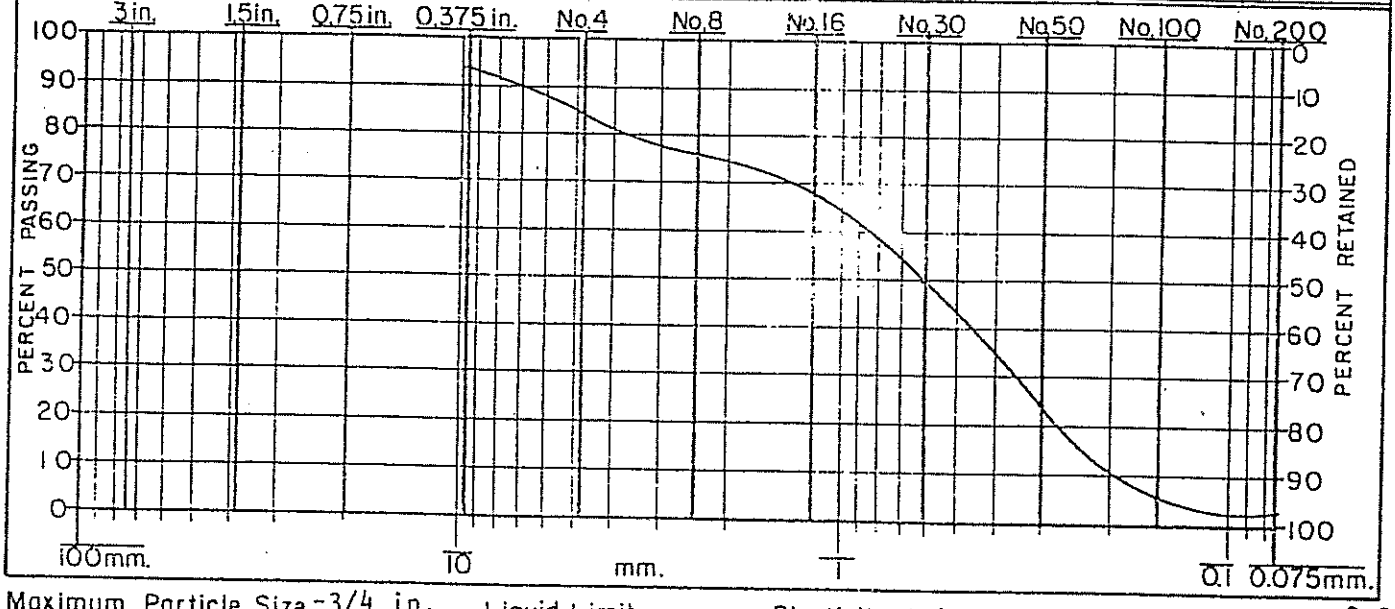
PROJECT Northeast Landfill

REPORT OF TEST ON SAND, poorly graded

RECEIVED FROM Boring Number 2 at 20 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | | | |
| 9.5 (0.375) | 26.9 | 93.5 | 6.5 |
| 4.75 (No. 4) | 65.2 | 84.2 | 15.8 |
| 2.36 (No. 8) | 96.6 | 76.5 | 23.5 |
| 1.18mm. (No.16) | 132.1 | 67.9 | 32.1 |
| 0.60 (No.30) | 208.0 | 49.5 | 50.5 |
| 0.30 (No.50) | 311.9 | 24.2 | 75.8 |
| 0.15 (No.100) | 391.6 | 4.9 | 95.1 |
| 0.075 (No.200) | 399.8 | 2.9 | 97.1 |




Maximum Particle Size 3/4 in. Liquid Limit _____ Plasticity Index _____ Moisture Content 2.0

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DATE

PROJECT Northeast Landfill

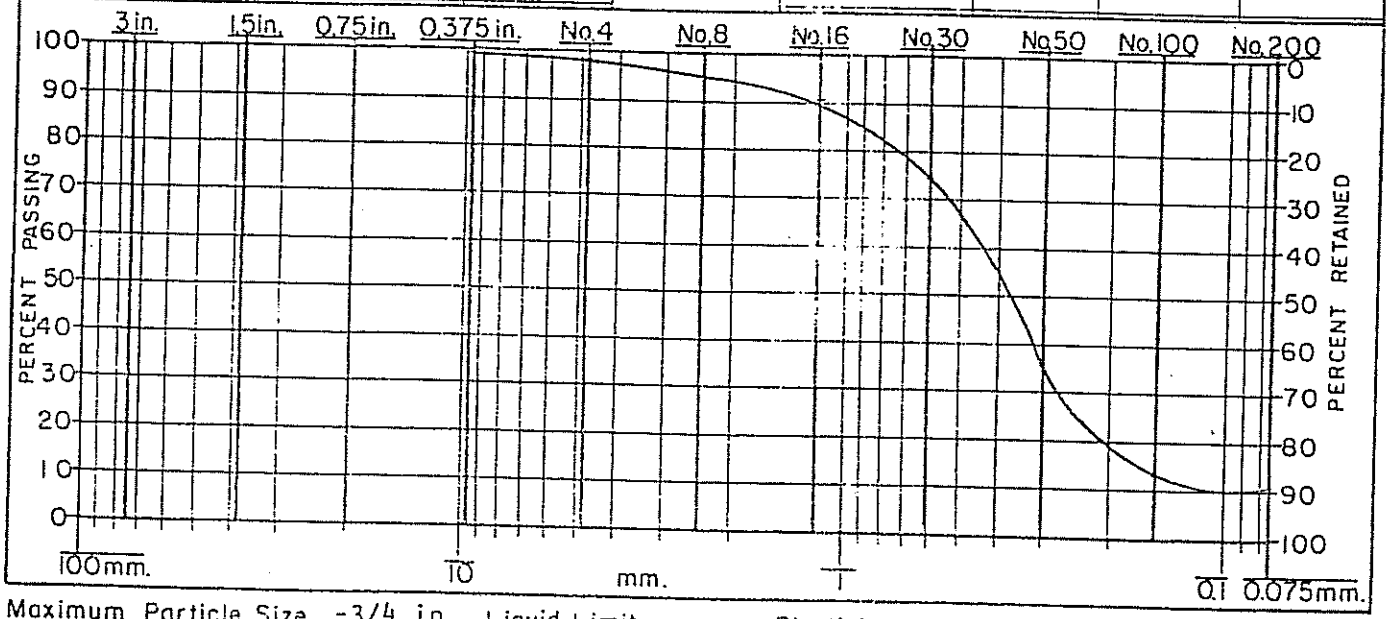
REPORT OF TEST ON SAND, poorly graded, SAND, silty

RECEIVED FROM Boring Number 2 at 30 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | | | |
| 9.5 (0.375) | 3.5 | 99 | .9 |
| 4.75 (No. 4) | 9.1 | 98 | 2.4 |
| 2.36 (No. 8) | 17.5 | 95 | 4.7 |

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 1.18 mm (No. 16) | 35.2 | 91 | 9.5 |
| 0.60 (No. 30) | 94.6 | 74 | 25.7 |
| 0.30 (No. 50) | 236.1 | 36 | 64.3 |
| 0.15 (No. 100) | 319.5 | 13 | 87.1 |
| 0.075 (No. 200) | 328.3 | 11 | 89.5 |




Maximum Particle Size -3/4 in. Liquid Limit _____ Plasticity Index _____ Moisture Content 5.6

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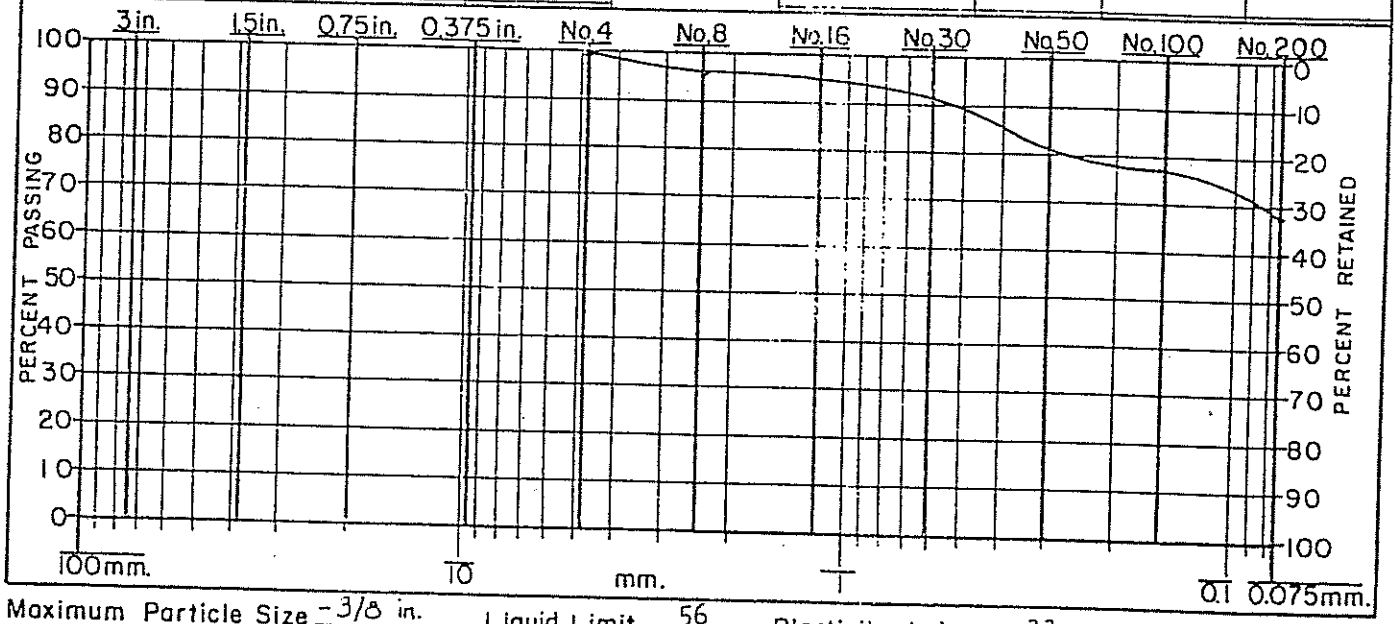
PROJECT Northeast Landfill

REPORT OF TEST ON CLAY of high plasticity

RECEIVED FROM Boring Number 2 at 45 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5) | | | |
| 19.0 (0.75) | | | |
| 9.5 (0.375) | | | |
| 4.75 (No. 4) | 2.4 | 98.8 | 1.2 |
| 2.36 (No. 8) | 4.3 | 95.7 | 2.1 |
| 1.18 mm (No. 16) | 7.8 | 96.2 | 3.8 |
| 0.60 (No. 30) | 16.4 | 92.0 | 8.0 |
| 0.30 (No. 50) | 41.9 | 79.7 | 20.3 |
| 0.15 (No. 100) | 46.9 | 77.2 | 22.8 |
| 0.075 (No. 200) | 66.6 | 67.6 | 32.4 |




Maximum Particle Size 3/8 in. Liquid Limit 56 Plasticity Index 33 Moisture Content 19.7

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DATE

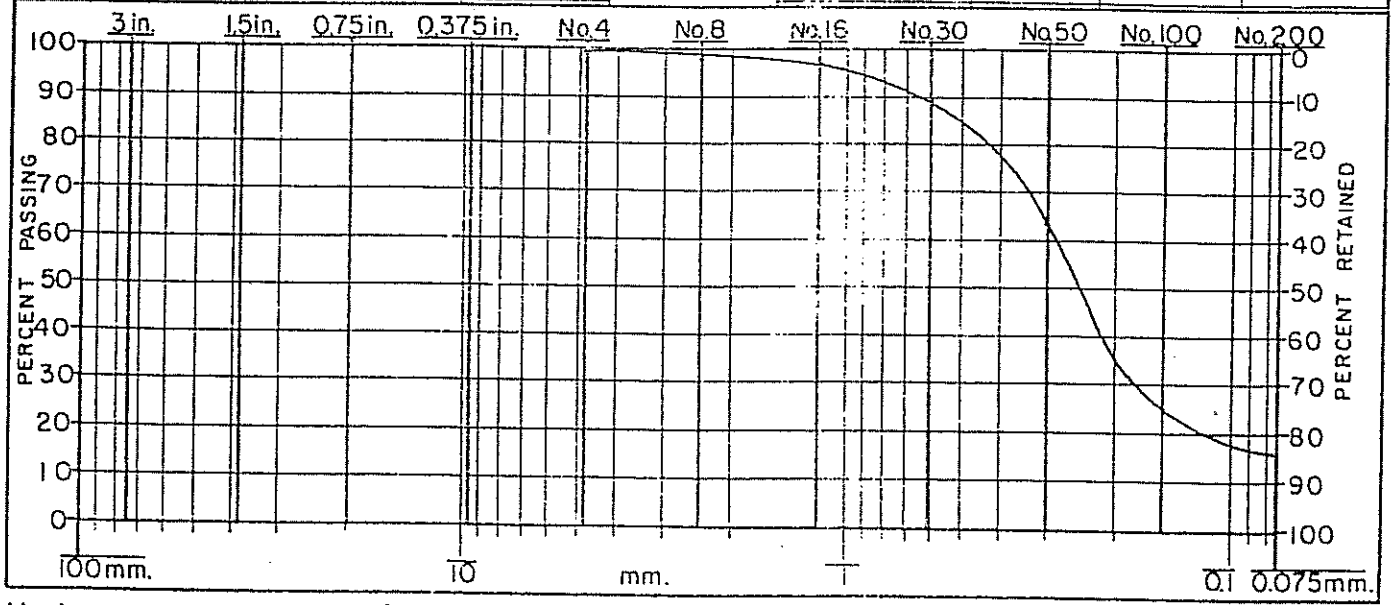
PROJECT Northeast Landfill

REPORT OF TEST ON SAND, silty

RECEIVED FROM Boring Number 2 at 50 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | | | |
| 9.5 (0.375) | | | |
| 4.75 (No. 4) | 2.4 | 99 | .6 |
| 2.36 (No. 8) | 6.5 | 98 | 1.7 |
| 1.18 mm. (No.16) | 13.4 | 97 | 3.5 |
| 0.60 (No.30) | 41.0 | 89 | 10.7 |
| 0.30 (No.50) | 143.1 | 63 | 37.4 |
| 0.15 (No.100) | 287.7 | 25 | 75.3 |
| 0.075 (No.200) | 320.6 | 16 | 83.9 |




Maximum Particle Size -3/8 in. Liquid Limit _____ Plasticity Index _____ Moisture Content 4.4

This report covers laboratory procedures in accordance with ASTM D 2487, D 2217, D422, D423, D424 & D2216.

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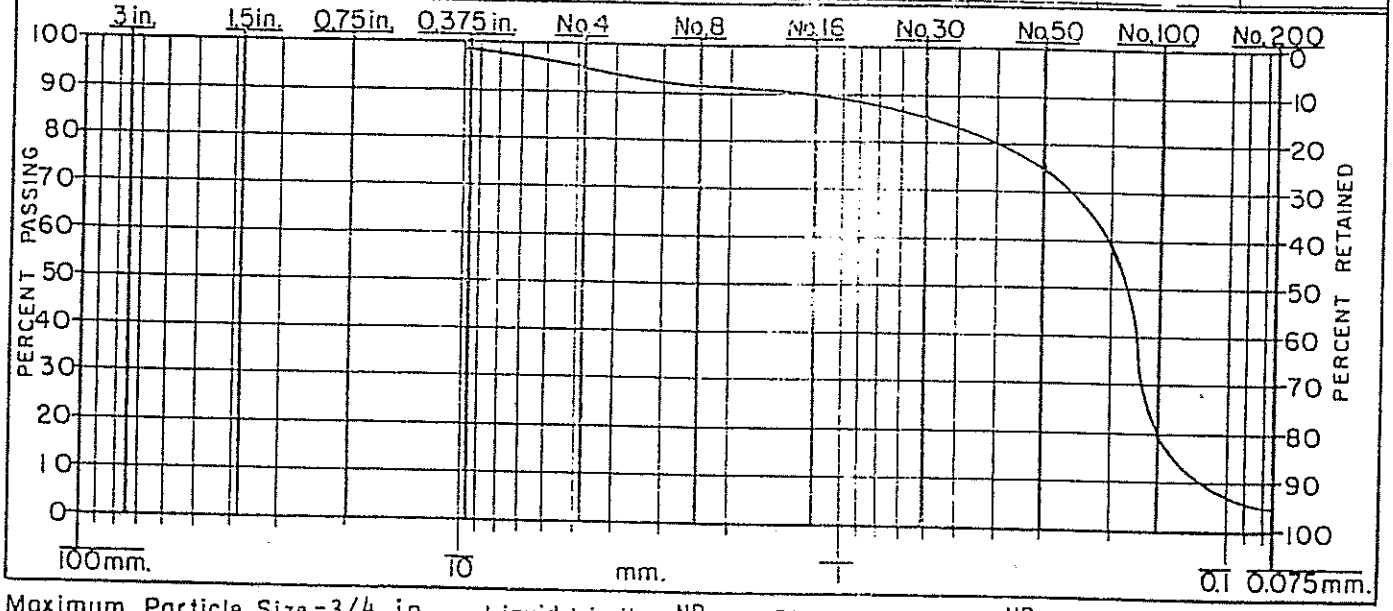
PROJECT Northeast Landfill

REPORT OF TEST ON SAND, poorly graded

RECEIVED FROM Boring Number 3 at 10 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | | | |
| 9.5 (0.375) | 5.6 | 98.2 | 1.8 |
| 4.75 (No. 4) | 16.5 | 94.6 | 5.4 |
| 2.36 (No. 8) | 24.9 | 91.9 | 8.1 |
| 1.18mm (No.16) | 32.5 | 89.4 | 10.6 |
| 0.60 (No.30) | 45.7 | 85.1 | 14.9 |
| 0.30 (No.50) | 78.0 | 74.6 | 25.4 |
| 0.15 (No.100) | 246.0 | 19.9 | 80.1 |
| 0.075 (No.200) | 293.5 | 4.4 | 95.6 |




Maximum Particle Size - 3/4 in. Liquid Limit NP Plasticity Index NP Moisture Content 3.8

This report covers laboratory procedures in accordance with ASTM D 2487, D 2217, D422, D423, D424 & D2216.

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DATE

PROJECT Northeast Landfill

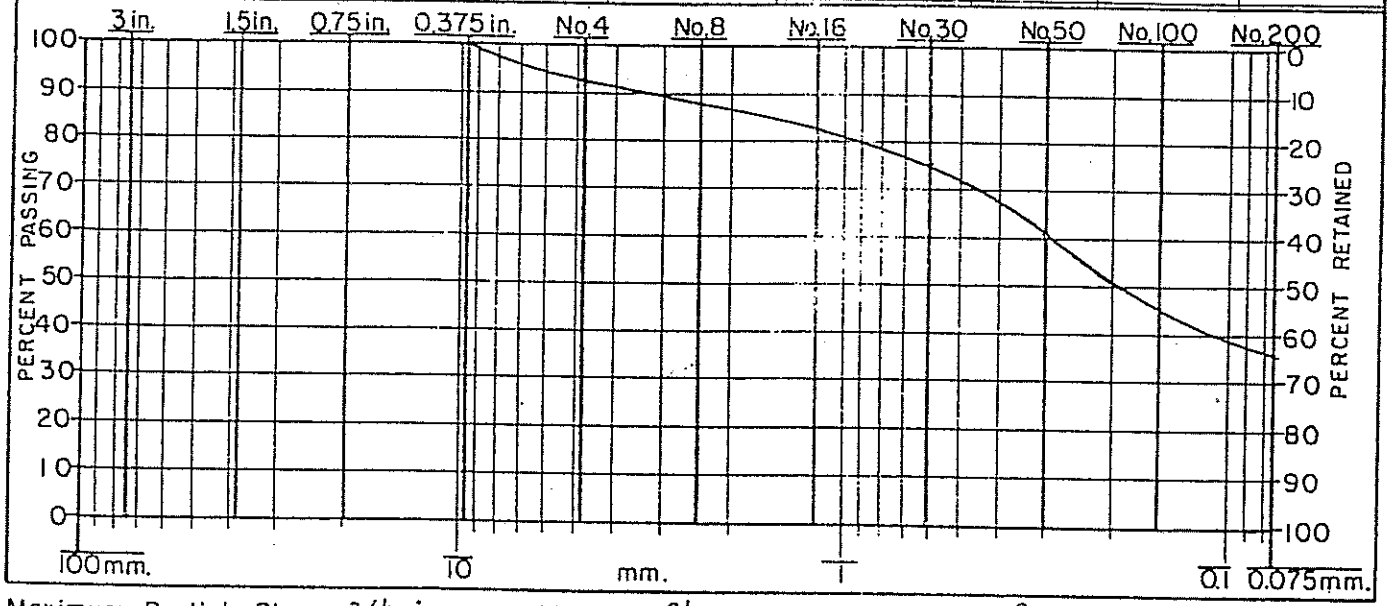
REPORT OF TEST ON SAND, clayey

RECEIVED FROM Boring Number 3 at 20 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | | | |
| (3/8) | 1.6 | 99.5 | .5 |
| 4.75 (No. 4) | 27.0 | 92.4 | 7.6 |
| 2.36 (No. 8) | 43.7 | 87.5 | 12.5 |

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 1.18 mm (No.16) | 61.3 | 82.5 | 17.5 |
| 0.60 (No.30) | 86.8 | 75.3 | 24.7 |
| 0.30 (No.50) | 136.0 | 61.3 | 38.7 |
| 0.15 (No.100) | 194.2 | 44.7 | 55.3 |
| 0.075 (No.200) | 222.8 | 36.5 | 63.5 |




Maximum Particle Size -3/4 in. Liquid Limit 24 Plasticity Index 9 Moisture Content 13.

This report covers laboratory procedures in accordance with ASTM D 2487, D 2217, D 422, D 423, D 424 & D 2216.

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PROJECT Northeast Landfill

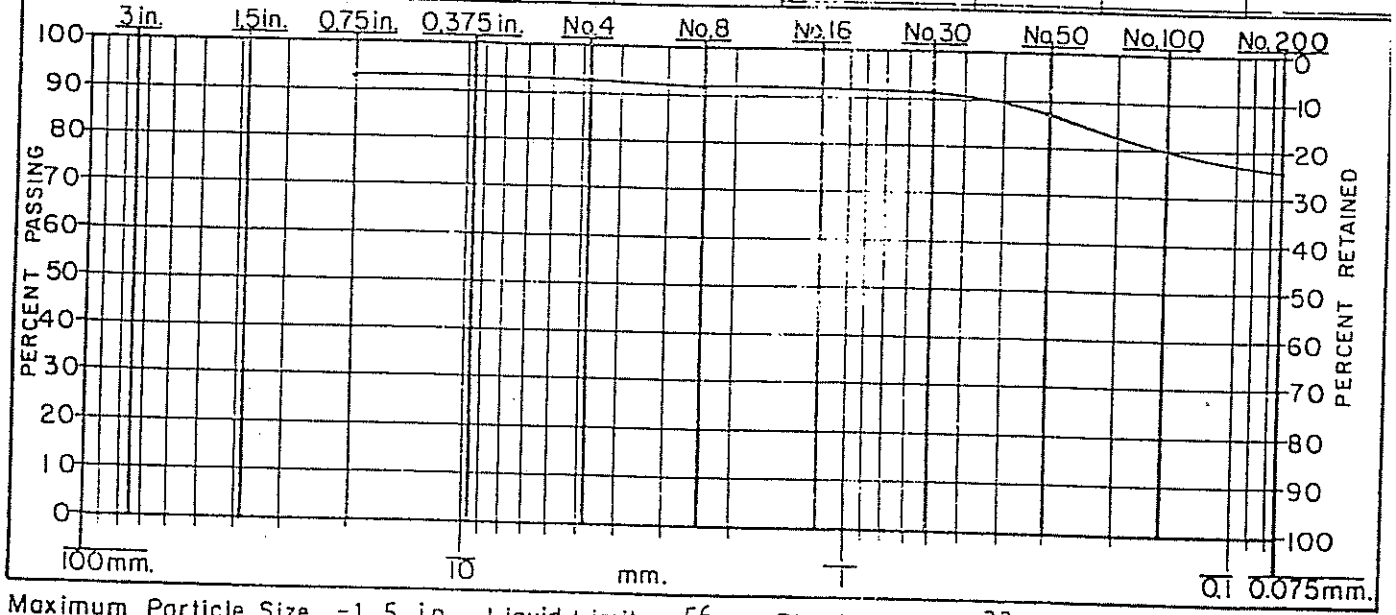
REPORT OF TEST ON CLAY of high plasticity

RECEIVED FROM Boring Number 3 at 25 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | 18 | 93 | 6.6 |
| 9.5 (0.375) | 18 | 93 | 6.6 |
| 4.75 (No. 4) | 19.7 | 93 | 7.2 |
| 2.36 (No. 8) | 20.7 | 92 | 7.6 |

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 1.18mm (No.16) | 21.5 | 92 | 7.9 |
| 0.60 (No.30) | 23.7 | 92 | 8.7 |
| 0.30 (No.50) | 35.2 | 87 | 12.9 |
| 0.15 (No.100) | 55.2 | 80 | 20.3 |
| 0.075 (No.200) | 65.5 | 76 | 24.1 |




Maximum Particle Size -1.5 in. Liquid Limit 56 Plasticity Index 33 Moisture Content 22.

This report covers laboratory procedures in accordance with ASTM D 2487, D 2217, D422, D423, D424 & D2216.

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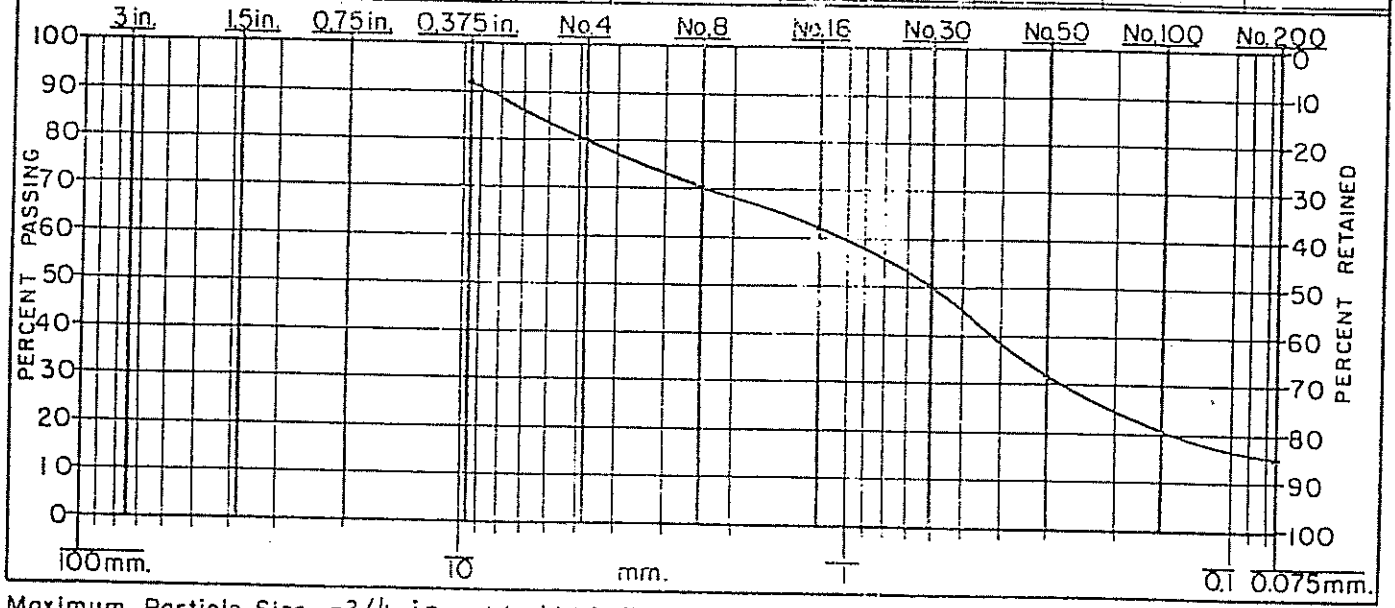
PROJECT Northeast Landfill

REPORT OF TEST ON SAND, silty

RECEIVED FROM Boring Number 4 at 5 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5) | | | |
| 19.0 (0.75) | | | |
| 9.5 (0.375) | 21.9 | 92 | 8.0 |
| 4.75 (No. 4) | 54.6 | 80 | 20.1 |
| 2.36 (No. 8) | 80.7 | 70 | 29.7 |
| 1.18 mm (No. 16) | 104.3 | 62 | 38.4 |
| 0.60 (No. 30) | 135.7 | 50 | 50.0 |
| 0.30 (No. 50) | 183.5 | 32 | 67.6 |
| 0.15 (No. 100) | 213.8 | 21 | 78.8 |
| 0.075 (No. 200) | 230.0 | 15 | 84.8 |




Maximum Particle Size -3/4 in. Liquid Limit _____ Plasticity Index _____ Moisture Content 4.8

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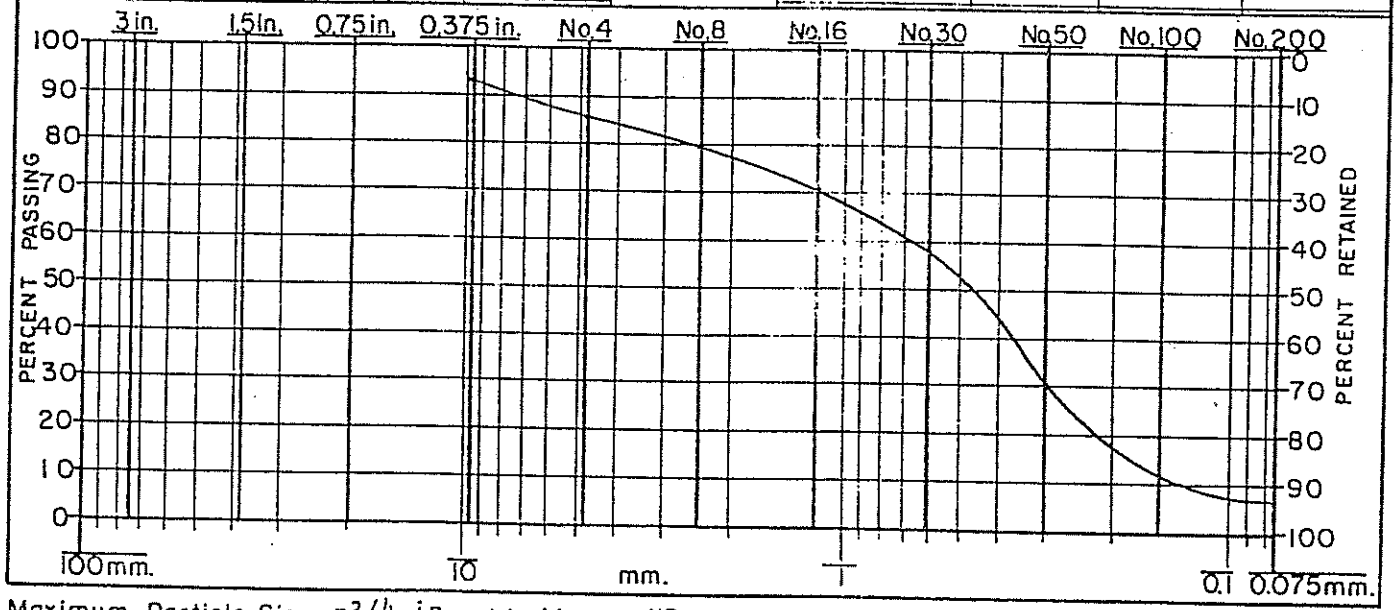
REPORT OF TEST ON SAND, poorly graded, SAND, silty

RECEIVED FROM Boring Number 4 at 15 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5) | | | |
| 19.0 (0.75) | | | |
| 9.5 (0.375) | 14.2 | 93 | 6.7 |
| 4.75 (No. 4) | 30.0 | 86 | 14.2 |
| 2.36 (No. 8) | 44.0 | 79 | 20.8 |
| 1.18mm (No.16) | 60.8 | 71 | 28.8 |
| 0.60 (No.30) | 88.5 | 58 | 41.9 |
| 0.30 (No.50) | 148.8 | 30 | 70.5 |
| 0.15 (No.100) | 186.1 | 12 | 88.1 |
| 0.075 (No.200) | 195.5 | 7 | 92.6 |




Maximum Particle Size -3/4 in. Liquid Limit NP Plasticity Index NP Moisture Content 2.2

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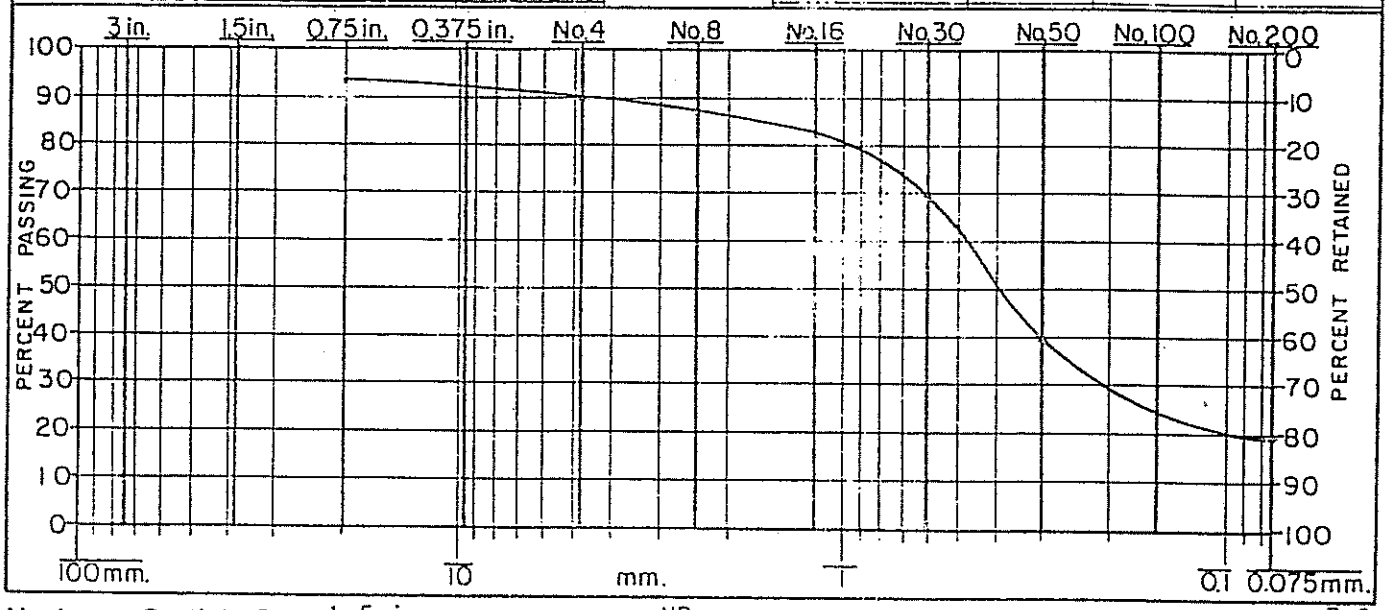
REPORT OF TEST ON SAND, silty

RECEIVED FROM Boring Number 4 at 25 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | 23.5 | 93 | 7.2 |
| 9.5 (0.375) | 25.8 | 92 | 7.9 |
| 4.75 (No. 4) | 35.0 | 89 | 10.8 |
| 2.36 (No. 8) | 41.3 | 87 | 12.7 |
| 1.18 mm (No. 16) | 56.0 | 83 | 17.2 |
| 0.60 (No. 30) | 101.8 | 69 | 31.4 |
| 0.30 (No. 50) | 197.5 | 39 | 60.9 |
| 0.15 (No. 100) | 245.5 | 24 | 75.8 |
| 0.075 (No. 200) | 261.3 | 19 | 80.6 |




Maximum Particle Size 1.5 in. Liquid Limit NP Plasticity Index NP Moisture Content 7.0

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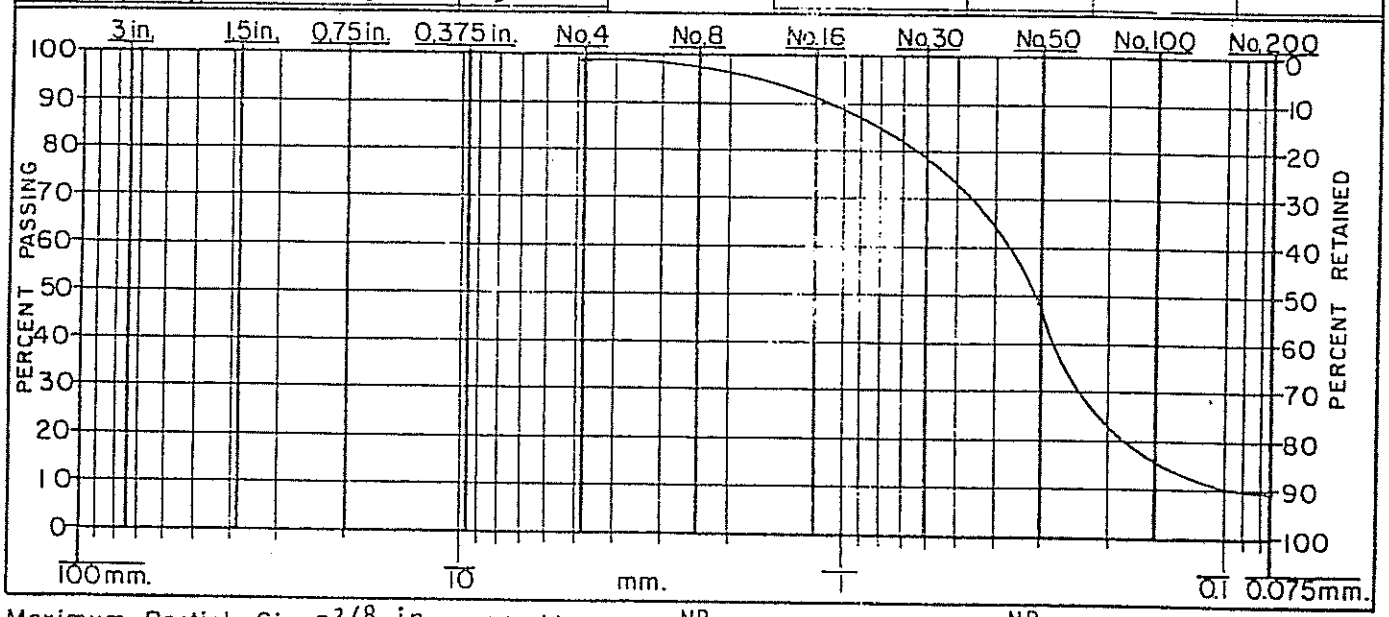
REPORT OF TEST ON SAND, poorly graded, SAND, silty

RECEIVED FROM Boring Number 4 at 35 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | | | |
| 9.5 (0.375) | | | |
| 4.75 (No. 4) | 4.2 | 98 | 1.7 |
| 2.36 (No. 8) | 9.0 | 96 | 3.8 |
| 1.18mm (No.16) | 17.4 | 93 | 7.4 |
| 0.60 (No.30) | 54.5 | 77 | 23.3 |
| 0.30 (No.50) | 121.9 | 48 | 52.2 |
| 0.15 (No.100) | 195.4 | 16 | 83.7 |
| 0.075 (No.200) | 212.4 | 9 | 91.0 |




Maximum Particle Size 3/8 in. Liquid Limit NP Plasticity Index NP Moisture Content 1.4

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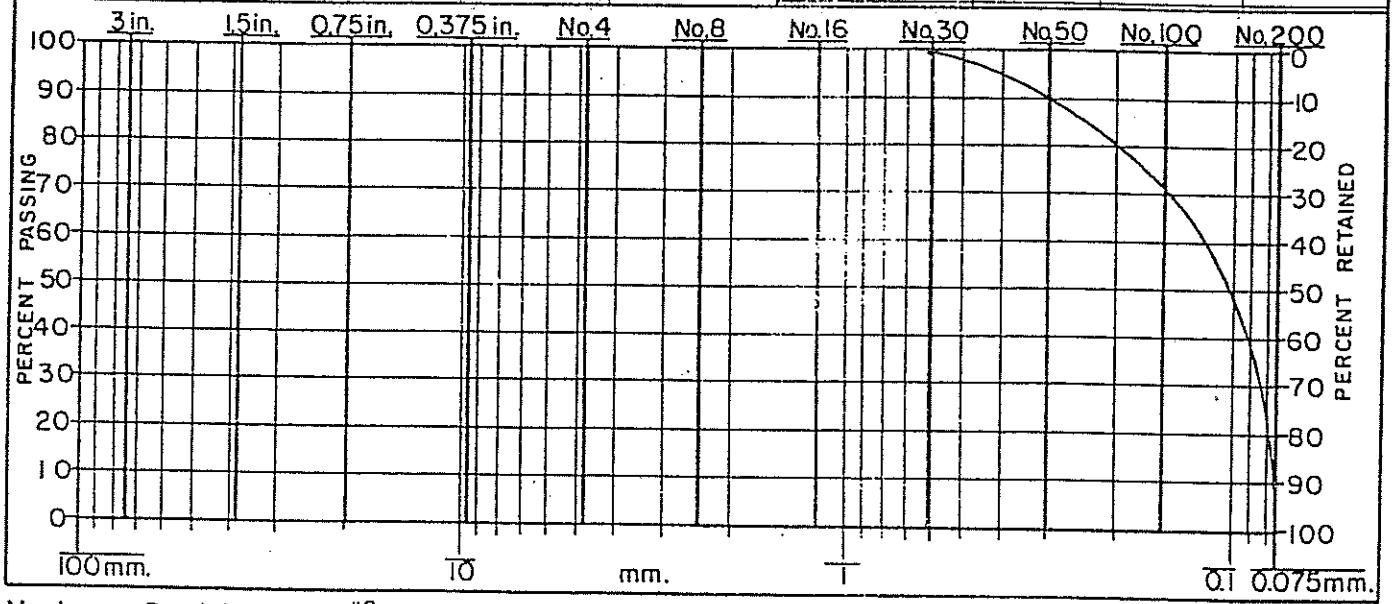
REPORT OF TEST ON SAND, poorly graded, SAND, silty

RECEIVED FROM Boring Number 4 at 45 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | | | |
| 9.5 (0.375) | | | |
| 4.75 (No. 4) | | | |
| 2.36 (No. 8) | | | |

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 1.18mm. (No.16) | .5 | 100 | .2 |
| 0.60 (No.30) | 3.5 | 99 | 1.4 |
| 0.30 (No.50) | 24.8 | 90 | 10.0 |
| 0.15 (No.100) | 68.6 | 72 | 27.8 |
| 0.075 (No.200) | 224.7 | 9 | 91.2 |




Maximum Particle Size -#8 Liquid Limit NP Plasticity Index NP Moisture Content 2.8

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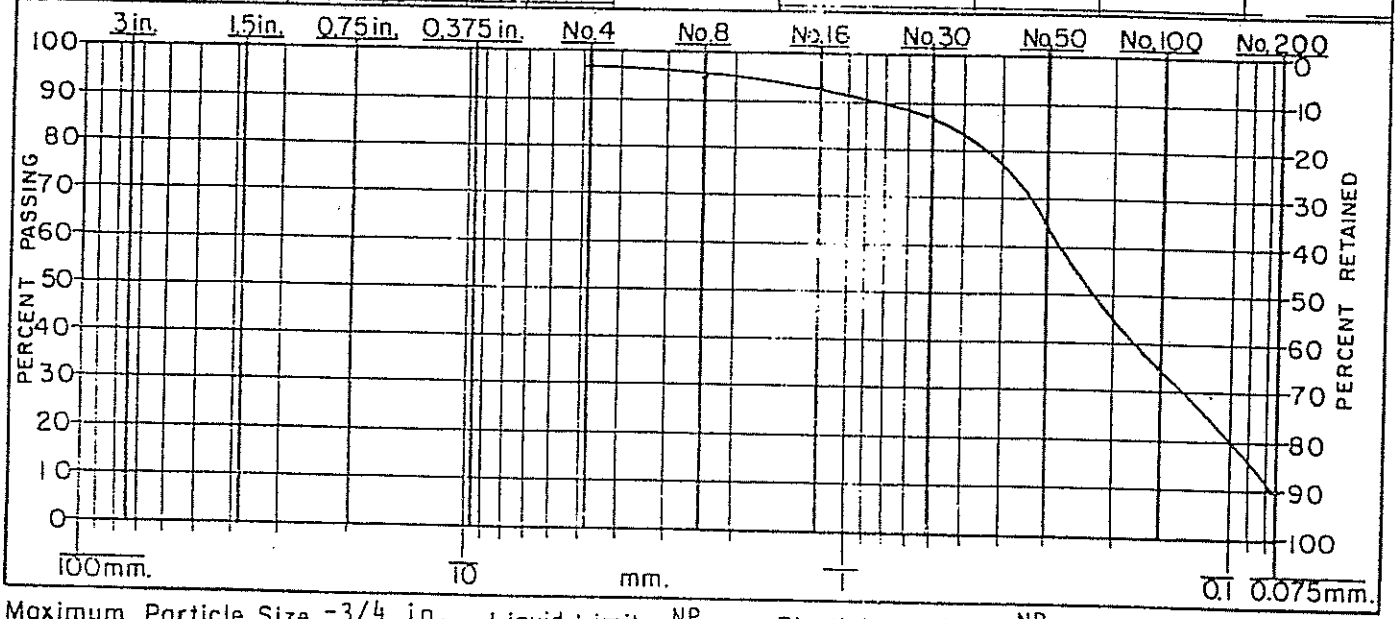
REPORT OF TEST ON SAND, poorly graded, SAND, silty

RECEIVED FROM Boring Number 5 at 10 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | | | |
| 9.5 (0.375) | 1.4 | 100 | .5 |
| 4.75 (No. 4) | 8.1 | 97 | 3.3 |
| 2.36 (No. 8) | 11.5 | 95 | 4.7 |
| 1.18 mm (No. 16) | 18.2 | 93 | 7.5 |
| 0.60 (No. 30) | 32.6 | 87 | 13.4 |
| 0.30 (No. 50) | 85.5 | 65 | 35.3 |
| 0.15 (No. 100) | 160.0 | 34 | 66.1 |
| 0.075 (No. 200) | 219.0 | 9.5 | 90.5 |




Maximum Particle Size -3/4 in. Liquid Limit NP Plasticity Index NP Moisture Content 3.6

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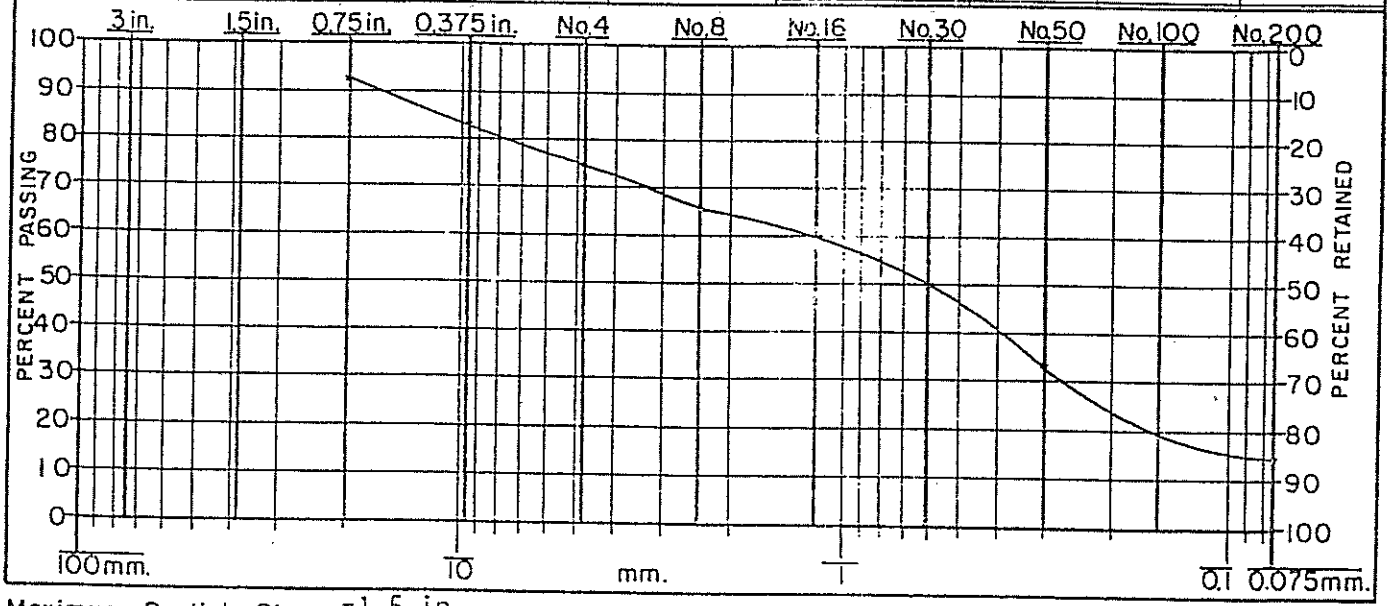
REPORT OF TEST ON SAND, silty

RECEIVED FROM Boring Number 5 at 20 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | 17.6 | 92 | 8.1 |
| 9.5 (0.375) | 36.4 | 83 | 16.9 |
| 4.75 (No. 4) | 56.8 | 74 | 26.4 |
| 2.36 (No. 8) | 72.9 | 66 | 33.9 |
| 1.18 mm. (No. 16) | 87.1 | 60 | 40.5 |
| 0.60 (No. 30) | 107.4 | 50 | 49.9 |
| 0.30 (No. 50) | 145.3 | 33 | 67.5 |
| 0.15 (No. 100) | 169.6 | 21 | 78.8 |
| 0.075 (No. 200) | 183.1 | 15 | 85.1 |




Maximum Particle Size -1.5 in. Liquid Limit _____ Plasticity Index _____ Moisture Content 4.3

This report covers laboratory procedures in accordance with ASTM D 2487, D 2217, D422, D423, D424 & D2216.

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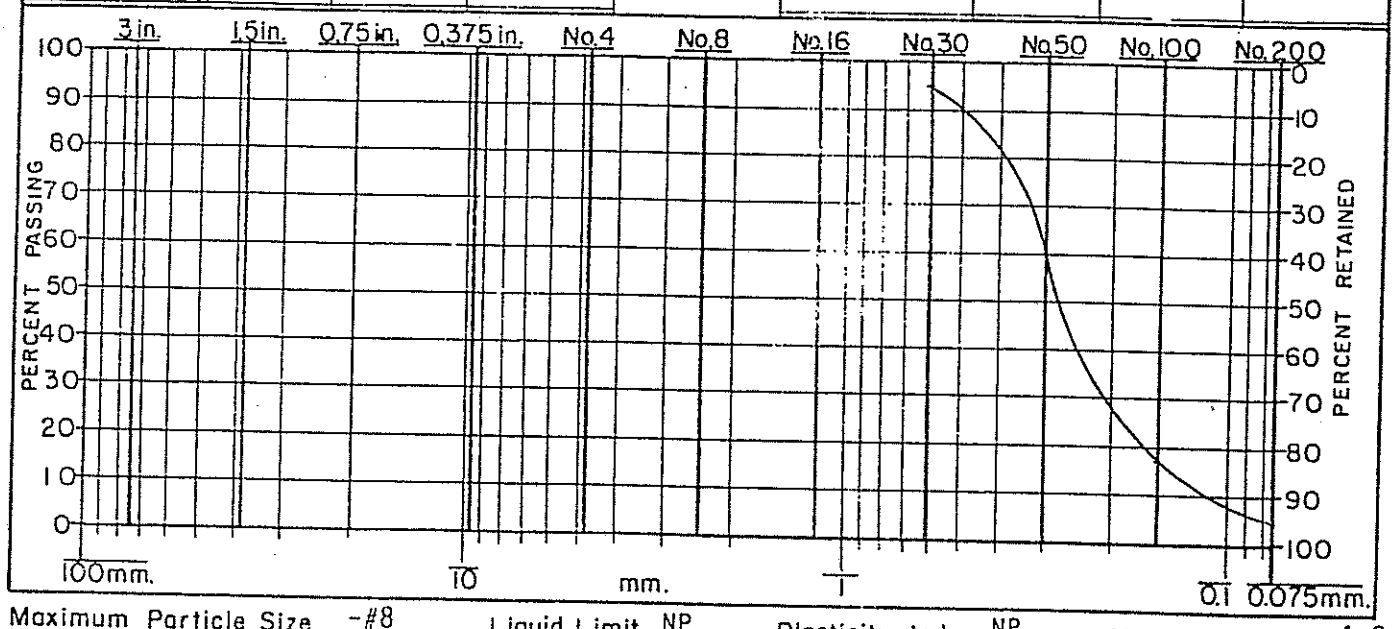
PROJECT Northeast Landfill

REPORT OF TEST ON SAND, poorly graded

RECEIVED FROM Boring Number 5 at 30 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75 ) | | | |
| 9.5 (0.375) | | | |
| 4.75 (No. 4) | | | |
| 2.36 (No. 8) | | | |
| 1.18mm. (No.16) | 1.2 | 100 | .4 |
| 0.60 (No.30) | 15.0 | 95 | 5.2 |
| 0.30 (No.50) | 114.8 | 60 | 40.5 |
| 0.15 (No.100) | 234.4 | 17 | 82.7 |
| 0.075 (No.200) | 272.0 | 4 | 96.0 |




Maximum Particle Size -#8 Liquid Limit NP Plasticity Index NP Moisture Content 1.9

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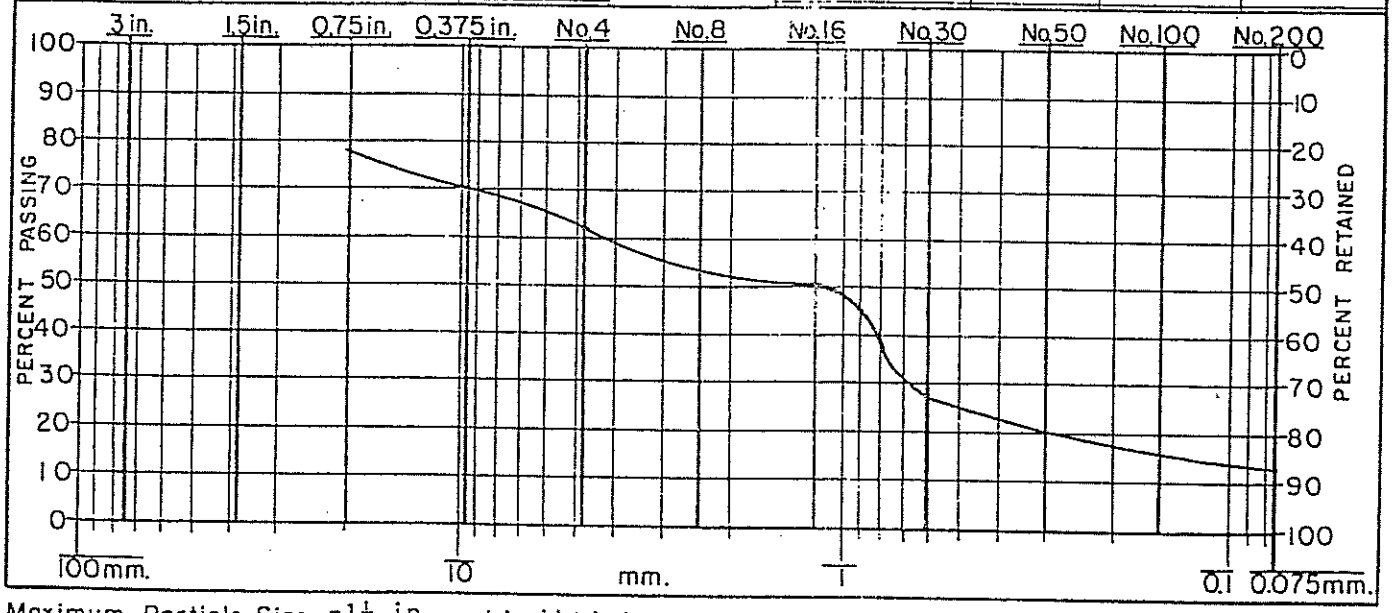
PROJECT Northeast Landfill

REPORT OF TEST ON SAND, silty

RECEIVED FROM Boring Number 5 at 40 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | 39.4 | 78 | 21.7 |
| 9.5 (0.375) | 54.0 | 70 | 29.8 |
| 4.75 (No. 4) | 69.0 | 62 | 38.1 |
| 2.36 (No.8) | 85.7 | 53 | 47.3 |
| 1.18 mm. (No.16) | 88.1 | 51 | 48.6 |
| 0.60 (No.30) | 132.9 | 27 | 73.4 |
| 0.30 (No.50) | 145.5 | 20 | 80.3 |
| 0.15 (No.100) | 152.7 | 16 | 84.3 |
| 0.075 (No.200) | 157.3 | 13 | 86.9 |




Maximum Particle Size -1½ in. Liquid Limit _____ Plasticity Index _____ Moisture Content 4.6

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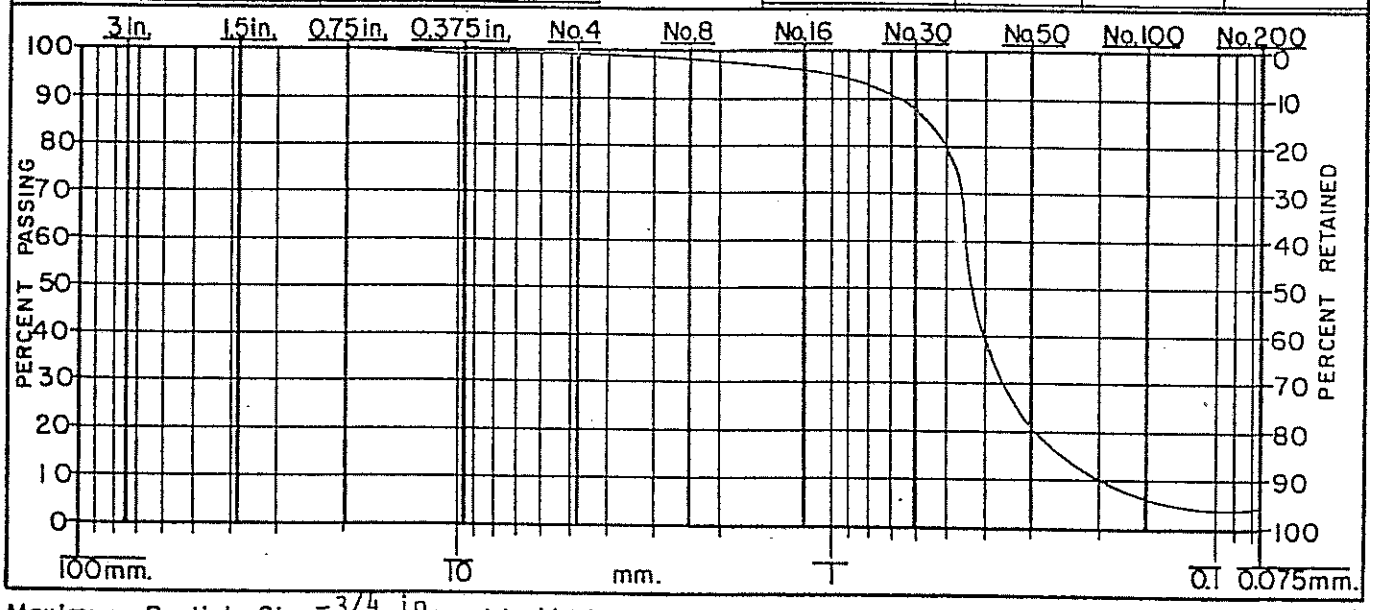
PROJECT Northeast Landfill

REPORT OF TEST ON SAND, poorly graded

RECEIVED FROM Boring Number 6 at 5 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75 ) | | | |
| 9.5 (0.375) | 7.0 | 98.8 | 1.2 |
| 4.75 (No. 4) | 11.8 | 98.1 | 1.9 |
| 2.36 (No. 8) | 13.3 | 97.8 | 2.2 |
| 1.18mm. (No.16) | 16.3 | 97.3 | 2.7 |
| 0.60 (No.30) | 73.6 | 87.9 | 12.1 |
| 0.30 (No.50) | 483.9 | 20.2 | 79.8 |
| 0.15 (No.100) | 568.5 | 6.2 | 93.9 |
| 0.075 (No.200) | 583.5 | 3.8 | 96.2 |




Maximum Particle Size 3/4 in. Liquid Limit _____ Plasticity Index _____ Moisture Content 1.8

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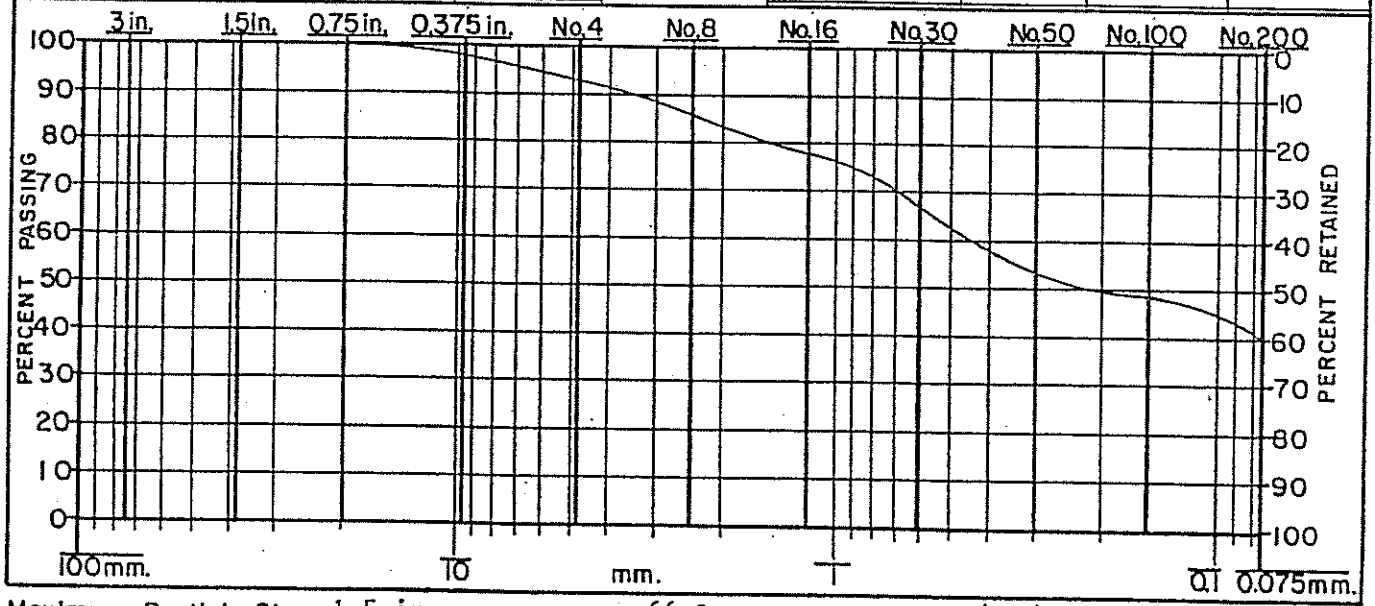
PROJECT Northeast Landfill

REPORT OF TEST ON SAND, clayey

RECEIVED FROM Boring Number 6 at 10 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | | | |
| 9.5 (0.375) | 4.2 | 98.2 | 1.8 |
| 4.75 (No. 4) | 15.7 | 93.3 | 6.7 |
| 2.36 (No.8) | 32.0 | 86.2 | 13.8 |
| 1.18mm. (No.16) | 49.9 | 78.5 | 21.5 |
| 0.60 (No.30) | 77.0 | 66.9 | 33.1 |
| 0.30 (No.50) | 109.7 | 52.8 | 47.2 |
| 0.15 (No.100) | 119.9 | 48.5 | 51.5 |
| 0.075 (No.200) | 139.3 | 40.1 | 59.9 |




Maximum Particle Size -1.5 in. Liquid Limit 66.3 Plasticity Index 49.6 Moisture Content 9.0

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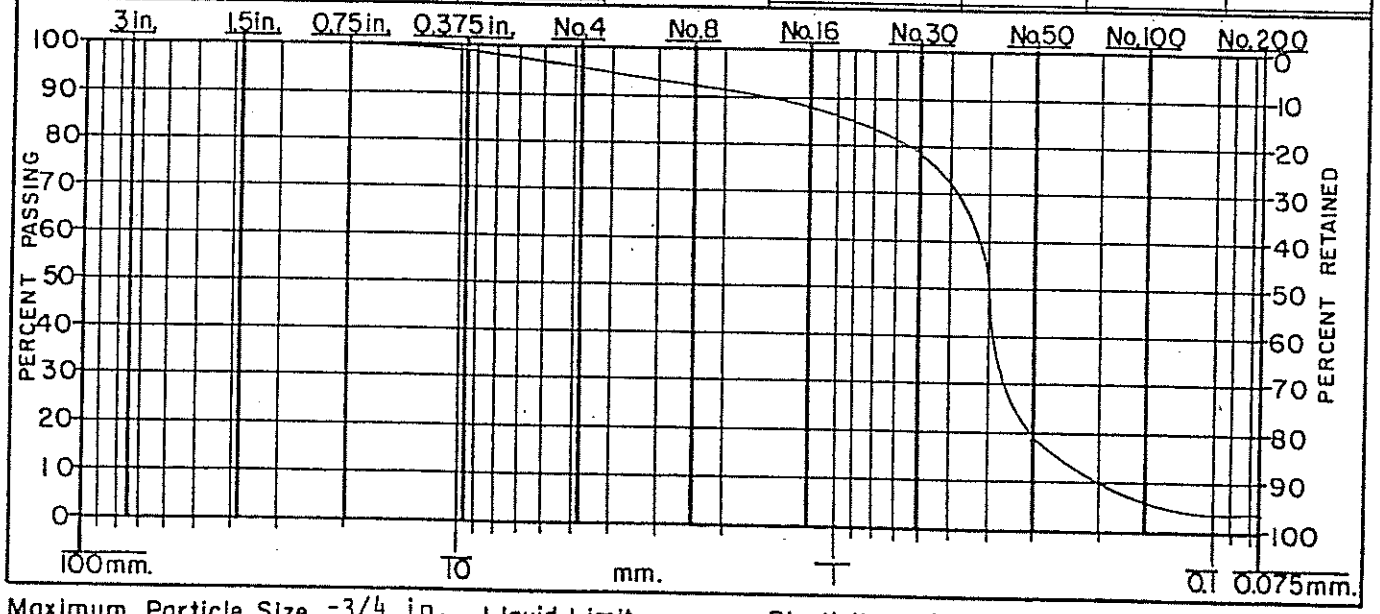
PROJECT Northeast Landfill

REPORT OF TEST ON SAND, poorly graded

RECEIVED FROM Boring Number 6 at 20 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | | | |
| 9.5 (0.375) | 7.2 | 98.8 | 1.2 |
| 4.75 (No. 4) | 24.6 | 95.8 | 4.2 |
| 2.36 (No.8) | 44.9 | 92.4 | 7.6 |
| 1.18mm. (No.16) | 74.0 | 87.4 | 12.6 |
| 0.60 (No.30) | 180.5 | 69.3 | 30.7 |
| 0.30 (No.50) | 478.8 | 18.6 | 81.4 |
| 0.15 (No.100) | 558.0 | 5.2 | 94.8 |
| 0.075 (No.200) | 573.1 | 2.6 | 97.4 |




Maximum Particle Size -3/4 in. Liquid Limit _____ Plasticity Index _____ Moisture Content 1.0

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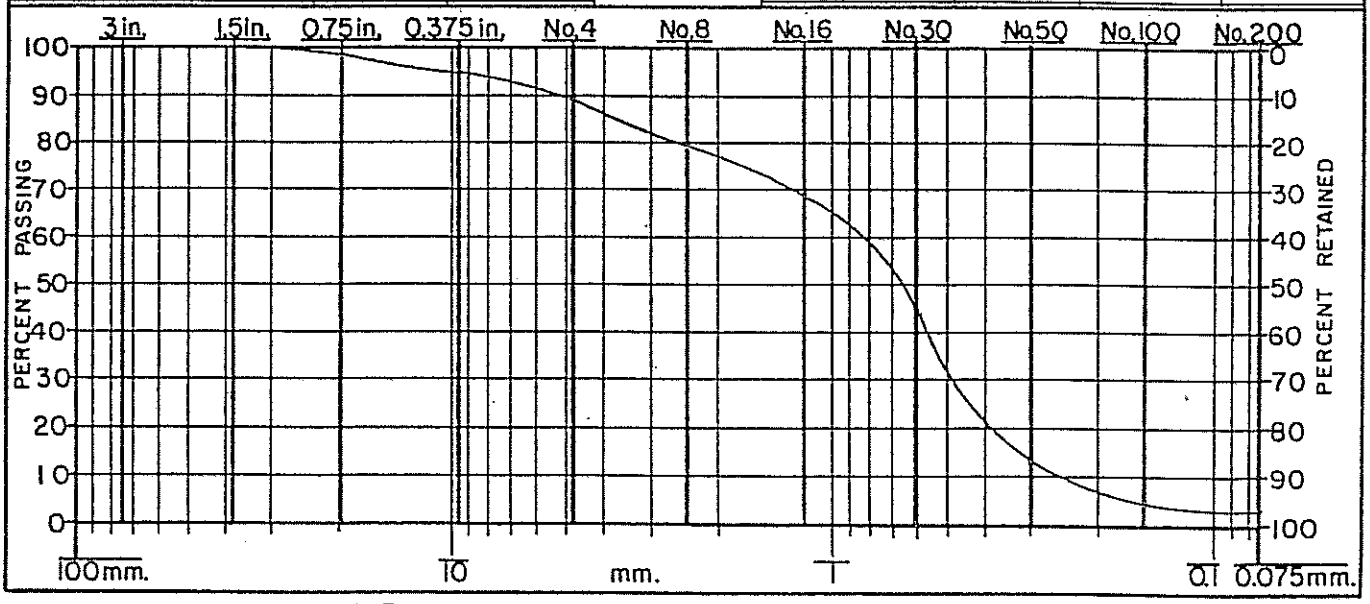
PROJECT Northeast Landfill

REPORT OF TEST ON SAND, poorly graded

RECEIVED FROM Boring Number 6 at 30 foot depht

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | 6.4 | 99.3 | 0.7 |
| 9.5 (0.375) | 44.5 | 94.9 | 5.1 |
| 4.75 (No. 4) | 98.6 | 88.8 | 11.2 |
| 2.36 (No. 8) | 178.6 | 79.6 | 20.4 |
| 1.18 mm. (No. 16) | 276.7 | 68.4 | 31.6 |
| 0.60 (No. 30) | 482.8 | 44.9 | 55.1 |
| 0.30 (No. 50) | 762.0 | 13.1 | 86.9 |
| 0.15 (No. 100) | 838.1 | 4.4 | 95.6 |
| 0.075 (No. 200) | 853.4 | 2.7 | 97.3 |




Maximum Particle Size -1.5 Liquid Limit _____ Plasticity Index _____ Moisture Content 2.3

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PROJECT Northeast Landfill

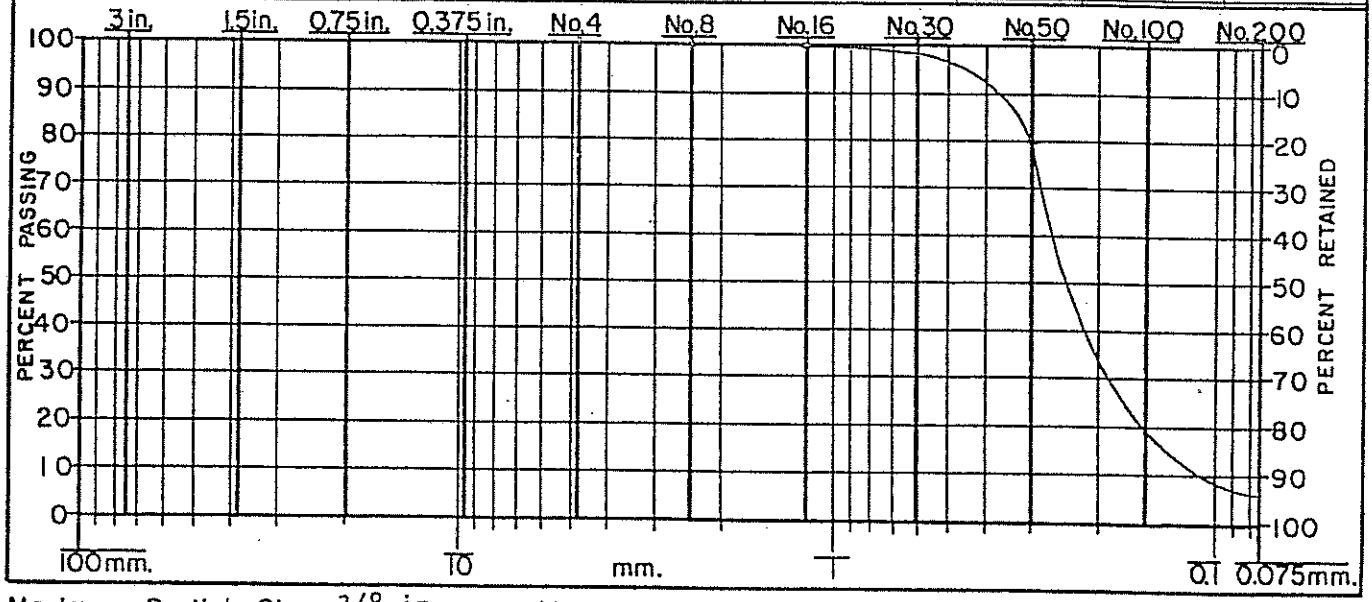
REPORT OF TEST ON SAND, poorly graded, SAND, silty

RECEIVED FROM Boring Number 7 at 5 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | | | |
| 9.5 (0.375) | | | |
| 4.75 (No. 4) | | | |
| 2.36 (No. 8) | 0.1 | 99.99 | 0.01 |

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 1.18 mm. (No.16) | 0.6 | 99.9 | 0.1 |
| 0.60 (No.30) | 14.5 | 98.1 | 1.9 |
| 0.30 (No.50) | 157.8 | 79.8 | 20.2 |
| 0.15 (No.100) | 636.6 | 18.4 | 81.6 |
| 0.075 (No.200) | 737.3 | 5.5 | 94.5 |




Maximum Particle Size -3/8 in. Liquid Limit _____ Plasticity Index _____ Moisture Content 3.5

This report covers laboratory procedures in accordance with ASTM D 2487, D 2217, D422, D423, D424 & D2216.

REMARKS:

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FILE NO 82182

CERTIFIED BY

Danny
R
Anderson, Consultants

GEOTECHNICAL ENGINEERS
2525 EAST YANDELL DR
EL PASO, TEXAS 79903
(915) 532-7566

DATE

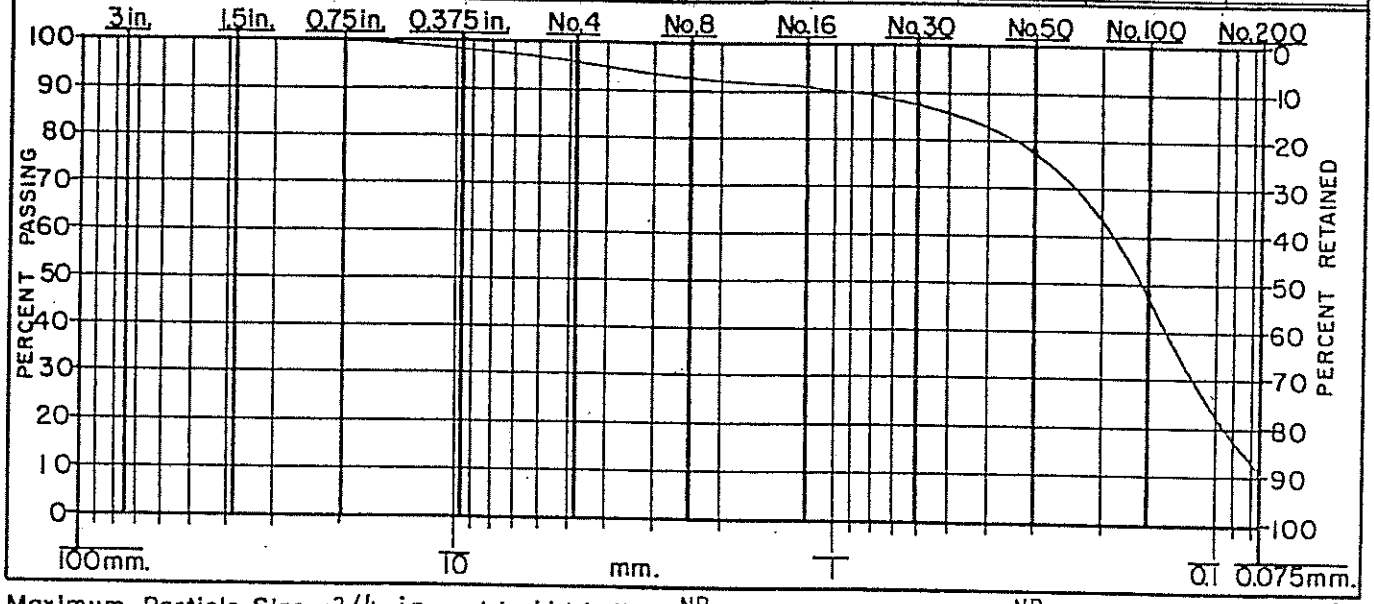
PROJECT Northeast Landfill

REPORT OF TEST ON SAND, poorly graded, SAND, silty

RECEIVED FROM Boring Number 7 at 20 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | | | |
| 9.5 (0.375) | 7.1 | 98.0 | 2.0 |
| 4.75 (No. 4) | 14.8 | 95.8 | 4.2 |
| 2.36 (No. 8) | 23.4 | 93.3 | 6.7 |
| 1.18 mm. (No. 16) | 31.1 | 91.1 | 8.9 |
| 0.60 (No. 30) | 42.2 | 87.9 | 12.1 |
| 0.30 (No. 50) | 77.7 | 77.7 | 22.3 |
| 0.15 (No. 100) | 180.1 | 48.3 | 51.7 |
| 0.075 (No. 200) | 311.5 | 10.6 | 89.4 |




Maximum Particle Size -3/4 in. Liquid Limit NP Plasticity Index NP Moisture Content 6.5

This report covers laboratory procedures in accordance with ASTM D 2487, D 2217, D 422, D 423, D 424 & D 2216.

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DATE

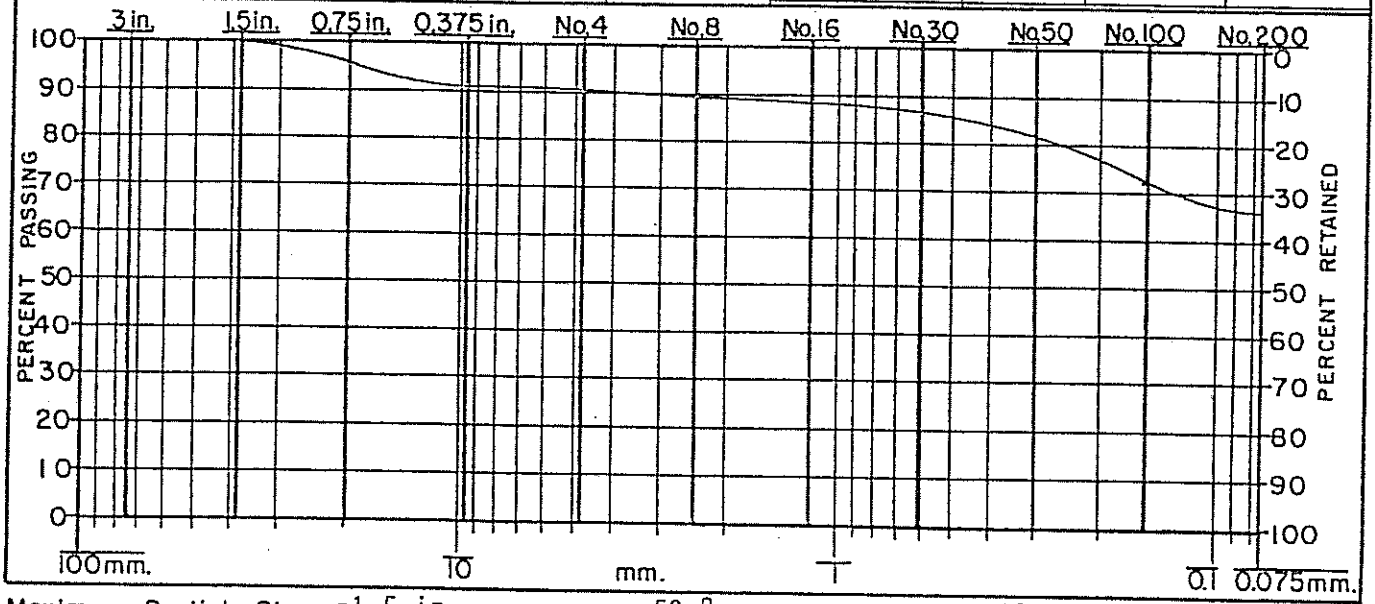
PROJECT Northeast Landfill

REPORT OF TEST ON CLAY, high plasticity

RECEIVED FROM Boring Number 7 at 30 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | 18.1 | 94.9 | 5.1 |
| 9.5 (0.375) | 31.4 | 91.2 | 8.8 |
| 4.75 (No. 4) | 33.3 | 90.7 | 9.3 |
| 2.36 (No.8) | 38.9 | 89.1 | 10.9 |
| 1.18mm. (No.16) | 42.3 | 88.2 | 11.8 |
| 0.60 (No.30) | 46.7 | 86.9 | 13.1 |
| 0.30 (No.50) | 63.7 | 82.2 | 17.8 |
| 0.15 (No.100) | 100.9 | 71.8 | 28.2 |
| 0.075 (No.200) | 122.6 | 65.7 | 34.3 |




Maximum Particle Size -1.5 in. Liquid Limit 52.8 Plasticity Index 32.7 Moisture Content 19.0

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R
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2525 EAST YANDELL DR
EL PASO, TEXAS 79903
(915) 532-7566

DATE

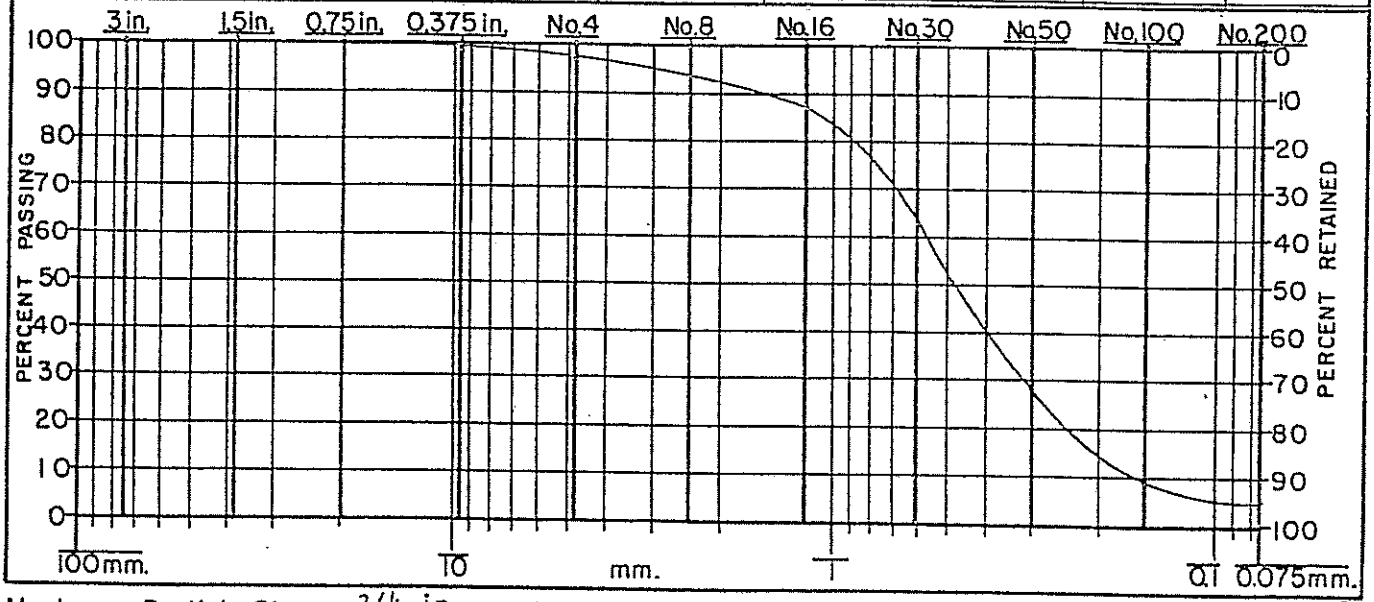
PROJECT Northeast Landfill

REPORT OF TEST ON SAND, poorly graded

RECEIVED FROM Boring Number 7 at 40 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | | | |
| 9.5 (0.375) | 10.2 | 98.4 | 1.6 |
| 4.75 (No. 4) | 19.3 | 97.0 | 3.0 |
| 2.36 (No. 8) | 40.2 | 93.7 | 6.3 |
| 1.18 mm. (No. 16) | 81.7 | 87.1 | 12.9 |
| 0.60 (No. 30) | 236.4 | 62.7 | 37.3 |
| 0.30 (No. 50) | 455.8 | 28.0 | 72.0 |
| 0.15 (No. 100) | 575.6 | 9.1 | 90.9 |
| 0.075 (No. 200) | 606.7 | 4.2 | 95.8 |




Maximum Particle Size -3/4 in. Liquid Limit _____ Plasticity Index _____ Moisture Content 2.0

This report covers laboratory procedures in accordance with ASTM D 2487, D 2217, D422, D423, D424 & D2216.

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EL PASO, TEXAS 79903
(915) 532-7566

DATE

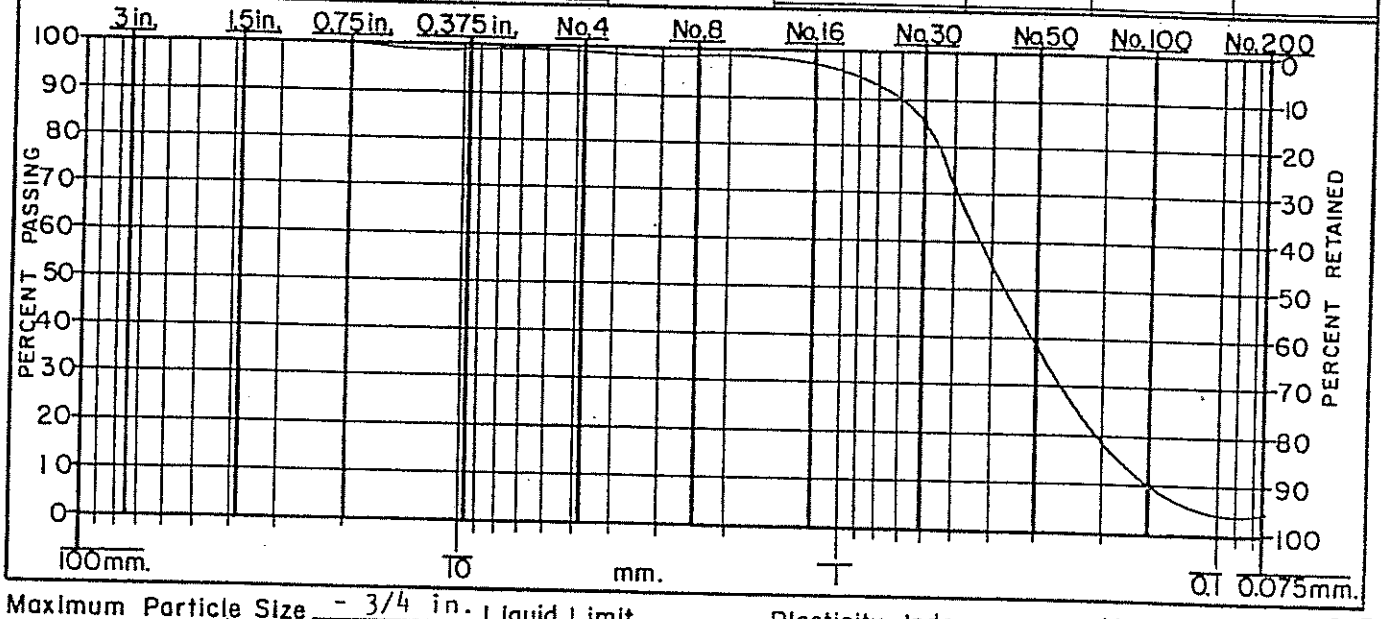
PROJECT Northeast Landfill

REPORT OF TEST ON SAND, poorly graded

RECEIVED FROM Boring Number 8 at 5 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5) | | | |
| 19.0 (0.75) | | | |
| 9.5 (0.375) | 5.0 | 99.4 | 0.6 |
| 4.75 (No. 4) | 10.1 | 98.8 | 1.2 |
| 2.36 (No. 8) | 14.8 | 98.3 | 1.7 |
| 1.18 mm. (No. 16) | 16.9 | 98.0 | 2.0 |
| 0.60 (No. 30) | 132.2 | 84.6 | 15.4 |
| 0.30 (No. 50) | 532.3 | 38.2 | 61.8 |
| 0.15 (No. 100) | 774.9 | 10.0 | 90.0 |
| 0.075 (No. 200) | 829.0 | 3.7 | 96.3 |




Maximum Particle Size - 3/4 in. Liquid Limit _____ Plasticity Index _____ Moisture Content 2.7

This report covers laboratory procedures in accordance with ASTM D 2487, D 2217, D422, D423, D424 & D2216.

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EL PASO, TEXAS 79903
(915) 532-7566

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PROJECT Northeast Landfill

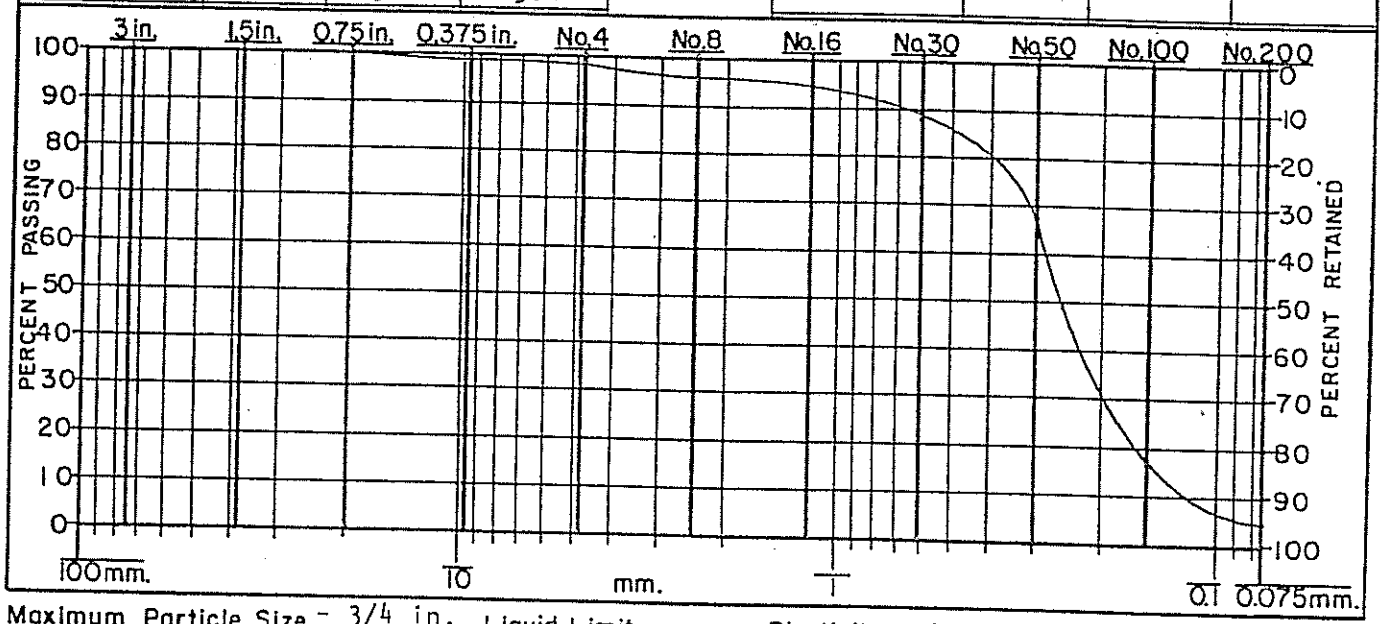
REPORT OF TEST ON SAND, poorly graded

RECEIVED FROM Boring Number 8 at 10 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | | | |
| 9.5 (0.375) | 5.7 | 99.2 | 0.8 |
| 4.75 (No. 4) | 12.9 | 98.3 | 1.7 |
| 2.36 (No. 8) | 25.0 | 96.6 | 3.4 |

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 1.18 mm. (No. 16) | 41.0 | 94.5 | 5.5 |
| 0.60 (No. 30) | 85.2 | 88.5 | 11.5 |
| 0.30 (No. 50) | 241.5 | 67.3 | 32.7 |
| 0.15 (No. 100) | 618.9 | 16.7 | 83.7 |
| 0.075 (No. 200) | 711.8 | 3.7 | 96.3 |




Maximum Particle Size - 3/4 in. Liquid Limit _____ Plasticity Index _____ Moisture Content 5.5

This report covers laboratory procedures in accordance with ASTM D 2487, D 2217, D422, D423, D424 & D2216.

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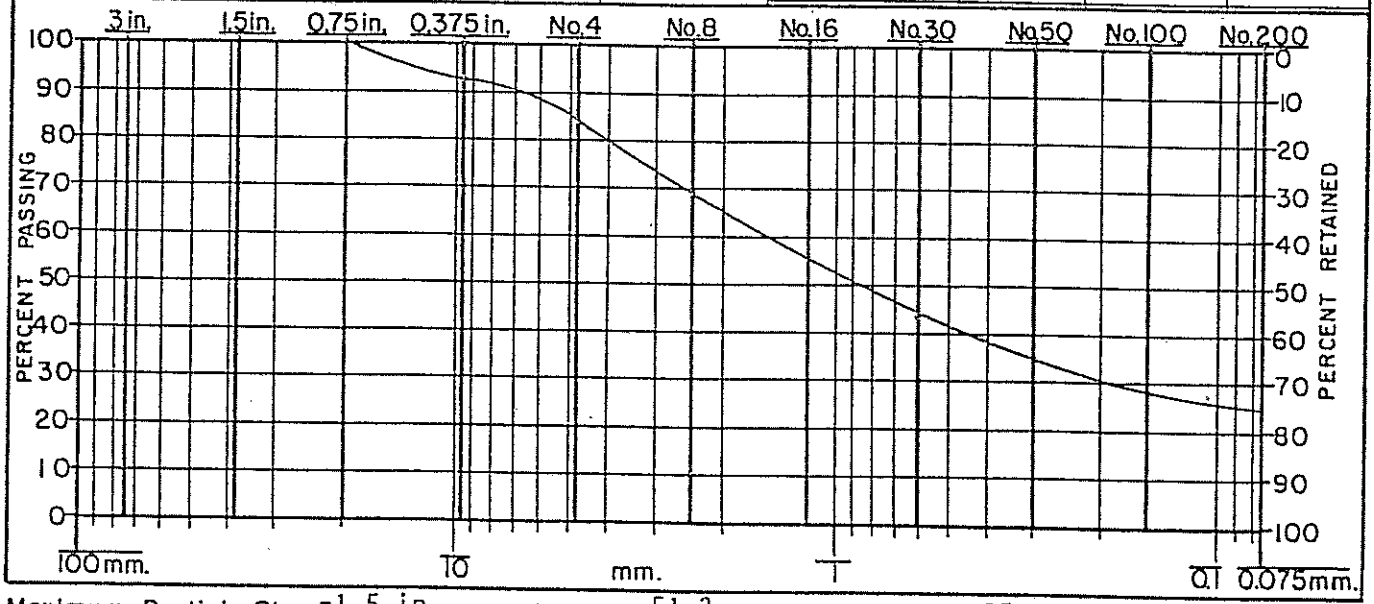
PROJECT Northeast Landfill

REPORT OF TEST ON SAND, clayey

RECEIVED FROM Boring Number 8 at 20 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | | | |
| 9.5 (0.375) | 21.7 | 92.8 | 7.2 |
| 4.75 (No. 4) | 50.6 | 83.3 | 16.7 |
| 2.36 (No.8) | 96.2 | 68.2 | 31.8 |
| 1.18 mm. (No.16) | 136.4 | 54.9 | 45.1 |
| 0.60 (No.30) | 173.0 | 42.8 | 57.2 |
| 0.30 (No.50) | 197.2 | 34.8 | 65.2 |
| 0.15 (No.100) | 218.1 | 27.9 | 72.1 |
| 0.075 (No.200) | 231.1 | 23.6 | 76.4 |




Maximum Particle Size -1.5 in. Liquid Limit 51.2 Plasticity Index 35.0 Moisture Content 9.7

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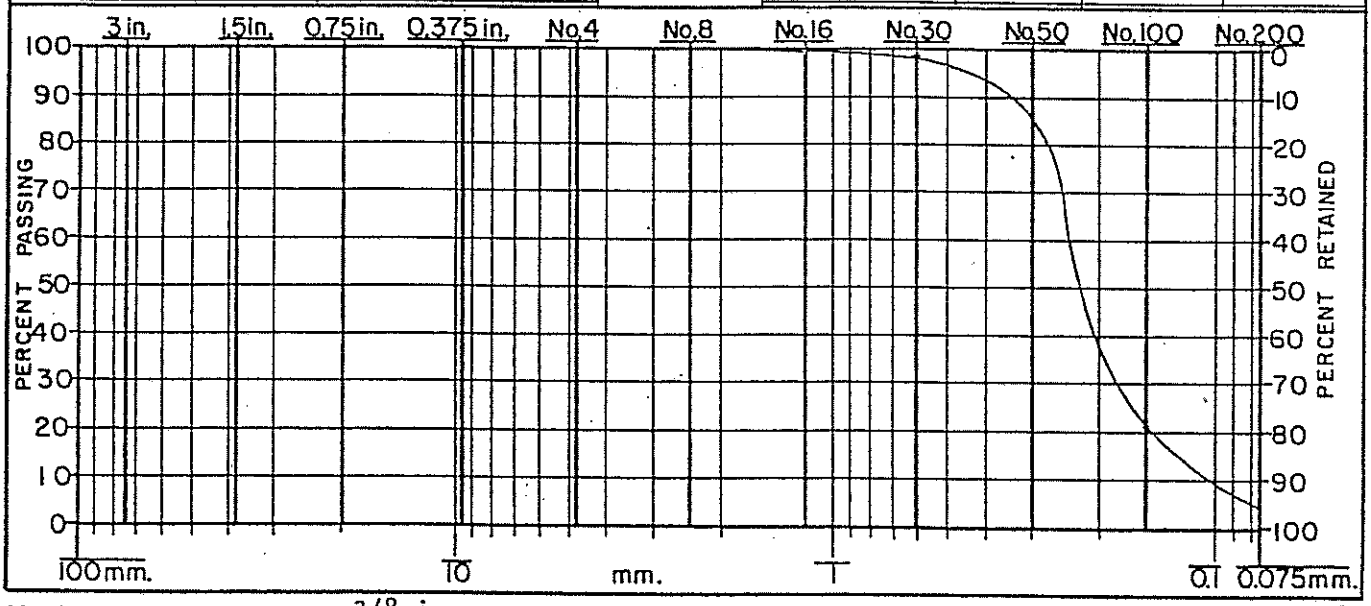
PROJECT Northeast Landfill

REPORT OF TEST ON SAND, poorly graded

RECEIVED FROM Boring Number 8 at 30 foot depth

## REPORT OF PARTICLE SIZE ANALYSIS

| SIEVE SIZE | CUM. WT. RETAINED | PERCENT PASSING | PERCENT RETAINED |
|---|---|---|---|
| 75 mm. (3 in.) | | | |
| 38.1 (1.5 ) | | | |
| 19.0 (0.75) | | | |
| 9.5 (0.375) | | | |
| 4.75 (No. 4) | 0.3 | 99.96 | 0.04 |
| 2.36 (No.8) | 1.3 | 99.8 | 0.2 |
| 1.18 mm. (No.16) | 3.1 | 99.6 | 0.4 |
| 0.60 (No.30) | 11.6 | 98.5 | 1.5 |
| 0.30 (No.50) | 107.4 | 86.0 | 14.0 |
| 0.15 (No.100) | 603.3 | 21.4 | 78.6 |
| 0.075 (No.200) | 738.8 | 3.8 | 96.2 |




Maximum Particle Size -3/8 in. Liquid Limit _____ Plasticity Index _____ Moisture Content 5.0

This report covers laboratory procedures in accordance with ASTM D 2487, D 2217, D422, D423, D424 & D2216.

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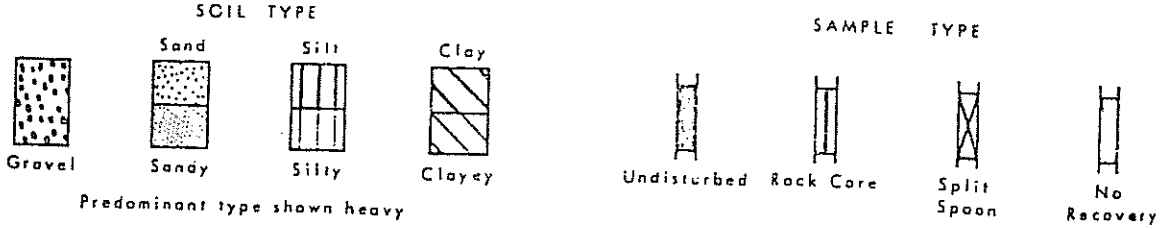
EL PASO, TEXAS 79903
(915) 532-7566

# KEY TO SOIL CLASSIFICATIONS AND SYMBOLS




## TERMS DESCRIBING CONSISTENCY OR CONDITION

### COARSE GRAINED SOILS
(Major portion retained on No. 200 sieve)

Includes (1) clean gravels and sands described as fine, medium or coarse, depending on distribution of grain sizes and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests or estimated from resistance to sampler.

| Penetration Resistance Blows/Foot ** | Descriptive Term | Relative Density * |
|---|---|---|
| 0 - 10 | Loose | 0 to 40% |
| 10 - 30 | Medium dense | 40 to 70% |
| 30 - 50 | Dense | 70 to 90% |
| Over 50 | Very dense | 90 to 100% |

* From tests on undisturbed sand sample
** 140# hammer, 30-inch drop

### FINE GRAINED SOILS
(Major portion passing No. 200 sieve)

Includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

| Descriptive Term | Compressive Strength Tons/Sq. Ft. |
|---|---|
| Very soft | less than 0.25 |
| Soft | 0.25 to 0.50 |
| Firm | 0.50 to 1.00 |
| Stiff | 1.00 to 2.00 |
| Very stiff | 2.00 to 4.00 |
| Hard | 4.00 and higher |

Note: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or shrinkage cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

## TERMS CHARACTERIZING SOIL STRUCTURE

Slickensided - having inclined planes of weakness that are slick and glossy in appearance

Fissured - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical

Sensitive - pertaining to cohesive soils that are subject to appreciable loss of strength when remolded

Laminated - composed of thin layers of varying color and texture

Interbedded - composed of alternate layers of different soil types

Calcareous - containing appreciable quantities of calcium carbonate

Well graded - having wide range in grain sizes and substantial amounts of all intermediate particle sizes

Poorly graded - predominantly of one grain size, or having a range of sizes with some intermediate size missing

November 17, 1982

TO WHOM IT MAY CONCERN:

The Eastern Boundary Fault Zone (EBFZ) in the vicinity of the proposed landfill site in northeast El Paso has not surface expression, having been covered by recent piedmont slope deposits and relict landslide blocks. Seismic and gravity profiles across the Hueco Bolson by Matticle (1967) indicate a drop of 25° eastward. Between 20,000 and 25,000 feet of throw would had to have occurred along this fault to account for displacement of strata between the Franklin Mountains and top of the Hueco Formation.

Thus, 400 feet of throw has occurred in the last 1 to 2.5 million years, decreasing in rate. No movement along the EPFZ has been documented since settlement in the El Paso area. For further reference, I would call your attention to the following publications:


Lovejoy, E.M.P., 1975a, An Interpretation of the Structural Geology of the Franklin Mountains, Texas. In: New Mexico Geological Society Guidebook, 26th Field Conference, Las Cruces Country, pp. 261-268.

Lovejoy, E.M.P., 1975b, Cenozoic Tectonics of the El Paso, Texas Region. In: Transactions of the Joint Meeting, Southwest Section of the American Association of Petroleum Geologist and Permian Basin Section of Society of Economic Paleontologists and Mineralogists, Exploration from the Mountains to the Basin, pp. 95-100.

Mattick, Robert E., 1976, A Seismic and Gravity Profile Across the Hueco Bolson, Texas: U.S. Geological Survey Prof. Pag. 575-D, p. D85-D91.

Sayne, A.N., and Livingston, P., 1945, Groundwater Resources of the El Paso Area, Texas. U.S. Geological Survey, Water Supply Paper 919, 140 pp.

If you have any further questions, please feel free to contact me at the Department of Geological Sciences, University of Texas at El Paso, El Paso, Texas 79968 (Phone 915-747-5842).

Sincerely,

Dr. Richard A. Marston

# Appendix 3K – Attachment 4
# Location Restrictions

SAIC®

## Memorandum

To: TCEQ

From: Randall J. Sippel, P.G., SAIC

Subject: Appendix 3K, Attachment 4 – Location Restrictions

Date: March 15, 2013

SAIC Energy, Environment & Infrastructure, LLC (SAIC) has included the site locational restrictions completed by SHB AGRA June 7, 1994 for informational purposes related to previous site characteristics and previous permitting of the facility. Site locational restrictions have been updated to comply with 30 TAC §330, Subchapter M (as they apply to vertical expansions). Information located within this Major Permit Amendment are summarized below:

- 30 TAC §330.543 - Easements and Buffer Zones
  - In accordance to 30 TAC §330.543(a), no solid waste unloading, storage, disposal, or processing operations will occur within any easement, buffer zone, or right-of-way that crosses the facility. The easements are identified on Drawing P2-7 and are discussed in further detail in Section 4.9.6 (text provided for reference below).
  - In accordance to 30 TAC §330.543(b)(2)(B)(D), the vertical expansion utilized a 125-foot buffer zone for the newly permitted airspace. Discussion is provided in Section 4.9.6 (text provided for reference below).

### "4.9.6 Easements and Buffer Zones

A 300-ft wide easement, owned by the El Paso Electric Company, is located adjacent and along the northern portion of the Landfill site. The easement is located outside of the permitted Landfill boundary. Contact information for the easement is:

El Paso Electric Company
P.O. Box 982
El Paso, TX 79960
(915) 543-4025 during work hours
(915) 543-5720 or (915) 543-6464 Emergency and after hours

The quarry operation is currently within the permitted Landfill boundary, but will move to the south and then to the adjacent eastern property upon development of future Landfill sectors. The quarry is currently using a 10-ft wide recorded easement, owned by the El Paso Electric Company, which is located north and within the permitted Landfill boundary, for delivery of power. This easement will be abandoned prior to the development of Landfill Sector C. The quarry is also currently using a telephone line located south of the Landfill running in a northern direction along the



SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI

proposed Landfill sectors. This telephone line will be removed prior to the development of Landfill Sectors E, F, and G. There is no recorded easement for the existing telephone line.

No solid waste unloading, storage, disposal, or processing operations will occur within any easement, buffer zone, or right-of-way that crosses the site. No solid waste disposal will occur within 25 feet of the center line of any utility line or pipeline easement, unless otherwise authorized by the executive director. All pipeline and utility easements will be clearly marked with posts which extend at least six feet above ground level, spaced at intervals no greater than 300 feet.

The buffer zones may vary around the perimeter of the site, but in no case will they be less than 50 feet for previously permitted waste boundaries. For the proposed vertical expansion of the Landfill, the buffer zone is 125-feet from the Landfill boundary in accordance with 30 TAC §330.543(b)(2)(B). All buffer zones, as depicted in the site design, will be clearly marked as specified in Section 4.9.7. Perimeter roads, which provide space for the safe passage and movement of operations and emergency fire fighting and other vehicles, are located within the buffer zone area. Drainage structures, berms, and landscaping as necessary for visual screening are also located in the buffer zone area."

- 30 TAC §330.545 - Airport Safety
  - Airport safety is addressed in Section 2.5.2 (text provided for reference below).

## "2.5.2 Airport Safety

Pursuant to 30 TAC §330.61(i)(5), an evaluation of the facility was completed in accordance with 30 TAC §330.545 (a). The identified airports within the general vicinity of the Landfill are provided in Appendix 2A – Maps. The Biggs Army Airfield was identified as being located approximately 9 miles from the Landfill and the El Paso International Airport was identified as being located approximately 11 miles from the Landfill. Additionally, correspondence was submitted to the Federal Aviation Administration to ensure that the Landfill is not:

1. Located within 10,000 feet of any airport runway end used by turbojet aircraft;
2. Within 5,000 feet of any airport runway end used by only piston-type aircraft;
3. Within a six mile radius of any small general service airport runway end used by turbojet or piston-type aircraft; or



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1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI

4. Within a five mile radius of any large general public commercial airport runway end used by turbojet or piston-type aircraft.

Documentation of this correspondence is also provided in Appendix 2C."

- 30 TAC §330.547 - Floodplains
  - Floodplains are addressed in Section 2.9.1 (text provided below for reference).

## "2.9.1 Floodplains

According to 40 CFR §258.11**,** 30 TAC §330.307 and §330.547, "owners or operators of new MSWLF units, existing MSWLF units, and lateral expansions located in 100-year floodplains must demonstrate that the unit will not restrict the flow of the 100-year flood, reduce the temporary water storage capacity of the floodplain, or results in washout of solid waste so as to pose a hazard to human health and the environment."

As shown in the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) provided in Appendix 2E – Floodplains and Wetlands Documentation, a portion of the landfill is located within the 100-year floodplain. No waste disposal activities will occur in the section of the property lying within the 100-year floodplain. Instead, existing Retention Pond A has been designed to cover the area affected by the 100-year floodplain. Refer to Section 3.3 – Facility Surface Water Drainage Report for further details concerning the effects of the 100-year floodplain and the design of the stormwater detention ponds."

- 30 TAC §330.549 - Groundwater
  - Groundwater conditions at the site are described in Section 2.7.1 (text provided below for reference). However, 30 TAC §330.549 does not apply as additional groundwater evaluation is not required for the proposed vertical expansion of this facility.

## "2.7.1 Groundwater Conditions

Consistent with §330.61(k)(1), a discussion of groundwater conditions at and near the facility was prepared. Data pertaining to the hydrogeology of the area and groundwater beneath the Landfill are provided in the reports *Site Characterization and Monitoring Plan, McCombs Municipal Landfill, El Paso, Texas* (SHB-AGRA, 1993) included in Appendix 3K, Attachment 1 and *Groundwater Monitoring System Installation, City of El Paso McCombs Landfill* (Raba-Kistner, 2003) included in Appendix 3L, Attachment 1.



*SAIC Energy, Environment & Infrastructure, LLC*
*1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI*

The regional groundwater system in the area primarily consists of the Hueco Bolson aquifers. The Hueco Bolson is divided into the City Artesian area, the Mesa area and the Lower Valley (Leggart, 1962). The Mesa area extends north of the City Artesian area into New Mexico and east to the Hueco Mountains. The Landfill is located within the Mesa area.

Two aquifers occur in these areas: an upper aquifer in the Rio Grande alluvium and a lower aquifer in the Hueco Bolson deposits. Since no known impermeable zone of regional extent separates these aquifers, the Rio Grande alluvium and the Hueco Bolson are considered to be, at least in part, hydrologically connected in the City Artesian and Lower Valley areas (Alvared and Buckner, 1980). The Mesa area primarily consists of Hueco Bolson deposits. Historic withdrawals of groundwater since 1906 for public water supply and irrigation have caused major declines in the water levels. The average water level decline in the Hueco Bolson from 1903 to 1980 is approximately 53 feet (White, 1987).

Locally, recharge to the aquifer occurs due to mountain front infiltration of precipitation from the surface and from the injection of treated sewage into the aquifer from the Hueco Bolson Recharge Project (White and Sladek, 1990). Numerous injection wells were constructed northeast of El Paso and water from the Fred Hervey Water Treatment Plant has been injected into the aquifer by El Paso Water Utilities (EPWU) since the mid-1980s. Since 1991, EPWU has been selling water to El Paso Electric Company for use as cooling water at the Newman Plant, thus less water has been injected into the aquifer (Sperka, 1993).

Based on available information, regional groundwater flow direction in the McCombs Landfill area is to the south-southeast. Groundwater movement in the area is generally less than 1.0 feet per day (White, 1987). EPWU groundwater data indicate that the static groundwater elevation in the area is between 3,670 and 3,675 feet MSL or approximately 370 to 390 feet below ground surface (EPWU, 1993).

Groundwater conditions at the site were determined using data from three groundwater monitoring wells constructed in 2003 around the landfill as part of the approved Subtitle D groundwater monitoring system. Water levels data from December 6, 2010 indicates ground water beneath the site occur approximately 390 to 398 feet below land surface, with corresponding elevations of 3,677 to 3,686 feet AMSI. Based on groundwater level measurements at the site, groundwater flow direction is S70$^{\circ}$ East or to the east-southeast.

Parkhill, Smith & Copper (PSC) completing an additional hydrogeologic evaluation for the Landfill that included the installation of two additional monitoring wells PZ-4



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and PZ-5. Data collected from August 2011 through July 2012 indicate groundwater flow direction is predominately to the east/southeast, likely influenced by the drawdown from the Cemex well located near the southeast corner of the landfill and just north of Stan Roberts Road. The PSC report also notes a northwest component of groundwater flow in the southwest portion of the site.

The site-specific groundwater flow direction correlates with regional groundwater flow direction within the Hueco Bolson aquifer."

- 30 TAC §330.551 - Endangered or Threatened Species
  - Section 2.10 addresses endangered species (text is provided for reference below).

## "2.10 Endangered Species Statement

To meet the requirements of 30 TAC §330.61(n) and 30 TAC §330.551, a letter dated August 13, 1982 from the United States Fish and Wildlife Service (USFWS) has been included in Appendix 2F – Endangered Species Documentation. This letter was previously included in both the 1984 and 2002 permit amendment application submittals. Additionally, current correspondence between the Texas Parks and Wildlife Department (TPWD) and the U.S. Fish and Wildlife Service is also provided in Appendix 2F.

According to the 1982 USFWS letter, the American Peregrine Falcon may use the project site as a feeding area or pass through the area during migration. According to the information provided on the USFWS website, the American Peregrine Falcon was delisted from the federal endangered species list on August 25, 1999. However, the American Peregrine Falcon remains a State of Texas protected species. A copy of the USFWS species profile is also provided in Appendix 2F – Endangered Species Documentation.

As indicated in the USFWS letter, it is unlikely that the Landfill will have any effect on this species. However, if the American Peregrine Falcon were to be observed within the permitted landfill area, the employees will be instructed to follow the steps listed below:

1. Avoid contact with the bird;
2. Temporarily halt or move site operations to an area away from the bird's location to prevent disrupting the bird's activities while feeding or passing by the site;
3. Wait until the bird abandons the site on its own will; and
4. Resume normal site operations once the bird has taken flight.



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In addition, Landfill personnel will be trained regarding the bird's physical characteristics and appearance in order to be able to identify it at once and with certainty during operations. This training will prevent unnecessary and unwarranted disruptions of site activities due to the presence of birds that may look similar to the American Peregrine Falcon.

According to the 2012 TPWD response letter, the following species have been listed as threatened or endangered under the Endangered Species Act (ESA) and have the potential to occur in El Paso County:

- Least Tern – Listed 08/28/1985
- Northern Aplomado Falcon – Listed 02/25/1986
- Mexican Spotted Owl – Listed 03/16/1993
- Southwestern Willow Flycatcher – Listed 02/27/1995

The following are state-listed threatened species that could potentially occur in the area:

- Texas Horned Lizard
- Mountain Short-Horned Lizard

The following are state-listed species of concern that could potentially occur in the area:

- Western Burrowing Owl
- Desert Night-Blooming Cereus

Further information regarding these species, their suitable habitats, and avoidance procedures are included in Appendix 2F."

- 30 TAC §330.553 – Wetlands
  - Wetlands are addressed in Section 2.9.2 (text is provided below for reference). However, 30 TAC §330.553 does not apply as additional wetland evaluation is not required for the proposed vertical expansion of this facility.

## "2.9.2 Wetlands

According to 30 TAC §330.553, new MSW landfill units, lateral expansions, and material recovery operations from a landfill shall not be located in wetlands, unless the owner or operator makes specific demonstrations to show that the landfill will not cause environmental harm.



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Based on a 1982 map prepared by T.E. Dohl, the Landfill is not located in area designated as a wetland. This map is included in Attachment 2E – Floodplains and Wetlands Documentation."

- 30 TAC §330.555 - Fault Areas
  - Fault areas are discussed in Section 2.6.4 (text is provided below for reference). However, 30 TAC §330.555 does not apply as additional fault area evaluation is not required for the proposed vertical expansion of this facility.

## "2.6.4 Fault Areas[2]

The fault area restriction states that no new landfill units or lateral expansions can be placed within 200 feet of a fault that has experienced Holocene displacement. This restriction provides for minimal setbacks from actual fault traces since faults can result in damage to the landfill's integrity through:

- Movement along the fault causing displacement;
- Seismic activity associated with faulting resulting in seismic shaking of facility structures; and
- Seismic shaking resulting in slope failures.

The original permit states that "…an Eastern Boundary Fault Zone exists between the Franklin Mountains and the Hueco Bolson deposits" and "…assuming continuous movement this (movement of the fault) would equate to approximately 0.005 inches per year" (DRA, 1984).

Since several Quaternary faults have been identified within and at the margins of the Hueco Bolson, SHB reviewed recent published geologic mapping and literature to evaluate the proximity and age of known faults in the vicinity of the McCombs Landfill.

Numerous fault scarps of Quaternary age are preset in the Hueco Bolson near the Landfill. One inferred scarp apparently traverses the northeastern quadrant of the Landfill permit area (SHB, 1993). This fault was not identified on the geologic map prepared by Harbour (1972). Insufficient information is available to confirm or refute the presence of the fault. This fault is more than 200 feet from any existing or proposed Landfill units. Other north-south trending scarps are also apparent in the area.

The age of faulting in Hueco Bolson has been dated as less than 0.5 million years (m.y.), based on offset in the Camp Rice Formation and in soils formed on the Camp Rice formation (Seager 1980). A report by Collins and Raney (1991), indicates that



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those faults near the site displace deposits of middle Pliestocene age (approximately 200,000 to 900,000 years old). Evidence of displacement of younger deposits have not been documented either because younger sediments do not exist along the fault traces or have been covered by windblown sand. Collins and Raney (1991) point out that movement on the basin bounding the East Franklin Mountains located a few miles to the west of the landfill may be as young as Holocene. Other basin bounding faults and some of the intragraben faults (such as those near the Landfill) most recently experienced rupture during the middle to late Pliestocene. More precise dating of the faults has not been performed, however, it is apparent that the faults have recurrence intervals of more than 10,000 years; otherwise the fault traces would be more clearly defined."

- 30 TAC §330.557 - Seismic Impact Zones
  - Seismic impact zones are discussed in Section 2.6.5 (text is provided below for reference). However, 30 TAC §330.557 does not apply as additional seismic impacts zone evaluation is not required for the proposed vertical expansion of this facility.

## "2.6.5 Seismic Impact Zones[2]

The seismic impact zone restrictions (30 TAC §330.557) states that "New municipal solid waste landfill (MSWLF) units and lateral expansions shall not located in seismic impact zones, unless the owner or operator demonstrates to the Director that all containment structures, including liners, leachate collection systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth materials for the site."

Under this regulation, a seismic risk zone is considered to be an area that has a 10 percent or more probability that the maximum horizontal acceleration in lithified material, expressed as a percentage of the earth's gravitational pull (g), will not exceed 0.10g in 250 years.

This regulation pertains to new MSWLF units and lateral expansions. This permit modification is a vertical expansion of the existing permitted Landfill and no new horizontal area will be opened under this permit modification. Based on the work completed by SHB-AGRA (1994) a review of USGS Miscellaneous Field Study Map MF-2121, "Probabilistic Earthquake Acceleration and Velocity Maps for the United States and Puerto Rico", (Algermissen, et. al, 1991) was conducted. El Paso County (and the Landfill) fall outside of any designated seismic impact zone.

The map on Figure 2-1 is from the USGS website:



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http://earthquake.usgs.gov/hazards/apps/map/

Based on 2008 revised data, this map demonstrates the facility is located within a seismic impact zone and exceeds the 30 TAC §330.557 standard of 10 percent or more probability. The seismic impact zone restrictions only apply to new MSWLF units and lateral expansions. The permit modification for the Landfill is for a vertical expansion and no previously-undisturbed earth will be added to the Landfill boundary.

The acreage within the proposed facility boundary was increased for this permit amendment from 327.29 to 346.74 acres at the request of the TCEQ to reflect the existing Landfill buildings and retention ponds that were submitted and approved by the TCEQ under Permit Amendment 729A. These features included existing buildings associated with the landfill operations on property previously leased and now owned by the City of El Paso. Retention ponds within this area were designed by Moreno Cardenas, Inc. to handle runoff from existing buildings and infrastructure (Permit Amendment 729-A, December 2010) in accordance with the applicable codes in place at that time.

- 30 TAC §330.559 - Unstable areas
  - Unstable areas are addressed in Section 2.6.6 (text is provided below for reference).

## "2.6.6 Unstable Areas

Consistent with 330.61(j)(4) and 330.559, unstable areas documentation was prepared and part of the application to demonstrate that the Landfill meets the location restriction for unstable area.

TCEQ regulations require the owner or operators of new MSWLF units, existing MSWLF units and lateral expansions located in an unstable area shall demonstrate that engineering measures have been incorporated into the MSWLF unit's design to ensure that the integrity of the structural components of the MSWLF unit will not be disrupted.

An unstable area is defined by TCEQ as a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity of some or all of the landfill's structural components responsible for preventing releases from a landfill. An unstable area can exhibit poor foundation conditions, area susceptible to mass movement, and karst terrains.



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#### 2.6.6.1 Unstable Slopes

No landslide deposits in the vicinity of the Landfill are shown on any published geologic information and none have been identified during site visits (SHB-AGRA, 1994).

#### 2.6.6.2 Karst

Several thousand feet of basin filling sediments occur beneath the Landfill. No limestone or other soluble units subject to karst formation exists in the vicinity (SHB-AGRA, 1994).

#### 2.6.6.3 Subsidence

Subsidence has been documented in the El Paso metropolitan area as a result of groundwater withdrawal and subsequent decline in groundwater levels, especially in area having thick accumulations of clay in the subsurface. The Landfill is located in an area of documented groundwater withdrawal resulting in groundwater declines up to 40 feet (Ashworth 1990). No land surface subsidence has been documented in the vicinity of the Landfill (Land and Armstrong, 1985). Due to depth to groundwater, formation of large scale subsidence features is not anticipated, but cannot be precluded (SHB-AGRA, 1994)

#### 2.6.6.4 Liquefaction

Since groundwater occurs at depths of 300-400 feet below land surface, no liquefaction concerns exist (SHB-AGRA, 1994)."

- 30 TAC §330.561 - Coastal Areas is not applicable to this facility.
- 30 TAC §330.563 - Type I and IV Landfill Permit Issuance Prohibited
  - 30 TAC §330.563 does not apply to vertical expansions of landfills.

RJS



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John Hall, *Chairman*
Pam Reed, *Commissioner*
Peggy Garner, *Commissioner*
Anthony Grigsby, *Executive Director*

# TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

*Protecting Texas by Reducing and Preventing Pollution*

July 5, 1994

John D. Cordova, P.E.
City of El Paso
Two Civic Center Plaza
El Paso, Texas 79901-1196

Re: City of El Paso
McCombs Municipal Solid Waste Landfill
MSW Permit No. 729A
Location Restrictions

Dear Mr. Cordova:

On June 20, 1994, the Texas Natural Resource Conservation Commission (TNRCC) received the certification of the demonstration of the location restrictions, pursuant to 30 Texas Administrative Code Section 330 Subchapter L, for the above-referenced facility. Based on a review of the information presented and the information contained within the TNRCC Central Records files, it appears that this facility meets the requirements of the demonstration of the location restrictions.

Please place individual certifications, signed by both the preparer of the location demonstration and the site operator, this letter, and the demonstration of the location restrictions within the facility's Site Operating Record.

If you have any questions concerning this letter, please contact Susan Janek, P.E. at (512) 239-6674.

Sincerely,

Susan Janek
for Mary B. Adrian, P.E.
Manager
Permits Section
Municipal Solid Waste Division

cc: TNRCC Regional Office - El Paso

# EVALUATION OF LOCATION RESTRICTIONS

McCOMBS LANDFILL
EL PASO, TEXAS

PREPARED FOR:

CITY OF EL PASO
PUBLIC WORKS DEPARTMENT
2 CIVIC CENTER PLAZA
EL PASO, TEXAS 79901

AND

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
DIVISION OF MUNICIPAL SOLID WASTE
AUSTIN, TEXAS

SHB AGRA JOB NO. E94-4082

JUNE 7, 1994


Ravi Murthy
Project Engineer

Jamie R. Barnes, P.G.
Project Geologist

Emmett F. Irby, P.E.
Vice President

STATE OF TEXAS
Emmett Fulton Irby, Jr.
49160
REGISTERED PROFESSIONAL ENGINEER
6/7/94

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## EXECUTIVE SUMMARY

An evaluation of potential landfill restrictions associated with the McCombs Municipal Landfill was completed by SHB AGRA, Inc. This evaluation was completed to comply with EPA and TNRCC requirements set forth in 40 CFR Part 258, Subpart B and in Chapter 31 of the Texas Administration Code, Sections 330.250 (b) and Subchapter L.

To achieve project goals, the evaluation included a review of existing geotechnical, geological, topographic and hydrologic data for the site. In addition, the relative locations of airports and from the landfill were evaluated.

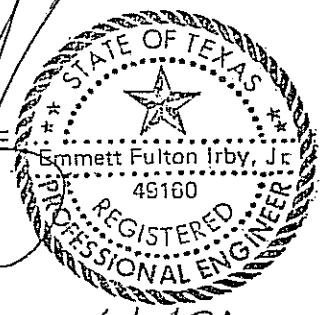
The results of our evaluation suggest the McCombs Municipal Landfill is not subject to restrictsions due to the presence of floodplains, wetlands, seismic zones or unstable areas. The site is not subject to restrictions due to the presence of nearby airports.

Several faults of Quaternary age are known in the immediate landfill vicinity. No evidence for Holocene displacement has been observed on known fault traces.

## CERTIFICATION

I, Emmett F. Irby, Jr.,P.E., do hereby certify that the documentation presented in the attached document, "Evaluation of Location Restrictions, McCombs Municipal Landfill, dated June 7, 1994, does to the best of my knowledge, accurately reflect the conditions at the landfill as they pertain to landfill location restrictions stipulated in 31 TAC 330.250(b) and in Subchapter L.

Emmett F. Irby, Jr., P.E.




6/7/94

# 1. INTRODUCTION

## 1.1 BACKGROUND

An evaluation of location restrictions for the McCombs Municipal Landfill was conducted by SHB AGRA, Inc. to comply with requirements specified by the U.S. Environmental Protection Agency (EPA) as adopted by the Texas Natural Resource Conservation Commission (TNRCC).

The EPA's Subtitle D, Part 258, Subpart B and the State of Texas' adaptation of these guidelines in 31 Texas Administrative Code (TAC) Section 330.250(b) specify an evaluation and demonstration of location restrictions to address both the potential effects that a municipal solid waste landfill (MSWLF) may have on the surrounding environment, and the effects that natural and man-made conditions may have on the performance of a landfill unit. Pursuant to these guidelines, "the owner or operator of all existing MSWLF units or lateral expansions at a facility shall submit to the Executive Director of the TNRCC for review and approval a certification of compliance with (the appropriate guidelines for) Airport Safety, Floodplain(s), and Unstable Areas."

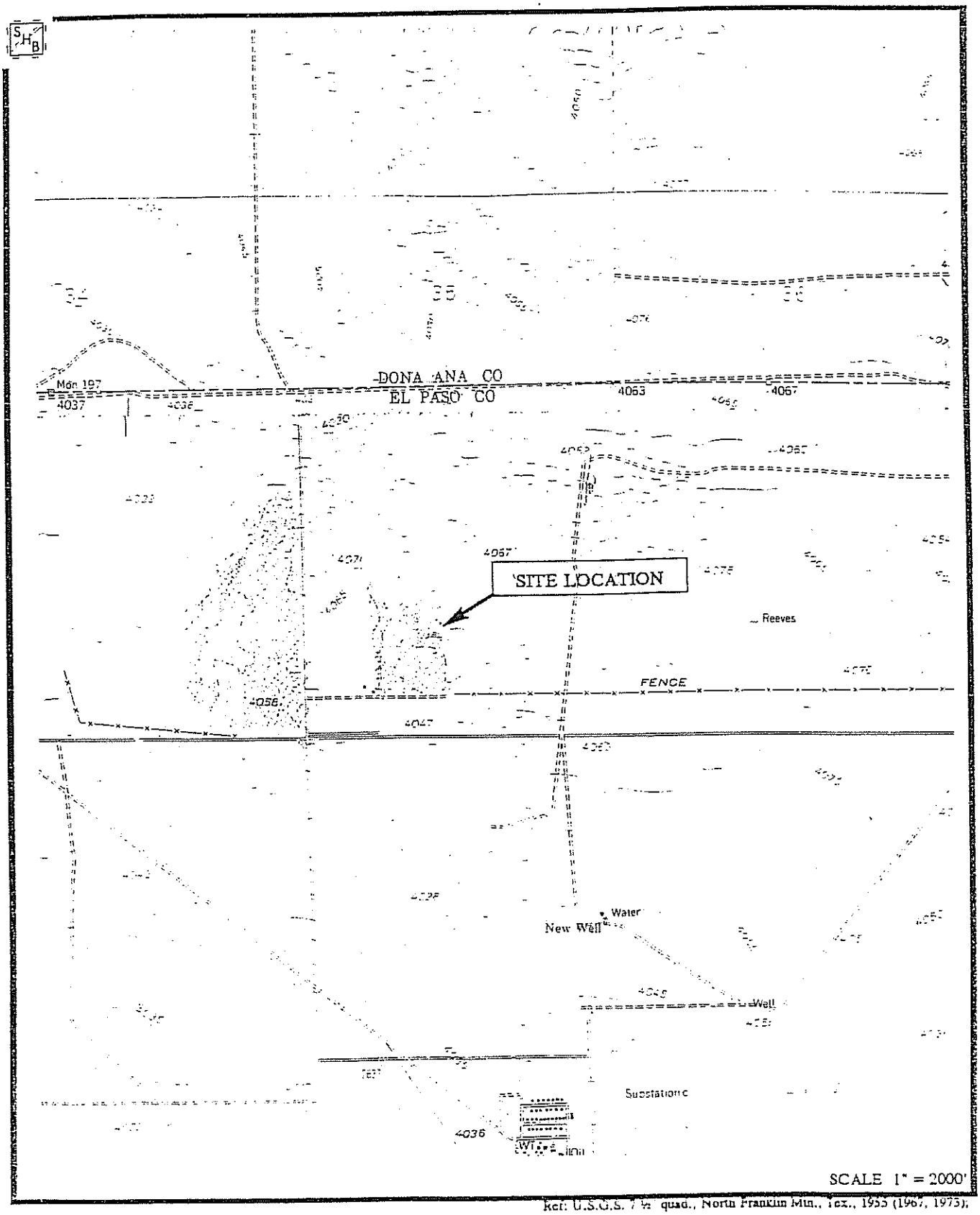
In summary these location restrictions state that existing MSWLF's within 10,000 feet of the end of any runway used by turbojet aircraft or within 5000 feet of runways used only by piston-type aircraft must demonstrate that the MSWLF does not pose a bird hazard to aircraft. Existing MSWLF's may not restrict the flow of the 100-year flood, reduce the temporary water storage capacity of the floodplain, or result in the washout of solid waste so as to pose a hazard to human health or the environment. Existing MSWLF's in unstable areas must demonstrate that the structural components of the MSWLF can withstand the impacts of events such as landslides, unstable slopes, karst areas, etc.

Existing MSWLF's that cannot establish the airport safety, floodplain or unstable area demonstrations are required to close the MSWLF by October, 1996, unless the State Director extends the deadline.

It is the intent of this document to be a modification of existing Permit No. 729A, and to be made part of the permanent permit files. A copy of this document, plus any correspondence between the City and the TNRCC, as well as final approval of the certification shall be made part of the permanent Site Operating Record of the landfill.

## 1.2 PROJECT LOCATION

The McCombs Landfill is located approximately 20 miles northeast of downtown El Paso in Section 6, Block 80, Township 1, Texas and Pacific Surveys. The landfill is situated at the northeast corner of the intersection of McCombs Road and Farm Road 2529 (see Figure 1). The landfill encompasses approximately 327 acres, although only a portion has been landfilled at present. The City owns and operates the facility. The landfill has been developed in an existing sand and gravel quarry.




Ref: U.S.G.S. 7½' quad., North Franklin Mtn., Tex., 1955 (1967, 1973).

Landfill Restrictions Evaluation
McCombs Landfill
El Paso, Texas
Job No. E94-4082

Figure 1
Site Location Map

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The McCombs Landfill was first permitted by the Texas Department of Health Resources (TDHR) as a Type I Municipal Landfill in 1976. The original permit was for a 25 acre area and for approximately 400 tons per day of municipal solid waste. In 1984, the permit was modified (Permit No. 729 A) to cover an area of approximately 327 acres.

### 1.3. REVIEW OF ORIGINAL PERMIT APPLICATION

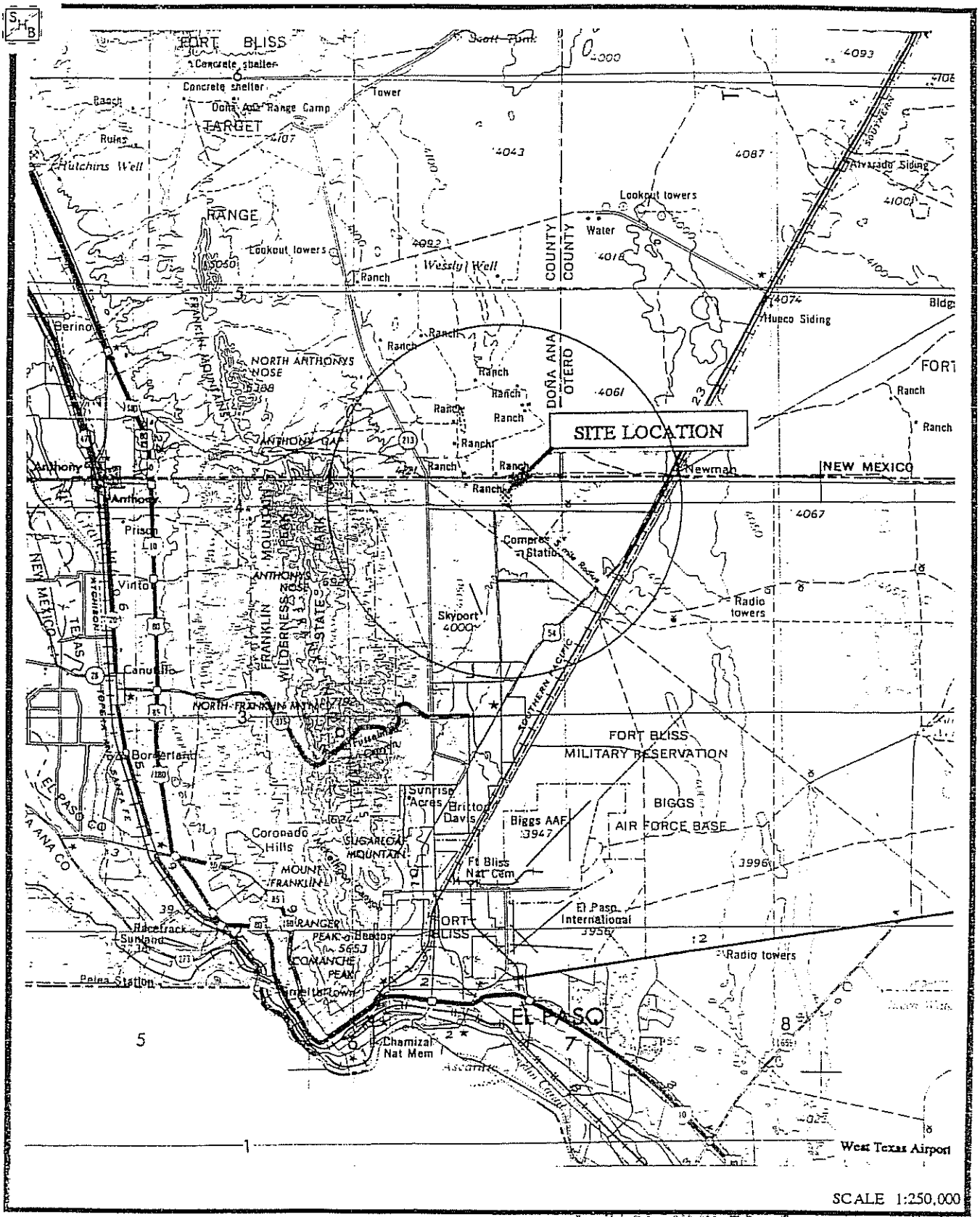
The initial permit application for the McCombs Landfill was completed by DRA on behalf of the City. The permit application addressed site characteristics, and included discussions of the types of wastes to be accepted, and presents pertinent operational and maintenance criteria. Subsurface investigations completed on site were presented in a report that was appended to the permit application.

Applicable sections of the original permit were reviewed to assist in the preparation of this document. This data was supplemented by our review of pertinent EPA and TNRCC guidance documents, publicly available documentation and maps, and a review of published literature for the site and surrounding area.

## 2. AIRPORT LOCATION RESTRICTIONS

Due to the potential for landfills to attract birds, the Federal Aviation Administration (FAA), has taken the position that when a new MSWLF unit or a lateral expansion is proposed within a 5 mile radius of any airport runway end, the owner or operator of the unit must notify both the affected airport and the FAA to allow for their review of any siting or expansion plans. In addition, MSWLF units within 10,000 feet of any airport runway used by turbojet aircraft or within 5000 feet of any airport runway used by only piston-type aircraft must demonstrate that the landfill unit does not pose a bird hazard to aircraft.

To evaluate this restriction, SHB obtained maps from both the United States Geologic Survey (USGS) and the FAA to identify any airports within 5 miles of the Landfill. No operating airports are currently known to be located within 5 miles of the McCombs Landfill. The nearest air strip to the McCombs Landfill is a private sail plane field (Skyport), more than two miles south-southwest of the landfill location. According to Mr. Antonio Borrego with the Engineering Department of the City of El Paso, this airfield is currently used for flying model aircraft. However, as a precautionary measure, this information is also being forwarded to the Aviation Division of the Department of Transportation for review. Biggs Airfield is approximately 10 miles south-southeast of the site, while the El Paso International Airport is more than 12 miles due south of the Landfill. Locations of the nearest airports with reference to the McCombs Landfill are shown in Figure 2. This information is generally consistent with that provided in the permit application for the facility. No further evaluation of bird hazards appears warranted.




Ref: U.S.G.S. 1:250,000, El Paso, Tex., New Mexico; 1959 (1973)

Location Restrictions Evaluation
McCombs Landfill
El Paso, Texas
Job No. E94-4082

Figure 2
Airport Location Map

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## 3. FLOODPLAIN RESTRICTIONS

As stated in 40 CFR section 258.11 and in 30 TAC 330.301, " owners or operators of new MSWLF units, existing MSWLF units and lateral expansions located in 100-year floodplains must demonstrate that the unit will not restrict the flow of the 100-year flood, reduce the temporary water storage capacity of the floodplain, or result in washout of solid waste so as to pose a hazard to human health and the environment."

To evaluate whether the McCombs Landfill lies within a 100-year floodplain, SHB reviewed applicable Federal Emergency Management Agency (FEMA) flood insurance rate maps (FIRMs) for the site and surrounding area. In addition, the original permit application completed for the City in 1983 was reviewed.

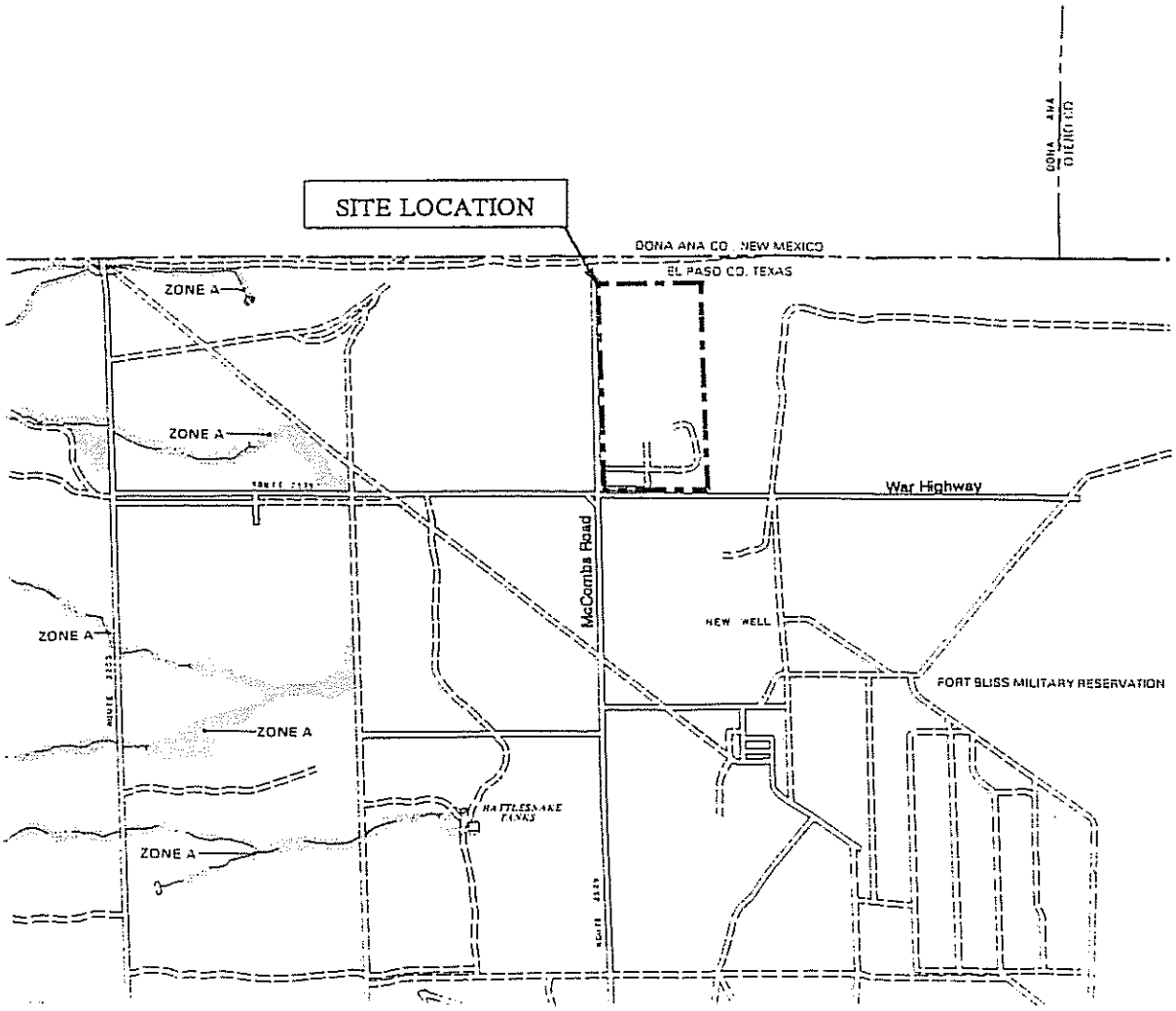
The FIRM map shown on Figure 3 indicates that the site does not lie within a designated 100-year floodplain.

## 4. WETLANDS RESTRICTIONS

Under the existing regulatory framework, new MSWLF units or lateral expansions shall not be located in wetlands. Existing MSWLF units in wetlands may continue operation if they can comply with a variety of state and federal guidelines.

A wetlands is currently defined by the U.S. Army Corps of Engineers (1987) to include a variety swamps, marshes, bogs and other inundated or saturated areas where certain hydric soils, hydrophylic vegetation and wetland hydrology criteria are met.

Based on published information (Dohl, 1982), the McCombs Landfill does not impinge and is not adjacent to a designated wetland (See Figure 4). Supporting documentation with the permit application quotes the Department of the Interior Fish and Wildlife Service as stating that two listed endangered species - the Peregrine Falcon and Sneed's Pincushion Cactus - are known to exist in El Paso County. However, neither of these two species were found within the project area.




Zone A - Special Flood Hazard Area

Approximate Scale 1" = 4000'

Location Restriction Evaluation
McCombs Landfill
El Paso, Texas
Job No. E94-4082

Ref: U.S. Dept. of H.U.D., Flood Hazard Boundary Map, July 19, 1977

Figure 3
Flood Zone Map

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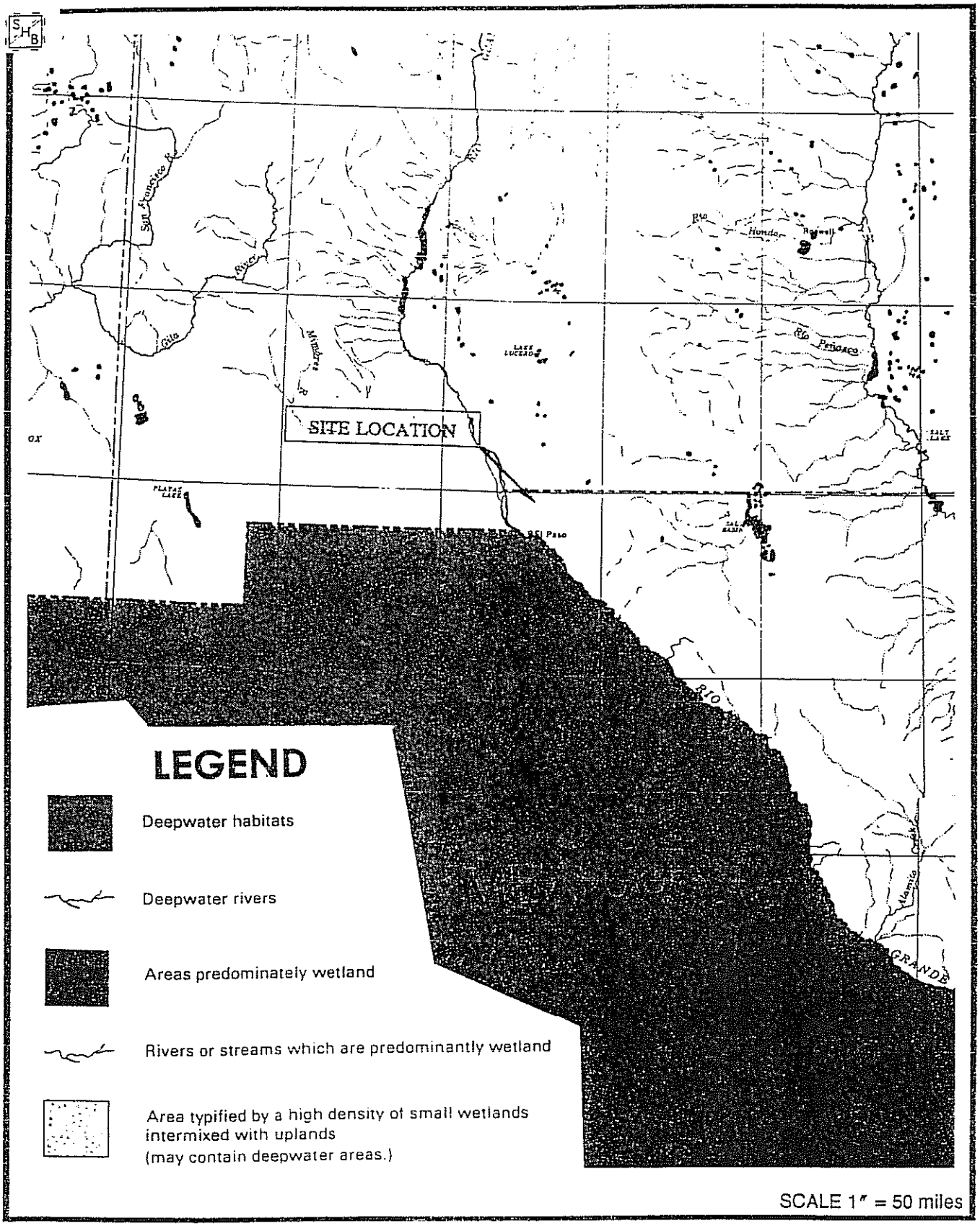


Location Restrictions Evaluation
McCombs Landfill
El Paso, Texas
Job No. E94-4082

Ref.: Wetland Resources of the U.S.; by T.E. Dohl; 1982

Figure 4
Wetlands Locations Map

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## 5. FAULT AREAS

The fault area restriction states that no new landfill units or lateral expansions can be placed within 200 feet of a fault that has experienced Holocene displacement. This restriction provides for minimal setbacks from actual fault traces since faults can result in damage to the landfill's integrity though:

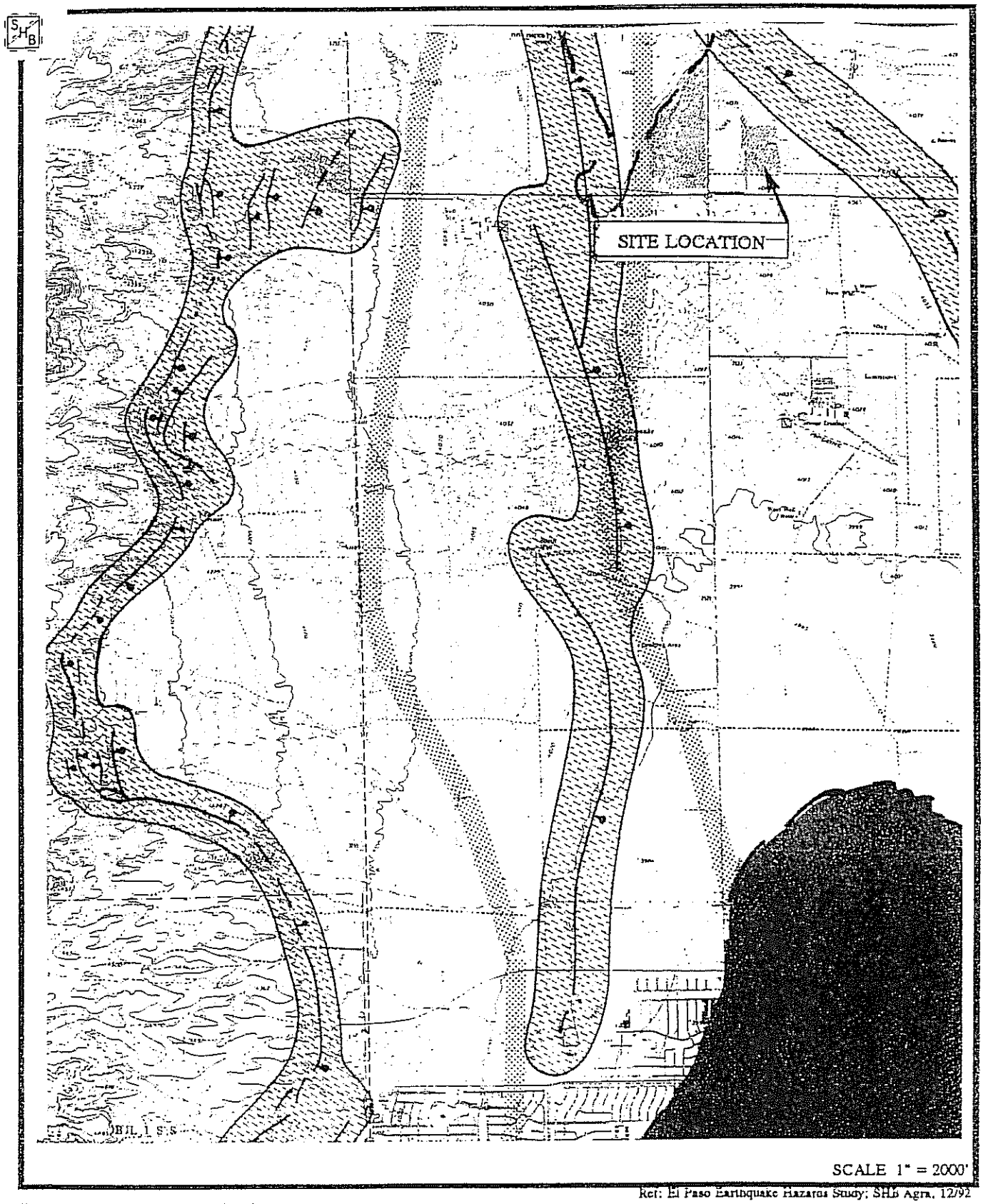
- movement along the fault causing displacement.
- seismic activity associated with faulting resulting in seismic shaking of facility structures.
- seismic shaking resulting in slope failures.

The original permit states that "...an Eastern Boundary Fault Zone exists between the Franklin Mountains and the Hueco Bolson deposits.", and "...assuming continuous movement this (movement of the fault) would equate to approximately 0.005 inches per year" (DRA, 1984).

Since several Quaternary faults have been identified within and at the margins of the Hueco Bolson, SHB reviewed recent published geologic mapping and literature to evaluate the proximity and age of known faults in the vicinity of the McCombs Landfill.

Numerous fault scarps of Quaternary age are present in the Hueco Bolson near the landfill. One inferred scarp apparently traverses the northeastern quadrant of the landfill permit area (SHB, 1993). This fault was not identified on the geologic map prepared by Harbour (1972). Insufficient information is available to confirm or refute the presence of the fault. This fault is more than 200 feet from any existing or proposed landfill units. Other north-south trending scarps are also apparent in the area. These faults are shown on Figure 5.

The age of faulting in Hueco Bolson has been dated as less than 0.5 m.y., based on offset in the Camp Rice Formation and in soils formed on the Camp Rice formation (Seager, 1980). A report by Collins and Raney, (1991), indicates that those faults near the site displace deposits of middle Pleistocene age (approximately 200,000 to 900,000 years old). Evidence of displacement of younger deposits have not been documented either because younger sediments do not exist along the fault traces or have been covered by windblown sand. Collins and Raney (1991) point out that movement on the basin bounding East Franklin Mountains located a few miles to the west of the landfill may be as young as Holocene. Other basin bounding faults and some of the intragraben faults (such as those near the landfill) most recently experienced rupture during the middle to late Pleistocene. More precise dating of the faults has not been performed, however, it is apparent that the faults have recurrence intervals of more than 10,000 years, otherwise the fault traces would be more clearly defined.




Ref: El Paso Earthquake Hazards Study; SHB Agra, 12/92

Landfill Restrictions Evaluation
McCombs Landfill
McCombs, Texas
Job No. E94-4082

Figure 5
Faults Location Map

AGRA
Earth & Environmental Group

Future development to the northern limits of the permit area will have to include either a detailed fault study or the incorporation of additional safety measures into the design. It is also considered prudent to design for fault contingencies in any new cell design.

## 6. SEISMIC IMPACT ZONES

The seismic impact zone restriction states that "New MSWLF units and lateral expansions shall not be located in seismic impact zones, unless the owner or operator demonstrates to the Director that all containment structures, including liners, leachate collection systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site."

Under this regulation, a seismic risk zone is considered to be an area that has a 10 percent or more probability that the maximum horizontal acceleration in lithified material, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10g in 250 years.

A review of USGS Miscellaneous Field Study Map MF-2120, "Probabilistic Earthquake Acceleration and Velocity Maps for the United States and Puerto Rico", (Algermissen, et. al., 1991), was conducted.

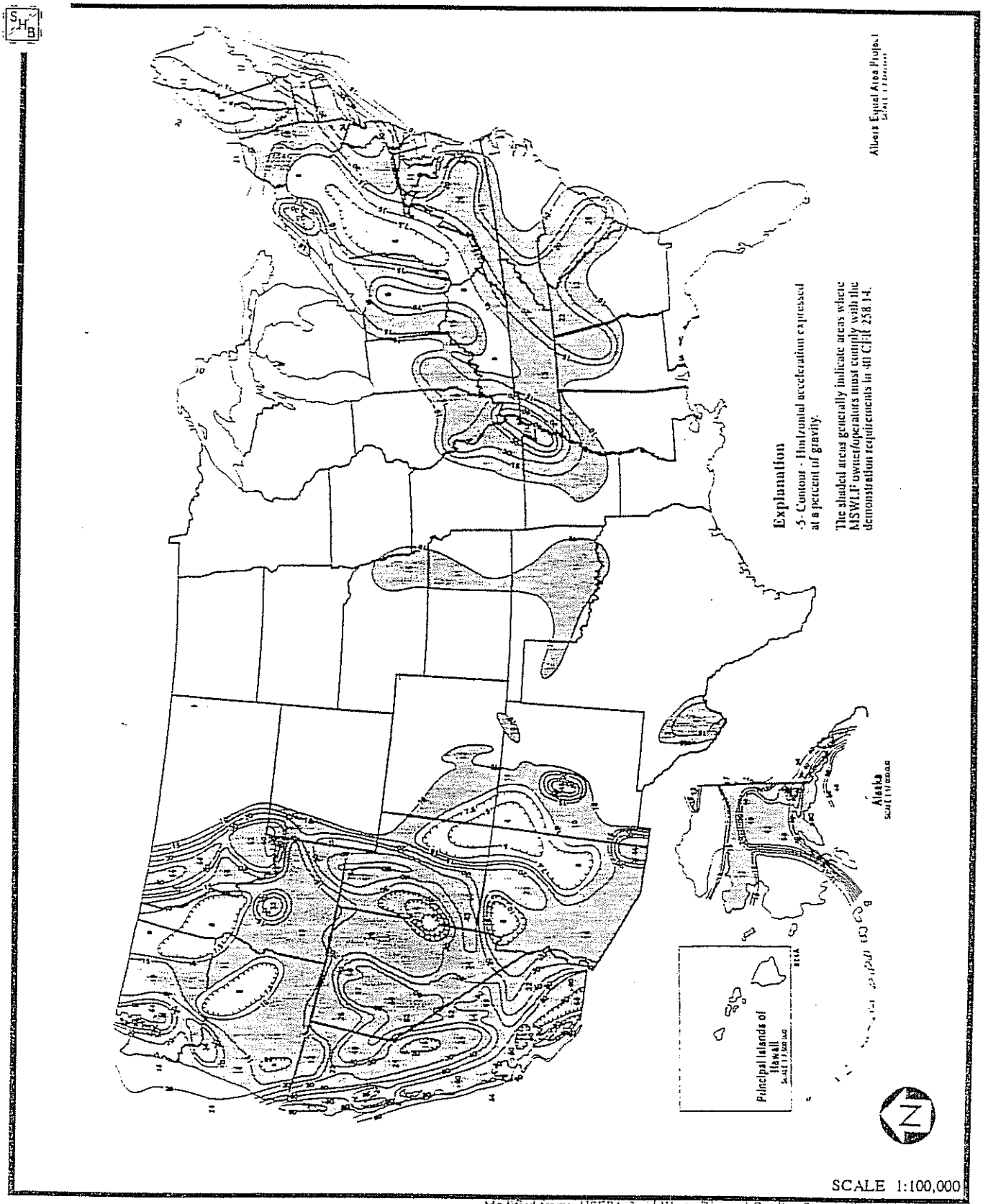
El Paso County (and the Landfill) fall outside of any designated seismic impact zones (See Figure 6).

## 7. UNSTABLE AREAS

### 7.1 REGULATORY REQUIREMENTS

Owners and operators of MSWLF units must demonstrate that proper engineering measures have been incorporated into the design in unstable areas. Those areas considered to be susceptible to natural or man-made events that may impair or destroy the integrity of any of the landfills structural components includes, but is not limited to:

- poor foundation conditions
- areas susceptible to mass movements (such as landslides, debris flows, etc.)
- Karst terranes




Modified from: USEPA Solid Waste Disposal Facility Criteria Tech. Manual 11/93

Location Restriction Evaluation
McCombs Landfill
El Paso, Texas
Job No. E94-4082

Figure 6
Seismic Zones Map

AGRA
Earth & Environmental Group

## 7.2 GEOLOGIC SETTING

The McCombs Landfill is located on deposits of the Hueco Bolson, probably Camp Rice Formation. These deposits primarily consist of clay, sand and gravel, with some caliche (Bureau of Economic Geology, 1983). The landfill site is underlain by Tertiary and Quaternary basin (bolson) deposits, overlain by areas of gravel and caliche rimrock (Harbour, 1972). Recent Quaternary alluvial deposits are also present in the landfill vicinity in topographically low areas.

The caliche rimrock of Pleistocene age is commonly two to four feet thick, and consists of angular fragments of bedrock derived from the mountains and cemented by white caliche. The bolson deposits in the area were described by Harbour (1972) as "friable white sand with rounded volcanic pebbles". Bolson deposits of clay and sand with some gravel and caliche have been observed in water wells drilled east of the Franklin Mountains. The bolson deposits have been documented to extend to a depth of at least 4,920 feet below ground surface in a well drilled south of Newman, New Mexico, approximately five miles east of the landfill (Harbour, 1972).

## 7.3 GEOTECHNICAL SETTING

A soil investigation was performed in 1983 by DRA. During the investigation, numerous soil borings were drilled on site to a depth of 60 feet below ground surface. According to boring logs generated during the investigation, the soils consist of an upper zone of variable thickness of silty sand, underlain by deposits of clean and gravelly sands. Stringers of clay which did not appear to be laterally extensive were observed in some of the soil borings. The sands and gravelly sands appear to be lenticular in nature, with little correlation across the site.

Based on the above information, it does not appear that any expansive or collapsible soils which would affect performance of the landfill have been identified.

## 7.4 UNSTABLE SLOPES

No landslide deposits in the vicinity of the Landfill are shown on any published geologic information and none have been identified during our site visits.

Since less than 40 feet of topographic relief occur across the site and no evidence of unstable slopes were observed, it is our opinion that no unstable slopes which would affect the structural integrity of the Landfill occur on site. Localized areas of loose soil could potentially produce unstable slopes in temporary excavations, but these can be mitigated by proper site grading.

## 7.5 KARST TERRANES

As noted above, several thousand feet of basin filling sediments occur beneath the Landfill. No limestone or other soluble units subject to karst formation exists in the vicinity.

## 7.6 SUBSIDENCE

Subsidence has been documented in the El Paso metropolitan area as a result of groundwater withdrawal and subsequent decline in groundwater levels, especially in areas having thick accumulations of clay in the subsurface.

The McCombs Landfill is located in an area of documented groundwater withdrawal resulting in groundwater declines up to 40 feet (Ashworth, 1990). No land surface subsidence has been documented in the vicinity of the Landfill (Land and Armstrong, 1985). Due to depth to groundwater, formation of large scale subsidence features is not anticipated, but cannot be precluded.

## 7.7 LIQUEFACTION

Since groundwater occurs at depths of over 400 feet (El Paso Water Utilities, 1993), no liquefaction concerns exist (SHB, 1993).

## 7.8 HUMAN-INDUCED INSTABILITIES

As part of the design of proposed additions to the McCombs Municipal Landfill, it is our understanding that a geotechnical engineering firm and a civil design team have been retained by the City. We assume these consultants are taking into account foundation conditions, slope stability and other sources in their design to minimize short-term or man-induced instabilities. This documentation has been submitted as part of the permit modification.

# 8. CONCLUSIONS

Based on our review of available information, the McCombs Municipal Landfill is not currently subject to any restrictions due to the presence of geologic hazards, airport safety concerns or from being within a 100-year floodplain. Fault restrictions may be a concern for future additions, however, no retrofitting of existing structures is required under current regulations.

## REFERENCES

Algermissen, S.T., 1991, Probabilistic Earthquake Acceleration and Velocity Map for the United States and Puerto Rico, USGS Miscellaneous Field Study Map MF-2120.

Ashworth, J.B., 1990, Water Resources of the El Paso Area, Texas; in Hydrogeology of Trans-Pecos Texas, C. Kreitler and J. Sharp, Jr., Eds., Texas Bureau of Economic Geology Guidebook 25, p. 21-25.

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Seager, W.R., 1980, Quaternary Fault System in the Tularosa and Hueco Basins, Southern New Mexico and West Texas, in New Mexico Geological Society Guidebook, 31st Field Conference, Texas Pecos, Texas.

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SHB AGRA, Inc., 1993, Maps of Potential Earthquake Hazards in the Urban Area of El Paso, Texas, Report prepared for the National Earthquake Hazard Reduction Program, U.S. Geological Survey.

U. S. Army Corps of Engineers, 1987, Corps of Engineers Wetlands Manual, Technical Report y-87-1, Waterways Experiment Station.

# Appendix 3L
# Groundwater Sampling and Analysis

SAIC®

# Appendix 3L – Attachment 1
# Groundwater Characterization

SAIC®

# Memorandum

SAIC®

To: TCEQ

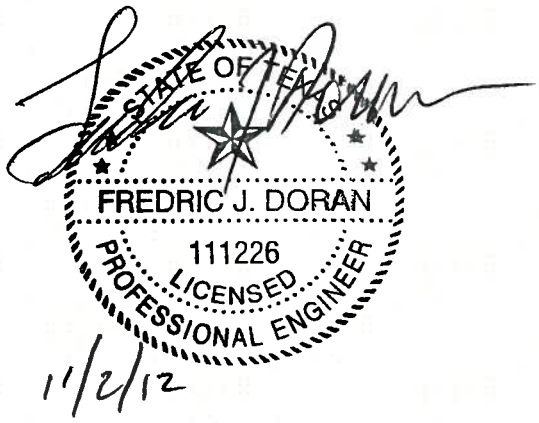
From: Fred J. Doran, SAIC

Subject: Appendix 3L, Attachment 1 – Groundwater Characterization

Date: November 2, 2012

The attached Groundwater Characterization data (reports, well logs, and approval letters) for the Landfill reference MSW Permit No. 729A throughout. It should be noted that the attached data are applicable to MSW Permit No. 729B and should be referenced within the document as part of MSW Permit No. 729B.

TLK






SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI

1005152011H PZ-4 & PZ-5 Installation Approval

Bryan W. Shaw, Ph.D., *Chairman*
Buddy Garcia, *Commissioner*
Carlos Rubinstein, *Commissioner*
Mark R. Vickery, P.G., *Executive Director*

RECEIVED
AUG 22 2011

# TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

*Protecting Texas by Reducing and Preventing Pollution*

August 17, 2011

AUG 22 2011

Ms. Ellen A. Smyth, P.E.
Director of Environmental Services
City of El Paso
7969 San Paulo
El Paso, TX 79907

Re: McCombs Municipal Solid Waste Landfill – El Paso County
Municipal Solid Waste (MSW) - Permit No. 729A
Monitor Well Installation Report
Tracking No. 14882536; CN601410244/RN100215599

Dear Ms. Smyth:

This letter acknowledges that we received a report documenting the installation of two piezometer monitor wells (PZ-4, PZ-5) at the referenced facility. The report was prepared by Parkhill, Smith & Cooper, Inc. (PSC) of El Paso, Texas and submitted on behalf of the facility by the supervising engineer Matt Dyer, P.E. of PSC, under a cover letter dated August 12, 2011. The report includes a well location map, geologic boring logs, well completion logs, monitor well data sheets, and State of Texas Well Reports for each well.

Thank you for the submittal. The installation appears to be in accordance with provisions of the permit modification issued on October 9, 2009.

If you have any questions in regard to this letter, please contact me at (512) 239-2242. When addressing written correspondence, please use mail code MC 124.

Sincerely,

Jason Wang, P.G.
Municipal Solid Waste Permits Section
Waste Permits Division

JW/sm

cc: Matt Dyer, P.E., Parkhill, Smith, & Cooper, Inc., El Paso



printed on recycled paper using soy-based ink

1005152011J

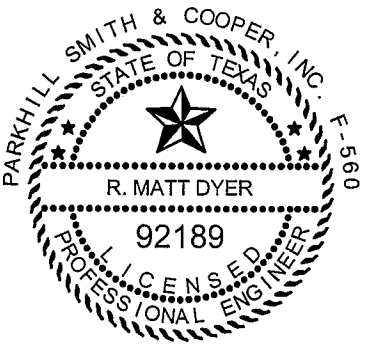
# Monitor Well Installation Report

## 30 TAC §330.421(e)

## City of El Paso McCombs Landfill

## MSW Permit No. 0729A

## El Paso, Texas




08/12/11

August 2011

PSC Project # 01515110

PARKHILLSMITH&COOPER

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2.0 GROUNDWATER MONITOR WELL CONSTRUCTION....1
3.0 WELL DEVELOPMENT....2
4.0 MISCELLANEOUS DOCUMENTATION....2
5.0 CERTIFICATION OF GROUNDWATER MONITORING SYSTEM....3

ATTACHMENTS

PIEZOMETER WELL 4 (PZ-4)
PIEZOMETER WELL 5 (PZ-5)
TCEQ CORRESPONDENCE
MATERIAL INFORMATION AND MSDS SAFETY SHEETS
GROUNDWATER MONITOR WELL CONSTRUCTION SPECIFICATIONS

FIGURES

FIGURE 1 – VICINITY LOCATION MAP
FIGURE 2 – MONITOR WELL LAYOUT MAP
FIGURE 3 – TYPICAL WELL CONSTRUCTION DETAILS
FIGURE 4 – SURVEY

## 1.0 INTRODUCTION

This report is submitted in accordance with 30 TAC §330.421 (e), and documents the construction of two piezometer wells, at the City of El Paso McCombs Landfill (MSW Permit No. 0729A) Changes to the groundwater monitoring system were submitted in two separate permit modification requests. The first request, approved in October 2009, updated the Groundwater Sampling and Analysis Plan and approved the installation of PZ-4 and PZ-5. The second request, approved December 2009, indicated that the facility would begin monitoring wells 1, 2, 3, and PZ-5 in accordance with the GWSAP as soon as PZ-5 is installed. Piezometer wells PZ-4 and PZ-5 have been installed to TCEQ groundwater monitoring well standards.

Actual construction of the wells was performed by WDC Exploration and Well of Peralta, New Mexico. Michael Hull, P.G. (Texas Registration No. 4152) witnessed the installation of the monitor and piezometer wells.

## 2.0 GROUNDWATER MONITOR WELL CONSTRUCTION

The piezometers were constructed using an Air Rotary Casing Hammer (ARCH) System, which consists of a non-rotating flush-threaded casing driven in conjunction with a conventional air rotary drill string. The advanced drive casing is a heavy walled pipe. The casing was driven with a pneumatic casing hammer. As the casing was advanced, the cuttings were cleared from the hole by rotation of the bit and air circulation. Cuttings were discharged though a hose into a cyclone, where they were separated from the air and contained for sample collection. Once the well was drilled to its total depth the drill rod and bit were extracted from the center of the drive casing and well casing was installed. After the casing was placed the annulus was filled as demonstrated in the design and permit documentation as the drive casing was pulled from the hole.

Well casing and screen was new 4-inch National Science Foundation certified Polyvinyl Chloride (PVC) Schedule 80 pipe. Screen pipe was slotted with 0.010-inch wide slots. The screened areas of the well were packed with Carmeuse Industrial Sands Colorado Spring Silica Sand 10/20 filter pack material. The annular seal above the gravel pack was made with a sodium

bentonite product (Holeplug) and the casing seal from the top of the annular seal to ground surface was made with a bentonite grout (Quik-Grout), both products manufactured by Baroid.

Following well construction, a concrete sealing block was constructed around the well for additional protection. Additionally, four 6-inch diameter steel bollards filled with concrete were placed around the well and painted with safety yellow paint for increased visibility and protection from vehicular traffic.

The well was then surveyed by Mr. Kenneth R. Kindle, a Texas Registered Professional Land Surveyor (RPLS 5710), and the well elevations were permanently mounted on each wells 8-inch diameter steel protective casing.

The construction specification for these wells is included for information in the Appendix.

## 3.0 WELL DEVELOPMENT

Following construction, each monitor well was developed using a small portable submersible stainless steel pump. The pump was placed at the bottom of the casing and pumped continuously for a minimum of between three and four hours. The water was relatively free of sand, and the temperature, specific conductivity and pH readings were constant at the end of the development period. A turbidity value of five (5) on the Jackson Turbidity Scale was used as a target well cleanliness value. The pumping rate varied between 5 and 5.3 gallons per minute during development. All equipment used in the development process was decontaminated between each well. The water produced during development was discharged onsite near the well.

## 4.0 MISCELLANEOUS DOCUMENTATION

The following items have been included in the Appendix to this report:

- State of Texas Well Report
- Monitor Well Data Sheet
- Geologic Boring Logs
- TCEQ Correspondence
- Material Information and MSDS Safety Sheets

- Construction Specifications
- Figure 1 – Vicinity Location Map
- Figure 2 – Monitor Well Layout Map
- Figure 3 – Typical Well Construction Details
- Figure 4 – Survey

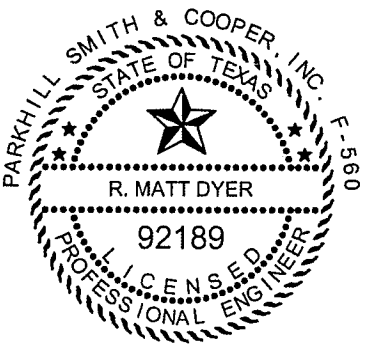
## 5.0 CERTIFICATION OF GROUNDWATER MONITORING SYSTEM

In the professional opinion of R. Matt Dyer, P.E. as a registered professional engineer in the State of Texas (Registration No. 92189), the groundwater monitoring system was designed in accordance with TCEQ rules and regulations as published in 30 TAC §330, Subchapter J. To the best of my knowledge, no significant alterations were made by the contractor during actual construction of the piezometers.

Sincerely,

PARKHILL, SMITH & COOPER, INC.

By R Matt Dyer
R. Matt Dyer, P.E.




08-12-11

# PIEZOMETER WELL 4 (PZ-4)

## State of Texas Well Report
## Monitor Well Data Sheet
## Boring Log

# STATE OF TEXAS WELL REPORT for Tracking #256244

| | | | |
|---|---|---|---|
| Owner: | **City of El Paso Environmental Services D** | Owner Well #: | **PZ-4** |
| Address: | **7968 San Paulo**<br>**El Paso , TX 79907** | Grid #: | **49-05-3** |
| Well Location: | **13600 McCombs St.**<br>**El Paso , TX 79934** | Latitude: | **31° 59' 19" N** |
| Well County: | **El Paso** | Longitude: | **106° 24' 08" W** |
| Elevation: | **4047 ft.** | GPS Brand Used: | **Samsung Epic** |
| Type of Work: | **New Well** | Proposed Use: | **Monitor** |

Drilling Date: Started: **5/26/2011**
Completed: **5/31/2011**

Diameter of Hole: Diameter: **10 in From Surface To 466 ft**

Drilling Method: **Air Rotary** Other: **Casing Hammer**

Borehole Completion: Gravel Packed From: **408 ft to 466 ft**
Gravel Pack Size: **10/20 Sand**

Annular Seal Data: 1st Interval: **From 3 ft to 398 ft with 40/ Bent. Grout (#sacks and material)**
2nd Interval: **From 398 ft to 408 ft with 5/ Bent. Chips (#sacks and material)**
3rd Interval: **No Data**
Method Used: **Tremie**
Cemented By: **WDC**
Distance to Septic Field or other Concentrated Contamination: **No Data**
Distance to Property Line: **No Data**
Method of Verification: **No Data**
Approved by Variance: **No Data**

Surface Completion: **Surface Sleeve Installed**

Water Level: Static level: **No Data**
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
Depth of Strata: **No Data**
Chemical Analysis Made: **No**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **WDC Exploration and Wells**
**3621 Hwy 47**

| | |
|---|---|
| | **Peralta , NM 87042** |
| Driller License Number: | **4885** |
| Licensed Well Driller Signature: | **William B. Bludworth** |
| Registered Driller Apprentice Signature: | **No Data** |
| Apprentice Registration Number: | **No Data** |
| Comments: | **No Data** |

**IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY**

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking **#256244**) on your written request.

**Texas Department of Licensing & Regulation**
**P.O. Box 12157**
**Austin, TX 78711**
**(512) 463-7880**

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
**0-10 Sand, tan, fine.**
**10-20 Sand, lt gray- red brown, fine to gravel.**
**20-30 Sand, lt red brown, fine.**
**30-40 Sand, lt brown, fine.**
**40-80 Sand and Gravel, brown to lt gray brown.**
**80-81 Clay, red brown.**
**81-89 Sand, lt brown, fine to medium,.**
**89-100 Sand and Gravel, light brown.**
**100-112 Sand, lt red brown, fine, damp.**
**112-116 Sandy Clay, red brown, damp.**
**116-120 Sand, lt brown, fine.**
**120-130 Silty Sand, lt brown, dry.**
**130-140 Sand, red brown, fine to gravel, sl damp.**
**140-168 Sand, brown, fine, moist.**
**168-170 Clay, red brown.**
**170-180 Sandy Clay, intermitent clay lenses, red brown.**
**180-189 Sand, lt brown, fine.**
**189-194 Silty Clay, red brown.**
**194-200 Silty Sand, red- yellow brown.**
**200-209 Silty Sand, lt brown.**
**209-220 Sandy Gravel, lt gray brown.**
**220-221 Sandy Clay, red brown.**
**221-226 Silty Sand, lt brown.**
**226-243 Clay, red brown, some silty sand, sl damp.**
**243-250 Sand, lt red brown, fine to pea gravel.**

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
**4 N PVC Riser +3-413 Sch#80**
**4 N PVC Slotted Screen 413-463 .010"**
**4 N PVC Sump 463-465 Sch#80**

250-270 Sand/ Gravel, medium to gravel, dry, w/ thin red brown clay lenses.
270-280 Sand, lt gray and brown, fine to medium.
280-300 Sand/ Silt.
300-304 Sand and Gravel, lt brown, fine to gravel.
304-306 Clay, red brown.
306-310 Silt and Sand, red brown.
310-320 Gravelly Sand, lt gray brown.
320-332 Silty Sand, lt brown to lt gray brown.
332-338 Silty Clay, red brown, dry.
338-342 Sand, lt red brown, fine.
342-350 Sand, lt gray brown, dry.
350-364 Sand/ Gravel, lt gray brown, dry.
364-370 Sand, lt gray brown, fine, dry.
370-380 Sand/ Gravel, lt gray brown, fine to gravel.
380-402 Sand, lt gray brown, fine to medium, sl damp to moist.
402-406 Clay, red brown, moist, plastic.
406-418 Sand, red brown, medium, dry to moist to sl wet.
418-425 Sand, brown, medium, wet.
425-430 Sand/Gravel, brown, medium to gravel, wet.
430-436 Silty Sand, lt brown, silt to medium, wet.
436-439 Clay, red brown.
439-461 Sand, lt brown, fine to coarse, wet.
461-466 Sand, brown, medium, wet.

# Monitor Well Data Sheet

Permittee or Site Name: McCombs Landfill
County: El Paso County
Date of Monitor Well Installation: June 1, 2011
Latitude: 31°59'18.81720" Longitude: 106°23'53.84750"
Monitor Well Groundwater Gradient Position:
Upgradient: _____ Downgradient: _____

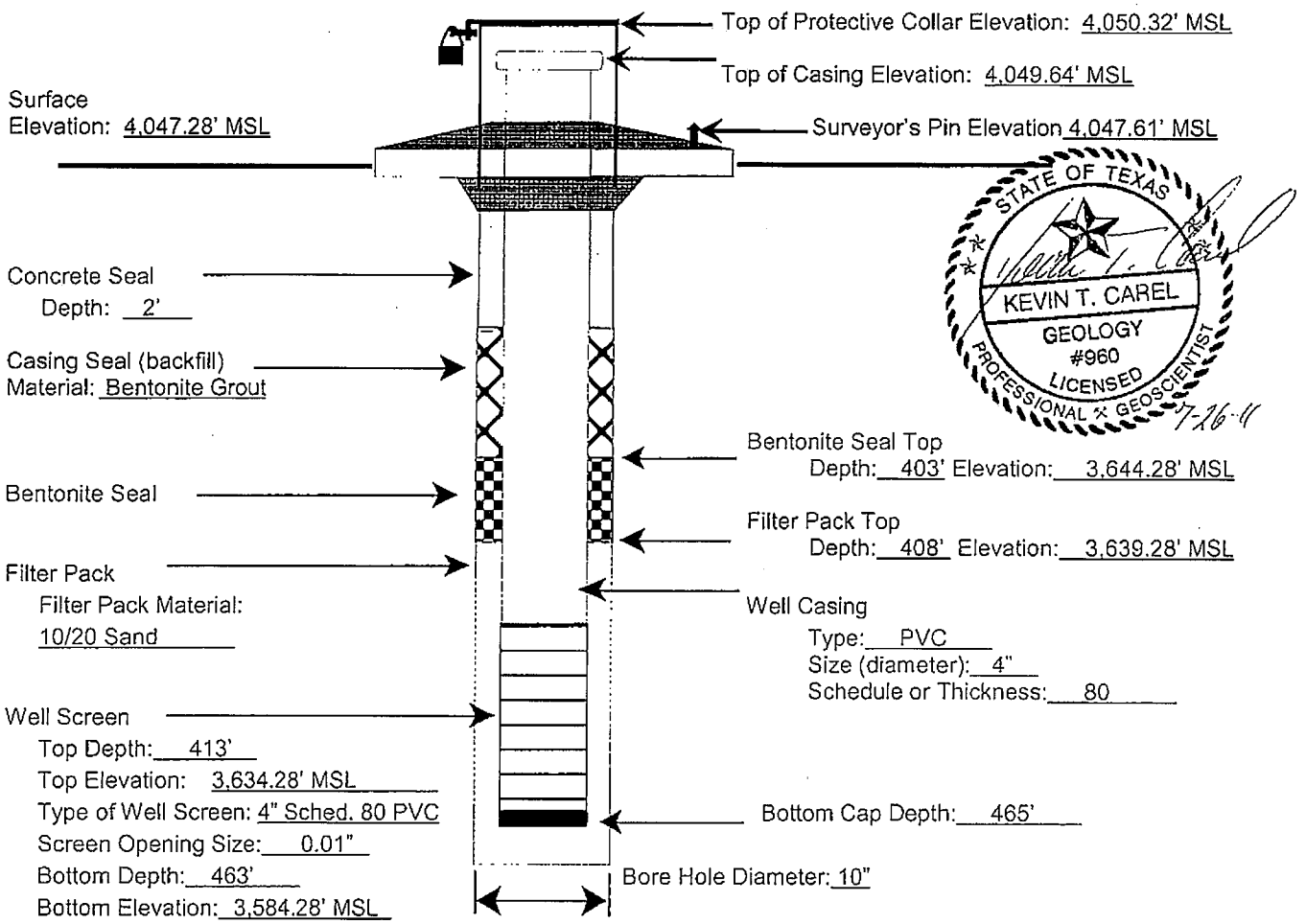
MSW Permit No.: 729A
Monitor Well I.D. No.: PZ-4
Date of Monitor Well Development: June 8, 2011
Monitor Well Driller
Name: William B. Bludworth
License No. 4885

**NOTES:**

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to nearest hundredth of a foot.
- Diameter of boring should be at least 4 inches larger than diameter of well casing.
- Use flush screw joint casing only, 2-inch diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommend).
- Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist, or Engineer Supervising Well Installation: Michael J. Hull, PG
Static Water Level Elevation (with respect to MSL) after Well Development: 3,650.81' MSL
Name of Geologic Formation(s) in which Well is completed: Hueco Bolson

Type of Locking Device: Pad Lock Type of Casing Protection: 6" x 6" x 5' Steel
Concrete Surface Pad (with steel reinforcement) Dimensions: 4' x 4' x 6"




TCEQ-10308

# LOG OF PIEZOMETER NO. PZ-4

Project Description: 2011 McCombs Landfill Piezometer Installations

CAREL CORPORATION

Location: McCombs Landfill
Top of PVC El.: 4049.64 feet MSL
Surface El.: 4047.28 feet MSL
Completion Depth: 466 feet
Date Boring Started: 5/26/2011
Date Boring Completed: 6/2/2011

Latitude: 31.988560
Longitude: 106.402142

| Depth, feet | Samples | Symbol/USCS | MATERIAL DESCRIPTION | Piezometer Construction Details | Piezometer Description |
|---|---|---|---|---|---|
| 0 | | | SAND, tan, well graded, subangular to angular, fine to cobble grained, dry, loose, some gravel, carbonate cement | | Concrete from surface to 2' bgs |
| 10 | | | SAND, light grayish red brown, well graded, round to subangular, fine to pebble grained, dry, loose, some gravel, some volcanic rock fragments, quartz rich with mafic gravel and volcanic rocks, multicolored grains | | |
| 20 | | | SAND, light reddish brown to brown, poorly graded, rounded, fine grained, dry, loose, quartz rich with mafic minerals, multicolored grains | | |
| 40 | | | SANDY GRAVEL, light brown, well graded, round to angular, fine to gravel grained, dry, loose, quartz rich with mafic minerals, multicolored grains | | |
| 50 | | | SAND, dark brown, well graded, fine to pebble grained, dry, loose, and gravel, iron oxide staining, quartz rich with multicolored grains | | |
| 60 | | | SAND, light grayish brown, well graded, round to subangular, fine to pebble grained, dry, loose, and gravel, with volcanic rock fragments, with limestone, quartz rich with multicolored grains | | |
| 70 | | | SAND, light brown, well graded, dry, loose, and gravel, quartz rich with mafic minerals, multicolored grains | | |
| 80 | | | CLAY, reddish brown, dry | | |
| 85 | | | SAND, light brown, well graded, subrounded, fine to medium grained, dry, loose, iron oxide staining, quartz rich with mafic minerals, multicolored grains | | |
| 90 | | | SAND, light brown, well graded, fine to pebble grained, dry, loose, and gravel, quartz rich with mafic minerals, multicolored grains | | |
| 100 | | | | | |

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST

7-19-11

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary with Casing Advance
Sampling Method: Cuttings
Geologist: Michael J. Hull, P.G.
Project No.: 10-01-22

| Groundwater Observations | |
|---|---|
| Date | Elevation (ft. MSL) |
| 05/27/11 | 3633.28 |
| 05/31/11 | 3651.28 |
| 06/08/11 | 3650.81 |

Remarks: Speedstar 50K Drilling Rig. 10" diameter boring. 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface.

EL PASO PZS MCCOMBS.GPJ CAREL.GDT 07/19/11



The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▼ Water level after drilling.

# LOG OF PIEZOMETER NO. PZ-4

Project Description: 2011 McCombs Landfill Piezometer Installations

Location: McCombs Landfill
Top of PVC El.: 4049.64 feet MSL
Surface El.: 4047.28 feet MSL
Completion Depth: 466 feet
Date Boring Started: 5/26/2011
Date Boring Completed: 6/2/2011
Latitude: 31.988560
Longitude: 106.402142

| Depth, feet | Samples | Symbol/USCS | MATERIAL DESCRIPTION | Piezometer Construction Details | Piezometer Description |
|---|---|---|---|---|---|
| 105 | | | SAND, light reddish brown, poorly graded, rounded, fine grained, moist, loose, quartz rich with multicolored grains | | |
| 110 | | | | | |
| 115 | | | SANDY CLAY, reddish brown, slightly moist | | |
| 120 | | | SAND, light brown, poorly graded, rounded, fine grained, dry, loose, quartz rich with mafic minerals, multicolored grains | | |
| 125 | | | SILTY SAND, light brown, poorly graded, rounded, very fine grained, dry, loose | | |
| 130 | | | SAND, reddish brown, well graded, subangular to subrounded, fine to gravel grained, slightly moist, loose, quartz rich with mafic minerals, multicolored grains | | |
| 135 | | | | | |
| 140 | | | SAND, brown, poorly graded, well rounded, fine grained, dry, loose, quartz rich with mafic minerals, multicolored grains | | |
| 145 | | | | | |
| 150 | | | SAND, brown, well graded, subrounded, medium grained, slightly moist, loose, quartz rich with mafic minerals, multicolored grains | | |
| 155 | | | | | |
| 160 | | | SAND, brown, well graded, subrounded, medium grained, moist, loose, quartz rich with mafic minerals, multicolored grains | | |
| 165 | | | | | |
| 170 | | | CLAY, reddish brown, dry | | |
| 175 | | | SANDY CLAY, reddish brown, well graded, fine to medium grained, dry, loose, with clay lenses, quartz rich with mafic minerals, multicolored grains | | |
| 180 | | | SAND, light brown, poorly graded, rounded, fine grained, dry, loose, quartz rich with mafic minerals, multicolored grains | | |
| 185 | | | | | |
| 190 | | | SILTY CLAY, reddish brown, dry | | |
| 195 | | | SILTY SAND, reddish yellow brown, poorly graded, rounded, very fine grained, dry, loose, quartz rich | | |
| 200 | | | | | |

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST
7-19-11

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary with Casing Advance
Sampling Method: Cuttings
Geologist: Michael J. Hull, P.G.
Project No.: 10-01-22

| Groundwater Observations | |
|---|---|
| Date | Elevation (ft. MSL) |
| 05/27/11 | 3633.28 |
| 05/31/11 | 3651.28 |
| 06/08/11 | 3650.81 |

Remarks: Speedstar 50K Drilling Rig. 10" diameter boring. 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface.

EL PASO PZS MCCOMBS GPJ CAREL GDT 07/19/11



The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

Water level at time of drilling.
Water level at end of drilling.
Water level after drilling.

# LOG OF PIEZOMETER NO. PZ-4

Project Description: 2011 McCombs Landfill Piezometer Installations

Location: McCombs Landfill
Top of PVC El.: 4049.64 feet MSL
Surface El.: 4047.28 feet MSL
Completion Depth: 466 feet
Date Boring Started: 5/26/2011
Date Boring Completed: 6/2/2011

Latitude: 31.988560
Longitude: 106.402142

| Depth, feet | Samples | Symbol/USCS | MATERIAL DESCRIPTION | Piezometer Construction Details | Piezometer Description |
|---|---|---|---|---|---|
| 205 | | | SILTY SAND, reddish yellow brown, poorly graded, rounded, very fine grained, dry, loose, quartz rich | | |
| 210 | | | SANDY GRAVEL, light grayish brown, well graded, round to subangular, fine to pebble grained, dry, loose, quartz rich with mafic minerals, multicolored grains | | |
| 215 | | | | | |
| 220 | | | SANDY CLAY, reddish brown, dry | | |
| 225 | | | SILTY SAND, light brown, poorly graded, rounded, very fine grained, dry, loose | | |
| 230 | | | CLAY, reddish brown, slightly moist, with sand, and silt | | |
| 235 | | | | | |
| 240 | | | | | |
| 245 | | | SAND, light reddish brown, well graded, subangular to subrounded, fine to pebble grained, dry, loose, quartz rich with mafic minerals, multicolored grains | | |
| 250 | | | SAND, light reddish brown, well graded, subrounded to angular, medium to coarse grained, dry, loose, and gravel, with clay lenses, quartz rich with mafic minerals, multicolored grains | | Bentonite grout from 2' to 403' bgs |
| 255 | | | | | |
| 260 | | | | | |
| 265 | | | | | |
| 270 | | | SAND, light gray, well graded, rounded to subrounded, fine to medium grained, dry, loose, quartz rich with multicolored grains | | |
| 275 | | | | | |
| 280 | | | SAND, well graded, rounded, very fine to medium grained, dry, loose, and silt, quartz rich with mafic minerals, multicolored grains | | |
| 285 | | | | | |
| 290 | | | | | |
| 295 | | | thin red-brown clay lense at 295' bgs | | |
| 300 | | | | | |

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST
7-19-11

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary with Casing Advance
Sampling Method: Cuttings
Geologist: Michael J. Hull, P.G.
Project No.: 10-01-22

| Groundwater Observations | |
|---|---|
| Date | Elevation (ft. MSL) |
| 05/27/11 | 3633.28 |
| 05/31/11 | 3651.28 |
| 06/08/11 | 3650.81 |

Remarks: Speedstar 50K Drilling Rig. 10" diameter boring, 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface.

EL PASO PZS MCCOMBS GPJ CAREL GDT 07/19/11



The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

Water level at time of drilling.
Water level at end of drilling.
Water level after drilling.

# LOG OF PIEZOMETER NO. PZ-4

Project Description: 2011 McCombs Landfill Piezometer Installations

CAREL CORPORATION

Location: McCombs Landfill
Top of PVC El.: 4049.64 feet MSL
Surface El.: 4047.28 feet MSL
Completion Depth: 466 feet
Date Boring Started: 5/26/2011
Date Boring Completed: 6/2/2011
Latitude: 31.988560
Longitude: 106.402142

| Depth, feet | Samples | Symbol/USCS | MATERIAL DESCRIPTION | Piezometer Construction Details | Piezometer Description |
|---|---|---|---|---|---|
| 305 | | | SAND, light brown, well graded, fine to pebble grained, dry, loose, with gravel, quartz rich with mafic minerals, multicolored grains | | |
| | | | CLAY, reddish brown, dry | | |
| 310 | | | SILTY SAND, light reddish brown, poorly graded, rounded, dry, loose | | |
| 315 | | | SAND, light grayish brown, well graded, subangular to subrounded, fine to pebble grained, dry, loose, with gravel, quartz rich with mafic minerals, multicolored grains | | |
| 320 | | | SILTY SAND, light brown to light grayish brown, poorly graded, rounded, very fine grained, dry, loose, quartz rich | | |
| 325 | | | | | |
| 330 | | | SILTY CLAY, reddish brown, dry, hard, calcite cement | | |
| 335 | | | SAND, light reddish brown, poorly graded, rounded to subrounded, fine to medium grained, dry, loose, with clay lenses, iron oxide staining, quartz rich with multicolored grains | | |
| 340 | | | | | |
| 345 | | | SAND, light grayish brown, well graded, subangular to subrounded, fine to pebble grained, dry, loose, with gravel, quartz rich with mafic minerals, multicolored grains | | |
| 350 | | | | | |
| 355 | | | | | |
| 360 | | | ARKOSIC SAND, light grayish brown, poorly graded, rounded, fine grained, dry, loose, quartz rich with feldspar and mafic minerals, multicolored grains | | |
| 365 | | | ARKOSIC SAND, light grayish brown, well graded, subangular to subrounded, fine to pebble grained, dry, loose, with gravel, quartz rich with feldspar and mafic minerals, multicolored grains | | |
| 370 | | | GRAVEL, grayish brown, well graded, dry, with volcanic rock fragments, with limestone, Volcanic | | |
| 375 | | | SAND, light grayish brown, poorly graded, rounded, fine grained, slightly moist, loose, quartz rich with mafic minerals, multicolored grains | | |
| 380 | | | SAND, light grayish brown, well graded, subrounded, medium grained, slightly moist, loose, quartz rich with mafic minerals, multicolored grains | | |
| 385 | | | moist at 399' bgs | | |
| 390 | | | | | |
| 395 | | | | | |
| 400 | | | | | |

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST
7-19-11

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary with Casing Advance
Sampling Method: Cuttings
Geologist: Michael J. Hull, P.G.
Project No.: 10-01-22

Groundwater Observations

| Date | Elevation (ft. MSL) |
|---|---|
| 05/27/11 | 3633.28 |
| 05/31/11 | 3651.28 |
| 06/08/11 | 3650.81 |

Remarks: Speedstar 50K Drilling Rig. 10" diameter boring. 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface.

EL PASO PZS MCCOMBS.GPJ CAREL.GDT 07/19/11



The stratification lines represent approximate strata boundanes. In situ, the transition may be gradual.

Water level at time of drilling.
Water level at end of drilling.
Water level after drilling.

# LOG OF PIEZOMETER NO. PZ-4

Project Description: 2011 McCombs Landfill Piezometer Installations

Location: McCombs Landfill
Top of PVC El.: 4049.64 feet MSL
Surface El.: 4047.28 feet MSL
Completion Depth: 466 feet
Date Boring Started: 5/26/2011
Date Boring Completed: 6/2/2011

Latitude: 31.988560
Longitude: 106.402142

| Depth, feet | Samples | Symbol/USCS | MATERIAL DESCRIPTION | Piezometer Construction Details | Piezometer Description |
|---|---|---|---|---|---|
| 405 | | | SAND, light reddish brown, fine to medium grained, dry, loose | | Hydrated bentonite seal from 403' to 408' bgs |
| | | | CLAY, reddish brown, moist | | |
| 410 | | | SAND, light reddish brown, well graded, subrounded, medium grained, dry, loose, quartz rich with multicolored grains moist to slightly wet at 414' bgs | | 10/20 Silica sand from 408' to 466' bgs |
| 415 | | | Adding water to hole from 418' bgs to total depth | | ▽ |
| 420 | | | SAND, brown, well graded, subrounded, medium grained, wet, loose, quartz rich with mafic minerals, multicolored grains | | |
| 425 | | | SAND, brown, well graded, medium to gravel grained, wet, loose, and gravel, some clay lenses, quartz rich with mafic minerals, multicolored grains | | |
| 430 | | | SILTY SAND, light brown, well graded, rounded to subrounded, very fine to medium grained, wet, loose, quartz rich with mafic minerals, multicolored grains | | 0.01" Slotted screen from 413' to 463' bgs |
| 435 | | | CLAY, reddish brown | | |
| 440 | | | SAND, light brown, well graded, rounded to subrounded, fine to coarse grained, loose, iron oxide staining, quartz rich with mafic minerals, multicolored grains | | |
| 445 | | | | | |
| 450 | | | SAND, light brown, poorly graded, rounded to subrounded, very fine to fine grained, loose, iron oxide staining, quartz rich with mafic minerals, multicolored grains | | |
| 455 | | | | | |
| 460 | | | SAND, light brown to blue, poorly graded, subrounded, medium grained, wet, loose, iron oxide staining, quartz rich with mafic minerals, multicolored grains | | Two foot sediment trap |
| 465 | | | | | |
| 470 | | | | | |
| 475 | | | | | |
| 480 | | | | | |
| 485 | | | | | |
| 490 | | | | | |
| 495 | | | | | |
| 500 | | | | | |

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST
7-19-11

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary with Casing Advance
Sampling Method: Cuttings
Geologist: Michael J. Hull, P.G.
Project No.: 10-01-22

| Groundwater Observations | |
|---|---|
| Date | Elevation (ft. MSL) |
| 05/27/11 | 3633.28 |
| 05/31/11 | 3651.28 |
| 06/08/11 | 3650.81 |

Remarks: Speedstar 50K Drilling Rig. 10" diameter boring, 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface.

EL PASO PZS MCCOMBS GPJ CAREL GDT 07/19/11



The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▼ Water level after drilling.

# PIEZOMETER WELL 5 (PZ-5)

## State of Texas Well Report
## Monitor Well Data Sheet
## Boring Log

# STATE OF TEXAS WELL REPORT for Tracking #256218

| | | | |
|---|---|---|---|
| Owner: | **City of El Paso Environmental Services D** | Owner Well #: | **PZ-5** |
| Address: | **7968 San Paulo<br>El Paso , TX 79907** | Grid #: | **49-05-3** |
| Well Location: | **13600 McCombs St.<br>El Paso , TX 79934** | Latitude: | **31° 59' 29" N** |
| Well County: | **El Paso** | Longitude: | **106° 23' 54" W** |
| Elevation: | **4058 ft.** | GPS Brand Used: | **Samsung Epic** |
| Type of Work: | **New Well** | Proposed Use: | **Monitor** |

Drilling Date: Started: **5/23/2011**
Completed: **5/25/2011**

Diameter of Hole: Diameter: **10 in From Surface To 441 ft**

Drilling Method: **Air Rotary** Other: **Casing Hammer**

Borehole Completion: Gravel Packed From: **413 ft to 441 ft**
Gravel Pack Size: **10/20 Sand**

Annular Seal Data: 1st Interval: **From 3 ft to 403 ft with 40/ Bent. Grout (#sacks and material)**
2nd Interval: **From 403 ft to 413 ft with 5/ Bent. Chips (#sacks and material)**
3rd Interval: **No Data**
Method Used: **Tremie**
Cemented By: **WDC**
Distance to Septic Field or other Concentrated Contamination: **No Data**
Distance to Property Line: **No Data**
Method of Verification: **No Data**
Approved by Variance: **No Data**

Surface Completion: **Surface Sleeve Installed**

Water Level: Static level: **No Data**
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
Depth of Strata: **No Data**
Chemical Analysis Made: **No**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **WDC Exploration and Wells**
**3621 Hwy 47**

| | |
|---|---|
| | **Peralta , NM 87042** |
| Driller License Number: | **4885** |
| Licensed Well Driller Signature: | **William B. Bludworth** |
| Registered Driller Apprentice Signature: | **No Data** |
| Apprentice Registration Number: | **No Data** |
| Comments: | **No Data** |

**IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY**

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking **#256218**) on your written request.

**Texas Department of Licensing & Regulation**
**P.O. Box 12157**
**Austin, TX 78711**
**(512) 463-7880**

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
**0- 43 Sand and Gravel, light red brown, vf to gravel.**
**43- 46 Silty Clay, lt brown.**
**46- 60 Sand and Gravel, lt red brown, fine to coarse gravel.**
**60- 61 Gravel, brown, pea size to cobbles.**
**61- 68 Clay, lt red brown.**
**68- 69 Sand, lt red brown, fine to coarse.**
**69- 72 Clay, lt red brown, some sand and silt.**
**72- 73 Sand, lt brown, fine to coarse.**
**73- 76 Silty Clay, lt gray brown.**
**76- 79 Sand, lt brown, fine to medium.**
**79- 90 Clay, red brown.**
**90-110 Sand, lt gray brown, silt to fine, dry.**
**110-138 Sand and Gravel, lt brown to lt gray, fine to coarse, dry.**
**138-141 Clay, brown and red brown.**
**141-160 Sand and Gravel, lt gray to lt gray brown, fine, some gravel, dry.**
**160-177 Silty Sand, lt gray brown, dry.**
**177-189 Silty Sand and Gravel, red brown, dry.**
**189-196 Clay, red brown, dry.**
**196-210 Sand, red brown, fine to medium, sl damp.**
**210-220 Sand, lt gray brown, fine to medium, dry.**
**220-223 Sand, lt gray, fine to medium.**
**223-230 Sandy Gravel, lt gray brown.**
**230-260 Sand, lt gray brown, fine to medium.**

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
**4 N PVC Riser +3-418 Sch#80**
**4 N PVC Slotted Screen 418-438 .010"**
**4 N PVC Sump 438-440 Sch#80**

260-280 Sand, as above, but vf.
280-300 Sand, lt brown, silt to medium.
300-310 Sand and Gravel, lt brown, sl damp.
310-313 Sand, red brown, silty to vf.
313-323 Sandy Silt, lt brown.
323-327 Gravel and Sand, lt gray brown.
327-332 Sand and Gravel, light gray brown.
332-335 Clay, red brown.
335-340 Silty Sand, red brown.
340-343 Sand and Gravel, light brown, fine to pea gravel.
343-369 Clay, red brown.
369-384 Sand, light red brown, very fine to coarse.
384-385 Silty Clay, red brown, moist.
385-387 Clay, red brown, dry, hard.
387-396 Sand, red brown, fine.
396-400 Clay, red brown, slightly moist.
400-402 Sand, red brown, fine, dry.
402-403 Clay, red brown, moist.
403-410 Sand, red brown, fine, moist.
410-420 Sand, brown, fine, wet.
420-429 Sand, light brown to brown, fine to coarse, wet.
429-435 Sand, brown, fine.
435-439 Sand and Gravel, brown.
439-441 Clay, red brown.

# Monitor Well Data Sheet

Permittee or Site Name: McCombs Landfill
County: El Paso County
Date of Monitor Well Installation: May 25, 2011
Latitude: 31°59'29.26715" Longitude: 106°23'53.84750"
Monitor Well Groundwater Gradient Position:
Upgradient: _____ Downgradient: _____

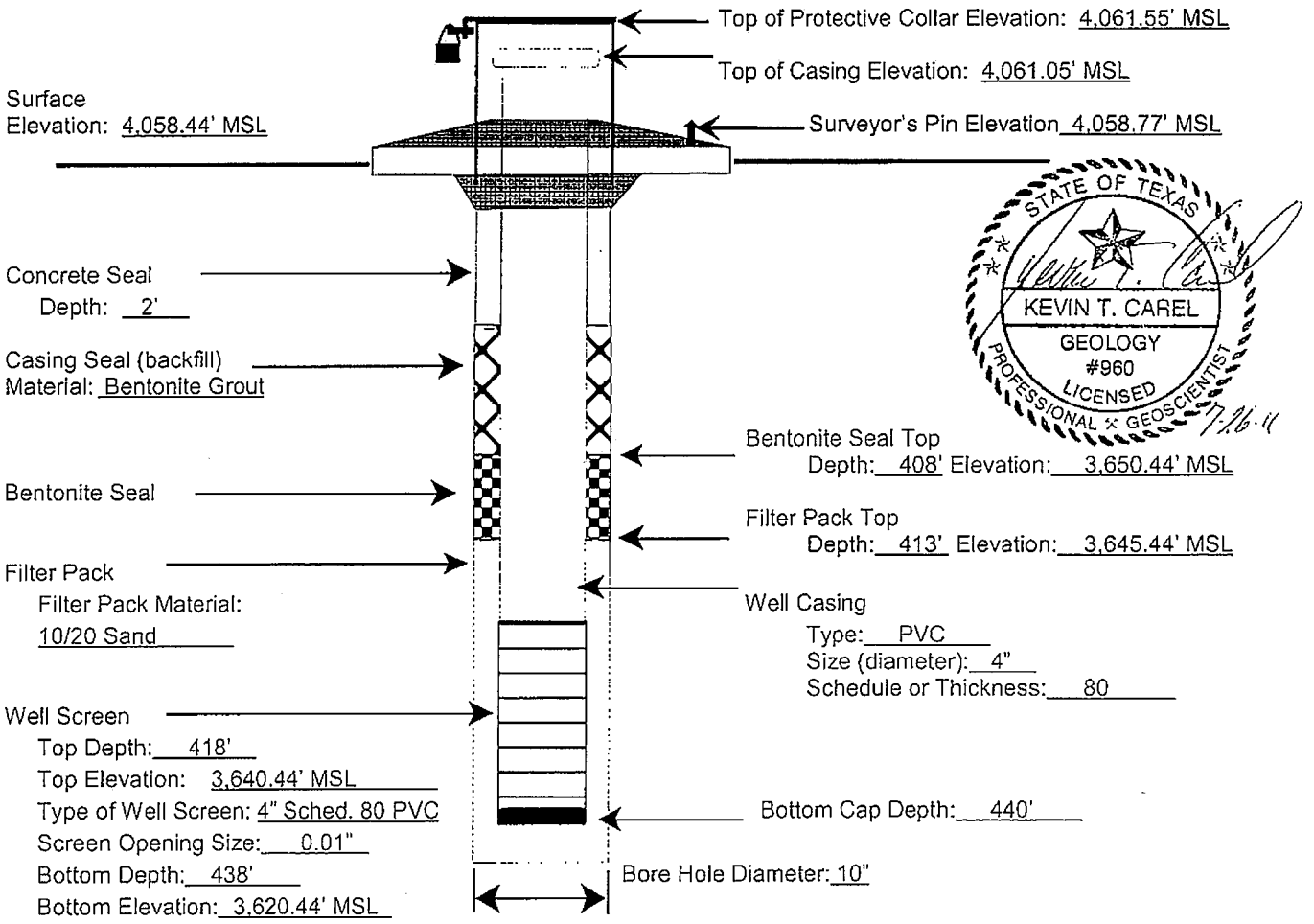
MSW Permit No.: 729A
Monitor Well I.D. No.: PZ-5
Date of Monitor Well Development: June 7, 2011
Monitor Well Driller
Name: William B. Bludworth
License No. 4885

**NOTES:**

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to nearest hundredth of a foot.
- Diameter of boring should be at least 4 inches larger than diameter of well casing.
- Use flush screw joint casing only, 2-inch diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommend).
- Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist, or Engineer Supervising Well Installation: Michael J. Hull, PG
Static Water Level Elevation (with respect to MSL) after Well Development: 3,653.97' MSL
Name of Geologic Formation(s) in which Well is completed: Hueco Bolson

Type of Locking Device: Pad Lock Type of Casing Protection: 6" x 6" x 5' Steel
Concrete Surface Pad (with steel reinforcement) Dimensions: 4' x 4' x 6"




TCEQ-10308

# LOG OF PIEZOMETER NO. PZ-5

Project Description: 2011 McCombs Landfill Piezometer Installations

CAREL CORPORATION

Location: McCombs Landfill
Top of PVC El.: 4061.05 feet MSL
Surface El.: 4058.44 feet MSL
Completion Depth: 441 feet
Date Boring Started: 5/23/2011
Date Boring Completed: 5/25/2011

Latitude: 31.991463
Longitude: 106.398291

| Depth, feet | Samples | Symbol/USCS | MATERIAL DESCRIPTION | Piezometer Construction Details | Piezometer Description |
|---|---|---|---|---|---|
| 0 | | | SAND, light reddish brown, well graded, subangular to subrounded, very fine to cobble grained, dry, loose, with gravel, quartz rich with feldspar and mafic minerals, multicolored grains | | Concrete from surface to 2' bgs |
| 35 | | | SAND, light reddish brown, well graded, coarse to cobble grained, dry, loose, with gravel, quartz rich with feldspar and mafic minerals, multicolored grains | | |
| 45 | | | SILTY CLAY, reddish brown, dry | | |
| 50 | | | SAND, light reddish brown, well graded, subangular to subrounded, fine to pebble grained, dry, loose, with gravel, iron oxide staining, quartz rich with feldspar and mafic minerals, multicolored grains | | |
| 60 | | | GRAVEL, brown, coarse to cobble grained, dry, loose | | |
| 65 | | | CLAY, light reddish brown, dry | | |
| 70 | | | SAND, light reddish brown, well graded, subangular to subrounded, fine to pebble grained, dry, loose | | |
| 75 | | | SAND, light reddish brown, well graded, subangular to subrounded, fine to coarse grained, dry, quartz rich, multicolored grains | | |
| 80 | | | SANDY CLAY, light reddish brown, dry, with silt | | |
| 85 | | | SAND, light brown, well graded, subrounded, fine to medium grained, dry, loose, iron oxide staining, quartz rich with feldspar and mafic minerals, multicolored grains | | |
| 90 | | | CLAY, dry | | |
| 95 | | | SAND, light grayish brown, well graded, subrounded, very fine to fine grained, dry, loose, iron oxide staining, quartz rich with feldspar and mafic minerals, multicolored grains | | |
| 100 | | | | | |

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST
7-19-11

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary with Casing Advance
Sampling Method: Cuttings
Geologist: Michael J. Hull, P.G.
Project No.: 10-01-22

| Groundwater Observations | |
|---|---|
| Date | Elevation (ft. MSL) |
| 05/24/11 | 3652.44 |
| 06/07/11 | 3653.97 |
| | |

Remarks: Speedstar 50K Drilling Rig. 10" diameter boring, 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface. Casing hammer continuous from 44' bgs to total depth.

EL PASO PZS MCCOMBS.GPJ CAREL.GDT 07/19/11



The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▼ Water level after drilling.

# LOG OF PIEZOMETER NO. PZ-5

Project Description: 2011 McCombs Landfill Piezometer Installations

Location: McCombs Landfill
Top of PVC El.: 4061.05 feet MSL
Surface El.: 4058.44 feet MSL
Completion Depth: 441 feet
Date Boring Started: 5/23/2011
Date Boring Completed: 5/25/2011
Latitude: 31.991463
Longitude: 106.398291

| Depth, feet | Samples | Symbol/USCS | MATERIAL DESCRIPTION | Piezometer Construction Details | Piezometer Description |
|---|---|---|---|---|---|
| 105 | | | SAND, light brown, well graded, subrounded, fine to medium grained, dry, loose, quartz rich with mafic minerals, multicolored grains | | |
| 110 | | | SAND, light gray, well graded, subangular to subrounded, fine to pebble grained, dry, loose, with gravel, quartz rich with mafic minerals, multicolored grains | | |
| 115 | | | | | |
| 120 | | | | | |
| 125 | | | | | |
| 130 | | | | | |
| 135 | | | | | |
| 140 | | | CLAY, reddish brown, dry | | |
| 145 | | | SAND, light gray, well graded, subangular to subrounded, fine to pebble grained, dry, loose, with volcanic rock fragments, and limestone, quartz rich with mafic minerals and limestone gravel fragments, multicolored grains | | |
| 150 | | | SAND, light grayish brown, poorly graded, rounded, fine grained, dry, loose, quartz rich with mafic minerals, multicolored grains | | |
| 155 | | | | | |
| 160 | | | SILTY SAND, light grayish brown, poorly graded, rounded, fine grained, dry, loose, Quartz Sand | | |
| 165 | | | | | |
| 170 | | | | | |
| 175 | | | SILTY SAND, reddish brown, well graded, round to subangular, very fine to cobble grained, dry, loose, with limestone, Quartz Sand with limestone gravel fragments | | |
| 180 | | | | | |
| 185 | | | | | |
| 190 | | | CLAY, reddish brown, dry | | |
| 195 | | | SAND, light reddish brown, poorly graded, subrounded, fine to medium grained, dry, loose, | | |
| 200 | | | | | |

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST
7-19-11

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary with Casing Advance
Sampling Method: Cuttings
Geologist: Michael J. Hull, P.G.
Project No.: 10-01-22

| Groundwater Observations | |
|---|---|
| Date | Elevation (ft. MSL) |
| 05/24/11 | 3652.44 |
| 06/07/11 | 3653.97 |
| | |

Remarks: Speedstar 50K Drilling Rig. 10" diameter boring, 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface. Casing hammer continuous from 44' bgs to total depth.

EL PASO PZS MCCOMBS GPJ CAREL GDT 07/19/11



The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▼ Water level after drilling.

# LOG OF PIEZOMETER NO. PZ-5

Project Description: 2011 McCombs Landfill Piezometer Installations

Location: McCombs Landfill
Top of PVC El.: 4061.05 feet MSL
Surface El.: 4058.44 feet MSL
Completion Depth: 441 feet
Date Boring Started: 5/23/2011
Date Boring Completed: 5/25/2011
Latitude: 31.991463
Longitude: 106.398291

| Depth, feet | Samples | Symbol/USCS | MATERIAL DESCRIPTION | Piezometer Construction Details | Piezometer Description |
|---|---|---|---|---|---|
| 205 | | | quartz rich with mafic minerals, multicolored grains | | |
| 210 | | | SAND, reddish brown, well graded, subrounded, fine grained, slightly moist, loose, quartz rich with mafic minerals, multicolored grains | | |
| 215 | | | SAND, light grayish brown, well graded, fine to medium grained, dry, loose, Quartz Sand | | |
| 220 | | | | | |
| 225 | | | SANDY GRAVEL, light grayish brown, well graded, subangular to well rounded, fine to pebble grained, dry, loose, with volcanic rock fragments, Quartz Sand | | |
| 230 | | | SAND, light grayish brown, well graded, subrounded, fine to medium grained, dry, loose, iron oxide staining, quartz rich with mafic minerals, multicolored grains | | |
| 235 | | | | | |
| 240 | | | | | |
| 245 | | | | | |
| 250 | | | SAND, light grayish brown, poorly graded, rounded, very fine to fine grained, dry, loose, quartz rich with mafic minerals, multicolored grains | | Bentonite grout from 2' to 408' bgs |
| 255 | | | | | |
| 260 | | | | | |
| 265 | | | | | |
| 270 | | | | | |
| 275 | | | | | |
| 280 | | | | | |
| 285 | | | | | |
| 290 | | | SAND, light brown, well graded, subrounded, fine to medium grained, dry, loose, Quartz Sand | | |
| 295 | | | | | |
| 300 | | | | | |

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST
7-19-11

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary with Casing Advance
Sampling Method: Cuttings
Geologist: Michael J. Hull, P.G.
Project No.: 10-01-22

| Groundwater Observations | |
|---|---|
| Date | Elevation (ft. MSL) |
| 05/24/11 | 3652.44 |
| 06/07/11 | 3653.97 |
| | |

Remarks: Speedstar 50K Drilling Rig. 10" diameter boring, 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface. Casing hammer continuous from 44' bgs to total depth.

EL PASO PZS MCCOMBS.GPJ CAREL.GDT 07/19/11



The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▼ Water level after drilling.

# LOG OF PIEZOMETER NO. PZ-5

Project Description: 2011 McCombs Landfill Piezometer Installations

Location: McCombs Landfill
Top of PVC El.: 4061.05 feet MSL
Surface El.: 4058.44 feet MSL
Completion Depth: 441 feet
Date Boring Started: 5/23/2011
Date Boring Completed: 5/25/2011
Latitude: 31.991463
Longitude: 106.398291

| Depth, feet | Samples | Symbol/USCS | MATERIAL DESCRIPTION | Piezometer Construction Details | Piezometer Description |
|---|---|---|---|---|---|
| 305 | | | SAND, light brown, well graded, subangular to subrounded, fine to pebble grained, slightly moist, loose, and gravel, Quartz Sand with Limestone Gravel | | |
| 310 | | | SAND, reddish brown, poorly graded, very fine grained, dry, loose, Quartz Sand | | |
| 315 | | | SANDY SILT, light brown, poorly graded, rounded, very fine grained, dry, loose | | |
| 320 | | | | | |
| 325 | | | SAND, light grayish brown, well graded, subangular to subrounded, fine to pebble grained, dry, loose, and volcanic rock fragments, and limestone, Quartz Sand with limestone and granite gravel fragments | | |
| 330 | | | CLAY, reddish brown, dry | | |
| 335 | | | SILTY SAND, reddish brown, poorly graded, rounded, dry, loose, iron oxide staining, Quartz Sand | | |
| 340 | | | SAND, light tannish brown, well graded, fine to pebble grained, slightly moist, loose, with gravel, Quartz Sand | | |
| 345 | | | CLAY, reddish brown, dry, calcareous | | |
| 350 | | | | | |
| 355 | | | | | |
| 360 | | | | | |
| 365 | | | SANDY CLAY, reddish brown, dry | | |
| 370 | | | ARKOSIC SAND, light reddish brown, well graded, rounded to subrounded, very fine to fine grained, dry, loose, quartz rich with mafic minerals, multicolored grains | | |
| 375 | | | | | |
| 380 | | | SAND, light reddish brown, well graded, subangular to subrounded, very fine to coarse grained, dry, loose, quartz rich with feldspar and mafic minerals, multicolored grains | | |
| 385 | | | SILTY CLAY, reddish brown, moist | | |
| 390 | | | CLAY, reddish brown, dry | | |
| 395 | | | SAND, reddish brown, poorly graded, rounded, fine grained, dry, loose | | |
| 400 | | | CLAY, reddish brown, slightly moist | | |

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST
7-19-11

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary with Casing Advance
Sampling Method: Cuttings
Geologist: Michael J. Hull, P.G.
Project No.: 10-01-22

| Groundwater Observations | |
|---|---|
| Date | Elevation (ft. MSL) |
| 05/24/11 | 3652.44 |
| 06/07/11 | 3653.97 |

Remarks: Speedstar 50K Drilling Rig. 10" diameter boring, 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface. Casing hammer continuous from 44' bgs to total depth.

EL PASO PZS MCCOMBS.GPJ CAREL.GDT 07/19/11



The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▼ Water level after drilling.

# LOG OF PIEZOMETER NO. PZ-5

Project Description: 2011 McCombs Landfill Piezometer Installations

The CAREL Corporation

Location: McCombs Landfill
Top of PVC El.: 4061.05 feet MSL
Surface El.: 4058.44 feet MSL
Completion Depth: 441 feet
Date Boring Started: 5/23/2011
Date Boring Completed: 5/25/2011

Latitude: 31.991463
Longitude: 106.398291

| Depth, feet | Samples | Symbol/USCS | MATERIAL DESCRIPTION | Piezometer Construction Details | Piezometer Description |
|---|---|---|---|---|---|
| 405 | | | SAND, reddish brown, poorly graded, rounded, fine grained, dry, loose, Quartz Sand | | |
| | | | CLAY, reddish brown, moist | | |
| 410 | | | SAND, reddish brown, poorly graded, rounded, fine grained, moist, loose<br>wet at 406' bgs | | Hydrated bentonite seal from 408' to 413' bgs |
| 415 | | | SAND, brown, poorly graded, rounded, fine grained, wet, loose, quartz rich with mafic minerals, multicolored grains | | 10/20 Silica sand from 413' to 441' bgs |
| 420 | | | SAND, light brown, well graded, subrounded to angular, fine to coarse grained, wet, loose, quartz rich with mafic minerals, multicolored grains | | |
| 425 | | | | | 0.01" Slotted screen from 418' to 438' bgs |
| 430 | | | SAND, brown, poorly graded, rounded, fine grained, loose, Quartz Sand | | |
| 435 | | | | | |
| 440 | | | SAND, brown, well graded, round to subangular, fine to pebble grained, loose, and volcanic rock fragments, and limestone, Quartz Sand with mafic minerals, limestone and granite gravel fragments, multicolored grains | | Two foot sediment trap |
| 445 | | | CLAY, reddish brown | | |
| 450 | | | | | |
| 455 | | | | | |
| 460 | | | | | |
| 465 | | | | | |
| 470 | | | | | |
| 475 | | | | | |
| 480 | | | | | |
| 485 | | | | | |
| 490 | | | | | |
| 495 | | | | | |
| 500 | | | | | |

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST

7-19-11

| | |
|---|---|
| Drilling Contractor: | WDC Exploration and Wells |
| Drilling Method: | Air Rotary with Casing Advance |
| Sampling Method: | Cuttings |
| Geologist: | Michael J. Hull, P.G. |
| Project No.: | 10-01-22 |

| Groundwater Observations | |
|---|---|
| Date | Elevation (ft. MSL) |
| 05/24/11 | 3652.44 |
| 06/07/11 | 3653.97 |
| | |

Remarks: Speedstar 50K Drilling Rig. 10" diameter boring, 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface. Casing hammer continuous from 44' bgs to total depth.

EL PASO PZS MCCOMBS.GPJ CAREL.GDT 07/19/11



The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▽ Water level after drilling.

# TCEQ CORRESPONDENCE

Bryan W. Shaw, Ph.D., *Chairman*
Buddy Garcia, *Commissioner*
Carlos Rubinstein, *Commissioner*
Mark R. Vickery, P.G., *Executive Director*

FEB 2 5 2010
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PSC

# TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

*Protecting Texas by Reducing and Preventing Pollution*

February 19, 2010

Ms. Ellen A. Smyth, P.E.
Director of Environmental Services
City of El Paso
7969 San Paulo Drive
El Paso, Texas 79907-1246

Re: City of El Paso McCombs Municipal Landfill – El Paso County
Municipal Solid Waste – Permit No. 729A
Permit Modification – Groundwater Monitoring System – Status Update
Tracking No. 12963070; RN100215599 / CN601410244

Dear Ms. Smyth:

This letter acknowledges that we received a response to our letter dated December 14, 2009, regarding your application for a municipal solid waste permit modification dated January 2, 2008 (and revisions), proposing changes to the Site Characterization and Monitoring Plan for the referenced facility. The response indicated that the facility would begin monitoring in accordance with the facility Groundwater Sampling and Analysis Plan in existing monitor wells MW-1, 2, and 3, and in piezometer PZ-5 at the first event following the installation of PZ-5, as requested in our letter.

Thank you for the response. We will look forward to receiving groundwater monitoring results later this year as indicated in the response letter, as well as the results of the additional groundwater investigation that is to take place this year, and following that a completed monitoring system design.

If you have questions regarding this letter, please contact me at (512) 239-4419. When addressing written correspondence, please use mail code MC 124.

Sincerely,

Arten J. Avakian, P.G., Project Manager
Municipal Solid Waste Permits Section
Waste Permits Division

AJA/fp

cc: Mr. Robert H. Holder, P.E., Parkhill, Smith & Cooper, Inc., Lubbock
Mr. Kevin T. Carel, P.G., The Carel Corporation, Keller

Bryan W. Shaw, Ph.D., *Chairman*
Buddy Garcia, *Commissioner*
Carlos Rubinstein, *Commissioner*
Mark R. Vickery, P.G., *Executive Director*

DEC 18 2009
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PSC

# TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

*Protecting Texas by Reducing and Preventing Pollution*

December 14, 2009

Ms. Ellen A. Smyth, P.E.
Director of Environmental Services
City of El Paso
7969 San Paulo Drive
El Paso, Texas 79907-1246

Re: City of El Paso McCombs Municipal Landfill – El Paso County
Municipal Solid Waste – Permit No. 729A
Permit Modification – Groundwater Monitoring System – Notice of Deficiency
Tracking No. 12904919; RN100215599 / CN601410244

Dear Ms. Smyth:

We have reviewed your application for a municipal solid waste permit modification dated January 2, 2008, and the revisions dated July 6, 2009, September 10, 2009, and November 6, 2009, proposing changes to the Site Characterization and Monitoring Plan for the referenced facility. The purpose of the changes is to address the revised groundwater monitoring and corrective action requirements in Title 30 Texas Administrative Code (30 TAC), Chapter 330, Subchapter J that became effective March 27, 2006 (2006 Revisions). The most recent revisions were submitted in response to comments in our letter dated October 8, 2009.

Thank you for the submittal. In our letter dated October 8, 2009, we advised that you may proceed with your plan to install two piezometers (PZ-4 and PZ-5) and conduct additional groundwater investigations for one year, and to submit a completed monitoring system design after the investigation. We also commented that during the interim you should begin groundwater monitoring in existing monitor wells MW-1, MW-2, and MW-3, and in piezometers PZ-4 and PZ-5 in accordance with the recently modified Groundwater Sampling and Analysis Plan (GWSAP) for the facility. The response to that comment requested that monitoring of the piezometers be delayed until after the additional investigation is complete and the hydraulic position of the piezometers is confirmed. According to information in the application, the location for PZ-4 may be upgradient of waste cells (instead of downgradient as indicated in the existing permit); however, it appears the location proposed for PZ-5 is downgradient from waste cells based on information in the existing permit and in the application. In addition, the location for PZ-5 may be on a groundwater flow path that leads back to existing landfill cells where waste has already been placed. It seems justifiable to delay sampling of PZ-4 (which may be upgradient), but not PZ-5.

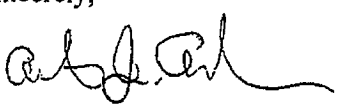
We therefore are modifying the request in our letter dated October 8, 2009, and ask that you begin monitoring in accordance with the facility GWSAP in existing monitor wells MW-1, 2, and 3, and in piezometer PZ-5 at the first event following the installation of PZ-5.

Please respond within 30 days from the date of this letter. As a reminder, when you later revise your application, please ensure that each page has a header or footer that indicates the revision number and date, in accordance with 30 TAC §330.57. The revised and/or additional pages should be in a form suitable for replacement and/or inclusion in the initial permit modification application. In accordance with 30 TAC §305.44, please include an original certification statement with the revision. Along with the original signature and date, the certification statement should indicate the name, title, and address of the responsible official.

Also, when you submit the next revision, please provide one original, two unmarked copies, and one marked copy (for example, in redline/strikeout format) of the revisions in accordance with 30 TAC §305.70(f), to facilitate our review. Please send one of the unmarked copies directly to TCEQ Region 6, to the attention of Mr. Kent Waggoner, Waste Section Manager, 401 East Franklin Avenue, Suite 560, El Paso, Texas 79901-1212. Also, please include the tracking number referenced above in the subject line of your response. Note that we may have additional comments after we review the revised application.

If you have questions regarding this letter, please contact me at (512) 239-4419. When addressing written correspondence, please use mail code MC 124.

Sincerely,



Arten J. Avakian, P.G., Project Manager
Municipal Solid Waste Permits Section
Waste Permits Division
Texas Commission on Environmental Quality

AJA/lh

cc: Mr. Robert H. Holder, P.E., Parkhill, Smith & Cooper, Inc., Lubbock
Mr. Kevin T. Carel, P.G., The Carel Corporation, Keller

Bryan W. Shaw, Ph.D., *Chairman*
Buddy Garcia, *Commissioner*
Carlos Rubinstein, *Commissioner*
Mark R. Vickery, P.G., *Executive Director*

received
10/15/09

# TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

*Protecting Texas by Reducing and Preventing Pollution*

October 9, 2009

Ms. Ellen Smyth P.E., Director
El Paso Environmental Services
7969 San Paulo
El Paso, TX 79907

Re: McCombs Landfill – El Paso County
Municipal Solid Waste - Permit No. 729A
Permit Modification – Groundwater Sampling and Analysis Plan (GWSAP)
Tracking Nos. 11969813 and 12831440; RN100215599/CN601410244

Dear Ms. Smyth:

We have reviewed your application for a municipal solid waste permit modification dated January 2, 2008, and the revision received September 11, 2009 requesting changes to the GWSAP for the referenced facility. The purpose of the requested changes is to address the revised groundwater monitoring and corrective action requirements in Title 30 Texas Administrative Code, Chapter 330, Subchapter J that became effective March 27, 2006 (2006 Revisions). The information presented is technically sufficient for a municipal solid waste permit modification.

Enclosed is a copy of the above referenced modification which is now part of your permit and should be attached thereto. The documentation prepared and submitted to support the modification request shall be considered as requirements of the permit.

If you have questions concerning this matter, please contact Ms. Eleanore Whitworth at (512) 239-2347. When addressing written correspondence, please use mail code MC 124.

This action is taken under authority delegated by the Executive Director of the Texas Commission on Environmental Quality.

Sincerely,

Richard C. Carmichael, Ph.D., P.E.
Manager, Municipal Solid Waste Permits Section
Waste Permits Division

RCC/EDW/fp

cc: The Honorable John Cook, Mayor, City of El Paso
Mr. Robert Holly Holder, P.E., Parkhill Smith and Cooper, Inc., Lubbock
Mr. Kevin T. Carel, P.G., The Carel Corporation, Keller

Enclosure

# TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

**MODIFICATION TO**

**MUNICIPAL SOLID WASTE PERMIT NO. 729A**

**CITY OF EL PASO MCCOMBS LANDFILL**

Municipal Solid Waste Permit No. 729A is hereby modified as follows:

Description of Change:

Authorizes changes to the Groundwater Sampling and Analysis Plan to address the revised groundwater monitoring and corrective action requirements of Title 30 Texas Administrative Code, Chapter 330, Subchapter J that became effective March 27, 2006, (2006 Revisions).

The details of this permit modification are contained in the application dated January 2, 2009, and the revision dated September 10, 2009.

Part of Permit Modified:

Site Development Plan

Attachment 11, Groundwater Sampling and Analysis Plan

This modification is a part of Permit No. 729A and should be attached thereto.

APPROVED, ISSUED, AND EFFECTIVE in accordance with Title 30 Texas Administrative Code, Chapter 305, Section 305.70(j)(23) and Chapter 330, Subchapter J.

ISSUED DATE:

OCT 09 2009

For the Commission

# MATERIAL INFORMATION

# AND MSDS SAFETY SHEETS

Carmeuse Industrial Sands, Inc.
11 Stanwix Street, 11th Floor
Pittsburgh, PA 15222
Phone: 412-995-5500
Fax: 412-995-5594

Date of Revision: 07/15/2009
Revision No. 3

# Material Safety Data Sheet

| Product Name: | **SAND** |
|---|---|

*INFOTRAC: 800-535-5053 [In case of an emergency call this number 24 HOURS a day 7 DAYS a week.]*

## SECTION 1 - IDENTIFICATION OF THE SUBSTANCE AND COMPANY

**1.1. Identification of the substance:**

| | |
|---|---|
| Chemical name: | Silica |
| Product name & synonyms: | Silica Sand, Colorado Silica Sand ®, Glass Sand, Flint, Sand, Silica Sand, Quartz, Crystalline Silica, Flint, Ground Silica, Foundry Sand, Engine Sand, Frac Sand, Filtration Sand, Bunker Sand, Turf Sand, Glass Sand, Silica Flour, Natural alluvial sand and gravel, ¾, $^5/_8$, ½, ¼, #4, #6, #12, #16, #20, #30, #60, #80, 4x50, Root Zone, Top Dressing, Bunker Sand, Play Sand, Masonry, Plaster Sand, $^1/_{8th}$ washed, .45-.55, Davis, or blends. |
| Formula: | $SiO_2$ |
| Material Uses: | Industries such as gas & oil, water filtration, construction materials, cement, non-skid surfaces, fillers, golf course sand, artificial athletic sands and insecticides |

**1.2. Company:**

Main Office:
11 Stanwix Street, 11th Floor
Pittsburgh, PA 15222
Telephone: 412-995-5500
Fax: 412-995-5594

Canadian Office:
P.O. Box 190
Ingersoll, Ontario N5C 3K5
Telephone: 519-423-6283
Fax: 519-423-6545

## SECTION 2 - COMPOSITION / INFORMATION ON INGREDIENTS

| Ingredient | % by Weight | CAS # | Exposure Limits |
|---|---|---|---|
| Crystalline silica quartz | 90.0 – 99.9 | 14808-60-7 | OSHA PEL: 30 mg/m³ / (% silica + 2) (total)<br>10 mg/m³ / (% silica + 2) (respirable)<br>ACGIH TLV: 0.025 mg/m³ (respirable) |

This material is classified as hazardous under OSHA regulations.

**WARNING: Never Use This Material for Sand Blasting**

| Product Name: | SAND (continued) |
|---|---|

## SECTION 3 – HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: A white or tan sand, or ground sand. It is not flammable, combustible or explosive. Do not breathe this material. Crystalline silica (quartz) is not known to be an environmental hazard. Crystalline silica (quartz) is incompatible with hydrofluoric acid, fluorine, chlorine trifluoride or oxygen difluoride.

POTENTIAL HEALTH EFFECTS

EYE Contact can cause moderate to severe irritation of eyes, including discomfort or pain, local redness and swelling of the conjuctiva.

SKIN Contact can cause dryness or moderate irritation of skin.

INGESTION None known.

INHALATION If inhaled as dust, this product can cause irritation of the respiratory system resulting in coughing and/or sneezing. Higher exposures may cause a build-up of fluid in the lungs with severe shortness of breath. Inhalation of silica can also cause a chronic irreversible lung disorder, silicosis. Some medical reports state inhalation of silica dust may cause lung cancer.

Per ACGIH, adverse effects are not likely to occur in the workplace provided exposure levels do not exceed the appropriate TLVs/PELs. See Section 8. However, because of the wide variation in individual susceptibility, lower exposure limits may be appropriate for some individuals including persons with pre-existing medical conditions.

CHRONIC EFFECTS / CARCINOGENICITY: Silicosis, cancer, scleroderma, tuberculosis, nephrotoxicity and arthritis are potential chronic effects. See Section 11 for further information regarding these conditions

SIGNS AND SYMPTOMS OF EXPOSURE: There are generally no signs or symptoms of exposure to crystalline silica (quartz). Often, chronic silicosis has no symptoms. The symptoms of chronic silicosis, if present, are shortness of breath, wheezing, cough and sputum production. The symptoms of acute silicosis are the same; additionally, weight loss and fever are associated with acute silicosis. The symptoms of scleroderma include thickening and stiffness of the skin, particularly in the fingers, shortness of breath, difficulty swallowing and joint problems.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE: The condition of individuals with lung disease (e.g., bronchitis, emphysema, chronic obstructive pulmonary disease) can be aggravated by exposure. See Section 11 for additional detail on potential adverse health effects.

POTENTIAL ENVIRONMENTAL EFFECTS: None known.

## SECTION 4 – FIRST AID MEASURES

EYE Quickly and gently blot or brush away sand. Immediately flush the contaminated eye(s) with lukewarm, gently flowing water for at least 15 minutes or until the sand is removed, while holding the eyelid(s) open. Occasionally lift eyelid(s) to ensure thorough rinsing. Beyond flushing, do not attempt to remove material from eye(s). Do not rub eyes. Seek medical attention immediately.

SKIN Wash with soap and water. Seek medical attention if irritation persists.

INGESTION Never give anything by mouth if the victim is rapidly losing consciousness, or is unconscious or convulsing. Have victim rinse mouth thoroughly with water. If irritation or discomfort occurs, obtain medical advice immediately.

INHALATION Remove source of contamination or move victim to fresh air. Seek medical attention if necessary. If breathing has stopped, give artificial respiration.

| Product Name: | SAND (continued) |
|---|---|

## SECTION 5 – FIRE FIGHTING MEASURES

Flammable Properties

Flash Point: Not flammable Method: N/A

| | |
|---|---|
| EXTINGUISHING MEDIA | None required. Use suitable extinguishing media for surrounding fire. |
| FIRE & EXPLOSION HAZARDS | None |
| FIRE FIGHTING INSTRUCTIONS | None |

## SECTION 6 – ACCIDENTAL RELEASE MEASURES

SPILL /LEAK PROCEDURES — Use dustless methods (vacuum) and place in closable container for disposal or flush with water. Do not dry sweep. Use proper protective equipment indicated in Section 8.

## SECTION 7 – HANDLING AND STORAGE

HANDLING — Keep in tightly closed containers. Protect containers from physical damage. Avoid direct skin contact with the material.

Silica sand material contains fine dust. If you breathe this dust you can suffer severe, irreversible lung damage and death. Some medical reports state inhalation of silica dust may cause lung cancer. Medical reports also link breathing silica dust to crippling arthritis and skin and eye irritation. See Section 11 for further information.

You must never use this material without having a government-approved respirator. The work area must also be thoroughly ventilated by the use of forced air ventilation during and after use of this material.

If dusty, use protective goggles. An eye wash station should be readily available where this product is used.

Prior to use or handling, you are advised to review and thoroughly understand all health precautions outlined in the Material Safety Data Sheet (MSDS).

STORAGE — Store in a cool, dry, and well-ventilated location. Do not store near incompatible materials. (See Section 10 for list of incompatible materials.) Avoid breakage of bagged materials or spills of bulk material.

| Product Name: | SAND (continued) |
|---|---|

## SECTION 8 – EXPOSURE CONTROLS / PERSONAL PROTECTION

**ENGINEERING CONTROLS**

Use sufficient local exhaust to reduce the level of respirable crystalline silica to below the PEL. See ACGIH "Industrial Ventilation, A Manual of Recommended Practice" (latest edition).

**RESPIRATORY PROTECTION**

Use NIOSH/MSHA approved respirators if airborne concentration exceeds PEL. It is a violation of federal safety laws (OSHA) for employers to require workers to use this material without full respiratory protection. The federal laws that apply are: 29CFR 1910.134; 29CFR 1910.1000; 29CFR 1910.94.

The following chart specifies the types of respirators that may provide respiratory protection for crystalline silica.

| Particulate Concentration | MINIMUM RESPIRATORY PROTECTION* |
|---|---|
| 10 x PEL or less | Any particulate respirator, except single -use or quarter-mask respirator.<br>Any fume respirator or high efficiency particulate filter respirator.<br>Any supplied-air respirator.<br>Any self-contained breathing apparatus. |
| 50 x PEL or less | A high efficiency particulate filter respirator with a full facepiece.<br>Any supplied-air respirator with a full facepiece, helmet, or hood.<br>Any self-contained breathing apparatus with a full facepiece. |
| 500 x PEL or less | A powered air-purifying respirator with a high efficiency particulate filter.<br>A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode. |
| Greater than 500 x PEL or entry and escape from unknown concentrations | A type C, supplied-air respirator with a full facepiece, hood, or helmet, operated in a positive pressure mode (see 29 CFR 1910.94(a)(iii)).<br>Also see 30 CFR Part 11. |

*Use only NIOSH-approved or MSHA-approved equipment. See 29 CFR §1910.134 and 42 CFR §84.

See also ANSI standard Z88.2 (latest revision) "American National Standard for Respiratory Protection"

**SKIN PROTECTION**

Use appropriate gloves to prevent skin contact. Clothing should fully cover arms and legs and be tight fitting at the cuffs, neck and ankles to prevent dust from contacting the body. Clothing should be regularly washed to prevent dust accumulation.

**EYE PROTECTION**

Use safety goggles.

| EXPOSURE GUIDELINES | OSHA PEL | ACGIH TLV |
|---|---|---|
| Crystalline silica (respirable) | 10 $mg/m^3$ ÷ (% silica in the dust plus 2) | 0.025 $mg/m^3$ |

Crystalline silica exists in several forms, the most common of which is quartz. If crystalline silica (quartz) is heated to more than 870°C it can change to a form of crystalline silica known as trydimite, and if crystalline silica (quartz) is heated to more than 1470°C, it can change to a form of crystalline silica known as cristobalite. Crystalline silica as trydimite and cristobalite are more fibrogenic than crystalline silica as quartz. The OSHA PEL for crystalline silica as trydimite and cristobalite is one-half the PEL for crystalline silica (quartz); the ACGIH TLV for crystalline silica as trydimite and cristobalite is one-half the TLV for crystalline silica as quartz.

| Product Name: | SAND (continued) |
|---|---|

## SECTION 9 – PHYSICAL AND CHEMICAL PROPERTIES

| | |
|---|---|
| APPEARANCE | White or tan sand; granular, crushed, or ground |
| ODOR | Odorless |
| BOILING POINT | 4046°F |
| MELTING POINT | 3110°F |
| VAPOR PRESSURE | N/A |
| SOLUBILITY IN WATER | Insoluble |
| SPECIFIC GRAVITY | 2.65 |
| pH | N/Ap |

## SECTION 10 – STABILITY AND REACTIVITY

| | |
|---|---|
| STABILITY | Chemically stable. |
| MATERIALS TO AVOID | Contact with powerful oxidizing agents such as fluorine, boron trifluoride, chlorine trifluoride, manganese trifluoride, oxygen difluoride, may cause fires and/or explosions. |
| CONDITIONS TO AVOID | None |
| HAZARDOUS DECOMPOSITION PRODUCTS | Silica will dissolve in hydrofluoric acid and produce a corrosive gas – silicon tetrafluoride. |

## SECTION 11 – TOXICOLOGICAL INFORMATION

No $LD_{50}$ or $LC_{50}$ have been identified for this product.

SILICOSIS

The major concern is silicosis, caused by the inhalation and retention of respirable crystalline silica dust. Silicosis can exist in several forms, chronic (or ordinary), accelerated, or acute.

Chronic or Ordinary Silicosis is the most common form of silicosis, and can occur after many years of exposure to relatively low levels of airborne respirable crystalline silica dust. It is further defined as either simple or complicated silicosis.

> Simple silicosis is characterized by lung lesions (shown as radiographic opacities) less than 1 centimeter in diameter, primarily in the upper lung zones. Often, simple silicosis is not associated with symptoms, detectable changes in lung function or disability. Simple silicosis may be progressive and may develop into complicated silicosis or progressive massive fibrosis (PMF).
>
> Complicated silicosis or PMF is characterized by lung lesions (shown as radiographic opacities) greater than 1 centimeter in diameter. Although there may be no symptoms associated with complicated silicosis or PMF, the symptoms, if present, are shortness of breath, wheezing, cough and sputum production. Complicated silicosis or PMF may be associated with decreased lung function and may be disabling. Advanced complicated silicosis or PMF may lead to death. Advanced complicated silicosis or PMF can result in heart disease secondary to the lung disease (cor pumonale).

Accelerated Silicosis can occur with exposure to high concentrations of respirable crystalline silica over a relatively short period; the lung lesions can appear within five (5) years of the initial exposure. The progression can be rapid. Accelerated silicosis is similar to chronic or ordinary silicosis, except that the lung lesions appear earlier and the progression is more rapid.

Acute Silicosis can occur with exposures to very high concentrations of respirable crystalline silica over a very short time period, sometimes as short as a few months. The symptoms of acute silicosis include progressive shortness of breath, fever, cough and weight loss. Acute silicosis is fatal.

CANCER

IARC - The International Agency for Research on Cancer ("IARC") concluded that there was "*sufficient evidence* in humans for the carcinogenicity of crystalline silica in the forms of quartz or cristobalite from occupational sources", and that there is "*sufficient evidence* in experimental animals for the carcinogenicity of quartz and cristobalite." The overall IARC evaluation was that "crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is *carcinogenic to humans*

*(Group 1)*." The IARC evaluation noted that "carcinogenicity was not detected in all industrial circumstances studies. Carcinogenicity may be dependent on inherent characteristics of the crystalline silica or on external factors affecting its biological activity or distribution of its polymorphs." For further information on the IARC evaluation, see IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Volume 68, "Silica, Some Silicates..." (1997). (Emphasis added)

NTP - The National Toxicology Program, in its Sixth Annual Report on Carcinogens, concluded that "silica, crystalline (respirable)" may reasonably be anticipated to be a carcinogen, based on sufficient evidence in experimental animals and limited evidence in humans.

OSHA - Crystalline silica (quartz) is not regulated by the U. S. Occupational Safety and Health Administration as a carcinogen.

There is substantial literature on the issues of the carcinogenicity of crystalline silica, which the reader should consult for additional information. A summary of the literature is set forth in "Exposure to crystalline silica and risk of lung cancer; the epidemiological evidence", Thorax, Volume 51, pp. 97-102 (1996). The official statement of the American Thoracic Society on the issue of silica carcinogenicity was published in "Adverse Effects of Crystalline Silica Exposure", American Journal of Respiratory and Critical Care Medicine, Volume 155, pp. 761-765 (1997). The official statement concluded that "The available data support the conclusion that silicosis produces increased risk for bronchogenic carcinoma. The cancer risk may also be increased by smoking and other carcinogens in the workplace. Epidemiologic studies provide convincing evidence for increased cancer risk among tobacco smokers with silicosis. Less information is available for never-smokers and for workers exposed to silica but who do not have silicosis. For workers with silicosis, the risks for lung cancer are relatively high and consistent among various countries and investigators. Silicosis should be considered a condition that predisposes workers to an increased risk of lung cancer." Id. at 763.

SCLERODERMA

There is evidence that exposure to respirable crystalline silica or that the disease silicosis is associated with the increased incidence of scleroderma, an immune system disorder manifested by a fibrosis (scarring) of the lungs, skin and other internal organs. Recently, the American Thoracic Society noted that "there is persuasive evidence relating scleroderma to occupational silica exposures in setting where there is appreciable silicosis risk." The following may be consulted for additional information on silica, silicosis and scleroderma (also known as progressive systemic sclerosis): Occupational Lung Disorders, Third Edition, Chapter 12, entitled "Silicosis and Related Diseases", Parkes, W. Raymond (1994). "Adverse Effects of Crystalline Silica Exposure", American Journal of Respiratory and Critical Care Medicine, Volume 155, pp. 761-765 (1997).

TUBERCULOSIS

Individuals with silicosis are at increased risk to develop tuberculosis, if exposed to persons with tuberculosis. The following may be consulted for further information: Occupational Lung Disorders, Third Edition, Chapter 12, entitled "Silicosis and Related Diseases", Parkes, W. Raymond (1994). "Adverse Effects of Crystalline Silica Exposure", American Journal of Respiratory and Critical Care Medicine, Volume 155, pp. 761-765 (1997). Silica Sand (Brady, Colorado Springs, Riverside, Bakersfield)

NEPHROTOXICITY

There are several recent studies suggesting that exposure to respirable crystalline silica or that the disease silicosis is associated with the increased incidence of kidney disorders. The following may be consulted for additional information on silica, silicosis and nephrotoxicity: Occupational Lung Disorders, Third Edition, Chapter 12, entitled "Silicosis and Related Diseases", Parkes, W. Raymond (1994). "Further evidence of human silica nephrotoxicity in occupationally exposed workers", British Journal of Industrial Medicine, Vol. 50, No. 10, pp. 907-912 (1993). "Adverse Effects of Crystalline Silica Exposure", American Journal of Respiratory and Critical Care Medicine, Volume 155, pp. 761-765 (1997).

ARTHRITIS

There are recent studies suggesting that exposure to respirable crystalline silica or that the disease silicosis is associated with the increased incidence of arthritis. The following may be consulted for additional information on silica exposure and arthritis: American Journal of Industrial Medicine, Volume 35, pp. 375-381 "Connective Tissue Disease and Silicosis", Rosenman KD; Moore-Fuller M.; Reilly MJ. (1999). Environmental Health Perspective, Volume 107, pp. 793-802 "Occupational Exposure to Crystalline Silica and Autoimmune Disease", Parks CG; Conrad K; Cooper GS. (1999).

| Product Name: | SAND (continued) |
|---|---|

## SECTION 12 – ECOLOGICAL INFORMATION

ECOTOXICITY: Crystalline silica (quartz) is not known to be ecotoxic; i.e., no data suggests that crystalline silica (quartz) is toxic to birds, fish, invertebrates, microorganisms or plants.

ENVIRONMENTAL FATE: This material shows no bioaccumulation effect or food chain concentration toxicity.

## SECTION 13 – DISPOSAL CONSIDERATIONS

Dispose of in accordance with all applicable federal, state, and local environmental regulations. The material may be landfilled; however, used material may contain materials derived from other sources that because of contamination may not be disposed of in landfills. Disposed material should be covered to minimize generation of airborne dust.

RCRA: Crystalline silica (quartz) is not classified as a hazardous waste under the Resource Conservation and Recovery Act, or its regulations, 40 CFR §261 et seq. However, the material may be contaminated during use, and it is the responsibility of the user to assess the appropriate disposal of the used material.

## SECTION 14 – TRANSPORT INFORMATION

| | |
|---|---|
| US DOT | Not regulated |
| Proper Shipping Name | NA |
| Class | NA |
| UN Number | NA |
| Packing Group | NA |

## SECTION 15 – REGULATORY INFORMATION

United States

**EPA**

RCRA Hazardous Waste Number: not listed (40 CFR 261.33)
RCRA Hazardous Waste Classification (40 CFR 261): not classified
CERCLA Hazardous Substance (40 CFR 302.4) unlisted specific per RCRA, Sec. 3001; CWA, Sec. 311(b)(4); CWA, Sec. 307(a), CAA, Sec. 112
CERCLA Reportable Quantity (RQ): not listed.
SARA 311/312 Codes: not listed.
SARA Toxic Chemical (40 CFR 372.65): not listed.
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed, Threshold Planning Quantity (TPQ): not listed.
TSCA: All chemical ingredients are listed on the U.S. TSCA Inventory List.
FDA: Silica is included in the list of substances that may be included in coatings used in food contact surfaces, 21 CFR §175.300(b)(3)(xxvi).
California Proposition 65: Respirable crystalline silica (quartz) is classified as a substance known to the state of California to be a carcinogen.

**OSHA/MSHA Regulations**

Air contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A): 5 mg/m$^3$ TWA-8
MSHA: not listed.
OSHA Specifically Regulated Substance (29CFR 1910): not listed.

## SECTION 16 – OTHER INFORMATION

**HMIS**: Health Risks 0*, Flammability 0, Reactivity 0, Personal Protection, E

**NFPA**: Health Hazard 0, Fire Hazard 0, Reactivity 0

The information contained herein is believed to be accurate and reliable as of the date hereof. However, Carmeuse makes no representation, warranty or guarantee as to results or as to the information's accuracy, reliability or completeness. Carmeuse has no liability for any loss or damage that may result from use of the information. Each user is responsible to review this information, satisfy itself as to the information's suitability and completeness, and circulate the information to its employees, customers and other appropriate third parties.

CARMEUSE
NATURAL CHEMICALS

U.S. Sieve Sizes - Individual Percent Weight Retained

| 6/9 | | 8/12 | | 8/16 | | 10/16 | | 10/20 | | 12/20 | | 16/30 | | 20/40 | | 30/70 | | 100 Mesh | | Traction Sand | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sieve | % | Sieve | % | Sieve | % | Sieve | % | Sieve | % | Sieve | % | Sieve | % | Sieve | % | Sieve | % | Sieve | % | Sieve | % |
| 5 | 1.04-2.4 | 5 | — | 5 | — | 5 | — | 5 | — | 5 | — | 5 | — | 5 | — | 5 | — | 5 | — | 5 | — |
| 6 | 3.2-3.8 | 6 | — | 6 | — | 6 | — | 6 | — | 6 | — | 6 | — | 6 | — | 6 | — | 6 | — | 6 | — |
| 7 | 12.3-14.2 | 7 | — | 7 | — | 7 | — | 7 | — | 7 | — | 7 | — | 7 | — | 7 | — | 7 | — | 7 | — |
| 8 | 51.4-57.3 | 8 | 2.8-4.8 | 8 | 0.78-0.97 | 8 | — | 8 | — | 8 | — | 8 | — | 8 | — | 8 | — | 8 | — | 8 | — |
| 10 | 21.2-29.8 | 10 | 54.7-56.8 | 10 | 15.4-23.3 | 10 | 1.0-3.5 | 10 | 1.36-1.39 | 10 | 0.1-0.9 | 10 | — | 10 | — | 10 | — | 10 | — | 10 | — |
| 12 | 0.2-1.3 | 12 | 36.7-37.2 | 12 | 24.1-37.9 | 12 | 35.0-55.0 | 12 | 3.8-17.4 | 12 | 9.6-11.6 | 12 | — | 12 | — | 12 | — | 12 | — | 12 | — |
| 14 | — | 14 | 2.9-3.4 | 14 | 31.0-40.1 | 14 | 90.0-95.0 | 14 | 31.7-35.2 | 14 | 33.5-49.1 | 14 | 0.15-0.93 | 14 | — | 14 | — | 14 | — | 14 | — |
| 16 | — | 16 | 0.08-0.12 | 16 | 10.4-10.9 | 16 | 97.0-99.0 | 16 | 31.4-39.3 | 16 | 23.5-37.0 | 16 | 0.69-2.53 | 16 | — | 16 | — | 16 | — | 16 | — |
| 18 | — | 18 | — | 18 | 0.4-3.9 | 18 | — | 18 | 12.1-19.5 | 18 | 15.6-15.7 | 18 | 25.4-40.8 | 18 | — | 18 | — | 18 | — | 18 | — |
| 20 | — | 20 | — | 20 | — | 20 | — | 20 | 1.5-2.4 | 20 | 0.9-1.5 | 20 | 26.0-29.7 | 20 | 0.12-0.63 | 20 | — | 20 | — | 20 | — |
| 30 | — | 30 | — | 30 | — | 30 | — | 30 | — | 30 | — | 30 | 7.1-11.6 | 30 | 28.9-56.3 | 30 | — | 30 | — | 30 | 56.6-65.8 |
| 40 | — | 40 | — | 40 | — | 40 | — | 40 | — | 40 | — | 40 | — | 40 | 15.4-26.2 | 40 | 15.2-18.5 | 40 | — | 40 | 0.04-36.4 |
| 50 | — | 50 | — | 50 | — | 50 | — | 50 | — | 50 | — | 50 | — | 50 | — | 50 | 35.5-58.0 | 50 | 1.7-5.4 | 50 | 1.38-29.3 |
| 60 | — | 60 | — | 60 | — | 60 | — | 60 | — | 60 | — | 60 | — | 60 | — | 60 | 15.6-27.2 | 60 | 10.1-15.1 | 60 | 5.1-17.4 |
| 70 | — | 70 | — | 70 | — | 70 | — | 70 | — | 70 | — | 70 | — | 70 | — | 70 | 7.3-7.8 | 70 | 15.7-19.0 | 70 | 7.73-11.9 |
| 100 | — | 100 | — | 100 | — | 100 | — | 100 | — | 100 | — | 100 | — | 100 | — | 100 | 3.0-8.2 | 100 | 30.8-34.1 | 100 | 6.2-9.56 |
| 140 | — | 140 | — | 140 | — | 140 | — | 140 | — | 140 | — | 140 | — | 140 | — | 140 | 2.3-0.1 | 140 | 17.7-21.7 | 140 | — |
| 200 | — | 200 | — | 200 | — | 200 | — | 200 | — | 200 | — | 200 | — | 200 | — | 200 | 0.09-0.07 | 200 | 8.4-9.1 | 200 | — |
| Pan | 0-0.5 | Pan | 0-0.1 | Pan | 0-0.1 | Pan | 0-.0.1 | Pan | 0-0.1 | Pan | 0-1 | Pan | 0-1 | Pan | 0-0.1 | Pan | 0-0.1 | Pan | 0-1 | Pan | 0-1 |
| E.S. (mm) | 2.0-3.0 | E.S. (mm) | 1.7-2.0 | E.S. (mm) | 1.40-1.65 | E.S. (mm) | 1.18-1.45 | E.S. (mm) | 1.10-1.50 | E.S. (mm) | 1.10-1.15 | E.S. (mm) | 0.55-0.75 | E.S. (mm) | 0.40-0.50 | E.S. (mm) | 0.15-0.25 | E.S. (mm) | 0.09-0.40 | E.S. (mm) | — |
| U.C. | <1.40 | U.C. | <1.40 | U.C. | <1.40 | U.C. | <1.30 | U.C. | <1.50 | U.C. | <1.40 | U.C. | <1.60 | U.C. | <1.40 | U.C. | <1.60 | U.C. | <2.0 | U.C. | — |

*Custom Gradations Available*

**BLAST SANDS -- #10 (10/20), #16 (16/30), #20 (20/40) #30 (30/70) and #70 (100 Mesh) with DUSTNET®**

# Carmeuse Industrial Sands

| | | | |
|---|---|---|---|
| Mineral | Quartz | Specific Gravity | 2.62+ |
| pH | Neutral (7.0) | LOI (Loss on Ignition) | <0.4 |
| Roundness | 0.6+ | Unit Weight | ~100 lbs. per Cubic Foot |
| Sphericity | 0.7+ | AWWA Acid Solubility | <1.0% |
| Hardness | 7.0 | Porosity | 44%+ |

| | 6/9 | 8/12 | 8/16 | 10/20 | 12/20 | 16/30 | 20/40 | 30/70 | 100 Mesh |
|---|---|---|---|---|---|---|---|---|---|
| $SiO_2$ (Silicon Dioxide) | 96.67 | 96.83 | 94.05 | 95.26 | 94.66 | 94.06 | 90.32 | 82.69 | 80.11 |
| $Fe_2O_3$ (Iron Oxide) | 0.06 | 0.06 | n/a | 0.04 | 0.08 | 0.12 | 0.18 | 0.41 | 1.06 |
| $Al_2O_3$ (Aluminum Oxide) | 0.85 | 1.11 | n/a | 1.16 | 1.91 | 2.7 | 5.06 | 9.86 | 10.7 |
| $TiO_2$ (Titanium Dioxide) | 0.04 | 0.06 | n/a | 0.05 | 0.02 | 0.04 | 0.03 | 0.14 | 0.55 |
| CaO (Calcium Oxide) | 0.02 | 0.02 | n/a | 0.01 | 0.03 | 0.04 | 0.06 | 0.12 | 0.25 |
| MgO (Magnesium Oxide) | <0.01 | <0.01 | n/a | <0.01 | 0.03 | 0.02 | 0.02 | 0.03 | 0.05 |
| $K_2O$ (Potassium Oxide) | 0.86 | 0.59 | n/a | 0.66 | 0.87 | 1.44 | 2.73 | 3.8 | 6.92 |
| $Na_2O$ (Sodium Oxide) | 0.14 | 0.11 | n/a | 0.12 | 0.22 | 0.29 | 0.42 | 0.57 | 0.73 |

## Colorado Silica Sand® Meets AWWA-A100 and B100 standards; NSF-61 certification

**CONTAINS FREE (RESPIRABLE) SILICA**
**DO NOT BREATHE DUST FROM THIS PRODUCT**
**NEVER USE FOR SAND BLASTING**

This material contains fine (respirable) silica dust. If you inhale dust from this product you may develop silicosis, a severe, irreversible lung disease that can cause death. The National Institute for Occupational Safety and Health (NIOSH), the International Agency for Research on Cancer (IRAC) and the American Thoracic Society (ATS) link inhalation of silica dust to lung cancer. Medical reports link inhalation of silica dust to crippling arthritis. Exposure may cause skin and eye irritation.

**NEVER USE THIS MATERIAL WITHOUT APPROVED RESPIRATORY PROTECTIVE EQUIPMENT**

For approved respiratory protection equipment, refer to the National Institute for Occupational Safety and Health (NIOSH), the Occupational Safety and Health Act (OSHA) and the Mine Safety and Health Act (MSHA). See applicable Federal Laws:

29 C.F.R.§1910.134;29 C.F.R. §1910.1000 and 29 C.F.R. §1910.1000.

The technical data contained herein is subject to change without notice and does not represent a commitment on the part of Carmeuse Industrial Sands or its representatives. Over time and even within the same shipment, product gradations as well as physical and chemical characteristics may fluctuate due to natural variations in the raw product. It is recommended that the user request current technical data before making any design decisions.

# HALLIBURTON

# MATERIAL SAFETY DATA SHEET

**Product Trade Name:** **HOLEPLUG® 3/8**

**Revision Date:** 04-Jan-2011

## 1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

**Product Trade Name:** HOLEPLUG® 3/8
**Synonyms:** None
**Chemical Family:** Mineral
**Application:** Fluid Loss Additive

**Manufacturer/Supplier**

Baroid Fluid Services
Product Service Line of Halliburton
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (281) 575-5000

**Prepared By**

Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

## 2. COMPOSITION/INFORMATION ON INGREDIENTS

| Substances | CAS Number | PERCENT | ACGIH TLV-TWA | OSHA PEL-TWA |
|---|---|---|---|---|
| Bentonite | 1302-78-9 | 60 - 100% | Not applicable | Not applicable |
| Crystalline silica, tridymite | 15468-32-3 | 0 - 1% | 0.05 mg/m$^3$ | $\frac{1/2 \times 10 \text{ mg/m}^3}{\%SiO2 + 2}$ |
| Crystalline silica, cristobalite | 14464-46-1 | 0 - 1% | 0.025 mg/m$^3$ | $\frac{1/2 \times 10 \text{ mg/m}^3}{\%SiO2 + 2}$ |
| Crystalline silica, quartz | 14808-60-7 | 0 - 5% | 0.025 mg/m$^3$ | $\frac{10 \text{ mg/m}^3}{\%SiO2 + 2}$ |

**More restrictive exposure limits may be enforced by some states, agencies, or other authorities.**

## 3. HAZARDS IDENTIFICATION

**Hazard Overview**

**CAUTION! - ACUTE HEALTH HAZARD**
May cause eye and respiratory irritation.

**DANGER! - CHRONIC HEALTH HAZARD**
Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Review the Material Safety Data Sheet (MSDS) for this product, which has been provided to your employer.

## 4. FIRST AID MEASURES

**Inhalation** — If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

**Skin** — Wash with soap and water. Get medical attention if irritation persists.

**Eyes** — In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

**Ingestion** — Under normal conditions, first aid procedures are not required.

**Notes to Physician** — Treat symptomatically.

## 5. FIRE FIGHTING MEASURES

| | |
|---|---|
| **Flash Point/Range (F):** | Not Determined |
| **Flash Point/Range (C):** | Not Determined |
| **Flash Point Method:** | Not Determined |
| **Autoignition Temperature (F):** | Not Determined |
| **Autoignition Temperature (C):** | Not Determined |
| **Flammability Limits in Air - Lower (%):** | Not Determined |
| **Flammability Limits in Air - Upper (%):** | Not Determined |

**Fire Extinguishing Media** — All standard firefighting media.

**Special Exposure Hazards** — Not applicable.

**Special Protective Equipment for Fire-Fighters** — Not applicable.

**NFPA Ratings:** Health 0, Flammability 0, Reactivity 0
**HMIS Ratings:** Health 0*, Flammability 0, Reactivity 0

## 6. ACCIDENTAL RELEASE MEASURES

**Personal Precautionary Measures** — Use appropriate protective equipment. Avoid creating and breathing dust.

**Environmental Precautionary Measures** — None known.

| | |
|---|---|
| **Procedure for Cleaning / Absorption** | Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal. |

## 7. HANDLING AND STORAGE

| | |
|---|---|
| **Handling Precautions** | This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet. |
| **Storage Information** | Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container. Product has a shelf life of 12 months. |

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

| | |
|---|---|
| **Engineering Controls** | Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2. |
| **Personal Protective Equipment** | If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product. |
| **Respiratory Protection** | Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. |
| **Hand Protection** | Normal work gloves. |
| **Skin Protection** | Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing. |
| **Eye Protection** | Wear safety glasses or goggles to protect against exposure. |
| **Other Precautions** | None known. |

## 9. PHYSICAL AND CHEMICAL PROPERTIES

| | |
|---|---|
| **Physical State:** | Solid |
| **Color:** | Various |
| **Odor:** | Odorless |
| **pH:** | 7.5 |
| **Specific Gravity @ 20 C (Water=1):** | 2.12 |
| **Density @ 20 C (lbs./gallon):** | Not Determined |
| **Bulk Density @ 20 C (lbs/ft3):** | 51 |
| **Boiling Point/Range (F):** | Not Determined |
| **Boiling Point/Range (C):** | Not Determined |
| **Freezing Point/Range (F):** | Not Determined |
| **Freezing Point/Range (C):** | Not Determined |
| **Vapor Pressure @ 20 C (mmHg):** | Not Determined |
| **Vapor Density (Air=1):** | Not Determined |
| **Percent Volatiles:** | Not Determined |
| **Evaporation Rate (Butyl Acetate=1):** | Not Determined |
| **Solubility in Water (g/100ml):** | Insoluble |
| **Solubility in Solvents (g/100ml):** | Not Determined |

## 9. PHYSICAL AND CHEMICAL PROPERTIES

| | |
|---|---|
| **VOCs (lbs./gallon):** | Not Determined |
| **Viscosity, Dynamic @ 20 C (centipoise):** | Not Determined |
| **Viscosity, Kinematic @ 20 C (centistrokes):** | Not Determined |
| **Partition Coefficient/n-Octanol/Water:** | Not Determined |
| **Molecular Weight (g/mole):** | Not Determined |

## 10. STABILITY AND REACTIVITY

| | |
|---|---|
| **Stability Data:** | Stable |
| **Hazardous Polymerization:** | Will Not Occur |
| **Conditions to Avoid** | None anticipated |
| **Incompatibility (Materials to Avoid)** | Hydrofluoric acid. |
| **Hazardous Decomposition Products** | Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C). |
| **Additional Guidelines** | Not Applicable |

## 11. TOXICOLOGICAL INFORMATION

| | |
|---|---|
| **Principle Route of Exposure** | Eye or skin contact, inhalation. |
| **Inhalation** | Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A).<br><br>Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below). |
| **Skin Contact** | May cause mechanical skin irritation. |
| **Eye Contact** | May cause eye irritation. |
| **Ingestion** | None known |
| **Aggravated Medical Conditions** | Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust. |

**Chronic Effects/Carcinogenicity**

Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2).

There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

**Other Information**

For further information consult "Adverse Effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, pages 761-768 (1997).

**Toxicity Tests**

| | |
|---|---|
| **Oral Toxicity:** | Not determined |
| **Dermal Toxicity:** | Not determined |
| **Inhalation Toxicity:** | Not determined |
| **Primary Irritation Effect:** | Not determined |
| **Carcinogenicity** | Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997). |
| **Genotoxicity:** | Not determined |
| **Reproductive / Developmental Toxicity:** | Not determined |

## 12. ECOLOGICAL INFORMATION

**Mobility (Water/Soil/Air)** Not determined

**Persistence/Degradability** Not determined

**Bio-accumulation** Not determined

### Ecotoxicological Information

**Acute Fish Toxicity:** Not determined
**Acute Crustaceans Toxicity:** Not determined

| | |
|---|---|
| **Acute Algae Toxicity:** | Not determined |
| **Chemical Fate Information** | Not determined |
| **Other Information** | Not applicable |

## 13. DISPOSAL CONSIDERATIONS

| | |
|---|---|
| **Disposal Method** | If practical, recover and reclaim, recycle, or reuse by the guidelines of an approved local reuse program. Should contaminated product become a waste, dispose of in a licensed industrial landfill according to federal, state, and local regulations. |
| **Contaminated Packaging** | Follow all applicable national or local regulations. |

## 14. TRANSPORT INFORMATION

### Land Transportation

**DOT**
Not restricted

**Canadian TDG**
Not restricted

**ADR**
Not restricted

### Air Transportation

**ICAO/IATA**
Not restricted

### Sea Transportation

**IMDG**
Not restricted

### Other Shipping Information

**Labels:** None

## 15. REGULATORY INFORMATION

### US Regulations

| | |
|---|---|
| **US TSCA Inventory** | All components listed on inventory or are exempt. |
| **EPA SARA Title III Extremely Hazardous Substances** | Not applicable |
| **EPA SARA (311,312) Hazard Class** | Acute Health Hazard<br>Chronic Health Hazard |
| **EPA SARA (313) Chemicals** | This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372). |

| | |
|---|---|
| **EPA CERCLA/Superfund Reportable Spill Quantity** | Not applicable. |
| **EPA RCRA Hazardous Waste Classification** | If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA. |
| **California Proposition 65** | The California Proposition 65 regulations apply to this product. |
| **MA Right-to-Know Law** | One or more components listed. |
| **NJ Right-to-Know Law** | One or more components listed. |
| **PA Right-to-Know Law** | One or more components listed. |

## Canadian Regulations

| | |
|---|---|
| **Canadian DSL Inventory** | All components listed on inventory. |
| **WHMIS Hazard Class** | D2A Very Toxic Materials<br>Crystalline silica |

## 16. OTHER INFORMATION

**The following sections have been revised since the last issue of this MSDS**
Not applicable

**Additional Information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

**Disclaimer Statement**

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

# HOLEPLUG®

**Graded Sodium Bentonite**

**Description**

HOLEPLUG® naturally occurring Wyoming sodium bentonite clay is a sized and graded chip material used to seal and plug earthen boreholes.

HOLEPLUG bentonite is available in two particle size grades:

- HOLEPLUG® 3/4" bentonite (100% of particles pass through 3/4" screen; all particles retained on 3/8" screen)
- HOLEPLUG® 3/8" bentonite (100% of particles pass through 3/8" screen; all particles retained on 1/4" screen)

**Applications/Functions**

The use of HOLEPLUG sodium bentonite assists or promotes the following:

- Grouting annulus in all types of wells, particularly environmental monitoring well applications
- Sealing above gravel packs
- Plugging decommissioned boreholes
- Stemming shotholes
- Sealing around conductor pipe
- Sealing lost circulation zones
- Shutting off artesian flow

**Advantages**

- Helps prevent entry of surface water into boreholes
- High swelling potential
- In situ swelling to provide a superior seal with excellent casing stabilization
- Easier to apply than pellets
- Cost effective
- Simple to apply, mixing not required
- Helps prevent vertical movement of fluids in the hole between porous zones
- Helps form a permanent, flexible downhole seal
- Helps allow hole re-entry
- Rehydratable
- NSF/ANSI Standard 60 certified

**Typical Properties**

| Volume of 50-lb (22.7 kg) sack | |
|---|---|
| HOLEPLUG 3/4" bentonite | 0.73 $ft^3$ or 0.027 $yd^3$ or 0.021 $m^3$ |
| HOLEPLUG 3/8" bentonite | 0.70 $ft^3$ or 0.026 $yd^3$ or 0.020 $m^3$ |
| Permeability | $1.5 \times 10^{-9}$ cm/sec (in fresh water) |
| Appearance | Beige to tan chips |

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*HOLEPLUG is a registered trademark of Halliburton*

*Rev. 03/2011 · IDP 006*

Because the conditions of use of this product are beyond the seller's control, the product is sold without warranty either express or implied and upon condition that purchaser make its own test to determine the suitability for purchaser's application. Purchaser assumes all risk of use and handling of this product. This product will be replaced if defective in manufacture or packaging or if damaged. Except for such replacement, seller is not liable for any damages caused by this product or its use. The statements and recommendations made herein are believed to be accurate. No guarantee of their accuracy is made, however.

**Recommended Treatment**

***Plugging and Stemming Drill Holes***

Due to shipping and handling, a small amount of fine bentonite particles may be present. For optimum results, HOLEPLUG® should be poured over a mesh or screen with ¼" (6.4 mm) openings to "sift out" the smaller particles. The screen should be large enough (approx.1 $yd^2$ or $1m^2$) to be folded into a "V" shape to allow sifting while the product is being poured into the hole. Also, HOLEPLUG bentonite should be poured slowly. Allow approximately two minutes to pour a 50-lb (22.7 kg) bag.

1. Position the screen with the lower end placed over the borehole
2. Slowly pour HOLEPLUG bentonite down the "V" so that fine particles fall through the screen before the larger particles fall into the borehole
3. Fill hole as required (above static water level or to ground level)
4. Observe all regulatory specifications

***Stopping loss of circulation and stabilizing unconsolidated formations***

1. Pull drill pipe out of hole
2. Pour HOLEPLUG bentonite into hole to fill above problem zone
3. Drill ahead slowly with reduced pump pressure

***Plugging flowing wells***

Pour HOLEPLUG bentonite into hole until water flow subsides or hole is filled to surface.

**Treatment Considerations**

- Adequate annular space, at least two inches on either side of the outside dimension of the casing, should be present to facilitate placement of HOLEPLUG bentonite into the desired area without bridging. The use of a tremie line may be necessary to ensure proper placement and is recommended for placement in deep hole applications.
- The grouting material and method selected will depend upon the specific subsurface environment including all prevailing geological and hydrological factors and any existing regulatory requirements.
- The use of bentonite may not be appropriate in environments where the formation water chemistry has a total hardness greater than 500 parts per million and/or a chloride content of greater than 1500 parts per million.
- If questions arise regarding subsurface environments it is always best to consult your local Baroid IDP representative to determine if the Baroid product of choice is appropriate for the given conditions.

**Application Amounts**

| Amounts of HOLEPLUG® bentonite Required for Plugging Applications | | | | |
|---|---|---|---|---|
| Hole Diameter (inches) | Hole Volume ($ft^3/ft$) | Pounds HOLEPLUG bentonite Needed to Fill One Foot | Feet Filled by One Bag HOLEPLUG bentonite | Bags HOLEPLUG bentonite Needed to Fill 100 ft |
| 2 | 0.022 | 1.6 | 32.6 | 3.2 |
| 2.5 | 0.034 | 2.4 | 20.5 | 5.0 |
| 3 | 0.049 | 3.5 | 14.3 | 7.0 |
| 3.5 | 0.067 | 4.8 | 10.4 | 9.6 |
| 4 | 0.087 | 6.3 | 7.9 | 12.6 |
| 4.5 | 0.110 | 7.9 | 6.3 | 15.8 |
| 5 | 0.136 | 9.8 | 5.1 | 19.6 |
| 5.5 | 0.165 | 11.9 | 4.2 | 23.8 |
| 6 | 0.196 | 14.1 | 3.5 | 28.2 |
| 6.5 | 0.230 | 16.6 | 3.0 | 33.2 |
| 7 | 0.267 | 19.2 | 2.6 | 38.4 |
| 7.5 | 0.307 | 22.1 | 2.3 | 44.2 |
| 8 | 0.349 | 25.1 | 2.0 | 50.2 |
| 8.5 | 0.394 | 28.4 | 1.8 | 56.8 |
| 9 | 0.442 | 31.8 | 1.6 | 63.6 |
| 9.5 | 0.492 | 35.4 | 1.4 | 70.8 |
| 10 | 0.545 | 39.2 | 1.3 | 78.4 |
| 11 | 0.660 | 47.5 | 1.1 | 95.0 |
| 12 | 0.785 | 56.5 | 0.89 | 113.0 |
| 15 | 1.227 | 88.3 | 0.57 | 176.6 |
| 18 | 1.767 | 127.2 | 0.39 | 254.4 |
| 20 | 2.182 | 157.1 | 0.32 | 314.2 |
| 25 | 3.409 | 245.4 | 0.20 | 490.8 |
| 30 | 4.909 | 353.4 | 0.14 | 706.8 |

**Application Amounts (metric equivalents)**

| Amounts of HOLEPLUG® bentonite Required for Plugging | | | | |
|---|---|---|---|---|
| Hole Diameter (mm) | Hole Volume ($m^3/m$) | Kilograms HOLEPLUG bentonite Needed to Fill One Meter | Meters Filled by One Bag HOLEPLUG bentonite | Bags HOLEPLUG bentonite Needed to Fill 10 meters |
| 51 | 0.002 | 2.3 | 9.87 | 1.0 |
| 64 | 0.003 | 3.6 | 6.31 | 1.6 |
| 76 | 0.005 | 5.2 | 4.38 | 2.3 |
| 89 | 0.006 | 7.0 | 3.22 | 3.1 |
| 102 | 0.008 | 9.2 | 2.47 | 4.1 |
| 114 | 0.010 | 11.6 | 1.95 | 5.1 |
| 127 | 0.013 | 14.4 | 1.58 | 6.3 |
| 140 | 0.015 | 17.4 | 1.30 | 7.7 |
| 152 | 0.018 | 20.7 | 1.10 | 9.1 |
| 165 | 0.021 | 24.3 | 0.93 | 10.7 |
| 178 | 0.025 | 28.2 | 0.81 | 12.4 |
| 191 | 0.029 | 32.4 | 0.70 | 14.3 |
| 203 | 0.032 | 36.8 | 0.62 | 16.2 |
| 216 | 0.037 | 41.6 | 0.55 | 18.2 |
| 229 | 0.041 | 46.6 | 0.49 | 20.5 |
| 241 | 0.046 | 51.9 | 0.44 | 22.9 |
| 254 | 0.051 | 57.5 | 0.39 | 25.3 |
| 279 | 0.061 | 69.6 | 0.33 | 30.7 |
| 305 | 0.073 | 82.8 | 0.27 | 36.5 |
| 381 | 0.114 | 129.4 | 0.18 | 57.0 |
| 457 | 0.164 | 186.4 | 0.12 | 82.1 |
| 508 | 0.203 | 230.1 | 0.10 | 101.4 |
| 635 | 0.317 | 359.5 | 0.06 | 158.4 |
| 762 | 0.456 | 517.7 | 0.04 | 228.1 |

**Packaging**

HOLEPLUG graded sodium bentonite is packaged in 50-lb (22.7 kg) multiwall paper bags.

**Availability**

HOLEPLUG graded sodium bentonite can be purchased through any Baroid Industrial Drilling Products Retailer. To locate the Baroid IDP retailer nearest you contact the Customer Service Department in Houston or your area IDP Sales Representative.


**Baroid Industrial Drilling Products**
**Product Service Line, Halliburton**
3000 N. Sam Houston Pkwy E.
Houston, TX 77032

| | | |
|---|---|---|
| **Customer Service** | (800) 735-6075 Toll Free | (281) 871-4612 |
| **Technical Service** | (877) 379-7412 Toll Free | (281) 871-4613 |

**HALLIBURTON**

# MATERIAL SAFETY DATA SHEET

**Product Trade Name:** **QUIK-GROUT®**

**Revision Date:** 25-Mar-2010

## 1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

**Product Trade Name:** QUIK-GROUT®
**Synonyms:** None
**Chemical Family:** Mineral
**Application:** Grouting Material

**Manufacturer/Supplier**

Baroid Fluid Services
Product Service Line of Halliburton
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (281) 575-5000

**Prepared By**

Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

## 2. COMPOSITION/INFORMATION ON INGREDIENTS

| SUBSTANCE | CAS Number | PERCENT | ACGIH TLV-TWA | OSHA PEL-TWA |
|---|---|---|---|---|
| Ammonium bisulfate | 7783-20-2 | 1 - 5% | Not applicable | Not applicable |
| Bentonite | 1302-78-9 | 60 - 100% | Not applicable | Not applicable |
| Crystalline silica, tridymite | 15468-32-3 | 0 - 1% | 0.05 $mg/m^3$ | $1/2 \times \frac{10\ mg/m^3}{\%SiO2 + 2}$ |
| Crystalline silica, cristobalite | 14464-46-1 | 0 - 1% | 0.025 $mg/m^3$ | $1/2 \times \frac{10\ mg/m^3}{\%SiO2 + 2}$ |
| Crystalline silica, quartz | 14808-60-7 | 1 - 5% | 0.025 $mg/m^3$ | $\frac{10\ mg/m^3}{\%SiO2 + 2}$ |

## 3. HAZARDS IDENTIFICATION

**Hazard Overview**

**CAUTION! - ACUTE HEALTH HAZARD**
May cause eye and respiratory irritation.

**DANGER! - CHRONIC HEALTH HAZARD**
Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Review the Material Safety Data Sheet (MSDS) for this product, which has been provided to your employer.

## 4. FIRST AID MEASURES

| | |
|---|---|
| **Inhalation** | If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult. |
| **Skin** | Wash with soap and water. Get medical attention if irritation persists. |
| **Eyes** | In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists. |
| **Ingestion** | Under normal conditions, first aid procedures are not required. |
| **Notes to Physician** | Treat symptomatically. |

## 5. FIRE FIGHTING MEASURES

| | |
|---|---|
| **Flash Point/Range (F):** | Not Determined |
| **Flash Point/Range (C):** | Not Determined |
| **Flash Point Method:** | Not Determined |
| **Autoignition Temperature (F):** | Not Determined |
| **Autoignition Temperature (C):** | Not Determined |
| **Flammability Limits in Air - Lower (%):** | Not Determined |
| **Flammability Limits in Air - Upper (%):** | Not Determined |

| | |
|---|---|
| **Fire Extinguishing Media** | All standard firefighting media. |
| **Special Exposure Hazards** | Not applicable. |
| **Special Protective Equipment for Fire-Fighters** | Not applicable. |
| **NFPA Ratings:** | Health 0, Flammability 0, Reactivity 0 |
| **HMIS Ratings:** | Health 0*, Flammability 0, Reactivity 0 |

## 6. ACCIDENTAL RELEASE MEASURES

| | |
|---|---|
| **Personal Precautionary Measures** | Use appropriate protective equipment. Avoid creating and breathing dust. |
| **Environmental Precautionary Measures** | None known. |
| **Procedure for Cleaning / Absorption** | Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal. |

## 7. HANDLING AND STORAGE

| | |
|---|---|
| **Handling Precautions** | This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet. |
| **Storage Information** | Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container. |

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

| | |
|---|---|
| **Engineering Controls** | Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2. |
| **Personal Protective Equipment** | If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product. |
| **Respiratory Protection** | Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. |
| **Hand Protection** | Normal work gloves. |
| **Skin Protection** | Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing. |
| **Eye Protection** | Wear safety glasses or goggles to protect against exposure. |
| **Other Precautions** | None known. |

## 9. PHYSICAL AND CHEMICAL PROPERTIES

| | |
|---|---|
| **Physical State:** | Solid |
| **Color:** | Beige to Tan |
| **Odor:** | Odorless |
| **pH:** | 8-10 |
| **Specific Gravity @ 20 C (Water=1):** | 2.5 |
| **Density @ 20 C (lbs./gallon):** | Not Determined |
| **Bulk Density @ 20 C (lbs/ft3):** | 74 |
| **Boiling Point/Range (F):** | Not Determined |
| **Boiling Point/Range (C):** | Not Determined |
| **Freezing Point/Range (F):** | Not Determined |
| **Freezing Point/Range (C):** | Not Determined |
| **Vapor Pressure @ 20 C (mmHg):** | Not Determined |
| **Vapor Density (Air=1):** | Not Determined |
| **Percent Volatiles:** | Not Determined |
| **Evaporation Rate (Butyl Acetate=1):** | Not Determined |
| **Solubility in Water (g/100ml):** | Insoluble |
| **Solubility in Solvents (g/100ml):** | Not Determined |
| **VOCs (lbs./gallon):** | Not Determined |
| **Viscosity, Dynamic @ 20 C (centipoise):** | Not Determined |
| **Viscosity, Kinematic @ 20 C (centistrokes):** | Not Determined |
| **Partition Coefficient/n-Octanol/Water:** | Not Determined |
| **Molecular Weight (g/mole):** | Not Determined |

## 10. STABILITY AND REACTIVITY

| | |
|---|---|
| **Stability Data:** | Stable |
| **Hazardous Polymerization:** | Will Not Occur |
| **Conditions to Avoid** | None anticipated |
| **Incompatibility (Materials to Avoid)** | Copper and copper alloys. Zinc. |

| | |
|---|---|
| **Hazardous Decomposition Products** | Oxides of sulfur. Oxides of nitrogen. Ammonia. Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C). |
| **Additional Guidelines** | Not Applicable |

## 11. TOXICOLOGICAL INFORMATION

| | |
|---|---|
| **Principle Route of Exposure** | Eye or skin contact, inhalation. |
| **Inhalation** | Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A).<br><br>Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below). |
| **Skin Contact** | May cause mechanical skin irritation. |
| **Eye Contact** | May cause eye irritation. |
| **Ingestion** | None known |
| **Aggravated Medical Conditions** | Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust. |
| **Chronic Effects/Carcinogenicity** | Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.<br><br>Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2).<br><br>There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease. |
| **Other Information** | For further information consult "Adverse Effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, pages 761-768 (1997). |
| **Toxicity Tests** | |

| | |
|---|---|
| **Oral Toxicity:** | Not determined |
| **Dermal Toxicity:** | Not determined |
| **Inhalation Toxicity:** | Not determined |
| **Primary Irritation Effect:** | Not determined |
| **Carcinogenicity** | Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997). |
| **Genotoxicity:** | Not determined |
| **Reproductive / Developmental Toxicity:** | Not determined |

## 12. ECOLOGICAL INFORMATION

| | |
|---|---|
| **Mobility (Water/Soil/Air)** | Not determined |
| **Persistence/Degradability** | Not determined |
| **Bio-accumulation** | Not Determined |

### Ecotoxicological Information

| | |
|---|---|
| **Acute Fish Toxicity:** | Not determined |
| **Acute Crustaceans Toxicity:** | Not determined |
| **Acute Algae Toxicity:** | Not determined |
| **Chemical Fate Information** | Not determined |
| **Other Information** | Not applicable |

## 13. DISPOSAL CONSIDERATIONS

| | |
|---|---|
| **Disposal Method** | If practical, recover and reclaim, recycle, or reuse by the guidelines of an approved local reuse program. Should contaminated product become a waste, dispose of in a licensed industrial landfill according to federal, state, and local regulations. |
| **Contaminated Packaging** | Follow all applicable national or local regulations. |

## 14. TRANSPORT INFORMATION

### Land Transportation

**DOT**
Not restricted

**Canadian TDG**
Not restricted

**ADR**
Not restricted

### Air Transportation

**ICAO/IATA**
Not restricted

## Sea Transportation

**IMDG**
Not restricted

## Other Shipping Information

**Labels:** None

## 15. REGULATORY INFORMATION

## US Regulations

| | |
|---|---|
| **US TSCA Inventory** | All components listed on inventory or are exempt. |
| **EPA SARA Title III Extremely Hazardous Substances** | Not applicable |
| **EPA SARA (311,312) Hazard Class** | Acute Health Hazard<br>Chronic Health Hazard |
| **EPA SARA (313) Chemicals** | This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372). |
| **EPA CERCLA/Superfund Reportable Spill Quantity** | Not applicable. |
| **EPA RCRA Hazardous Waste Classification** | If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA. |
| **California Proposition 65** | The California Proposition 65 regulations apply to this product. |
| **MA Right-to-Know Law** | One or more components listed. |
| **NJ Right-to-Know Law** | One or more components listed. |
| **PA Right-to-Know Law** | One or more components listed. |

## Canadian Regulations

| | |
|---|---|
| **Canadian DSL Inventory** | All components listed on inventory. |
| **WHMIS Hazard Class** | D2A Very Toxic Materials<br>Crystalline silica |

## 16. OTHER INFORMATION

**The following sections have been revised since the last issue of this MSDS**
Not applicable

**Additional Information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

**Disclaimer Statement**

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

# QUIK-GROUT®

**One-Sack Borehole Grouting and Plugging Material**

**Description**

QUIK-GROUT is a single-sack, easy-to-use, sodium-based bentonite grout designed for grouting water wells, monitoring wells, and for plugging holes. QUIK-GROUT does not contain any polymers.

**Applications/Functions**

- Seal or grout plastic and steel casings
- Seal downhole instrumentation in test and observation holes
- Plug abandoned boreholes and earthen cavities

*Note:* Not recommended for use as a cement additive

**Advantages**

- Easy one-sack, dust-free mixing
- Develops a 20% active solids slurry weighing 9.4 lb/gal (1.13 g/cm$^3$) with hydrostatic gradient of 0.489 psi/ft (11.1 kPa/meter)
- Mix and handle with conventional rig equipment
- Creates a low permeability seal
- Develops a permanent, flexible seal to prevent commingling between aquifers
- Prevent entry of contaminants from the surface
- Rehydratable
- No heat of hydration
- NSF/ANSI Standard 60 certified

**Typical Properties**

| | |
|---|---|
| Appearance | Beige to tan granular |
| Specific gravity | 2.6 |
| pH (8% slurry) | 8.2 |
| Electrical Resistivity, ohm-meter | 0.98 |
| Yield Volume gal/sack (liters/sack) | 26.3 (99.5) |
| Permeability | 2.5 x $10^{-8}$ cm/sec (in fresh water) |

**Recommended Treatment**

QUIK-GROUT should be mixed with fresh water to obtain maximum results. The recommended mixing rate is a 50-lb (22.7 kg) sack of QUIK-GROUT with 24 gallons (91 liters) of fresh water to create a 20% active solids by weight grout with a density of 9.4 lb/gal or 1.13 g/cm$^3$.

*© Copyright 2006 Halliburton*

*QUIK-GROUT is a registered trademark of Halliburton*

*Rev. 10/2006 · IDP 023*

Because the conditions of use of this product are beyond the seller's control, the product is sold without warranty either express or implied and upon condition that purchaser make its own test to determine the suitability for purchaser's application. Purchaser assumes all risk of use and handling of this product. This product will be replaced if defective in manufacture or packaging or if damaged. Except for such replacement, seller is not liable for any damages caused by this product or its use. The statements and recommendations made herein are believed to be accurate. No guarantee of their accuracy is made, however.

**Recommended Mixing Procedure**

- Using a mixing device, blend one sack of QUIK-GROUT® into 24 gallons (91 liters) of fresh water. Rate of addition should be about 20 to 30 seconds per 50-lb (22.7 kg) bag.
- Blend, do not over mix and do not use a centrifugal pump. The resulting slurry should have an oatmeal consistency containing unyielded or partially yielded bentonite. Pump through tremie into hole without delay.

*Note:*

- The grouting method selected will depend upon, and you should carefully consider, all prevailing geological and hydrological factors and any existing regulatory requirements. The grouting process may not be complete until the grout is static at the desired level.
- The subsurface environment that the respective bentonite sealing material or grout is to be placed into should always be taken into consideration when selecting the appropriate material to compose the well seal. If the formation water chemistry has a total hardness of greater than or equal to 500 parts per million and/or a chloride content of greater than or equal to 1500 parts per million the use of a bentonite material may not be appropriate for this environment. In the event that questions regarding subsurface environments arise it is always best to consult your local Baroid IDP representative to determine if the Baroid product of choice is appropriate for the given conditions.

**Packaging**

QUIK-GROUT is packaged in 50-lb (22.7 kg) multiwall paper bags, containing 0.7 $ft^3$ (0.02 $m^3$).

**Availability**

QUIK-GROUT can be purchased through any Baroid Industrial Drilling Products Retailer. To locate the Baroid IDP retailer nearest you contact the Customer Service Department in Houston or your area IDP Sales Representative.

**Baroid Industrial Drilling Products**
**Product Service Line, Halliburton**
3000 N. Sam Houston Pkwy E.
Houston, TX 77032

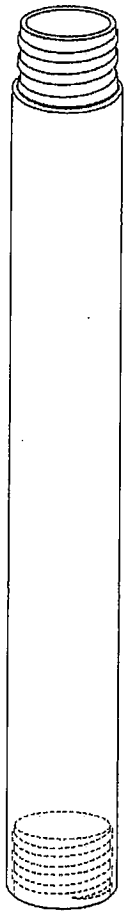
| | | |
|---|---|---|
| **Customer Service** | (800) 735-6075 Toll Free | (281) 871-4612 |
| **Technical Service** | (877) 379-7412 Toll Free | (281) 871-4613 |

# FLUSH THREAD PVC SCREEN AND CASING

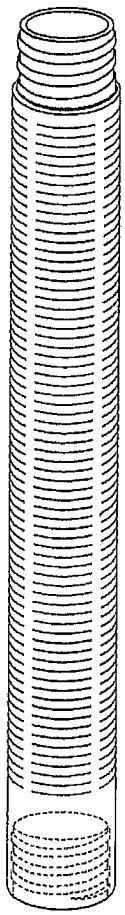
- ✓ Monoflex CNC computer lathed flush threads follow ASTM F-480 recommendations for reliable, consistent results on the job site.
- ✓ Our close tolerances provide a strong connection while retaining ease of assembly.
- ✓ Manufactured from quality PVC pipe, Monoflex flush thread screens and casings are available in diameters of 1/2" through 16" with 2, 4, or 8 threads per inch in Sch. 40 & Sch. 80. Other schedules and SDR's are available in PVC and high density polyethylene.
- ✓ Lengths are measured as "laying length", (not including male thread length), in 2" and 4" diameters, Sch. 40 and Sch. 80 and 6" Sch. 80. All other diameters and schedules are measured end to end. Custom lengths are available in all diameters.
- ✓ All standard Monoflex PVC threads are compatible with other materials threaded to ASTM F-480 recommendations, with the same TPI. **Note**: Threads on 14" and 16" Monoflex screens and casings are not ASTM F-480 as the flush thread guideline does not specify pipe diameters larger than 12".
- ✓ All standard screens provide maximum net open area. A wide variety of slot sizes and spacings are available to adapt to various site conditions and applications.
- ✓ 1/2" through 6" Sch. 40 and Sch. 80 screens and casings are provided with Buna-N O-rings. O-rings may be installed or packaged separately depending on size. O-rings for all other sizes and schedules are sold separately. Please specify if O-rings are required when placing order.
- ✓ All flush thread screens and casings are Envirowrapped and hermetically sealed at both ends as a standard practice.

The following pages list flush thread PVC screens and casings along with the appropriate Buna-N O-rings, and flush thread caps, plugs, and points. Custom lengths, threads and adapters are available.

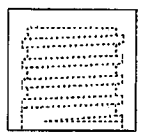
**Please specify part number when ordering.**



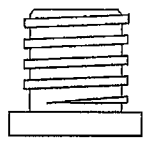
Flush Thread Casing



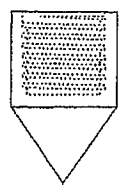
Flush Thread Screen



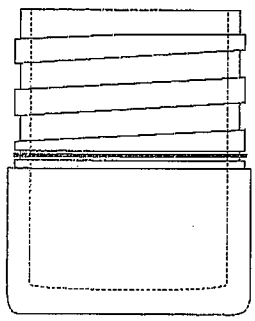
Female Cap (solid)



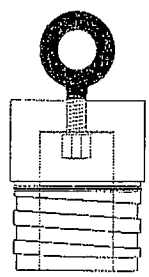
Male Plug (solid)



Female Point (solid)



Male Plug (molded)



Hoist Plug (solid)

# ENGINEERING SPECIFICATIONS

## PVC FLUSH THREAD MONITOR WELL SCREENS AND CASINGS

1. All PVC well screens and casings used on this project shall be manufactured by Monoflex and conform to ASTM F-480: "Standard Specification for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80."
2. PVC materials used to produce the raw PVC pipe shall meet ASTM Standard D-1784: "Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds for PVC Normal Impact, Type I Grade I (1120), cell classification 12454-B."
3. The finished schedules 40, 80, and 120 raw pipe shall meet the requirements of ASTM Standard D-1785: "Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120." In addition, both the raw material and the finished raw pipe shall be approved by the National Sanitation Foundation (NSF) for use in potable water applications.
4. The PVC pipe used to produce the well screens and casings shall be made from virgin plastic produced by the original compounder.
5. The pipe shall be homogeneous throughout and essentially uniform in color, opacity and density. The inside and outside surfaces shall be glossy in appearance and free of chalking, sticky or tacky material and visually free of oils, grease, dust and marks imparted as a result of the manufacturing process. In addition the pipe walls shall be free of ink, cracks, holes, blisters, voids, foreign inclusions, or other defects that are visible to the naked eye and that may affect the wall integrity. Machined slots or holes deliberately placed in the pipe are acceptable.
6. The outside diameters, wall thicknesses and out of roundness tolerances shall fall within the guidelines of Tables 1 & 2 of the ASTM F-480 Standard Specification when measured in accordance with Test Method D-2122.
7. All flush thread materials must be slotted and threaded without the use of any type of liquid coolant. Air is the only acceptable coolant.
8. Well screens 1/2" through 5" are to be slotted on 1/8" spacing. Well screens 6" and larger are to be slotted on 1/4" spacing unless otherwise specified. ALL well screens .040 slot and larger will be slotted on 1/4" spacing unless otherwise specified.
9. All screens and casings shall be nominal length except for 2" and 4" sch. 40 and 6" sch. 80 which shall be laying length. The term "laying length" refers to the overall length less the length required to complete the assembly.
10. The threads per inch for the various diameters and schedules of flush thread materials shall be the same as that produced by Monoflex, Bechtelsville, Pennsylvania or approved equal.
11. All flush thread screens & casings shall be supplied in individual polyethylene bags hermetically sealed at BOTH ends. Said products shall be shipped in cardboard boxes with properly secured ends. Each box shall display a color coded label containing a full description of the product inside. Said label must indicate the number of pieces per box, the threads per inch, the date of packaging, the signatures of the packer and QC inspector and show a drawing of the product.

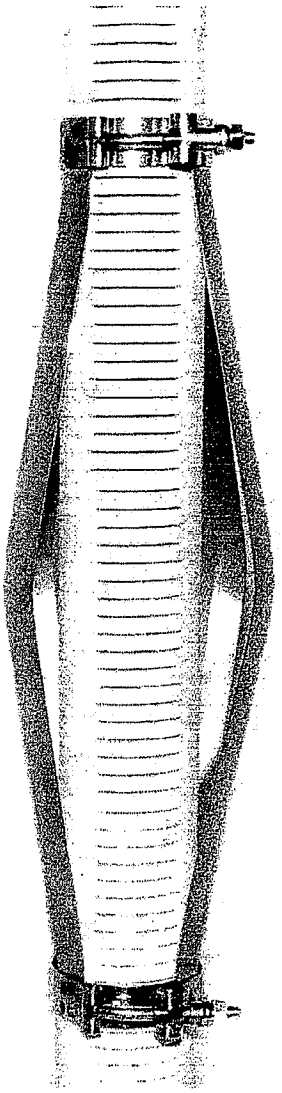
# Stainless Steel Centralizers

The Bear Stainless Steel Centralizers are made from durable 201 Stainless Steel and feature an industry unique eyebolt fastening design that is highly sought after by field installation crews. The centralizers are made to easily fit around the center pipe and maintain its position in the center of the riser as it is fed down-hole.

Product Option:

- Stainless Steel Centralizers are also available in Heavy Duty 301Stainless Steel for heavier pipe
- Centralizers are also available in PVC
- Please contact our Sales Staff for any custom application

| Description | Part Number |
|---|---|
| 3/4in SS Centralizer Standard | 720075XXX001 |
| 1in SS Centralizer Standard | 720100XXX002 |
| 1-1/4in SS Centralizer Standard | 720125XXX003 |
| 1-1/2in SS Centralizer Standard | 720150XXX004 |
| 2in SS Centralizer Standard | 720200XXX005 |
| 2in SS Centralizer Heavy Duty | 720200XXX019 |
| 2-1/2in SS Centralizer Standard | 720250XXX006 |
| 3in SS Centralizer Standard | 720300XXX007 |
| 3in SS Centralizer Heavy Duty | 720300XXX020 |
| 4in SS Centralizer Standard | 720400XXX008 |
| 4in SS Centralizer Heavy Duty | 720400XXX021 |
| 5in SS Centralizer Standard | 720500XXX010 |
| 5in SS Centralizer Heavy Duty | 720500XXX022 |
| 6in SS Centralizer Standard | 720600XXX011 |
| 6in SS Centralizer Heavy Duty | 720600XXX023 |
| 8in SS Centralizer Standard | 720800XXX012 |
| 8in SS Centralizer Heavy Duty | 720800XXX024 |
| 10in SS Centralizer Standard | 721000XXX013 |
| 10in SS Centralizer Heavy Duty | 721000XXX025 |
| 12in SS Centralizer Standard | 721200XXX014 |
| 12in SS Centralizer Heavy Duty | 721200XXX026 |
| 14in SS Centralizer Standard | 721400XXX015 |
| 14in SS Centralizer Heavy Duty | 721400XXX027 |
| 16in SS Centralizer Standard | 721600XXX016 |
| 16in SS Centralizer Heavy Duty | 721600XXX029 |
| 20in SS Centralizer Standard | 722000XXX017 |
| 24in SS Centralizer Standard | 722400XXX018 |



# GROUNDWATER MONITOR WELL

# CONSTRUCTION SPECIFICATIONS

# Specifications

## City of El Paso, Texas

## Groundwater Monitoring Wells and

## Gas Monitoring Probes Installation Project

## Clint Landfill TCEQ MSW Permit No. 2284

## McCombs Landfill TCEQ MSW Permit No. 0729A

November 2010

PSC Project # 01515110

PARKHILLSMITH&COOPER

PSC

# Specifications

## City of El Paso, Texas

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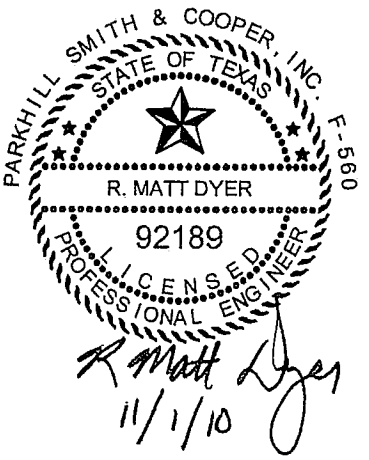



November 2010

PSC Project # 01515110

PARKHILLSMITH&COOPER

## SECTION 02145

## GROUNDWATER MONITORING WELL CONSTRUCTION

### PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, General Conditions of the Contract for Construction, Supplementary Conditions and Division 1 – General Requirements apply to the work of this Section.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation, title or are used to establish criteria. The latest publication in use at the time of the executed contract shall be the one used on this project.

A. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
   1. ASTM C150 Standard Specification for Portland Cement.
   2. ASTM F480 Standard Specification for Thermoplastic Well Casing Pipe and Couplings made in SDR, SCH40 and SCH80.

B. TEXAS COMMISSION ON ENVIRONMENTAL QUALITY (TCEQ)
   1. Owner's MSW Permit
   2. 30 TAC §330.421 Monitor Well Construction Specification.

1.3 RELATED SECTIONS

A. Section 03300 – Cast-In-Place Concrete.

1.4 SUMMARY

A. These specifications describe the installation of two (2) new piezometers and one (1) new groundwater monitoring wells. The piezometers shall be installed to groundwater monitoring well standards. The new wells will be drilled at the specific site locations designated on the plans. Well installation and development shall be performed by a qualified monitor well driller licensed in the State of Texas, experienced specifically in the installation of landfill monitoring wells. Installation and development will be supervised by a licensed professional engineer that the Engineer hires who is familiar with the geology of the area.

B. Each well and piezometer will require 20-feet of screen. Well and piezometer depths range from approximately 403 feet to 459 feet in depth.

1.5 REPORTS

A. The Contractor is required to submit detailed geologic information from each well, a description of development procedures, any particle size or other sample data from the well, and all forms required by TCEQ or other agencies to the Owner and Engineer within 10 days after completion of the monitor well installation. Forms the Contractor will complete to TCEQ, and provide to Engineer in addition to the State of Texas Well Report, are included in Appendix A.

1.6 SURVEY

A. The owner will provide survey hubs near each location for final elevation verification.
B. It will be the Contractor's responsibility to protect the hubs during construction. All survey work in setting the final elevations will be accomplished by a licensed professional surveyor employed by the Owner. Any off-set hubs that are lost or damaged by the Contractor will be replaced at the Contractor's expense.

**PART 2 - PRODUCTS**

2.1 CASING MATERIAL

A. The casing shall be 4-inch nominal diameter and shall be new National Science Foundation certified polyvinyl chloride (PVC) Schedule 80 pipe (ASTM F480). The casing shall be furnished with flush-threaded ends, screw joints (no glue or solvents are allowed), and in such lengths that they can be properly handled and aligned with the equipment. Polytetrafluorethylene (PTF) or O-rings shall be used at all casing joints. Collar couplings are not allowed. No cement glue or solvent joints are permitted. No inks, labels, or other manufacturer markings will be permitted on the casing. The contractor shall provide a manufacturer's affidavit which states the ASTM specification to which the casing complies. The casing shall be cleaned and packaged at the place of manufacture; the packaging shall include a PVC wrapping on each section of casing to keep it from being contaminated prior to installation.

2.2 WELL SCREEN MATERIAL

A. The well screen shall be 4-inch nominal diameter and shall be new National Science Foundation certified polyvinyl chloride (PVC) Schedule 80 pipe (ASTM F480). All materials shall be prime quality and no rejects or limited service pipe will be acceptable. All screen pipe shall be furnished with threaded flush ends and screw joints. No cement glue or solvent joints are permitted. Screen pipe shall be free of ink, labels or other markings. Screen pipe shall be furnished in such lengths that they can be properly handled and aligned with the equipment. The Contractor shall provide a manufacturer's affidavit which states the ASTM specification to which the screen complies.
B. The slot opening size shall be 0.010 inches wide by 2 inches long. There shall be 4 rows of slots along the entire length of the screen with 44 slot openings per row per foot of length of pipe. The well screen shall be of sufficient size and design to hold back and support the filter pack material. The openings shall be smooth, sharp-edged and free of any burns, chipped edges or broken pieces on the interior and exterior surface of the pipe and the openings shall not be larger than the smallest fraction of filter pack. Field constructed screen (field-cut slots) is not acceptable. Filter cloth shall not be used. The plastic pipe screen strength properties shall be equivalent to those for the plastic casing with which the screen is used. The pattern of the openings shall be uniformly spaced around the periphery of the well screen.
C. A two (2) foot length of blank screen or casing shall be used at the base of the screen as a sediment trap. The material used shall be the same material used for casing and screen.

2.3 FILTER PACK

A. Material for filter packing the wells shall consist of prepackaged, inert, clean 10/20 silica sand or glass beads. Open stockpile sources of sand or gravel are not permitted. All equipment that comes into direct contact with the filter material shall not introduce any contaminant into the material. Any filter material contaminated by Contractor efforts shall be properly disposed and replaced at the Contractor's expense.

2.4 BENTONITE ANNULAR SEAL

A. Annular seal shall consist of coarse-grain or coarse-grit sodium bentonite pellets, having a nominal dimension of 3/8-inch. The bentonite used will be of the variety normally used in water well operations. Irregular bentonite pellets, i.e. "Hole Plug" by trade name, may be used unless the Engineer determines that the material will not flow properly into place. Bentonite grout may also be utilized for the annular seal.

2.5 CASING SEAL

A. The casing seal shall consist of either a bentonite grout or a cement-bentonite mixture placed on top of the annular seal. Drilling spools, cuttings, or other native materials are not permitted for use as a casing seal. Quick-setting cements are not permitted because contaminants may leach from them into the groundwater. If a cement bentonite mixture is used, the cement shall conform to ASTM C150, Type I or II. The mixture shall be proportioned in the amount of 5.2 gallons of water to 94 pounds of cement. Combine four (4) or five (5) pounds of bentonite powder by weight with the cement/water mixture. Water used shall be free of oil and other organic material. Dissolved minerals in the water should be less than 2,000 mg/1.

2.6 CASING PLUG

A. The top of the casing shall be protected by a threaded or slip-on top cap or by a sealing cap or screw-plug seal inserted into the top of the casing. The casing plug shall be a Universal Valve Co. model number 1300-40 or approved equal. The cap shall be vented to prevent buildup of methane or other gases and shall be designed to prevent moisture from entering the well.

2.7 PORTLAND CEMENT CONCRETE

A. Concrete shall be high-quality structural-type concrete and shall conform to Section 03300.

2.8 PROTECTIVE STEEL COLLAR

A. Provide an 8-inch steel pipe with a lockable hinged top flap or cover as shown on the plans. Owner will furnish locks for each that are to be maintained in working order, and kept locked when the well is not being purged or sampled. Each master lock for the wells will be operational with the same key. Square shaped protective collars, 8-inch by 8-inch, may be acceptable upon Engineers approval. Wall thickness and fabrication must be comparable to pipe collars.

2.9 BOLLARD

A. Provide 6-inch (Sch. 40) steel pipe filled with Portland cement concrete as shown on the plans.

## PART 3 - EXECUTION

3.1 SLUSH PITS

A. The Contractor shall provide, if necessary, slush pits and drainage ditches. Slush pits and drainage ditches shall be excavated as required and, after completion of each well, the slush pits and drainage ditches shall be filled and all sand, muck, and other unsuitable materials shall be removed from the site and the entire area regraded to approximately its original condition. Slush pit locations shall be coordinated with the Owner to cause the minimum damage to the adjacent areas and simultaneous construction by others.

3.2 GROUNDWATER MONITORING WELL CONSTRUCTION

A. Decontamination:
   1. Prior to drilling each hole, all drilling equipment must be decontaminated by steam cleaning with equipment approved for use by the Engineer. Care must be taken not to introduce contaminants (grease, diesel fuel, drilling mud, drill stem thread lubricants, solvents, contaminated water, etc.). Any drilling fluid used other than a TCEQ approved city water source must be approved by the Engineer or Owner before use at Contractor's expense. If city water is used, a current chemical analysis of the city water shall be provided with the monitor well report. Also, decontaminate all casing, screens, bailers, pumps, piping, etc., before placing in bore hole.

B. Drilling:
   1. Drilling and well construction shall be performed using Air Rotary Casing Hammer (ARCH) drilling methods, which are capable of driving casing into an undersized bore to the required depth. Drill casing shall be a heavy wall, flush threaded pipe, no welded drive casing will be allowed. The drill rig shall be required to have an on-board air compressor with a minimum capacity of 1,050 scfm at 350 psi. The well and annular materials shall be placed inside of the drive casing and the casing removed as the construction materials are added. The hydraulic casing puller, used to remove the drive casing during well construction, shall be rated at a minimum of 250 tons of pull back capacity. The well shall be drilled, cased and developed in a workmanlike manner. The well shall be drilled straight and plumb within the limits specified. The plumbness of the well shall be such that the variation from truly vertical does not vary more than one-half of one degree at any point being tested. The Contractor shall make such checks of the hole while drilling is in progress as he may deem necessary to maintain the proper alignment and plumbness of the hole.
   2. When groundwater is encountered, drilling operations shall be suspended for 24-hours to allow for stabilization of the static groundwater level. At the end of the 24-hour period, the driller shall take a static groundwater measurement, in the presence of the Engineer, and submit that information to the Engineer. Once the stabilized groundwater depth has been recorded by the Engineer, drilling will resume at the direction of the Engineer.
   3. From the ground surface to bottom of each planned well, the bore hole diameter shall be a minimum of 4-inches larger than the diameter of the PVC casing and screen.

C. Samples and Drilling Log:
   1. A careful log of each hole drilled shall be prepared and signed by the driller. The log shall describe in detail each formation found, with sample number and depth, the depth to each water-bearing formation found, and the static water level in the well. The

soils/sediments encountered will be visually classified in the field using the Unified Soils Classification System.

D. Casing and Screen:
   1. The Contractor shall furnish and set all casing and well screen required for the construction of the wells. The well screens shall be directly connected to the casing.
   2. The solid casing and well screen shall be set as soon as drilling is completed and shall extend from the bottom of the drilled hole to above the existing ground as shown on the plans. The casing shall be set truly vertical and centered in the hole. Well casing and screen shall have approved centering devices spaced 120 degrees apart at intervals not exceeding 40-feet along the length of the screen and casing.

E. Filter Pack:
   1. As soon as the casing has been set, the space between the casing and the wall of the well shall be filled with an approved filter pack by Tremie tube. The filter pack shall be tremied into the annulus in maximum 20-foot lifts so that the maximum distance between the bottom of the tremie tube and the top of the filter pack is never greater than 20-feet. The method shall be such that the material is uniformly placed around the casing to the desired thickness. The process shall be continued until the filter pack is five (5) feet above the well screen.

F. Annular Seal:
   1. The annular seal shall be placed above the gravel pack and shall be at least five feet thick. The seal will be placed within the zone of saturation to maintain hydration. The Contractor shall place the seal on top of the filter pack by Tremie tube. The method shall be such that the pellets are uniformly distributed around the casing to obtain the desired thickness. Verification of the uniformity shall be made. Once verification of uniformity is complete, the bentonite shall be hydrated with clean water and let stand for 12 hours. No bentonite is to be dropped into the well casing. Special care shall be taken to ensure that fine material or grout does not plug the filter below.

G. Casing Seal:
   1. The annular space between the casing and walls of the hole shall be filled with a high solids bentonite groute or a cement-bentonite slurry mixture in the upper region of each well above the annular seal. No method will be approved that does not specify the forcing of the slurry from the bottom of the space to be grouted toward the surface. Grouting shall be done in a continuous manner to insure that the entire annular space is filled in one operation. The cement-bentonite slurry will be placed from the top of the annular seal upward, to 2-feet from ground surface.

H. Development and Testing:
   1. Following construction, the well shall be developed until the water pumped from the well is substantially free from all artifacts of drilling (clay film, bentonite, sand, etc.). The well shall also be developed to open the water bearing zone for maximum flow into the well. Pumping shall continue until the turbidity is less than five (5) on the Jackson Turbidity Scale specified in AWWA Standard Methods for the Examination of Water and Wastewater. Developing equipment and additives shall be of an approved type and of sufficient capacity to remove all sand, rock cuttings, drilling fluid and wall cake and any other foreign material. Development shall not commence on any individual well unless that well has been grouted at least twenty-four (24) hours with the approved grout.
   2. In addition to turbidity, driller shall test for pH, specific conductance and temperature. Development shall continue until water runs clean and these field measurements have stabilized.

3.3 CONCRETE SEALING BLOCK

A. After completion of the well a concrete pad shall be constructed continuously from the top of the casing seal to the top of the ground in accordance with the plans. The pad shall be reinforced as shown on the plans. The top of the well foundation shall be given a smooth, neat finish with trowel and light brush. The slab will be constructed so as to drain away from the protective casing cover with a minimum slope of 1/4-inch per foot.

3.4 PROTECTIVE STEEL COLLAR AND CASING PLUG

A. The protective steel collar shall be set in the concrete sealing block during its construction, embedded to a minimum depth of two-feet and shall extend at least three inches above the top of the well casing (and top cap, if present). The well number or other designation shall be marked permanently on the protective steel collar.

3.5 BOLLARD

A. Construct the bollards so they form an independent protective barrier for the concrete cap and seal as shown on the plans.

3.6 CLEANING UP

A. After completion and testing of the well, the Contractor shall remove all debris including excess sand from the site, fill all slush pits and drainage ditches, and grade around the site, leveling all materials taken from the well during drilling so that the area is left in a neat condition. No separate payment will be made for cleaning up the site, the cost of such work shall be included in the bid price for pay items.

END OF SECTION

## SECTION 03300

## CAST-IN-PLACE CONCRETE

### PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, General Conditions of the Contract for Construction, Supplementary Conditions and Division 1 - General Requirements apply to work of this section.

1.2 SECTION INCLUDES

A. Cast-in-place concrete foundations, building frame members, and foundation walls.
B. Floors and slabs on grade.
C. Control, and expansion and contraction joint devices associated with concrete work.
D. Equipment pads.

1.3 REFERENCES

A. ACI 301 - Structural Concrete for Buildings.
B. ACI 302 - Guide for Concrete Floor and Slab Construction.
C. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
D. ACI 305R - Hot Weather Concreting.
E. ACI 306R - Cold Weather Concreting.
F. ACI 308 - Standard Practice for Curing Concrete.
G. ACI 318 Building Code Requirements for Reinforced Concrete.
H. ASTM C33 - Concrete Aggregates.
I. ASTM C94 - Ready-Mixed Concrete.
J. ASTM C150 - Portland Cement.
K. ASTM C260 - Air Entraining Admixtures for Concrete.
L. ASTM C494 - Chemicals Admixtures for Concrete.
M. ASTM C618 - Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.

1.4 SUBMITTALS

A. Submit under provisions of Section 01300.
B. Product Data: Provide data on joint devices, attachment accessories, admixtures and cement types to be used.
C. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent Work.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.
B. Acquire cement and aggregate from same source for all work.
C. Conform to ACI 305R when concreting during hot weather.
D. Conform to ACI 306R when concreting during cold weather.

1.6 COORDINATION

A. Coordinate the placement of joint devices with erection of concrete formwork and placement of form accessories.

**PART 2 - PRODUCTS**

2.1 CONCRETE MATERIALS

A. Cement: ASTM C150, Type I - Normal, Type II - Moderate, Portland type. All cement shall be from the same manufacturer unless approved by the Engineer.
B. Fine and Coarse Aggregates: ASTM C33.
C. Water: Clean and not detrimental to concrete.

2.2 ADMIXTURES

A. Air Entrainment: ASTM C260.
B. Chemical: ASTM C494, Type A - Water Reducing; Type B - Retarding; Type C - Accelerating; Type D - Water Reducing and Retarding; Type E - Water Reducing and Accelerating admixture.
C. Fly Ash: ASTM C618.

2.3 CONCRETE MIX

A. Mix and deliver concrete in accordance with ASTM C94, Alternative No. 2 and 3.
B. Select proportions for normal weight concrete in accordance with ACI 301 Method 1, Method 2 and Method 3.
C. Provide concrete to the following criteria:
   1. Compressive Strength (28 days): 3,000 psi.
   2. Slump: 1 to 4 inches.
   3. Maximum Water/Cement Ratio: 0.50.
D. Use set retarding admixtures during hot weather only when approved by Engineer.
E. Add air entraining agent to normal weight concrete mix for work exposed to exterior.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Verify requirements for concrete cover over reinforcement.
B. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

3.2 PLACING CONCRETE

A. Place concrete in accordance with ACI 304.
B. Notify Engineer minimum 24 hours prior to commencement of operations.
C. Ensure reinforcement, inserts, embedded parts, formed joint fillers are not disturbed during concrete placement.

## 3.3 CONCRETE FINISHING

A. Provide formed concrete surfaces to be left exposed with smooth rubbed finish as Scheduled in this Section.
B. Finish concrete floor surfaces in accordance with ACI 301.
C. Steel trowel surfaces which are scheduled to be exposed.

## 3.4 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
C. Cure floor surfaces in accordance with ACI 308.

## 3.5 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed in accordance with ACI 301.
B. Provide free access to Work and cooperate with appointed firm.
C. Submit proposed mix design of each class of concrete to Engineer for review prior to commencement of Work.
D. Tests of cement and aggregates may be performed to ensure conformance with specified requirements.

## 3.6 PATCHING

A. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.
B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Engineer upon discovery.
C. Patch imperfections as directed.

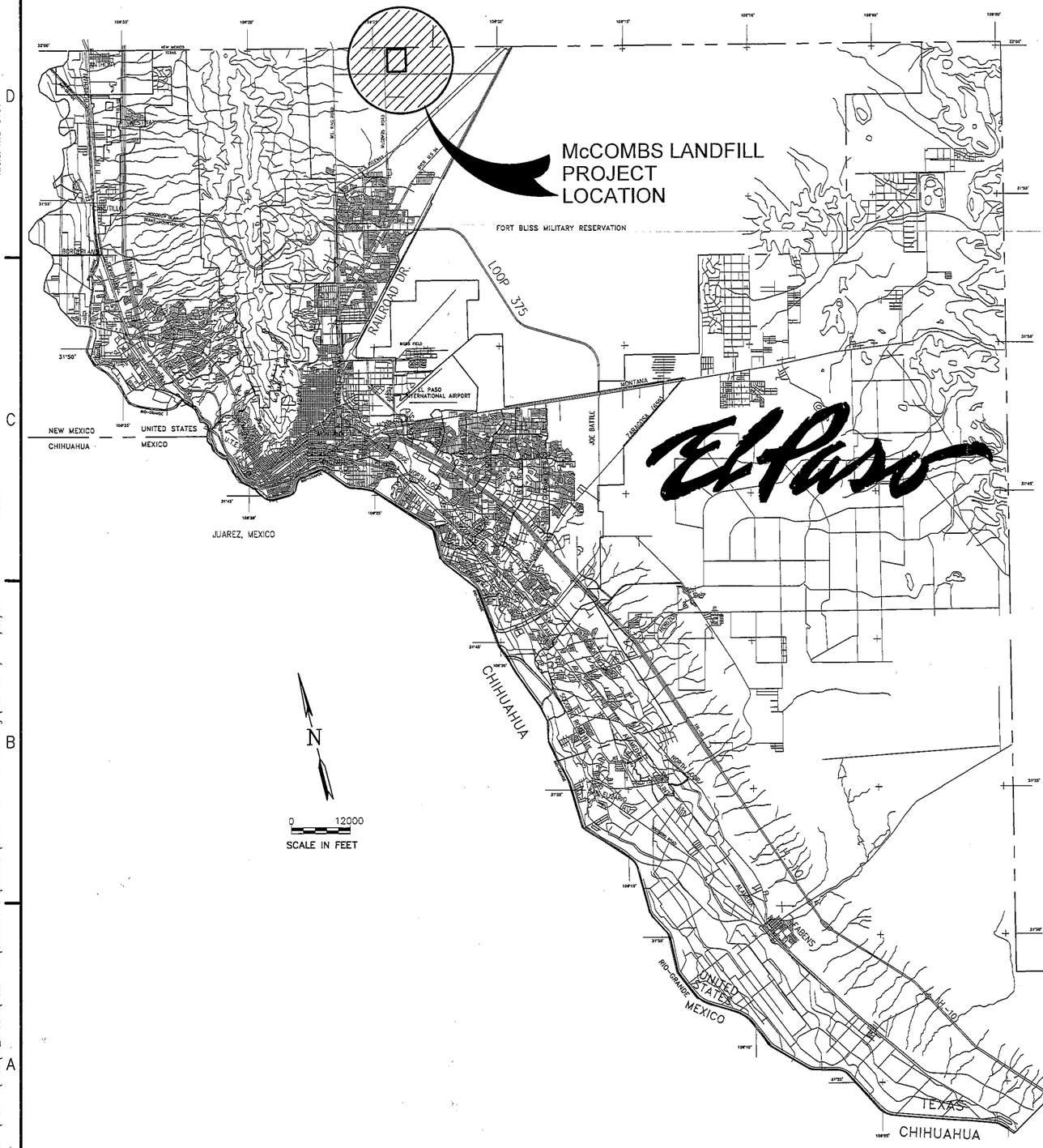
## 3.7 DEFECTIVE CONCRETE

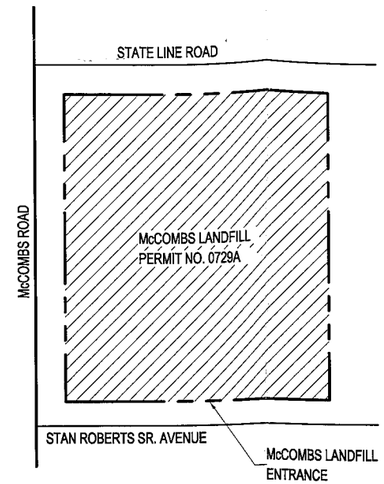
A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
B. Repair or replacement of defective concrete will be determined by the Engineer.
C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

END OF SECTION

# FIGURES

FIGURE 1 – VICINITY LOCATION MAP
FIGURE 2 – MONITOR WELL LAYOUT MAP
FIGURE 3 – TYPICAL WELL CONSTRUCTION DETAILS
FIGURE 4 – SURVEY




McCOMBS LOCATION PLAN

NTS

TABLE OF CONTENTS

| SHEET NAME | DESCRIPTION |
|---|---|
| G-001 | PROJECT LOCATION MAP |
| C-101 | PIEZOMETER LAYOUT PLAN |
| C-501 | GROUNDWATER MONITORING WELL DETAILS |

PSC

PARKHILL SMITH & COOPER

PARKHILL SMITH & COOPER, INC.
STATE OF TEXAS
F-5660
R. MATT DYER
92189
LICENSED
PROFESSIONAL ENGINEER
07/27/11

THE CITY OF EL PASO TEXAS

**CITY OF EL PASO, TEXAS**
**GROUNDWATER**
**MONITORING WELLS REPORT**

**McCOMBS LANDFILL**
**TCEQ MSW PERMIT NO. 0729A**

**7968 SAN PAULO DRIVE**
**EL PASO, TEXAS 79907**

KEY PLAN

| NO | DATE | DESCRIPTION |
|---|---|---|

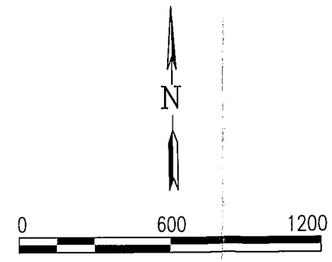
ISSUING OFFICE: LUBBOCK, TX PROJECT NO: 01.5151.10

**PROJECT LOCATION MAP**

**G-001**

Xrefs: XIB-5151

Drawing File: X:\2010\5151.10\CADD\00_SHEETS\WELL_RPTS\McCOMBS_LF\GRWATER\G-001-WRPT-MCC-5151.dwg (GEORGE_M) 7/27/2011 16:32:55




LEGEND

- PERMITTED BOUNDARY (PERMIT NO. 0729A)
- EXISTING GROUNDWATER MONITORING WELL
- NEW 4" PIEZOMETER

PSC
PARKHILL SMITH & COOPER

PARKHILL SMITH & COOPER, INC. F-560
STATE OF TEXAS
R. MATT DYER
92189
LICENSED PROFESSIONAL ENGINEER
07/27/11

THE CITY OF EL PASO TEXAS

**CITY OF EL PASO, TEXAS**
**GROUNDWATER**
**MONITORING WELLS REPORT**

**McCOMBS LANDFILL**
**TCEQ MSW PERMIT NO. 0729A**

**7968 SAN PAULO DRIVE**
**EL PASO, TEXAS 79907**

KEY PLAN

| NO | DATE | DESCRIPTION |
|---|---|---|

ISSUING OFFICE: LUBBOCK, TX PROJECT NO: 01.5151.10

**PIEZOMETER**
**LAYOUT PLAN**

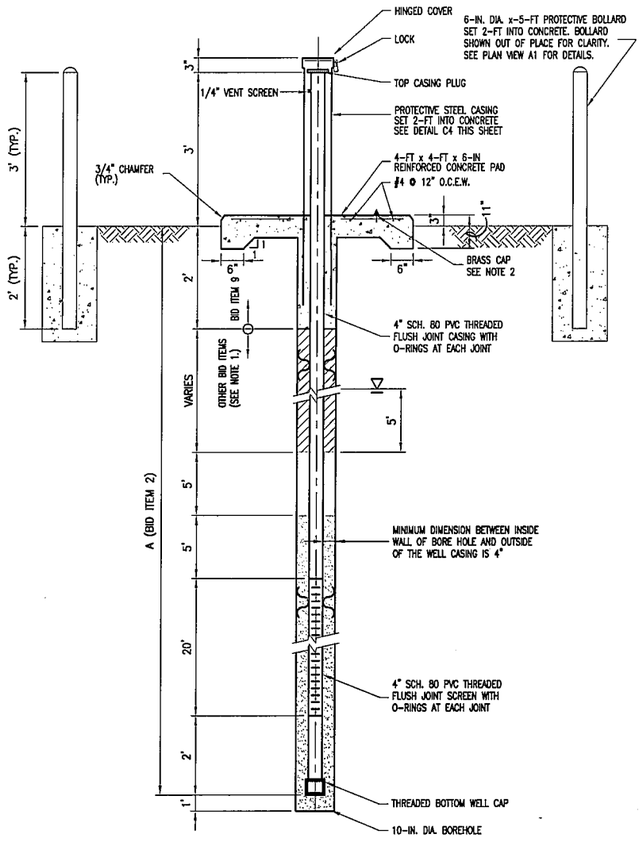
**C-101**

Drawing File: X:\2010\5151.10\CADD\00_SHEETS\WELL-RPTS\McCOMBS-LF\GRWATER\C-101-WRPT-MCC-5151.dwg (GEORGE-M) 7/27/2011 16:32:43
Xrefs: XSV-5151-McCOMBS, XTB-5151

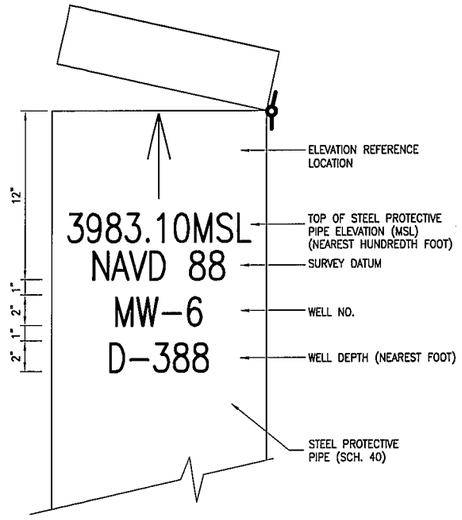
| VARYING WELL DEPTHS | |
|---|---|
| WELL NO. | A±(FT.) |
| PZ-4 | 440 |
| PZ-5 | 459 |
| | |
| | |

## MATERIAL LEGEND

- CONCRETE CAP AND SEAL
- CASING SEAL
- ANNULAR SEAL
- GRAVEL



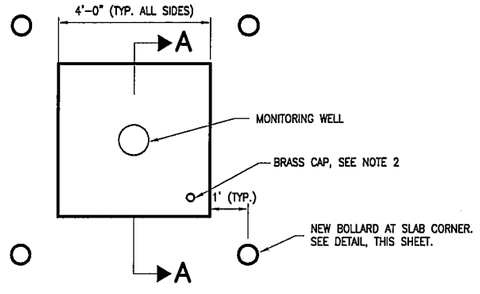

**B2 MONITOR WELL CROSS SECTION A-A**
NO SCALE



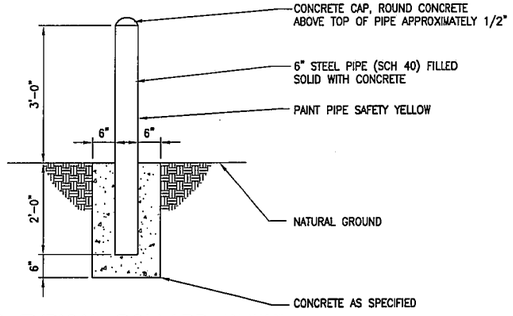

**C4 WELL IDENTIFICATION**
NO SCALE

NOTES:

1. NUMBERS SHOWN ARE FOR EXAMPLE ONLY.
2. INFORMATION SHOWN SHALL BE PERMANENTLY ATTACHED TO STEEL PROTECTIVE PIPE BY WELDING OR OTHER METHOD APPROVED BY ENGINEER.
3. PAINT PROTECTIVE PIPE AND COVER SAFETY YELLOW.




**A1 WELL CAP PLAN VIEW & BOLLARD PLACEMENT DETAIL**
NO SCALE




**A3 TYPICAL BOLLARD DETAIL**
NO SCALE

PSC
PARKHILL SMITH & COOPER

PARKHILL SMITH & COOPER, INC. F-569
STATE OF TEXAS
R. MATT DYER
92189
LICENSED PROFESSIONAL ENGINEER
07/27/11

THE CITY OF EL PASO TEXAS

**CITY OF EL PASO, TEXAS**
**GROUNDWATER MONITORING WELLS REPORT**

**McCOMBS LANDFILL**
**TCEQ MSW PERMIT NO. 0729A**

**7968 SAN PAULO DRIVE**
**EL PASO, TEXAS 79907**

KEY PLAN

| NO | DATE | DESCRIPTION |
|---|---|---|

ISSUING OFFICE: LUBBOCK, TX PROJECT NO: 01.5151.10

**GROUNDWATER MONITORING WELL DETAILS**

**C-501**

Xrefs: XTB-8.5x11-5127, XTB-5151
Drawing File: X:\2010\5151.10\CADD\00_SHEETS\WELL-RPTS\McCOMBS-LF\GRWATER\C-501-MRPT-MCC-5151.dwg (GEORGE-M) 7/27/2011 16:32:32

# Land–Mark Professional Surveying Inc.

*"Serving Texas, New Mexico and Arizona"*

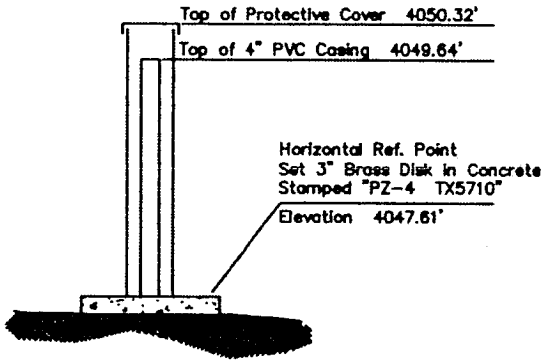

June 16, 2011

Parkhill, Smith & Cooper, Inc.
115 W. Griggs
Las Cruces, New Mexico 88001
Attn: Matt Dyer, P.E.

Subject: McCombs Landfill new Monitor Well Locations.

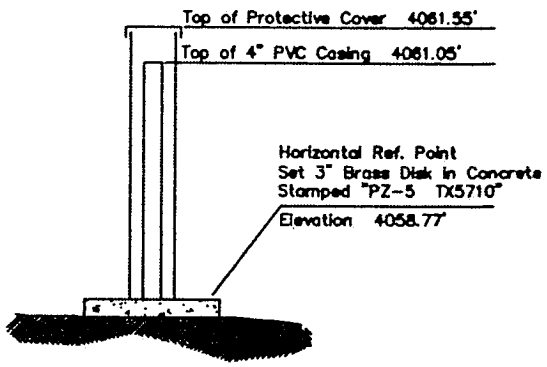
Dear Matt:

Coordinates shown hereon are based on Texas State Plane Coordinates, central zone. NAD83(1993) datum. Elevations are based on NGS vertical control monument J 110. Record elevation 4006.37' (NAVD 88 Datum).




Well PZ–4

Latitude N 31°59'18.81720"
Longitude W 106°24'07.71131"




Well PZ–5

Latitude N 31°59'29.26715"
Longitude W 106°23'53.84750"

Vertical Datum Conversion Factors are: NAVD 88 Datum to NGVD 29 Datum subtract 1.99'
NGVD 29 Datum to City of El Paso Datum add 27.65'

I, Kenneth R. Kindle, hereby certify that the forgoing horizontal and vertical data was calculated from the field notes an actual survey performed by me or under my direction on June 14, 2011, and that the same is true and correct to the best of my knowledge and belief.

STATE OF TEXAS REGISTERED KENNETH R. KINDLE 5710 PROFESSIONAL LAND SURVEYOR

Kenneth R. Kindle R.P.L.S.
Texas Registration No.5710
Job #28006


1420 Bessemer Drive, Suite 'A', El Paso Texas 79936
Tel. (915) 598–1300 Fax (915) 598–1221 email address: Bob@Land–Marksurvey.com

Engineers, Geologists, Hygienists and Environmental Scientists

Raba Kistner

Raba-Kistner Consultants (SW), Inc.
7002 Commerce
El Paso, Texas 79915
(915) 778-5233 • FAX (915) 779-8301
www.rkci.com

Project No. ASF02-045-00
April 8, 2004

Mr. Ziad Al-Dasouqi, P.E.
City of El Paso, Engineering Dept.
2 Civic Center Plaza
El Paso, Texas 79901-1196

Re: Groundwater Monitoring System Installation
Additional Well Development Activities
City of El Paso McCombs Landfill - Permit No. MSW-729A
El Paso County, Texas

Dear Mr. Al-Dasouqi:

Raba-Kistner Consultants (SW), Inc. (Raba-Kistner) is pleased to submit this documentation of additional groundwater monitor well development activities at the above referenced facility. The groundwater monitoring system installation was documented in a previous letter report to the Texas Commission on Environmental Quality (TCEQ) dated December 18, 2003. As indicated in the letter report, additional groundwater monitor well development was recommended for the three recently installed monitor wells at the McCombs Landfill. Based on the recorded water quality parameters from the initial well development, it appeared that an insufficient water volume was initially purged to restore natural hydrogeological conditions. Therefore, the additional well development was performed to remove any residual drilling artifacts and restore the natural hydrogeological conditions.

## DESCRIPTION OF ADDITIONAL DEVELOPMENT ACTIVITIES

Raba-Kistner completed the additional well development at each of the three monitoring wells at the above referenced site between January 19, 2004 and January 27, 2004. The well development was performed by Lirasa Drilling Company and Raba-Kistner observed and documented the well development activities.

On January 19 and January 20, 2004, 230 gallons of groundwater were removed from MW-1 using an approximate 2.5 gallon bailer. The groundwater removed from MW-1 was initially clear, however upon further development fine-grained sand with silt was observed to be present within the groundwater at MW-1. The fine-grained sand with silt did not appear to be artifacts of drilling mud or additives, but rather appeared to be naturally occurring sediments within the water bearing formation, which migrated with groundwater into MW-1. Groundwater samples were collected at discrete intervals during well development to monitor water quality parameters (pH, conductivity, turbidity, and temperature). Turbidity readings generally exceeded the range of the turbidity metar, which was 1000 NTUs. This may have been due to the agitated state of the fine-grained sand with silt in the groundwater. Development continued until 10 well volumes were removed and pH, conductivity and temperature readings stabilized (i.e. less than

10 percent variation for at least three consecutive readings). Upon completion of the additional well development activities at MW-1, a total of 360 gallons of groundwater was removed from MW-1.

On January 21, 2004, approximately 100 gallons of groundwater were removed from MW-2 using an approximate 5 gallon bailer. The groundwater removed from MW-2 was found to be clear with minimal fine-grained sand present. As indicated on the well development form the water quality parameters (pH, conductivity, and temperature) were found to have stabilized within 100 gallons of groundwater being removed from the wells. Upon completion of the well development activities a total of 360 gallons were removed from MW-2.

On January 21, 2004, approximately 35 gallons of groundwater were removed from MW-3 using an approximate 5 gallon bailer. After the 35 gallons were removed, minimal groundwater was observed in the bailer. Upon attempting to record the total depth of the well, an obstruction was encountered at a depth of 454.6 feet below ground surface. Development of MW-3 continued on January 23, 2004, using compressed air, however minimal groundwater was being removed from MW-3. Initially, medium to coarse grained sands were removed from MW-3 followed by fine grained sand and silt. Between approximately 4:05 and 4:08 p.m. on January 23, 2004, angular and subangular gravels with silt were removed from MW-3. The medium to coarse grained sands and gravels could not have entered through the 0.010-inch size slotted screen and the source of the materials could not be determined. Therefore, the presence of the gravels and minimal amount of groundwater presented an abnormal condition. After the gravels were removed from MW-3, minimal water with silt continued to be removed. On January 26, 2004, redevelopment of MW-3 continued and a connection was added to the top of the PVC casing to capture the development water. The water collected initially contained approximately 75 percent fine grained sands with silt and as development continued less fine grained sand was observed in the development water until the water was clear to cloudy with minimal sediment. On January 26, 2004 over 500 additional gallons of groundwater (13 well volumes) were removed using compressed air. Development continued on January 26 and 27, 2004 to remove any remaining sediment from the bottom of MW-3, however samples were not collected until development was completed on January 27, 2004. Although, the water quality parameters were found to have stabilized, the groundwater contained fine-grained sands. The fine-grained sands appear to be naturally occurring sediments within the water bearing formation, which have migrated with groundwater into MW-3. Upon completion of the additional well development activities at MW-3, a total of over 815 gallons of groundwater were removed from the well.

Water levels were gauged and recorded prior to and following well development of each of the monitoring wells. The volumes removed, water quality parameters and depths to groundwater can be found on the attached well development forms.

With the additional well development that was completed, Raba-Kistner concludes that the groundwater monitor wells have been properly developed in accordance with the well development requirements of 30 TAC 330.242 (c). Groundwater within the water bearing zone of the monitor wells has been restored to natural hydrogeological conditions.

Project No. ASF02-045-00
April 8, 2004

**CLOSING**

We trust that the information provided herein in conjunction with that provided previously in our letter report dated December 18, 2003, satisfies the groundwater monitoring system installation requirements for this site. If you have any questions or need additional information regarding the information included herein, please do not hesitate to contact either of the undersigned.

Respectfully submitted,

**RABA-KISTNER CONSULTANTS (SW), INC.**

Valerie A. Joosten, P.E.
Environmental Engineer

Walter L. Miller
Manager, Environmental Services

Copies Submitted: Above (1)
Ms. Emma Acosta, City of El Paso, Solid Waste Management (1)
Mr. Ed Drusina, P.E., City of El Paso, Municipal Services (1)
File (1)

Enclosures: Well Development Forms

Sv\VJ\H:\Data\Env\ASF02\045\monitwells\LTR040804.doc

# WELL DEVELOPMENT FORM
## McCombs Landfill
## MSW Permit No. 729A

| DEVELOPMENT DATE | WELL NO. | TOTAL DEPTH (FT) | DEPTH TO WATER (FT) | DEVELOP/ PURGE (GAL) | TOTAL VOLUME REMOVED (GAL) | pH | CONDUCT. (mS) | TEMP. (C) | TIME | COMMENTS (Odors, Sheen, PSH, Turbidity, Well Inspection) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1/19/2004 | 1 | See Comments | 394.89 | | | | | | 12:30 | Water level reading prior to redevelopment. Total depth could not be determined using the water level indicator. |
| 1/19/2004 | 1 | | | 22.5 | 22.5 | 10.42 | -0.02 | 20.9 | 1:50 | Water very cloudy with sediment. |
| 1/19/2004 | 1 | | | 32.5 | 55 | 9.75 | 6.71 | 22.8 | 3:10 | Sample contained fine grained sand with silt. |
| 1/19/2004 | 1 | | | 7.5 | 62.5 | 9.44 | 6.78 | 23.1 | 3:50 | Sample contained fine grained sand with silt |
| 1/20/2004 | 1 | 470.02 | 396.00 | | | | | | 8:55 | Water level reading prior to redevelopment on 1/20/2004. A weight was added to water level indicator to determine total depth. |
| 1/20/2004 | 1 | | | 7.5 | 70 | 9.32 | 7.13 | 17.9 | 9:20 | Water slightly cloudy. |
| 1/20/2004 | 1 | | | 37.5 | 107.5 | 9.4 | 6.95 | 20.2 | 10:10 | Water cloudy with sediments. |
| 1/20/2004 | 1 | | | 50 | 157.5 | 9 | 6.08 | 19.0 | 11:40 | Water cloudy with silt. |
| 1/20/2004 | 1 | | | 30 | 187.5 | 8.46 | 6.16 | 21.2 | 1:15 | Water cloudy with suspended sediment. |
| 1/20/2004 | 1 | | | 5 | 192.5 | 8.97 | 6.22 | 20.9 | 1:28 | Water cloudy with suspended solids. |
| 1/20/2004 | 1 | | | 5 | 197.5 | 8.93 | 6.18 | 20.6 | 1:43 | See above. |
| 1/20/2004 | 1 | | | 5 | 202.5 | 8.87 | 6.21 | 20.8 | 1:49 | See above. pH, Cond., Temp. have stabilized for 3 consecutive measurements. 8.6 well volumes removed. |
| 1/20/2004 | 1 | | | 17.5 | 220 | 8.94 | 6.32 | 20.3 | 1:59 | See above. |
| 1/20/2004 | 1 | 470.02 | 407.30 | 10 | 230 | 8.93 | 6.34 | 20.1 | 2:10 | See above. 10 well volumes removed. Water level reading following development. |
| 3/24/2004 | 1 | 470.40 | 394.08 | | | | | | 5:00 | Sand or silt observed on bottom 2 - inches of water level indicator probe. |
| 4/7/2004 | 1 | | | | | | | | | Well was not accessible due to recent rain event. No measurements collected. |

DESCRIBE THE DISPOSITION, AMOUNT, AND LOCATION OF PURGED WATER AND ANY OTHER COMMENTS:

1. Purge water stored in 55 gallon drums on site pending groundwater sampling results

2. Development was performed with a 2.5 gallon bailer.

3. Well Volume = Volume of Casing within Screened Interval (12' x 0.6 gal/ft) + Effective Volume of Filter Pack (Volume of Filter Pack x 0.25)
Well Volume = 7.2 gallons + 15.8 gallons = 23.0 gallons

4. Parameters (pH, cond., temp.) were considered stabilized when 3 consecutive readings (every 5 gallons) were within 10 percent. Water quality parameters were measured at discrete intervals.

5. Turbidity readings exceeded the limits of the meter. The maximum range of the turbidity meter was 1000 NTUs.

*Prepared by:* Raba-Kistner Consultants, Inc.



APR-12-2004(MON) 15:26 RABA-KISTNER CONSULTANTS, INC. (FAX)915 7788301 P.005/007

# WELL DEVELOPMENT FORM
## McCombs Landfill
## MSW Permit No. 729A

| DEVELOPMENT DATE | WELL NO. | TOTAL DEPTH (FT) | DEPTH TO WATER (FT) | DEVELOP/ PURGE (GAL) | TOTAL VOLUME REMOVED (GAL) | pH | CONDUCT. (mS) | TURB. (NTU) | TEMP. (C) | TIME | COMMENTS (Odors, Sheen, PSH, Turbidity, Well Inspection) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/21/2004 | 2 | 506.80 | 399.50 | | | | | | | 11:05 | Water level reading prior to redevelopment. |
| 1/21/2004 | 2 | | | 5 | 5 | 8.07 | 6.21 | 7.42 | 21.9 | 11:45 | Water is clear |
| 1/21/2004 | 2 | | | 15 | 20 | 8.13 | 6.2 | 10.7 | 20.8 | 12:00 | Water is very clear. |
| 1/21/2004 | 2 | | | 35 | 55 | 8.16 | 4.27 | 214 | 25.6 | 1:10 | Water cloudy with silt. |
| 1/21/2004 | 2 | | | 5 | 60 | 8.42 | 4.27 | 419 | 25.5 | 1:15 | Water cloudy with silt. |
| 1/21/2004 | 2 | | | 20 | 80 | 8.21 | 4.1 | 315 | 25.3 | 1:30 | Water cloudy with silt. |
| 1/21/2004 | 2 | | | 10 | 90 | 8.33 | 4.13 | 291 | 25 | 1:40 | pH, Cond, Temp have stabilized for 3 consecutive measurements. 2.3 well volumes removed. |
| 1/21/2004 | 2 | | | 10 | 100 | 8.23 | 4.17 | 391 | 23.9 | 1:52 | Water cloudy with light silt. 2.6 well volumes removed. |
| 1/21/2004 | 2 | 506.83 | 420.30 | | | | | | | 2:00 | Water level reading following development. |
| 3/25/2004 | 2 | 500.62 | 400.45 | | | | | | | 8:00 | No sand or silt observed on water level indicator probe. |
| 4/7/2004 | 2 | 506.80 | 400.59 | | | | | | | 9:45 | No sand or silt observed on water level indicator probe. |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

DESCRIBE THE DISPOSITION, AMOUNT, AND LOCATION OF PURGED WATER AND ANY OTHER COMMENTS:

1. Purge water stored in 55 gallon drums on site pending groundwater sampling results.

2. Development was performed with a 5.0 gallon bailer.

3. Well Volume = Volume of Casing within Screened Interval (20' x 0.6 gal/ft) + Effective Volume of Filter Pack (Volume of Filter Pack x 0.25)
Well Volume = 12.0 gallons + 26.4 gallons = 38.4 gallons

4. Parameters (pH, Cond., Temp.) were considered stabilized when 3 consecutive readings were within 10 percent. Samples were collected at discrete intervals.

*Prepared by:* Raba-Kistner Consultants, Inc.



APR-12-2004(MON) 15:26 RABA-KISTNER CONSULTANTS, INC. (FAX)915 7798301 P.006/007

# WELL DEVELOPMENT FORM
## McCombs Landfill
## MSW Permit No. 729A

| DEVELOPMENT DATE | WELL NO. | TOTAL DEPTH (FT) | DEPTH TO WATER (FT) | DEVELOP/ PURGE (GAL) | TOTAL VOLUME REMOVED (GAL) | pH | CONDUCT. (mS) Note 6 | TURB. (NTU) | TEMP. (C) | TIME | COMMENTS (Odors, Sheen, PSH, Turbidity, Well Inspection) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/21/2004 | 3 | 468.00 | 328.85 | 10 | 10 | 8.28 | 2.81 | 128 | 18.1 | 8:50 | Water level reading prior to redevelopment. Water sample was slightly cloudy. |
| 1/21/2004 | 3 | See Comments | 451.03 | 25 | 35 | | | | | 10:00 | See Note 1. |
| 1/23/2004 | 3 | | | | | | | | | | See Note 2. |
| 1/26/2004 | 3 | | | 55 | 90 | 8.09 | Error | Error | 20.8 | 10:50 | Sample contained approx. 75% silt. |
| 1/26/2004 | 3 | | | 55 | 145 | 8.16 | Error | Error | 21.3 | 11:00 | Sample contained approx. 25% silt. |
| 1/26/2004 | 3 | | | 55 | 200 | 8.18 | Error | 230 | 21.2 | 11:10 | Sample contained approx. 20% silt. |
| 1/26/2004 | 3 | | | 55 | 255 | 8.02 | Error | 358 | 21.4 | 11:20 | Sample contained approx. 10% silt. |
| 1/26/2004 | 3 | | | 55 | 310 | 7.66 | Error | 373 | 21.5 | 11:35 | Sample contained less sediments. |
| 1/26/2004 | 3 | | | 55 | 365 | 8.66 | Error | 348 | 19.6 | 11:40 | Water slightly cloudy. |
| 1/26/2004 | 3 | | | 55 | 420 | 8.68 | Error | 180 | 21.9 | 12:00 | |
| 1/26/2004 | 3 | | | 55 | 475 | 8.67 | Error | 68.5 | 19.4 | 12:05 | Water clear to cloudy. |
| 1/26/2004 | 3 | | | 20 | 495 | 8.61 | Error | 158 | 21.9 | 12:15 | |
| 1/26/2004 | 3 | | | 20 | 515 | 8.55 | Error | 104 | 20.5 | 12:20 | |
| 1/26/2004 | 3 | | | 20 | 535 | 8.56 | Error | 144 | 20.4 | 12:25 | pH and Temp have stabilized for 3 consecutive measurements. 13.9 well volumes were removed. See Note 5. |
| 1/27/2004 | 3 | | | | | 8.66 | | 470 | 23.4 | 2:20 | Water is clear with minimal sand. |
| 1/27/2004 | 3 | | | | | 8.61 | | 390 | 22.9 | 2:30 | |
| 1/28/2004 | 3 | 491.33 | 388.10 | | | | | | | | Water level reading following development. |
| 3/24/2004 | 3 | 493.85 | 389.54 | | | | | | | 4:15 | Sand or silt observed on bottom 4-inches of water level indicator probe. |
| 4/7/2004 | 3 | 493.03 | 389.70 | | | | | | | 9:20 | Sand or silt observed on bottom 1-inch of water level indicator probe. |

DESCRIBE THE DISPOSITION, AMOUNT, AND LOCATION OF PURGED WATER AND ANY OTHER COMMENTS:

1. The water level indicator could not extend beyond a depth of 454.6 feet and very little water was being recovered at this time, therefore bailing was discontinued at MW-3 on 1/21/04. Development on 1/21/04 was performed using a 5.0 gallon bailer.

2. On 1/23/04 development was continued using compressed air. However, no samples collected due to minimal water being removed. Fine, medium and coarse grained sands and silt were being removed from the well. Between 4:05 and 4:08 p.m., angular and subangular gravel with sand and silt was being blown out of well.

3. Well Volume = Volume of Casing within Screened Interval (20' x 0.6 gal/ft) + Effective Volume of Filter Pack (Volume of Filter Pack x 0.25)
Well Volume = 12.0 gallons + 28.4 gallons = 39.4 gallons

4. Parameters (pH, temp.) were considered stabilized when three consecutive readings were within 10 percent.

5. Additional water was removed on 1/26/04 and 1/27/04 to remove additional sediments from the bottom of MW-3. Samples were not collected and activities were not recorded.

6. Error = Parameter levels exceed limits of meter. Conductivity meter did not appear to be working properly even after recalibrating and troubleshooting.

Kathleen Hartnett White, *Chairman*
R. B. "Ralph" Marquez, *Commissioner*
Larry R. Soward, *Commissioner*
Margaret Hoffman, *Executive Director*

# TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

*Protecting Texas by Reducing and Preventing Pollution*

March 12, 2004

The Honorable Joe Wardy
Mayor of El Paso
2 Civic Center Plaza
10th Floor
El Paso, TX 79901

Re: Municipal Solid Waste - El Paso County
City of El Paso/McCombs Landfill - MSW Permit No. 729A
Groundwater Monitor Well Installation Report
WWC No. 10443047, Mail Log No. 04-4140
RN100215599, 601410244

Dear Mayor Wardy:

On December 29, 2003, the Texas Commission on Environmental Quality (TCEQ) received the referenced report dated December 18, 2003, documenting the installation of monitor wells MW-1, MW-2, and MW-3 at the City of El Paso McCombs Landfill, as required by Attachment 5 (Groundwater Characterization Report) in the current Site Development Plan. The report was prepared by Raba-Kistner Consultants (SW), Inc., and was signed and sealed by Ms. Valerie A. Joosten, P.E. (#89118), Environmental Engineer. The report was also signed by Mr. Richard V. Klar, P.G., Environmental Geologist.

This report included a detailed site map drawn to scale depicting the new monitor well locations and the relevant point of compliance, detailed geologic boring logs, Monitor Well Data Sheets (Form TCEQ-10308), State of Texas Well Reports (Form TNRCC-0199), typical monitor well construction detail, generalized groundwater flow direction map, summary of groundwater level data, a current chemical analysis of city water used during drilling activities, well development forms, surveyor's certification, and a qualified groundwater scientist certification that was signed and sealed by Mr. Richard V. Klar, P.G. (#259).

This report included the documentation as required by 30 TAC §§330.231 and 330.242, and is in accordance with the requirements of the permit modification issued on August 22, 2002, for the upgrade of the landfill to the meet the requirements of 40 CFR Part 258, Subtitle "D".

Please contact me at 512/239-6730 if you have any questions concerning this matter. When addressing written correspondence, please use Mail Code 124 (MC-124).

Sincerely,

Gale L. Baker, P.G.
MSW Permits Section
Waste Permits Division

GLB/gb

cc: Ms. Emma Acosta, Solid Waste Management Director, El Paso
Ms. Valerie A. Joosten, P.E., Raba-Kistner Consultants (SW), Inc., El Paso
Mr. Richard V. Klar, P.G., Raba-Kistner Consultants (SW) Inc., San Antonio

Raba Kistner

Raba-Kistner Consultants (SW), Inc.
7002 Commerce
El Paso, Texas 79915
(915) 778-5233 • FAX (915) 779-8301
www.rkci.com

Project No. ASF02-045-00
December 18, 2003

03 DEC 24 P 4:25

Mr. Jeff Davis
Permits Team II Leader – MC 124
Municipal Solid Waste Permits Section – Waste Permits Division
Texas Commission on Environmental Quality
12100 Park 35 Circle, Bldg. F
Austin, Texas 78753

Re: Groundwater Monitoring System Installation
City of El Paso McCombs Landfill - Permit No. MSW-729A
El Paso County, Texas

Dear Mr. Davis:

On behalf of the City of El Paso, Raba-Kistner Consultants (SW), Inc. (Raba-Kistner) is pleased to submit this letter report documenting the installation of the groundwater monitoring system at the above referenced facility. The groundwater monitoring system installation described herein was conducted in accordance with Site Development Plan (SDP) - Attachment 5 (Groundwater Characterization Report), applicable sections of the municipal solid waste (MSW) rules relating to monitor well construction specifications (30 TAC §330.242), and recent communications with the Texas Commission on Environmental Quality (TCEQ).

## Groundwater Monitoring System Installation

As required by SDP - Attachment 5, three (3) groundwater monitor wells were installed at the McCombs Landfill. Drilling and monitor well installation activities were performed between July 17, 2003 and September 1, 2003 by a Texas-licensed driller, Mr. R.C. Corona (Texas Drillers License No. 4709M). Ms. Valerie Joosten, P.E. of Raba-Kistner monitored and logged the drilling and well installation activities. Figure 1 depicts the location of the three (3) groundwater monitor wells (designated as MW-1, MW-2 and MW-3) installed at the site.

The groundwater monitor wells were installed by mud rotary drilling methods using clean, treated city water and a bentonite additive, Quick-Gel®. Said drilling method and the use of the bentonite-based drilling additive were authorized by TCEQ correspondence dated June 20, 2003. As required by 30 TAC §330.242(a)(1)(B), a copy of the current chemical analysis of the city water used during drilling activities is included as Attachment 1.

The boreholes were advanced using a truck-mounted drilling rig equipped with a 10-inch outer diameter tri-cone drill bit. The drilling fluids and drilling cuttings were circulated from the borehole to a mud pit constructed adjacent to the borehole. Drilling cutting samples were collected from the recovered drilling fluid at approximately 10-ft intervals and at apparent changes in lithology. The samples were washed to remove the drilling mud from the samples and subsequently visually examined, classified and logged by the on-site Raba-Kistner

professional engineer in general accordance with standard field geotechnical sampling methods. The resulting boring logs depicting the subsurface strata encountered during drilling are presented as Attachment 2. As indicated on the boring logs, the subsurface strata encountered included intermittent and/or interbedded layers of clay, sand, gravel, cemented sands and caliche (calcareous soils).

The ambient levels of methane, hydrogen sulfide, oxygen, and combustible gas (lower explosive level) were continuously monitored during field activities using a Gastech GT Land Surveyor, which was calibrated with ambient air at the start of each day. In addition, a Photoionization Detector (PID) was used to continuously monitor ambient volatile organic compound (VOC) concentrations within the project area. The PID was calibrated with Zero Air and Isobutylene prior to the start of drilling operations. Methane, hydrogen sulfide, VOC or combustible gas concentrations were not detected during field drilling and sampling activities.

The boreholes for the three (3) groundwater monitor wells (i.e., MW-1, MW-2 and MW-3) were advanced to respective depths of 600, 505 and 520 feet below ground surface (ft bgs). The uppermost groundwater bearing zone was encountered during drilling at 456, 475 and 485 ft bgs (corresponding to elevations relative to mean sea level (msl) of approximately 3,611, 3,606 and 3,589 ft msl) for wells MW-1, MW-2 and MW-3, respectively.

Results of the previously conducted water well search for the landfill vicinity indicate that nearest water wells are located approximately 1,500 to 2,500 ft away and installed to approximate depths of 600 ft below ground surface. Based on review of available well construction details for nearest water wells, it is Raba-Kistner's understanding that screen lengths are on the order of 200 ft and likely tap multiple zones of saturation starting at approximately 400 ft below ground surface. On the basis of this data, MW-1 was advanced to 600 ft below ground surface in order to evaluate potential zones of saturation occurring between the 400 ft to 600 ft interval at the landfill site. On the basis of geologic conditions observed, Raba-Kistner contacted TCEQ MSW staff in order to confirm that landfill monitoring wells should be constructed to screen only the uppermost saturated interval identified. Based on discussions and email correspondence between R-K and TCEQ MSW staff, it was agreed that MW-1 should be completed in the following manner:

- Set top of well screen approximately 5 ft below the top of medium/coarse grained sand stratum identified at 456 ft bgs (i.e., 461 ft bgs [approx. 3,606 ft msl]).

- Set bottom of well screen to coincide with the base of the second underlying medium/coarse grained sand stratum at 473 ft bgs (approx. 3,594 ft msl).

- Install bentonite plug immediately above the well screen to extend a minimum of 5 ft into the suspected zone of saturation (i.e., 456 to 461 ft bgs).

Further, it was agreed that should similar subsurface geologic conditions be observed and the uppermost water bearing zones be encountered at similar depths during the installation of MW-2 and MW-3, then the screened intervals for said wells shall be constructed in a similar manner as for MW-1 (approximately 20 ft in length instead of using a longer screen). On the basis that similar subsurface geologic conditions were observed and the uppermost water

bearing zones were encountered at similar depths in MW-2 and MW-3, the respective screens were set at 478 to 498 ft bgs (approx. 3,603 to 3,583 ft msl) in MW-2 and 475 to 495 ft bgs (approx. 3,599 to 3,579 ft msl) in MW-3. The bentonite plug for the three (3) wells was constructed to extend approximately 8 ft from the top of the screen.

As indicated above, all three monitor wells were screened approximately 20 feet within the uppermost saturated interval encountered during drilling. In general, these intervals corresponded to medium/coarse-grained sand strata, which were in some cases separated by a thinly bedded clay or fine-grained sand stratum.

Well completion details can be found in the following attachments to this letter report:

- Attachment 2 - Boring Logs
- Attachment 3 - Monitor Well Data Sheets (TCEQ Form 10308)
- Attachment 4 - Texas Department of Licensing and Regulation (TDLR) Well Reports

The wells were constructed of 4-in. diameter Schedule 80 PVC casing and 0.01–in. slotted screen, with flush jointed sections and O-ring seals at each joint, and a bottom cap. The casing was centered within the borehole using stainless steel centralizers spaced at intervals of approximately 40 feet along the well solid casing length with additional centralizers at the top and bottom of the well screen.

The following monitor well components were installed around the well screen and casing (from bottom to top) using a tremie pipe:

- filter pack (10-20 silica sand) – extending from bottom of borehole to depths corresponding, at a minimum, to the top of screen
- annular seal (3/8-inch hydrated bentonite pellets) – extending approximately eight (8) feet above the top of filter pack or top of screen
- grout seal (Portland cement, bentonite, and water mixture) – extending from the top of the annular seal to ground surface.

The wells were completed with a vented PVC slip-on cap, 8-in. square by 5-ft long protective steel collar extending at least 1 ft bgs, a 5-ft long x 5-ft wide x 6-in. thick concrete pad constructed with wire mesh for structural stability, and a keyed padlock. Additionally, four 4-inch diameter by 5-ft long steel bollards were set in concrete approximately 2 ft offset from the corners of the concrete pad and extending to approximately 1.5 ft bgs. Figure 2 depicts a typical groundwater monitor well construction diagram, while Table 2 presents the associated monitor well construction data.

Upon completion of the installation of the three (3) groundwater monitor wells, the locations were surveyed by a Texas-licensed professional land surveyor. The elevations and coordinates are included on the TCEQ Monitor Well Data Sheets (Attachment 3) and the surveyor's certification (Attachment 5). The locations from which the well elevations were recorded were permanently marked in the concrete pad, top of casing, and top of protective collar.

## Well Development

Upon the respective completion of well installation activities, each well was developed by bailing water from the well to remove drilling artifacts (i.e., drilling mud) and restore hydrogeological conditions of the water bearing zone surrounding the well screen. Subsequent to evacuating the drilling mud from the well casing, a minimum of three (3) well volumes were evacuated from each well. The actual volume of water removed was recorded on the well development forms included as Attachment 6. In addition, water pH, turbidity, conductivity, and temperature readings were also collected and recorded during well development. As indicated on the well development forms (Attachment 6), well development continued until the drilling fluids were adequately removed and effluent was clear. Water levels were gauged and recorded during and following well development. Based on the recorded water quality parameters, additional development is recommended.

## Groundwater Levels and Flow Direction Data

The static groundwater level elevations were calculated based on the top of casing elevations and the gauged depth to groundwater at each of the three (3) installed wells and are indicated in Table 1 (Static Water Level Elevations) and on Figure 3 (Generalized Groundwater Flow Direction). As indicated on Table 1 and Figure 3, the static groundwater level elevations were calculated to be approximately 3,674, 3,684, and 3,685 ft msl for MW-1, MW-2, and MW-3, respectively. These static groundwater levels correspond to elevations approximately 68, 81 and 86 ft above the respective screened interval for wells MW-1, MW-2 and MW-3.

As indicated on Table 1, no water was encountered at MW-2 (i.e., dry well) during the gauging events conducted on October 30 and 31, 2003 due to an apparent obstruction encountered at approximately 430 feet below the top of casing (TOC) which prevented the measuring probe from advancing deeper into the well casing (total well depth is approx. 501 feet below TOC). However, subsequent gauging events did not detect the presence of said obstruction and the depth to water at MW-2 was measured to be approximately 400 feet below TOC (corresponding to an approximate elevation of 3684 ft msl).

On the basis of the groundwater level measurements conducted to date at the site, it appears that groundwater flow direction at this site is generally from to the south-southeast, with a localized west-to-east disturbance near the southern boundary of the site due to the apparent groundwater mounding measured at MW-2. The site-specific groundwater flow direction generally appears to correlate with the regional groundwater flow direction (also to the south-southeast) discussed in SDP-Attachment 5 for regional groundwater located within the Hueco Bolson aquifer. Figure 3 depicts the generalized groundwater flow direction at the site.

Localized disturbances in the groundwater flow direction may become apparent at subsequent monitoring event due to groundwater recharge/extraction activities at off-site water wells. However, the generalized site-specific groundwater flow direction at the site is expected to correlate with the regional groundwater flow direction to the south-southeast. Thus, as depicted on Figures 1 and 3, the point of compliance for this site is defined as the plane formed by drawing a line through monitor wells MW-1 and MW-2, and will be located along the

southern property boundary.

## Qualified Groundwater Scientist Certification

The required certification by a qualified groundwater scientist is included herein as Attachment 7. The qualified groundwater scientist for this site is Richard V. Klar, P.G. of Raba-Kistner. Mr. Klar has a master's degree in Applied Geology (Hydrogeology emphasis) and over eight (8) years of experience in groundwater monitoring, hydrogeologic assessments, and monitoring well design and construction in support of corrective actions for leaking petroleum storage tanks, industrial/hazardous waste and closed municipal solid waste landfills, and permitting requirements for municipal solid waste facilities. Mr. Klar's corporate resume is also included in Attachment 7.

We trust that the information provided herein satisfies the groundwater monitoring system installation requirements for this site. If you have any questions or need additional information regarding this letter report, please do not hesitate to contact us.

Respectfully submitted,

**RABA-KISTNER CONSULTANTS (SW), INC.**

Valerie A. Joosten, P.E.
Environmental Engineer

STATE OF TEXAS
VALERIE A. JOOSTEN
89118
12/22/03
LICENSED
PROFESSIONAL ENGINEER

Richard V. Klar, P.G.
Environmental Geologist

Copies Submitted: Above (3)
Ms. Emma Acosta, City of El Paso, Solid Waste Management (1)
Mr. Antonio Flores, P.E., City of El Paso, Municipal Services (1)
Mr. Javier Reyes, P.E., City of El Paso, Engineering Dept. (1)

Enclosures: Figure 1 - Groundwater Monitor Well Location Map
Figure 2 – Typical Monitor Well Construction Detail
Figure 3 – Generalized Groundwater Flow Direction
Table 1 – Summary of Groundwater Level Data
Table 2 – Monitor Well Construction Data
Attachment 1, El Paso Water Utilities, Public Water Systems Water Analysis
Attachment 2, Boring Logs
Attachment 3, Monitor Well Data Sheets, TCEQ Form 10308
Attachment 4, TDLR Well Reports
Attachment 5, Surveyor's Certification
Attachment 6, Well Development Forms
Attachment 7, Qualified Groundwater Scientist Certification

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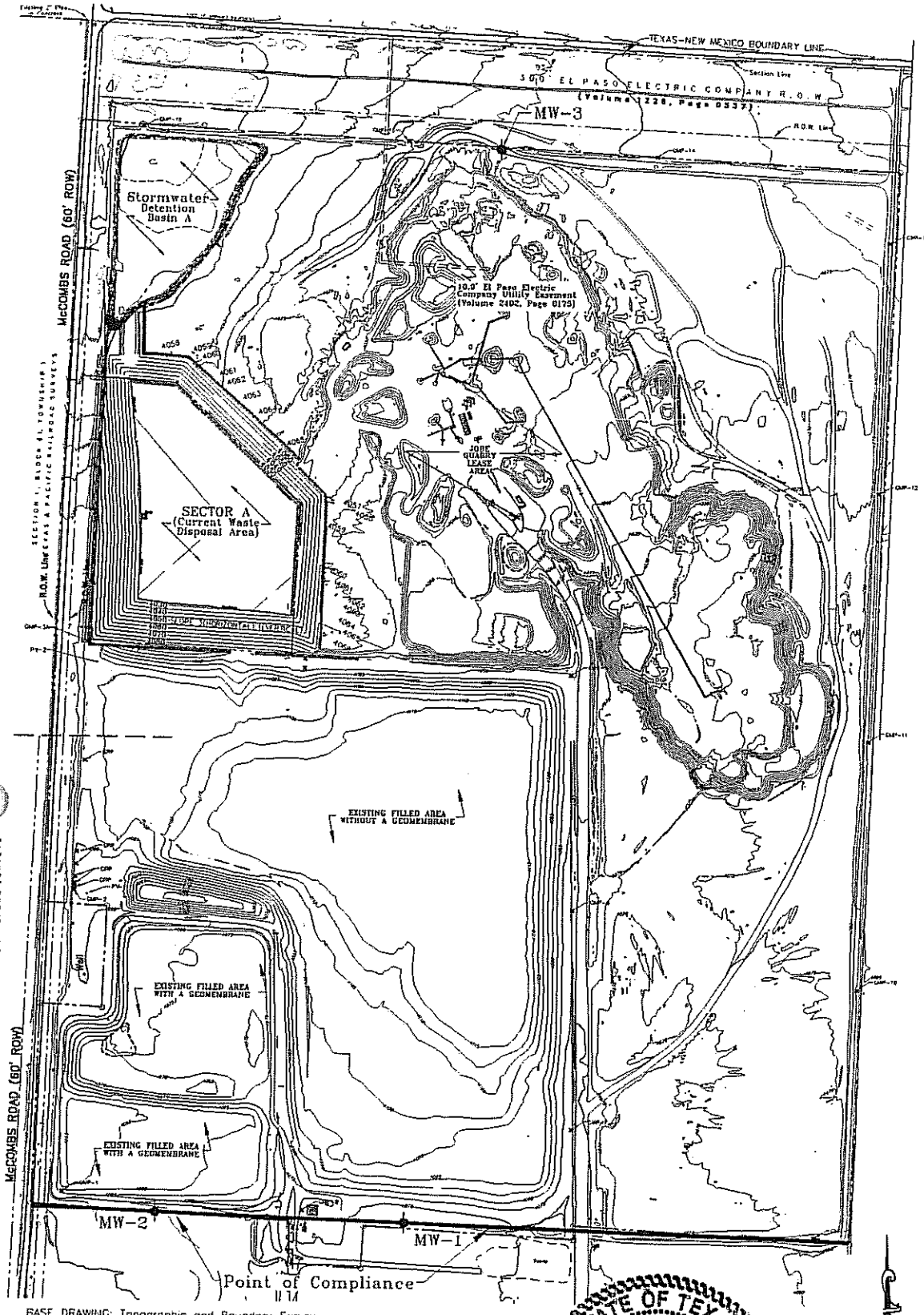



BASE DRAWING: Topographic and Boundary Survey,
Figure Att3-1a and Att3-1b of the Site Development Plan, April 2002

## LEGEND

- PERMIT BOUNDARY
- GROUNDWATER MONITOR WELL
- POINT OF COMPLIANCE

0 200 400 600
GRAPHIC SCALE
SCALE : 1" = 600'

STATE OF TEXAS
VALERIE A. JOOSTEN
89118
12/23/03
LICENSED
PROFESSIONAL ENGINEER

Valerie Joosten

| NO. | DATE | REVISION REMARKS | BY |
|---|---|---|---|
| | | | |

Raba Kistner

PROJECT: ASF02-045-00

SCALE Horiz. 1" = 600' Vert. 1" = 600'
Date 12-10-02
Drawn by A.A.
Chkd. by E.D.C./V.A.J.
Appd. by V.A.J.

FILE: H:\Data\Env\Asf02\045\VSF02045 F01.dwg

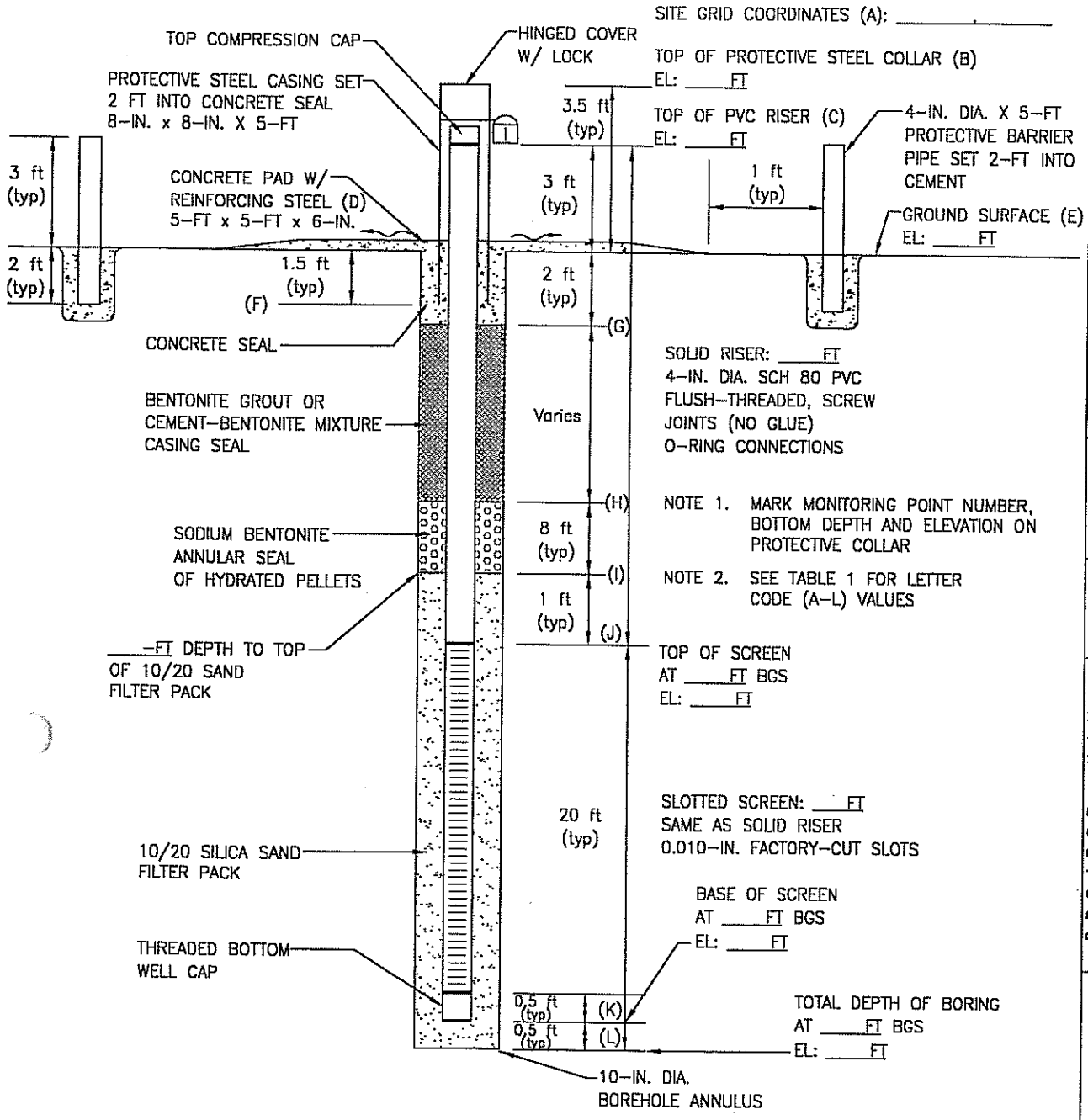
PROJECT NAME
McCOMBS LANDFILL
PHASE III - SECTOR A
MSW PERMIT No. 729A
EL PASO, TEXAS

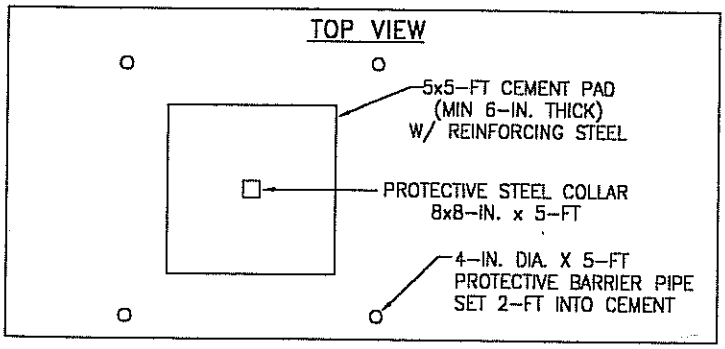
CITY OF El Paso
#2 CIVIC CENTER PLAZA PH. (915) 541-4200

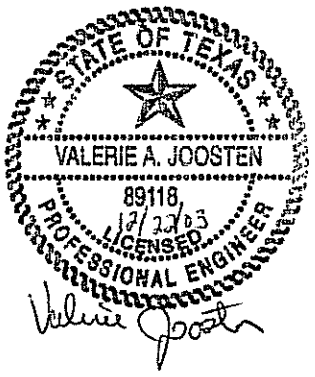
SHEET TITLE
GROUNDWATER MONITOR WELL LOCATION MAP

SHEET 1 OF 1

FIGURE 1




| NO. | DATE | REVISION REMARKS | BY |
|---|---|---|---|
| | | | |

Raba Kistner

PROJECT: A5F02-048-00

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Date 12-05-03
Drawn by A.M.
Chkd. by E.D.C./V.A.J.
Appd. by V.A.J.

FILE: H:\Data\Env\Arf02\048\A5F02048-Fig2.dwg

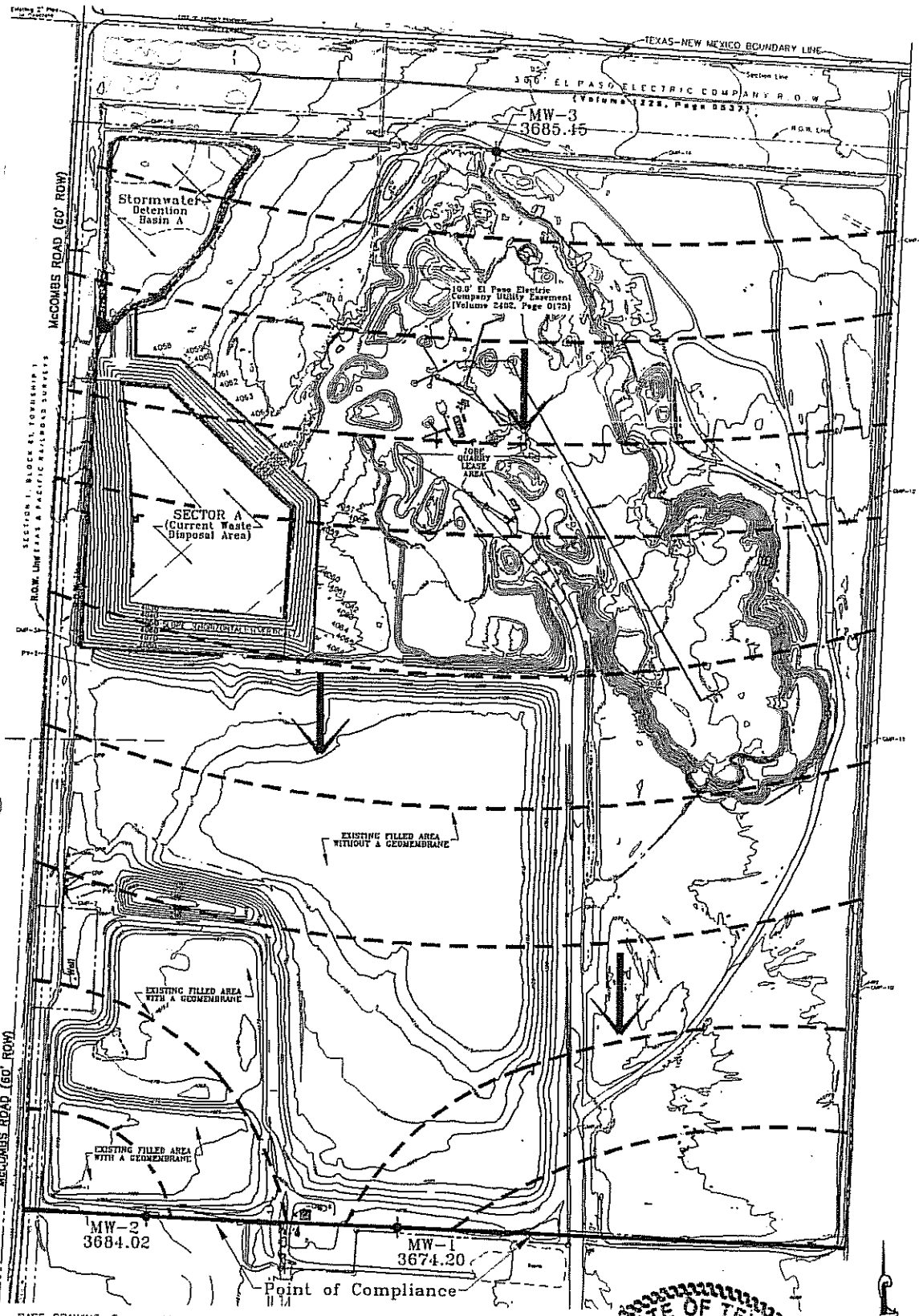
PROJECT NAME
McCOMBS LANDFILL
MSW PERMIT No. 729A
EL PASO, TEXAS

CITY OF El Paso
#2 CIVIC CENTER PLAZA PH. (915) 541-4259

SHEET TITLE
TYPICAL MONITOR WELL CONSTRUCTION DETAIL

SHEET 1 OF 1

FIGURE 2




BASE DRAWING: Topographic and Boundary Survey,
Figure Att3-1a and Att3-1b of the Site Development Plan, April 2002

## LEGEND

- PERMIT BOUNDARY
- GROUNDWATER MONITOR WELL
- STATIC WATER LEVEL ELEVATION, IN FEET ABOVE MEAN SEA LEVEL
- POINT OF COMPLIANCE
- GENERAL GROUNDWATER FLOW DIRECTION
- INFERRED GROUNDWATER CONTOUR

STATE OF TEXAS
VALERIE A. JOOSTEN
89118
12/29/03
LICENSED
PROFESSIONAL ENGINEER

Valerie Joosten

| NO. | DATE | REVISION REMARKS | BY |
|---|---|---|---|
| | | | |

Raba Kistner

PROJECT NAME
McCOMBS LANDFILL
PHASE III - SECTOR A
MSW PERMIT No. 729A
EL PASO, TEXAS

SCALE
Horiz. 1" = 600'
Vert. 1" = 800'
Date 12-10-03
Drawn by A.E.
Chkd. by E.U.C./V.A.J.
Appd. by V.A.J.

PROJECT: ASF02-045-00

FILE: H:\Data\Em\Ash02\045\ASF02045 fig3.dwg

CITY OF El Paso
#2 CIVIC CENTER PLAZA PH. (915) 541-4200

SHEET TITLE
GENERALIZED GROUNDWATER FLOW DIRECTION MAP

SHEET 1 OF 1

FIGURE 3

# TABLE 1 -- SUMMARY OF GROUNDWATER LEVEL DATA
## City of El Paso McCombs Landfill -- Permit No. MSW-729A
## El Paso County, Texas
## R-K Project No. ASF02-045-00

| Monitor Well | MW-1 | | MW-2 | | MW-3 | |
|---|---|---|---|---|---|---|
| Installation Date | 09-Aug-03 | | 20-Aug-03 | | 28-Aug-03 | |
| Well Geodetic Coordinates (Latitude and Longitude[1]) | N 31°59'00.63869" W 106°24'14.06849" | | N 31°59'00.54479" W 106°24'25.57457" | | N 31°59'43.41299" W 106°24'13.33502" | |
| **Top of PVC Riser Elevation, ft msl** | *4070.23* | | *4083.89* | | *4076.70* | |
| Surveyor's Pin Elevation, ft msl | *4067.72* | | *4081.58* | | *4074.11* | |
| Ground Surface Elevation, ft msl | *4067.35* | | *4081.06* | | *4073.68* | |
| Total Well Depth from Top of PVC, ft | 475.88 | | 500.83 | | 498.02 | |
| Well Bottom Elevation, ft msl | *3594.35* | | *3583.06* | | *3578.68* | |
| **Measurement Date** | **WATER LEVEL DEPTH (FT) / *ELEVATION (FT MSL)*** [2, 3] | | | | | |
| 09/05/2003 | 396.15 | *3674.08* | 400.27 | *3683.62* | 397.71 | *3678.99* |
| 10/30/2003 | 396.04 | *3674.19* | DRY[4] | ---- | 391.79 | *3684.91* |
| 10/31/2003 | 396.05 | *3674.18* | DRY[4] | ---- | 391.85 | *3684.85* |
| 11/14/2003 | 396.29 | *3673.94* | 399.89 | *3684.00* | 391.52 | *3685.18* |
| 11/18/2003 | 396.03 | *3674.20* | 399.87 | *3684.02* | 391.25 | *3685.45* |

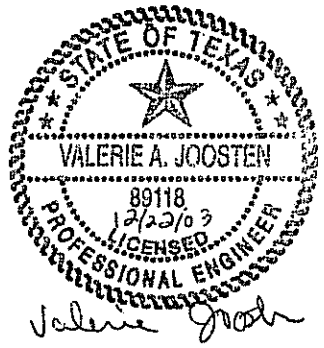
**Notes:**

1- Geodetic (latitude & longitude) coordinates were developed using Texas State Plane Coordinate System, central zone NAD833 (1993) datum. Elevations are based upon City of El Paso McCombs Landfil Datum.

2- Water level depths are indicated in feet (ft) measured from top of PVC riser

3- Top of PVC riser and water level elevations are indicated in feet referenced to mean sea level (ft msl)

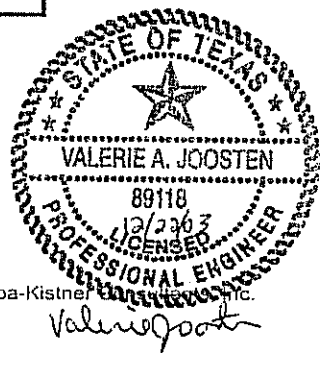
4- An apparent obstruction was encountered at MW-2 at approximately 430 feet below the top of PVC riser. However, subsequent gauging events did not detect the presence of said obstruction.



# TABLE 2 -- MONITOR WELL CONSTRUCTION DATA
## City of El Paso McCombs Landfill -- Permit No. MSW-729A
## El Paso County, Texas
## R-K Project No. ASF02-045-00

| CODE | COMPONENT | DEPTH BELOW GROUND SURFACE (FT) / *ELEVATION (FT MSL)* | | | | | |
|---|---|---|---|---|---|---|---|
| | | MW-1 | | MW-2 | | MW-3 | |
| | Installation Date | 09-Aug-03 | | 20-Aug-03 | | 28-Aug-03 | |
| A | Well Geodetic Coordinates (Latitude and Longitude) | N 31°59'00.63869" W 106°24'14.06849" | | N 31°59'00.54479" W 106°24'25.57457" | | N 31°59'43.41299" W 106°24'13.33502" | |
| B | Top of Protective Steel Collar | -3.60 | *4070.95* | -3.46 | *4084.52* | -3.71 | *4077.39* |
| C | Top of PVC Riser | -2.88 | *4070.23* | -2.83 | *4083.89* | -3.02 | *4076.70* |
| D | Top of Concrete Pad | -0.37 | *4067.72* | -0.52 | *4081.58* | -0.43 | *4074.11* |
| E | **Ground Surface Elevation** | ---- | ***4067.35*** | ---- | ***4081.06*** | ---- | ***4073.68*** |
| F | Bottom of Protective Steel Collar | 1.4 | *4065.95* | 1.5 | *4079.52* | 1.3 | *4072.39* |
| G | Bottom of Concrete Seal/ Top of Casing Seal | 2.0 | *4065.35* | 2.0 | *4079.06* | 2.0 | *4071.68* |
| H | Bottom of Casing Seal/ Top of Annular Bentonite Seal | 452.0 | *3615.35* | 470.0 | *3611.06* | 467.0 | *3606.68* |
| I | Bottom of Annular Bent. Seal/ Top of Filter Pack | 460.0 | *3607.35* | 478.0 | *3603.06* | 475.0 | *3598.68* |
| J | **Top of Screen** | **461.0** | ***3606.35*** | **478.0** | ***3603.06*** | **475.0** | ***3598.68*** |
| K | Bottom of Screen/ Top of Bottom Cap | 473.0 | *3594.35* | 498.0 | *3583.06* | 495.0 | *3578.68* |
| L | Bottom of Filter Pack/ Bottom of Well | 473.0 | *3594.35* | 498.0 | *3583.06* | 495.0 | *3578.68* |
| (C-J) | **Solid Pipe Length, ft** | ***463.9*** | | ***480.8*** | | ***478.0*** | |
| (J-K) | **Slotted Screen Length, ft** | ***12.0*** | | ***20.0*** | | ***20.0*** | |

Notes:
- Geodetic (latitude & longitude) coordinates (Code A) were developed using Texas State Plane Coordinate System, central zone NAD833 (1993) datum. Elevations are based upon City of El Paso McCombs Landfil Datum.
- Surface elevations and coordinates (Codes A through E) were obtained from surveyor's vertical and horizontal control
- Codes F through L were measured for each monitor well using a field tape
- See **Figure 2** *Typical Monitor Well Construction Detail* for letter code (A-L) visualization
- Depths are indicated in feet (ft) measured from ground surface
- Elevations are indicated in feet referenced to mean sea level (ft msl)



ATTACHMENT 1

EL PASO WATER UTILITIES
PUBLIC WATER SYSTEMS WATER ANALYSIS

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

VOC

# Public Water Syste... Water Analysis

TEXAS RURAL WATER ASSOCIATION

REPORT TO: [ ] Check if New Address

EL PASO WATER UTILITIES PUB SERV B
Name

-THE GENERAL MANAGER
Address 1

PO BOX 511
Address 2

EL PASO, TX 79961
City, State, Zip

BILL TO: (If other than above)

Name

Address 1

Address 2

City, State, Zip

I acknowledge that this Water System will be billed for the testing performed per this request and that the water system is liable for all charges associated with this request.

X _____
Signature (System Official)

X Elizabeth F. DeMontrie
Print Name

WATER SYSTEM ID NO: 0 7 1 0 0 0 2 (Required)

NAME OF WATER SYSTEM: EL PASO WATER UTILITIES PUB SERV B

DATE/TIME COLLECTED: 01 (Month) 17 (Day) 02 (Year) 12:15 (Military Time)

SAMPLE: [X] Routine [ ] Check [ ] Quarterly (detect) [ ] Priority

SOURCE: [X] Ground [ ] Surface [ ] GUI [ ] Blended [ ] New Source

SAMPLING LOCATION:

[ ] RAW; Source Name: _____

[ ] DISTRIBUTION; Location: _____

[X] ENTRY POINT(S); (List each E.P. in this sample) N.E. #5

0 0 4

REGION NO: 6 CHLORINE RESIDUAL 1.71 T

Signature (TRWA Sampling Technician)

Instruction for sample collection and submission are available on request from the Public Drinking Water Section of the Texas Natural Resource Conservation Commission

EP02 00801

LAB NAME: _____

DATE RECEIVED: JAN 24 2002 DATE REPORTED: JAN 31 2002

PC

EACH BLOCK REQUIRES SEPARATE CONTAINERS AND FORM

| | | | |
|---|---|---|---|
| 1 [ ] ALL MINERALS<br>Cl, F, NO3, SO4, pH, Cond, T-P Alk, HCO3, CO3, TDS<br>Iced, 14 Day Hold Time | 1 QT PLASTIC | 150.1, 300.0<br>SM 2501B, SM 2520B |
| 1A [ ] NITRATE/NITRITE<br>Iced, 48 Hour Hold Time | 100 mL PLASTIC | 353.2, 300.0 |
| 1C [ ] NITRATE<br>Iced, 14 Day Hold Time | 100 mL PLASTIC | 300.0 |
| 2 [ ] ALL METALS<br>No Field Preservation, 14 Day Hold Time | 1 QT PLASTIC | 200.8, 200.7, 245.1 |
| 2A [ ] METALS 14 GROUP (ICP)<br>Al, Be, Ba, Cr, Cu, Fe, Pb, Mn, Ni, Na, Ag, Zn, Ca, Mg<br>No Field Preservation, 14 Day Hold Time | 1 QT PLASTIC | 200.8, 200.7 |
| [ ] SINGLE METAL<br>Al, Sb, As, Ba, Be, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Ni, Ag, Tl, Zn Se, Na, (Hardness Ca, Mg)<br>No Field Preservation, 14 Day Hold Time | 1 QT PLASTIC | 200.8, 200.7, 245.1 |
| [ ] _____ ONLY | | |
| 16 [ ] RADIOCHEMICAL<br>No Field Preservation, 5 Day Hold Time | 1 GAL PLASTIC | 900.0, 804.0 903.1<br>SM 7500-UC |
| 17 [ ] ASBESTOS<br>Iced, 48 Hour Hold Time | 1QT PLASTIC | |

| | | |
|---|---|---|
| 18 [X] VOC<br>Ascorbic Acid, HCl, Iced, 14 Day Hold Time | 2-40 mL GLASS | 524.2 |
| 14 [ ] TRIHALOMETHANES<br>Sodium Thiosulfate, Iced, 14 Day Hold Time | 2-40 mL GLASS | 502.2 or 524.2 |
| [ ] MTHM – Potential<br>No Field Preservation, 7 Day Hold Time | 3-40 mL GLASS | 502.2 or 524.2 |
| 18 [ ] HALOACETIC ACIDS (HAA)<br>Ammonium Chloride, Iced, 14 Day Hold Time | 2-60 mL GLASS | 552.2 |
| 4 [ ] INSECTICIDES (SOC1)<br>Sodium Thiosulfate, Iced, 7 Day Hold Time | 1 QT GLASS | 505 |
| 6 [ ] HERBICIDES (SOC3)<br>Sodium Thiosulfate, Iced, 14 Day Hold Time | 500 mL GLASS | 515.1 |
| 8 [ ] SEMIVOLATILES (SOC5)<br>Sodium Sulfite, HCl, Iced, 14 day Hold Time | 1 QT GLASS | 525.2 |
| [ ] OTHER _____ | | |

G7711

WHITE - Lab YELLOW - Sampler PINK - TRWA GOLDENROD - Water System

# TEXAS DEPARTMENT OF HE[illegible]TH
## VOLATILE ORGANIC COMPOUND[illegible] by GC/MS

| | | | |
|---|---|---|---|
| Submitter Number | TX 0710002 | Date Collected: | 01/22/2002 |
| TDH Sample Number | EP02-00801 | Date Extracted: | 01/24/2002 |
| Method: | EPA 524.2 rev. 4.1 | Date Analyzed: | 01/24/2002 |
| Data File Number: | 24JAN-15.D | Analyst: | M. Kabay |
| Q.C. File: | OV040124.S | Dilution Factor: | 1 |
| Sample Type: | water | Concentration Units: | µg/l |

| Regulated Cmpds. [40 CFR §141.61(a)] | Result |
|---|---|
| Benzene | <0.5 |
| Carbon tetrachloride | <0.5 |
| Chlorobenzene | <0.5 |
| 1,2-Dichlorobenzene | <0.5 |
| 1,4-Dichlorobenzene | <0.5 |
| 1,2-Dichloroethane | <0.5 |
| 1,1-Dichloroethene | <0.5 |
| cis-1,2-dichloroethene | <0.5 |
| trans-1,2-Dichloroethene | <0.5 |
| 1,2-Dichloropropane | <0.5 |
| Methylene chloride (DCM) | <0.5 |
| Ethyl benzene | <0.5 |
| Styrene | <0.5 |
| Tetrachloroethene | <0.5 |
| Toluene | <0.5 |
| 1,2,4-Trichlorobenzene | <0.5 |
| 1,1,1-Trichloroethane | <0.5 |
| 1,1,2-Trichloroethane | <0.5 |
| Trichloroethene | <0.5 |
| Vinyl chloride | <0.5 |
| m&p-Xylene | <1.0 |
| o-Xylene | <0.5 |

| Monitored Cmpds. [40 CFR §141.40(e)] | |
|---|---|
| **Chloroform** | **1.3** |
| **Bromodichloromethane** | **0.7** |
| Dibromochloromethane | <0.5 |
| Bromoform | <0.5 |
| Dibromomethane | <1.0 |
| 1,3-Dichlorobenzene | <1.0 |
| 1,1-Dichloropropene | <1.0 |
| 1,1-Dichloroethane | <1.0 |
| 1,1,2,2-Tetrachloroethane | <1.0 |
| 1,3-Dichloropropane | <1.0 |
| Chloromethane | <2.0 |
| Bromomethane | <2.0 |
| 1,2,3-Trichloropropane | <1.0 |
| 1,1,1,2-Tetrachloroethane | <1.0 |
| Chloroethane | <2.0 |
| 2,2-Dichloropropane | <1.0 |
| 2-Chlorotoluene | <1.0 |
| 4-Chlorotoluene | <1.0 |
| Bromobenzene | <1.0 |
| cis-1,3-Dichloropropene | <2.0 |
| trans-1,3-Dichloropropene | <1.0 |

| * Screened Compounds | |
|---|---|
| 1,2-Dibromo-3-chloropropane | <1.0 |
| 1,2-Dibromoethane | <1.0 |

* **EPA 524.2 is not the approved method for analysis of these compounds. Compounds are listed per TNRCC request.**

| Monitored Cmpds. [40 CFR §141.40(j)] | Result |
|---|---|
| 1,2,4-Trimethylbenzene | <1.0 |
| 1,2,3-Trichlorobenzene | <1.0 |
| n-Propylbenzene | <1.0 |
| n-Butylbenzene | <1.0 |
| Naphthalene | <1.0 |
| Hexachlorobutadiene | <1.0 |
| 1,3,5-Trimethylbenzene | <1.0 |
| 4-Isopropyltoluene | <1.0 |
| Isopropylbenzene | <1.0 |
| t-Butylbenzene | <1.0 |
| s-Butylbenzene | <1.0 |
| Trichlorofluoromethane | <2.0 |
| Dichlorodifluoromethane | <2.0 |
| Bromochloromethane | <1.0 |

| Other Compounds | |
|---|---|
| Acetone | <10 |
| Acrylonitrile | <10 |
| 2-Butanone (MEK) | <10 |
| Carbon disulfide | <1.0 |
| Ethyl methacrylate | <1.0 |
| 2-Hexanone | <1.0 |
| Iodomethane | <2.0 |
| Methyl methacrylate | <1.0 |
| 4-Methyl-2-pentanone (MIBK) | <2.0 |
| Methyl-t-butyl ether (MTBE) | <2.0 |
| Tetrahydrofuran | <2.0 |
| Vinyl acetate | <10 |

Tentative identification of the largest non-priority pollutant peaks is provided by comparison with the EPA/NIH mass spectral library. Approximate quantitation is performed using internal standards and an assumed response factor of one.

| Tentative Compound ID | Result |
|---|---|
| None | |

Comments:

Rev. 3 (03/24/00)

Approval: [signature]

JAN 3 1 2002

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

SOC5

# Public Water System Water Analysis

TEXAS RURAL WATER ASSOCIATION — RURAL PEOPLE PROUD UNITY

REPORT TO: [ ] Check if New Address

EL PASO WATER UTILITIES PUB SERV B
Name
-THE GENERAL MANAGER
Address 1
PO BOX 511
Address 2
EL PASO, TX 79961
City, State, Zip

BILL TO: (If other than above)

Name

Address 1

Address 2

City, State, Zip

I acknowledge that this Water System will be billed for the testing performed per this request and that the water system is liable for all charges associated with this request.

X _____
Signature (System Official)

X Elizabeth F. DeMoultrie
Print Name

WATER SYSTEM ID NO: 0 7 1 0 0 0 2 (Required)

NAME OF WATER SYSTEM: EL PASO WATER UTILITIES PUB SERV B

DATE/TIME COLLECTED: 01 21 02 12:15 (Month, Day, Year, Military Time)

SAMPLE: [ ] Routine [ ] Check [ ] Quarterly (detect) [ ] Priority

SOURCE: [X] Ground [ ] Surface [ ] GUI [ ] Blended [ ] New Source

SAMPLING LOCATION:

[ ] RAW; Source Name: _____

[ ] DISTRIBUTION; Location: _____

[X] ENTRY POINT(S); (List each E.P. in this sample) N.E. 185

0 0 4

REGION NO: 6

CHLORINE RESIDUAL 1.71 T

Signature (TRWA Sampling Technician)

Instruction for sample collection and submission are available on request from the Public Drinking Water Section of the Texas Natural Resource Conservation Commission

LI EP02 00779

LA

LAB NAME: _____

DATE RECEIVED: JAN 23 2002

DATE REPORTED: JAN 28 2002

EACH BLOCK REQUIRES SEPARATE CONTAINERS AND FORM

| | | | |
|---|---|---|---|
| 1 | [ ] ALL MINERALS<br>Cl, F, NO3, SO4, pH, Cond, T-P Alk, HCO3, CO3, TDS<br>Iced, 14 Day Hold Time | 1 QT PLASTIC | 150.1, 300.0<br>SM 2501B, SM 2520B |
| 1A | [ ] NITRATE/NITRITE<br>Iced, 48 Hour Hold Time | 100 mL PLASTIC | 353.2, 300.0 |
| 1C | [ ] NITRATE<br>Iced, 14 Day Hold Time | 100 mL PLASTIC | 300.0 |
| 2 | [ ] ALL METALS<br>No Field Preservation, 14 Day Hold Time | 1 QT PLASTIC | 200.8, 200.7, 245.1 |
| 2A | [ ] METALS 14 GROUP (ICP)<br>Al, Be, Ba, Cr, Cu, Fe, Pb, Mn, Ni, Na, Ag, Zn, Ca, Mg<br>No Field Preservation, 14 Day Hold Time | 1 QT PLASTIC | 200.8, 200.7 |
| | [ ] SINGLE METAL<br>Al, Sb, As, Ba, Be, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Ni, Ag, Tl, Zn Se, Na, (Hardness Ca, Mg)<br>No Field Preservation, 14 Day Hold Time | 1 QT PLASTIC | 200.8, 200.7, 245.1 |
| | [ ] _____ ONLY | | |
| 16 | [ ] RADIOCHEMICAL<br>No Field Preservation, 5 Day Hold Time | 1 GAL PLASTIC | 900.0, 804.0 903.1<br>SM 7500-UC |
| 17 | [ ] ASBESTOS<br>Iced, 48 Hour Hold Time | 1QT PLASTIC | |

| | | | |
|---|---|---|---|
| 13 | [ ] VOC<br>Ascorbic Acid, HCl, Iced, 14 Day Hold Time | 2-40 mL GLASS | 524.2 |
| 14 | [ ] TRIHALOMETHANES<br>Sodium Thiosulfate, Iced, 14 Day Hold Time | 2-40 mL GLASS | 502.2 or 524.2 |
| | [ ] MTHM – Potential<br>No Field Preservation, 7 Day Hold Time | 3-40 mL GLASS | 502.2 or 524.2 |
| 18 | [ ] HALOACETIC ACIDS (HAA)<br>Ammonium Chloride, Iced, 14 Day Hold Time | 2-60 mL GLASS | 552.2 |
| 4 | [ ] INSECTICIDES (SOC1)<br>Sodium Thiosulfate, Iced, 7 Day Hold Time | 1 QT GLASS | 505 |
| 6 | [ ] HERBICIDES (SOC3)<br>Sodium Thiosulfate, Iced, 14 Day Hold Time | 500 mL GLASS | 515.1 |
| 8 | [X] SEMIVOLATILES (SOC5)<br>Sodium Sulfite, HCl, Iced, 14 day Hold Time | 1 QT GLASS | 525.2 |
| | [ ] OTHER _____ | | |

WHITE - Lab YELLOW - Sampler PINK - TRWA GOLDENROD - Water System

6771

# TEXAS DEPARTMENT OF HEALTH
# WATER ANALYSIS RESULTS by GC/MS

| | | | |
|---|---|---|---|
| Submitter Number: | 0710002 | Date Collected: | 1/22/02 |
| TDH Sample Number: | ep02-00779 | Date Extracted: | 1/25/02 |
| Method: | 525.2 Rev 1.0 SOC5 | Date Analyzed: | 1/25/02 9:10 |
| Data File Number: | A5519.D | Analyst: | dhardin |
| QC Batch: | o01s0125 | Dilution Factor: | 1.02 |
| Sample Type: | water | Conc. Units: | µg/L |

| Pesticides | Result: |
|---|---|
| • Alachlor | <0.20 |
| Aldrin | <0.20 |
| • Atrazine | <0.20 |
| Bromacil | <0.20 |
| Butachlor | <0.20 |
| • Chlordane (alpha-chlordane) | <0.20 |
| • Chlordane (gamma-chlordane) | <0.20 |
| • Chlordane (trans-nonachlor) | <0.20 |
| Dieldrin | <0.20 |
| • Endrin | <0.20 |
| • Heptachlor | <0.20 |
| • Heptachlor epoxide | <0.20 |
| • Hexachlorobenzene | <0.20 |
| • Hexachlorocyclopentadiene* | <1.02 |
| • Lindane | <0.20 |
| • Methoxychlor | <0.20 |
| Metolachlor | <0.20 |
| Metribuzin | <0.20 |
| Parathion, ethyl | <0.20 |
| Parathion, methyl | <0.20 |
| • Pentachlorophenol | <1.02 |
| Prometon ## | <0.20 |
| Propachlor | <0.20 |
| • Simazine | <0.20 |
| Trifluralin | <0.20 |

| PAHs | Result: |
|---|---|
| Acenaphthene | <0.20 |
| Acenaphthylene | <0.20 |
| Anthracene | <0.20 |

| PAHs (cont). | Result: |
|---|---|
| Benzo[a]anthracene | <0.20 |
| • Benzo[a]pyrene | <0.20 |
| Benzo[b]fluoranthene | <0.20 |
| Benzo[g,h,i]perylene | <0.20 |
| Benzo[k]fluoranthene | <0.20 |
| Chrysene | <0.20 |
| Dibenz[a,h]anthracene | <0.20 |
| Fluorene | <0.20 |
| Indeno[1,2,3,c,d]pyrene | <0.20 |
| Naphthalene | <0.20 |
| Phenanthrene | <0.20 |
| Pyrene | <0.20 |

| PCBs | Result: |
|---|---|
| 2-Chlorobiphenyl | <0.20 |
| 2,3-Dichlorobiphenyl | <0.20 |
| 2,4,5-Trichlorobiphenyl | <0.20 |
| 2,2',4,4'-Tetrachlorobiphenyl | <0.20 |
| 2,2',3',4,6-Pentachlorobiphenyl | <0.20 |
| 2,2',4,4',5,6'-Hexachlorobiphenyl | <0.20 |
| 2,2',3,3',4,4',6-Heptachlorobiphenyl | <0.51 |
| 2,2',3,3',4,5',6,6'-Octachlorobiphenyl | <0.51 |

| Phthalates** | Result: |
|---|---|
| • Di-(2-ethylhexyl)adipate | <2.04 |
| • Di-(2-ethylhexyl)phthalate | <2.04 |
| Butylbenzylphthalate | <2.04 |
| Di-n-butylphthalate | <2.04 |
| Diethylphthalate | <2.04 |
| Dimethylphthalate | <2.04 |

* This analyte is of known instability and quantitation should be considered approximate

** Phthalate contamination is unavoidable with this method's extraction technique. Consequently, phthalate levels cannot be accurately measured below 2.0 µg/L.

# Analyte detected below the quantitation limit.

## This analyte is known for extraction instability and quantitation should be considered approximate.

• Regulated compounds

Comments: The precision for hexachlorobenzene was outside QC limits for the LFB/LFB duplicate analysis with this extraction batch.

Rev. 7, 12/01

Approval: JAN 28 2002

Texas Department of Health

1100 WEST 49TH STREET
AUSTIN, TEXAS 78756-3194
(512) 458-7318

BUREAU OF LABORATORIES
CLIA #45D0660644

CONFIDENTIAL LABORATORY REPORT

# WATER ANALYSIS REPORT
## MINERALS

Submitter Identification Number: 0710002

EL PASO WATER UTILITIES PUB SERV B
-THE GENERAL MANAGER
PO BOX 511
EL PASO, TX 79961-0001

Laboratory Number: EP200783
Sample Type:
Sample Source:
Entry Points: 004
Collector Remarks:

Date Collected: 01/22/2002
Date Received: 01/23/2002
Date Reported: 03/06/2002

| Constituent Name | Result | Units | +/- |
|---|---|---|---|
| Chloride | 207 | mg/l | |
| Fluoride | 0.5 | mg/l | |
| Nitrate | 2.31 | mg/l | |
| Sulfate | 63 | mg/l | |
| Total Hardness as CaCO3 | 172 | mg/l | |
| pH | 7.1 | | |
| Fil.Conduct(umhos/cm) | 1120 | | |
| Tot. Alka. as CaCO3 | 100 | mg/l | |
| Bicarbonate | 122 | mg/l | |
| Carbonate | 0 | mg/l | |
| Dissolved solids | 333 | mg/l | |
| P. Alkalinity as CaCO3 | 0 | mg/l | |

media Group 96-131522

Te as Department of H alth

1100 WEST 49TH STREET
AUSTIN, TEXAS 78756-3194
(512) 458-7318

BUREAU OF LABORATORIES
CLIA #45D0660644

CONFIDENTIAL LABORATORY REPORT

# WATER ANALYSIS REPORT
## METALS -

Submitter Identification Number: 0710002

EL PASO WATER UTILITIES PUB SERV B
-THE GENERAL MANAGER
PO BOX 511
EL PASO, TX 79961-0001

Laboratory Number: EP200845
Sample Type:
Sample Source:
Entry Points: 004
Collector Remarks:

Date Collected: 01/22/2002
Date Received: 01/24/2002
Date Reported: 02/03/2002

| Constituent Name | | Result | Units | +/- |
|---|---|---|---|---|
| Aluminum | < | 0.050 | mg/l | |
| Arsenic | | 0.0059 | mg/l | |
| Barium | | 0.158 | mg/l | |
| Cadmium | < | 0.0012 | mg/l | |
| Chromium | < | 0.01 | mg/l | |
| Copper | < | 0.006 | mg/l | |
| Iron | | 0.021 | mg/l | |
| Lead | < | 0.0011 | mg/l | |
| Manganese | < | 0.008 | mg/l | |
| Mercury | < | 0.00040 | mg/l | |
| Nickel | < | 0.02 | mg/l | |
| Selenium | | 0.0026 | mg/l | |
| Silver | < | 0.01 | mg/l | |
| Sodium | | 132.00 | mg/l | |
| Antimony | < | 0.0040 | mg/l | |
| Beryllium | < | 0.001 | mg/l | |
| Thallium | < | 0.0010 | mg/l | |
| Zinc | | 0.14 | mg/l | |
| 1016 Calcium | | 54.5 | mg/l | |
| 1031 Magnesium | | 11.9 | mg/l | |

dia Group 96-131522

Texas Department of Health

1100 WEST 49TH STREET
AUSTIN, TEXAS 78756-3194
(512) 458-7318

BUREAU OF LABORATORIES
CLIA #45D0660644

CONFIDENTIAL LABORATORY REPORT

# WATER ANALYSIS REPORT
# RADIOCHEMICALS

Submitter Identification Number: 0710002

EL PASO WATER UTILITIES PUB SERV B
-THE GENERAL MANAGER
PO BOX 511
EL PASO, TX 79961-0001

Laboratory Number: EP200853
Sample Type:
Sample Source:
Entry Points: 004
Collector Remarks:

Date Collected: 01/22/2002
Date Received: 01/24/2002
Date Reported: 05/15/2002

| Constituent Name | Result | Units | +/- |
|---|---|---|---|
| Radium 228 | 1.2 | pCi/l | 0.8 |
| Gross Beta | 9.3 | pCi/l | 2.3 |
| Gross Alpha Particle Activity | 3.3 | pCi/l | 1.5 |

nadia Group 96-131522

ATTACHMENT 2

BORING LOGS

# LOG OF BORING NO. MW-1

McCombs Landfill - Phase III

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling(10"DiaHole)

LOCATION: El Paso County, Texas

| DEPTH | SYMBOL | SAMPLES | PERCENT RECOVERED | DESCRIPTION OF MATERIAL<br>SURFACE ELEVATION: 4067.35' | FORMATION | WELL | METHANE | HYDROGEN SULFIDE | OXYGEN % | PID ppm |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | CLAY, Sandy Brown<br>- calcareous material at 6 feet | | | | | | |
| | | | | CLAY, Sandy, Light Brown, with calcareous material | | | | | | |
| 25 | | | | SAND, Medium to Coarse Grained, Brown and Multicolored; Poorly Graded | | | | | | |
| 50 | | | | SAND, Medium Grained, Multicolored, Poorly Graded with fine gravel | | | | | | |
| | | | | CLAY, Sandy, Brown | | | | | | |
| | | | | SAND, Fine Grained, Brownish-gray, Poorly Graded | | | | | | |
| 75 | | | | GRAVEL, Fine to Medium Grained, Multicolored, Poorly Graded | | | | | | |
| | | | | CLAY, Sandy, Light Brown, with some fine grained gravel | | | | | | |
| 100 | | | | SAND, Medium to Coarse Grained, Multicolored, Poorly Graded | | | | | | |
| | | | | CLAY, Sandy, Brown | | | | | | |
| 125 | | | | SAND, Fine Grained, Brown, Poorly Graded | | | | | | |
| | | | | CLAY, Sandy, Brown | | | | | | |
| | | | | SAND, Fine Grained, Brown, Poorly Graded, with a layer of medium grained sand and fine gravel | | | | | | |
| 150 | | | | CLAY, Sandy, Brown | | | | | | |
| | | | | CLAY, Sandy, Brown, with fine gravel | | | | | | |
| | | | | SAND, Fine to Medium Grained, Brown, Poorly Graded | | | | | | |
| 175 | | | | SAND, Fine to Coarse Grained, Brown and Multicolored, Poorly Graded | | | | | | |
| | | | | CLAY, Sandy, Brown | | | | | | |
| 200 | | | | SAND, Medium Grained, Multicolored, with fine gravel | | | | | | |

DEPTH DRILLED: 600 ft | STATIC WATER ELEV: 3674.08 | PROJ. No: ASF02-045-00

DATE DRILLED: 7/17/03-7/30/03 | DATE MEASURED: 9/05/03 | FIGURE 1

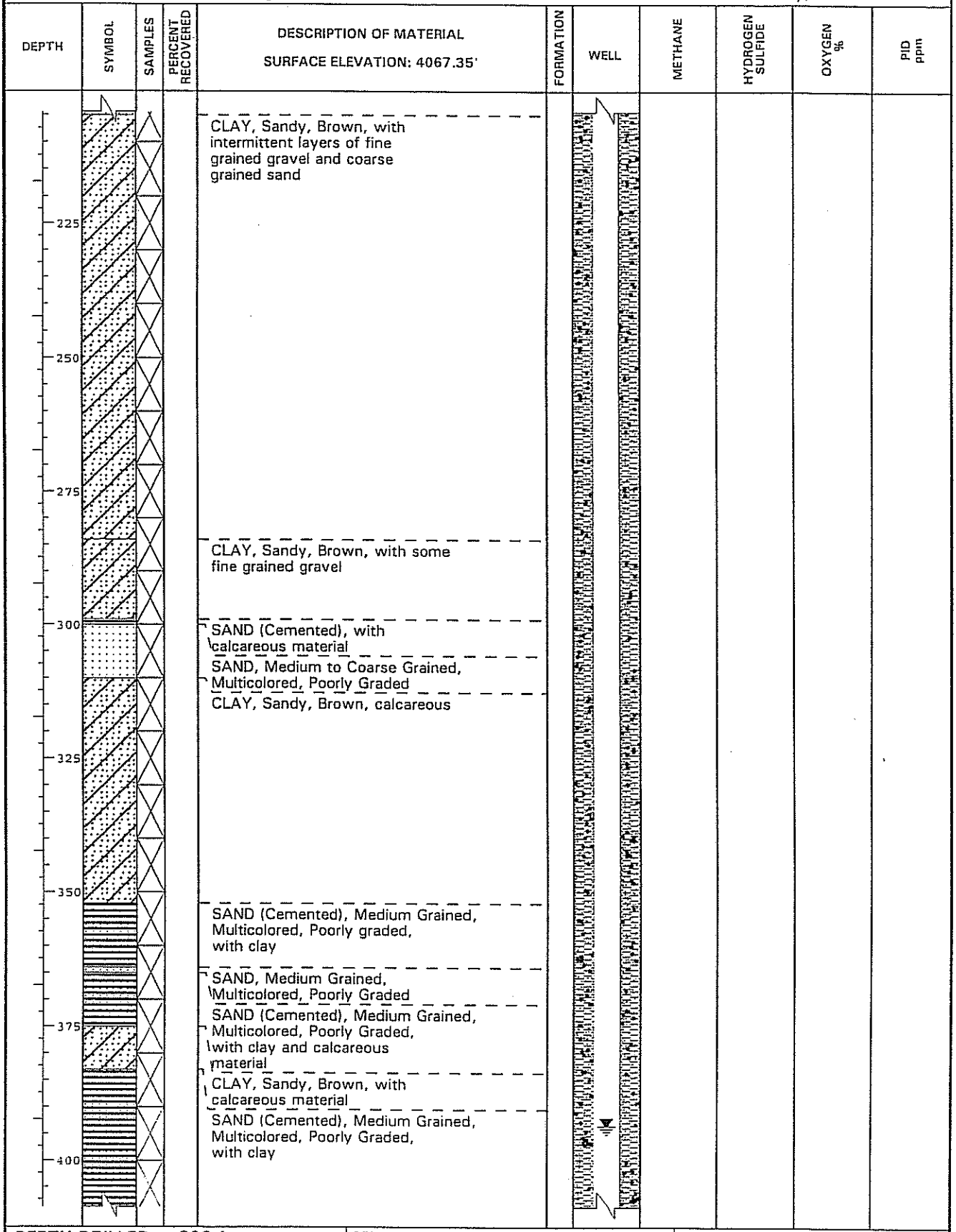
# LOG OF BORING NO. MW-1

McCombs Landfill - Phase III

**Raba-Kistner**
Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling(10"DiaHole)

LOCATION: El Paso County, Texas




| | | |
|---|---|---|
| DEPTH DRILLED: 600 ft | STATIC WATER ELEV: 3674.08 | PROJ. No: ASF02-045-00 |
| DATE DRILLED: 7/17/03-7/30/03 | DATE MEASURED: 9/05/03 | FIGURE 1 |

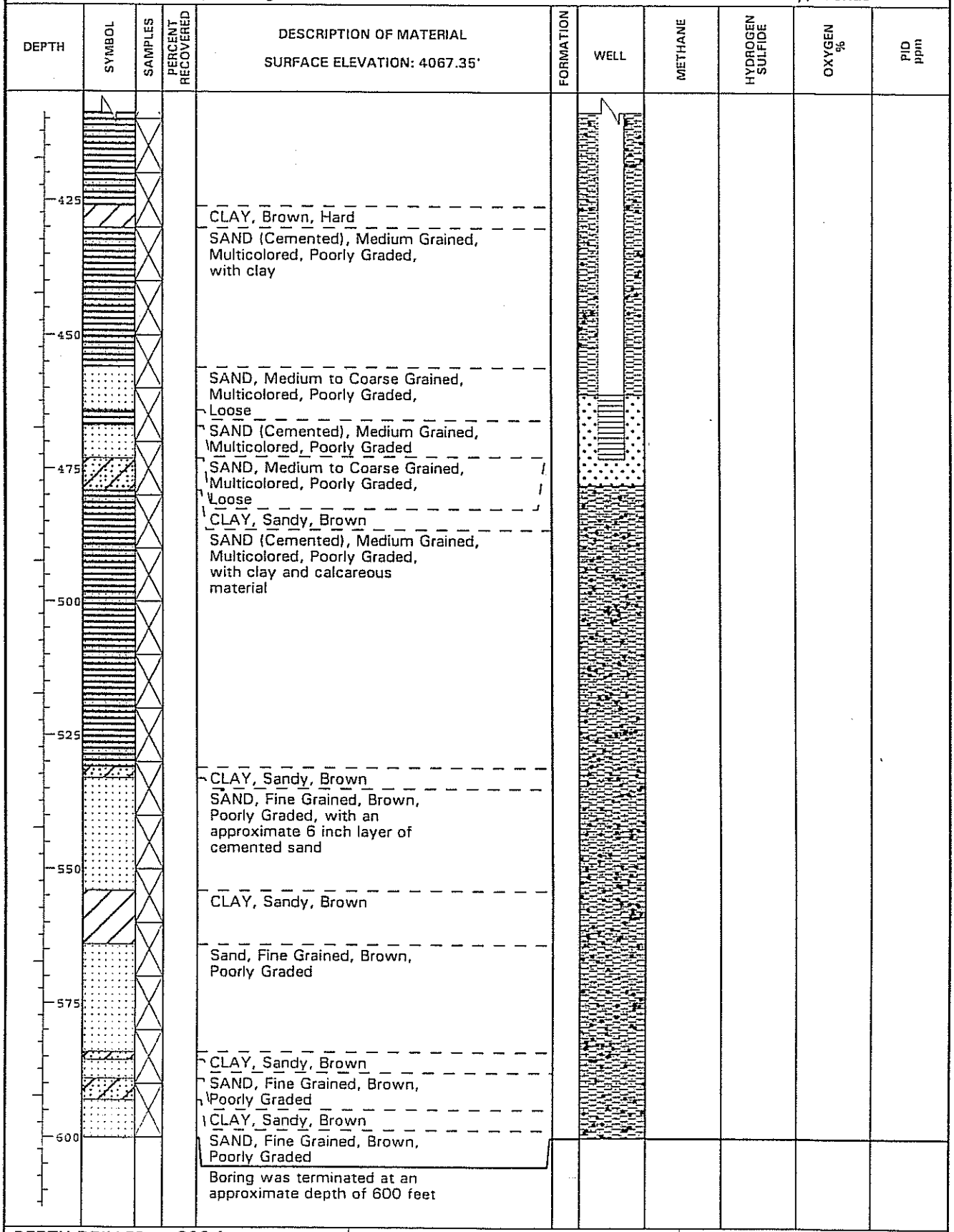
# LOG OF BORING NO. MW-1

McCombs Landfill - Phase III

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling(10"DiaHole)

LOCATION: El Paso County, Texas




| | | |
|---|---|---|
| DEPTH DRILLED: 600 ft | STATIC WATER ELEV: 3674.08 | PROJ. No: ASF02-045-00 |
| DATE DRILLED: 7/17/03-7/30/03 | DATE MEASURED: 9/05/03 | FIGURE 1 |

# LOG OF BORING NO. MW-1

McCombs Landfill - Phase III

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling(10"DiaHole)

LOCATION: El Paso County, Texas

| DEPTH | SYMBOL | SAMPLES | PERCENT RECOVERED | DESCRIPTION OF MATERIAL<br>SURFACE ELEVATION: 4067.35' | FORMATION | WELL | METHANE | HYDROGEN SULFIDE | OXYGEN % | PID ppm |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | below ground surface | | | | | | |

625
650
675
700
725
750
775
800

DEPTH DRILLED: 600 ft
DATE DRILLED: 7/17/03-7/30/03

STATIC WATER ELEV: 3674.08
DATE MEASURED: 9/05/03

PROJ. No: ASF02-045-00
FIGURE 1

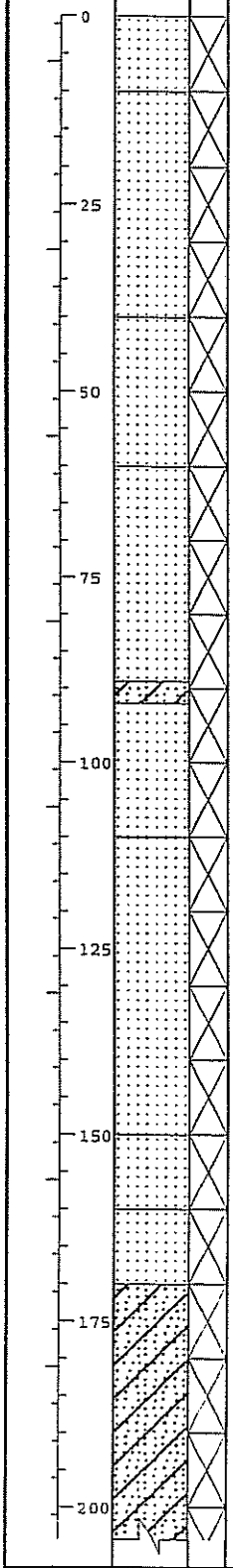
# LOG OF BORING NO. MW-2

McCombs Landfill - Phase III

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling(10"DiaHole)

LOCATION: El Paso County, Texas




| DEPTH | SYMBOL | SAMPLES | PERCENT RECOVERED | DESCRIPTION OF MATERIAL<br>SURFACE ELEVATION: 4081.06' | FORMATION | WELL | METHANE | HYDROGEN SULFIDE | OXYGEN % | PID ppm |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | SAND, Fine to Coarse Grained, Brown, Multicolored, Poorly Graded, with calcareous material | | | | | | |
| 25 | | | | SAND, Medium to Coarse Grained, Multicolored, Poorly Graded, with fine grained gravel and calcareous material<br>- with clay layer at 16 feet<br>- with 2 to 3 inch cobbles at 21 feet | | | | | | |
| 50 | | | | SAND, Medium to Coarse Grained, Multicolored, Poorly Graded with fine grained gravel, clay and calcareous material | | | | | | |
| 75 | | | | SAND, Medium to Coarse Grained, with fine grained gravel and calcareous material | | | | | | |
| | | | | CLAY, Sandy, Brown, with fine gravel | | | | | | |
| 100 | | | | SAND, Medium to Coarse Grained, Multicolored, Poorly Graded, with fine gravel | | | | | | |
| 125 | | | | SAND, Medium to Coarse Grained, Multicolored, Poorly Graded, with fine to pea size gravel, clay, and calcareous material | | | | | | |
| 150 | | | | SAND, Fine to Coarse Grained, Multicolored, Poorly Graded | | | | | | |
| | | | | SAND, Medium to Coarse Grained, Multicolored, Poorly Graded, with fine gravel clay and calcareous material<br>- with cobble 166 to 170 feet | | | | | | |
| 175 | | | | CLAY, Sandy, Brown, with fine gravel | | | | | | |
| 200 | | | | | | | | | | |

DEPTH DRILLED: 505 ft

DATE DRILLED: 8/14/03-8/18/03

STATIC WATER ELEV: 3683.62

DATE MEASURED: 9/05/03

PROJ. No: ASF02-045-00

FIGURE 2

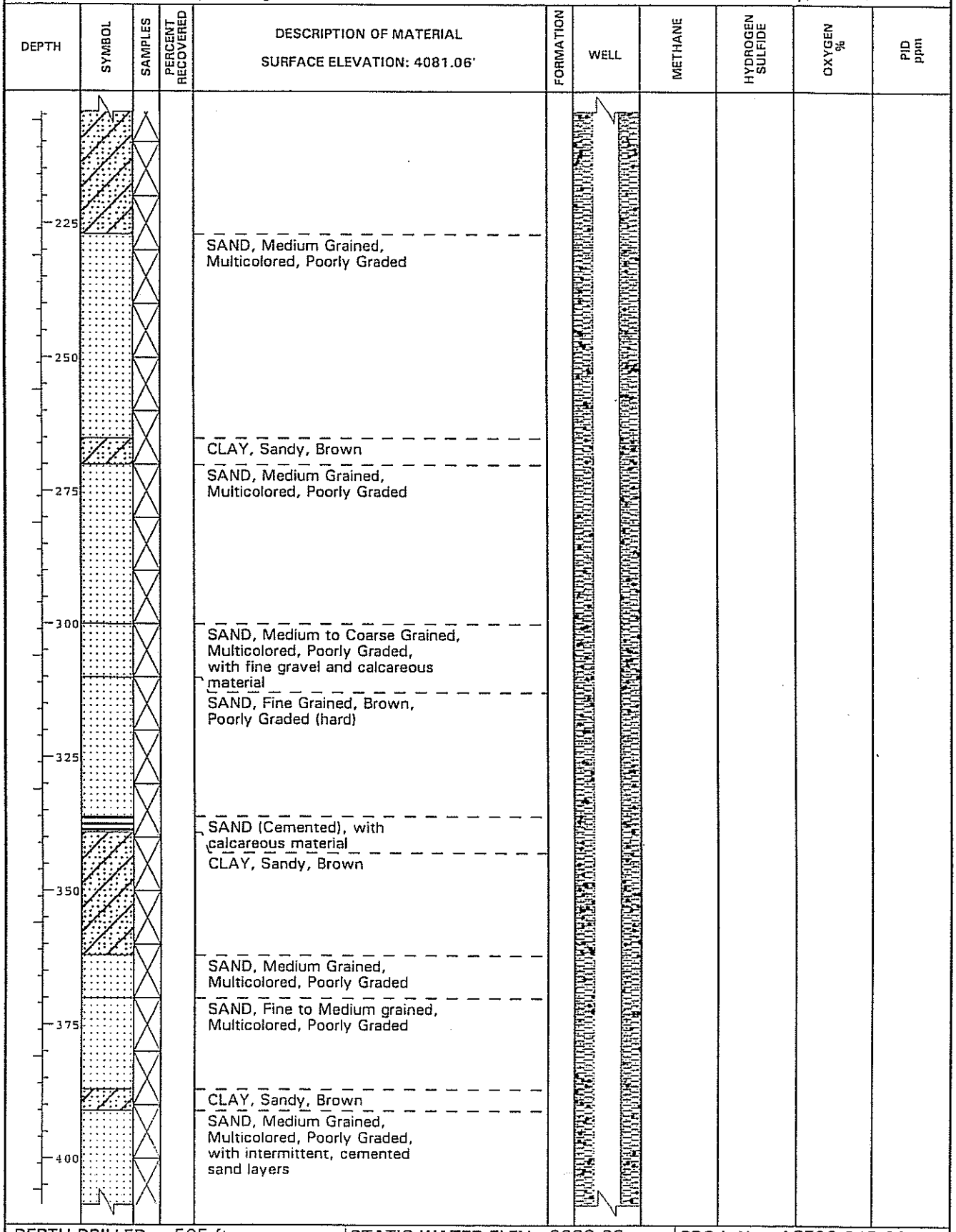
# LOG OF BORING NO. MW-2

McCombs Landfill - Phase III

**Raba-Kistner**
Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling(10"DiaHole)

LOCATION: El Paso County, Texas




| | | |
|---|---|---|
| DEPTH DRILLED: 505 ft | STATIC WATER ELEV: 3683.62 | PROJ. No: ASF02-045-00 |
| DATE DRILLED: 8/14/03-8/18/03 | DATE MEASURED: 9/05/03 | FIGURE 2 |

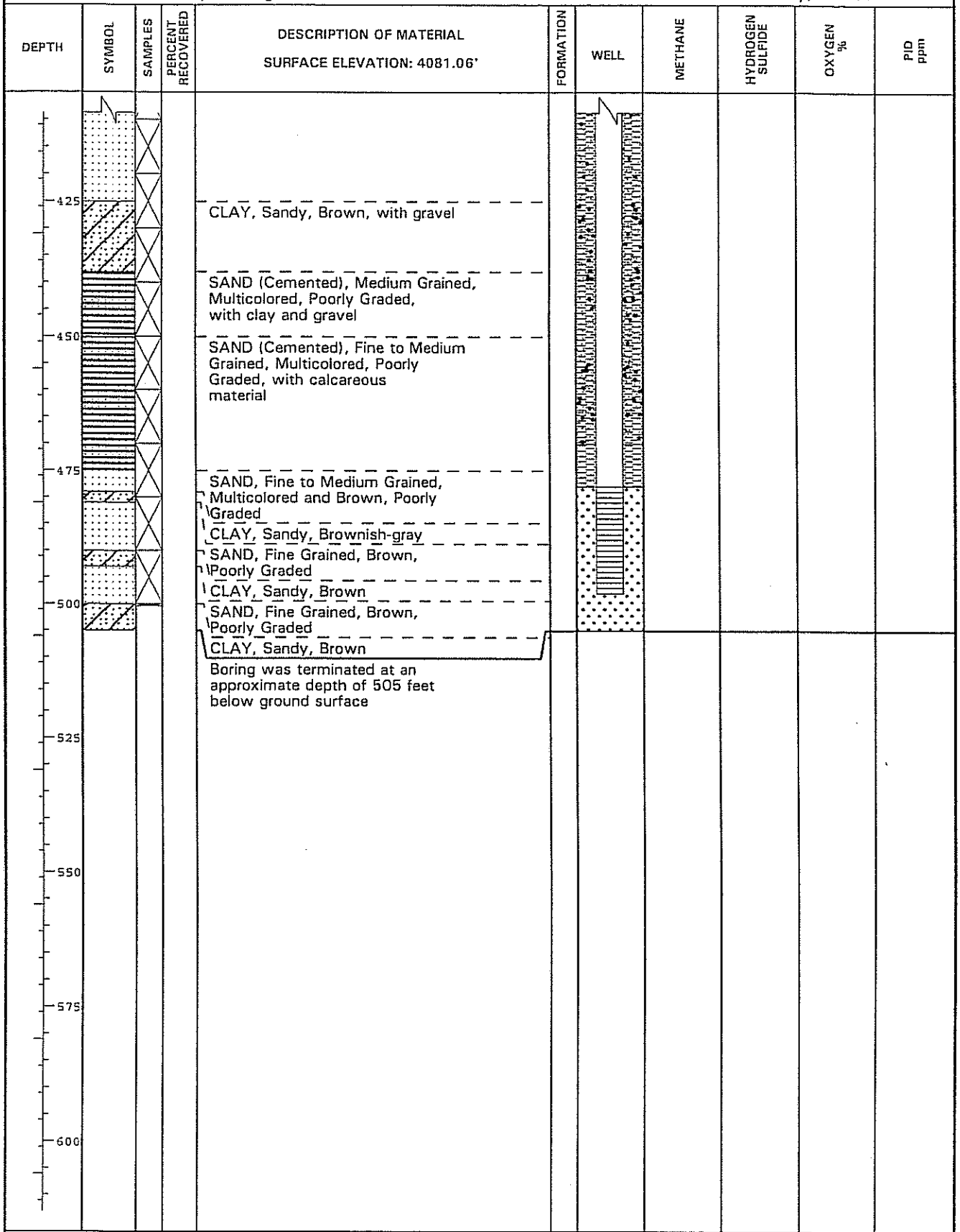
# LOG OF BORING NO. MW-2

McCombs Landfill - Phase III

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling(10"DiaHole)

LOCATION: El Paso County, Texas




| | | |
|---|---|---|
| DEPTH DRILLED: 505 ft | STATIC WATER ELEV: 3683.62 | PROJ. No: ASF02-045-00 |
| DATE DRILLED: 8/14/03-8/18/03 | DATE MEASURED: 9/05/03 | FIGURE 2 |

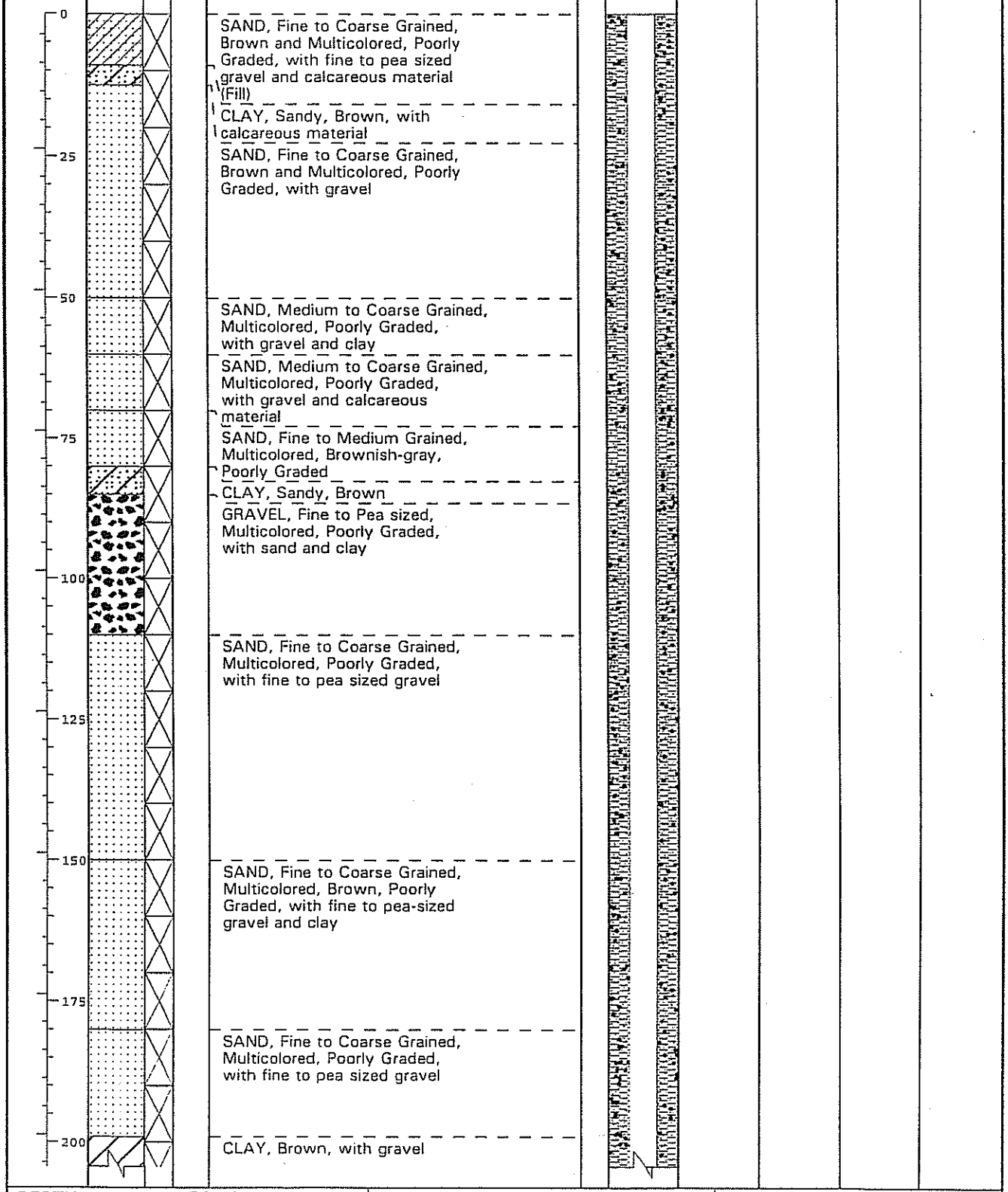
# LOG OF BORING NO. MW-3

McCombs Landfill - Phase III

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling(10"DiaHole)

LOCATION: El Paso County, Texas




| | | |
|---|---|---|
| DEPTH DRILLED: 520 ft | STATIC WATER ELEV: 3678.99 | PROJ. No: ASF02-045-00 |
| DATE DRILLED: 8/25/03-8/28/03 | DATE MEASURED: 9/05/03 | FIGURE 3 |

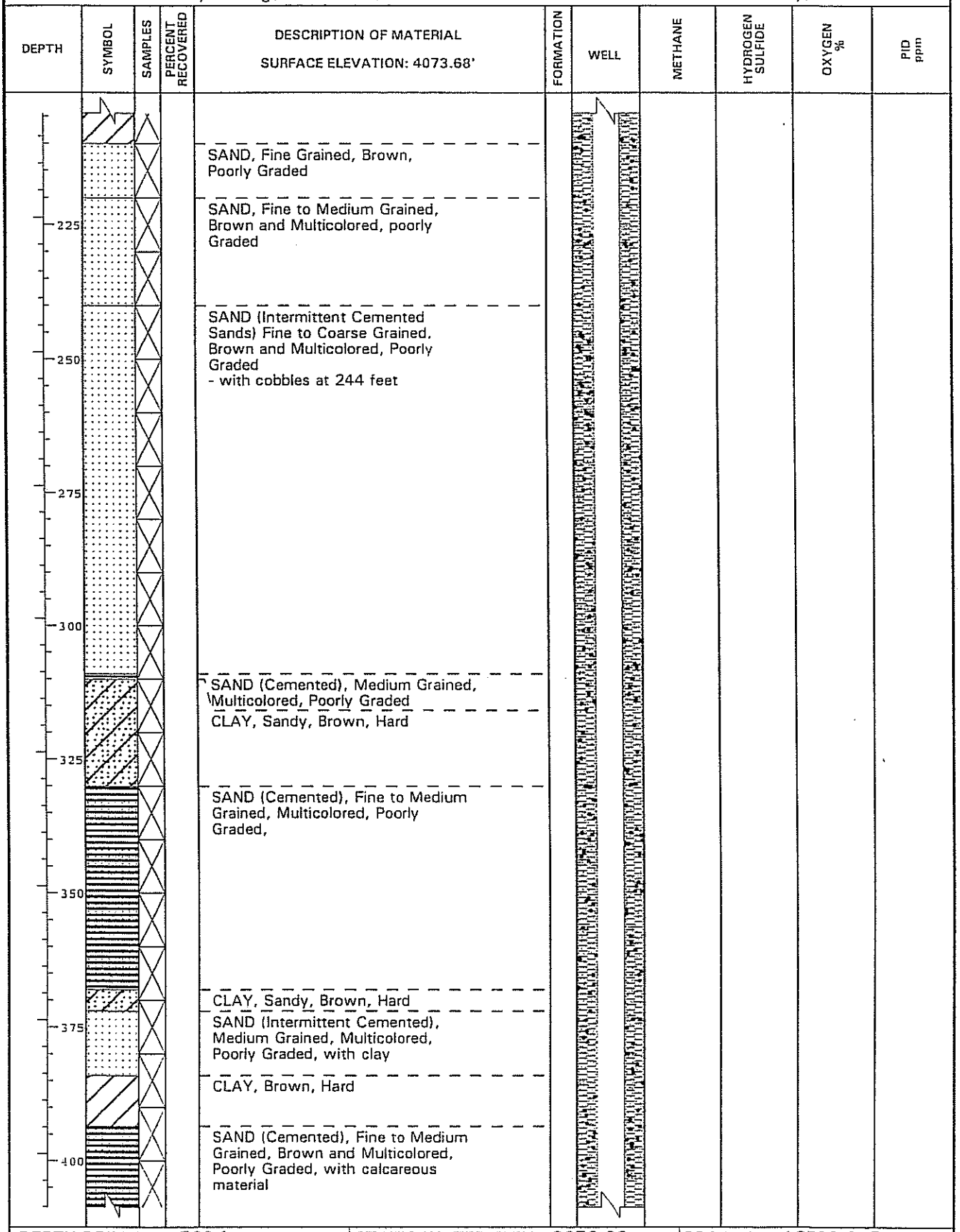
# LOG OF BORING NO. MW-3

McCombs Landfill - Phase III

**Raba-Kistner**
Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling(10"DiaHole)

LOCATION: El Paso County, Texas




| | | |
|---|---|---|
| DEPTH DRILLED: 520 ft | STATIC WATER ELEV: 3678.99 | PROJ. No: ASF02-045-00 |
| DATE DRILLED: 8/25/03-8/28/03 | DATE MEASURED: 9/05/03 | FIGURE 3 |

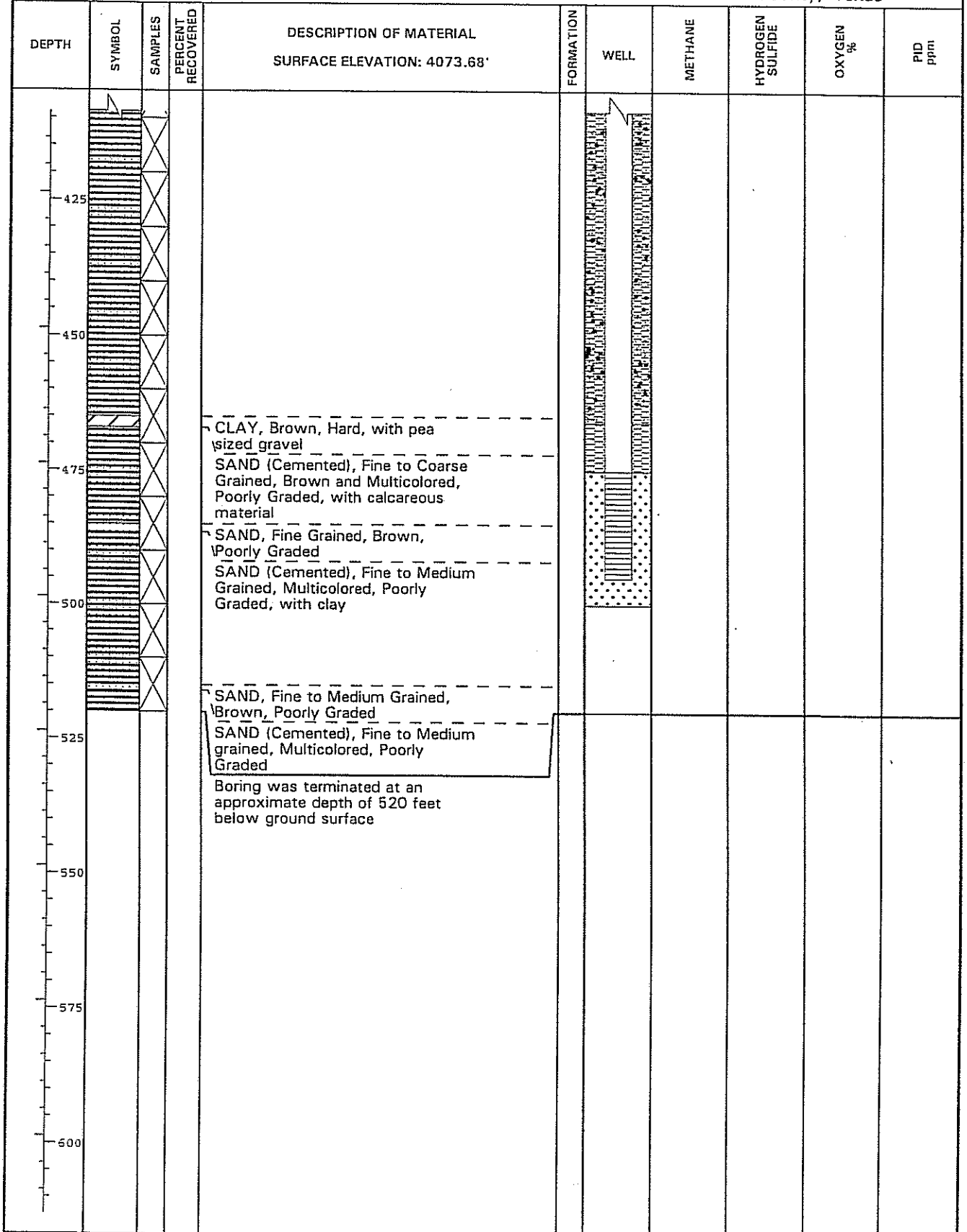
# LOG OF BORING NO. MW-3

McCombs Landfill - Phase III

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling(10"DiaHole)

LOCATION: El Paso County, Texas




| | | |
|---|---|---|
| DEPTH DRILLED: 520 ft | STATIC WATER ELEV: 3678.99 | PROJ. No: ASF02-045-00 |
| DATE DRILLED: 8/25/03-8/28/03 | DATE MEASURED: 9/05/03 | FIGURE 3 |

# KEY TO SYMBOLS

Symbol Description

Strata symbols

Clay with Sand

Sand

Gravel

Clay

Cemented Sand

Clayey Sand

Misc. Symbols

Boring continues

Water table at boring completion

Soil Samplers

Sample Interval

Monitor Well Details

cement/bentonite grout with pipe

hydrated bentonite pellets with pipe

slotted pipe w/ sand

silica sand, no pipe (end plug)

cement/bentonite grout

end of well installation

# KEY TO SYMBOLS

Notes:

## DEFINITION OF DESCRIPTIVE TERMS

| DENSITY OF GRANULAR SOILS | |
|---|---|
| SPT N Value | Relative Density |
| < 4 | Very Loose |
| 4 - 10 | Loose |
| 11 - 30 | Med. Dense |
| 31 - 50 | Dense |
| 50 - 80 | Very Dense |
| > 80 | Hard |

| CONSISTENCY OF COHESIVE SOILS | |
|---|---|
| SPT N Value | Consistency |
| < 2 | Very Soft |
| 2 - 4 | Soft |
| 5 - 8 | Medium Stiff |
| 9 - 15 | Stiff |
| 16 - 50 | Very Stiff |
| 50 - 80 | Hard |
| > 80 | Very Hard |

## DEGREE OF PLASTICITY

Non Plastic - Has no cohesion; will not roll into a thread.
Trace of Plasticity - Barely hold its shape when rolled into a thread.
Low Plasticity - Has sufficient cohesion to form a thread but will quickly rupture when deformed.
Med. Plasticity - Has considerable cohesion. Can be molded into a thread and will withstand considerable deformation without rupture.
High Plasticity - Can be kneaded like dough without trace of rupture.

## MOISTURE DESCRIPTIONS

| | Granular Soils | Cohesive Soils |
|---|---|---|
| Dry | No Apparent Moisture | No Apparent Moisture |
| Slightly Moist | < Than 3% by Weight | <Less Than Plastic Limit |
| Moist | 3% to 9% by Weight | Approximatley Plastic Limit |
| Very Moist | >9% by Weight | > than PL but < than LL |
| Wet | Submerged or Saturated | Submerged or Saturated |

## ABBBREVATIONS

V. - Very  Fl.- Fairly  Sl. - Slightly  Med. - Medium
Tr. - Trace  < - Less than  > - Greater Than  PL - Plastic Limit
Mod. - Moderately

ATTACHMENT 3

MONITOR WELL DATA SHEETS
TCEQ FORM 10308

# Monitor Well Data Sheet

Permittee or Site Name: City of El Paso - McCombs Landfill
County: El Paso County
Date of Monitor Well Installation: 7/17/2003 - 8/9/2003
Monitor Well Latitude: 31 59'00.63869"Longitude: 106 24'14.06849"
Monitor Well Groundwater Gradient Position:
Upgradient _____ Downgradient X

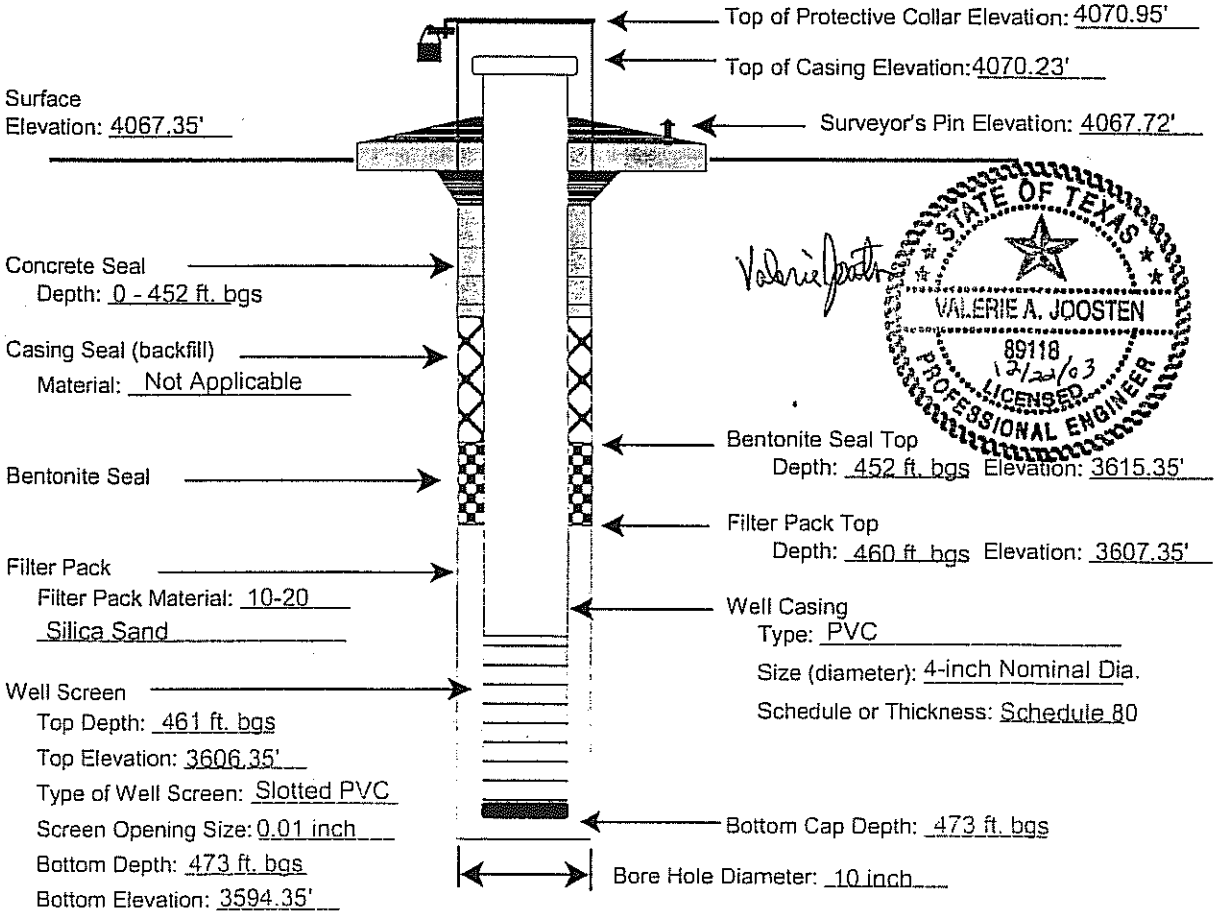
MSW Permit No.: 729A
Monitor Well I.D. No.: MW-1
Date of Monitor Well
Development: 8/12/3003 - 8/13/2003
Monitor Well Driller
Name: R.C. Corona
License No.: 4709M

**NOTES:**

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to nearest hundredth of a foot.
- Diameter of boring should be at least 4 inches larger than diameter of well casing.
- Use flush screw joint casing only, 2-inch diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommend).
- Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist, or Engineer Supervising Well Installation: Valerie A. Joosten, P.E.
Static Water Level Elevation (with respect to MSL) after Well Development: 3674.08 ft.
Name of Geologic Formation(s) in which Well is completed: Hueco Bolson

Type of Locking Device: Padlock Type of Casing Protection: 8-inch Square Steel Protective Collar
Concrete Surface Pad (with steel reinforcement) Dimensions: 6-in. x 5-ft. x 5-ft.




TCEQ-10308

# Monitor Well Data Sheet

Permittee or Site Name: City of El Paso - McCombs Landfill
County: El Paso County
Date of Monitor Well Installation: 8/14/2003 - 8/20/2003
Monitor Well Latitude: 31 59'00.54479"Longitude: 106 24'25.57457"
Monitor Well Groundwater Gradient Position:
Upgradient _____ Downgradient X

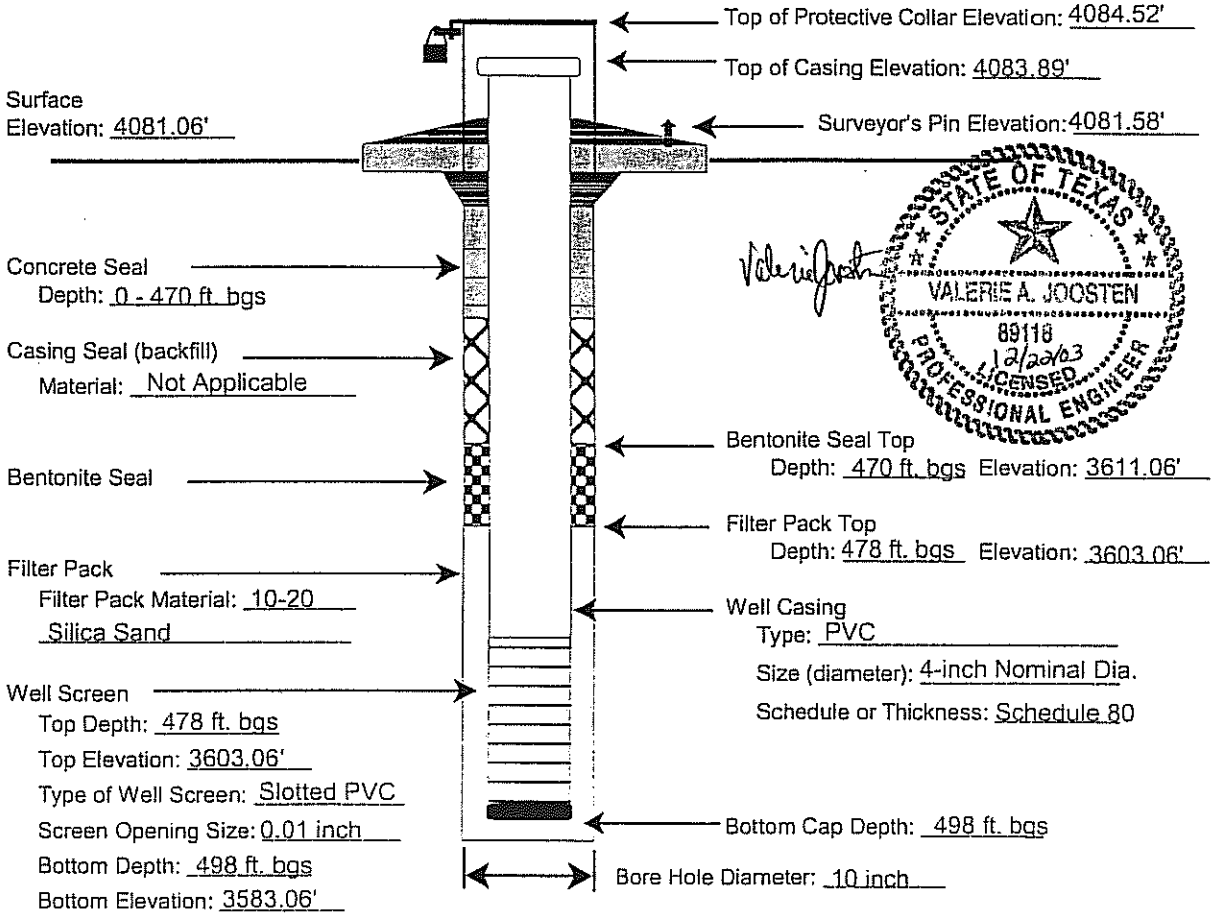
MSW Permit No.: 729A
Monitor Well I.D. No.: MW-2
Date of Monitor Well Development: 8/21/2003
Monitor Well Driller
Name: R.C. Corona
License No.: 4709M

**NOTES:**

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to nearest hundredth of a foot.
- Diameter of boring should be at least 4 inches larger than diameter of well casing.
- Use flush screw joint casing only, 2-inch diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommend).
- Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist, or Engineer Supervising Well Installation: Valerie A. Joosten, P.E.
Static Water Level Elevation (with respect to MSL) after Well Development: 3683.62'
Name of Geologic Formation(s) in which Well is completed: Hueco Bolson

Type of Locking Device: Padlock
Type of Casing Protection: 8-inch Square Steel Protective Collar
Concrete Surface Pad (with steel reinforcement) Dimensions: 6-in. x 5-ft. x 5-ft.




TCEQ-10308

# Monitor Well Data Sheet

Permittee or Site Name: City of El Paso - McCombs Landfill
County: El Paso County
Date of Monitor Well Installation: 8/25/2003 - 8/28/2003
Monitor Well Latitude: 31 59'43.41299" Longitude: 106 24' 13.33502"
Monitor Well Groundwater Gradient Position:
Upgradient X Downgradient

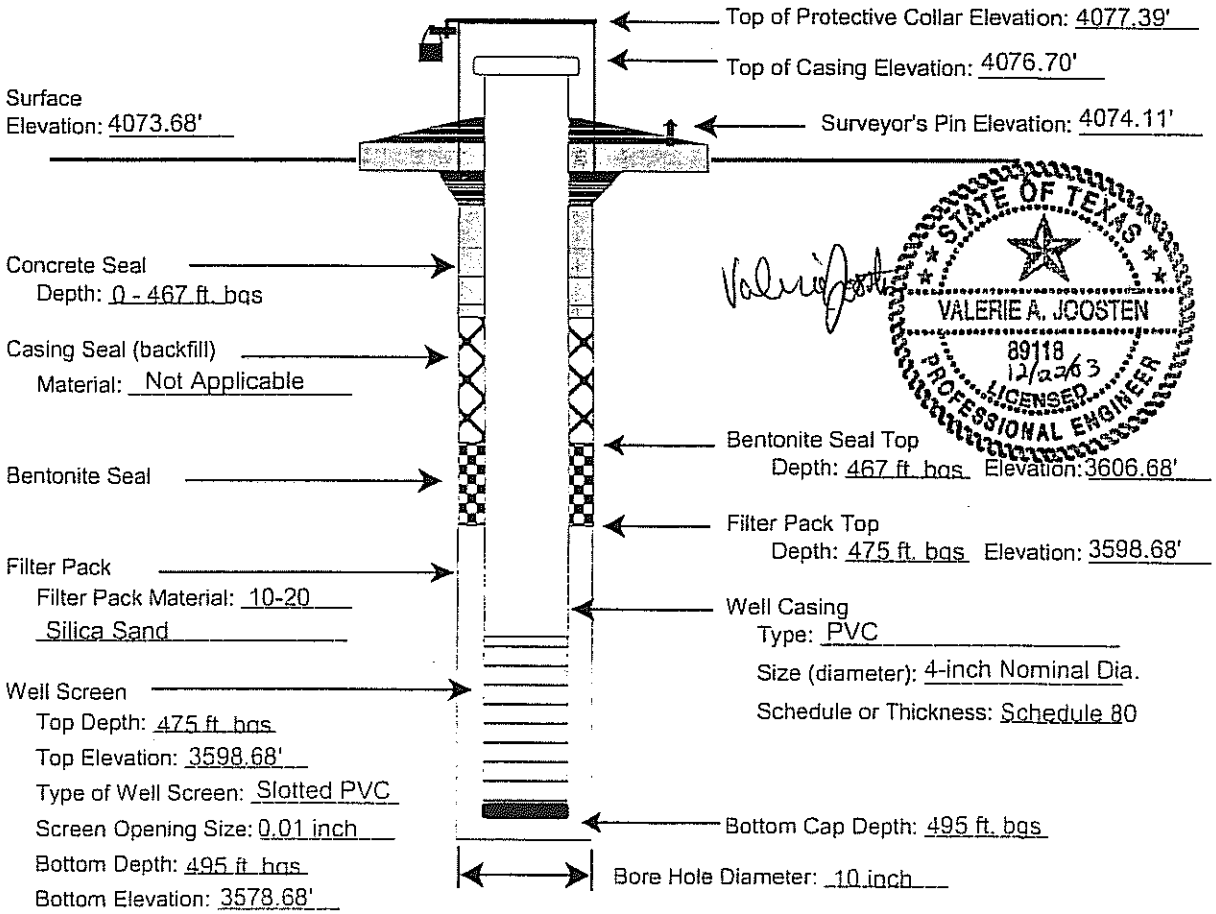
MSW Permit No.: 729A
Monitor Well I.D. No.: MW-3
Date of Monitor Well Development: 9/2/2003 - 9/3/2003
Monitor Well Driller
Name: R.C. Corona
License No.: 4709M

NOTES:

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to nearest hundredth of a foot.
- Diameter of boring should be at least 4 inches larger than diameter of well casing.
- Use flush screw joint casing only, 2-inch diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommend).
- Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist, or Engineer Supervising Well Installation: Valerie A. Joosten, P.E.
Static Water Level Elevation (with respect to MSL) after Well Development: 3678.99'
Name of Geologic Formation(s) in which Well is completed: Hueco Bolson

Type of Locking Device: Padlock Type of Casing Protection: 8-inch Square Steel Protective Collar
Concrete Surface Pad (with steel reinforcement) Dimensions: 6-in. x 5-ft. x 5-ft.




TCEQ-10308

ATTACHMENT 4

TDLR WELL REPORTS

Send original copy by certified return receipt requested mail to: TNRCC, MC 177, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on on reverse side of Well Owner's copy (pink)*

# State of Texas
# WELL REPORT

MW #1

Texas Water Well Drillers Advisory Council
MC 177
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

OWNER CITY OF EL PASO (Name) ADDRESS 7969 San Paulo Dr. El P. Tx 79915 (Street or RFD) (City) (State) (Zip)

2) ADDRESS OF WELL:
County EL PASO McCombs Landfill ELP Tx 79915 (Street, RFD or other) (City) (State) (Zip) GRID # 49-05-3

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5)

6) WELL LOG:
Date Drilling:
Started 7/17 19 03
Completed 7/30 19 03

DIAMETER OF HOLE

| Dia. (in.) | From (ft.) | To (ft.) |
|---|---|---|
| 10 | Surface | 600 |
| | | |
| | | |

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☒ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

N

From (ft.) To (ft.) Description and color of formation material

See Attached

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☒ Other Cemented
If Gravel Packed give interval ... from 420 ft. to 473 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

| Dia. (in.) | New or Used | Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial | Setting (ft.) From | Setting (ft.) To | Gage Casting Screen |
|---|---|---|---|---|---|
| 4 | N | Sch 80 PVC | 0 | 461 | |
| | | | | | |
| 4 | N | Sch 80 PVC | 461 | 473 | .01 |
| | | | | | |

*(Use reverse side of Well Owner's copy, if necessary)*

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 473 ft. to 600 ft. No. of sacks used 40
0 ft. to 452 ft. No. of sacks used 110
Method used Tremie Pipe
Cemented by R C Moore
Distance to septic system field lines or other concentrated contamination ____ ft.
Method of verification of above distance

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other Bailer
Depth to pump bowls, cylinder, jet, etc., ____ ft.

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

14) WELL TESTS:
Type test: ☐ Pump ☒ Bailer ☐ Jetted ☐ Estimated
Yield: ____ gpm with ____ ft. drawdown after ____ hrs.

11) WATER LEVEL:
Static level 392.64 ft. below land surface Date 9/25/03
Artesian flow ____ gpm. Date ____

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ____ Depth of strata ____
Was a chemical analysis made? ☐ Yes ☐ No

12) PACKERS: Type Depth

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME LIRASA Drlg. Co (Type or print) WELL DRILLER'S LICENSE NO. 47669

ADDRESS 245 Harvard Ave El Paso Tx 79907 (Street or RFD) (City) (State) (Zip)

(Signed) R C Moore (Licensed Well Driller) (Signed) ____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 05-21-96) White - TNRCC Yellow - DRILLER Pink - WELL OWNER

Send original copy by certified return receipt requested mail to: TNRCC, MC 177, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on on reverse side of Well Owner's copy (pink)*

# State of Texas
# WELL REPORT

MW # 2

Texas Water Well Drillers Advisory Council
MC 177
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

OWNER City of El Paso (Name) ADDRESS 7969 San Paulo Dr, ELP (Street or RFD) (City) Tx (State) 79915 (Zip)

2) ADDRESS OF WELL:
County El Paso McCombs Landfill (Street, RFD or other) ELP (City) Tx (State) 79915 (Zip) GRID # 49-05-3

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening
☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic
☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5)

N↑

6) WELL LOG:
Date Drilling:
Started 8/14 19 03
Completed 8/18 19 03

DIAMETER OF HOLE

| Dia. (in.) | From (ft.) | To (ft.) |
|---|---|---|
| 10 | Surface | 505 |
| | | |
| | | |

7) DRILLING METHOD (Check): ☐ Driven
☐ Air Rotary ☒ Mud Rotary ☐ Bored
☐ Air Hammer ☐ Cable Tool ☐ Jetted
☐ Other ______

| From (ft.) | To (ft.) | Description and color of formation material |
|---|---|---|
| | | [illegible] |
| | | |

*(Use reverse side of Well Owner's copy, if necessary)*

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall
☐ Underreamed ☒ Gravel Packed ☒ Other Cemented
If Gravel Packed give interval ... from 473 ft. to 498 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

| Dia. (in.) | New or Used | Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial | Setting (ft.) From | Setting (ft.) To | Gage Casting Screen |
|---|---|---|---|---|---|
| 4 | N | Sch 80 PVC | 0 | 478 | |
| 4 | N | Sch 80 PVC | 478 | 498 | .01 |

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 0 ft. to 470 ft. No. of sacks used 115
______ ft. to ______ ft. No. of sacks used ______
Method used Tremie Pipe
Cemented by [illegible]
Distance to septic system field lines or other concentrated contamination ______ ft.
Method of verification of above distance ______

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other Bailer
Depth to pump bowls, cylinder, jet, etc., ______ ft.

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

14) WELL TESTS:
Type test: ☐ Pump ☒ Bailer ☐ Jetted ☐ Estimated
Yield: ______ gpm with ______ ft. drawdown after ______ hrs.

11) WATER LEVEL:
Static level 397.96 ft. below land surface Date 9/05/03
Artesian flow ______ gpm. Date ______

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ______ Depth of strata ______
Was a chemical analysis made? ☐ Yes ☐ No

12) PACKERS:

| | Type | Depth |
|---|---|---|
| | | |
| | | |

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Lidasa [illegible] Co (Type or print) WELL DRILLER'S LICENSE NO. 4709M

ADDRESS 245 Harvard Ave (Street or RFD) El Paso (City) Tx (State) 79907 (Zip)

(Signed) [signature] (Licensed Well Driller) (Signed) ______ (Registered Driller Trainee)

**Please attach electric log, chemical analysis, and other pertinent information, if available.**

TNRCC-0199 (Rev. 05-21-96)

*White - TNRCC Yellow - DRILLER Pink - WELL OWNER*

Send original copy by certified return receipt requested mail to: TNRCC, MC 177, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on on reverse side of Well Owner's copy (pink)*

# State of Texas
# WELL REPORT

MW # 2

Texas Water Well Drillers Advisory Council
MC 177
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

OWNER CITY OF EL PASO (Name) ADDRESS 7969 San Paulo Dr. (Street or RFD) EL P (City) Tx (State) 79915 (Zip)

2) ADDRESS OF WELL: County EL PASO McCombs LandFill (Street, RFD or other) EL P (City) Tx (State) 79915 (Zip) GRID # 49-55-3

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) D

6) WELL LOG:
Date Drilling: Started 8/25 19 03 Completed 8/28 19 03

DIAMETER OF HOLE

| Dia. (in.) | From (ft.) | To (ft.) |
|---|---|---|
| 10 | Surface | 520 |
| | | |
| | | |

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☒ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

N

From (ft.) To (ft.) Description and color of formation material

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☒ Other CEMENTED
If Gravel Packed give interval ... from 475 ft. to 495 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

| Dia. (in.) | New or Used | Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial | Setting (ft.) From | Setting (ft.) To | Gage Casting Screen |
|---|---|---|---|---|---|
| 4 | N | Sch. 80 PVC | 0 | 475 | |
| | | | | | |
| 4 | N | Sch. 80 PVC | 475 | 495 | 0.01 |

(Use reverse side of Well Owner's copy, if necessary)

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 0 ft. to 467 ft. No. of sacks used 110
ft. to ft. No. of sacks used
Method used Tremie Pipe
Cemented by Pat Gonzales
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other Bailer
Depth to pump bowls, cylinder, jet, etc., ft.

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

14) WELL TESTS:
Type test: ☐ Pump ☒ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

11) WATER LEVEL:
Static level 396.12 ft. below land surface Date 9/15/03
Artesian flow gpm. Date

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

12) PACKERS: Type Depth

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME LIRA-CA Drlg. Co. (Type or print) WELL DRILLER'S LICENSE NO. 47109

ADDRESS 245 Hayward Ave. (Street or RFD) El Paso (City) Tx (State) 79907 (Zip)

(Signed) (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 05-21-96) White - TNRCC Yellow - DRILLER Pink - WELL OWNER

ATTACHMENT 5

SURVEYOR'S CERTIFICATION

*Land–Mark Professional Surveying Inc.*

*"Serving Texas, New Mexico and Arizona"*

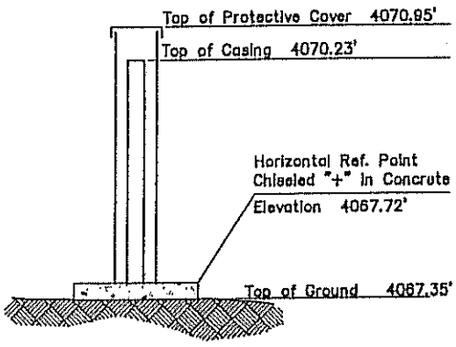
September 8, 2003

Raba Kistner
7002 Commerce
El Paso, Texas 79915
Attn: Valerie A. Joosten, P.E.

Subject: McCombs Landfill new Monitor Well Locations.

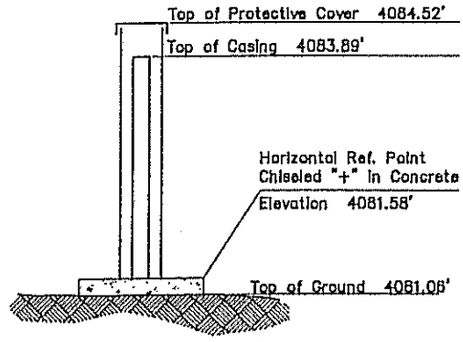
Dear Valerie:

Geodetic coordinates shown hereon are based upon Texas State Plane Coordinates, central zone. NAD83(1993) datum. Elevations are based upon City of El Paso McCombs Landfill Datum.



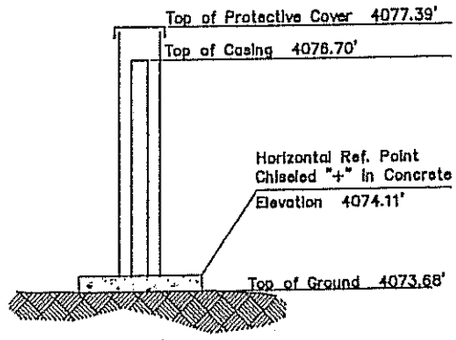

Well MW–1

Latitude N 31°59'00.63869"
Longitude W 106°24'14.06849"




Well MW–2

Latitude N 31°59'00.54479"
Longitude W 106°24'25.57457"




Well MW–3

Latitude N 31°59'43.41299"
Longitude W 106°24'13.33502"

I, Kenneth R. Kindle, hereby certify that the forgoing horizontal and vertical data was calculated from the field notes an actual survey performed by me or under my direction on September 5, 2003, and that the same is true and correct ot the best of my knowledge and belief.

STATE OF TEXAS
REGISTERED
KENNETH R. KINDLE
5710
PROFESSIONAL
LAND SURVEYOR

Kenneth R. Kindle R.P.L.S.
Texas Registration No.5710
September 8, 2003
Job #17632

1420 Bessemer Drive, Suite 'A', El Paso Texas 79936
Tel. (915) 598–1300 Fax (915) 598–1221 email address: Lmsurvey@swbell.net

ATTACHMENT 6

WELL DEVELOPMENT FORMS

# WELL DEVELOPMENT FORM
## McCombs Landfill
## MSW Permit No. 729A

| DATE | WELL NO. | TOTAL DEPTH (FT) | DEPTH TO WATER/PSH (FT) | WATER COLMN. (FT) | CONVERS. FACTOR (GAL/FT) | CASING VOL. (GAL) | DEVELOP/ PURGE (GAL) | TOTAL VOLUME REMOVED (GAL) | pH | CONDUCT. (mS) | TURB. (NU) | TEMP. (F / C) | SAMPLE TIME | COMMENTS (Odors, Sheen, PSH, Turbidity, Well Inspection) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 08/11/2003 | 1 | 476 | 392.00 | 84.00 | 0.6 | 50.4 | | | | | | | 8:30 | |
| 08/12/2003 | 1 | - | 391.90 | | | | | | 8.35 | 14.23 | 180 | 28.5 | 9:00 | |
| 08/12/2003 | 1 | - | - | | | | 20 | 20 | 8.4 | 12.62 | 41 | 30.1 | 12:35 | |
| 08/12/2003 | 1 | - | 428.00 | | | | | | 8.42 | 14.42 | 91 | 28.2 | 1:20 | |
| 08/12/2003 | 1 | - | 462.00 | | | | | | 8.69 | 13.14 | 208 | 28.6 | 1:50 | |
| 08/12/2003 | 1 | - | 462.00 | | | | | | 8.95 | 13.29 | 215 | 27.9 | 2:05 | |
| 08/12/2003 | 1 | - | 472.75 | | | | 50 | 70 | 8.95 | 13.58 | 283 | 29.3 | 3:30 | |
| 08/13/2003 | 1 | - | 445.20 | | | | | | 8.9 | 16.29 | 59.2 | 24.1 | 8:30 | Well began to recharge quickly |
| 08/13/2003 | 1 | - | 412.50 | | | | | | 8.59 | 15 | 4.3 | 24.5 | 9:30 | Water began to become clear. |
| 08/13/2003 | 1 | - | - | | | | | | 8.4 | 15.56 | 1 | 24.6 | 9:55 | |
| 08/13/2003 | 1 | 474 | 408.50 | 65.50 | 0.6 | 39.3 | 60 | 130 | 8.5 | 15.37 | 5 | 25.4 | 10:30 | |
| 08/14/2003 | 1 | 474 | 397.10 | 76.90 | 0.6 | 46.14 | | | | | | | 11:00 | |
| 08/19/2003 | 1 | 474 | 396.50 | 77.50 | 0.6 | 46.5 | | | | | | | 10:00 | |
| 08/25/2003 | 1 | - | 396.31 | | | | | | | | | | 9:30 | |
| 09/05/2003 | 1 | | 396.15 | | | | | | | | | | 11:00 | |
| | | | | | | | | | | | | | | |

DESCRIBE THE DISPOSITION, AMOUNT, AND LOCATION OF PURGED WATER AND ANY OTHER COMMENTS:

| CASING VOLUME DETERMINATION | |
|---|---|
| CASING DIAMETER (INCHES) | CONVERSION FACTOR FOR CASING VOLUME (GAL/FT) |
| 2 | 0.16 |
| 4 (Schedule 80) | 0.6 |
| 4 (Schedule 40) | 0.66 |
| 6 | 1.47 |
| 8 | 2.61 |

$CV = H \times CF$

where: CV = Casing Volume (gal)
H = Height of the water column (ft)
CF = Conversion factor (gal/ft)

STATE OF TEXAS
VALERIE A. JOOSTEN
89118
12/22/03
LICENSED
PROFESSIONAL ENGINEER

Valerie Joosten

*Prepared by:* Raba-Kistner Consultants, Inc.

# WELL DEVELOPMENT FORM
## McCombs Landfill
## MSW Permit No. 729A

| DATE | WELL NO. | TOTAL DEPTH (FT) | DEPTH TO WATER/PSH (FT) | WATER COLMN. (FT) | CONVERS. FACTOR (GAL/FT) | CASING VOL. (GAL) | DEVELOP/ PURGE (GAL) | TOTAL VOLUME REMOVED (GAL) | pH | CONDUCT. (mS) | TURB. (NU) | TEMP. (F / C) | SAMPLE TIME | COMMENTS (Odors, Sheen, PSH, Turbidity, Well Inspection) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 08/21/2003 | 2 | 500 | 243.50 | 256.50 | 0.6 | 153.9 | | | | | | | 9:06 | |
| 08/21/2003 | 2 | - | | | | | 35 | 35 | 8.69 | 12.11 | 47 | 32.5 | 9:48 | |
| 08/21/2003 | 2 | - | 349.60 | | | | 25 | 60 | 8.76 | 12 | 48 | 32.3 | 10:10 | |
| 08/21/2003 | 2 | | 427.50 | | | | 55 | 115 | 8.45 | 11.57 | 20 | 31.2 | 11:00 | Well is recharging quickly |
| 08/21/2003 | 2 | | | | | | 25 | 140 | 8.58 | 10.82 | 112 | 32.3 | 11:30 | |
| 08/21/2003 | 2 | | 446.00 | | | | 60 | 200 | 8.37 | 8.46 | 180 | 29.6 | 12:20 | |
| 08/21/2003 | 2 | | | | | | | | 8.78 | 11.3 | 93 | 30 | 12:35 | Water is clear to slightly cloudy |
| 08/21/2003 | 2 | | | | | | | | 8.63 | 11.44 | 61 | 28 | 12:50 | |
| 08/21/2003 | 2 | 500 | 445.00 | 55.00 | 0.6 | 33 | 60 | 260 | 8.59 | 10.9 | 60 | 27.8 | 1:15 | |
| 08/22/2003 | 2 | | 400.51 | | | | | | | | | | 1:30 | |
| 08/25/2003 | 2 | | 400.95 | | | | | | | | | | 9:30 | |
| 09/05/2003 | 2 | | 400.27 | | | | | | | | | | 10:45 | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |

DESCRIBE THE DISPOSITION, AMOUNT, AND LOCATION OF PURGED WATER AND ANY OTHER COMMENTS:

| CASING VOLUME DETERMINATION | |
|---|---|
| CASING DIAMETER (INCHES) | CONVERSION FACTOR FOR CASING VOLUME (GAL/FT) |
| 2 | 0.16 |
| 4 (Schedule 80) | 0.6 |
| 4 (Schedule 40) | 0.66 |
| 6 | 1.47 |
| 8 | 2.61 |

$$CV = H \times CF$$

where: CV = Casing Volume (gal)
H = Height of the water column (ft)
CF = Conversion factor (gal/ft)

STATE OF TEXAS
VALERIE A. JOOSTEN
89118
12/22/03
LICENSED
PROFESSIONAL ENGINEER

Valerie Joosten

*Prepared by:* Raba-Kistner Consultants, Inc.

# WELL DEVELOPMENT FORM
## McCombs Landfill
## MSW Permit No. 729A

| DATE | WELL NO. | TOTAL DEPTH (FT) | DEPTH TO WATER/PSH (FT) | WATER COLMN. (FT) | CONVERS. FACTOR (GAL/FT) | CASING VOL. (GAL) | DEVELOP/ PURGE (GAL) | TOTAL VOLUME REMOVED (GAL) | pH | CONDUCT. (mS) | TURB. (NU) | TEMP. (F / C) | SAMPLE TIME | COMMENTS (Odors, Sheen, PSH, Turbidity, Well Inspection) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 09/02/2003 | 3 | 498 | 283.82 | 214.18 | 0.6 | 128.508 | | | | | | | 10:15 | |
| 09/02/2003 | 3 | | 373.60 | | | | 55 | 55 | 8.88 | 8.03 | 22 | 28.6 | 11:00 | |
| 09/02/2003 | 3 | | 425.90 | | | | 55 | 110 | 8.94 | 7.81 | 34 | 28.9 | 12:00 | |
| 09/02/2003 | 3 | | 498.00 | | | | 55 | 165 | 9.57 | 10.26 | 128 | 29.1 | 2:00 | Water recovering slowly. |
| 09/02/2003 | 3 | | 496.30 | | | | | | | | | | 5:00 | |
| 09/03/2003 | 3 | 498 | 480.00 | 18.00 | 0.6 | 10.8 | | | 10.05 | 12.06 | 50 | 29.2 | 8:15 | Water is clear. |
| 09/03/2003 | 3 | | - | | | | 85 | 250 | 9.48 | 16.58 | 2 | 27.9 | 9:45 | Water recovering quickly. |
| 09/03/2003 | 3 | 495 | 436.95 | | | | 30 | 280 | 9.34 | 16.83 | 2 | 25.7 | 10:15 | |
| 09/04/2003 | 3 | | 463.56 | | | | | | | | | | 2:00 | |
| 09/05/2003 | 3 | | 397.71 | | | | | | | | | | 10:30 | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | |

DESCRIBE THE DISPOSITION, AMOUNT, AND LOCATION OF PURGED WATER AND ANY OTHER COMMENTS:

| CASING VOLUME DETERMINATION | |
|---|---|
| CASING DIAMETER (INCHES) | CONVERSION FACTOR FOR CASING VOLUME (GAL/FT) |
| 2 | 0.16 |
| 4 (Schedule 80) | 0.6 |
| 4 (Schedule 40) | 0.66 |
| 6 | 1.47 |
| 8 | 2.61 |

$$CV = H \times CF$$

where: CV = Casing Volume (gal)
H = Height of the water column (ft)
CF = Conversion factor (gal/ft)

STATE OF TEXAS
VALERIE A. JOOSTEN
89118
12/22/03
LICENSED
PROFESSIONAL ENGINEER

Valerie Joosten

*Prepared by:* Raba-Kistner Consultants, Inc.

# ATTACHMENT 7

# QUALIFIED GROUNDWATER SCIENTIST CERTIFICATION

# RICHARD V. KLAR, P.G.

## ENVIRONMENTAL GEOLOGIST

### PRINCIPAL PRACTICE
Environmental Geology and Hydrogeology

### EDUCATION
The University of Texas at San Antonio; M.S. Applied Geology (Hydrogeology), 1996
St. Mary's University, San Antonio, TX; B.S. Earth Sciences, 1992

### PROFESSIONAL REGISTRATIONS
Professional Geologist: State of Texas Board of Geoscientists, No. 259
Professional Geologist: State of Nebraska Board of Geologists, No. G-0125
LPST Corrective Action Project Manager: TNRCC No. CAPM01395

### PROFESSIONAL EXPERIENCE
Raba-Kistner Consultants, Inc., 1996 - Present
Center for Nuclear Waste Regulatory Analyses, SwRI, Graduate Scientist, 1992 - 1996
The U.T.S.A. Center for Water Research, Technical Staff II, 1995 - 1996

### SELECTED PROJECT EXPERIENCE
Mr. Klar has over 8 years of diversified experience in geologic and hydrogeologic investigations in South Central Texas, New Mexico, and Nevada. Mr. Klar is currently responsible for implementing/overseeing site characterization and contamination assessment activities at municipal solid waste disposal sites in accordance with Federal and State regulations. Representative project experience includes surface and subsurface sampling of environmental media, landfill-gas and ground-water monitoring/recovery well design and installation, hydrogeologic investigations, earth electrical resistivity/conductivity surveys, investigation-derived wastes profiling and disposal, and associated data reduction/report preparation. Mr. Klar served as project geologist and prepared the Geology Report and Groundwater Characterization Report for the City of Seguin *(IESI Stagecoach Road Landfill)* permit modification. Additionally, Mr. Klar served as the project geologist for the preparation of closure and waste characterization plans for the *Hidalgo County Precinct 4 Landfill.*

Additional experience includes preparation of ground water monitoring reports and sampling and analyses plans *(Cities of Raymondville, Harlingen, and Seguin; and Hidalgo County)*, and the performance of earth electrical resistivity surveys to evaluate the potential for leachate migration as part of post-closure care activities *(City of Raymondville).* Other profesional experience includes modeling of ground water flow and contaminant transport; construction of 3-D hydrostratigraphic models; acquisition and analysis of ground magnetic, electromagnetic, and resistivity data; and development of GIS databases in support of site characterization activities for the U.S. DOE licensing of a proposed high level nuclear waste repository at Yucca Mountain, Nevada.

### PROFESSIONAL MEMEBERSHIPS
South Texas Geological Society, Association of Engineering Geologists, National Ground Water Association

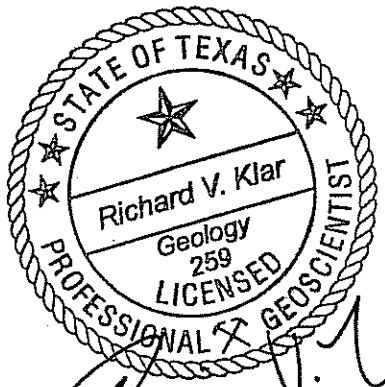
§330.230(c)(2) **Qualified Groundwater Scientist Certification**

I, Richard V. Klar, P.G., certify that the City of El Paso - McCombs Landfill, MSW Permit No. 729A, is in compliance with the groundwater monitoring requirements specified in 30 TAC §§330.231-330.235 (relating to Groundwater Monitoring and Corrective Action).

Richard V. Klar, P.G.

12-19-07

Date




12-19-07

**ATTACHMENT 5**
GROUNDWATER CHARACTERIZATION REPORT

Raba Kistner

**Raba-Kistner Consultants (SW), Inc.**
7002 Commerce, El Paso, TX 79915
(915)778-5233 • FAX (915)779-8301
www.rkci.com

R-K Project No. ASF02-045-00
April 25, 2002 (Revision 1 - August 7, 2002)

Texas Natural Resource Conservation Commission
Municipal Solid Waste Division
MC-124, P.O. Box 13087
Austin, Texas 78711-3087

Attention: Mr. Jeff Holderread, P.E.

RE: Attachment 5 - Groundwater Characterization Report
McCombs Landfill
MSW Permit No. 729A
Class I Permit Modification
El Paso County, Texas

Dear Mr. Holderread:

Per the request of our client, The City of El Paso, Raba-Kistner Consultants (SW), Inc. is resubmitting to the Texas Natural Resource Conservation Commission (TNRCC) the document listed below in partial compliance with 30 TAC 330.56(e) as it pertains to the McCombs Landfill Permit Modification Application. Thus, Attachment 5 consists of a copy of Sections 1.0 through 3.0 (and applicable figures) of the following document, which is included as an Appendix:

- Appendix Att5-A: May 12, 1995 Groundwater Sampling and Analysis Plan (partial sections)

This document is being submitted in partial compliance with the TNRCC first technical review letter dated June 21, 2002.

Upon approval of this permit modification, the City of El Paso will install the groundwater monitoring system described in this application. Upon installation of said system, the City of El Paso will submit a statement of certification for the well installation as required under 30 TAC §330.230(c)(2), monitoring well reporting forms (TNRCC-10308), and a figure complying with the requirements of 30 TAC §330.56(e)(3).

Respectfully submitted,

**RABA-KISTNER CONSULTANTS (SW), INC.**

Valerie Joosten

Valerie A. Joosten, P.E.
Project Manager

STATE OF TEXAS
8/7/02
VALERIE A. JOOSTEN
89118
LICENSED
PROFESSIONAL ENGINEER

John D. Cordova, P.E.
Vice President

Enclosures

H:DATA\ENV\ASF02\045\project letters\att.5.ltr.08[illegible]02.doc

# GROUNDWATER SAMPLING AND ANALYSIS PLAN

McCOMBS MUNICIPAL LANDFILL
EL PASO COUNTY, TEXAS
PERMIT No. 729A

PREPARED FOR:

CITY OF EL PASO
PUBLIC WORKS DEPARTMENT
2 CIVIC CENTER PLAZA
EL PASO, TEXAS 79901

AND

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
BUREAU OF SOLID WASTE MANAGEMENT
AUSTIN, TEXAS

AEE JOB NO. E93-4034
REVISION NO. 1

May 12, 1995

AGRA
Earth & Environmental

GROUNDWATER SAMPLING AND ANALYSIS PLAN

McCOMBS LANDFILL
EL PASO COUNTY, TEXAS

By: _____
Ravi Murthy
Project Engineer

Reviewed by: _____
Jamie R. Barnes, P.G.
Project Manager

and: _____
Emmett F. Irby, Jr., P.E.
Vice President

Approved by: _____
City of El Paso

_____
City of El Paso

Approved by: _____
Texas Natural Resource Conservation Commission

_____
Texas Natural Resource Conservation Commission

AEE JOB NO. E93-4034

AGRA
*Earth & Environmental*

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## 1. INTRODUCTION

AGRA Earth & Environmental, Inc. (AEE) has prepared this Groundwater Sampling and Analysis Plan (GWSAP) as part of the scope of services to be performed during the implementation of a groundwater monitoring program at the McCombs Landfill in El Paso County, Texas. This sampling plan is designed to provide details of field activities and documentation to be implemented. This plan replaces our October, 1993 version of the GWSAP, however, the Site Characterization portion of that document has not changed and should be used in conjunction with this plan.

Included in this document are:

- Details of borings to be drilled to evaluate the hydrogeologic and geotechnical properties of the soil.
- Installation details for monitor wells which will be placed to determine the depth to and quality of groundwater beneath and adjacent to the site.
- Details describing groundwater sampling and field analytical testing.
- Guidelines for preservation, transportation and analysis of groundwater samples.
- Guidelines for handling, temporary storage and disposal of materials suspected to be hazardous that will be generated during implementation.

It is understood that the details of the field exploration program provided herein are based on the information available at the time this document was prepared. AEE may modify these specifications based on conditions encountered in the field, pending review and approval by the City of El Paso (City) and the Texas Natural Resource Conservation Commission (TNRCC).

## 2. OBJECTIVES

The principal objective of this study is to formulate and implement a groundwater monitoring plan at the McCombs Landfill in order to comply with regulatory requirements set forth by Chapter 330 of the Texas Administrative Code (TAC) pertaining to Solid Waste Disposal. To accomplish this, a two-phased approach was adopted.

**Phase I:**

The primary objective of Phase I is to review available geologic, hydrogeologic, and geotechnical information on the site. This information along with climatological data and site specific landfilling operational data was processed utilizing the HELP model. HELP is a computer program used to model leachate production and physical attenuation at landfill sites. Based on results of the above studies, the location and number of monitor wells will be determined. Details regarding placement, development and sampling of wells are provided in this GWSAP. Phase I will be complete with the submission of the GWSAP to the TNRCC and negotiating acceptance.

Phase II:

Upon approval of the GWSAP, subsurface drilling and monitor well installation will commence in accordance with guidelines specified in this document. Groundwater sample collection, preservation, transportation, and chain-of-custody documentation will be completed as discussed in the GWSAP.

Subsequent phases of the project will include implementation of Detection and Assessment Monitoring programs in accordance with TAC §330.234 & §330.235. If required, an assessment of corrective measures will be implemented in accordance with TAC §330.236.

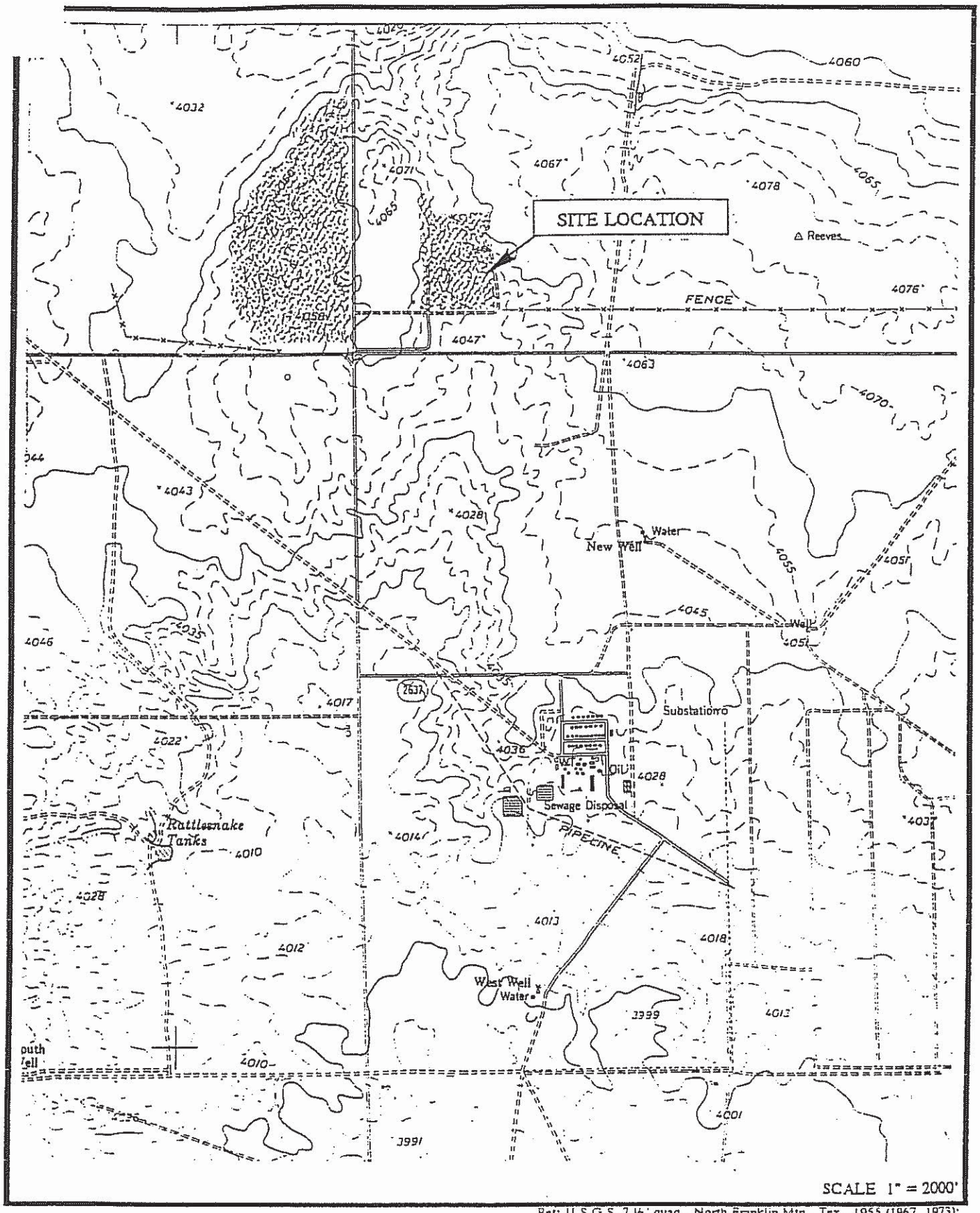
## 3. SITE BACKGROUND

A detailed description of the site history and operations is included in the Site Characterization document submitted earlier, and summarized herein for completeness.

According to City personnel, landfilling operations began at the McCombs Landfill in 1960. The landfill was initially permitted by the Texas Department of Health in August, 1976. The Permit was modified in May, 1984 to cover a total area of 327 acres.

The landfill is located approximately 20 miles northeast of downtown El Paso, in Section 6, Block 80, Township 1, Texas and Pacific Surveys, in El Paso County (see Figure 1). The landfill permit area encompasses approximately 327 acres, although only a portion is developed as a landfill at present. The landfill is situated on deposits of the Hueco Bolson. The Hueco Bolson sediments have been divided into three rock stratigraphic units, the Fort Hancock and the Camp Rice Formations of Pleistocene age and recent alluvial and eolian deposits developed on them. The McCombs landfill is probably directly underlain by Pleistocene sediments of the Camp Rice Formation. These deposits primarily consist of clay, sand and gravel, with some caliche.

Based on a review of published data, depth to groundwater at the landfill site is estimated to be between 370 to 390 feet, however, some variation in depth to groundwater is expected. The groundwater flow direction is generally assumed to be primarily to the south and southeast, however, pumping in the area may locally affect groundwater gradients both now and in the future.




Ref: U.S.G.S. 7 ½' quad., North Franklin Mtn., Tex., 1955 (1967, 1973);

Existing Landfill Site Assessment
McCombs Landfill
El Paso, Texas
Job No. E93-4034

Figure 1
Site Location Map

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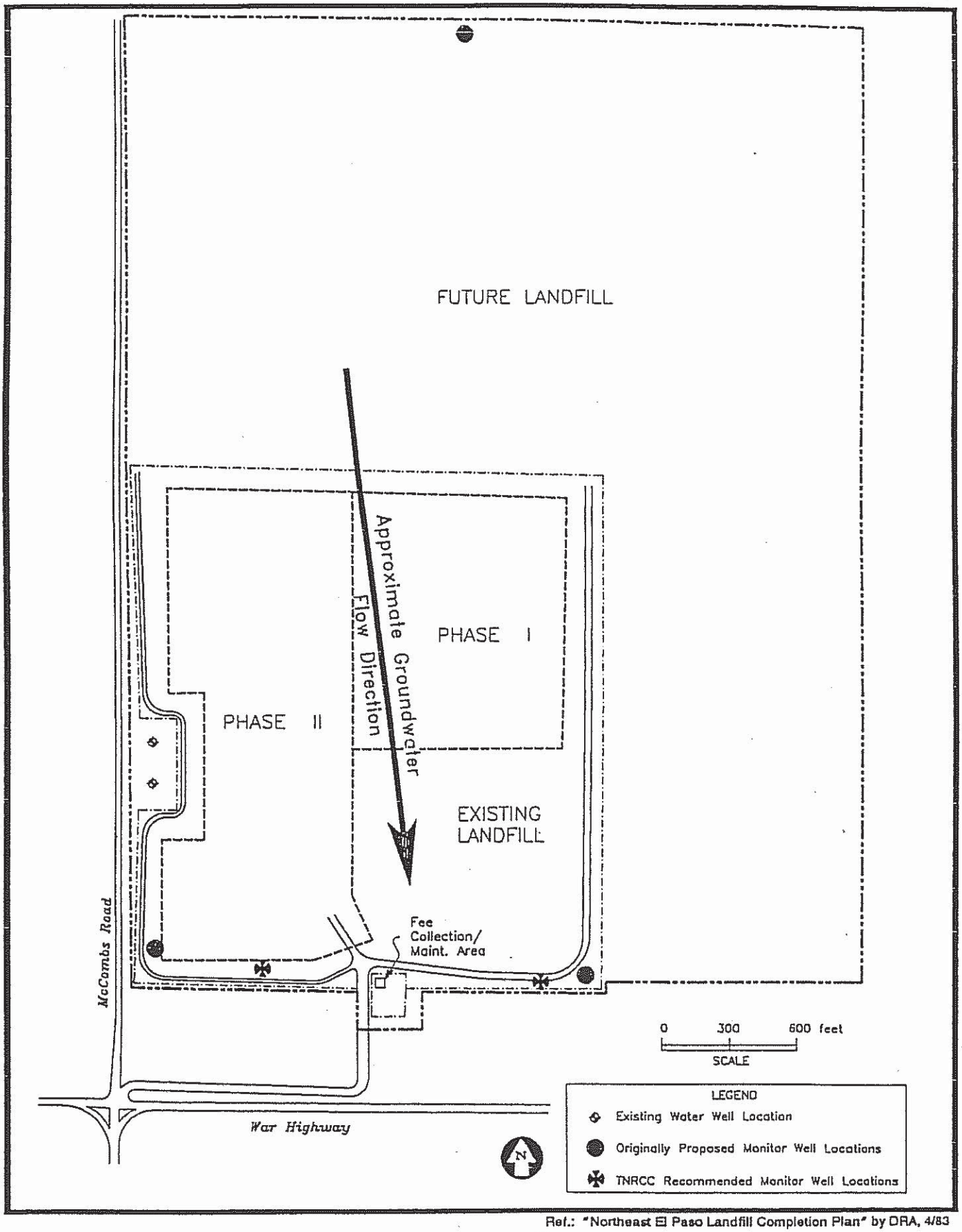


Ref.: "Northeast El Paso Landfill Completion Plan" by DRA, 4/83

Groundwater Sampling and Analysis Plan
McCombs Landfill
El Paso, Texas
AEE Job E93-4034

Figure 2
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Monitor Well Locations

AGRA
Earth & Environmental

Report

# Major Permit Amendment – Part III: Volume III
# McCombs Municipal Landfill
# El Paso County, Texas
# TCEQ MSW Permit No. 729B

Prepared for: City of El Paso

Revised July 2013, Revision 6

SAIC

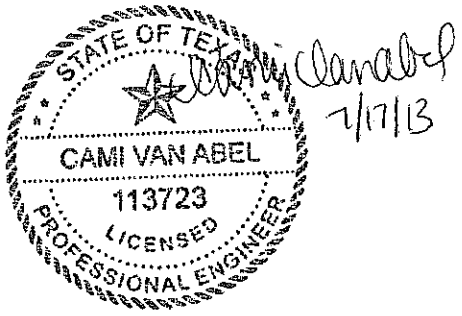
# McCombs Municipal Landfill
# El Paso County, Texas
# TCEQ MSW Permit No. 729B

# Major Permit Amendment Application
# Part III
# Volume III

Prepared for

**City of El Paso**

Updated July 2013, Revision 6




Prepared by

**SAIC**
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Texas Board of Professional Engineers
Firm Registration No. 3823

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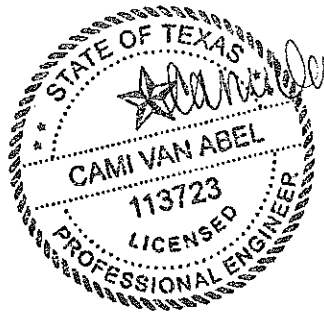


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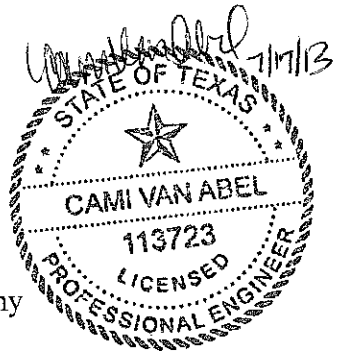

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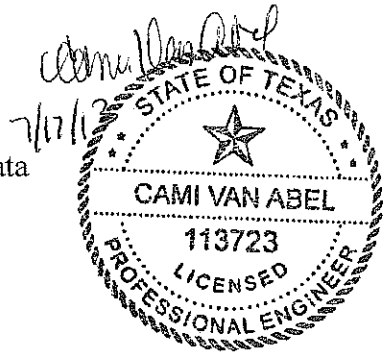

# Appendix 3L – Attachment 2
# Groundwater Sampling and Analysis Plan

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# Part III
# Site Development Plan
# Appendix 3L, Attachment 2
# Groundwater Sampling and Analysis Plan

McCombs Landfill
MSW Permit No. 729B
City of El Paso
El Paso County, Texas
September 4, 2002
Revised September 2009

The attached document was modified from its original form only to modify the MSW Permit No. 729A to 729B.

# PART III

# SITE DEVELOPMENT PLAN

Appendix 3L, Attachment 2

# GROUNDWATER SAMPLING AND ANALYSIS PLAN

**McCOMBS LANDFILL**

**MSW PERMIT NO. 729B** XB

**CITY OF EL PASO**

**EL PASO COUNTY, TEXAS**

**SEPTEMBER 4, 2002**

**REVISED SEPTEMBER 2009**

THE CITY OF EL PASO TEXAS

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Engineers ▫ Architects ▫ Planners

The CAREL CORPORATION

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# 1 INTRODUCTION AND PURPOSE

The Ground Water Sampling and Analysis Plan (GWSAP) presented herein was prepared to describe procedures and methodologies associated with the collection, handling and laboratory testing of ground water samples for the City of El Paso McCombs Landfill (MSW Permit No. 729B). The purpose of the GWSAP is to define site-specific standards and practices for ground water sampling and analysis within the context of a stand-alone document that provides a concise set of instructions to sampling and analytical personnel conducting a ground water sampling program. This GWSAP has been updated to comply with 30 TAC 330 Subchapter J: Groundwater Monitoring and Corrective Action (effective March 27, 2006). Once approved by the Texas Commission on Environmental Quality (TCEQ), this GWSAP will replace the previous GWSAP within the Site Development Plan for the City of El Paso McCombs Landfill.

The ground water sampling program will be conducted in accordance with the procedures established herein. Although the GWSAP addresses the collection, handling, storage, and treatment of the samples (both in the field and at the testing laboratory), the contract laboratory that actually performs the analyses of ground water samples will submit a Laboratory Standard Operating Procedures (LSOP) document to the TCEQ prior to the implementation of the sampling program. The LSOP will describe specific laboratory protocols used to provide data of stated quality with a stated probability of being correct including all procedures to handle and analyze samples from receipt until results are officially reported.

# 2 MONITORING POINT INSPECTION

The location of each monitoring point (hereinafter also referred to as "monitoring well" or "well") will be initially verified using a current site map to confirm that appropriate monitoring wells are identified for sampling. The unique well identification numbers will be verified with the identification markers shown on well installations and recorded on the field data sheet (or an equivalent form) (depicted as ***Figure Att11-1***). Field data sheets for each monitoring well will accompany field personnel performing ground water monitoring to the subject landfill during monitoring events.

Prior to the commencement of monitoring well gauging or purging activities, the condition of site wells will be visually inspected. The well casing and concrete pads will be checked for the presence of cracks or fissures that could compromise the integrity of the surface completion. Each well will be additionally inspected for damage due to vandalism, animals or insects, and/or heavy equipment operations. Descriptions of apparent well damage or conditions conducive to the transmission of surface runoff along monitoring well installations will be noted in the *"Remarks"* section of the field data sheet. If any problems are discovered, they will be repaired/replaced as soon as practicable.

# 3 GAS MONITORING/WATER LEVEL MEASUREMENTS

The presence of explosive gases within the well casing at respective monitoring well locations will be evaluated utilizing a properly calibrated landfill gas monitor. Measurements will consist of gas temperature, pressure, and concentration. Well casings will be screened during each monitoring event to verify that the concentration of methane gas does not exceed 25 percent of the lower explosive limit (LEL) for methane. In the event that methane is detected at concentrations that exceed 25 percent of the LEL, steps will be immediately taken to ensure the protection of human health and safety pursuant to the contingencies described in *30 TAC §330.371*. A record of field methane measurements will be recorded on the field data sheet-(or an equivalent form).

Prior to purging site monitoring wells, the depth to water and total well depth measurements will be gauged at each well location from a permanent, clearly marked reference point on the well (i.e., top of casing [TOC]). The water level measurements will be recorded to the nearest hundredth of a foot utilizing an electronic water-level indicator (e-line). To ascertain that potential contaminants are not introduced to the monitoring wells as the result of gauging activities, the e-line probe and measurement tape will be decontaminated before and after each use. Decontamination procedures are further described in **Section 4.0: Well Purging** of this GWSAP. The decontamination fluids will be containerized pending the results of ground water sampling and analyses.

# 4 WELL PURGING

In order to obtain representative ground water samples, the monitoring wells will be purged to remove water from the well casing that may not be chemically representative of the formation ground water. Well purging will be accomplished utilizing either a properly decontaminated submersible pump or a dedicated Teflon® or polyethylene bailer. In the event that a pump is used to purge monitoring wells, purging equipment including pump, tubing, and connectors will be decontaminated according to the following procedure:

1) Conduct an initial wash using a mild solution containing a biodegradable, phosphate-free detergent such as Alconox®;

2) Conduct a second wash utilizing clean drinking-grade water; and

3) Conduct a final rinse using reagent-grade water obtained from the analytical laboratory.

In order to prevent cross-contamination of purging equipment by field personnel, clean, disposable, powder-free, nitrile or latex gloves will be used when handling the decontaminated purging equipment. Prior to purging and sampling, clean, disposable plastic sheeting will be placed around respective wells in order to prevent clean equipment from coming into contact with the ground.

During purging, a minimum of three (3) well casing volumes of ground water will be removed from respective monitoring wells. As indicated on the attached field data sheet (please see ***Figure Att11-1***), the volume of water to be removed at each well location will be calculated based on the respective height of the water column in the monitoring well and the well casing diameter. If sufficient ground water is available, purging will continue until field parameters including pH, temperature, turbidity, and conductivity have stabilized and the ground water is clear. A description of measurement protocols for field parameters is provided in **Section 6.2: Field Measurements** of this GWSAP. Parameter stabilization is defined as:

- Specific Conductivity = ± 10% for three (3) consecutive measurements;
- pH = ± 0.2 standard pH units for three (3) consecutive measurements;
- Temperature = ± 10% for three (3) consecutive measurements;
- Turbidity = ± 10% for three (3) consecutive measurements unless under 10 NTU (all values under 10 NTU are considered stable).

In the event that monitoring wells recharge very slowly, wells will be purged to dryness in order to remove stagnant water from well casings. Wells will be allowed sufficient time (maximum of 72 hours) to recover such that ground water samples can be collected. Whenever possible, the ground water level shall be allowed to recover to within 90 percent of the original water level measurement prior to sampling. In the event that sufficient well volume for sampling is not available within 72 hours of purging, it is understood that TCEQ may require a longer duration for recovery of sufficient sampling volume or the adoption of an alternate strategy to obtain samples from low-yield wells. As further described in **Section 6.1** of this GWSAP, site conditions may facilitate the application of Low-Flow Purging and Sampling Techniques as an alternative to conventional well purging and sampling methods described above.

All data collected prior to sampling will be recorded on the field data sheet (or an equivalent form) and will include the following, at a minimum:

- initial depth to water,
- measured depth to the bottom of the well,
- height of the water column inside the well,
- well casing volume,
- purging rate,
- time spent purging the well,
- water volume purged from the well,
- a record of pH, conductivity, temperature, turbidity readings, and
- information resulting form the well inspection and other pertinent information.

Ground water removed from site monitoring wells during purging activities will be stored in labeled 55-gallon drums or similar containers. The ground water containers will be temporarily stored on site until analytical results are received from the contract laboratory. If the report of laboratory analyses indicates that the concentrations of contaminants do not exceed levels of concern as determined by TCEQ, the water will be applied to the unsaturated soil on-site. In the event that analytical results indicate concentrations of contaminants that are above levels of concern or classified as hazardous by TCEQ, the water will be properly disposed of at a wastewater treatment facility, hazardous waste facility, or other authorized facility in accordance with applicable TCEQ and federal regulations.

# 5 TIMING AND ORDER OF SAMPLING

In association with each monitoring event, ground water sampling will be accomplished as soon as practicable subsequent to the completion of purging activities to avoid temporal variations in water levels and water chemistry. When possible, sampling activities will be conducted within twenty-four (24) hours of well purging. As described in **Section 4.0: Well Purging** of this GWSAP, a maximum of 72 hours will be allowed subsequent to purging in the event that monitoring wells recharge slowly and sufficient water volume is not available for sampling at a lesser duration. In the event that sufficient well volume for sampling is not available within 72 hours of purging, it is understood that TCEQ may require a longer duration for recovery of sufficient sampling volume or the adoption of an alternate strategy to obtain samples from low-yield wells. In general, the time interval between purging and sampling activities will be kept to a minimum, particularly when the analysis of volatile organic compounds (VOCs) is required.

In an effort to avoid cross-contamination of samples between monitoring wells during respective monitoring events, sampling will commence at the monitoring well which is known to be the least contaminated and conclude with the most contaminated well. In the absence of contamination data for newly installed monitoring wells during initial background monitoring events, the order of sampling will be from the well with the highest water-level elevation to the well with the lowest elevation (upgradient to downgradient) for each group of wells completed within a discrete water bearing interval.

# 6 SAMPLE COLLECTION, PRESERVATION, AND SHIPMENT

In an effort to maximize the validity of ground water samples and protect sample integrity, the following procedures for sample collection, preservation, and shipment will be implemented. The methods and procedures described herein will be consistently applied at site monitoring wells and throughout subsequent ground water monitoring events.

## 6.1 Sample Collection

Ground water samples will be collected at each well location utilizing a pump or a new, clean, disposable bailer suspended from new, clean nylon string. In order to minimize turbulence and aeration and associated potential volatilization of organic compounds during sampling, adjustable flow rate pumps will be used or bailers will be equipped with a bottom-emptying device allowing water to be discharged slowly from the bottom directly into sample containers. Field personnel will wear new, clean, disposable nitrile or latex gloves throughout the duration of sampling at each well location. Soiled sample bottles, bailers, nylon string, and filtration media will not be reused at subsequent well sampling locations.

In the event that ground water samples are collected immediately subsequent to purging activities (6 to 12 hours), it is not anticipated that ground water present at the top of the water column will be oxidized to an extent that could potentially affect the collection of representative ground water samples. In the event that sufficient sample volume recharges into monitoring wells and sampling is conducted within 24 hours of purging the first portion of collected water (approximately 2 liters [i.e., 0.5 gallons]) will be discarded to eliminate potentially oxidized water prior to filling sample containers. In the event that site wells recharge slowly and must be sampled more than 24 hours after purging, a lesser volume may be initially discarded in order to preserve sufficient sampling volume for analytical chemistry assignments.

In the event that site wells recharge slowly, low-flow purging and sampling techniques in accordance with guidance contained in EPA publication *EPA/540/S-95/504, Low-Flow (Minimal Drawdown) Ground Water Sampling Procedures (April 1996)*, may be adopted as an alternative to conventional purging and sampling methods described in **Section 4.0** of this GWSAP. If low-flow procedures are to be used, a demonstration of the suitability of low-flow procedures will be prepared and submitted to TCEQ for review and acceptance prior to implementation.

## 6.2 Field Measurements

An unfiltered portion of the ground water will be poured into a clean container for field measurement of temperature, specific conductance, and pH. The temperature readings will be measured immediately upon collection. Subsequently, measurements of specific conductance

will be accomplished to avoid any effect on the sample from salts on the pH probe. The specific conductance readings will be followed by the pH measurements. In addition to recording ground water parameter measurements, observations regarding the ground water color, odor, foaming, presence of more than one phase of liquid, and turbidity will be recorded on the field data sheet (or an equivalent form).

Equipment utilized for the field measurements will be calibrated each day that the equipment is used in the field. Copies of the daily calibration logs will be kept on file. Provisions will be made for backup equipment in the event of a primary equipment failure during the course of a monitoring event.

## 6.3 Sample Containers

The volume of samples and the types of sample containers depends on the parameters to be analyzed during respective monitoring events and will be consistent with EPA guidance. Sampling, preservation, and storage procedures for potential ground water monitoring parameters are presented in ***Table Att11-1***.

Sample containers will be filled in the following order according to volatilization sensitivity:

1. **VOCs** (volatile organic compounds)
2. **SVOCs** (semi-volatile organic compounds) (if collected)
3. **Metals**
4. **Other Inorganic Parameters** (if collected)

Although volatilization is of primary concern during VOC sampling, designated VOC vials will additionally be sampled from the same bailer or directly from the pump in order to prevent inhomogeneity in the samples resulting from the presence of suspended sediments. Inhomogeneity of samples owing to the presence of suspended sediments is additionally of concern when collecting samples with a bailer to the extent that VOCs adsorbed to sediment particles can influence measured concentrations in ground water. However, as wells were or will be properly designed, constructed, and installed, it is not anticipated that appreciable suspended sediments will be encountered during sampling activities.

The contract analytical laboratory will supply appropriate pre-preserved sampling containers, labeled by analyte, prior to the mobilization of sampling personnel to the subject landfill. Sample containers will be subsequently labeled in the field for identification purposes and will include the following information at a minimum: site identification, monitoring well number, date and time of sample collection, type of preservatives used, analyses to be performed (in accordance with laboratory designation), and the name of the sampler. Information will be written on laboratory-supplied sample labels using indelible ink and covered with transparent tape to protect written data.

## 6.4 Types of Sample Containers

As referenced in ***Table Att11-1*** of this GWSAP, the following sample containers and protocols will be utilized during ground water monitoring at the subject landfill.

- VOCs: Two (2) 40-ml glass vials with special caps containing Teflon septa will be used per analysis. Containers will be pre-preserved with HCL by the contract laboratory. Prior to filling, the septum of each vial will be placed with the Teflon side toward the sample. During filling, water will be allowed to stream down the inner wall of the vial to minimize formation of air bubbles. The vials will be slightly overfilled in order to create a positive meniscus. Upon completion of filling, caps will be carefully screwed on to avoid leaving any airspace within the vials. In the event that an air bubble forms in a vial subsequent to capping, an additional separate 40-ml sample will be collected.

- SVOCs (if collected): One (1) amber one-liter glass bottle with Teflon-lined cap will be used per analysis. Containers will be completely filled and capped.

- Metals: One (1) one-liter polyethylene bottle, pre-preserved with $HNO_3$ by the contract laboratory, will be used per analyses for total metals. Containers will be completely filled and capped. Groundwater samples for constituents in Appendices I and II to Title 40 Code of Federal Regulations, Part 258 will not be filtered in the field or the laboratory prior to analysis.

- Other Inorganic Parameters (if collected): Depending on the specific parameters to be analyzed, one or more glass/plastic one-liter containers will be used per analyses of the suite of inorganic parameters including those listed on ***Table Att11-1***. With the exception of ammonia (in the event that it is assigned for analysis), preservatives will not be used on samples collected for other inorganic parameter analyses.

## 6.5 Sample Preservation and Holding Times

Sample preservation is intended to 1) retard biological action, 2) retard hydrolysis, and 3) reduce sorption effects. Preservation methods are generally limited to pH control, chemical addition, refrigeration, and protection from light. Specific preservation methods for analytes that may be assigned in association with ground water monitoring at the subject landfill are presented in ***Table Att11-1***.

Specific sample volumes required for each analysis and associated sample holding times will be reviewed with the contract analytical laboratory prior to sampling. In general, these requirements will be consistent with those presented in ***Table Att11-1***.

## 6.6 Sample Storage and Transport

In accordance with preservation requirements presented in ***Table Att11-1***, sample containers will be placed into a clean, insulated cooler and kept on ice following sample collection. Adequate

ice will be kept on the samples to maintain a maximum temperature of 4°C (39.2°F) during transport to the contract analytical laboratory. The samples will be kept in the sampler's possession at all times, unless samples are shipped to the laboratory by a courier, and will be submitted to the laboratory via proper chain-of-custody protocol within forty-eight (48) hours of sampling.

## 6.7 Chain-of-Custody Documentation

Appropriate Chain-of-Custody (COC) procedures will be implemented to protect sample integrity and to provide technically and legally defensible ground water quality data. At any time that a ground water monitoring event is conducted, a COC form will be completed, placed in a sealable plastic bag, and placed in the cooler with the samples collected. The completed COC form will accompany the samples at every step from the field to the laboratory and will be signed by each party handling the samples, from sampler, through transporter to the laboratory to document the possession of the samples at all times. An example COC form is provided as ***Figure Att11-2*** of this GWSAP.

In the event that samples are sent by mail to the contract analytical laboratory, packages containing samples will be certified with return receipt requested to document shipment. If the samples are shipped via overnight courier, the bill of lading will be retained to document shipment. Copies of the return receipt/bill of lading will be subsequently attached to the COC at the completion of each stage of shipment.

## 6.8 Documentation of Sampling

As described in ***Sections 2.0 though 4.0*** of this GWSAP, information related to a sampling event will be recorded on the field data sheet (or an equivalent form) (***Figure Att11-1***). All entries will be legible and made in indelible black ink. Entry errors will be crossed out with a single line, dated, and initialed by the person making the corrections. Sufficient information including sample location, date, time, weather, and affiliation of field personnel, field measurements including the numerical values and units, the integrity of the well, methane gas measurements, etc. will be recorded on field data sheets such that the monitoring event can be reconstructed without relying on the sampler's memory. Completed field data sheets will be maintained in project files as a permanent record of ground water monitoring activities and submitted to TCEQ along with the standard ground water sampling report forms (TCEQ-0312) for respective sampling events.

Pursuant to directives issued by the MSW Permits Section effective February 1, 2001, ground water sampling reports will be submitted in electronic format, in addition to paper copies. Electronic versions of the ground water sampling reports will be submitted in accordance with procedures established by TCEQ in place at the time of sampling.

# 7 ANALYTICAL PARAMETERS

The detection monitoring constituents at the facility will be as specified in 30 TAC §330.419 and 40 Code of Federal Regulations (CFR) 258 Appendix I (see ***Table Att11-2*** of this GWSAP). The practical quantitation limit (PQL) for each constituent will be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions that are available to the facility, per 30 TAC §330. 405(f)(5).

The practical quantitation limit (PQL) is defined as the lowest concentration reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions and is analogous to the limit of quantitation (LOQ) definition in the most recent available NELAC Standard (National Environmental Laboratory Accreditation Conference). The PQL is method, instrument, and analyte specific and may be updated as more data becomes available. The PQL must be below the groundwater protection standard established for that analyte as defined by 30 Texas Administrative Code Section §330.409(h) unless approved otherwise by the TCEQ. The precision and accuracy of the PQL shall be initially determined from the PQLs reported over the course of a minimum of eight groundwater monitoring events.

The results obtained from these events shall be used to demonstrate that the PQLs meet the specified precision and accuracy as shown in the table below. The PQL will be supported by analysis of a PQL check sample, which is a laboratory reagent grade sample matrix spiked with chemicals of concern at concentrations equal to or less than the PQL. At a minimum, a PQL check sample will be performed quarterly during the calendar year to demonstrate that the PQL continues to meet the specified limits for precision and accuracy as defined in the table below.

**QC Specification Limits for the PQL and Lower Limit of Quantitation Check Samples**

| COC | Precision (% RSD) | Accuracy (% Recovery) |
|---|---|---|
| Metals | 10 | 70-130 |
| Volatiles | 20 | 50-150 |
| Semi-Volatiles | 30 | 50-150 |
| | | |

For analytes that the established PQL cannot meet the precision and accuracy requirements in the table above, the owner/operator will ensure the laboratory will submit sufficient documentation and information to the TCEQ for alternate precision and accuracy limits on a case by case basis. Non-detected results will be reported as less than the established PQL limit that meets these precision and accuracy requirements.

It is not considered likely that metals including antimony, beryllium, thallium, and vanadium will be present in ground water present beneath a municipal solid waste landfill (MSWLF). After the completion of the background monitoring program, it is anticipated that the omission of some heavy metals will be proposed to TCEQ. Changes and/or modifications to the list of analytes provided in ***Table Att11-2***, if necessary, will be submitted to TCEQ in the form of a permit modification request.

# 8 ANALYTICAL METHODS

The ground water monitoring program described herein will include the application of appropriate analytical methods in order to accurately measure concentrations of hazardous constituents or other monitoring parameters that may be present in the ground water samples. EPA-approved methods will be utilized for analyses of ground water samples obtained at the subject landfill in accordance with procedures described in the following published references:

- EPA 600/4-79-020, *Methods for Chemical Analysis of Water and Wastes*, March 1983
- EPA SW-846, *Test Methods for Evaluating Solid Waste*, Third Edition, November 1986, and its updates.
- *Standard Methods for the Examination of Water and Wastewater*, 18th Edition, 1992.

As stipulated previously in ***Section 1.0: Introduction and Purpose*** of this GWSAP, the contract laboratory that performs analyses of ground water samples will submit a LSOP document to TCEQ prior to the implementation of the sampling program described herein. The LSOP will describe specific laboratory protocols used to provide data of stated quality with a stated probability of being correct including all procedures to handle and analyze samples from receipt until results are officially reported.

# 9 LABORATORY PROCEDURES AND PERFORMANCE STANDARDS

The facility will submit laboratory data and analyses prepared by a TCEQ-accredited environmental testing laboratory and in accordance with acceptable accreditation standards (e.g. NELAC).

The owner or operator shall review all analytical data submitted under the requirements of this permit to ensure compliance with data quality objectives, prior to submittal of the data to the TCEQ for review. This data review will include examination of the quality control results and other supporting data, including any data review by the laboratory. This data review will also identify any potential impacts such as bias on the quality of the data using qualifiers in the test reports tied to explanations in footnotes and in any laboratory case narrative which is required.

It is the responsibility of the owner or operator to ensure that the laboratory documents and reports all problems and anomalies observed that are associated with the analysis. If the analysis of the data indicates that it failed to meet the quality control goals for the laboratory's analytical data analysis program, it does not necessarily mean that the data is unusable. The owner or operator may still report to the TCEQ the analytical data but will also report any and all problems and corrective action that the laboratory identified during the analysis.

A Laboratory Case Narrative (LCN) report for all problems and anomalies observed will be submitted by the owner and/or operator. The LCN will report the following information:

1. State the exact number of samples, testing parameters, and sample matrix.
2. The name of the laboratory involved in the analysis. If more than one laboratory is used, all laboratories shall be identified in the case narrative.
3. State the test objective regarding samples.
4. Explain each failed precision and accuracy measurement determined to be outside of the laboratory and/or method control limits.
5. Explain if the effect of the failed precision and accuracy measurements on the results induces a positive or negative bias.
6. Identify and explain problems associated with the sample results, along with the limitations these problems have on data usability.
7. A statement on the estimated uncertainty of analytical results of the samples when appropriate and/or when requested.
8. A statement of compliance and/or noncompliance with the requirements and specifications. Exceedence of holding times and identification of matrix interferences will be identified. Dilutions shall be identified and if dilutions are necessary, they will be done to the smallest

dilution possible to effectively minimize matrix interferences and bring the sample into control for analysis.

9. Identify any and all applicable quality assurance and quality control samples that will require special attention by the reviewer.
10. A statement on the quality control of the analytical method of the permit and the analytical recoveries information shall be provided when appropriate and/or when requested.

In addition to the LCN, the following information will be submitted for all analytical data:

1. A Table identifying the field sample name with the sample identification in the laboratory report.
2. Chain of custody will be provided.
3. Analytical Report that documents the results and methods for each sample and analyte to be included for every analytical testing event. These test reports will document the reporting limit/method detection limit the laboratory used. The reporting limit for each analyte will be less than the maximum contaminant level (MCL) or as low as practically feasible per 30 TAC 330.263(b) for each of the analytes. In accordance with Appendix B of 40 CFR Part 136, the method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.
4. A release statement will be submitted from the laboratory. This statement will state "I am responsible for the release of this laboratory data package. This data package has been reviewed by the laboratory and is complete and technically compliant with the requirements of the methods used, except where noted by the laboratory in the attached exception reports. By my signature below, I affirm to the best of my knowledge, all problems/anomalies, observed by the laboratory as having the potential to affect the quality of the data, have been identified by the laboratory in the Laboratory Review Checklist, and no information or data have been knowingly withheld that would affect the quality of the data."
    a. If it is an in-house laboratory, it will have the following statement: This laboratory is an in-house laboratory controlled by the person responding to rule. The official signing the cover page of the rule-required report (for example, the APAR) in which these data are used is responsible for releasing this data package and is by signature affirming the above release statement is true.
5. If the data is from soil and/or sediment samples, it will be reported on a dry weight basis with the percent solids and the percent moisture reported so that any back calculations of the wet analysis may be preformed.
6. Include a Laboratory checklist in the Laboratory Data Package. An example of the Laboratory checklist is provided in Appendix 1. The permittee may amend the checklist as long as it includes the information found in Appendix 1. For every response of "No, NA, or NR" that is reported on the checklist, the permittee will ensure the laboratory provides a detailed description of the "exception report" in the summary of the LCN. The phrase "exception report" in the checklist is meant to clue the owner/operator to include the

exceptions and any potential bias in the data will be in the LCN. The permittee will ask the laboratory to use the checklist and do an equivalent of an EPA Level 3 review regarding quality control analysis.

Please note the Laboratory Checklist provided in Appendix 1 is amended from the Texas Risk Reduction Prevention (TRRP) Appendix A checklist. TRRP standards and requirements for quality apply in a limited capacity only. TRRP requires an EPA Level 4 review of the data for analysis. The analytical results, quality control information, and a laboratory case narrative are essentially required by an EPA Level 3 review. Hence, the TRRP standards for an EPA Level 3 review apply; whereas, the standards of an EPA Level 4 review do not apply. The laboratory checklist is intended to aid the permittee in ensuring the laboratory did a quality control analysis and to alert one of any potential problems, bias, or anomalies during the analysis of the sample. The analytical report, LCN, and the checklist are to be included along with the TCEQ-0312 forms for all monitoring events for groundwater.

# 10 BACKGROUND SAMPLES

"Background" refers to the chemical characteristics of ground water comprising a data set to which the chemical characteristics of the current samples are compared to determine if the current samples show statistically significant increase (SSIs) in those characteristics. Background water quality will be established for the metals and VOCs listed in ***Table Att11-2*** of this GWSAP pursuant to 30 TAC 330.419 and 40 Code of Federal Regulations (CFR) 258 Appendix I. Additionally, water quality parameters may be sampled and analyzed at the discretion of the facility operator, but that the results will not be subject to statistical evaluation.

The spacing of background monitoring events will be adequate to facilitate the hydraulic and chemical stabilization of ground water such that consecutive samples are statistically independent. It is initially proposed that background monitoring events be conducted quarterly over the duration of two years in order to incorporate seasonal variations in water chemistry into the background data set. In the event results of initial background monitoring indicate that a quarterly frequency will not likely produce statistically independent samples based upon the calculated ground water gradient, an alternate background monitoring frequency will be proposed to TCEQ as a permit modification. The specific methodology for determining ground water sampling frequency is further discussed in ***Section 14.2: Independent Samples*** of this GWSAP.

Background samples will be collected from the site monitoring wells included as part of the ground water monitoring system. After background analyses have been completed, data will be treated statistically and background concentrations established for each parameter.

Per 30 TAC §330.407 (a)(1), semi-annual data may be incorporated into the background data set at a maximum frequency of once every two years. New data will be evaluated for any significant trends and potential outliers (or by an approved alternative method that provides equivalent or better performance). Appropriate data will then be incorporated into background with prior TCEQ approval.

A general discussion and flow chart describing the application of statistical methods to background and detection monitoring are presented in ***Section 14.0: Statistical Methods*** and ***Figure Att11-3***, respectively. In accordance with 30 TAC §330.407(a)(1), upon completion of background monitoring and during background updates, the owner or operator will evaluate the background data to ensure that the data are representative of background groundwater constituent concentrations unaffected by waste management activities or other sources of contamination, and that the evaluation will be documented in a report and submitted to the executive director before the next subsequent groundwater monitoring event following the updated (or initial) background period.

# 11 DETECTION MONITORING

Subsequent to the completion of background monitoring, detection monitoring will be conducted on a semi-annual basis (i.e., once every six months). The first detection monitoring event will occur approximately six (6) months after completion of background sampling pending the reduction of background sampling data. In the event that statistical analysis of the groundwater analytical results indicates an initial statistically significant increase (SSI) from background of any tested constituent at any on-site well, a notice in writing to the Executive Director and any local pollution agency with jurisdiction that has requested to be notified will be submitted within fourteen (14) days of the determination of the SSI (30 TAC §330.407(b)). In the event that a SSI occurs in ground water chemistry data, or if deemed necessary by TCEQ, and alternate monitoring frequency may be adopted. It is understood that the adoption of an alternate monitoring frequency will require TCEQ concurrence. If warranted, an alternate detection monitoring frequency will be proposed as a permit modification request.

Site wells comprising the ground water monitoring network will be sampled during each detection monitoring event in accordance with the methodologies and procedures described herein. As previously stipulated, it is anticipated that the omission of some heavy metals will be proposed to TCEQ following the completion of the background monitoring program. If warranted, proposed changes and/or modifications to the list of analytes provided in ***Table Att11-2*** will be submitted to TCEQ as a permit modification request.

# 12 ASSESSMENT MONITORING

The occurrence of a confirmed SSI from background for a specific detection monitoring constituent (see ***Table Att11-2***) during a sampling event will result in the implementation of assessment monitoring unless it can be adequately demonstrated that the SSI is due to a source other than the landfill, or that it resulted from error in sampling, analyses, statistical evaluation, or natural variation in ground water quality. For purposes of this GWSAP, an apparent SSI is defined as an initial statistical exceedence that has not been verified. It is understood that verification re-sampling events are essential to a satisfactory demonstration to avoid assessment monitoring. In the event that an apparent SSI is determined as the result of a detection monitoring event, site monitoring wells exhibiting statistically anomalous analytical results will be immediately re-sampled in order to confirm the SSI. The following flexible procedures will be followed with regard to the performance of verification re-sampling and assessment monitoring at the subject landfill:

- If a confirmed SSI occurs for a constituent that is listed in 30 TAC 330.419 assessment monitoring will be initiated within ninety (90) days of the date of the SSI notice to the TCEQ Executive Director per 30 TAC §330.407 (b)(1) unless it can be adequately demonstrated that the SSI is due to a source other than the landfill, or that it resulted from error in sampling, analyses, statistical evaluation, or natural variation in ground water quality.

Assessment monitoring will be performed on a site-specific basis in accordance with *30 TAC §330.409*. Although the initiation of assessment monitoring does not require TCEQ concurrence, these activities will be coordinated with TCEQ to confirm adequate characterization of potential ground water contamination.

# 13 QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC)

The assessment of data reliability is essential to determine if the analytical parameters detected by the contract laboratory are truly present in the ground water at the reported concentrations and to confirm that all compounds of interest in the sample have been detected. A good QA/QC program confirms that the data generated are accurate, precise, and legally defensible and enhances consistency in data analysis.

Quality assurance and quality control (QA/QC) procedures address both the field and laboratory activities. In order to provide good QA/QC for field data generated during background and detection monitoring at the subject landfill, project documentation for each monitoring event will include descriptions of the following areas and activities at a minimum. Specific discussions pertaining to items listed below are provided in the preceding sections of this GWSAP.

- The location where decontamination of sampling equipment is to be performed, the method, solvents, and purity of water used for decontamination purposes, and the method and storage location for purged ground water generated as a result of sampling activities.

- Sample management procedures including the container types, volume of samples, preservatives, labeling, holding times, chain-of-custody documentation, and shipping methods.

- Field equipment and instrumentation used in the field including calibration and maintenance procedures.

- Sample collection information including the names of field personnel, sample numbers, dates and times, climatic conditions, and documentation QC samples including trip and equipment blanks, and duplicate samples.

Laboratory QA/QC procedures will be established and followed for the analyses of samples from the subject landfill in order to reduce the frequency of random and systematic errors and to maintain such errors within tolerable limits. As referenced in ***Section 1.0: Introduction and Purpose*** of this GWSAP, the contract analytical laboratory will provide an LSOP for TCEQ review prior to the implementation of the background monitoring program in partial fulfillment of QA/QC requirements. The LSOP will describe a detailed program of how the laboratory will proceed to provide data of stated quality with stated probability of being correct including all procedures to handle and analyze samples from receipt until results are reported. At a minimum, the laboratory QA/QC program described in the LSOP will address the following:

- Procedures will be in place for demonstrating proficiency with each analytical method used in the laboratory including documentation of precision, bias, methods and frequency of the determinations of method detection limits (MDLs), check on reagent purity and glassware purity, and check on spike and surrogate recoveries.

- The laboratory will have methods in place for establishing control limits for analysis, documenting the effect of the matrix on analytical results, and reviewing, approving, and revising laboratory records.

- The laboratory will maintain equipment records documenting the frequency of equipment maintenance, standards used, calibration history, and verification of all work standards against appropriate primary grade standards.

- The laboratory will maintain records including descriptions of samples received, steps of sample handling, assigned personnel responsibilities, chain-of-custody, and reagents used and date of purchase.

- The laboratory will maintain in permanent records the raw data and calculated results for all QC, field samples, and standards.

## 13.1 Trip Blanks

Trip blanks are used to test whether sample bottles or collected samples may have been contaminated before or during sampling, or whether sample shipment, handling and storage may have had an effect on sample integrity. Trip blanks, supplied by the contract laboratory containing laboratory-grade water, will be prepared and sent from and to the laboratory in the same manner as actual ground water samples. One properly preserved trip blank will accompany sampling personnel into the field during each sampling event and subsequently analyzed for VOCs specified in ***Table Att11-2***.

## 13.2 Field Blanks

Field blanks are used to test sampling procedures and evaluate potential airborne contaminants. Field blanks will be prepared by sampling personnel in the field by placing laboratory-grade water, into clean sample containers. Pending the initial determination of ground water gradient at the site, field blanks will be collected when sampling downgradient wells. At a minimum, one field blank per day or per every ten (10) wells, whichever is greater, will be collected and analyzed for VOCs listed in ***Table Att11-2*** for each monitoring event.

## 13.3 Equipment Blanks

Equipment blanks are used to test the effectiveness of decontamination procedures for sampling equipment. Equipment blanks will be prepared by sampling personnel by procession laboratory-grade water trough the sampling equipment (i.e., bailer or pump) in the same manner as the

actual ground water samples obtained for site monitoring wells. One equipment blank per day will be collected and analyzed for VOCs listed in ***Table Att11-2*** during each monitoring events.

## 13.4 Field Duplicates

Field duplicates will be collected in order to test the precision of laboratory techniques. Duplicates will be prepared by collecting two ground water samples from the same well, preferably from the same sampling device, but labeled differently, so that the analytical laboratory is unaware that the samples are duplicate. One field duplicate will be collected per ten (10) wells sampled, or per sampling event for fewer than ten (10) wells and analyzed for parameters listed in ***Table Att11-2***.

# 14 STATISTICAL METHODS

Statistical analysis will be provided in accordance with 30 TAC §330.405. The purpose of the statistical evaluation of ground water data is to determine whether "there is evidence of a SSI from background values for each detection /monitoring constituent required as part of the ground water monitoring." *30 TAC §330.405* allows the use of a wide variety of statistical methods but requires that the method chosen for a constituent be appropriate for the constituent, for the data available, and for the site. It is crucial to select appropriate statistical methods for a variety of reasons: the necessity of being able to detect a release from the subject landfill in a timely way, the ability to evaluate data clearly and quickly, and the intent to detect SSIs that may indicate contamination.

Appropriate statistical methods cannot be chosen in advance of sampling as specific methods depend upon the distribution of data, although it is possible to establish guidelines for the application of statistical methods to analytical data prior to sampling. Therefore, a general discussion pertaining to the application of statistical methods to background and detection monitoring is presented in ***Section 14.1: Statistical Comparisons*** of this GWSAP. Information provided in ***Section 14.1*** is based to a large extent upon recommendations set forth in the following publications:

- American Society for Testing and Materials (ASTM), 1998; *Standard Guide for Developing Appropriate Statistical Approaches for Ground Water Detection Monitoring Programs, (Designation: D 6312-98).*

- EPA, Office of Solid Waste, Waste Management Division, 1989; *Statistical Analysis of Ground-Water Monitoring Data and RCRA Facilities, Interim Final Guidance, April 1989.*

- EPA, Office of Solid Waste, Waste Management Division, 1992; *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Draft Addendum to Interim Final Guidance, July 1992.*

Subsequent to the completion of background monitoring, a plan outlining the statistical approach to be applied to background and detection monitoring data will be submitted to TCEQ for review and approval prior to implementation. The statistical plan will compliment the GWSAP, utilize, site specific analytical data, and present a more detailed approach than described herein.

## 14.1 Statistical Comparisons

Three types of statistical comparisons are possible at a site with more than one monitoring well for background and detection monitoring:

1) the current data for a well may be compared to the historical data for that same well (intrawell comparison);

2) one downgradient well may be compared to one or a group of upgradient wells (interwell comparison); and

3) a variation of the second type, a group of downgradient wells may be compared to a group of upgradient wells.

In the event that a SSI is detected and assessment monitoring is conducted, a fourth type of statistical comparison may be employed involving the comparison of well data to a constant limit such as a maximum concentration limit (MCL).

A serious difficulty associated with the comparison of downgradient water quality with upgradient water quality is the underlying assumption that the two sets of data are from water that has everywhere had an identical history. This assumption would imply that the upgradient and downgradient water would have the same infiltration time, period of contact with water-bearing sediments, chemical reactions with passing constituents, and no other significant differences from one part of the water-bearing zone to another. Although such assumptions are often necessary to make comparisons, they are generally not realistic with regard to natural ground water systems.

Intrawell comparisons are generally preferable to their interwell counterparts because they completely eliminate the spatial component of variability in samples. Due to the absence of spatial variability, the uncertainty associated with measured concentrations is decreased, making intrawell comparisons more sensitive to real releases (that is, false statistical negatives), and false positives. For sites where the hydraulic gradient is indefinite, the intrawell comparison is probably the most useful treatment of ground water sampling data. As per the above discussion, it is anticipated that intrawell comparisons will be applied to sampling data generated at the subject landfill following the completion of eight background monitoring events.

Flow charts can be valuable tools, aiding in the selection of appropriate statistical methods. A flow chart depicting methods likely to be used along with decision points of basis for making selections has been included in this GWSAP as ***Figure Att11-3***. It is anticipated that this format will allow for future flexibility contingent upon analytical data and minimize potential future changes to this plan. Information provided in the referenced figure was adapted from the example provided in ASTM publication *D 6312-98*.

Detailed descriptions of the selected statistical comparison method(s), decision points, and specific statistical treatments presented in the referenced flow chart will be provided to TCEQ in a statistical plan subsequent to the completion of background monitoring. Descriptions of

specific methods presented in the statistical plan will include appropriate information pertaining to normality of data, statistical intervals, and the handling on non-detects. A description of graphical methods to be applied to monitoring data will additionally be discussed in the statistical plan.

## 14.2 Independent Samples

Statistical methods generally used in ground water monitoring require that data be statistically independent for the results to be strictly valid. The sampling frequency must be established such that sufficient elapsed time occurs between monitoring events ensuring that consecutive samples are not taken from the "same" water. In general, the more permeable the water-bearing zone and the steeper the hydraulic gradient, the less time is necessary between monitoring events to facilitate the collection of statistically independent samples.

As discussed briefly in ***Section 10.0: Background Samples*** of this GWSAP, background monitoring events will be conducted quarterly for a duration of two years in order to construct a background database consisting of eight statistically independent samples per well. In order to confirm the adequacy of a quarterly monitoring program, site-specific lithologic and depth-to-water information including measurements/estimations of effective porosity, ground water gradient, and hydraulic conductivity will be used to calculate the horizontal ground water flow velocity. Given the diameter of site monitoring wells, it will be possible to determine whether flow velocities are such that water within the well casing will completely change within the three-month duration between monitoring events.

In the event that the site-specific determination of ground water flow velocity indicates that an alternate monitoring frequency is warranted (i.e., semi-annual as opposed to quarterly), a revised frequency will be proposed to TCEQ for remaining background and detection monitoring events as a permit modification request.

## 14.3 Seasonal Variation

Seasonal variation of ground water chemistry is well known in the state of Texas. Determination of seasonal influences requires adequate data, i.e., data collected over a full range of seasons, in order to make proper adjustments. Therefore, as described in ***Section 10.0: Background Sample*** of this GWSAP, a total of eight background sampling events will be conducted quarterly over a duration of two years in order to obtain data that reflects seasonal variations in ground water chemistry. By incorporating such data into the background monitoring database, it is anticipated that seasonal influences on the statistical treatment of data collected during detection monitoring events can be minimized.

# 15 REPORTING AND SUBMITTALS

Statistical analysis will be performed no later than 60 days after each semi-annual sampling event. In the event that statistical analysis of the groundwater analytical results indicates an initial SSI from background of any tested constituent at any downgradient monitor well, a notice in writing to the executive director and any local pollution agency with jurisdiction that has requested to be notified will be submitted within fourteen (14) days after the determination of the SSI (30 TAC §330.407 (b)). Three (3) copies (triplicate) of an annual detection monitoring report describing groundwater sampling and analyses results will be completed on state reporting forms (e.g. TCEQ-0312 or subsequent versions) and will be submitted to the TCEQ no later than ninety (90) days after the facility's last groundwater sampling event in a calendar year and will include information determined since the previously submitted annual report (30 TAC §330.407 (c)). In accordance with 30 TAC §330.407 (c)(1) to (6), the following information will be included in the annual detection monitoring report:

- A statement regarding whether a statistically significant increase has occurred over background values in any well during the previous calendar year period and the status of any statistically significant increase events;
- The results of all groundwater monitoring, testing, and analytical work obtained or prepared under the requirements of 30 TAC §330, including a summary of background groundwater quality values, groundwater monitoring analyses, statistical calculations, graphs, and drawings;
- The groundwater flow rate and direction in the uppermost aquifer. The groundwater flow rate and direction of groundwater flow shall be established using the data collected during the preceding calendar year's sampling events from the monitoring wells of the Detection Monitoring Program. All documentation used to determine the groundwater flow rate and direction of groundwater flow shall also be included in the annual report;
- A contour map of piezometric water levels in the uppermost aquifer based, at a minimum, upon concurrent measurement in all monitoring wells. All data or documentation used to establish the contour map will be included in the annual report;
- Recommendations for any changes; and
- Any other items requested by the executive director.

If an SSI occurs, assessment monitoring will be initiated according to the specified timelines presented in ***Section 12.0: Assessment Monitoring*** of this GWSAP unless it is demonstrated within the allotted time that the SSI is due to an error, natural variation, or another source. If initiated, assessment monitoring will be performed on a site-specific basis in accordance with *30 TAC §330.409.* Although the initiation of assessment monitoring does not require TCEQ

concurrence, these activities will be coordinated with TCEQ to confirm adequate characterization of potential ground water contamination.

In the event that statistical analysis of the groundwater analytical results indicates an initial SSI from background of any tested constituent at any downgradient monitor well, a notice in writing to the executive director and any local pollution agency with jurisdiction that has requested to be notified will be submitted within fourteen (14) days after the determination of the SSI (30 TAC §330.407 (b)). In the event the facility is in assessment monitoring, three (3) copies (triplicate) of an annual assessment monitoring report describing groundwater sampling and analyses results will be completed on state reporting forms (e.g. TCEQ-0312 or subsequent versions) and will be submitted to the TCEQ no later than sixty (60) days after the facility's last groundwater sampling event in a calendar year and will include information determined since the previously submitted annual report (30 TAC §330.409 (k)). Data may also be required to be submitted to the TCEQ on diskette or another format as specified by the TCEQ. In accordance with 30 TAC §330.409 (k)(1) to (6), the following information will be included in the annual assessment monitoring report:

- A statement whether a statistically significant level above a groundwater protection standard (GWPS) established in 30 TAC §330.407 (h) or (i) has occurred in any well during the previous calendar year period and the status of any statistically significant level events;
- The results of all groundwater monitoring, testing, and analytical work obtained or prepared under the requirements of 30 TAC §330, including a summary of background groundwater quality values, groundwater monitoring analyses, statistical calculations, graphs, and drawings;
- The groundwater flow rate and direction in the uppermost aquifer. The groundwater flow rate and direction of groundwater flow shall be established using the data collected during the preceding calendar year's sampling events from the monitoring wells of the Assessment Monitoring Program. All documentation used to determine the groundwater flow rate and direction of groundwater flow shall also be included in the annual report;
- A contour map of piezometric water levels in the uppermost aquifer based, at a minimum, upon concurrent measurement in all monitoring wells. All data or documentation used to establish the contour map will be included in the annual report;
- Recommendations for any changes; and
- Any other items requested by the executive director.

# 16 HEALTH AND SAFETY

A site-specific health and safety plan will be maintained independent of GWSAP due to the potential changes and updates of information such as emergency contacts and telephone numbers. This plan will include a summary of work tasks, site conditions, parties involved, and assigned responsibilities. The plan will describe emergency communications and response procedures with emphasis on the types of potential and existing hazards, exposure routes, Material Safety Data Sheets information, escape routes, personal protective equipment, first aid, and routes to the nearest hospital. A general site location map and detailed facility map will be included as part of the health and safety plan.

In summary, the permittee and/or subcontractors performing functions specific to activities associated with, and identified in the GWSAP, will establish and implement, and maintain appropriate health and safety plans.

# FIGURES

Figure Att11-1
McCombs Landfill XB
Permit No. MSW 729B
City of El Paso, Texas

**GROUNDWATER SAMPLING FIELD DATA SHEET**

Well Number:_____
Project Number:_____

Project:_____
Personnel:_____

Date: _____
Weather Conditions: _____ Air Temp: _____

**WELL DATA:**

Casing Diameter: _____ (in) ☐ PVC ☐ Other: . METHANE CONCENTRATION: _____ % by volume

DEPTH TO: Static Water Level (WL): _____ (ft)

DATUM: ☐ Top of Well Casing ☐ Top of Protective Casing ☐ Other: _____

CONDITION: Is well clearly labeled? ☐ Yes ☐ No

Is prot. casing in good cond.? (not bent or corroded) ☐ Yes ☐ No

Is concrete pad intact? (not cracked or frost heaved) ☐ Yes ☐ No-

Is padlock functional? ☐ Yes ☐ No Is inner casing intact? ☐ Yes ☐ No

Is inner casing properly capped and vented? ☐ Yes ☐ No

**PURGE DATA:** Low-Flow Purging Used? ☐ Yes ☐ No

METHOD: ☐ Bladder Pump ☐ Bailer ☐ Other: _____ (if no – Water Standing in Well _____ (gal)

MATERIALS: Type of Pump: _____ To be Purged _____ (gal)

Tubing: ☐ Teflon® ☐ Polyethylene ☐ Polypropylene ☐ Other: _____

PURGING EQUIPMENT: ☐ Dedicated ☐ Prepared Off-Site ☐ Field-Cleaned

PROCEDURES: Pump & Tubing Vol.: _____(ml) Pumping Rate: _____ (ml/min)

CALIBRATION: pH Meter Model: _____ Meter S/N: _____ Time: _____

Cond. Meter Model: _____Meter S/N: _____ Time: _____

**TIME SERIES DATA:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Time: | _____ | _____ | _____ | _____ | _____ | _____ | _____ |
| Cum. Volume Removed (ml) | Start | _____ | _____ | _____ | _____ | _____ | _____ |
| Temp. (°C): | --- | _____ | _____ | _____ | _____ | _____ | _____ |
| pH (s.u.): | --- | _____ | _____ | _____ | _____ | _____ | _____ |
| Spec. Cond. (µmhos/cm): | --- | _____ | _____ | _____ | _____ | _____ | _____ |
| Turbidity (NTU): | --- | _____ | _____ | _____ | _____ | _____ | _____ |
| Water Level (ft.) | --- | _____ | _____ | _____ | _____ | _____ | _____ |
| Other:_____ | --- | _____ | _____ | _____ | _____ | _____ | _____ |

**SAMPLING DATA:**

Sample Collection Time: _____

Water Level at Time of Sample: _____

METHOD: ☐ Bladder Pump ☐ Bailer ☐ Other: _____

SAMPLING EQUIPMENT: ☐ Dedicated ☐ Prepared Off-Site ☐ Field-Cleaned ☐ Disposable

APPEARANCE: ☐ Clear Turbid (NTU): _____Color: _____☐ Contains Immiscible Liquid

FIELD DETERMINATIONS: Temp. (°C):_____pH (s.u.):_____Spec. Cond. (µmhos/cm): _____

☐ Background ☐ Detection ☐ Assessment ☐ Quarterly ☐ Other

REMARKS:_____

I certify that this sample was collected and handled in accordance with applicable regulatory and project protocols.

Signature:_____ Date:_____

# Figure Att1[illegible]2 Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

| | | | |
|---|---|---|---|
| Client | Project Manager | Date | Page _____ of _____ |
| Address | Telephone Number (Area Code)/Fax Number | Lab Location | Analysis |
| City / State / Zip Code | Site Contact | | |
| Project Number/Name | Carrier/Waybill Number | | |
| Contract/Purchase Order/Quote Number | | | |

| Sample ID. Number and Description | Date | Time | Sample Type | Containers: Volume | Containers: Type | Containers: No. | Preservative | Condition on Receipt/Comments |
|---|---|---|---|---|---|---|---|---|
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SAMPLE

Special Instructions

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal
☐ Return to Client ☐ Disposal By Lab ☐ Archive For _____ Months
(A fee may be assessed if samples are retained longer than 3 months)

Turn Around Time Required
☐ Normal ☐ Rush ☐ Other _____

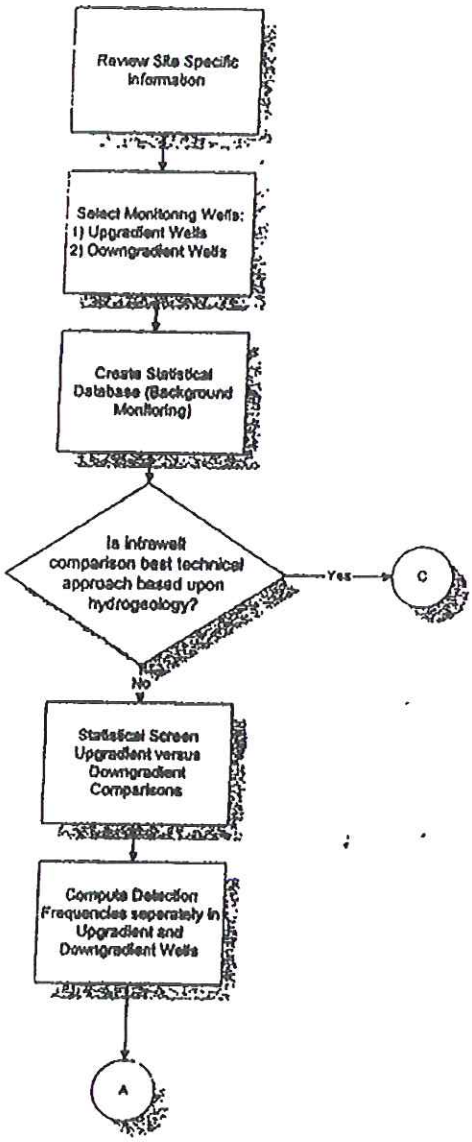
QC Level
☐ I. ☐ II. ☐ III.

Project Specific Requirements (Specify)

| | Date | Time | | Date | Time |
|---|---|---|---|---|---|
| Relinquished By | | | 1. Received By | | |
| Relinquished By | | | 2. Received By | | |
| Relinquished By | | | 3. Received By | | |

Comments

## Figure Att11-3
## Development of a Statistical Detection Monitoring Plan
## McCombs Landfill XB
## MSW Permit No. 729B




Note: Figure Att11-4 was adapted from *American Society for Testing and Materials (ASTM), 1998; Standard Guide for Developing Appropriate Statistical Approaches for Ground-Water Detection Monitoring Programs, (Designation: D 6312-98).*

**Figure Att11-3 (Continued)**
**Development of a Statistical Detection Monitoring Plan**
**McCombs Landfill** XB
**MSW Permit No. 729B**

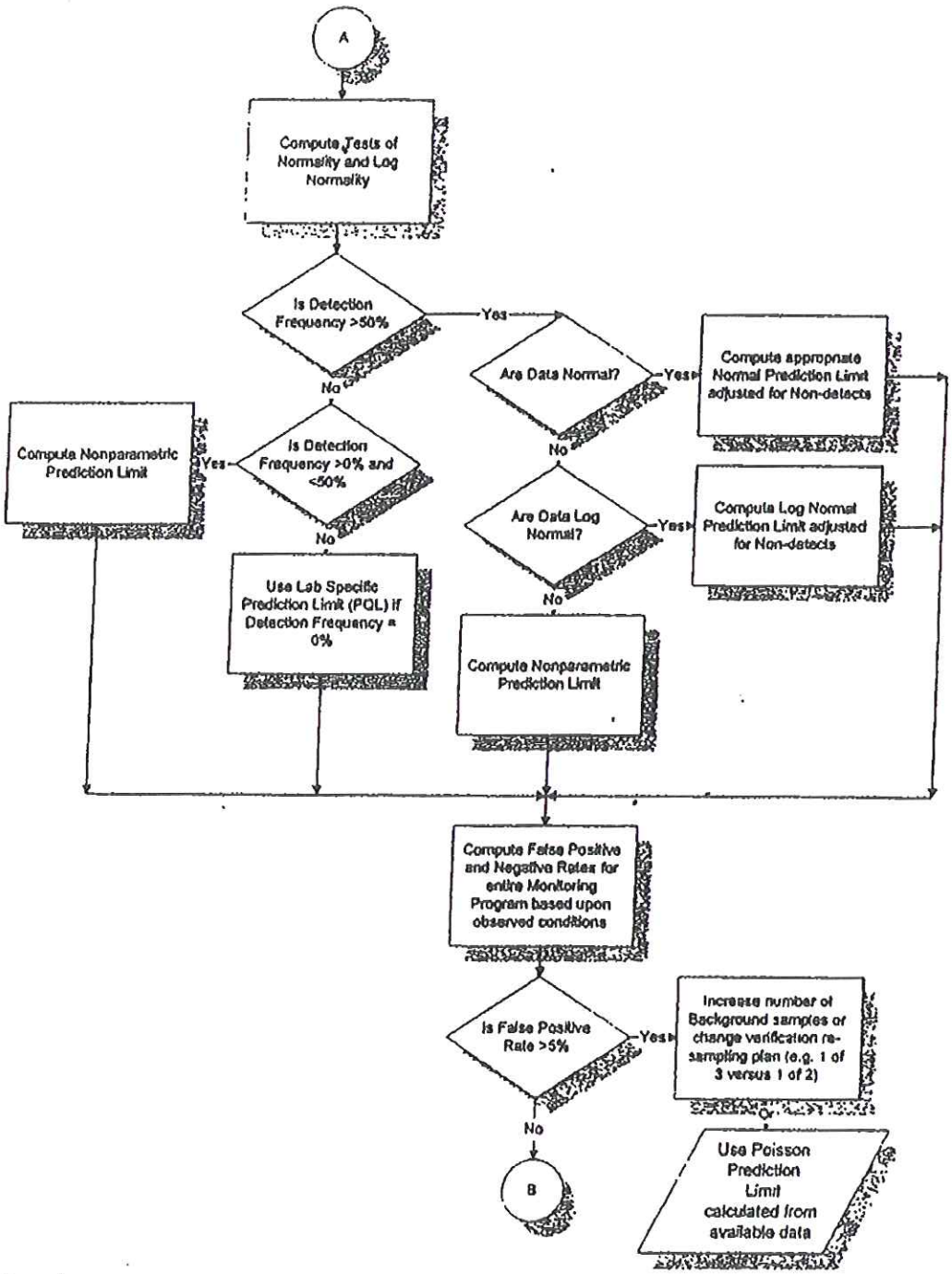


**Figure Att11-3 (Continued)**
**Development of a Statistical Detection Monitoring Plan**
**McCombs Landfill XB**
**MSW Permit No. 729B**

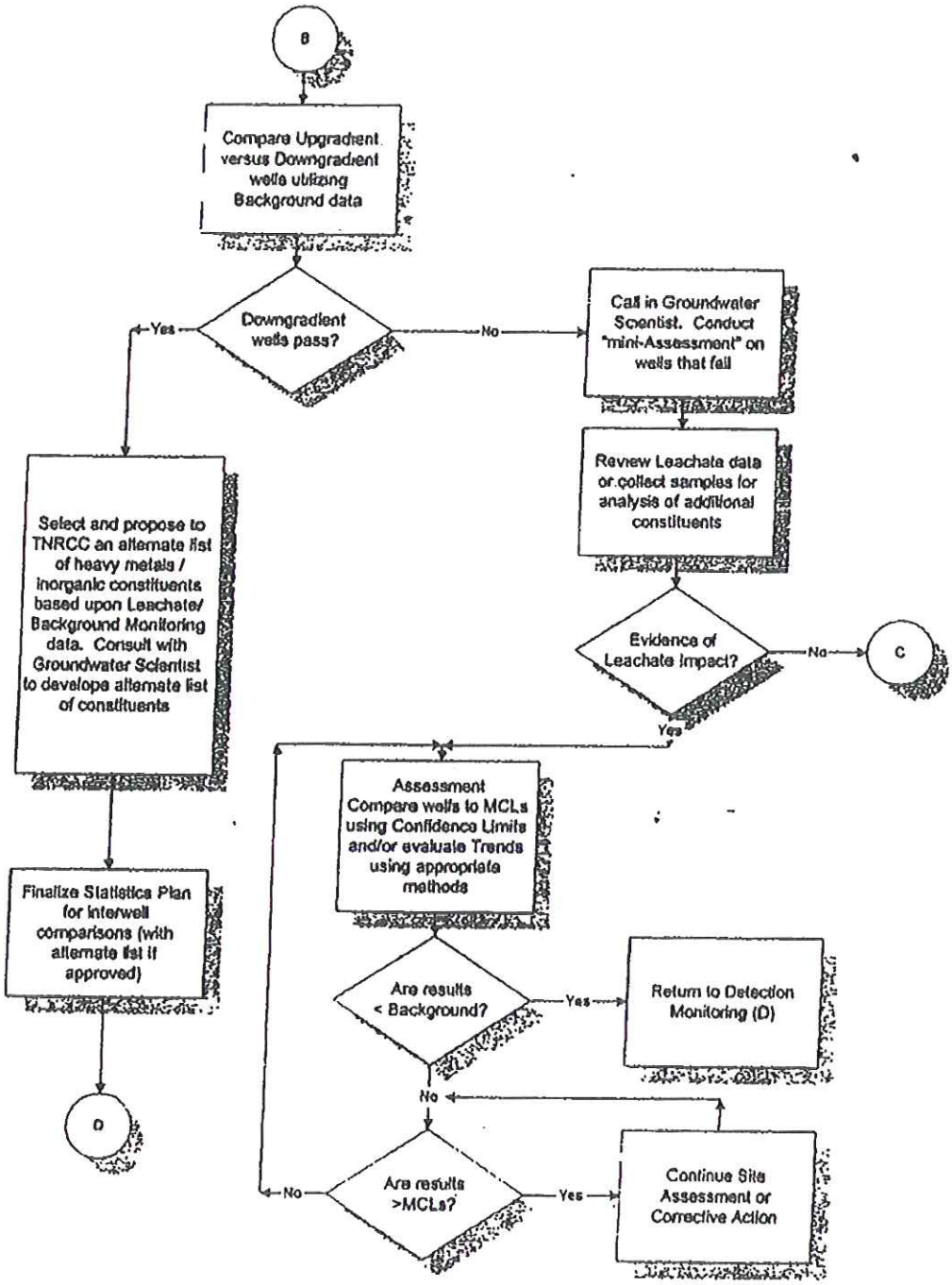


**Figure Att11-3 (Continued)**
**Development of a Statistical Detection Monitoring Plan**
**McCombs Landfill** XB
**MSW Permit No. 729B**

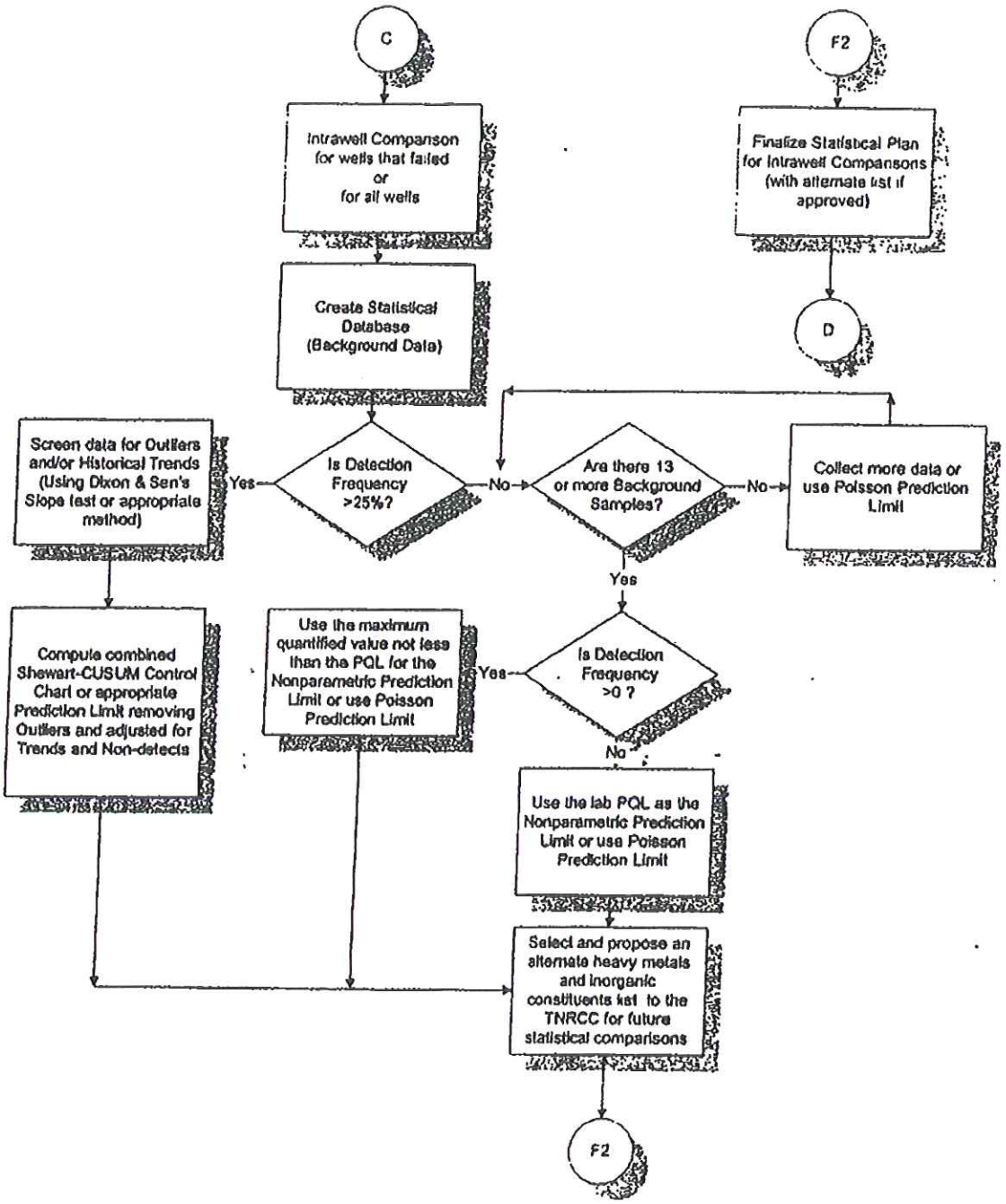
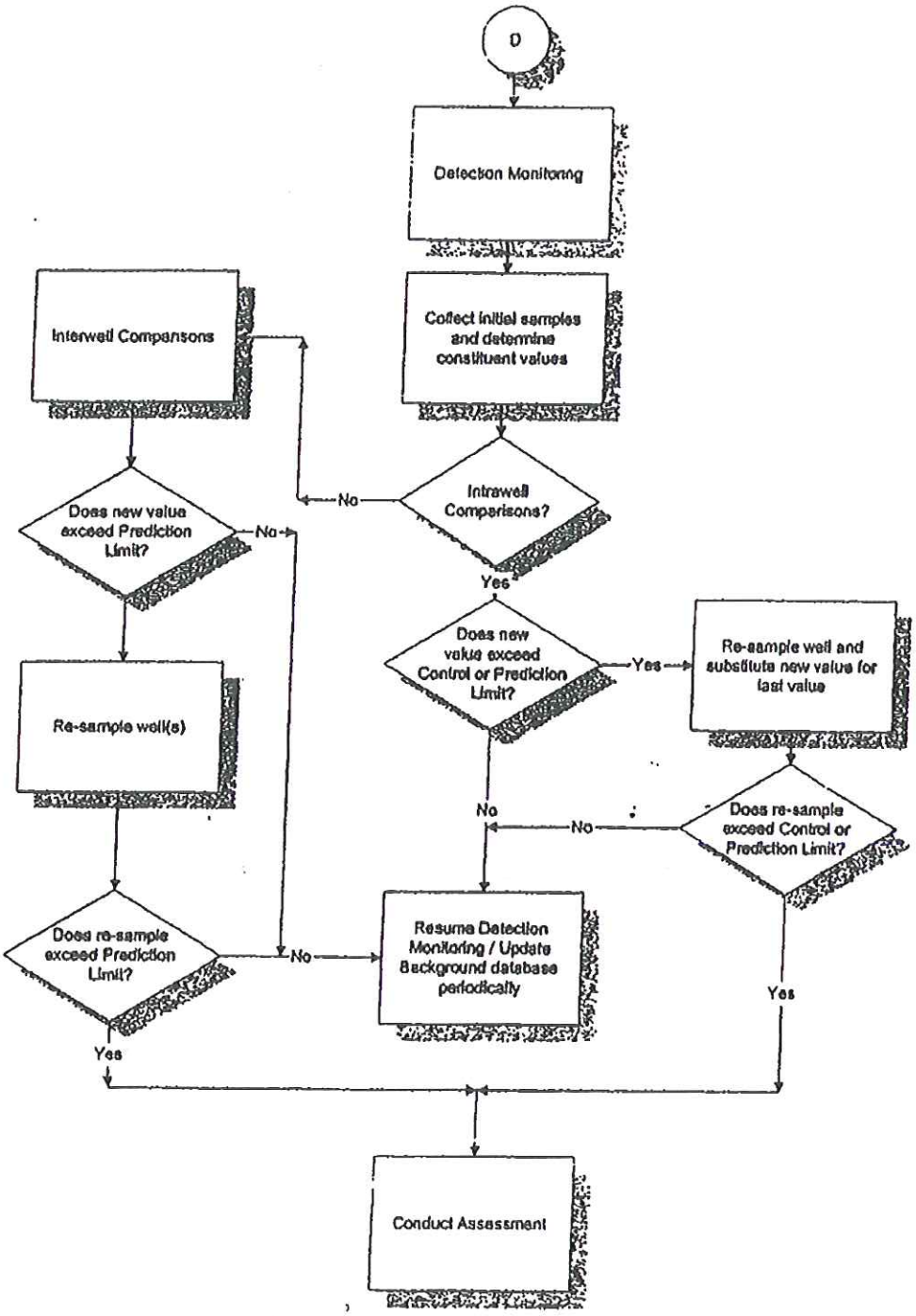


**Figure Att11-3 (Continued)**
**Development of a Statistical Detection Monitoring Plan**
**McCombs Landfill** XB
**MSW Permit No. 729B**



# TABLES

**Table Att11-1**
**Sampling, Preservation, and Storage Procedures for Ground Water Monitoring**
**McCombs Landfill** XB
**MSW Permit No. 729B**

| Parameter | Recommended Containers | Preservation | Maximum Holding Time | Minimum Volume |
|---|---|---|---|---|
| pH | P, G | None | Analyze immediately | 25 ml |
| Spec. Conductivity | P, G | None | Analyze immediately | 100 ml |
| Temperature | P, G | None | Analyze immediately | 1 Liter |
| Heavy Metals | P | *Acidify w/$HNO_3$ to pH<2, 4 °C | 6 months | 1 Liter |
| VOC | G, T-lined septa | Acidify w/HCL to pH<2, 4 °C | 14 days | 2 x 40 ml |

P=Polyethylene, G=Glass, T=Teflon

## Table Att11-2
## Background/Detection Monitoring Parameters
## City of El Paso McCombs Landfill

| Parameter | Notes | Method [1] [2] |
|---|---|---|
| Antimony | (total) | EPA 6020 |
| Arsenic | (total) | EPA 6020 |
| Barium | (total) | EPA 6020 |
| Beryllium | (total) | EPA 6020 |
| Cadmium | (total) | EPA 6020 |
| Chromium | (total) | EPA 6020 |
| Cobalt | (total) | EPA 6020 |
| Copper | (total) | EPA 6020 |
| Lead | (total) | EPA 6020 |
| Nickel | (total) | EPA 6020 |
| Selenium | (total) | EPA 6020 |
| Silver | (total) | EPA 6020 |
| Thallium | (total) | EPA 6020 |
| Vanadium | (total) | EPA 6020 |
| Zinc | (total) | EPA 6020 |

## Table Att11-2 (cont.)
## Background/Detection Monitoring Parameters
## City of El Paso McCombs Landfill

| Volatile Organic Compounds | Method[(1) (2)] |
|---|---|
| Acetone | 8260 |
| Acrylonitrile | 8260 |
| Benzene | 8260 |
| Bromochloromethane | 8260 |
| Bromodichloromethane | 8260 |
| Bromoform | 8260 |
| Carbon Disulfide | 8260 |
| Carbon Tetrachloride | 8260 |
| Chlorobenzene | 8260 |
| Chloroethane | 8260 |
| Chloroform | 8260 |
| Dibromochloromethane | 8260 |
| 1,2-Dibromo-3-chloropropane | 8260 |
| 1,2-Dibromoethane | 8260 |
| 1,2-Dichlorobenzene | 8260 |
| 1,4-Dichlorobenzene | 8260 |
| Trans-1,4-Dichloro-2-Butene | 8260 |
| 1,1-Dichloroethane | 8260 |
| 1,2-Dichloroethane | 8260 |
| 1,1-Dichloroethylene | 8260 |
| Cis-1,2-Dichloroethylene | 8260 |
| Trans-1,2-Dichloroethylene | 8260 |
| 1,2-Dichloropropane | 8260 |
| Cis-1,3-Dichloropropene | 8260 |

## Table Att11-2 (cont.)
## Background/Detection Monitoring Parameters
## City of El Paso McCombs Landfill

| Volatile Organic Compounds | Method[(1) (2)] |
|---|---|
| Trans-1,3-Dichloropropene | 8260 |
| Ethylbenzene | 8260 |
| 2-Hexanone | 8260 |
| Bromomethane | 8260 |
| Chloromethane | 8260 |
| Methylene Bromide | 8260 |
| Methylene Chloride | 8260 |
| Methyl ethyl ketone | 8260 |
| Iodomethane | 8260 |
| 4-Methyl-2-Pentanone | 8260 |
| Styrene | 8260 |
| 1,1,1,2-Tetrachloroethane | 8260 |
| 1,1,2,2-Tetrachloroethane | 8260 |
| Tetrachloroethylene | 8260 |
| Toluene | 8260 |
| 1,1,1-Trichloroethane | 8260 |
| 1,1,2-Trichloroethane | 8260 |
| Trichloroethylene | 8260 |
| Trichlorofluoromethane | 8260 |
| 1,2,3-Trichloropropane | 8260 |
| Vinyl Acetate | 8260 |
| Vinyl Chloride | 8260 |
| Xylenes (Total) | 8260 |

(1) Analyses will be performed using the above listed methods or an equivalent or better EPA-approved method.
(2) Test Methods for Evaluating Solid Waste, Physical/Chemical Method, November, 1986, Third Edition, USEPA, SW-846 and additions thereto.

# APPENDICES

# APPENDIX
# ATT11-1

# LABORATORY CHECKLIST

# Laboratory Data Package Cover Page

This data package consists of:

- ☐ This signature page, the laboratory review checklist, and the following reportable data:
- ☐ R1 Field chain-of-custody documentation;
- ☐ R2 Sample identification cross-reference;
- ☐ R3 Test reports (analytical data sheets) for each environmental sample that includes:
  - a) Items consistent with NELAC 5.13 or ISO/IEC 17025 Section 5.10
  - b) dilution factors,
  - c) preparation methods,
  - d) cleanup methods, and
  - e) if required for the project, tentatively identified compounds (TICs).
- ☐ R4 Surrogate recovery data including:
  - a) Calculated recovery (%R), and
  - b) The laboratory's surrogate QC limits.
- ☐ R5 Test reports/summary forms for blank samples;
- ☐ R6 Test reports/summary forms for laboratory control samples (LCSs) including:
  - a) LCS spiking amounts,
  - b) Calculated %R for each analyte, and
  - c) The laboratory's LCS QC limits.
- ☐ R7 Test reports for project matrix spike/matrix spike duplicates (MS/MSDs) including:
  - a) Samples associated with the MS/MSD clearly identified,
  - b) MS/MSD spiking amounts,
  - c) Concentration of each MS/MSD analyte measured in the parent and spiked samples,
  - d) Calculated %Rs and relative percent differences (RPDs), and
  - e) The laboratory's MS/MSD QC limits
- ☐ R8 Laboratory analytical duplicate (if applicable) recovery and precision:
  - a) the amount of analyte measured in the duplicate,
  - b) the calculated RPD, and
  - c) the laboratory's QC limits for analytical duplicates.
- ☐ R9 List of practical quantitation limits (PQLs) for each analyte for each method and matrix;
- ☐ R10 Other problems or anomalies.
- ☐ The Exception Report for every "No" or "Not Reviewed (NR)" item in laboratory review checklist.

**Release Statement:** I am responsible for the release of this laboratory data package. This data package has been reviewed by the laboratory and is complete and technically compliant with the requirements of the methods used, except where noted by the laboratory in the attached exception reports. By my signature below, I affirm to the best of my knowledge, all problems/anomalies, observed by the laboratory as having the potential to affect the quality of the data, have been identified by the laboratory in the Laboratory Review Checklist, and no information or data have been knowingly withheld that would affect the quality of the data.

**Check, if applicable:** ☐☐ This laboratory is an in-house laboratory controlled by the person responding to rule. The official signing the cover page of the rule-required report (for example, the APAR) in which these data are used is responsible for releasing this data package and is by signature affirming the above release statement is true.

| Name (Printed) | Signature | Official Title (printed) | Date |
|---|---|---|---|

# Laboratory Review Checklist: Reportable Data

| | |
|---|---|
| Laboratory Name: | LRC Date: |
| Project Name: | Laboratory Job Number: |
| Reviewer Name: | Prep Batch Number(s): |

| #[1] | A[2] | Description | Yes | No | NA[3] | NR[3] | ER#[4] |
|---|---|---|---|---|---|---|---|
| R1 | OI | **Chain-of-custody (C-O-C)** | | | | | |
| | | Did samples meet the laboratory's standard conditions of sample acceptability upon receipt? | | | | | |
| | | Were all departures from standard conditions described in an exception report? | | | | | |
| R2 | OI | **Sample and quality control (QC) identification** | | | | | |
| | | Are all field sample ID numbers cross-referenced to the laboratory ID numbers? | | | | | |
| | | Are all laboratory ID numbers cross-referenced to the corresponding QC data? | | | | | |
| R3 | OI | **Test reports** | | | | | |
| | | Were all samples prepared and analyzed within holding times? | | | | | |
| | | Other than those results < PQL, were all other raw values bracketed by calibration standards? | | | | | |
| | | Were calculations checked by a peer or supervisor? | | | | | |
| | | Were all analyte identifications checked by a peer or supervisor? | | | | | |
| | | Were sample quantitation limits reported for all analytes not detected? | | | | | |
| | | Were all results for soil and sediment samples reported on a dry weight basis? | | | | | |
| | | Were % moisture (or solids) reported for all soil and sediment samples? | | | | | |
| | | If required for the project, TICs reported? | | | | | |
| R4 | O | **Surrogate recovery data** | | | | | |
| | | Were surrogates added prior to extraction? | | | | | |
| | | Were surrogate percent recoveries in all samples within the laboratory QC limits? | | | | | |
| R5 | OI | **Test reports/summary forms for blank samples** | | | | | |
| | | Were appropriate type(s) of blanks analyzed? | | | | | |
| | | Were blanks analyzed at the appropriate frequency? | | | | | |
| | | Were method blanks taken through the entire analytical process, including preparation and, if applicable, cleanup procedures? | | | | | |
| | | Were blank concentrations < PQL? | | | | | |
| R6 | OI | **Laboratory control samples (LCS):** | | | | | |
| | | Were all COCs included in the LCS? | | | | | |
| | | Was each LCS taken through the entire analytical procedure, including prep and cleanup steps? | | | | | |
| | | Were LCSs analyzed at the required frequency? | | | | | |
| | | Were LCS (and LCSD, if applicable) %Rs within the laboratory QC limits? | | | | | |
| | | Does the detectability data document the laboratory's capability to detect the COCs at the MDL used to calculate the SQLs? | | | | | |
| | | Was the LCSD RPD within QC limits? | | | | | |
| R7 | OI | **Matrix spike (MS) and matrix spike duplicate (MSD) data** | | | | | |
| | | Were the project/method specified analytes included in the MS and MSD? | | | | | |
| | | Were MS/MSD analyzed at the appropriate frequency? | | | | | |
| | | Were MS (and MSD, if applicable) %Rs within the laboratory QC limits? | | | | | |
| | | Were MS/MSD RPDs within laboratory QC limits? | | | | | |
| R8 | OI | **Analytical duplicate data** | | | | | |
| | | Were appropriate analytical duplicates analyzed for each matrix? | | | | | |
| | | Were analytical duplicates analyzed at the appropriate frequency? | | | | | |
| | | Were RPDs or relative standard deviations within the laboratory QC limits? | | | | | |
| R9 | OI | **Practical quantitation limits (PQLs):** | | | | | |
| | | Are the PQLs for each method analyte included in the laboratory data package? | | | | | |
| | | Do the PQLs correspond to the concentration of the lowest non-zero calibration standard? | | | | | |
| | | Are unadjusted PQLs included in the laboratory data package? | | | | | |
| R10 | OI | **Other problems/anomalies** | | | | | |
| | | Are all known problems/anomalies/special conditions noted in this LRC and ER? | | | | | |
| | | Were all necessary corrective actions performed for the reported data? | | | | | |
| | | Was applicable and available technology used to lower the SQL minimize the matrix interference affects on the sample results? | | | | | |

1. Items identified by the letter "R" must be included in the laboratory data package submitted in required report(s). Items identified by the letter "S" should be retained and made available upon request for the appropriate retention period.
2. = organic analyses; I = inorganic analyses (and general chemistry, when applicable);
3. NA = Not applicable; and NR = Not reviewed;
4. ER# = Exception Report identification number (an Exception Report should be completed for an item if "NR" or "No" is checked on the LRC)

| Laboratory Review Checklist: Reportable Data | |
|---|---|
| Laboratory Name: | LRC Date: |
| Project Name: | Laboratory Job Number: |

| Reviewer Name: | | | Prep Batch Number(s): | | | | | |
|---|---|---|---|---|---|---|---|---|
| #[1] | A[2] | Description | Yes | No | NA[3] | NR[4] | ER#[5] |
| S1 | OI | **Initial calibration (ICAL)** | | | | | |
| | | Were response factors and/or relative response factors for each analyte within QC limits? | | | | | |
| | | Were percent RSDs or correlation coefficient criteria met? | | | | | |
| | | Was the number of standards recommended in the method used for all analytes? | | | | | |
| | | Were all points generated between the lowest and highest standard used to calculate the curve? | | | | | |
| | | Are ICAL data available for all instruments used? | | | | | |
| | | Has the initial calibration curve been verified using an appropriate second source standard? | | | | | |
| | OI | **Initial and continuing calibration verification (ICCV and CCV) and continuing calibration** | | | | | |
| | | Was the CCV analyzed at the method-required frequency? | | | | | |
| | | Were percent differences for each analyte within the method-required QC limits? | | | | | |
| | | Was the ICAL curve verified for each analyte? | | | | | |
| | | Was the absolute value of the analyte concentration in the inorganic CCB < MDL? | | | | | |
| | O | **Mass spectral tuning:** | | | | | |
| | | Was the appropriate compound for the method used for tuning? | | | | | |
| | | Were ion abundance data within the method-required QC limits? | | | | | |
| | O | **Internal standards (IS):** | | | | | |
| | | Were IS area counts and retention times within the method-required QC limits? | | | | | |
| S5 | OI | **Raw data (NELAC section 1 appendix A glossary, and section 5.12 or ISO/IEC 17025 section 4.12.2)** ***(ONLY USE DATA FOR EPA LEVEL 3 QA/QC REVIEW, IF RAW DATA NOT APPLICATBLE, THEN CHANGE APPROPRIATELY).*** | | | | | |
| | | Were the raw data (for example, chromatograms, spectral data) reviewed by an analyst? | | | | | |
| | | Were data associated with manual integrations flagged on the raw data? | | | | | |
| | O | **Dual column confirmation** | | | | | |
| | | Did dual column confirmation results meet the method-required QC? | | | | | |
| | O | **Tentatively identified compounds (TICs):** | | | | | |
| | | If TICs were requested, were the mass spectra and TIC data subject to appropriate checks? | | | | | |
| | I | **Interference Check Sample (ICS) results:** | | | | | |
| | | Were percent recoveries within method QC limits? | | | | | |
| | I | **Serial dilutions, post digestion spikes, and method of standard additions** | | | | | |
| | | Were percent differences, recoveries, and the linearity within the QC limits specified in the method? | | | | | |
| | OI | **Method detection limit (MDL) studies** | | | | | |
| | | Was a MDL study performed for each reported analyte? | | | | | |
| | | Is the MDL either adjusted or supported by the analysis of DCSs? | | | | | |
| | OI | **Proficiency test reports:** | | | | | |
| | | Was the laboratory's performance acceptable on the applicable proficiency tests or evaluation studies? | | | | | |
| | OI | **Standards documentation** | | | | | |
| | | Are all standards used in the analyses NIST-traceable or obtained from other appropriate sources? | | | | | |
| | OI | **Compound/analyte identification procedures** | | | | | |
| | | Are the procedures for compound/analyte identification documented? | | | | | |
| | OI | **Demonstration of analyst competency (DOC)** | | | | | |
| | | Was DOC conducted consistent with NELAC Chapter 5C or ISO/IEC 4? | | | | | |
| | | Is documentation of the analyst's competency up-to-date and on file? | | | | | |
| | OI | **Verification/validation documentation for methods** (NELAC Chap 5 or ISO/IEC 17025 Section 5) | | | | | |
| | | Are all the methods used to generate the data documented, verified, and validated, where applicable? | | | | | |
| | OI | **Laboratory standard operating procedures (SOPs):** | | | | | |
| | | Are laboratory SOPs current and on file for each method performed? | | | | | |

1 Items identified by the letter "R" should be included in the laboratory data package submitted to the TCEQ in the required report(s). Items identified by the letter "S" should be retained and made available upon request for the appropriate retention period.
2 O = organic analyses; I = inorganic analyses (and general chemistry, when applicable).
3 NA = Not applicable.
4 NR = Not Reviewed.
5 ER# = Exception Report identification number (an Exception Report should be completed for an item if "NR" or "No" is checked).

| Laboratory Review Checklist: Exception Reports | | |
|---|---|---|
| Laboratory Name: | | LRC Date: |
| Project Name: | | Laboratory Job Number: |
| Reviewer Name: | | Prep Batch Number(s): |
| ER #[1] | DESCRIPTION | |
| | | |
| | | |
| | | |

1 ER# = Exception Report identification number (an Exception Report should be completed for an item if "NR" or "No" is checked on the LR

## NOTES

1. DIGITIZED TOPOGRAPHY FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS.
2. COORDINATES ARE BASED ON THE TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NAD 83. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM. NAVD 88 DATUM TO NGVD 29 DATUM, SUBTRACT 1.99–FEET. NGVD 29 DATUM TO CITY OF EL PASO DATUM, ADD 27.65–FEET.
3. EXISTING CONTOUR INTERVAL IS TWO FEET.
4. SITE TOPOGRAPHY MAY VARY DUE TO OWNER'S OPERATIONS.
5. PIEZOMETERS INSTALLED IN MAY/JUNE 2011.
6. REFER TO APPENDIX 3K, ATTACHMENT 1 FOR FUTURE MONITORING WELL LOCATIONS.

## LEGEND

- MW-3 — MONITORING WELL
- GMP-8 — GAS MONITORING PROBE
- △ — PIEZOMETER
- PV-7 — VERTICAL GAS WELL
- 1*, 1RI, 1 — SOIL BORING, TYPICAL
- BUILDING/STRUCTURE
- 4100 — ELEVATION CONTOURS
- —X—X—X— CHAIN LINK OR OTHER FENCE
- UGE — UNDERGROUND ELECTRIC
- OHE — OVERHEAD ELECTRIC UTILITY
- UGC — UNDERGROUND COMMUNICATIONS
- GMCS — GAS MIGRATION CONTROL SYSTEM
- FACILITY/PROPERTY BOUNDARY
- SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- W — W — WATER LINE
- HIGHWAY
- LANDFILL ACCESS ROAD
- SECTION LINE

GRAPHIC SCALE

1"=250'–0" 250 0 250 500

Scale Feet

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STATE OF TEXAS
FREDRIC J. DORAN
111226
REGISTERED PROFESSIONAL ENGINEER
11/2/12

| DESIGNED | TLK |
|---|---|
| DRAWN | CAD |
| VERIFY SCALE | BAR IS ONE INCH ON ANSI "D" DRAWING |
| | 0 1" |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| | | | | |
| | | | | |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

THE CITY OF EL PASO TEXAS

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1380 Corporate Center Curve
Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

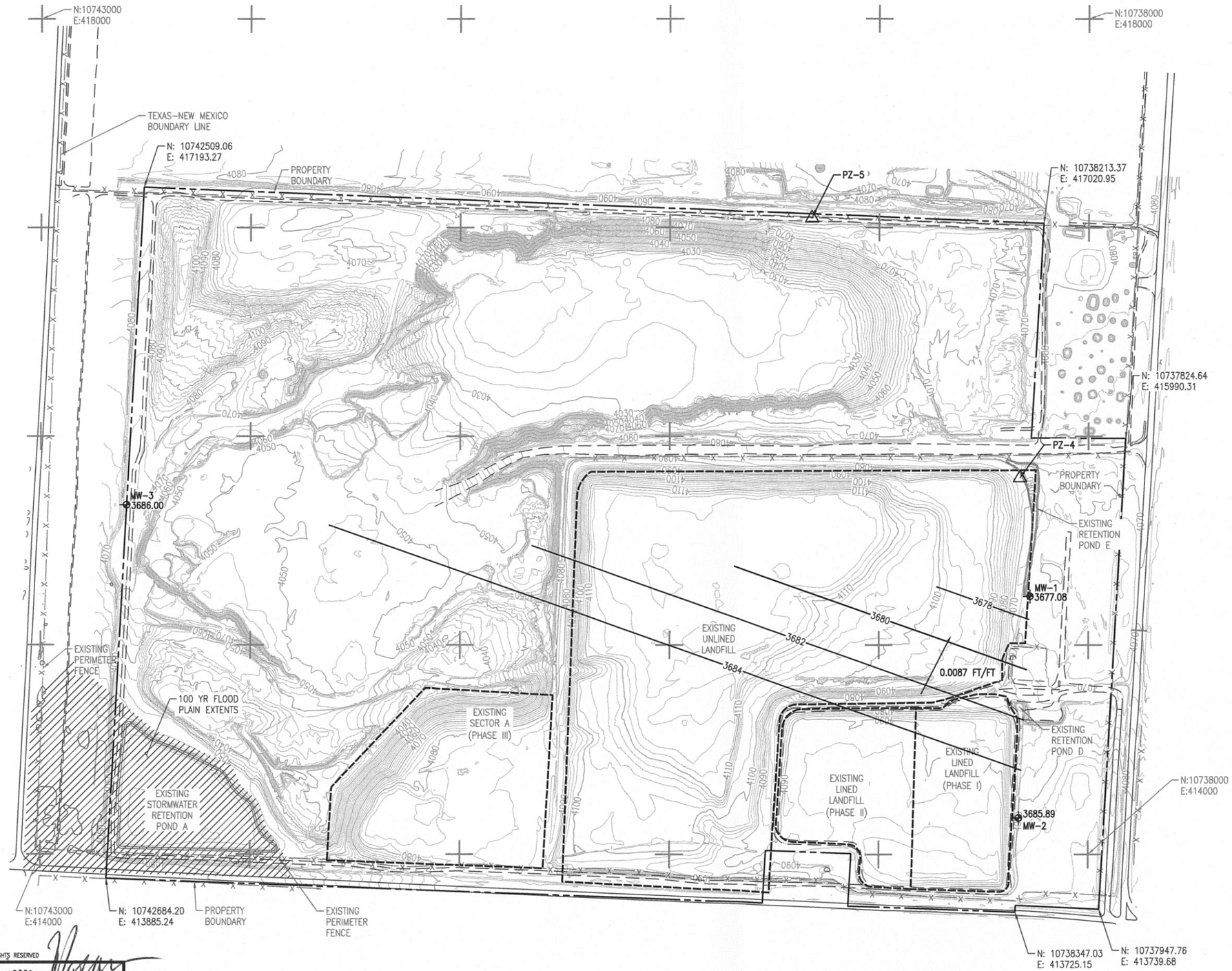
MONITORING WELL LOCATIONS

PROJECT NUMBER: 9631500115

SHT. 69 OF: 78

DRAWING NUMBER: P3–36

Keller, Tonya L. 10/29/2012 12:41:18 PM – P:\00218000 el paso tx\9631500115\data analytical\CAD\P3-36 MONITORING WELL LOCATIONS.dwg




## NOTES

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3. EXISTING CONTOUR INTERVAL IS TWO FEET.
4. SITE TOPOGRAPHY MAY VARY DUE TO OWNER'S OPERATIONS.
5. GROUNDWATER ELEVATIONS MEASURED ON DECEMBER 6, 2010.

## LEGEND

- MW–3 — MONITORING WELL
- △ — PIEZOMETER
- 4100 — ELEVATION CONTOURS
- 3680 — GROUNDWATER ELEVATION CONTOURS
- —X—X—X— — CHAIN LINK OR OTHER FENCE
- — — FACILITY/PROPERTY BOUNDARY
- — — SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- LANDFILL ACCESS ROAD

GRAPHIC SCALE

1"=250'–0" (250 0 250 500 Scale Feet)

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STATE OF TEXAS — FREDRIC J. DORAN — 111226 — REGISTERED PROFESSIONAL ENGINEER

11/2/12

| DESIGNED | TLK |
|---|---|
| DRAWN | CAD |
| VERIFY SCALE | BAR IS ONE INCH ON ANSI "D" DRAWING (0 — 1") |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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MAJOR PERMIT AMENDMENT

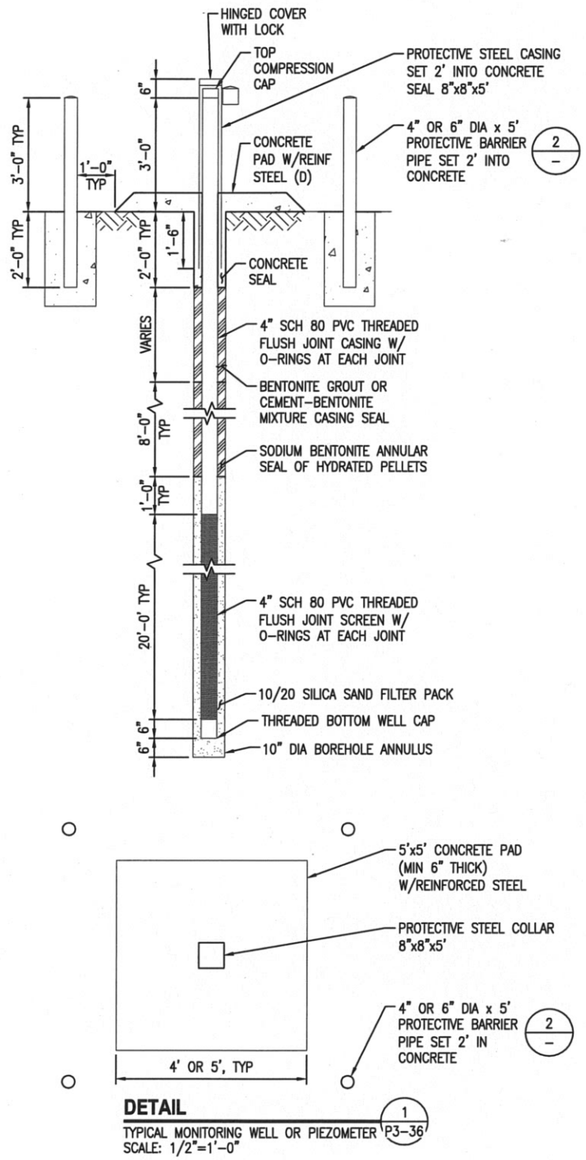
GROUND WATER CONTOUR MAP

PROJECT NUMBER: 9631500115
SHT. 70 OF: 78
DRAWING NUMBER: P3–37

Keller, Tonya L. 10/29/2012 12:51:54 PM – P:\00218000 el paso tx\9631500115\data analytical\CADD\P3–37 GROUND WATER CONTOUR MAP.dwg

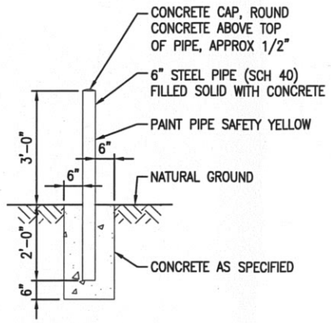
## NOTES

1. GROUND WATER MONITORING WELL AND PIEZOMETER DETAIL TYPICAL DESIGN AS PREPARED BY RABA KISTNER, DECEMBER 2003 AND PARKHILL SMITH & COOPER, NOVEMBER 2010.




**DETAIL** 1 / P3-36
TYPICAL MONITORING WELL OR PIEZOMETER
SCALE: 1/2"=1'-0"




**DETAIL** 2 / —
TYPICAL BOLLARD
SCALE: 1/2"=1'-0"

GRAPHIC SCALE
1/2"=1'-0" 1 0 1 2 3 4 5
Scale Feet

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STATE OF TEXAS
FREDRIC J. DORAN
111226
REGISTERED
PROFESSIONAL ENGINEER
11/2/12

DESIGNED TLK
DRAWN CAD
VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 1 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

TYPICAL MONITORING WELL CONSTRUCTION DETAIL

PROJECT NUMBER: 9631500115
SHT. 71 OF: 78
DRAWING NUMBER: P3-38

Keller, Tonya L. 10/29/2012 12:59:23 PM – P:\00218000 el paso tx\9631500115\data analytical\CADD\P3-38 TYPICAL MONITORING WELL CONSTRUCTION DETAIL.dwg

# Appendix 3M
# Landfill Gas Management Details

SAIC®

# Appendix 3M – Attachment 1
# Landfill Gas Monitoring Report Form

SAIC®

# LFG Monitoring Report Form
## McCombs Landfill El Paso, TX

Date: Time: By: _____

Current Weather Conditions: Temperature: Wind Direction/Speed:

Weather Conditions Last 24 Hours: Barometric Pressure:

| Sample Point | LFG Temp (°F) | | LFG Pressure/Vacuum (in. w.c.) | | LFG Flow (scfm) | | Methane (%) | Oxygen (%) | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | Blower In. | Blower Out. | Blower In. | Blower Out. | Instant | Total | | | |
| *Blower Pad* | | | | | | | | | |
| Blower Pad Start | | | | | | | | | |
| Blower Pad Finish | | | | | | | | | |

Flow Meter Reading Totalizer Reading

| Sample Point | LFG Temp (°F) | LFG Vacuum (in. w.c.) | LFG Flow (scfm) | Methane (%) | Oxygen (%) | Comments |
|---|---|---|---|---|---|---|
| *GCCS/GMCS Monitoring* | | | | | | |
| PV-1 | | | | | | |
| PV-1A | | | | | | |
| PV-2 | | | | | | |
| PV-2A | | | | | | |
| PV-3R | | | | | | |
| PV-4 | | | | | | |
| PV-5 | | | | | | |
| PV-6 | | | | | | |
| PV-7 | | | | | | |
| (future well) | | | | | | |
| (future well) | | | | | | |
| (future well) | | | | | | |
| (future well) | | | | | | |
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| (future well) | | | | | | |
| (future well) | | | | | | |
| (future well) | | | | | | |
| (future well) | | | | | | |
| (future well) | | | | | | |

TBD = To be determined.

NO = No odor detected.

SL = Slight odor detected.

STR = Strong odor detected.

| Sample Point | | Gas Pressure (in. w.c.) | | Methane (%) | Oxygen (%) | Comments |
|---|---|---|---|---|---|---|
| *Perimeter Monitoring* | | | | | | |
| GMP-1 | | | | | | |
| GMP-2 | | | | | | |
| GMP-3A | | | | | | |
| GMP-7 | | | | | | |
| GMP-8 | | | | | | |
| GMP-9 | | | | | | |
| GMP-10 | | | | | | |
| GMP-11 | | | | | | |
| GMP-12 | | | | | | |
| GMP-13 | | | | | | |
| GMP-14 | | | | | | |
| GMP-15 | | | | | | |
| GMP-16 | | | | | | |
| GMP-17 | | | | | | |
| GMP-18 | | | | | | |
| GMP-19 | | | | | | |
| GMP-20 | | | | | | |
| GMP-21 | | | | | | |
| GMP-22 | | | | | | |
| GMP-23 | | | | | | |

TBD = To be determined.

NO = No odor detected.

SL = Slight odor detected.

STR = Strong odor detected.

# Appendix 3M - Attachment 2
# NMOC Monitoring Results

SAIC®

## Memorandum

SAIC

To: TCEQ

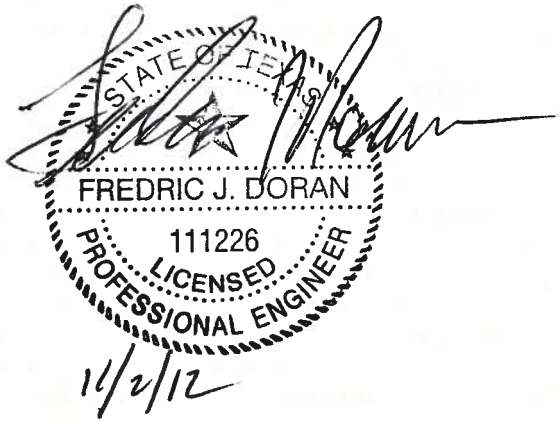
From: Fred J. Doran, SAIC

Subject: Appendix 3M, Attachment 2

Date: November 2, 2012

The attached NMOC Monitoring Results were completed in 2007 and reference MSW Permit No. 729A throughout. It should be noted that the attached results are applicable to MSW Permit No. 729B and should be referenced within the document as part of MSW Permit No. 729B.

TLK





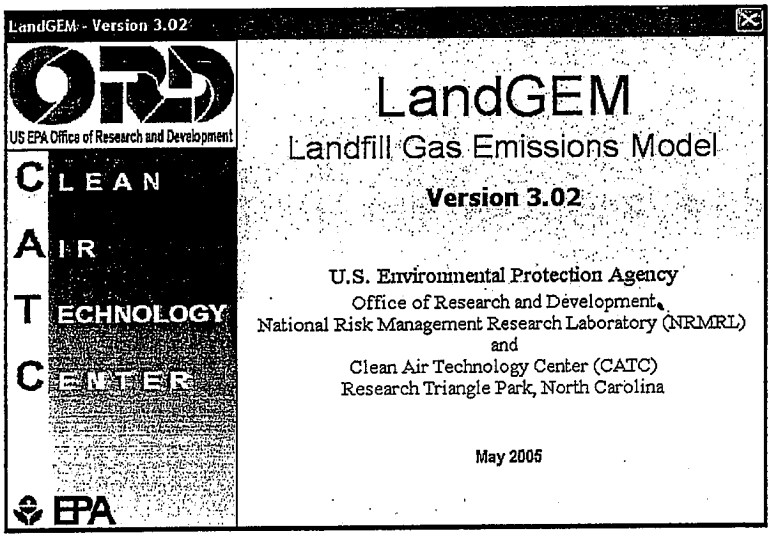

SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI

# Municipal Solid Waste Landfill
# 40 CFR Part 60, Subpart WWW Reporting Submittal Forms

**Revised NMOC Emission Rate Report (Tier 2) Submittal Form**

Landfills that have 50 Mg/year or greater of NMOC emission rate as determined by using the Tier 1 formulas and defaults must submit this report if they choose not to submit a Collection and Control System Design Plan, but choose instead to use the Tier 2 procedures to recalculate the NMOC emission rate. ***Submit this form to the Report Submittal Address Number 1.***

| | | | |
|---|---|---|---|
| **I. COMPANY IDENTIFYING INFORMATION** | | | |
| A. Company Name: City of El Paso | | B. Primary Account Number: | |
| C. Customer Reference Number: CN601410244 | | D. Regulated Entity Number: RN100215599 | |
| **II. SITE INFORMATION** | | | |
| A. Site/Area Name: McCombs Landfill MSW Permit No. 729A | | | |
| B. Delivery Address: 7969 San Paulo Drive | | | |
| City: El Paso | County: El Paso | State: Texas | Zip Code: 79907 |
| C. Physical Location: 13660 McCombs | | | |
| Nearest City: El Paso | County: El Paso | State: Texas | Zip Code: 79934 |
| **III. APPLICATION AND CERTIFICATION SUBMITTAL TYPE** *(Place an "X" in the appropriate boxes and fill in the numbers.)* | | | |
| ☒ MSWLF Permit Number: 729A | | | |
| ☒ Air Permit Number(s): 517 | | | |
| ☒ MSWLF GOP Number: 1749 | | | |
| ☐ MSWLF SOP Number: | | | |
| **IV. RESPONSIBLE OFFICIAL (RO) OR DULY AUTHORIZED REPRESENTATIVE (DAR)** | | | |
| A. RO or DAR Name: (☐ Mr. ☐ Mrs. ☒ Ms. ☐ Dr.) Smyth, Ellen A. | | | |
| B. RO or DAR Title: Director of Environmental Services | | C. Effective Date: July 8, 2004 | |
| D. Employer Name: City of El Paso | | | |
| E. Mailing Address: 7969 San Paulo Drive | | | |
| City: El Paso | County: El Paso | State: Texas | Zip Code: 79907 |
| Telephone No.: 915-621-6719 | Fax No.: 915-621-6711 | Email Address: smythea@elpasotexas.gov | |
| F. To the best of my knowledge and belief the statements and information contained in the attached document are true, accurate, and complete. The facility will operate in compliance with all Regulations of the Texas Commission on Environmental Quality and with Federal Environmental Protection Agency Regulations governing air pollution. | | | |
| Signature: Ellen A Smyth | | Signature Date: 4/27/2007 | |
| Title: Director of Environmental Services | | | |
| **Check each line in the appropriate boxes, as applicable** | | | |
| Was the report submitted within 180 days of the first calculated exceedance of 50 Mg/yr? | | | ☒ YES ☐ NO |
| If the recalculated NMOC emission was less than 50 Mg/yr, then was annual period reporting resumed? | | | ☐ YES ☐ NO |
| If the recalculated NMOC emission rate is greater than 50 Mg/yr, did the owner/operator submit a Collection and Control System Design Plan, or recalculated the NMOC emission rate according to Tier 3 procedures? | | | ☐ YES ☐ NO |




# Summary Report

**Landfill Name or Identifier:** McCombs #729A, Inventory, waste report data

**Date:** Wednesday, April 11, 2007

**Description/Comments:**

**About LandGEM:**

First-Order Decomposition Rate Equation: $$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left( \frac{M_i}{10} \right) e^{-kt_{ij}}$$

Where,

$Q_{CH4}$ = annual methane generation in the year of the calculation ($m^3/year$)
i = 1-year time increment
n = (year of the calculation) - (initial year of waste acceptance)
j = 0.1-year time increment
k = methane generation rate ($year^{-1}$)
$L_o$ = potential methane generation capacity ($m^3/Mg$)
$M_i$ = mass of waste accepted in the $i^{th}$ year ($Mg$)
$t_{ij}$ = age of the $j^{th}$ section of waste mass $M_i$ accepted in the $i^{th}$ year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

## Input Review

LANDFILL CHARACTERISTICS

| | | |
|---|---|---|
| Landfill Open Year | 1977 | |
| Landfill Closure Year (with 80-year limit) | 2046 | |
| *Actual Closure Year (without limit)* | *2046* | |
| Have Model Calculate Closure Year? | No | |
| Waste Design Capacity | | *megagrams* |

MODEL PARAMETERS

| | | |
|---|---|---|
| Methane Generation Rate, k | 0.020 | $year^{-1}$ |
| Potential Methane Generation Capacity, $L_o$ | 100 | $m^3/Mg$ |
| NMOC Concentration | 270 | *ppmv as hexane* |
| Methane Content | 50 | *% by volume* |

GASES / POLLUTANTS SELECTED

| | |
|---|---|
| Gas / Pollutant #1: | Total landfill gas |
| Gas / Pollutant #2: | Methane |
| Gas / Pollutant #3: | Carbon dioxide |
| Gas / Pollutant #4: | NMOC |

WASTE ACCEPTANCE RATES

| Year | Waste Accepted | | Waste-In-Place | |
|---|---|---|---|---|
| | *(Mg/year)* | *(short tons/year)* | *(Mg)* | *(short tons)* |
| 1977 | 56,572 | 62,229 | 0 | 0 |
| 1978 | 57,726 | 63,499 | 56,572 | 62,229 |
| 1979 | 58,905 | 64,795 | 114,298 | 125,728 |
| 1980 | 60,107 | 66,117 | 173,203 | 190,523 |
| 1981 | 61,333 | 67,467 | 233,309 | 256,640 |
| 1982 | 62,585 | 68,844 | 294,643 | 324,107 |
| 1983 | 63,862 | 70,248 | 357,228 | 392,951 |
| 1984 | 65,166 | 71,682 | 421,090 | 463,199 |
| 1985 | 66,495 | 73,145 | 486,256 | 534,881 |
| 1986 | 67,853 | 74,638 | 552,751 | 608,026 |
| 1987 | 69,237 | 76,161 | 620,604 | 682,664 |
| 1988 | 34,800 | 38,280 | 689,841 | 758,825 |
| 1989 | 33,671 | 37,038 | 724,641 | 797,105 |
| 1990 | 32,473 | 35,720 | 758,312 | 834,143 |
| 1991 | 25,819 | 28,401 | 790,785 | 869,863 |
| 1992 | 21,641 | 23,805 | 816,604 | 898,264 |
| 1993 | 32,192 | 35,411 | 838,245 | 922,069 |
| 1994 | 44,468 | 48,915 | 870,436 | 957,480 |
| 1995 | 46,409 | 51,050 | 914,905 | 1,006,395 |
| 1996 | 112,406 | 123,647 | 961,314 | 1,057,445 |
| 1997 | 120,959 | 133,055 | 1,073,720 | 1,181,092 |
| 1998 | 115,976 | 127,574 | 1,194,679 | 1,314,147 |
| 1999 | 89,461 | 98,407 | 1,310,655 | 1,441,721 |
| 2000 | 59,133 | 65,046 | 1,400,116 | 1,540,128 |
| 2001 | 138,255 | 152,081 | 1,459,249 | 1,605,174 |
| 2002 | 152,939 | 168,233 | 1,597,505 | 1,757,255 |
| 2003 | 150,000 | 165,000 | 1,750,444 | 1,925,488 |
| 2004 | 257,209 | 282,930 | 1,900,444 | 2,090,488 |
| 2005 | 37,910 | 41,701 | 2,157,653 | 2,373,418 |
| 2006 | 13,847 | 15,232 | 2,195,563 | 2,415,119 |
| 2007 | 0 | 0 | 2,209,410 | 2,430,351 |
| 2008 | 0 | 0 | 2,209,410 | 2,430,351 |
| 2009 | 0 | 0 | 2,209,410 | 2,430,351 |
| 2010 | 0 | 0 | 2,209,410 | 2,430,351 |
| 2011 | 0 | 0 | 2,209,410 | 2,430,351 |
| 2012 | 0 | 0 | 2,209,410 | 2,430,351 |
| 2013 | 0 | 0 | 2,209,410 | 2,430,351 |
| 2014 | 0 | 0 | 2,209,410 | 2,430,351 |
| 2015 | 0 | 0 | 2,209,410 | 2,430,351 |
| 2016 | 0 | 0 | 2,209,410 | 2,430,351 |

WASTE ACCEPTANCE RATES (Continued)

| Year | Waste Accepted | | Waste-In-Place | |
|---|---|---|---|---|
| | *(Mg/year)* | *(short tons/year)* | *(Mg)* | *(short tons)* |
| 2017 | 0 | 0 | 2,209,410 | 2,430,351 |
| 2018 | 0 | 0 | 2,209,410 | 2,430,351 |
| 2019 | 0 | 0 | 2,209,410 | 2,430,351 |
| 2020 | 0 | 0 | 2,209,410 | 2,430,351 |
| 2021 | 0 | 0 | 2,209,410 | 2,430,351 |
| 2022 | 0 | 0 | 2,209,410 | 2,430,351 |
| 2023 | 0 | 0 | 2,209,410 | 2,430,351 |
| 2024 | 0 | 0 | 2,209,410 | 2,430,351 |
| 2025 | 0 | 0 | 2,209,410 | 2,430,351 |
| 2026 | 0 | 0 | 2,209,410 | 2,430,351 |
| 2027 | 0 | 0 | 2,209,410 | 2,430,351 |
| 2028 | 0 | 0 | 2,209,410 | 2,430,351 |
| 2029 | 0 | 0 | 2,209,410 | 2,430,351 |
| 2030 | 0 | 0 | 2,209,410 | 2,430,351 |
| 2031 | 0 | 0 | 2,209,410 | 2,430,351 |
| 2032 | 424,594 | 467,054 | 2,209,410 | 2,430,351 |
| 2033 | 576,051 | 633,656 | 2,634,004 | 2,897,405 |
| 2034 | 587,572 | 646,329 | 3,210,055 | 3,531,061 |
| 2035 | 599,323 | 659,256 | 3,797,627 | 4,177,390 |
| 2036 | 611,310 | 672,441 | 4,396,950 | 4,836,645 |
| 2037 | 623,536 | 685,890 | 5,008,260 | 5,509,086 |
| 2038 | 636,007 | 699,607 | 5,631,796 | 6,194,976 |
| 2039 | 648,727 | 713,600 | 6,267,803 | 6,894,583 |
| 2040 | 661,701 | 727,872 | 6,916,530 | 7,608,183 |
| 2041 | 674,935 | 742,429 | 7,578,232 | 8,336,055 |
| 2042 | 688,434 | 757,278 | 8,253,167 | 9,078,484 |
| 2043 | 702,203 | 772,423 | 8,941,601 | 9,835,761 |
| 2044 | 716,247 | 787,872 | 9,643,804 | 10,608,184 |
| 2045 | 730,572 | 803,629 | 10,360,051 | 11,396,056 |
| 2046 | 517,323 | 569,056 | 11,090,623 | 12,199,685 |
| 2047 | 0 | 0 | 11,607,946 | 12,768,741 |
| 2048 | 0 | 0 | 11,607,946 | 12,768,741 |
| 2049 | 0 | 0 | 11,607,946 | 12,768,741 |
| 2050 | 0 | 0 | 11,607,946 | 12,768,741 |
| 2051 | 0 | 0 | 11,607,946 | 12,768,741 |
| 2052 | 0 | 0 | 11,607,946 | 12,768,741 |
| 2053 | 0 | 0 | 11,607,946 | 12,768,741 |
| 2054 | 0 | 0 | 11,607,946 | 12,768,741 |
| 2055 | 0 | 0 | 11,607,946 | 12,768,741 |
| 2056 | 0 | 0 | 11,607,946 | 12,768,741 |

## Pollutant Parameters

| | | *Gas / Pollutant Default Parameters:* | | *User-specified Pollutant Parameters:* | |
|---|---|---|---|---|---|
| | Compound | Concentration (*ppmv*) | Molecular Weight | Concentration (*ppmv*) | Molecular Weight |
| Gases | Total landfill gas | | 0.00 | | |
| | Methane | | 16.04 | | |
| | Carbon dioxide | | 44.01 | | |
| | NMOC | 4,000 | 86.18 | | |
| Pollutants | 1,1,1-Trichloroethane (methyl chloroform) - HAP | 0.48 | 133.41 | | |
| | 1,1,2,2-Tetrachloroethane - HAP/VOC | 1.1 | 167.85 | | |
| | 1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC | 2.4 | 98.97 | | |
| | 1,1-Dichloroethene (vinylidene chloride) - HAP/VOC | 0.20 | 96.94 | | |
| | 1,2-Dichloroethane (ethylene dichloride) - HAP/VOC | 0.41 | 98.96 | | |
| | 1,2-Dichloropropane (propylene dichloride) - HAP/VOC | 0.18 | 112.99 | | |
| | 2-Propanol (isopropyl alcohol) - VOC | 50 | 60.11 | | |
| | Acetone | 7.0 | 58.08 | | |
| | Acrylonitrile - HAP/VOC | 6.3 | 53.06 | | |
| | Benzene - No or Unknown Co-disposal - HAP/VOC | 1.9 | 78.11 | | |
| | Benzene - Co-disposal - HAP/VOC | 11 | 78.11 | | |
| | Bromodichloromethane - VOC | 3.1 | 163.83 | | |
| | Butane - VOC | 5.0 | 58.12 | | |
| | Carbon disulfide - HAP/VOC | 0.58 | 76.13 | | |
| | Carbon monoxide | 140 | 28.01 | | |
| | Carbon tetrachloride - HAP/VOC | 4.0E-03 | 153.84 | | |
| | Carbonyl sulfide - HAP/VOC | 0.49 | 60.07 | | |
| | Chlorobenzene - HAP/VOC | 0.25 | 112.56 | | |
| | Chlorodifluoromethane | 1.3 | 86.47 | | |
| | Chloroethane (ethyl chloride) - HAP/VOC | 1.3 | 64.52 | | |
| | Chloroform - HAP/VOC | 0.03 | 119.39 | | |
| | Chloromethane - VOC | 1.2 | 50.49 | | |
| | Dichlorobenzene - (HAP for para isomer/VOC) | 0.21 | 147 | | |
| | Dichlorodifluoromethane | 16 | 120.91 | | |
| | Dichlorofluoromethane - VOC | 2.6 | 102.92 | | |
| | Dichloromethane (methylene chloride) - HAP | 14 | 84.94 | | |
| | Dimethyl sulfide (methyl sulfide) - VOC | 7.8 | 62.13 | | |
| | Ethane | 890 | 30.07 | | |
| | Ethanol - VOC | 27 | 46.08 | | |

## Pollutant Parameters (Continued)

| | | *Gas / Pollutant Default Parameters:* | | *User-specified Pollutant Parameters:* | |
|---|---|---|---|---|---|
| | Compound | Concentration (*ppmv*) | Molecular Weight | Concentration (*ppmv*) | Molecular Weight |
| Pollutants | Ethyl mercaptan (ethanethiol) - VOC | 2.3 | 62.13 | | |
| | Ethylbenzene - HAP/VOC | 4.6 | 106.16 | | |
| | Ethylene dibromide - HAP/VOC | 1.0E-03 | 187.88 | | |
| | Fluorotrichloromethane - VOC | 0.76 | 137.38 | | |
| | Hexane - HAP/VOC | 6.6 | 86.18 | | |
| | Hydrogen sulfide | 36 | 34.08 | | |
| | Mercury (total) - HAP | 2.9E-04 | 200.61 | | |
| | Methyl ethyl ketone - HAP/VOC | 7.1 | 72.11 | | |
| | Methyl isobutyl ketone - HAP/VOC | 1.9 | 100.16 | | |
| | Methyl mercaptan - VOC | 2.5 | 48.11 | | |
| | Pentane - VOC | 3.3 | 72.15 | | |
| | Perchloroethylene (tetrachloroethylene) - HAP | 3.7 | 165.83 | | |
| | Propane - VOC | 11 | 44.09 | | |
| | t-1,2-Dichloroethene - VOC | 2.8 | 96.94 | | |
| | Toluene - No or Unknown Co-disposal - HAP/VOC | 39 | 92.13 | | |
| | Toluene - Co-disposal - HAP/VOC | 170 | 92.13 | | |
| | Trichloroethylene (trichloroethene) - HAP/VOC | 2.8 | 131.40 | | |
| | Vinyl chloride - HAP/VOC | 7.3 | 62.50 | | |
| | Xylenes - HAP/VOC | 12 | 106.16 | | |
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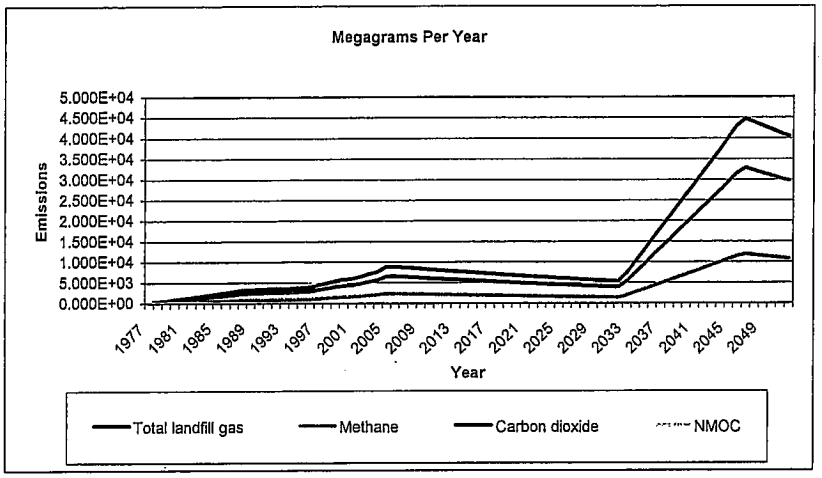
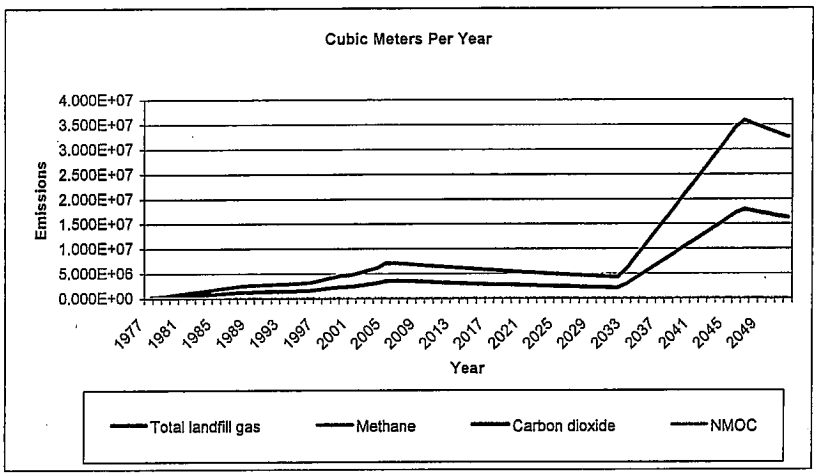
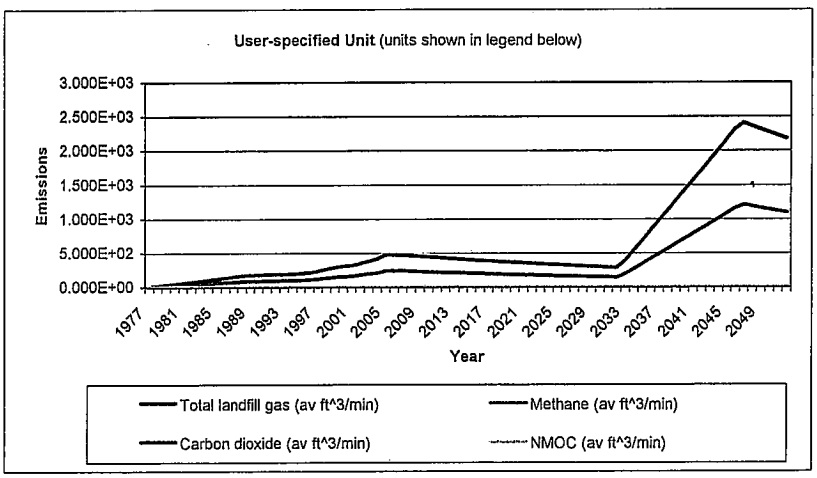
## Graphs


Megagrams Per Year
Emissions
5.000E+04
4.500E+04
4.000E+04
3.500E+04
3.000E+04
2.500E+04
2.000E+04
1.500E+04
1.000E+04
5.000E+03
0.000E+00
1977 1981 1985 1989 1993 1997 2001 2005 2009 2013 2017 2021 2025 2029 2033 2037 2041 2045 2049
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
Emissions
4.000E+07
3.500E+07
3.000E+07
2.500E+07
2.000E+07
1.500E+07
1.000E+07
5.000E+06
0.000E+00
1977 1981 1985 1989 1993 1997 2001 2005 2009 2013 2017 2021 2025 2029 2033 2037 2041 2045 2049
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
Emissions
3.000E+03
2.500E+03
2.000E+03
1.500E+03
1.000E+03
5.000E+02
0.000E+00
1977 1981 1985 1989 1993 1997 2001 2005 2009 2013 2017 2021 2025 2029 2033 2037 2041 2045 2049
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

## Results

| Year | Total landfill gas | | | Methane | | |
|---|---|---|---|---|---|---|
| | (Mg/year) | ($m^3$/year) | (av ft^3/min) | (Mg/year) | ($m^3$/year) | (av ft^3/min) |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 2.801E+02 | 2.243E+05 | 1.507E+01 | 7.481E+01 | 1.121E+05 | 7.534E+00 |
| 1979 | 5.603E+02 | 4.487E+05 | 3.015E+01 | 1.497E+02 | 2.243E+05 | 1.507E+01 |
| 1980 | 8.408E+02 | 6.733E+05 | 4.524E+01 | 2.246E+02 | 3.366E+05 | 2.262E+01 |
| 1981 | 1.122E+03 | 8.982E+05 | 6.035E+01 | 2.996E+02 | 4.491E+05 | 3.018E+01 |
| 1982 | 1.403E+03 | 1.124E+06 | 7.549E+01 | 3.748E+02 | 5.618E+05 | 3.775E+01 |
| 1983 | 1.685E+03 | 1.349E+06 | 9.067E+01 | 4.501E+02 | 6.747E+05 | 4.533E+01 |
| 1984 | 1.968E+03 | 1.576E+06 | 1.059E+02 | 5.257E+02 | 7.879E+05 | 5.294E+01 |
| 1985 | 2.252E+03 | 1.803E+06 | 1.211E+02 | 6.014E+02 | 9.015E+05 | 6.057E+01 |
| 1986 | 2.536E+03 | 2.031E+06 | 1.365E+02 | 6.775E+02 | 1.015E+06 | 6.823E+01 |
| 1987 | 2.822E+03 | 2.260E+06 | 1.518E+02 | 7.538E+02 | 1.130E+06 | 7.591E+01 |
| 1988 | 3.109E+03 | 2.489E+06 | 1.673E+02 | 8.304E+02 | 1.245E+06 | 8.363E+01 |
| 1989 | 3.220E+03 | 2.578E+06 | 1.732E+02 | 8.600E+02 | 1.289E+06 | 8.661E+01 |
| 1990 | 3.322E+03 | 2.660E+06 | 1.788E+02 | 8.875E+02 | 1.330E+06 | 8.938E+01 |
| 1991 | 3.417E+03 | 2.737E+06 | 1.839E+02 | 9.128E+02 | 1.368E+06 | 9.193E+01 |
| 1992 | 3.478E+03 | 2.785E+06 | 1.871E+02 | 9.289E+02 | 1.392E+06 | 9.355E+01 |
| 1993 | 3.516E+03 | 2.815E+06 | 1.892E+02 | 9.391E+02 | 1.408E+06 | 9.458E+01 |
| 1994 | 3.606E+03 | 2.887E+06 | 1.940E+02 | 9.631E+02 | 1.444E+06 | 9.700E+01 |
| 1995 | 3.754E+03 | 3.006E+06 | 2.020E+02 | 1.003E+03 | 1.503E+06 | 1.010E+02 |
| 1996 | 3.910E+03 | 3.131E+06 | 2.104E+02 | 1.044E+03 | 1.565E+06 | 1.052E+02 |
| 1997 | 4.389E+03 | 3.514E+06 | 2.361E+02 | 1.172E+03 | 1.757E+06 | 1.181E+02 |
| 1998 | 4.901E+03 | 3.924E+06 | 2.637E+02 | 1.309E+03 | 1.962E+06 | 1.318E+02 |
| 1999 | 5.378E+03 | 4.306E+06 | 2.893E+02 | 1.436E+03 | 2.153E+06 | 1.447E+02 |
| 2000 | 5.714E+03 | 4.576E+06 | 3.074E+02 | 1.526E+03 | 2.288E+06 | 1.537E+02 |
| 2001 | 5.894E+03 | 4.720E+06 | 3.171E+02 | 1.574E+03 | 2.360E+06 | 1.586E+02 |
| 2002 | 6.462E+03 | 5.174E+06 | 3.477E+02 | 1.726E+03 | 2.587E+06 | 1.738E+02 |
| 2003 | 7.091E+03 | 5.678E+06 | 3.815E+02 | 1.894E+03 | 2.839E+06 | 1.908E+02 |
| 2004 | 7.693E+03 | 6.160E+06 | 4.139E+02 | 2.055E+03 | 3.080E+06 | 2.070E+02 |
| 2005 | 8.814E+03 | 7.058E+06 | 4.742E+02 | 2.354E+03 | 3.529E+06 | 2.371E+02 |
| 2006 | 8.827E+03 | 7.068E+06 | 4.749E+02 | 2.358E+03 | 3.534E+06 | 2.375E+02 |
| 2007 | 8.721E+03 | 6.983E+06 | 4.692E+02 | 2.329E+03 | 3.492E+06 | 2.346E+02 |
| 2008 | 8.548E+03 | 6.845E+06 | 4.599E+02 | 2.283E+03 | 3.423E+06 | 2.300E+02 |
| 2009 | 8.379E+03 | 6.709E+06 | 4.508E+02 | 2.238E+03 | 3.355E+06 | 2.254E+02 |
| 2010 | 8.213E+03 | 6.577E+06 | 4.419E+02 | 2.194E+03 | 3.288E+06 | 2.209E+02 |
| 2011 | 8.050E+03 | 6.446E+06 | 4.331E+02 | 2.150E+03 | 3.223E+06 | 2.166E+02 |
| 2012 | 7.891E+03 | 6.319E+06 | 4.246E+02 | 2.108E+03 | 3.159E+06 | 2.123E+02 |
| 2013 | 7.735E+03 | 6.194E+06 | 4.162E+02 | 2.066E+03 | 3.097E+06 | 2.081E+02 |
| 2014 | 7.582E+03 | 6.071E+06 | 4.079E+02 | 2.025E+03 | 3.036E+06 | 2.040E+02 |
| 2015 | 7.431E+03 | 5.951E+06 | 3.998E+02 | 1.985E+03 | 2.975E+06 | 1.999E+02 |
| 2016 | 7.284E+03 | 5.833E+06 | 3.919E+02 | 1.946E+03 | 2.916E+06 | 1.960E+02 |
| 2017 | 7.140E+03 | 5.717E+06 | 3.842E+02 | 1.907E+03 | 2.859E+06 | 1.921E+02 |
| 2018 | 6.999E+03 | 5.604E+06 | 3.765E+02 | 1.869E+03 | 2.802E+06 | 1.883E+02 |
| 2019 | 6.860E+03 | 5.493E+06 | 3.691E+02 | 1.832E+03 | 2.747E+06 | 1.845E+02 |
| 2020 | 6.724E+03 | 5.384E+06 | 3.618E+02 | 1.796E+03 | 2.692E+06 | 1.809E+02 |
| 2021 | 6.591E+03 | 5.278E+06 | 3.546E+02 | 1.761E+03 | 2.639E+06 | 1.773E+02 |
| 2022 | 6.461E+03 | 5.173E+06 | 3.476E+02 | 1.726E+03 | 2.587E+06 | 1.738E+02 |
| 2023 | 6.333E+03 | 5.071E+06 | 3.407E+02 | 1.692E+03 | 2.535E+06 | 1.704E+02 |
| 2024 | 6.207E+03 | 4.971E+06 | 3.340E+02 | 1.658E+03 | 2.485E+06 | 1.670E+02 |
| 2025 | 6.084E+03 | 4.872E+06 | 3.274E+02 | 1.625E+03 | 2.436E+06 | 1.637E+02 |
| 2026 | 5.964E+03 | 4.776E+06 | 3.209E+02 | 1.593E+03 | 2.388E+06 | 1.604E+02 |

## Results (Continued)

| Year | Total landfill gas | | | Methane | | |
|---|---|---|---|---|---|---|
| | (Mg/year) | ($m^3$/year) | (av ft^3/min) | (Mg/year) | ($m^3$/year) | (av ft^3/min) |
| 2027 | 5.846E+03 | 4.681E+06 | 3.145E+02 | 1.561E+03 | 2.341E+06 | 1.573E+02 |
| 2028 | 5.730E+03 | 4.588E+06 | 3.083E+02 | 1.531E+03 | 2.294E+06 | 1.541E+02 |
| 2029 | 5.617E+03 | 4.498E+06 | 3.022E+02 | 1.500E+03 | 2.249E+06 | 1.511E+02 |
| 2030 | 5.505E+03 | 4.408E+06 | 2.962E+02 | 1.471E+03 | 2.204E+06 | 1.481E+02 |
| 2031 | 5.396E+03 | 4.321E+06 | 2.903E+02 | 1.441E+03 | 2.161E+06 | 1.452E+02 |
| 2032 | 5.290E+03 | 4.236E+06 | 2.846E+02 | 1.413E+03 | 2.118E+06 | 1.423E+02 |
| 2033 | 7.287E+03 | 5.835E+06 | 3.920E+02 | 1.946E+03 | 2.917E+06 | 1.960E+02 |
| 2034 | 9.994E+03 | 8.003E+06 | 5.377E+02 | 2.670E+03 | 4.001E+06 | 2.689E+02 |
| 2035 | 1.271E+04 | 1.017E+07 | 6.836E+02 | 3.394E+03 | 5.087E+06 | 3.418E+02 |
| 2036 | 1.542E+04 | 1.235E+07 | 8.297E+02 | 4.119E+03 | 6.174E+06 | 4.148E+02 |
| 2037 | 1.814E+04 | 1.453E+07 | 9.761E+02 | 4.846E+03 | 7.264E+06 | 4.880E+02 |
| 2038 | 2.087E+04 | 1.671E+07 | 1.123E+03 | 5.574E+03 | 8.356E+06 | 5.614E+02 |
| 2039 | 2.360E+04 | 1.890E+07 | 1.270E+03 | 6.305E+03 | 9.451E+06 | 6.350E+02 |
| 2040 | 2.635E+04 | 2.110E+07 | 1.418E+03 | 7.038E+03 | 1.055E+07 | 7.088E+02 |
| 2041 | 2.910E+04 | 2.330E+07 | 1.566E+03 | 7.774E+03 | 1.165E+07 | 7.829E+02 |
| 2042 | 3.187E+04 | 2.552E+07 | 1.715E+03 | 8.512E+03 | 1.276E+07 | 8.573E+02 |
| 2043 | 3.465E+04 | 2.774E+07 | 1.864E+03 | 9.254E+03 | 1.387E+07 | 9.320E+02 |
| 2044 | 3.744E+04 | 2.998E+07 | 2.014E+03 | 9.999E+03 | 1.499E+07 | 1.007E+03 |
| 2045 | 4.024E+04 | 3.222E+07 | 2.165E+03 | 1.075E+04 | 1.611E+07 | 1.083E+03 |
| 2046 | 4.306E+04 | 3.448E+07 | 2.317E+03 | 1.150E+04 | 1.724E+07 | 1.158E+03 |
| 2047 | 4.477E+04 | 3.585E+07 | 2.409E+03 | 1.196E+04 | 1.792E+07 | 1.204E+03 |
| 2048 | 4.388E+04 | 3.514E+07 | 2.361E+03 | 1.172E+04 | 1.757E+07 | 1.180E+03 |
| 2049 | 4.301E+04 | 3.444E+07 | 2.314E+03 | 1.149E+04 | 1.722E+07 | 1.157E+03 |
| 2050 | 4.216E+04 | 3.376E+07 | 2.268E+03 | 1.126E+04 | 1.688E+07 | 1.134E+03 |
| 2051 | 4.133E+04 | 3.309E+07 | 2.223E+03 | 1.104E+04 | 1.655E+07 | 1.112E+03 |
| 2052 | 4.051E+04 | 3.244E+07 | 2.179E+03 | 1.082E+04 | 1.622E+07 | 1.090E+03 |
| 2053 | 3.971E+04 | 3.179E+07 | 2.136E+03 | 1.061E+04 | 1.590E+07 | 1.068E+03 |
| 2054 | 3.892E+04 | 3.117E+07 | 2.094E+03 | 1.040E+04 | 1.558E+07 | 1.047E+03 |
| 2055 | 3.815E+04 | 3.055E+07 | 2.053E+03 | 1.019E+04 | 1.527E+07 | 1.026E+03 |
| 2056 | 3.739E+04 | 2.994E+07 | 2.012E+03 | 9.988E+03 | 1.497E+07 | 1.006E+03 |
| 2057 | 3.665E+04 | 2.935E+07 | 1.972E+03 | 9.791E+03 | 1.468E+07 | 9.860E+02 |
| 2058 | 3.593E+04 | 2.877E+07 | 1.933E+03 | 9.597E+03 | 1.438E+07 | 9.665E+02 |
| 2059 | 3.522E+04 | 2.820E+07 | 1.895E+03 | 9.407E+03 | 1.410E+07 | 9.474E+02 |
| 2060 | 3.452E+04 | 2.764E+07 | 1.857E+03 | 9.220E+03 | 1.382E+07 | 9.286E+02 |
| 2061 | 3.384E+04 | 2.709E+07 | 1.820E+03 | 9.038E+03 | 1.355E+07 | 9.102E+02 |
| 2062 | 3.317E+04 | 2.656E+07 | 1.784E+03 | 8.859E+03 | 1.328E+07 | 8.922E+02 |
| 2063 | 3.251E+04 | 2.603E+07 | 1.749E+03 | 8.683E+03 | 1.302E+07 | 8.745E+02 |
| 2064 | 3.186E+04 | 2.552E+07 | 1.714E+03 | 8.511E+03 | 1.276E+07 | 8.572E+02 |
| 2065 | 3.123E+04 | 2.501E+07 | 1.680E+03 | 8.343E+03 | 1.251E+07 | 8.402E+02 |
| 2066 | 3.062E+04 | 2.452E+07 | 1.647E+03 | 8.178E+03 | 1.226E+07 | 8.236E+02 |
| 2067 | 3.001E+04 | 2.403E+07 | 1.615E+03 | 8.016E+03 | 1.202E+07 | 8.073E+02 |
| 2068 | 2.942E+04 | 2.355E+07 | 1.583E+03 | 7.857E+03 | 1.178E+07 | 7.913E+02 |
| 2069 | 2.883E+04 | 2.309E+07 | 1.551E+03 | 7.701E+03 | 1.154E+07 | 7.756E+02 |
| 2070 | 2.826E+04 | 2.263E+07 | 1.521E+03 | 7.549E+03 | 1.132E+07 | 7.603E+02 |
| 2071 | 2.770E+04 | 2.218E+07 | 1.490E+03 | 7.400E+03 | 1.109E+07 | 7.452E+02 |
| 2072 | 2.715E+04 | 2.174E+07 | 1.461E+03 | 7.253E+03 | 1.087E+07 | 7.305E+02 |
| 2073 | 2.662E+04 | 2.131E+07 | 1.432E+03 | 7.109E+03 | 1.066E+07 | 7.160E+02 |
| 2074 | 2.609E+04 | 2.089E+07 | 1.404E+03 | 6.969E+03 | 1.045E+07 | 7.018E+02 |
| 2075 | 2.557E+04 | 2.048E+07 | 1.376E+03 | 6.831E+03 | 1.024E+07 | 6.879E+02 |
| 2076 | 2.507E+04 | 2.007E+07 | 1.349E+03 | 6.695E+03 | 1.004E+07 | 6.743E+02 |
| 2077 | 2.457E+04 | 1.967E+07 | 1.322E+03 | 6.563E+03 | 9.837E+06 | 6.610E+02 |

## Results (Continued)

| Year | Total landfill gas | | | Methane | | |
|---|---|---|---|---|---|---|
| | (Mg/year) | ($m^3$/year) | (av ft^3/min) | (Mg/year) | ($m^3$/year) | (av ft^3/min) |
| 2078 | 2.408E+04 | 1.928E+07 | 1.296E+03 | 6.433E+03 | 9.642E+06 | 6.479E+02 |
| 2079 | 2.361E+04 | 1.890E+07 | 1.270E+03 | 6.305E+03 | 9.451E+06 | 6.350E+02 |
| 2080 | 2.314E+04 | 1.853E+07 | 1.245E+03 | 6.181E+03 | 9.264E+06 | 6.225E+02 |
| 2081 | 2.268E+04 | 1.816E+07 | 1.220E+03 | 6.058E+03 | 9.081E+06 | 6.101E+02 |
| 2082 | 2.223E+04 | 1.780E+07 | 1.196E+03 | 5.938E+03 | 8.901E+06 | 5.981E+02 |
| 2083 | 2.179E+04 | 1.745E+07 | 1.172E+03 | 5.821E+03 | 8.725E+06 | 5.862E+02 |
| 2084 | 2.136E+04 | 1.710E+07 | 1.149E+03 | 5.705E+03 | 8.552E+06 | 5.746E+02 |
| 2085 | 2.094E+04 | 1.677E+07 | 1.126E+03 | 5.592E+03 | 8.383E+06 | 5.632E+02 |
| 2086 | 2.052E+04 | 1.643E+07 | 1.104E+03 | 5.482E+03 | 8.217E+06 | 5.521E+02 |
| 2087 | 2.012E+04 | 1.611E+07 | 1.082E+03 | 5.373E+03 | 8.054E+06 | 5.411E+02 |
| 2088 | 1.972E+04 | 1.579E+07 | 1.061E+03 | 5.267E+03 | 7.894E+06 | 5.304E+02 |
| 2089 | 1.933E+04 | 1.548E+07 | 1.040E+03 | 5.162E+03 | 7.738E+06 | 5.199E+02 |
| 2090 | 1.894E+04 | 1.517E+07 | 1.019E+03 | 5.060E+03 | 7.585E+06 | 5.096E+02 |
| 2091 | 1.857E+04 | 1.487E+07 | 9.991E+02 | 4.960E+03 | 7.435E+06 | 4.995E+02 |
| 2092 | 1.820E+04 | 1.457E+07 | 9.793E+02 | 4.862E+03 | 7.287E+06 | 4.896E+02 |
| 2093 | 1.784E+04 | 1.429E+07 | 9.599E+02 | 4.766E+03 | 7.143E+06 | 4.799E+02 |
| 2094 | 1.749E+04 | 1.400E+07 | 9.409E+02 | 4.671E+03 | 7.002E+06 | 4.704E+02 |
| 2095 | 1.714E+04 | 1.373E+07 | 9.223E+02 | 4.579E+03 | 6.863E+06 | 4.611E+02 |
| 2096 | 1.680E+04 | 1.345E+07 | 9.040E+02 | 4.488E+03 | 6.727E+06 | 4.520E+02 |
| 2097 | 1.647E+04 | 1.319E+07 | 8.861E+02 | 4.399E+03 | 6.594E+06 | 4.430E+02 |
| 2098 | 1.614E+04 | 1.293E+07 | 8.686E+02 | 4.312E+03 | 6.463E+06 | 4.343E+02 |
| 2099 | 1.582E+04 | 1.267E+07 | 8.514E+02 | 4.227E+03 | 6.335E+06 | 4.257E+02 |
| 2100 | 1.551E+04 | 1.242E+07 | 8.345E+02 | 4.143E+03 | 6.210E+06 | 4.172E+02 |
| 2101 | 1.520E+04 | 1.217E+07 | 8.180E+02 | 4.061E+03 | 6.087E+06 | 4.090E+02 |
| 2102 | 1.490E+04 | 1.193E+07 | 8.018E+02 | 3.981E+03 | 5.966E+06 | 4.009E+02 |
| 2103 | 1.461E+04 | 1.170E+07 | 7.859E+02 | 3.902E+03 | 5.848E+06 | 3.929E+02 |
| 2104 | 1.432E+04 | 1.147E+07 | 7.703E+02 | 3.824E+03 | 5.733E+06 | 3.852E+02 |
| 2105 | 1.403E+04 | 1.124E+07 | 7.551E+02 | 3.749E+03 | 5.619E+06 | 3.775E+02 |
| 2106 | 1.376E+04 | 1.102E+07 | 7.401E+02 | 3.674E+03 | 5.508E+06 | 3.701E+02 |
| 2107 | 1.348E+04 | 1.080E+07 | 7.255E+02 | 3.602E+03 | 5.399E+06 | 3.627E+02 |
| 2108 | 1.322E+04 | 1.058E+07 | 7.111E+02 | 3.530E+03 | 5.292E+06 | 3.556E+02 |
| 2109 | 1.296E+04 | 1.037E+07 | 6.970E+02 | 3.461E+03 | 5.187E+06 | 3.485E+02 |
| 2110 | 1.270E+04 | 1.017E+07 | 6.832E+02 | 3.392E+03 | 5.084E+06 | 3.416E+02 |
| 2111 | 1.245E+04 | 9.967E+06 | 6.697E+02 | 3.325E+03 | 4.984E+06 | 3.348E+02 |
| 2112 | 1.220E+04 | 9.770E+06 | 6.564E+02 | 3.259E+03 | 4.885E+06 | 3.282E+02 |
| 2113 | 1.196E+04 | 9.576E+06 | 6.434E+02 | 3.194E+03 | 4.788E+06 | 3.217E+02 |
| 2114 | 1.172E+04 | 9.387E+06 | 6.307E+02 | 3.131E+03 | 4.693E+06 | 3.153E+02 |
| 2115 | 1.149E+04 | 9.201E+06 | 6.182E+02 | 3.069E+03 | 4.600E+06 | 3.091E+02 |
| 2116 | 1.126E+04 | 9.019E+06 | 6.060E+02 | 3.008E+03 | 4.509E+06 | 3.030E+02 |
| 2117 | 1.104E+04 | 8.840E+06 | 5.940E+02 | 2.949E+03 | 4.420E+06 | 2.970E+02 |

## Results (Continued)

| Year | Carbon dioxide | | | NMOC | | |
|---|---|---|---|---|---|---|
| | (Mg/year) | ($m^3$/year) | (av ft^3/min) | (Mg/year) | ($m^3$/year) | (av ft^3/min) |
| 1977 | 0 | 0 | 0 | 0. | 0 | 0 |
| 1978 | 2.053E+02 | 1.121E+05 | 7.534E+00 | 2.170E-01 | 6.055E+01 | 4.068E-03 |
| 1979 | 4.106E+02 | 2.243E+05 | 1.507E+01 | 4.342E-01 | 1.211E+02 | 8.139E-03 |
| 1980 | 6.162E+02 | 3.366E+05 | 2.262E+01 | 6.516E-01 | 1.818E+02 | 1.221E-02 |
| 1981 | 8.221E+02 | 4.491E+05 | 3.018E+01 | 8.693E-01 | 2.425E+02 | 1.630E-02 |
| 1982 | 1.028E+03 | 5.618E+05 | 3.775E+01 | 1.087E+00 | 3.034E+02 | 2.038E-02 |
| 1983 | 1.235E+03 | 6.747E+05 | 4.533E+01 | 1.306E+00 | 3.643E+02 | 2.448E-02 |
| 1984 | 1.442E+03 | 7.879E+05 | 5.294E+01 | 1.525E+00 | 4.255E+02 | 2.859E-02 |
| 1985 | 1.650E+03 | 9.015E+05 | 6.057E+01 | 1.745E+00 | 4.868E+02 | 3.271E-02 |
| 1986 | 1.859E+03 | 1.015E+06 | 6.823E+01 | 1.966E+00 | 5.483E+02 | 3.684E-02 |
| 1987 | 2.068E+03 | 1.130E+06 | 7.591E+01 | 2.187E+00 | 6.101E+02 | 4.099E-02 |
| 1988 | 2.278E+03 | 1.245E+06 | 8.363E+01 | 2.409E+00 | 6.721E+02 | 4.516E-02 |
| 1989 | 2.360E+03 | 1.289E+06 | 8.661E+01 | 2.495E+00 | 6.961E+02 | 4.677E-02 |
| 1990 | 2.435E+03 | 1.330E+06 | 8.938E+01 | 2.575E+00 | 7.183E+02 | 4.826E-02 |
| 1991 | 2.505E+03 | 1.368E+06 | 9.193E+01 | 2.648E+00 | 7.389E+02 | 4.964E-02 |
| 1992 | 2.549E+03 | 1.392E+06 | 9.355E+01 | 2.695E+00 | 7.519E+02 | 5.052E-02 |
| 1993 | 2.577E+03 | 1.408E+06 | 9.458E+01 | 2.725E+00 | 7.601E+02 | 5.107E-02 |
| 1994 | 2.643E+03 | 1.444E+06 | 9.700E+01 | 2.794E+00 | 7.796E+02 | 5.238E-02 |
| 1995 | 2.752E+03 | 1.503E+06 | 1.010E+02 | 2.910E+00 | 8.117E+02 | 5.454E-02 |
| 1996 | 2.865E+03 | 1.565E+06 | 1.052E+02 | 3.030E+00 | 8.453E+02 | 5.680E-02 |
| 1997 | 3.217E+03 | 1.757E+06 | 1.181E+02 | 3.401E+00 | 9.489E+02 | 6.376E-02 |
| 1998 | 3.592E+03 | 1.962E+06 | 1.318E+02 | 3.798E+00 | 1.060E+03 | 7.119E-02 |
| 1999 | 3.941E+03 | 2.153E+06 | 1.447E+02 | 4.168E+00 | 1.163E+03 | 7.812E-02 |
| 2000 | 4.188E+03 | 2.288E+06 | 1.537E+02 | 4.428E+00 | 1.235E+03 | 8.301E-02 |
| 2001 | 4.320E+03 | 2.360E+06 | 1.586E+02 | 4.568E+00 | 1.274E+03 | 8.562E-02 |
| 2002 | 4.736E+03 | 2.587E+06 | 1.738E+02 | 5.008E+00 | 1.397E+03 | 9.387E-02 |
| 2003 | 5.197E+03 | 2.839E+06 | 1.908E+02 | 5.495E+00 | 1.533E+03 | 1.030E-01 |
| 2004 | 5.638E+03 | 3.080E+06 | 2.070E+02 | 5.962E+00 | 1.663E+03 | 1.118E-01 |
| 2005 | 6.460E+03 | 3.529E+06 | 2.371E+02 | 6.831E+00 | 1.906E+03 | 1.280E-01 |
| 2006 | 6.469E+03 | 3.534E+06 | 2.375E+02 | 6.841E+00 | 1.908E+03 | 1.282E-01 |
| 2007 | 6.391E+03 | 3.492E+06 | 2.346E+02 | 6.758E+00 | 1.885E+03 | 1.267E-01 |
| 2008 | 6.265E+03 | 3.423E+06 | 2.300E+02 | 6.625E+00 | 1.848E+03 | 1.242E-01 |
| 2009 | 6.141E+03 | 3.355E+06 | 2.254E+02 | 6.493E+00 | 1.812E+03 | 1.217E-01 |
| 2010 | 6.019E+03 | 3.288E+06 | 2.209E+02 | 6.365E+00 | 1.776E+03 | 1.193E-01 |
| 2011 | 5.900E+03 | 3.223E+06 | 2.166E+02 | 6.239E+00 | 1.741E+03 | 1.169E-01 |
| 2012 | 5.783E+03 | 3.159E+06 | 2.123E+02 | 6.115E+00 | 1.706E+03 | 1.146E-01 |
| 2013 | 5.669E+03 | 3.097E+06 | 2.081E+02 | 5.994E+00 | 1.672E+03 | 1.124E-01 |
| 2014 | 5.556E+03 | 3.036E+06 | 2.040E+02 | 5.876E+00 | 1.639E+03 | 1.101E-01 |
| 2015 | 5.446E+03 | 2.975E+06 | 1.999E+02 | 5.759E+00 | 1.607E+03 | 1.080E-01 |
| 2016 | 5.339E+03 | 2.916E+06 | 1.960E+02 | 5.645E+00 | 1.575E+03 | 1.058E-01 |
| 2017 | 5.233E+03 | 2.859E+06 | 1.921E+02 | 5.533E+00 | 1.544E+03 | 1.037E-01 |
| 2018 | 5.129E+03 | 2.802E+06 | 1.883E+02 | 5.424E+00 | 1.513E+03 | 1.017E-01 |
| 2019 | 5.028E+03 | 2.747E+06 | 1.845E+02 | 5.316E+00 | 1.483E+03 | 9.965E-02 |
| 2020 | 4.928E+03 | 2.692E+06 | 1.809E+02 | 5.211E+00 | 1.454E+03 | 9.768E-02 |
| 2021 | 4.831E+03 | 2.639E+06 | 1.773E+02 | 5.108E+00 | 1.425E+03 | 9.575E-02 |
| 2022 | 4.735E+03 | 2.587E+06 | 1.738E+02 | 5.007E+00 | 1.397E+03 | 9.385E-02 |
| 2023 | 4.641E+03 | 2.535E+06 | 1.704E+02 | 4.908E+00 | 1.369E+03 | 9.199E-02 |
| 2024 | 4.549E+03 | 2.485E+06 | 1.670E+02 | 4.810E+00 | 1.342E+03 | 9.017E-02 |
| 2025 | 4.459E+03 | 2.436E+06 | 1.637E+02 | 4.715E+00 | 1.315E+03 | 8.839E-02 |
| 2026 | 4.371E+03 | 2.388E+06 | 1.604E+02 | 4.622E+00 | 1.289E+03 | 8.664E-02 |

## Results (Continued)

| Year | Carbon dioxide | | | NMOC | | |
|---|---|---|---|---|---|---|
| | (Mg/year) | ($m^3$/year) | (av ft^3/min) | (Mg/year) | ($m^3$/year) | (av ft^3/min) |
| 2027 | 4.284E+03 | 2.341E+06 | 1.573E+02 | 4.530E+00 | 1.264E+03 | 8.492E-02 |
| 2028 | 4.199E+03 | 2.294E+06 | 1.541E+02 | 4.441E+00 | 1.239E+03 | 8.324E-02 |
| 2029 | 4.116E+03 | 2.249E+06 | 1.511E+02 | 4.353E+00 | 1.214E+03 | 8.159E-02 |
| 2030 | 4.035E+03 | 2.204E+06 | 1.481E+02 | 4.267E+00 | 1.190E+03 | 7.997E-02 |
| 2031 | 3.955E+03 | 2.161E+06 | 1.452E+02 | 4.182E+00 | 1.167E+03 | 7.839E-02 |
| 2032 | 3.877E+03 | 2.118E+06 | 1.423E+02 | 4.099E+00 | 1.144E+03 | 7.684E-02 |
| 2033 | 5.340E+03 | 2.917E+06 | 1.960E+02 | 5.647E+00 | 1.575E+03 | 1.059E-01 |
| 2034 | 7.325E+03 | 4.001E+06 | 2.689E+02 | 7.745E+00 | 2.161E+03 | 1.452E-01 |
| 2035 | 9.312E+03 | 5.087E+06 | 3.418E+02 | 9.846E+00 | 2.747E+03 | 1.846E-01 |
| 2036 | 1.130E+04 | 6.174E+06 | 4.148E+02 | 1.195E+01 | 3.334E+03 | 2.240E-01 |
| 2037 | 1.330E+04 | 7.264E+06 | 4.880E+02 | 1.406E+01 | 3.922E+03 | 2.635E-01 |
| 2038 | 1.529E+04 | 8.356E+06 | 5.614E+02 | 1.617E+01 | 4.512E+03 | 3.032E-01 |
| 2039 | 1.730E+04 | 9.451E+06 | 6.350E+02 | 1.829E+01 | 5.103E+03 | 3.429E-01 |
| 2040 | 1.931E+04 | 1.055E+07 | 7.088E+02 | 2.042E+01 | 5.697E+03 | 3.828E-01 |
| 2041 | 2.133E+04 | 1.165E+07 | 7.829E+02 | 2.255E+01 | 6.292E+03 | 4.228E-01 |
| 2042 | 2.336E+04 | 1.276E+07 | 8.573E+02 | 2.470E+01 | 6.890E+03 | 4.629E-01 |
| 2043 | 2.539E+04 | 1.387E+07 | 9.320E+02 | 2.685E+01 | 7.490E+03 | 5.033E-01 |
| 2044 | 2.744E+04 | 1.499E+07 | 1.007E+03 | 2.901E+01 | 8.094E+03 | 5.438E-01 |
| 2045 | 2.949E+04 | 1.611E+07 | 1.083E+03 | 3.119E+01 | 8.700E+03 | 5.846E-01 |
| 2046 | 3.156E+04 | 1.724E+07 | 1.158E+03 | 3.337E+01 | 9.310E+03 | 6.255E-01 |
| 2047 | 3.281E+04 | 1.792E+07 | 1.204E+03 | 3.469E+01 | 9.679E+03 | 6.503E-01 |
| 2048 | 3.216E+04 | 1.757E+07 | 1.180E+03 | 3.401E+01 | 9.487E+03 | 6.375E-01 |
| 2049 | 3.152E+04 | 1.722E+07 | 1.157E+03 | 3.333E+01 | 9.300E+03 | 6.248E-01 |
| 2050 | 3.090E+04 | 1.688E+07 | 1.134E+03 | 3.267E+01 | 9.115E+03 | 6.125E-01 |
| 2051 | 3.029E+04 | 1.655E+07 | 1.112E+03 | 3.203E+01 | 8.935E+03 | 6.003E-01 |
| 2052 | 2.969E+04 | 1.622E+07 | 1.090E+03 | 3.139E+01 | 8.758E+03 | 5.885E-01 |
| 2053 | 2.910E+04 | 1.590E+07 | 1.068E+03 | 3.077E+01 | 8.585E+03 | 5.768E-01 |
| 2054 | 2.852E+04 | 1.558E+07 | 1.047E+03 | 3.016E+01 | 8.415E+03 | 5.654E-01 |
| 2055 | 2.796E+04 | 1.527E+07 | 1.026E+03 | 2.956E+01 | 8.248E+03 | 5.542E-01 |
| 2056 | 2.741E+04 | 1.497E+07 | 1.006E+03 | 2.898E+01 | 8.085E+03 | 5.432E-01 |
| 2057 | 2.686E+04 | 1.468E+07 | 9.860E+02 | 2.841E+01 | 7.925E+03 | 5.325E-01 |
| 2058 | 2.633E+04 | 1.438E+07 | 9.665E+02 | 2.784E+01 | 7.768E+03 | 5.219E-01 |
| 2059 | 2.581E+04 | 1.410E+07 | 9.474E+02 | 2.729E+01 | 7.614E+03 | 5.116E-01 |
| 2060 | 2.530E+04 | 1.382E+07 | 9.286E+02 | 2.675E+01 | 7.463E+03 | 5.014E-01 |
| 2061 | 2.480E+04 | 1.355E+07 | 9.102E+02 | 2.622E+01 | 7.315E+03 | 4.915E-01 |
| 2062 | 2.431E+04 | 1.328E+07 | 8.922E+02 | 2.570E+01 | 7.170E+03 | 4.818E-01 |
| 2063 | 2.383E+04 | 1.302E+07 | 8.745E+02 | 2.519E+01 | 7.028E+03 | 4.722E-01 |
| 2064 | 2.335E+04 | 1.276E+07 | 8.572E+02 | 2.469E+01 | 6.889E+03 | 4.629E-01 |
| 2065 | 2.289E+04 | 1.251E+07 | 8.402E+02 | 2.421E+01 | 6.753E+03 | 4.537E-01 |
| 2066 | 2.244E+04 | 1.226E+07 | 8.236E+02 | 2.373E+01 | 6.619E+03 | 4.447E-01 |
| 2067 | 2.199E+04 | 1.202E+07 | 8.073E+02 | 2.326E+01 | 6.488E+03 | 4.359E-01 |
| 2068 | 2.156E+04 | 1.178E+07 | 7.913E+02 | 2.280E+01 | 6.360E+03 | 4.273E-01 |
| 2069 | 2.113E+04 | 1.154E+07 | 7.756E+02 | 2.234E+01 | 6.234E+03 | 4.188E-01 |
| 2070 | 2.071E+04 | 1.132E+07 | 7.603E+02 | 2.190E+01 | 6.110E+03 | 4.105E-01 |
| 2071 | 2.030E+04 | 1.109E+07 | 7.452E+02 | 2.147E+01 | 5.989E+03 | 4.024E-01 |
| 2072 | 1.990E+04 | 1.087E+07 | 7.305E+02 | 2.104E+01 | 5.871E+03 | 3.945E-01 |
| 2073 | 1.951E+04 | 1.066E+07 | 7.160E+02 | 2.063E+01 | 5.754E+03 | 3.866E-01 |
| 2074 | 1.912E+04 | 1.045E+07 | 7.018E+02 | 2.022E+01 | 5.640E+03 | 3.790E-01 |
| 2075 | 1.874E+04 | 1.024E+07 | 6.879E+02 | 1.982E+01 | 5.529E+03 | 3.715E-01 |
| 2076 | 1.837E+04 | 1.004E+07 | 6.743E+02 | 1.943E+01 | 5.419E+03 | 3.641E-01 |
| 2077 | 1.801E+04 | 9.837E+06 | 6.610E+02 | 1.904E+01 | 5.312E+03 | 3.569E-01 |

## Results (Continued)

| Year | Carbon dioxide | | | NMOC | | |
|---|---|---|---|---|---|---|
| | (Mg/year) | ($m^3$/year) | (av ft^3/min) | (Mg/year) | ($m^3$/year) | (av ft^3/min) |
| 2078 | 1.765E+04 | 9.642E+06 | 6.479E+02 | 1.866E+01 | 5.207E+03 | 3.498E-01 |
| 2079 | 1.730E+04 | 9.451E+06 | 6.350E+02 | 1.829E+01 | 5.104E+03 | 3.429E-01 |
| 2080 | 1.696E+04 | 9.264E+06 | 6.225E+02 | 1.793E+01 | 5.003E+03 | 3.361E-01 |
| 2081 | 1.662E+04 | 9.081E+06 | 6.101E+02 | 1.758E+01 | 4.904E+03 | 3.295E-01 |
| 2082 | 1.629E+04 | 8.901E+06 | 5.981E+02 | 1.723E+01 | 4.807E+03 | 3.229E-01 |
| 2083 | 1.597E+04 | 8.725E+06 | 5.862E+02 | 1.689E+01 | 4.711E+03 | 3.166E-01 |
| 2084 | 1.565E+04 | 8.552E+06 | 5.746E+02 | 1.655E+01 | 4.618E+03 | 3.103E-01 |
| 2085 | 1.534E+04 | 8.383E+06 | 5.632E+02 | 1.623E+01 | 4.527E+03 | 3.041E-01 |
| 2086 | 1.504E+04 | 8.217E+06 | 5.521E+02 | 1.590E+01 | 4.437E+03 | 2.981E-01 |
| 2087 | 1.474E+04 | 8.054E+06 | 5.411E+02 | 1.559E+01 | 4.349E+03 | 2.922E-01 |
| 2088 | 1.445E+04 | 7.894E+06 | 5.304E+02 | 1.528E+01 | 4.263E+03 | 2.864E-01 |
| 2089 | 1.416E+04 | 7.738E+06 | 5.199E+02 | 1.498E+01 | 4.179E+03 | 2.808E-01 |
| 2090 | 1.388E+04 | 7.585E+06 | 5.096E+02 | 1.468E+01 | 4.096E+03 | 2.752E-01 |
| 2091 | 1.361E+04 | 7.435E+06 | 4.995E+02 | 1.439E+01 | 4.015E+03 | 2.697E-01 |
| 2092 | 1.334E+04 | 7.287E+06 | 4.896E+02 | 1.411E+01 | 3.935E+03 | 2.644E-01 |
| 2093 | 1.308E+04 | 7.143E+06 | 4.799E+02 | 1.383E+01 | 3.857E+03 | 2.592E-01 |
| 2094 | 1.282E+04 | 7.002E+06 | 4.704E+02 | 1.355E+01 | 3.781E+03 | 2.540E-01 |
| 2095 | 1.256E+04 | 6.863E+06 | 4.611E+02 | 1.328E+01 | 3.706E+03 | 2.490E-01 |
| 2096 | 1.231E+04 | 6.727E+06 | 4.520E+02 | 1.302E+01 | 3.633E+03 | 2.441E-01 |
| 2097 | 1.207E+04 | 6.594E+06 | 4.430E+02 | 1.276E+01 | 3.561E+03 | 2.392E-01 |
| 2098 | 1.183E+04 | 6.463E+06 | 4.343E+02 | 1.251E+01 | 3.490E+03 | 2.345E-01 |
| 2099 | 1.160E+04 | 6.335E+06 | 4.257E+02 | 1.226E+01 | 3.421E+03 | 2.299E-01 |
| 2100 | 1.137E+04 | 6.210E+06 | 4.172E+02 | 1.202E+01 | 3.353E+03 | 2.253E-01 |
| 2101 | 1.114E+04 | 6.087E+06 | 4.090E+02 | 1.178E+01 | 3.287E+03 | 2.209E-01 |
| 2102 | 1.092E+04 | 5.966E+06 | 4.009E+02 | 1.155E+01 | 3.222E+03 | 2.165E-01 |
| 2103 | 1.071E+04 | 5.848E+06 | 3.929E+02 | 1.132E+01 | 3.158E+03 | 2.122E-01 |
| 2104 | 1.049E+04 | 5.733E+06 | 3.852E+02 | 1.110E+01 | 3.096E+03 | 2.080E-01 |
| 2105 | 1.029E+04 | 5.619E+06 | 3.775E+02 | 1.088E+01 | 3.034E+03 | 2.039E-01 |
| 2106 | 1.008E+04 | 5.508E+06 | 3.701E+02 | 1.066E+01 | 2.974E+03 | 1.998E-01 |
| 2107 | 9.882E+03 | 5.399E+06 | 3.627E+02 | 1.045E+01 | 2.915E+03 | 1.959E-01 |
| 2108 | 9.687E+03 | 5.292E+06 | 3.556E+02 | 1.024E+01 | 2.858E+03 | 1.920E-01 |
| 2109 | 9.495E+03 | 5.187E+06 | 3.485E+02 | 1.004E+01 | 2.801E+03 | 1.882E-01 |
| 2110 | 9.307E+03 | 5.084E+06 | 3.416E+02 | 9.841E+00 | 2.746E+03 | 1.845E-01 |
| 2111 | 9.123E+03 | 4.984E+06 | 3.348E+02 | 9.646E+00 | 2.691E+03 | 1.808E-01 |
| 2112 | 8.942E+03 | 4.885E+06 | 3.282E+02 | 9.455E+00 | 2.638E+03 | 1.772E-01 |
| 2113 | 8.765E+03 | 4.788E+06 | 3.217E+02 | 9.268E+00 | 2.586E+03 | 1.737E-01 |
| 2114 | 8.591E+03 | 4.693E+06 | 3.153E+02 | 9.085E+00 | 2.534E+03 | 1.703E-01 |
| 2115 | 8.421E+03 | 4.600E+06 | 3.091E+02 | 8.905E+00 | 2.484E+03 | 1.669E-01 |
| 2116 | 8.254E+03 | 4.509E+06 | 3.030E+02 | 8.728E+00 | 2.435E+03 | 1.636E-01 |
| 2117 | 8.091E+03 | 4.420E+06 | 2.970E+02 | 8.556E+00 | 2.387E+03 | 1.604E-01 |

INVENTORY **Landfill Name or Identifier:** McCombs #729A, Inventory, waste report data

Enter year of emissions inventory: 2047

| Gas / Pollutant | Emission Rate | | | | |
|---|---|---|---|---|---|
| | (Mg/year) | ($m^3$/year) | (av $ft^3$/min) | ($ft^3$/year) | (short tons/year) |
| Total landfill gas | 4.477E+04 | 3.585E+07 | 2.409E+03 | 1.266E+09 | 4.925E+04 |
| Methane | 1.196E+04 | 1.792E+07 | 1.204E+03 | 6.330E+08 | 1.315E+04 |
| Carbon dioxide | 3.281E+04 | 1.792E+07 | 1.204E+03 | 6.330E+08 | 3.609E+04 |
| NMOC | 3.469E+01 | 9.679E+03 | 6.503E-01 | 3.418E+05 | 3.816E+01 |
| 1,1,1-Trichloroethane (methyl chloroform) - HAP | 9.548E-02 | 1.721E+01 | 1.156E-03 | 6.077E+02 | 1.050E-01 |
| 1,1,2,2-Tetrachloroethane - HAP/VOC | 2.753E-01 | 3.943E+01 | 2.650E-03 | 1.393E+03 | 3.028E-01 |
| 1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC | 3.542E-01 | 8.604E+01 | 5.781E-03 | 3.038E+03 | 3.896E-01 |
| 1,1-Dichloroethene (vinylidene chloride) - HAP/VOC | 2.891E-02 | 7.170E+00 | 4.817E-04 | 2.532E+02 | 3.180E-02 |
| 1,2-Dichloroethane (ethylene dichloride) - HAP/VOC | 6.050E-02 | 1.470E+01 | 9.876E-04 | 5.191E+02 | 6.655E-02 |
| 1,2-Dichloropropane (propylene dichloride) - HAP/VOC | 3.033E-02 | 6.453E+00 | 4.336E-04 | 2.279E+02 | 3.336E-02 |
| 2-Propanol (isopropyl alcohol) - VOC | 4.481E+00 | 1.792E+03 | 1.204E-01 | 6.330E+04 | 4.929E+00 |
| Acetone | 6.062E-01 | 2.509E+02 | 1.686E-02 | 8.862E+03 | 6.668E-01 |
| Acrylonitrile - HAP/VOC | 4.984E-01 | 2.258E+02 | 1.517E-02 | 7.976E+03 | 5.483E-01 |
| Benzene - No or Unknown Co-disposal - HAP/VOC | 2.213E-01 | 6.811E+01 | 4.576E-03 | 2.405E+03 | 2.434E-01 |
| Benzene - Co-disposal - HAP/VOC | 1.281E+00 | 3.943E+02 | 2.650E-02 | 1.393E+04 | 1.409E+00 |
| Bromodichloromethane - VOC | 7.573E-01 | 1.111E+02 | 7.467E-03 | 3.925E+03 | 8.330E-01 |
| Butane - VOC | 4.333E-01 | 1.792E+02 | 1.204E-02 | 6.330E+03 | 4.766E-01 |
| Carbon disulfide - HAP/VOC | 6.584E-02 | 2.079E+01 | 1.397E-03 | 7.343E+02 | 7.242E-02 |
| Carbon monoxide | 5.847E+00 | 5.019E+03 | 3.372E-01 | 1.772E+05 | 6.432E+00 |
| Carbon tetrachloride - HAP/VOC | 9.175E-04 | 1.434E-01 | 9.635E-06 | 5.064E+00 | 1.009E-03 |
| Carbonyl sulfide - HAP/VOC | 4.389E-02 | 1.757E+01 | 1.180E-03 | 6.203E+02 | 4.828E-02 |
| Chlorobenzene - HAP/VOC | 4.196E-02 | 8.962E+00 | 6.022E-04 | 3.165E+02 | 4.615E-02 |
| Chlorodifluoromethane | 1.676E-01 | 4.660E+01 | 3.131E-03 | 1.646E+03 | 1.844E-01 |
| Chloroethane (ethyl chloride) - HAP/VOC | 1.251E-01 | 4.660E+01 | 3.131E-03 | 1.646E+03 | 1.376E-01 |
| Chloroform - HAP/VOC | 5.340E-03 | 1.075E+00 | 7.226E-05 | 3.798E+01 | 5.875E-03 |
| Chloromethane - VOC | 9.034E-02 | 4.302E+01 | 2.890E-03 | 1.519E+03 | 9.937E-02 |
| Dichlorobenzene - (HAP for para isomer/VOC) | 4.603E-02 | 7.528E+00 | 5.058E-04 | 2.659E+02 | 5.063E-02 |
| Dichlorodifluoromethane | 2.885E+00 | 5.736E+02 | 3.854E-02 | 2.026E+04 | 3.173E+00 |
| Dichlorofluoromethane - VOC | 3.990E-01 | 9.321E+01 | 6.263E-03 | 3.292E+03 | 4.389E-01 |
| Dichloromethane (methylene chloride) - HAP | 1.773E+00 | 5.019E+02 | 3.372E-02 | 1.772E+04 | 1.950E+00 |
| Dimethyl sulfide (methyl sulfide) - VOC | 7.226E-01 | 2.796E+02 | 1.879E-02 | 9.875E+03 | 7.948E-01 |
| Ethane | 3.990E+01 | 3.191E+04 | 2.144E+00 | 1.127E+06 | 4.389E+01 |
| Ethanol - VOC | 1.855E+00 | 9.679E+02 | 6.503E-02 | 3.418E+04 | 2.041E+00 |
| Ethyl mercaptan (ethanethiol) - VOC | 2.131E-01 | 8.245E+01 | 5.540E-03 | 2.912E+03 | 2.344E-01 |
| Ethylbenzene - HAP/VOC | 7.281E-01 | 1.649E+02 | 1.108E-02 | 5.824E+03 | 8.009E-01 |
| Ethylene dibromide - HAP/VOC | 2.801E-04 | 3.585E-02 | 2.409E-06 | 1.266E+00 | 3.082E-04 |
| Fluorotrichloromethane - VOC | 1.557E-01 | 2.724E+01 | 1.831E-03 | 9.622E+02 | 1.712E-01 |
| Hexane - HAP/VOC | 8.481E-01 | 2.366E+02 | 1.590E-02 | 8.356E+03 | 9.329E-01 |
| Hydrogen sulfide | 1.829E+00 | 1.291E+03 | 8.671E-02 | 4.558E+04 | 2.012E+00 |
| Mercury (total) - HAP | 8.674E-05 | 1.040E-02 | 6.985E-07 | 3.671E-01 | 9.542E-05 |
| Methyl ethyl ketone - HAP/VOC | 7.634E-01 | 2.545E+02 | 1.710E-02 | 8.989E+03 | 8.397E-01 |
| Methyl isobutyl ketone - HAP/VOC | 2.838E-01 | 6.811E+01 | 4.576E-03 | 2.405E+03 | 3.121E-01 |
| Methyl mercaptan - VOC | 1.793E-01 | 8.962E+01 | 6.022E-03 | 3.165E+03 | 1.973E-01 |
| Pentane - VOC | 3.550E-01 | 1.183E+02 | 7.949E-03 | 4.178E+03 | 3.905E-01 |
| Perchloroethylene (tetrachloroethylene) - HAP | 9.149E-01 | 1.326E+02 | 8.912E-03 | 4.684E+03 | 1.006E+00 |
| Propane - VOC | 7.231E-01 | 3.943E+02 | 2.650E-02 | 1.393E+04 | 7.955E-01 |
| t-1,2-Dichloroethene - VOC | 4.047E-01 | 1.004E+02 | 6.744E-03 | 3.545E+03 | 4.452E-01 |
| Toluene - No or Unknown Co-disposal - HAP/VOC | 5.357E+00 | 1.398E+03 | 9.394E-02 | 4.937E+04 | 5.893E+00 |
| Toluene - Co-disposal - HAP/VOC | 2.335E+01 | 6.094E+03 | 4.095E-01 | 2.152E+05 | 2.569E+01 |
| Trichloroethylene (trichloroethene) - HAP/VOC | 5.486E-01 | 1.004E+02 | 6.744E-03 | 3.545E+03 | 6.034E-01 |
| Vinyl chloride - HAP/VOC | 6.803E-01 | 2.617E+02 | 1.758E-02 | 9.242E+03 | 7.483E-01 |
| Xylenes - HAP/VOC | 1.899E+00 | 4.302E+02 | 2.890E-02 | 1.519E+04 | 2.089E+00 |
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**Tier 2 NMOC Sampling and Analyis Results - March 2007**
**McCombs Landfill, MSW Permit No. 729A**

| Summary of Tier 2 NMOC Concentration Results | | |
|---|---|---|
| Sample ID | $NMOC_{Carbon}$ (ppmv) | $NMOC_{Hexane}$ (ppmv) |
| #1373, Pts 2E, 4E, 6E | 3700 | 617 |
| #1444, Pts 6G, 4G, 2G | 3800 | 633 |
| #1441, Pts 2H, 4I, 6I | 2900 | 483 |
| #5971, Pts 3Y, 6Y, 9X | 900 | 150 |
| #3103, Pts 9W, 6X, 3X | 1200 | 200 |
| #11252, Pts 3W, 6W, 6U | 880 | 147 |
| #1359, Pts 9Y, 3W, 6.5Q | 1300 | 217 |
| #1365, Pts. 6.5P, 6.5M, 6.5N | 2200 | 367 |
| #1351, Pts 6.5O, 2.5L, 2.5K | 2000 | 333 |
| #1297, Pts 2.5J, 2.5I, 2.5H | 1300 | 217 |
| #3579, Pts. 12T, 12S, 12R | 990 | 165 |
| #5956, Pts. 12Q, 12P, 12P-I | 1100 | 183 |
| #3737, Pts. 12O, 12N, 12M | 1400 | 233 |
| #6061, Pts. 12L, 12J, 18J | 790 | 132 |
| #02010, Pts. 18L, 18M, 18N | 1100 | 183 |
| #5963, Pts. 18O, 18P, 18Q | 980 | 163 |
| #3744, Pts 18R, 18T | 990 | 165 |
| **Average** | **1619** | **270** |

Notes:
1. NMOC as Hexane was calculated by dividing the NMOC as Carbon concentration by six.

**Archana, Inc**
Environmental and Geotechnical Engineering Consultants

March 21, 2007 
Proposal No. 021407021
Tier 2 McCombs Landfill

City of El Paso
Environmental Management Division
Environmental Services Department
7969 San Paulo Dr.
El Paso, TX 79915
Attn: John Garza, P.E.

RE: Tier 2 NMOC McCombs Landfill

Dear Mr. Garza,

Archana Inc. submits this report, which presents the results for the Tier II analysis of the McCombs Landfill. These results of the Tier II testing were used to calculate the potential Non-methane Organic Carbon (NMOC) emissions at the landfill. Tier II sampling and analysis were performed in general accordance with 40 CFR 60.754(a) (3) using Method 25-C and Method 3-C to evaluate NMOC concentrations. Included in this letter, you will find field sampling techniques, results of laboratory testing.

**Field Sampling**

Environmental Services Network South completed sampling of landfill gas at the following sites shown in Figure 1 attached in this letter. Sampling depth is 6' (3' of screen), the installation of inline water trap at top of probe rod, which connects the summa canister assembly (vacuum gauge, cross flow valve to Landtech, and flow limiter) to the summa canister. Test the gases with the Landtech unit to determine that ambient air has not been drawn into the system. Log the $O_2$, $CO_2$, and $CH_4$ readings. The combined $CO_2$ and $CH_4$ should be greater than 90%, and the $O_2$ reading should be in the 1% range. Once methane and carbon dioxide levels have become constant, the summa valve and the 2-way valve are opened sampling of the landfill gas at a rate of approximately 250ml/min. A 1-liter sample will be taken in 4 minutes. The flow limiter may need to be adjusted due to changes in vacuum. At 250ml/min the vacuum will drop .1"hg every 5-6 seconds. The samples were composite three points per canister and were shipped to Air Technologies for analysis.

**Laboratory Analysis**

Landfill gas was submitted to Air Technologies for testing. As required by Method 25-C, NMOC concentrations were corrected for nitrogen and moisture content. Using the corrected results, a NMOC concentration of hexane was measured. Results of analytical testing are attached to this report.

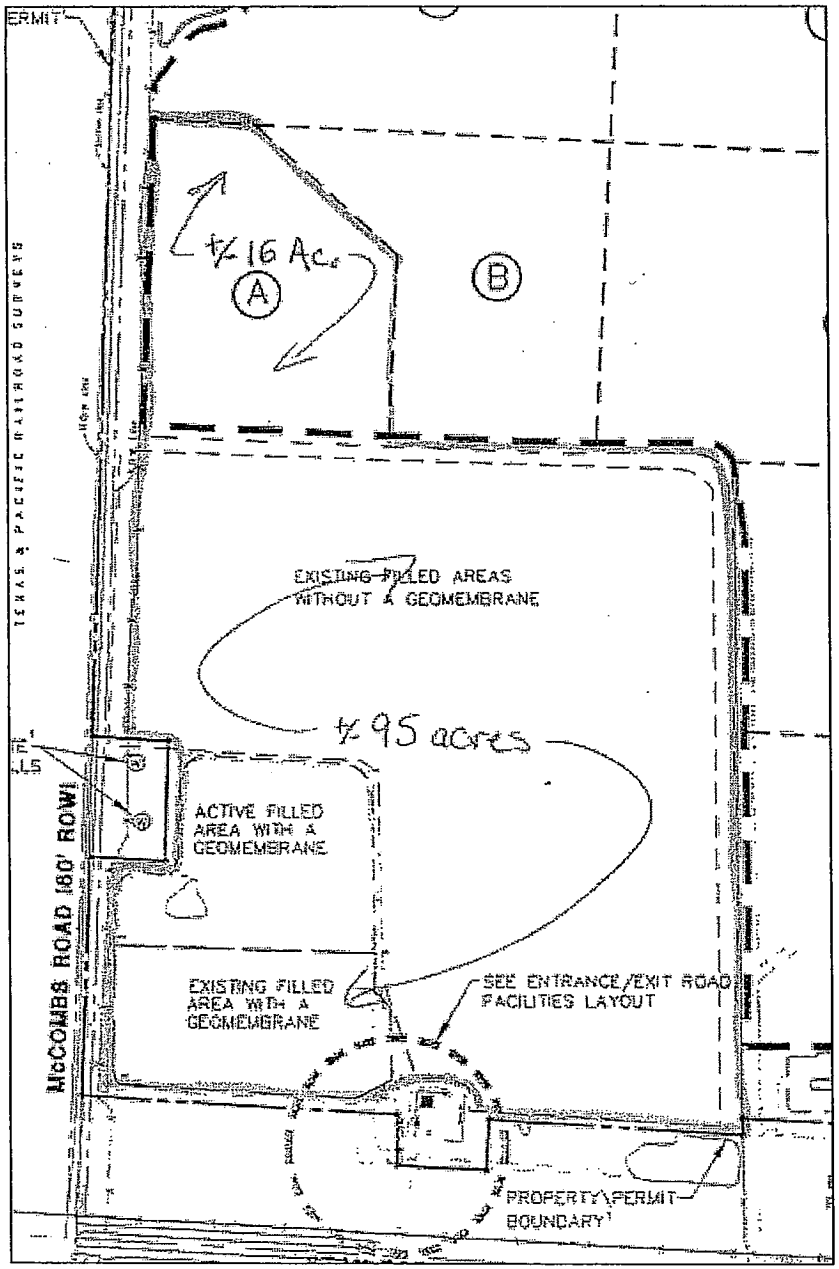
March 21, 2007
Proposal No. 021407021
Tier 2 McCombs Landfill

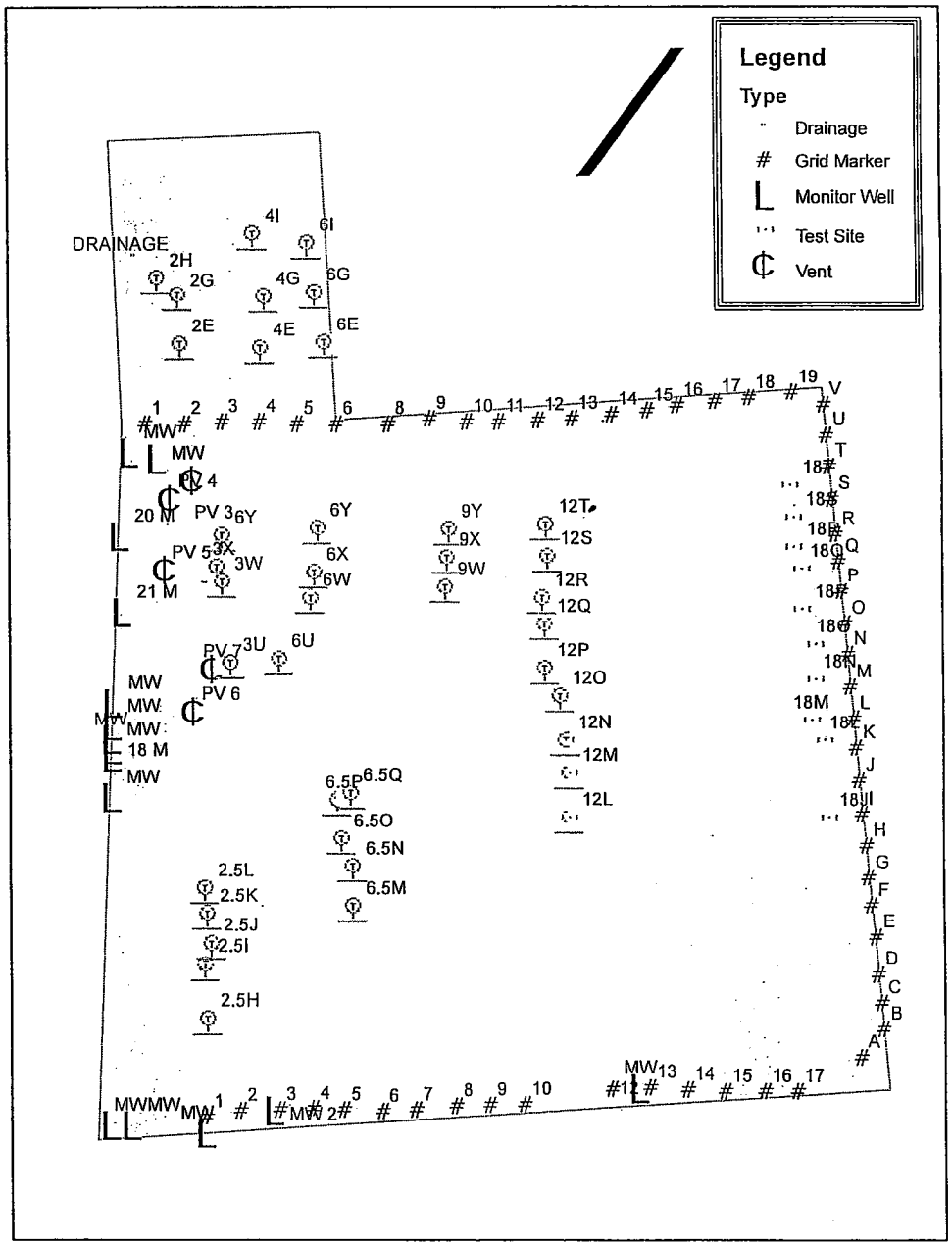


Sincerely,

Pratap G. Reddy, Ph.D.
President
Archana, Inc.

# McCombs Landfill Tier II Testing




0 0.5 1 2 3 4 Miles

# CHAIN OF CUSTODY RECORD

AirTECHNOLOGY Laboratories, Inc.
18501 E. Gale Avenue, Suite 130
City of Industry, CA 91748
626-964-4032 • Fax: 626-964-5832

Project Name: City of El Paso McCombs Landfill
Project #: Tier II
P.O. #:

**FOR LABORATORY USE ONLY**

Method of Transport: Walk-in ☐ Courier ☐ UPS ☐ FedEx ☐ ATL ☐

Sample Condition Upon Receipt
1. CHILLED Y☐ N☐ 4. SEALED Y☐ N☐
2. HEADSPACE (VOA) Y☐ N☐ 5. # OF SPLS MATCH COC Y☐ N☐
3. CONTAINER INTACT Y☐ N☐ 6. PRESERVED Y☐ N☐

Company: Arcadis Inc
Contact: Elizabeth Gonzales
Address: 1155 Larry Mahan Suite B
City El Paso State Texas Zip Code 79925
TEL: (915) 599-2183
FAX: (915) 592-4659

| | Date: | Time: | Received by: (Signature and Printed Name) | Date: | Time: |
|---|---|---|---|---|---|
| Sampled/Relinquished by: (Signature and Printed Name) Dan Christian | 3/8/07 | 1300 | | | |
| Relinquished by: (Signature and Printed Name) FEDEX | 3/12/07 | 0900 | Received by: (Signature and Printed Name) Joann DeLaOssa | 3/12/07 | 0900 |
| Relinquished by: (Signature and Printed Name) | | | Received by: (Signature and Printed Name) | | |

I hereby authorize ATL to perform the work indicated below:
PRATAP REDDY 3/8/07
Project Mgr./Submitter (Print Name) Date
Signature

Send Report To:
Attn: Elizabeth Gonzales
Co: Arcadis Inc
Address 1155 Larry Mahan Suite B
City El Paso State TX Zip 79925

Bill To: ESN-South
Attn: Rolf Woods
Co: ESN-South
Address 14493 SPID # A388
City Corpus Christi State TX Zip 78418

Special Instructions/Comments:

Unless otherwise requested, all samples will be disposed 14 days after reporting or at Lab's discretion.

Sample Archive/Disposal:
☐ Laboratory Standard
☐ Other
☐ Return To:
* $10.00 FEE PER HAZARDOUS SAMPLE DISPOSAL.

Circle or Add Analysis(es) Requested

CIRCLE APPROPRIATE MATRIX: AIR • VAPOR; INDOOR AIR; LANDFILL GAS; WATER; SOLID • SOIL; OIL • SOLVENT • LIQUID; OTHER

| LAB USE ONLY Lab No. | Sample Description: Sample I.D. | Date | Time | T03 Gas / BTEX / MTBE | T03 Hexane | T03 Carbon Chain | TO14A VOCs | TO15 VOCs Std or Low Level | 15/16 Sulfur Comp Std/Low Level | 15/16 H2S Std or Low Level | Fixed Gas D1946 or 3C | 25C/3C TNMOC | 25.1 TGNMHC | D1945 Natural Gas | RSK 175 Dissolved Gas | TAT | Container(s) # | Container(s) Type | PRESERVATION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A7031204-11 | #3574 pTS. 12T, 12S, 12R | 3/7/07 | | | | | | | | | X | | | | | E | 11 | C | | |
| -12 | #5956 pTS. 12Q, 12P, 12P-1 | 3/7/07 | | | | | | | | | X | | | | | E | 12 | C | | |
| -13 | #3737 pTS. 12O, 12N, 12M | 3/7/07 | | | | | | | | | X | | | | | E | 13 | C | | |
| — | #1415 DO NOT USE | | | | | | | | | | | | | | | | 14 | | | |
| A7031204-14 | #6061 pTS. 12L, 12J, 18J | 3/8/07 | | | | | | | | | X | | | | | E | 15 | C | | |
| -15 | #02010 pTS. 18L, 18M, 18N | 3/8/07 | | | | | | | | | X | | | | | E | 16 | C | | |
| -16 | #5963 pTS. 18O, 18L, 18Q | 3/8/07 | | | | | | | | | X | | | | | E | 17 | C | | |
| -17 | #3744 pTS. 18R, 18T | 3/8/07 | | | | | | | | | X | | | | | E | 18 | C | | |
| — | #1375 NOT used | | | | | | | | | | | | | | | | 19 | | | |

DELIVERABLES: EDD ☐ LEVEL III ☐ LEVEL IV ☐

• TAT starts 8 a.m. following day if samples received after 5 p.m.

TAT: A=Overnight ≤ 24 hr B=Emergency Next workday C=Critical 2 Workdays D=Urgent 3 Workdays E=Routine 7 Workdays

Container Types: B=Tedlar Bag C=Canister V=VOA O= Other

Preservatives: H=Hcl N=None

DISTRIBUTION: White with report, Yellow to folder, Pink to submitter.

Revised November 2, 2012

# CHAIN OF CUSTODY RECORD

AIR TECHNOLOGY Laboratories, Inc.
18501 E. Gale Avenue, Suite 130
City of Industry, CA 91748
626-964-4032 • Fax: 626-964-5832

Project Name: City of El Paso McCombs landfill
Project #: Tier II
P.O. #:

**FOR LABORATORY USE ONLY**

Method of Transport: Walk-in ☐ Courier ☐ UPS ☐ FedEx ☐ ATL ☐

Sample Condition Upon Receipt
1. CHILLED Y☐ N☐ 4. SEALED Y☐ N☐
2. HEADSPACE (VOA) Y☐ N☐ 5. # OF SPLS MATCH COC Y☐ N☐
3. CONTAINER INTACT Y☐ N☐ 6. PRESERVED Y☐ N☐

Company: Archana INC
Contact: Elizabeth Gonzales
Address: 1155 Larry Mahan Suite B
City El Paso State Texas Zip Code 79925
TEL: (915) 599-2183
FAX: (915) 592-4659

| Sampled/Relinquished by: (Signature and Printed Name) | Date: | Time: | Received by: (Signature and Printed Name) | Date: | Time: |
|---|---|---|---|---|---|
| Don Christain | 3/8/07 | 1300 | | | |
| Relinquished by: (Signature and Printed Name) FEDEX | Date: 3/12/07 | Time: 0900 | Received by: (Signature and Printed Name) Joann DeLaOssa | Date: 3/12/07 | Time: 0900 |
| Relinquished by: (Signature and Printed Name) | Date: | Time: | Received by: (Signature and Printed Name) | Date: | Time: |

I hereby authorize ATL to perform the work indicated below:
PRATAP REDDY 3/8/07
Project Mgr./Submitter (Print Name) Date
Signature

Send Report To:
Attn: Elizabeth Gonzales
Co: Archana Inc
Address 1155 Larry Mahan Suite B
City El Paso State TX Zip 79925

Bill To: ESN-South
Attn: Rolf Woods
Co: ESN-South
Address 14993 SPID # A388
City Corpus Christi State TX Zip 78418

Special Instructions/Comments:

Unless otherwise requested, all samples will be disposed 14 days after reporting or at Lab's discretion.

Sample Archive/Disposal:
☐ Laboratory Standard
☐ Other
☐ Return To:
* $10.00 FEE PER HAZARDOUS SAMPLE DISPOSAL.

Circle or Add Analysis(es) Requested

CIRCLE APPROPRIATE MATRIX: AIR • VAPOR / INDOOR AIR / LANDFILL GAS / WATER / SOLID • SOIL / OIL • SOLVENT • LIQUID / OTHER

| LAB USE ONLY Lab No. | Sample Description Sample I.D. | Date | Time | T03 Gas / BTEX / MTBE | T03 Hexane | T03 Carbon Chain | TO14A VOCs | TO15 VOCs Std or Low Level | 15/16 Sulfur Comp Std/Low Level | 15/16 $H_2S$ Std or Low Level | Fixed Gas D1946 or SC | 25C/3C TNMOC | 25.1 TGNMHC | D1945 Natural Gas | RSK 175 Dissolved Gas | TAT | Container(s) # | Container(s) Type | PRESERVATION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A7031204-11 | #3579 pTS. 12T, 12S, 12R | 3/7/07 | | | | | | | | | X | | | | | E | 11 | C | | |
| -12 | #5956 pTS. 12Q, 12P, 12P-1 | 3/7/07 | | | | | | | | | X | | | | | E | 12 | C | | |
| -13 | #3737 pTS. 12O, 12N, 12M | 3/7/07 | | | | | | | | | X | | | | | E | 13 | C | | |
| — | #1415 Do NOT USE | | | | | | | | | | | | | | | · | 14 | | | |
| A7031204-14 | #6061 pTS. 12L, 12J, 18J | 3/8/07 | | | | | | | | | X | | | | | E | 15 | C | | |
| -15 | #02010 pTS. 18L, 18M, 18N | 3/8/07 | | | | | | | | | X | | | | | E | 16 | C | | |
| -16 | #5963 pTS. 18O, 18L, 18Q | 3/8/07 | | | | | | | | | X | | | | | E | 17 | C | | |
| -17 | #3744 pTS. 18R, 18T | 3/8/07 | | | | | | | | | X | | | | | E | 18 | C | | |
| — | #1375 Not used | | | | | | | | | | | | | | | | 19 | | | |

DELIVERABLES: EDD ☐ LEVEL III ☐ LEVEL IV ☐

• TAT starts 8 a.m. following day if samples received after 5 p.m.

TAT: A=Overnight ≤ 24 hr B=Emergency Next workday C=Critical 2 Workdays D=Urgent 3 Workdays E=Routine 7 Workdays

Container Types: B=Tedlar Bag C=Canister V=VOA O= Other

Preservatives: H=Hcl N=None

DISTRIBUTION: White with report, Yellow to folder, Pink to submitter.

Revised November 2, 2012

Client: Archana Inc.
Attn: Elizabeth Gonzales

Project Name: City of El Paso McCombs Landfill
Project Number: Tier II
Date Received: 3/12/2007
Matrix: Vapor

TNMOC by EPA METHOD 25C
Fixed Gases by EPA METHOD 3C

| Lab Number: | | | A7031204-01 | | A7031204-02 | | A7031204-03 | | A7031204-04 | | A7031204-05 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample ID: | | | # 1373 pts. 2E, 4E, 6E | | # 1444 pts. 6G, 4G, 2G | | # 1441 pts. HI, 4I, 6I | | # 5971 pts. 3Y, 6Y, 9X | | # 3103 pts. 9W, 6X, 3X | |
| Date Collected: | | | 3/5/2007 | | 3/5/2007 | | 3/5/2007 | | 3/6/2007 | | 3/6/2007 | |
| Date Analyzed: | | | 3/16/2007 | | 3/16/2007 | | 3/16/2007 | | 3/16/2007 | | 3/16/2007 | |
| Analyst Initials: | | | DT | | DT | | DT | | DT | | DT | |
| QC Batch: | | | 070316GC8A1 | | 070316GC8A1 | | 070316GC8A1 | | 070316GC8A1 | | 070316GC8A1 | |
| Dilution Factor: | | | 3.2 | | 3.2 | | 3.2 | | 3.2 | | 3.2 | |
| ANALYTE | Units | PQL | Result | RL | Result | RL | Result | RL | Result | RL | Result | RL |
| TNMOC | ppmv C | 10 | 3,700 | 32 | 3,800 | 32 | 2,900 | 32 | 900 | 32 | 1,200 | 32 |
| TNMOC uncorr* | ppmv C | 10 | 3,200 | 32 | 3,300 | 32 | 2,700 | 32 | 760 | 32 | 970 | 32 |
| Nitrogen | % v/v | 1.0 | 27 | 3.2 | 26 | 3.2 | 11 | 3.2 | 33 | 3.2 | 35 | 3.2 |
| Oxygen | % v/v | 0.50 | ND | 1.6 | ND | 1.6 | ND | 1.6 | 1.9 | 1.6 | ND | 1.6 |
| | | | | | | | | | | | | |

ND = Not detected at or above reporting limit.
PQL = Practical Quantitation Limit.
TNMOC = Total Non-Methane Organic Carbon.
TNMOC uncorr* = TNMOC concentration in sample without nitrogen/moisture correction.
NA = Nitrogen/moisture correction causes division by zero.

Reviewed/Approved By: _____ Date: 3/20/07
Mark Johnson
Operations Manager

The cover letter is an integral part of this analytical report.

Client: Archana Inc.
Attn: Elizabeth Gonzales

Project Name: City of El Paso McCombs Landfill
Project Number: Tier II
Date Received: 3/12/2007
Matrix: Vapor

TNMOC by EPA METHOD 25C
Fixed Gases by EPA METHOD 3C

| Lab Number: | | | A7031204-06 | | A7031204-07 | | A7031204-08 | | A7031204-09 | | A7031204-10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample ID: | | | # 11252 pts. 3W, 6W, 6U | | # 1359 pts. 9Y, 3W, 6.5Q | | # 1365 pts. 6.5P, 6.5M, 6.5N | | # 1351 pts. 6.5O, 2.5L, 2.5K | | # 1297 pts. 2.5J, 2.5I, 2.5H | |
| Date Collected: | | | 3/6/2007 | | 3/6/2007 | | 3/6-7/2007 | | 3/7/2007 | | 3/7/2007 | |
| Date Analyzed: | | | 3/16/2007 | | 3/16/2007 | | 3/16/2007 | | 3/16/2007 | | 3/16/2007 | |
| Analyst Initials: | | | DT | | DT | | DT | | DT | | DT | |
| QC Batch: | | | 070316GC8A1 | | 070316GC8A1 | | 070316GC8A1 | | 070316GC8A1 | | 070316GC8A1 | |
| Dilution Factor: | | | 3.2 | | 3.2 | | 3.4 | | 3.2 | | 3.2 | |
| ANALYTE | Units | PQL | Result | RL | Result | RL | Result | RL | Result | RL | Result | RL |
| TNMOC | ppmv C | 10 | 880 | 32 | 1,300 | 32 | 2,200 | 34 | 2,000 | 32 | 1,300 | 32 |
| TNMOC uncorr* | ppmv C | 10 | 710 | 32 | 1,100 | 32 | 2,000 | 34 | 1,700 | 32 | 1,100 | 32 |
| Nitrogen | % v/v | 1.0 | 40 | 3.2 | 31 | 3.2 | 25 | 3.4 | 34 | 3.2 | 29 | 3.2 |
| Oxygen | % v/v | 0.50 | ND | 1.6 | ND | 1.6 | ND | 1.7 | ND | 1.6 | ND | 1.6 |
| | | | | | | | | | | | | |

ND = Not detected at or above reporting limit.
PQL = Practical Quantitation Limit.
TNMOC = Total Non-Methane Organic Carbon.
TNMOC uncorr* = TNMOC concentration in sample without nitrogen/moisture correction.
NA = Nitrogen/moisture correction causes division by zero.

Reviewed/Approved By: MAH-1 Date: 3/20/07
Mark Johnson
Operations Manager

The cover letter is an integral part of this analytical report.

Client: Archana Inc.
Attn: Elizabeth Gonzales

Project Name: City of El Paso McCombs Landfill
Project Number: Tier II
Date Received: 3/12/2007
Matrix: Vapor

TNMOC by EPA METHOD 25C
Fixed Gases by EPA METHOD 3C

| Lab Number: | | | A7031204-11 | | A7031204-12 | | A7031204-13 | | A7031204-14 | | A7031204-15 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample ID: | | | # 3579 pts. 12T, 12S, 12R | | # 5956 pts. 12Q, 12P, 12P-I | | # 3737 pts. 12O, 12N, 12M | | # 6061 pts. 12L, 12J, 18J | | # 02010 pts. 18L, 18M, 18N | |
| Date Collected: | | | 3/7/2007 | | 3/7/2007 | | 3/7/2007 | | 3/8/2007 | | 3/8/2007 | |
| Date Analyzed: | | | 3/16/2007 | | 3/16/2007 | | 3/16/2007 | | 3/16/2007 | | 3/16/2007 | |
| Analyst Initials: | | | DT | | DT | | DT | | DT | | DT | |
| QC Batch: | | | 070316GC8A2 | | 070316GC8A2 | | 070316GC8A2 | | 070316GC8A2 | | 070316GC8A2 | |
| Dilution Factor: | | | 3.2 | | 3.3 | | 3.3 | | 3.2 | | 3.2 | |
| ANALYTE | Units | PQL | Result | RL | Result | RL | Result | RL | Result | RL | Result | RL |
| TNMOC | ppmv C | 10 | 990 | 32 | 1,100 | 33 | 1,400 | 33 | 790 | 32 | 1,100 | 32 |
| TNMOC uncorr* | ppmv C | 10 | 870 | 32 | 1,000 | 33 | 1,300 | 33 | 700 | 32 | 950 | 32 |
| Nitrogen | % v/v | 1.0 | 24 | 3.2 | 15 | 3.3 | 15 | 3.3 | 22 | 3.2 | 32 | 3.2 |
| Oxygen | % v/v | 0.50 | ND | 1.6 | ND | 1.6 | ND | 1.6 | ND | 1.6 | ND | 1.6 |
| | | | | | | | | | | | | |

ND = Not detected at or above reporting limit.
PQL = Practical Quantitation Limit.
TNMOC = Total Non-Methane Organic Carbon.
TNMOC uncorr* = TNMOC concentration in sample without nitrogen/moisture correction.
NA = Nitrogen/moisture correction causes division by zero.

Reviewed/Approved By: MAH - fo Date: 3/20/07
Mark Johnson
Operations Manager

The cover letter is an integral part of this analytical report.

Client: Archana Inc.
Attn: Elizabeth Gonzales

Project Name: City of El Paso McCombs Landfill
Project Number: Tier II
Date Received: 3/12/2007
Matrix: Vapor

TNMOC by EPA METHOD 25C
Fixed Gases by EPA METHOD 3C

| Lab Number: | | | A7031204-16 | | A7031204-17 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample ID: | | | # 5963 pts. 18O, 18P, 18Q | | # 3744 pts. 18R, 18T | | | | | | | |
| Date Collected: | | | 3/8/2007 | | 3/8/2007 | | | | | | | |
| Date Analyzed: | | | 3/16/2007 | | 3/16/2007 | | | | | | | |
| Analyst Initials: | | | DT | | DT | | | | | | | |
| QC Batch: | | | 070316GC8A2 | | 070316GC8A2 | | | | | | | |
| Dilution Factor: | | | 3.3 | | 4.6 | | | | | | | |
| ANALYTE | Units | PQL | Result | RL | Result | RL | | | | | | |
| TNMOC | ppmv C | 10 | 980 | 33 | 990 | 46 | | | | | | |
| TNMOC uncorr* | ppmv C | 10 | 840 | 33 | 900 | 46 | | | | | | |
| Nitrogen | % v/v | 1.0 | 29 | 3.3 | 23 | 4.6 | | | | | | |
| Oxygen | % v/v | 0.50 | ND | 1.6 | ND | 2.3 | | | | | | |
| | | | | | | | | | | | | |

ND = Not detected at or above reporting limit.
PQL = Practical Quantitation Limit.
TNMOC = Total Non-Methane Organic Carbon.
TNMOC uncorr* = TNMOC concentration in sample without nitrogen/moisture correction.
NA = Nitrogen/moisture correction causes division by zero.

Reviewed/Approved By: _____ Date: 3/20/07
Mark Johnson
Operations Manager

The cover letter is an integral part of this analytical report.

CALCULATIONS

| | Variable | A7031204-01 | A7031204-02 | A7031204-03 | A7031204-04 | A7031204-05 |
|---|---|---|---|---|---|---|
| Moisture content, fraction | $B_w$ | 0.02940 | 0.02940 | 0.02940 | 0.02940 | 0.02940 |
| Calculated NMOC concentration, ppmv C | $C_t$ | 3725.4 | 3845.6 | 2913.7 | 900.6 | 1159.8 |
| Uncorr NMOC concentration, ppmv C | $C_t$ | 3221.5 | 3332.2 | 2705.7 | 757.9 | 967.4 |
| Calculated N2 concentration, fraction | | 0.26902 | 0.26455 | 0.10669 | 0.32772 | 0.34684 |
| Measured N2 concentration, fraction | $C_{N2}$ | 0.08341 | 0.08203 | 0.03308 | 0.10161 | 0.10754 |
| Calculated O2 concentration, fraction | | 0.01463 | 0.00511 | 0.00351 | 0.01866 | 0.00645 |
| Measured O2 concentration, fraction | | 0.00453 | 0.00159 | 0.00109 | 0.00579 | 0.00200 |
| measured NMOC concentration, ppmv C | $C_{im1}$ | 1032.3 | 1061.4 | 864.4 | 244.4 | 306.5 |
| measured NMOC concentration, ppmv C | $C_{im2}$ | 1030.1 | 1064.1 | 864.3 | 241.9 | 307.4 |
| measured NMOC concentration, ppmv C | $C_{im3}$ | 1025.0 | 1068.0 | 864.3 | 240.1 | 313.2 |
| barometric pressure, mm Hg | $P_b$ | 762.0 | 762.0 | 762.0 | 762.0 | 762.0 |
| gas sample tank pressure before sampling, mm Hg | $P_{ti}$ | 228.59 | 228.59 | 228.59 | 228.59 | 228.59 |
| gas sample tank pressure at completion of sampling, mm Hg | $P_t$ | 634.98 | 634.98 | 634.98 | 634.98 | 634.98 |
| final gas sample tank pressure after pressurization, mm Hg | $P_{tf}$ | 1272.13 | 1272.13 | 1272.13 | 1272.13 | 1272.13 |
| vapor pressure of H2O, mm Hg | $P_w$ | 22.4 | 22.4 | 22.4 | 22.4 | 22.4 |
| sample tank temperature before sampling, oK | $T_{ti}$ | 297.0 | 297.0 | 297.0 | 297.0 | 297.0 |
| sample tank temperature at completion of sampling, oK | $T_t$ | 297.0 | 297.0 | 297.0 | 297.0 | 297.0 |
| sample tank temperature after pressurization, oK | $T_{tf}$ | 297.0 | 297.0 | 297.0 | 297.0 | 297.0 |
| Sample tank temperature in field, oC | | 23.9 | 23.9 | 23.9 | 23.9 | 23.9 |
| total number of analyzer injections | r | 3 | 3 | 3 | 3 | 3 |
| barometric pressure, inches Hg | | 30 | 30 | 30 | 30 | 30 |
| sample temp in field before sampling, oF | | 75 | 75 | 75 | 75 | 75 |
| sample temp in field after sampling, oF | | 75 | 75 | 75 | 75 | 75 |
| Sample pressure prior to sampling, inches Hg | | -21 | -21 | -21 | -21 | -21 |
| Sample pressure after sampling, inches Hg | | -5 | -5 | -5 | -5 | -5 |
| Sample pressure after pressurization, psia | | 24.6 | 24.6 | 24.6 | 24.6 | 24.6 |
| Sample temp after pressurization, oF | | 75 | 75 | 75 | 75 | 75 |

| | RL | SAMPLE1 | | SAMPLE2 | | SAMPLE3 | | SAMPLE4 | | SAMPLE5 |
|---|---|---|---|---|---|---|---|---|---|---|
| NMOC RUN1 | 10 | 1032.3 | | 1061.4 | | 864.4 | | 244.4 | | 306.5 |
| NMOC RUN2 | 10 | 1030.1 | | 1064.1 | | 864.3 | | 241.9 | | 307.4 |
| NMOC RUN3 | 10 | 1025.0 | | 1068.0 | | 864.3 | | 240.1 | | 313.2 |
| NMOC DATAFILE1 | | 16mar001 | | 16mar004 | | 16mar007 | | 16mar010 | | 16mar013 |
| NMOC DATAFILE2 | | 16mar002 | | 16mar005 | | 16mar008 | | 16mar011 | | 16mar014 |
| NMOC DATAFILE3 | | 16mar003 | | 16mar006 | | 16mar009 | | 16mar012 | | 16mar015 |
| NMOC TIME/DATE1 | 7:57 | 03/16/07 | 8:41 | 03/16/07 | 9:28 | 03/16/07 | 10:12 | 03/16/07 | 10:56 | 03/16/07 |
| NMOC TIME/DATE2 | 8:11 | 03/16/07 | 8:55 | 03/16/07 | 9:43 | 03/16/07 | 10:27 | 03/16/07 | 11:11 | 03/16/07 |
| NMOC TIME/DATE3 | 8:26 | 03/16/07 | 9:10 | 03/16/07 | 9:57 | 03/16/07 | 10:41 | 03/16/07 | 11:25 | 03/16/07 |
| RESULT RSD | | 0.36 | | 0.31 | | 0.00 | | 0.89 | | 1.18 |
| NITROGEN RUN1 | | 8.351 | | 8.213 | | 3.296 | | 10.185 | | 10.741 |
| NITROGEN RUN2 | | 8.332 | | 8.192 | | 3.320 | | 10.138 | | 10.767 |
| OXYGEN RUN1 | | 0.454 | | 0.159 | | 0.108 | | 0.582 | | 0.200 |
| OXYGEN RUN2 | | 0.453 | | 0.158 | | 0.110 | | 0.575 | | 0.200 |
| 3C DATAFILE1 | | 16mar002 | | 16mar005 | | 16mar008 | | 16mar011 | | 16mar014 |
| 3C DATAFILE2 | | 16mar003 | | 16mar006 | | 16mar009 | | 16mar012 | | 16mar015 |
| 3C TIME/DATE | 8:11 | 03/16/07 | 8:55 | 03/16/07 | 9:43 | 03/16/07 | 10:27 | 03/16/07 | 11:11 | 03/16/07 |
| 3C TIME/DATE | 8:26 | 03/16/07 | 9:10 | 03/16/07 | 9:57 | 03/16/07 | 10:41 | 03/16/07 | 11:25 | 03/16/07 |
| N2 RSD | | 0.22 | | 0.26 | | 0.73 | | 0.47 | | 0.24 |
| O2 RSD | | 0.11 | | 0.53 | | 1.26 | | 1.17 | | 0.20 |

$$C_t = \frac{\frac{P_{tf}}{T_{tf}}}{\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}} * \frac{1}{(1 - B_w - 99/78 * C_{N2})r} \sum_{j=1}^{r} C_{im(j)} \qquad B_w = \frac{P_w}{P_b}$$

CALCULATIONS

| | Variable | A7031204-06 | A7031204-07 | A7031204-08 | A7031204-09 | A7031204-10 |
|---|---|---|---|---|---|---|
| Moisture content, fraction | $B_w$ | 0.02940 | 0.02940 | 0.02940 | 0.02940 | 0.02940 |
| Calculated NMOC concentration, ppmv C | $C_t$ | 876.1 | 1271.2 | 2235.0 | 2014.8 | 1259.4 |
| Uncorr NMOC concentration, ppmv C | $C_t$ | 713.2 | 1079.5 | 1966.0 | 1682.6 | 1077.0 |
| Calculated N2 concentration, fraction | | 0.39778 | 0.30860 | 0.24649 | 0.34429 | 0.29331 |
| Measured N2 concentration, fraction | $C_{N2}$ | 0.12334 | 0.09569 | 0.07165 | 0.10675 | 0.09094 |
| Calculated O2 concentration, fraction | | 0.01203 | 0.00595 | 0.01513 | 0.00914 | 0.00630 |
| Measured O2 concentration, fraction | | 0.00373 | 0.00184 | 0.00440 | 0.00283 | 0.00195 |
| measured NMOC concentration, ppmv C | $C_{tm1}$ | 227.6 | 344.5 | 587.7 | 534.2 | 341.8 |
| measured NMOC concentration, ppmv C | $C_{tm2}$ | 228.8 | 343.1 | 587.1 | 538.6 | 345.3 |
| measured NMOC concentration, ppmv C | $C_{tm3}$ | 227.2 | 347.0 | 591.5 | 539.7 | 345.1 |
| barometric pressure, mm Hg | $P_b$ | 762.0 | 762.0 | 762.0 | 762.0 | 762.0 |
| gas sample tank pressure before sampling, mm Hg | $P_{ti}$ | 228.59 | 228.59 | 228.59 | 228.59 | 228.59 |
| gas sample tank pressure at completion of sampling, mm Hg | $P_t$ | 634.98 | 634.98 | 609.58 | 634.98 | 634.98 |
| final gas sample tank pressure after pressurization, mm Hg | $P_{tf}$ | 1272.13 | 1272.13 | 1272.13 | 1272.13 | 1272.13 |
| vapor pressure of H2O, mm Hg | $P_w$ | 22.4 | 22.4 | 22.4 | 22.4 | 22.4 |
| sample tank temperature before sampling, oK | $T_{ti}$ | 297.0 | 297.0 | 297.0 | 297.0 | 297.0 |
| sample tank temperature at completion of sampling, oK | $T_t$ | 297.0 | 297.0 | 297.0 | 297.0 | 297.0 |
| sample tank temperature after pressurization, oK | $T_{tf}$ | 297.0 | 297.0 | 297.0 | 297.0 | 297.0 |
| Sample tank temperature in field, oC | | 23.9 | 23.9 | 23.9 | 23.9 | 23.9 |
| total number of analyzer injections | r | 3 | 3 | 3 | 3 | 3 |
| barometric pressure, inches Hg | | 30 | 30 | 30 | 30 | 30 |
| sample temp in field before sampling, oF | | 75 | 75 | 75 | 75 | 75 |
| sample temp in field after sampling, oF | | 75 | 75 | 75 | 75 | 75 |
| Sample pressure prior to sampling, inches Hg | | -21 | -21 | -21 | -21 | -21 |
| Sample pressure after sampling, inches Hg | | -5 | -5 | -6 | -5 | -5 |
| Sample pressure after pressurization, psia | | 24.6 | 24.6 | 24.6 | 24.6 | 24.6 |
| Sample temp after pressurization, oF | | 75 | 75 | 75 | 75 | 75 |

| | RL | SAMPLE1 | | SAMPLE2 | | SAMPLE3 | | SAMPLE4 | | SAMPLE5 |
|---|---|---|---|---|---|---|---|---|---|---|
| NMOC RUN1 | 10 | 227.6 | | 344.5 | | 587.7 | | 534.2 | | 341.8 |
| NMOC RUN2 | 10 | 228.8 | | 343.1 | | 587.1 | | 538.6 | | 345.3 |
| NMOC RUN3 | 10 | 227.2 | | 347.0 | | 591.5 | | 539.7 | | 345.1 |
| NMOC DATAFILE1 | | 16mar016 | | 16mar019 | | 16mar022 | | 16mar025 | | 16mar028 |
| NMOC DATAFILE2 | | 16mar017 | | 16mar020 | | 16mar023 | | 16mar026 | | 16mar029 |
| NMOC DATAFILE3 | | 16mar018 | | 16mar021 | | 16mar024 | | 16mar027 | | 16mar030 |
| NMOC TIME/DATE1 | | 11:40 03/16/07 | 12:24 | 03/16/07 | 1:07 | 03/16/07 | 1:51 | 03/16/07 | 2:35 | 03/16/07 |
| NMOC TIME/DATE2 | | 11:55 03/16/07 | 12:38 | 03/16/07 | 1:22 | 03/16/07 | 2:06 | 03/16/07 | 2:50 | 03/16/07 |
| NMOC TIME/DATE3 | | 12:09 03/16/07 | 12:53 | 03/16/07 | 1:37 | 03/16/07 | 2:20 | 03/16/07 | 3:04 | 03/16/07 |
| RESULT RSD | | 0.36 | | 0.57 | | 0.40 | | 0.53 | | 0.57 |
| NITROGEN RUN1 | | 12.297 | | 9.565 | | 7.138 | | 10.674 | | 9.098 |
| NITROGEN RUN2 | | 12.370 | | 9.572 | | 7.192 | | 10.676 | | 9.090 |
| OXYGEN RUN1 | | 0.371 | | 0.184 | | 0.439 | | 0.282 | | 0.195 |
| OXYGEN RUN2 | | 0.375 | | 0.185 | | 0.440 | | 0.285 | | 0.195 |
| 3C DATAFILE1 | | 16mar017 | | 16mar020 | | 16mar023 | | 16mar026 | | 16mar029 |
| 3C DATAFILE2 | | 16mar018 | | 16mar021 | | 16mar024 | | 16mar027 | | 16mar030 |
| 3C TIME/DATE | | 11:55 03/16/07 | 12:38 | 03/16/07 | 1:22 | 03/16/07 | 2:06 | 03/16/07 | 2:50 | 03/16/07 |
| 3C TIME/DATE | | 12:09 03/16/07 | 12:53 | 03/16/07 | 1:37 | 03/16/07 | 2:20 | 03/16/07 | 3:04 | 03/16/07 |
| N2 RSD | | 0.59 | | 0.08 | | 0.76 | | 0.01 | | 0.09 |
| O2 RSD | | 0.87 | | 0.57 | | 0.25 | | 0.95 | | 0.05 |

$$C_t = \frac{\frac{P_{tf}}{T_{tf}}}{\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}} * \frac{1}{(1 - B_w - 99/78 * C_{N2})} \sum_{j=1}^{r} C_{tm(j)} \qquad B_{ww} = \frac{P_w}{P_b}$$

CALCULATIONS

| | Variable | A7031204-11 | A7031204-12 | A7031204-13 | A7031204-14 | A7031204-15 |
|---|---|---|---|---|---|---|
| Moisture content, fraction | $B_w$ | 0.02940 | 0.02940 | 0.02940 | 0.02940 | 0.02940 |
| Calculated NMOC concentration, ppmv C | $C_i$ | 995.0 | 1145.0 | 1431.8 | 791.0 | 1124.6 |
| Uncorr NMOC concentration, ppmv C | $C_i$ | 873.1 | 1045.3 | 1305.6 | 698.5 | 949.8 |
| Calculated N2 concentration, fraction | | 0.23647 | 0.15139 | 0.15397 | 0.22267 | 0.32021 |
| Measured N2 concentration, fraction | $C_{N2}$ | 0.07332 | 0.04547 | 0.04625 | 0.06904 | 0.09929 |
| Calculated O2 concentration, fraction | | 0.00514 | 0.00650 | 0.00395 | 0.00536 | 0.00615 |
| Measured O2 concentration, fraction | | 0.00159 | 0.00195 | 0.00119 | 0.00166 | 0.00191 |
| measured NMOC concentration, ppmv C | $C_{im1}$ | 276.7 | 323.9 | 397.7 | 221.5 | 299.5 |
| measured NMOC concentration, ppmv C | $C_{im2}$ | 279.6 | 321.7 | 406.5 | 224.6 | 304.0 |
| measured NMOC concentration, ppmv C | $C_{im3}$ | 280.5 | 324.8 | 408.0 | 223.3 | 306.7 |
| barometric pressure, mm Hg | $P_b$ | 762.0 | 762.0 | 762.0 | 762.0 | 762.0 |
| gas sample tank pressure before sampling, mm Hg | $P_{ti}$ | 228.59 | 228.59 | 228.59 | 228.59 | 228.59 |
| gas sample tank pressure at completion of sampling, mm Hg | $P_t$ | 634.98 | 622.28 | 622.28 | 634.98 | 634.98 |
| final gas sample tank pressure after pressurization, mm Hg | $P_{tf}$ | 1272.13 | 1272.13 | 1272.13 | 1272.13 | 1272.13 |
| vapor pressure of H2O, mm Hg | $P_w$ | 22.4 | 22.4 | 22.4 | 22.4 | 22.4 |
| sample tank temperature before sampling, oK | $T_{ti}$ | 297.0 | 297.0 | 297.0 | 297.0 | 297.0 |
| sample tank temperature at completion of sampling, oK | $T_t$ | 297.0 | 297.0 | 297.0 | 297.0 | 297.0 |
| sample tank temperature after pressurization, oK | $T_{tf}$ | 297.0 | 297.0 | 297.0 | 297.0 | 297.0 |
| Sample tank temperature in field, oC | | 23.9 | 23.9 | 23.9 | 23.9 | 23.9 |
| total number of analyzer injections | r | 3 | 3 | 3 | 3 | 3 |
| barometric pressure, inches Hg | | 30 | 30 | 30 | 30 | 30 |
| sample temp in field before sampling, oF | | 75 | 75 | 75 | 75 | 75 |
| sample temp in field after sampling, oF | | 75 | 75 | 75 | 75 | 75 |
| Sample pressure prior to sampling, inches Hg | | -21 | -21 | -21 | -21 | -21 |
| Sample pressure after sampling, inches Hg | | -5 | -5.5 | -5.5 | -5 | -5 |
| Sample pressure after pressurization, psia | | 24.6 | 24.6 | 24.6 | 24.6 | 24.6 |
| Sample temp after pressurization, oF | | 75 | 75 | 75 | 75 | 75 |

| | RL | SAMPLE1 | SAMPLE2 | SAMPLE3 | SAMPLE4 | SAMPLE5 |
|---|---|---|---|---|---|---|
| NMOC RUN1 | 10 | 276.7 | 323.9 | 397.7 | 221.5 | 299.5 |
| NMOC RUN2 | 10 | 279.6 | 321.7 | 406.5 | 224.6 | 304.0 |
| NMOC RUN3 | 10 | 280.5 | 324.8 | 408.0 | 223.3 | 306.7 |
| NMOC DATAFILE1 | | 16mar038 | 16mar041 | 16mar044 | 16mar047 | 16mar050 |
| NMOC DATAFILE2 | | 16mar039 | 16mar042 | 16mar045 | 16mar048 | 16mar051 |
| NMOC DATAFILE3 | | 16mar040 | 16mar043 | 16mar046 | 16mar049 | 16mar052 |
| NMOC TIME/DATE1 | | 4:59 03/16/07 | 5:43 03/16/07 | 6:26 03/16/07 | 7:47 03/16/07 | 8:31 03/16/07 |
| NMOC TIME/DATE2 | | 5:13 03/16/07 | 5:57 03/16/07 | 6:41 03/16/07 | 8:02 03/16/07 | 8:46 03/16/07 |
| NMOC TIME/DATE3 | | 5:28 03/16/07 | 6:12 03/16/07 | 6:55 03/16/07 | 8:17 03/16/07 | 9:00 03/16/07 |
| RESULT RSD | | 0.72 | 0.49 | 1.38 | 0.70 | 1.20 |
| | | | | | | |
| NITROGEN RUN1 | | 7.352 | 4.558 | 4.635 | 6.884 | 9.952 |
| NITROGEN RUN2 | | 7.312 | 4.537 | 4.615 | 6.924 | 9.905 |
| OXYGEN RUN1 | | 0.160 | 0.197 | 0.119 | 0.168 | 0.191 |
| OXYGEN RUN2 | | 0.159 | 0.194 | 0.118 | 0.165 | 0.190 |
| 3C DATAFILE1 | | 16mar039 | 16mar042 | 16mar045 | 16mar048 | 16mar051 |
| 3C DATAFILE2 | | 16mar040 | 16mar043 | 16mar046 | 16mar049 | 16mar052 |
| 3C TIME/DATE | | 5:13 03/16/07 | 5:57 03/16/07 | 6:41 03/16/07 | 8:02 03/16/07 | 8:46 03/16/07 |
| 3C TIME/DATE | | 5:28 03/16/07 | 6:12 03/16/07 | 6:55 03/16/07 | 8:17 03/16/07 | 9:00 03/16/07 |
| N2 RSD | | 0.54 | 0.45 | 0.42 | 0.58 | 0.48 |
| O2 RSD | | 0.43 | 1.88 | 0.97 | 1.66 | 0.87 |

$$C_i = \frac{\frac{P_{tf}}{T_{tf}}}{\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}} \bullet \frac{1}{(1 - B_w - 99/78 * C_{N2})r} \sum_{j=1}^{r} C_{im(j)} \qquad B_w = \frac{P_w}{P_b}$$

CALCULATIONS

| | Variable | A7031204-16 | A7031204-17 |
|---|---|---|---|
| Moisture content, fraction | $B_w$ | 0.02940 | 0.02940 |
| Calculated NMOC concentration, ppmv C | $C_t$ | 980.8 | 993.0 |
| Uncorr NMOC concentration, ppmv C | $C_t$ | 842.2 | 900.7 |
| Calculated N2 concentration, fraction | | 0.29335 | 0.23482 |
| Measured N2 concentration, fraction | $C_{N2}$ | 0.08811 | 0.05006 |
| Calculated O2 concentration, fraction | | 0.00759 | 0.00556 |
| Measured O2 concentration, fraction | | 0.00228 | 0.00119 |
| measured NMOC concentration, ppmv C | $C_{tm1}$ | 259.2 | 197.1 |
| measured NMOC concentration, ppmv C | $C_{tm2}$ | 262.8 | 196.4 |
| measured NMOC concentration, ppmv C | $C_{tm3}$ | 259.9 | 199.9 |
| barometric pressure, mm Hg | $P_b$ | 762.0 | 762.0 |
| gas sample tank pressure before sampling, mm Hg | $P_{ti}$ | 228.59 | 228.59 |
| gas sample tank pressure at completion of sampling, mm Hg | $P_t$ | 622.28 | 507.98 |
| final gas sample tank pressure after pressurization, mm Hg | $P_{tf}$ | 1272.13 | 1272.13 |
| vapor pressure of H2O, mm Hg | $P_w$ | 22.4 | 22.4 |
| sample tank temperature before sampling, oK | $T_{ti}$ | 297.0 | 297.0 |
| sample tank temperature at completion of sampling, oK | $T_t$ | 297.0 | 297.0 |
| sample tank temperature after pressurization, oK | $T_{tf}$ | 297.0 | 297.0 |
| Sample tank temperature in field, oC | | 23.9 | 23.9 |
| total number of analyzer injections | r | 3 | 3 |
| barometric pressure, inches Hg | | 30 | 30 |
| sample temp in field before sampling, oF | | 75 | 75 |
| sample temp in field after sampling, oF | | 75 | 75 |
| Sample pressure prior to sampling, inches Hg | | -21 | -21 |
| Sample pressure after sampling, inches Hg | | -5.5 | -10 |
| Sample pressure after pressurization, psia | | 24.6 | 24.6 |
| Sample temp after pressurization, oF | | 75 | 75 |

| | RL | | SAMPLE1 | | SAMPLE2 |
|---|---|---|---|---|---|
| NMOC RUN1 | 10 | | 259.2 | | 197.1 |
| NMOC RUN2 | 10 | | 262.8 | | 196.4 |
| NMOC RUN3 | 10 | | 259.9 | | 199.9 |
| NMOC DATAFILE1 | | | 16mar053 | | 16mar056 |
| NMOC DATAFILE2 | | | 16mar054 | | 16mar057 |
| NMOC DATAFILE3 | | | 16mar055 | | 16mar058 |
| NMOC TIME/DATE1 | | 9:15 | 03/16/07 | 9:59 | 03/16/07 |
| NMOC TIME/DATE2 | | 9:30 | 03/16/07 | 10:13 | 03/16/07 |
| NMOC TIME/DATE3 | | 9:44 | 03/16/07 | 10:28 | 03/16/07 |
| RESULT RSD | | | 0.73 | | 0.92 |
| | | | | | |
| NITROGEN RUN1 | | | 8.819 | | 5.011 |
| NITROGEN RUN2 | | | 8.804 | | 5.000 |
| OXYGEN RUN1 | | | 0.228 | | 0.119 |
| OXYGEN RUN2 | | | 0.228 | | 0.118 |
| 3C DATAFILE1 | | | 16mar054 | | 16mar057 |
| 3C DATAFILE2 | | | 16mar055 | | 16mar058 |
| 3C TIME/DATE | | 9:30 | 03/16/07 | 10:13 | 03/16/07 |
| 3C TIME/DATE | | 9:44 | 03/16/07 | 10:28 | 03/16/07 |
| N2 RSD | | | 0.18 | | 0.23 |
| O2 RSD | | | 0.01 | | 0.68 |

$$C_t = \frac{\frac{P_{tf}}{T_{tf}}}{\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}} * \frac{1}{(1 - B_w - 99/78 * C_{N2})r} \sum_{j=1}^{r} C_{tm(j)} \qquad B_w = \frac{P_w}{P_b}$$

# Appendix 3M - Attachment 3
# Landfill Gas Management Details

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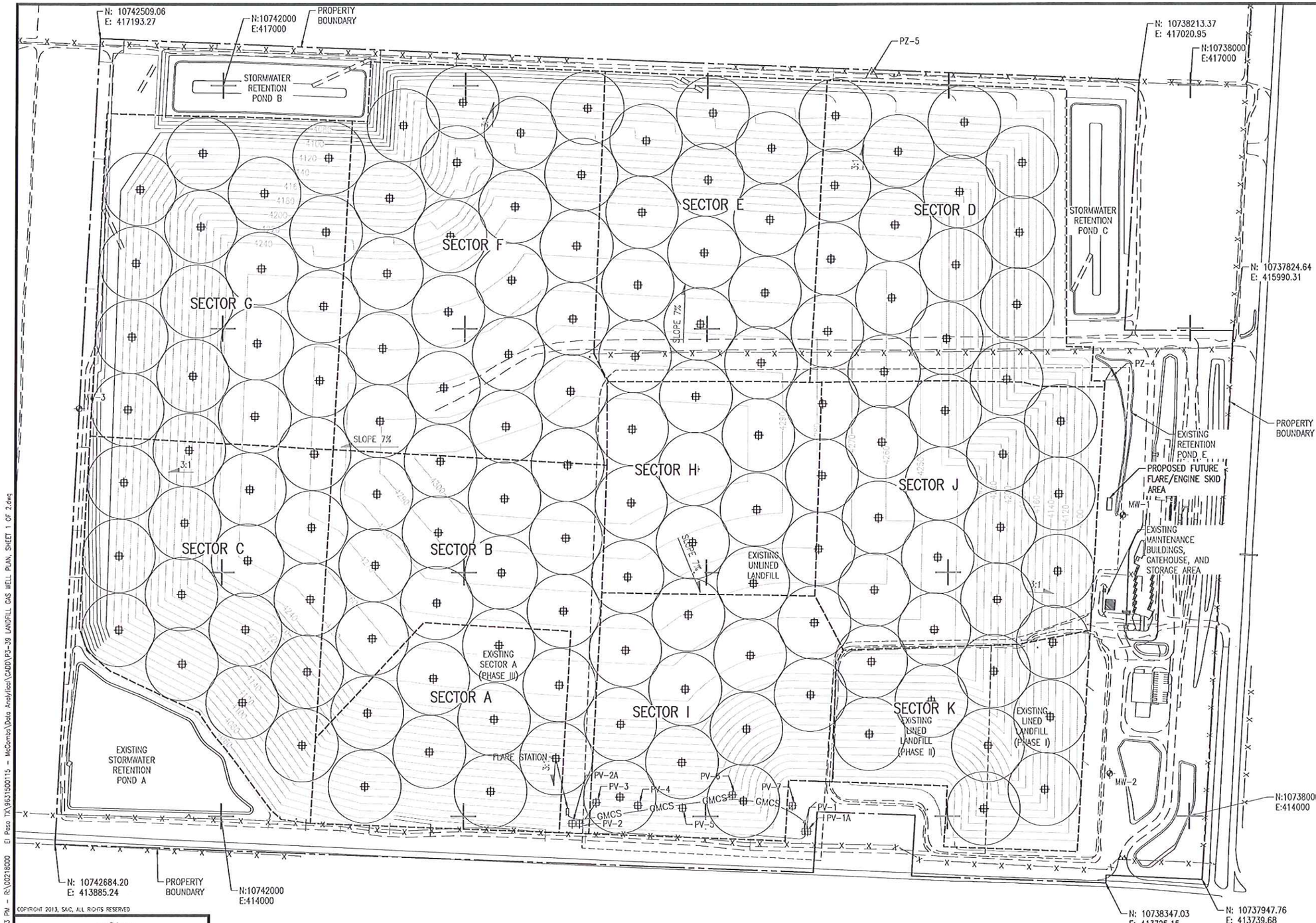


## NOTES

1. FINAL COVER CONTOURS SHOWN ARE DESIGN CONTOURS.
2. FINAL COVER CONTOUR INTERVAL IS TEN FEET. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM.
3. THE PROPOSED LFG PLAN PORTRAYS AN ACTIVE GAS COLLECTION SYSTEM. IF AN ACTIVE SYSTEM IS NOT REQUIRED, THE WELLS WILL BE INSTALLED AS PASSIVE GAS VENTS UNTIL THE LANDFILL IS REQUIRED TO INSTALL AN ACTIVE SYSTEM BY NSPS STANDARDS OR IF THE LANDFILL INSTALLS AN ACTIVE SYSTEM VOLUNTARILY.
4. IT IS ANTICIPATED THAT THE EXISTING GCCS SYSTEM WILL BE ABANDONED UPON FUTURE LANDFILL DEVELOPMENT AND THE EXISTING LANDFILL GAS FLARE STATION WILL BE RELOCATED AND UTILIZED IN FUTURE DEVELOPMENT.

## LEGEND

- FUTURE GAS WELL WITH 150' RADIUS OF INFLUENCE
- PV-3 — EXISTING MONITORING WELL
- MW-3 — MONITORING WELL
- PIEZOMETER
- BUILDING/STRUCTURE
- 4250 — ELEVATION CONTOURS
- FACILITY/PROPERTY BOUNDARY
- SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- LANDFILL ACCESS ROAD
- x——x — CHAIN LINK OR OTHER FENCE
- GMCS — GAS MONITORING CONTROL SYSTEM

GRAPHIC SCALE

1"=200'-0" (200 0 200 400 Scale Feet)

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| DESIGNED | DRAWN | VERIFY SCALE |
|---|---|---|
| TLK | CAD | BAR IS ONE INCH ON ANSI "D" DRAWING (0 — 1") |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 3 | 6/3/13 | JSR | CAV | FOURTH TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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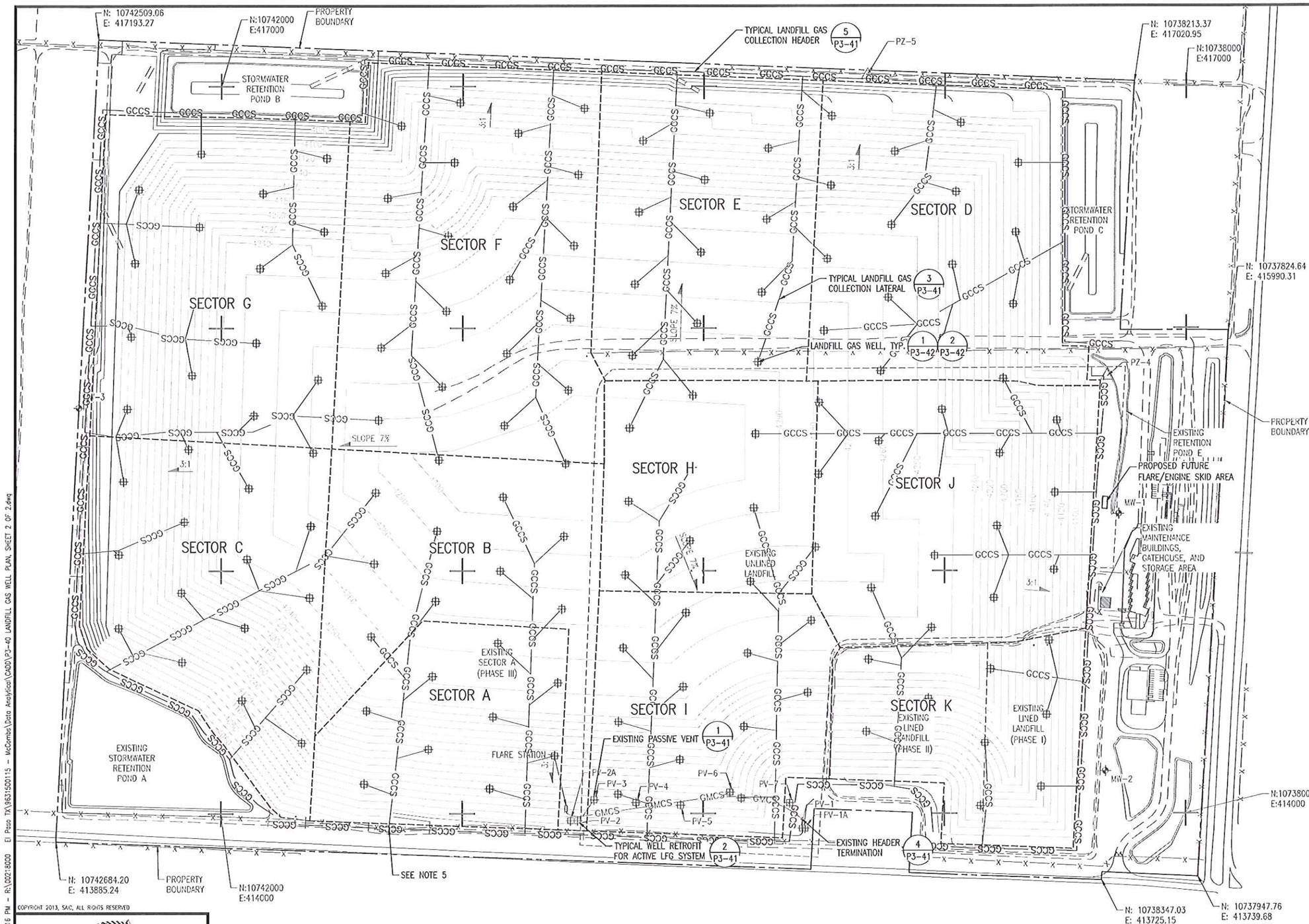
LANDFILL GAS WELL PLAN, SHEET 1 OF 2

PROJECT NUMBER: 9631500115
SHT. 72 OF: 78
DRAWING NUMBER: P3-39

Rose, Jacob S. 5/30/2013 4:43:23 PM – R:\0021600 El Paso TX\9631500115 – McCombs\Data Analytical\CADD\P3-39 LANDFILL GAS WELL PLAN, SHEET 1 OF 2.dwg




## NOTES

1. FINAL COVER CONTOURS SHOWN ARE DESIGN CONTOURS.
2. FINAL COVER CONTOUR INTERVAL IS TEN FEET. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM.
3. THE PROPOSED LFG PLAN PORTRAYS AN ACTIVE GAS COLLECTION SYSTEM. IF AN ACTIVE SYSTEM IS NOT REQUIRED, THE WELLS WILL BE INSTALLED AS PASSIVE GAS VENTS UNTIL THE LANDFILL IS REQUIRED TO INSTALL AN ACTIVE SYSTEM BY NSPS STANDARDS OR IF THE LANDFILL INSTALLS AN ACTIVE SYSTEM VOLUNTARILY.
4. IT IS ANTICIPATED THAT THE EXISTING GMCS SYSTEM WILL BE ABANDONED UPON FUTURE LANDFILL DEVELOPMENT. THE EXISTING LANDFILL GAS FLARE STATION WILL BE RELOCATED AND UTILIZED IN FUTURE DEVELOPMENT.
5. CONDENSATE SUMPS WILL BE INSTALLED AT LOW POINTS ALONG THE PERIMETER MANIFOLD.
6. ISOLATION VALVES WILL BE INSTALLED AT LATERAL JUNCTIONS AND CERTAIN POINTS ALONG THE PERIMETER MANIFOLD TO ALLOW FOR CONSTRUCTION AND MAINTENANCE.

## LEGEND

- FUTURE GAS WELL
- PV-3 — EXISTING MONITORING WELL
- MW-3 — MONITORING WELL
- PIEZOMETER
- BUILDING/STRUCTURE
- 4250 — ELEVATION CONTOURS
- FACILITY/PROPERTY BOUNDARY
- SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- LANDFILL ACCESS ROAD
- x——x CHAIN LINK OR OTHER FENCE
- GMCS GAS MONITORING CONTROL SYSTEM
- GCCS GAS COLLECTION CONTROL SYSTEM

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| | |
|---|---|
| DESIGNED | TLK |
| DRAWN | CAD |
| VERIFY SCALE | BAR IS ONE INCH ON ANSI "D" DRAWING (0 — 1") |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 3 | 6/3/13 | JSR | CAV | FOURTH TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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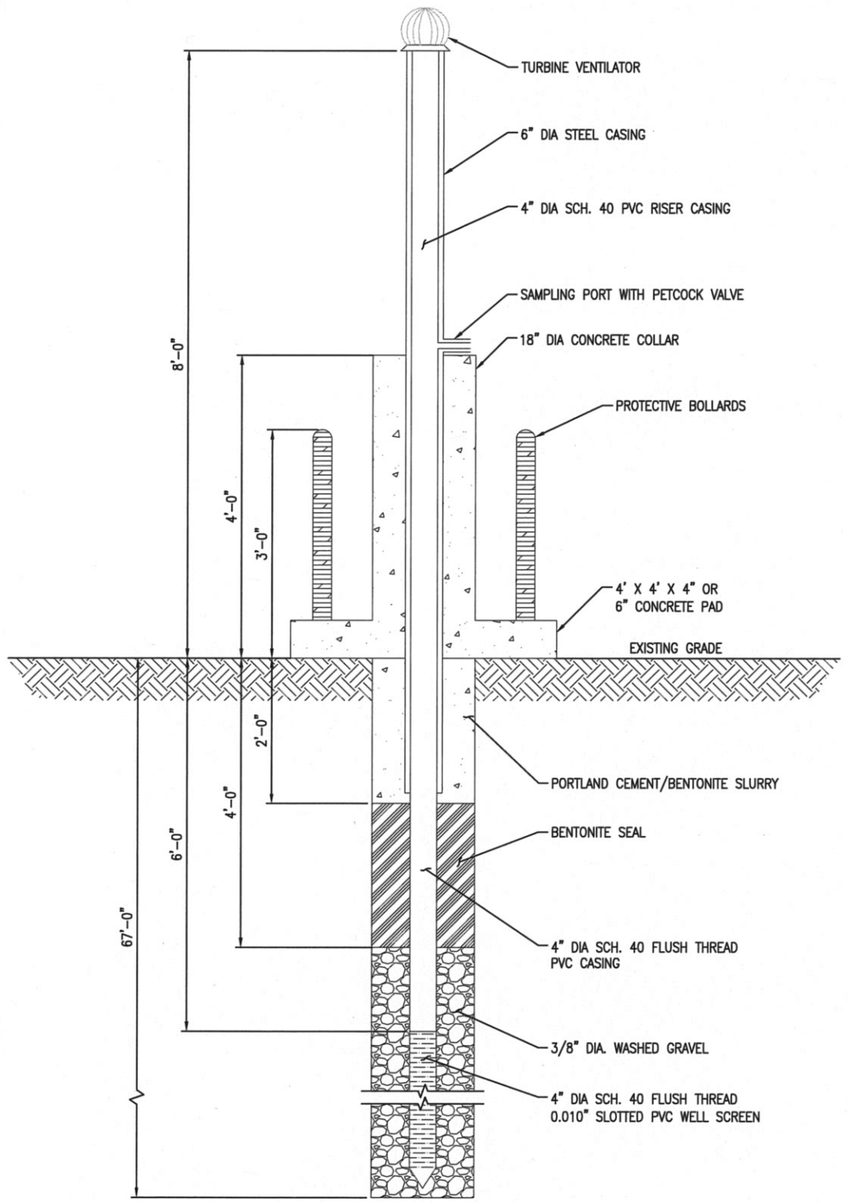
LANDFILL GAS WELL PLAN, SHEET 2 OF 2

PROJECT NUMBER: 9631500115
SHT. 73 OF: 78
DRAWING NUMBER: P3-40

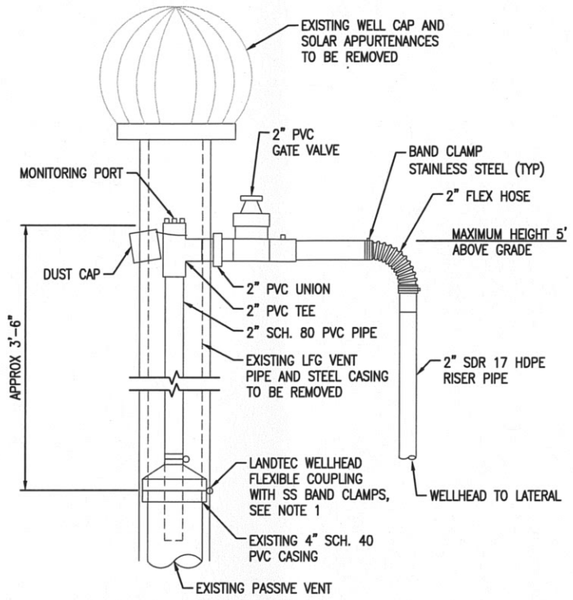
Ros, Jocco S. 5/30/2013 4:31:16 PM - R:\0021800 - El Paso TX\9631500115 - McCombs\Data Analysis\CADD\P3-40 LANDFILL GAS WELL PLAN, SHEET 2 OF 2.dwg

## NOTES

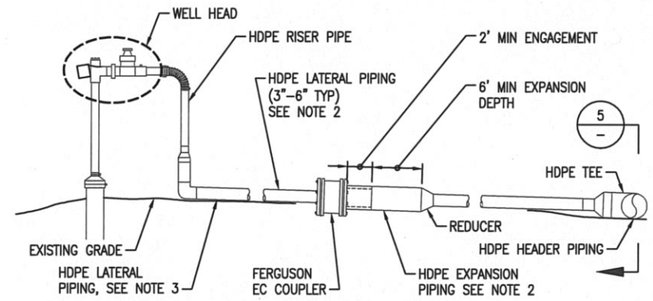
1. WELLHEAD ILLUSTRATED IS 2" LANDTEC ACCU-FLO WELLHEAD OR EQUIVALENT.
2. ALL PIPE SIZES AND DIMENSIONS ARE APPROXIMATE. EXACT SIZING AND DIMENSIONS SHALL BE DETERMINED DURING DESIGN.
3. HEADER AND LATERAL PIPING ABOVE GROUND.



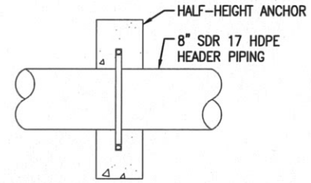

**DETAIL** 1 / P3-40
EXISTING PASSIVE VENT
SCALE: 1"=1'-0"



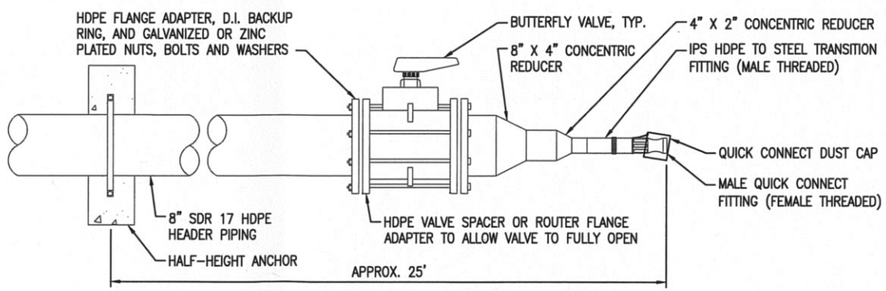

**DETAIL** 2 / P3-40
TYPICAL WELL RETROFIT FOR ACTIVE LFG SYSTEM
SCALE: 1"=1'-0"




**DETAIL** 3 / P3-40
TYPICAL LANDFILL GAS COLLECTION LATERAL
SCALE: 1/2"=1'-0"




**DETAIL** 5 / - / 5 / P3-40
TYPICAL LANDFILL GAS COLLECTION HEADER
SCALE: 1"=1'-0"




**DETAIL** 4 / P3-40
EXISTING HEADER TERMINATION
SCALE: 1"=1'-0"

GRAPHIC SCALES
1"=1'-0" 1 0 1 2 Scale Feet
1/2"=1'-0" 1 0 1 2 3 4 5 Scale Feet

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FREDRIC J. DORAN
111226
REGISTERED
PROFESSIONAL ENGINEER
11/2/12

| DESIGNED | DRAWN | VERIFY SCALE |
|---|---|---|
| TLK | CAD | BAR IS ONE INCH ON ANSI "D" DRAWING 0 1" |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 1 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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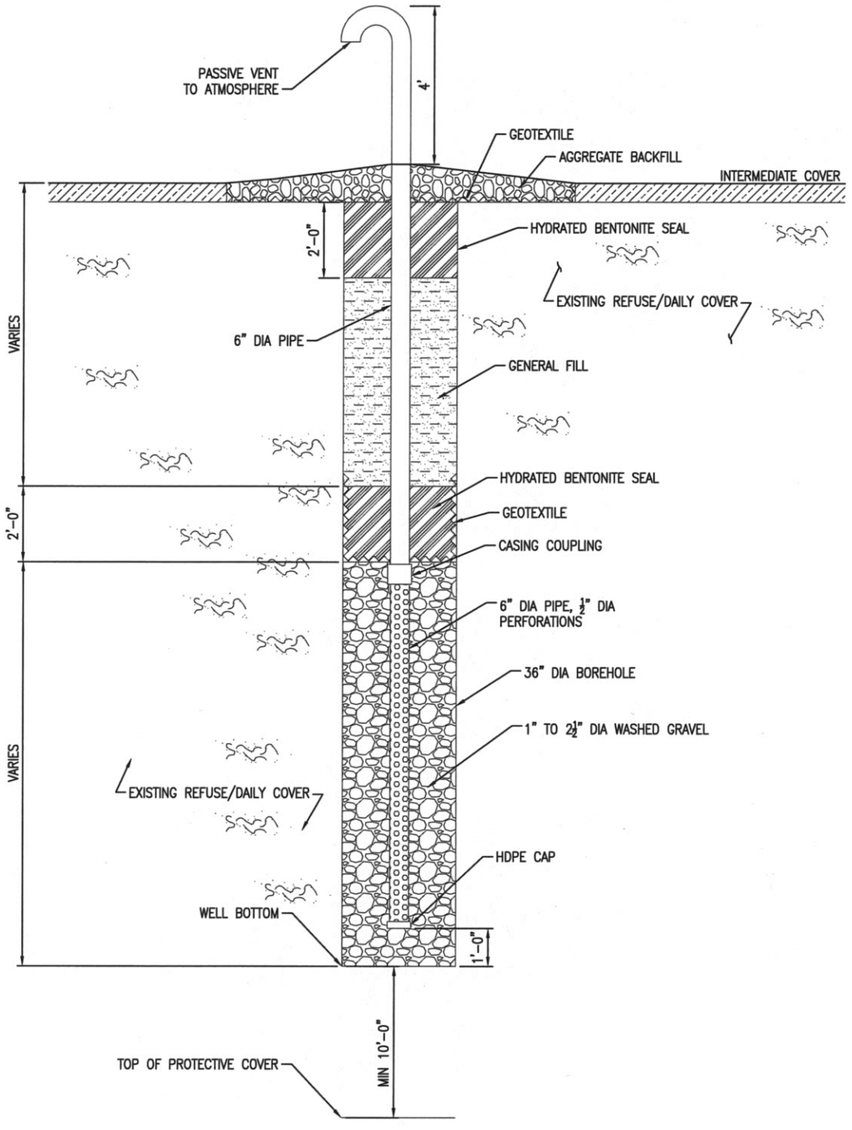
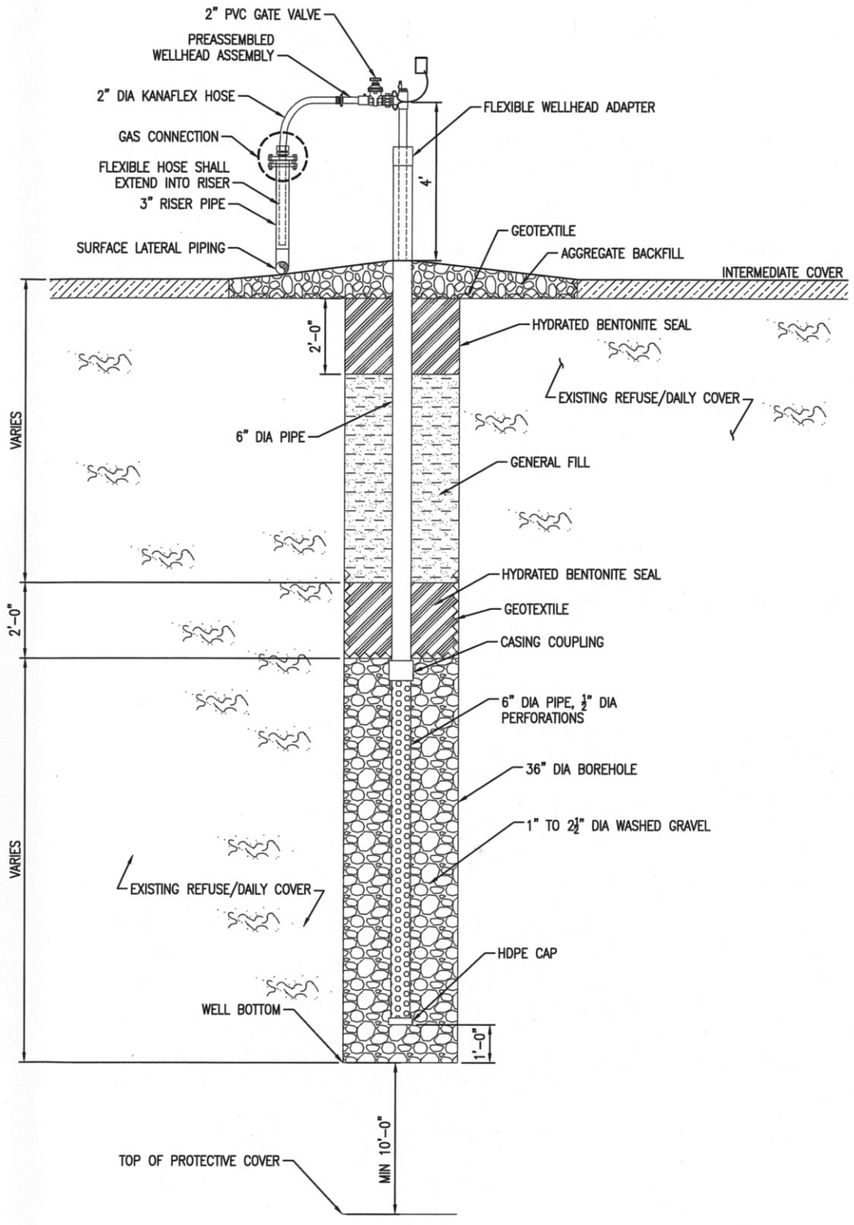
TYPICAL GAS WELL AND VENT DETAILS, SHEET 1 OF 2

PROJECT NUMBER: 9631500115
SHT. 74 OF: 78
DRAWING NUMBER: P3-41

Keller, Tonya L. 10/29/2012 2:32:25 PM - P:\0021800 el paso tx\9631500115\data analytical\CAD\P3-41 TYPICAL GAS WELL AND VENT DETAILS, SHEET 1 OF 2.dwg




**DETAIL** 1 P3-40
FUTURE PASSIVE VENT
TYPICAL – SEE NOTE 3
SCALE: 1/2"=1'-0"




**DETAIL** 2 P3-40
ACTIVE LANDFILL GAS COLLECTION WELL
TYPICAL – SEE NOTE 3
SCALE: 1/2"=1'-0"

## NOTES

1. THE PROPOSED LFG PLAN PORTRAYS AN ACTIVE GAS COLLECTION SYSTEM. IF AN ACTIVE SYSTEM IS NOT REQUIRED, THE WELLS WILL BE INSTALLED AS PASSIVE GAS VENTS UNTIL THE LANDFILL IS REQUIRED TO INSTALL AN ACTIVE SYSTEM BY NSPS STANDARDS OR IF THE LANDFILL INSTALLS AN ACTIVE SYSTEM VOLUNTARILY.
2. PASSIVE GAS VENTS WILL BE CONVERTED TO ACTIVE VENTS UPON THE INSTALLATION OF AN ACTIVE SYSTEM.
3. THE DETAILS SHOWN FOR THE FUTURE PASSIVE VENT AND THE ACTIVE LANDFILL GAS COLLECTION WELL ARE PROVIDED FOR TYPICAL CONDITIONS ONLY. IT SHOULD BE NOTED THAT THE MATERIALS USED FOR THE CONSTRUCTION OF THE GAS VENTS AND WELLS MAY VARY FROM THOSE PROVIDED. ACTUAL MATERIALS TO BE UTILIZED WILL BE DETERMINED DURING THE DESIGN PHASE OF CONSTRUCTION.

GRAPHIC SCALE
1/2"=1'-0" 1 0 1 2 3 4 5
Scale Feet

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FREDRIC J. DORAN
111226
REGISTERED PROFESSIONAL ENGINEER
11/2/12

DESIGNED TLK
DRAWN CAD
VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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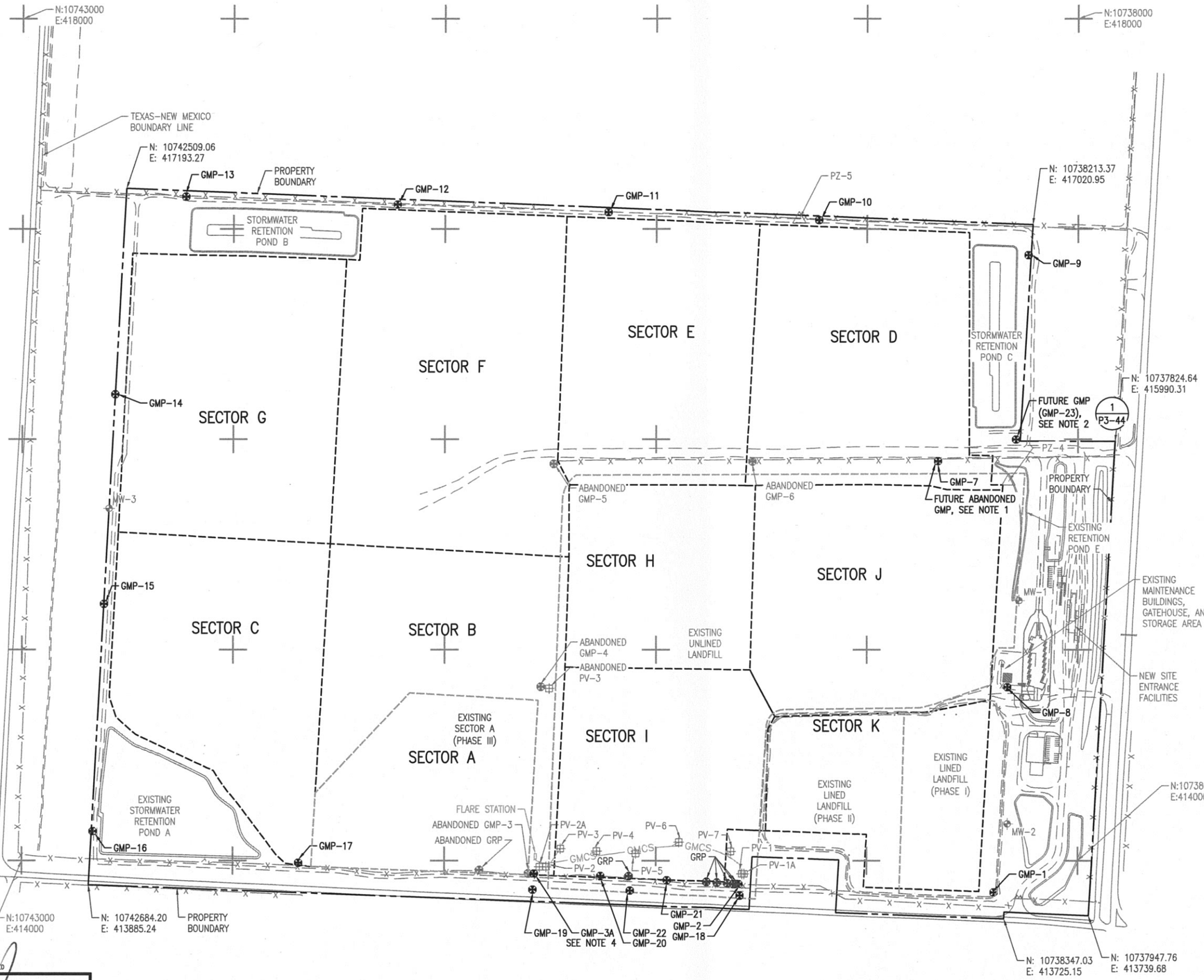
TYPICAL GAS WELL AND VENT DETAILS, SHEET 2 OF 2

PROJECT NUMBER: 9631500115
SHT. 75 OF: 78
DRAWING NUMBER: P3-42

Keller, Tonya L. 10/29/2012 2:34:47 PM – P:\00218000 el paso tx\9631500115\data analytical\CADD\P3-42 TYPICAL GAS WELL AND VENT DETAILS, SHEET 2 OF 2.dwg




## NOTES

1. EXISTING LANDFILL GAS MONITORING PROBE (GMP–7) TO BE ABANDONED AS LANDFILL VERTICAL EXPANSION IS COMPLETED.
2. FUTURE LANDFILL GAS MONITORING PROBE (GMP–23) TO BE ADDED WHEN EXISTING GAS MONITORING PROBE (GMP–7) IS ABANDONED.
3. GAS RECOVERY PROBES ARE NOT PART OF THE CURRENT LANDFILL GAS MONITORING PLAN AND MAY BE ABANDONED AT ANY TIME.
4. GMP–2, GMP–3A, GMP–20, GMP–21, AND GMP–22 ARE TO BE DECOMMISSIONED, PLUGGED, AND ABANDONED AS DESCRIBED IN THE LANDFILL GAS MANAGEMENT PLAN (PART 3.7).

## LEGEND

| | |
|---|---|
| GMP–8 | GAS MONITORING PROBE |
| GRP | GAS RECOVERY PROBE |
| PV–3 | EXISTING MONITORING WELL |
| MW–3 | MONITORING WELL |
| △ | PIEZOMETER |
| | BUILDING/STRUCTURE |
| 4250 | ELEVATION CONTOURS |
| | FACILITY/PROPERTY BOUNDARY |
| | SECTOR BOUNDARIES |
| | STORMWATER RETENTION POND BOUNDARY |
| | HIGHWAY |
| | LANDFILL ACCESS ROAD |
| X X | CHAIN LINK OR OTHER FENCE |
| GMCS | GAS MONITORING CONTROL SYSTEM |

GRAPHIC SCALE

1"=250'–0" 250 0 250 500

Scale Feet

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FREDRIC J. DORAN
111226
REGISTERED PROFESSIONAL ENGINEER
11/2/12

| | |
|---|---|
| DESIGNED | TLK |
| DRAWN | CAD |
| VERIFY SCALE | BAR IS ONE INCH ON ANSI "D" DRAWING |
| | 0 1" |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| | | | | |
| | | | | |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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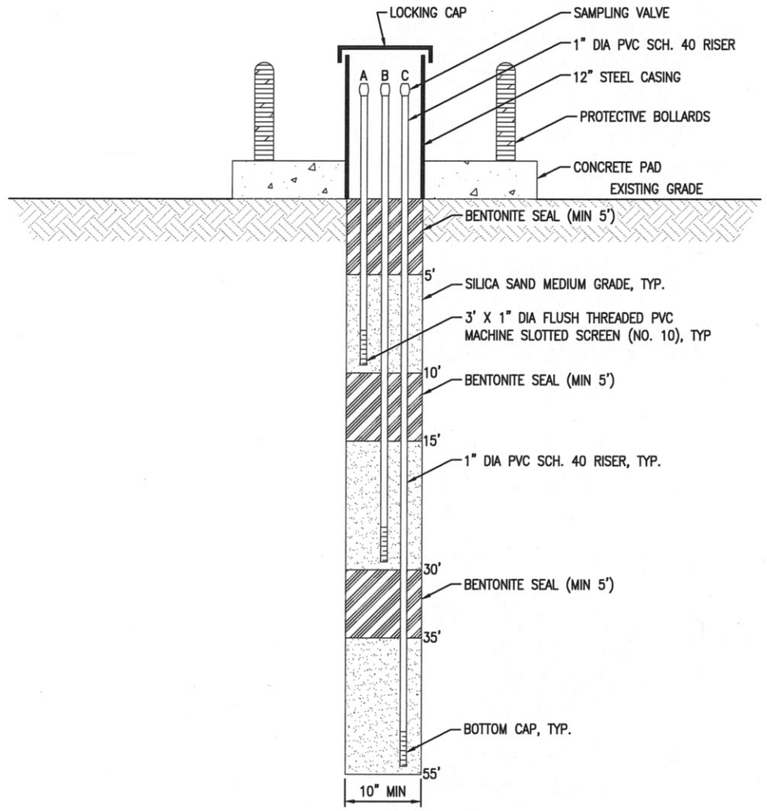
LANDFILL GAS MONITORING PROBE PLAN

PROJECT NUMBER: 9631500115

SHT. 76 OF: 78

DRAWING NUMBER: P3–43

Keller, Tonya L. 10/29/2012 2:51:49 PM – P:\0021B000 el paso tx\9631500115\data analytical\CADD\P3-43 LANDFILL GAS MONITORING PROBE PLAN.dwg




**DETAIL** 1 / P3–43

TYPICAL LANDFILL GAS MONITORING PROBE
SCALE: 1"=1'–0"

## NOTES

1. TYPICAL LANDFILL GAS MONITORING PROBE DESIGN PER AGRA EARTH AND ENVIRONMENTAL GROUP, 1994 AND VIVA ENVIRONMENTAL, INC. 2001.

GRAPHIC SCALE

1"=1'–0" 1 0 1 2
Scale Feet

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111226
REGISTERED
PROFESSIONAL ENGINEER
11/2/12

DESIGNED TLK
DRAWN CAD
VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
0 1"

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 1 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

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LANDFILL GAS MONITORING PROBE DETAILS

PROJECT NUMBER: 9631500115
SHT. 77 OF: 78
DRAWING NUMBER: P3–44

Keller, Tonya L. 10/29/2012 2:47:09 PM – P:\00218000 el paso tx\9631500115\data analytical\CADD\P3-44 LANDFILL GAS MONITORING PROBE DETAILS.dwg

# Appendix 3M - Attachment 4
# Previous Landfill Gas Management Plans
(as developed by R.W. Beck 2009, VIVA 2001, and AGRA 1994)

SAIC®

## Memorandum

SAIC®

To: TCEQ

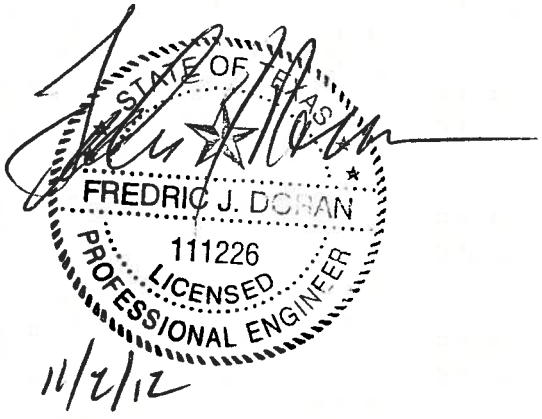
From: Fred J. Doran, SAIC FJD

Subject: Appendix 3M, Attachment 4

Date: November 2, 2012

The attached historic Landfill Gas Management Plans were completed in 2009, 2001, and 1994 and reference MSW Permit No. 729A throughout. It should be noted that the attached reports are provided for reference as identified in the new Landfill Gas Management Plan provided as Section 3.7 and reference to MSW Permit No. 729A should be used synonymously with MSW Permit No. 729B where appropriate.

TLK






SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI

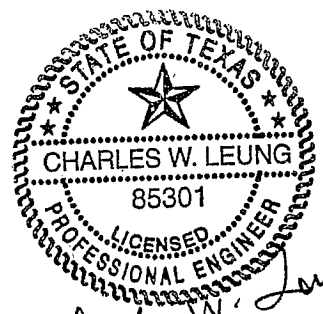
(CONTINUED)

# SITE DEVELOPMENT PLAN
# PART III – ATTACHMENT 14
# LANDFILL GAS MANAGEMENT PLAN

## McCombs Landfill
## El Paso County, Texas
## TCEQ MSW Permit No. 729A

**Approved December 14, 2001**
**Revision 1 Approved November 13, 2003**
**Revision 2 April 3, 2009**

Prepared for:
City of El Paso – Environmental Services
7969 San Paulo Drive
El Paso, Texas 79907




Charles W. Leung
April 3, 2009
(Rev. 2 only)

Prepared by:
R. W. Beck
4975 Preston Park Blvd., Suite 850
Plano, Texas 75093

Project No. 15-00297-01000

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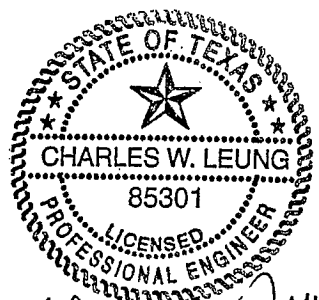
REFERENCES


Charles W. Leung
April 3, 2009
(Rev. 2 only)

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STATE OF TEXAS
CHARLES W. LEUNG
85301
LICENSED
PROFESSIONAL ENGINEER

Charles W. Leung
April 3, 2009
CRW. 2 only.

# 7 BASIS OF PROBE AND VENT PLACEMENT

In June 2000, two passive venting wells (PV-1 and PV-2) were installed in order to intercept and vent methane gas prior to reaching GMP-2 and GMP-3. One (1) venting well was installed approximately fifty (50) feet east of GMP-2, with the other venting well installed approximately fifty (50) feet south and thirty (30) feet east of GMP-3. Both venting wells were installed to a depth approximately sixty (60) feet bgs in order to capture methane gas at depths where the majority of the elevated methane gas levels were detected and may be generated.

In 2001, one vertical passive venting well (PV-3) was installed to a depth of 55-feet below grade. The venting well was located approximately 10 feet south of GMP-4. Construction details for the Passive Venting Wells are included in Appendix D-1. The locations of the passive venting wells are shown in Appendix A-2.

Five (5) additional passive venting wells (PV-3 to PV-7) were installed in 2006 to provide additional gas venting in the area between GMP 2 and GMP 3. PV-3 was a replacement vent of the one installed in 2001. GMP 18 and GMP 19 were installed in 2004 to eventually replace GMP 2, and GMP 3, respectively. GMP 2 and GMP 3 will be decommissioned, plugged and abandoned after their gas readings have returned to compliance due to the installation and operation of the proposed active Gas Migration Control System (GMCS) along a portion of the western perimeter as part of the gas migration remediation plan. The current locations of GMPs 2 and 3 are too close to the waste limits, and the locations of GMPs 18 and 19 are more suitable for gas monitoring at these two locations.

Temporary GMPs 20, 21 and 22 were installed in 2006 to provide additional information on gas migration. These probes will also be decommissioned, plugged and abandoned after the gas readings of the impacted probes in the affected area have returned to compliance. The City has also decommissioned, plugged and abandoned GMPs 4, 5 and 6 based on previous TCEQ approval.

The locations of the GMPs and passive venting wells are shown in Figure 14G-1, and the approximately coordinates and elevations are shown in Appendix A-3.

The permanent Site Methane Monitoring Network consists of fourteen (14) GMPs spaced approximately 1,000 feet apart. The GMPs were installed along the permitted area and property boundary. A review of on-site geological/soil data revealed little evidence of any laterally extensive stratographic units which could significantly influence migration of any gases produced within the landfill cells (AGRA, 1994). The locations of the GMPs are shown in Appendix A-2. Except for GMP-7 (10 feet deep), the GMPs depths are 55 feet. The depth of each GMP was based on the following information:

**Closed Cell Area:**

According to information provided by the City, the southeastern quadrant of the landfill was used for disposal of municipal solid waste in the early 1960's. Information available suggests that little excavating was performed; waste was placed on the surface of the ground and covered (Borrego, 1994). AGRA Earth and Environmental Group estimated that the depth of waste in this area extends less than 5 feet below the surrounding land surface. The top of this cell is approximately 15 feet above grade (AGRA, 1994). The cell is covered with silty sand.

**Phase II Area:**

Excavations southwest of the potential area extended to a depth of 65 feet below the surface (Borrego, 2000).

# 8 GAS MONITORING PROBE INSTALLATION (Continued)

Gas Monitoring Probes 18 to 22 (AMEC, 2004 - 2006)

The gas monitoring probes were installed by a licensed monitor well driller (Mr. John McDuffee License No. 2994W) employing a CME 75 truck mounted drill rig equipped with 10-inch O.D. hollow stem augers. All drilling and probe operations were performed under the direction of an AMEC Texas-registered professional geologist. During the placement of the probes, the soil encountered was continuously examined, visually classified and logged. The boring and well logs of the GMPs 18 to 22 are presented in Appendix F. Locations of GMPs 18 to 22 are shown in Appendix G.

GMP 18 and GMP 19 were installed in 2004 to eventually replace GMP 2, and GMP 3A, respectively. GMP 2 and GMP 3A will be decommissioned, plugged and abandoned after their gas readings have returned to compliance due to the installation and operation of the proposed active Gas Migration Control System (GMCS) along a portion of the western perimeter as part of the gas migration remediation plan. The current locations of GMPs 2 and 3A are too close to the waste limits, and the locations of GMPs 18 and 19 are more suitable for gas monitoring at these two locations. The original GMP 3 was damaged and was replaced by GMP 3A in 2003.

Temporary GMPs 20, 21 and 22 were installed in 2006 to provide additional information on gas migration. These probes will also be decommissioned, plugged and abandoned after the gas readings of the impacted probes in the affected area have returned to compliance. The City has also decommissioned, plugged and abandoned GMPs 4, 5 and 6 based on previous TCEQ approval.

# 18 GAS MIGRATION CONTROL SYSTEM ALONG WESTERN PERIMETER

Existing gas monitoring probes (GMPs) 2, 3, 20, and 21 along the western perimeter of the McCombs Landfill have been experiencing periodic elevated methane readings above the regulatory limit of 5 percent (%) for some time. Certain investigations and field work had been performed by consulting firms in the past on LFG migration at the landfill, and the landfill is currently under enforcement actions by TCEQ to mitigate the affected GMPs due to elevated methane readings.

Additional passive vents (PV-3 to PV-7) were installed along the western waste limit of the Landfill in 2006 by AMEC (a local consulting firm) as part of the on-going remediation efforts. The boring and well completion logs and state well reports are provided in Appendix F. The locations of PV-3 to PV-7 are presented in Figure 14G-1. However, the passive vents were not effective in controlling gas migration toward the affected GMPs. As a result, the City decided to install an active gas migration control system (GMCS) as part of the site gas remediation plan.

The proposed GMCS is an active extraction system to control LFG migration in the affected area. The system is a partial active system because it will be installed only along a distance of approximately 1,000 to 1,500 feet over the western portion of McCombs Landfill (Phases I – III) to remediate LFG migration in the affected area. Existing passive vents PV-2 to PV-7 will be converted into active gas extraction wells as part of the GMCS. In addition to the 6 converted extraction wells, the GMCS will consist of LFG header and lateral pipes, a condensate sump and pump system, a blower/flare (b/f) station, a condensate storage tank and an air compressor system to power the condensate pump system. Future new gas extraction wells may be installed if the gas readings of the affected GMPs are not under the compliance level after 6 months of operating the GMCS with the converted passive vents. See Figures 14G-1 and 14G-2 for the approximate location and layout of the proposed GMCS. Typical details of the passive vents conversion and potential new gas extraction wells are presented in Figure 14G-3.

The Landfill site is currently under the annual air emissions threshold of the Federal New Source Performance Standards (NSPS). As a result, there is no present requirement for the City to install a LFG collection and control system (GCCS) covering the entire landfill under the NSPS rules, unless there are changes in the anticipated waste acceptance rates and/or site specific non-methane organic compounds (NMOC) concentrations in the future that may increase air emissions.

APPENDIX A-3

HORIZONTAL LOCATIONS AND ELEVATIONS TABLE
FOR GAS MONITORING PROBES AND PASSIVE VENTING WELLS

| Reference Point | North | South | Elevation |
|---|---|---|---|
| GMP-1 | 10675.08 | 10110.84 | 4086.41 |
| GMP-2 | 11883.99 | 10084.55 | 4088.11 |
| GMP-3A (replaced original GMP-3) | 12885.06 | 10080.40 | 4096.68 |
| GMP-4 (decommissioned) | | | |
| GMP-5 (decommissioned) | | | |
| GMP-6 (decommissioned) | | | |
| GMP-7 | 11051.54 | 12140.06 | 4072.61 |
| GMP-8 | 10665.08 | 11084.89 | 4072.38 |
| GMP-9 | 10680.16 | 13140.49 | 4078.55 |
| GMP-10 | 11681.36 | 13252.38 | 4084.32 |
| GMP-11 | 12680.13 | 13235.89 | 4087.33 |
| GMP-12 | 13679.19 | 13217.35 | 4082.85 |
| GMP-13 | 14680.49 | 13199.921 | 4082.21 |
| GMP-14 | 14964.03 | 12243.49 | 4075.69 |
| GMP-15 | 14961.44 | 12244.89 | 4067.69 |
| GMP-16 | 14953.59 | 10166.20 | 4048.13 |
| GMP-17 | 13973.30 | 10070.10 | 4056.37 |
| *GMP-18*** | *10738875.87* | *413522.86* | |
| *GMP-19*** | *10739860.13* | *413550.26* | |
| *GMP-20*** | *10739538.43* | *413615.12* | |
| *GMP-21*** | *10739225.81* | *413595.36* | |
| *GMP-22*** | *10739398.67* | *413545.64* | |
| PV-1 | 11870.84 | 10134.05 | 4092.70 |
| PV-2 | 12803.58 | 10116.34 | 4101.28 |
| PV-3 | 12835.90 | 10960.34 | 4081.81 |

| | | | |
|---|---|---|---|
| RR Spike (Benchmark)* | 10000.00 | 10000.00 | 4080.16 |
| FND CM @ Back Bldg. (Benchmark) | 10609.25 | 11047.33 | 4072.11 |
| *PV-4*** | *10739557.07* | *413732.35* | |
| *PV-5*** | *10739372.37* | *413721.45* | |
| *PV-6*** | *10739168.26* | *413775.74* | |
| *PV-7*** | *10739168.26* | *413775.74* | |

*** Approximately locations only, coordinates and elevations not surveyed.*

* The RR Spike Benchmark was designated as the reference point for the survey. This benchmark is located at the common corner of Section 1 and Section 12, Block 81, Township 1, and Sections 6 and 7, Block 80 Township 1, Texas and Pacific Railway Surveys.

# PART III SITE DEVELOPMENT PLAN
# ATTACHMENT 14 – LGMP

## APPENDIX 14-F

## ADDITIONAL GAS MONITORING PROBES (GMPs 18 TO 22) AND PASSIVE VENTS BORING LOGS AND WELL REPORTS

**(Added April 3, 2009)**

amec

June 29, 2007
AMEC Project Ref. 6717500029

City of El Paso Environmental Services
Environmental Management
7969 San Paulo Dr.
El Paso, Texas 79907

Attention: Mr. John D. Garza, P.E
Mr. Said Larbi-Cherif, P.E.

Re: Transmittal of Completion Documents
McCombs Municipal Solid Waste Landfill
El Paso, Texas
MSW Permit No. 729A
WWC No. 11004302

Gentlemen:

Transmitted herewith are borings logs, well completion as-built diagrams and State well records for gas monitoring probes (GMPs), passive vents (PVs), and test monitoring points (MPs) placed at the McCombs MSW landfill during the last few phases of work. Some of these documents were previously submitted in other correspondence; however, we have provided all applicable documentation to ensure the completeness of your records.

These as-built diagrams and supporting information will be incorporated into a permit modification documenting changes to the landfill gas monitoring and abatement system at the time a formal submittal to the State is deemed appropriate.

We have omitted details concerning passive vent modification (turbines/solar vents) to minimize confusion associated with various configurations that have or may be employed.

Should you have any questions or concerns associated with these documents, please feel free to contact us at your convenience.

Respectfully submitted,
AMEC Earth & Environmental, Inc.

David Varela, P.E.
Senior Engineer

DAVID A. VARELA
90556
LICENSED
PROFESSIONAL ENGINEER
6/29/07

David Hartsfield, P.G.
Senior Geologist

Jamie Barnes
Unit Manager

Copies: Addressee (3)

Permit No. 729A, Revision 1, Jan. 9, 2006

# LOG OF TEST BORING NO. GMP-18

amec

PROJECT McCombs Landfill Gas Study
JOB NO. 4-717-000291 DATE December 15, 2004 SHEET 1 OF 2

RIG TYPE CME 75
BORING TYPE 10" O.D. Hollow Stem Auger
SURFACE ELEV.
DATUM Existing

LOGGED BY W. Smith
DWG BY C. Holguin
CHEK'D BY D. Varela
DRILLED BY E. Osorio
File No. [illegible]

| Depth in meters | Sample Number | Graphical Log | Sample | Sample Type | Blows per foot 140 lb. 30" free-fall drop hammer | PID Reading @ Sample Tube | % LEL | Unified Soil Classification | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | X | A | | 0.0 | 0.0 | SM | | SILTY SAND, nonplastic, brown, dry. |
| | | | | | | | | SM | | SILTY SAND, low to moderate calcium carbonate induration, nonplastic, white brown. |
| 5 | | | X | A | | 0.0 | 0.0 | | | |
| | | | | | | | | SP | | SAND, fine to medium grained, nonplastic, light brown, dry. |
| 10 | | | X | A | | 0.0 | 0.0 | | | |
| | | | | | | | | SP | | SAND with some gravel, low calcium carbonate induration, nonplastic, dry. Gravel 1/4" to 1" sub-angular, sub-rounded. |
| 15 | | | X | A | | 0.0 | 0.0 | | | |
| | | | | | | | | SP | | GRAVELLY SAND, nonplastic, light brown, dry. Gravel 1/4" to 1" sub-angular, sub-rounded. |
| 20 | | | X | A | | 0.0 | 0.0 | | | |
| | | | | | | | | SP | | SAND with some gravel, medium to coarse grained, nonplastic, light brown, damp. Gravel 1/4" to 1", 5-10% gravel, sub-angular, sub-rounded. |
| 25 | | | X | A | | 0.0 | 0.0 | | | |
| 30 | | | X | A | | 0.0 | 0.0 | | | |
| 35 | | | X | A | | 0.0 | 0.0 | | | |
| 40 | | | | | | | | | | |

STATE OF TEXAS
David L. Hartsfield
Geology
2707
LICENSED PROFESSIONAL GEOSCIENTIST

David L. Hartsfield, P.G.
6-28-07

| GROUND WATER | | |
|---|---|---|
| DEPTH | HOUR | DATE |
| | | |
| | | |

SAMPLE TYPE
A – Auger cuttings B – Block sample
S – 2" O.D. 1.38" I.D. tube sample M – Macrocore
U – 3" O.D. 2.42" I.D. tube sample
T – 3" O.D. thin-walled Shelby tube

Permit No. 729A, Revision 1, Jan. 9, 2006

# LOG OF TEST BORING NO. GMP-18

amec

PROJECT McCombs Landfill Gas Study
JOB NO. 4-717-000291 DATE December 15, 2004

SHEET 2 OF 2
RIG TYPE CME 75
BORING TYPE 10" O.D. Hollow Stem Auger
SURFACE ELEV.
DATUM Existing

LOGGED BY W. Smith
DWG BY C. Holguin
CHEK'D BY D. Varela
DRILLED BY E. Osorio

File No: P:\Drafting\2007-07\[illegible]

| Depth in meters | Sample Number | Graphical Log | Sample | Sample Type | Blows per foot 140 lb. 30" free-fall drop hammer | PID Reading @ Sample Tube | % LEL | Unified Soil Classification | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|
| 40 | | | X | A | | 0.0 | 0.0 | SP | | SAND with some gravel, medium to coarse grained, nonplastic, light brown, damp. Gravel 1/4" to 1", 5-10% gravel, sub-angular, sub-rounded. |
| 45 | | | X | A | | 0.0 | 0.0 | | | |
| 50 | | | X | A | | 0.0 | 0.0 | SP | | SAND, fine to coarse grained, nonplastic, light brown, damp. Less than 5% gravel content. |
| 55 | | | X | A | | 0.0 | 0.0 | | | |
| 60 | | | X | A | | 0.0 | 10 | | | |
| 65 | | | X | A | | 0.0 | 8 | | | |
| 70 | | | | | | | | | | Auger Stopped at 67'. |
| 75 | | | | | | | | | | |
| 80 | | | | | | | | | | |

STATE OF TEXAS
David L. Hartsfield
Geology
2707
LICENSED PROFESSIONAL GEOSCIENTIST

P.G.
6-28-07

| GROUND WATER | | |
|---|---|---|
| DEPTH | HOUR | DATE |
| | | |
| | | |

SAMPLE TYPE
A – Auger cuttings
S – 2" O.D. 1.38" I.D. tube sample
U – 3" O.D. 2.42" I.D. tube sample
T – 3" O.D. thin-walled Shelby tube
B – Block sample
M – Macrocore

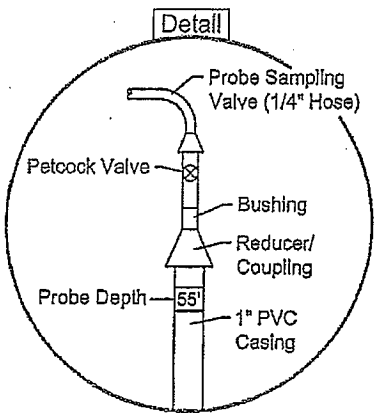
# GAS MONITOR WELL SCHEMATIC GMP-18

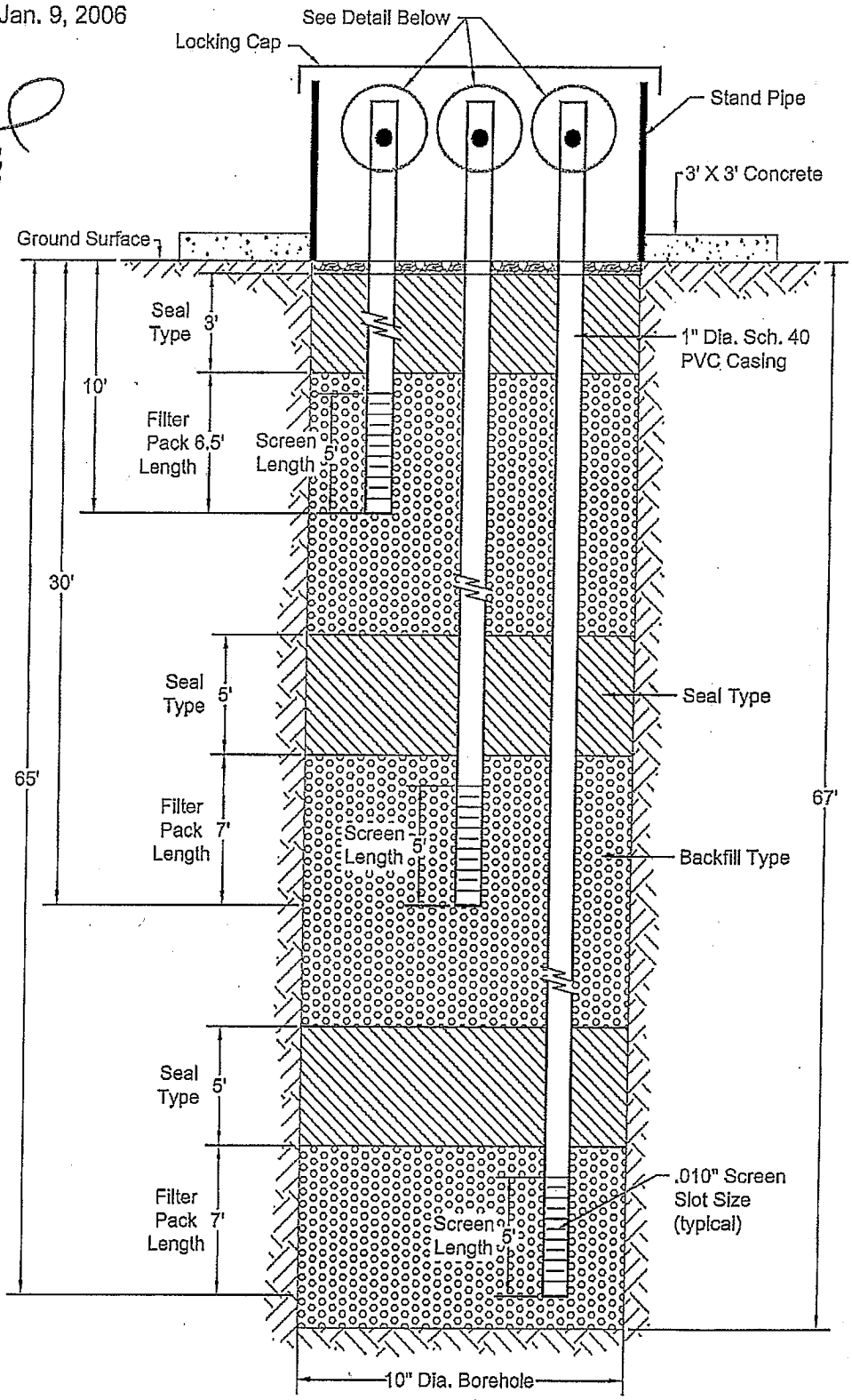
PROJECT Landfill Gas Study - McCombs Landfill
JOB NO. 4-717-000291 DATE 12/15/2004
RIG TYPE CME 75 LOGGED W. Smith
BORING TYPE 10" O.D. Hollow Stem Auger DWG BY C. Holguin
File No: P:\Drafting2\2004\0291\VMW-2 Well.dwg CHECKED BY E. Osorio
DRILLED BY- Tierra

Permit No. 729A, Revision 1, Jan. 9, 2006

STATE OF TEXAS
DAVID A. VARELA
90556
LICENSED PROFESSIONAL ENGINEER
4/22/07

| Legend |
|---|
| 1/4" Washed Gravel |
| Bentonite |
| Native Soil |
| Cement / Bentonite Grout |



Permit No. 729A, Revision 1, Jan. 9, 2006

# LOG OF TEST BORING NO. GMP-19

amec

PROJECT McCombs Landfill Gas Study
JOB NO. 4-717-000291 DATE December 16, 2004

SHEET 1 OF 2
RIG TYPE CME 75
BORING TYPE 10" O.D. Hollow Stem Auger
SURFACE ELEV.
DATUM Existing

LOGGED BY W. Smith
DWG BY C. Holguin
CHEK'D BY D. Varela
DRILLED BY E. Osorio

File No: P:\Projects\2004\4-717-000291\Misc\Logs.dwg

| Depth in meters | Sample Number | Graphical Log | Sample | Sample Type | Blows per foot 140 lb. 30" free-fall drop hammer | PID Reading @ Sample Tube | % LEL | Unified Soil Classification | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | X | A | | 0.0 | 0.0 | SC | | CLAYEY SAND, low plasticity, red brown, damp. |
| | | | | | | | | SM | | SILTY SAND, low calcium carbonate induration, nonplastic, white brown, dry. |
| 5 | | | X | A | | 0.0 | 0.0 | | | |
| | | | | | | | | SP | | SAND with some gravel, fine to coarse grained, nonplastic, light brown, dry. Gravel 1/4" to 1" sub-angular, sub-rounded. |
| 10 | | | X | A | | 0.0 | 0.0 | | | |
| | | | | | | | | GP | | SANDY GRAVEL, nonplastic, light brown, dry. Gravel 1/4" to 1" sub-angular, sub-rounded. |
| 15 | | | X | A | | 0.0 | 0.0 | | | |
| | | | | | | | | SP | | SAND with some gravel, fine to coarse grained, nonplastic, light brown, dry. Gravel 1/4" to 1" sub-angular, sub-rounded. |
| 20 | | | X | A | | 0.0 | 0.0 | | | |
| 25 | | | X | A | | 0.0 | 0.0 | | | |
| 30 | | | X | A | | 0.0 | 0.0 | | | |
| 35 | | | X | A | | 0.0 | 0.0 | | | |
| 40 | | | | | | | | | | |

STATE OF TEXAS
David L. Hartsfield
Geology
2707
LICENSED PROFESSIONAL GEOSCIENTIST

David L. Hartsfield, P.G.
6-28-07

| GROUND WATER | | |
|---|---|---|
| DEPTH | HOUR | DATE |
| | | |
| | | |

SAMPLE TYPE
A – Auger cuttings
S – 2" O.D. 1.38" I.D. tube sample
U – 3" O.D. 2.42" I.D. tube sample
T – 3" O.D. thin-walled Shelby tube
B – Block sample
M – Macrocore

# LOG OF TEST BORING NO. GMP-19

amec

PROJECT McCombs Landfill Gas Study
JOB NO. 4-717-000291 DATE December 16, 2004 SHEET 2 OF 2

RIG TYPE CME 75
BORING TYPE 10" O.D. Hollow Stem Auger
SURFACE ELEV.
DATUM Existing

LOGGED BY W. Smith
DWG BY C. Holguin
CHEK'D BY D. Varela
DRILLED BY E. Osorio

| Depth in meters | Sample Number | Graphical Log | Sample | Sample Type | Blows per foot 140 lb. 30" free-fall drop hammer | PID Reading @ Sample Tube | % LEL | Unified Soil Classification | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|
| 40 | | | X | A | | 0.0 | 0.0 | SP | | SAND, fine to coarse grained, nonplastic, light brown, dry. |
| 45 | | | X | A | | 0.0 | 0.0 | | | |
| 50 | | | X | A | | 0.0 | 0.0 | | | |
| 55 | | | X | A | | 0.0 | 0.0 | | | |
| 60 | | | X | A | | 0.0 | 0.0 | | | |
| 65 | | | X | A | | 0.0 | 0.0 | | | |
| 70 | | | | | | | | | | Auger Stopped at 68'. |
| 75 | | | | | | | | | | |
| 80 | | | | | | | | | | |

STATE OF TEXAS
David L. Hartsfield
Geology
2707
LICENSED PROFESSIONAL GEOSCIENTIST

D. Hartsfield, P.G.
6-28-07

| GROUND WATER | | |
|---|---|---|
| DEPTH | HOUR | DATE |
| | | |
| | | |

SAMPLE TYPE
A – Auger cuttings B – Block sample
S – 2" O.D. 1.38" I.D. tube sample M – Macrocore
U – 3" O.D. 2.42" I.D. tube sample
T – 3" O.D. thin-walled Shelby tube

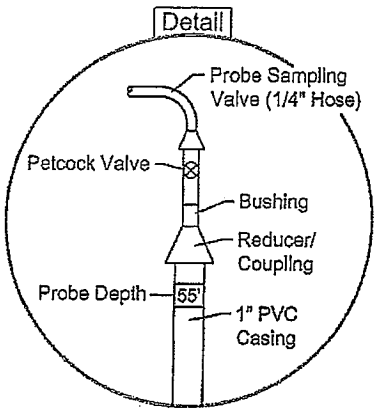
# GAS MONITOR WELL SCHEMATIC GMP-19

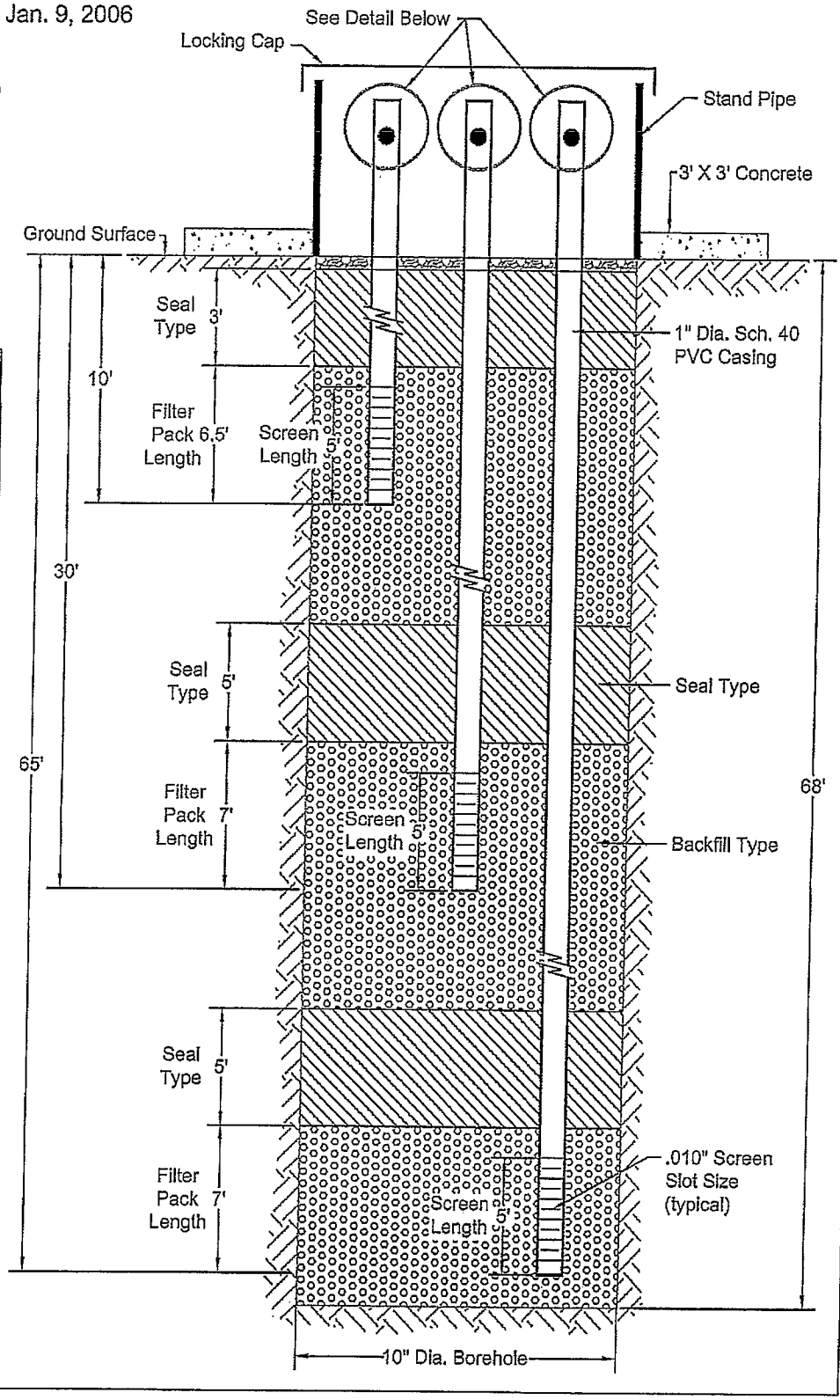
PROJECT Landfill Gas Study - McCombs Landfill
JOB NO. 4-717-000291 DATE 12/15/2004
RIG TYPE CME 75 LOGGED W. Smith
BORING TYPE 10" O.D. Hollow Stem Auger DWG BY C. Holguin
File No: P:\Drafting2\2004\0291\VMW-3 Well.dwg CHECKED BY E. Osorio
DRILLED BY Tierra

Permit No. 729A, Revision 1, Jan. 9, 2006

STATE OF TEXAS
DAVID A. VARELA
90556
LICENSED
PROFESSIONAL ENGINEER
6/28/07

| Legend |
|---|
| 1/4" Washed Gravel |
| Bentonite |
| Native Soil |
| Cement / Bentonite Grout |



AMEC Earth and Enviromental
125 Montoya Rd.
El Paso 79932
Telephone: 915.585.2472
Fax: 915 585.2626

# BORING NUMBER GMP-20



CLIENT City of El Paso
PROJECT NAME McCombs Landfill
PROJECT NUMBER 6-717-000104
PROJECT LOCATION 13600 McCombs, El Paso, Texas 79934
DATE STARTED 09/08/06 COMPLETED 09/08/06
GROUND ELEVATION ____ HOLE SIZE 10-inch
DRILLING CONTRACTOR AMEC
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY E. Cutler CHECKED BY ____
AT END OF DRILLING ---
NOTES ____
AFTER DRILLING ---

| DEPTH (ft) | LAB SAMPLE TYPE/NUMBER | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION | PID (ppm) |
|---|---|---|---|---|---|
| 0 | | | | SILTY SAND, medium to fine grained, mostly medium, moderately plastic, white to brown, dry. | |
| 5 | 1 | SM | | SILTY SAND, same as above, with trace gravel, white to brown, dry. | 0.0 |
| 10 | 2 | | | SAND, fine to medium grained, mostly medium, trace nonplastic fines, trace pea size gravel, light brown, dry. | 0.0 |
| 15 | 3 | | | SAND, same as above, dry. | 0.0 |
| 20 | 4 | | | SAND, same as above, dry. | 0.0 |
| 25 | 5 | | | SAND, coarse to medium grained, mostly medium, trace pea size gravel, white to brown, dry. | 0.0 |
| 30 | 6 | | | SAND, hard to fine grained, mostly fine, white to brown, dry. | 0.0 |
| 35 | | | | SAND, hard to fine grained, mostly fine, white to brown, dry. | |

STATE OF TEXAS
David L. Hartsfield
Geology
2707
LICENSED
PROFESSIONAL GEOSCIENTIST

David L. Hartsfield, P.G.
6-28-07

(Continued Next Page)

AMEC WELL LOG AND DIAGRAM BORE LOGS GMP-20 TO 22.GPJ GINT US LAB.GDT 06/27/07

AMEC Earth and Enviromental
125 Montoya Rd.
El Paso 79932
Telephone: 915.585.2472
Fax: 915.585.2626

# BORING NUMBER GMP-20



CLIENT City of El Paso

PROJECT NAME McCombs Landfill

PROJECT NUMBER 6-717-000104

PROJECT LOCATION 13600 McCombs, El Paso, Texas 79934

| DEPTH (ft) | LAB SAMPLE TYPE/NUMBER | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION | PID (ppm) |
|---|---|---|---|---|---|
| 35 | 7 | | | SAND, hard to fine grained, mostly fine, white to brown, dry. | |
| 40 | 8 | | | SAND, same as above, dry. | 0.0 |
| 45 | 9 | | | SAND, fine to medium sand, mostly medium, trace pea size gravel, light brown to white, dry. | 0.0 |
| 50 | 10 | | | SAND, medium to very fine, mostly fine, light brown to white, dry. | 0.0 |
| 55 | 11 | | | SAND, fine to very fine, mostly fine, light brown to white, dry. | 0.0 |
| 60 | 12 | | | SAND, same as above. | 0.0 |
| 65 | 13 | | | SAND, same as above<br>65.0<br>Boring Terminated at 65'.<br>Bottom of hole at 65.0 feet. | 0.0 |
| 70 | | | | | |
| 75 | | | | | |

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David L. Hartsfield P.G.
6-28-07

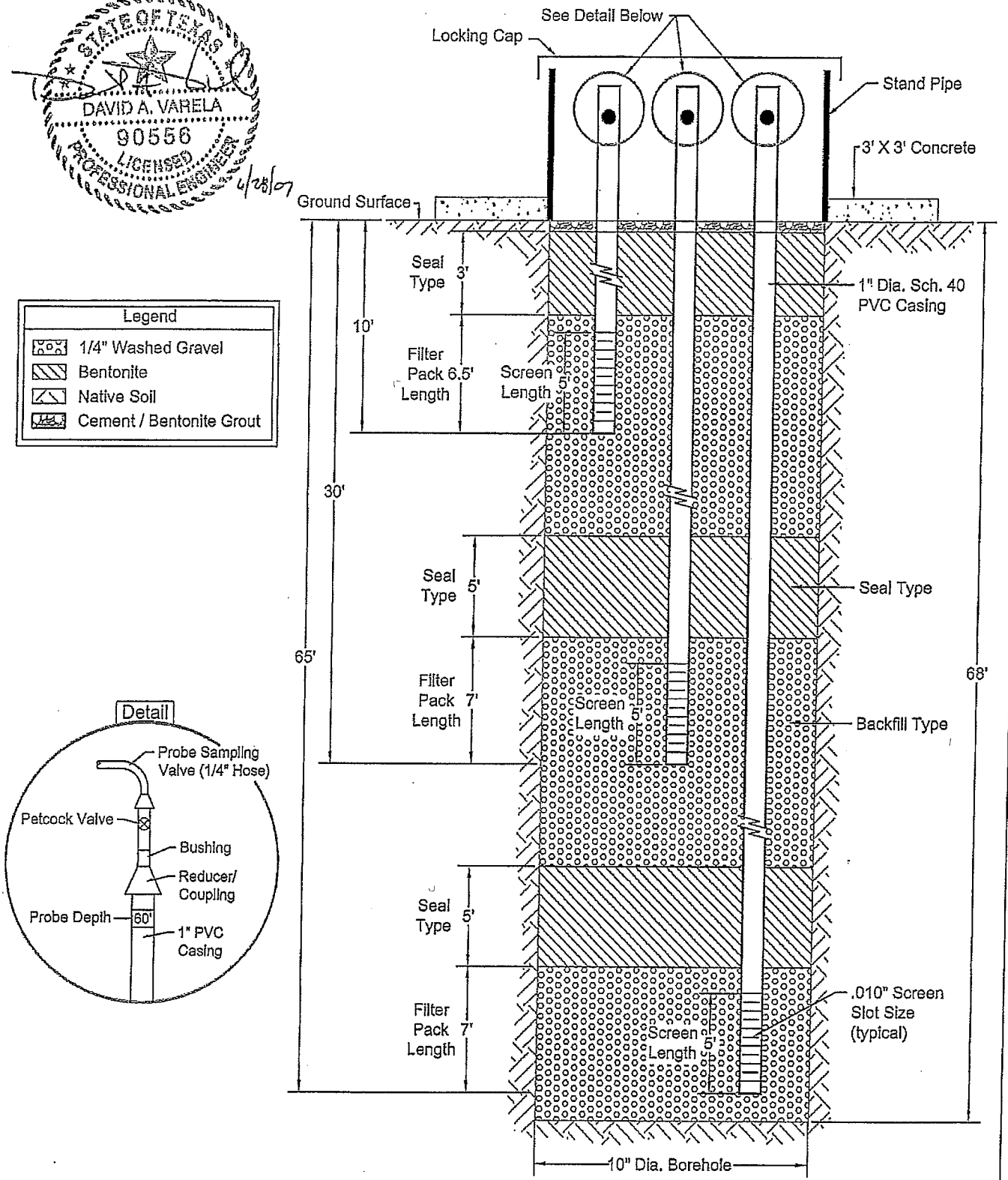
AMEC WELL LOG AND DIAGRAM BORE LOGS GMP-20 TO 22.GPJ GINT US LAB.GDT 06/27/07

# GAS MONITOR WELL SCHEMATIC GMP-20

PROJECT McCombs Landfill Methane Support
JOB NO. 6-717-000104 DATE 9/08/2006
RIG TYPE Mobile B-57 LOGGED E. Cuttler
BORING TYPE 10" O.D. Hollow Stem Auger DWG BY E. Osorio
File No: P:\Drafting\2006\0104\Well.. GMP-20.dwg CHECKED BY D. Hartsfield
DRILLED BY TSS

amec

STATE OF TEXAS
DAVID A. VARELA
90556
LICENSED
PROFESSIONAL ENGINEER
4/25/07



AMEC Earth and Environmental
125 Montoya Rd.
El Paso 79932
Telephone: 915.585.2472
Fax: 915.585.2626

# BORING NUMBER GMP-21



CLIENT City of El Paso
PROJECT NAME McCombs Landfill
PROJECT NUMBER 6-717-000104
PROJECT LOCATION 13600 McCombs, El Paso, Texas 79934
DATE STARTED 09/08/06 COMPLETED 09/08/06
GROUND ELEVATION ____ HOLE SIZE 10-inch
DRILLING CONTRACTOR AMEC
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY E. Cutler CHECKED BY ____
AT END OF DRILLING ---
NOTES ____
AFTER DRILLING ---

| DEPTH (ft) | LAB SAMPLE TYPE/NUMBER | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION | PID (ppm) |
|---|---|---|---|---|---|
| 0 | | SM | | SILTY SAND, coarse to medium, some nonplastic fines, brown, dry. | |
| 5 | 1 | | | SILTY SAND, same as above, with trace gravel, white to brown, dry. | 0.0 |
| 10 | 2 | SP | | 10.0 SAND, fine to medium grained, mostly medium, trace nonplastic fines, trace gravel, white to brown, dry. | 0.0 |
| 15 | 3 | | | SAND, same as above, white to brown, dry. | 0.0 |
| 20 | 4 | | | SAND, same as above, white to brown, dry. | 0.0 |
| 25 | 5 | | | SAND, same as above, white to brown, dry. | 0.0 |
| 30 | 6 | | | SAND, same as above, white to brown, dry. | 0.0 |
| 35 | | | | 35.0 SAND, same as above, white to brown, dry. | |

STATE OF TEXAS
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PROFESSIONAL GEOSCIENTIST

P.G.
6-28-07

AMEC WELL LOG AND DIAGRAM BORE LOGS GMP-20 TO 22.GPJ GINT US LAB.GDT 06/27/07

(Continued Next Page)

AMEC Earth and Enviromental
125 Montoya Rd.
El Paso 79932
Telephone: 915.585.2472
Fax: 915.585.2626

# BORING NUMBER GMP-21



CLIENT City of El Paso PROJECT NAME McCombs Landfill

PROJECT NUMBER 6-717-000104 PROJECT LOCATION 13600 McCombs, El Paso, Texas 79934

| DEPTH (ft) | LAB SAMPLE TYPE/NUMBER | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION | PID (ppm) |
|---|---|---|---|---|---|
| 35 | | | | | |
| | 7 | SP | | SAND, fine to very fine, mostly fine, trave pea size gravel, white to brown, dry. | 0.0 |
| 40 | 8 | | | SAND, medium to fine grained, mostly fine, trace pea size gravel, white to brown, dry. | 0.0 |
| 45 | 9 | | | SAND, same as above, white to brown, dry. | 0.0 |
| 50 | 10 | | | 50.0 | |
| | | CL | | SANDY CLAY, some medium to fine sand, mostly medium, slightly plastic, medium brown, dry. | 0.0 |
| | | | | 53.0 | |
| 55 | 11 | SP | | SAND, medium to fine, mostly fine, white to brown, dry. | 0.0 |
| 60 | 12 | | | SAND, fine to very fine grained, mostly fine, light brown to white, dry. | 0.0 |
| 65 | 13 | | | 65.0 | |
| | | | | Boring Terminated at 65'. | 0.0 |
| 70 | | | | Bottom of hole at 65.0 feet. | |
| 75 | | | | | |

STATE OF TEXAS
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LICENSED PROFESSIONAL GEOSCIENTIST

P.G.
6-28-07

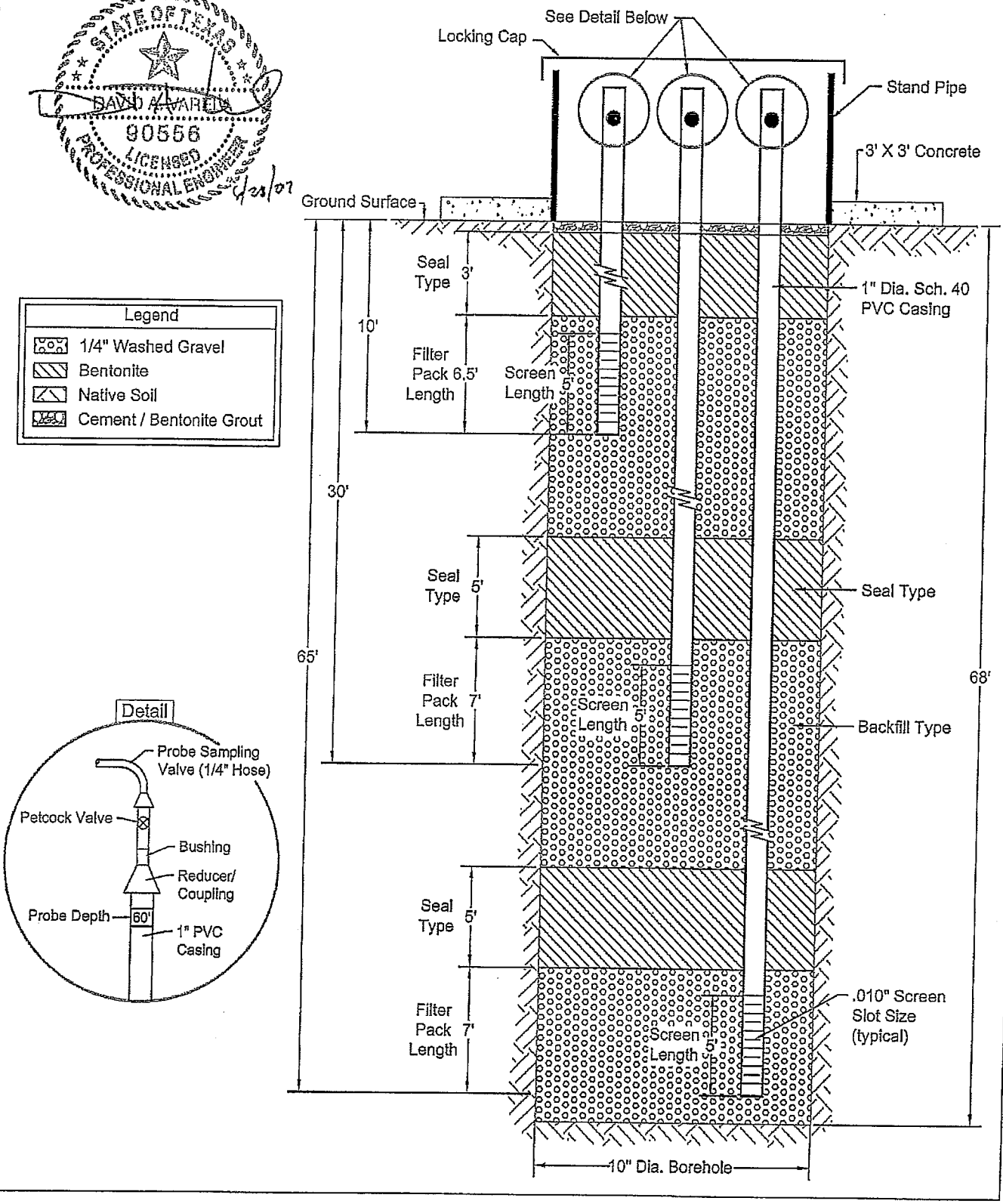
AMEC WELL LOG AND DIAGRAM BORE LOGS GMP-20 TO 22.GPJ GINT US LAB.GDT 06/27/07

# GAS MONITOR WELL SCHEMATIC GMP-21

PROJECT McCombs Landfill Methane Support
JOB NO. 6-717-000104 DATE 9/08/2006
RIG TYPE Mobile B-57 LOGGED E. Cuttler
BORING TYPE 10" O.D. Hollow Stem Auger DWG BY E. Osorio
File No: P:\Drafting\2006\0104\Well.. GMP-21.dwg CHECKED BY D. Hartsfield
DRILLED BY TSS

amec

STATE OF TEXAS
DAVID A. VARELA
90556
LICENSED
PROFESSIONAL ENGINEER
12/5/07



AMEC Earth and Enviromental
125 Montoya Rd.
El Paso 79932
Telephone: 915.585.2472
Fax: 915.585.2626

# BORING NUMBER GMP-22



CLIENT City of El Paso
PROJECT NAME McCombs Landfill
PROJECT NUMBER 6-717-000104
PROJECT LOCATION 13600 McCombs, El Paso, Texas 79934
DATE STARTED 09/09/06 COMPLETED 09/09/06
GROUND ELEVATION ____ HOLE SIZE 10-Inch
DRILLING CONTRACTOR AMEC
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY E. Cutler CHECKED BY ____
AT END OF DRILLING ---
NOTES ____
AFTER DRILLING ---

| DEPTH (ft) | LAB SAMPLE TYPE/NUMBER | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION | PID (ppm) |
|---|---|---|---|---|---|
| 0 | | SM | | SILTY SAND, medium to fine, mostly medium, some nonplastic fines, trace gravel, brown, dry. | |
| 5 | | | | 5.0 | |
| 10 | 1 | SP | | SAND, medium to fine grained, mostly medium, trace silt, trace gravel, light brown, dry. | 0.0 |
| | | | | 10.0 | |
| 15 | 2 | SP | | GRAVELLY SAND, medium to coarse sand, mostly medium, some 1/8" to 1/2" pea gravel, white to brown, dry. | 0.0 |
| | | | | 15.0 | |
| 20 | 3 | SP | | SAND, coarse to fine, mostly medium, trace gravel, white to brown, dry. | 0.0 |
| | 4 | | | SAND, same as above, white to brown, dry. | 0.0 |
| 25 | 5 | | | SAND, medium to fine grained, mostly fine, white to brown, dry. | 0.0 |
| 30 | 6 | | | SAND, same as above, with trace pea size gravel, white to brown, dry | 0.0 |
| 35 | | | | SAND, same as above, white to brown, dry. | |
| | | | | 35.0 | |

STATE OF TEXAS
David L. Hartsfield
Geology
2707
LICENSED
PROFESSIONAL GEOSCIENTIST

David L. Hartsfield, P.G.
6-28-07

(Continued Next Page)

AMEC WELL LOG AND DIAGRAM BORE LOGS GMP-20 TO 22.GPJ GINT US LAB.GDT 09/27/07

AMEC Earth and Enviromental
125 Montoya Rd.
El Paso 79932
Telephone: 915.585.2472
Fax: 915.585.2626

# BORING NUMBER GMP-22



CLIENT City of El Paso

PROJECT NAME McCombs Landfill

PROJECT NUMBER 6-717-000104

PROJECT LOCATION 13600 McCombs, El Paso, Texas 79934

| DEPTH (ft) | LAB SAMPLE TYPE/NUMBER | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION | PID (ppm) |
|---|---|---|---|---|---|
| 35 | 7 | | | SAND, same as above, white to brown, dry. | 0.0 |
| 40 | 8 | | | SAND, fine to very fine grained, mostly fine, white to brown, dry. | 0.0 |
| 45 | 9 | | | SAND, same as above, white to brown, dry. | 0.0 |
| 50 | 10 | SP | | SAND, coarse to finegrained, mostly medium, dark to light brown, damp. | 0.0 |
| 55 | 11 | | | SAND, same as above, white to brown, dry. | 0.0 |
| 60 | 12 | | | SAND, same as above, with trace pea size gravel, white to brown, dry. | 0.0 |
| 65 | 13 | | 65.0 | Boring Terminated at 65'. Bottom of hole at 65.0 feet. | 0.0 |
| 70 | | | | | |
| 75 | | | | | |

STATE OF TEXAS
David L. Hartsfield
Geology
2707
LICENSED PROFESSIONAL GEOSCIENTIST

P.G.
6-28-07

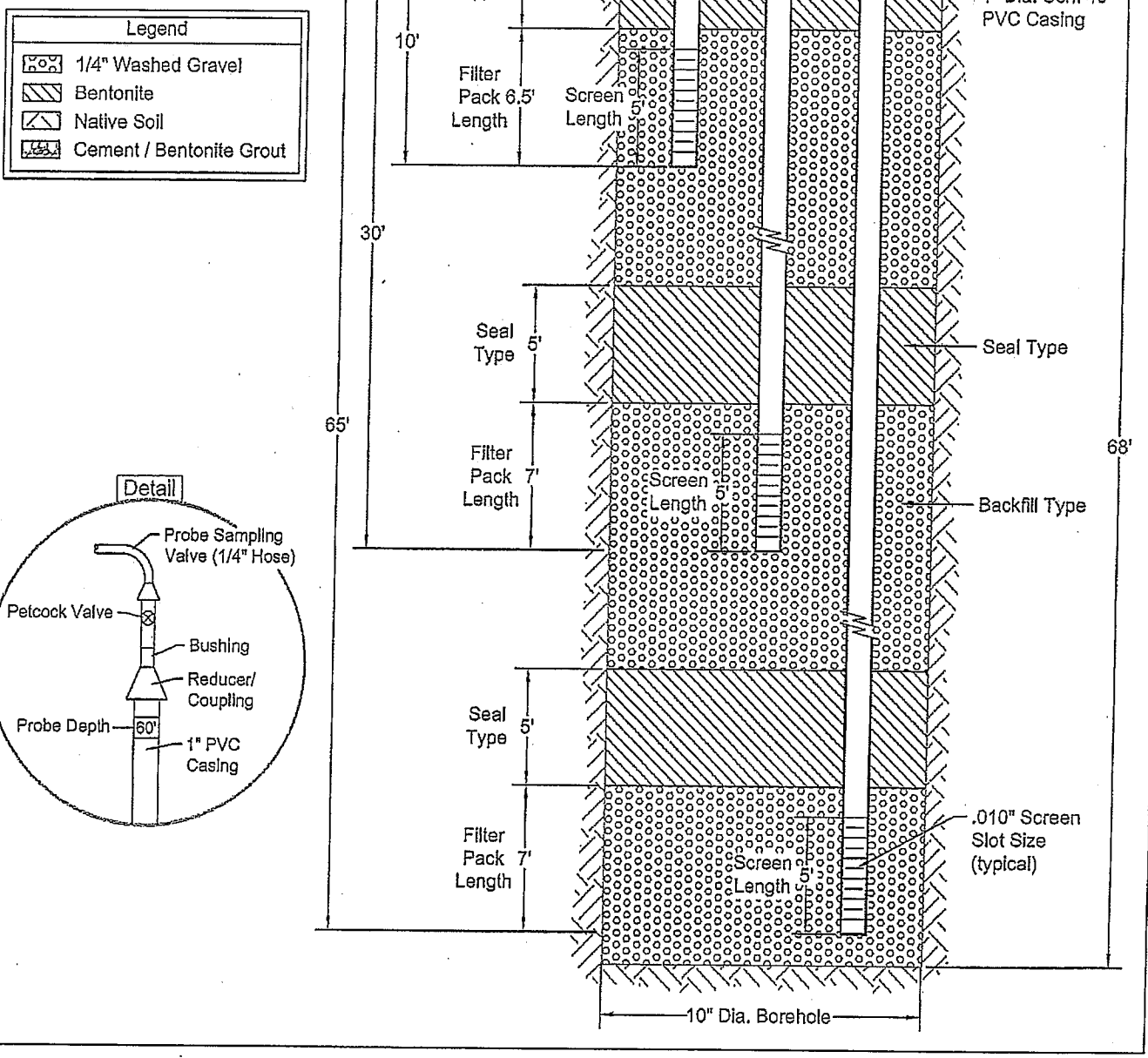
AMEC WELL LOG AND DIAGRAM BORE LOGS GMP-20 TO 22.GPJ GINT US LAB.GDT 05/27/07

# GAS MONITOR WELL SCHEMATIC GMP-22

PROJECT McCombs Landfill Methane Support
JOB NO. 6-717-000104 DATE 9/09/2006
RIG TYPE Mobile B-57 LOGGED E. Cuttler
BORING TYPE 10" O.D. Hollow Stem Auger DWG BY E. Osorio
File No: P:\Drafting\2006\0104\Well_ GMP-22.dwg CHECKED BY D. Hartsfield
DRILLED BY TSS

amec

STATE OF TEXAS
DAVID A. VARELA
90556
LICENSED
PROFESSIONAL ENGINEER
4/20/07




| Legend |
|---|
| 1/4" Washed Gravel |
| Bentonite |
| Native Soil |
| Cement / Bentonite Grout |

Detail

Attention Owner:
Confidentiality Privilege Notice
on reverse side of owner's copy.

# Texas Department of Licensing and Regulation

Water Well Driller/Pump Installer Section
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Toll free (800)803-9202
Email address: water.well@license.state.tx.us Web address: www.license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

## WELL REPORT

### A. WELL IDENTIFICATION AND LOCATION DATA

**1) OWNER**

| Name: | Address: | City: | State: | Zip: |
|---|---|---|---|---|
| The City of El Paso, Texas | 2 Civic Center Plaza | El Paso | Texas | 79901 |

**2) WELL LOCATION**

| Well # or # of wells drilled | County: | Physical Address: | City: |
|---|---|---|---|
| MP- 6C | El Paso | 13600 McCombs | El Paso/79934 |

| 3) Type of Work | Lat. | Long. | Grid# |
|---|---|---|---|
| ☒ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening | 106° 24.844' | 31° 59.379' | 49-05-3 |

4) Proposed Use (check) ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Extraction ☐ Industrial ☐ Irrigation ☐ Injection ☐ Closed-Loop Geothermal ☐ De-watering ☐ Testwell ☐ Rig Supply ☐ Stock ☐ Public Supply – If Public Supply, were plans approved? ☐ Yes ☐ No

5) NT

6) Drilling Date
Started 05 / 23 / 07
Completed 05 / 24 / 07

Diameter of Hole

| Dia.(in) | From (ft) | To (ft) |
|---|---|---|
| | Surface | |
| 7 | 0 | 60 |
| | | |
| | | |

7) Drilling Method (check)
☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool
☐ Jetted ☒ Hollow Stem Auger ☐ Reverse Circulation ☐ Other

| From (ft) | To (ft) | Description and color of formation material |
|---|---|---|
| 0 | 2 | Sand, brown, dry. |
| 2 | 60 | Land-fill trash. |

(Use reverse side of Well Owner's copy, If necessary)

8) Borehole Completion ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☒ Other SI02
~~Gravel~~ packed interval from: 22 ft. to: 60 ft. Size: 10/20

**Casing, Blank Pipe, and Well Screen Data**

| Dia. (in.) | New Or Used | Steel, Plastic, etc. Perf., Slotted, etc Screen Mfg., if commercial | Setting (ft) From | Setting (ft) To | Gage Casing Screen |
|---|---|---|---|---|---|
| 2 | New | PVC Casing, | +3 | 24 | Blk. |
| 2 | New | PVC Screen, Mfg. | 24 | 59 | 0.01 |
| | | | | | |
| | | | | | |

9) Annular Seal Data: i.e. (from 0 ft to 100 ft #sacks & material 13 cement)
from 0 ft. to 18 ft. #sacks & material 3sk/cmt.
from 18 ft. to 22 ft. #sacks & material 2sk/bent.
from ____ ft. to ____ ft. #sacks & material ____
Method Used poured Performed By Tierra
Distance to septic field or other concentrated contamination 0 ft.
Distance to Property Line 200 ft Method visual
Verified: JPM Land-fill cell

13) Plugged ☐ Well plugged within 48 hours N/A

| Casing left in well: From (ft) | To (ft) | Cement/Bentonite placed in well: From (ft) | To (ft) | # Sacks & Material used |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

10) Surface Completion (If steel cased, leave blank)
☐ Surface Slab Installed ☒ Surface Sleeve Installed
☐ Pitless Adapter Used ☐ Alternative Procedure Used

14) Type Pump
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other N/A
Depth to pump bowls, cylinder, jet etc., ____ ft.

11) Water Level Well Dry when set.
Static level ____ ft. Date: / /
Artesian Flow ____ gpm

12) Packers: N/A

| Type | Depth | Type | Depth |
|---|---|---|---|
| | | | |

15) Water Test N/A
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

16) Water Quality
Type of water N/A Depth of Strata: ____ Was a chemical analysis made? ☐ Yes ☒ No
Did you knowingly penetrate a strata which contains undesirable constituents? ☒ Yes ☐ No If yes, Continue:
Check One: ☐ Naturally poor-quality groundwater – type ____ ☒ Hydrocarbons (i.e. gas, oil, etc.)
☒ Hazardous material/waste contamination encountered ☐ Other (describe) ____

☒ *I certify that while drilling, deepening, or otherwise altering the above described well, undesirable water or constituents was encountered and the landowner was informed that such well must be completed or plugged in such a manner as to avoid injury or pollution.*

**By signing this well report, I certify that I drilled or supervised the drilling of this well and that each and all of the statements herein are true and correct.**

| Company & Individual's Name: (type or print) | Lic. No.: |
|---|---|
| Tierra Drilling & Env.Svc.Inc. John P. McDuffee | 2994A |

| Address: | City: | State: | Zip |
|---|---|---|---|
| 5309 Mace St. Ste.A1 | El Paso | Tx. | 79932 |

| Signature: | Date | Signature: | |
|---|---|---|---|
| John P. McDuffee | 06/06/07 | | |
| Licensed Driller/Pump Installer | | Apprentice | Apprentice Reg. Number |

TDLR FORM 001WWD / 2-06 *TDLR (Original)* *Landowner (copy)* *Driller/Pump Installer (copy)*

Permit No. 729A Revision 1, January 9, 2006

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

# Texas Department of License and Regulation

Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Toll free (800)803-9202
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

## WELL REPORT

| Name | Address | City | State | Zip |
|---|---|---|---|---|
| City of El Paso, Texas | 2 Civic Center Plaza | El Paso | Texas | 79901 |

| County | Physical Address | City | State | Zip |
|---|---|---|---|---|
| El Paso | See page 1 | | | |

3) Type of Work Pg. 2of2
☒ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening
VMW-18

Lat. Long. Grid # 49-05-03

4) Proposed Use (check) ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell ☐ Rig Supply
If Public Supply well, were plans submitted? ☐ Yes ☐ No

5) NT
e

6) Drilling Date
Started 12/ 15 / 04
Completed 12 / 15 / 04

Diameter of Hole

| Dia.(in) | From (ft) | To (ft) |
|---|---|---|
| 11 | 0 | 67 |
| | | |
| | | |

7) Drilling Method (check) ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

| From (ft) | To (ft) | Description and color of formation material |
|---|---|---|
| | | *#8&#9 Borehole Completion & Cement Data |
| | | 0-5 ft. Bentonite chips |
| | | 5-18ft. Gravel, .25inch |
| | | 18-23ft. Bentonite chips |
| | | 23-53ft. Gravel, .25inch |
| | | 53-58ft. Bentonite chips |
| | | 58-67ft. Gravel, .25inch |

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☒ Other See#8&9
If Gravel Packed give the interval from ft. to ft.

Casing, Blank Pipe, and Well Screen Data

| Dia. (in.) | New Or Used | Steel, Plastic, etc. Perf., Slotted, etc Screen Mfg., if commercial | Setting (ft) From | Setting (ft) To | Gage Casing Screen |
|---|---|---|---|---|---|
| 1 | New | PVC Casing, | +2.5 | 5 | Blk. |
| 1 | New | PVC Screen. | 5 | 10 | 0.01 |
| | | Mfg. | | | |
| | | | | | |

9) Cementing Data See #8&#9 and page 1
Cementing from ft. to ft. # of sacks used
ft. to ft. # of sacks used
Method Used
Cementing By
Distance to septic system field or other concentrated contamination ft.
Method of verification of above distance

13) Plugged ☐ Well plugged within 48 hours N/A
Casing left in well: Cement/Bentonite placed in well:

| From (ft) | To (ft) | From (ft) | To (ft) | Sacks used |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

10) Surface Completion
☐ Specified Surface Slab Installed
☒ Specified Surface Sleeve Installed
☐ Pitless Adapter Used
☐ Approved Alternative Procedure Used

14) Type Pump
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☒ Other N/A
Depth to pump bowls, cylinder, jet etc., ft.

11) Water Level N/A
Static level ft. below Date / /
Artesian Flow gpm. Date / /

15) Water Test
Typetest ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

16) Water Quality
Did you knowingly penetrate a strata which contain undesirable constituents.
☐ YES ☒ NO If yes, did you submit a REPORT OF UNDESIRABLE WATER
Type of water Depth of Strata
Was a chemical analysis made ☐ Yes ☒ No

12) Packers N/A Type Depth

| Company or individual's Name (type or print) | Tierra Drilling & Env.Svc.Inc. | Lic. No. 2994W |
|---|---|---|
| Address 5309 Mace St. Suite A1 | City El Paso | State Texas Zip 79932 |
| Signature John P McDuffee 01/03/05 | Signature | / / |

Permit No. 729A Revision 1, January 9, 2006

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

# Texas Department of License and Regulation

*Water Well Driller/Pump Installer Program*
*P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616*
*Toll free (800)803-9202*
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

## WELL REPORT

| Name | Address | City | State | Zip |
|---|---|---|---|---|
| City of El Paso, Texas | 2 Civic Center Plaza | El Paso | Texas | 79901 |

| County | Physical Address | City | State | Zip |
|---|---|---|---|---|
| El Paso | 13600 McCombs St. | El Paso | Texas | 79934 |

Lat. 106° 24.524' Long. 31° 59.506' Grid # 49-05-03

3) Type of Work Pg. 1 of 2
☒ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening
VMW-1 (3-strings)

4) Proposed Use (check) ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell ☐ Rig Supply
If Public Supply well, were plans submitted? ☐ Yes ☐ No

5) N↑

6) Drilling Date
Started 12/ 15 / 04
Completed 12 / 15 /04

Diameter of Hole

| Dia.(in) | From (ft) | To (ft) |
|---|---|---|
| 11 | 0 | 67 |

7) Drilling Method (check) ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

| From (ft) | To (ft) | Description and color of formation material |
|---|---|---|
| 0 | 7 | Silt/sand, with caliche, light brown, dry. |
| 7 | 67 | Sand, gravel, brown, dry. |

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☒ Other See Pg. 2*
If Gravel Packed give the interval from ft. to ft.

Casing, Blank Pipe, & Well Screen Data

| Dia. (in.) | New Or Used | Steel, Plastic, etc. Perf., Slotted, etc Screen Mfg., if commercial | Setting (ft) From | Setting (ft) To | Gage Casing Screen |
|---|---|---|---|---|---|
| 1 | New | PVC Casing, | +2.5 | 60 | Blk. |
| 1 | New | PVC Screen. | 60 | 65 | 0.01 |
| 1 | New | PVC Casing, | +2.5 | 25 | Blk. |
| 1 | New | PVC Screen, | 25 | 30 | 0.01 |

9) Cementing Data See #8&9 page two *
Cementing from ____ ft. to ____ ft. # of sacks used ____
____ ft. to ____ ft. # of sacks used ____
Method Used Tremie placed via auger
Cementing By Tierra Drilling
Distance to septic system field or other concentrated contamination 20 ft.
Method of verification of above distance Landfill

13) Plugged ☐ Well plugged within 48 hours N/A
Casing left in well: Cement/Bentonite placed in well:

| From (ft) | To (ft) | From (ft) | To (ft) | Sacks used |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

10) Surface Completion
☐ Specified Surface Slab Installed
☒ Specified Surface Sleeve Installed
☐ Pitless Adapter Used
☐ Approved Alternative Procedure Used

14) Type Pump
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☒ Other N/A
Depth to pump bowls, cylinder, jet etc., ____ ft.

15) Water Test N/A
Typetest ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ____ gpm with ____ ft. drawdown after ____ hrs.

11) Water Level N/A
Static level ____ ft. below Date ____/____/____
Artesian Flow ____ gpm. Date ____/____/____

16) Water Quality
Did you knowingly penetrate a strata which contain undesirable constituents
☐ YES ☒ NO If yes, did you submit a REPORT OF UNDESIRABLE WATER
Type of water ____ Depth of Strata ____
Was a chemical analysis made ☐ Yes ☒ No

12) Packers N/A Type Depth

| Company or individual's Name (type or print) | Tierra Drilling & Env.Svc.Inc. | Lic. No. 2994W | |
|---|---|---|---|
| Address 5309 Mace St. Suite A1 | City El Paso | State Texas | Zip 79932 |
| Signature John P. McDuffee 01/03/05 | Signature | | |

Permit No. 729A Revision 1, January 9, 2006

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*Water Well Driller/Pump Installer Program*
*P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616*
*Toll free (800)803-9202*
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

## WELL REPORT

| Name | Address | City | State | Zip |
|---|---|---|---|---|
| City of El Paso, Texas | 2 Civic Center Plaza | El Paso | Texas | 79901 |

| County | Physical Address | City | State | Zip |
|---|---|---|---|---|
| El Paso | See page 1 | | | |

Lat. | Long. | Grid # 49-05-03

3) Type of Work Pg. 2 of 2
☒ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening
VMW-19

4) Proposed Use (check) ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell ☐ Rig Supply
If Public Supply well, were plans submitted? ☐ Yes ☐ No

5) N↑

6) Drilling Date
Started 12 / 16 / 04
Completed 12 / 16 / 04

Diameter of Hole

| Dia.(in). | From (ft) | To (ft) |
|---|---|---|
| 11 | 0 | 68 |
| | | |
| | | |

7) Drilling Method (check) ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

| From (ft) | To (ft) | Description and color of formation material |
|---|---|---|
| * #8&#9 Borehole Completion & Cement Data | | |
| 0-5 ft. | Bentonite chips | |
| 5-18ft. | Gravel, .25inch | |
| 18-23ft. | Bentonite chips | |
| 23-53ft. | Gravel, .25inch | |
| 53-58ft. | Bentonite chips | |
| 58-68ft. | Gravel, .25inch | |

(Use reverse side of Well Owner's copy, If necessary)

8) Borehole Completion ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☒ Other See#8&#9
If Gravel Packed give the interval from ft. to ft.

Casing, Blank Pipe and Well Screen Data

| Dia. (in.) | New Or Used | Steel, Plastic, etc. Perf., Slotted, etc Screen Mfg., if commercial | Setting (ft) From | Setting (ft) To | Gage Casing | Gage Screen |
|---|---|---|---|---|---|---|
| 1 | New | PVC Casing, | +2.5 | 5 | Blk. | |
| 1 | New | PVC Screen, | 5 | 10 | | 0.01 |
| | | Mfg. | | | | |

9) Cementing Data See #8&#9 and page 1
Cementing from ft. to ft. # of sacks used
ft. to ft. # of sacks used
Method Used
Cementing By
Distance to septic system field or other concentrated contamination ft.
Method of verification of above distance

13) Plugged ☐ Well plugged within 48 hours
Casing left in well: Cement/Bentonite placed in well: N/A

| From (ft) | To (ft) | From (ft) | To (ft) | Sacks used |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

10) Surface Completion
☐ Specified Surface Slab Installed
☒ Specified Surface Sleeve Installed
☐ Pitless Adapter Used
☐ Approved Alternative Procedure Used

14) Type Pump
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☒ Other N/A
Depth to pump bowls, cylinder, jet etc., ft.

11) Water Level N/A
Static level ft. below Date / /
Artesian Flow gpm. Date / /

15) Water Test N/A
Typetest ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

16) Water Quality
Did you knowingly penetrate a strata which contain undesirable constituents.
☐ YES ☒ NO If yes, did you submit a REPORT OF UNDESIRABLE WATER
Type of water Depth of Strata
Was a chemical analysis made ☐ Yes ☒ No

12) Packers N/A Type Depth

| Company or individual's Name (type or print) | Tierra Drilling & Env.Svc.Inc. | Lic. No. 2994W | |
|---|---|---|---|
| Address 5309 Mace St. Suite A1 | City El Paso | State Texas | Zip 79932 |
| Signature John P. McDuffee | 01/03/05 | Signature | / / |

Permit No. 729A Revision 1, January 9, 2006

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This form must be completed and filed with the department and owner within 60 days upon completion of the well.

## WELL REPORT

| Name | Address | City | State | Zip |
|---|---|---|---|---|
| City of El Paso Texas | 2 Civic Center Plaza | El Paso | Texas | 79901 |

| County | Physical Address | City | State | Zip |
|---|---|---|---|---|
| El Paso | 13600 McCombs St. | El Paso | Texas | 79934 |

3) Type of Work Pg.1of2
☒ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening
VMW-19(3-strings)

Lat. 106° 24.526' Long. 31° 59.686' Grid # 49-05-03

4) Proposed Use (check) ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell ☐ Rig Supply
If Public Supply well, were plans submitted? ☐ Yes ☐ No

5) NT

6) Drilling Date
Started 12 / 16 / 04
Completed 12 / 16 /04

Diameter of Hole

| Dia.(in) | From (ft) | To (ft) |
|---|---|---|
| 11 | 0 | 68 |
| | | |
| | | |

7) Drilling Method (check) ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

| From (ft) | To (ft) | Description and color of formation material |
|---|---|---|
| 0 | 2 | Clay/sand, brown, dry. |
| 2 | 7 | Silt/sand, caliche, light brown, dry. |
| 7 | 68 | Sand, gravel, brown, dry. |

(Use reverse side of Well Owner's copy, If necessary)

8) Borehole Completion ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☒ Other See Pg.2*
If Gravel Packed give the interval from ft. to ft.

Casing, Blank Pipe and Well Screen Data

| Dia. (in.) | New Or Used | Steel, Plastic, etc. Perf., Slotted, etc Screen Mfg., if commercial | Setting (ft) From | Setting (ft) To | Gage Casing | Gage Screen |
|---|---|---|---|---|---|---|
| 1 | New | PVC Casing, | +2.5 | 60 | Blk. | |
| 1 | New | PVC Screen, | 60 | 65 | | 0.01 |
| 1 | New | PVC Casing, | +2.5 | 25 | Blk. | |
| 1 | New | PVC Screen, | 25 | 30 | | 0.01 |

9) Cementing Data See #8&#9 page two *
Cementing from ft. to ft. # of sacks used
ft. to ft. # of sacks used
Method Used Tremie placed Via Auger
Cementing By Tierra Drilling
Distance to septic system field or other concentrated contamination 25 ft.
Method of verification of above distance Landfill

13) Plugged ☐ Well plugged within 48 hours
Casing left in well: Cement/Bentonite placed in well: N/A

| From (ft) | To (ft) | From (ft) | To (ft) | Sacks used |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

10) Surface Completion
☐ Specified Surface Slab Installed
☒ Specified Surface Sleeve Installed
☐ Pitless Adapter Used
☐ Approved Alternative Procedure Used

14) Type Pump
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☒ Other N/A
Depth to pump bowls, cylinder, jet etc.. ft.

15) Water Test N/A
Typetest ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

11) Water Level N/A
Static level ft. below Date / /
Artesian Flow gpm. Date / /

16) Water Quality
Did you knowingly penetrate a strata which contain undesirable constituents.
☐ YES ☒ NO If yes, did you submit a REPORT OF UNDESIRABLE WATER
Type of water Depth of Strata
Was a chemical analysis made ☐ Yes ☒ No

12) Packers N/A

| Type | Depth |
|---|---|
| | |
| | |
| | |

| Company or individual's Name (type or print) | Tierra Drilling & Env.Svc.Inc. | Lic. No. 2994W | |
|---|---|---|---|
| Address 5309 Mace St. Suite A1 | City El Paso | State Texas | Zip 79932 |
| Signature John J. McDuffee | 01 / 03 / 05 | Signature | / / |

TDLR FORM [illegible]

# STATE OF TEXAS WELL REPORT for Tracking #96258

| | | | |
|---|---|---|---|
| Owner: | City of El Paso | Owner Well #: | GMP-20 |
| Address: | NEC McCombs Dr. @ Stan Roberts<br>El Paso , TX | Grid #: | 49-05-3 |
| Well Location: | Same<br>El Paso , TX | Latitude: | 31° 59' 37" N |
| Well County: | El Paso | Longitude: | 106° 24' 31" W |
| Elevation: | No Data | GPS Brand Used: | Motorola |
| Type of Work: | New Well | Proposed Use: | Monitor |

| | |
|---|---|
| Drilling Date: | Started: 9/8/2006<br>Completed: 9/11/2006 |
| Diameter of Hole: | Diameter: 10.25 in From Surface To 65 ft |
| Drilling Method: | Hollow Stem Auger |
| Borehole Completion: | Other: Pea Gravel 58-65',23-53',3-18' |
| Annular Seal Data: | 1st Interval: From 0 ft to 1 ft with Concrete (#sacks and material)<br>2nd Interval: No Data<br>3rd Interval: No Data<br>Method Used: Gravity<br>Cemented By: Crew<br>Distance to Septic Field or other Concentrated Contamination: No Data<br>Distance to Property Line: No Data<br>Method of Verification: No Data<br>Approved by Variance: No Data |
| Surface Completion: | Surface Sleeve Installed |

| | |
|---|---|
| Water Level: | Static level: No Data<br>Artesian flow: No Data |
| Packers: | No Data |
| Plugging Info: | Casing or Cement/Bentonite left in well: No Data |
| Type Of Pump: | No Data |
| Well Tests: | No Data |

| | |
|---|---|
| Water Quality: | Type of Water: No Data<br>Depth of Strata: No Data<br>Chemical Analysis Made: No Data<br>Did the driller knowingly penetrate any strata which contained undesirable constituents: No Data |
| Certification Data: | The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal. |
| Company Information: | Total Support Services<br>P.O. Box 81621 |

| | |
|---|---|
| | Austin , TX 78708 |
| Driller License Number: | 54611 |
| Licensed Well Driller Signature: | Brian Kern |
| Registered Driller Apprentice Signature: | No Data |
| Apprentice Registration Number: | No Data |
| Comments: | 3 Nested Wells:<br>1st @ 0-10' w/Bentonite 1-3', Pea Gravel 3-18'; 2nd @ 0-25' w/Bentonite 18-23, Pea Gravel 23-53; 3rd @ 0-65' w/Bentonite 53-58', Pea Gravel 58-65. |

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking #96258) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

| From (ft) | To (ft) | Description |
|---|---|---|
| 0 | 7 | Tan Silty Sand |
| 7 | 18 | Tan Sand |
| 18 | 24 | Brown Gravelly Sand |
| 24 | 65 | Tan Sand |

CASING, BLANK PIPE & WELL SCREEN DATA

| Dia. | New/Used | Type | Setting From/To |
|---|---|---|---|
| 1 | New | PVC Riser | 0/60 Sched. 40 |
| 1 | New | PVC Screen | 60/65 0.010 Slotted |
| 1 | New | PVC Riser | 0/20 Sched. 40 |
| 1 | New | PVC Screen | 20/25 0.010 Slotted |
| 1 | New | PVC Riser | 0/5 Sched.40 |
| 1 | New | PVC Screen | 5/10 0.010 Slotted |

# STATE OF TEXAS WELL REPORT for Tracking #96259

| | | | |
|---|---|---|---|
| Owner: | City of El Paso | Owner Well #: | GMP 21 |
| Address: | NEC McCombs Dr. @ Stan Roberts<br>El Paso , TX | Grid #: | 49-05-3 |
| Well Location: | Same<br>El Paso , TX | Latitude: | 31° 59' 34" N |
| Well County: | El Paso | Longitude: | 106° 24' 31" W |
| Elevation: | No Data | GPS Brand Used: | Motorola |
| Type of Work: | New Well | Proposed Use: | Monitor |

| | |
|---|---|
| Drilling Date: | Started: 9/8/2006<br>Completed: 9/11/2006 |
| Diameter of Hole: | Diameter: 10.25 In From Surface To 65 ft |
| Drilling Method: | Hollow Stem Auger |
| Borehole Completion: | Other: Pea Gravel 58-65',23-53',3-18' |
| Annular Seal Data: | 1st Interval: From 0 ft to 1 ft with Concrete (#sacks and material)<br>2nd Interval: No Data<br>3rd Interval: No Data<br>Method Used: Gravity<br>Cemented By: Crew<br>Distance to Septic Field or other Concentrated Contamination: No Data<br>Distance to Property Line: No Data<br>Method of Verification: No Data<br>Approved by Variance: No Data |
| Surface Completion: | Surface Sleeve Installed |

| | |
|---|---|
| Water Level: | Static level: No Data<br>Artesian flow: No Data |
| Packers: | No Data |
| Plugging Info: | Casing or Cement/Bentonite left in well: No Data |
| Type Of Pump: | No Data |
| Well Tests: | No Data |

| | |
|---|---|
| Water Quality: | Type of Water: No Data<br>Depth of Strata: No Data<br>Chemical Analysis Made: No Data<br>Did the driller knowingly penetrate any strata which contained undesirable constituents: No Data |
| Certification Data: | The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal. |
| Company Information: | Total Support Services<br>P.O. Box 81621 |

| | |
|---|---|
| | Austin , TX 78708 |
| Driller License Number: | 54611 |
| Licensed Well Driller Signature: | Brian Kern |
| Registered Driller Apprentice Signature: | No Data |
| Apprentice Registration Number: | No Data |
| Comments: | 3 Nested Wells:<br>1st @ 0-10' w/Bentonite 1-3', Pea Gravel 3-18'; 2nd @ 0-25' w/Bentonite 18-23, Pea Gravel 23-53; 3rd @ 0-65' w/Bentonite 53-58', Pea Gravel 58-65. |

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Please include the report's Tracking number (Tracking #96259) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0 to 7 Tan Silty Sand
7 to 18 Tan Sand
18 to 24 Brown Gravelly Sand
24 to 65 Tan Sand

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
1 New PVC Riser 0/60 Sched. 40
1 New PVC Screen 60/65 0.010 Slotted

1 New PVC Riser 0/20 Sched. 40
1 New PVC Screen 20/25 0.010 Slotted

1 New PVC Riser 0/5 Sched.40
1 New PVC Screen 5/10 0.010 Slotted

# STATE OF TEXAS WELL REPORT for Tracking #96260

| | | | |
|---|---|---|---|
| Owner: | City of El Paso | Owner Well #: | GMP 22 |
| Address: | NEC McCombs Dr. @ Stan Roberts<br>El Paso , TX | Grid #: | 49-05-3 |
| Well Location: | Same<br>El Paso , TX | Latitude: | 31° 59' 36" N |
| Well County: | El Paso | Longitude: | 106° 24' 31" W |
| Elevation: | No Data | GPS Brand Used: | Motorola |
| Type of Work: | New Well | Proposed Use: | Monitor |

Drilling Date: Started: 9/8/2006
Completed: 9/11/2006

Diameter of Hole: Diameter: 10.25 In From Surface To 65 ft

Drilling Method: Hollow Stem Auger

Borehole Completion: Other: Pea Gravel 58-65',23-53',3-18'

Annular Seal Data: 1st Interval: From 0 ft to 1 ft with Concrete (#sacks and material)
2nd Interval: No Data
3rd Interval: No Data
Method Used: Gravity
Cemented By: Crew
Distance to Septic Field or other Concentrated Contamination: No Data
Distance to Property Line: No Data
Method of Verification: No Data
Approved by Variance: No Data

Surface Completion: Surface Sleeve Installed

---

Water Level: Static level: No Data
Artesian flow: No Data

Packers: No Data

Plugging Info: Casing or Cement/Bentonite left in well: No Data

Type Of Pump: No Data

Well Tests: No Data

---

Water Quality: Type of Water: No Data
Depth of Strata: No Data
Chemical Analysis Made: No Data
Did the driller knowingly penetrate any strata which contained undesirable constituents: No Data

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: Total Support Services
P.O. Box 81621

# LOG OF TEST BORING NO. PV-3

PROJECT McCombs Municipal Solid Waste Landfill
JOB NO. 6-717-500029 DATE November 13, 2006

SHEET 1 OF 2
RIG TYPE CME 75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. Existing
DATUM

LOGGED E. Osorio
DWG BY E. Osorio
CHEKED BY D. Hartsfield
DRILLED BY Tierra

| Depth in feet | Graphical Log | Sample | Sample Type | Blows per foot 140 lb. 30" free-fall drop hammer | Hand Penetrometer (tons/sq. ft.) | Moisture Content % of Dry Weight | Unified Soil Classification | CO | LEL | H2S | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | ML | | | | | SANDY SILT, nonplastic, light gray, dry. |
| | | | | | | | SM | | | | Note: Trash which included plastic, paper, glass, metal mixed with . | SILTY SAND, nonplastic, light brown, dry. |
| 5 | | | | | | | | | | | | |
| 10 | | | | | | | SC | | | | | CLAYEY SAND mixed with trash, low plasticity, gray, dry to damp. |
| 15 | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | |
| 25 | | | | | | | CL | | | | | SANDY CLAY mixed with trash, low plasticity, dark gray, damp. |
| 30 | | | | | | | | | | | | |
| 35 | | | | | | | | 5 | 100 | 0 | | |
| 40 | | | | | | | | 5 | 7 | 0 | | |

STATE OF TEXAS
David L. Hartsfield
Geology
2707
LICENSED
PROFESSIONAL GEOSCIENTIST

P.G.
6-28-07

| GROUND WATER | | |
|---|---|---|
| DEPTH | HOUR | DATE |
| | | |

SAMPLE TYPE
A - Auger cuttings B - Block sample
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 3" O.D. thin-walled Shelby tube

# LOG OF TEST BORING NO. PV-3

PROJECT McCombs Municipal Solid Waste Landfill
JOB NO. 6-717-500029 DATE November 13, 2006

SHEET 2 OF 2
RIG TYPE CME 75
BORING TYPE 6.5/8' Hollow Stem Auger
SURFACE ELEV. Existing
DATUM

LOGGED E. Osorio
DWG BY E. Osorio
CHEKED BY D. Hartsfield
DRILLED BY Tierra

| Depth in feet | Graphical Log | Sample | Sample Type | Blows per foot 140 lb. 30" free-fall drop hammer | Hand Penatrometer (tons/sq. ft.) | Moisture Content % of Dry Weight | Unified Soil Classification | CO | LEL | H2S | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40 | | | | | | | SC | 5 | 7 | 0 | | SANDY CLAY mixed with trash, low plasticity, dark gray, damp. |
| 45 | | | | | | | | 60 | 100 | 0 | Decaying trash | |
| 50 | | | | | | | | 20 | 100 | 0 | Note: Strong sewer odor, moderately stained | |
| 55 | | | | | | | | 43 | 100 | 0 | | |
| 60 | | | | | | | | 1500 | 100 | 0 | | |
| 65 | | | | | | | | | | | | Auger Stopped at 60' |
| 70 | | | | | | | | | | | | |
| 75 | | | | | | | | | | | | |
| 80 | | | | | | | | | | | | |

STATE OF TEXAS
David L. Hartsfield
Geology
2707
LICENSED
PROFESSIONAL GEOSCIENTIST

P.G.
6-28-07

| GROUND WATER | | |
|---|---|---|
| DEPTH | HOUR | DATE |
| | | |
| | | |

SAMPLE TYPE
A - Auger cuttings B - Block sample
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 3" O.D. thin-walled Shelby tube

PROJECT McCombs Solid Waste Landfill WELL NUMBER: PV-3

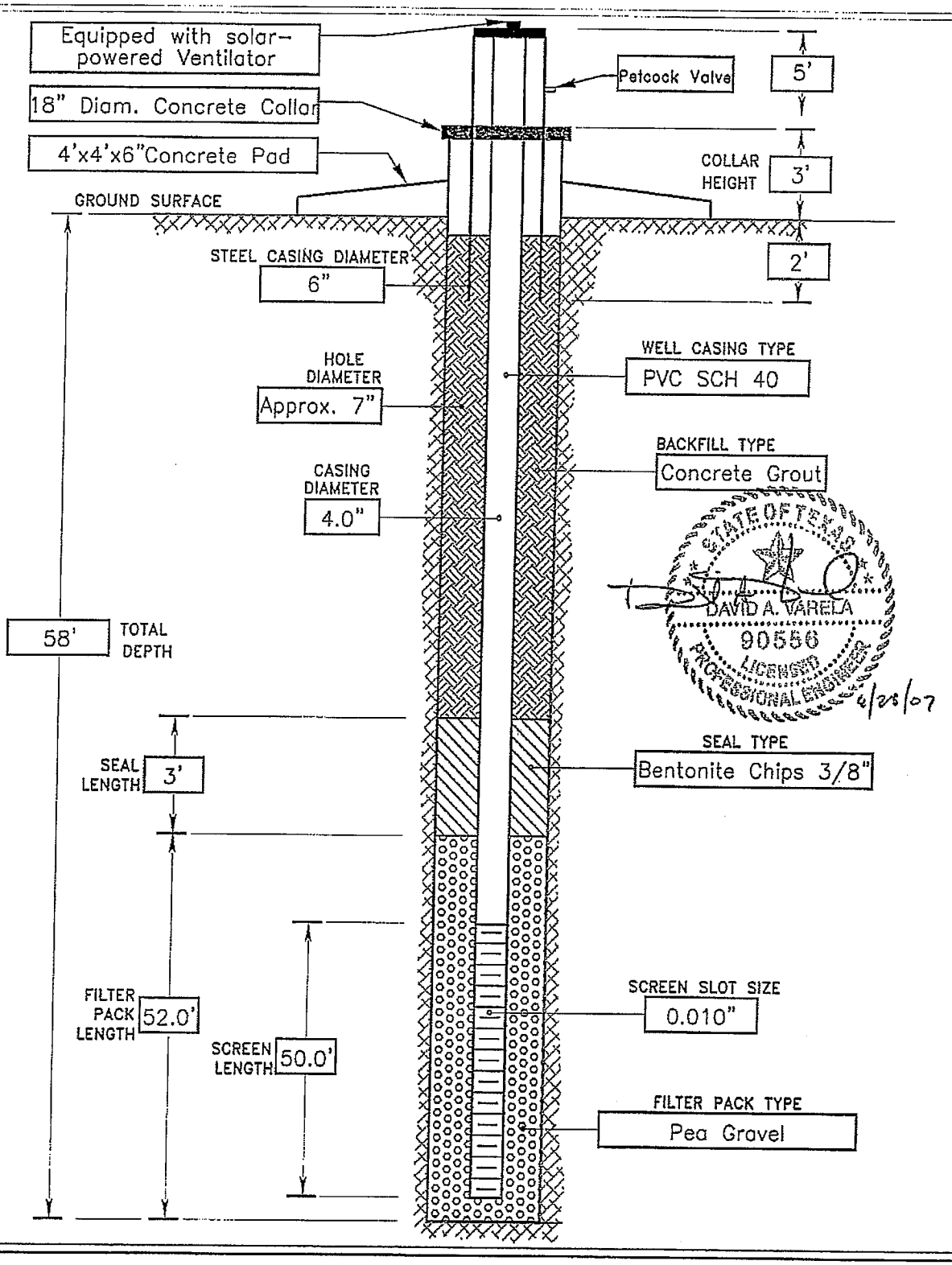
JOB NO. 6-717-500029 DATE INSTALLED 11/13/2006

# WELL COMPLETION LOG

DEVELOPMENT N/A GROUNDWATER DEPTH N/A

FORMATION OF COMPLETION N/A DRILL METHOD Hollow Stem Auger

COMMENTS: DRILLER Tierra Drilling



# LOG OF TEST BORING NO. PV-4

PROJECT McCombs Municipal Solid Waste Landfill
JOB NO. 6-717-500029 DATE November 9, 2006

SHEET 1 OF 2
RIG TYPE CME 75
BORING TYPE 6 5/8' Hollow Stem Auger
SURFACE ELEV. Existing
DATUM

LOGGED E. Osorio
DWG BY E. Osorio
CHEKED BY D. Hartsfield
DRILLED BY Tierra

| Depth in feet | Graphical Log | Sample | Sample Type | Blows per foot 140 lb. 30" free-fall drop hammer | Hand Penetrometer (tons/sq. ft.) | Moisture Content % of Dry Weight | Unified Soil Classification | CO | LEL | H2S | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | ML | | | | | SILT WITH SAND, nonplastic, light brown, dry. |
| | | | | | | | ML | | | | Note: Moderate methane odor, slightly stained soils | SILT WITH SAND mixed with trash, nonplastic, dark gray, dry to damp. |
| 5 | | | | | | | | | | | | |
| 10 | | | | | | | | 10 | 4 | 0 | Note: Added water to aid drilling. | |
| 15 | | | | | | | | 40 | 7 | 0 | Note: Added water to aid drilling. | |
| 20 | | | | | | | | 13 | 6 | 0 | Note: Added water to aid drilling. | |
| 25 | | | | | | | SM | 7 | 4 | 0 | Note: Added water to aid drilling. | SILTY SAND mixed with trash, non plastic, dark gray. |
| 30 | | | | | | | | 131 | 9 | 0 | Note: High (sweet) methane odor, slightly stained soils | |
| 35 | | | | | | | | 124 | 100 | 0 | Note: Added water to aid drilling. | |
| 40 | | | | | | | SC | 7 | 100 | 0 | Note: Added water to aid drilling. | CLAYEY SAND, low plasticity, dark gray. |

STATE OF TEXAS
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LICENSED PROFESSIONAL GEOSCIENTIST
P.G.
6-28-07

| GROUND WATER | | |
|---|---|---|
| DEPTH | HOUR | DATE |
| | | |
| | | |

SAMPLE TYPE
A - Auger cuttings B - Block sample
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 3" O.D. thin-walled Shelby tube

# LOG OF TEST BORING NO. PV-4

PROJECT McCombs Municipal Solid Waste Landfill
JOB NO. 6-717-500029 DATE November 9, 2006

SHEET 2 OF 2
RIG TYPE CME 75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. Existing
DATUM

LOGGED E. Osorio
DWG BY E. Osorio
CHEKED BY D. Hartsfield
DRILLED BY Tierra

| Depth in feet | Graphical Log | Sample | Sample Type | Blows per foot 140 lb. 30" free-fall drop hammer | Hand Penetrometer (tons/sq. ft.) | Moisture Content % of Dry Weight | Unified Soil Classification | CO | LEL | H2S | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40 | | | | | | | SC | 7 | 100 | 0 | Note: Added water to aid drilling. | CLAYEY SAND, low plasticity, dark gray. |
| 45 | | | | | | | | 8 | 27 | 0 | Note: Added water to aid drilling. | |
| 50 | | | | | | | CL | 6 | 3 | 0 | Note: Added water to aid drilling. | SANDY CLAY, medium to high plasticity, brown with dark gray, damp. |
| 55 | | | | | | | | 50 | 26 | 0 | | |
| | | | | | | | CH | | | | Note: Auger got stuck in clay material. | FAT CLAY, high plasticity, brown, dry. |
| 60 | | | | | | | | 68 | 100 | 0 | | Auger Stopped at 60' |
| 65 | | | | | | | | | | | | |
| 70 | | | | | | | | | | | | |
| 75 | | | | | | | | | | | | |
| 80 | | | | | | | | | | | | |

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6-28-07

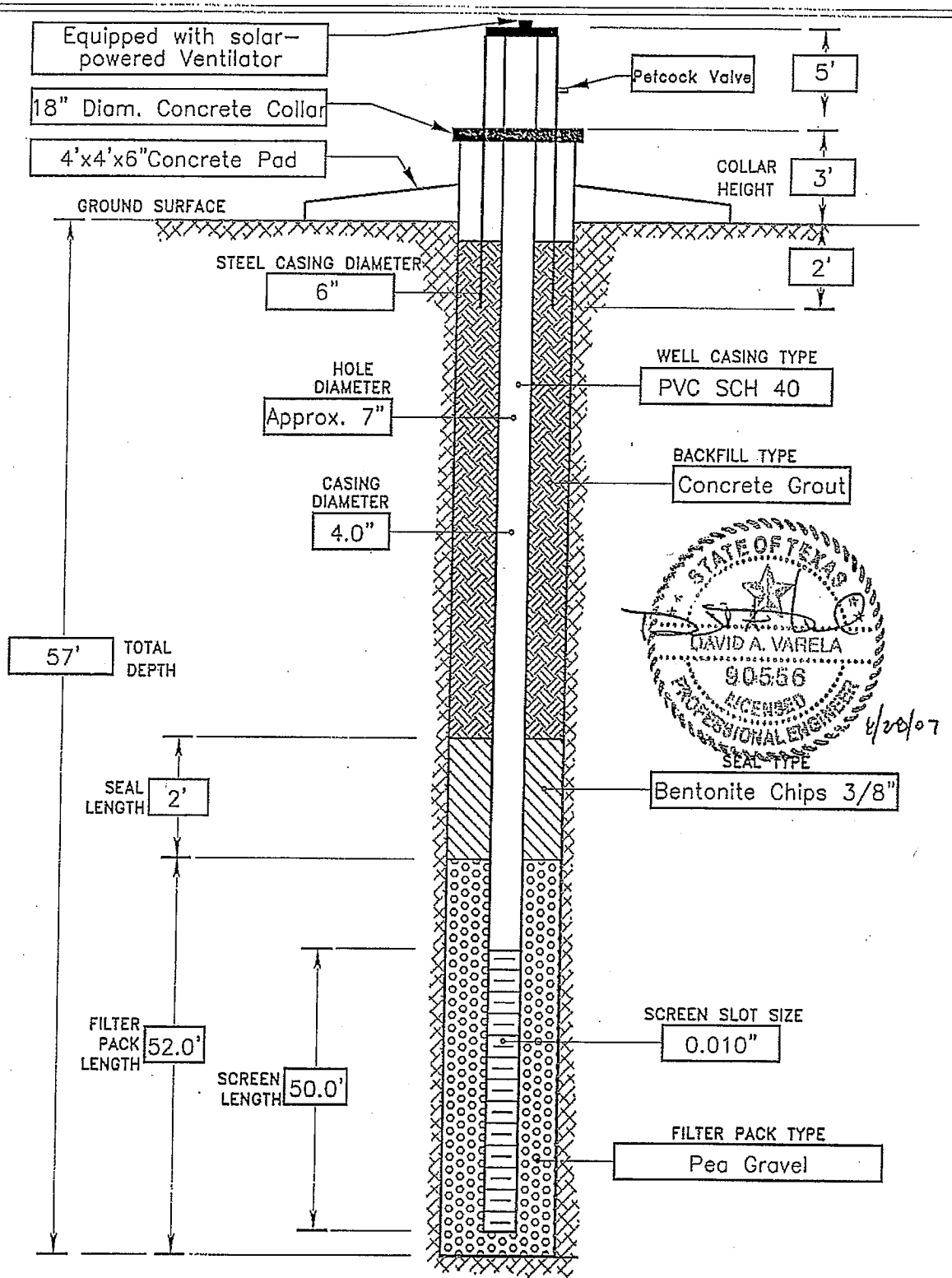
| GROUND WATER | | |
|---|---|---|
| DEPTH | HOUR | DATE |
| | | |

SAMPLE TYPE
A - Auger cuttings B - Block sample
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 3" O.D. thin-walled Shelby tube

PROJECT McCombs Solid Waste Landfill WELL NUMBER: PV-4
JOB NO. 6-717-500029 DATE INSTALLED 11/9/2006

# WELL COMPLETION LOG

DEVELOPMENT N/A GROUNDWATER DEPTH N/A
FORMATION OF COMPLETION N/A DRILL METHOD Hollow Stem Auger
COMMENTS: DRILLER Tierra Drilling



# LOG OF TEST BORING NO. PV-5

PROJECT McCombs Municipal Solid Waste Landfill
JOB NO. 6-717-500029 DATE November 9, 2006

SHEET 1 OF 2
RIG TYPE CME 75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. Existing
DATUM

LOGGED E. Osorio
DWG BY E. Osorio
CHEKED BY D. Hartsfield
DRILLED BY Tierra

| Depth in feet | Graphical Log | Sample | Sample Type | Blows per foot 140 lb. 30" free-fall drop hammer | Hand Penetrometer (tons/sq. ft.) | Moisture Content % of Dry Weight | Unified Soil Classification | CO | LEL | H2S | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | ML | | | | | SANDY SILT, nonplastic, light gray, dry. |
| | | | | | | | ML | 0 | 0 | 0 | | SANDY SILT mixed with trash, nonplastic, light gray, dry. |
| 5 | | | | | | | | 0 | 0 | 0 | | |
| 10 | | | | | | | | 149 | 12 | 0 | Note: Added water to aid drilling. | |
| 15 | | | | | | | | 16 | 54 | 0 | Note: Hit a tree log, had to stop to get rid of wood plug. Added water to aid drilling. | |
| 20 | | | | | | | | 0 | 0 | 0 | Note: Added water to aid drilling. | |
| | | | | | | | SC | | | | Note: Added water to aid drilling. | CLAYEY SAND, very low plasticity, dark gray. |
| 25 | | | | | | | | 83 | 24 | 0 | | |
| 30 | | | | | | | CL | 0 | 0 | 0 | | SANDY CLAY, low plasticity, graY, moist (possibly from water added on 25' bgs). |
| 35 | | | | | | | | 183 | 100 | 0 | | |
| 40 | | | | | | | | 1100 | 100 | 2 | | |

STATE OF TEXAS
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2707
LICENSED PROFESSIONAL GEOSCIENTIST

P.G.
6-28-07

| GROUND WATER | | |
|---|---|---|
| DEPTH | HOUR | DATE |
| | | |
| | | |

SAMPLE TYPE
A - Auger cuttings B - Block sample
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 3" O.D. thin-walled Shelby tube

# LOG OF TEST BORING NO. PV-5

PROJECT McCombs Municipal Solid Waste Landfill
JOB NO. 6-717-500029 DATE November 9, 2006

SHEET 2 OF 2
RIG TYPE CME 75
BORING TYPE 6 5/8' Hollow Stem Auger
SURFACE ELEV. Existing
DATUM

LOGGED E. Osorio
DWG BY E. Osorio
CHEKED BY D. Hartsfield
DRILLED BY Tierra

| Depth in feet | Graphical Log | Sample | Sample Type | Blows per foot 140 lb. 30" free-fall drop hammer | Hand Penetrometer (tons/sq. ft.) | Moisture Content % of Dry Weight | Unified Soil Classification | CO | LEL | H2S | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40 | | | | | | | CL | 1100 | 100 | 2 | | SANDY CLAY, low plasticity, gray, moist (possibly from water added at 25' bgs) |
| 45 | | | | | | | SP | 330 | 100 | 3 | | GRAVELLY SAND, nonplastic, light gray, damp. |
| 50 | | | | | | | | | 100 | | Note: High sewer odor, slightly stained. | |
| 55 | | | | | | | | 196 | 100 | 9 | | |
| 60 | | | | | | | | 240 | 100 | 4 | | Auger Stopped at 60' |
| 65 | | | | | | | | | | | | |
| 70 | | | | | | | | | | | | |
| 75 | | | | | | | | | | | | |
| 80 | | | | | | | | | | | | |

STATE OF TEXAS
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P.G.
6-28-07

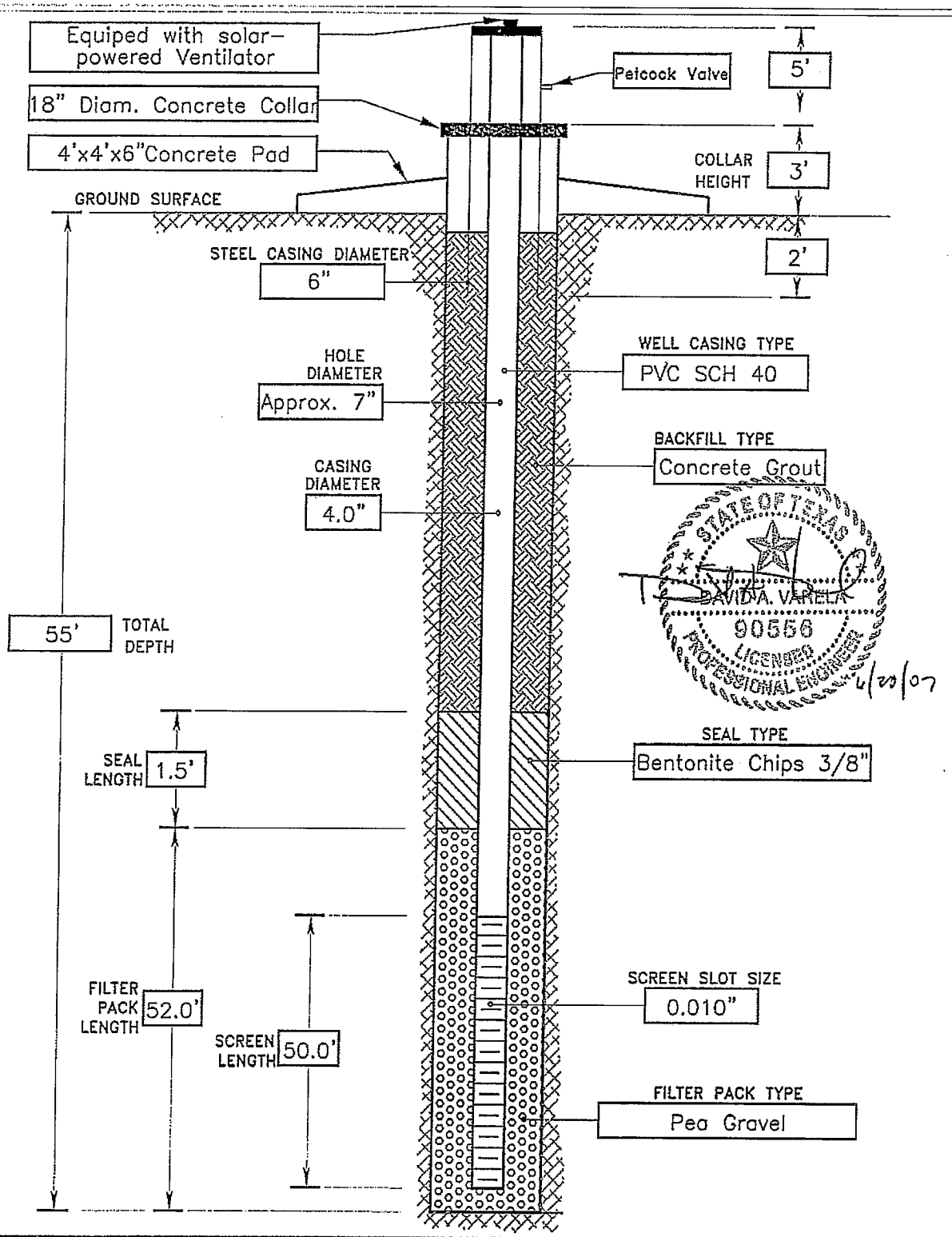
| GROUND WATER | | |
|---|---|---|
| DEPTH | HOUR | DATE |
| | | |
| | | |

SAMPLE TYPE
A - Auger cuttings B - Block sample
S - 2" O.D. 1.33" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 3" O.D. thin-walled Shelby tube

PROJECT McCombs Solid Waste Landfill WELL NUMBER: PV-5
JOB NO. 6-717-500029 DATE INSTALLED 11/9/2006

# WELL COMPLETION LOG

DEVELOPMENT N/A GROUNDWATER DEPTH N/A
FORMATION OF COMPLETION N/A DRILL METHOD Hollow Stem Auger
COMMENTS: DRILLER Tierra Drilling



# LOG OF TEST BORING NO. PV-6

PROJECT McCombs Municipal Solid Waste Landfill
JOB NO. 6-717-500029 DATE November 10, 2006

SHEET 1 OF 1
RIG TYPE CME 75
BORING TYPE 6 5/8' Hollow Stem Auger
SURFACE ELEV. Existing
DATUM

LOGGED E. Osorio
DWG BY E. Osorio
CHEKED BY D. Hartsfield
DRILLED BY Tierra

| Depth in feet | Graphical Log | Sample | Sample Type | Blows per foot 140 lb. 30" free-fall drop hammer | Hand Penetrometer (tons/sq. ft.) | Moisture Content % of Dry Weight | Unified Soil Classification | CO | LEL | H2S | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | SM | | | | | SILTY SAND, nonplastic, light brown, dry to damp. |
| | | | | | | | | | | | Note: Slight sewer odor, slight stain | SILTY SAND mixed with trash, nonplastic, light gray, damp. |
| | | | | | | | SM | | | | | |
| 5 | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 10 | | | | | | | | 63 | 10 | 0 | Note: Slight to moderate sewer odor, slight stain | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 15 | | | | | | | | 102 | 13 | 0 | Note: tree cuttings | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 20 | | | | | | | | 83 | 10 | 0 | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 25 | | | | | | | | 3 | 12 | 0 | | |
| | | | | | | | | | | | | |
| | | | | | | | SC | | | | Note: Decomposing organic matter | SANDY CLAY mixed with trash, low plasticity, black, damp. |
| 30 | | | | | | | | 250 | 100 | 0 | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 35 | | | | | | | | 200 | 100 | 0 | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 40 | | | | | | | | 566 | 100 | 1 | | |

STATE OF TEXAS
David L. Hartsfield
Geology
2707
LICENSED PROFESSIONAL GEOSCIENTIST

P.G.
6-28-07

| GROUND WATER | | |
|---|---|---|
| DEPTH | HOUR | DATE |
| | | |
| | | |

SAMPLE TYPE
A - Auger cuttings B - Block sample
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 3" O.D. thin-walled Shelby tube

# LOG OF TEST BORING NO. PV-6

PROJECT McCombs Municipal Solid Waste Landfill
JOB NO. 6-717-500029 DATE November 10, 2006

SHEET 2 OF 2
RIG TYPE CME 75
BORING TYPE 6 5/8' Hollow Stem Auger
SURFACE ELEV. Existing
DATUM

LOGGED E. Osorio
DWG BY E. Osorio
CHEKED BY D. Hartsfield
DRILLED BY Tierra

| Depth in feet | Graphical Log | Sample | Sample Type | Blows per foot 140 lb. 30" free-fall drop hammer | Hand Penetrometer (tons/sq. ft.) | Moisture Content % of Dry Weight | Unified Soil Classification | CO | LEL | H2S | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40 | | | | | | | SC | 566 | 100 | 1 | | CLAYEY SAND mixed with trash, low plasticity, dark gray, damp. |
| 45 | | | | | | | | 280 | 100 | 0 | | |
| 50 | | | | | | | | 17 | 100 | 0 | | |
| 55 | | | | | | | | 0 | 0 | 0 | Note: contains lots of organic matter | |
| 60 | | | | | | | | | | | | Auger Stopped at 60' |
| 65 | | | | | | | | | | | | |
| 70 | | | | | | | | | | | | |
| 75 | | | | | | | | | | | | |
| 80 | | | | | | | | | | | | |

STATE OF TEXAS
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Geology
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P.G.
6-28-07

| GROUND WATER | | |
|---|---|---|
| DEPTH | HOUR | DATE |
| | | |
| | | |

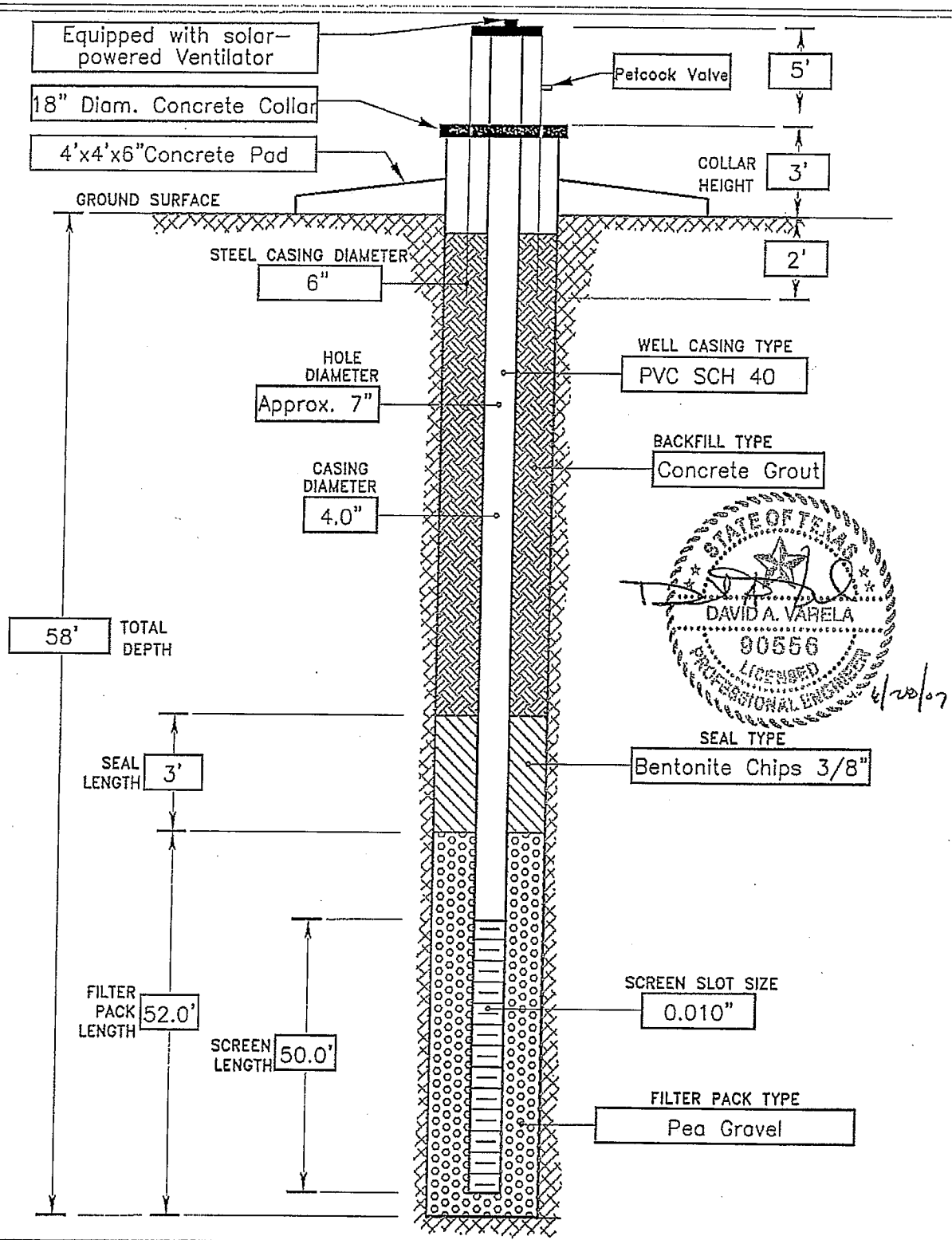
SAMPLE TYPE
A - Auger cuttings B - Block sample
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 3" O.D. thin-walled Shelby tube

amec

PROJECT McCombs Solid Waste Landfill WELL NUMBER: PV-6
JOB NO. 6-717-500029 DATE INSTALLED 11/10/2006

# WELL COMPLETION LOG

DEVELOPMENT N/A GROUNDWATER DEPTH N/A
FORMATION OF COMPLETION N/A DRILL METHOD Hollow Stem Auger
COMMENTS: DRILLER Tierra Drilling




STATE OF TEXAS
DAVID A. VARELA
90556
LICENSED
PROFESSIONAL ENGINEER
4/20/07

# LOG OF TEST BORING NO. PV-7

PROJECT McCombs Municipal Solid Waste Landfill
JOB NO. 6-717-500029 DATE November 13, 2006

SHEET 1 OF 1
RIG TYPE CME 75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. Existing
DATUM

LOGGED E. Osorio
DWG BY E. Osorio
CHEKED BY D. Hartsfield
DRILLED BY Tierra

| Depth in feet | Graphical Log | Sample | Sample Type | Blows per foot 140 lb, 30" free-fall drop hammer | Hand Penetrometer (tons/sq. ft.) | Moisture Content % of Dry Weight | Unified Soil Classification | CO | LEL | H2S | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | SC | | | | | CLAYEY SAND, low plasticity, light brown, dry. |
| | | | | | | | SM | | | | | SILTY SAND mixed with trash, nonplastic, dark gray, dry to damp. |
| 5 | | | | | | | | 15 | 35 | 0 | | |
| | | | | | | | CL | | | | | GRAVELLY CLAY mixed with trash, low plasticity, black, damp. |
| 10 | | | | | | | | 0 | 1 | 0 | | |
| | | | | | | | CL | | | | | SANDY CLAY, low to medium plasticity, brown, damp. |
| 15 | | | | | | | | 110 | 10 | 0 | | |
| 20 | | | | | | | | 75 | 7 | 0 | | |
| 25 | | | | | | | | 58 | 7 | 0 | | |
| | | | | | | | SC | | | | | CLAYEY SAND mixed with trash, low plasticity, less than 1% peat content, damp. |
| 30 | | | | | | | | 8 | 4 | 0 | | |
| | | | | | | | CL | | | | | SANDY CLAY, low to medium plasticity, gray, damp. |
| 35 | | | | | | | | 80 | 33 | 0 | | |
| 40 | | | | | | | CL | 875 | 100 | 0 | | GRAVELLY CLAY, low plasticity, light gray, damp. |

STATE OF TEXAS
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Geology
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LICENSED
PROFESSIONAL GEOSCIENTIST

P.G.
6-28-07

| GROUND WATER | | |
|---|---|---|
| DEPTH | HOUR | DATE |
| | | |
| | | |

SAMPLE TYPE
A - Auger cuttings B - Block sample
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 3" O.D. thin-walled Shelby tube

# LOG OF TEST BORING NO. PV-7

PROJECT McCombs Municipal Solid Waste Landfill
JOB NO. 6-717-500029 DATE November 13, 2006

SHEET 2 OF 2
RIG TYPE CME 75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. Existing
DATUM

LOGGED E. Osorio
DWG BY E. Osorio
CHEKED BY J. Barnes
DRILLED BY Tierra

| Depth in feet | Graphical Log | Sample | Sample Type | Blows per foot 140 lb. 30" free-fall drop hammer | Hand Penetrometer (tons/sq. ft.) | Moisture Content % of Dry Weight | Unified Soil Classification | CO | LEL | H2S | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40 | | | | | | | CL | 875 | 100 | 0 | | GRAVELLY CLAY, low plasticity, light gray, damp. |
| 45 | | | | | | | | 55 | 27 | 0 | | |
| 50 | | | | | | | | 230 | 100 | 0 | | |
| 55 | | | | | | | SP | 350 | | 0 | | POORLY GRADED SAND, nonplastic, gray, damp. |
| 60 | | | | | | | | | | | | Auger Stopped at 60' |
| 65 | | | | | | | | | | | | |
| 70 | | | | | | | | | | | | |
| 75 | | | | | | | | | | | | |
| 80 | | | | | | | | | | | | |

STATE OF TEXAS
David L. Hartsfield
Geology
2707
LICENSED PROFESSIONAL GEOSCIENTIST

D. L. Hartsfield, P.G.
6-28-07

| GROUND WATER | | |
|---|---|---|
| DEPTH | HOUR | DATE |
| | | |
| | | |

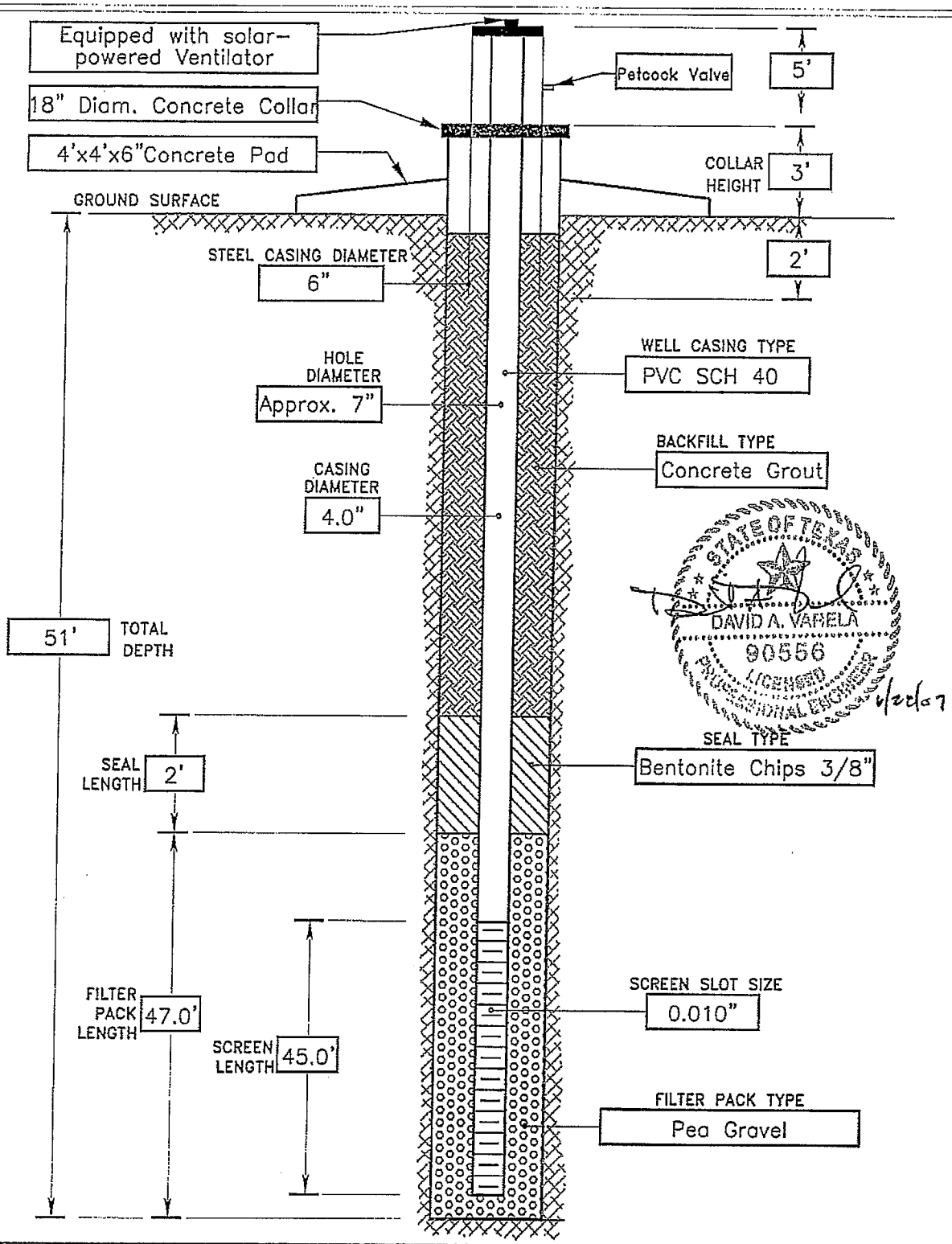
SAMPLE TYPE
A - Auger cuttings B - Block sample
S - 2" O.D. 1.35" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 3" O.D. thin-walled Shelby tube

amec

PROJECT McCombs Solid Waste Landfill WELL NUMBER: PV-7
JOB NO. 6-717-500029 DATE INSTALLED 11/10/2006

# WELL COMPLETION LOG

DEVELOPMENT N/A GROUNDWATER DEPTH N/A
FORMATION OF COMPLETION N/A DRILL METHOD Hollow Stem Auger
COMMENTS: DRILLER Tierra Drilling



# Texas Department of Licensing and Regulation

Water Well Driller/Pump Installer Program
P.O. Box 12157, Austin, Texas 78711 (512) 463-8770 FAX (512) 463-8616
Toll Free (800) 803-9202
Email: water.well@license.state.tx.us

## Report of Undesirable Water or Constituents

*To be completed by the Well Driller: (Type or Print)*

1. Well Driller: John P. McDuffee

   Company Name: Tierra Drilling and Environmental Services, Inc.

   Address: 5309 Mace St. Suite A1 (street or RFD) El Paso (city) Texas (state) 79932 (zip)

2. Landowner or Well Owner: The City of El Paso, Texas

   Address: 2 Civic Center Plaza (street or RFD) El Paso (city) Texas (state) 79901 (zip)

   Site location; 13600 McCombs El Paso, Texas 79934

3. Location of Well: County El Paso ☒ See Attached Map

   Lat.: 106° 24.843' Long.: 31° 59.380' Grid No.: 49-05-3

   _____ Miles on _____ (Hwy or Rd) from _____ (Hwy or Rd) from _____ (Hwy or Rd)

   _____ (NE, SW, etc.) of _____ (town)

4. Reason for Report:
   - ☐ Naturally-occurring, poor-quality groundwater encountered;
   - ☒ Hydrocarbon contamination encountered (includes gasoline, diesel, etc.);
   - ☐ Hazardous material/hazardous waste contamination encountered;
   - ☐ Other; describe _____

5. Date Well Drilled: 11-08 to 11-13-2006 Type Well: Monitor Wells-PV3C, PV4,PV5,PV6B,PV7 also; Environmental Soil Borings PV3A.PV3B,PV6A

6. Has a State Well Report form relating to this well been forwarded to the Texas Department of Licensing and Regulation? ☒ Yes ☐ No Date: 12-21-2006

7. I certify that while drilling, deepening or altering the above described well, undesirable water or constituents was encountered and the landowner or well owner was informed by certified mail (recommended) that such well must be completed or plugged in accordance with 16 TAC Chapter 76.

   Date: 12-14-2006 Cert. Mail No.: 7005 1820 0001 0925 6909

   Licensed Well Driller: John P. McDuffee Lic. No.: 2994A

   Driller's Signature: John P. McDuffee

Send Original Copy by certified mail to TDLR, PO Box 12157, Austin, TX 78711
Send a Copy by certified mail (recommended) to the Landowner or Well Owner
Keep a Copy for the Well Driller's records

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

# Texas Department of Licensing and Regulation

Water Well Driller/Pump Installer Section
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Toll free (800)803-9202
Email address: water.well@license.state.tx.us Web address: www.license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

## WELL REPORT

### A. WELL IDENTIFICATION AND LOCATION DATA

**1) OWNER**

| Name: | Address: | City: | State: | Zip: |
|---|---|---|---|---|
| The City of El Paso Texas | 2 Civic Center Plaza | El Paso | Texas | 79901 |

**2) WELL LOCATION**

| Well # or # of wells drilled | County: | Physical Address: | City: |
|---|---|---|---|
| PV3A | El Paso | 13600 McCombs | El Paso/79934 |

| Lat. | Long. | Grid # |
|---|---|---|
| 106° 24.843' | 31° 59.380' | 49-05-3 |

**3) Type of Work**
☒ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening

**4) Proposed Use (check)** ☐ Monitor ☒ Environmental Soil Boring ☐ Domestic ☐ Extraction ☐ Industrial ☐ Irrigation ☐ Injection ☐ Closed-Loop Geothermal ☐ De-watering ☐ Testwell ☐ Rig Supply ☐ Stock ☐ Public Supply – If Public Supply, were plans approved? ☐ Yes ☐ No

**5)** NT

**6) Drilling Date**
Started 11 / 08 /06
Completed 11 / 08 /06

**Diameter of Hole**

| Dia.(in) | From (ft) | To (ft) |
|---|---|---|
| 11 | Surface 0 | 20 |
| | | |
| | | |

**7) Drilling Method (check)**
☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☒ Hollow Stem Auger ☐ Reverse Circulation ☐ Other

| From (ft) | To (ft) | Description and color of formation material |
|---|---|---|
| 0 | 2 | Sand, brown, dry. |
| 2 | 20 | Land-fill trash. |

(Use reverse side of Well Owner's copy, If necessary)

**8) Borehole Completion** ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☒ Other Backfill
Gravel packed interval from: _____ ft. to: _____ ft. Size:

**Casing, Blank Pipe, and Well Screen Data**

| Dia. (in.) | New Or Used | Steel, Plastic, etc. Perf., Slotted, etc Screen Mfg., if commercial | Setting (ft) From | Setting (ft) To | Gage Casing | Gage Screen |
|---|---|---|---|---|---|---|
| | | None used | | | | |

**9) Annular Seal Data:** i.e. *(from 0 ft to 100 ft #sacks & material 13 cement)*
from 0 ft. to 20 ft. #sacks & material Backfill
from _____ ft. to _____ ft. #sacks & material _____
from _____ ft. to _____ ft. #sacks & material _____
Method Used Gravity Performed By Tierra
Distance to septic field or other concentrated contamination 0 ft.
Distance to Property Line 125 ft Method tape
Verified: JPM

**13) Plugged** ☒ Well plugged within 48 hours
Casing left in well: Cement/Bentonite placed in well:

| From (ft) | To (ft) | From (ft) | To (ft) | # Sacks & Material used |
|---|---|---|---|---|
| N/A | | Backfill | | |
| | | | | |
| | | | | |

**10) Surface Completion** (If steel cased, leave blank)
☐ Surface Slab Installed ☐ Surface Sleeve Installed ☐ Pitless Adapter Used ☒ Alternative Procedure Used Cap

**14) Type Pump** N/A
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other _____
Depth to pump bowls, cylinder, jet etc., _____ ft.

**11) Water Level** N/A
Static level _____ ft. Date: / /
Artesian Flow _____ gpm

**12) Packers:** N/A

| Type | Depth | Type | Depth |
|---|---|---|---|
| | | | |
| | | | |

**15) Water Test** N/A
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

**16) Water Quality**
Type of water N/A Depth of Strata: _____ Was a chemical analysis made? ☐ Yes ☒ No
Did you knowingly penetrate a strata which contains undesirable constituents? ☒ Yes ☐ No If yes, Continue:
Check One: ☐ Naturally poor-quality groundwater – type _____ ☒ Hydrocarbons (i.e. gas, oil, etc.) ☐ Hazardous material/waste contamination encountered ☐ Other (describe): _____

☒ *I certify that while drilling, deepening, or otherwise altering the above described well, undesirable water or constituents was encountered and the landowner was informed that such well must be completed or plugged in such a manner as to avoid injury or pollution.*

**By signing this well report, I certify that I drilled or supervised the drilling of this well and that each and all of the statements herein are true and correct.**

| Company & Individual's Name: (type or print) | Tierra Drilling & Env.Svc.Inc. | Lic. No.: | 2994A |
|---|---|---|---|
| Address: 5309 Mace St. Ste.A1 | City: El Paso | State: Texas | Zip 79932 |
| Signature: [signature] Licensed Driller/Pump Installer | Date: 12 / 08 /06 | Signature: Apprentice | Apprentice Reg. Number |

TDLR FORM 001WWD / 2-06 *TDLR (Original)* *Landowner (copy)* *Driller/Pump Installer (copy)*

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

# Texas Department of Licensing and Regulation

Water Well Driller/Pump Installer Section
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Toll free (800)803-9202
Email address: water.well@license.state.tx.us Web address: www.license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

## WELL REPORT

### A. WELL IDENTIFICATION AND LOCATION DATA

**1) OWNER**

| Name: | Address: | City: | State: | Zip: |
|---|---|---|---|---|
| The City of El Paso Texas | 2 Civic Center Plaza | El Paso | Texas | 79901 |

**2) WELL LOCATION**

| Well # or # of wells drilled | County: | Physical Address: | City: |
|---|---|---|---|
| PV3B | El Paso | 13600 McCombs | El Paso/79934 |

| Lat. | Long. | Grid # |
|---|---|---|
| 106° 24.843' | 31° 59.380' | 49-05-3 |

**3) Type of Work**
☒ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening

**4) Proposed Use (check)** ☐ Monitor ☒ Environmental Soil Boring ☐ Domestic ☐ Extraction ☐ Industrial ☐ Irrigation ☐ Injection ☐ Closed-Loop Geothermal ☐ De-watering ☐ Testwell ☐ Rig Supply ☐ Stock ☐ Public Supply – If Public Supply, were plans approved? ☐ Yes ☐ No

5) NT

**6) Drilling Date**
Started 11 / 08 / 06
Completed 11 / 08 / 06

**Diameter of Hole**

| Dia.(in) | From (ft) | To (ft) |
|---|---|---|
| 7 | Surface 0 | 25 |
| | | |
| | | |

**7) Drilling Method (check)**
☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☒ Hollow Stem Auger ☐ Reverse Circulation ☐ Other

| From (ft) | To (ft) | Description and color of formation material |
|---|---|---|
| 0 | 2 | Sand, brown, dry. |
| 2 | 20 | Land-fill trash. |

(Use reverse side of Well Owner's copy, If necessary)

**8) Borehole Completion** ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☒ Other Backfill
Gravel packed interval from: ____ ft. to: ____ ft. Size:

**Casing, Blank Pipe, and Well Screen Data**

| Dia. (in.) | New Or Used | Steel, Plastic, etc. Perf., Slotted, etc Screen Mfg., if commercial | Setting (ft) From | Setting (ft) To | Gage Casing Screen |
|---|---|---|---|---|---|
| | | N/A | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**9) Annular Seal Data:** i.e. *(from 0 ft to 100 ft #sacks & material 13 cement)*
from 0 ft. to 25 ft. #sacks & material Backfill
from ____ ft. to ____ ft. #sacks & material ____
from ____ ft. to ____ ft. #sacks & material ____
Method Used Gravity Performed By Tierra
Distance to septic field or other concentrated contamination 0 ft.
Distance to Property Line 125 ft Method Tape
Verified: JPM

**13) Plugged** XX Well plugged within 48 hours
Casing left in well: Cement/Bentonite placed in well:

| From (ft) | To (ft) | From (ft) | To (ft) | # Sacks & Material used |
|---|---|---|---|---|
| N/A | | Backfill | | |
| | | | | |
| | | | | |

**10) Surface Completion** (If steel cased, leave blank)
☐ Surface Slab Installed ☐ Surface Sleeve Installed ☐ Pitless Adapter Used ☒ Alternative Procedure Used Cap

**14) Type Pump** N/A
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other ____
Depth to pump bowls, cylinder, jet etc., ____ ft.

**11) Water Level** N/A
Static level ____ ft. Date: / /
Artesian Flow ____ gpm

**12) Packers:** N/A

| Type | Depth | Type | Depth |
|---|---|---|---|
| | | | |
| | | | |

**15) Water Test** N/A
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ____ gpm with ____ ft. drawdown after ____ hrs.

**16) Water Quality**
Type of water N/A Depth of Strata: ____ Was a chemical analysis made? ☐ Yes ☒ No
Did you knowingly penetrate a strata which contains undesirable constituents? ☒ Yes ☐ No If yes, Continue:
Check One: ☐ Naturally poor-quality groundwater – type ____ XX Hydrocarbons (i.e. gas, oil, etc.)
☐ Hazardous material/waste contamination encountered ☐ Other (describe) ____

☒ *I certify that while drilling, deepening, or otherwise altering the above described well, undesirable water or constituents was encountered and the landowner was informed that such well must be completed or plugged in such a manner as to avoid injury or pollution.*

By signing this well report, I certify that I drilled or supervised the drilling of this well and that each and all of the statements herein are true and correct.

| Company & Individual's Name: (type or print) | Tierra Drilling & Env.Svc.Inc. | Lic. No.: | 2994A |
|---|---|---|---|
| Address: 5309 Mace St. Ste.A1 | City: El Paso | State: Texas | Zip79932 |

| Signature: John P. McDuffee | 12 / 08 / 06 | Signature: | |
|---|---|---|---|
| Licensed Driller/Pump Installer | Date | Apprentice | Apprentice Reg. Number |

TDLR FORM 001WWD / 2-06 TDLR (Original) Landowner (copy) Driller/Pump Installer (copy)

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

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Water Well Driller/Pump Installer Section
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Toll free (800)803-9202
Email address: water.well@license.state.tx.us Web address: www.license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

## WELL REPORT

### A. WELL IDENTIFICATION AND LOCATION DATA

**1) OWNER**

| Name: | Address: | City: | State: | Zip: |
|---|---|---|---|---|
| The City of El Paso Texas | 2 Civic Center Plaza | El Paso | Texas | 79901 |

**2) WELL LOCATION**

| Well # or # of wells drilled | County: | Physical Address: | City: |
|---|---|---|---|
| PV3C | El Paso | 13600 McCombs | El Paso/79934 |

| Lat. | Long. | Grid # |
|---|---|---|
| 106° 24.843' | 31° 59.380' | 49-05-3 |

**3) Type of Work**
☒ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening

**4) Proposed Use (check)** ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Extraction ☐ Industrial ☐ Irrigation ☐ Injection ☐ Closed-Loop Geothermal ☐ De-watering ☐ Testwell ☐ Rig Supply ☐ Stock ☐ Public Supply – If Public Supply, were plans approved? ☐ Yes ☐ No

**5)** NT 0

**6) Drilling Date**
Started 11 / 13 /06
Completed 11 / 15 /06

**Diameter of Hole**

| Dia.(in) | From (ft) | To (ft) |
|---|---|---|
| | Surface | |
| 7 | 0 | 60 |
| | | |
| | | |

**7) Drilling Method (check)**
☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☒ Hollow Stem Auger ☐ Reverse Circulation ☐ Other

| From (ft) | To (ft) | Description and color of formation material |
|---|---|---|
| 0 | 2 | Sand, brown, dry. |
| 2 | 60 | Land-fill trash. |

(Use reverse side of Well Owner's copy, If necessary)

**8) Borehole Completion** ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☒ Gravel Packed ☐ Other
Gravel packed interval from: 6 ft. to: 60 ft. Size: 3/8 in

**Casing, Blank Pipe, and Well Screen Data**

| Dia. (in.) | New Or Used | Steel, Plastic, etc. Perf., Slotted, etc Screen Mfg., if commercial | Setting (ft) From | Setting (ft) To | Gage Casing Screen |
|---|---|---|---|---|---|
| 4 | New | PVC Casing, | ±8 | 8 | Blk. |
| 4 | New | PVC Screen, MFG. | 8 | 58 | 0.01 |
| | | | | | |
| | | | | | |

**9) Annular Seal Data:** i.e. (from 0 ft to 100 ft #sacks & material 13 cement)
from 0 ft. to 3 ft. #sacks & material 1sk/cmt
from 3 ft. to 6 ft. #sacks & material 2sk/Bent.
from ____ ft. to ____ ft. #sacks & material chip
Method Used poured Performed By Tierra
Distance to septic field or other concentrated contamination 0 ft.
Distance to Property Line 125 ft Method Tape
Verified: JPM

**13) Plugged** ☐ Well plugged within 48 hours N/A
Casing left in well: Cement/Bentonite placed in well:

| From (ft) | To (ft) | From (ft) | To (ft) | # Sacks & Material used |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

**10) Surface Completion** (If steel cased, leave blank)
☐ Surface Slab Installed ☒ Surface Sleeve Installed ☐ Pitless Adapter Used ☐ Alternative Procedure Used

**14) Type Pump** N/A
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other
Depth to pump bowls, cylinder, jet etc.. ____ ft.

**11) Water Level** N/A
Static level ____ ft. Date: / /
Artesian Flow ____ gpm

**12) Packers:** N/A

| Type | Depth | Type | Depth |
|---|---|---|---|
| | | | |
| | | | |

**15) Water Test** N/A
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ____ gpm with ____ ft. drawdown after ____ hrs.

**16) Water Quality**
Type of water N/A Depth of Strata: ____ Was a chemical analysis made? ☐ Yes ☒ No
Did you knowingly penetrate a strata which contains undesirable constituents? ☒ Yes ☐ No If yes, Continue:
Check One: ☐ Naturally poor-quality groundwater – type ____ ☒ Hydrocarbons (i.e. gas, oil, etc.) ☐ Hazardous material/waste contamination encountered ☐ Other (describe) ____

☒ *I certify that while drilling, deepening, or otherwise altering the above described well, undesirable water or constituents was encountered and the landowner was informed that such well must be completed or plugged in such a manner as to avoid injury or pollution.*

By signing this well report, I certify that I drilled or supervised the drilling of this well and that each and all of the statements herein are true and correct.

| Company & Individual's Name: (type or print) | Tierra Drilling & Env.Svc.Inc. | Lic. No.: | 2994A |
|---|---|---|---|
| Address: 5309 Mace St. Ste.A1 | City: El Paso | State: Texas | Zip 79932 |
| Signature: John P. McDuffee | 12 / 08/06 | Signature: | |
| Licensed Driller/Pump Installer | Date | Apprentice | Apprentice Reg. Number |

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

# Texas Department of Licensing and Regulation

Water Well Driller/Pump Installer Section
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Toll free (800)803-9202
Email address: water.well@license.state.tx.us Web address: www.license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

## WELL REPORT

### A. WELL IDENTIFICATION AND LOCATION DATA

1) OWNER

| Name: | Address: | City: | State: | Zip: |
|---|---|---|---|---|
| The City of El Paso Texas | 2 Civic Center Plaza | El Paso | Texas | 79901 |

2) WELL LOCATION

| Well # or # of wells drilled | County: | Physical Address: | City: |
|---|---|---|---|
| PV4 | El Paso | 13600 McCombs | El Paso/79934 |

| 3) Type of Work | Lat. | Long. | Grid # |
|---|---|---|---|
| ☒ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening | 106° 24.843' | 31° 59.380' | 49-05-3 |

4) Proposed Use (check) ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Extraction ☐ Industrial ☐ Irrigation ☐ Injection ☐ Closed-Loop Geothermal ☐ De-watering ☐ Testwell ☐ Rig Supply ☐ Stock ☐ Public Supply – If Public Supply, were plans approved? ☐ Yes ☐ No

5) NT

6) Drilling Date
Started 11/ 09 /06
Completed 11/ 15 /06

Diameter of Hole

| Dia.(in) | From (ft) | To (ft) |
|---|---|---|
| 7 | Surface 0 | 60 |
| | | |
| | | |

7) Drilling Method (check)
☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☒ Hollow Stem Auger ☐ Reverse Circulation ☐ Other

| From (ft) | To (ft) | Description and color of formation material |
|---|---|---|
| 0 | 2 | Sand, brown, dry. |
| 2 | 60 | Land-fill trash. |

(Use reverse side of Well Owner's copy, If necessary)

8) Borehole Completion ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☒ Gravel Packed ☐ Other
Gravel packed interval from: 5 ft. to: 57 ft. Size: 3/8"

Casing, Blank Pipe, and Well Screen Data

| Dia. (in.) | New Or Used | Steel, Plastic, etc. Perf., Slotted, etc Screen Mfg., if commercial | Setting (ft) From | Setting (ft) To | Gage Casing Screen |
|---|---|---|---|---|---|
| 4 | New | PVC Casing, | ±8 | 7 | Blk. |
| 4 | New | PVC Screen, MFG. | 7 | 57 | 0.01 |
| | | | | | |
| | | | | | |

9) Annular Seal Data: i.e. (from 0 ft to 100 ft #sacks & material 13 cement)
from 0 ft. to 3 ft. #sacks & material 1sk/cmt
from 3 ft. to 5 ft. #sacks & material 2sk/Bent.
from ____ ft. to ____ ft. #sacks & material chip
Method Used poured Performed By Tierra
Distance to septic field or other concentrated contamination 0 ft.
Distance to Property Line 125 ft Method Tape
Verified: JPM

13) Plugged ☐ Well plugged within 48 hours N/A
Casing left in well: Cement/Bentonite placed in well:

| From (ft) | To (ft) | From (ft) | To (ft) | # Sacks & Material used |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

10) Surface Completion (If steel cased, leave blank)
☐ Surface Slab Installed ☒ Surface Sleeve Installed ☐ Pitless Adapter Used ☐ Alternative Procedure Used

14) Type Pump N/A
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other
Depth to pump bowls, cylinder, jet etc., ____ ft.

11) Water Level N/A
Static level ____ ft. Date: / /
Artesian Flow ____ gpm

12) Packers: N/A

| Type | Depth | Type | Depth |
|---|---|---|---|
| | | | |
| | | | |

15) Water Test N/A
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

16) Water Quality
Type of water N/A Depth of Strata: Was a chemical analysis made? ☐ Yes ☒ No
Did you knowingly penetrate a strata which contains undesirable constituents? ☒ Yes ☐ No If yes, Continue:
Check One: ☐ Naturally poor-quality groundwater – type ☒ Hydrocarbons (i.e. gas, oil, etc.) ☐ Hazardous material/waste contamination encountered ☐ Other (describe)

☒ *I certify that while drilling, deepening, or otherwise altering the above described well, undesirable water or constituents was encountered and the landowner was informed that such well must be completed or plugged in such a manner as to avoid injury or pollution.*

By signing this well report, I certify that I drilled or supervised the drilling of this well and that each and all of the statements herein are true and correct.

| Company & Individual's Name: (type or print) | Lic. No.: |
|---|---|
| Tierra Drilling & Env.Svc.Inc. | 2994A |

| Address: | City: | State: | Zip |
|---|---|---|---|
| 5309 Mace St. Ste.A1 | El Paso | Texas | 79932 |

| Signature: Licensed Driller/Pump Installer | Date | Signature: Apprentice | Apprentice Reg. Number |
|---|---|---|---|
| | 12/08/06 | | |

TDLR FORM 001WWD / 2-06 TDLR (Original) Landowner (copy) Driller/Pump Installer (copy)

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

# Texas Department of Licensing and Regulation

Water Well Driller/Pump Installer Section
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Toll free (800)803-9202
Email address: water.well@license.state.tx.us Web address: www.license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

## WELL REPORT

### A. WELL IDENTIFICATION AND LOCATION DATA

**1) OWNER**

| Name: | Address: | City: | State: | Zip: |
|---|---|---|---|---|
| The City of El Paso Texas | 2 Civic Center Plaza | El Paso | Texas | 79901 |

**2) WELL LOCATION**

| Well # or # of wells drilled | County: | Physical Address: | City: |
|---|---|---|---|
| PV5 | El Paso | 13600 McCombs | El Paso/79934 |

| Lat. | Long. | Grid # |
|---|---|---|
| 106° 24.843' | 31° 59.380' | 49-05-3 |

**3) Type of Work**
☒ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening

**4) Proposed Use (check)** ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Extraction ☐ Industrial ☐ Irrigation ☐ Injection ☐ Closed-Loop Geothermal ☐ De-watering ☐ Testwell ☐ Rig Supply ☐ Stock ☐ Public Supply – If Public Supply, were plans approved? ☐ Yes ☐ No

**5)** NT 0

**6) Drilling Date**
Started 11/ 09 /06
Completed 11/ 15 /06

**Diameter of Hole**

| Dia.(in) | From (ft) | To (ft) |
|---|---|---|
| 7 | Surface 0 | 60 |
| | | |
| | | |

**7) Drilling Method (check)**
☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☒ Hollow Stem Auger ☐ Reverse Circulation ☐ Other

| From (ft) | To (ft) | Description and color of formation material |
|---|---|---|
| 0 | 2 | Sand, brown, dry. |
| 2 | 60 | Land-fill trash. |

(Use reverse side of Well Owner's copy, If necessary)

**8) Borehole Completion** ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☒ Gravel Packed ☐ Other
Gravel packed interval from: 3 ft. to: 55 ft. Size: 3/8"

**Casing, Blank Pipe, and Well Screen Data**

| Dia. (in.) | New Or Used | Steel, Plastic, etc. Perf., Slotted, etc Screen Mfg., if commercial | Setting (ft) From | Setting (ft) To | Gage Casing Screen |
|---|---|---|---|---|---|
| 4 | New | PVC Casing, | ±8 | 5 | Blk. |
| 4 | New | PVC Screen, MFG. | 5 | 55 | 0.01 |
| | | | | | |
| | | | | | |

**9) Annular Seal Data:** i.e. *(from 0 ft to 100 ft #sacks & material 13 cement)*
from 0 ft. to 1 ft. #sacks & material 1sk/cmt
from 1 ft. to 3 ft. #sacks & material 2sk/Bent
from ____ ft. to ____ ft. #sacks & material chip
Method Used poured Performed By Tierra
Distance to septic field or other concentrated contamination 0 ft.
Distance to Property Line 125 ft Method Tape
Verified: JPM

**13) Plugged** ☐ Well plugged within 48 hours N/A
Casing left in well: Cement/Bentonite placed in well:

| From (ft) | To (ft) | From (ft) | To (ft) | # Sacks & Material used |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

**10) Surface Completion** (If steel cased, leave blank)
☐ Surface Slab Installed ☒ Surface Sleeve Installed ☐ Pitless Adapter Used ☐ Alternative Procedure Used

**14) Type Pump** N/A
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other
Depth to pump bowls, cylinder, jet etc., ____ ft.

**11) Water Level** N/A
Static level ____ ft. Date: / /
Artesian Flow ____ gpm

**12) Packers:** N/A

| Type | Depth | Type | Depth |
|---|---|---|---|
| | | | |
| | | | |

**15) Water Test** N/A
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ____ gpm with ____ ft. drawdown after ____ hrs.

**16) Water Quality**
Type of water N/A Depth of Strata: ____ Was a chemical analysis made? ☐ Yes ☒ No
Did you knowingly penetrate a strata which contains undesirable constituents? ☒ Yes ☐ No If yes, Continue:
Check One: ☐ Naturally poor-quality groundwater – type ____ ☒ Hydrocarbons (i.e. gas, oil, etc.) ☐ Hazardous material/waste contamination encountered ☐ Other (describe) ____

☒ *I certify that while drilling, deepening, or otherwise altering the above described well, undesirable water or constituents was encountered and the landowner was informed that such well must be completed or plugged in such a manner as to avoid injury or pollution.*

By signing this well report, I certify that I drilled or supervised the drilling of this well and that each and all of the statements herein are true and correct.

| Company & Individual's Name: (type or print) | | Lic. No.: |
|---|---|---|
| | Tierra Drilling & Env.Svc.Inc. | 2994A |

| Address: | City: | State: | Zip |
|---|---|---|---|
| 5309 Mace St. Ste.A1 | El Paso | Texas | 79932 |

| Signature: Licensed Driller/Pump Installer | Date | Signature: Apprentice | Apprentice Reg. Number |
|---|---|---|---|
| John P McDuffee | 12/ 08/06 | | |

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

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Water Well Driller/Pump Installer Section
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Toll free (800)803-9202
Email address: water.well@license.state.tx.us Web address: www.license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

## WELL REPORT

### A. WELL IDENTIFICATION AND LOCATION DATA

**1) OWNER**

| Name: | Address: | City: | State: | Zip: |
|---|---|---|---|---|
| The City of El Paso Texas | 2 Civic Center Plaza | El Paso | Texas | 79901 |

**2) WELL LOCATION**

| Well # or # of wells drilled | County: | Physical Address: | City: |
|---|---|---|---|
| PV6A | El Paso | 13600 McCombs | El Paso/ 79934 |

Lat. 106° 24.843' Long. 31° 59.380' Grid # 49-05-3

**3) Type of Work**
☒ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening

**4) Proposed Use (check)** ☐ Monitor ☒ Environmental Soil Boring ☐ Domestic ☐ Extraction ☐ Industrial ☐ Irrigation ☐ Injection ☐ Closed-Loop Geothermal ☐ De-watering ☐ Testwell ☐ Rig Supply ☐ Stock ☐ Public Supply – If Public Supply, were plans approved? ☐ Yes ☐ No

**5)** NT

**6) Drilling Date**
Started 11 / 10 / 06
Completed 11 / 10 / 06

**Diameter of Hole**

| Dia.(in) | From (ft) | To (ft) |
|---|---|---|
| | Surface | |
| 7 | 0 | 40 |
| | | |
| | | |

**7) Drilling Method (check)**
☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☒ Hollow Stem Auger ☐ Reverse Circulation ☐ Other

| From (ft) | To (ft) | Description and color of formation material |
|---|---|---|
| 0 | 2 | Sand, brown, dry. |
| 2 | 40 | Land-fill trash. |

(Use reverse side of Well Owner's copy, If necessary)

**8) Borehole Completion** ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☒ Other Backfill
Gravel packed interval from: _____ ft. to: _____ ft. Size:

**Casing, Blank Pipe, and Well Screen Data**

| Dia. (in.) | New Or Used | Steel, Plastic, etc. Perf., Slotted, etc Screen Mfg., if commercial | Setting (ft) From | Setting (ft) To | Gage Casing Screen |
|---|---|---|---|---|---|
| | | None used | | | |

**9) Annular Seal Data:** i.e. *(from 0 ft to 100 ft #sacks & material 13 cement)*
from 0 ft. to 40 ft. #sacks & material Backfill
from _____ ft. to _____ ft. #sacks & material _____
from _____ ft. to _____ ft. #sacks & material _____
Method Used Gravity Performed By Tierra
Distance to septic field or other concentrated contamination 0 ft.
Distance to Property Line 125 ft Method tape
Verified: JPM

**13) Plugged** ☒ Well plugged within 48 hours
Casing left in well: Cement/Bentonite placed in well:

| From (ft) | To (ft) | From (ft) | To (ft) | # Sacks & Material used |
|---|---|---|---|---|
| N/A | | Backfill | | |
| | | | | |
| | | | | |

**10) Surface Completion** (If steel cased, leave blank)
☐ Surface Slab Installed ☐ Surface Sleeve Installed ☐ Pitless Adapter Used ☒ Alternative Procedure Used Cap

**14) Type Pump** N/A
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other _____
Depth to pump bowls, cylinder, jet etc.. _____ ft.

**11) Water Level** N/A
Static level _____ ft. Date: / /
Artesian Flow _____ gpm

**12) Packers:** N/A

| Type | Depth | Type | Depth |
|---|---|---|---|
| | | | |
| | | | |

**15) Water Test** N/A
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

**16) Water Quality**
Type of water N/A Depth of Strata: _____ Was a chemical analysis made? ☐ Yes ☒ No
Did you knowingly penetrate a strata which contains undesirable constituents? ☒ Yes ☐ No If yes, Continue:
Check One: ☐ Naturally poor-quality groundwater – type _____ ☒ Hydrocarbons (i.e. gas, oil, etc.) ☐ Hazardous material/waste contamination encountered ☐ Other (describe) _____

☒ *I certify that while drilling, deepening, or otherwise altering the above described well, undesirable water or constituents was encountered and the landowner was informed that such well must be completed or plugged in such a manner as to avoid injury or pollution.*

By signing this well report, I certify that I drilled or supervised the drilling of this well and that each and all of the statements herein are true and correct.

| Company & Individual's Name: (type or print) | | Lic. No.: | |
|---|---|---|---|
| | Tierra Drilling & Env.Svc.Inc. | | 2994A |
| Address: 5309 Mace St. Ste.A1 | City: El Paso | State: Texas | Zip 79932 |
| Signature: John P. McBuffee | 12/08/06 | Signature: | |
| Licensed Driller/Pump Installer | Date | Apprentice | Apprentice Reg. Number |

TDLR FORM 001WWD / 2-06 TDLR (Original) Landowner (copy) Driller/Pump Installer (copy)

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

# Texas Department of Licensing and Regulation

Water Well Driller/Pump Installer Section
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Toll free (800)803-9202
Email address: water.well@license.state.tx.us Web address: www.license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

## WELL REPORT

### A. WELL IDENTIFICATION AND LOCATION DATA

**1) OWNER**

| Name: | Address: | City: | State: | Zip: |
|---|---|---|---|---|
| The City of El Paso Texas | 2 Civic Center Plaza | El Paso | Texas | 79901 |

**2) WELL LOCATION**

| Well # or # of wells drilled | County: | Physical Address: | City: |
|---|---|---|---|
| PV6B | El Paso | 13600 McCombs | El Paso/79934 |
| | Lat. 106° 24.843' | Long. 31° 59.380' | Grid # 49-05-3 |

3) Type of Work: ☒ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening

4) Proposed Use (check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Extraction ☐ Industrial ☐ Irrigation ☐ Injection ☐ Closed-Loop Geothermal ☐ De-watering ☐ Testwell ☐ Rig Supply ☐ Stock ☐ Public Supply – If Public Supply, were plans approved? ☐ Yes ☐ No

5) NT: 0

6) Drilling Date: Started 11/ 10 /06 Completed 11/ 15 /06

Diameter of Hole

| Dia.(in) | From (ft) | To (ft) |
|---|---|---|
| | Surface | |
| 7 | 0 | 60 |
| | | |

7) Drilling Method (check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☒ Hollow Stem Auger ☐ Reverse Circulation ☐ Other

| From (ft) | To (ft) | Description and color of formation material |
|---|---|---|
| 0 | 2 | Sand, brown, dry. |
| 2 | 60 | Land-fill trash. |

(Use reverse side of Well Owner's copy, If necessary)

8) Borehole Completion ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☒ Gravel Packed ☐ Other

Gravel packed interval from: 6 ft. to: 58 ft. Size: 3/8"

Casing, Blank Pipe, and Well Screen Data

| Dia. (in.) | New Or Used | Steel, Plastic, etc. Perf., Slotted, etc Screen Mfg., if commercial | Setting (ft) From | Setting (ft) To | Gage Casing Screen |
|---|---|---|---|---|---|
| 4 | New | PVC Casing, | ±8 | 8 | Blk. |
| 4 | New | PVC Screen, MFG. | 8 | 58 | 0.01 |
| | | | | | |

9) Annular Seal Data: i.e. (from 0 ft to 100 ft #sacks & material 13 cement)
from 0 ft. to 3 ft. #sacks & material 1sk/cmt
from 3 ft. to 6 ft. #sacks & material 2sk/Bent
from ____ ft. to ____ ft. #sacks & material chip
Method Used poured Performed By Tierra
Distance to septic field or other concentrated contamination 0 ft.
Distance to Property Line 125ft Method Tape
Verified: JPM

13) Plugged ☐ Well plugged within 48 hours N/A
Casing left in well: Cement/Bentonite placed in well:

| From (ft) | To (ft) | From (ft) | To (ft) | #Sacks & Material used |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

10) Surface Completion (If steel cased, leave blank)
☐ Surface Slab Installed ☒ Surface Sleeve Installed
☐ Pitless Adapter Used ☐ Alternative Procedure Used

14) Type Pump N/A
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other
Depth to pump bowls, cylinder, jet etc., ____ ft.

11) Water Level N/A
Static level ____ ft. Date: / /
Artesian Flow ____ gpm

12) Packers: N/A

| Type | Depth | Type | Depth |
|---|---|---|---|
| | | | |
| | | | |

15) Water Test N/A
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

16) Water Quality
Type of water N/A Depth of Strata: ____ Was a chemical analysis made? ☐ Yes ☒ No
Did you knowingly penetrate a strata which contains undesirable constituents? ☒ Yes ☐ No If yes, Continue:
Check One: ☐ Naturally poor-quality groundwater – type ____ ☒ Hydrocarbons (i.e. gas, oil, etc.)
☐ Hazardous material/waste contamination encountered ☐ Other (describe) ____

☒ *I certify that while drilling, deepening, or otherwise altering the above described well, undesirable water or constituents was encountered and the landowner was informed that such well must be completed or plugged in such a manner as to avoid injury or pollution.*

By signing this well report, I certify that I drilled or supervised the drilling of this well and that each and all of the statements herein are true and correct.

| Company & Individual's Name: (type or print) | | Lic. No.: |
|---|---|---|
| | Tierra Drilling & Env.Svc.Inc. | 2994A |

| Address: | City: | State: | Zip |
|---|---|---|---|
| 5309 Mace St. Ste.A1 | El Paso | Texas | 79932 |

| Signature: | Date | Signature: | |
|---|---|---|---|
| John P. McDuffee | 12/08/06 | | |
| Licensed Driller/Pump Installer | | Apprentice | Apprentice Reg. Number |

TDLR FORM 001WWD / 2-06 TDLR (Original) Landowner (copy) Driller/Pump Installer (copy)

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

# Texas Department of Licensing and Regulation

Water Well Driller/Pump Installer Section
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Toll free (800)803-9202
Email address: water.well@license.state.tx.us Web address: www.license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

## WELL REPORT

### A. WELL IDENTIFICATION AND LOCATION DATA

**1) OWNER**

| Name: | Address: | City: | State: | Zip: |
|---|---|---|---|---|
| The City of El Paso Texas | 2 Civic Center Plaza | El Paso | Texas | 79901 |

**2) WELL LOCATION**

| Well # or # of wells drilled | County: | Physical Address: | City: |
|---|---|---|---|
| PV7 | El Paso | 13600 McCombs | El Paso/79934 |

| Lat. | Long. | Grid # |
|---|---|---|
| 106° 24.843' | 31° 59.380' | 49-05-3 |

**3) Type of Work**
☒ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening

**4) Proposed Use (check)** ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Extraction ☐ Industrial ☐ Irrigation ☐ Injection ☐ Closed-Loop Geothermal ☐ De-watering ☐ Testwell ☐ Rig Supply ☐ Stock ☐ Public Supply – If Public Supply, were plans approved? ☐ Yes ☐ No

**5)** NT 0

**6) Drilling Date**
Started 11/ 13 /06
Completed 11/ 15 /06

**Diameter of Hole**

| Dia.(in) | From (ft) | To (ft) |
|---|---|---|
| 7 | Surface 0 | 60 |
| | | |
| | | |

**7) Drilling Method (check)**
☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☒ Hollow Stem Auger ☐ Reverse Circulation ☐ Other

| From (ft) | To (ft) | Description and color of formation material |
|---|---|---|
| 0 | 2 | Sand, brown, dry. |
| 2 | 51 | Land-fill trash. |
| 51 | 60 | Sand, brown, dry. |

(Use reverse side of Well Owner's copy, If necessary)

**8) Borehole Completion** ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☒ Gravel Packed ☐ Other
Gravel packed interval from: 4 ft. to: 51 ft. Size: 3/8"

**Casing, Blank Pipe, and Well Screen Data**

| Dia. (in.) | New Or Used | Steel, Plastic, etc. Perf., Slotted, etc Screen Mfg., if commercial | Setting (ft) From | Setting (ft) To | Gage Casing Screen |
|---|---|---|---|---|---|
| 4 | New | PVC Casing, | +8 | 6 | Blk. |
| 4 | New | PVC Screen, MFG. | 6 | 51 | 0.01 |
| | | | | | |
| | | | | | |

**9) Annular Seal Data:** i.e. *(from 0 ft to 100 ft #sacks & material 13 cement)*
from 0 ft. to 1 ft. #sacks & material 1sk/cmt
from 1 ft. to 4 ft. #sacks & material 2sk/Bent
from ____ ft. to ____ ft. #sacks & material chip
Method Used poured Performed By Tierra
Distance to septic field or other concentrated contamination 0 ft.
Distance to Property Line 125 ft Method Tape
Verified: JPM

**10) Surface Completion** (If steel cased, leave blank)
☐ Surface Slab Installed ☒ Surface Sleeve Installed ☐ Pitless Adapter Used ☐ Alternative Procedure Used

**11) Water Level** N/A
Static level ____ ft. Date: / /
Artesian Flow ____ gpm

**12) Packers:** N/A

| Type | Depth | Type | Depth |
|---|---|---|---|
| | | | |
| | | | |

**13) Plugged** ☐ Well plugged within 48 hours N/A
Casing left in well: Cement/Bentonite placed in well:

| From (ft) | To (ft) | From (ft) | To (ft) | # Sacks & Material used |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

**14) Type Pump** N/A
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other
Depth to pump bowls, cylinder, jet etc., ____ ft.

**15) Water Test** N/A
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ____ gpm with ____ ft. drawdown after ____ hrs.

**16) Water Quality**
Type of water N/A Depth of Strata: ____ Was a chemical analysis made? ☐ Yes ☒ No
Did you knowingly penetrate a strata which contains undesirable constituents? ☒ Yes ☐ No If yes, Continue:
Check One: ☐ Naturally poor-quality groundwater – type ____ ☒ Hydrocarbons (i.e. gas, oil, etc.) ☐ Hazardous material/waste contamination encountered ☐ Other (describe) ____

☒ *I certify that while drilling, deepening, or otherwise altering the above described well, undesirable water or constituents was encountered and the landowner was informed that such well must be completed or plugged in such a manner as to avoid injury or pollution.*

By signing this well report, I certify that I drilled or supervised the drilling of this well and that each and all of the statements herein are true and correct.

| Company & Individual's Name: (type or print) | | Lic. No.: |
|---|---|---|
| | Tierra Drilling & Env.Svc.Inc. | 2994A |

| Address: | City: | State: | Zip |
|---|---|---|---|
| 5309 Mace St. Ste.A1 | El Paso | Texas | 79932 |

| Signature: Licensed Driller/Pump Installer | Date | Signature: Apprentice | Apprentice Reg. Number |
|---|---|---|---|
| John McDuffee | 12/08/06 | | |

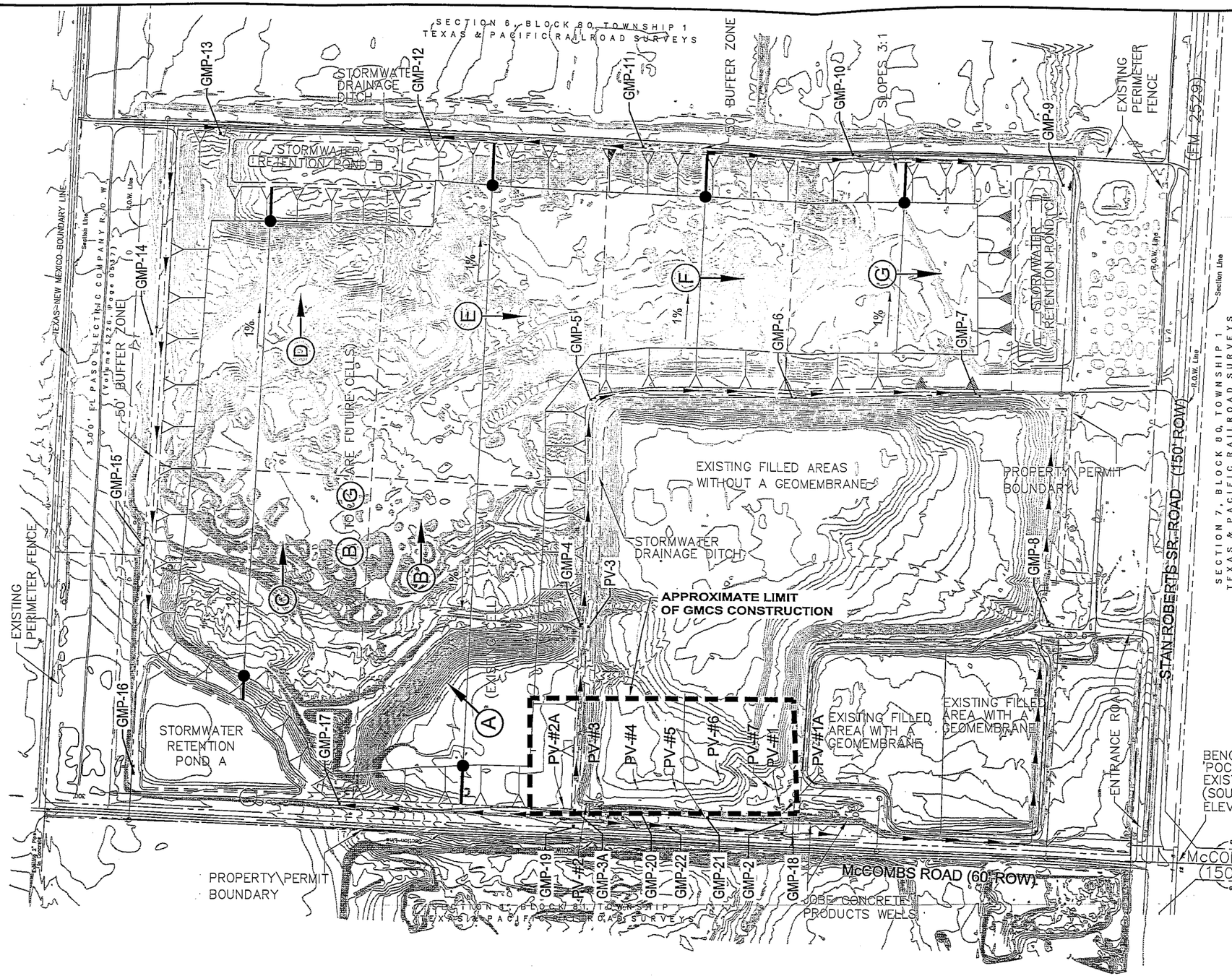
TDLR FORM 001WWD / 2-06 *TDLR (Original)* *Landowner (copy)* *Driller/Pump Installer (copy)*

# PART III SITE DEVELOPMENT PLAN
# ATTACHMENT 14 – LGMP

## APPENDIX 14-G

## LANDFILL GAS MIGRATION CONTROL SYSTEM (GMCS) ALONG WESTERN PERIMETER

## (Added April 3, 2009)




## LEGEND

- PROPERTY\PERMIT BOUNDARY
- CELL BOUNDARY
- SECTOR BOUNDARY
- LEACHATE COLLECTION PIPE
- CELL FLOOR
- EXISTING PERIMETER FENCE
- STORMWATER DRAINAGE DITCH AND FLOW DIRECTION
- GMP-9 — EXISTING GAS MONITORING PROBE (GMP)
- (A) — SECTOR DENOMINATION AND FILL DIRECTION
- 1% — DIRECTION AND GRADE OF LEACHATE COLLECTION PIPE
- LEACHATE SUMP AND EXTRACTION PIPE
- PV-2 — PASSIVE VENTING (PV) WELL
- ROW — RIGHT-OF-WAY

## SITE PLAN

250 125 0 250 500

SCALE IN FEET

## NOTES

1. DIGITIZED TOPOGRAPHY FROM SURVEY DATED FEBRUARY 4, 2007 BY GEODETIX. DATUM NAVD88.
2. CONTOUR INTERVAL IS 2 FEET.
3. SITE TOPOGRAPHY MAY VARY DUE TO OWNER OPERATIONS.
4. GMP 20 TO 22 ARE TEMPORARY GAS MONITORING PROBES.

STATE OF TEXAS
CHARLES W. LEUNG
85301
LICENSED
PROFESSIONAL ENGINEER
April 3, 2008

FOR PERMITTING ONLY

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| DESIGNED | JM/CL |
|---|---|
| CHECKED | CL |
| APPROVED | CL |
| DRAWN | SS |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 1 | 11-08 | CL | CL | ADDED NOTE 4. |
| 1 | 11-08 | CL | CL | ADDED BACK PV-#1A AND PV-#2A, PREVIOUSLY OMITTED. |

THE CITY OF EL PASO TEXAS

R.W. Beck, Inc.
4975 Preston Park Blvd., SUITE 850
Plano, TX 75093
(972) 372-1200

CITY OF EL PASO, TEXAS
McCOMBS LANDFILL ACTIVE LFG MIGRATION CONTROL SYSTEM (WESTERN PERIMETER)

**SITE PLAN**

PROJECT NUMBER: 15-002180-01000
SHT. OF:
DRAWING NUMBER: FIGURE 14G-1

asborne Nov 26, 2008 - 1:28pm - R:\Seattle\McCombs\LFG\McCombs LFG Migration CAD\Permit\FIGURE14G-1_recover.dwg

## NOTES

1. DIGITIZED TOPOGRAPHY FROM SURVEY DATED FEBRUARY 4th, 2007 BY GEODETIX.
2. CONTOUR INTERVAL IS 2 FEET.
3. SITE TOPOGRAPHY MAY VARY DUE TO OWNER OPERATIONS.
4. PROPOSED LOCATION OF BLOWER FLARE STATION MAY CHANGE DUE TO FIELD CONDITIONS.

CELL BOUNDARY
APPROXIMATE LIMIT OF GMCS CONSTRUCTION
GRADING MODIFICATION
PASSIVE VENT-RETROFIT-DETAIL (TYP.)
LFG HEADER PIPE ANCHOR (TYP.)
APPROX LOCATION OF PROPOSED BLOWER FLARE STATION
4" SDR 17 HDPE ABOVE-GRADE LATERAL PIPING (TYP.)
8" SDR 17 HDPE HEADER PIPING (ABOVE-GRADE)
CONDENSATE STORAGE TANK
DUAL-CONTAINED CONDENSATE SUMP
FUTURE LFG EXTRACTION WELLS (IF NEEDED) (TYP.)
McCOMBS ROAD (60' ROW)
PROPERTY/PERMIT BOUNDARY
EXISTING PASSIVE VENT DETAIL (TYP.) — 1 / D-1
HEADER TERMINATION DETAIL — 4 / D-2
PV-1
PV-2
PV-3
PV-4
PV-5
PV-6
PV-7
GMP-19
GMP-3
GMP-20
GMP-22
GMP-21
GMP-2
GMP-18
SECTION 1, BLOCK 81, TOWNSHIP 1
TEXAS & PACIFIC RAILROAD SURVEYS

LAYOUT OF ACTIVE LFG MIGRATION CONTROL SYSTEM

50 25 0 50 100
SCALE IN FEET

STATE OF TEXAS
CHARLES W. LEUNG
85301
LICENSED
PROFESSIONAL ENGINEER
April 3, 2009

FOR PERMITTING ONLY

druppharen Aug 26, 2008 - 10:12am - R:\Seattle\McCombs\LFG\McCombs LFG Migration CAD-DoNotUse\Permit\FIGURE14G-2.dwg

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| | |
|---|---|
| DESIGNED | JM/CL |
| CHECKED | CL |
| APPROVED | CL |
| DRAWN | SS |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 1 | 7-08 | CL | CL | - |

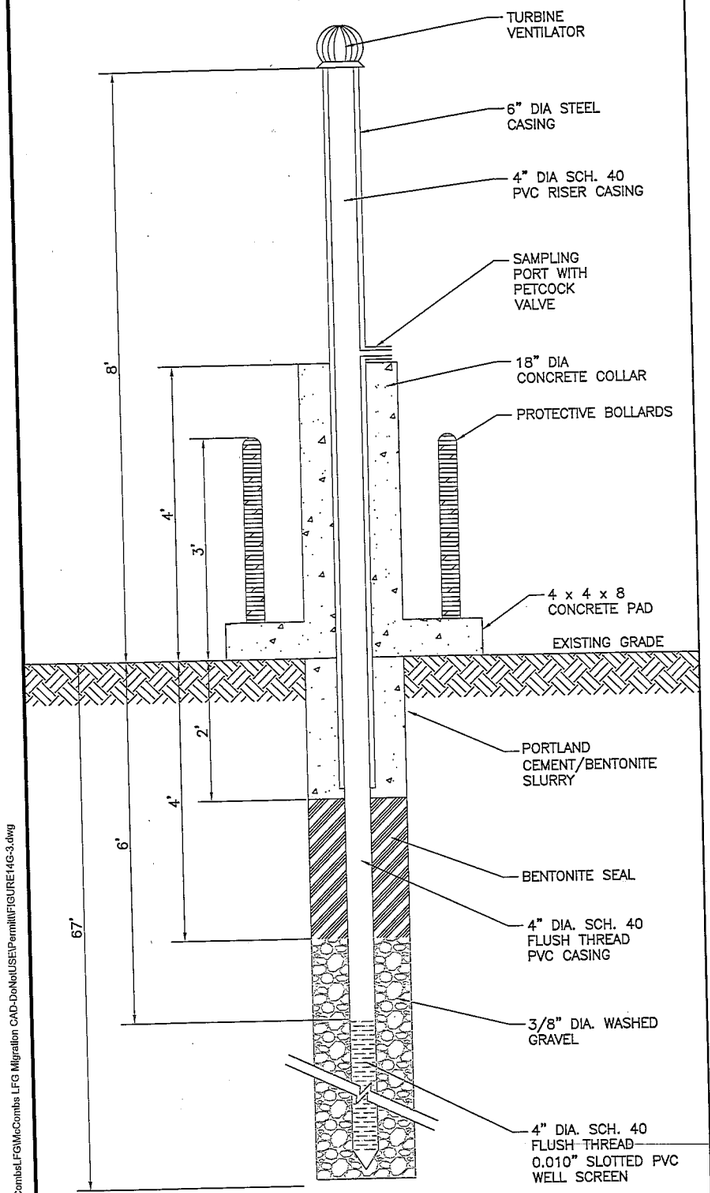
THE CITY OF EL PASO TEXAS

R·W·BECK
R.W. Beck, Inc.
1300 East Lookout Drive, Suite 145
Richardson, TX 75082
(972) 994-0300

CITY OF EL PASO, TEXAS
McCOMBS LANDFILL ACTIVE LFG MIGRATION CONTROL SYSTEM (WESTERN PERIMETER)

LAYOUT OF ACTIVE LFG
MIGRATION CONTROL SYSTEM (GMCS)

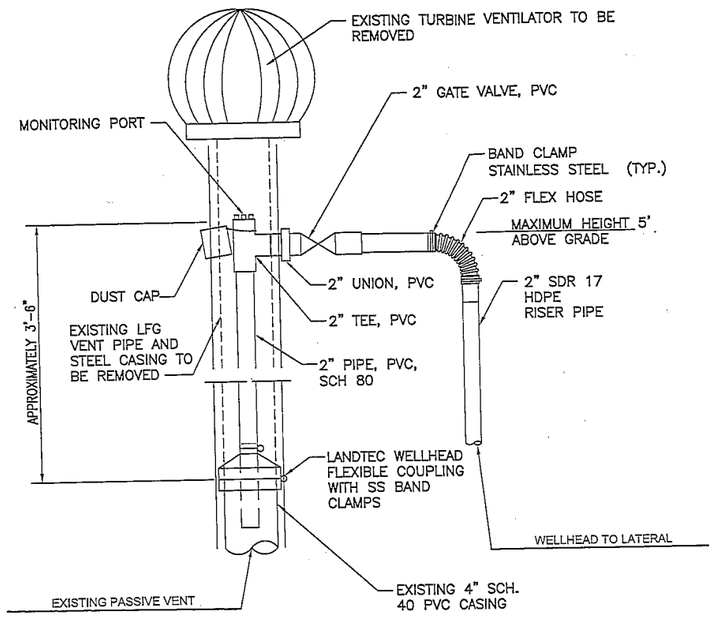
| | |
|---|---|
| PROJECT NUMBER: | 15-002180-01000 |
| SHT. | OF: - |
| DRAWING NUMBER: | Figure 14G-2 |




EXISTING PASSIVE VENT DETAIL

NOTES:

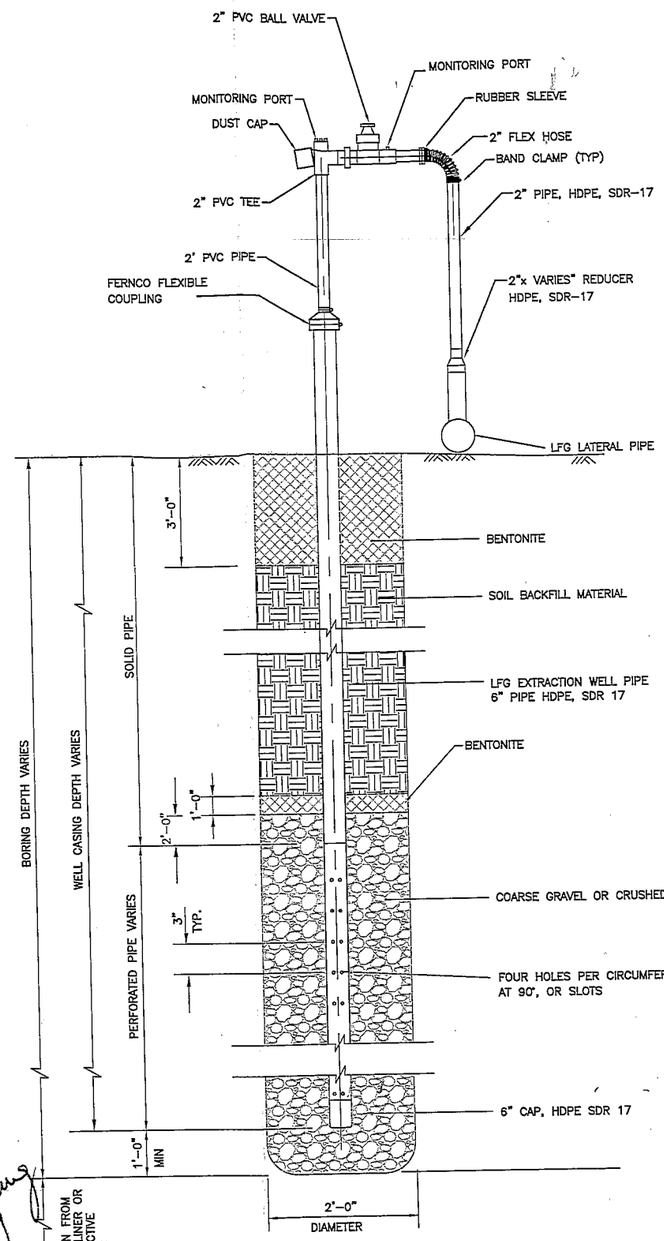
1. EXISTING DETAIL REPRODUCED WITHOUT MODIFICATION FROM CITY OF EL PASO DOCUMENTATION.




NOTES:

1. WELLHEAD ILLUSTRATED IS 2" LANDTEC ACCU-FLO WELLHEAD OR EQUIVALENT.
2. ALL PIPE SIZES AND DIMENSIONS ARE APPROXIMATE.
3. REMOVED MATERIAL AND EQUIPMENT TO BE RETURNED TO OWNER IN EXISTING CONDITION.

PASSIVE VENT-RETROFIT DETAIL
TYPICAL
NTS




TYPICAL FUTURE LFG EXTRACTION WELL DETAIL (IF NEEDED)
NTS

STATE OF TEXAS
CHARLES W. LEUNG
85301
LICENSED PROFESSIONAL ENGINEER
April 3, 2009

FOR PERMITTING ONLY

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 1 | 7-08 | CL | CL | - |

DESIGNED JM/CL
CHECKED CL
APPROVED CL
DRAWN SS

THE CITY OF EL PASO, TEXAS

R.W. Beck, Inc.
1300 East Lookout Drive, Suite 145
Richardson, TX 75082
(972) 994-0300

CITY OF EL PASO, TEXAS
McCOMBS LANDFILL ACTIVE LFG MIGRATION CONTROL SYSTEM (WESTERN PERIMETER)

TYPICAL GMCS DETAILS

PROJECT NUMBER: 15-002180-01000
SHT. OF: -
DRAWING NUMBER: Figure 14G-3

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dnupcharoon Aug 26, 2008 - 10:16am - R:\Seattle\McCombs\LFG\McCombs LFG Migration CAD-DoNotUSE\Permit\FIGURE14G-3.dwg

# LANDFILL GAS MANAGEMENT PLAN

## McCombs Landfill
## El Paso, Texas
## Modification to Permit 729A

*Prepared for:*

City of El Paso
Public Works Department
2 Civic Center Plaza
El Paso, Texas 79901

*And:*

Texas Natural Resource Conservation Commission
Municipal Solid Waste Division
Austin, Texas

*Prepared by:*

VIVA Environmental, Inc.
7201 Stiles Drive
El Paso, Texas 79901

November 27, 2001

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4 HYDROGEOLOGY ..... 3

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## EXECUTIVE SUMMARY

The McCombs Municipal Solid Waste Landfill (Permit No. 729A), located at 13600 McCombs Road, El Paso, Texas, requires a Landfill Gas Management Plan in accordance with 30 Texas Administrative Code (TAC) 330.56 (relating to Municipal Solid Waste Permit Procedures). The McCombs Landfill accepts approximately 100,000 tons of solid waste per year (R. Dominguez, 2001). The Landfill is permitted to accept municipal solid wastes from households and any Class II non-hazardous material, as defined by the Texas Natural Resource Conservation Commission (TNRCC). The landfill will not accept any industrial Class I hazardous, radioactive, or liquid wastes.

The permanent Site Perimeter Methane Monitoring Network consists of fourteen (14) Gas Monitoring Probes) spaced approximately 1,000 feet apart. The GMPs were installed along the property boundary. The locations of each GMP are shown in Appendix A-2. The GMPs were placed at depths of 55 feet except for GMP-7 (depth of 10 feet). The depth of each GMP was based on existing excavation depth or expected future depth of excavation below ground surface (bgs). To date, no waste has been placed in the northern or eastern portion of the landfill site. The City plans to use this area for future land filling activities. Future landfill depths may reach 55 feet bgs. Please note that the Proposed Site Perimeter Methane Monitoring Plan includes GMP-1 through GMP-3 and GMP-7 through GMP-17. GMP-4, GMP-5, and GMP-6 were installed around the initial permitted area and are not expected to be part of the permanent Site Perimeter Monitoring Network.

Borings for GMP-1 through GMP-8 were advanced with a truck-mounted, hollow stem auger drilling-rig with 10 inch diameter augers (See Gas Management Plan by SHB AGRA, Inc., April 8, 1994). The soil encountered during the installation of each boring was continuously examined, visually classified and logged in accordance with American Standard of Testing Materials (ASTM) D2488. Borings for GMP-9 through GMP-17 were also installed using a truck-mounted, hollow stem auger drilling-rig with 10 inch diameter augers in October 2001

Three passive venting wells (PV-1, PV-2, and PV-3) have been installed to depths of 55 to 60 feet bgs. The objective for the construction of these passive venting wells at these depths is to capture the methane gas being generated at previously detected elevations. The locations of these passive venting wells are shown in Appendix A-2. Locations and elevations of all GMPs were determined by a registered land surveyor.

The City of El Paso personnel shall collect methane readings at each GMP on a quarterly basis in accordance with TNRCC regulations and guidelines. Each gas monitoring probe shall be inspected for damage on a regular basis. The gas monitoring probes shall be checked for methane gas pressure, temperature, and concentration. Barometric pressure and ambient temperature shall

also be recorded. A copy of quarterly sampling results shall be kept in the operating record and maintained on-site for inspection.

If measured methane levels at the landfill GMPs are in excess of the LEL, or in excess of 25% of the LEL in facility structures, the City of El Paso shall report the results to the TNRCC. The City of El Paso shall also provide written notification to the TNRCC, and take other steps in accordance with the Municipal Solid Waste Landfill Gas Reporting and Corrective Action Procedures outlined in the May 14, 1999 letter from the TNRCC.

## 1 INTRODUCTION

Site Development Plans for Municipal Solid Waste Landfills (MSWL) shall contain a Landfill Gas Management Plan in accordance with 30 TAC §§330.56 (relating to Municipal Solid Waste Permit Procedures). This document should describe how gases at the McCombs landfill shall be managed and controlled. It also should include a description of the current monitoring and sampling equipment; a GMP location survey; GMP monitoring and maintenance. It should also include recordkeeping procedures; and a contingency plan in accordance with the Municipal Solid Waste Landfill Gas Reporting and Corrective Action Procedures outlined in the May 14, 1999 letter from the TNRCC.

## 2 SITE SPECIFIC DESCRIPTION

The McCombs Landfill (Permit No. 729A) is located at 13600 McCombs Road, El Paso, Texas approximately 20 miles northeast of downtown El Paso (Appendix A-1). The site encompasses over 300 acres, of which approximately 100 acres have been landfilled. El Paso Water Utilities owns and operates a sludge monofill to the west of the site. The area to the north, south and east of the landfill boundary site is mostly agricultural. Structures are located to the northeast of the property boundary; however they are more than 1,000 feet away from the existing landfilled area.

The general layout of the facility is shown in Appendix A-2. The southeast section of the landfilled boundary (Phase I, Phase II, and Phase III) is an apparent old landfill cell. This area was first permitted to receive solid waste by the Texas Department of Health (TDH) on August 17, 1976 (Permit No. 729). The initial permit was later incorporated in a 327 acre permit (Permit No. 729-A, dated May 30, 1984) (AGRA, 1994). The area north (Phase I, Appendix A-2) of the closed cell is an area that was used for initial placement of waste under Permit No. 729. According to City records, the closed cells were used for waste disposal during the 1960's. The waste in this area was apparently placed at or near the ground surface. Little or no excavation was performed during the time these two cells were utilized. Based on the information available, the bottom of the waste in these areas is estimated at less than five feet below the surrounding natural land surface (Borrego, 1994). The western half of the operational area (Phase III) was developed as a quarry, with excavations extending down to depths of approximately 50 to 55 feet

below the surrounding land surface (AGRA, 1994). The current phase of landfilling is confined to the southwest (Phase II) quadrant of the operational area. Excavations of the southwest of the operational area extend down to depths of 65 feet below the surface (Borrego, 2000). To date no waste has been placed in the northern property boundary, eastern property boundary, and northern portion of the western property boundary. The City is planning to use this area for future land filling activities with assumed landfill depths of 55 feet bgs.

On-site enclosed structures located adjacent to the McCombs MSWL waste deposal areas include the fee collection building, the lunch room, southern storage building and northern storage building.

## 3 SOILS AND THE GEOLOGY

The site lies within the Rio Grande rift which starts in central Colorado's Rocky Mountains and runs southward through Colorado and New Mexico into the Mexican State of Chihuahua. The rift was formed where a section arched, weakened, and spread apart. Two major extensions have formed the Rio Grande rift. The first extensive episode occurred in late Oligocene to early Miocene time. The second extensive episode was the mid-Miocene to Quaternary phase. The rift first developed as chain of closed basins that gradually filled with lava, ash flows and sediments that washed in from the mountain ranges. The broad intermountain basins with internal drianage are called bolsons.

The area of the site is located at the northern part of the Trans-Pecos Texas region directly south of the Texas New Mexico boundary. The site is bordered by two mountain ranges, the Franklin Mountains to the west and the Hueco Mountains to east. This basin is subdivided into the Hueco Bolson and Rio Grande Valley subsections of the Quaternary system. The rock deposits that occupy these subsections are unconsolidated for considerable depths. The bolson deposits consist chiefly of gravel, sand and clay as outlined above from the disintegration of the rocks of the highlands. Some outcrops of deposits of caliche are encountered within a few feet of the surface in irregularly thickening and thinning deposits.

Soil investigations conducted at the site reveal sand or sandy clay covering with stratified deposits of sand, fine to coarse, with some silt and gravel. Some outcrops of caliche near the surface were found in some test borings. Based on the soils investigation, the soils are lenticular in nature across the site. The sands and gravels at the site are favorable for gas migration.

## 4 HYDROGEOLOGY

The regional groundwater in the area primarily consists of the Hueco Bolson aquifer. The Hueco Bolson aquifer has been divided into the City Artesian area, the Mesa area and the Lower Valley (Leggat, 1962). The McCombs Landfill is located in the Mesa area. This area is generally an unconfined aquifer which extends into New Mexico and east to the Hueco Mountains (AGRA, 1994). El Paso Water Utilities (EPWU) groundwater data indicate that the static groundwater

elevation in the McCombs area is between 3670 and 3675 feet above the mean sea level, or approximately 370 to 390 feet below groundwater surface (EPWU, 1993). Recharge of the aquifer occurs through mountain front infiltration of surface precipitation and injection of treated sewage from the Hueco Bolson Recharge Project (White and Sladek, 1990). Review of a United States Geographic Survey (USGS) topographic map indicates that no surface water was located at one half mile radius of the site.

## 5 CLIMATE

Tables with records of the extremes for temperatures, rainfall, snowfall, pressure, wind and relative humidity for the City of El Paso is included in Appendix B. This data was obtained from the National Weather Service for El Paso Area (http://www.srh.noaa.gov/elp/climat/recelp.html).

## 6 WASTE STREAM

The McCombs Landfill accepts approximately 100,000 tons of solid waste per year (R. Dominguez, 2001). The McCombs Landfill is permitted to accept municipal solid wastes from households and any Class II Non-Hazardous material. The landfill will not accept any industrial Class I hazardous, radioactive, or liquid wastes. The facility will only accept Class I (Non-Hazardous) waste upon specific prior written approval from the TNRCC. Any special waste received will be in strict compliance with the TNRCC Municipal Solid Waste Management (MSWM) regulations ensuring that non-allowable materials are eliminated from their waste streams including identification and classification of all special wastes prior to disposal. This classification requires the generator to state the characteristics, origin, and estimated quantity of the special waste proposed for disposal. Also, the generator must provide any other pertinent information regarding the waste that might aid in its identification. In some cases, as determined by the City of El Paso, this information may require sampling and analysis of representative samples. Each generator is required to re-certify every special waste they dispose of at this site at intervals not to exceed two years. Any hauler that cannot provide the necessary documentation and certification for special waste shall be refused entry into the facility (McCombs Site Operating Plan, 1999).

The following wastes are specifically excluded from the landfill site:

- Liquid wastes;
- Articles, equipment, and clothing containing or contaminated with polychlorinated biphenyls (PCBs);
- Contents from septic tanks;
- Grease/grit trap waste;
- Any wastes classified as hazardous by TNRCC;
- Waste oil, oil filters, batteries;
- Asbestos; and
- Non-stabilized sludge.

# 7 BASIS OF PROBE AND VENT PLACEMENT

In June 2000 two passive venting wells (PV-1 and PV-2) were installed in order to intercept and vent methane gas prior to reaching GMP-2 and GMP-3. One (1) venting well was installed approximately fifty (50) feet east of GMP-2, with the other venting well installed approximately fifty (50) feet south and thirty (30) feet east of GMP-3. Both venting wells were installed to a depth of approximately sixty (60) feet bgs in order to capture methane gas at depths where the majority of the elevated methane gas levels were detected and may be generated.

In 2001, one vertical passive venting well (PV-3) was installed to a depth of 55-feet below grade. The venting well was located approximately 10 feet south of GMP-4. Construction details for the Passive Venting Wells are included in Appendix D-1. The locations of the passive venting wells are shown in Appendix A-2.

The permanent Site Methane Monitoring Network consists of fourteen (14) GMPs spaced approximately 1,000 feet apart. The GMPs were installed along the permitted area and property boundary. A review of on-site geologic/soil data revealed little evidence of any laterally extensive stratographic units which could significantly influence migration of any gases produced within the landfill cells (AGRA, 1994). The locations of the GMPs are shown in Appendix A-2. Except for GMP-7 (10 feet deep), the GMPs depths are 55 feet. The depth of each GMP was based on the following information:

**Closed Cell Area:**

According to information provided by the City, the southeastern quadrant of the landfill was used for disposal of municipal solid waste in the early 1960's. Information available suggests that little excavating was performed; waste was placed on the surface of the ground and covered (Borrego, 1994). AGRA Earth and Environmental Group estimated that the depth of waste in this area extends less than 5 feet below the surrounding land surface. The top of this cell is approximately 15 feet above grade (AGRA, 1994). The cell is covered with silty sand.

**Phase II Area:**

Excavations southwest of the operational area extended to a depth of 65 feet below the surface (Borrego, 2000).

**Phase III Area:**

The western half of the operational area was developed as a quarry, with excavations extending down to depths of approximately 50 to 55 feet below the surrounding land surface (AGRA, 1994).

**Future Landfill Expansion Area:**

To date no waste has been placed in the northern property boundary, eastern property boundary, and northern portion of the western property boundary. The City is planning to use this area for future land filling activities. It is assumed landfill depths may reach 55 feet below the surface.

## 8 GAS MONITORING PROBE INSTALLATION

Gas Monitoring Probes 1 through 8

GMP-1 through GMP-8 were installed by a licensed monitor well driller. All drilling and probe placement operations were performed under the direction of an experienced geologist. During the placement of the probes, the soil encountered was continuously examined, visually classified and logged in accordance with the methods specified in D2488-84 (Standard Practice for Description and Identification of Soils -Visual-Manual Procedure). Drilling operations were continuously monitored for explosive gases using a methane monitor and explosivity meter. Results of the field monitoring were recorded on the field logs (AGRA, 1994).

Gas Monitoring Probes 9 Through 17 (VIVA, 2001)

JEDI Drilling Contractors, Inc. was sub-contracted by VIVA Environmental, Inc. to install GMP- 9 through GMP-17. Paul Daniloff, (Texas Drillers License number 4931-M) and more than 13 years of geotechnical experience, was the drilling supervisor. Soil borings were advanced with a truck-mounted, hollow-stem auger drilling-rig with 10-inch outside diameter augers. Soil samples were collected continuously from the ground surface to the total depth of investigation with a five foot long continuous core sampler. After reaching the soil boring total depth, the inner rod of the augers was removed and completion of monitoring probe procedures was accomplished. Samples, were lithologically logged according to the ASTM Standard D2488 by Mark Weatherly, Project Geologist. Borings logs and well reports are attached in Appendices C-1 and C-2.

## 9 GAS MONITORING PROBE DESIGN

Gas Monitoring Probes 9 Through 17 (VIVA, 2001):

Monitoring probes were constructed in clusters of three, with one monitoring probe (Probe C) set at a total depth of 55 feet below grade, one monitoring probe (Probe B) set at a total depth of 30 feet below grade, and one monitoring probe (Probe A) set at a total depth of 10 feet below grade (See Appendix C-2). Each cluster was completed as follows:

Monitoring Probe C:

Five feet of 0.010-inch vertical slotted 1-inch diameter, flush-threaded, Schedule 40 PVC screen and 53 feet of 1-inch diameter, flush-threaded, Schedule 40 PVC casing were installed in the borehole. Upon completion of well casing and screen installation, medium grade silica sand was placed in the annular space between the well casing and screen and the hollow-stem augers to a height of approximately two feet above the screened interval. Concurrent with silica sand installation, the augers were removed. This procedure ensured that the silica sand was appropriately placed during monitoring probe completion. Approximately 18 feet of 1/2-inch bentonite chips were placed above the silica sand and hydrated with distilled water.

Monitoring Probe B:

Five feet of 0.010-inch vertical slotted 1-inch diameter, flush-threaded, Schedule 40 PVC screen and 28 feet of 1-inch diameter flush-treaded, Schedule 40 casing was installed in the borehole. Upon completion of well casing and screen installation, medium grade silica sand was placed in the annular space between the well casing and screen and the hollow-stem augers to a height of approximately two feet above the screened interval. Concurrent with silica sand installation, the augers were removed. This procedure ensured that the silica sand was appropriately placed during monitoring probe completion. Approximately 13 feet of 1/2-inch bentonite chips were placed above the silica sand and hydrated with distilled water.

Monitoring Probe A:

Three feet of 0.010-inch vertical slotted 1-inch diameter, flush-threaded, Schedule 40 PVC screen and 10 feet of 1-inch diameter flush-treaded, Schedule 40 casing was installed within the borehole. Upon completion of well casing and screen installation, medium grade silica sand was placed in the annular space between the well casing and screen and the hollow-stem augers to a height of approximately two feet above the screened interval. Concurrent with silica sand installation, the augers were removed. This procedure ensured that the silica sand was

appropriately placed during monitoring probe completion. Approximately two feet of 1/2-inch bentonite chips were placed above the silica sand and hydrated with distilled water.

From the top layer of bentonite to ground surface, the annular spaces were filled with cement/bentonite grout. The surface completion of the well consists of a 12-inch diameter, Schedule 40 steel protective casing extending from ground surface to approximately three feet above grade and fitted with a steel cover. The steel casings were mounted within a 4 feet wide by 4 feet long by 4-inch thick concrete pad. Pipe bollards were installed at each corner of the surface pad. Construction details for GMPs 9 through 17 are shown in Appendix D-2.

Gas Monitoring Probes 1 through 8 (AGRA, 1994):

GMP-1 through 8 were placed at locations specified in the Site Development Plan. Borings were advanced with a hollow steam-auger with a minimum diameter of ten inches to the specified depths. Boreholes were advanced to at least two feet below the elevation of the deepest probe (AGRA,1994).

One inch diameter schedule 80 polyvinil (PVC) casing was placed through the annulus of the auger to the depths specifed in Table 1. The PVC was perforated with 1/8 inch diameter holes over the lower 3 to 5 feet from the casing prior to installation to attain the screened intervals specified in Table 1 of the Landfill Gas Management Plan, SHB AGRA, Inc. (April 8, 1994). The remainder of the probes length consists of blank PVC with threaded couplings. A petcock valve was cemented to the top of each probe suitable for gas monitoring purposes. The probe was placed at the end. All materials were approved by the project engineer prior to the installation (AGRA, 1994).

After the probes were inserted in the auger to the proper depth, the annular space surrounding the deep probe was filled with clean coarse and open graded sand/gravel pack to at least two feet above the screened interval. The lower sections of the auger were removed and a bentonite seal (minimum 5 feet) was placed in the boring. The seal was hydrated for a minimum of one hour (AGRA, 1994).

The borehole was then filled with sand to the depth of the intermediate probe. The intermediate probe was then introduced into the auger with the perforated interval set at the depth specified in Table 1 of the Landfill Gas Management Plan, SHB AGRA, Inc. (April 8, 1994). A gravel/sand pack and bentonite seal was then placed following the procedures specified above. The procedures were repeated for the shallow probe with the exeption that a minimum of five feet of bentonite was placed between the top of the perforated interval and the ground surface (AGRA, 1994).

Each probe was labeled with a permanent identification tag specifyng well number and probe depth (AGRA, 1994).

The nested probes were completed at the surface with a minimum of 3 feet by 3 feet wire mesh reinforced concrete slab and a protective steel casing. The concrete slab was finished to provide positive drainage away from the casing. The steel casings were painted with high visibility paint and were provided with a lock.

**Table 1 - GMP-1 Through GMP-8 Placement (AGRA, 1994)**

| Location Number | Depth of Waste in Nearest Cell | GMP Number | Screened Interval |
|---|---|---|---|
| 1 | NA | 1A | 7'-10' |
| | | 1B | 25'-30' |
| | | 1C | 50'-55' |
| 2 | 55' | 2A | 7'-10' |
| | | 2B | 25'-30' |
| | | 2C | 50'-55' |
| 3 | 55' | 3A | 7'-10' |
| | | 3B | 25'-30' |
| | | 3C | 50'-55' |
| 7 | 5' | 7A | 7'-10' |
| 8 | 5' to 55' | 8A | 7'-10' |
| | | 8B | 25'-30' |
| | | 8C | 50'-55' |

## 10 GAS MONITORING PROBE LOCATION SURVEY

As-built elevations and locations of all gas monitoring probes and passive venting wells were determined by a registered land surveyor. These data includes the horizontal location of each probe and elevation of the adjacent ground surface. The data is included in the site map and well placement locations, Appendix A-2 and in tabular form in Appendix A-3

## 11 GAS MONITORING PROBE INSPECTION AND MAINTENANCE

City of El Paso personnel shall collect methane readings on a quarterly basis in accordance with TNRCC regulations and guidelines. At the same time, each gas monitoring probe shall be inspected for any damage to identification number, protective barrier pipes, working pad, lock, and hinged cover. Any damage should be noted on the Quarterly Methane Inspection Form, Appendix E. Also, the top of the casing and fittings should be inspected for damage. Any damage shall be repaired immediately.

## 12 ENCLOSED STRUCTURE MONITORING

On-site enclosed structures located adjacent to waste deposit areas of the McCombs MSWL includes the southern storage building, northern storage building, the fee collection building and the lunch room for landfill employees. A smoke detector, with alarm, is installed in both locations (Dominguez, 2001). The scale house and lunch room buildings shall be monitored quarterly with a hand held gas meter at the base of each exterior wall, and ambient air.

## 13 MONITORING OF EASEMENT FOR BURIED UTILITIES

No major utilities are located within the perimeter area. Overhead lines provide electricity and telephone service to the buildings on-site. Consequently, monitoring or reporting of easement for buried utilities is not applicable.

## 14 SAMPLING EQUIPMENT

The City of El Paso uses a LANDTEC GA-90 gas analyzer as a data logging, field analyzer designed to monitor methane, carbon dioxide, and oxygen. Collected data is date & time stamped for as many as 1,200 stored readings. Data can also be downloaded to a personal computer. Additional features include adjustable alarms, unattended logging functions and flow fail alarm. The GA-90, Gas Analyzer, is designed for passive landfill gas monitoring for the following parameters:

Methane 0-50% accuracy ±1.9% or better
Oxygen 0-21% accuracy ±0.25% at 5%
Carbon Dioxide 0-50% accuracy ±3% or better
Static pressure ±0.15 in. Hg
Data storage up to 1,200 data sets

## 15 RECORD KEEPING

Appendix D includes installation specifications for gas monitoring probes and vent wells. Quarterly field sampling forms, evaluation forms, and reporting forms are included in Appendix E. The quarterly sampling results shall be placed in the site operating record and maintained on-site for inspection. If measured methane levels of the permitted landfill site are in excess of the LEL, or in excess of 25 percent of the LEL in facility structures, the City of El Paso must report the results to the TNRCC in accordance with Municipal Solid Waste Landfill Gas Reporting and Corrective Action Procedures outlined in a letter dated May 14, 1999 from the TNRCC.

## 16 MONITORING PROCEDURES

The gas monitoring probes shall be tested for the following parameters:

- Probe gas pressure;
- Probe gas temperature;
- Methane gas concentrations;
- Barometric pressure; and
- Ambient temperature.

A list of sampling procedures for monitoring probes is given below:

Preparatory Activities

1. Initiate field records;
2. Calibrate field meters; and
3. Review map of probe locations.

Gas Monitoring Probe Sampling Procedure

1. Perform monitoring probe maintenance check;
2. Determine pressure within sealed monitoring tube;
3. Make an initial explosive gas (percent methane) reading within sealed monitoring probe with the meter set on high range;
4. Make an explosive gas reading (percent methane) within sealed monitoring probe with the meter set on the low range if the initial reading was less than five percent; and
5. Record all technical data on the data sheet.

## 17 CONTINGENCY PLAN

If measured methane levels at the permitted landfill site are in excess of the LEL, or in excess of 25% of the LEL in facility structures, then the City of El Paso shall report the results to the TNRCC, provide written notifications, and take other steps in accordance with Municipal Solid Waste Landfill Gas Reporting and Corrective Action Procedures outlined in a letter from the TNRCC to landfill owners and operators, dated May 14, 1999. Daily follow-up verification readings must then be made for one week. If the follow-up readings suggest that there are explosive methane gas levels exceeding allowable limits, a gas sample will be collected for laboratory analysis and soil gas sampling will be conducted to determine the extent of gas migration beyond the permitted landfill facility. The TNRCC Enforcement Section shall be consulted for specific instructions.

Within seven days from the date of an initial reading above allowable levels, the owner shall submit to the Executive Director a report that includes the following:

- Information regarding the initial reading (date, location, measured and methane concentration);
- Description of immediate actions taken to protect human health; and
- Information regarding the notifications to the Executive Director, Regional Office, city, county, and local government officials and any residents within 1000 ft of the reading.

This report shall be placed in the site operating record. Within 60 days, the City of El Paso shall take the following actions:

- Submit to the Executive Director a report that describes the nature and extent of gas migration;
- Submit and implement a remediation plan; and
- Provide notification to the Executive Director that the remediation plan has been implemented.

All of the above records shall be placed in the site operating record.

## REFERENCES

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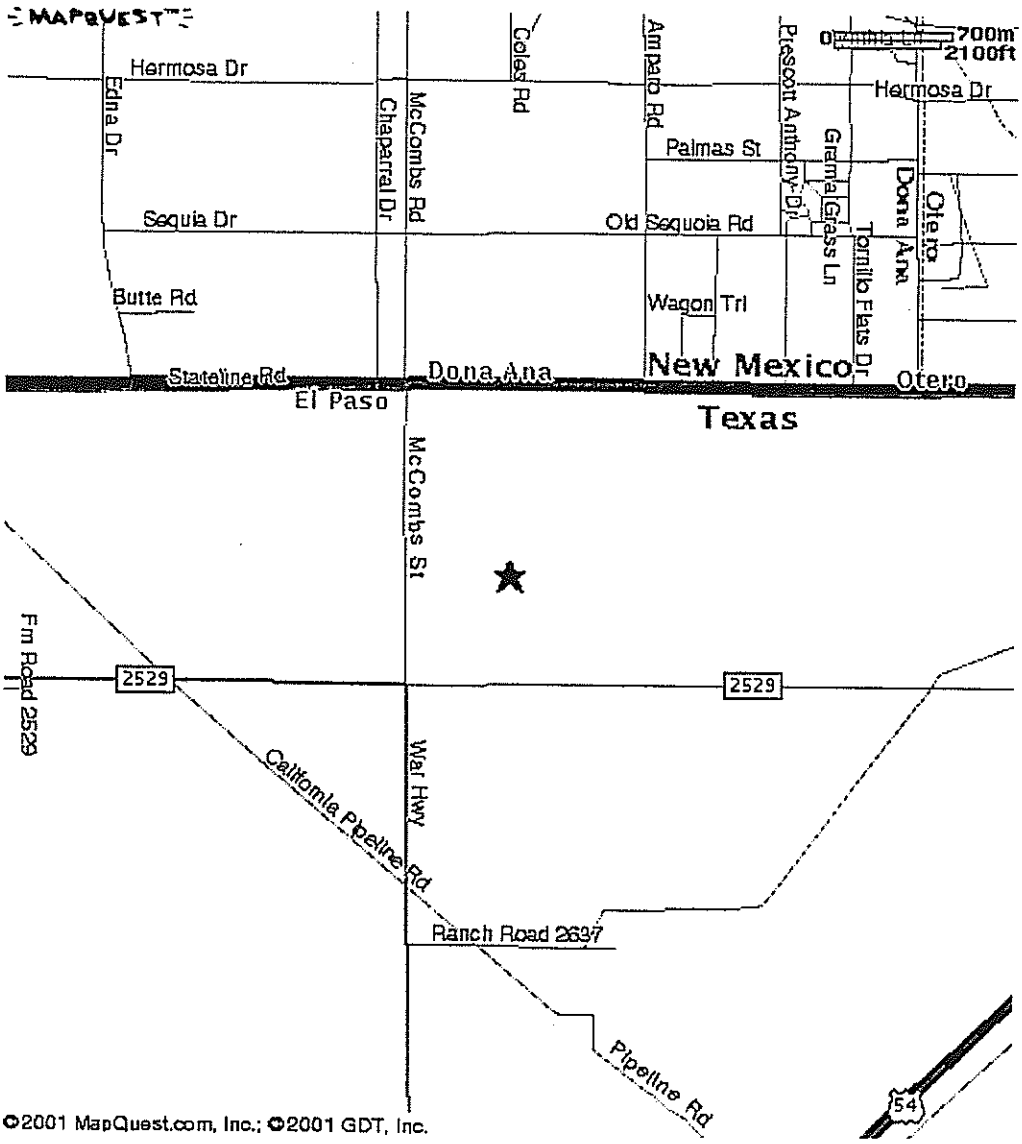
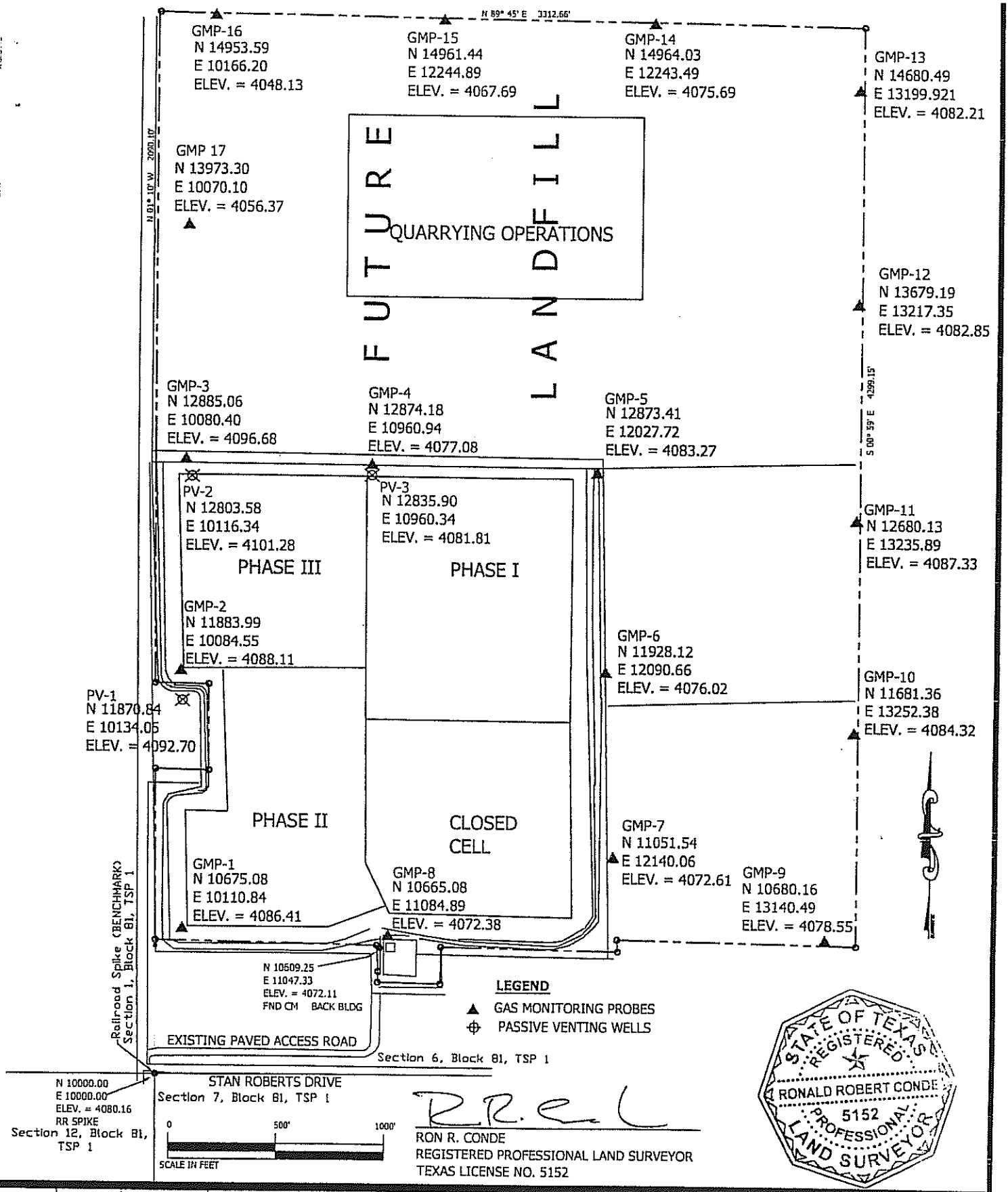



**Vicinity Map**

**13600 McCombs Rd.**
**El Paso, Texas 79934**

**Permit No. 729A**




RON R. CONDE
REGISTERED PROFESSIONAL LAND SURVEYOR
TEXAS LICENSE NO. 5152

| DRAWN BY: | REVIEWED BY: | APPROVED BY: | R.P.L.S. | JOB NO. | LOCATION: | DATE: |
|---|---|---|---|---|---|---|
| S. | E.O. | R.C. | RON R. CONDE | CITY .3.33.34 | Mc COMBS LANDFILL | 11/27/01 |

VIVA ENVIRONMENTAL, INC.
The Future Is Clean
7201 STILES EL PASO, TEXAS 79915

VIVA ENVIRONMENTAL, INC.
7201 STILES DR.
EL PASO, TX. 79915

LOCATION:
SITE MAP AND
WELL PLACEMENT LOCATIONS

DRAWING NO.
FIGURE 01

## HORIZONTAL LOCATIONS AND ELEVATIONS TABLE FOR GAS MONITORING PROBES AND PASSIVE VENTING WELLS

| Reference Point | North | East | Elevation |
|---|---|---|---|
| GMP-1 | 10675.08 | 10110.84 | 4086.41 |
| GMP-2 | 11883.99 | 10084.55 | 4088.11 |
| GMP-3 | 12885.06 | 10080.40 | 4096.68 |
| GMP-4 | 12874.18 | 10960.94 | 4077.08 |
| GMP-5 | 12873.41 | 12027.72 | 4083.27 |
| GMP-6 | 11928.12 | 12090.66 | 4076.02 |
| GMP-7 | 11051.54 | 12140.06 | 4072.61 |
| GMP-8 | 10665.08 | 11084.89 | 4072.38 |
| GMP-9 | 10680.16 | 13140.49 | 4078.55 |
| GMP-10 | 11681.36 | 13252.38 | 4084.32 |
| GMP-11 | 12680.13 | 13235.89 | 4087.33 |
| GMP-12 | 13679.19 | 13217.35 | 4082.85 |
| GMP-13 | 14680.49 | 13199.921 | 4082.21 |
| GMP-14 | 14964.03 | 12243.49 | 4075.69 |
| GMP-15 | 14961.44 | 12244.89 | 4067.69 |
| GMP-16 | 14953.59 | 10166.20 | 4048.13 |
| GMP-17 | 13973.30 | 10070.10 | 4056.37 |
| PV-1 | 11870.84 | 10134.05 | 4092.70 |
| PV-2 | 12803.58 | 10116.34 | 4101.28 |
| PV-3 | 12835.90 | 10960.34 | 4081.81 |
| RR Spike (Benchmark)* | 10000.00 | 10000.00 | 4080.16 |
| FND CM @ Back Bldg. (Benchmark) | 10609.25 | 11047.33 | 4072.11 |

* The RR Spike Benchmark was designated as the reference point for this survey. This benchmark is located at the common corner of Section 1 and 12, Block 81, Township 1, and Sections 6 and 7, Block 80 Township 1, Texas and Pacific Railway Surveys.

*VIVA Environmental, Inc.*
*7201 Stiles*
*El Paso, Texas 79915*

**EXTREMES FOR EL PASO TEXAS 1879 THROUGH 1998**

TEMPERATURES

| | | |
|---|---|---|
| HIGHEST | 114 DEG F | JUN 30, 1994 |
| LOWEST | -8 DEG F | JAN 11, 1962 |
| EARLIEST 32 DEG OR BELOW | 30 DEG F | OCT 16, 1880 |
| LATEST 32 DEG OR BELOW | 31 DEG F | MAY 02, 1967 |
| NORMAL DATE OF FIRST/LAST | 32 DEG F | NOV 12 / MAR 20 |
| LOWEST MAXIMUM | 17 DEG F | JAN 10, 1962 |
| HIGHEST MINIMUM | 85 DEG F | JUL 01 & 03, 1994 |
| AVERAGE ANNUAL MAXIMUM/MINIMUM | | 77.5 / 49.0 |
| EARLIEST 90 DEG OR ABOVE | 91 DEG | MAR 18, 1907 |
| LATEST 90 DEG OR BELOW | 90 DEG | OCT 26, 1979 |
| AVERAGE ANNUAL NUMBER 100 DEG OR ABOVE ( 1879 - 1994 ) | | 12.26 DAYS |
| EARLIEST 100 DEG OR ABOVE | 100 DEG | MAY 08, 1989 |
| LATEST 100 DEG OR ABOVE | 101 DEG | SEP 16, 1966 |
| GREATEST NUMBER DAYS 100 DEG OR ABOVE | | 62 IN 1994 |
| LEAST NUMBER DAYS 100 DEG OR ABOVE | | 1 IN 1967 & PREV YRS |
| CONSECUTIVE DAYS 100 DEG OR ABOVE | 23 DAYS | JUN 23 - JUL 15, 1994 |
| CONSECUTIVE HOURS 32 DEG OR BELOW | 94 HOURS | 3PM JAN 09 - 11AM JAN 13, 1962 |

RAINFALL

| | | |
|---|---|---|
| ANNUAL (NORMAL) | 8.81 INCHES | |
| MAX IN 24 HOURS | 6.50 INCHES | JUL 09, 1881 |
| MAX MONTHLY | 8.18 INCHES | JUL 1881 |
| MAX YEARLY | 18.29 INCHES | 1884 |

MIN YEARLY.....2.22 INCHES.....1891

WETTEST MONTH (NORMAL).....1.70 INCHES.....SEP

DRIEST MONTH (NORMAL).....0.20 INCHES.....APR

CONSEC. DAYS MEASUR RAIN... (.01 IN. OR MORE).....10 DAYS.....SEP 15 - 24, 1974

CONSEC DAYS WITHOUT RAIN... (INCL A TRACE).....126 DAYS.....FEB 22 - JUN 22, 1910

SNOWFALL

ANNUAL NORMAL.....6.6 INCHES

MAXIMUM SEASONAL.....32.5 INCHES.....NOV 1987 - FEB 1988

MAXIMUM IN ANY 12 MONTH PERIOD...35.2 INCHES.....NOV 1982 - APR 1983

MINIMUM YEARLY.....0.0 INCHES.....NUMEROUS YEARS

MAXIMUM MONTHLY.....25.9 INCHES.....DEC 1987

MAXIMUM IN 24 HOURS.....16.8 INCHES.....DEC 13 - 14, 1987

EARLIEST TRACE AMOUNT.. ( LESS THAN 0.5 INCHES).....OCT 15, 1925

EARLIEST MEASUR AMOUNT...( 0.5 INCHES OR MORE).....1.0 INCH.....OCT 28, 1980

GREATEST DEPTH ON GROUND.....16 INCHES.....DEC 14, 1987

PRESSURE

HIGHEST.....30.82 INS. / 1043.7 hPa

LOWEST.....29.22 INS. / 989.5 hPa

MEAN STATION PRESSURE.....25.99 INS. / 880.1 hPa

MEAN SEA LEVEL PRESSURE.....29.41 INS. / 995.9 hPa

HIGHEST STATION PRESSURE.....26.73 INS / 905.2 hPa

LOWEST STATION PRESSURE.....25.30 INS. / 856.8 hPa

WIND

MEAN DIRECTION.....NORTH

AVERAGE SPEED.....8.9 MPH

PEAK GUST .....MAR 10, 1977.....84 MPH

RELATIVE HUMIDITY

NORMALS.....5 AM 57 PERCENT 11 AM 35 PERCENT

(MOUNTAIN STANDARD TIMES) 5 PM 27 PERCENT 11 PM 45 PERCENT

ANNUAL PERCENT OF POSSIBLE SUNSHINE.....(NORMAL).....84 PERCENT

VIVA Environmental, Inc.
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# BORING LOG

**WELL NO.** PVW- 3

**PROJECT NAME:** Methane Gas Monitoring Probe

**PROJECT LOCATION:** McCombs Landfill
13600 McCombs
El Paso, Texas 79934

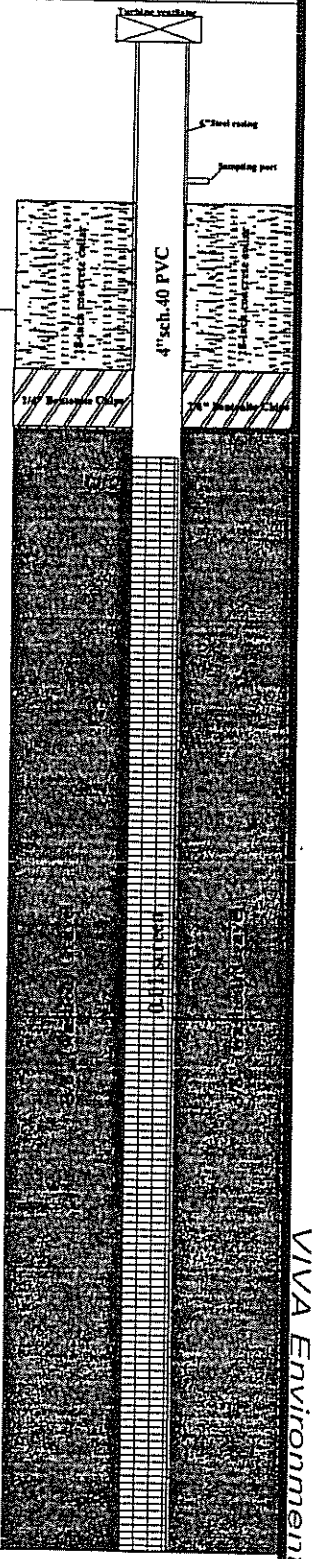
**BORING EQUIPMENT & METHOD:** Truck-mounted Mobile B-61 Drill Rig & 6 5\8" I.D. 10" O.D. Hollowstem Auger

**SURFACE ELEVATION:**

**BENCHMARK:**

| DESCRIPTION | Depth in Feet | Sample | Graphical Log | USCS |
|---|---|---|---|---|
| Sand, well graded, small percentage of gravel, loose, dry, reddish brown. 6/1-7.5YR. | 5, 10 | | | |
| Sand, very hard packed medium grained sand, intermixed with dry caliche beds. | 15, 20 | | | SP |
| Sand, poorly graded, less than 10% gravel, dry, loose 6/1-7.5YR. | 25, 30, 35, 40 | | | |

WELL CONSTRUCTION




**REMARKS:**

**DRILLED BY:** Paul Daniloff
Jones Enviro. Drilling

**DATE STARTED:** 9/28/01

**LOGGED BY:** Mark Weatherly

**DATE COMPLETED:** 9/28/01

**GROUNDWATER-DEPTH** N/A **HOUR:** _____ **DATE:** _____

**CHECKED BY:** Mark Weatherly

**SHEET 1 OF 2**

VIVA Environmental Inc.

VIVA Environmental, Inc.
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# BORING LOG

**WELL NO.** PVW-13

**PROJECT NAME:** Methane Gas Monitoring Probe

**PROJECT LOCATION:** McCombs Landfill
13600 McCombs
El Paso, Texas 79934

**BORING EQUIPMENT & METHOD:**
Truck-mounted Mobile B-61 Drill Rig & 6 5\8" I.D. 10" O.D. Hollowstem Auger

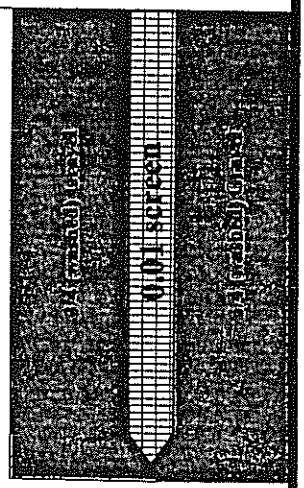
**SURFACE ELEVATION:**

**BENCHMARK:**

## DESCRIPTION

**Sand, poorly graded, 25 -30% gravel, dry, loose 6/1-7.5YR.**

| Depth in Feet | Sample | Graphical Log | USCS | WELL CONSTRUCTION |
|---|---|---|---|---|
| 45 | | | | |
| 50 | | | SP | |
| 55 | | | | |
| 60 | | | | |
| 65 | | | | |
| 70 | | | | |
| 75 | | | | |
| 80 | | | | |




**REMARKS:**
Boring Termination Depth 55'
Sampler Termination Depth 56.5'
No water encountered

**GROUNDWATER-DEPTH:** N/A **HOUR:** _____ **DATE:** _____

**DRILLED BY:** Paul Daniloff, Jones Enviro. Drilling

**LOGGED BY:** Mark Weatherly

**CHECKED BY:** Mark Weatherly

**DATE STARTED:** 9/28/01

**DATE COMPLETED:** 9/28/01



VIVA Environmental Inc.

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# BORING LOG

**WELL NO.** GMP-9

**PROJECT NAME:** Methane Gas Monitoring Probe

**PROJECT LOCATION:** McCombs Landfill
13600 McCombs
El Paso, Texas 79934

**BORING EQUIPMENT & METHOD:**
Truck-mounted Mobile B-61 Drill Rig & 6 5\8" I.D. 10" O.D. Hollowstem Auger

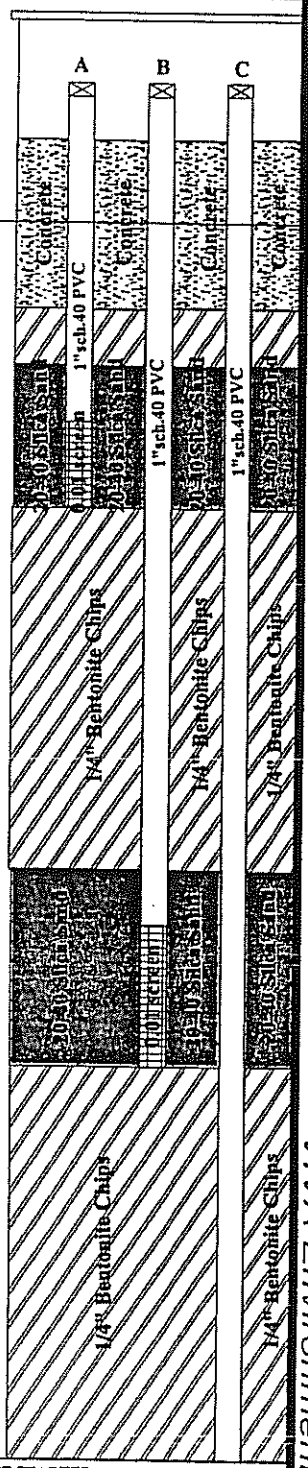
**SURFACE ELEVATION:**

**BENCHMARK:**

## DESCRIPTION

| Depth in Feet | Sample | Graphical Log | USCS | DESCRIPTION |
|---|---|---|---|---|
| | | | MH | Silt, (calcareous material) firm, medium-high plasticity, white 7.5-8/1YR. |
| 5 | | | SM | Sand, silty, fine to medium grain, predominately fine, little gravel (1/4"), interbedded calcareous material, no plasticity, dry, 5/8-7.5YR. |
| 10 | | | SW | Sand, well graded, little gravel, loose (1 1/4"), dry, 6/1-7.5YR. |
| | | | | Sand, well graded, little gravel, loose (1/2 "), dry, 6/1-7.5YR. |
| 15 | | | SP | Sand, fine to medium grain, prodomitity fine, loose, dry, 5/8-7.5YR. |
| 20 | | | | Sand, poorly graded, little gravel, loose (1/2"), dry, 6/1-7.5YR. |
| 25 | | | SW | Sand, well graded, slightly moist, very dense, 6/1-7.5YR. |
| 30 | | | | |
| 35 | | | SP | Sand, poorly graded, little silt, some gravel (1/4), no plasitcity, dense, dry, 6/1-7.5YR. |
| 40 | | | | Sand, fine to medium grain, predominately fine, little silt, no plasitcity, very sense, slighty moist, 6/1-7.5YR. |

**WELL CONSTRUCTION**




**REMARKS:**

**DRILLED BY:** Paul Daniloff
Jones Enviro. Drilling

**DATE STARTED:** 10/1/01

**LOGGED BY:** Gerald Goodwin
CAPM00810

**DATE COMPLETED:** 10/1/01

**GROUNDWATER-DEPTH** N/A **HOUR:** _____ **DATE:** _____

**CHECKED BY:** Mark Weatherly

**SHEET 1 OF 2**

VIVA Environmental Inc.

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# BORING LOG

**WELL NO.** GMP-9

**PROJECT NAME:** Methane Gas Monitoring Probe

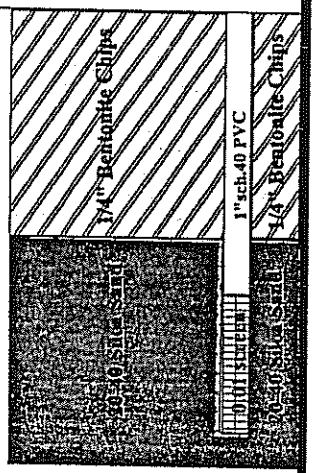
**PROJECT LOCATION:** McCombs Landfill
13600 McCombs
El Paso, Texas 79934

**BORING EQUIPMENT & METHOD:**
Truck-mounted Mobile B-61 Drill Rig & 6 5\8" I.D. 10" O.D. Hollowstem Auger

**SURFACE ELEVATION:**

**BENCHMARK:**

| DESCRIPTION | Depth in Feet | Sample | Graphical Log | USCS | WELL CONSTRUCTION |
|---|---|---|---|---|---|
| Sand, well graded, little gravel (1/2"), dense, dry, 6/1-7.5YR. | 45 | | | SW | |
| Sand, fine to medium grain, little silt, no plasitcity, very dense, slighty moist, 6/1-7.5YR. | 50 | | | SP | |
| | 55 | | | | |
| | 60 | | | | |
| | 65 | | | | |
| | 70 | | | | |
| | 75 | | | | |
| | 80 | | | | |




**REMARKS:**
Boring Termination Depth 55'
Sampler Termination Depth 56.5'
No water encountered

**GROUNDWATER-DEPTH:** N/A **HOUR:** _____ **DATE:** _____

**DRILLED BY:** Paul Daniloff
Jones Enviro. Drilling

**LOGGED BY:** Gerald L. Goodwin, CAPM 0810

**CHECKED BY:** Mark Weatherly

**DATE STARTED:** 10/3/01

**DATE COMPLETED:** 10/4/01

**SHEET 2 OF 2**

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# BORING LOG

**WELL NO.** GMP-10

**PROJECT NAME:** Methane Gas Monitoring Probe

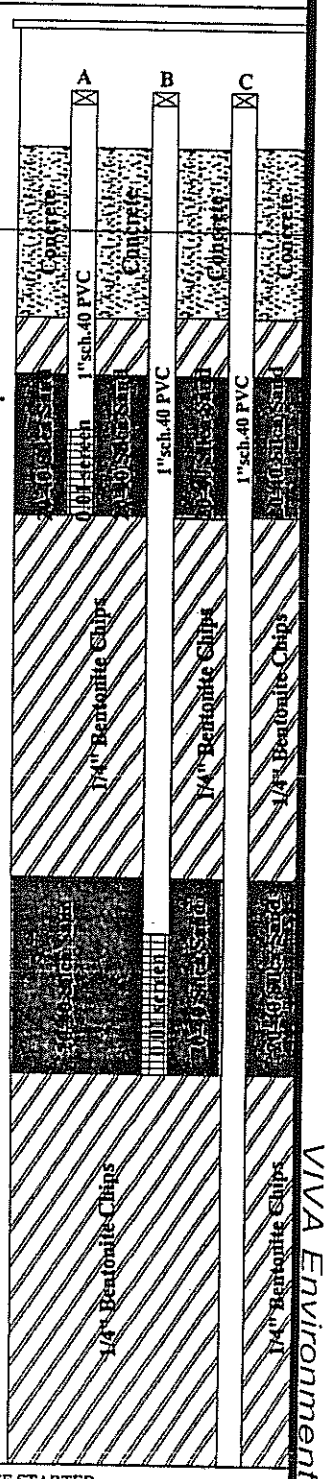
**PROJECT LOCATION:** McCombs Landfill, 13600 McCombs, El Paso, Texas 79934

**BORING EQUIPMENT & METHOD:** Truck-mounted Mobile B-61 Drill Rig & 6 5\8" I.D. 10" O.D. Hollowstem Auger

**SURFACE ELEVATION:**

**BENCHMARK:**

| DESCRIPTION | Depth in Feet | Sample | Graphical Log | USCS |
|---|---|---|---|---|
| Silt, (calcareous material) firm, medium-high plasticity, white 7.5-8/1YR. | | | | ML |
| Sand, silty, fine to medium grain, predominately fine, little gravel (1/4"), interbedded calcareous material, no plasticity, dry, 5/8-7.5YR. | 5 | | | SM |
| Sand, poorly graded, little gravel, loose (1/2"), dry, 6/1-7.5YR. | 10 | | | SP |
| Sand, well graded, little gravel, loose (1"), dry, 6/1-7.5YR. | 15, 20, 25 | | | SW |
| Sand, fine, little silt, very dense, dry, 5/8-7.5YR. | 30 | | | SM |
| Sand, well graded, dry, very dense, 6/1-7.5YR. | 35 | | | SW |
| Sand, well graded, little gravel, loose (1"), dry, 6/1-7.5YR. | 40 | | | |




**REMARKS:**

**DRILLED BY:** Paul Daniloff, Jones Enviro. Drilling

**DATE STARTED:** 10/2/01

**LOGGED BY:** Gerald Goodwin, CAPM00810

**DATE COMPLETED:** 10/2/01

**GROUNDWATER-DEPTH:** N/A **HOUR:** _____ **DATE:** _____

**CHECKED BY:** Mark Weatherly

**SHEET 1 OF 2**

VIVA Environmental Inc.

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# BORING LOG

**WELL NO.** GMP-10

**PROJECT NAME:** Methane Gas Monitoring Probe

**PROJECT LOCATION:** McCombs Landfill
13600 McCombs
El Paso, Texas 79934

**BORING EQUIPMENT & METHOD:**
Truck-mounted Mobile B-61 Drill Rig & 6 5\8" I.D. 10" O.D. Hollowstem Auger

**SURFACE ELEVATION:**

**BENCHMARK:**

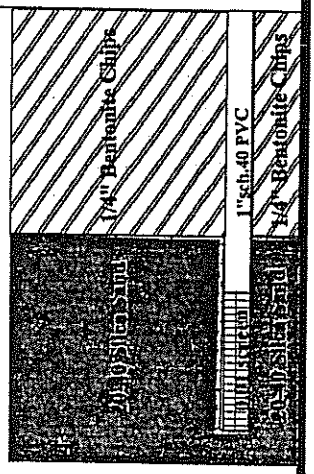
## DESCRIPTION

| Depth in Feet | Sample | Graphical Log | USCS | WELL CONSTRUCTION |
|---|---|---|---|---|
| | | | SW | |
| 45 | | | SM | |
| 50 | | | SP | |
| 55 | | | | |
| 60 | | | | |
| 65 | | | | |
| 70 | | | | |
| 75 | | | | |
| 80 | | | | |

Sand, well graded, little gravel (1/2"), dense, dry, 6/1-7.5YR.

Silt, no plasitcity, loose moist, 7/1-7.5YR.

Sand, fine to medium grain, little silt, no plasitcity, very dense, slighty moist, 6/1-7.5YR.




**REMARKS:**
Boring Termination Depth 55'
Sampler Termination Depth 56.5'
No water encountered

**GROUNDWATER-DEPTH:** N/A **HOUR:** _____ **DATE:** _____

**DRILLED BY:** Paul Daniloff, Jones Enviro. Drilling

**DATE STARTED:** 10/2/01

**LOGGED BY:** Gerald L. Goodwin, CAPM 0810

**DATE COMPLETED:** 10/2/01

**CHECKED BY:** Mark Weatherly



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# BORING LOG

**WELL NO. GMP-11**

PROJECT NAME: Methane Gas Monitoring Probe

PROJECT LOCATION: McCombs Landfill
13600 McCombs
El Paso, Texas 79934

BORING EQUIPMENT & METHOD:

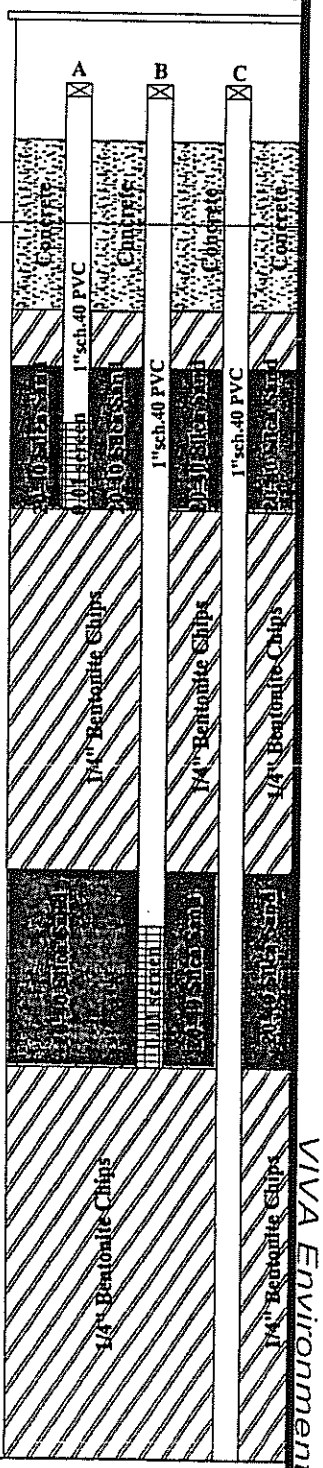
Truck-mounted Mobile B-61 Drill Rig & 6 5\8" I.D. 10" O.D. Hollowstem Auger

SURFACE ELEVATION:

BENCHMARK:

| DESCRIPTION | Depth in Feet | Sample | Graphical Log | USCS |
|---|---|---|---|---|
| Silt, (calcareous material) firm, medium-high plasticity, white 7.5-8/1YR. | 0 | | | ML |
| Sand, well graded, little gravel, loose (1/2 "), dry, 6/1-7.5YR. | 5 | X | | SW |
| Sand, poorly graded, little gravel, loose (1/2"), dry, 6/1-7.5YR. | 10 | X | | SP |
| Sand, well graded, slightly moist, very dense, 6/1-7.5YR. | 15 | X | | SW |
| Sand, poorly graded, little silt, some gravel (1/4), no plasitcity, dense, dry, 6/1-7.5YR. | 20 | X | | SW |
| Sand, fine to medium grain, little silt, no plasitcity, very sense, slighty moist, 6/1-7.5YR. | 25 | X | | SP |
| Sand, well graded, little gravel, loose (1/2 "), dry, 6/1-7.5YR. | 30 | X | | SW |
| | 35 | X | | |
| | 40 | X | | |

WELL CONSTRUCTION




REMARKS:

DRILLED BY: Paul Daniloff
Jones Enviro. Drilling

DATE STARTED: 10/3/01

LOGGED BY: Gerald Goodwin
CAPM00810

DATE COMPLETED: 10/4/01

GROUNDWATER-DEPTH N/A HOUR:_____ DATE:_____

CHECKED BY: Mark Weatherly

SHEET 1 OF 2

VIVA Environmental Inc.

VIVA Environmental, Inc.
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# BORING LOG

**WELL NO.** GMP-11

**PROJECT NAME:** Methane Gas Monitoring Probe

**PROJECT LOCATION:** McCombs Landfill
13600 McCombs
El Paso, Texas 79934

**BORING EQUIPMENT & METHOD:**
Truck-mounted Mobile B-61 Drill Rig & 6 5\8" I.D. 10" O.D. Hollowstem Auger

**SURFACE ELEVATION:**

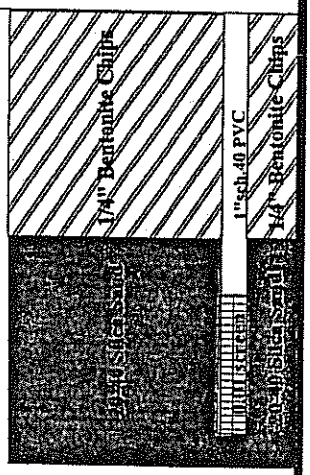
**BENCHMARK:**

## DESCRIPTION

| Depth in Feet | Sample | Graphical Log | USCS | WELL CONSTRUCTION |
|---|---|---|---|---|
| 45 | | | SW | |
| 50 | | | SP | |
| 55 | | | | |
| 60 | | | | |
| 65 | | | | |
| 70 | | | | |
| 75 | | | | |
| 80 | | | | |

Sand, well graded, little gravel (1/2"), dense, dry, 6/1-7.5YR.

Sand, fine to medium grain, little silt, no plasitcity, very dense, slighty moist, 6/1-7.5YR.




**REMARKS:**
Boring Termination Depth 55'
Sampler Termination Depth 56.5'
No water encountered

**GROUNDWATER-DEPTH:** N/A **HOUR:** _____ **DATE:** _____

**DRILLED BY:** Paul Daniloff
Jones Enviro. Drilling

**LOGGED BY:** Gerald L. Goodwin, CAPM 0810

**CHECKED BY:** Mark Weatherly

**DATE STARTED:** 10/3/01

**DATE COMPLETED:** 10/4/01

**SHEET 2 OF 2**

VIVA Environmental Inc.

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# BORING LOG

**WELL NO.** GMP-12

**PROJECT NAME:** Methane Gas Monitoring Probe

**PROJECT LOCATION:** McCombs Landfill
13600 McCombs
El Paso, Texas 79934

**BORING EQUIPMENT & METHOD:**
Truck-mounted Mobile B-61 Drill Rig & 6 5\8" I.D. 10" O.D. Hollowstem Auger

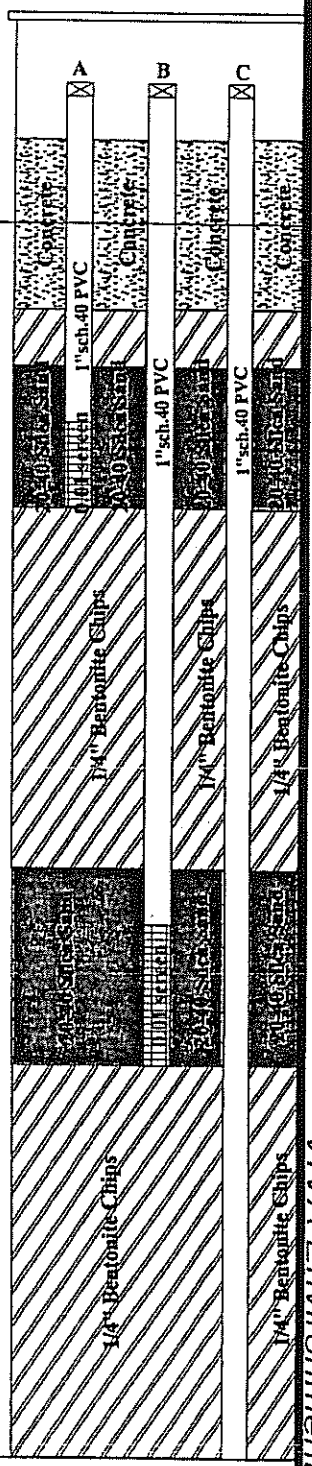
**SURFACE ELEVATION:**

**BENCHMARK:**

## DESCRIPTION

| Depth in Feet | Sample | Graphical Log | USCS | DESCRIPTION |
|---|---|---|---|---|
| | | | ML | Silt, (calcareous material) firm, medium-high plasticity, dry white |
| 5 | | | | |
| 10 | | | SW | Sand, well graded, gravel, loose (1/2 "), dry, 6/1-7.5YR. gravel to 1" |
| 15 | | | | |
| 20 | | | SP | Sand, poorly graded, gravel, (1/2"), dry, 6/1-7.5YR. |
| 25 | | | | |
| 30 | | | SW | Sand, well graded, slightly moist, very dense, 6/1-7.5YR. |
| | | | SP | Sand, poorly graded, little silt, some gravel (1/4), no plasitcity, dense, dry, 6/1-7.5YR. |
| 35 | | | | Sand, fine to medium grain, little silt, no plasitcity, very sense, slighty moist, 6/1-7.5YR. |
| 40 | | | SW | Sand, well graded, little gravel, loose (1/2 "), dry, 6/1-7.5YR. |

**WELL CONSTRUCTION**




**REMARKS:**

**DRILLED BY:** Paul Daniloff
Jones Enviro. Drilling

**DATE STARTED:** 10/4/01

**LOGGED BY:** Gerald Goodwin
CAPM00810

**DATE COMPLETED:** 10/4/01

**GROUNDWATER-DEPTH** N/A **HOUR:** _____ **DATE:** _____

**CHECKED BY:** Mark Weatherly

**SHEET 1 OF 2**

VIVA Environmental Inc.

VIVA Environmental, Inc.
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# BORING LOG

**WELL NO.** GMP-12

**PROJECT NAME:** Methane Gas Monitoring Probe

**PROJECT LOCATION:** McCombs Landfill
13600 McCombs
El Paso, Texas 79934

**BORING EQUIPMENT & METHOD:**
Truck-mounted Mobile B-61 Drill Rig & 6 5\8" I.D. 10" O.D. Hollowstem Auger

**SURFACE ELEVATION:**

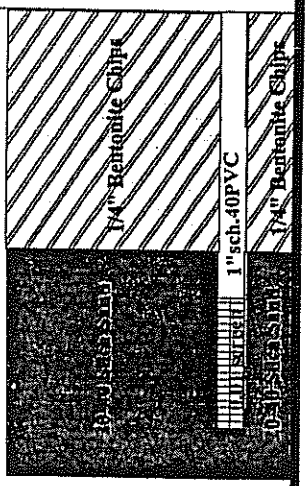
**BENCHMARK:**

## DESCRIPTION

| Depth in Feet | Sample | Graphical Log | USCS | WELL CONSTRUCTION |
|---|---|---|---|---|
| 45 | | | SW | |
| 50 | | | SP | |
| 55 | | | | |
| 60 | | | | |
| 65 | | | | |
| 70 | | | | |
| 75 | | | | |
| 80 | | | | |

Sand, well graded, little gravel (1/2"), dense, dry, 6/1-7.5YR.

Sand, poorly graded, silty, dry, plasticity 6/1-7.5YR.




**REMARKS:**
Boring Termination Depth 55'
Sampler Termination Depth 56.5'
No water encountered

**GROUNDWATER-DEPTH:** N/A **HOUR:** _____ **DATE:** _____

**DRILLED BY:** Paul Daniloff
Jones Enviro. Drilling

**LOGGED BY:** Gerald L. Goodwin, CAPM 0810

**CHECKED BY:** Mark Weatherly

**DATE STARTED:** 10/3/01

**DATE COMPLETED:** 10/4/01



VIVA Environmental Inc.

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# BORING LOG

**WELL NO.** GMP-13

**PROJECT NAME:** Methane Gas Monitoring Probe

**PROJECT LOCATION:** McCombs Landfill
13600 McCombs
El Paso, Texas 79934

**BORING EQUIPMENT & METHOD:**
Truck-mounted Mobile B-61 Drill Rig & 6 5\8" I.D. 10" O.D. Hollowstem Auger

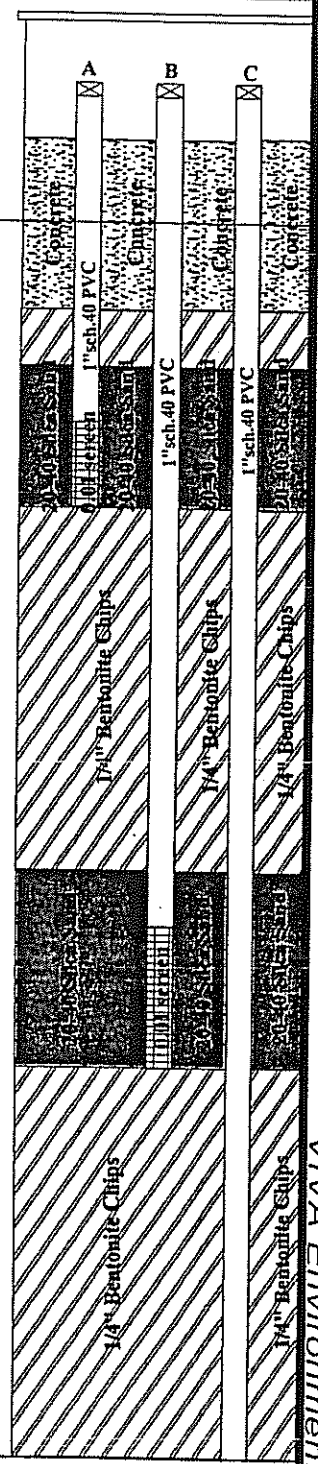
**SURFACE ELEVATION:**

**BENCHMARK:**

## DESCRIPTION

| Depth in Feet | Sample | Graphical Log | USCS | DESCRIPTION |
|---|---|---|---|---|
| 5 | | | ML | Silt, (Cache) firm, medium-high plasticity, dry white |
| 10 | | | | Sand, well graded, gravel, (1/2 "), dry, 6/1-7.5YR. |
| 15 | | | SW | |
| 20 | | | | |
| 25 | | | SP | Sand, poorly graded, gravel, (1/2"), dry, 6/1-7.5YR. |
| 30 | | | | |
| 35 | | | SP | Sand, fine to medium, fine grain, some silt, no plasiticity,dry, 6/1-7.5YR. |
| 40 | | | SW | Sand, poorly graded, little gravel, dry, 6/1-7.5YR. |
| | | | | Sand, well graded, gravel, (1/2 "), dry, 6/1-7.5YR. |

**WELL CONSTRUCTION**




**REMARKS:**

**DRILLED BY:** Paul Daniloff
Jones Enviro. Drilling

**DATE STARTED:** 10/3/01

**LOGGED BY:** Gerald Goodwin
CAPM00810

**DATE COMPLETED:** 10/4/01

**GROUNDWATER-DEPTH** N/A **HOUR:** _____ **DATE:** _____

**CHECKED BY:** Mark Weatherly

**SHEET 1 OF 2**

VIVA Environmental Inc.

VIVA Environmental, Inc.
*The Future Is Clear!*

# BORING LOG

**WELL NO.** GMP-13

**PROJECT NAME:** Methane Gas Monitoring Probe

**PROJECT LOCATION:** McCombs Landfill
13600 McCombs
El Paso, Texas 79934

**BORING EQUIPMENT & METHOD:**
Truck-mounted Mobile B-61 Drill Rig & 6 5\8" I.D. 10" O.D. Hollowstem Auger

**SURFACE ELEVATION:**

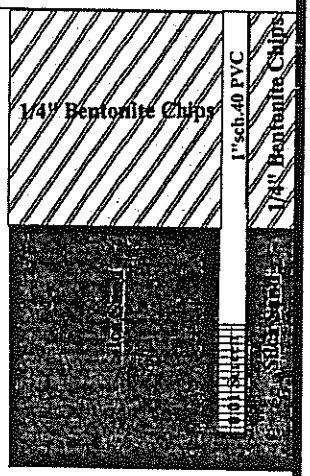
**BENCHMARK:**

## DESCRIPTION

| Depth in Feet | Sample | Graphical Log | USCS | WELL CONSTRUCTION |
|---|---|---|---|---|
| 45 | | | SW | |
| 50 | | | SP | |
| 55 | | | | |
| 60 | | | | |
| 65 | | | | |
| 70 | | | | |
| 75 | | | | |
| 80 | | | | |

Sand, well graded, little gravel (1/2'), dry, 6/1-7.5YR.

Sand, poorly graded, silty , dry, no plasticity, 6/1-7.5YR.




**REMARKS:**
Boring Termination Depth 55'
Sampler Termination Depth 56.5'
No water encountered

**GROUNDWATER-DEPTH:** N/A **HOUR:** _____ **DATE:** _____

**DRILLED BY:** Paul Daniloff
Jones Enviro. Drilling

**DATE STARTED:** 10/3/01

**LOGGED BY:** Gerald L. Goodwin, CAPM 0810

**DATE COMPLETED:** 10/4/01

**CHECKED BY:** Mark Weatherly



VIVA Environmental Inc.

VIVA Environmental, Inc.
*The Future Is Clear!*

# BORING LOG

**WELL NO.GMP-14**

PROJECT NAME: Methane Gas Monitoring Probe

PROJECT LOCATION: McCombs Landfill
13600 McCombs
El Paso, Texas 79934

BORING EQUIPMENT & METHOD:
Truck-mounted Mobile B-61 Drill Rig & 6 5\8" I.D. 10" O.D. Hollowstem Auger

SURFACE ELEVATION:

BENCHMARK:

## DESCRIPTION

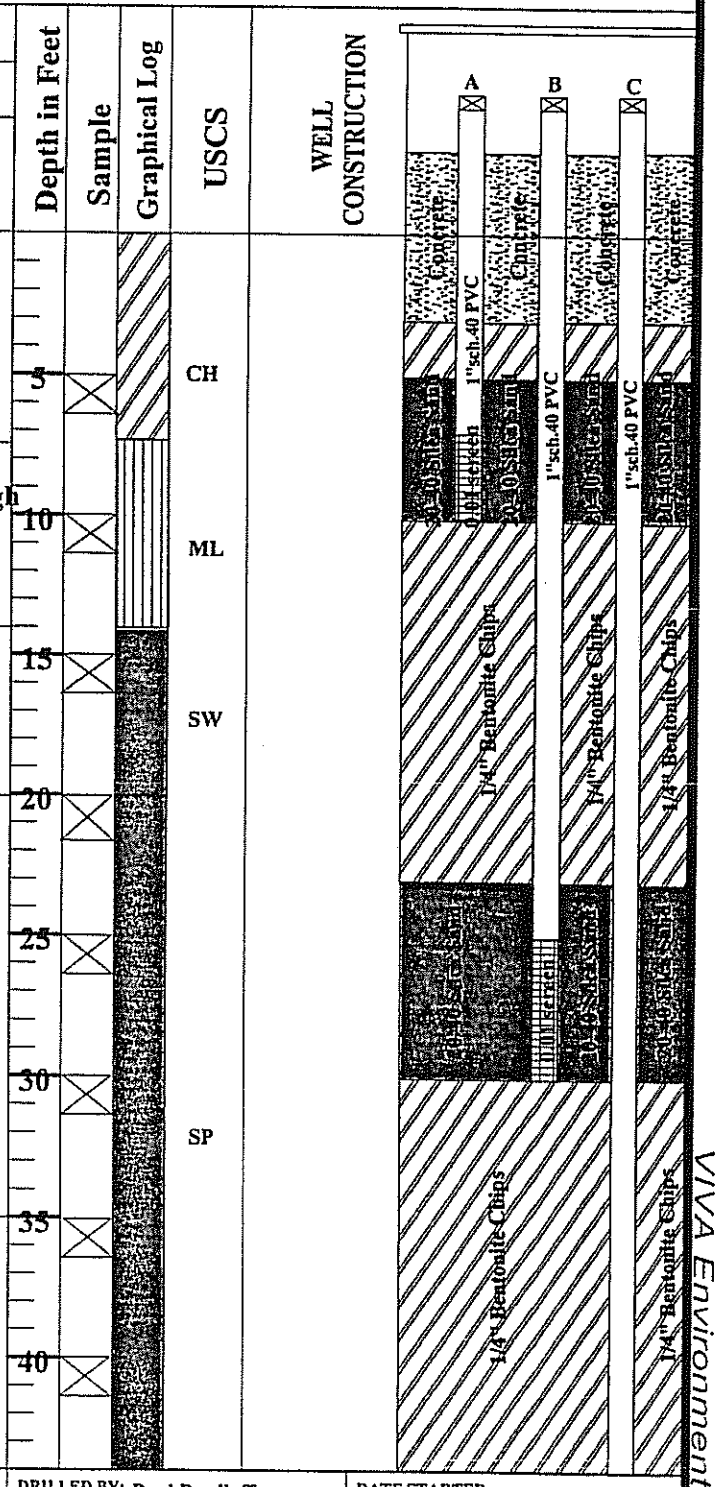
Clay, silty, some sand, fine grain, high plasitcity, dry, 5/6-7.5YR.

Silt, (calcareous material) firm, medium to hard, high plasticity, dry, 7/1-8.5YR.

Sand, well graded, gravel (1/2"), dry, 6/1-7.5YR.

Sand, poorly graded, gravel, (1/2"), dry, 6/1-7.5YR.

Sand, fine to medium, silty, no plasiticity, dry, 6/1-7.5YR.




REMARKS:

DRILLED BY: Paul Daniloff
Jones Enviro. Drilling

DATE STARTED: 10/3/01

LOGGED BY: Gerald Goodwin
CAPM00810

DATE COMPLETED: 10/4/01

GROUNDWATER-DEPTH N/A HOUR:_____ DATE:_____

CHECKED BY: Mark Weatherly

SHEET 1 OF 2

VIVA Environmental Inc.

VIVA Environmental, Inc.
*The Future Is Clear!*

# BORING LOG

**WELL NO. GMP-14**

**PROJECT NAME:** Methane Gas Moitoring Probe

**PROJECT LOCATION:** McCombs Landfill
13600 McCombs
El Paso, Texas 79934

**BORING EQUIPMENT & METHOD:**
Truck-mounted Mobile B-61 Drill Rig & 6 5\8" I.D. 10" O.D. Hollowstem Auger

**SURFACE ELEVATION:**

**BENCHMARK:**

## DESCRIPTION

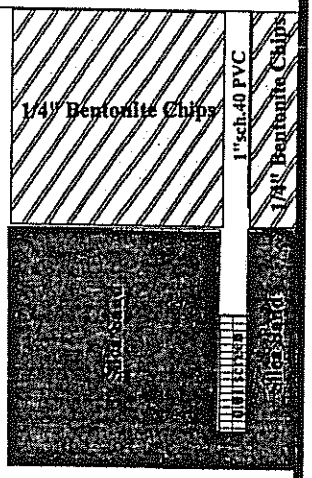
| Depth in Feet | Sample | Graphical Log | USCS | WELL CONSTRUCTION |
|---|---|---|---|---|
| | | | SP | |
| 45 | | | | |
| | | | SW | |
| 50 | | | | |
| | | | SP | |
| 55 | | | CH | |
| 60 | | | | |
| 65 | | | | |
| 70 | | | | |
| 75 | | | | |
| 80 | | | | |

Sand, fine to medium, silty, no plasticity, dry, 6/1-7.5YR.

Sand, well graded, little gravel, (1/2) dry, 6/1-7.5YR.

Sand, silty, fine graded, no plasticity, dry, 6/1-7.5YR.

Clay, silty, high plasticity, dry, stiff-hard, 6/3-7.5YR.




**REMARKS:**
Boring Termination Depth 55'
Sampler Termination Depth 56.5'
No water encountered

**GROUNDWATER-DEPTH:** N/A **HOUR:** _____ **DATE:** _____

**DRILLED BY:** Paul Daniloff, Jones Enviro. Drilling

**LOGGED BY:** Gerald L. Goodwin, CAPM 0810

**CHECKED BY:** Mark Weatherly

**DATE STARTED:** 10/3/01

**DATE COMPLETED:** 10/4/01

**SHEET 2 OF 2**

VIVA Environmental Inc.

VIVA Environmental, Inc.
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# BORING LOG — WELL NO. GMP-15

PROJECT NAME: Methane Gas Monitoring Probe

PROJECT LOCATION: McCombs Landfill, 13600 McCombs, El Paso, Texas 79934

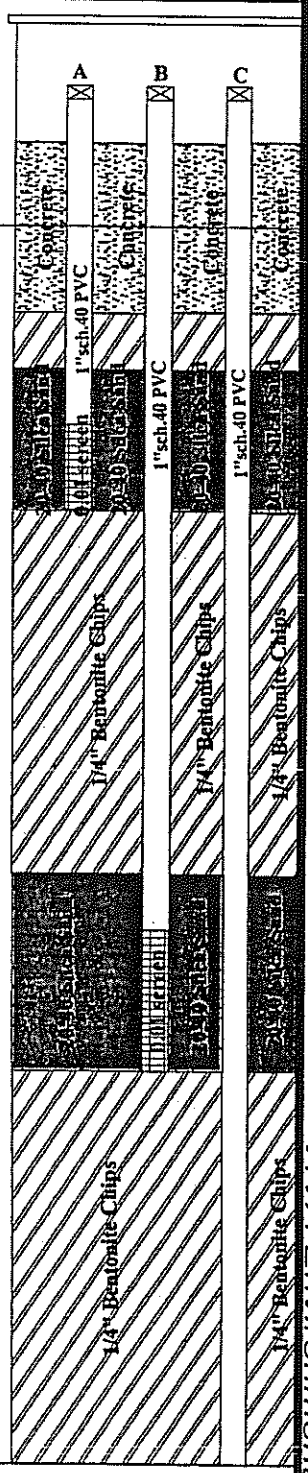
BORING EQUIPMENT & METHOD: Truck-mounted Mobile B-61 Drill Rig & 6 5\8" I.D. 10" O.D. Hollowstem Auger

SURFACE ELEVATION:

BENCHMARK:

| DESCRIPTION | Depth in Feet | Sample | Graphical Log | USCS |
|---|---|---|---|---|
| Silt, (calcareous material) firm, medium-high plasticity, white 7.5-8/1YR. | 5 | | | ML |
| | 10 | | | |
| Sand, well graded, gravel (1/2"), dry, 6/1-7.5YR. | 15 | | | SW |
| | 20 | | | |
| Sand, poorly graded, gravel, (1/2"), dry, 6/1-7.5YR. | 25 | | | SP |
| | 30 | | | |
| Sand, fine to medium, silty, no plasiticity, dry, 6/1-7.5YR. | 35 | | | |
| | 40 | | | |
| Sand, well graded, little gravel (1/2"), dry, 6/1-7.5YR. | | | | SW |

WELL CONSTRUCTION




REMARKS:

DRILLED BY: Paul Daniloff, Jones Enviro. Drilling — DATE STARTED: 10/5/01

LOGGED BY: Gerald Goodwin, CAPM00810 — DATE COMPLETED: 10/5/01

GROUNDWATER-DEPTH N/A HOUR:_____ DATE:_____

CHECKED BY: Mark Weatherly

SHEET 1 OF 2

VIVA Environmental Inc.

VIVA Environmental, Inc.
*The Future Is Clear!*

# BORING LOG

**WELL NO:** GMP-15

**PROJECT NAME:** Methane Gas Monitoring Probe

**PROJECT LOCATION:** McCombs Landfill
13600 McCombs
El Paso, Texas 79934

**BORING EQUIPMENT & METHOD:**
Truck-mounted Mobile B-61 Drill Rig & 6 5\8" I.D. 10" O.D. Hollowstem Auger

**SURFACE ELEVATION:**

**BENCHMARK:**

| DESCRIPTION | Depth in Feet | Sample | Graphical Log | USCS | WELL CONSTRUCTION |
|---|---|---|---|---|---|
| Sand, well graded, little gravel, dry (1/2), 6/1-7.5YR. | 45 | | | SW | |
| Sand, poorly graded, little gravel, (1/2) dry, 6/1-7.5YR. | 50 | | | SP | |
| Sand, poorly graded, silty, no plasticity, dry, 6/1-7.5YR. | 55 | | | ML | |
| Silt, sandy, fine grain, medium plasticity, dry 6/2-7.5YR. | 60 | | | | |
| | 65 | | | | |
| | 70 | | | | |
| | 75 | | | | |
| | 80 | | | | |

WELL CONSTRUCTION: 1/4" Bentonite Chips; 1"sch.40 PVC; 1/4" Bentonite Chips; 20-40 Silica Sand; 20-40 Silica Sand

**REMARKS:**
Boring Termination Depth 55'
Sampler Termination Depth 56.5'
No water encountered

GROUNDWATER-DEPTH: N/A HOUR:_____ DATE:_____

DRILLED BY: Paul Daniloff, Jones Enviro. Drilling
DATE STARTED: 10/5/01

LOGGED BY: Gerald L. Goodwin, CAPM 0810
DATE COMPLETED: 10/5/01

CHECKED BY: Mark Weatherly

SHEET 2 OF 2

VIVA Environmental Inc.

VIVA Environmental, Inc.
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# BORING LOG

**WELL NO.** GMP-16

**PROJECT NAME:** Methane Gas Monitoring Probe

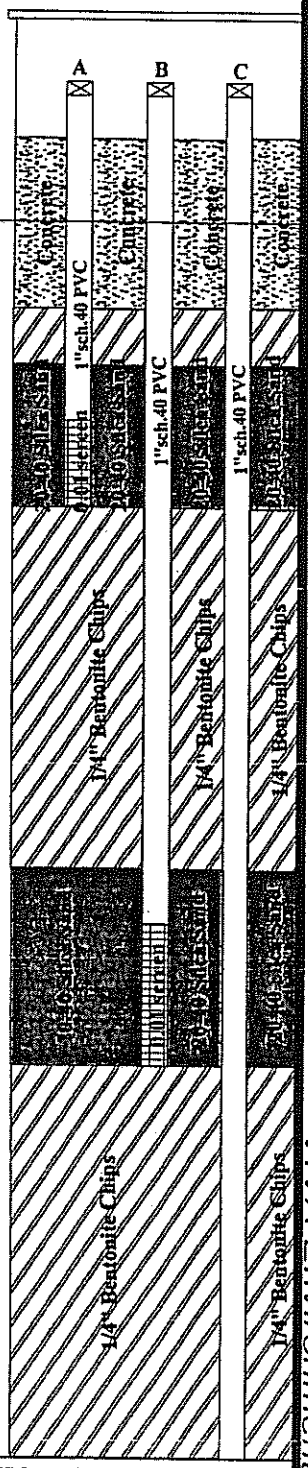
**PROJECT LOCATION:** McCombs Landfill
13600 McCombs
El Paso, Texas 79934

**BORING EQUIPMENT & METHOD:**
Truck-mounted Mobile B-61 Drill Rig & 6 5\8" I.D. 10" O.D. Hollowstem Auger

**SURFACE ELEVATION:**

**BENCHMARK:**

| DESCRIPTION | Depth in Feet | Sample | Graphical Log | USCS | WELL CONSTRUCTION |
|---|---|---|---|---|---|
| Clay, sandy, fine graded, high plasticity, dry, soft, 6/3-7.5YR. | 0–5 | | | CH | HARD DRILLING-ADDED WATER |
| Silt, (calcareous material), firm, high plasticity, dry, 5/6-7.5YR. | 5–10 | | | ML | |
| Clay, silty, interbedded calcareous material, little sand, fine graded, high plasticity, very stiff, dry, 5/6-7.5YR. | 10–20 | | | CH | |
| Sand, well grained, gravel, dry, 6/1-7.5YR. | 20–40 | | | SW | |




**REMARKS:**

**GROUNDWATER-DEPTH** N/A **HOUR:** _____ **DATE:** _____

**DRILLED BY:** Paul Daniloff, Jones Enviro. Drilling
**DATE STARTED:** 10/8/01

**LOGGED BY:** Gerald Goodwin, CAPM00810
**DATE COMPLETED:** 10/8/01

**CHECKED BY:** Mark Weatherly

**SHEET 1 OF 2**

VIVA Environmental Inc.

VIVA Environmental, Inc.
*The Future Is Clear!*

# BORING LOG

**WELL NO.** GMP-16

**PROJECT NAME:** Methane Gas Monitoring Probe

**PROJECT LOCATION:** McCombs Landfill
13600 McCombs
El Paso, Texas 79934

**BORING EQUIPMENT & METHOD:**
Truck-mounted Mobile B-61 Drill Rig & 6 5\8" I.D. 10" O.D. Hollowstem Auger

**SURFACE ELEVATION:**

**BENCHMARK:**

## DESCRIPTION

Sand, well graded, gravel, dry, 6/1-7.5YR.

Sand, poorly graded, silty, no plasticity, 6/1-7.5YR.

Depth in Feet | Sample | Graphical Log | USCS | WELL CONSTRUCTION

45 50 55 60 65 70 75 80

USCS: SW, SP

WELL CONSTRUCTION: 1/4" Bentonite Chips; 1" sch.40 PVC; 1/4" Bentonite Chips; Filter Pack; 0.010 Slot Screen

**REMARKS:**
Boring Termination Depth 55'
Sampler Termination Depth 56.5'
No water encountered

**GROUNDWATER-DEPTH:** N/A **HOUR:** _____ **DATE:** _____

**DRILLED BY:** Paul Daniloff
Jones Enviro. Drilling

**LOGGED BY:** Gerald L. Goodwin, CAPM 0810

**CHECKED BY:** Mark Weatherly

**DATE STARTED:** 10/8/01

**DATE COMPLETED:** 10/8/01



VIVA Environmental Inc.

VIVA Environmental, Inc.
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# BORING LOG

**WELL NO.** GMP-17

**PROJECT NAME:** Methane Gas Monitoring Probe

**PROJECT LOCATION:** McCombs Landfill
13600 McCombs
El Paso, Texas 79934

**BORING EQUIPMENT & METHOD:**
Truck-mounted Mobile B-61 Drill Rig & 6 5\8" I.D. 10" O.D. Hollowstem Auger

**SURFACE ELEVATION:**

**BENCHMARK:**

## DESCRIPTION

Depth in Feet | Sample | Graphical Log | USCS | WELL CONSTRUCTION

Clay, silty, shift, medium to hard, plasticity, clay some sand, fine grained, 5/6-7.5YR.

Hard Drilling

Sand, silty, hard, plasticity, dry 5/6-7.5YR.

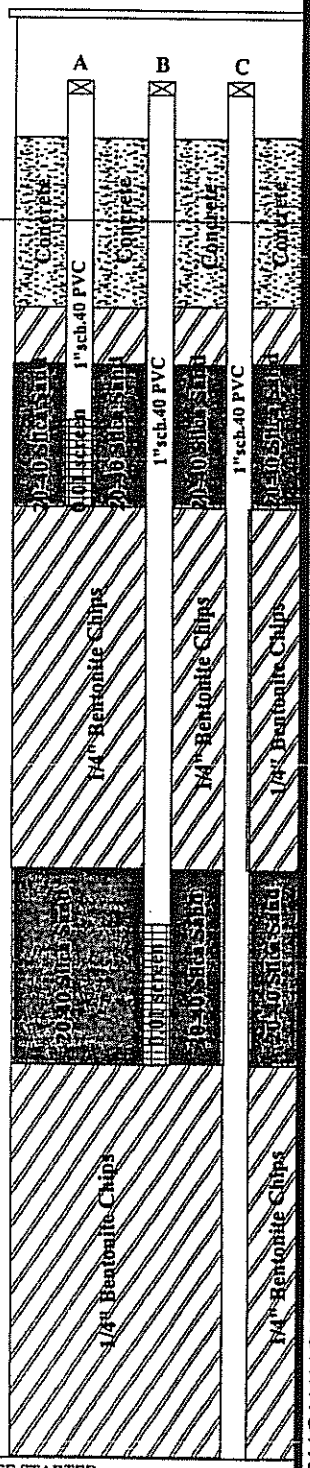
SM

Sand, poorly graded, dry, 6/1-7.5YR.

Gravel to 1"

Gravel to 1/2"

SP




**REMARKS:**

**DRILLED BY:** Paul Daniloff
Jones Enviro. Drilling

**DATE STARTED:** 10/3/01

**LOGGED BY:** Gerald Goodwin
CAPM00810

**DATE COMPLETED:** 10/4/01

**GROUNDWATER-DEPTH** N/A **HOUR:**_____ **DATE:**_____

**CHECKED BY:** Mark Weatherly

**SHEET 1 OF 2**

VIVA Environmental Inc.

VIVA Environmental, Inc.
The Future Is Clear!

# BORING LOG

WELL NO. GMP-17

PROJECT NAME: Methane Gas Monitoring Probe

PROJECT LOCATION: McCombs Landfill
13600 McCombs
El Paso, Texas 79934

BORING EQUIPMENT & METHOD:
Truck-mounted Mobile B-61 Drill Rig & 6 5\8" I.D. 10" O.D. Hollowstem Auger

SURFACE ELEVATION:

BENCHMARK:

| DESCRIPTION | Depth in Feet | Sample | Graphical Log | USCS | WELL CONSTRUCTION |
|---|---|---|---|---|---|
| Sand, poorly graded, dry, 6/1-7.5YR. | 45, 50, 55, 60, 65, 70, 75, 80 | | | SP | 1/4" Bentonite Chips; 1" sch.40 PVC; 1/4" Bentonite Chips |

REMARKS:
Boring Termination Depth 55'
Sampler Termination Depth 56.5'
No water encountered

GROUNDWATER-DEPTH: N/A HOUR: _____ DATE: _____

DRILLED BY: Paul Daniloff, Jones Enviro. Drilling
DATE STARTED: 10/3/01

LOGGED BY: Gerald L. Goodwin, CAPM 0810
DATE COMPLETED: 10/4/01

CHECKED BY: Mark Weatherly

SHEET 2 OF 2

VIVA Environmental Inc.

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

# Texas Department of License and Regulation

Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Toll free (800)803-9202
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

## WELL REPORT

### A. WELL IDENTIFICATION AND LOCATION DATA

1) OWNER

| Name | Address | City | State | Zip |
|---|---|---|---|---|
| McCombs LANDFILL | 13600 McCombs | EL PASO | TX | 79934 |

2) WELL LOCATION

| County | Physical Address | City | State | Zip |
|---|---|---|---|---|
| | 13600 McCombs | EL PASO | TX | 79934 |

| Lat. | Long. | Grid # |
|---|---|---|
| | | |

3) Type of Work: ☒ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening — GM P-9

4) Proposed Use (check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell ☐ Rig Supply — If Public Supply well, were plans submitted? ☐ Yes ☐ No

5) NT

6) Drilling Date: Started 10/1/01 Completed 10/1/01

Diameter of Hole

| Diameter | From (ft) | To (ft) |
|---|---|---|
| 10 | 0 | 55 |

7) Drilling Method (check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☒ Other: HSA

| From (ft) | To (ft) | Description and color of formation material |
|---|---|---|
| 0 | 4 | Silt |
| 4 | 15 | Sand Some gravel |
| 15 | 20 | Sand |
| 20 | 25 | Sand Some gravel |
| 25 | 30 | Sand moist |
| 30 | 40 | Sand Some Gravel |
| 40 | 44 | Sand slightly moist |
| 44 | 50 | Sand Some gravel |
| 50 | 55 | Sand moist |

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion: ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☒ Other 10/20
If Gravel Packed give the interval from ft. to ft.

Casing, Blank Pipe, and Well Screen Data

| Dia. (in.) | New Or Used | Steel, Plastic, etc. Perf., Slotted, etc Screen Mfg., if commercial | Setting (ft) From | Setting (ft) To | Gage Casing | Gage Screen |
|---|---|---|---|---|---|---|
| | | See map | | | | |

9) Cementing Data
Cementing from ft. to ft. # of sacks used
ft. to ft. # of sacks used
Method Used
Cementing By
Distance to septic system field or other concentrated contamination ft.
Method of verification of above distance

13) Plugged ☐ Well plugged within 48 hours
Casing left in well: Cement/Bentonite placed in well: N/A

| From (ft) | To (ft) | From (ft) | To (ft) | Sacks used |
|---|---|---|---|---|
| | | | | |
| | | | | |

10) Surface Completion
☒ Specified Surface Slab Installed
☐ Specified Surface Sleeve Installed
☐ Pitless Adapter Used
☐ Approved Alternative Procedure Used

14) Type Pump
☐ Turbine ☐ Jet N/A ☐ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet etc. ft.

15) Water Test N/A
Typetest ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

11) Water Level
Static level Dry ft. below Date / /
Artesian Flow gpm. Date / /

16) Water Quality
Did you knowingly penetrate a strata which contain undesirable constituents.
☐ YES ☒ NO If yes, did you submit a REPORT OF UNDESIRABLE WATER
Type of water Depth of Strata
Was a chemical analysis made ☐ Yes ☒ No

12) Packers N/A Type Depth

| Company or individual's Name (type or print) | JEDI, INC. | Lic. No. | 4931M |
|---|---|---|---|
| Address | 1911 N. Lexington Blvd | City | C.C. |
| State | TX | Zip | 78409 |

| Signature | Date | Signature | Date |
|---|---|---|---|
| Paul Daniloff | 11/28/01 | | / / |
| Licensed Driller/Pump Installer | | Apprentice | |

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

# Texas Department of License and Regulation

Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Toll free (800)803-9202
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

## WELL REPORT

### A. WELL IDENTIFICATION AND LOCATION DATA

1) OWNER

| Name | Address | City | State | Zip |
|---|---|---|---|---|
| McCombs LANDFILL | 13600 McCombs | EL PASO | Tx. | 79934 |

2) WELL LOCATION

| County | Physical Address | City | State | Zip |
|---|---|---|---|---|
| | 13600 McCombs | EL PASO | Tx | 79934 |

| Lat. | Long. | Grid # |
|---|---|---|
| | | |

3) Type of Work: ☑ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening

4) Proposed Use (check): ☑ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell ☐ Rig Supply
If Public Supply well, were plans submitted? ☐ Yes ☐ No

5) NT

6) Drilling Date: Started 10/4/01 Completed 10/4/01
GMB-11

Diameter of Hole

| Dia.(in) | From (ft) | To (ft) |
|---|---|---|
| 10 | 0 | 55 |

7) Drilling Method (check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other: HSA

| From (ft) | To (ft) | Description and color of formation material |
|---|---|---|
| 0 | 5.5 | Silt, Calcareous |
| 5.5 | 20 | Sand & gravel |
| 20 | 30 | Sand Moist |
| 30 | 35 | Sand w/gravel |
| 35 | 40 | Sand w/Silt |
| 40 | 50 | Sand w/gravel |
| 50 | 55 | Sand w/Silt |

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion: ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☐ Other 10, 20
If Gravel Packed give the interval from ____ ft. to ____ ft.

Casing, Blank Pipe, and Well Screen Data

| Dia. (in.) | New Or Used | Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial | Setting (ft) From | Setting (ft) To | Gage Casing | Gage Screen |
|---|---|---|---|---|---|---|
| | | See-map | | | | |

9) Cementing Data
Cementing from ____ ft. to ____ ft. # of sacks used ____
____ ft. to ____ ft. # of sacks used ____
Method Used ____
Cementing By ____
Distance to septic system field or other concentrated contamination ____ ft.
Method of verification of above distance ____

13) Plugged ☐ Well plugged within 48 hours
Casing left in well: Cement/Bentonite placed in well:

| From (ft) | To (ft) | From (ft) | To (ft) | Sacks used |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

10) Surface Completion
☐ Specified Surface Slab Installed
☐ Specified Surface Sleeve Installed
☐ Pitless Adapter Used
☐ Approved Alternative Procedure Used

14) Type Pump
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other: ____
Depth to pump bowls, cylinder, jet etc.. ____ ft.

11) Water Level
Static level 5.0 ft. below ____ Date ____
Artesian Flow ____ gpm. Date ____

15) Water Test
Typetest ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ____ gpm with ____ ft. drawdown after ____ hrs.

16) Water Quality
Did you knowingly penetrate a strata which contain undesirable constituents.
☐ YES ☐ NO If yes, did you submit a REPORT OF UNDESIRABLE WATER
Type of water ____ Depth of Strata ____
Was a chemical analysis made ☐ Yes ☐ No

12) Packers

| Type | Depth |
|---|---|
| | |
| | |
| | |

| Company or individual's Name (type or print) | | Lic. No. |
|---|---|---|
| JEDI, INC. | | 4931M |

| Address | City | State | Zip |
|---|---|---|---|
| 1911 N. Lexington Blvd | C.C. | Tx | 78409 |

| Signature | Date | Signature | Date |
|---|---|---|---|
| Paul Danloff | 11/28/01 | | |
| Licensed Driller/Pump Installer | | Apprentice | |

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Water Well Driller/Pump Installer Program
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Toll free (800)803-9202
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This form must be completed and filed with the department and owner within 60 days upon completion of the well.

## WELL REPORT

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1) OWNER

| Name | Address | City | State | Zip |
|---|---|---|---|---|
| McCombs LANDFILL | 13600 McCombs | EL PASO | TX. | 79934 |

2) WELL LOCATION

| County | Physical Address | City | State | Zip |
|---|---|---|---|---|
| | 13600 McCombs | EL PASO | TX. | 79934 |

| Lat. | Long. | Grid # |
|---|---|---|
| | | |

3) Type of Work: ☑ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening — GMP-10

4) Proposed Use (check): ☑ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell ☐ Rig Supply — If Public Supply well, were plans submitted? ☐ Yes ☐ No

5) NT

6) Drilling Date: Started 10/2/01 Completed 10/2/01

Diameter of Hole

| Dia (in) | From (ft) | To (ft) |
|---|---|---|
| 10 | 0 | 55 |

7) Drilling Method (check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☑ Other HSA

| From (ft) | To (ft) | Description and color of formation material |
|---|---|---|
| 0 | 4 | Silt |
| 4 | 30 | Sand Some gravel |
| 30 | 31 | Sand & Silt |
| 31 | 40 | Sand |
| 40 | 45 | Sand Some gravel |
| 45 | 50 | Silt moist |
| 50 | 55 | Sand moist |

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion: ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☐ Other 10/20
If Gravel Packed give the interval from ft. to ft.

Casing, Blank Pipe, and Well Screen Data

| Dia. (in.) | New Or Used | Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial | Setting (ft) From | Setting (ft) To | Cage Casing Screen |
|---|---|---|---|---|---|
| | | See Mud | | | |

9) Cementing Data
Cementing from ____ ft. to ____ ft. # of sacks used ____
____ ft. to ____ ft. # of sacks used ____
Method Used ____
Cementing By ____
Distance to septic system field or other concentrated contamination ____ ft.
Method of verification of above distance ____

13) Plugged ☐ Well plugged within 48 hours
Casing left in well: Cement/Bentonite placed in well:

| From (ft) | To (ft) | From (ft) | To (ft) | Sacks used |
|---|---|---|---|---|
| | N/A | | | |

10) Surface Completion
☑ Specified Surface Slab Installed
☐ Specified Surface Sleeve Installed
☐ Pitless Adapter Used
☐ Approved Alternative Procedure Used

14) Type Pump: ☐ Turbine ☐ Jet N/A ☐ Submersible ☐ Cylinder ☐ Other ____
Depth to pump bowls, cylinder, jet etc. ____ ft.

15) Water Test N/A
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ____ gpm with ____ ft. drawdown after ____ hrs.

11) Water Level
Static level 0-4 ft. below Date ____
Artesian Flow ____ gpm. Date ____

16) Water Quality
Did you knowingly penetrate a strata which contain undesirable constituents.
☐ YES ☐ NO If yes, did you submit a REPORT OF UNDESIRABLE WATER
Type of water ____ Depth of Strata ____
Was a chemical analysis made ☐ Yes ☐ No

12) Packers N/A Type Depth

| Company or individual's Name (type or print) | JEDI, INC. | Lic. No. | 4931M |
|---|---|---|---|
| Address | 1911 N. LEXINGTON Blvd. C.C. | State | TX |
| Zip | 78409 | | |

| Signature | Licensed Driller/Pump Installer | Date | Signature | Apprentice | Date |
|---|---|---|---|---|---|
| | Paul Danilo | 11/28/01 | | | |

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

# Texas Department of License and Regulation

Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Toll free (800)803-9202
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

## WELL REPORT

### A. WELL IDENTIFICATION AND LOCATION DATA

**1) OWNER**

| Name | Address | City | State | Zip |
|---|---|---|---|---|
| McCombs LANDFILL | 13600 McCombs | EL PASO | TX. | 79934 |

**2) WELL LOCATION**

| County | Physical Address | City | State | Zip |
|---|---|---|---|---|
| | 13600 McCombs | EL PASO | TX. | 79934 |

| Lat. | Long. | Grid # |
|---|---|---|
| | | |

**3) Type of Work**
☒ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening
GMP-12

**4) Proposed Use (check)** ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell ☐ Rig Supply
If Public Supply well, were plans submitted? ☐ Yes ☐ No

**5)** NT

**6) Drilling Date**
Started 10/4/01
Completed 10/4/01

**Diameter of Hole**

| Dia.(in) | From (ft) | To (ft) |
|---|---|---|
| 1.5 | 0 | 55 |

**7) Drilling Method (check)** ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☒ Other: HSA

| From (ft) | To (ft) | Description and color of formation material |
|---|---|---|
| 0 | 4.5 | Silt |
| 4.5 | 28.5 | Sand w/gravel |
| 28.5 | 31 | Sand moist |
| 31 | 34 | Sand moist w/silt & gravel |
| 34 | 36.5 | Sand w/silt |
| 36.5 | 48. | Sand w/gravel |
| 48 | 55 | Sand w/silt |

(Use reverse side of Well Owner's copy, if necessary)

**8) Borehole Completion** ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☒ Other 10/20
If Gravel Packed give the interval from ft. to ft.

**Casing, Blank Pipe, and Well Screen Data**

| Dia. (in.) | New Or Used | Steel, Plastic, etc. Perf., Slotted, etc Screen Mfr., if commercial | Setting (ft) From | Setting (ft) To | Gage Casing Screen |
|---|---|---|---|---|---|
| | | See-mfg | | | |

**9) Cementing Data**
Cementing from ____ ft. to ____ ft. # of sacks used ____
____ ft. to ____ ft. # of sacks used ____
Method Used ____
Cementing By ____
Distance to septic system field or other concentrated contamination ____ ft.
Method of verification of above distance ____

**13) Plugged** ☐ Well plugged within 48 hours
Casing left in well: Cement/Bentonite placed in well:

| From (ft) | To (ft) | From (ft) | To (ft) | Sacks used |
|---|---|---|---|---|
| | N/A | | | |

**10) Surface Completion**
☐ Specified Surface Slab Installed
☐ Specified Surface Sleeve Installed
☐ Pitless Adapter Used
☐ Approved Alternative Procedure Used

**14) Type Pump**
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other N/A
Depth to pump bowls, cylinder, jet etc. ____ ft.

**15) Water Test**
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated N/A
Yield: ____ gpm with ____ ft. drawdown after ____ hrs.

**11) Water Level**
Static level DC / ft. below Date ____
Artesian Flow ____ gpm. Date ____

**16) Water Quality**
Did you knowingly penetrate a strata which contain undesirable constituents.
☐ YES ☒ NO If yes, did you submit a REPORT OF UNDESIRABLE WATER
Type of water ____ Depth of Strata ____
Was a chemical analysis made ☐ Yes ☒ No

**12) Packers** N/A

| Type | Depth |
|---|---|
| | |

| Company or individual's Name (type or print) | JEDI, INC. | Lic. No. 4931M |
|---|---|---|
| Address 1911 N. Lexington | City C.C. | State TX Zip 78409 |

| Signature of Licensed Driller/Pump Installer | Date | Signature of Apprentice | Date |
|---|---|---|---|
| David Daniels | 11/28/01 | | / / |

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

# Texas Department of License and Regulation

Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Toll free (800)803-9202
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

## WELL REPORT

### A. WELL IDENTIFICATION AND LOCATION DATA

1) OWNER

| Name | Address | City | State | Zip |
|---|---|---|---|---|
| McCombs LANDFILL | 13600 McCombs | EL PASO | Tx. | 79934 |

2) WELL LOCATION

| County | Physical Address | City | State | Zip |
|---|---|---|---|---|
| | 13600 McCombs | EL PASO | Tx | 79934 |

| Lat. | Long. | Grid # |
|---|---|---|
| | | |

3) Type of Work: ☐ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening — GMP-13

4) Proposed Use (check): ☐ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell ☐ Rig Supply — If Public Supply well, were plans submitted? ☐ Yes ☐ No

5) NT

6) Drilling Date: Started 10 3 01 Completed 10 3 01

| Diameter of Hole | Dia (in) | From (ft) | To (ft) |
|---|---|---|---|
| | 10 | 0 | 55 |

7) Drilling Method (check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other: HSA

| From (ft) | To (ft) | Description and color of formation material |
|---|---|---|
| 0 | 7.5 | Silt |
| 7.5 | 31 | Sand w/gravel |
| 31 | 35 | sand w/silt |
| 35 | 40 | Sand w/gravel |
| 40 | 50 | Same |
| 50 | 55 | Sand w/silt |

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion: ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☐ Other 10/20
If Gravel Packed give the interval from ____ ft. to ____ ft.

Casing, Blank Pipe, and Well Screen Data

| Dia. (in.) | New Or Used | Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfr., if commercial | Setting (ft) From | Setting (ft) To | Gage Casing | Gage Screen |
|---|---|---|---|---|---|---|
| | | See map | | | | |

9) Cementing Data
Cementing from ____ ft. to ____ ft. # of sacks used ____
____ ft. to ____ ft. # of sacks used ____
Method Used ____
Cementing By ____
Distance to septic system field or other concentrated contamination ____ ft.
Method of verification of above distance ____

13) Plugged ☐ Well plugged within 48 hours
Casing left in well: Cement/Bentonite placed in well:

| From (ft) | To (ft) | From (ft) | To (ft) | Sacks used |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

10) Surface Completion
☐ Specified Surface Slab Installed
☐ Specified Surface Sleeve Installed
☐ Pitless Adapter Used
☐ Approved Alternative Procedure Used

14) Type Pump
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other ____
Depth to pump bowls, cylinder, jet etc. ____ ft.

11) Water Level
Static level ____ ft. below ____ Date ____
Artesian Flow ____ gpm. Date ____

15) Water Test
Typetest ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ____ gpm with ____ ft. drawdown after ____ hrs.

16) Water Quality
Did you knowingly penetrate a strata which contain undesirable constituents.
☐ YES ☐ NO If yes, did you submit a REPORT OF UNDESIRABLE WATER
Type of water ____ Depth of Strata ____
Was a chemical analysis made ☐ Yes ☐ No

12) Packers

| Type | Depth |
|---|---|
| | |
| | |

| Company or individual's Name (type or print) | JEDI, INC. | Lic. No. | 493M |
|---|---|---|---|
| Address | 1961 N. Lexington | City | C.C. |
| State | Tx. | Zip | 78409 |

| Signature | Licensed Driller/Pump Installer | Date | Signature | Apprentice | Date |
|---|---|---|---|---|---|
| | Paul Daniels | 11/28/01 | | | |

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Toll free (800)803-9202
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

## WELL REPORT

### A. WELL IDENTIFICATION AND LOCATION DATA

1) OWNER

| Name | Address | City | State | Zip |
|---|---|---|---|---|
| McCombs LANDFILL | 13600 McCombs | EL PASO | Tx. | 79934 |

2) WELL LOCATION

| County | Physical Address | City | State | Zip |
|---|---|---|---|---|
| | 13600 McCombs | EL PASO | Tx. | 79934 |

Lat. | Long. | Grid #

3) Type of Work: ☑ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening — GMP-14

4) Proposed Use (check): ☐ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell ☐ Rig Supply — If Public Supply well, were plans submitted? ☐ Yes ☐ No

5) NT

6) Drilling Date: Started 10/3/01 Completed 10/4/01

Diameter of Hole

| Dia.(in) | From (ft) | To (ft) |
|---|---|---|
| 10 | 0 | 57 |

7) Drilling Method (check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☑ Other: HSA

| From (ft) | To (ft) | Description and color of formation material |
|---|---|---|
| 0 | 7.5 | Clay w/silt |
| 7.5 | 14 | Silt w/Caliche |
| 14 | 20 | Sand w/gravel |
| 20 | 35 | Small Sand |
| 35 | 45 | Sand w/silt |
| 45 | 50 | Sand w/Gravel |
| 50 | 55 | Sand w/silt |
| 55 | 57 | Clay silt |

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion: ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☐ Other 10/20
If Gravel Packed give the interval from ft. to ft.

Casing, Blank Pipe, and Well Screen Data

| Dia. (in.) | New Or Used | Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfr., if commercial | Setting (ft) From | Setting (ft) To | Gage Casing | Gage Screen |
|---|---|---|---|---|---|---|
| | | See map | | | | |

9) Cementing Data
Cementing from ft. to ft. # of sacks used
ft. to ft. # of sacks used
Method Used
Cementing By
Distance to septic system field or other concentrated contamination ft.
Method of verification of above distance

10) Surface Completion
☑ Specified Surface Slab Installed
☐ Specified Surface Sleeve Installed
☐ Pitless Adapter Used
☐ Approved Alternative Procedure Used

13) Plugged ☐ Well plugged within 48 hours
Casing left in well: Cement/Bentonite placed in well:

| From (ft) | To (ft) | From (ft) | To (ft) | Sacks used |
|---|---|---|---|---|
| | N/A | | | |

14) Type Pump: N/A ☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other:
Depth to pump bowls, cylinder, jet etc. ft.

15) Water Test: N/A
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

11) Water Level
Static level 24 ft. below Date
Artesian Flow gpm. Date

16) Water Quality
Did you knowingly penetrate a strata which contain undesirable constituents,
☐ YES ☑ NO If yes, did you submit a REPORT OF UNDESIRABLE WATER
Type of water Depth of Strata
Was a chemical analysis made ☐ Yes ☑ No

12) Packers: N/A Type Depth

| Company or individual's Name (type or print) | JEDI, INC. | Lic. No. | 4931M |
|---|---|---|---|
| Address | 1911 N. LEXINGTON | City | C.C. |
| State | TX. | Zip | 78409 |

| Signature | Date | Signature | Date |
|---|---|---|---|
| Paul Daniels | 11/28/01 | | |
| Licensed Driller/Pump Installer | | Apprentice | |

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

# Texas Department of License and Regulation

Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Toll free (800)803-9202
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

## WELL REPORT

### A. WELL IDENTIFICATION AND LOCATION DATA

1) OWNER

| Name | Address | City | State | Zip |
|---|---|---|---|---|
| McCombs LANDFILL | 13600 McCombs | El Paso | Tx. | 79934 |

2) WELL LOCATION

| County | Physical Address | City | State | Zip |
|---|---|---|---|---|
| El Paso | 13600 McCombs | El Paso | Tx. | 79934 |

| Lat. | Long. | Grid # |
|---|---|---|
| | | |

3) Type of Work: ☒ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening

4) Proposed Use (check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell ☐ Rig Supply. If Public Supply well, were plans submitted? ☐ Yes ☐ No

5) NT

6) Drilling Date: Started 10/5/01 Completed 10/5/01

Diameter of Hole

| Dia.(in) | From (ft) | To (ft) |
|---|---|---|
| 10 | 0 | 56.5 |

7) Drilling Method (check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other: HSA

| From (ft) | To (ft) | Description and color of formation material |
|---|---|---|
| 0 | 12 | Silt Calareous |
| 12 | 30 | Sand w/gravel |
| 30 | 39 | Sand w/silt |
| 39 | 50 | Sand w/gravel |
| 50 | 55 | Sand w/silt |
| 55 | 56.5 | silty Sand |

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion: ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☒ Other 0 20
If Gravel Packed give the interval from ____ ft. to ____ ft.

Casing, Blank Pipe, and Well Screen Data

| Dia. (in.) | New Or Used | Steel, Plastic, etc. Perf., Slotted, etc Screen Mfr., if commercial | Setting (ft) From | Setting (ft) To | Gage Casing | Gage Screen |
|---|---|---|---|---|---|---|
| | | See map | | | | |

9) Cementing Data
Cementing from ____ ft. to ____ ft. # of sacks used ____
____ ft. to ____ ft. # of sacks used ____
Method Used ____
Cementing By ____
Distance to septic system field or other concentrated contamination ____ ft.
Method of verification of above distance ____

13) Plugged ☐ Well plugged within 48 hours

| Casing left in well: From (ft) | To (ft) | Cement/Bentonite placed in well: From (ft) | To (ft) | Sacks used |
|---|---|---|---|---|
| | | | | |

10) Surface Completion
☐ Specified Surface Slab Installed
☐ Specified Surface Sleeve Installed
☐ Pitless Adapter Used
☐ Approved Alternative Procedure Used

14) Type Pump
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other: ____
Depth to pump bowls, cylinder, jet etc. ____ ft.

11) Water Level
Static level ____ ft. below ____ Date ____
Artesian Flow ____ gpm. Date ____

15) Water Test
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ____ gpm with ____ ft. drawdown after ____ hrs.

16) Water Quality
Did you knowingly penetrate a strata which contain undesirable constituents.
☐ YES ☐ NO If yes, did you submit a REPORT OF UNDESIRABLE WATER
Type of water ____ Depth of Strata ____
Was a chemical analysis made ☐ Yes ☐ No

12) Packers

| Type | Depth |
|---|---|
| | |

| Company or individual's Name (type or print) | JEDI, INC | Lic. No. | 4931M |
|---|---|---|---|
| Address | 1911 N. Lexington | City C.C. | State Tx Zip 78409 |
| Signature (Licensed Driller/Pump Installer) | Paul Daniloff | Date 11/28/01 | Signature (Apprentice) / Date |

Received Time Nov. 28. 10:48AM

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

# Texas Department of License and Regulation

Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Toll free (800)803-9202
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

## WELL REPORT

### A. WELL IDENTIFICATION AND LOCATION DATA

**1) OWNER**

| Name | Address | City | State | Zip |
|---|---|---|---|---|
| McCombs LANDFILL | 13600 McCombs | EL PASO | Tx | 79934 |

**2) WELL LOCATION**

| County | Physical Address | City | State | Zip |
|---|---|---|---|---|
| EL PASO | 13600 McCombs | EL PASO | Tx | 79934 |

| Lat. | Long. | Grid # |
|---|---|---|
| | | |

**3) Type of Work**
☑ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening
GMP-16

**4) Proposed Use (check)** ☑ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell ☐ Rig Supply
If Public Supply well, were plans submitted? ☐ Yes ☐ No

**5)** NT

**6) Drilling Date**
Started 10/8/01
Completed 10/8/01

**Diameter of Hole**

| Dia.(in) | From (ft) | To (ft) |
|---|---|---|
| 10 | 0 | 55 |
| | | |
| | | |

**7) Drilling Method (check)** ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☑ Other HSA

| From (ft) | To (ft) | Description and color of formation material |
|---|---|---|
| 0 | 7 | Clay, Sand |
| 7 | 15 | silt |
| 15 | 22 | Clay, silt Calcareous |
| 22 | 51 | Sand w/gravel |
| 51 | 55 | Sand w/silt |

(Use reverse side of Well Owner's copy, if necessary)

**8) Borehole Completion** ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☐ Other 10/20
If Gravel Packed give the interval from ft. to ft.

**Casing, Blank Pipe, and Well Screen Data**

| Dia. (in.) | New Or Used | Steel, Plastic, etc. Perf., Slotted, etc Screen Mfr., if commercial | Setting (ft) From | Setting (ft) To | Gage Casing | Gage Screen |
|---|---|---|---|---|---|---|
| | | See map | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

**9) Cementing Data**
Cementing from ft. to ft. # of sacks used
ft. to ft. # of sacks used
Method Used
Cementing By
Distance to septic system field or other concentrated contamination ft.
Method of verification of above distance

**13) Plugged** ☐ Well plugged within 48 hours
Casing left in well: Cement/Bentonite placed in well:

| From (ft) | To (ft) | From (ft) | To (ft) | Sacks used |
|---|---|---|---|---|
| | N/A | | | |
| | | | | |
| | | | | |

**10) Surface Completion**
☒ Specified Surface Slab Installed
☐ Specified Surface Sleeve Installed
☐ Pitless Adapter Used
☐ Approved Alternative Procedure Used

**14) Type Pump**
☐ Turbine ☐ Jet N/A ☐ Submersible ☐ Cylinder
☐ Other:
Depth to pump bowls, cylinder, jet etc. ft.

**15) Water Test** N/A
Typetest ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

**11) Water Level**
Static level DRY ft. below Date / /
Artesian Flow gpm. Date / /

**16) Water Quality**
Did you knowingly penetrate a strata which contain undesirable constituents.
☐ YES ☒ NO If yes, did you submit a REPORT OF UNDESIRABLE WATER
Type of water Depth of Strata
Was a chemical analysis made ☐ Yes ☒ No

**12) Packers**

| Type | Depth |
|---|---|
| | |
| | |
| | |

| Company or individual's Name (type or print) | JEDI, INC. | Lic. No. | 493/M |
|---|---|---|---|
| Address | 1911 N. Lexington Blvd | City C.C. | State Tx Zip 78409 |

| Signature Licensed Driller/Pump Installer | Date | Signature Apprentice | Date |
|---|---|---|---|
| Paul Davidson | 11, 28, 01 | | / / |

TDLR FORM 001WWD White - TDLR Yellow - Owner Pink - Driller/Pump Installer

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

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Water Well Driller/Pump Installer Program
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Toll free (800)803-9202
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

## WELL REPORT

### A. WELL IDENTIFICATION AND LOCATION DATA

**1) OWNER**

| Name | Address | City | State | Zip |
|---|---|---|---|---|
| McCombs LANDFILL | 13600 McCombs | EL PASO | TX. | 79934 |

**2) WELL LOCATION**

| County | Physical Address | City | State | Zip |
|---|---|---|---|---|
| EL PASO | 13600 McCombs | EL PASO | TX. | 79934 |

Lat. | Long. | Grid #

**3) Type of Work**
☒ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening
GMP-17

**4) Proposed Use** (check) ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell ☐ Rig Supply
If Public Supply well, were plans submitted? ☐ Yes ☐ No

**5)** NT

**6) Drilling Date**
Started 10 3 01
Completed 10 4 01

**Diameter of Hole**

| Dia.(in) | From (ft) | To (ft) |
|---|---|---|
| 10 | 0 | 55 |
| | | |
| | | |

**7) Drilling Method** (check) ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☒ Other HSA

| From (ft) | To (ft) | Description and color of for mation material |
|---|---|---|
| 0 | 22 | Clay, Silty |
| 22 | 55 | Sand w/gravel |

(Use reverse side of Well Owner's copy, if necessary)

**8) Borehole Completion** ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☐ Other 10/20
If Gravel Packed give the interval from ft. to ft.

**Casing, Blank Pipe, and Well Screen Data**

| Dia. (in.) | New Or Used | Steel, Plastic, etc. Perf., Slotted, etc Screen Mfg., if commercial | Setting (ft) From | Setting (ft) To | Gage Casing | Gage Screen |
|---|---|---|---|---|---|---|
| | | See map | | | | |
| | | | | | | |
| | | | | | | |

**9) Cementing Data**
Cementing from ft. to ft. # of sacks used
ft. to ft. # of sacks used
Method Used
Cementing By
Distance to septic system field or other concentrated contamination ft.
Method of verification of above distance

**13) Plugged** ☐ Well plugged within 48 hours
Casing left in well: Cement/Bentonite placed in well: N/A

| From (ft) | To (ft) | From (ft) | To (ft) | Sacks used |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

**10) Surface Completion**
☒ Specified Surface Slab Installed
☐ Specified Surface Sleeve Installed
☐ Pitless Adapter Used
☐ Approved Alternative Procedure Used

**14) Type Pump** N/A
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet etc. ft.

**15) Water Test** N/A
Typetest ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

**11) Water Level**
Static level 10.4 ft. below Date / /
Artesian Flow gpm. Date / /

**16) Water Quality**
Did you knowingly penetrate a strata which contain undesirable constituents.
☐ YES ☒ NO If yes, did you submit a REPORT OF UNDESIRABLE WATER
Type of water Depth of Strata
Was a chemical analysis made ☐ Yes ☐ No

**12) Packers** N/A Type Depth

| Company or individual's Name (type or print) | JEDI INC. | Lic. No. 4931M |
|---|---|---|
| Address 1911 N Lexington Blvd | City C.C. | State TX Zip 78409 |

| Signature (Licensed Driller/Pump Installer) | Date | Signature (Apprentice) | Date |
|---|---|---|---|
| Paul Daniels | 11, 28, 01 | | / / |

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

# Texas Department of License and Regulation

Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Toll free (800)803-9202
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

## WELL REPORT

### A. WELL IDENTIFICATION AND LOCATION DATA

**1) OWNER**

| Name | Address | City | State | Zip |
|---|---|---|---|---|
| McCombs LANDFILL | 13600 McCombs | EL PASO | Tx. | 79934 |

**2) WELL LOCATION**

| County | Physical Address | City | State | Zip |
|---|---|---|---|---|
| EL PASO | 13600 McCombs | EL PASO | Tx. | 79934 |

Lat. Long. Grid #

**3) Type of Work**
☒ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening
PVW-3

**4) Proposed Use** (check) ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell ☐ Rig Supply
If Public Supply well, were plans submitted? ☐ Yes ☐ No

**5)** NT

**6) Drilling Date**
Started 9 28 01
Completed 9 28 01

**Diameter of Hole**

| Dia.(in) | From (ft) | To (ft) |
|---|---|---|
| 15 | 0 | 56 |

**7) Drilling Method** (check) ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☒ Other: HSA

| From (ft) | To (ft) | Description and color of formation material |
|---|---|---|
| 0 | 15 | Sand w/gravel Reddish brown |
| 15 | 25 | Sand w/caliche |
| 25 | 56 | Sand w/gravel |

(Use reverse side of Well Owner's copy, if necessary)

**8) Borehole Completion** ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☒ Other #3/8 Gravel
If Gravel Packed give the interval from 56 ft. to 45 ft.

**Casing, Blank Pipe, and Well Screen Data**

| Dia. (in.) | New Or Used | Steel, Plastic, etc. Perf., Slotted, etc Screen Mfr., if commercial | Setting (ft) From | Setting (ft) To | Gage Casing Screen |
|---|---|---|---|---|---|
| 4 | N | PVC RISER | 5 | +7 | 40 slot |
| 4 | N | PVC SCREEN | 56 | 5 | .020 |

**9) Cementing Data**
Cementing from 3 ft. to 0 ft. #of sacks used 6
B/S 5 ft. to 3 ft. #of sacks used 3
Method Used
Cementing By
Distance to septic system field or other concentrated contamination ft.
Method of verification of above distance

**13) Plugged** ☐ Well plugged within 48 hours
Casing left in well: Cement/Bentonite placed in well: N/A

| From (ft) | To (ft) | From (ft) | To (ft) | Sacks used |
|---|---|---|---|---|
| | | | | |

**10) Surface Completion**
☒ Specified Surface Slab Installed
☐ Specified Surface Sleeve Installed
☐ Pitless Adapter Used
☐ Approved Alternative Procedure Used

**14) Type Pump** N/A
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other:
Depth to pump bowls, cylinder, jet etc., ft.

**15) Water Test** N/A
Typetest ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

**11) Water Level**
Static level DRY ft. below Date / /
Artesian Flow gpm. Date / /

**16) Water Quality**
Did you knowingly penetrate a strata which contain undesirable constituents.
☐ YES ☒ NO If yes, did you submit a REPORT OF UNDESIRABLE WATER
Type of water Depth of Strata
Was a chemical analysis made ☐ Yes ☒ No

**12) Packers** N/A Type Depth

| Company or individual's Name (type or print) | JEDI, INC. | Lic. No. | 4931M |
|---|---|---|---|
| Address 1911 N. Lexington Blvd. | City C.C. | State Tx. | Zip 78409 |
| Signature Licensed Driller/Pump Installer | Paul Daniels 11,28,01 Date | Signature Apprentice | / / Date |

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

# Texas Department of License and Regulation

Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Toll free (800)803-9202
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

## WELL REPORT

### A. WELL IDENTIFICATION AND LOCATION DATA

1) OWNER

| Name | Address | City | State | Zip |
|---|---|---|---|---|
| USACE | 1202 N. Hickory | Ft. Pecos | Tx. | |

2) WELL LOCATION

| County | Physical Address | City | State | Zip |
|---|---|---|---|---|
| Reeves | 1202 N. Hickory | Ft. Pecos | Tx. | |

Lat. | Long. | Grid #

3) Type of Work: ☑ New Well ☐ Reconditioning ☐ Replacement ☐ Deepening — MW 4-6

4) Proposed Use (check): ☑ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell ☐ Rig Supply — If Public Supply well, were plans submitted? ☐ Yes ☐ No

5) NT

6) Drilling Date: Started 9/27/01 Completed 9/28/01

Diameter of Hole

| Diameter | From (ft) | To (ft) |
|---|---|---|
| 8 | 0 | 20 |

7) Drilling Method (check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other: HSA

| From (ft) | To (ft) | Description and color of formation material |
|---|---|---|
| 0 | 17.5 | silty sand |
| 17.5 | 20 | wet silty sand |

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion: ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☐ Other 20/40
If Gravel Packed give the interval from 20 ft. to 8 ft.

Casing, Blank Pipe, and Well Screen Data

| Dia. (in.) | New Or Used | Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfr., if commercial | Setting (ft) From | Setting (ft) To | Gage Casing | Gage Screen |
|---|---|---|---|---|---|---|
| 2 | N | PVC Reed | 10 | 0 | 40 | |
| 2 | N | PVC Screen | 20 | 10 | | 010 |

9) Cementing Data
Cementing from 6 ft. to 0 ft. # of sacks used 1
BS 8 ft. to 6 ft. # of sacks used 1
Method Used hand
Cementing By JEDI
Distance to septic system field or other concentrated contamination ___ ft.
Method of verification of above distance ___

13) Plugged ☐ Well plugged within 48 hours — N/A

| Casing left in well: From (ft) | To (ft) | Cement/Bentonite placed in well: From (ft) | To (ft) | Sacks used |
|---|---|---|---|---|
| | | | | |

10) Surface Completion
☒ Specified Surface Slab Installed
☐ Specified Surface Sleeve Installed
☐ Pitless Adapter Used
☐ Approved Alternative Procedure Used

14) Type Pump: ☐ Turbine ☐ Jet N/A ☐ Submersible ☐ Cylinder ☐ Other:
Depth to pump bowls, cylinder, jet etc. ___ ft.

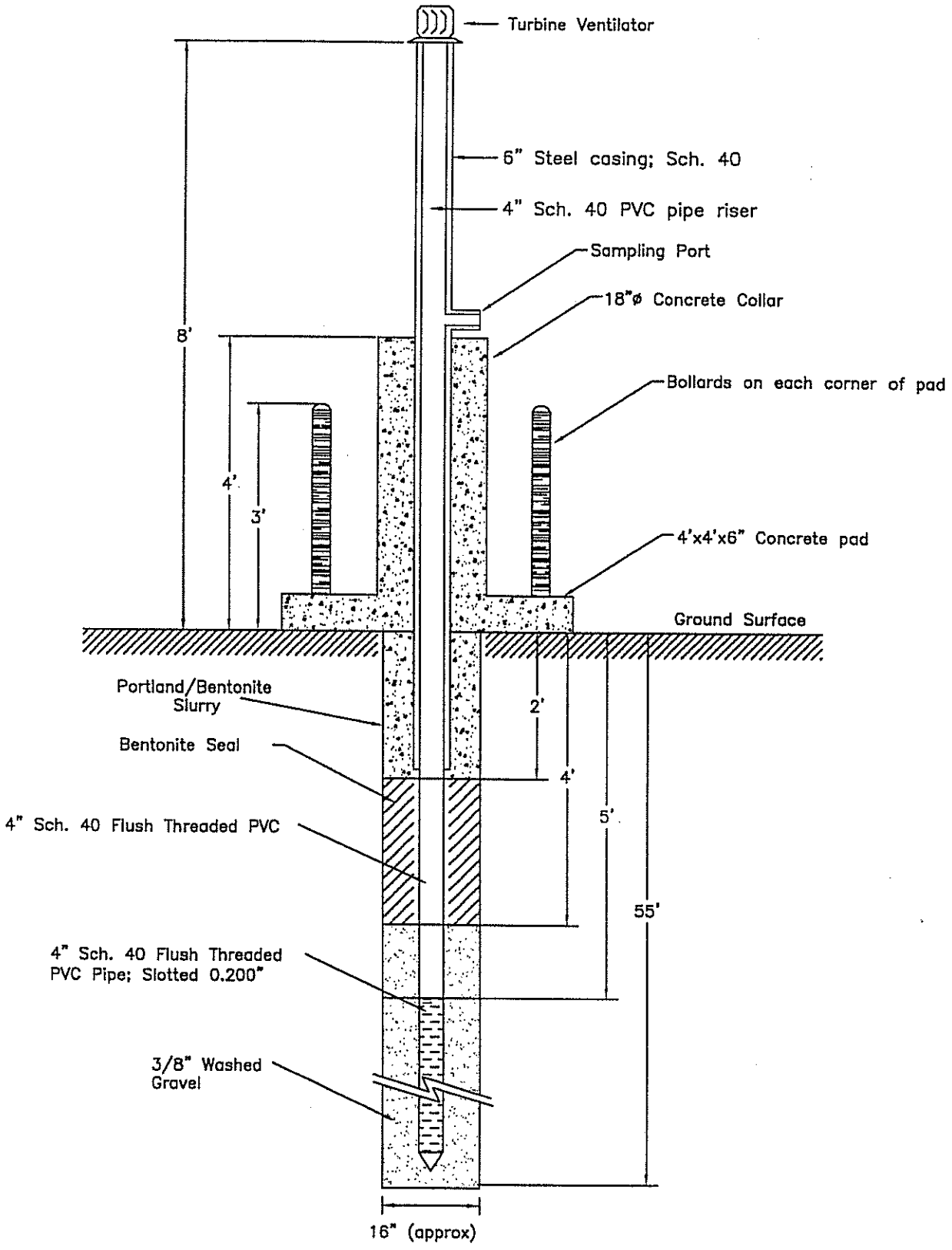
15) Water Test: Typetest ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated N/A
Yield: ___ gpm with ___ ft. drawdown after ___ hrs.

11) Water Level: Static level 16.4 ft. below Date ___
Artesian Flow ___ gpm. Date ___

16) Water Quality
Did you knowingly penetrate a strata which contain undesirable constituents.
☐ YES ☒ NO If yes, did you submit a REPORT OF UNDESIRABLE WATER
Type of water ___ Depth of Strata ___
Was a chemical analysis made ☐ Yes ☒ No

12) Packers N/A Type Depth

| Company or individual's Name (type or print) | JEDI, INC. | Lic. No. | 4931M |
|---|---|---|---|
| Address | 1911 N. Lexington | City C.C. | State Tx Zip 78409 |
| Signature | Paul Daniloff 11,28,01 | Signature | |
| Licensed Driller/Pump Installer | Date | Apprentice | Date |




| DRAWN BY: | REVIEWED BY: | ENGINEER: | JOB NO. | TITLE: | DATE: |
|---|---|---|---|---|---|
| AS | JM | PATRICK GOBB | CITY.03.33.34 | McCOMBS LANDFILL | 09/21/01 |

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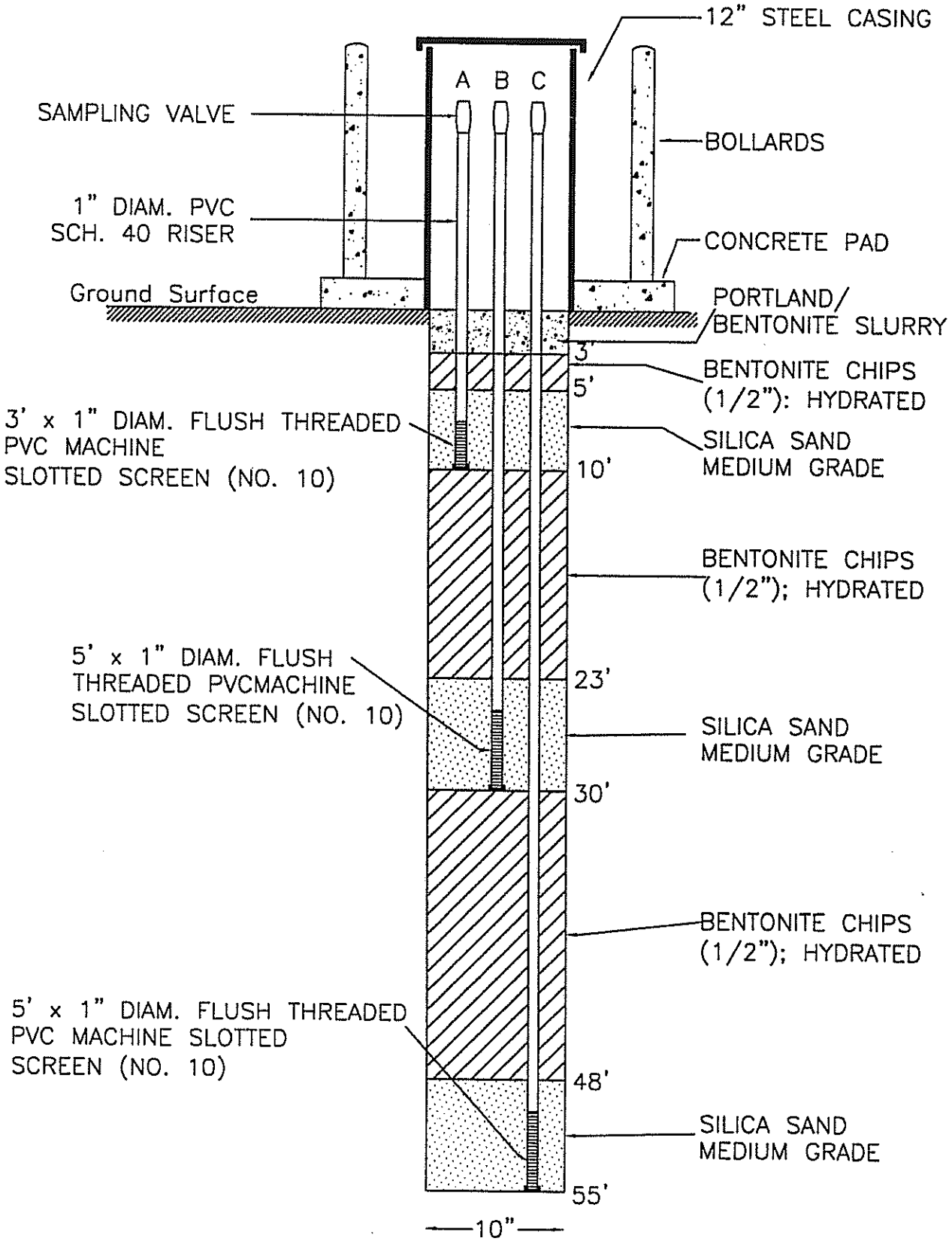
VIVA ENVIRONMENTAL,INC.
7201 STILES DR.
EL PASO, TX.79915

TITLE: PASSIVE VENTING WELL CONSTRUCTION PLAN

| DRAWING NO. | SCALE: |
|---|---|
| 02 | NTS |




| DRAWN BY: | REVIEWED BY: | APPROVED BY: | JOB NO. | LOCATION: | DATE: |
|---|---|---|---|---|---|
| AS | JM | PATRICK GOBB | CITY.03.33.34 | McCOMBS LANDFILL | 08/16/01 |

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VIVA ENVIRONMENTAL,INC.
7201 STILES DR.
EL PASO, TX.79915

TITLE: GAS MONITORING PROBE CONSTRUCTION PLAN

DRAWING NO. FIGURE 03 | SCALE: NTS

# McCOMBS LANDFILL QUARTERLY METHANE INSPECTION FORM

Table 1. Landfill Conditions

| |
|---|
| Report Completed By: Date: |
| Temperature: °F Atmospheric Pressure: in of Hg in of $H_2O$ |
| Cumulative rainfall since last monitoring event: |
| Ambient conditions (Weather): |
| Methane monitor charge check: Methane monitor calibration check: |

Table 2. GMP Monitoring

| GMP Number | Gas Probe Pressure | Ambient Methane Reading | GMP Peak Methane Reading | GMP Steady State Methane Reading |
|---|---|---|---|---|
| 1 A | | | | |
| 1 B | | | | |
| 1 C | | | | |
| 2 A | | | | |
| 2 B | | | | |
| 2 C | | | | |
| 3 A | | | | |
| 3 B | | | | |
| 3 C | | | | |
| 4 A | | | | |
| 4 B | | | | |
| 4 C | | | | |
| 7 A | | | | |
| 9 A | | | | |
| 9 B | | | | |
| 9 C | | | | |
| 10 A | | | | |
| 10 B | | | | |
| 10 C | | | | |
| 11 A | | | | |
| 11 B | | | | |
| 11 C | | | | |
| 12 A | | | | |
| 12 B | | | | |
| 12 C | | | | |
| 13 A | | | | |
| 13 B | | | | |
| 13 C | | | | |

Table 2. GMP Monitoring (cont.)

| GMP Number | Gas Probe Pressure | Ambient Methane Reading | GMP Peak Methane Reading | GMP Steady State Methane Reading |
|---|---|---|---|---|
| 14 A | | | | |
| 14 B | | | | |
| 14 C | | | | |
| 15 A | | | | |
| 15 B | | | | |
| 15 C | | | | |
| 16 A | | | | |
| 16 B | | | | |
| 16 C | | | | |
| 17 A | | | | |
| 17 B | | | | |
| 17 C | | | | |

Table 3. GMP Monitoring

| Structure | Methane Readings (Range) | Comments |
|---|---|---|
| Fee Collection Building | | |
| Maintenance Building | | |
| Southern Storage Building | | |
| Northern Storage Building | | |

Table 4. Maintenance Inspection Table

| Item | Damage (yes/no) | Comments |
|---|---|---|
| Identification Number | | |
| Protective Barrier Bars | | |
| Working Pad | | |
| Lock | | |
| Hinged Cover | | |
| Top of Casing | | |
| Fittings | | |

ADDITIONAL COMMENTS

_____

_____

_____

_____

_____

# LANDFILL GAS MANAGEMENT PLAN

**McCOMBS LANDFILL**
**EL PASO, TEXAS**
**MODIFICATION TO**
**PERMIT NO. 729A**

**PREPARED FOR:**

**CITY OF EL PASO**
**PUBLIC WORKS DEPARTMENT**
**2 CIVIC CENTER PLAZA**
**EL PASO, TEXAS 79901**

**AND**

**TEXAS NATURAL RESOURCE CONSERVATION COMMISSION**
**MUNICIPAL SOLID WASTE DIVISION**
**AUSTIN, TEXAS**

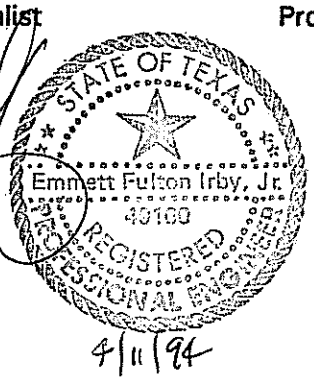
**SHB AGRA JOB NO. E94-4037**

**APRIL 8, 1994**


Brenda Barnes
Environmental Specialist

Jamie R. Barnes, P.G.
Project Manager

Emmett F. Irby, P.E.
Vice President


4/11/94

AGRA
*Earth & Environmental Group*

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## EXECUTIVE SUMMARY

A Landfill Gas Management Plan, to be a modification to the McCombs Sanitary Landfill Operating Plan, has been completed by SHB AGRA, Inc. The plan was developed in order to comply with requirements set forth by the Texas Natural Resource Conservation Commission, under Chapter 330 of the Texas Administrative Code.

To develop the plan, a review of existing geotechnical, geological, and hydrogeological data for the site was performed. Details of waste thickness were obtained from City of El Paso personnel familiar with the site. A site and perimeter survey was performed to document the presence of any permanent enclosed structures on-site or within 3,000 feet of the landfill boundary. The presence of subsurface utility corridors was also researched.

Our survey of adjacent properties indicated that the land surrounding the permitted area is generally undeveloped desert terrain. A small housing development lies approximately 1,500 feet northeast of the permitted area, however, the nearest residence is over 4,000 feet from the operational area of the landfill. Few other permanent enclosed structures are present within 3,000 feet of the operational area. No evidence of stressed or dead vegetation which would be indicative of gas migration was observed.

A review of available geologic/soil data revealed no laterally extensive stratigraphic units which could significantly affect the migration of methane. Based on all available information, a plan for the initial monitoring, as well as the placement of the permanent perimeter monitoring network probes, was developed.

Initial methane monitoring was performed by the installation of soil gas vapor probes (SGVPs) every 1,000 feet around the perimeter of the facility. The probes were installed to depths ranging from four to eleven feet below the surface. Monitoring conducted of each of the SVGPs and within all on-site structures indicated no detectable concentrations of methane present.

Permanent gas monitoring probes (GMPs) will be installed at each of the SVGP locations. Probes will be placed at various depths at each location, based on the depth of waste within 1,000 feet of each monitoring point. Monitoring for methane will be performed on a quarterly basis. In addition to the perimeter survey monitoring, the plan specifies that all structures on-site will be monitored for the presence of methane during each quarterly monitoring event.

In addition to measurement of the methane concentrations at each monitoring point and within each structure on-site, basic parameters including barometric pressure, probe pressure, temperature and the cumulative on-site rainfall since the last monitoring event will be noted.

The Methane Monitoring plan also includes a contingency plan for actions should methane concentrations in excess of 25% of the LEL be detected in any of the on-site structures, or in excess of the LEL at the landfill perimeter.

## 1. INTRODUCTION

Recent revisions to the EPA's Subtitle D and the State of Texas adaptation of the same requires large municipal landfills to have a methane monitoring program submitted as a modification to the landfill's permit. Pursuant to 30 TAC § 330.56, a methane monitoring plan is required to be submitted to the TNRCC by April 9, 1994, for any site accepting 100 or more tons per day of municipal solid waste.

This document presents supporting data and justification for an amendment to Permit No. 729A for the inclusion of a landfill gas management and methane monitoring plan. It is the intent of SHB and the City of El Paso that this plan be a "living document", subject to revision and amendment as the program develops and landfill operations expand. It is also our intent that this document be made a part of the landfill operating plan.

This plan is based in a large part on our review and interpretation of the following documents:

- Title 40 Code of Federal Regulations, § 258.23
- Title 30 TAC § 330.56
- TNRCC Municipal Solid Waste Division Methane Monitoring Handbook, Version 2 (TNRCC, 1993)
- EPA Solid Waste Disposal Facility Criteria Technical Manual (EPA, 1993)

### 1.1 METHANE GENERATION

The microbial degradation of solid waste within a landfill is known to produce a variety of gases, such as methane, carbon dioxide, hydrogen, hydrogen sulfide and a number of volatile organic compounds. Methane gas is a concern in evaluating landfill gas generation because it is both odorless and combustible (EPA, 1993). Migration of methane and any other gases produced within a landfill cell has the potential to migrate from localized areas of high microbial activity. The generation of these gases is controlled by a variety of factors resulting in formation of pressure, concentration or density gradients. These factors, coupled with the permeability of the units through which the gases may travel, control gas migration.

Methane and associated gases present the potential for an explosive hazard when at concentrations exceeding 25 percent of the lower explosive limit. Due to the risk to human health and safety, the existence of and potential for migration of methane into structures is of concern and thus regulated.

## 1.2 SITE LOCATION

The McCombs Landfill (Permit No. 729A) is located approximately 20 miles northeast of downtown El Paso at the northeast corner of the intersection of McCombs Road and Farm Road 2529 (Figure 1). The site encompasses over 300 acres, of which only a portion has been landfilled. The landfill currently accepts about 220 tons of domestic waste per day.

## 2. SITE CONDITIONS

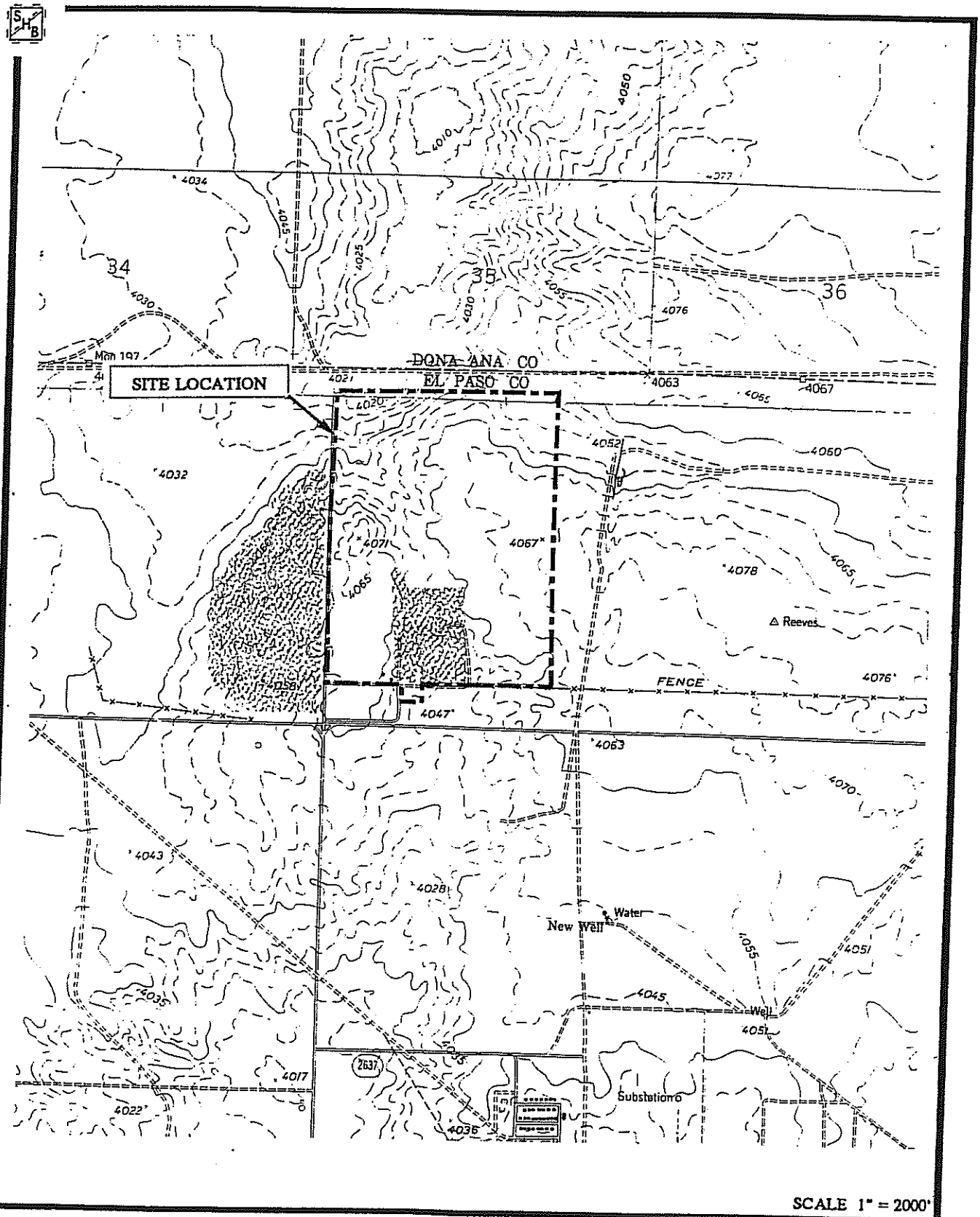
## 2.1 LANDFILL OPERATIONS

Although a total of 327 acres has been permitted for landfilling, at the time of preparation of this report, the City has access to an area of only approximately 100 acres (Borrego, 1994). This operational area of 100 acres is divided into four sections of roughly equal size.

The general layout of the facility is shown in Figure 2. The southeastern section apparently is an old landfill cell that has been capped and re-vegetated. This area was first permitted by the Texas Department of Health (TDH) to receive solid waste in 1976 (Permit No. 729, dated August 17, 1976), and later incorporated into the 327 acre parcel permitted through Permit No. 729-A, dated May 30, 1984. To the north of this completed cell is an area that was used during the first phase of landfilling. This cell also has been capped and is undergoing revegetation. According to City records, these two cells were used during the 1960's. The waste in these areas was apparently placed at or near the surface, according to Tony Borrego (1994), of the El Paso City Engineering Department. Little or no excavation was performed during the time these cells were utilized. Based on information available, the bottom of the waste in these areas is estimated at less than five feet below the surrounding natural land surface.

The current phase of landfilling is confined to the northwest quadrant of the operational area. The southwest quadrant of the operational area will be used for future landfilling operations. These areas were developed in the 1960's, 1970's and 1980's as a quarrying operation. Excavations up to approximately 55 feet below the surrounding land surface were opened during quarrying. Current landfilling is conducted within the previously excavated area. The bottom of the waste is estimated to be about 50 to 55 feet below the surface in this cell (Borrego, 1994).

The "area method" of landfilling is used at the McCombs Landfill (Serrano, 1993). According to Mr. Serrano, landfilling operations typically commence in a relatively small area within the section of the site dedicated to that particular phase of landfilling. Operations then spread out from this initial area as required. Salvaging operations at the landfill are performed by the Amaya Corporation under contract with the City. The remainder of the waste is compacted using bulldozers and other earthworking equipment. The refuse is covered with native soil on a continuous basis. Native soil is used to provide no less than 6 inches of cover at the end of each day.




Ref: U.S.G.S. 7 ½' quad., North Franklin Mtn., Tex., 1955 (1967, 1973);

Landfill Gas Management Plan
McCombs Landfill
El Paso, Texas
Job No. E94-4037

Figure 1
Site Location Map

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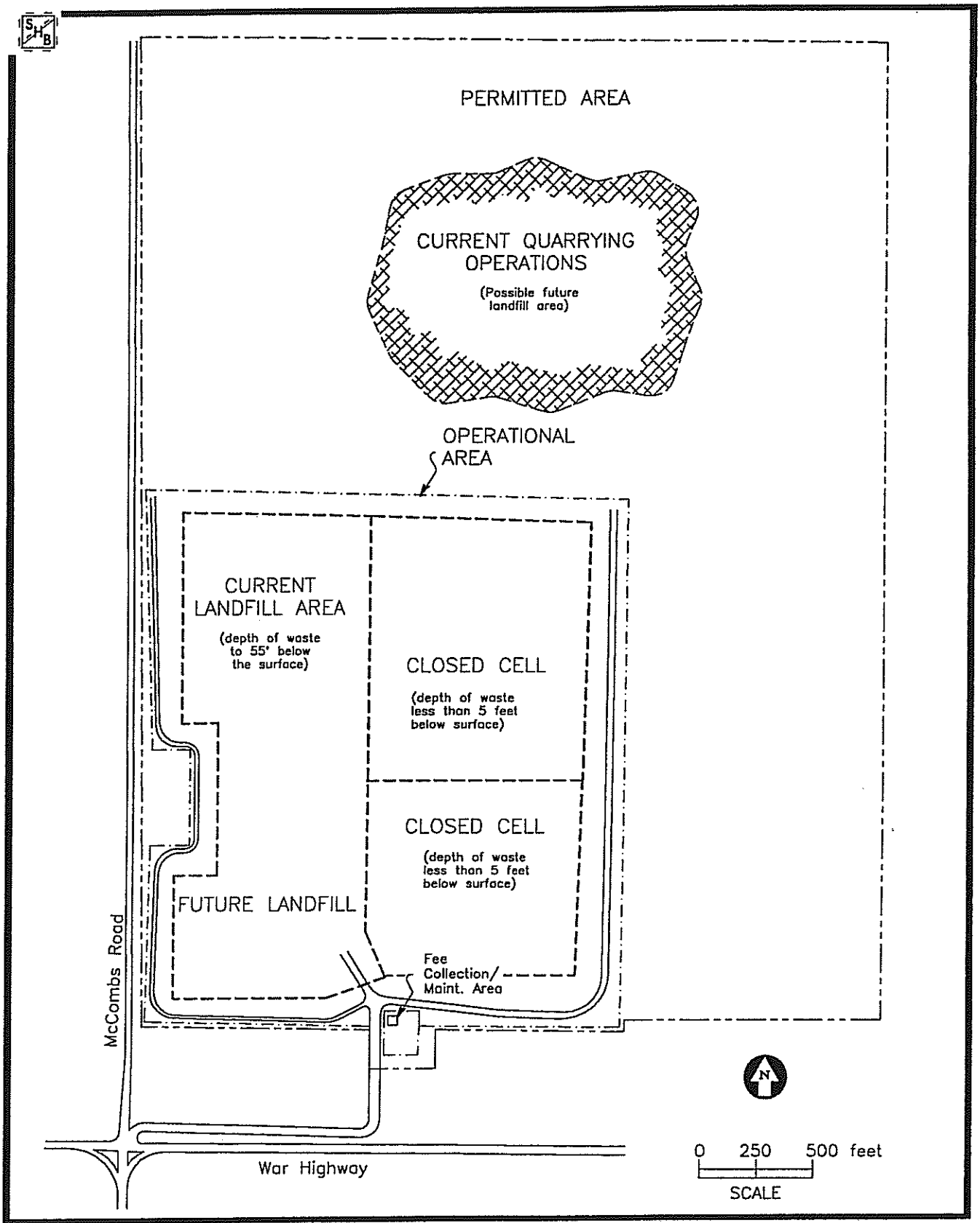
Earth & Environmental Group




Landfill Gas Management Plan
McCombs Landfill
El Paso, Texas
Job No. E94-4037

Ref.: "Northeast El Paso Landfill Completion Plan" by DRA, 4/83

**Figure 2**
**Site Plan**

AGRA
*Earth & Environmental Group*

During our site visit in March, 1994, the soil cover generally appeared to be adequate, with little exposure of buried waste. Only minor windblown materials were noted. Older cells appeared to have been satisfactorily capped, revegetated and reasonably reclaimed. Although some illegal dumping was noted along the perimeter, the facility itself appears to be reasonably secure.

Wastes accepted at the McCombs Landfill are limited to domestic household refuse and some construction debris. During the site reconnaissance completed by SHB wastes noted at the facility included roofing materials, shrubs, clippings, a few tires, and general domestic waste.

The facility periodically has been inspected by the TDHR and the TNRCC following permitting. A review of the inspection reports revealed no violations of the permit requirements that would indicate bulk liquids or hazardous materials were dumped on site. The records indicate that the McCombs Landfill is operated in general compliance with regulatory requirements.

According to City personnel (Serrano and Borrego, personal communication, 1993) two lysimeters were installed at the landfill. Mr. Serrano stated that City personnel attempt to sample soil moisture using the lysimeters once a month. So far, the lysimeters have not yielded soil moisture samples.

## 2.2 GEOLOGIC SETTING AND SOIL PROFILE

The McCombs Landfill lies within the Rio Grande Rift portion of the Mexican Highlands section of the Basin and Range Physiographic Province (Fenneman, 1931; Thornbury, 1965). This area has been further subdivided into the Bolson and Rio Grande subsections (Hawley, 1975). This region is characterized by broad intermontane basins with internal drainage, called bolsons, that are bounded by fault-block mountain ranges.

The mountain ranges on the eastern side of the Bolson subsection trend in a general north-to-northwest direction and typically flank sizeable basins, including the Hueco Bolson in which the site is located (Thornbury, 1965). The Rio Grande Valley is incised into thick deposits of basin fill at the southern end of the Hueco Bolson typically ranging in age from Pliocene to Holocene. A broad alluvial plain with gently sloping terraces characterizes the valley of the Rio Grande River.

The Hueco Bolson deposits have been divided into two rock stratigraphic units by Strain (1966), the Fort Hancock Formation and the Camp Rice Formation. The older Fort Hancock Formation is a massive unit composed of poorly consolidated clays, silts and fine grained sands ranging in color from grayish red to brown (Strain, 1966, 1980). The persistent and essentially horizontal bedding and fine grained texture of the Fort Hancock Formation indicates that it was deposited in lacustrine and playa environments. Goebel and others (1987) hypothesized deposition of the Fort Hancock Formation on a low-relief basin floor with a highly sinuous meandering river and ephemeral lakes.

Deposition of fine grained sediments in the Hueco Bolson continued until early Pleistocene time, when the depositional environment changed from predominantly lacustrine to fluvial (Strain, 1980). The Camp Rice Formation (Strain, 1966) records continued fluvial aggradation by the ancestral Rio Grande River in the Hueco Bolson.

The Camp Rice Formation is primarily composed of gravel, sand, silt and occasional discontinuous lenses of volcanic ash. Its color varies from very light gray to shades of pink, orange and light brown. The Camp Rice Formation is composed of two basic subdivisions, a fluvial and a piedmont facies (Gile and others, 1981). The fluvial facies is chiefly sandy to pebbly river-channel deposits with subordinate fine-grained overbank units. This facies thickens toward the bolson axes and commonly wedges out against the piedmont facies. The permitted area is probably underlain by fluvial deposits of the Camp Rice Formation (Seager and others, 1987).

Termination of Camp Rice deposition probably occurred as a result of spillover from the upper reaches of the Rio Grande River or stream capture by an arroyo system draining the Hueco Bolson. The upper reach of the Rio Grande River in the Mesilla Bolson was thus joined to the Rio Conchos through El Paso Canyon in mid-Pleistocene time (Strain, 1970; Hawley and Kottlowski, 1969). Integration of the upstream and downstream reaches of the Rio Grande River, re-establishing through-flowing drainage, was apparently the major cause of subsequent valley incision (Johnson and others, 1984).

As noted previously, the McCombs Landfill is located on deposits of the Hueco Bolson, probably Camp Rice Formation. These deposits primarily consist of clay, silt, sand and gravel, with some caliche (Bureau of Economic Geology, 1983). The landfill site is underlain by Tertiary and Quaternary basin (bolson) deposits, overlain by areas of gravel and caliche rimrock (Harbour, 1972). Recent Quaternary eolian and alluvial deposits are also present in the landfill vicinity.

A soil investigation was performed prior to landfill permitting in 1983 by Danny R. Anderson Consultants (DRA). During the investigation, numerous soil borings were drilled on-site to a depth of 60 feet below ground surface. According to boring logs generated during the investigation, the soil underlying the site consists of an upper zone of variable thickness of silty sand, underlain by deposits of clean and gravelly sand. Stringers of clay which did not appear to be laterally extensive were observed in some of the soil borings. The sand and gravelly sand is lenticular in nature, with little apparent correlation across the site. Since the on-site topography has changed substantially in the years since the soil investigation was performed, and no surface elevations were recorded at the time of the investigation, the existing data must be interpreted cautiously. However, based on our review of the logs and observations of quarry cuts at the site, no laterally extensive stratigraphic units were apparent which could significantly alter the expected migration of methane.

## 2.3 HYDROGEOLOGY OF THE SITE AREA

Published information on the hydrogeology of the site area was reviewed to evaluate the factors influencing the groundwater system at the site. The regional groundwater system in the area primarily consists of the Hueco Bolson aquifers.

The Hueco Bolson has been divided into the City Artesian area, the Mesa area and the Lower Valley (Leggat, 1962). The City Artesian area underlies downtown El Paso and east El Paso as far as Ysleta. The Mesa area is generally an unconfined aquifer which extends north of the City Artesian area into New Mexico and east to the Hueco Mountains. The Lower Valley area parallels the Rio Grande, and extends from Ysleta to beyond Tornillo. The McCombs Landfill is located in the Mesa area.

Based on available information regional groundwater flow in the McCombs landfill area is to the south-southeast. Groundwater movement in the area is generally less than 1.0 feet per day (White, 1987). EPWU groundwater data indicate that the static groundwater elevation in the area is between 3670 and 3675 feet above mean sea level (msl), or approximately 370 to 390 feet below ground surface (EPWU, 1993). No evidence of perched aquifers in the area was noted during our research.

Historic withdrawals of groundwater since 1906 for public water supply and irrigation have caused major declines in the water level. The average water level decline in the Hueco Bolson from 1903 to 1980 is approximately 53 feet (White, 1987).

Locally, recharge to the aquifer occurs due to mountain front infiltration of precipitation from the surface, and from the injection of treated sewage into the aquifer from the Hueco Bolson Recharge Project (White and Sladek, 1990). Numerous injection wells have been constructed northeast of El Paso and water from the Fred Hervey Water Treatment Plant has been injected into the aquifer by El Paso Water Utilities (EPWU) since the mid-1980's. Over one billion gallons of treated water per year were injected into the Hueco Bolson between 1986 and 1991. The reinjection resulted in mounding of groundwater in the recharge project area, and has caused some change in the groundwater flow regime.

The Hueco Bolson generally contains fresh water in its upper portion and becomes saline at depth (Davis and Leggat, 1965). Groundwater quality in the landfill area is variable, with total dissolved solids (TDS) contents ranging from less than 500 ppm to greater than 1000 ppm (White, 1987). A localized plume of groundwater exhibiting elevated TDS and high nitrate values was observed in the vicinity of the former Price's Dairy Farm during the 1960's and 1970's. The Dairy was located approximately ¾-mile southwest of the permitted area. The plume probably occurred due to leaching during excessive irrigation of crops in the area from 1956 to 1974 (White, 1987). Injection of high quality water from the Hueco Bolson Recharge Project has essentially diluted and dissipated the plume (Sperka, 1993).

## 2.4 ADJACENT LAND USE

A perimeter survey of the area surrounding the landfill was performed on March 21, 1994. Land use in the immediate vicinity of the McCombs Landfill is as delineated in Figure 3. In the past, most of the surrounding area was utilized as ranch land. The adjacent parcels east, south and north of the landfill remain undeveloped. West of the landfill lies a gravel pit which is not being quarried at this time, and the El Paso Water Utilities Sludge Disposal Monofill.

A small housing development lies across the Texas-New Mexico border northeast of the permitted area. The undeveloped portion of the permitted area, as well as the quarrying operation on-site lie between the operational area and the housing development. The nearest residence is about 4,000 feet northeast of the operational portion of the landfill.

## 2.5 FACILITY STRUCTURES

Four small structures are present within the landfill permit area, as depicted in Figure 4. These consist of a fee collection booth, a maintenance shop, and two small storage buildings. All of the structures within the operational area of McCombs Landfill are located in the south-central portion of the site. No structures are located on top of the waste disposal area. No basements or subsurface features are associated with any of the structures on-site. A brief description of each of the structures within the operational area is presented below:

- Fee Collection Building - a 10' by 15' structure consisting of a wood frame on a wood plank foundation placed on the natural ground surface. No concrete slab was present beneath the wood flooring.

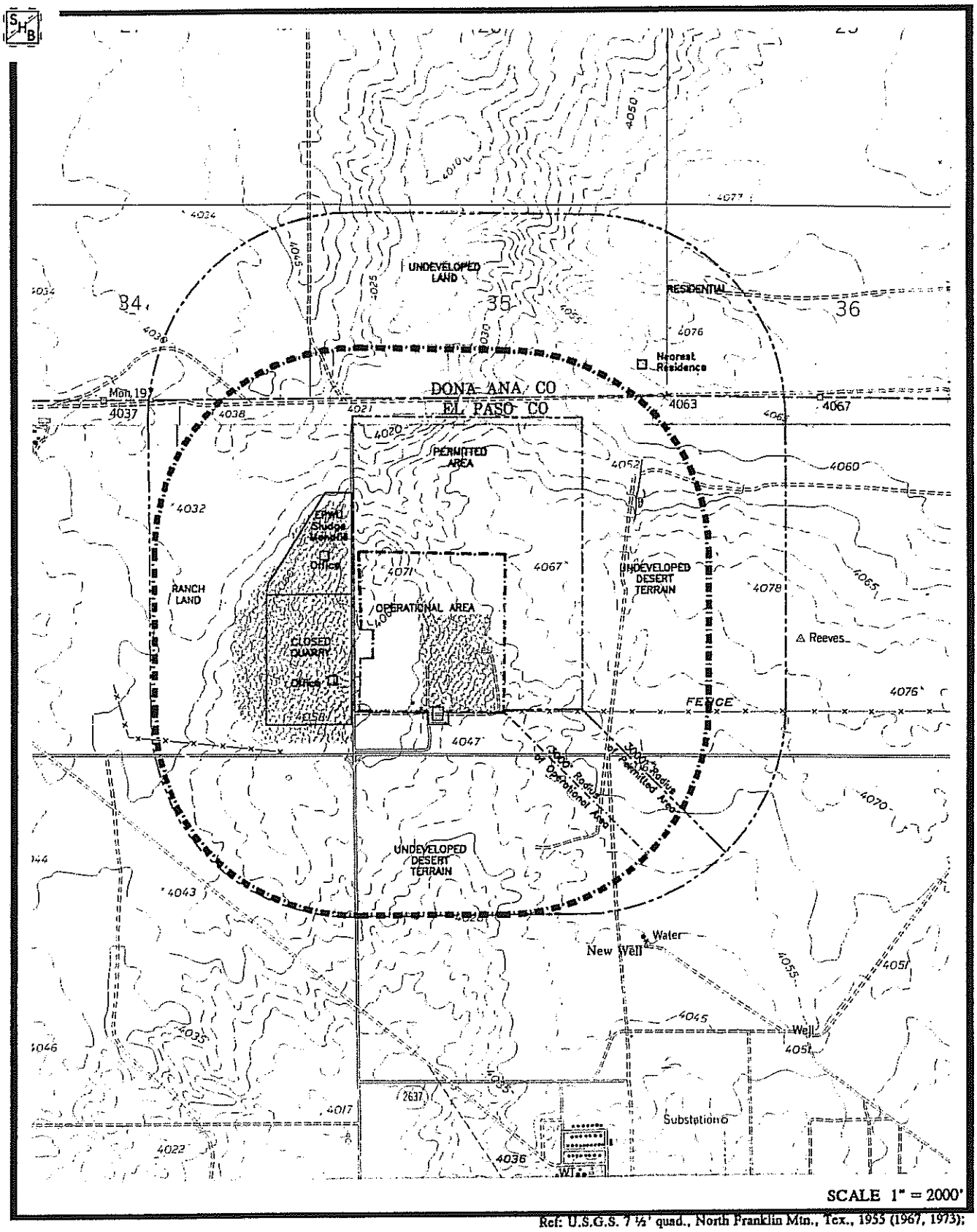
- Maintenance Building - a 40' by 40' metal building set on a concrete slab.

- Southern Storage Building - an 8' by 8' prefab metal storage building set on wooden pallets on the natural ground surface.

- Northern Storage Building - a 10' by 12' metal building set on a wooden plank floor on the natural ground surface.

## 2.6 UTILITY LINES AND PIPELINES

No major utility easements are located within the permitted area. Subsurface utilities may be present along the western and southern property margins beyond the permit boundary. Overhead lines provide electricity and telephone service to the buildings on-site, via lines running from War Highway (F.M. 2529) to the Fee Collection/Maintenance Area. The electric and telephone cables appear to be buried along the 50 feet between the Maintenance Building and the Fee Collection Building. These cables do not appear to have been placed within a trench or conduit.




Ref: U.S.G.S. 7 ½' quad., North Franklin Mtn., Tex., 1955 (1967, 1973);

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Figure 3
Adjacent Land Use

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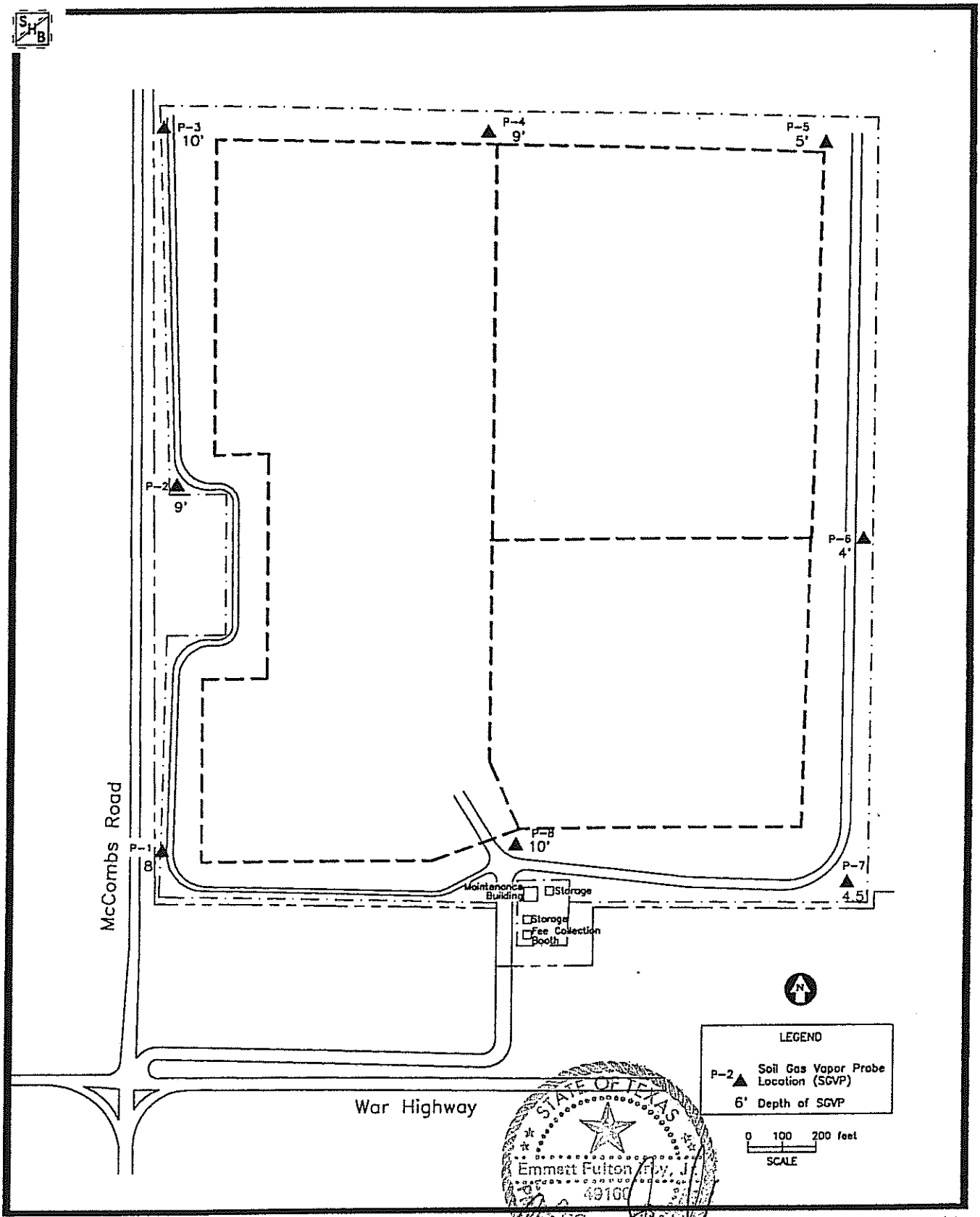


Ref: "Northeast El Paso Landfill Completion Plan" by DRA, 4/83

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Figure 4
Soil Gas Vapor Probe Locations

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## 3. INITIAL MONITORING

In late March, 1994, initial methane monitoring in general accordance with 30 TAC § 330.56(n)(8)(A) was performed around the perimeter of the McCombs Landfill. A plan was forwarded on March 24, 1994 to the TNRCC for review and was verbally approved. During the initial monitoring, soil gas vapor probes (SGVPs) were placed at approximately 1,000-foot intervals around the perimeter of the site, as depicted in Figure 4. The depth of each probe is also shown on Figure 4.

SGVPs were advanced using a Makita roto-hammer to depths of between 5 to 11 feet below the existing grades. Once the probes were driven to the desired depth, the drive casing was pulled up, leaving a detachable tip and exposing the sampling screen. A ¼" diameter polyethylene tubing was then attached to a vacuum pump and air was purged for approximately one minute. A Bacharach Sniffer 301 Combustible Gas Indicator calibrated to methane was then used to monitor for the presence of methane. No methane was detected during monitoring of any of the probes. During our perimeter survey, no stressed or dead vegetation which would be indicative of gas migration was observed.

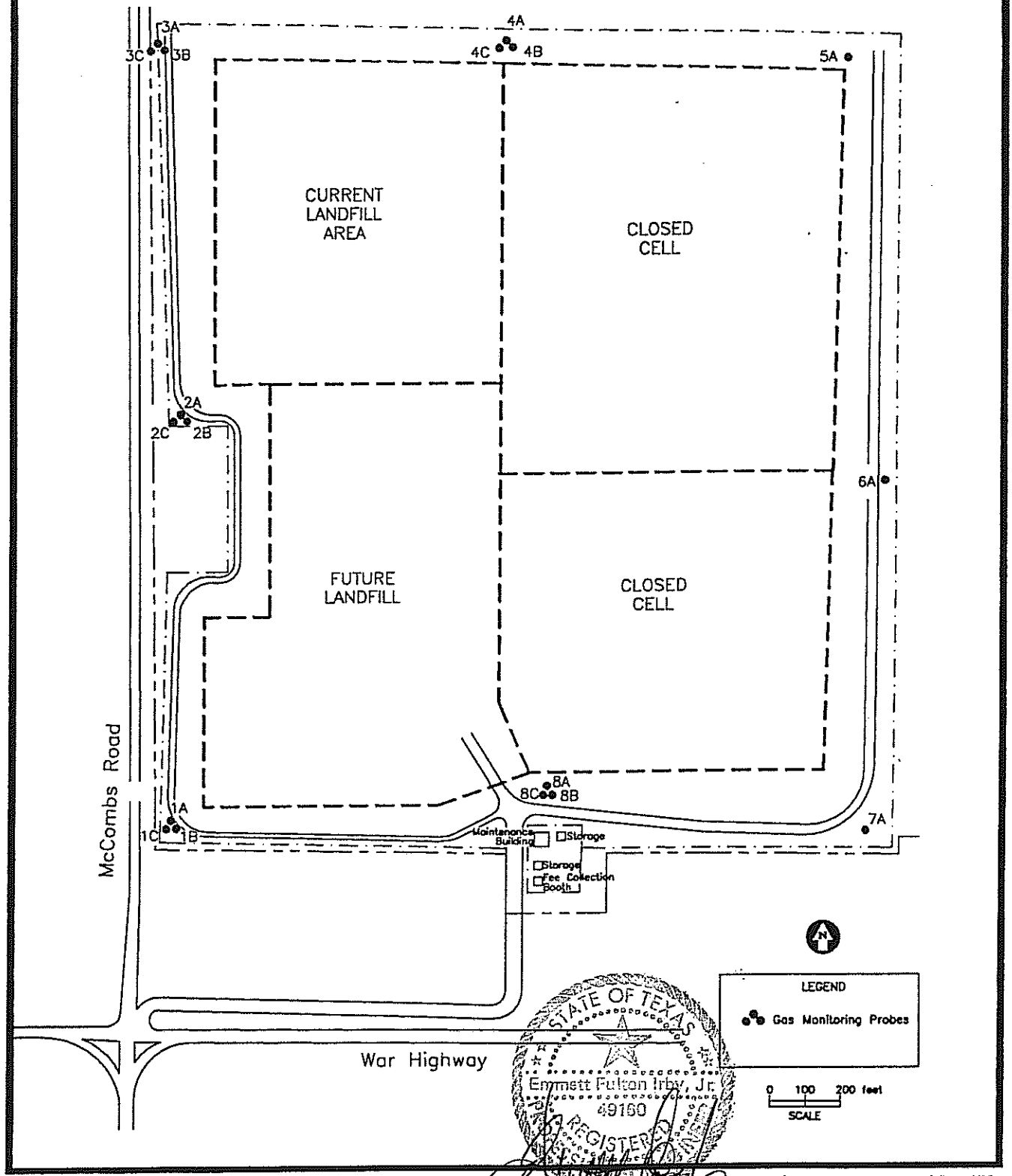
Permanent enclosed structure monitoring was performed on April 4, 1994. The interior of each of the structures on-site was monitored using a Bacharach Sniffer 301 Combustible Gas Indicator calibrated to methane. Special attention was given to cracks in the slabs and/or flooring. In addition, the exterior perimeter around each building near the foundation, slab or flooring was monitored. No methane was detected during monitoring of any of the structures on-site.

## 4. SITE PERIMETER MONITORING NETWORK

### 4.1 GAS MONITORING PROBE PLACEMENT

The proposed permanent site perimeter monitoring network will consist of a series of gas monitoring probes (GMPs). These will be installed in the general vicinity of the existing SGVPs, at intervals of approximately 1,000 feet around the perimeter of the operational area, as shown on Figure 5, the Site Development Plan (SDP).

GMPs will be placed to various depths at each of the monitoring points based on the depth of waste in the cell(s) within 1,000 feet of each monitoring point. A review of on-site geologic/soil data revealed little evidence of any laterally extensive stratigraphic units which could significantly influence migration of any gases produced within the landfill cells. Based on the information collected, the proposed GMP placement is as detailed in Table 1. Information regarding the characteristics of the waste in each cell which influenced the placement of the GMPs is outlined in the following paragraphs.




Landfill Gas Management Plan
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Figure 5
Site Developement Plan with
Gas Monitoring Probe Locations

Source: "Southeast El Paso Landfill Completion Plan" by DRA, 4/83

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- Southeast Quadrant - According to information provided by the City, the southeastern quadrant of the landfill was used for disposal of municipal solid waste in the early 1960's. Information available suggests that little excavating was performed; waste was placed on the surface of the ground and covered (Borrego, 1994). We are estimating that the depth of waste in this area extends less than 5 feet below the surrounding land surface. The top of this cell is approximately 15 feet above grade. The cell has been covered with silty sand. Based on this information, we are expecting that any methane generated within this cell would migrate upward through the relatively permeable cover.

- Northeast Quadrant - The northeastern quadrant of the landfill was used for disposal of municipal solid waste in the mid-to-late-1960's and 1970's. As with the southeast quadrant, waste was placed on the surface of the ground and covered (Borrego, 1994). We are estimating that the depth of waste in this area extends less than 5 feet below the surrounding land surface. The top of this cell is approximately 15 feet above grade and has been covered with silty sand. Based on this information, we are expecting that any methane generated within this cell would migrate upward through the relatively permeable cover.

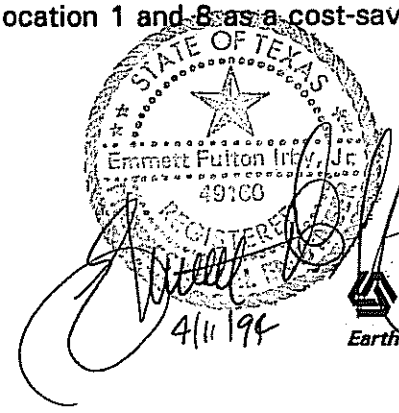
- Northwest Quadrant - The western half of the operational area was developed as a quarry, with excavations extending down to depths of approximately 50 to 55 feet below the surrounding land surface. During the last decade, municipal solid waste has been placed within the quarried areas of the northwest quadrant to depths of up to 55 feet below the surface.

- Southwest Quadrant - The southwest quadrant of the operational area was quarried extensively in the past, however, to date, no waste has been placed in this area. The City is planning to use this area for future landfilling activities. It is assumed landfill depths will reach 55 feet below the surface.

Table 1. Proposed GMP Placement

| Location Number | Depth of Waste in Nearest Cell | GMP Number | Proposed Screened Interval |
|---|---|---|---|
| 1 | NA | 1A | 7' - 10' |
| | | 1B | 25' - 30' |
| | | 1C | 50' - 55' |
| 2 | 55' | 2A | 7' - 10' |
| | | 2B | 25' - 30' |
| | | 2C | 50' - 55' |
| 3 | 55' | 3A | 7' - 10' |
| | | 3B | 25' - 30' |
| | | 3C | 50' - 55' |
| 4 | 55' | 4A | 7' - 10' |
| | | 4B | 25' - 30' |
| | | 4C | 50' - 55' |
| 5 | 5' | 5A | 7' - 10' |
| 6 | 5' | 6A | 7' - 10' |
| 7 | 5' | 7A | 7' - 10' |
| 8 | 5'to 55' | 8A | 7' - 10' |
| | | 8B | 25'-30' |
| | | 8C | 50' - 55' |

NA - Not Applicable; area near this probe has not yet been landfilled
Note: Multiple probe depths are planned at location 1 and 8 as a cost-savings measure to avoid future mobilization charges.

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## 4.2 GMP INSTALLATION

Figure 6 is a schematic view of a typical methane monitoring location, where probes have been placed at multiple depths. GMPs at the McCombs Landfill will be installed in general accordance with the schematic and modified to reflect actual field conditions encountered. In the event that a modification is needed the project engineer (SHB AGRA),will be notified for approval. All modifications will be reflected on as-built drawings of each GMP. The as-built drawings will include probe material and depth, extent and type of filter pack, seals and backfill, the size and interval of perforations, and a description of petcocks, caps and covers. All as-builts will be reviewed and sealed by the project engineer. Copies of a site plan showing final GMP locations, boring logs generated during placement of the GMPs and as-built drawings of each GMP will be made a part of the Landfill Gas Management Plan.

The following guidelines will be followed during installation of the GMPs:

- GMPs will be placed at locations specified in the Site Development Plan (Figure 5). If topography, access or any unforeseen conditions preclude probe placement at these locations, the borings may be moved to alternate locations upon approval of the project engineer. Any deviation from the plan will be noted and appended to this document in the as-builts.

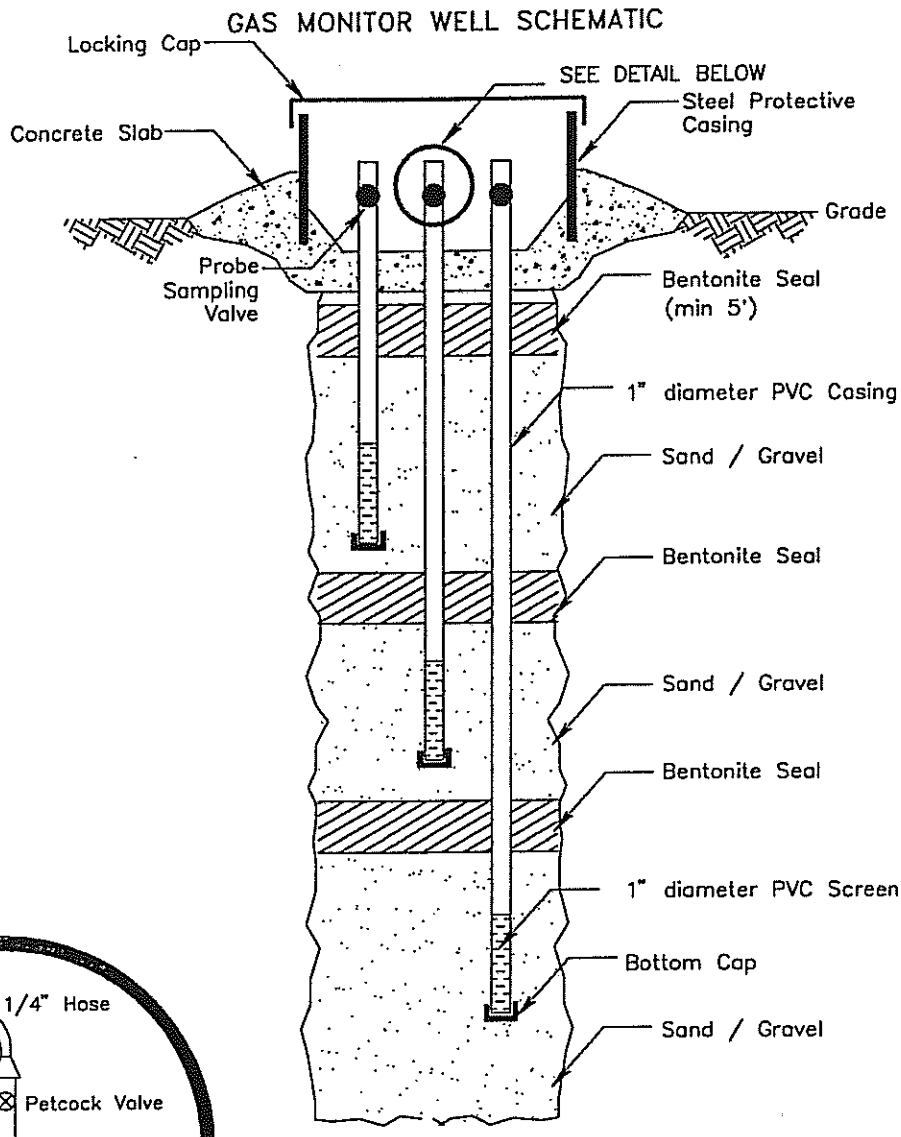
- The GMPs will be installed by a licensed monitor well driller in accordance with applicable Texas Water Well Drillers Board requirements.

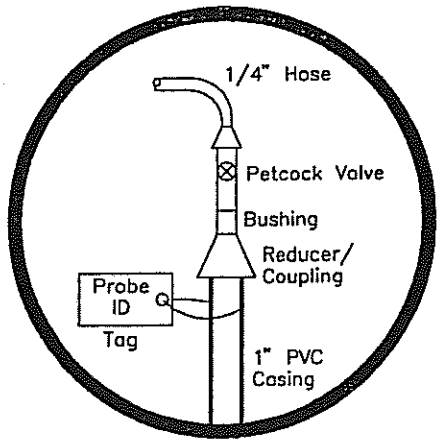
- All drilling and probe placement operations will be performed under the direction of an experienced geologist or engineer.

- During the placement of the probes, the soil encountered will be continuously examined, visually classified and logged by a qualified geologist or engineer in accordance with the methods specified in D2488-84 (Standard Practice for Description and Identification of Soils -Visual-Manual Procedure). Drilling operations will be continuously monitored for explosive gases using a methane monitor and explosivity meter. Results of the field monitoring will be recorded on the field logs. An example field log form is included in Appendix A.

- Borings will be advanced with a hollow-stem auger with a minimum diameter of ten inches to the specified depths. Boreholes will be advanced to at least two feet below the elevation of the deepest probe. Should difficult drilling conditions prevent attaining the appropriate depth, alternate drilling methods may be approved by the engineer. No additives will be introduced into the boring, or lubricants allowed on the downhole equipment without the prior approval of the project engineer.

- All probe installation will be conducted in accordance with the Site Health and Safety Plan (see Section 5).




DETAIL
OF PROBE
SAMPLING VALVE

STATE OF TEXAS
Emmett Fulton Arbuckle
4/11/94

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**Figure 6**
**Typical Gas Monitoring Probe Installation Schematic**

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- One-inch diameter schedule 80 polyvinyl chloride (PVC) casing will be placed through the annulus of the auger to the depths specified in Table 1. The PVC will be perforated with 1/8 inch diameter holes over the lower 3 to 5 feet of the casing prior to installation to attain the screened intervals specified on Table 1. The remainder of the probes length will consist of blank PVC with threaded couplings. A petcock valve will be cemented to the top of each probe suitable for gas monitoring purposes. The probe will be capped at the end. All materials must be approved by the project engineer prior to installation. The field engineer may adjust the screened intervals if soil conditions warrant.

- After the probes are inserted in the auger to the proper depth, the annular space surrounding the deep probe will be filled with a clean coarse and open graded sand/gravel pack to at least two feet above the screened interval. The lower sections of the auger will be removed and a bentonite seal (minimum 5 feet) will be placed. The seal will be hydrated for a minimum of one hour.

- The borehole will then be filled with sand to the depth of the intermediate probe. The intermediate probe will then be introduced into the auger with the perforated interval set at the depth specified in Table 1. A gravel/sand pack and bentonite seal will then be placed following the procedures specified above. The procedure will be repeated for the shallow probe with the exception that a minimum of five feet of bentonite will be placed between the top of the perforated interval and the ground surface.

- Each probe will be labeled with a permanent identification tag specifying well number and probe depth.

- The nested probes will be completed at the surface with a concrete slab and protective steel casing. The concrete slab will be a minimum of 3 by 3 feet and have a wire mesh reinforcement. The concrete will be finished to provide positive drainage away from the casing. The steel casing will be painted with a high visibility paint and be provided with a lock.

- A GMP construction log form will be completed and submitted as an as-built to the project engineer.

- The driller will complete and submit to the TNRCC a Well Report (TNRCC form WWD-012) for each set of probes. An example of the Well Log is included in Appendix A. A copy of the completed form will be appended to this document and be made part of the permanent records of the landfill.

As outlined in the TNRCC Municipal Solid Waste Division Methane Monitoring Handbook, additional parameters including gas probe pressure and probe gas temperature are to be monitored during each quarterly monitoring event. At present, we recommend the measurement of these parameters be done as best as possible at the surface. It is our opinion

that unless elevated methane is detected, the installation of downhole gas pressure probes and temperature monitoring equipment is not warranted. If, in the future, methane concentrations in excess of 25 percent of the LEL are encountered in the perimeter monitoring network during quarterly monitoring activities and a landfill gas control system is deemed appropriate, equipment for monitoring the additional parameters will be installed.

### 4.3 GMP MONITORING

It is the intent of the City that the initial monitoring of the GMP system be performed in conjunction with the project engineer (SHB AGRA, Inc.). This (and if necessary subsequent events), will be used as a training program to orient personnel of the City in the use of the equipment and reporting, so that the monitoring program can performed in the future by Landfill personnel. SHB AGRA will be available for consultation and assistance as needed.

SHB AGRA is currently assisting the City in evaluating auxiliary equipment to be used during quarterly monitoring. All equipment specifications will be reviewed and approved by the project engineer. Copies of technical specifications for all equipment will be appended to this document.

Methane monitoring at each of the GMP will be performed on a quarterly basis in general accordance with published EPA and TNRCC regulations and guidelines. During monitoring, methane concentrations from each probe along with information concerning ambient conditions will be noted and recorded on a field monitoring log. A proposed log is presented in Appendix A.

The following equipment and procedures will be used during GMP monitoring:

- A thermometer will be used to measure ambient temperature which will be capable of measuring temperatures from -15 to 120 degrees (Fahrenheit) with a least count not exceeding one (1) degree F.

- Atmospheric pressure will be measured using a portable barometer calibrated to read pressures in equivalent inches of water column. A reading measured relative to an equivalent mercury column will also be obtained from a static weather station at the landfill.

- A magnehelic gage will be utilized to measure gas probe pressure. The gage will be marked to read deviation in pressure from ambient conditions, in equivalent inches of water column. The magnehelic gage will be capable of measuring pressure deviations (positive or vacuum) of at least five (5) inches of water column from ambient conditions.

- The portable methane monitor used will be calibrated pursuant to the manufacturer's instructions to directly read methane concentrations in parts per million (ppm) or as a percentage (volumetric) of the gas sampled. The results of calibration should be noted on

the field monitoring log. Any problems with calibration or the use of the instrument should be promptly addressed. The measuring unit will have a self contained pump unit capable of drawing a gas sample from the specified depths. The City has selected a Bacharach, Inc. Sniffer 503A Portable Combustible Gas and Oxygen Alarm Instrument. A copy of the instruments technical specifications are included in Appendix B.

- In order to obtain accurate monitoring data, gas probes will remain undisturbed for a minimum of twenty four (24) hours to let gas pressures and concentrations reach equilibrium.

- All field equipment including pressure gages and the methane monitor will be properly charged, checked and calibrated as recommended by the manufacturer.

- Ambient temperature will be recorded during each monitoring event.

- Barometric pressure will be recorded at each monitoring location.

- A measurement of ambient methane concentrations will be performed at each location prior to opening the casing.

- The magnehelic gage will be connected to the petcock of each probe using tight-fitting teflon or comparable tubing and the check valve will be opened. Subsurface gas pressure deviations from background will be recorded on the monitoring log.

- The methane monitoring unit will be switched on and connected to each gas probe at the location. The peak (if applicable) and steady state methane concentration will be recorded.

- The process will be repeated for other gas probes in the well.

- The completed field form will be submitted to the project manager for inclusion into the permanent files of the landfill. The data will be used to produce a quarterly monitoring report (see Section 6).

### 4.4. PERMANENT ENCLOSED STRUCTURE MONITORING

All structures located within the permitted area of the McCombs Landfill will be monitored for the presence of methane on a quarterly basis. Methane accumulation within structures can potentially cause explosions or fires, endangering the lives of employees and landfill users. If methane levels in any of the on-site structures exceeds 25% of the LEL, the contingency plan outlined in Section 7 will be implemented immediately.

The interior of each structure will be monitored with a Bacharach Sniffer 503A, as described above, or a comparable meter calibrated to methane. In addition, any subsurface vaults or accessible utility chambers will be monitored.

Monitoring events will be scheduled for early morning after the structure has been closed overnight. Special care will be taken to monitor any crawl spaces, floor seams or cracks and subsurface utility connections.

## 5. SITE HEALTH AND SAFETY

A site Health and Safety Plan (HSP), will be developed for use during the installation and monitoring of the methane probes. All personnel associated with the methane monitoring program will be required to review and sign the plan. A copy of the final plan with the applicable signatures will become part of the permanent files of the landfill. The HSP will meet minimum criteria set forth in 29 CFR 1910.120. The plan will also designate a site safety officer to monitor safety practices employed throughout the installation and monitoring phases.

## 6. SAMPLING, DATA EVALUATION AND REPORTING

As stated above, sampling of the GMPs and all on-site structures will be conducted on a quarterly basis. Data will be recorded on a quarterly field monitoring worksheet which will include, at a minimum, the date, time of reading, reading location (probe identification number), methane concentration, and name of the person performing the monitoring. In addition, the probe pressure, barometric pressure, ambient weather conditions during monitoring and the cumulative on-site rainfall since the last monitoring event will be noted. The form will also include space to summarize the enclosed structure monitoring. An example Quarterly Field Monitoring Worksheet is presented in Appendix A. The monitoring data will then be transferred onto a graphic format for submission to the TNRCC. SHB AGRA is developing a program for data input to assist the City in generating the quarterly reports. The data will be presented graphically in a format similar to that provided in Appendix C.

The results of methane monitoring will be forwarded on a quarterly basis to:

Texas Natural Resource Conservation Commission
Municipal Solid Waste Division
Compliance and Enforcement Section
P.O. Box 13087
Austin, Texas 78711-3087

A copy of the results will be made a part of this document (Appendix G and H) and the permanent records of the landfill.

A copy of the results will also be forwarded to the Sanitation Superintendent, the Director of Public Works, and the project engineer for review.

## 7. CONTINGENCY PLAN

Since no methane has been detected to-date at the landfill, we recommend that the project engineer be contacted to confirm measurements and verify field methods if any elevated methane readings are obtained. Revision to this plan may be deemed necessary at that time. However, the protection of human health and safety should take precedent over any technical issues.

Should methane gas levels exceed 25% of the lower explosive limit (LEL) for methane in facility structures, or exceed the LEL for methane at the facility property boundary (point of compliance), in the perimeter monitoring network, the following steps shall be taken:

- All landfill employees and persons within the landfill will be immediately evacuated until it is deemed that there is no longer any threat to human health. If explosive conditions exist, a minimum of 1/4 to 1/2 mile from the area of elevated reading should be evacuated.

- All structures within 950 feet of the point of concern should be checked to ensure the safety of any occupants.

- The Texas Natural Resource Conservation Commission (TNRCC) must be notified of the presence of excess methane gas levels. The Region 6 office of the TNRCC can be reached at (915) 778-9634.

- If deemed necessary, local emergency response personnel, including the El Paso Fire Department, El Paso City-County Health Department and the El Paso Police Department should be notified. Contact information is as follows:

  El Paso Fire Department - 911 or 564-6932

  El Paso City-County Health Department - 532-5966 or 543-3509

  El Paso Police Department - 911 or 564-6900

- Monitoring intervals should be shortened once the immediate threat no longer exists. The project engineer and the local TNRCC office should be consulted, however, daily monitoring within the first two-weeks of detecting elevated methane concentrations is recommended.

- Within seven days of detection, records regarding the methane gas levels detected and a description of the steps taken to protect human health must be placed in the operating record.

- Within 60 days of detection, a remediation plan for the methane gas releases must be implemented and a copy of the plan must be placed in the operating record. An investigation as to the extent and possible causes of the excess methane should be conducted in time to meet this schedule. Notification of the implementation of the plan must be provided to the TNRCC, in addition to providing them with copies of the remediation plan. The plan must describe the nature and extent of the problem and the proposed remedy. Additional remedial measures may be required by the TNRCC.

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APPENDIX A

SAMPLE FORMS

## PERMANENT ENCLOSED STRUCTURE MONITORING

| Structure | Methane Readings (Range) | Comments |
|---|---|---|
| Fee Collection Building | | |
| Maintenance Building | | |
| Southern Storage Building | | |
| Northern Storage Building | | |

## ADDITIONAL COMMENTS

PROJECT _____ **LOG OF TEST BORING NO.** _____

JOB NO. _____ DATE _____

RIG TYPE _____

BORING TYPE _____

SURFACE ELEV. _____

DATUM _____

| Depth in Feet | Sample Number | Graphical Log | Sample | Sample Type | Blows per foot 140 lb. 30" free-fall drop hammer | UNU/PID Headspace Downhole | %LEL | Unified Soil Classification | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|

**GROUND WATER**

| DEPTH | HOUR | DATE |
|---|---|---|
| | | |
| | | |

**SAMPLE TYPE**

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.
U – 3" O.D. 2.42" I.D. tube sample.
T – 3" O.D. thin-walled Shelby tube

SERGENT, HAUSKINS & BECKWITH

CONSULTING GEOTECHNICAL ENGINEERS

PHOENIX - TUCSON

ALBUQUERQUE - SANTA FE - SALT LAKE CITY - EL PASO - RENO SPARKS

Send original copy by certified mail to: Texas Water Commission, P.O. Box 13087, Austin, Texas 78711 *Please use black ink.*

**ATTENTION OWNER:** *Confidentiality Privilege Notice on Reverse Side*

# State of Texas
# WELL REPORT

Texas Water Well Drillers Board
P.O. Box 13087
Austin, Texas 78711

1) **OWNER** ______________________ (Name) **ADDRESS** ______________________ (Street or RFD) (City) (State) (Zip)

2) **LOCATION OF WELL:**
County ______________ , ______________ miles in ______________ (NE, SW, etc.) direction from ______________ (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ **LEGAL DESCRIPTION:**

Section No. ________ Block No. ________ Township ____________ Abstract No. ____________ Survey Name ______________

Distance and direction from two intersecting section or survey lines ______________________

☐ **SEE ATTACHED MAP**

3) **TYPE OF WORK (Check):**
☐ New Well ☐ Deepening
☐ Reconditioning ☐ Plugging

4) **PROPOSED USE (Check):**
☐ Domestic ☐ Industrial ☐ Monitor ☐ Public Supply
☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) **DRILLING METHOD (Check):** ☐ Driven
☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Bored
☐ Air Rotary ☐ Cable Tool ☐ Other ________

6) **WELL LOG:**
Date Drilling:
Started ____________ 19 __
Completed ____________ 19 __

**DIAMETER OF HOLE**

| Dia. (in.) | From (ft.) | To (ft.) |
|---|---|---|
| | Surface | |
| | | |
| | | |

7) **BOREHOLE COMPLETION:**
☐ Open Hole ☐ Straight Wall ☐ Underreamed
☐ Gravel Packed ☐ Other ______________
If Gravel Packed give interval . . . from ________ ft. to ________ ft.

| From (ft.) | To (ft.) | Description and color of formation material |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

*(Use reverse side if necessary)*

8) **CASING, BLANK PIPE, AND WELL SCREEN DATA:**

| Dia. (in.) | New or Used | Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial | Setting (ft.) From | Setting (ft.) To | Gage Casting Screen |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

9) **CEMENTING DATA** [Rule 287.44(1)]
Cemented from ________ ft. to ________ ft. No. of Sacks Used ________
________ ft. to ________ ft. No. of Sacks Used ________
Method used ______________
Cemented by ______________

10) **SURFACE COMPLETION**
☐ Specified Surface Slab Installed [Rule 287.44(2)(A)]
☐ Specified Steel Sleeve Installed [Rule 287.44(3)(A)]
☐ Pitless Adapter Used [Rule 287.44(3)(B)]
☐ Approved Alternative Procedure Used [Rule 287.71]

11) **WATER LEVEL:**
Static level ________ ft. below land surface Date ________
Artesian flow ________ gpm. Date ________

12) **PACKERS:** Type Depth

13) **TYPE PUMP:**
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other ______________
Depth to pump bowls, cylinder, jet, etc., ________ ft.

14) **WELL TESTS:**
Type Test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ________ gpm with ________ ft. drawdown after ________ hrs.

15) **WATER QUALITY:**
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☐ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ________ Depth of strata ________
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

**COMPANY NAME** ______________________ (Type or print) **WELL DRILLER'S LICENSE NO.** ______________

**ADDRESS** ______________________ (Street or RFD) (City) (State) (Zip)

(Signed) ______________________ (Licensed Well Driller) (Signed) ______________________ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TWC use only: Well No. ________ Located on map ________

WWD-012 (Rev. 05-18-90)

TEXAS WATER COMMISSION COPY

# McCOMBS LANDFILL QUARTERLY METHANE MONITORING REPORT

## LANDFILL CONDITIONS

| |
|---|
| Report Completed By:_____ Date:_____ |
| Temperature:_____ Atmospheric Conditions:_____inches of mercury _____inches of water |
| Cumulative rainfall since last monitoring event:_____ |
| Ambient conditions (Weather):_____ |
| Methane monitor charge check:_____ Methane monitor calibration check:_____ |

## GMP MONITORING

| GMP Number | Gas Probe Pressure | Ambient Methane Reading | GMP Peak Methane Reading | GMP Steady State Methane Reading |
|---|---|---|---|---|
| 1A | | | | |
| 1B | | | | |
| 1C | | | | |
| 2A | | | | |
| 2B | | | | |
| 2C | | | | |
| 3A | | | | |
| 3B | | | | |
| 3C | | | | |
| 4A | | | | |
| 4B | | | | |
| 4C | | | | |
| 5A | | | | |
| 6A | | | | |
| 7A | | | | |
| 8A | | | | |
| 8B | | | | |
| 8C | | | | |

APPENDIX B

EQUIPMENT SPECIFICATIONS

(Partially Complete)

AGRA
Earth & Environmental Group

BRENDA 915-542-0078



# 1 INTRODUCTION AND GENERAL INFORMATION

## 1.1 INTRODUCTION

This manual contains information for the preparation, operation, calibration, maintenance, and trouble-shooting of the Sniffer 503A Portable Combustible Gas and Oxygen Alarm instrument (Part No. 51-7334).

**WARNING!**

*Do not operate the Sniffer 503A in any potentially explosive or hazardous location with an external charger attached to it. Disconnect the charger from the instrument before entering the hazardous area. The instrument is designed to be intrinsically safe for operation in Class I, Division 1, Groups A, B, C and D locations with all chargers disconnected. The instrument is not intrinsically safe with the charger or any other external power source attached.*

## 1.2 GENERAL INFORMATION

The Sniffer 503A is an intrinsically safe instrument used for detecting the presence of combustible gases and vapors in air, and also indicating the oxygen concentration of the air directly in $\%O_2$.

The instrument consists of: two meters, two visible alarm lights, an audible alarm, a self-contained sample drawing pump, oxygen and combustible sensors, a sealed lead acid battery pack and associated electronics. The instrument is equipped with a hinged lid and a tempered safety glass window for viewing the operator panel. Construction permits gas sampling with the lid closed.

## 1.3 PRODUCT SPECIFICATIONS

Important operating characteristics, dimensions, and other particulars about the Sniffer 503A are listed in Table 1-1.

**TABLE 1-1. PRODUCT SPECIFICATIONS**

**SENSOR TYPE:**

| | |
|---|---|
| Combustibles | Catalytic (Platinum Bead) |
| Oxygen | Electrochemical Cell |

**DETECTION RANGES:**

| | |
|---|---|
| Lower Explosive Limit (LEL) | 0–100% LEL Methane |
| PPM x 100 | 0–10,000 PPM Methane |
| PPM x 20 | 0–2000 PPM Methane |
| Oxygen | 0–25% |

**TYPES OF COMBUSTIBLES:**

Typical Gases and Vapors Detected ..... See Appendix A and Appendix B

| | |
|---|---|
| Pentane | Ethyl Alcohol |
| Ethane | Isopropyl Alcohol |
| Toluene | Hydrogen |
| Acetone | Acetylene |
| Benzene | O-Xylene |
| Heptane | MEK |
| Hexane | Ethylene |

## TABLE 1-1. PRODUCT SPECIFICATIONS (Continued)

| | |
|---|---|
| **ALARMS:** | |
| Combustibles | Audible and Visual Set Point: From 2% to 60% LEL, normal (2% to 42% Guaranteed) |
| Oxygen | Audible and Visual Set Point: From 1% to 25% $O_2$ |
| **RESPONSE TIME** | 50% LEL indicated within 10 seconds, and 90% LEL indicated within 30 seconds |
| **TRANSPORT TIME** (Start of detection with 15 foot of tubing) | 5 seconds |
| **OPERATING TEMPERATURE RANGE:** | |
| Combustible Gas Alarm | 0 to 125°F (-18 to 52°C) |
| **OXYGEN DEFICIENCY:** | |
| Temperature Compensated | 32 to 104°F (0 to 40°C) |
| Usable Range | 0 to 125°F (-18 to 52°C) |
| **STORAGE TEMPERATURE** | 0 to 125°F (-18 to 52°C) |
| **HUMIDITY** | 10 to 95% RH, Non-condensing |
| **ALARM HORN OUTPUT:** | *Pulse* tone for combustibles indication. *Steady* tone for Oxygen Deficiency or both Combustibles and Oxygen Deficiency. *Slow chirping* alarm for low battery indication and pump malfunction. |
| **POWER SUPPLY** | 220 VAC, 50 Hz Charger, 120 VAC, 60 Hz Charger, 12 VDC Charger, Portable operation on internal battery pack. |

## TABLE 1-1. PRODUCT SPECIFICATIONS (Continued)

**BATTERY:**

| | |
|---|---|
| Life per Charge | 10 Hours (min.) at 77°F (25°C) |
| Full Recharge Time | 14–16 Hours |
| Low Battery Shutdown | 4.9–5.3 VDC |
| **DIMENSIONS** (178 x 228 x 165 mm) | 7 x 9 x 6-1/2 inches |
| **WEIGHT** | Under 9.5 lb (excluding probe, line cord, hoses and accessories). |
| **OPERATING FLOW RATE** | 700 cc per minute minimum |
| **HAZARDOUS AREA USE** | Instrument is designed to be intrinsically safe for use in Class I, Division 1, Groups A, B, C and D. |

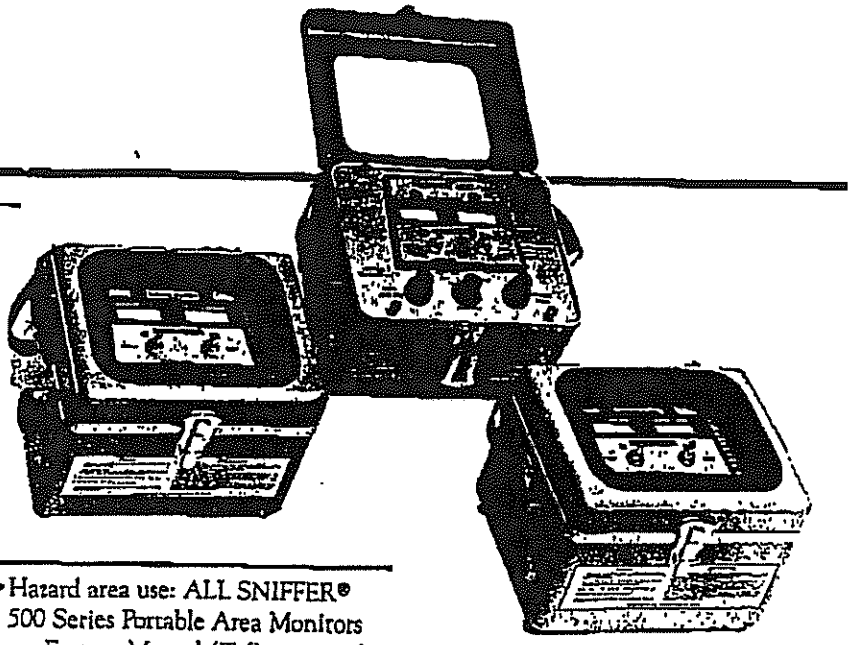
**WARNING!**

*Do not operate the Sniffer 503A in any potentially explosive or hazardous location with an external charger attached to it. Disconnect the charger from the instrument before entering the hazardous area. The instrument is designed to be intrinsically safe for operation in Class I, Division 1, Groups A, B, C and D locations with all chargers disconnected. The instrument is not intrinsically safe with the charger or any other external power source attached.*

# Sniffer® 500 Series

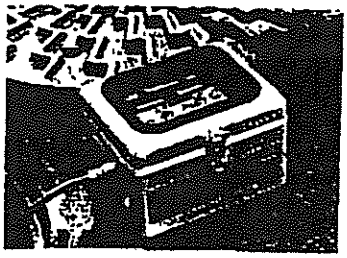
## Portable Area Monitors

BACHARACH



### Features

- Three models:
  - SNIFFER® 503A—0-25% $O_2$, 0-100% LEL, 0-2,000 PPM and 0-10,000 PPM combustible gas
  - SNIFFER® 505—0-25% $O_2$, 0-100% LEL combustible gas, 0-100 PPM $H_2S$
  - SNIFFER® 506—0-25% $O_2$, 0-100% LEL combustible gas, 0-500 PPM CO
- Construction: Rugged weather-resistant, heavy gauge aluminum with weather-sealed, hinged lid and tempered glass window
- Rechargeable battery pack: Reliable, sealed lead acid battery, 10 hours of operation
- High output/high frequency audible alarm system: Intense alarm, noticeable even in the noisiest environments, offers individual latching audible alarms for each gas channel and non-latching audible alarms for low flow and low battery. Visual alarms are also provided for each gas channel.
- Remote alarm: Optional alarm can be remoted 25 feet (or longer if required) and is activated with the internal alarm
- Meters: Rugged analog meters continuously backlit
- Sampling method: Integral pump with low flow sensor and alarm, 100 ft. max. distance
- Charger options: 115 VAC/60 $H_z$, 230 VAC/50 $H_z$, 12 VDC (cigarette lighter adapter)
- The SNIFFER® 503A can be used in accordance with EPA Method 21



- Hazard area use: ALL SNIFFER® 500 Series Portable Area Monitors are Factory Mutual (FM) approved as intrinsically safe for use in Class I, Division I, Groups A, B, C and D areas.

Factory Mutual System

**Approved**

The SNIFFER® 505 and SNIFFER® 506 Portable Area Monitors are approved by the Canadian Standards Association (CSA) as intrinsically safe for use in Class I, Groups A, B, C, and D areas.

CSA®

### General Description

The SNIFFER® 500 Series Portable Area Monitors are rugged, weather resistant instruments designed to alert personnel to the hazards of oxygen deficiency and the presence of dangerous concentrations of combustible gases, carbon monoxide and hydrogen sulfide. This design permits reliable, 10 hour operation while withstanding the many abuses of extreme weather and hostile workplaces. The 500 Series also offers simple operation, a dependable (lead acid battery) power source and high intensity, latching audible alarm system—three critical requirements of a practical field instrument.

### Applications

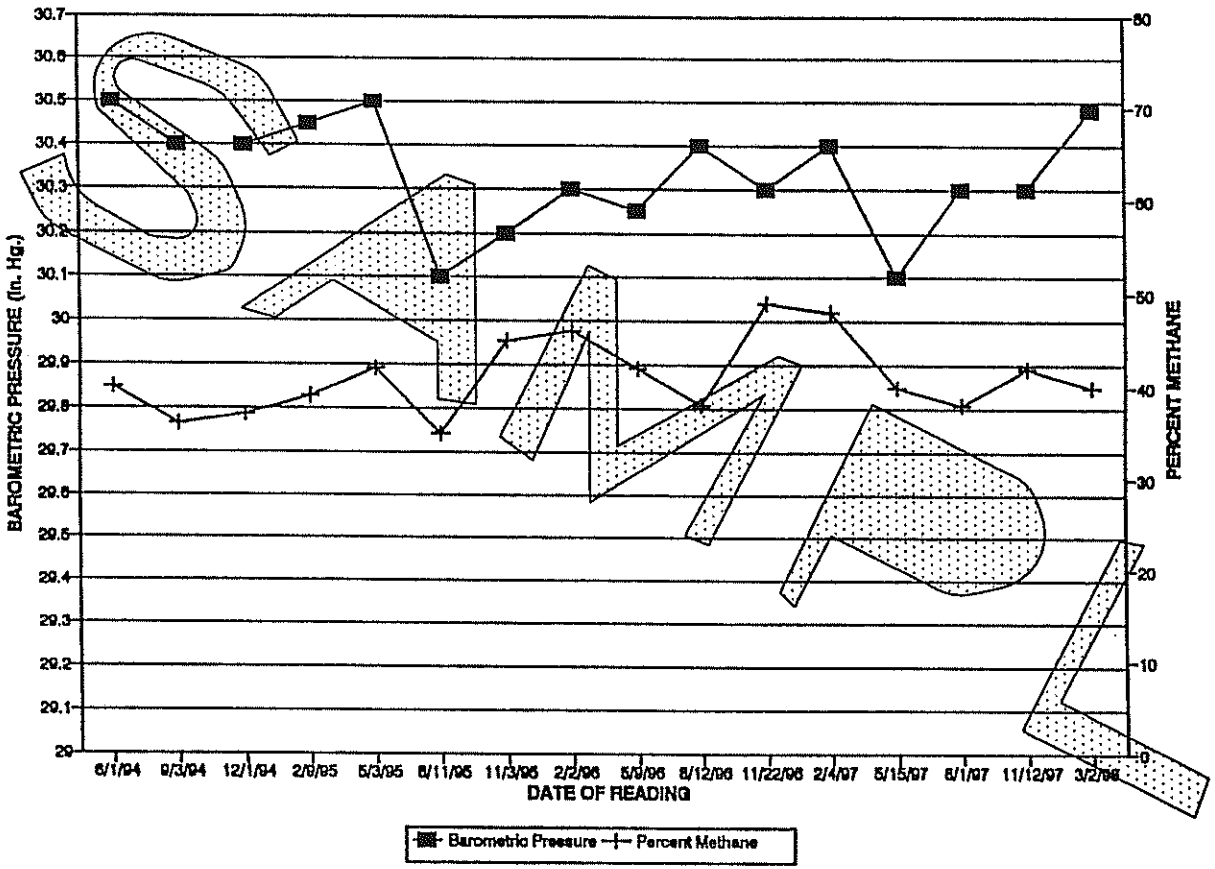
- Continuous monitoring for the hazard of confined space entry in:
  - Storage tanks
  - Ship compartments
  - Process or reaction vessels
  - Underground cable vaults
  - Meter and valve pits
  - Wells
  - Degreasers
  - Boilers
  - Tunnels
  - Sewers
  - Manholes
  - Silos
  - Bins
  - Pipelines
  - Ventilation and exhaust ducts
  - Vats
- Continuous monitoring of hazardous areas while welding or other hot work is in progress
- Plant surveys on a systematic basis to identify areas which could be potentially dangerous
- Leak detection surveys for locating escaping gas or vapor from buried pipelines or underground storage tanks for economic reasons as well as safety reasons.

®—Registered Trademarks

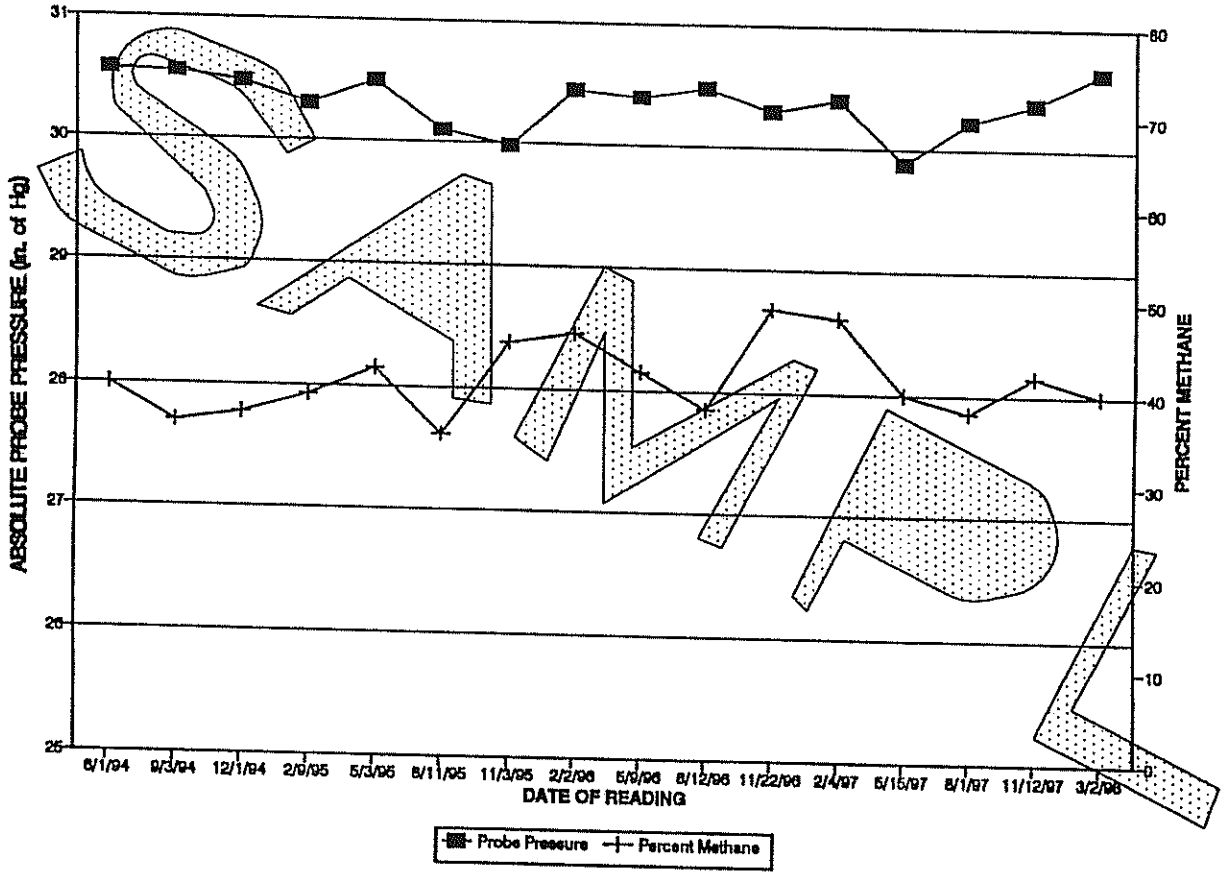
# APPENDIX C

# PRESENTATION OF DATA

# METHANE MONITORING DATA
# McCOMBS MUNICIPAL LANDFILL

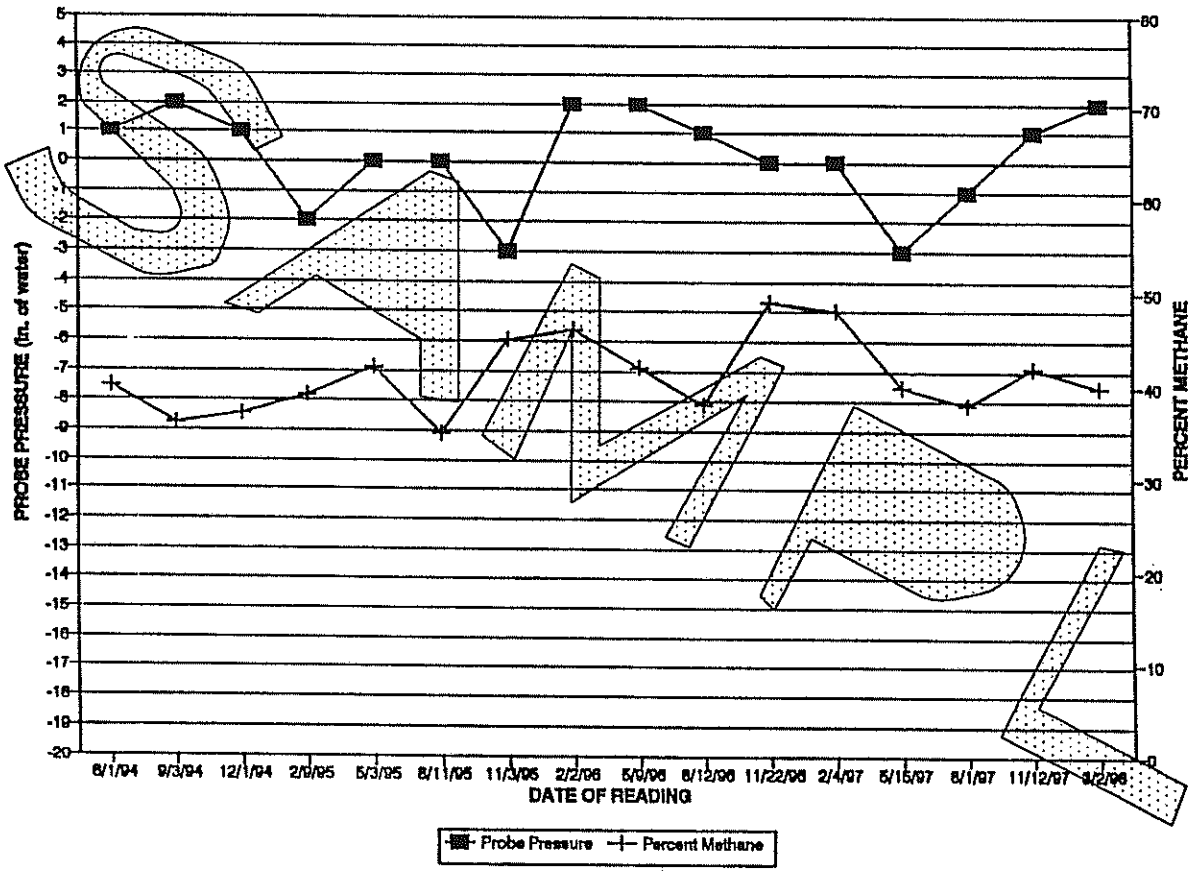


# METHANE MONITORING DATA
# McCOMBS MUNICIPAL LANDFILL




SAMPLE

# METHANE MONITORING DATA
# McCOMBS MUNICIPAL LANDFILL




PROBE PRESSURE MEASURED AS DEVIATION FROM ATMOSPHERIC PRESSURE

APPENDIX D

AS-BUILT DRAWNGS

(To Be Completed)

APPENDIX E

BORING LOGS

(To Be Completed)

PROJECT_____ **LOG OF TEST BORING NO.**_____

JOB NO._____ DATE_____

RIG TYPE_____

BORING TYPE_____

SURFACE ELEV._____

DATUM_____

| Depth Feet | Sample Number | Graphical Log | Sample | Sample Type | Blows per foot 140 lb. 30" free-fall drop hammer | HNU/PID Headspace Downhole | %LEL | Unified Soil Classification | REMARKS | VISUAL CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |

GROUND WATER

| DEPTH | HOUR | DATE |
|---|---|---|
| | | |
| | | |

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.
U – 3" O.D. 2.42" I.D. tube sample.
T – 3" O.D. thin-walled Shelby tube.

SERGENT, HAUSKINS & BECKWITH

CONSULTING GEOTECHNICAL ENGINEERS
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ALBUQUERQUE • SANTA FE • SALT LAKE CITY • EL PASO • RENO SPARKS

APPENDIX F

TNRCC WELL LOGS

(To Be Completed)

Send original copy by certified mail to: **Texas Water Commission, P.O. Box 13087, Austin, Texas 78711**

*Please use black ink.*

**ATTENTION OWNER:** *Confidentiality Privilege Notice on Reverse Side*

# State of Texas
# WELL REPORT

**Texas Water Well Drillers Board**
**P.O. Box 13087**
**Austin, Texas 78711**

1) **OWNER** _____ (Name) **ADDRESS** _____ (Street or RFD) (City) (State) (Zip)

2) **LOCATION OF WELL:**
County _____, _____ miles in _____ (NE, SW, etc.) direction from _____ (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ **LEGAL DESCRIPTION:**
Section No. _____ Block No. _____ Township _____ Abstract No. _____ Survey Name _____
Distance and direction from two intersecting section or survey lines _____

☐ **SEE ATTACHED MAP**

3) **TYPE OF WORK (Check):**
☐ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) **PROPOSED USE (Check):**
☐ Domestic ☐ Industrial ☐ Monitor ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) **DRILLING METHOD (Check):** ☐ Driven
☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Bored ☐ Air Rotary ☐ Cable Tool ☐ Other _____

6) **WELL LOG:**
Date Drilling:
Started _____ 19__
Completed _____ 19__

| DIAMETER OF HOLE | | |
|---|---|---|
| Dia. (in.) | From (ft.) | To (ft.) |
| | Surface | |
| | | |
| | | |

7) **BOREHOLE COMPLETION:**
☐ Open Hole ☐ Straight Wall ☐ Underreamed
☐ Gravel Packed ☐ Other _____
If Gravel Packed give interval . . . from _____ ft. to _____ ft.

| From (ft.) | To (ft.) | Description and color of formation material |
|---|---|---|
| | | |

8) **CASING, BLANK PIPE, AND WELL SCREEN DATA:**

| Dia. (in.) | New or Used | Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial | Setting (ft.) From | Setting (ft.) To | Gage Casting Screen |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

*(Use reverse side if necessary)*

9) **CEMENTING DATA** [Rule 287.44(1)]
Cemented from _____ ft. to _____ ft. No. of Sacks Used _____
_____ ft. to _____ ft. No. of Sacks Used _____
Method used _____
Cemented by _____

10) **SURFACE COMPLETION**
☐ Specified Surface Slab Installed [Rule 287.44(2)(A)]
☐ Specified Steel Sleeve Installed [Rule 287.44(3)(A)]
☐ Pitless Adapter Used [Rule 287.44(3)(B)]
☐ Approved Alternative Procedure Used [Rule 287.71]

11) **WATER LEVEL:**
Static level _____ ft. below land surface Date _____
Artesian flow _____ gpm. Date _____

12) **PACKERS:** Type Depth

13) **TYPE PUMP:**
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other _____
Depth to pump bowls, cylinder, jet, etc., _____ ft.

14) **WELL TESTS:**
Type Test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

15) **WATER QUALITY:**
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☐ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? _____ Depth of strata _____
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

**COMPANY NAME** _____ (Type or print) **WELL DRILLER'S LICENSE NO.** _____

**ADDRESS** _____ (Street or RFD) (City) (State) (Zip)

**(Signed)** _____ (Licensed Well Driller) **(Signed)** _____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TWC use only: Well No. _____ Located on map _____

WWD-012 (Rev. 05-18-90)

TEXAS WATER COMMISSION COPY

APPENDIX G

QUARTERLY MONITORING FIELD FORMS

(To Be Completed)

## McCOMBS LANDFILL QUARTERLY METHANE MONITORING REPORT

### LANDFILL CONDITIONS

| |
|---|
| Report Completed By:_____ Date:_____ |
| Temperature:_____ Atmospheric Conditions:_____inches of mercury _____inches of water |
| Cumulative rainfall since last monitoring event:_____ |
| Ambient conditions (Weather):_____ |
| Methane monitor charge check:_____ Methane monitor calibration check:_____ |

### GMP MONITORING

| GMP Number | Gas Probe Pressure | Ambient Methane Reading | GMP Peak Methane Reading | GMP Steady State Methane Reading |
|---|---|---|---|---|
| 1A | | | | |
| 1B | | | | |
| 1C | | | | |
| 2A | | | | |
| 2B | | | | |
| 2C | | | | |
| 3A | | | | |
| 3B | | | | |
| 3C | | | | |
| 4A | | | | |
| 4B | | | | |
| 4C | | | | |
| 5A | | | | |
| 6A | | | | |
| 7A | | | | |
| 8A | | | | |
| 8B | | | | |
| 8C | | | | |

## PERMANENT ENCLOSED STRUCTURE MONITORING

| Structure | Methane Readings (Range) | Comments |
|---|---|---|
| Fee Collection Building | | |
| Maintenance Building | | |
| Southern Storage Building | | |
| Northern Storage Building | | |

## ADDITIONAL COMMENTS

APPENDIX H

QUARTERLY TNRCC REPORTS

(To Be Completed)

# Appendix 3N
# Closure Details

SAIC®

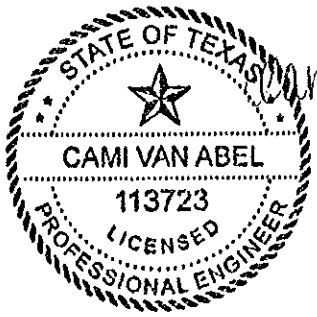
# McCombs Municipal Landfill
# El Paso County, Texas
# TCEQ MSW Permit No. 729B

## Part III
## Appendix 3N
## Use of Alternative CAP

Prepared for

**City of El Paso**

Updated June 2013, Revision 3




Cami Van Abel
6/13/13

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Texas Board of Professional Engineers
Firm Registration No. 3823

# Part III

# Appendix 3N – Use of Alternative CAP

## City of El Paso

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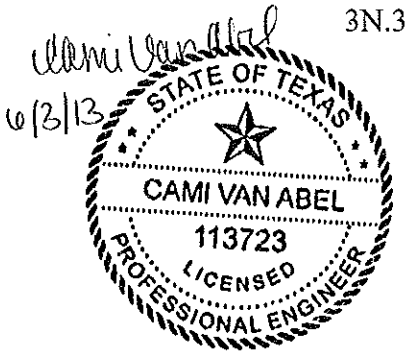


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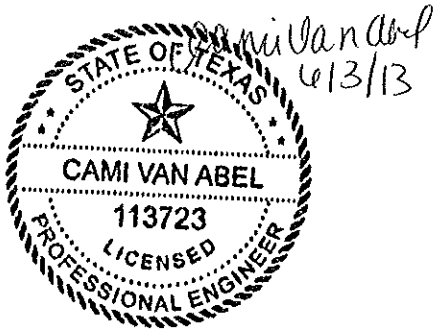


Cami Van Abel 6/13/13

# Appendix 3N
# USE OF ALTERNATIVE CAP

To demonstrate that an alternative earthen cap, or Evapotranspiration (ET) monolithic soil cover design, will perform as well or better than a conventional composite geomembrane cap for the McCombs Landfill closure area, SAIC and Parkhill, Smith, and Cooper (PSC) have completed an UNSAT-H model of the alternative cap for a 30-year period. The results show that the 3 mm/year maximum percolation rate guideline is met with this ET cap, demonstrating that the performance of the alternative cap against percolation is equivalent or better than the conventional composite geomembrane cap. This alternative cap report has been prepared in accordance with the TCEQ Guidance for Authorizing a Water Balance Alternative Final Cover for a Municipal Solid Waste Landfill (TCEQ Guidance).

## 3N.1 Introduction

The ET soil cover design for the McCombs Landfill consists of (in descending order):

- 4-inch Rock Armor. Unvegetated rock and gravel surface was selected as an erosion control surface for the arid conditions at the Landfill.
- 18-inch Thick Erosion Layer. The selected material will have sufficient capacity to store infiltration moisture to promote evapotranspiration at the final cover surface.
- 6-inch Thick Support Layer: The selected material will have sufficient capacity to assist the Erosion Layer with moisture storage.

The ET soil cover will be placed on top of a 12" intermediate cover layer, consisting of on-site sand material.

## 3N.2 UNSAT-H Modeling Approach

### 3N.2.1 Summary of UNSAT-H

SAIC/PSC has compared the performance of the conventional composite geomembrane cap to the alternative cap using the UNSAT-H program for the final cover.

The UNSAT-H program was developed by the Pacific Northwest National Laboratory as a computer modeling tool for one-dimensional flow. The program is one of the most commonly used models to evaluate alternative cap systems for MSW landfills in the United States. The UNSAT-H version 3.01 was used for this alternative cap analysis.

### 3N.2.2 Methodology

Laboratory tested saturated hydraulic conductivity at anticipated natural soil compaction were utilized in the model. While during construction, compaction may be slightly greater, in the long term, seasonal stresses on soil structure due to varying precipitation and temperature tend to restructure compacted soils into a less dense, natural state. Laboratory tested permeability values were used to model the natural state that soil structures will adapt and stabilize over time. Two soil layers and types were used for the model of the alternative cap including an 18-inch unvegetated erosion control layer (top layer) and a 6-inch thick support soil layer (bottom layer).

The model was performed to simulate the water balance within the alternative cap materials and the percolation rate at the bottom of the cap during the required 30-year post-closure care period. The ET cap designs are successful when there is sufficient soil water storage capacity to store infiltrated water until it can be removed through evaporation or transpiration.

The current UNSAT-H version 3.01 has the capability of multi-year simulation and therefore is able to model the entire 30-year post-closure care duration. Input weather conditions included wet weather data, as described in section 1.1.3 Input Parameters, for a conservative approach. Model input and output files and weather data used for the model are included as Appendix 3N, Attachment 1. In order to demonstrate that the alternative cap is equivalent to the conventional composite geomembrane cap, the following design criteria are used:

- The storage capacity of the vegetative support soil layer should not be exceeded throughout the 30-year modeling period. This would mathematically verify that there is zero or a negligible amount of percolation through the bottom of the alternative cap into the underlying waste.
- The recommended maximum annual percolation rate for an alternative earthen final cap set by the US EPA guideline for the Alternative Cover Assessment Program (ACAP, www.acap.dri.edu) is 3 millimeter per year (mm/yr) to compare to the equivalent percolation rate of a conventional composite geomembrane cap system. The same guideline of 3 mm/yr maximum percolation rate has been adopted by several other states, including Texas, for alternative cap evaluation and permit approval.

## 3N.3 UNSAT-H Model Setup

Where applicable, input parameters are typical data recommended by the UNSAT-H User Manual. Other input parameters including soil properties, weather, and plant information were obtained through laboratory testing, calculations, and additional references.

### 3N.3.1 Options, Constants and Limits

Variables in this portion of input parameters define the characteristics of water flow to modeled, the soil profile thicknesses, and modeling preferences including equations to be utilized.

An entire year of data was modeled (365 days) for 30 years. Weather data used for the model is provided in Appendix 3N, Attachment 1. The option for cloud cover in the meteorological data was not selected as it was not available. However, the solar radiation is provided and will be used to evaluate a similar effect to cloud cover. The time step control utilized was based on the total mass balance rather than a change in water content (water content is assumed to be a source of the largest error). A summary of UNSAT-H Input parameters is summarized in Table 3N-1.

Table 3N-1
Summary of UNSAT-H Parameters

| Parameter Name | Parameter Description | Value | Source |
|---|---|---|---|
| TITLE | Input file description | McCombs Landfill ET Cap design Two Layer No Plants | n/a |
| IPLANT | Option of plants | 1 (Plants) | Simulation to include plants |
| NGRAV | Domain orientation | 1 (Vertical) | Simulation of vertical network |
| IFDEND | Last day of the year of the simulation | 365 | 365 days |
| IDTBEG | First day for which data have been provided | 1 | Data provided for Day 1, Year 1 |
| IDTEND | Last day for which data have been provided | 365 | Data provided for Day 365, Year 30 |
| IYS | Year of the simulation | 1 | Simulation to begin in Year 1 |
| NYEARS | Number of years to simulate | 30 | Simulation to run to Year 30 |
| ISTEAD | Steady state option | 0 (Transient Solution) | Each year only simulated once |
| IFLIST | Option for entering meteorological information | 1 (Data provided in separate files) | Matches weather data files |
| NFLIST | Number of filenames | 30 | 30 weather data files |
| NPRINT | Option for level of output | 0 | Larger files not needed |
| STOPHR | Time to stop daily simulation | 24 | Simulation to stop at end of day |
| ISMETH | Option for method of solution | 0 (Crank-Nicholson) | Standard method of UNSAT-H solution |
| INMAX | Number of iterations allowed for solving the water flow equation | 4 | 2 is minimum, selected for stability and mass balance error |
| ISWDIF | Option for time step control | 1 (Reduce time step if mass balance exceeds DMAXBA) | Standard method of UNSAT-H solution |
| DMAXBA | Time step control parameter | 1.00E-06 | Suggested value is 0.01, selected to reduce mass balance error |
| DELMAX | Maximum allowable time step | 1.0 | Normally 1 hour, selected to reduce mass balance error |
| DELMIN | Minimum allowable time step | 1.00E-08 | Selected to reduce mass balance error |
| OUTTIM | Time-step parameter | 1.0 | Selected to reduce mass balance error |
| RFACT | Maximum time-step factor | 1.2 | Selected to increase stability |

Table 3N-1
Summary of UNSAT-H Parameters

| Parameter Name | Parameter Description | Value | Source |
|---|---|---|---|
| RAINIF | Rainfall time-step reduction factor | 1.00E-04 | Selected to increase stability |
| DHTOL | Iteration control parameter | 0.0 | Selected to increase stability |
| DHMAX | Iteration control parameter | 0.0 | Selected to increase stability |
| DHFACT | Time step reduction factor | 0.0 | DHMAX = 0 |
| KOPT | Options for describing the soil hydraulic properties | 4 (van Genuchten) | Site soil were tested for van Genuchten parameters |
| KEST | Option for estimating the liquid conductivity between nodes | 3 (Geometric Mean) | Selected to increase stability |
| WTF | Weighting factor | 0 | Weights the nodes equally |
| ITOPBC | Option for the surface-boundary condition | 0 (Flux) | Flux to simulate changes soil-atmosphere interaction |
| IEVOPT | Option to allow evaporation | 1 (Evaporation) | Simulation must include evaporation |
| NFHOUR | Option to distribute the daily potential evapotranspiration (PET) | 2 (Distributed with sine function) | Data on site specific distribution not available |
| LOWER | Lower boundary condition option | 1 (Unit gradient) | Selected to allow for free drainage at the lower boundary |
| HIRRI | Minimum head to which the soil can wet up | 1.0 | Typical soil value, confirmed by laboratory results |
| HDRY | Maximum head to which the soil can dry out | 1.00E+06 | Typical soil value, confirmed by laboratory results |
| HTOP | Constant head value of the surface node | 0.0 | ITOPBC ≠ 1 |
| RHA | Relative humidity of the air | 0.0 | HDRY ≠ 0 |
| IETOPT | Option to input daily meteorological data | 1 (Daily data are entered) | 30 years of daily data must be used in simulation |
| ICLOUD | Option to use cloud cover data | 0 (No) | Cloud cover is already included in daily solar radiation values in the weather data files |
| ISHOPT | Option for the upper surface head limit | 1 (HDRY based on calculated humidity) | Selected to utilize weather data |
| IRAIN | Option for water application information | 1 (Apply precipitation at HPR rate) | Selected as hourly precipitation data is not available |
| HPR | Hourly precipitation rate | 1.0 | Default value is 1.0, this value is conservative and allows greater infiltration |
| IHYS | Option for hysteresis | 0 (No hysteresis) | Hysteresis data for this soil not available |
| AIRTOL | Tolerance limit on entrapped air content | 0.0 | IHYS = 0 |
| HYSTOL | Tolerance limit on head changes | 0.0 | IHYS = 0 |
| HYSMXH | Maximum head value | 0.0 | IHYS = 0 |
| HYFILE | Name of restart file | 0 | IHYS = 0 |

Table 3N-1
Summary of UNSAT-H Parameters

| Parameter Name | Parameter Description | Value | Source |
|---|---|---|---|
| IHEAT | Option for simulating heat flow | 0 (No heat flow) | Heat flow parameters not available for this soil |
| ICONVH | Option to allow convective heat flow | 0 (No convective heat flow) | Heat flow parameters not available for this soil |
| DMAXHE | Time step control parameter | 0.0 | IHEAT ≠ 1 |
| UPPERH | Option for the upper boundary condition for heat flow | 0 | IHEAT ≠ 1 |
| TSMEAN | Daily mean surface temperature | 0.0 | IHEAT ≠ 1 |
| TSAMP | Daily surface temperature amplitude | 0.0 | IHEAT ≠ 1 |
| QHCTOP | User-specified surface heat flux | 0.0 | IHEAT ≠ 1 |
| LOWERH | Option for the lower boundary condition for heat flow | 0 | IHEAT ≠ 1 |
| QHLEAK | Heat flux at the bottom boundary | 0.0 | IHEAT ≠ 1 |
| TGRAD | Temperature gradient | 0.0 | IHEAT ≠ 1 |
| IVAPOR | Option to allow vapor flow | 1 (Yes) | Typical soil values for vapor flow area available |
| TORT | Tortuosity | 0.66 | Average solid values are between 0-2, 0.66 is conservative estimate for sandy soils |
| TSOIL | Average temperature of the soil | 291.0 | Average air temperature for site is 291K |
| VAPDIF | Diffusion coefficient of vapor in air | 0.24 | Coefficient of vapor at 291 K, per Bolz and Tuve (1976) |
| MATN | Number of different soil materials | 2 | Base and Infiltration layer soils |
| NPT | Number of nodes | 43 | 43 nodes |
| MAT,Z | Soil material identification number for | See input file in Appendix 1-A | |
| Z | Depth of node below the surface | See input file in Appendix 1-A | |

The van Genuchten (van Genuchten, 1978) method was selected to represent the hydraulic properties of the soils. Soil samples were tested to determine the soil parameters. The option for estimating liquid conductivity at the midpoint between the 43 nodes was geometric mean which is the most commonly used method for the UNSAT-H model.

## 3N.3.2 Soil Property Information

Soil samples were collected from a selected off-site borrow source stockpile to be used for the final cover in order to determine their suitability for use in the ET cap at McCombs Landfill. On-site soils that are equivalent to the off-site borrow source (as well as other off-site borrow sources) may also be utilized for the alternative cap profile, provided they meet the same testing standards. The soil samples obtained by PSC and tested by Daniel B. Stephens and Associates, Inc. (DBS) were a silty sand.

The soil hydraulic conductivities were tested at 75%, 80, 85%, 90% and 95% compaction to determine the best use for the ET cover system. It should be noted that only the data results from the 80% and 90% compaction rates are used for the modeling, as those values are assigned to the ET cap profile. Laboratory report data is provided as Appendix 3N, Attachment 2. The van Genuchten parameters were also tested by DBS and the water retention curves are provided as Appendix 3N, Attachment 2. Soil property information is presented as Table 3N-2.

Table 3N-2
Soil Testing Results

| | | |
|---|---|---|
| USCS Classification | Silty Sand (SM) | |
| Bulk Density | 1.56 g/cm3 (97.38 lb/cf) | |
| Maximum Dry Density (Standard Proctor) | 1.83 g/cm3 (114.24 lb/cf) | |
| Percent Optimum Moisture | 10.90% | |
| Soil Water Retention Curve - 80% | Suction (cm) | Moisture Content |
| | 0 | 0.452 |
| | 12 | 0.415 |
| | 38 | 0.397 |
| | 79 | 0.188 |
| | 510 | 0.104 |
| | 11,728 | 0.056 |
| | 851,293 | 0.012 |
| Soil Water Retention Curve - 90% | Suction (cm) | Moisture Content |
| | 0 | 0.377 |
| | 11 | 0.361 |
| | 40 | 0.348 |
| | 83 | 0.336 |
| | 510 | 0.115 |
| | 11,728 | 0.063 |
| | 851,293 | 0.014 |
| Saturated Hydraulic Conductivity - 80% | 6.6E-03 cm/sec (23.76 cm/hr) | |
| Saturated Hydraulic Conductivity - 90% | 1.3E-03 cm/sec (4.68 cm/hr) | |

This site has a very deep groundwater elevation, has a Subtitle D Liner system, and is designed and operation to pose no risk to human health or the environment.

Soil input parameters are provided on the following Table 3N-3 below.

Table 3N-3
Summary of UNSAT-H Parameters - Soil

| Parameter Name | Parameter Description | Value | Source |
|---|---|---|---|
| DUMMY | Soil type name | 90% Compaction Layer | |
| THET | Saturated water content | 0.37 | Calculated lab data |
| THTR | Residual water content | 0.04 | Calculated lab data |
| VGA | Van Genuchten - α | 0.006 | Calculated lab data |
| VGN | Van Genuchten - n | 2.16 | Calculated lab data |
| RKMOD | Conductivity model options | 2 (Mualem) | Typical option utilized |
| SK | Saturated hydraulic conductivity | 4.6 | Lab measurement |
| EPIT | Exponent of the pore interaction term | 0.5 | Value for used with Mualem option |
| DUMMY | Soil type name | 80% Compaction Layer | |
| THET | Saturated water content | 0.44 | Calculated lab data |
| THTR | Residual water content | 0.057 | Calculated lab data |
| VGA | Van Genuchten - α | 0.017 | Calculated lab data |
| VGN | Van Genuchten - n | 3.99 | Calculated lab data |
| RKMOD | Conductivity model options | 2 | Typical option utilized |
| SK | Saturated hydraulic conductivity | 23.7 | Lab measurement |
| EPIT | Exponent of the pore interaction term | 0.5 | Value for used with Mualem option |

## 3N.3.3 Initial Conditions

The initial conditions variables for the UNSAT-H model include the initial suction head of the soil for initial hydraulic conditions. The wilting point is a suction head value of 15,000 cm for loamy sand (LS) soil (Winkler, 1999), but at placement the suction head will be lower than wilting point. Therefore a value of 10,000 cm was assigned for the erosion layer.

Initial conditions also include initial soil temperature which was set at 291K.

Initial conditions data is summarized in Table 3N-4.

Table 3N-4
Summary of UNSAT-H Parameters - Initial Conditions

| Parameter Name | Parameter Description | Value | Source |
|---|---|---|---|
| NDAY | Day before suction head values are set | 0 | Sets initial suction head values for Day 1 |
| H | Suction Head - 90% | 575 (nodes 1 - 37) | Calculated value soil suction at optimum moisture |
| H | Suction Head - 80% | 125 (nodes 38 - 43) | Calculated value soil suction at optimum moisture |

## 3N.3.4 Plant Information

UNSAT-H plant input is necessary for this model as plants are an important part of the ET cap. However, due to the arid climate of the Landfill, an unvegetated rock cover has been designed for the ET cap. The model input plant information is summarized in Table 3N-5 indicating the values used for the lack of vegetation designed for this cover.

Table 3N-5
Summary of UNSAT-H Parameters - Plant Information

| Parameter Name | Parameter Description | Value | Source |
|---|---|---|---|
| LEAF | Option for leaf area index | 0 (LAI values not needed) | NFPET = 1 |
| NFROOT | Option for root growth | 1 (Exponential relationship) | Only option available |
| NUPTAK | Option for plant water uptake | 1 (Sink term approximation proposed by Feddes) | Only option available |
| NFPET | Option for partitioning PET | 1 (Partitioning using LAI of Richie and Burnett (1971)) | Typical option used for partitioning |
| NSOW | Day of the year on which seeds germinate | 1 | Rocks will be present on Day 1 of each year |
| NHRVST | Day of the year on which plants cease transpiring | 365 | Rocks will be present on Day 365 of each year |
| BARE | Fraction of soil surface that is bare of plants | 0.2 | Average percentage of exposed soil under rock cover |
| AA,B1, B2 | Root growth coefficients | 0.0 , 0.0, 0.0 | Roots not allowed to grow |
| NTROOT | Growth day on which roots reach the corresponding node | 365 (All Nodes) | Roots not allowed to grow |
| HW, HD, HN | Head values for wilting, transpiration decrease, and anaerobic conditions | 0.1, 0.05, 0.0 | Roots not allowed to grow, so there will be no transpiration |
| PETPC | Coefficients for partitioning of PET using LAI | 0.0, 0.52, 0.5, 0.1, 2.7 | All default values for Ritchie and Burnett (1971) |

## 3N.3.5 Boundary Conditions

Boundary conditions for the UNSAT-H model include potential evapotranspiration, altitude of the site, height of the wind speed measurement and average annual atmospheric pressure. Daily meteorological input is also required, including maximum and minimum air temperature, dew point temperature, solar radiation or average cloud cover, average wind speed, and inches of precipitation. Model boundary conditions are summarized in Table 3N-6.

Table 3N-6
Summary of UNSAT-H Parameters - Boundary Conditions

| Parameter Name | Parameter Description | Value | Source |
|---|---|---|---|
| ALBEDO | Potential evapotranspiration | 0.49 | Average daily pan evaporation for El Paso |
| ALT | Altitude of the site being simulated | 1217 | Average elevation of final cap |
| ZU | Height of the wind speed measurement | 0.5 | Height of wind speed meter at weather station |
| PMB | Average annual atmospheric pressure | 882 | Average pressure measure at weather station |

## 3N.3.6 Results

The table below provides a summary of the output data. Most importantly, the percolation rates from the bottom of the alternative cap after 30 years have been provided.

Table 3N-7
Summary of UNSAT-H ET Cap Performance

| | Precipitation P (cm) | Potential Evapotranspiration PET (cm) | P/PET Ratio | Actual Evaporation (cm) | Actual Transpiration (cm) | Runoff (% of P) | End of Year Storage (cm) | Percolation (mm) | Mass Balance Error (cm) | Percolation + Mass Balance Error |
|---|---|---|---|---|---|---|---|---|---|---|
| Year 1 | 32.08 | 338.20 | 0.09 | 35.19 | 0.00 | 0.00% | 3.42 | 2.43E+00 | 8.48E-03 | 2.43E+00 |
| Year 2 | 27.86 | 333.15 | 0.08 | 25.44 | 0.00 | 0.00% | 5.83 | 2.28E-02 | 9.61E-03 | 3.24E-02 |
| Year 3 | 20.30 | 327.11 | 0.06 | 20.30 | 0.00 | 0.00% | 3.65 | 6.36E-03 | 8.91E-03 | 1.53E-02 |
| Year 4 | 41.07 | 290.78 | 0.14 | 40.24 | 0.00 | 0.00% | 4.44 | 4.22E-01 | 8.14E-03 | 4.30E-01 |
| Year 5 | 20.73 | 236.56 | 0.09 | 21.71 | 0.00 | 0.00% | 3.44 | 5.86E-02 | 7.20E-03 | 6.59E-02 |
| Year 6 | 30.91 | 245.32 | 0.13 | 29.32 | 0.00 | 0.00% | 5.02 | 6.21E-03 | 8.91E-03 | 1.51E-02 |
| Year 7 | 27.79 | 273.51 | 0.10 | 26.16 | 0.00 | 0.00% | 6.64 | 1.58E-03 | 9.75E-03 | 1.13E-02 |
| Year 8 | 28.09 | 283.60 | 0.10 | 31.02 | 0.00 | 0.00% | 3.71 | 5.56E-04 | 7.41E-03 | 7.97E-03 |
| Year 9 | 18.44 | 309.23 | 0.06 | 18.67 | 0.00 | 0.00% | 3.47 | 1.45E-04 | 7.99E-03 | 8.13E-03 |
| Year 10 | 32.64 | 308.68 | 0.11 | 32.25 | 0.00 | 0.00% | 3.85 | 2.73E-06 | 8.21E-03 | 8.22E-03 |
| Year 11 | 31.45 | 298.97 | 0.11 | 26.95 | 0.00 | 0.00% | 8.34 | 4.64E-06 | 9.10E-03 | 9.10E-03 |
| Year 12 | 28.96 | 305.44 | 0.09 | 32.94 | 0.00 | 0.00% | 4.35 | 4.24E-05 | 9.54E-03 | 9.58E-03 |
| Year 13 | 24.46 | 336.56 | 0.07 | 24.68 | 0.00 | 0.00% | 4.12 | 1.87E-05 | 8.38E-03 | 8.40E-03 |
| Year 14 | 13.92 | 356.84 | 0.04 | 12.81 | 0.00 | 0.00% | 5.22 | 2.65E-07 | 8.16E-03 | 8.16E-03 |
| Year 15 | 20.47 | 349.82 | 0.06 | 22.24 | 0.00 | 0.00% | 3.45 | 1.56E-07 | 7.64E-03 | 7.64E-03 |
| Year 16 | 21.31 | 376.36 | 0.06 | 21.50 | 0.00 | 0.00% | 3.25 | 1.57E-07 | 6.31E-03 | 6.31E-03 |
| Year 17 | 24.46 | 312.89 | 0.08 | 23.05 | 0.00 | 0.00% | 4.65 | 1.45E-07 | 1.16E-02 | 1.16E-02 |
| Year 18 | 17.20 | 328.21 | 0.05 | 18.10 | 0.00 | 0.00% | 3.74 | 2.06E-07 | 7.46E-03 | 7.46E-03 |
| Year 19 | 20.73 | 324.97 | 0.06 | 20.08 | 0.00 | 0.00% | 4.37 | 2.46E-07 | 6.47E-03 | 6.47E-03 |
| Year 20 | 18.82 | 334.21 | 0.06 | 19.47 | 0.00 | 0.00% | 3.70 | 1.75E-07 | 7.81E-03 | 7.81E-03 |
| Year 21 | 10.90 | 331.25 | 0.03 | 11.06 | 0.00 | 0.00% | 3.53 | 4.60E-08 | 7.75E-03 | 7.75E-03 |
| Year 22 | 17.50 | 337.82 | 0.05 | 16.44 | 0.00 | 0.00% | 4.58 | 5.56E-08 | 7.77E-03 | 7.77E-03 |
| Year 23 | 10.69 | 347.20 | 0.03 | 11.84 | 0.00 | 0.00% | 3.43 | 1.35E-07 | 6.86E-03 | 6.86E-03 |
| Year 24 | 30.71 | 309.41 | 0.10 | 30.29 | 0.00 | 0.00% | 3.84 | 4.92E-07 | 8.96E-03 | 8.96E-03 |
| Year 25 | 32.69 | 312.90 | 0.10 | 33.17 | 0.00 | 0.00% | 3.36 | 6.97E-06 | 7.14E-03 | 7.15E-03 |
| Year 26 | 18.57 | 326.87 | 0.06 | 18.32 | 0.00 | 0.00% | 3.60 | 1.51E-04 | 8.69E-03 | 8.84E-03 |
| Year 27 | 25.71 | 333.23 | 0.08 | 25.42 | 0.00 | 0.00% | 3.87 | 3.95E-04 | 9.43E-03 | 9.83E-03 |
| Year 28 | 25.04 | 363.23 | 0.07 | 25.47 | 0.00 | 0.00% | 3.44 | 5.32E-07 | 6.58E-03 | 6.58E-03 |
| Year 29 | 22.05 | 349.97 | 0.06 | 21.13 | 0.00 | 0.00% | 4.35 | 1.17E-07 | 7.74E-03 | 7.74E-03 |
| Year 30 | 16.94 | 337.22 | 0.05 | 17.86 | 0.00 | 0.00% | 3.42 | 2.56E-07 | 7.02E-03 | 7.02E-03 |

The results from the UNSAT-H modeling indicate the alternative cap is effective in minimizing percolation of precipitation through the bottom of the alternative cap for as demonstrated above. In addition, the model thickness shows a runoff quantity of less than 10% of precipitation as described in the TCEQ Guidance.

Results, consisting of 30 years of output for the model, are presented within this appendix (as Attachment 1). The results have been utilized to graph the water content of the vegetative support layer soil, shown in Figure 3N-1. The moisture content varies greatly in the top layer, demonstrating the movement of water due to the natural water cycle of precipitation, evaporation, transpiration and infiltration. In the lower level of the profile, moisture values remain fairly constant. This demonstrates the suitability of the material as an ET cover in providing a water storage in the cap.

## 3N.3.7 Conclusions

According to the results of the 30-year model run for the alternative cover soil profile (depicted in Drawing P3-35), the percolation rates of the alternative cap range from $4.6x10^{-8}$ mm/year to 2.43 mm/year, which is less than the maximum allowed percolation rate of 3 mm/year. Note the UNSAT-H model does not account for structural integrity and cost. Consequently, these parameters must also be considered when choosing a final cap. The alternative cap does not have the stringent compaction specifications required for the conventional cap.

## 3N.3.8 References


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# Appendix 3N – Attachment 1
# UNSAT-H Model Summary and Input Data

SAIC®

# Permit Modification

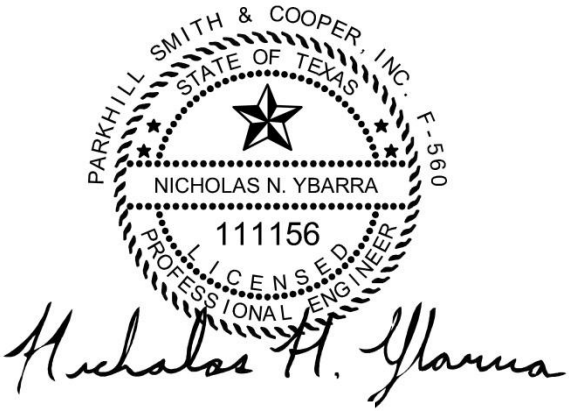
City of El Paso, Texas

McCombs Landfill

TCEQ Permit No. 729B

## Alternate Final Cover

## UNSAT-H Modeling




08/08/12

August 2012

PSC Project # 01384012

PARKHILLSMITH&COOPER

```
McCombs Landfill-ET Cap design-Two Layer-No Plants
1,1,                                IPLANT,NGRAV
365,1,365,                          IFDEND,IDTBEG,IDTEND
1,30,0,1,30,                        IYS,NYEARS,ISTEAD,IFLIST,NFLIST
0,24,                              NPRINT,STOPHR
0,4,1,1.0E-6,                       ISMETH,INMAX,ISWDIF,DMAXBA
1.0,1.0E-8,1.0,                    DELMAX,DELMIN,OUTTIM
1.2,1.0E-4,0.0,0.0,0.0,             RFACT,RAINIF,DHTOL,DHMAX,DHFACT
4,3,0.0,                            KOPT,KEST,WTF
0,1,2,1,                            ITOPBC,IEVOPT,NFHOUR,LOWER
1.0,1.0E6,0.0,0.0,                  HIRRI,HDRY,HTOP,RHA
1,0,1,                              IETOPT,ICLOUD,ISHOPT
1,1.0,                              IRAIN,HPR
0,0.0,0.0,0.0,0,                    IHYS,AIRTOL,HYSTOL,HYSMXH,HYFILE
0,0,0.0,                            IHEAT,ICONVH,DMAXHE
0,0.0,0.0,0.0,                      UPPERH,TSMEAN,TSAMP,QHCTOP
0,0.0,0.0,                          LOWERH,QHLEAK,TGRAD
1,0.66,291.0,0.24,                  IVAPOR,TORT,TSOIL,VAPDIF
2,43,                               matn,npt
1,0.00,1,0.10,1,0.20,1,0.30,
1,0.40,1,0.50,1,0.60,1,0.70,
1,0.80,1,0.90,1,1.00,1,1.25,
1,1.50,1,1.75,1,2.00,1,2.50,
1,3.00,1,3.50,1,4.00,1,4.50,
1,5.08,1,7.62,1,10.16,1,12.70,
1,15.24,1,17.78,1,20.32,1,22.86,
1,25.40,1,27.94,1,30.48,1,33.02,
1,35.56,1,38.10,1,40.64,1,43.18,
1,45.72,2,48.26,2,50.80,2,53.34,
2,55.88,2,58.42,2,60.96,
90% Compaction Layer
0.37,0.04,0.006,2.16,
conductivity
2.0,4.6,0.006,2.16,0.5,
80% Compaction Layer
0.44,0.057,0.017,3.99,
conductivity
2.0,23.7,0.017,3.99,0.5,
0,                                  NDAY
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,125.0,125.0,125.0,
125.0,125.0,125.0,
0,1,1,1,1,365,
0.2,
0.0,0.0,0.0,
365,365,365,365,365,365,365,365,365,365,365,
365,365,365,365,365,365,365,365,365,365,365,
365,365,365,365,365,365,365,365,365,365,365,
365,365,365,365,365,365,365,365,365,365,365,
365,365,365,
0.1,0.05,0.0,
0.1,0.05,0.0,
0.0,0.52,0.5,0.1,2.7,
0.2,1217,0.5,1000.0,                                ALBEDO,ALT,ZU,PMB
```

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a000
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 5.750E+02 | 0.1157 | 291.00 | 2 | 1.000E-01 | 5.750E+02 | 0.1157 | 291.00 |
| 3 | 2.000E-01 | 5.750E+02 | 0.1157 | 291.00 | 4 | 3.000E-01 | 5.750E+02 | 0.1157 | 291.00 |
| 5 | 4.000E-01 | 5.750E+02 | 0.1157 | 291.00 | 6 | 5.000E-01 | 5.750E+02 | 0.1157 | 291.00 |
| 7 | 6.000E-01 | 5.750E+02 | 0.1157 | 291.00 | 8 | 7.000E-01 | 5.750E+02 | 0.1157 | 291.00 |
| 9 | 8.000E-01 | 5.750E+02 | 0.1157 | 291.00 | 10 | 9.000E-01 | 5.750E+02 | 0.1157 | 291.00 |
| 11 | 1.000E+00 | 5.750E+02 | 0.1157 | 291.00 | 12 | 1.250E+00 | 5.750E+02 | 0.1157 | 291.00 |
| 13 | 1.500E+00 | 5.750E+02 | 0.1157 | 291.00 | 14 | 1.750E+00 | 5.750E+02 | 0.1157 | 291.00 |
| 15 | 2.000E+00 | 5.750E+02 | 0.1157 | 291.00 | 16 | 2.500E+00 | 5.750E+02 | 0.1157 | 291.00 |
| 17 | 3.000E+00 | 5.750E+02 | 0.1157 | 291.00 | 18 | 3.500E+00 | 5.750E+02 | 0.1157 | 291.00 |
| 19 | 4.000E+00 | 5.750E+02 | 0.1157 | 291.00 | 20 | 4.500E+00 | 5.750E+02 | 0.1157 | 291.00 |
| 21 | 5.080E+00 | 5.750E+02 | 0.1157 | 291.00 | 22 | 7.620E+00 | 5.750E+02 | 0.1157 | 291.00 |
| 23 | 1.016E+01 | 5.750E+02 | 0.1157 | 291.00 | 24 | 1.270E+01 | 5.750E+02 | 0.1157 | 291.00 |
| 25 | 1.524E+01 | 5.750E+02 | 0.1157 | 291.00 | 26 | 1.778E+01 | 5.750E+02 | 0.1157 | 291.00 |
| 27 | 2.032E+01 | 5.750E+02 | 0.1157 | 291.00 | 28 | 2.286E+01 | 5.750E+02 | 0.1157 | 291.00 |
| 29 | 2.540E+01 | 5.750E+02 | 0.1157 | 291.00 | 30 | 2.794E+01 | 5.750E+02 | 0.1157 | 291.00 |
| 31 | 3.048E+01 | 5.750E+02 | 0.1157 | 291.00 | 32 | 3.302E+01 | 5.750E+02 | 0.1157 | 291.00 |
| 33 | 3.556E+01 | 5.750E+02 | 0.1157 | 291.00 | 34 | 3.810E+01 | 5.750E+02 | 0.1157 | 291.00 |
| 35 | 4.064E+01 | 5.750E+02 | 0.1157 | 291.00 | 36 | 4.318E+01 | 5.750E+02 | 0.1157 | 291.00 |
| 37 | 4.572E+01 | 5.750E+02 | 0.1157 | 291.00 | 38 | 4.826E+01 | 1.250E+02 | 0.0958 | 291.00 |
| 39 | 5.080E+01 | 1.250E+02 | 0.0958 | 291.00 | 40 | 5.334E+01 | 1.250E+02 | 0.0958 | 291.00 |
| 41 | 5.588E+01 | 1.250E+02 | 0.0958 | 291.00 | 42 | 5.842E+01 | 1.250E+02 | 0.0958 | 291.00 |
| 43 | 6.096E+01 | 1.250E+02 | 0.0958 | 291.00 | | | | | |

Initial Water Storage = 6.7752 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.04007
Head (cm) = 2.51455E+05
LiqWater Flow (cm)=-2.29708E-01
IsoVapor Flow (cm)=-1.25637E-01
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 6.7752+ | 0.0000+ | 0.0000 | - 0.3591- | 0.0000- | 0.1046 = | 6.3114 vs. | 6.3115 |

Mass Balance = -6.8203E-05 cm; Time step attempts = 403 and successes = 346
Evaporation: Potential = 0.5673 cm, Actual = 0.3591 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 40.1 %;  TMEAN = 283.7 K;  HDRY =  1.2523E+06 cm;  DAYUBC =    68

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04001
 Head (cm)         = 1.36378E+06
 LiqWater Flow (cm)=-7.57384E-13
 IsoVapor Flow (cm)=-6.22860E-03
 Plant Sink (cm)   = 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR        STORAGE
   3.4219+ 0.0000+ 0.0000 - 0.0062- 0.0000-  0.0000 =    3.4156 vs.    3.4157

 Mass Balance = -7.3183E-06 cm;  Time step attempts =   47 and successes =   38
   Evaporation:  Potential =  0.5352 cm, Actual =  0.0062 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 37.0 %;  TMEAN = 283.4 K;  HDRY =  1.3638E+06 cm;  DAYUBC =    38
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.3820E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.3820E+02     [cm]
 Actual Evaporation                 =  3.5189E+01     [cm]
 Evaporation during Growth          =  3.5189E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  3.2080E+01     [cm]
 Total Basal Liquid Flux (drainage) =  2.4263E-01     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  3.2080E+01     [cm]
 Actual Rainfall                    =  3.2080E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  3.4157E+00     [cm]
 Mass Balance Error                 =  8.4845E-03     [cm]
 Total Successful Time Steps        =     67979
 Total Attempted Time Steps         =     83594
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     33255
 Total Time Actually Simulated      =  3.6500E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000   -3.1084E+00      0.050    1.6175E+01      0.150    9.2289E+00
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 6.6256E+00 | 0.350 | 5.2751E+00 | 0.450 | 4.4643E+00 |
| 0.550 | 3.6058E+00 | 0.650 | 2.9094E+00 | 0.750 | 2.3158E+00 |
| 0.850 | 1.7293E+00 | 0.950 | 1.2857E+00 | 1.125 | 9.5572E-01 |
| 1.375 | -3.0235E-02 | 1.625 | -5.4339E-01 | 1.875 | -9.8871E-01 |
| 2.250 | -1.3080E+00 | 2.750 | -1.8987E+00 | 3.250 | -2.2391E+00 |
| 3.750 | -2.4257E+00 | 4.250 | -2.4992E+00 | 4.790 | -2.5593E+00 |
| 6.350 | -2.5653E+00 | 8.890 | -2.4718E+00 | 11.430 | -2.3148E+00 |
| 13.970 | -2.1606E+00 | 16.510 | -2.0088E+00 | 19.050 | -1.8589E+00 |
| 21.590 | -1.7107E+00 | 24.130 | -1.5639E+00 | 26.670 | -1.4183E+00 |
| 29.210 | -1.2737E+00 | 31.750 | -1.1300E+00 | 34.290 | -9.8696E-01 |
| 36.830 | -8.4458E-01 | 39.370 | -7.0270E-01 | 41.910 | -5.6120E-01 |
| 44.450 | -4.2000E-01 | 46.990 | -2.7721E-01 | 49.530 | -1.7468E-01 |
| 52.070 | -8.6141E-02 | 54.610 | 7.9577E-03 | 57.150 | 1.0189E-01 |
| 59.690 | 1.9573E-01 | 60.960 | 2.4263E-01 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a000
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 1.364E+06 | 0.0400 | 291.00 | 2 | 1.000E-01 | 1.333E+06 | 0.0400 | 291.00 |
| 3 | 2.000E-01 | 1.304E+06 | 0.0400 | 291.00 | 4 | 3.000E-01 | 1.276E+06 | 0.0400 | 291.00 |
| 5 | 4.000E-01 | 1.248E+06 | 0.0400 | 291.00 | 6 | 5.000E-01 | 1.220E+06 | 0.0400 | 291.00 |
| 7 | 6.000E-01 | 1.193E+06 | 0.0400 | 291.00 | 8 | 7.000E-01 | 1.166E+06 | 0.0400 | 291.00 |
| 9 | 8.000E-01 | 1.140E+06 | 0.0400 | 291.00 | 10 | 9.000E-01 | 1.114E+06 | 0.0400 | 291.00 |
| 11 | 1.000E+00 | 1.089E+06 | 0.0400 | 291.00 | 12 | 1.250E+00 | 1.028E+06 | 0.0400 | 291.00 |
| 13 | 1.500E+00 | 9.701E+05 | 0.0400 | 291.00 | 14 | 1.750E+00 | 9.142E+05 | 0.0400 | 291.00 |
| 15 | 2.000E+00 | 8.605E+05 | 0.0400 | 291.00 | 16 | 2.500E+00 | 7.591E+05 | 0.0400 | 291.00 |
| 17 | 3.000E+00 | 6.646E+05 | 0.0400 | 291.00 | 18 | 3.500E+00 | 5.762E+05 | 0.0400 | 291.00 |
| 19 | 4.000E+00 | 4.932E+05 | 0.0400 | 291.00 | 20 | 4.500E+00 | 4.149E+05 | 0.0400 | 291.00 |
| 21 | 5.080E+00 | 3.294E+05 | 0.0400 | 291.00 | 22 | 7.620E+00 | 2.935E+03 | 0.0518 | 291.00 |
| 23 | 1.016E+01 | 2.602E+03 | 0.0536 | 291.00 | 24 | 1.270E+01 | 2.415E+03 | 0.0548 | 291.00 |
| 25 | 1.524E+01 | 2.285E+03 | 0.0558 | 291.00 | 26 | 1.778E+01 | 2.189E+03 | 0.0566 | 291.00 |
| 27 | 2.032E+01 | 2.114E+03 | 0.0573 | 291.00 | 28 | 2.286E+01 | 2.056E+03 | 0.0579 | 291.00 |
| 29 | 2.540E+01 | 2.009E+03 | 0.0583 | 291.00 | 30 | 2.794E+01 | 1.970E+03 | 0.0588 | 291.00 |
| 31 | 3.048E+01 | 1.939E+03 | 0.0591 | 291.00 | 32 | 3.302E+01 | 1.914E+03 | 0.0594 | 291.00 |
| 33 | 3.556E+01 | 1.894E+03 | 0.0596 | 291.00 | 34 | 3.810E+01 | 1.878E+03 | 0.0598 | 291.00 |
| 35 | 4.064E+01 | 1.865E+03 | 0.0600 | 291.00 | 36 | 4.318E+01 | 1.856E+03 | 0.0601 | 291.00 |
| 37 | 4.572E+01 | 1.850E+03 | 0.0602 | 291.00 | 38 | 4.826E+01 | 1.341E+03 | 0.0570 | 291.00 |
| 39 | 5.080E+01 | 3.647E+02 | 0.0586 | 291.00 | 40 | 5.334E+01 | 3.576E+02 | 0.0587 | 291.00 |
| 41 | 5.588E+01 | 3.530E+02 | 0.0588 | 291.00 | 42 | 5.842E+01 | 3.505E+02 | 0.0588 | 291.00 |
| 43 | 6.096E+01 | 3.497E+02 | 0.0589 | 291.00 | | | | | |

Initial Water Storage = 3.4157 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.04001
Head (cm) = 1.37172E+06
LiqWater Flow (cm)=-6.66047E-13
IsoVapor Flow (cm)=-5.65338E-03
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 3.4157+ | 0.0000+ | 0.0000 - | 0.0057- | 0.0000- | 0.0000 = | 3.4100 vs. | 3.4100 |

Mass Balance = -4.3562E-08 cm; Time step attempts = 24 and successes = 24
Evaporation: Potential = 0.5615 cm, Actual = 0.0057 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 36.8 %;  TMEAN = 285.1 K;  HDRY =  1.3717E+06 cm;  DAYUBC =    24

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.11160
 Head (cm)         = 6.05142E+02
 LiqWater Flow (cm)= 7.16570E-01
 IsoVapor Flow (cm)=-4.02967E-07
 Plant Sink (cm)   = 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR        STORAGE
   5.1148+ 0.7874+ 0.0000 - 0.0698- 0.0000-  0.0000 =    5.8324 vs.    5.8323

 Mass Balance =  1.1400E-04 cm;  Time step attempts =  194 and successes =  184
   Evaporation:  Potential =  0.0705 cm, Actual =  0.0698 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 79.7 %;  TMEAN = 272.3 K;  HDRY =  3.1088E+05 cm;  DAYUBC =     0
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.3315E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.3315E+02     [cm]
 Actual Evaporation                 =  2.5435E+01     [cm]
 Evaporation during Growth          =  2.5435E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.7864E+01     [cm]
 Total Basal Liquid Flux (drainage) =  2.2757E-03     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  2.7864E+01     [cm]
 Actual Rainfall                    =  2.7864E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  5.8323E+00     [cm]
 Mass Balance Error                 =  9.6138E-03     [cm]
 Total Successful Time Steps        =     68739
 Total Attempted Time Steps         =     85392
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     31990
 Total Time Actually Simulated      =  3.6500E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000    2.4286E+00      0.050    1.6487E+01      0.150    1.0921E+01
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 9.2998E+00 | 0.350 | 8.3598E+00 | 0.450 | 7.6333E+00 |
| 0.550 | 6.9408E+00 | 0.650 | 6.4645E+00 | 0.750 | 6.1235E+00 |
| 0.850 | 5.8795E+00 | 0.950 | 5.6427E+00 | 1.125 | 5.4150E+00 |
| 1.375 | 4.8815E+00 | 1.625 | 4.3488E+00 | 1.875 | 4.0983E+00 |
| 2.250 | 3.8437E+00 | 2.750 | 3.4933E+00 | 3.250 | 3.2834E+00 |
| 3.750 | 3.0708E+00 | 4.250 | 2.9001E+00 | 4.790 | 2.7390E+00 |
| 6.350 | 2.4922E+00 | 8.890 | 2.0063E+00 | 11.430 | 1.7594E+00 |
| 13.970 | 1.5539E+00 | 16.510 | 1.4147E+00 | 19.050 | 1.2814E+00 |
| 21.590 | 1.1512E+00 | 24.130 | 1.0240E+00 | 26.670 | 8.9987E-01 |
| 29.210 | 7.7870E-01 | 31.750 | 6.6041E-01 | 34.290 | 5.4486E-01 |
| 36.830 | 4.3181E-01 | 39.370 | 3.2089E-01 | 41.910 | 2.1160E-01 |
| 44.450 | 1.0328E-01 | 46.990 | -2.0801E-03 | 49.530 | 1.5598E-03 |
| 52.070 | -3.4344E-03 | 54.610 | -1.8187E-03 | 57.150 | -1.9018E-04 |
| 59.690 | 1.4517E-03 | 60.960 | 2.2757E-03 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a000
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 6.051E+02 | 0.1116 | 291.00 | 2 | 1.000E-01 | 6.257E+02 | 0.1090 | 291.00 |
| 3 | 2.000E-01 | 6.308E+02 | 0.1084 | 291.00 | 4 | 3.000E-01 | 6.296E+02 | 0.1086 | 291.00 |
| 5 | 4.000E-01 | 6.270E+02 | 0.1089 | 291.00 | 6 | 5.000E-01 | 6.250E+02 | 0.1091 | 291.00 |
| 7 | 6.000E-01 | 6.239E+02 | 0.1093 | 291.00 | 8 | 7.000E-01 | 6.234E+02 | 0.1093 | 291.00 |
| 9 | 8.000E-01 | 6.234E+02 | 0.1093 | 291.00 | 10 | 9.000E-01 | 6.235E+02 | 0.1093 | 291.00 |
| 11 | 1.000E+00 | 6.236E+02 | 0.1093 | 291.00 | 12 | 1.250E+00 | 6.238E+02 | 0.1093 | 291.00 |
| 13 | 1.500E+00 | 6.235E+02 | 0.1093 | 291.00 | 14 | 1.750E+00 | 6.232E+02 | 0.1093 | 291.00 |
| 15 | 2.000E+00 | 6.229E+02 | 0.1094 | 291.00 | 16 | 2.500E+00 | 6.224E+02 | 0.1094 | 291.00 |
| 17 | 3.000E+00 | 6.219E+02 | 0.1095 | 291.00 | 18 | 3.500E+00 | 6.215E+02 | 0.1095 | 291.00 |
| 19 | 4.000E+00 | 6.211E+02 | 0.1096 | 291.00 | 20 | 4.500E+00 | 6.208E+02 | 0.1096 | 291.00 |
| 21 | 5.080E+00 | 6.204E+02 | 0.1097 | 291.00 | 22 | 7.620E+00 | 6.196E+02 | 0.1098 | 291.00 |
| 23 | 1.016E+01 | 6.198E+02 | 0.1097 | 291.00 | 24 | 1.270E+01 | 6.210E+02 | 0.1096 | 291.00 |
| 25 | 1.524E+01 | 6.232E+02 | 0.1093 | 291.00 | 26 | 1.778E+01 | 6.264E+02 | 0.1089 | 291.00 |
| 27 | 2.032E+01 | 6.306E+02 | 0.1084 | 291.00 | 28 | 2.286E+01 | 6.356E+02 | 0.1078 | 291.00 |
| 29 | 2.540E+01 | 6.415E+02 | 0.1072 | 291.00 | 30 | 2.794E+01 | 6.481E+02 | 0.1064 | 291.00 |
| 31 | 3.048E+01 | 6.551E+02 | 0.1056 | 291.00 | 32 | 3.302E+01 | 6.623E+02 | 0.1048 | 291.00 |
| 33 | 3.556E+01 | 6.692E+02 | 0.1041 | 291.00 | 34 | 3.810E+01 | 6.753E+02 | 0.1035 | 291.00 |
| 35 | 4.064E+01 | 6.799E+02 | 0.1030 | 291.00 | 36 | 4.318E+01 | 6.826E+02 | 0.1027 | 291.00 |
| 37 | 4.572E+01 | 6.828E+02 | 0.1027 | 291.00 | 38 | 4.826E+01 | 7.296E+02 | 0.0572 | 291.00 |
| 39 | 5.080E+01 | 4.384E+02 | 0.0579 | 291.00 | 40 | 5.334E+01 | 4.193E+02 | 0.0581 | 291.00 |
| 41 | 5.588E+01 | 4.102E+02 | 0.0582 | 291.00 | 42 | 5.842E+01 | 4.058E+02 | 0.0582 | 291.00 |
| 43 | 6.096E+01 | 4.045E+02 | 0.0582 | 291.00 | | | | | |

Initial Water Storage = 5.8323 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.10820
Head (cm) = 6.32677E+02
LiqWater Flow (cm)= 1.72536E-04
IsoVapor Flow (cm)=-9.36585E-07
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 5.8323+ | 0.0000+ | 0.0000 - | 0.0000- | 0.0000- | 0.0000 = | 5.8323 vs. | 5.8323 |

Mass Balance = -1.3837E-06 cm; Time step attempts = 24 and successes = 24
Evaporation: Potential = 0.0000 cm, Actual = 0.0000 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = **** %;  TMEAN = 268.7 K;  HDRY =  0.0000E+00 cm;  DAYUBC =     0

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04002
 Head (cm)         = 7.51360E+05
 LiqWater Flow (cm)=-1.43980E-03
 IsoVapor Flow (cm)=-4.34090E-02
 Plant Sink (cm)   = 0.00000E+00

                                                 LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS     DRAIN      NEWSTOR        STORAGE
   3.6975+ 0.0000+ 0.0000 - 0.0454- 0.0000-  0.0000 =     3.6521 vs.     3.6522

 Mass Balance = -8.7550E-05 cm;  Time step attempts =  383 and successes =  295
   Evaporation:  Potential =  0.3329 cm, Actual =  0.0454 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 57.8 %;  TMEAN = 277.0 K;  HDRY =  7.5136E+05 cm;  DAYUBC =   183
1

-------------------------------------------------------------------------------
                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.2711E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.2711E+02     [cm]
 Actual Evaporation                 =  2.2465E+01     [cm]
 Evaporation during Growth          =  2.2465E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.0295E+01     [cm]
 Total Basal Liquid Flux (drainage) =  6.3608E-04     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  2.0295E+01     [cm]
 Actual Rainfall                    =  2.0295E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  3.6522E+00     [cm]
 Mass Balance Error                 =  8.9141E-03     [cm]
 Total Successful Time Steps        =     68707
 Total Attempted Time Steps         =     84564
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     34084
 Total Time Actually Simulated      =  3.6500E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000   -2.1706E+00      0.050    1.3908E+01      0.150    1.0532E+01
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 8.4473E+00 | 0.350 | 6.6766E+00 | 0.450 | 5.5791E+00 |
| 0.550 | 4.4609E+00 | 0.650 | 3.7823E+00 | 0.750 | 3.0072E+00 |
| 0.850 | 2.5473E+00 | 0.950 | 2.0794E+00 | 1.125 | 1.6456E+00 |
| 1.375 | 9.1665E-01 | 1.625 | 4.5345E-01 | 1.875 | 8.8090E-02 |
| 2.250 | -2.8988E-01 | 2.750 | -9.1034E-01 | 3.250 | -1.2194E+00 |
| 3.750 | -1.4956E+00 | 4.250 | -1.6662E+00 | 4.790 | -1.7263E+00 |
| 6.350 | -1.7154E+00 | 8.890 | -1.6973E+00 | 11.430 | -1.5760E+00 |
| 13.970 | -1.4562E+00 | 16.510 | -1.3375E+00 | 19.050 | -1.2197E+00 |
| 21.590 | -1.1027E+00 | 24.130 | -9.8656E-01 | 26.670 | -8.7158E-01 |
| 29.210 | -7.5796E-01 | 31.750 | -6.4596E-01 | 34.290 | -5.3576E-01 |
| 36.830 | -4.2739E-01 | 39.370 | -3.2071E-01 | 41.910 | -2.1537E-01 |
| 44.450 | -1.1086E-01 | 46.990 | -5.3055E-03 | 49.530 | -9.5000E-04 |
| 52.070 | -3.4922E-03 | 54.610 | -2.4971E-03 | 57.150 | -1.2402E-03 |
| 59.690 | 1.2997E-05 | 60.960 | 6.3608E-04 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a000
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 7.514E+05 | 0.0400 | 291.00 | 2 | 1.000E-01 | 6.547E+05 | 0.0400 | 291.00 |
| 3 | 2.000E-01 | 5.645E+05 | 0.0400 | 291.00 | 4 | 3.000E-01 | 4.798E+05 | 0.0400 | 291.00 |
| 5 | 4.000E-01 | 4.001E+05 | 0.0400 | 291.00 | 6 | 5.000E-01 | 3.247E+05 | 0.0401 | 291.00 |
| 7 | 6.000E-01 | 2.533E+05 | 0.0401 | 291.00 | 8 | 7.000E-01 | 1.854E+05 | 0.0401 | 291.00 |
| 9 | 8.000E-01 | 1.208E+05 | 0.0402 | 291.00 | 10 | 9.000E-01 | 5.902E+04 | 0.0404 | 291.00 |
| 11 | 1.000E+00 | 4.751E+03 | 0.0468 | 291.00 | 12 | 1.250E+00 | 3.474E+03 | 0.0497 | 291.00 |
| 13 | 1.500E+00 | 3.058E+03 | 0.0513 | 291.00 | 14 | 1.750E+00 | 2.818E+03 | 0.0524 | 291.00 |
| 15 | 2.000E+00 | 2.652E+03 | 0.0533 | 291.00 | 16 | 2.500E+00 | 2.431E+03 | 0.0547 | 291.00 |
| 17 | 3.000E+00 | 2.285E+03 | 0.0558 | 291.00 | 18 | 3.500E+00 | 2.179E+03 | 0.0567 | 291.00 |
| 19 | 4.000E+00 | 2.098E+03 | 0.0574 | 291.00 | 20 | 4.500E+00 | 2.033E+03 | 0.0581 | 291.00 |
| 21 | 5.080E+00 | 1.973E+03 | 0.0587 | 291.00 | 22 | 7.620E+00 | 1.813E+03 | 0.0606 | 291.00 |
| 23 | 1.016E+01 | 1.735E+03 | 0.0617 | 291.00 | 24 | 1.270E+01 | 1.698E+03 | 0.0623 | 291.00 |
| 25 | 1.524E+01 | 1.683E+03 | 0.0625 | 291.00 | 26 | 1.778E+01 | 1.684E+03 | 0.0625 | 291.00 |
| 27 | 2.032E+01 | 1.694E+03 | 0.0623 | 291.00 | 28 | 2.286E+01 | 1.709E+03 | 0.0621 | 291.00 |
| 29 | 2.540E+01 | 1.725E+03 | 0.0619 | 291.00 | 30 | 2.794E+01 | 1.739E+03 | 0.0617 | 291.00 |
| 31 | 3.048E+01 | 1.749E+03 | 0.0615 | 291.00 | 32 | 3.302E+01 | 1.754E+03 | 0.0614 | 291.00 |
| 33 | 3.556E+01 | 1.755E+03 | 0.0614 | 291.00 | 34 | 3.810E+01 | 1.753E+03 | 0.0615 | 291.00 |
| 35 | 4.064E+01 | 1.749E+03 | 0.0615 | 291.00 | 36 | 4.318E+01 | 1.745E+03 | 0.0616 | 291.00 |
| 37 | 4.572E+01 | 1.742E+03 | 0.0616 | 291.00 | 38 | 4.826E+01 | 1.438E+03 | 0.0570 | 291.00 |
| 39 | 5.080E+01 | 7.557E+02 | 0.0572 | 291.00 | 40 | 5.334E+01 | 5.450E+02 | 0.0575 | 291.00 |
| 41 | 5.588E+01 | 5.061E+02 | 0.0576 | 291.00 | 42 | 5.842E+01 | 4.910E+02 | 0.0577 | 291.00 |
| 43 | 6.096E+01 | 4.866E+02 | 0.0577 | 291.00 | | | | | |

Initial Water Storage = 3.6522 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.04001
Head (cm) = 9.26464E+05
LiqWater Flow (cm)=-1.90502E-11
IsoVapor Flow (cm)=-2.63341E-02
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 3.6522+ | 0.0000+ | 0.0000 - | 0.0263- | 0.0000- | 0.0000 = | 3.6258 vs. | 3.6259 |

Mass Balance = -2.3537E-05 cm; Time step attempts = 105 and successes = 84
Evaporation: Potential = 0.3771 cm, Actual = 0.0263 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 50.9 %;  TMEAN = 281.2 K;  HDRY =  9.2646E+05 cm;  DAYUBC =    84

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04002
 Head (cm)         = 8.17331E+05
 LiqWater Flow (cm)=-2.46872E-02
 IsoVapor Flow (cm)=-6.53158E-02
 Plant Sink (cm)   = 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS    DRAIN      NEWSTOR        STORAGE
   4.5260+ 0.0000+ 0.0000 - 0.0910- 0.0000-  0.0001 =     4.4350 vs.     4.4350

 Mass Balance = -4.9817E-05 cm;  Time step attempts =  283 and successes =  228
   Evaporation:  Potential =  0.3244 cm, Actual =  0.0910 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 55.1 %;  TMEAN = 283.2 K;  HDRY =  8.1733E+05 cm;  DAYUBC =   195
1

-------------------------------------------------------------------------------
                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  2.9078E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  2.9078E+02     [cm]
 Actual Evaporation                 =  4.0239E+01     [cm]
 Evaporation during Growth          =  4.0148E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  4.1072E+01     [cm]
 Total Basal Liquid Flux (drainage) =  4.2202E-02     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  4.1072E+01     [cm]
 Actual Rainfall                    =  4.1072E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  4.4350E+00     [cm]
 Mass Balance Error                 =  8.1425E-03     [cm]
 Total Successful Time Steps        =     59066
 Total Attempted Time Steps         =     71873
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     25299
 Total Time Actually Simulated      =  3.6600E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000    8.3318E-01      0.050    1.8404E+01      0.150    1.0492E+01
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 8.5822E+00 | 0.350 | 6.9584E+00 | 0.450 | 5.9455E+00 |
| 0.550 | 5.2039E+00 | 0.650 | 4.7001E+00 | 0.750 | 4.2097E+00 |
| 0.850 | 3.8079E+00 | 0.950 | 3.4513E+00 | 1.125 | 3.1350E+00 |
| 1.375 | 2.6136E+00 | 1.625 | 2.2842E+00 | 1.875 | 2.1055E+00 |
| 2.250 | 1.9731E+00 | 2.750 | 1.8119E+00 | 3.250 | 1.6991E+00 |
| 3.750 | 1.5977E+00 | 4.250 | 1.4899E+00 | 4.790 | 1.3782E+00 |
| 6.350 | 1.2294E+00 | 8.890 | 9.1286E-01 | 11.430 | 7.3721E-01 |
| 13.970 | 6.9182E-01 | 16.510 | 6.5638E-01 | 19.050 | 6.1794E-01 |
| 21.590 | 5.7660E-01 | 24.130 | 5.3254E-01 | 26.670 | 4.8605E-01 |
| 29.210 | 4.3750E-01 | 31.750 | 3.8727E-01 | 34.290 | 3.3572E-01 |
| 36.830 | 2.8319E-01 | 39.370 | 2.2991E-01 | 41.910 | 1.7607E-01 |
| 44.450 | 1.2182E-01 | 46.990 | 6.8463E-02 | 49.530 | 7.0569E-02 |
| 52.070 | 6.2742E-02 | 54.610 | 5.6159E-02 | 57.150 | 5.0435E-02 |
| 59.690 | 4.4941E-02 | 60.960 | 4.2202E-02 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a000
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 8.173E+05 | 0.0400 | 291.00 | 2 | 1.000E-01 | 5.646E+05 | 0.0400 | 291.00 |
| 3 | 2.000E-01 | 3.513E+05 | 0.0400 | 291.00 | 4 | 3.000E-01 | 1.669E+05 | 0.0401 | 291.00 |
| 5 | 4.000E-01 | 4.238E+03 | 0.0477 | 291.00 | 6 | 5.000E-01 | 3.285E+03 | 0.0504 | 291.00 |
| 7 | 6.000E-01 | 2.907E+03 | 0.0520 | 291.00 | 8 | 7.000E-01 | 2.679E+03 | 0.0531 | 291.00 |
| 9 | 8.000E-01 | 2.520E+03 | 0.0541 | 291.00 | 10 | 9.000E-01 | 2.399E+03 | 0.0549 | 291.00 |
| 11 | 1.000E+00 | 2.303E+03 | 0.0557 | 291.00 | 12 | 1.250E+00 | 2.126E+03 | 0.0572 | 291.00 |
| 13 | 1.500E+00 | 2.002E+03 | 0.0584 | 291.00 | 14 | 1.750E+00 | 1.908E+03 | 0.0595 | 291.00 |
| 15 | 2.000E+00 | 1.833E+03 | 0.0604 | 291.00 | 16 | 2.500E+00 | 1.719E+03 | 0.0620 | 291.00 |
| 17 | 3.000E+00 | 1.634E+03 | 0.0633 | 291.00 | 18 | 3.500E+00 | 1.568E+03 | 0.0644 | 291.00 |
| 19 | 4.000E+00 | 1.513E+03 | 0.0654 | 291.00 | 20 | 4.500E+00 | 1.468E+03 | 0.0663 | 291.00 |
| 21 | 5.080E+00 | 1.424E+03 | 0.0673 | 291.00 | 22 | 7.620E+00 | 1.290E+03 | 0.0705 | 291.00 |
| 23 | 1.016E+01 | 1.208E+03 | 0.0729 | 291.00 | 24 | 1.270E+01 | 1.151E+03 | 0.0748 | 291.00 |
| 25 | 1.524E+01 | 1.110E+03 | 0.0763 | 291.00 | 26 | 1.778E+01 | 1.078E+03 | 0.0775 | 291.00 |
| 27 | 2.032E+01 | 1.053E+03 | 0.0785 | 291.00 | 28 | 2.286E+01 | 1.033E+03 | 0.0794 | 291.00 |
| 29 | 2.540E+01 | 1.016E+03 | 0.0801 | 291.00 | 30 | 2.794E+01 | 1.002E+03 | 0.0807 | 291.00 |
| 31 | 3.048E+01 | 9.910E+02 | 0.0813 | 291.00 | 32 | 3.302E+01 | 9.815E+02 | 0.0817 | 291.00 |
| 33 | 3.556E+01 | 9.736E+02 | 0.0821 | 291.00 | 34 | 3.810E+01 | 9.671E+02 | 0.0824 | 291.00 |
| 35 | 4.064E+01 | 9.617E+02 | 0.0827 | 291.00 | 36 | 4.318E+01 | 9.573E+02 | 0.0829 | 291.00 |
| 37 | 4.572E+01 | 9.538E+02 | 0.0831 | 291.00 | 38 | 4.826E+01 | 8.924E+02 | 0.0571 | 291.00 |
| 39 | 5.080E+01 | 3.174E+02 | 0.0595 | 291.00 | 40 | 5.334E+01 | 3.114E+02 | 0.0596 | 291.00 |
| 41 | 5.588E+01 | 3.073E+02 | 0.0597 | 291.00 | 42 | 5.842E+01 | 3.049E+02 | 0.0598 | 291.00 |
| 43 | 6.096E+01 | 3.041E+02 | 0.0598 | 291.00 | | | | | |

Initial Water Storage = 4.4350 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.04002
Head (cm) = 7.28174E+05
LiqWater Flow (cm)= 3.58536E-03
IsoVapor Flow (cm)=-5.90245E-02
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 4.4350+ | 0.0254+ | 0.0000 - | 0.0808- | 0.0000- | 0.0001 = | 4.3795 vs. | 4.3795 |

Mass Balance = -5.7700E-07 cm; Time step attempts = 451 and successes = 369
Evaporation: Potential = 0.3091 cm, Actual = 0.0808 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 58.8 %;  TMEAN = 278.2 K;  HDRY =  7.2817E+05 cm;  DAYUBC =   212

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04001
 Head (cm)         = 1.09545E+06
 LiqWater Flow (cm)=-1.41797E-12
 IsoVapor Flow (cm)=-4.90720E-03
 Plant Sink (cm)   = 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS    DRAIN      NEWSTOR        STORAGE
   3.4400+ 0.0000+ 0.0000 - 0.0049- 0.0000-  0.0000 =    3.4351 vs.    3.4351

 Mass Balance = -1.3140E-06 cm;  Time step attempts =   78 and successes =   78
   Evaporation:  Potential =  0.3996 cm, Actual =  0.0049 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 45.0 %;  TMEAN = 287.3 K;  HDRY =  1.0954E+06 cm;  DAYUBC =    63
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  2.3656E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  2.3656E+02     [cm]
 Actual Evaporation                 =  2.1713E+01     [cm]
 Evaporation during Growth          =  2.1713E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.0726E+01     [cm]
 Total Basal Liquid Flux (drainage) =  5.8647E-03     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  2.0726E+01     [cm]
 Actual Rainfall                    =  2.0726E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  3.4351E+00     [cm]
 Mass Balance Error                 =  7.2042E-03     [cm]
 Total Successful Time Steps        =     60227
 Total Attempted Time Steps         =     73458
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     28453
 Total Time Actually Simulated      =  3.6500E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000   -9.8685E-01      0.050    1.3298E+01      0.150    9.5452E+00
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 7.3145E+00 | 0.350 | 6.0635E+00 | 0.450 | 4.7307E+00 |
| 0.550 | 3.7358E+00 | 0.650 | 3.1129E+00 | 0.750 | 2.6955E+00 |
| 0.850 | 2.2553E+00 | 0.950 | 2.0322E+00 | 1.125 | 1.8690E+00 |
| 1.375 | 1.3532E+00 | 1.625 | 9.8294E-01 | 1.875 | 7.5565E-01 |
| 2.250 | 5.4632E-01 | 2.750 | 1.9250E-01 | 3.250 | -3.7377E-02 |
| 3.750 | -2.9459E-01 | 4.250 | -3.9371E-01 | 4.790 | -4.7620E-01 |
| 6.350 | -5.3913E-01 | 8.890 | -6.5219E-01 | 11.430 | -7.3443E-01 |
| 13.970 | -7.1362E-01 | 16.510 | -6.6350E-01 | 19.050 | -6.1221E-01 |
| 21.590 | -5.6002E-01 | 24.130 | -5.0712E-01 | 26.670 | -4.5364E-01 |
| 29.210 | -3.9967E-01 | 31.750 | -3.4530E-01 | 34.290 | -2.9054E-01 |
| 36.830 | -2.3547E-01 | 39.370 | -1.8011E-01 | 41.910 | -1.2448E-01 |
| 44.450 | -6.8611E-02 | 46.990 | -1.0617E-02 | 49.530 | -6.0776E-03 |
| 52.070 | -8.1995E-03 | 54.610 | -4.2401E-03 | 57.150 | -2.2800E-04 |
| 59.690 | 3.8283E-03 | 60.960 | 5.8647E-03 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a000
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 1.095E+06 | 0.0400 | 291.00 | 2 | 1.000E-01 | 1.074E+06 | 0.0400 | 291.00 |
| 3 | 2.000E-01 | 1.052E+06 | 0.0400 | 291.00 | 4 | 3.000E-01 | 1.031E+06 | 0.0400 | 291.00 |
| 5 | 4.000E-01 | 1.011E+06 | 0.0400 | 291.00 | 6 | 5.000E-01 | 9.904E+05 | 0.0400 | 291.00 |
| 7 | 6.000E-01 | 9.703E+05 | 0.0400 | 291.00 | 8 | 7.000E-01 | 9.505E+05 | 0.0400 | 291.00 |
| 9 | 8.000E-01 | 9.310E+05 | 0.0400 | 291.00 | 10 | 9.000E-01 | 9.118E+05 | 0.0400 | 291.00 |
| 11 | 1.000E+00 | 8.928E+05 | 0.0400 | 291.00 | 12 | 1.250E+00 | 8.465E+05 | 0.0400 | 291.00 |
| 13 | 1.500E+00 | 8.017E+05 | 0.0400 | 291.00 | 14 | 1.750E+00 | 7.583E+05 | 0.0400 | 291.00 |
| 15 | 2.000E+00 | 7.163E+05 | 0.0400 | 291.00 | 16 | 2.500E+00 | 6.359E+05 | 0.0400 | 291.00 |
| 17 | 3.000E+00 | 5.599E+05 | 0.0400 | 291.00 | 18 | 3.500E+00 | 4.879E+05 | 0.0400 | 291.00 |
| 19 | 4.000E+00 | 4.196E+05 | 0.0400 | 291.00 | 20 | 4.500E+00 | 3.544E+05 | 0.0400 | 291.00 |
| 21 | 5.080E+00 | 2.826E+05 | 0.0401 | 291.00 | 22 | 7.620E+00 | 2.816E+03 | 0.0524 | 291.00 |
| 23 | 1.016E+01 | 2.522E+03 | 0.0541 | 291.00 | 24 | 1.270E+01 | 2.343E+03 | 0.0554 | 291.00 |
| 25 | 1.524E+01 | 2.219E+03 | 0.0564 | 291.00 | 26 | 1.778E+01 | 2.125E+03 | 0.0572 | 291.00 |
| 27 | 2.032E+01 | 2.053E+03 | 0.0579 | 291.00 | 28 | 2.286E+01 | 1.995E+03 | 0.0585 | 291.00 |
| 29 | 2.540E+01 | 1.948E+03 | 0.0590 | 291.00 | 30 | 2.794E+01 | 1.910E+03 | 0.0594 | 291.00 |
| 31 | 3.048E+01 | 1.878E+03 | 0.0598 | 291.00 | 32 | 3.302E+01 | 1.853E+03 | 0.0601 | 291.00 |
| 33 | 3.556E+01 | 1.832E+03 | 0.0604 | 291.00 | 34 | 3.810E+01 | 1.816E+03 | 0.0606 | 291.00 |
| 35 | 4.064E+01 | 1.803E+03 | 0.0608 | 291.00 | 36 | 4.318E+01 | 1.794E+03 | 0.0609 | 291.00 |
| 37 | 4.572E+01 | 1.788E+03 | 0.0610 | 291.00 | 38 | 4.826E+01 | 1.375E+03 | 0.0570 | 291.00 |
| 39 | 5.080E+01 | 4.470E+02 | 0.0579 | 291.00 | 40 | 5.334E+01 | 4.233E+02 | 0.0580 | 291.00 |
| 41 | 5.588E+01 | 4.117E+02 | 0.0581 | 291.00 | 42 | 5.842E+01 | 4.060E+02 | 0.0582 | 291.00 |
| 43 | 6.096E+01 | 4.042E+02 | 0.0582 | 291.00 | | | | | |

Initial Water Storage = 3.4351 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.04002
Head (cm) = 6.35849E+05
LiqWater Flow (cm)= 1.78693E-02
IsoVapor Flow (cm)=-1.81668E-02
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 3.4351+ | 0.0254+ | 0.0000 - | 0.0257- | 0.0000- | 0.0000 = | 3.4348 vs. | 3.4348 |

Mass Balance = 4.2824E-05 cm; Time step attempts = 789 and successes = 604
Evaporation: Potential = 0.2650 cm, Actual = 0.0257 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 62.9 %;  TMEAN = 282.3 K;  HDRY =  6.3585E+05 cm;  DAYUBC =   215

------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.07222
 Head (cm)         = 1.23093E+03
 LiqWater Flow (cm)=-7.53879E-02
 IsoVapor Flow (cm)=-6.03726E-02
 Plant Sink (cm)   = 0.00000E+00

                                                LIQUID
  PRESTOR    INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR        STORAGE
   5.1574+ 0.0000+ 0.0000 - 0.1359- 0.0000-  0.0000 =    5.0215 vs.    5.0215

 Mass Balance = -1.1448E-05 cm;  Time step attempts =  347 and successes =  284
   Evaporation:  Potential =  0.1836 cm, Actual =  0.1359 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 56.1 %;  TMEAN = 277.3 K;  HDRY =  7.9304E+05 cm;  DAYUBC =   110
1

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  2.4532E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  2.4532E+02     [cm]
 Actual Evaporation                 =  2.9316E+01     [cm]
 Evaporation during Growth          =  2.9316E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  3.0912E+01     [cm]
 Total Basal Liquid Flux (drainage) =  6.2115E-04     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  3.0912E+01     [cm]
 Actual Rainfall                    =  3.0912E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  5.0215E+00     [cm]
 Mass Balance Error                 =  8.9089E-03     [cm]
 Total Successful Time Steps        =     63704
 Total Attempted Time Steps         =     77759
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     27401
 Total Time Actually Simulated      =  3.6500E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000    1.5959E+00      0.050    1.7896E+01      0.150    1.0442E+01
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 8.4278E+00 | 0.350 | 7.1410E+00 | 0.450 | 6.3865E+00 |
| 0.550 | 5.6139E+00 | 0.650 | 5.1546E+00 | 0.750 | 4.7543E+00 |
| 0.850 | 4.5138E+00 | 0.950 | 4.2885E+00 | 1.125 | 4.0474E+00 |
| 1.375 | 3.3939E+00 | 1.625 | 3.1879E+00 | 1.875 | 2.8749E+00 |
| 2.250 | 2.6660E+00 | 2.750 | 2.3285E+00 | 3.250 | 2.2193E+00 |
| 3.750 | 2.1514E+00 | 4.250 | 2.0781E+00 | 4.790 | 2.0098E+00 |
| 6.350 | 1.8872E+00 | 8.890 | 1.4813E+00 | 11.430 | 1.2825E+00 |
| 13.970 | 1.1405E+00 | 16.510 | 1.0604E+00 | 19.050 | 9.7873E-01 |
| 21.590 | 8.9529E-01 | 24.130 | 8.1028E-01 | 26.670 | 7.2386E-01 |
| 29.210 | 6.3617E-01 | 31.750 | 5.4732E-01 | 34.290 | 4.5744E-01 |
| 36.830 | 3.6661E-01 | 39.370 | 2.7495E-01 | 41.910 | 1.8254E-01 |
| 44.450 | 8.9477E-02 | 46.990 | -2.3217E-03 | 49.530 | 7.3334E-04 |
| 52.070 | -3.1156E-03 | 54.610 | -2.1863E-03 | 57.150 | -1.0857E-03 |
| 59.690 | 4.9219E-05 | 60.960 | 6.2115E-04 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a000
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 1.231E+03 | 0.0722 | 291.00 | 2 | 1.000E-01 | 1.228E+03 | 0.0723 | 291.00 |
| 3 | 2.000E-01 | 1.226E+03 | 0.0724 | 291.00 | 4 | 3.000E-01 | 1.223E+03 | 0.0725 | 291.00 |
| 5 | 4.000E-01 | 1.220E+03 | 0.0726 | 291.00 | 6 | 5.000E-01 | 1.217E+03 | 0.0726 | 291.00 |
| 7 | 6.000E-01 | 1.214E+03 | 0.0727 | 291.00 | 8 | 7.000E-01 | 1.211E+03 | 0.0728 | 291.00 |
| 9 | 8.000E-01 | 1.208E+03 | 0.0729 | 291.00 | 10 | 9.000E-01 | 1.205E+03 | 0.0730 | 291.00 |
| 11 | 1.000E+00 | 1.202E+03 | 0.0731 | 291.00 | 12 | 1.250E+00 | 1.194E+03 | 0.0734 | 291.00 |
| 13 | 1.500E+00 | 1.186E+03 | 0.0736 | 291.00 | 14 | 1.750E+00 | 1.177E+03 | 0.0739 | 291.00 |
| 15 | 2.000E+00 | 1.169E+03 | 0.0742 | 291.00 | 16 | 2.500E+00 | 1.152E+03 | 0.0747 | 291.00 |
| 17 | 3.000E+00 | 1.135E+03 | 0.0753 | 291.00 | 18 | 3.500E+00 | 1.119E+03 | 0.0759 | 291.00 |
| 19 | 4.000E+00 | 1.102E+03 | 0.0765 | 291.00 | 20 | 4.500E+00 | 1.087E+03 | 0.0771 | 291.00 |
| 21 | 5.080E+00 | 1.069E+03 | 0.0778 | 291.00 | 22 | 7.620E+00 | 1.000E+03 | 0.0808 | 291.00 |
| 23 | 1.016E+01 | 9.473E+02 | 0.0834 | 291.00 | 24 | 1.270E+01 | 9.062E+02 | 0.0857 | 291.00 |
| 25 | 1.524E+01 | 8.739E+02 | 0.0876 | 291.00 | 26 | 1.778E+01 | 8.479E+02 | 0.0892 | 291.00 |
| 27 | 2.032E+01 | 8.266E+02 | 0.0906 | 291.00 | 28 | 2.286E+01 | 8.090E+02 | 0.0919 | 291.00 |
| 29 | 2.540E+01 | 7.942E+02 | 0.0930 | 291.00 | 30 | 2.794E+01 | 7.816E+02 | 0.0939 | 291.00 |
| 31 | 3.048E+01 | 7.710E+02 | 0.0948 | 291.00 | 32 | 3.302E+01 | 7.619E+02 | 0.0955 | 291.00 |
| 33 | 3.556E+01 | 7.542E+02 | 0.0961 | 291.00 | 34 | 3.810E+01 | 7.477E+02 | 0.0967 | 291.00 |
| 35 | 4.064E+01 | 7.423E+02 | 0.0971 | 291.00 | 36 | 4.318E+01 | 7.379E+02 | 0.0975 | 291.00 |
| 37 | 4.572E+01 | 7.344E+02 | 0.0978 | 291.00 | 38 | 4.826E+01 | 7.211E+02 | 0.0572 | 291.00 |
| 39 | 5.080E+01 | 5.692E+02 | 0.0574 | 291.00 | 40 | 5.334E+01 | 5.140E+02 | 0.0576 | 291.00 |
| 41 | 5.588E+01 | 4.901E+02 | 0.0577 | 291.00 | 42 | 5.842E+01 | 4.793E+02 | 0.0577 | 291.00 |
| 43 | 6.096E+01 | 4.761E+02 | 0.0577 | 291.00 | | | | | |

Initial Water Storage = 5.0215 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.06732
Head (cm) = 1.42150E+03
LiqWater Flow (cm)=-5.98481E-02
IsoVapor Flow (cm)=-6.59605E-02
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 5.0215+ | 0.0000+ | 0.0000 - | 0.1261- | 0.0000- | 0.0000 = | 4.8954 vs. | 4.8955 |

Mass Balance = -1.2493E-05 cm; Time step attempts = 343 and successes = 273
Evaporation: Potential = 0.2331 cm, Actual = 0.1261 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 54.0 %;  TMEAN = 278.4 K;  HDRY =  8.4505E+05 cm;  DAYUBC =   106

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.11215
 Head (cm)         = 6.00954E+02
 LiqWater Flow (cm)=-3.86137E-01
 IsoVapor Flow (cm)=-6.59905E-07
 Plant Sink (cm)   = 0.00000E+00

                                                 LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS     DRAIN      NEWSTOR        STORAGE
   7.0303+ 0.0000+ 0.0000 - 0.3867- 0.0000-  0.0000 =    6.6436 vs.    6.6436

 Mass Balance = -1.0827E-05 cm;  Time step attempts =   69 and successes =   55
   Evaporation:  Potential =  0.3867 cm, Actual =  0.3867 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 51.7 %;  TMEAN = 276.2 K;  HDRY =  9.0545E+05 cm;  DAYUBC =     0
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  2.7351E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  2.7351E+02     [cm]
 Actual Evaporation                 =  2.6156E+01     [cm]
 Evaporation during Growth          =  2.6156E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.7788E+01     [cm]
 Total Basal Liquid Flux (drainage) =  1.5789E-04     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  2.7788E+01     [cm]
 Actual Rainfall                    =  2.7788E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  6.6436E+00     [cm]
 Mass Balance Error                 =  9.7480E-03     [cm]
 Total Successful Time Steps        =     69390
 Total Attempted Time Steps         =     85815
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     32593
 Total Time Actually Simulated      =  3.6500E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000    1.6320E+00      0.050    1.7689E+01      0.150    1.3448E+01
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 1.1820E+01 | 0.350 | 1.0224E+01 | 0.450 | 8.8223E+00 |
| 0.550 | 7.9109E+00 | 0.650 | 7.0589E+00 | 0.750 | 6.4777E+00 |
| 0.850 | 5.9883E+00 | 0.950 | 5.4254E+00 | 1.125 | 5.0102E+00 |
| 1.375 | 4.2211E+00 | 1.625 | 3.6872E+00 | 1.875 | 3.2746E+00 |
| 2.250 | 2.9751E+00 | 2.750 | 2.3793E+00 | 3.250 | 2.0351E+00 |
| 3.750 | 1.8898E+00 | 4.250 | 1.7611E+00 | 4.790 | 1.6556E+00 |
| 6.350 | 1.4644E+00 | 8.890 | 1.2879E+00 | 11.430 | 1.1999E+00 |
| 13.970 | 1.1142E+00 | 16.510 | 1.0300E+00 | 19.050 | 9.4653E-01 |
| 21.590 | 8.6324E-01 | 24.130 | 7.7982E-01 | 26.670 | 6.9604E-01 |
| 29.210 | 6.1172E-01 | 31.750 | 5.2675E-01 | 34.290 | 4.4105E-01 |
| 36.830 | 3.5460E-01 | 39.370 | 2.6737E-01 | 41.910 | 1.7935E-01 |
| 44.450 | 9.0549E-02 | 46.990 | 1.7408E-03 | 49.530 | 2.6522E-03 |
| 52.070 | -5.4616E-04 | 54.610 | -1.1444E-03 | 57.150 | -7.0492E-04 |
| 59.690 | -1.3504E-04 | 60.960 | 1.5789E-04 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a000
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 6.010E+02 | 0.1121 | 291.00 | 2 | 1.000E-01 | 5.935E+02 | 0.1131 | 291.00 |
| 3 | 2.000E-01 | 5.919E+02 | 0.1134 | 291.00 | 4 | 3.000E-01 | 5.920E+02 | 0.1133 | 291.00 |
| 5 | 4.000E-01 | 5.924E+02 | 0.1133 | 291.00 | 6 | 5.000E-01 | 5.925E+02 | 0.1133 | 291.00 |
| 7 | 6.000E-01 | 5.924E+02 | 0.1133 | 291.00 | 8 | 7.000E-01 | 5.921E+02 | 0.1133 | 291.00 |
| 9 | 8.000E-01 | 5.918E+02 | 0.1134 | 291.00 | 10 | 9.000E-01 | 5.915E+02 | 0.1134 | 291.00 |
| 11 | 1.000E+00 | 5.912E+02 | 0.1135 | 291.00 | 12 | 1.250E+00 | 5.905E+02 | 0.1135 | 291.00 |
| 13 | 1.500E+00 | 5.899E+02 | 0.1136 | 291.00 | 14 | 1.750E+00 | 5.891E+02 | 0.1137 | 291.00 |
| 15 | 2.000E+00 | 5.884E+02 | 0.1138 | 291.00 | 16 | 2.500E+00 | 5.868E+02 | 0.1140 | 291.00 |
| 17 | 3.000E+00 | 5.853E+02 | 0.1143 | 291.00 | 18 | 3.500E+00 | 5.837E+02 | 0.1145 | 291.00 |
| 19 | 4.000E+00 | 5.821E+02 | 0.1147 | 291.00 | 20 | 4.500E+00 | 5.805E+02 | 0.1149 | 291.00 |
| 21 | 5.080E+00 | 5.786E+02 | 0.1152 | 291.00 | 22 | 7.620E+00 | 5.698E+02 | 0.1165 | 291.00 |
| 23 | 1.016E+01 | 5.607E+02 | 0.1178 | 291.00 | 24 | 1.270E+01 | 5.515E+02 | 0.1192 | 291.00 |
| 25 | 1.524E+01 | 5.426E+02 | 0.1206 | 291.00 | 26 | 1.778E+01 | 5.340E+02 | 0.1220 | 291.00 |
| 27 | 2.032E+01 | 5.258E+02 | 0.1234 | 291.00 | 28 | 2.286E+01 | 5.182E+02 | 0.1247 | 291.00 |
| 29 | 2.540E+01 | 5.112E+02 | 0.1259 | 291.00 | 30 | 2.794E+01 | 5.047E+02 | 0.1271 | 291.00 |
| 31 | 3.048E+01 | 4.988E+02 | 0.1282 | 291.00 | 32 | 3.302E+01 | 4.934E+02 | 0.1292 | 291.00 |
| 33 | 3.556E+01 | 4.885E+02 | 0.1301 | 291.00 | 34 | 3.810E+01 | 4.842E+02 | 0.1310 | 291.00 |
| 35 | 4.064E+01 | 4.803E+02 | 0.1318 | 291.00 | 36 | 4.318E+01 | 4.769E+02 | 0.1325 | 291.00 |
| 37 | 4.572E+01 | 4.739E+02 | 0.1331 | 291.00 | 38 | 4.826E+01 | 4.672E+02 | 0.0578 | 291.00 |
| 39 | 5.080E+01 | 4.240E+02 | 0.0580 | 291.00 | 40 | 5.334E+01 | 5.832E+02 | 0.0574 | 291.00 |
| 41 | 5.588E+01 | 5.884E+02 | 0.0574 | 291.00 | 42 | 5.842E+01 | 5.610E+02 | 0.0575 | 291.00 |
| 43 | 6.096E+01 | 5.531E+02 | 0.0575 | 291.00 | | | | | |

Initial Water Storage = 6.6436 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.11032
Head (cm) = 6.15265E+02
LiqWater Flow (cm)=-2.58229E-01
IsoVapor Flow (cm)=-6.09579E-07
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 6.6436+ | 0.0000+ | 0.0000 - | 0.2583- | 0.0000- | 0.0000 = | 6.3853 vs. | 6.3853 |

Mass Balance = -7.4848E-06 cm; Time step attempts = 53 and successes = 43
Evaporation: Potential = 0.2583 cm, Actual = 0.2583 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 56.6 %;  TMEAN = 276.8 K;  HDRY =  7.8041E+05 cm;  DAYUBC =     0

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04001
 Head (cm)         = 1.69120E+06
 LiqWater Flow (cm)=-9.29631E-13
 IsoVapor Flow (cm)=-1.61312E-02
 Plant Sink (cm)   = 0.00000E+00

                                                LIQUID
  PRESTOR    INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR        STORAGE
   3.7251+ 0.0000+ 0.0000 - 0.0161- 0.0000-  0.0000 =    3.7090 vs.    3.7090

 Mass Balance = -5.1656E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.3606 cm, Actual =  0.0161 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 29.1 %;  TMEAN = 275.4 K;  HDRY =  1.6912E+06 cm;  DAYUBC =    24
1

-------------------------------------------------------------------------------
                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  2.8360E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  2.8360E+02     [cm]
 Actual Evaporation                 =  3.1020E+01     [cm]
 Evaporation during Growth          =  3.1003E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.8092E+01     [cm]
 Total Basal Liquid Flux (drainage) =  5.5642E-05     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  2.8092E+01     [cm]
 Actual Rainfall                    =  2.8092E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  3.7090E+00     [cm]
 Mass Balance Error                 =  7.4149E-03     [cm]
 Total Successful Time Steps        =     60326
 Total Attempted Time Steps         =     73673
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     27595
 Total Time Actually Simulated      =  3.6600E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000   -2.9271E+00      0.050    1.5966E+01      0.150    7.8829E+00
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 5.3691E+00 | 0.350 | 4.0227E+00 | 0.450 | 2.9738E+00 |
| 0.550 | 2.2502E+00 | 0.650 | 1.5676E+00 | 0.750 | 1.0982E+00 |
| 0.850 | 6.2439E-01 | 0.950 | 3.2278E-01 | 1.125 | 8.9771E-02 |
| 1.375 | -5.8202E-01 | 1.625 | -1.0305E+00 | 1.875 | -1.1695E+00 |
| 2.250 | -1.3018E+00 | 2.750 | -1.5476E+00 | 3.250 | -1.8010E+00 |
| 3.750 | -1.9415E+00 | 4.250 | -2.0449E+00 | 4.790 | -2.1305E+00 |
| 6.350 | -2.1684E+00 | 8.890 | -2.2634E+00 | 11.430 | -2.2005E+00 |
| 13.970 | -2.0531E+00 | 16.510 | -1.9043E+00 | 19.050 | -1.7545E+00 |
| 21.590 | -1.6033E+00 | 24.130 | -1.4506E+00 | 26.670 | -1.2962E+00 |
| 29.210 | -1.1403E+00 | 31.750 | -9.8266E-01 | 34.290 | -8.2345E-01 |
| 36.830 | -6.6268E-01 | 39.370 | -5.0041E-01 | 41.910 | -3.3673E-01 |
| 44.450 | -1.7169E-01 | 46.990 | -4.3303E-03 | 49.530 | -3.8151E-04 |
| 52.070 | 1.3129E-04 | 54.610 | -1.6587E-04 | 57.150 | -1.6738E-04 |
| 59.690 | -2.8327E-05 | 60.960 | 5.5642E-05 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a000
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 1.691E+06 | 0.0400 | 291.00 | 2 | 1.000E-01 | 1.585E+06 | 0.0400 | 291.00 |
| 3 | 2.000E-01 | 1.487E+06 | 0.0400 | 291.00 | 4 | 3.000E-01 | 1.395E+06 | 0.0400 | 291.00 |
| 5 | 4.000E-01 | 1.309E+06 | 0.0400 | 291.00 | 6 | 5.000E-01 | 1.227E+06 | 0.0400 | 291.00 |
| 7 | 6.000E-01 | 1.151E+06 | 0.0400 | 291.00 | 8 | 7.000E-01 | 1.078E+06 | 0.0400 | 291.00 |
| 9 | 8.000E-01 | 1.010E+06 | 0.0400 | 291.00 | 10 | 9.000E-01 | 9.441E+05 | 0.0400 | 291.00 |
| 11 | 1.000E+00 | 8.815E+05 | 0.0400 | 291.00 | 12 | 1.250E+00 | 7.365E+05 | 0.0400 | 291.00 |
| 13 | 1.500E+00 | 6.054E+05 | 0.0400 | 291.00 | 14 | 1.750E+00 | 4.857E+05 | 0.0400 | 291.00 |
| 15 | 2.000E+00 | 3.757E+05 | 0.0400 | 291.00 | 16 | 2.500E+00 | 1.789E+05 | 0.0401 | 291.00 |
| 17 | 3.000E+00 | 6.320E+03 | 0.0449 | 291.00 | 18 | 3.500E+00 | 3.523E+03 | 0.0496 | 291.00 |
| 19 | 4.000E+00 | 3.050E+03 | 0.0513 | 291.00 | 20 | 4.500E+00 | 2.788E+03 | 0.0526 | 291.00 |
| 21 | 5.080E+00 | 2.587E+03 | 0.0537 | 291.00 | 22 | 7.620E+00 | 2.146E+03 | 0.0570 | 291.00 |
| 23 | 1.016E+01 | 1.941E+03 | 0.0591 | 291.00 | 24 | 1.270E+01 | 1.814E+03 | 0.0606 | 291.00 |
| 25 | 1.524E+01 | 1.725E+03 | 0.0619 | 291.00 | 26 | 1.778E+01 | 1.658E+03 | 0.0629 | 291.00 |
| 27 | 2.032E+01 | 1.606E+03 | 0.0637 | 291.00 | 28 | 2.286E+01 | 1.564E+03 | 0.0645 | 291.00 |
| 29 | 2.540E+01 | 1.530E+03 | 0.0651 | 291.00 | 30 | 2.794E+01 | 1.502E+03 | 0.0656 | 291.00 |
| 31 | 3.048E+01 | 1.479E+03 | 0.0661 | 291.00 | 32 | 3.302E+01 | 1.460E+03 | 0.0665 | 291.00 |
| 33 | 3.556E+01 | 1.444E+03 | 0.0668 | 291.00 | 34 | 3.810E+01 | 1.432E+03 | 0.0671 | 291.00 |
| 35 | 4.064E+01 | 1.422E+03 | 0.0673 | 291.00 | 36 | 4.318E+01 | 1.415E+03 | 0.0675 | 291.00 |
| 37 | 4.572E+01 | 1.410E+03 | 0.0676 | 291.00 | 38 | 4.826E+01 | 1.319E+03 | 0.0570 | 291.00 |
| 39 | 5.080E+01 | 9.981E+02 | 0.0571 | 291.00 | 40 | 5.334E+01 | 7.482E+02 | 0.0572 | 291.00 |
| 41 | 5.588E+01 | 6.403E+02 | 0.0573 | 291.00 | 42 | 5.842E+01 | 6.057E+02 | 0.0574 | 291.00 |
| 43 | 6.096E+01 | 5.968E+02 | 0.0574 | 291.00 | | | | | |

Initial Water Storage = 3.7090 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.04001
Head (cm) = 1.58175E+06
LiqWater Flow (cm)=-1.09075E-12
IsoVapor Flow (cm)=-1.46615E-02
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 3.7090+ | 0.0000+ | 0.0000 | - 0.0147- | 0.0000- | 0.0000 = | 3.6943 vs. | 3.6944 |

Mass Balance = -1.1319E-05 cm; Time step attempts = 81 and successes = 70
Evaporation: Potential = 0.4687 cm, Actual = 0.0147 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 31.5 %;  TMEAN = 279.0 K;  HDRY =  1.5817E+06 cm;  DAYUBC =    69

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04003
 Head (cm)         = 5.14739E+05
 LiqWater Flow (cm)=-1.71811E-02
 IsoVapor Flow (cm)=-3.69303E-02
 Plant Sink (cm)   = 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR        STORAGE
   3.5271+ 0.0000+ 0.0000 - 0.0552- 0.0000-  0.0000 =    3.4719 vs.    3.4719

 Mass Balance = -6.5972E-05 cm;  Time step attempts =  332 and successes =  260
   Evaporation:  Potential =  0.2347 cm, Actual =  0.0552 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 68.7 %;  TMEAN = 277.0 K;  HDRY =  5.1474E+05 cm;  DAYUBC =   222
1

-------------------------------------------------------------------------------
                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.0923E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.0923E+02     [cm]
 Actual Evaporation                 =  1.8669E+01     [cm]
 Evaporation during Growth          =  1.8669E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  1.8440E+01     [cm]
 Total Basal Liquid Flux (drainage) =  1.4509E-05     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  1.8440E+01     [cm]
 Actual Rainfall                    =  1.8440E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  3.4719E+00     [cm]
 Mass Balance Error                 =  7.9878E-03     [cm]
 Total Successful Time Steps        =     57981
 Total Attempted Time Steps         =     70685
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     28973
 Total Time Actually Simulated      =  3.6500E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000   -2.2907E-01      0.050    1.2536E+01      0.150    8.2032E+00
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 6.9328E+00 | 0.350 | 6.0959E+00 | 0.450 | 5.5409E+00 |
| 0.550 | 5.0352E+00 | 0.650 | 4.5563E+00 | 0.750 | 4.2158E+00 |
| 0.850 | 3.8023E+00 | 0.950 | 3.5662E+00 | 1.125 | 3.3718E+00 |
| 1.375 | 2.8764E+00 | 1.625 | 2.5173E+00 | 1.875 | 2.2502E+00 |
| 2.250 | 1.9691E+00 | 2.750 | 1.3629E+00 | 3.250 | 1.0874E+00 |
| 3.750 | 8.3773E-01 | 4.250 | 6.6985E-01 | 4.790 | 4.6818E-01 |
| 6.350 | 2.3542E-01 | 8.890 | -2.3721E-01 | 11.430 | -2.9991E-01 |
| 13.970 | -2.9912E-01 | 16.510 | -2.9259E-01 | 19.050 | -2.8028E-01 |
| 21.590 | -2.6266E-01 | 24.130 | -2.4094E-01 | 26.670 | -2.1669E-01 |
| 29.210 | -1.9114E-01 | 31.750 | -1.6490E-01 | 34.290 | -1.3827E-01 |
| 36.830 | -1.1136E-01 | 39.370 | -8.4229E-02 | 41.910 | -5.6924E-02 |
| 44.450 | -2.9479E-02 | 46.990 | -1.0713E-03 | 49.530 | 2.7009E-05 |
| 52.070 | -2.0314E-05 | 54.610 | -1.0735E-04 | 57.150 | -1.7348E-04 |
| 59.690 | -7.5504E-05 | 60.960 | 1.4509E-05 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a001
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 5.147E+05 | 0.0400 | 291.00 | 2 | 1.000E-01 | 4.181E+05 | 0.0400 | 291.00 |
| 3 | 2.000E-01 | 3.279E+05 | 0.0400 | 291.00 | 4 | 3.000E-01 | 2.432E+05 | 0.0401 | 291.00 |
| 5 | 4.000E-01 | 1.635E+05 | 0.0401 | 291.00 | 6 | 5.000E-01 | 8.829E+04 | 0.0402 | 291.00 |
| 7 | 6.000E-01 | 1.748E+04 | 0.0415 | 291.00 | 8 | 7.000E-01 | 4.286E+03 | 0.0476 | 291.00 |
| 9 | 8.000E-01 | 3.796E+03 | 0.0488 | 291.00 | 10 | 9.000E-01 | 3.488E+03 | 0.0497 | 291.00 |
| 11 | 1.000E+00 | 3.272E+03 | 0.0504 | 291.00 | 12 | 1.250E+00 | 2.923E+03 | 0.0519 | 291.00 |
| 13 | 1.500E+00 | 2.709E+03 | 0.0530 | 291.00 | 14 | 1.750E+00 | 2.560E+03 | 0.0539 | 291.00 |
| 15 | 2.000E+00 | 2.448E+03 | 0.0546 | 291.00 | 16 | 2.500E+00 | 2.288E+03 | 0.0558 | 291.00 |
| 17 | 3.000E+00 | 2.178E+03 | 0.0567 | 291.00 | 18 | 3.500E+00 | 2.096E+03 | 0.0575 | 291.00 |
| 19 | 4.000E+00 | 2.034E+03 | 0.0581 | 291.00 | 20 | 4.500E+00 | 1.985E+03 | 0.0586 | 291.00 |
| 21 | 5.080E+00 | 1.940E+03 | 0.0591 | 291.00 | 22 | 7.620E+00 | 1.839E+03 | 0.0603 | 291.00 |
| 23 | 1.016E+01 | 1.822E+03 | 0.0605 | 291.00 | 24 | 1.270E+01 | 1.857E+03 | 0.0601 | 291.00 |
| 25 | 1.524E+01 | 1.934E+03 | 0.0592 | 291.00 | 26 | 1.778E+01 | 2.045E+03 | 0.0580 | 291.00 |
| 27 | 2.032E+01 | 2.173E+03 | 0.0567 | 291.00 | 28 | 2.286E+01 | 2.275E+03 | 0.0559 | 291.00 |
| 29 | 2.540E+01 | 2.320E+03 | 0.0555 | 291.00 | 30 | 2.794E+01 | 2.317E+03 | 0.0556 | 291.00 |
| 31 | 3.048E+01 | 2.291E+03 | 0.0558 | 291.00 | 32 | 3.302E+01 | 2.262E+03 | 0.0560 | 291.00 |
| 33 | 3.556E+01 | 2.235E+03 | 0.0562 | 291.00 | 34 | 3.810E+01 | 2.213E+03 | 0.0564 | 291.00 |
| 35 | 4.064E+01 | 2.196E+03 | 0.0565 | 291.00 | 36 | 4.318E+01 | 2.184E+03 | 0.0567 | 291.00 |
| 37 | 4.572E+01 | 2.176E+03 | 0.0567 | 291.00 | 38 | 4.826E+01 | 1.865E+03 | 0.0570 | 291.00 |
| 39 | 5.080E+01 | 1.521E+03 | 0.0570 | 291.00 | 40 | 5.334E+01 | 1.210E+03 | 0.0570 | 291.00 |
| 41 | 5.588E+01 | 9.667E+02 | 0.0571 | 291.00 | 42 | 5.842E+01 | 8.377E+02 | 0.0571 | 291.00 |
| 43 | 6.096E+01 | 8.022E+02 | 0.0572 | 291.00 | | | | | |

Initial Water Storage = 3.4719 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.04003
Head (cm) = 5.28720E+05
LiqWater Flow (cm)=-2.42654E-10
IsoVapor Flow (cm)=-2.61550E-02
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 3.4719+ | 0.0000+ | 0.0000 | - 0.0262- | 0.0000- | 0.0000 = | 3.4458 vs. | 3.4458 |

Mass Balance = -2.5957E-05 cm; Time step attempts = 131 and successes = 100
Evaporation: Potential = 0.1836 cm, Actual = 0.0262 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 68.0 %;  TMEAN = 275.1 K;  HDRY =  5.2872E+05 cm;  DAYUBC =   100

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04002
 Head (cm)         = 9.10457E+05
 LiqWater Flow (cm)=-2.18199E-11
 IsoVapor Flow (cm)=-2.78730E-02
 Plant Sink (cm)   = 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR        STORAGE
   3.8821+ 0.0000+ 0.0000 - 0.0279- 0.0000-  0.0000 =    3.8543 vs.    3.8543

 Mass Balance = -1.0967E-05 cm;  Time step attempts =   69 and successes =   59
   Evaporation:  Potential =  1.0080 cm, Actual =  0.0279 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 51.5 %;  TMEAN = 281.2 K;  HDRY =  9.1046E+05 cm;  DAYUBC =    59
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.0868E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.0868E+02     [cm]
 Actual Evaporation                 =  3.2248E+01     [cm]
 Evaporation during Growth          =  3.2248E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  3.2639E+01     [cm]
 Total Basal Liquid Flux (drainage) =  2.7345E-07     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  3.2639E+01     [cm]
 Actual Rainfall                    =  3.2639E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  3.8543E+00     [cm]
 Mass Balance Error                 =  8.2136E-03     [cm]
 Total Successful Time Steps        =     59911
 Total Attempted Time Steps         =     73500
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     27647
 Total Time Actually Simulated      =  3.6500E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000    3.9056E-01      0.050    1.5412E+01      0.150    9.0260E+00
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 7.3937E+00 | 0.350 | 6.3440E+00 | 0.450 | 5.4038E+00 |
| 0.550 | 4.6883E+00 | 0.650 | 4.0832E+00 | 0.750 | 3.8222E+00 |
| 0.850 | 3.5225E+00 | 0.950 | 3.3277E+00 | 1.125 | 3.1191E+00 |
| 1.375 | 2.4766E+00 | 1.625 | 2.2001E+00 | 1.875 | 1.9564E+00 |
| 2.250 | 1.7537E+00 | 2.750 | 1.5291E+00 | 3.250 | 1.3928E+00 |
| 3.750 | 1.2827E+00 | 4.250 | 1.1503E+00 | 4.790 | 1.0504E+00 |
| 6.350 | 8.9306E-01 | 8.890 | 5.9171E-01 | 11.430 | 4.9546E-01 |
| 13.970 | 4.0404E-01 | 16.510 | 3.6221E-01 | 19.050 | 3.4139E-01 |
| 21.590 | 3.1600E-01 | 24.130 | 2.8714E-01 | 26.670 | 2.5631E-01 |
| 29.210 | 2.2464E-01 | 31.750 | 1.9273E-01 | 34.290 | 1.6078E-01 |
| 36.830 | 1.2885E-01 | 39.370 | 9.6931E-02 | 41.910 | 6.4997E-02 |
| 44.450 | 3.3010E-02 | 46.990 | 1.7054E-03 | 49.530 | 2.3272E-03 |
| 52.070 | 3.7766E-04 | 54.610 | 3.3669E-05 | 57.150 | 1.1256E-06 |
| 59.690 | -2.3137E-06 | 60.960 | 2.7345E-07 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a001
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 9.105E+05 | 0.0400 | 291.00 | 2 | 1.000E-01 | 8.113E+05 | 0.0400 | 291.00 |
| 3 | 2.000E-01 | 7.190E+05 | 0.0400 | 291.00 | 4 | 3.000E-01 | 6.326E+05 | 0.0400 | 291.00 |
| 5 | 4.000E-01 | 5.513E+05 | 0.0400 | 291.00 | 6 | 5.000E-01 | 4.745E+05 | 0.0400 | 291.00 |
| 7 | 6.000E-01 | 4.018E+05 | 0.0400 | 291.00 | 8 | 7.000E-01 | 3.327E+05 | 0.0400 | 291.00 |
| 9 | 8.000E-01 | 2.670E+05 | 0.0401 | 291.00 | 10 | 9.000E-01 | 2.043E+05 | 0.0401 | 291.00 |
| 11 | 1.000E+00 | 1.443E+05 | 0.0401 | 291.00 | 12 | 1.250E+00 | 4.918E+03 | 0.0465 | 291.00 |
| 13 | 1.500E+00 | 3.545E+03 | 0.0495 | 291.00 | 14 | 1.750E+00 | 3.107E+03 | 0.0511 | 291.00 |
| 15 | 2.000E+00 | 2.855E+03 | 0.0522 | 291.00 | 16 | 2.500E+00 | 2.552E+03 | 0.0539 | 291.00 |
| 17 | 3.000E+00 | 2.366E+03 | 0.0552 | 291.00 | 18 | 3.500E+00 | 2.235E+03 | 0.0562 | 291.00 |
| 19 | 4.000E+00 | 2.136E+03 | 0.0571 | 291.00 | 20 | 4.500E+00 | 2.057E+03 | 0.0578 | 291.00 |
| 21 | 5.080E+00 | 1.983E+03 | 0.0586 | 291.00 | 22 | 7.620E+00 | 1.774E+03 | 0.0612 | 291.00 |
| 23 | 1.016E+01 | 1.656E+03 | 0.0629 | 291.00 | 24 | 1.270E+01 | 1.579E+03 | 0.0642 | 291.00 |
| 25 | 1.524E+01 | 1.524E+03 | 0.0652 | 291.00 | 26 | 1.778E+01 | 1.483E+03 | 0.0660 | 291.00 |
| 27 | 2.032E+01 | 1.452E+03 | 0.0667 | 291.00 | 28 | 2.286E+01 | 1.428E+03 | 0.0672 | 291.00 |
| 29 | 2.540E+01 | 1.408E+03 | 0.0676 | 291.00 | 30 | 2.794E+01 | 1.392E+03 | 0.0680 | 291.00 |
| 31 | 3.048E+01 | 1.379E+03 | 0.0683 | 291.00 | 32 | 3.302E+01 | 1.368E+03 | 0.0685 | 291.00 |
| 33 | 3.556E+01 | 1.359E+03 | 0.0688 | 291.00 | 34 | 3.810E+01 | 1.352E+03 | 0.0689 | 291.00 |
| 35 | 4.064E+01 | 1.345E+03 | 0.0691 | 291.00 | 36 | 4.318E+01 | 1.341E+03 | 0.0692 | 291.00 |
| 37 | 4.572E+01 | 1.337E+03 | 0.0693 | 291.00 | 38 | 4.826E+01 | 1.244E+03 | 0.0570 | 291.00 |
| 39 | 5.080E+01 | 7.427E+02 | 0.0572 | 291.00 | 40 | 5.334E+01 | 7.253E+02 | 0.0572 | 291.00 |
| 41 | 5.588E+01 | 8.281E+02 | 0.0571 | 291.00 | 42 | 5.842E+01 | 9.073E+02 | 0.0571 | 291.00 |
| 43 | 6.096E+01 | 9.344E+02 | 0.0571 | 291.00 | | | | | |

Initial Water Storage = 3.8543 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.04001
Head (cm) = 9.43756E+05
LiqWater Flow (cm)=-1.55516E-11
IsoVapor Flow (cm)=-2.40978E-02
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 3.8543+ | 0.0000+ | 0.0000 - | 0.0241- | 0.0000- | 0.0000 = | 3.8302 vs. | 3.8302 |

Mass Balance = -1.1610E-05 cm; Time step attempts = 66 and successes = 54
Evaporation: Potential = 0.3290 cm, Actual = 0.0241 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 50.2 %;  TMEAN = 280.4 K;  HDRY =  9.4376E+05 cm;  DAYUBC =    54

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.15198
 Head (cm)         = 3.95957E+02
 LiqWater Flow (cm)=-4.87876E-01
 IsoVapor Flow (cm)=-1.29705E-07
 Plant Sink (cm)   = 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR        STORAGE
   8.8259+ 0.0000+ 0.0000 - 0.4883- 0.0000-  0.0000 =    8.3376 vs.    8.3376

 Mass Balance = -1.1528E-05 cm;  Time step attempts =   47 and successes =   37
   Evaporation:  Potential =  0.4883 cm, Actual =  0.4883 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 46.6 %;  TMEAN = 282.3 K;  HDRY =  1.0455E+06 cm;  DAYUBC =     0
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  2.9897E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  2.9897E+02     [cm]
 Actual Evaporation                 =  2.6953E+01     [cm]
 Evaporation during Growth          =  2.6953E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  3.1445E+01     [cm]
 Total Basal Liquid Flux (drainage) =  4.6442E-07     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  3.1445E+01     [cm]
 Actual Rainfall                    =  3.1445E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  8.3376E+00     [cm]
 Mass Balance Error                 =  9.0974E-03     [cm]
 Total Successful Time Steps        =     61734
 Total Attempted Time Steps         =     75112
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     28120
 Total Time Actually Simulated      =  3.6500E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000    4.4924E+00      0.050    2.0119E+01      0.150    1.4513E+01
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 1.2053E+01 | 0.350 | 1.0707E+01 | 0.450 | 9.7616E+00 |
| 0.550 | 8.9978E+00 | 0.650 | 8.4087E+00 | 0.750 | 7.8049E+00 |
| 0.850 | 7.5446E+00 | 0.950 | 7.3345E+00 | 1.125 | 7.1444E+00 |
| 1.375 | 6.7092E+00 | 1.625 | 6.2318E+00 | 1.875 | 5.8776E+00 |
| 2.250 | 5.6380E+00 | 2.750 | 5.1858E+00 | 3.250 | 4.8597E+00 |
| 3.750 | 4.7202E+00 | 4.250 | 4.6119E+00 | 4.790 | 4.5002E+00 |
| 6.350 | 4.2777E+00 | 8.890 | 3.8309E+00 | 11.430 | 3.4220E+00 |
| 13.970 | 3.1538E+00 | 16.510 | 2.9204E+00 | 19.050 | 2.6866E+00 |
| 21.590 | 2.4518E+00 | 24.130 | 2.2158E+00 | 26.670 | 1.9782E+00 |
| 29.210 | 1.7390E+00 | 31.750 | 1.4980E+00 | 34.290 | 1.2550E+00 |
| 36.830 | 1.0101E+00 | 39.370 | 7.6314E-01 | 41.910 | 5.1411E-01 |
| 44.450 | 2.6296E-01 | 46.990 | 1.0305E-02 | 49.530 | 5.6707E-03 |
| 52.070 | 1.5915E-04 | 54.610 | 3.7718E-06 | 57.150 | 1.6476E-06 |
| 59.690 | 2.7146E-07 | 60.960 | 4.6442E-07 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a001
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 3.960E+02 | 0.1520 | 291.00 | 2 | 1.000E-01 | 3.986E+02 | 0.1512 | 291.00 |
| 3 | 2.000E-01 | 4.001E+02 | 0.1508 | 291.00 | 4 | 3.000E-01 | 4.007E+02 | 0.1506 | 291.00 |
| 5 | 4.000E-01 | 4.008E+02 | 0.1506 | 291.00 | 6 | 5.000E-01 | 4.006E+02 | 0.1507 | 291.00 |
| 7 | 6.000E-01 | 4.003E+02 | 0.1508 | 291.00 | 8 | 7.000E-01 | 3.999E+02 | 0.1509 | 291.00 |
| 9 | 8.000E-01 | 3.995E+02 | 0.1510 | 291.00 | 10 | 9.000E-01 | 3.991E+02 | 0.1511 | 291.00 |
| 11 | 1.000E+00 | 3.988E+02 | 0.1512 | 291.00 | 12 | 1.250E+00 | 3.981E+02 | 0.1514 | 291.00 |
| 13 | 1.500E+00 | 3.977E+02 | 0.1515 | 291.00 | 14 | 1.750E+00 | 3.973E+02 | 0.1516 | 291.00 |
| 15 | 2.000E+00 | 3.970E+02 | 0.1517 | 291.00 | 16 | 2.500E+00 | 3.964E+02 | 0.1519 | 291.00 |
| 17 | 3.000E+00 | 3.958E+02 | 0.1520 | 291.00 | 18 | 3.500E+00 | 3.951E+02 | 0.1522 | 291.00 |
| 19 | 4.000E+00 | 3.945E+02 | 0.1524 | 291.00 | 20 | 4.500E+00 | 3.938E+02 | 0.1526 | 291.00 |
| 21 | 5.080E+00 | 3.931E+02 | 0.1528 | 291.00 | 22 | 7.620E+00 | 3.896E+02 | 0.1538 | 291.00 |
| 23 | 1.016E+01 | 3.862E+02 | 0.1548 | 291.00 | 24 | 1.270E+01 | 3.827E+02 | 0.1559 | 291.00 |
| 25 | 1.524E+01 | 3.793E+02 | 0.1569 | 291.00 | 26 | 1.778E+01 | 3.759E+02 | 0.1579 | 291.00 |
| 27 | 2.032E+01 | 3.725E+02 | 0.1590 | 291.00 | 28 | 2.286E+01 | 3.692E+02 | 0.1600 | 291.00 |
| 29 | 2.540E+01 | 3.660E+02 | 0.1611 | 291.00 | 30 | 2.794E+01 | 3.628E+02 | 0.1621 | 291.00 |
| 31 | 3.048E+01 | 3.597E+02 | 0.1631 | 291.00 | 32 | 3.302E+01 | 3.567E+02 | 0.1642 | 291.00 |
| 33 | 3.556E+01 | 3.537E+02 | 0.1652 | 291.00 | 34 | 3.810E+01 | 3.509E+02 | 0.1661 | 291.00 |
| 35 | 4.064E+01 | 3.481E+02 | 0.1671 | 291.00 | 36 | 4.318E+01 | 3.454E+02 | 0.1681 | 291.00 |
| 37 | 4.572E+01 | 3.428E+02 | 0.1690 | 291.00 | 38 | 4.826E+01 | 3.394E+02 | 0.0590 | 291.00 |
| 39 | 5.080E+01 | 3.303E+02 | 0.0592 | 291.00 | 40 | 5.334E+01 | 8.035E+02 | 0.0572 | 291.00 |
| 41 | 5.588E+01 | 1.069E+03 | 0.0571 | 291.00 | 42 | 5.842E+01 | 1.093E+03 | 0.0571 | 291.00 |
| 43 | 6.096E+01 | 1.090E+03 | 0.0571 | 291.00 | | | | | |

Initial Water Storage = 8.3376 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.14038
Head (cm) = 4.40787E+02
LiqWater Flow (cm)=-4.37847E-01
IsoVapor Flow (cm)=-1.74210E-07
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 8.3376+ | 0.0000+ | 0.0000 - | 0.4384- | 0.0000- | 0.0000 = | 7.8992 vs. | 7.8992 |

Mass Balance = -1.0405E-05 cm; Time step attempts = 47 and successes = 37
Evaporation: Potential = 0.4384 cm, Actual = 0.4384 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 47.7 %;  TMEAN = 279.8 K;  HDRY =  1.0133E+06 cm;  DAYUBC =     0

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.08113
 Head (cm)         = 9.93693E+02
 LiqWater Flow (cm)= 3.02700E-01
 IsoVapor Flow (cm)= 2.61866E-05
 Plant Sink (cm)   = 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS    DRAIN      NEWSTOR        STORAGE
   4.0434+ 0.3048+ 0.0000 - 0.0000- 0.0000-  0.0000 =     4.3482 vs.     4.3479

 Mass Balance =  2.7500E-04 cm;  Time step attempts =  612 and successes =  479
   Evaporation:  Potential =  0.0000 cm, Actual =  0.0000 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 93.5 %;  TMEAN = 282.6 K;  HDRY =  9.2552E+04 cm;  DAYUBC =     0
1

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.0544E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.0544E+02     [cm]
 Actual Evaporation                 =  3.2936E+01     [cm]
 Evaporation during Growth          =  3.2936E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.8956E+01     [cm]
 Total Basal Liquid Flux (drainage) =  4.2393E-06     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  2.8956E+01     [cm]
 Actual Rainfall                    =  2.8956E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  4.3479E+00     [cm]
 Mass Balance Error                 =  9.5407E-03     [cm]
 Total Successful Time Steps        =     73212
 Total Attempted Time Steps         =     90562
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     33379
 Total Time Actually Simulated      =  3.6600E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000   -3.9802E+00      0.050    1.2646E+01      0.150    7.2691E+00
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 4.8895E+00 | 0.350 | 3.7746E+00 | 0.450 | 2.7964E+00 |
| 0.550 | 2.0394E+00 | 0.650 | 1.4276E+00 | 0.750 | 8.9127E-01 |
| 0.850 | 3.8807E-01 | 0.950 | -1.2096E-01 | 1.125 | -3.3039E-01 |
| 1.375 | -9.2955E-01 | 1.625 | -1.3453E+00 | 1.875 | -1.7798E+00 |
| 2.250 | -2.2306E+00 | 2.750 | -2.7822E+00 | 3.250 | -3.0973E+00 |
| 3.750 | -3.3099E+00 | 4.250 | -3.4117E+00 | 4.790 | -3.4866E+00 |
| 6.350 | -3.4986E+00 | 8.890 | -3.3418E+00 | 11.430 | -3.1484E+00 |
| 13.970 | -2.9496E+00 | 16.510 | -2.7451E+00 | 19.050 | -2.5351E+00 |
| 21.590 | -2.3199E+00 | 24.130 | -2.1002E+00 | 26.670 | -1.8769E+00 |
| 29.210 | -1.6506E+00 | 31.750 | -1.4220E+00 | 34.290 | -1.1913E+00 |
| 36.830 | -9.5875E-01 | 39.370 | -7.2435E-01 | 41.910 | -4.8808E-01 |
| 44.450 | -2.4986E-01 | 46.990 | -8.8037E-03 | 49.530 | -1.5621E-03 |
| 52.070 | 1.4368E-03 | 54.610 | 5.1295E-04 | 57.150 | 1.0534E-04 |
| 59.690 | 2.4298E-05 | 60.960 | 4.2393E-06 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a001
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| | Initial Conditions | | | | | Initial Conditions | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 9.937E+02 | 0.0811 | 291.00 | 2 | 1.000E-01 | 1.022E+03 | 0.0798 | 291.00 |
| 3 | 2.000E-01 | 1.014E+03 | 0.0802 | 291.00 | 4 | 3.000E-01 | 1.011E+03 | 0.0803 | 291.00 |
| 5 | 4.000E-01 | 1.011E+03 | 0.0803 | 291.00 | 6 | 5.000E-01 | 1.012E+03 | 0.0803 | 291.00 |
| 7 | 6.000E-01 | 1.012E+03 | 0.0803 | 291.00 | 8 | 7.000E-01 | 1.012E+03 | 0.0803 | 291.00 |
| 9 | 8.000E-01 | 1.012E+03 | 0.0803 | 291.00 | 10 | 9.000E-01 | 1.012E+03 | 0.0803 | 291.00 |
| 11 | 1.000E+00 | 1.012E+03 | 0.0803 | 291.00 | 12 | 1.250E+00 | 1.012E+03 | 0.0803 | 291.00 |
| 13 | 1.500E+00 | 1.012E+03 | 0.0803 | 291.00 | 14 | 1.750E+00 | 1.012E+03 | 0.0803 | 291.00 |
| 15 | 2.000E+00 | 1.012E+03 | 0.0803 | 291.00 | 16 | 2.500E+00 | 1.013E+03 | 0.0802 | 291.00 |
| 17 | 3.000E+00 | 1.014E+03 | 0.0802 | 291.00 | 18 | 3.500E+00 | 1.015E+03 | 0.0802 | 291.00 |
| 19 | 4.000E+00 | 1.016E+03 | 0.0801 | 291.00 | 20 | 4.500E+00 | 1.018E+03 | 0.0800 | 291.00 |
| 21 | 5.080E+00 | 1.020E+03 | 0.0799 | 291.00 | 22 | 7.620E+00 | 1.034E+03 | 0.0793 | 291.00 |
| 23 | 1.016E+01 | 1.054E+03 | 0.0785 | 291.00 | 24 | 1.270E+01 | 1.079E+03 | 0.0774 | 291.00 |
| 25 | 1.524E+01 | 1.109E+03 | 0.0763 | 291.00 | 26 | 1.778E+01 | 1.140E+03 | 0.0752 | 291.00 |
| 27 | 2.032E+01 | 1.168E+03 | 0.0742 | 291.00 | 28 | 2.286E+01 | 1.190E+03 | 0.0735 | 291.00 |
| 29 | 2.540E+01 | 1.202E+03 | 0.0731 | 291.00 | 30 | 2.794E+01 | 1.206E+03 | 0.0730 | 291.00 |
| 31 | 3.048E+01 | 1.202E+03 | 0.0731 | 291.00 | 32 | 3.302E+01 | 1.195E+03 | 0.0733 | 291.00 |
| 33 | 3.556E+01 | 1.187E+03 | 0.0736 | 291.00 | 34 | 3.810E+01 | 1.179E+03 | 0.0738 | 291.00 |
| 35 | 4.064E+01 | 1.172E+03 | 0.0741 | 291.00 | 36 | 4.318E+01 | 1.166E+03 | 0.0743 | 291.00 |
| 37 | 4.572E+01 | 1.162E+03 | 0.0744 | 291.00 | 38 | 4.826E+01 | 1.126E+03 | 0.0571 | 291.00 |
| 39 | 5.080E+01 | 9.538E+02 | 0.0571 | 291.00 | 40 | 5.334E+01 | 8.972E+02 | 0.0571 | 291.00 |
| 41 | 5.588E+01 | 7.992E+02 | 0.0572 | 291.00 | 42 | 5.842E+01 | 7.328E+02 | 0.0572 | 291.00 |
| 43 | 6.096E+01 | 7.160E+02 | 0.0572 | 291.00 | | | | | |

Initial Water Storage = 4.3479 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.10160
Head (cm) = 6.93734E+02
LiqWater Flow (cm)= 6.59379E-01
IsoVapor Flow (cm)=-2.27762E-07
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 4.3479+ | 0.6604+ | 0.0000 - | 0.0000- | 0.0000- | 0.0000 = | 5.0083 vs. | 5.0082 |

Mass Balance = 1.5008E-04 cm; Time step attempts = 247 and successes = 216
Evaporation: Potential = 0.0000 cm, Actual = 0.0000 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 94.0 %;  TMEAN = 279.8 K;  HDRY =  8.4704E+04 cm;  DAYUBC =     0

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04005
 Head (cm)         = 3.26167E+05
 LiqWater Flow (cm)=-3.12614E-08
 IsoVapor Flow (cm)=-6.57562E-02
 Plant Sink (cm)   = 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR        STORAGE
   4.1862+ 0.0000+ 0.0000 - 0.0658- 0.0000-  0.0000 =    4.1205 vs.    4.1205

 Mass Balance = -1.3634E-05 cm;  Time step attempts =  148 and successes =  117
   Evaporation:  Potential =  0.2317 cm, Actual =  0.0658 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 71.4 %;  TMEAN = 279.5 K;  HDRY =  4.6240E+05 cm;  DAYUBC =    65
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.3656E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.3656E+02     [cm]
 Actual Evaporation                 =  2.4679E+01     [cm]
 Evaporation during Growth          =  2.4679E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.4460E+01     [cm]
 Total Basal Liquid Flux (drainage) =  1.8744E-06     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  2.4460E+01     [cm]
 Actual Rainfall                    =  2.4460E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  4.1205E+00     [cm]
 Mass Balance Error                 =  8.3802E-03     [cm]
 Total Successful Time Steps        =     64799
 Total Attempted Time Steps         =     79502
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     30618
 Total Time Actually Simulated      =  3.6500E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000   -2.1902E-01      0.050    1.7484E+01      0.150    1.1040E+01
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 8.7728E+00 | 0.350 | 7.3037E+00 | 0.450 | 6.1228E+00 |
| 0.550 | 5.0329E+00 | 0.650 | 4.1865E+00 | 0.750 | 3.5718E+00 |
| 0.850 | 3.2145E+00 | 0.950 | 3.0098E+00 | 1.125 | 2.8271E+00 |
| 1.375 | 2.1940E+00 | 1.625 | 1.7665E+00 | 1.875 | 1.3903E+00 |
| 2.250 | 1.1900E+00 | 2.750 | 9.5977E-01 | 3.250 | 7.7670E-01 |
| 3.750 | 6.5569E-01 | 4.250 | 4.8721E-01 | 4.790 | 3.8744E-01 |
| 6.350 | 2.9834E-01 | 8.890 | 1.3055E-01 | 11.430 | 3.0550E-02 |
| 13.970 | -1.6179E-02 | 16.510 | -2.0462E-02 | 19.050 | -1.4521E-02 |
| 21.590 | -1.2062E-02 | 24.130 | -1.2006E-02 | 26.670 | -1.3191E-02 |
| 29.210 | -1.4605E-02 | 31.750 | -1.5527E-02 | 34.290 | -1.5516E-02 |
| 36.830 | -1.4401E-02 | 39.370 | -1.2206E-02 | 41.910 | -9.0804E-03 |
| 44.450 | -5.2828E-03 | 46.990 | -4.3055E-04 | 49.530 | 3.2964E-05 |
| 52.070 | -3.6855E-06 | 54.610 | -1.3454E-05 | 57.150 | -2.3492E-05 |
| 59.690 | -1.2378E-05 | 60.960 | 1.8744E-06 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a001
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 3.262E+05 | 0.0401 | 291.00 | 2 | 1.000E-01 | 2.131E+05 | 0.0401 | 291.00 |
| 3 | 2.000E-01 | 1.059E+05 | 0.0402 | 291.00 | 4 | 3.000E-01 | 3.955E+03 | 0.0484 | 291.00 |
| 5 | 4.000E-01 | 3.338E+03 | 0.0502 | 291.00 | 6 | 5.000E-01 | 3.018E+03 | 0.0515 | 291.00 |
| 7 | 6.000E-01 | 2.810E+03 | 0.0524 | 291.00 | 8 | 7.000E-01 | 2.659E+03 | 0.0533 | 291.00 |
| 9 | 8.000E-01 | 2.542E+03 | 0.0540 | 291.00 | 10 | 9.000E-01 | 2.447E+03 | 0.0546 | 291.00 |
| 11 | 1.000E+00 | 2.368E+03 | 0.0552 | 291.00 | 12 | 1.250E+00 | 2.214E+03 | 0.0564 | 291.00 |
| 13 | 1.500E+00 | 2.101E+03 | 0.0574 | 291.00 | 14 | 1.750E+00 | 2.012E+03 | 0.0583 | 291.00 |
| 15 | 2.000E+00 | 1.940E+03 | 0.0591 | 291.00 | 16 | 2.500E+00 | 1.828E+03 | 0.0605 | 291.00 |
| 17 | 3.000E+00 | 1.743E+03 | 0.0616 | 291.00 | 18 | 3.500E+00 | 1.676E+03 | 0.0626 | 291.00 |
| 19 | 4.000E+00 | 1.622E+03 | 0.0635 | 291.00 | 20 | 4.500E+00 | 1.576E+03 | 0.0643 | 291.00 |
| 21 | 5.080E+00 | 1.532E+03 | 0.0651 | 291.00 | 22 | 7.620E+00 | 1.399E+03 | 0.0678 | 291.00 |
| 23 | 1.016E+01 | 1.321E+03 | 0.0697 | 291.00 | 24 | 1.270E+01 | 1.271E+03 | 0.0711 | 291.00 |
| 25 | 1.524E+01 | 1.237E+03 | 0.0720 | 291.00 | 26 | 1.778E+01 | 1.215E+03 | 0.0727 | 291.00 |
| 27 | 2.032E+01 | 1.201E+03 | 0.0731 | 291.00 | 28 | 2.286E+01 | 1.193E+03 | 0.0734 | 291.00 |
| 29 | 2.540E+01 | 1.189E+03 | 0.0735 | 291.00 | 30 | 2.794E+01 | 1.189E+03 | 0.0735 | 291.00 |
| 31 | 3.048E+01 | 1.192E+03 | 0.0734 | 291.00 | 32 | 3.302E+01 | 1.196E+03 | 0.0733 | 291.00 |
| 33 | 3.556E+01 | 1.201E+03 | 0.0731 | 291.00 | 34 | 3.810E+01 | 1.207E+03 | 0.0730 | 291.00 |
| 35 | 4.064E+01 | 1.211E+03 | 0.0728 | 291.00 | 36 | 4.318E+01 | 1.213E+03 | 0.0728 | 291.00 |
| 37 | 4.572E+01 | 1.213E+03 | 0.0728 | 291.00 | 38 | 4.826E+01 | 1.251E+03 | 0.0570 | 291.00 |
| 39 | 5.080E+01 | 1.286E+03 | 0.0570 | 291.00 | 40 | 5.334E+01 | 1.222E+03 | 0.0570 | 291.00 |
| 41 | 5.588E+01 | 1.133E+03 | 0.0571 | 291.00 | 42 | 5.842E+01 | 1.073E+03 | 0.0571 | 291.00 |
| 43 | 6.096E+01 | 1.053E+03 | 0.0571 | 291.00 | | | | | |

Initial Water Storage = 4.1205 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.04003
Head (cm) = 5.48421E+05
LiqWater Flow (cm)=-6.83844E-10
IsoVapor Flow (cm)=-5.00123E-02
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 4.1205+ | 0.0000+ | 0.0000 - | 0.0500- | 0.0000- | 0.0000 = | 4.0705 vs. | 4.0705 |

Mass Balance = -2.3098E-05 cm; Time step attempts = 126 and successes = 99
Evaporation: Potential = 0.2753 cm, Actual = 0.0500 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 67.0 %;  TMEAN = 280.1 K;  HDRY =  5.4842E+05 cm;  DAYUBC =    80

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04009
 Head (cm)         = 2.00558E+05
 LiqWater Flow (cm)=-1.25226E-02
 IsoVapor Flow (cm)=-1.75869E-01
 Plant Sink (cm)   = 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS    DRAIN      NEWSTOR        STORAGE
   5.4113+ 0.0000+ 0.0000 - 0.1884- 0.0000-  0.0000 =    5.2229 vs.    5.2229

 Mass Balance = -8.4180E-06 cm;  Time step attempts =  188 and successes =  144
   Evaporation:  Potential =  0.4304 cm, Actual =  0.1884 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 53.9 %;  TMEAN = 279.5 K;  HDRY =  8.4789E+05 cm;  DAYUBC =    28
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.5684E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.5684E+02     [cm]
 Actual Evaporation                 =  1.2809E+01     [cm]
 Evaporation during Growth          =  1.2809E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  1.3919E+01     [cm]
 Total Basal Liquid Flux (drainage) =  2.6521E-08     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  1.3919E+01     [cm]
 Actual Rainfall                    =  1.3919E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  5.2229E+00     [cm]
 Mass Balance Error                 =  8.1640E-03     [cm]
 Total Successful Time Steps        =     57734
 Total Attempted Time Steps         =     71126
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     29225
 Total Time Actually Simulated      =  3.6500E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000    1.1106E+00      0.050    1.0373E+01      0.150    8.3240E+00
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 7.5800E+00 | 0.350 | 7.0437E+00 | 0.450 | 6.6942E+00 |
| 0.550 | 6.3530E+00 | 0.650 | 6.1085E+00 | 0.750 | 5.8641E+00 |
| 0.850 | 5.6618E+00 | 0.950 | 5.4665E+00 | 1.125 | 5.2569E+00 |
| 1.375 | 4.7059E+00 | 1.625 | 4.3090E+00 | 1.875 | 3.9270E+00 |
| 2.250 | 3.6242E+00 | 2.750 | 3.0270E+00 | 3.250 | 2.5741E+00 |
| 3.750 | 2.1217E+00 | 4.250 | 1.8510E+00 | 4.790 | 1.6543E+00 |
| 6.350 | 1.4454E+00 | 8.890 | 1.0902E+00 | 11.430 | 9.3680E-01 |
| 13.970 | 8.4857E-01 | 16.510 | 7.9749E-01 | 19.050 | 7.4399E-01 |
| 21.590 | 6.8790E-01 | 24.130 | 6.2922E-01 | 26.670 | 5.6795E-01 |
| 29.210 | 5.0415E-01 | 31.750 | 4.3790E-01 | 34.290 | 3.6933E-01 |
| 36.830 | 2.9864E-01 | 39.370 | 2.2606E-01 | 41.910 | 1.5190E-01 |
| 44.450 | 7.6496E-02 | 46.990 | 5.6914E-04 | 49.530 | 2.2920E-06 |
| 52.070 | -1.0291E-07 | 54.610 | -2.4962E-07 | 57.150 | -2.8433E-07 |
| 59.690 | -1.1799E-07 | 60.960 | 2.6521E-08 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a001
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 2.006E+05 | 0.0401 | 291.00 | 2 | 1.000E-01 | 1.155E+03 | 0.0746 | 291.00 |
| 3 | 2.000E-01 | 1.151E+03 | 0.0748 | 291.00 | 4 | 3.000E-01 | 1.146E+03 | 0.0750 | 291.00 |
| 5 | 4.000E-01 | 1.142E+03 | 0.0751 | 291.00 | 6 | 5.000E-01 | 1.138E+03 | 0.0753 | 291.00 |
| 7 | 6.000E-01 | 1.133E+03 | 0.0754 | 291.00 | 8 | 7.000E-01 | 1.129E+03 | 0.0756 | 291.00 |
| 9 | 8.000E-01 | 1.125E+03 | 0.0757 | 291.00 | 10 | 9.000E-01 | 1.120E+03 | 0.0759 | 291.00 |
| 11 | 1.000E+00 | 1.116E+03 | 0.0760 | 291.00 | 12 | 1.250E+00 | 1.106E+03 | 0.0764 | 291.00 |
| 13 | 1.500E+00 | 1.096E+03 | 0.0768 | 291.00 | 14 | 1.750E+00 | 1.086E+03 | 0.0772 | 291.00 |
| 15 | 2.000E+00 | 1.077E+03 | 0.0775 | 291.00 | 16 | 2.500E+00 | 1.059E+03 | 0.0783 | 291.00 |
| 17 | 3.000E+00 | 1.041E+03 | 0.0790 | 291.00 | 18 | 3.500E+00 | 1.025E+03 | 0.0797 | 291.00 |
| 19 | 4.000E+00 | 1.010E+03 | 0.0804 | 291.00 | 20 | 4.500E+00 | 9.949E+02 | 0.0811 | 291.00 |
| 21 | 5.080E+00 | 9.789E+02 | 0.0818 | 291.00 | 22 | 7.620E+00 | 9.187E+02 | 0.0850 | 291.00 |
| 23 | 1.016E+01 | 8.726E+02 | 0.0876 | 291.00 | 24 | 1.270E+01 | 8.368E+02 | 0.0900 | 291.00 |
| 25 | 1.524E+01 | 8.082E+02 | 0.0919 | 291.00 | 26 | 1.778E+01 | 7.851E+02 | 0.0937 | 291.00 |
| 27 | 2.032E+01 | 7.661E+02 | 0.0952 | 291.00 | 28 | 2.286E+01 | 7.502E+02 | 0.0965 | 291.00 |
| 29 | 2.540E+01 | 7.369E+02 | 0.0976 | 291.00 | 30 | 2.794E+01 | 7.255E+02 | 0.0986 | 291.00 |
| 31 | 3.048E+01 | 7.158E+02 | 0.0995 | 291.00 | 32 | 3.302E+01 | 7.075E+02 | 0.1003 | 291.00 |
| 33 | 3.556E+01 | 7.005E+02 | 0.1009 | 291.00 | 34 | 3.810E+01 | 6.945E+02 | 0.1015 | 291.00 |
| 35 | 4.064E+01 | 6.894E+02 | 0.1020 | 291.00 | 36 | 4.318E+01 | 6.853E+02 | 0.1024 | 291.00 |
| 37 | 4.572E+01 | 6.819E+02 | 0.1028 | 291.00 | 38 | 4.826E+01 | 6.721E+02 | 0.0573 | 291.00 |
| 39 | 5.080E+01 | 1.258E+03 | 0.0570 | 291.00 | 40 | 5.334E+01 | 1.550E+03 | 0.0570 | 291.00 |
| 41 | 5.588E+01 | 1.695E+03 | 0.0570 | 291.00 | 42 | 5.842E+01 | 1.763E+03 | 0.0570 | 291.00 |
| 43 | 6.096E+01 | 1.782E+03 | 0.0570 | 291.00 | | | | | |

Initial Water Storage = 5.2229 cm

NOTE: There are no temperature data when plants are modelled.

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DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.04021
Head (cm) = 9.55047E+04
LiqWater Flow (cm)=-6.16736E-02
IsoVapor Flow (cm)=-1.01119E-01
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 5.2229+ | 0.0000+ | 0.0000 | - 0.1628- | 0.0000- | 0.0000 = | 5.0601 vs. | 5.0602 |

Mass Balance = -1.2981E-05 cm; Time step attempts = 426 and successes = 334
Evaporation: Potential = 0.3108 cm, Actual = 0.1628 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 59.1 %;  TMEAN = 278.4 K;  HDRY =  7.2110E+05 cm;  DAYUBC =   128

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04001
 Head (cm)         = 1.30490E+06
 LiqWater Flow (cm)= 5.29287E-02
 IsoVapor Flow (cm)=-4.17709E-02
 Plant Sink (cm)   = 0.00000E+00

                                                LIQUID
  PRESTOR    INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR        STORAGE
   3.4398+ 0.0762+ 0.0000 - 0.0650- 0.0000-  0.0000 =    3.4510 vs.    3.4509

 Mass Balance =  1.4908E-04 cm;  Time step attempts = 1327 and successes = 1037
   Evaporation:  Potential =  1.0975 cm, Actual =  0.0650 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 38.6 %;  TMEAN = 284.8 K;  HDRY =  1.3049E+06 cm;  DAYUBC =   414
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.4982E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.4982E+02     [cm]
 Actual Evaporation                 =  2.2237E+01     [cm]
 Evaporation during Growth          =  2.2237E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.0472E+01     [cm]
 Total Basal Liquid Flux (drainage) =  1.5604E-08     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  2.0472E+01     [cm]
 Actual Rainfall                    =  2.0472E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  3.4509E+00     [cm]
 Mass Balance Error                 =  7.6358E-03     [cm]
 Total Successful Time Steps        =     62452
 Total Attempted Time Steps         =     76771
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     31612
 Total Time Actually Simulated      =  3.6500E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000   -1.7644E+00      0.050    1.2384E+01      0.150    8.6188E+00
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 7.2269E+00 | 0.350 | 6.1970E+00 | 0.450 | 5.3181E+00 |
| 0.550 | 4.4288E+00 | 0.650 | 3.8500E+00 | 0.750 | 3.3432E+00 |
| 0.850 | 2.8506E+00 | 0.950 | 2.4946E+00 | 1.125 | 2.1476E+00 |
| 1.375 | 1.4454E+00 | 1.625 | 9.9718E-01 | 1.875 | 5.7428E-01 |
| 2.250 | 2.8333E-01 | 2.750 | -3.6071E-01 | 3.250 | -7.9595E-01 |
| 3.750 | -1.0104E+00 | 4.250 | -1.0759E+00 | 4.790 | -1.1653E+00 |
| 6.350 | -1.2177E+00 | 8.890 | -1.3351E+00 | 11.430 | -1.3565E+00 |
| 13.970 | -1.3156E+00 | 16.510 | -1.2264E+00 | 19.050 | -1.1344E+00 |
| 21.590 | -1.0398E+00 | 24.130 | -9.4302E-01 | 26.670 | -8.4413E-01 |
| 29.210 | -7.4339E-01 | 31.750 | -6.4097E-01 | 34.290 | -5.3705E-01 |
| 36.830 | -4.3180E-01 | 39.370 | -3.2537E-01 | 41.910 | -2.1791E-01 |
| 44.450 | -1.0958E-01 | 46.990 | -1.9437E-04 | 49.530 | 7.6307E-05 |
| 52.070 | 1.1930E-06 | 54.610 | 2.5983E-07 | 57.150 | 8.7860E-08 |
| 59.690 | 3.1774E-08 | 60.960 | 1.5604E-08 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a001
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 1.305E+06 | 0.0400 | 291.00 | 2 | 1.000E-01 | 1.208E+06 | 0.0400 | 291.00 |
| 3 | 2.000E-01 | 1.117E+06 | 0.0400 | 291.00 | 4 | 3.000E-01 | 1.031E+06 | 0.0400 | 291.00 |
| 5 | 4.000E-01 | 9.513E+05 | 0.0400 | 291.00 | 6 | 5.000E-01 | 8.755E+05 | 0.0400 | 291.00 |
| 7 | 6.000E-01 | 8.037E+05 | 0.0400 | 291.00 | 8 | 7.000E-01 | 7.356E+05 | 0.0400 | 291.00 |
| 9 | 8.000E-01 | 6.706E+05 | 0.0400 | 291.00 | 10 | 9.000E-01 | 6.087E+05 | 0.0400 | 291.00 |
| 11 | 1.000E+00 | 5.495E+05 | 0.0400 | 291.00 | 12 | 1.250E+00 | 4.120E+05 | 0.0400 | 291.00 |
| 13 | 1.500E+00 | 2.879E+05 | 0.0401 | 291.00 | 14 | 1.750E+00 | 1.758E+05 | 0.0401 | 291.00 |
| 15 | 2.000E+00 | 7.746E+04 | 0.0403 | 291.00 | 16 | 2.500E+00 | 4.142E+03 | 0.0479 | 291.00 |
| 17 | 3.000E+00 | 3.728E+03 | 0.0490 | 291.00 | 18 | 3.500E+00 | 3.489E+03 | 0.0497 | 291.00 |
| 19 | 4.000E+00 | 3.328E+03 | 0.0502 | 291.00 | 20 | 4.500E+00 | 3.205E+03 | 0.0507 | 291.00 |
| 21 | 5.080E+00 | 3.084E+03 | 0.0512 | 291.00 | 22 | 7.620E+00 | 2.672E+03 | 0.0532 | 291.00 |
| 23 | 1.016E+01 | 2.431E+03 | 0.0547 | 291.00 | 24 | 1.270E+01 | 2.281E+03 | 0.0558 | 291.00 |
| 25 | 1.524E+01 | 2.180E+03 | 0.0567 | 291.00 | 26 | 1.778E+01 | 2.108E+03 | 0.0573 | 291.00 |
| 27 | 2.032E+01 | 2.054E+03 | 0.0579 | 291.00 | 28 | 2.286E+01 | 2.013E+03 | 0.0583 | 291.00 |
| 29 | 2.540E+01 | 1.981E+03 | 0.0586 | 291.00 | 30 | 2.794E+01 | 1.955E+03 | 0.0589 | 291.00 |
| 31 | 3.048E+01 | 1.935E+03 | 0.0591 | 291.00 | 32 | 3.302E+01 | 1.919E+03 | 0.0593 | 291.00 |
| 33 | 3.556E+01 | 1.906E+03 | 0.0595 | 291.00 | 34 | 3.810E+01 | 1.895E+03 | 0.0596 | 291.00 |
| 35 | 4.064E+01 | 1.887E+03 | 0.0597 | 291.00 | 36 | 4.318E+01 | 1.881E+03 | 0.0598 | 291.00 |
| 37 | 4.572E+01 | 1.877E+03 | 0.0598 | 291.00 | 38 | 4.826E+01 | 1.753E+03 | 0.0570 | 291.00 |
| 39 | 5.080E+01 | 1.598E+03 | 0.0570 | 291.00 | 40 | 5.334E+01 | 1.464E+03 | 0.0570 | 291.00 |
| 41 | 5.588E+01 | 1.363E+03 | 0.0570 | 291.00 | 42 | 5.842E+01 | 1.303E+03 | 0.0570 | 291.00 |
| 43 | 6.096E+01 | 1.283E+03 | 0.0570 | 291.00 | | | | | |

Initial Water Storage = 3.4509 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.04002
Head (cm) = 6.22116E+05
LiqWater Flow (cm)=-3.49108E-11
IsoVapor Flow (cm)=-9.86036E-03
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 3.4509+ | 0.0000+ | 0.0000 | - 0.0099- | 0.0000- | 0.0000 = | 3.4410 vs. | 3.4410 |

Mass Balance = -1.0166E-05 cm; Time step attempts = 68 and successes = 60
Evaporation: Potential = 0.2142 cm, Actual = 0.0099 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 63.5 %;  TMEAN = 279.0 K;  HDRY =  6.2212E+05 cm;  DAYUBC =    57

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04001
 Head (cm)         = 1.38664E+06
 LiqWater Flow (cm)=-4.79412E-13
 IsoVapor Flow (cm)=-4.27663E-03
 Plant Sink (cm)   = 0.00000E+00

                                                LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR        STORAGE
   3.2577+ 0.0000+ 0.0000 - 0.0043- 0.0000-  0.0000 =    3.2534 vs.    3.2534

 Mass Balance =  3.4073E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.3918 cm, Actual =  0.0043 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 36.4 %;  TMEAN = 282.9 K;  HDRY =  1.3866E+06 cm;  DAYUBC =    24
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.7636E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.7636E+02     [cm]
 Actual Evaporation                 =  2.1502E+01     [cm]
 Evaporation during Growth          =  2.1497E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.1311E+01     [cm]
 Total Basal Liquid Flux (drainage) =  1.5736E-08     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  2.1311E+01     [cm]
 Actual Rainfall                    =  2.1311E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  3.2534E+00     [cm]
 Mass Balance Error                 =  6.3071E-03     [cm]
 Total Successful Time Steps        =     49337
 Total Attempted Time Steps         =     59161
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     25500
 Total Time Actually Simulated      =  3.6600E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000   -1.9111E-01      0.050    1.4412E+01      0.150    7.5922E+00
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 5.7612E+00 | 0.350 | 4.5429E+00 | 0.450 | 3.9433E+00 |
| 0.550 | 3.5616E+00 | 0.650 | 3.3360E+00 | 0.750 | 3.0082E+00 |
| 0.850 | 2.8478E+00 | 0.950 | 2.6295E+00 | 1.125 | 2.5031E+00 |
| 1.375 | 2.2025E+00 | 1.625 | 2.0094E+00 | 1.875 | 1.8418E+00 |
| 2.250 | 1.6083E+00 | 2.750 | 1.4293E+00 | 3.250 | 1.2956E+00 |
| 3.750 | 1.1259E+00 | 4.250 | 1.0125E+00 | 4.790 | 8.9229E-01 |
| 6.350 | 7.4941E-01 | 8.890 | 2.6871E-01 | 11.430 | 6.6322E-02 |
| 13.970 | -6.3340E-02 | 16.510 | -8.6235E-02 | 19.050 | -7.7739E-02 |
| 21.590 | -6.9524E-02 | 24.130 | -6.1620E-02 | 26.670 | -5.4017E-02 |
| 29.210 | -4.6691E-02 | 31.750 | -3.9597E-02 | 34.290 | -3.2705E-02 |
| 36.830 | -2.5980E-02 | 39.370 | -1.9388E-02 | 41.910 | -1.2896E-02 |
| 44.450 | -6.4703E-03 | 46.990 | 3.6383E-04 | 49.530 | 2.7198E-05 |
| 52.070 | 1.1699E-06 | 54.610 | 2.6019E-07 | 57.150 | 5.5574E-08 |
| 59.690 | 1.3317E-08 | 60.960 | 1.5736E-08 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a001
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 1.387E+06 | 0.0400 | 291.00 | 2 | 1.000E-01 | 1.364E+06 | 0.0400 | 291.00 |
| 3 | 2.000E-01 | 1.341E+06 | 0.0400 | 291.00 | 4 | 3.000E-01 | 1.318E+06 | 0.0400 | 291.00 |
| 5 | 4.000E-01 | 1.296E+06 | 0.0400 | 291.00 | 6 | 5.000E-01 | 1.274E+06 | 0.0400 | 291.00 |
| 7 | 6.000E-01 | 1.253E+06 | 0.0400 | 291.00 | 8 | 7.000E-01 | 1.232E+06 | 0.0400 | 291.00 |
| 9 | 8.000E-01 | 1.211E+06 | 0.0400 | 291.00 | 10 | 9.000E-01 | 1.191E+06 | 0.0400 | 291.00 |
| 11 | 1.000E+00 | 1.170E+06 | 0.0400 | 291.00 | 12 | 1.250E+00 | 1.121E+06 | 0.0400 | 291.00 |
| 13 | 1.500E+00 | 1.074E+06 | 0.0400 | 291.00 | 14 | 1.750E+00 | 1.028E+06 | 0.0400 | 291.00 |
| 15 | 2.000E+00 | 9.834E+05 | 0.0400 | 291.00 | 16 | 2.500E+00 | 8.986E+05 | 0.0400 | 291.00 |
| 17 | 3.000E+00 | 8.188E+05 | 0.0400 | 291.00 | 18 | 3.500E+00 | 7.434E+05 | 0.0400 | 291.00 |
| 19 | 4.000E+00 | 6.720E+05 | 0.0400 | 291.00 | 20 | 4.500E+00 | 6.041E+05 | 0.0400 | 291.00 |
| 21 | 5.080E+00 | 5.293E+05 | 0.0400 | 291.00 | 22 | 7.620E+00 | 2.423E+05 | 0.0401 | 291.00 |
| 23 | 1.016E+01 | 3.618E+03 | 0.0493 | 291.00 | 24 | 1.270E+01 | 3.002E+03 | 0.0515 | 291.00 |
| 25 | 1.524E+01 | 2.734E+03 | 0.0528 | 291.00 | 26 | 1.778E+01 | 2.571E+03 | 0.0538 | 291.00 |
| 27 | 2.032E+01 | 2.459E+03 | 0.0545 | 291.00 | 28 | 2.286E+01 | 2.376E+03 | 0.0551 | 291.00 |
| 29 | 2.540E+01 | 2.313E+03 | 0.0556 | 291.00 | 30 | 2.794E+01 | 2.263E+03 | 0.0560 | 291.00 |
| 31 | 3.048E+01 | 2.223E+03 | 0.0563 | 291.00 | 32 | 3.302E+01 | 2.190E+03 | 0.0566 | 291.00 |
| 33 | 3.556E+01 | 2.165E+03 | 0.0568 | 291.00 | 34 | 3.810E+01 | 2.145E+03 | 0.0570 | 291.00 |
| 35 | 4.064E+01 | 2.130E+03 | 0.0571 | 291.00 | 36 | 4.318E+01 | 2.119E+03 | 0.0572 | 291.00 |
| 37 | 4.572E+01 | 2.113E+03 | 0.0573 | 291.00 | 38 | 4.826E+01 | 1.946E+03 | 0.0570 | 291.00 |
| 39 | 5.080E+01 | 1.773E+03 | 0.0570 | 291.00 | 40 | 5.334E+01 | 1.620E+03 | 0.0570 | 291.00 |
| 41 | 5.588E+01 | 1.497E+03 | 0.0570 | 291.00 | 42 | 5.842E+01 | 1.415E+03 | 0.0570 | 291.00 |
| 43 | 6.096E+01 | 1.387E+03 | 0.0570 | 291.00 | | | | | |

Initial Water Storage = 3.2534 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.04001
Head (cm) = 1.37506E+06
LiqWater Flow (cm)=-4.88182E-13
IsoVapor Flow (cm)=-4.24874E-03
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 3.2534+ | 0.0000+ | 0.0000 - | 0.0042- | 0.0000- | 0.0000 = | 3.2492 vs. | 3.2492 |

Mass Balance = 2.5056E-07 cm; Time step attempts = 37 and successes = 35
Evaporation: Potential = 0.6194 cm, Actual = 0.0042 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 36.7 %;  TMEAN = 287.6 K;  HDRY =  1.3751E+06 cm;  DAYUBC =    34

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04007
 Head (cm)         = 2.54750E+05
 LiqWater Flow (cm)=-2.95970E-02
 IsoVapor Flow (cm)=-6.63853E-02
 Plant Sink (cm)   = 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR        STORAGE
   4.7455+ 0.0000+ 0.0000 - 0.0972- 0.0000-  0.0000 =    4.6484 vs.    4.6484

 Mass Balance = -2.9548E-05 cm;  Time step attempts =  220 and successes =  174
   Evaporation:  Potential =  0.2581 cm, Actual =  0.0972 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 66.5 %;  TMEAN = 278.7 K;  HDRY =  5.6014E+05 cm;  DAYUBC =    93
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.1289E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.1289E+02     [cm]
 Actual Evaporation                 =  2.3054E+01     [cm]
 Evaporation during Growth          =  2.3054E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.4460E+01     [cm]
 Total Basal Liquid Flux (drainage) =  1.4547E-08     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  2.4460E+01     [cm]
 Actual Rainfall                    =  2.4460E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  4.6484E+00     [cm]
 Mass Balance Error                 =  1.1557E-02     [cm]
 Total Successful Time Steps        =     76543
 Total Attempted Time Steps         =     95277
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     35274
 Total Time Actually Simulated      =  3.6500E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000    1.4065E+00      0.050    1.7671E+01      0.150    1.3282E+01
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 1.1369E+01 | 0.350 | 9.9013E+00 | 0.450 | 8.9097E+00 |
| 0.550 | 7.8834E+00 | 0.650 | 7.1443E+00 | 0.750 | 6.5217E+00 |
| 0.850 | 5.9958E+00 | 0.950 | 5.4562E+00 | 1.125 | 5.1273E+00 |
| 1.375 | 4.0842E+00 | 1.625 | 3.5607E+00 | 1.875 | 3.1495E+00 |
| 2.250 | 2.8162E+00 | 2.750 | 2.2712E+00 | 3.250 | 2.0015E+00 |
| 3.750 | 1.7067E+00 | 4.250 | 1.5834E+00 | 4.790 | 1.5105E+00 |
| 6.350 | 1.4021E+00 | 8.890 | 1.1660E+00 | 11.430 | 1.0767E+00 |
| 13.970 | 1.0072E+00 | 16.510 | 9.3669E-01 | 19.050 | 8.6485E-01 |
| 21.590 | 7.9162E-01 | 24.130 | 7.1702E-01 | 26.670 | 6.4116E-01 |
| 29.210 | 5.6412E-01 | 31.750 | 4.8601E-01 | 34.290 | 4.0695E-01 |
| 36.830 | 3.2702E-01 | 39.370 | 2.4634E-01 | 41.910 | 1.6500E-01 |
| 44.450 | 8.3095E-02 | 46.990 | 8.0128E-04 | 49.530 | 7.6977E-06 |
| 52.070 | 6.8658E-07 | 54.610 | 2.6324E-07 | 57.150 | 1.1976E-07 |
| 59.690 | 4.3497E-08 | 60.960 | 1.4547E-08 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a001
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 2.548E+05 | 0.0401 | 291.00 | 2 | 1.000E-01 | 1.129E+05 | 0.0402 | 291.00 |
| 3 | 2.000E-01 | 1.922E+03 | 0.0593 | 291.00 | 4 | 3.000E-01 | 1.891E+03 | 0.0597 | 291.00 |
| 5 | 4.000E-01 | 1.862E+03 | 0.0600 | 291.00 | 6 | 5.000E-01 | 1.835E+03 | 0.0604 | 291.00 |
| 7 | 6.000E-01 | 1.810E+03 | 0.0607 | 291.00 | 8 | 7.000E-01 | 1.786E+03 | 0.0610 | 291.00 |
| 9 | 8.000E-01 | 1.763E+03 | 0.0613 | 291.00 | 10 | 9.000E-01 | 1.741E+03 | 0.0616 | 291.00 |
| 11 | 1.000E+00 | 1.720E+03 | 0.0619 | 291.00 | 12 | 1.250E+00 | 1.673E+03 | 0.0626 | 291.00 |
| 13 | 1.500E+00 | 1.630E+03 | 0.0633 | 291.00 | 14 | 1.750E+00 | 1.592E+03 | 0.0640 | 291.00 |
| 15 | 2.000E+00 | 1.557E+03 | 0.0646 | 291.00 | 16 | 2.500E+00 | 1.496E+03 | 0.0658 | 291.00 |
| 17 | 3.000E+00 | 1.445E+03 | 0.0668 | 291.00 | 18 | 3.500E+00 | 1.400E+03 | 0.0678 | 291.00 |
| 19 | 4.000E+00 | 1.361E+03 | 0.0687 | 291.00 | 20 | 4.500E+00 | 1.327E+03 | 0.0696 | 291.00 |
| 21 | 5.080E+00 | 1.292E+03 | 0.0705 | 291.00 | 22 | 7.620E+00 | 1.177E+03 | 0.0739 | 291.00 |
| 23 | 1.016E+01 | 1.102E+03 | 0.0765 | 291.00 | 24 | 1.270E+01 | 1.049E+03 | 0.0787 | 291.00 |
| 25 | 1.524E+01 | 1.008E+03 | 0.0805 | 291.00 | 26 | 1.778E+01 | 9.761E+02 | 0.0820 | 291.00 |
| 27 | 2.032E+01 | 9.501E+02 | 0.0833 | 291.00 | 28 | 2.286E+01 | 9.286E+02 | 0.0844 | 291.00 |
| 29 | 2.540E+01 | 9.106E+02 | 0.0854 | 291.00 | 30 | 2.794E+01 | 8.954E+02 | 0.0863 | 291.00 |
| 31 | 3.048E+01 | 8.826E+02 | 0.0870 | 291.00 | 32 | 3.302E+01 | 8.717E+02 | 0.0877 | 291.00 |
| 33 | 3.556E+01 | 8.626E+02 | 0.0883 | 291.00 | 34 | 3.810E+01 | 8.550E+02 | 0.0888 | 291.00 |
| 35 | 4.064E+01 | 8.488E+02 | 0.0892 | 291.00 | 36 | 4.318E+01 | 8.439E+02 | 0.0895 | 291.00 |
| 37 | 4.572E+01 | 8.402E+02 | 0.0897 | 291.00 | 38 | 4.826E+01 | 8.259E+02 | 0.0571 | 291.00 |
| 39 | 5.080E+01 | 1.041E+03 | 0.0571 | 291.00 | 40 | 5.334E+01 | 1.141E+03 | 0.0571 | 291.00 |
| 41 | 5.588E+01 | 1.176E+03 | 0.0570 | 291.00 | 42 | 5.842E+01 | 1.190E+03 | 0.0570 | 291.00 |
| 43 | 6.096E+01 | 1.194E+03 | 0.0570 | 291.00 | | | | | |

Initial Water Storage = 4.6484 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.04004
Head (cm) = 3.64512E+05
LiqWater Flow (cm)=-2.18740E-03
IsoVapor Flow (cm)=-7.80275E-02
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 4.6484+ | 0.0000+ | 0.0000 | - 0.0802- | 0.0000- | 0.0000 = | 4.5682 vs. | 4.5682 |

Mass Balance = -1.9198E-05 cm; Time step attempts = 290 and successes = 225
Evaporation: Potential = 0.2261 cm, Actual = 0.0802 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 66.8 %;  TMEAN = 279.3 K;  HDRY =  5.5228E+05 cm;  DAYUBC =   124

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04002
 Head (cm)         = 9.04100E+05
 LiqWater Flow (cm)=-9.22348E-12
 IsoVapor Flow (cm)=-1.32197E-02
 Plant Sink (cm)   = 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR        STORAGE
   3.7490+ 0.0000+ 0.0000 - 0.0132- 0.0000-  0.0000 =    3.7358 vs.    3.7358

 Mass Balance = -5.2651E-07 cm;  Time step attempts =   78 and successes =   78
   Evaporation:  Potential =  0.2699 cm, Actual =  0.0132 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 51.7 %;  TMEAN = 282.0 K;  HDRY =  9.0410E+05 cm;  DAYUBC =    72
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.2821E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.2821E+02     [cm]
 Actual Evaporation                 =  1.8101E+01     [cm]
 Evaporation during Growth          =  1.8101E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  1.7196E+01     [cm]
 Total Basal Liquid Flux (drainage) =  2.0579E-08     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  1.7196E+01     [cm]
 Actual Rainfall                    =  1.7196E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  3.7358E+00     [cm]
 Mass Balance Error                 =  7.4562E-03     [cm]
 Total Successful Time Steps        =     59301
 Total Attempted Time Steps         =     72641
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     29627
 Total Time Actually Simulated      =  3.6500E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000   -9.0511E-01      0.050    1.1289E+01      0.150    7.9094E+00
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 6.4857E+00 | 0.350 | 5.5013E+00 | 0.450 | 4.8433E+00 |
| 0.550 | 4.2513E+00 | 0.650 | 3.7026E+00 | 0.750 | 3.3190E+00 |
| 0.850 | 2.9486E+00 | 0.950 | 2.7006E+00 | 1.125 | 2.3999E+00 |
| 1.375 | 1.5207E+00 | 1.625 | 1.0840E+00 | 1.875 | 8.0716E-01 |
| 2.250 | 5.8822E-01 | 2.750 | 1.6560E-01 | 3.250 | -8.6462E-02 |
| 3.750 | -2.0151E-01 | 4.250 | -2.5821E-01 | 4.790 | -3.1318E-01 |
| 6.350 | -3.8945E-01 | 8.890 | -5.3368E-01 | 11.430 | -5.9769E-01 |
| 13.970 | -6.1327E-01 | 16.510 | -6.2461E-01 | 19.050 | -5.7865E-01 |
| 21.590 | -5.3018E-01 | 24.130 | -4.8056E-01 | 26.670 | -4.2995E-01 |
| 29.210 | -3.7846E-01 | 31.750 | -3.2619E-01 | 34.290 | -2.7321E-01 |
| 36.830 | -2.1961E-01 | 39.370 | -1.6546E-01 | 41.910 | -1.1082E-01 |
| 44.450 | -5.5765E-02 | 46.990 | 2.7273E-05 | 49.530 | 2.9074E-05 |
| 52.070 | 7.1848E-07 | 54.610 | 1.8399E-07 | 57.150 | 4.3611E-08 |
| 59.690 | 1.5820E-08 | 60.960 | 2.0579E-08 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a001
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 9.041E+05 | 0.0400 | 291.00 | 2 | 1.000E-01 | 8.540E+05 | 0.0400 | 291.00 |
| 3 | 2.000E-01 | 8.057E+05 | 0.0400 | 291.00 | 4 | 3.000E-01 | 7.590E+05 | 0.0400 | 291.00 |
| 5 | 4.000E-01 | 7.138E+05 | 0.0400 | 291.00 | 6 | 5.000E-01 | 6.701E+05 | 0.0400 | 291.00 |
| 7 | 6.000E-01 | 6.278E+05 | 0.0400 | 291.00 | 8 | 7.000E-01 | 5.867E+05 | 0.0400 | 291.00 |
| 9 | 8.000E-01 | 5.468E+05 | 0.0400 | 291.00 | 10 | 9.000E-01 | 5.080E+05 | 0.0400 | 291.00 |
| 11 | 1.000E+00 | 4.703E+05 | 0.0400 | 291.00 | 12 | 1.250E+00 | 3.804E+05 | 0.0400 | 291.00 |
| 13 | 1.500E+00 | 2.960E+05 | 0.0401 | 291.00 | 14 | 1.750E+00 | 2.164E+05 | 0.0401 | 291.00 |
| 15 | 2.000E+00 | 1.413E+05 | 0.0401 | 291.00 | 16 | 2.500E+00 | 3.580E+03 | 0.0494 | 291.00 |
| 17 | 3.000E+00 | 3.097E+03 | 0.0511 | 291.00 | 18 | 3.500E+00 | 2.828E+03 | 0.0523 | 291.00 |
| 19 | 4.000E+00 | 2.646E+03 | 0.0533 | 291.00 | 20 | 4.500E+00 | 2.511E+03 | 0.0542 | 291.00 |
| 21 | 5.080E+00 | 2.390E+03 | 0.0550 | 291.00 | 22 | 7.620E+00 | 2.068E+03 | 0.0577 | 291.00 |
| 23 | 1.016E+01 | 1.894E+03 | 0.0596 | 291.00 | 24 | 1.270E+01 | 1.780E+03 | 0.0611 | 291.00 |
| 25 | 1.524E+01 | 1.697E+03 | 0.0623 | 291.00 | 26 | 1.778E+01 | 1.634E+03 | 0.0633 | 291.00 |
| 27 | 2.032E+01 | 1.584E+03 | 0.0641 | 291.00 | 28 | 2.286E+01 | 1.544E+03 | 0.0648 | 291.00 |
| 29 | 2.540E+01 | 1.512E+03 | 0.0655 | 291.00 | 30 | 2.794E+01 | 1.485E+03 | 0.0660 | 291.00 |
| 31 | 3.048E+01 | 1.462E+03 | 0.0664 | 291.00 | 32 | 3.302E+01 | 1.444E+03 | 0.0668 | 291.00 |
| 33 | 3.556E+01 | 1.429E+03 | 0.0672 | 291.00 | 34 | 3.810E+01 | 1.416E+03 | 0.0674 | 291.00 |
| 35 | 4.064E+01 | 1.407E+03 | 0.0676 | 291.00 | 36 | 4.318E+01 | 1.400E+03 | 0.0678 | 291.00 |
| 37 | 4.572E+01 | 1.395E+03 | 0.0679 | 291.00 | 38 | 4.826E+01 | 1.343E+03 | 0.0570 | 291.00 |
| 39 | 5.080E+01 | 1.222E+03 | 0.0570 | 291.00 | 40 | 5.334E+01 | 1.193E+03 | 0.0570 | 291.00 |
| 41 | 5.588E+01 | 1.205E+03 | 0.0570 | 291.00 | 42 | 5.842E+01 | 1.222E+03 | 0.0570 | 291.00 |
| 43 | 6.096E+01 | 1.229E+03 | 0.0570 | 291.00 | | | | | |

Initial Water Storage = 3.7358 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.04001
Head (cm) = 1.34114E+06
LiqWater Flow (cm)=-2.54251E-12
IsoVapor Flow (cm)=-1.69776E-02
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 3.7358+ | 0.0000+ | 0.0000 | - 0.0170- | 0.0000- | 0.0000 = | 3.7188 vs. | 3.7188 |

Mass Balance = -1.3536E-06 cm; Time step attempts = 24 and successes = 24
Evaporation: Potential = 0.8999 cm, Actual = 0.0170 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 37.6 %;  TMEAN = 284.0 K;  HDRY =  1.3411E+06 cm;  DAYUBC =    24

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04002
 Head (cm)         = 8.41353E+05
 LiqWater Flow (cm)=-1.37913E-10
 IsoVapor Flow (cm)=-6.91710E-02
 Plant Sink (cm)   = 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR        STORAGE
   4.4423+ 0.0000+ 0.0000 - 0.0692- 0.0000-  0.0000 =    4.3731 vs.    4.3731

 Mass Balance = -1.5404E-05 cm;  Time step attempts =  116 and successes =   92
   Evaporation:  Potential =  0.3087 cm, Actual =  0.0692 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 54.1 %;  TMEAN = 285.7 K;  HDRY =  8.4135E+05 cm;  DAYUBC =    63
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.2497E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.2497E+02     [cm]
 Actual Evaporation                 =  2.0083E+01     [cm]
 Evaporation during Growth          =  2.0083E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.0726E+01     [cm]
 Total Basal Liquid Flux (drainage) =  2.4576E-08     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  2.0726E+01     [cm]
 Actual Rainfall                    =  2.0726E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  4.3731E+00     [cm]
 Mass Balance Error                 =  6.4678E-03     [cm]
 Total Successful Time Steps        =     47465
 Total Attempted Time Steps         =     57104
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     23807
 Total Time Actually Simulated      =  3.6500E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000    6.4375E-01      0.050    1.4413E+01      0.150    8.8438E+00
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 7.4530E+00 | 0.350 | 6.1844E+00 | 0.450 | 5.4423E+00 |
| 0.550 | 4.9084E+00 | 0.650 | 4.3255E+00 | 0.750 | 3.9282E+00 |
| 0.850 | 3.5843E+00 | 0.950 | 3.2622E+00 | 1.125 | 3.0589E+00 |
| 1.375 | 2.5244E+00 | 1.625 | 2.2765E+00 | 1.875 | 2.1123E+00 |
| 2.250 | 2.0123E+00 | 2.750 | 1.7525E+00 | 3.250 | 1.6278E+00 |
| 3.750 | 1.4832E+00 | 4.250 | 1.3474E+00 | 4.790 | 1.2274E+00 |
| 6.350 | 1.0813E+00 | 8.890 | 8.7843E-01 | 11.430 | 7.2165E-01 |
| 13.970 | 6.2801E-01 | 16.510 | 5.3674E-01 | 19.050 | 4.4373E-01 |
| 21.590 | 3.7455E-01 | 24.130 | 3.3861E-01 | 26.670 | 3.0253E-01 |
| 29.210 | 2.6599E-01 | 31.750 | 2.2902E-01 | 34.290 | 1.9164E-01 |
| 36.830 | 1.5391E-01 | 39.370 | 1.1585E-01 | 41.910 | 7.7524E-02 |
| 44.450 | 3.8943E-02 | 46.990 | 5.6456E-04 | 49.530 | 2.6534E-05 |
| 52.070 | 1.2535E-06 | 54.610 | 3.2463E-07 | 57.150 | 1.1103E-07 |
| 59.690 | 4.3234E-08 | 60.960 | 2.4576E-08 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a002
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 8.414E+05 | 0.0400 | 291.00 | 2 | 1.000E-01 | 6.291E+05 | 0.0400 | 291.00 |
| 3 | 2.000E-01 | 4.433E+05 | 0.0400 | 291.00 | 4 | 3.000E-01 | 2.803E+05 | 0.0401 | 291.00 |
| 5 | 4.000E-01 | 1.351E+05 | 0.0401 | 291.00 | 6 | 5.000E-01 | 4.352E+03 | 0.0475 | 291.00 |
| 7 | 6.000E-01 | 3.427E+03 | 0.0499 | 291.00 | 8 | 7.000E-01 | 3.039E+03 | 0.0514 | 291.00 |
| 9 | 8.000E-01 | 2.803E+03 | 0.0525 | 291.00 | 10 | 9.000E-01 | 2.638E+03 | 0.0534 | 291.00 |
| 11 | 1.000E+00 | 2.512E+03 | 0.0542 | 291.00 | 12 | 1.250E+00 | 2.291E+03 | 0.0558 | 291.00 |
| 13 | 1.500E+00 | 2.143E+03 | 0.0570 | 291.00 | 14 | 1.750E+00 | 2.033E+03 | 0.0581 | 291.00 |
| 15 | 2.000E+00 | 1.947E+03 | 0.0590 | 291.00 | 16 | 2.500E+00 | 1.817E+03 | 0.0606 | 291.00 |
| 17 | 3.000E+00 | 1.723E+03 | 0.0619 | 291.00 | 18 | 3.500E+00 | 1.649E+03 | 0.0630 | 291.00 |
| 19 | 4.000E+00 | 1.589E+03 | 0.0640 | 291.00 | 20 | 4.500E+00 | 1.539E+03 | 0.0649 | 291.00 |
| 21 | 5.080E+00 | 1.490E+03 | 0.0659 | 291.00 | 22 | 7.620E+00 | 1.342E+03 | 0.0692 | 291.00 |
| 23 | 1.016E+01 | 1.251E+03 | 0.0716 | 291.00 | 24 | 1.270E+01 | 1.187E+03 | 0.0736 | 291.00 |
| 25 | 1.524E+01 | 1.140E+03 | 0.0752 | 291.00 | 26 | 1.778E+01 | 1.103E+03 | 0.0765 | 291.00 |
| 27 | 2.032E+01 | 1.073E+03 | 0.0777 | 291.00 | 28 | 2.286E+01 | 1.049E+03 | 0.0787 | 291.00 |
| 29 | 2.540E+01 | 1.029E+03 | 0.0795 | 291.00 | 30 | 2.794E+01 | 1.012E+03 | 0.0803 | 291.00 |
| 31 | 3.048E+01 | 9.976E+02 | 0.0809 | 291.00 | 32 | 3.302E+01 | 9.858E+02 | 0.0815 | 291.00 |
| 33 | 3.556E+01 | 9.759E+02 | 0.0820 | 291.00 | 34 | 3.810E+01 | 9.678E+02 | 0.0824 | 291.00 |
| 35 | 4.064E+01 | 9.612E+02 | 0.0827 | 291.00 | 36 | 4.318E+01 | 9.560E+02 | 0.0830 | 291.00 |
| 37 | 4.572E+01 | 9.522E+02 | 0.0832 | 291.00 | 38 | 4.826E+01 | 9.418E+02 | 0.0571 | 291.00 |
| 39 | 5.080E+01 | 1.242E+03 | 0.0570 | 291.00 | 40 | 5.334E+01 | 1.302E+03 | 0.0570 | 291.00 |
| 41 | 5.588E+01 | 1.253E+03 | 0.0570 | 291.00 | 42 | 5.842E+01 | 1.202E+03 | 0.0570 | 291.00 |
| 43 | 6.096E+01 | 1.184E+03 | 0.0570 | 291.00 | | | | | |

Initial Water Storage = 4.3731 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.04001
Head (cm) = 1.05598E+06
LiqWater Flow (cm)=-3.14536E-11
IsoVapor Flow (cm)=-5.72935E-02
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 4.3731+ | 0.0000+ | 0.0000 | - 0.0573- | 0.0000- | 0.0000 = | 4.3158 vs. | 4.3158 |

Mass Balance = -2.1122E-05 cm; Time step attempts = 131 and successes = 104
Evaporation: Potential = 0.7502 cm, Actual = 0.0573 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 46.3 %;  TMEAN = 285.9 K;  HDRY =  1.0560E+06 cm;  DAYUBC =   104

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04001
 Head (cm)         = 1.01190E+06
 LiqWater Flow (cm)=-7.61455E-12
 IsoVapor Flow (cm)=-1.66249E-02
 Plant Sink (cm)   = 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR        STORAGE
   3.7207+ 0.0000+ 0.0000 - 0.0166- 0.0000-  0.0000 =    3.7041 vs.    3.7041

 Mass Balance = -1.2812E-05 cm;  Time step attempts =   64 and successes =   51
   Evaporation:  Potential =  0.3449 cm, Actual =  0.0166 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 47.8 %;  TMEAN = 278.7 K;  HDRY =  1.0119E+06 cm;  DAYUBC =    51
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.3421E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.3421E+02     [cm]
 Actual Evaporation                 =  1.9483E+01     [cm]
 Evaporation during Growth          =  1.9466E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  1.8821E+01     [cm]
 Total Basal Liquid Flux (drainage) =  1.7461E-08     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  1.8821E+01     [cm]
 Actual Rainfall                    =  1.8821E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  3.7041E+00     [cm]
 Mass Balance Error                 =  7.8055E-03     [cm]
 Total Successful Time Steps        =     56842
 Total Attempted Time Steps         =     69556
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     29100
 Total Time Actually Simulated      =  3.6600E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000   -6.6119E-01      0.050    1.3416E+01      0.150    8.7685E+00
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 7.5254E+00 | 0.350 | 6.6024E+00 | 0.450 | 5.8102E+00 |
| 0.550 | 5.1651E+00 | 0.650 | 4.6595E+00 | 0.750 | 4.2075E+00 |
| 0.850 | 3.8292E+00 | 0.950 | 3.4877E+00 | 1.125 | 3.1288E+00 |
| 1.375 | 2.2731E+00 | 1.625 | 1.8256E+00 | 1.875 | 1.4043E+00 |
| 2.250 | 1.0600E+00 | 2.750 | 5.3055E-01 | 3.250 | 3.3539E-01 |
| 3.750 | 1.7443E-01 | 4.250 | 6.0549E-02 | 4.790 | -2.5486E-02 |
| 6.350 | -1.3896E-01 | 8.890 | -3.9720E-01 | 11.430 | -4.6560E-01 |
| 13.970 | -5.0226E-01 | 16.510 | -4.6919E-01 | 19.050 | -4.3434E-01 |
| 21.590 | -3.9834E-01 | 24.130 | -3.6136E-01 | 26.670 | -3.2353E-01 |
| 29.210 | -2.8494E-01 | 31.750 | -2.4568E-01 | 34.290 | -2.0583E-01 |
| 36.830 | -1.6547E-01 | 39.370 | -1.2466E-01 | 41.910 | -8.3476E-02 |
| 44.450 | -4.1982E-02 | 46.990 | 1.3454E-04 | 49.530 | 2.9363E-05 |
| 52.070 | 6.0610E-07 | 54.610 | 8.4889E-08 | 57.150 | -1.5209E-08 |
| 59.690 | -5.9672E-09 | 60.960 | 1.7461E-08 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a002
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 1.012E+06 | 0.0400 | 291.00 | 2 | 1.000E-01 | 9.534E+05 | 0.0400 | 291.00 |
| 3 | 2.000E-01 | 8.974E+05 | 0.0400 | 291.00 | 4 | 3.000E-01 | 8.436E+05 | 0.0400 | 291.00 |
| 5 | 4.000E-01 | 7.918E+05 | 0.0400 | 291.00 | 6 | 5.000E-01 | 7.420E+05 | 0.0400 | 291.00 |
| 7 | 6.000E-01 | 6.939E+05 | 0.0400 | 291.00 | 8 | 7.000E-01 | 6.474E+05 | 0.0400 | 291.00 |
| 9 | 8.000E-01 | 6.024E+05 | 0.0400 | 291.00 | 10 | 9.000E-01 | 5.588E+05 | 0.0400 | 291.00 |
| 11 | 1.000E+00 | 5.166E+05 | 0.0400 | 291.00 | 12 | 1.250E+00 | 4.164E+05 | 0.0400 | 291.00 |
| 13 | 1.500E+00 | 3.231E+05 | 0.0401 | 291.00 | 14 | 1.750E+00 | 2.357E+05 | 0.0401 | 291.00 |
| 15 | 2.000E+00 | 1.535E+05 | 0.0401 | 291.00 | 16 | 2.500E+00 | 3.499E+03 | 0.0497 | 291.00 |
| 17 | 3.000E+00 | 3.046E+03 | 0.0513 | 291.00 | 18 | 3.500E+00 | 2.795E+03 | 0.0525 | 291.00 |
| 19 | 4.000E+00 | 2.625E+03 | 0.0535 | 291.00 | 20 | 4.500E+00 | 2.499E+03 | 0.0543 | 291.00 |
| 21 | 5.080E+00 | 2.385E+03 | 0.0550 | 291.00 | 22 | 7.620E+00 | 2.080E+03 | 0.0576 | 291.00 |
| 23 | 1.016E+01 | 1.914E+03 | 0.0594 | 291.00 | 24 | 1.270E+01 | 1.806E+03 | 0.0607 | 291.00 |
| 25 | 1.524E+01 | 1.728E+03 | 0.0618 | 291.00 | 26 | 1.778E+01 | 1.669E+03 | 0.0627 | 291.00 |
| 27 | 2.032E+01 | 1.623E+03 | 0.0634 | 291.00 | 28 | 2.286E+01 | 1.586E+03 | 0.0641 | 291.00 |
| 29 | 2.540E+01 | 1.556E+03 | 0.0646 | 291.00 | 30 | 2.794E+01 | 1.531E+03 | 0.0651 | 291.00 |
| 31 | 3.048E+01 | 1.511E+03 | 0.0655 | 291.00 | 32 | 3.302E+01 | 1.494E+03 | 0.0658 | 291.00 |
| 33 | 3.556E+01 | 1.480E+03 | 0.0661 | 291.00 | 34 | 3.810E+01 | 1.469E+03 | 0.0663 | 291.00 |
| 35 | 4.064E+01 | 1.460E+03 | 0.0665 | 291.00 | 36 | 4.318E+01 | 1.453E+03 | 0.0666 | 291.00 |
| 37 | 4.572E+01 | 1.449E+03 | 0.0667 | 291.00 | 38 | 4.826E+01 | 1.409E+03 | 0.0570 | 291.00 |
| 39 | 5.080E+01 | 1.343E+03 | 0.0570 | 291.00 | 40 | 5.334E+01 | 1.321E+03 | 0.0570 | 291.00 |
| 41 | 5.588E+01 | 1.318E+03 | 0.0570 | 291.00 | 42 | 5.842E+01 | 1.320E+03 | 0.0570 | 291.00 |
| 43 | 6.096E+01 | 1.322E+03 | 0.0570 | 291.00 | | | | | |

Initial Water Storage = 3.7041 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.04002
Head (cm) = 8.53064E+05
LiqWater Flow (cm)=-1.14719E-11
IsoVapor Flow (cm)=-1.26846E-02
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 3.7041+ | 0.0000+ | 0.0000 - | 0.0127- | 0.0000- | 0.0000 = | 3.6914 vs. | 3.6914 |

Mass Balance = 2.0327E-07 cm; Time step attempts = 49 and successes = 47
Evaporation: Potential = 0.1954 cm, Actual = 0.0127 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 53.7 %;  TMEAN = 277.3 K;  HDRY =  8.5306E+05 cm;  DAYUBC =    46

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04048
 Head (cm)         = 4.63129E+04
 LiqWater Flow (cm)= 1.70237E-01
 IsoVapor Flow (cm)=-3.83467E-02
 Plant Sink (cm)   = 0.00000E+00

                                                 LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS     DRAIN      NEWSTOR        STORAGE
   3.4021+ 0.2032+ 0.0000 - 0.0713- 0.0000-  0.0000 =     3.5340 vs.     3.5335

 Mass Balance =  5.2876E-04 cm;  Time step attempts = 1730 and successes = 1315
   Evaporation:  Potential =  0.0969 cm, Actual =  0.0713 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 53.3 %;  TMEAN = 276.2 K;  HDRY =  8.6118E+05 cm;  DAYUBC =   134
1

-------------------------------------------------------------------------------
                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.3125E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.3125E+02     [cm]
 Actual Evaporation                 =  1.1059E+01     [cm]
 Evaporation during Growth          =  1.1059E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  1.0897E+01     [cm]
 Total Basal Liquid Flux (drainage) =  4.6014E-09     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  1.0897E+01     [cm]
 Actual Rainfall                    =  1.0897E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  3.5335E+00     [cm]
 Mass Balance Error                 =  7.7528E-03     [cm]
 Total Successful Time Steps        =     58983
 Total Attempted Time Steps         =     72925
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     29710
 Total Time Actually Simulated      =  3.6500E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000   -1.6287E-01      0.050    8.1996E+00      0.150    6.5373E+00
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 5.8308E+00 | 0.350 | 5.2866E+00 | 0.450 | 4.8401E+00 |
| 0.550 | 4.4164E+00 | 0.650 | 4.1261E+00 | 0.750 | 3.9046E+00 |
| 0.850 | 3.6947E+00 | 0.950 | 3.4257E+00 | 1.125 | 3.2513E+00 |
| 1.375 | 2.9211E+00 | 1.625 | 2.6371E+00 | 1.875 | 2.4267E+00 |
| 2.250 | 2.2206E+00 | 2.750 | 1.7855E+00 | 3.250 | 1.5024E+00 |
| 3.750 | 1.1248E+00 | 4.250 | 8.8579E-01 | 4.790 | 6.5392E-01 |
| 6.350 | 3.6999E-01 | 8.890 | -6.7204E-02 | 11.430 | -2.1513E-01 |
| 13.970 | -2.0436E-01 | 16.510 | -1.9022E-01 | 19.050 | -1.7519E-01 |
| 21.590 | -1.5983E-01 | 24.130 | -1.4430E-01 | 26.670 | -1.2864E-01 |
| 29.210 | -1.1286E-01 | 31.750 | -9.6997E-02 | 34.290 | -8.1046E-02 |
| 36.830 | -6.5014E-02 | 39.370 | -4.8912E-02 | 41.910 | -3.2743E-02 |
| 44.450 | -1.6510E-02 | 46.990 | 7.8891E-05 | 49.530 | 6.5991E-07 |
| 52.070 | 2.0278E-08 | 54.610 | -1.5804E-08 | 57.150 | -1.5600E-08 |
| 59.690 | -3.3928E-09 | 60.960 | 4.6014E-09 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a002
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 4.631E+04 | 0.0405 | 291.00 | 2 | 1.000E-01 | 5.009E+03 | 0.0464 | 291.00 |
| 3 | 2.000E-01 | 4.100E+03 | 0.0480 | 291.00 | 4 | 3.000E-01 | 3.653E+03 | 0.0492 | 291.00 |
| 5 | 4.000E-01 | 3.371E+03 | 0.0501 | 291.00 | 6 | 5.000E-01 | 3.171E+03 | 0.0508 | 291.00 |
| 7 | 6.000E-01 | 3.020E+03 | 0.0514 | 291.00 | 8 | 7.000E-01 | 2.901E+03 | 0.0520 | 291.00 |
| 9 | 8.000E-01 | 2.803E+03 | 0.0525 | 291.00 | 10 | 9.000E-01 | 2.721E+03 | 0.0529 | 291.00 |
| 11 | 1.000E+00 | 2.651E+03 | 0.0533 | 291.00 | 12 | 1.250E+00 | 2.511E+03 | 0.0542 | 291.00 |
| 13 | 1.500E+00 | 2.406E+03 | 0.0549 | 291.00 | 14 | 1.750E+00 | 2.323E+03 | 0.0555 | 291.00 |
| 15 | 2.000E+00 | 2.256E+03 | 0.0560 | 291.00 | 16 | 2.500E+00 | 2.153E+03 | 0.0569 | 291.00 |
| 17 | 3.000E+00 | 2.080E+03 | 0.0576 | 291.00 | 18 | 3.500E+00 | 2.026E+03 | 0.0582 | 291.00 |
| 19 | 4.000E+00 | 1.987E+03 | 0.0586 | 291.00 | 20 | 4.500E+00 | 1.960E+03 | 0.0589 | 291.00 |
| 21 | 5.080E+00 | 1.940E+03 | 0.0591 | 291.00 | 22 | 7.620E+00 | 1.973E+03 | 0.0587 | 291.00 |
| 23 | 1.016E+01 | 2.131E+03 | 0.0571 | 291.00 | 24 | 1.270E+01 | 2.258E+03 | 0.0560 | 291.00 |
| 25 | 1.524E+01 | 2.247E+03 | 0.0561 | 291.00 | 26 | 1.778E+01 | 2.178E+03 | 0.0567 | 291.00 |
| 27 | 2.032E+01 | 2.108E+03 | 0.0573 | 291.00 | 28 | 2.286E+01 | 2.049E+03 | 0.0579 | 291.00 |
| 29 | 2.540E+01 | 2.001E+03 | 0.0584 | 291.00 | 30 | 2.794E+01 | 1.962E+03 | 0.0588 | 291.00 |
| 31 | 3.048E+01 | 1.930E+03 | 0.0592 | 291.00 | 32 | 3.302E+01 | 1.904E+03 | 0.0595 | 291.00 |
| 33 | 3.556E+01 | 1.883E+03 | 0.0598 | 291.00 | 34 | 3.810E+01 | 1.867E+03 | 0.0600 | 291.00 |
| 35 | 4.064E+01 | 1.854E+03 | 0.0601 | 291.00 | 36 | 4.318E+01 | 1.845E+03 | 0.0602 | 291.00 |
| 37 | 4.572E+01 | 1.839E+03 | 0.0603 | 291.00 | 38 | 4.826E+01 | 1.780E+03 | 0.0570 | 291.00 |
| 39 | 5.080E+01 | 1.721E+03 | 0.0570 | 291.00 | 40 | 5.334E+01 | 1.681E+03 | 0.0570 | 291.00 |
| 41 | 5.588E+01 | 1.657E+03 | 0.0570 | 291.00 | 42 | 5.842E+01 | 1.644E+03 | 0.0570 | 291.00 |
| 43 | 6.096E+01 | 1.640E+03 | 0.0570 | 291.00 | | | | | |

Initial Water Storage = 3.5335 cm

NOTE: There are no temperature data when plants are modelled.

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DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.04003
Head (cm) = 4.75592E+05
LiqWater Flow (cm)=-9.74887E-04
IsoVapor Flow (cm)=-3.00513E-02
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 3.5335+ | 0.0000+ | 0.0000 | - 0.0311- | 0.0000- | 0.0000 = | 3.5024 vs. | 3.5025 |

Mass Balance = -6.1783E-05 cm; Time step attempts = 275 and successes = 213
Evaporation: Potential = 0.1040 cm, Actual = 0.0311 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 70.7 %;  TMEAN = 276.2 K;  HDRY =  4.7559E+05 cm;  DAYUBC =   171

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04002
 Head (cm)         = 8.27288E+05
 LiqWater Flow (cm)=-1.60636E-10
 IsoVapor Flow (cm)=-7.79815E-02
 Plant Sink (cm)   = 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR        STORAGE
   4.6622+ 0.0000+ 0.0000 - 0.0780- 0.0000-  0.0000 =    4.5842 vs.    4.5842

 Mass Balance = -1.2708E-06 cm;  Time step attempts =   86 and successes =   86
   Evaporation:  Potential =  0.4056 cm, Actual =  0.0780 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 54.7 %;  TMEAN = 277.9 K;  HDRY =  8.2729E+05 cm;  DAYUBC =    84
1

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.3782E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.3782E+02     [cm]
 Actual Evaporation                 =  1.6442E+01     [cm]
 Evaporation during Growth          =  1.6442E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  1.7501E+01     [cm]
 Total Basal Liquid Flux (drainage) =  5.5553E-09     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  1.7501E+01     [cm]
 Actual Rainfall                    =  1.7501E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  4.5842E+00     [cm]
 Mass Balance Error                 =  7.7713E-03     [cm]
 Total Successful Time Steps        =     57732
 Total Attempted Time Steps         =     70564
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     28498
 Total Time Actually Simulated      =  3.6500E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000    1.0585E+00      0.050    1.2133E+01      0.150    9.4358E+00
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 8.4598E+00 | 0.350 | 7.6484E+00 | 0.450 | 6.8895E+00 |
| 0.550 | 6.2291E+00 | 0.650 | 5.6284E+00 | 0.750 | 5.2190E+00 |
| 0.850 | 4.8753E+00 | 0.950 | 4.6300E+00 | 1.125 | 4.4094E+00 |
| 1.375 | 3.7862E+00 | 1.625 | 3.4728E+00 | 1.875 | 3.1915E+00 |
| 2.250 | 2.8728E+00 | 2.750 | 2.4074E+00 | 3.250 | 2.1054E+00 |
| 3.750 | 1.8616E+00 | 4.250 | 1.7588E+00 | 4.790 | 1.6499E+00 |
| 6.350 | 1.5397E+00 | 8.890 | 1.2238E+00 | 11.430 | 1.0431E+00 |
| 13.970 | 8.9745E-01 | 16.510 | 8.1237E-01 | 19.050 | 7.5096E-01 |
| 21.590 | 6.8796E-01 | 24.130 | 6.2355E-01 | 26.670 | 5.5788E-01 |
| 29.210 | 4.9107E-01 | 31.750 | 4.2323E-01 | 34.290 | 3.5447E-01 |
| 36.830 | 2.8492E-01 | 39.370 | 2.1466E-01 | 41.910 | 1.4379E-01 |
| 44.450 | 7.2416E-02 | 46.990 | 8.3385E-04 | 49.530 | 4.4403E-06 |
| 52.070 | 3.0280E-07 | 54.610 | 9.0059E-08 | 57.150 | 3.5090E-08 |
| 59.690 | 1.2944E-08 | 60.960 | 5.5553E-09 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a002
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 8.273E+05 | 0.0400 | 291.00 | 2 | 1.000E-01 | 5.686E+05 | 0.0400 | 291.00 |
| 3 | 2.000E-01 | 3.511E+05 | 0.0400 | 291.00 | 4 | 3.000E-01 | 1.635E+05 | 0.0401 | 291.00 |
| 5 | 4.000E-01 | 2.348E+03 | 0.0553 | 291.00 | 6 | 5.000E-01 | 2.253E+03 | 0.0561 | 291.00 |
| 7 | 6.000E-01 | 2.175E+03 | 0.0567 | 291.00 | 8 | 7.000E-01 | 2.109E+03 | 0.0573 | 291.00 |
| 9 | 8.000E-01 | 2.052E+03 | 0.0579 | 291.00 | 10 | 9.000E-01 | 2.001E+03 | 0.0584 | 291.00 |
| 11 | 1.000E+00 | 1.957E+03 | 0.0589 | 291.00 | 12 | 1.250E+00 | 1.863E+03 | 0.0600 | 291.00 |
| 13 | 1.500E+00 | 1.789E+03 | 0.0610 | 291.00 | 14 | 1.750E+00 | 1.727E+03 | 0.0618 | 291.00 |
| 15 | 2.000E+00 | 1.675E+03 | 0.0626 | 291.00 | 16 | 2.500E+00 | 1.590E+03 | 0.0640 | 291.00 |
| 17 | 3.000E+00 | 1.523E+03 | 0.0652 | 291.00 | 18 | 3.500E+00 | 1.468E+03 | 0.0663 | 291.00 |
| 19 | 4.000E+00 | 1.422E+03 | 0.0673 | 291.00 | 20 | 4.500E+00 | 1.382E+03 | 0.0682 | 291.00 |
| 21 | 5.080E+00 | 1.343E+03 | 0.0692 | 291.00 | 22 | 7.620E+00 | 1.218E+03 | 0.0726 | 291.00 |
| 23 | 1.016E+01 | 1.138E+03 | 0.0752 | 291.00 | 24 | 1.270E+01 | 1.080E+03 | 0.0774 | 291.00 |
| 25 | 1.524E+01 | 1.037E+03 | 0.0792 | 291.00 | 26 | 1.778E+01 | 1.002E+03 | 0.0807 | 291.00 |
| 27 | 2.032E+01 | 9.742E+02 | 0.0821 | 291.00 | 28 | 2.286E+01 | 9.512E+02 | 0.0832 | 291.00 |
| 29 | 2.540E+01 | 9.320E+02 | 0.0842 | 291.00 | 30 | 2.794E+01 | 9.158E+02 | 0.0851 | 291.00 |
| 31 | 3.048E+01 | 9.022E+02 | 0.0859 | 291.00 | 32 | 3.302E+01 | 8.908E+02 | 0.0866 | 291.00 |
| 33 | 3.556E+01 | 8.812E+02 | 0.0871 | 291.00 | 34 | 3.810E+01 | 8.733E+02 | 0.0876 | 291.00 |
| 35 | 4.064E+01 | 8.669E+02 | 0.0880 | 291.00 | 36 | 4.318E+01 | 8.618E+02 | 0.0883 | 291.00 |
| 37 | 4.572E+01 | 8.580E+02 | 0.0886 | 291.00 | 38 | 4.826E+01 | 8.434E+02 | 0.0571 | 291.00 |
| 39 | 5.080E+01 | 1.081E+03 | 0.0571 | 291.00 | 40 | 5.334E+01 | 1.225E+03 | 0.0570 | 291.00 |
| 41 | 5.588E+01 | 1.298E+03 | 0.0570 | 291.00 | 42 | 5.842E+01 | 1.334E+03 | 0.0570 | 291.00 |
| 43 | 6.096E+01 | 1.345E+03 | 0.0570 | 291.00 | | | | | |

Initial Water Storage = 4.5842 cm

NOTE: There are no temperature data when plants are modelled.

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DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.04001
Head (cm) = 1.33176E+06
LiqWater Flow (cm)=-2.33652E-11
IsoVapor Flow (cm)=-8.35103E-02
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 4.5842+ | 0.0000+ | 0.0000 - | 0.0835- | 0.0000- | 0.0000 = | 4.5007 vs. | 4.5008 |

Mass Balance = -2.7193E-05 cm; Time step attempts = 141 and successes = 106
Evaporation: Potential = 0.6193 cm, Actual = 0.0835 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 37.8 %;  TMEAN = 280.9 K;  HDRY =  1.3318E+06 cm;  DAYUBC =   106

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04001
 Head (cm)         = 2.18999E+06
 LiqWater Flow (cm)=-1.55546E-13
 IsoVapor Flow (cm)=-7.12472E-03
 Plant Sink (cm)   = 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR        STORAGE
   3.4336+ 0.0000+ 0.0000 - 0.0071- 0.0000-  0.0000 =    3.4264 vs.    3.4264

 Mass Balance = -2.1692E-08 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.4800 cm, Actual =  0.0071 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 20.2 %;  TMEAN = 279.3 K;  HDRY =  2.1900E+06 cm;  DAYUBC =    24
1

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.4720E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.4720E+02     [cm]
 Actual Evaporation                 =  1.1844E+01     [cm]
 Evaporation during Growth          =  1.1844E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  1.0693E+01     [cm]
 Total Basal Liquid Flux (drainage) =  1.3522E-08     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  1.0693E+01     [cm]
 Actual Rainfall                    =  1.0693E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  3.4264E+00     [cm]
 Mass Balance Error                 =  6.8648E-03     [cm]
 Total Successful Time Steps        =     57357
 Total Attempted Time Steps         =     70564
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     30717
 Total Time Actually Simulated      =  3.6500E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000   -1.1509E+00      0.050    8.2115E+00      0.150    6.7159E+00
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 5.8608E+00 | 0.350 | 5.3466E+00 | 0.450 | 4.8203E+00 |
| 0.550 | 4.4942E+00 | 0.650 | 4.0326E+00 | 0.750 | 3.6105E+00 |
| 0.850 | 3.3556E+00 | 0.950 | 3.0993E+00 | 1.125 | 2.8790E+00 |
| 1.375 | 2.2372E+00 | 1.625 | 1.8251E+00 | 1.875 | 1.4136E+00 |
| 2.250 | 1.0600E+00 | 2.750 | 5.4349E-01 | 3.250 | 2.3943E-01 |
| 3.750 | -1.1374E-02 | 4.250 | -1.8817E-01 | 4.790 | -3.1369E-01 |
| 6.350 | -4.7820E-01 | 8.890 | -7.7284E-01 | 11.430 | -8.5450E-01 |
| 13.970 | -8.4292E-01 | 16.510 | -7.8569E-01 | 19.050 | -7.2659E-01 |
| 21.590 | -6.6586E-01 | 24.130 | -6.0369E-01 | 26.670 | -5.4021E-01 |
| 29.210 | -4.7558E-01 | 31.750 | -4.0993E-01 | 34.290 | -3.4337E-01 |
| 36.830 | -2.7601E-01 | 39.370 | -2.0795E-01 | 41.910 | -1.3930E-01 |
| 44.450 | -7.0137E-02 | 46.990 | -2.4780E-04 | 49.530 | 3.5322E-06 |
| 52.070 | 2.4062E-07 | 54.610 | 6.5874E-08 | 57.150 | 1.5855E-08 |
| 59.690 | 9.1464E-09 | 60.960 | 1.3522E-08 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a002
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 2.190E+06 | 0.0400 | 291.00 | 2 | 1.000E-01 | 2.122E+06 | 0.0400 | 291.00 |
| 3 | 2.000E-01 | 2.057E+06 | 0.0400 | 291.00 | 4 | 3.000E-01 | 1.995E+06 | 0.0400 | 291.00 |
| 5 | 4.000E-01 | 1.935E+06 | 0.0400 | 291.00 | 6 | 5.000E-01 | 1.878E+06 | 0.0400 | 291.00 |
| 7 | 6.000E-01 | 1.823E+06 | 0.0400 | 291.00 | 8 | 7.000E-01 | 1.771E+06 | 0.0400 | 291.00 |
| 9 | 8.000E-01 | 1.720E+06 | 0.0400 | 291.00 | 10 | 9.000E-01 | 1.671E+06 | 0.0400 | 291.00 |
| 11 | 1.000E+00 | 1.624E+06 | 0.0400 | 291.00 | 12 | 1.250E+00 | 1.512E+06 | 0.0400 | 291.00 |
| 13 | 1.500E+00 | 1.409E+06 | 0.0400 | 291.00 | 14 | 1.750E+00 | 1.313E+06 | 0.0400 | 291.00 |
| 15 | 2.000E+00 | 1.223E+06 | 0.0400 | 291.00 | 16 | 2.500E+00 | 1.059E+06 | 0.0400 | 291.00 |
| 17 | 3.000E+00 | 9.133E+05 | 0.0400 | 291.00 | 18 | 3.500E+00 | 7.814E+05 | 0.0400 | 291.00 |
| 19 | 4.000E+00 | 6.612E+05 | 0.0400 | 291.00 | 20 | 4.500E+00 | 5.506E+05 | 0.0400 | 291.00 |
| 21 | 5.080E+00 | 4.326E+05 | 0.0400 | 291.00 | 22 | 7.620E+00 | 3.020E+03 | 0.0514 | 291.00 |
| 23 | 1.016E+01 | 2.557E+03 | 0.0539 | 291.00 | 24 | 1.270E+01 | 2.338E+03 | 0.0554 | 291.00 |
| 25 | 1.524E+01 | 2.201E+03 | 0.0565 | 291.00 | 26 | 1.778E+01 | 2.104E+03 | 0.0574 | 291.00 |
| 27 | 2.032E+01 | 2.032E+03 | 0.0581 | 291.00 | 28 | 2.286E+01 | 1.975E+03 | 0.0587 | 291.00 |
| 29 | 2.540E+01 | 1.929E+03 | 0.0592 | 291.00 | 30 | 2.794E+01 | 1.892E+03 | 0.0596 | 291.00 |
| 31 | 3.048E+01 | 1.862E+03 | 0.0600 | 291.00 | 32 | 3.302E+01 | 1.837E+03 | 0.0603 | 291.00 |
| 33 | 3.556E+01 | 1.817E+03 | 0.0606 | 291.00 | 34 | 3.810E+01 | 1.801E+03 | 0.0608 | 291.00 |
| 35 | 4.064E+01 | 1.789E+03 | 0.0610 | 291.00 | 36 | 4.318E+01 | 1.780E+03 | 0.0611 | 291.00 |
| 37 | 4.572E+01 | 1.774E+03 | 0.0612 | 291.00 | 38 | 4.826E+01 | 1.722E+03 | 0.0570 | 291.00 |
| 39 | 5.080E+01 | 1.671E+03 | 0.0570 | 291.00 | 40 | 5.334E+01 | 1.644E+03 | 0.0570 | 291.00 |
| 41 | 5.588E+01 | 1.631E+03 | 0.0570 | 291.00 | 42 | 5.842E+01 | 1.627E+03 | 0.0570 | 291.00 |
| 43 | 6.096E+01 | 1.627E+03 | 0.0570 | 291.00 | | | | | |

Initial Water Storage = 3.4264 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.04002
Head (cm) = 8.55088E+05
LiqWater Flow (cm)=-3.32310E-12
IsoVapor Flow (cm)=-4.08360E-03
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 3.4264+ | 0.0000+ | 0.0000 - | 0.0041- | 0.0000- | 0.0000 = | 3.4224 vs. | 3.4224 |

Mass Balance = -5.3594E-06 cm; Time step attempts = 58 and successes = 53
Evaporation: Potential = 0.3761 cm, Actual = 0.0041 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 53.6 %;  TMEAN = 283.7 K;  HDRY =  8.5509E+05 cm;  DAYUBC =    50

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04003
 Head (cm)         = 5.70174E+05
 LiqWater Flow (cm)=-8.83474E-11
 IsoVapor Flow (cm)=-1.57185E-02
 Plant Sink (cm)   = 0.00000E+00

                                                LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR        STORAGE
   3.8554+ 0.0000+ 0.0000 - 0.0157- 0.0000-  0.0000 =    3.8397 vs.    3.8397

 Mass Balance = -2.7406E-07 cm;  Time step attempts =   78 and successes =   78
   Evaporation:  Potential =  0.0997 cm, Actual =  0.0157 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 66.0 %;  TMEAN = 283.2 K;  HDRY =  5.7017E+05 cm;  DAYUBC =    77
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.0941E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.0941E+02     [cm]
 Actual Evaporation                 =  3.0286E+01     [cm]
 Evaporation during Growth          =  3.0271E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  3.0709E+01     [cm]
 Total Basal Liquid Flux (drainage) =  4.9237E-08     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  3.0709E+01     [cm]
 Actual Rainfall                    =  3.0709E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  3.8397E+00     [cm]
 Mass Balance Error                 =  8.9565E-03     [cm]
 Total Successful Time Steps        =     62207
 Total Attempted Time Steps         =     76390
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     28871
 Total Time Actually Simulated      =  3.6600E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000    4.2220E-01      0.050    1.9115E+01      0.150    1.2064E+01
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 9.9347E+00 | 0.350 | 8.2262E+00 | 0.450 | 7.1800E+00 |
| 0.550 | 6.4562E+00 | 0.650 | 5.9406E+00 | 0.750 | 5.3747E+00 |
| 0.850 | 4.8526E+00 | 0.950 | 4.5079E+00 | 1.125 | 4.1920E+00 |
| 1.375 | 3.1810E+00 | 1.625 | 2.5318E+00 | 1.875 | 2.1350E+00 |
| 2.250 | 1.8009E+00 | 2.750 | 1.3444E+00 | 3.250 | 1.0407E+00 |
| 3.750 | 8.3171E-01 | 4.250 | 7.1524E-01 | 4.790 | 6.0849E-01 |
| 6.350 | 5.0212E-01 | 8.890 | 3.2122E-01 | 11.430 | 3.0097E-01 |
| 13.970 | 2.8118E-01 | 16.510 | 2.6129E-01 | 19.050 | 2.4111E-01 |
| 21.590 | 2.2059E-01 | 24.130 | 1.9972E-01 | 26.670 | 1.7854E-01 |
| 29.210 | 1.5706E-01 | 31.750 | 1.3531E-01 | 34.290 | 1.1333E-01 |
| 36.830 | 9.1150E-02 | 39.370 | 6.8788E-02 | 41.910 | 4.6269E-02 |
| 44.450 | 2.3613E-02 | 46.990 | 9.5288E-04 | 49.530 | 6.2518E-04 |
| 52.070 | 1.9909E-05 | 54.610 | 2.8043E-06 | 57.150 | 9.2328E-07 |
| 59.690 | 2.7287E-07 | 60.960 | 4.9237E-08 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a002
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 5.702E+05 | 0.0400 | 291.00 | 2 | 1.000E-01 | 5.234E+05 | 0.0400 | 291.00 |
| 3 | 2.000E-01 | 4.782E+05 | 0.0400 | 291.00 | 4 | 3.000E-01 | 4.345E+05 | 0.0400 | 291.00 |
| 5 | 4.000E-01 | 3.921E+05 | 0.0400 | 291.00 | 6 | 5.000E-01 | 3.510E+05 | 0.0400 | 291.00 |
| 7 | 6.000E-01 | 3.110E+05 | 0.0401 | 291.00 | 8 | 7.000E-01 | 2.722E+05 | 0.0401 | 291.00 |
| 9 | 8.000E-01 | 2.345E+05 | 0.0401 | 291.00 | 10 | 9.000E-01 | 1.978E+05 | 0.0401 | 291.00 |
| 11 | 1.000E+00 | 1.620E+05 | 0.0401 | 291.00 | 12 | 1.250E+00 | 7.645E+04 | 0.0403 | 291.00 |
| 13 | 1.500E+00 | 3.414E+03 | 0.0499 | 291.00 | 14 | 1.750E+00 | 3.145E+03 | 0.0509 | 291.00 |
| 15 | 2.000E+00 | 2.957E+03 | 0.0517 | 291.00 | 16 | 2.500E+00 | 2.698E+03 | 0.0530 | 291.00 |
| 17 | 3.000E+00 | 2.523E+03 | 0.0541 | 291.00 | 18 | 3.500E+00 | 2.393E+03 | 0.0550 | 291.00 |
| 19 | 4.000E+00 | 2.291E+03 | 0.0558 | 291.00 | 20 | 4.500E+00 | 2.208E+03 | 0.0564 | 291.00 |
| 21 | 5.080E+00 | 2.127E+03 | 0.0572 | 291.00 | 22 | 7.620E+00 | 1.890E+03 | 0.0597 | 291.00 |
| 23 | 1.016E+01 | 1.748E+03 | 0.0615 | 291.00 | 24 | 1.270E+01 | 1.651E+03 | 0.0630 | 291.00 |
| 25 | 1.524E+01 | 1.579E+03 | 0.0642 | 291.00 | 26 | 1.778E+01 | 1.523E+03 | 0.0652 | 291.00 |
| 27 | 2.032E+01 | 1.479E+03 | 0.0661 | 291.00 | 28 | 2.286E+01 | 1.443E+03 | 0.0668 | 291.00 |
| 29 | 2.540E+01 | 1.413E+03 | 0.0675 | 291.00 | 30 | 2.794E+01 | 1.389E+03 | 0.0681 | 291.00 |
| 31 | 3.048E+01 | 1.368E+03 | 0.0685 | 291.00 | 32 | 3.302E+01 | 1.351E+03 | 0.0689 | 291.00 |
| 33 | 3.556E+01 | 1.337E+03 | 0.0693 | 291.00 | 34 | 3.810E+01 | 1.326E+03 | 0.0696 | 291.00 |
| 35 | 4.064E+01 | 1.317E+03 | 0.0698 | 291.00 | 36 | 4.318E+01 | 1.311E+03 | 0.0700 | 291.00 |
| 37 | 4.572E+01 | 1.306E+03 | 0.0701 | 291.00 | 38 | 4.826E+01 | 1.244E+03 | 0.0570 | 291.00 |
| 39 | 5.080E+01 | 9.777E+02 | 0.0571 | 291.00 | 40 | 5.334E+01 | 9.594E+02 | 0.0571 | 291.00 |
| 41 | 5.588E+01 | 9.948E+02 | 0.0571 | 291.00 | 42 | 5.842E+01 | 1.020E+03 | 0.0571 | 291.00 |
| 43 | 6.096E+01 | 1.028E+03 | 0.0571 | 291.00 | | | | | |

Initial Water Storage = 3.8397 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.04002
Head (cm) = 6.23434E+05
LiqWater Flow (cm)=-6.39543E-11
IsoVapor Flow (cm)=-1.67725E-02
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 3.8397+ | 0.0000+ | 0.0000 | - 0.0168- | 0.0000- | 0.0000 = | 3.8229 vs. | 3.8229 |

Mass Balance = -1.8843E-07 cm; Time step attempts = 24 and successes = 24
Evaporation: Potential = 0.2498 cm, Actual = 0.0168 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 63.5 %;  TMEAN = 283.7 K;  HDRY =  6.2343E+05 cm;  DAYUBC =    24

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04001
 Head (cm)         = 1.91374E+06
 LiqWater Flow (cm)=-2.33499E-13
 IsoVapor Flow (cm)=-6.72248E-03
 Plant Sink (cm)   = 0.00000E+00

                                                LIQUID
  PRESTOR    INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR        STORAGE
   3.3642+ 0.0000+ 0.0000 - 0.0067- 0.0000-  0.0000 =    3.3574 vs.    3.3574

 Mass Balance =  6.0946E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.8288 cm, Actual =  0.0067 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 24.8 %;  TMEAN = 286.8 K;  HDRY =  1.9137E+06 cm;  DAYUBC =    24
1

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.1290E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.1290E+02     [cm]
 Actual Evaporation                 =  3.3165E+01     [cm]
 Evaporation during Growth          =  3.3165E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  3.2690E+01     [cm]
 Total Basal Liquid Flux (drainage) =  6.9716E-07     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  3.2690E+01     [cm]
 Actual Rainfall                    =  3.2690E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  3.3574E+00     [cm]
 Mass Balance Error                 =  7.1443E-03     [cm]
 Total Successful Time Steps        =     54984
 Total Attempted Time Steps         =     66914
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     26601
 Total Time Actually Simulated      =  3.6500E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000   -4.7510E-01      0.050    1.4413E+01      0.150    9.4145E+00
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 7.6893E+00 | 0.350 | 6.4673E+00 | 0.450 | 5.3056E+00 |
| 0.550 | 4.8268E+00 | 0.650 | 4.3819E+00 | 0.750 | 3.9571E+00 |
| 0.850 | 3.5290E+00 | 0.950 | 3.2622E+00 | 1.125 | 3.0048E+00 |
| 1.375 | 2.3854E+00 | 1.625 | 2.0099E+00 | 1.875 | 1.7316E+00 |
| 2.250 | 1.4777E+00 | 2.750 | 9.4640E-01 | 3.250 | 6.5656E-01 |
| 3.750 | 4.1906E-01 | 4.250 | 2.3426E-01 | 4.790 | 4.9069E-02 |
| 6.350 | -1.3331E-01 | 8.890 | -3.7256E-01 | 11.430 | -3.4787E-01 |
| 13.970 | -3.2392E-01 | 16.510 | -3.0010E-01 | 19.050 | -2.7615E-01 |
| 21.590 | -2.5196E-01 | 24.130 | -2.2748E-01 | 26.670 | -2.0272E-01 |
| 29.210 | -1.7768E-01 | 31.750 | -1.5238E-01 | 34.290 | -1.2684E-01 |
| 36.830 | -1.0108E-01 | 39.370 | -7.5140E-02 | 41.910 | -4.9037E-02 |
| 44.450 | -2.2803E-02 | 46.990 | 4.1328E-03 | 49.530 | 5.6661E-03 |
| 52.070 | 2.9465E-03 | 54.610 | 1.4052E-03 | 57.150 | 2.9425E-04 |
| 59.690 | 2.7595E-05 | 60.960 | 6.9716E-07 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a002
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 1.914E+06 | 0.0400 | 291.00 | 2 | 1.000E-01 | 1.860E+06 | 0.0400 | 291.00 |
| 3 | 2.000E-01 | 1.810E+06 | 0.0400 | 291.00 | 4 | 3.000E-01 | 1.761E+06 | 0.0400 | 291.00 |
| 5 | 4.000E-01 | 1.714E+06 | 0.0400 | 291.00 | 6 | 5.000E-01 | 1.667E+06 | 0.0400 | 291.00 |
| 7 | 6.000E-01 | 1.623E+06 | 0.0400 | 291.00 | 8 | 7.000E-01 | 1.580E+06 | 0.0400 | 291.00 |
| 9 | 8.000E-01 | 1.538E+06 | 0.0400 | 291.00 | 10 | 9.000E-01 | 1.497E+06 | 0.0400 | 291.00 |
| 11 | 1.000E+00 | 1.458E+06 | 0.0400 | 291.00 | 12 | 1.250E+00 | 1.364E+06 | 0.0400 | 291.00 |
| 13 | 1.500E+00 | 1.276E+06 | 0.0400 | 291.00 | 14 | 1.750E+00 | 1.193E+06 | 0.0400 | 291.00 |
| 15 | 2.000E+00 | 1.115E+06 | 0.0400 | 291.00 | 16 | 2.500E+00 | 9.717E+05 | 0.0400 | 291.00 |
| 17 | 3.000E+00 | 8.416E+05 | 0.0400 | 291.00 | 18 | 3.500E+00 | 7.229E+05 | 0.0400 | 291.00 |
| 19 | 4.000E+00 | 6.137E+05 | 0.0400 | 291.00 | 20 | 4.500E+00 | 5.125E+05 | 0.0400 | 291.00 |
| 21 | 5.080E+00 | 4.039E+05 | 0.0400 | 291.00 | 22 | 7.620E+00 | 4.722E+03 | 0.0468 | 291.00 |
| 23 | 1.016E+01 | 3.013E+03 | 0.0515 | 291.00 | 24 | 1.270E+01 | 2.636E+03 | 0.0534 | 291.00 |
| 25 | 1.524E+01 | 2.432E+03 | 0.0547 | 291.00 | 26 | 1.778E+01 | 2.297E+03 | 0.0557 | 291.00 |
| 27 | 2.032E+01 | 2.201E+03 | 0.0565 | 291.00 | 28 | 2.286E+01 | 2.128E+03 | 0.0572 | 291.00 |
| 29 | 2.540E+01 | 2.071E+03 | 0.0577 | 291.00 | 30 | 2.794E+01 | 2.026E+03 | 0.0582 | 291.00 |
| 31 | 3.048E+01 | 1.989E+03 | 0.0585 | 291.00 | 32 | 3.302E+01 | 1.960E+03 | 0.0589 | 291.00 |
| 33 | 3.556E+01 | 1.936E+03 | 0.0591 | 291.00 | 34 | 3.810E+01 | 1.918E+03 | 0.0593 | 291.00 |
| 35 | 4.064E+01 | 1.904E+03 | 0.0595 | 291.00 | 36 | 4.318E+01 | 1.894E+03 | 0.0596 | 291.00 |
| 37 | 4.572E+01 | 1.887E+03 | 0.0597 | 291.00 | 38 | 4.826E+01 | 1.450E+03 | 0.0570 | 291.00 |
| 39 | 5.080E+01 | 5.999E+02 | 0.0574 | 291.00 | 40 | 5.334E+01 | 5.353E+02 | 0.0575 | 291.00 |
| 41 | 5.588E+01 | 5.568E+02 | 0.0575 | 291.00 | 42 | 5.842E+01 | 6.506E+02 | 0.0573 | 291.00 |
| 43 | 6.096E+01 | 7.092E+02 | 0.0572 | 291.00 | | | | | |

Initial Water Storage = 3.3574 cm

NOTE: There are no temperature data when plants are modelled.

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DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.04002
Head (cm) = 6.08436E+05
LiqWater Flow (cm)=-1.12908E-11
IsoVapor Flow (cm)=-3.08514E-03
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 3.3574+ | 0.0000+ | 0.0000 | - 0.0031- | 0.0000- | 0.0000 = | 3.3544 vs. | 3.3544 |

Mass Balance = -5.9410E-06 cm; Time step attempts = 44 and successes = 42
Evaporation: Potential = 0.2675 cm, Actual = 0.0031 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 64.2 %;  TMEAN = 276.5 K;  HDRY =  6.0844E+05 cm;  DAYUBC =    35

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04001
 Head (cm)         = 9.63046E+05
 LiqWater Flow (cm)=-4.43358E-12
 IsoVapor Flow (cm)=-8.67284E-03
 Plant Sink (cm)   = 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS    DRAIN      NEWSTOR        STORAGE
   3.6090+ 0.0000+ 0.0000 - 0.0087- 0.0000-  0.0000 =     3.6003 vs.     3.6003

 Mass Balance = -1.0561E-06 cm;  Time step attempts =   78 and successes =   78
   Evaporation:  Potential =  0.4426 cm, Actual =  0.0087 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 49.5 %;  TMEAN = 280.7 K;  HDRY =  9.6305E+05 cm;  DAYUBC =    65
1

-------------------------------------------------------------------------------
                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.2687E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.2687E+02     [cm]
 Actual Evaporation                 =  1.8316E+01     [cm]
 Evaporation during Growth          =  1.8316E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  1.8567E+01     [cm]
 Total Basal Liquid Flux (drainage) =  1.5067E-05     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  1.8567E+01     [cm]
 Actual Rainfall                    =  1.8567E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  3.6003E+00     [cm]
 Mass Balance Error                 =  8.6895E-03     [cm]
 Total Successful Time Steps        =     61513
 Total Attempted Time Steps         =     75683
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     30441
 Total Time Actually Simulated      =  3.6500E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000    2.5160E-01      0.050    1.3132E+01      0.150    1.0526E+01
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 8.9771E+00 | 0.350 | 7.8605E+00 | 0.450 | 6.7561E+00 |
| 0.550 | 5.9702E+00 | 0.650 | 5.3161E+00 | 0.750 | 4.6367E+00 |
| 0.850 | 4.1767E+00 | 0.950 | 3.7724E+00 | 1.125 | 3.4253E+00 |
| 1.375 | 2.6522E+00 | 1.625 | 2.2627E+00 | 1.875 | 2.0196E+00 |
| 2.250 | 1.8597E+00 | 2.750 | 1.5075E+00 | 3.250 | 1.2514E+00 |
| 3.750 | 1.0313E+00 | 4.250 | 9.1445E-01 | 4.790 | 8.2510E-01 |
| 6.350 | 7.0555E-01 | 8.890 | 4.1280E-01 | 11.430 | 2.6539E-01 |
| 13.970 | 1.6802E-01 | 16.510 | 1.5463E-01 | 19.050 | 1.4180E-01 |
| 21.590 | 1.2905E-01 | 24.130 | 1.1626E-01 | 26.670 | 1.0340E-01 |
| 29.210 | 9.0438E-02 | 31.750 | 7.7367E-02 | 34.290 | 6.4198E-02 |
| 36.830 | 5.0937E-02 | 39.370 | 3.7594E-02 | 41.910 | 2.4178E-02 |
| 44.450 | 1.0697E-02 | 46.990 | -1.3292E-03 | 49.530 | -8.8190E-06 |
| 52.070 | -2.3021E-04 | 54.610 | -1.1420E-04 | 57.150 | 4.5488E-05 |
| 59.690 | 2.3403E-05 | 60.960 | 1.5067E-05 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a002
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 9.630E+05 | 0.0400 | 291.00 | 2 | 1.000E-01 | 9.283E+05 | 0.0400 | 291.00 |
| 3 | 2.000E-01 | 8.948E+05 | 0.0400 | 291.00 | 4 | 3.000E-01 | 8.619E+05 | 0.0400 | 291.00 |
| 5 | 4.000E-01 | 8.297E+05 | 0.0400 | 291.00 | 6 | 5.000E-01 | 7.983E+05 | 0.0400 | 291.00 |
| 7 | 6.000E-01 | 7.676E+05 | 0.0400 | 291.00 | 8 | 7.000E-01 | 7.376E+05 | 0.0400 | 291.00 |
| 9 | 8.000E-01 | 7.082E+05 | 0.0400 | 291.00 | 10 | 9.000E-01 | 6.794E+05 | 0.0400 | 291.00 |
| 11 | 1.000E+00 | 6.513E+05 | 0.0400 | 291.00 | 12 | 1.250E+00 | 5.833E+05 | 0.0400 | 291.00 |
| 13 | 1.500E+00 | 5.185E+05 | 0.0400 | 291.00 | 14 | 1.750E+00 | 4.566E+05 | 0.0400 | 291.00 |
| 15 | 2.000E+00 | 3.974E+05 | 0.0400 | 291.00 | 16 | 2.500E+00 | 2.861E+05 | 0.0401 | 291.00 |
| 17 | 3.000E+00 | 1.832E+05 | 0.0401 | 291.00 | 18 | 3.500E+00 | 8.750E+04 | 0.0402 | 291.00 |
| 19 | 4.000E+00 | 3.498E+03 | 0.0497 | 291.00 | 20 | 4.500E+00 | 3.173E+03 | 0.0508 | 291.00 |
| 21 | 5.080E+00 | 2.929E+03 | 0.0519 | 291.00 | 22 | 7.620E+00 | 2.391E+03 | 0.0550 | 291.00 |
| 23 | 1.016E+01 | 2.146E+03 | 0.0570 | 291.00 | 24 | 1.270E+01 | 1.996E+03 | 0.0585 | 291.00 |
| 25 | 1.524E+01 | 1.892E+03 | 0.0597 | 291.00 | 26 | 1.778E+01 | 1.814E+03 | 0.0606 | 291.00 |
| 27 | 2.032E+01 | 1.754E+03 | 0.0614 | 291.00 | 28 | 2.286E+01 | 1.706E+03 | 0.0621 | 291.00 |
| 29 | 2.540E+01 | 1.668E+03 | 0.0627 | 291.00 | 30 | 2.794E+01 | 1.636E+03 | 0.0632 | 291.00 |
| 31 | 3.048E+01 | 1.610E+03 | 0.0637 | 291.00 | 32 | 3.302E+01 | 1.589E+03 | 0.0640 | 291.00 |
| 33 | 3.556E+01 | 1.572E+03 | 0.0643 | 291.00 | 34 | 3.810E+01 | 1.558E+03 | 0.0646 | 291.00 |
| 35 | 4.064E+01 | 1.547E+03 | 0.0648 | 291.00 | 36 | 4.318E+01 | 1.539E+03 | 0.0649 | 291.00 |
| 37 | 4.572E+01 | 1.534E+03 | 0.0650 | 291.00 | 38 | 4.826E+01 | 1.408E+03 | 0.0570 | 291.00 |
| 39 | 5.080E+01 | 1.082E+03 | 0.0571 | 291.00 | 40 | 5.334E+01 | 8.949E+02 | 0.0571 | 291.00 |
| 41 | 5.588E+01 | 8.061E+02 | 0.0572 | 291.00 | 42 | 5.842E+01 | 7.507E+02 | 0.0572 | 291.00 |
| 43 | 6.096E+01 | 7.296E+02 | 0.0572 | 291.00 | | | | | |

Initial Water Storage = 3.6003 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.04002
Head (cm) = 8.32262E+05
LiqWater Flow (cm)=-7.50723E-12
IsoVapor Flow (cm)=-7.85028E-03
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 3.6003+ | 0.0000+ | 0.0000 - | 0.0078- | 0.0000- | 0.0000 = | 3.5925 vs. | 3.5925 |

Mass Balance = 4.2084E-07 cm; Time step attempts = 43 and successes = 41
Evaporation: Potential = 0.3762 cm, Actual = 0.0078 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 54.5 %;  TMEAN = 278.7 K;  HDRY =  8.3226E+05 cm;  DAYUBC =    40

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04001
 Head (cm)         = 1.66220E+06
 LiqWater Flow (cm)=-1.61351E-12
 IsoVapor Flow (cm)=-2.36862E-02
 Plant Sink (cm)   = 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR        STORAGE
   3.8953+ 0.0000+ 0.0000 - 0.0237- 0.0000-  0.0000 =    3.8716 vs.    3.8716

 Mass Balance = -1.4557E-05 cm;  Time step attempts =   66 and successes =   52
   Evaporation:  Potential =  0.7017 cm, Actual =  0.0237 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 29.7 %;  TMEAN = 283.4 K;  HDRY =  1.6622E+06 cm;  DAYUBC =    52
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.3323E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.3323E+02     [cm]
 Actual Evaporation                 =  2.5424E+01     [cm]
 Evaporation during Growth          =  2.5424E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.5705E+01     [cm]
 Total Basal Liquid Flux (drainage) =  1.5550E-06     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  2.5705E+01     [cm]
 Actual Rainfall                    =  2.5705E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  3.8716E+00     [cm]
 Mass Balance Error                 =  9.4309E-03     [cm]
 Total Successful Time Steps        =     67130
 Total Attempted Time Steps         =     82843
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     31258
 Total Time Actually Simulated      =  3.6500E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000    2.8072E-01      0.050    1.7748E+01      0.150    1.2322E+01
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 1.0488E+01 | 0.350 | 8.8513E+00 | 0.450 | 7.7041E+00 |
| 0.550 | 6.8240E+00 | 0.650 | 6.2345E+00 | 0.750 | 5.5785E+00 |
| 0.850 | 5.0442E+00 | 0.950 | 4.5844E+00 | 1.125 | 4.1742E+00 |
| 1.375 | 3.2374E+00 | 1.625 | 2.7382E+00 | 1.875 | 2.2885E+00 |
| 2.250 | 1.8297E+00 | 2.750 | 1.3630E+00 | 3.250 | 1.0750E+00 |
| 3.750 | 8.9596E-01 | 4.250 | 7.4788E-01 | 4.790 | 6.3175E-01 |
| 6.350 | 4.8811E-01 | 8.890 | 2.6127E-01 | 11.430 | 2.1474E-01 |
| 13.970 | 2.0080E-01 | 16.510 | 1.8668E-01 | 19.050 | 1.7230E-01 |
| 21.590 | 1.5765E-01 | 24.130 | 1.4273E-01 | 26.670 | 1.2754E-01 |
| 29.210 | 1.1212E-01 | 31.750 | 9.6466E-02 | 34.290 | 8.0623E-02 |
| 36.830 | 6.4615E-02 | 39.370 | 4.8455E-02 | 41.910 | 3.2167E-02 |
| 44.450 | 1.5768E-02 | 46.990 | -2.7758E-04 | 49.530 | 1.8474E-05 |
| 52.070 | -4.1988E-06 | 54.610 | -1.2464E-05 | 57.150 | -1.9427E-05 |
| 59.690 | -1.0151E-05 | 60.960 | 1.5550E-06 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a002
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 1.662E+06 | 0.0400 | 291.00 | 2 | 1.000E-01 | 1.539E+06 | 0.0400 | 291.00 |
| 3 | 2.000E-01 | 1.426E+06 | 0.0400 | 291.00 | 4 | 3.000E-01 | 1.321E+06 | 0.0400 | 291.00 |
| 5 | 4.000E-01 | 1.224E+06 | 0.0400 | 291.00 | 6 | 5.000E-01 | 1.134E+06 | 0.0400 | 291.00 |
| 7 | 6.000E-01 | 1.049E+06 | 0.0400 | 291.00 | 8 | 7.000E-01 | 9.684E+05 | 0.0400 | 291.00 |
| 9 | 8.000E-01 | 8.928E+05 | 0.0400 | 291.00 | 10 | 9.000E-01 | 8.211E+05 | 0.0400 | 291.00 |
| 11 | 1.000E+00 | 7.530E+05 | 0.0400 | 291.00 | 12 | 1.250E+00 | 5.961E+05 | 0.0400 | 291.00 |
| 13 | 1.500E+00 | 4.554E+05 | 0.0400 | 291.00 | 14 | 1.750E+00 | 3.277E+05 | 0.0400 | 291.00 |
| 15 | 2.000E+00 | 2.110E+05 | 0.0401 | 291.00 | 16 | 2.500E+00 | 2.966E+03 | 0.0517 | 291.00 |
| 17 | 3.000E+00 | 2.680E+03 | 0.0531 | 291.00 | 18 | 3.500E+00 | 2.496E+03 | 0.0543 | 291.00 |
| 19 | 4.000E+00 | 2.358E+03 | 0.0552 | 291.00 | 20 | 4.500E+00 | 2.248E+03 | 0.0561 | 291.00 |
| 21 | 5.080E+00 | 2.146E+03 | 0.0570 | 291.00 | 22 | 7.620E+00 | 1.863E+03 | 0.0600 | 291.00 |
| 23 | 1.016E+01 | 1.708E+03 | 0.0621 | 291.00 | 24 | 1.270E+01 | 1.606E+03 | 0.0637 | 291.00 |
| 25 | 1.524E+01 | 1.532E+03 | 0.0651 | 291.00 | 26 | 1.778E+01 | 1.475E+03 | 0.0662 | 291.00 |
| 27 | 2.032E+01 | 1.430E+03 | 0.0671 | 291.00 | 28 | 2.286E+01 | 1.393E+03 | 0.0679 | 291.00 |
| 29 | 2.540E+01 | 1.363E+03 | 0.0687 | 291.00 | 30 | 2.794E+01 | 1.339E+03 | 0.0693 | 291.00 |
| 31 | 3.048E+01 | 1.318E+03 | 0.0698 | 291.00 | 32 | 3.302E+01 | 1.301E+03 | 0.0702 | 291.00 |
| 33 | 3.556E+01 | 1.287E+03 | 0.0706 | 291.00 | 34 | 3.810E+01 | 1.276E+03 | 0.0709 | 291.00 |
| 35 | 4.064E+01 | 1.267E+03 | 0.0712 | 291.00 | 36 | 4.318E+01 | 1.260E+03 | 0.0714 | 291.00 |
| 37 | 4.572E+01 | 1.256E+03 | 0.0715 | 291.00 | 38 | 4.826E+01 | 1.215E+03 | 0.0570 | 291.00 |
| 39 | 5.080E+01 | 1.080E+03 | 0.0571 | 291.00 | 40 | 5.334E+01 | 1.062E+03 | 0.0571 | 291.00 |
| 41 | 5.588E+01 | 1.052E+03 | 0.0571 | 291.00 | 42 | 5.842E+01 | 1.036E+03 | 0.0571 | 291.00 |
| 43 | 6.096E+01 | 1.027E+03 | 0.0571 | 291.00 | | | | | |

Initial Water Storage = 3.8716 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.04001
Head (cm) = 1.91826E+06
LiqWater Flow (cm)=-7.82039E-13
IsoVapor Flow (cm)=-2.05937E-02
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 3.8716+ | 0.0000+ | 0.0000 | - 0.0206- | 0.0000- | 0.0000 = | 3.8510 vs. | 3.8510 |

Mass Balance = -4.1322E-08 cm; Time step attempts = 27 and successes = 27
Evaporation: Potential = 0.5400 cm, Actual = 0.0206 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 24.7 %;  TMEAN = 276.2 K;  HDRY =  1.9183E+06 cm;  DAYUBC =    27

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04001
 Head (cm)         = 1.35560E+06
 LiqWater Flow (cm)=-1.06311E-12
 IsoVapor Flow (cm)=-8.43452E-03
 Plant Sink (cm)   = 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR        STORAGE
   3.4455+ 0.0000+ 0.0000 - 0.0084- 0.0000-  0.0000 =    3.4371 vs.    3.4371

 Mass Balance = -8.2863E-07 cm;  Time step attempts =   78 and successes =   78
   Evaporation:  Potential =  0.3349 cm, Actual =  0.0084 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 37.2 %;  TMEAN = 279.8 K;  HDRY =  1.3556E+06 cm;  DAYUBC =    72
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.6323E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.6323E+02     [cm]
 Actual Evaporation                 =  2.5472E+01     [cm]
 Evaporation during Growth          =  2.5464E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.5044E+01     [cm]
 Total Basal Liquid Flux (drainage) =  5.3196E-08     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  2.5044E+01     [cm]
 Actual Rainfall                    =  2.5044E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  3.4371E+00     [cm]
 Mass Balance Error                 =  6.5793E-03     [cm]
 Total Successful Time Steps        =     51986
 Total Attempted Time Steps         =     62858
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     25746
 Total Time Actually Simulated      =  3.6600E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000   -4.2796E-01      0.050    1.5592E+01      0.150    6.7994E+00
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 5.1137E+00 | 0.350 | 3.9583E+00 | 0.450 | 3.2962E+00 |
| 0.550 | 2.9405E+00 | 0.650 | 2.7200E+00 | 0.750 | 2.5763E+00 |
| 0.850 | 2.3926E+00 | 0.950 | 2.2889E+00 | 1.125 | 2.1885E+00 |
| 1.375 | 1.9134E+00 | 1.625 | 1.7256E+00 | 1.875 | 1.5120E+00 |
| 2.250 | 1.3770E+00 | 2.750 | 1.0722E+00 | 3.250 | 8.8860E-01 |
| 3.750 | 7.2191E-01 | 4.250 | 4.8380E-01 | 4.790 | 3.5023E-01 |
| 6.350 | 2.4944E-01 | 8.890 | 3.0296E-02 | 11.430 | -4.2223E-02 |
| 13.970 | -9.8583E-02 | 16.510 | -1.4216E-01 | 19.050 | -1.9139E-01 |
| 21.590 | -2.1384E-01 | 24.130 | -2.2708E-01 | 26.670 | -2.0400E-01 |
| 29.210 | -1.7986E-01 | 31.750 | -1.5522E-01 | 34.290 | -1.3014E-01 |
| 36.830 | -1.0471E-01 | 39.370 | -7.8962E-02 | 41.910 | -5.2972E-02 |
| 44.450 | -2.6792E-02 | 46.990 | 2.4755E-04 | 49.530 | 1.2553E-04 |
| 52.070 | 2.4671E-06 | 54.610 | 1.0896E-07 | 57.150 | -2.5936E-07 |
| 59.690 | -1.1814E-07 | 60.960 | 5.3196E-08 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a002
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 1.356E+06 | 0.0400 | 291.00 | 2 | 1.000E-01 | 1.311E+06 | 0.0400 | 291.00 |
| 3 | 2.000E-01 | 1.268E+06 | 0.0400 | 291.00 | 4 | 3.000E-01 | 1.226E+06 | 0.0400 | 291.00 |
| 5 | 4.000E-01 | 1.186E+06 | 0.0400 | 291.00 | 6 | 5.000E-01 | 1.146E+06 | 0.0400 | 291.00 |
| 7 | 6.000E-01 | 1.108E+06 | 0.0400 | 291.00 | 8 | 7.000E-01 | 1.071E+06 | 0.0400 | 291.00 |
| 9 | 8.000E-01 | 1.035E+06 | 0.0400 | 291.00 | 10 | 9.000E-01 | 9.993E+05 | 0.0400 | 291.00 |
| 11 | 1.000E+00 | 9.649E+05 | 0.0400 | 291.00 | 12 | 1.250E+00 | 8.825E+05 | 0.0400 | 291.00 |
| 13 | 1.500E+00 | 8.047E+05 | 0.0400 | 291.00 | 14 | 1.750E+00 | 7.311E+05 | 0.0400 | 291.00 |
| 15 | 2.000E+00 | 6.612E+05 | 0.0400 | 291.00 | 16 | 2.500E+00 | 5.314E+05 | 0.0400 | 291.00 |
| 17 | 3.000E+00 | 4.127E+05 | 0.0400 | 291.00 | 18 | 3.500E+00 | 3.036E+05 | 0.0401 | 291.00 |
| 19 | 4.000E+00 | 2.024E+05 | 0.0401 | 291.00 | 20 | 4.500E+00 | 1.083E+05 | 0.0402 | 291.00 |
| 21 | 5.080E+00 | 6.887E+03 | 0.0444 | 291.00 | 22 | 7.620E+00 | 2.870E+03 | 0.0521 | 291.00 |
| 23 | 1.016E+01 | 2.515E+03 | 0.0541 | 291.00 | 24 | 1.270E+01 | 2.317E+03 | 0.0555 | 291.00 |
| 25 | 1.524E+01 | 2.187E+03 | 0.0566 | 291.00 | 26 | 1.778E+01 | 2.094E+03 | 0.0575 | 291.00 |
| 27 | 2.032E+01 | 2.023E+03 | 0.0582 | 291.00 | 28 | 2.286E+01 | 1.968E+03 | 0.0588 | 291.00 |
| 29 | 2.540E+01 | 1.924E+03 | 0.0593 | 291.00 | 30 | 2.794E+01 | 1.889E+03 | 0.0597 | 291.00 |
| 31 | 3.048E+01 | 1.861E+03 | 0.0600 | 291.00 | 32 | 3.302E+01 | 1.837E+03 | 0.0603 | 291.00 |
| 33 | 3.556E+01 | 1.819E+03 | 0.0606 | 291.00 | 34 | 3.810E+01 | 1.804E+03 | 0.0608 | 291.00 |
| 35 | 4.064E+01 | 1.792E+03 | 0.0609 | 291.00 | 36 | 4.318E+01 | 1.784E+03 | 0.0610 | 291.00 |
| 37 | 4.572E+01 | 1.779E+03 | 0.0611 | 291.00 | 38 | 4.826E+01 | 1.683E+03 | 0.0570 | 291.00 |
| 39 | 5.080E+01 | 1.557E+03 | 0.0570 | 291.00 | 40 | 5.334E+01 | 1.448E+03 | 0.0570 | 291.00 |
| 41 | 5.588E+01 | 1.357E+03 | 0.0570 | 291.00 | 42 | 5.842E+01 | 1.292E+03 | 0.0570 | 291.00 |
| 43 | 6.096E+01 | 1.268E+03 | 0.0570 | 291.00 | | | | | |

Initial Water Storage = 3.4371 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.04001
Head (cm) = 1.57845E+06
LiqWater Flow (cm)=-6.54208E-13
IsoVapor Flow (cm)=-9.13240E-03
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 3.4371+ | 0.0000+ | 0.0000 | - 0.0091- | 0.0000- | 0.0000 = | 3.4280 vs. | 3.4280 |

Mass Balance = -6.3288E-06 cm; Time step attempts = 32 and successes = 28
Evaporation: Potential = 0.4165 cm, Actual = 0.0091 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 31.6 %;  TMEAN = 281.8 K;  HDRY =  1.5785E+06 cm;  DAYUBC =    28

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04001
 Head (cm)         = 1.04789E+06
 LiqWater Flow (cm)=-5.41136E-10
 IsoVapor Flow (cm)=-1.16928E-01
 Plant Sink (cm)   = 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR        STORAGE
   4.4676+ 0.0000+ 0.0000 - 0.1169- 0.0000-  0.0000 =    4.3507 vs.    4.3507

 Mass Balance = -3.4028E-05 cm;  Time step attempts =  219 and successes =  174
   Evaporation:  Potential =  0.5581 cm, Actual =  0.1169 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 46.6 %;  TMEAN = 279.0 K;  HDRY =  1.0479E+06 cm;  DAYUBC =   140
1

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.4997E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.4997E+02     [cm]
 Actual Evaporation                 =  2.1126E+01     [cm]
 Evaporation during Growth          =  2.1126E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.2047E+01     [cm]
 Total Basal Liquid Flux (drainage) =  1.1741E-08     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  2.2047E+01     [cm]
 Actual Rainfall                    =  2.2047E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  4.3507E+00     [cm]
 Mass Balance Error                 =  7.7433E-03     [cm]
 Total Successful Time Steps        =     57493
 Total Attempted Time Steps         =     70356
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     28697
 Total Time Actually Simulated      =  3.6500E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000    9.2138E-01      0.050    1.4535E+01      0.150    9.7620E+00
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 8.2314E+00 | 0.350 | 7.3048E+00 | 0.450 | 6.5588E+00 |
| 0.550 | 5.8088E+00 | 0.650 | 5.2546E+00 | 0.750 | 4.8032E+00 |
| 0.850 | 4.4246E+00 | 0.950 | 4.0491E+00 | 1.125 | 3.7548E+00 |
| 1.375 | 3.1656E+00 | 1.625 | 2.6462E+00 | 1.875 | 2.4265E+00 |
| 2.250 | 2.2524E+00 | 2.750 | 2.0048E+00 | 3.250 | 1.8161E+00 |
| 3.750 | 1.7214E+00 | 4.250 | 1.6084E+00 | 4.790 | 1.5450E+00 |
| 6.350 | 1.4087E+00 | 8.890 | 1.1186E+00 | 11.430 | 9.8002E-01 |
| 13.970 | 8.4905E-01 | 16.510 | 7.2026E-01 | 19.050 | 6.1679E-01 |
| 21.590 | 5.2226E-01 | 24.130 | 4.2925E-01 | 26.670 | 3.7672E-01 |
| 29.210 | 3.2718E-01 | 31.750 | 2.7849E-01 | 34.290 | 2.3063E-01 |
| 36.830 | 1.8356E-01 | 39.370 | 1.3718E-01 | 41.910 | 9.1325E-02 |
| 44.450 | 4.5801E-02 | 46.990 | 6.1623E-04 | 49.530 | 3.2825E-05 |
| 52.070 | 7.8395E-07 | 54.610 | 1.9989E-07 | 57.150 | 5.9415E-08 |
| 59.690 | 1.8082E-08 | 60.960 | 1.1741E-08 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a.in
Results File: C:\Users\NYbarra\Desktop\UNSAT-H - McCombs-Clint - Two Layer\a003
Date of Run: 17 Jul 2012
Time of Run: 14:56:46.85
Title:
McCombs Landfill-ET Cap design-Two Layer-No Plants

| Initial Conditions | | | | | Initial Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) | NODE | DEPTH (cm) | HEAD (cm) | THETA (vol.) | TEMP (K) |
| 1 | 0.000E+00 | 1.048E+06 | 0.0400 | 291.00 | 2 | 1.000E-01 | 7.040E+05 | 0.0400 | 291.00 |
| 3 | 2.000E-01 | 4.294E+05 | 0.0400 | 291.00 | 4 | 3.000E-01 | 2.009E+05 | 0.0401 | 291.00 |
| 5 | 4.000E-01 | 4.300E+03 | 0.0476 | 291.00 | 6 | 5.000E-01 | 3.208E+03 | 0.0507 | 291.00 |
| 7 | 6.000E-01 | 2.817E+03 | 0.0524 | 291.00 | 8 | 7.000E-01 | 2.589E+03 | 0.0537 | 291.00 |
| 9 | 8.000E-01 | 2.432E+03 | 0.0547 | 291.00 | 10 | 9.000E-01 | 2.314E+03 | 0.0556 | 291.00 |
| 11 | 1.000E+00 | 2.220E+03 | 0.0563 | 291.00 | 12 | 1.250E+00 | 2.048E+03 | 0.0579 | 291.00 |
| 13 | 1.500E+00 | 1.928E+03 | 0.0592 | 291.00 | 14 | 1.750E+00 | 1.838E+03 | 0.0603 | 291.00 |
| 15 | 2.000E+00 | 1.766E+03 | 0.0613 | 291.00 | 16 | 2.500E+00 | 1.656E+03 | 0.0629 | 291.00 |
| 17 | 3.000E+00 | 1.575E+03 | 0.0643 | 291.00 | 18 | 3.500E+00 | 1.512E+03 | 0.0654 | 291.00 |
| 19 | 4.000E+00 | 1.461E+03 | 0.0665 | 291.00 | 20 | 4.500E+00 | 1.418E+03 | 0.0674 | 291.00 |
| 21 | 5.080E+00 | 1.376E+03 | 0.0683 | 291.00 | 22 | 7.620E+00 | 1.252E+03 | 0.0716 | 291.00 |
| 23 | 1.016E+01 | 1.179E+03 | 0.0738 | 291.00 | 24 | 1.270E+01 | 1.131E+03 | 0.0755 | 291.00 |
| 25 | 1.524E+01 | 1.098E+03 | 0.0767 | 291.00 | 26 | 1.778E+01 | 1.075E+03 | 0.0776 | 291.00 |
| 27 | 2.032E+01 | 1.059E+03 | 0.0782 | 291.00 | 28 | 2.286E+01 | 1.049E+03 | 0.0787 | 291.00 |
| 29 | 2.540E+01 | 1.042E+03 | 0.0790 | 291.00 | 30 | 2.794E+01 | 1.039E+03 | 0.0791 | 291.00 |
| 31 | 3.048E+01 | 1.038E+03 | 0.0791 | 291.00 | 32 | 3.302E+01 | 1.038E+03 | 0.0791 | 291.00 |
| 33 | 3.556E+01 | 1.040E+03 | 0.0791 | 291.00 | 34 | 3.810E+01 | 1.041E+03 | 0.0790 | 291.00 |
| 35 | 4.064E+01 | 1.043E+03 | 0.0789 | 291.00 | 36 | 4.318E+01 | 1.043E+03 | 0.0789 | 291.00 |
| 37 | 4.572E+01 | 1.042E+03 | 0.0790 | 291.00 | 38 | 4.826E+01 | 1.082E+03 | 0.0571 | 291.00 |
| 39 | 5.080E+01 | 1.116E+03 | 0.0571 | 291.00 | 40 | 5.334E+01 | 1.160E+03 | 0.0571 | 291.00 |
| 41 | 5.588E+01 | 1.208E+03 | 0.0570 | 291.00 | 42 | 5.842E+01 | 1.236E+03 | 0.0570 | 291.00 |
| 43 | 6.096E+01 | 1.245E+03 | 0.0570 | 291.00 | | | | | |

Initial Water Storage = 4.3507 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.05152
Head (cm) = 3.00249E+03
LiqWater Flow (cm)=-1.31301E-02
IsoVapor Flow (cm)=-4.42109E-02
Plant Sink (cm) = 0.00000E+00

| PRESTOR | INFIL | RUNOFF | EVAPO | TRANS | LIQUID DRAIN | NEWSTOR | STORAGE |
|---|---|---|---|---|---|---|---|
| 4.3507+ | 0.0000+ | 0.0000 - | 0.0568- | 0.0000- | 0.0000 = | 4.2940 vs. | 4.2939 |

Mass Balance = 1.7502E-05 cm; Time step attempts = 559 and successes = 448
Evaporation: Potential = 0.1163 cm, Actual = 0.0568 cm

```
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 54.4 %;  TMEAN = 276.8 K;  HDRY =  8.3514E+05 cm;  DAYUBC =   145

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1
 Depth (cm)        =     0.00000
 Water (cm3/cm3)   =     0.04002
 Head (cm)         = 9.13733E+05
 LiqWater Flow (cm)=-3.28765E-11
 IsoVapor Flow (cm)=-3.78171E-02
 Plant Sink (cm)   = 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR        STORAGE
   3.4604+ 0.0000+ 0.0000 - 0.0378- 0.0000-  0.0000 =    3.4226 vs.    3.4227

 Mass Balance = -4.5387E-05 cm;  Time step attempts =  279 and successes =  235
   Evaporation:  Potential =  0.4827 cm, Actual =  0.0378 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 51.3 %;  TMEAN = 273.7 K;  HDRY =  9.1373E+05 cm;  DAYUBC =   232
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.3722E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.3722E+02     [cm]
 Actual Evaporation                 =  1.7863E+01     [cm]
 Evaporation during Growth          =  1.7863E+01     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  1.6942E+01     [cm]
 Total Basal Liquid Flux (drainage) =  2.5645E-08     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  1.6942E+01     [cm]
 Actual Rainfall                    =  1.6942E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  3.4227E+00     [cm]
 Mass Balance Error                 =  7.0214E-03     [cm]
 Total Successful Time Steps        =     62086
 Total Attempted Time Steps         =     76010
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     32082
 Total Time Actually Simulated      =  3.6500E+02     [days]


 Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

    DEPTH          FLOW        DEPTH          FLOW        DEPTH          FLOW
   --------   -----------   --------   -----------   --------   -----------
      0.000   -9.2102E-01      0.050    1.2255E+01      0.150    8.9132E+00
```

| | | | | | |
|---|---|---|---|---|---|
| 0.250 | 7.4706E+00 | 0.350 | 6.3235E+00 | 0.450 | 5.4472E+00 |
| 0.550 | 4.7462E+00 | 0.650 | 4.1586E+00 | 0.750 | 3.6441E+00 |
| 0.850 | 3.1575E+00 | 0.950 | 2.8718E+00 | 1.125 | 2.6601E+00 |
| 1.375 | 1.9087E+00 | 1.625 | 1.5559E+00 | 1.875 | 1.2237E+00 |
| 2.250 | 8.6700E-01 | 2.750 | 3.9881E-01 | 3.250 | 1.8716E-01 |
| 3.750 | -4.1907E-03 | 4.250 | -1.4544E-01 | 4.790 | -2.2173E-01 |
| 6.350 | -3.2317E-01 | 8.890 | -5.9750E-01 | 11.430 | -6.6424E-01 |
| 13.970 | -6.9643E-01 | 16.510 | -6.7692E-01 | 19.050 | -6.1954E-01 |
| 21.590 | -5.6079E-01 | 24.130 | -5.0194E-01 | 26.670 | -4.4352E-01 |
| 29.210 | -3.8576E-01 | 31.750 | -3.2876E-01 | 34.290 | -2.7257E-01 |
| 36.830 | -2.1715E-01 | 39.370 | -1.6241E-01 | 41.910 | -1.0818E-01 |
| 44.450 | -5.4263E-02 | 46.990 | 8.9257E-05 | 49.530 | 9.8616E-06 |
| 52.070 | 5.2784E-07 | 54.610 | 1.3119E-07 | 57.150 | 2.8007E-08 |
| 59.690 | 1.5180E-08 | 60.960 | 2.5645E-08 | | |

Total plant water uptake (cm) at different depths:

| DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE | DEPTH | WATER UPTAKE |
|---|---|---|---|---|---|
| 0.000 | 0.0000E+00 | 0.100 | 0.0000E+00 | 0.200 | 0.0000E+00 |
| 0.300 | 0.0000E+00 | 0.400 | 0.0000E+00 | 0.500 | 0.0000E+00 |
| 0.600 | 0.0000E+00 | 0.700 | 0.0000E+00 | 0.800 | 0.0000E+00 |
| 0.900 | 0.0000E+00 | 1.000 | 0.0000E+00 | 1.250 | 0.0000E+00 |
| 1.500 | 0.0000E+00 | 1.750 | 0.0000E+00 | 2.000 | 0.0000E+00 |
| 2.500 | 0.0000E+00 | 3.000 | 0.0000E+00 | 3.500 | 0.0000E+00 |
| 4.000 | 0.0000E+00 | 4.500 | 0.0000E+00 | 5.080 | 0.0000E+00 |
| 7.620 | 0.0000E+00 | 10.160 | 0.0000E+00 | 12.700 | 0.0000E+00 |
| 15.240 | 0.0000E+00 | 17.780 | 0.0000E+00 | 20.320 | 0.0000E+00 |
| 22.860 | 0.0000E+00 | 25.400 | 0.0000E+00 | 27.940 | 0.0000E+00 |
| 30.480 | 0.0000E+00 | 33.020 | 0.0000E+00 | 35.560 | 0.0000E+00 |
| 38.100 | 0.0000E+00 | 40.640 | 0.0000E+00 | 43.180 | 0.0000E+00 |
| 45.720 | 0.0000E+00 | 48.260 | 0.0000E+00 | 50.800 | 0.0000E+00 |
| 53.340 | 0.0000E+00 | 55.880 | 0.0000E+00 | 58.420 | 0.0000E+00 |
| 60.960 | 0.0000E+00 | | | | |

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# Appendix 3N – Attachment 2
# Soil Sampling Results

SAIC®

# Summary of Sample Preparation

| | Proctor Data | | Target Remold Densities | Actual Remold Values | | |
|---|---|---|---|---|---|---|
| Sample Number | Optimum Moisture Content (% g/g) | Maximum Dry Bulk Density ($g/cm^3$) | Dry Bulk Density ($g/cm^3$) | Moisture Content (% g/g) | Dry Bulk Density ($g/cm^3$) | % of Max. Dry Bulk Density (%) |
| El Paso 75% | | | 1.37 | 6.1 | 1.41 | 77.2% |
| El Paso 80% | | | 1.46 | 6.1 | 1.50 | 82.2% |
| El Paso 85% | 10.9 | 1.83 | 1.56 | 6.2 | 1.60 | 87.3% |
| El Paso 90% | | | 1.65 | 6.2 | 1.69 | 92.4% |
| El Paso 95% | | | 1.74 | 6.1 | 1.79 | 97.6% |

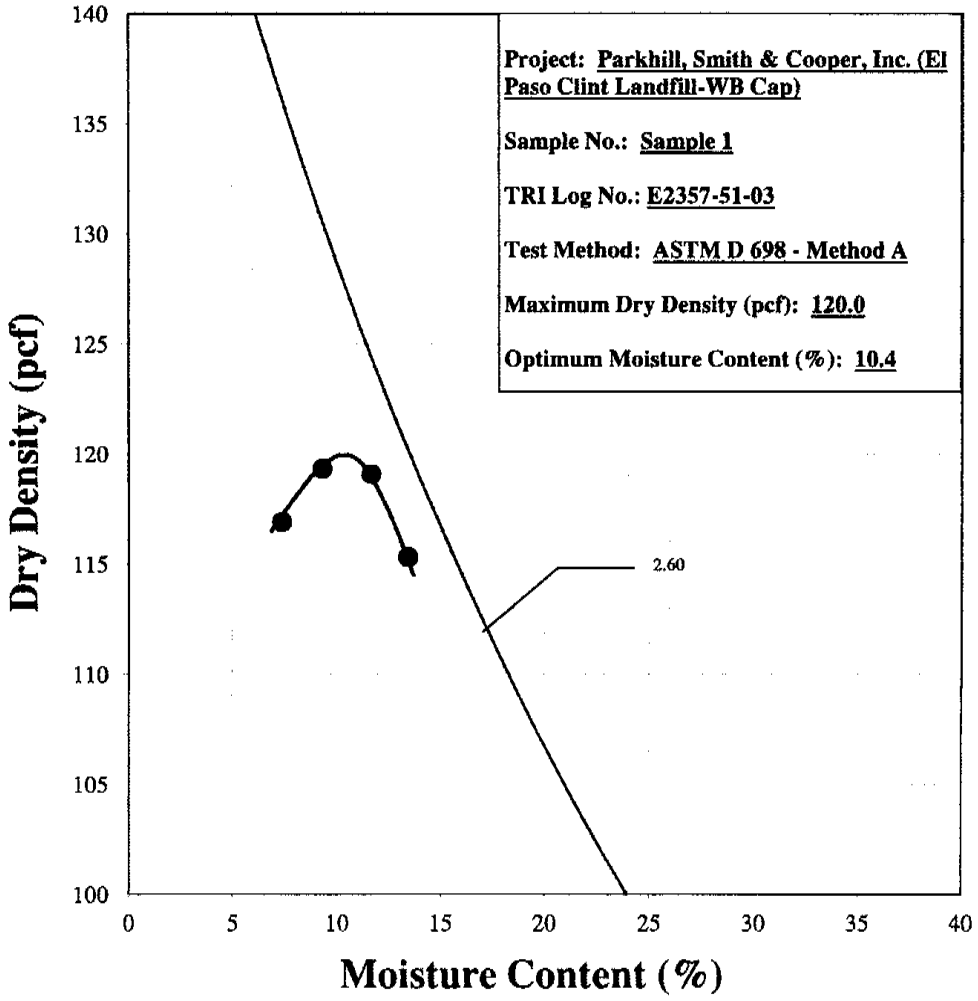
## Summary of Saturated Hydraulic Conductivity Tests

| Sample Number | $K_{sat}$ (cm/sec) | Method of Analysis | |
|---|---|---|---|
| | | Constant Head | Falling Head |
| El Paso 75% | 1.2E-02 | X | |
| El Paso 80% | 6.6E-03 | X | |
| El Paso 85% | 3.1E-03 | X | |
| El Paso 90% | 1.3E-03 | X | |
| El Paso 95% | 7.9E-04 | X | |

## Summary of Moisture Characteristics of the Initial Drainage Curve

| Sample Number | Pressure Head (-cm water) | Moisture Content (%, $cm^3/cm^3$) |
|---|---|---|
| El Paso 75% | 0 | 46.0 |
| | 12 | 41.3 |
| | 38 | 40.1 |
| | 79 | 18.7 |
| | 510 | 13.8 |
| | 11728 | 5.2 |
| | 851293 | 1.2 |
| El Paso 80% | 0 | 45.2 |
| | 12 | 41.5 |
| | 38 | 39.7 |
| | 79 | 18.8 |
| | 510 | 10.4 |
| | 11728 | 5.6 |
| | 851293 | 1.2 |
| El Paso 85% | 0 | 43.4 |
| | 12 | 40.1 |
| | 38 | 39.3 |
| | 79 | 21.5 |
| | 510 | 10.8 |
| | 11728 | 5.9 |
| | 851293 | 1.3 |
| El Paso 90% | 0 | 37.7 |
| | 11 | 36.1 |
| | 40 | 34.8 |
| | 83 | 33.6 |
| | 510 | 11.5 |
| | 11728 | 6.3 |
| | 851293 | 1.4 |

# Proctor Compaction Test




John M. Allen, P.E., 09/16/11

Quality Review/Date

Tested by: Joe Vasquez

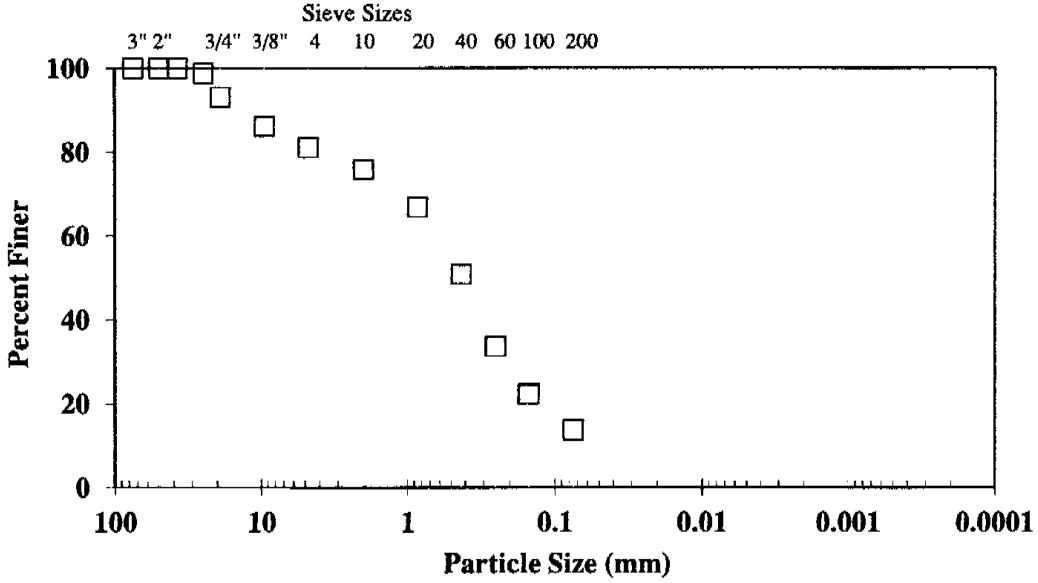
The testing herein is based upon accepted industry practice as well as the test method listed. Test results reported herein do not apply to samples other than those tested. TRI neither accepts responsibility for nor makes claim as to the final use and purpose of the material. TRI observes and maintains client confidentiality. TRI limits reproduction of this report, except in full, without prior approval of TRI.

9063 Bee Caves Road □ Austin, TX 78733-6201 □ (512) 263-2101 □ (512) 263-2558 □ 1-800-880-TEST

# Particle Size Analysis for Soils

Client: Parkhill, Smith, & Cooper, Inc.
Project: El Paso Clint Landfill-WB Cap
Sample: Sample 1

TRI Log#: E2357-51-03
Test Method: ASTM D 422
Test Date: 09/13/11




| Sieve Analysis | |
|---|---|
| Sieve Size | Percentage Passing (%) |
| 3 in. | 100.0 |
| 2 in. | 100.0 |
| 1.5 in. | 100.0 |
| 1 in. | 98.8 |
| 3/4 in. | 93.1 |
| 3/8 in. | 86.1 |
| No. 4 (4.75 mm) | 81.1 |
| No. 10 (2.00 mm) | 75.7 |
| No. 20 (850 µm) | 66.8 |
| No. 40 (425 µm) | 50.8 |
| No. 60 (250 µm) | 33.5 |
| No. 100 (150 µm) | 22.3 |
| No. 200 (75 µm) | 13.7 |

Notes: Soil classifies as a silty sand with gravel (SM) in accordance with ASTM D 2487.

| Plastic Index (ASTM D 4318) Results | |
|---|---|
| Liquid Limit | NL |
| Plastic Limit | NP |
| Plastic Index | NP |
| Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. | |

John M. Allen, P.E., 09/15/11
Quality Review/Date
Tested by: Joe Vasquez & Tierra Jackson

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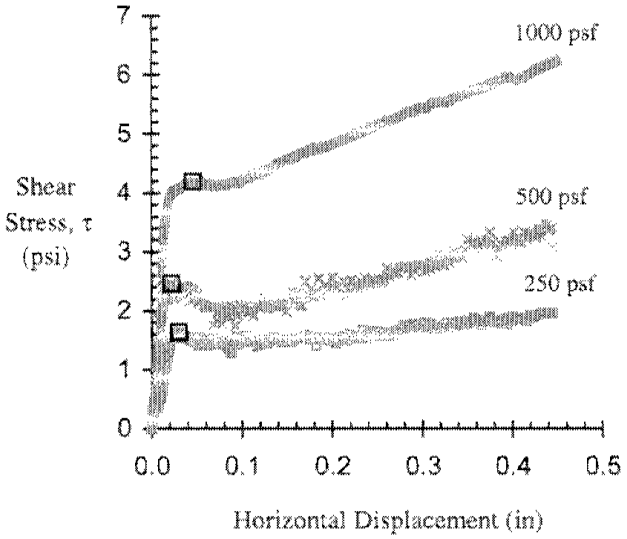
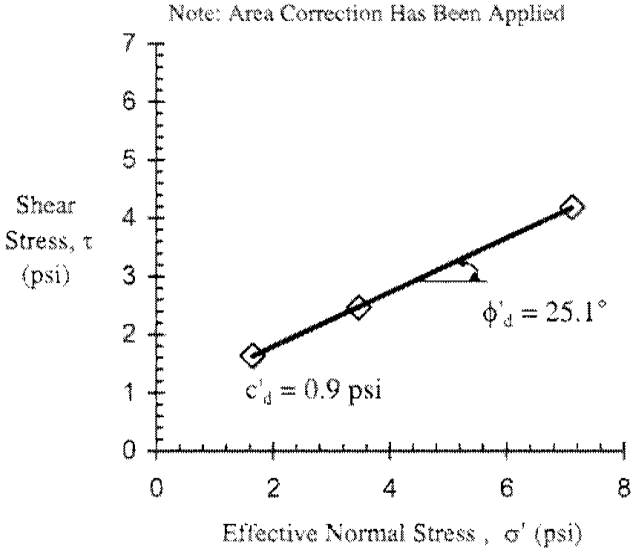
# Direct Shear of Soil Under Consolidated-Drained Conditions

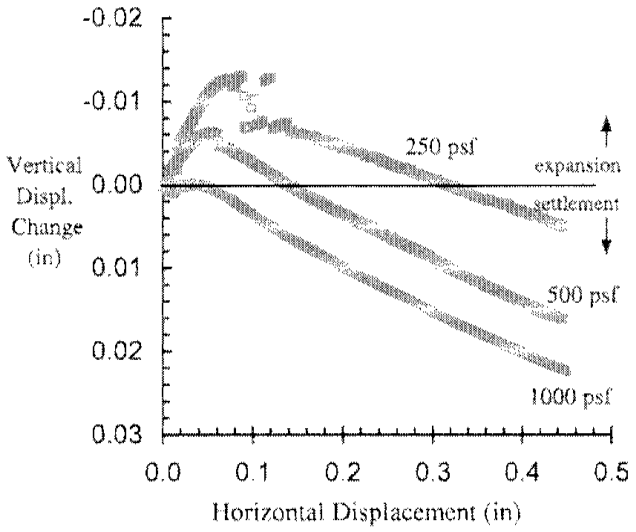
Client: Parkhill, Smith, Cooper Inc.
Project: El Paso Clint Landfill
Specimen: Sample #1

TRI Log#: E2357-51-03
Test Method: ASTM D 3080
Test Date: 09/20/11




Note: Area Correction Has Been Applied




| Sample Number | | 1 | 2 | 3 |
|---|---|---|---|---|
| Initial Condition | Diameter, in | 2.50 | 2.50 | 2.50 |
| | Height, in (before consol) | 0.99 | 0.99 | 1.00 |
| | Water Content, % | 10.0 | 10.1 | 10.0 |
| | Saturation, % | 51.0 | 51.7 | 51.2 |
| | Dry Density, pcf | 108.2 | 108.4 | 108.3 |
| | Void Ratio | 0.52 | 0.51 | 0.51 |
| Post Consol | Height, in (prior to shear) | 0.99 | 0.98 | 0.99 |
| | Final Water Content, % | 16.8 | 17.9 | 16.5 |
| | Dry Density, pcf | 108.8 | 108.9 | 109.1 |
| | Void Ratio | 0.51 | 0.51 | 0.50 |
| Peak Normal Stress, σ' (psi) | | 1.6 | 3.5 | 7.1 |
| Peak Shear Stress, τ (psi) | | 1.6 | 2.5 | 4.2 |
| Displacement at Failure (in) | | 0.03 | 0.02 | 0.05 |
| Displacement rate (in/min) | | 0.001 | 0.001 | 0.001 |
| Sample Type | Remolded | $\phi'_d$, degrees | | **25.1** |
| $G_s$ (measured) | 2.626 | $c'_d$, psi | | **0.9** |

Note: The soil was air dried and passed through a No. 4 sieve to eliminate any over sized particles. Specimens were remolded a target dry density of 90% standard compaction at optimum moisture content or 108.0 pcf dry density at a moisture content of 10.4 %.

Cheng-Wei Chen, 09/28/11
Analysis & Quality Review/Date
Specimens prepared by: Chirag Rakholia

The testing herein is based upon accepted industry practice as well as the test method listed. Test results reported herein do not apply to samples other than those tested. TRI neither accepts responsibility for nor makes claim as to the final use and purpose of the material. TRI observes and maintains client confidentiality. TRI limits reproduction of this report, except in full, without prior approval of TRI.

Client: Parkhill, Smith, Cooper Inc.
Project: El Paso Clint Landfill
Specimen: Sample #1
Normal Stress (psf) : 250

TRI Log No.: E2357-51-03
Test Method: ASTM D 3080
Test Date: 09/20/11
Displacement rate (in/min): 0.001

## Testing Reading for Specimen No. 1

| No. | Vert. Displ. Changes (in) | Horiz. Displ.(in) | Corrected Area ($in^2$) | Shear Stress (psi) |
|---|---|---|---|---|
| 1 | 0.000 | 0.000 | 4.89 | 0.00 |
| 2 | 0.000 | 0.001 | 4.89 | 0.10 |
| 3 | 0.000 | 0.003 | 4.89 | 0.39 |
| 4 | 0.001 | 0.006 | 4.88 | 0.37 |
| 5 | 0.001 | 0.008 | 4.87 | 0.38 |
| 6 | 0.001 | 0.011 | 4.87 | 0.52 |
| 7 | 0.001 | 0.013 | 4.86 | 0.76 |
| 8 | -0.002 | 0.016 | 4.85 | 1.06 |
| 9 | -0.005 | 0.018 | 4.85 | 1.23 |
| 10 | -0.005 | 0.020 | 4.84 | 1.42 |
| 11 | -0.006 | 0.026 | 4.83 | 1.58 |
| 12 | -0.008 | 0.033 | 4.81 | 1.61 |
| 13 | -0.009 | 0.041 | 4.79 | 1.53 |
| 14 | -0.011 | 0.048 | 4.77 | 1.47 |
| 15 | -0.011 | 0.056 | 4.75 | 1.52 |
| 16 | -0.012 | 0.063 | 4.74 | 1.46 |
| 17 | -0.013 | 0.071 | 4.72 | 1.48 |
| 18 | -0.012 | 0.078 | 4.70 | 1.47 |
| 19 | -0.013 | 0.086 | 4.68 | 1.37 |
| 20 | -0.007 | 0.093 | 4.66 | 1.52 |
| 21 | -0.007 | 0.105 | 4.63 | 1.57 |
| 22 | -0.013 | 0.120 | 4.59 | 1.44 |
| 23 | -0.007 | 0.135 | 4.56 | 1.55 |
| 24 | -0.006 | 0.150 | 4.52 | 1.51 |
| 25 | -0.006 | 0.165 | 4.48 | 1.53 |
| 26 | -0.005 | 0.180 | 4.44 | 1.53 |
| 27 | -0.005 | 0.195 | 4.41 | 1.52 |
| 28 | -0.004 | 0.210 | 4.37 | 1.55 |
| 29 | -0.003 | 0.240 | 4.29 | 1.64 |
| 30 | -0.002 | 0.270 | 4.22 | 1.65 |
| 31 | -0.001 | 0.300 | 4.15 | 1.77 |
| 32 | 0.001 | 0.330 | 4.07 | 1.71 |
| 33 | 0.002 | 0.360 | 4.00 | 1.84 |
| 34 | 0.003 | 0.390 | 3.92 | 1.77 |
| 35 | 0.004 | 0.420 | 3.85 | 1.92 |

Client: Parkhill, Smith, Cooper Inc.
Project: El Paso Clint Landfill
Specimen: Sample #1
Normal Stress (psf) : 500

TRI Log No.: E2357-51-03
Test Method: ASTM D 3080
Test Date: 09/20/11
Displacement rate (in/min): 0.001

## Testing Reading for Specimen No. 2

| No. | Vert. Displ. Changes (in) | Horiz. Displ.(in) | Corrected Area ($in^2$) | Shear Stress (psi) |
|---|---|---|---|---|
| 1 | 0.000 | 0.000 | 4.89 | 0.00 |
| 2 | 0.000 | 0.001 | 4.89 | 0.08 |
| 3 | 0.000 | 0.003 | 4.88 | 0.36 |
| 4 | 0.000 | 0.006 | 4.88 | 0.74 |
| 5 | -0.002 | 0.008 | 4.87 | 1.27 |
| 6 | -0.002 | 0.011 | 4.87 | 1.87 |
| 7 | -0.002 | 0.013 | 4.86 | 2.22 |
| 8 | -0.003 | 0.016 | 4.85 | 2.25 |
| 9 | -0.003 | 0.018 | 4.85 | 2.41 |
| 10 | -0.004 | 0.021 | 4.84 | 2.44 |
| 11 | -0.005 | 0.028 | 4.82 | 2.33 |
| 12 | -0.005 | 0.036 | 4.80 | 2.42 |
| 13 | -0.006 | 0.043 | 4.78 | 2.18 |
| 14 | -0.006 | 0.051 | 4.77 | 2.27 |
| 15 | -0.006 | 0.057 | 4.75 | 2.22 |
| 16 | -0.005 | 0.064 | 4.73 | 2.07 |
| 17 | -0.005 | 0.072 | 4.71 | 2.06 |
| 18 | -0.004 | 0.079 | 4.69 | 1.99 |
| 19 | -0.004 | 0.087 | 4.68 | 2.09 |
| 20 | -0.003 | 0.094 | 4.66 | 2.01 |
| 21 | -0.002 | 0.108 | 4.62 | 1.98 |
| 22 | -0.001 | 0.120 | 4.59 | 2.06 |
| 23 | 0.000 | 0.135 | 4.56 | 2.07 |
| 24 | 0.001 | 0.150 | 4.52 | 1.98 |
| 25 | 0.002 | 0.165 | 4.48 | 2.09 |
| 26 | 0.002 | 0.180 | 4.44 | 2.24 |
| 27 | 0.003 | 0.195 | 4.41 | 2.38 |
| 28 | 0.004 | 0.210 | 4.37 | 2.35 |
| 29 | 0.006 | 0.240 | 4.29 | 2.49 |
| 30 | 0.007 | 0.270 | 4.22 | 2.63 |
| 31 | 0.009 | 0.300 | 4.15 | 2.80 |
| 32 | 0.011 | 0.330 | 4.07 | 2.82 |
| 33 | 0.012 | 0.360 | 4.00 | 3.15 |
| 34 | 0.014 | 0.390 | 3.92 | 3.10 |
| 35 | 0.015 | 0.420 | 3.85 | 3.32 |

Client: Parkhill, Smith, Cooper Inc.
Project: El Paso Clint Landfill
Specimen: Sample #1
Normal Stress (psf) : 1000

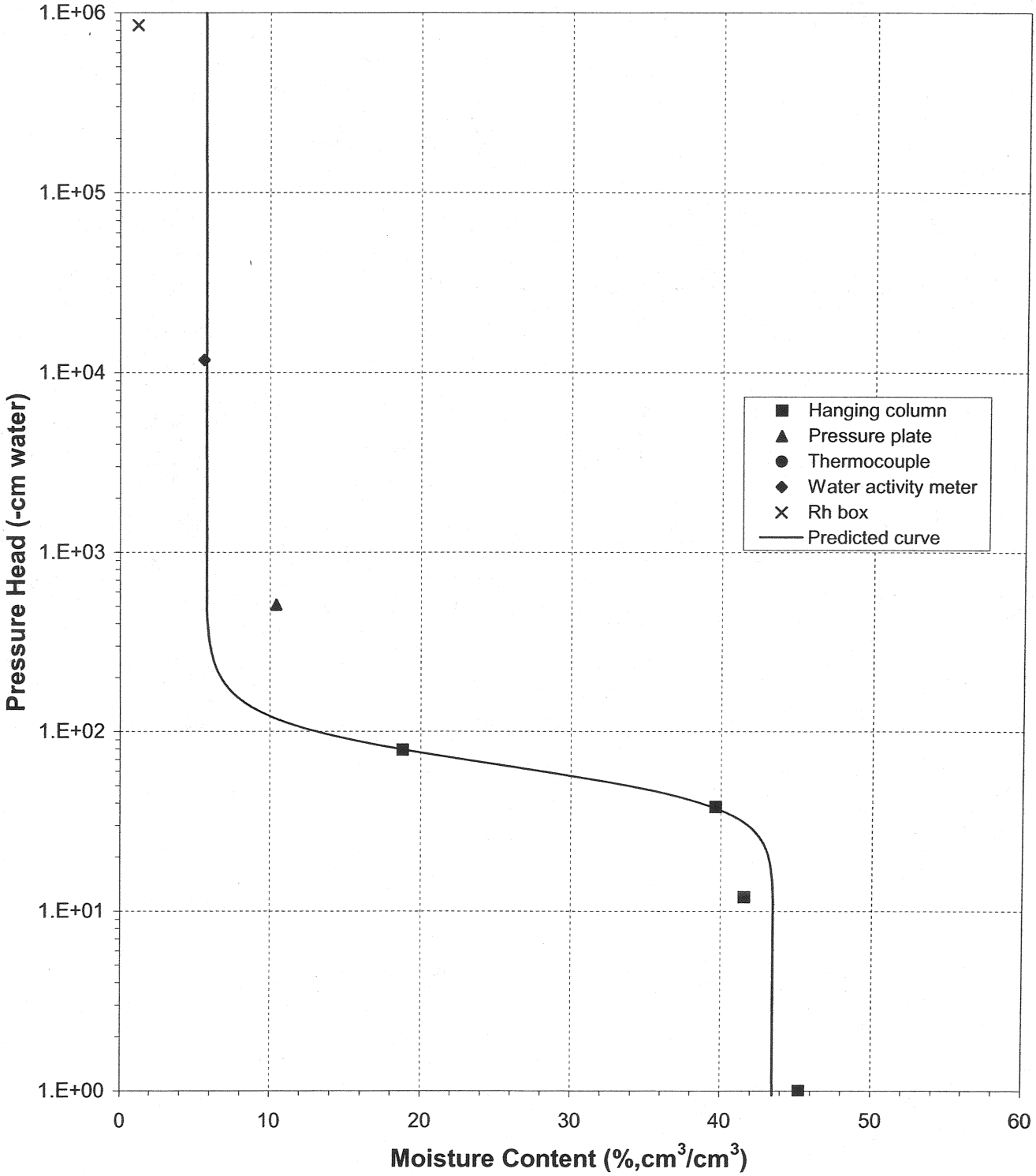
TRI Log No.: E2357-51-03
Test Method: ASTM D 3080
Test Date: 09/20/11
Displacement rate (in/min): 0.001

## Testing Reading for Specimen No. 3

| No. | Vert. Displ. Changes (in) | Horiz. Displ.(in) | Corrected Area ($in^2$) | Shear Stress (psi) |
|---|---|---|---|---|
| 1 | 0.000 | 0.000 | 4.89 | 0.00 |
| 2 | 0.000 | 0.000 | 4.90 | -0.01 |
| 3 | 0.000 | 0.003 | 4.90 | 0.54 |
| 4 | 0.000 | 0.006 | 4.89 | 0.96 |
| 5 | 0.000 | 0.008 | 4.88 | 1.48 |
| 6 | 0.000 | 0.011 | 4.88 | 2.47 |
| 7 | 0.000 | 0.013 | 4.87 | 3.21 |
| 8 | 0.000 | 0.016 | 4.87 | 3.60 |
| 9 | 0.000 | 0.018 | 4.86 | 3.87 |
| 10 | 0.000 | 0.021 | 4.85 | 4.00 |
| 11 | 0.000 | 0.023 | 4.85 | 4.02 |
| 12 | 0.000 | 0.026 | 4.84 | 4.04 |
| 13 | 0.000 | 0.032 | 4.83 | 4.11 |
| 14 | 0.000 | 0.038 | 4.81 | 4.16 |
| 15 | 0.000 | 0.045 | 4.79 | 4.18 |
| 16 | 0.000 | 0.053 | 4.77 | 4.17 |
| 17 | 0.001 | 0.060 | 4.75 | 4.16 |
| 18 | 0.001 | 0.068 | 4.74 | 4.14 |
| 19 | 0.002 | 0.075 | 4.72 | 4.14 |
| 20 | 0.002 | 0.083 | 4.70 | 4.15 |
| 21 | 0.003 | 0.090 | 4.68 | 4.19 |
| 22 | 0.003 | 0.098 | 4.66 | 4.21 |
| 23 | 0.004 | 0.110 | 4.63 | 4.29 |
| 24 | 0.005 | 0.125 | 4.59 | 4.38 |
| 25 | 0.006 | 0.140 | 4.56 | 4.52 |
| 26 | 0.007 | 0.155 | 4.52 | 4.59 |
| 27 | 0.008 | 0.170 | 4.48 | 4.69 |
| 28 | 0.009 | 0.185 | 4.44 | 4.75 |
| 29 | 0.011 | 0.215 | 4.37 | 4.93 |
| 30 | 0.012 | 0.245 | 4.29 | 5.11 |
| 31 | 0.014 | 0.275 | 4.22 | 5.30 |
| 32 | 0.015 | 0.305 | 4.14 | 5.46 |
| 33 | 0.017 | 0.335 | 4.07 | 5.64 |
| 34 | 0.018 | 0.365 | 4.00 | 5.78 |
| 35 | 0.020 | 0.395 | 3.92 | 5.96 |
| 36 | 0.020 | 0.410 | 3.88 | 5.94 |

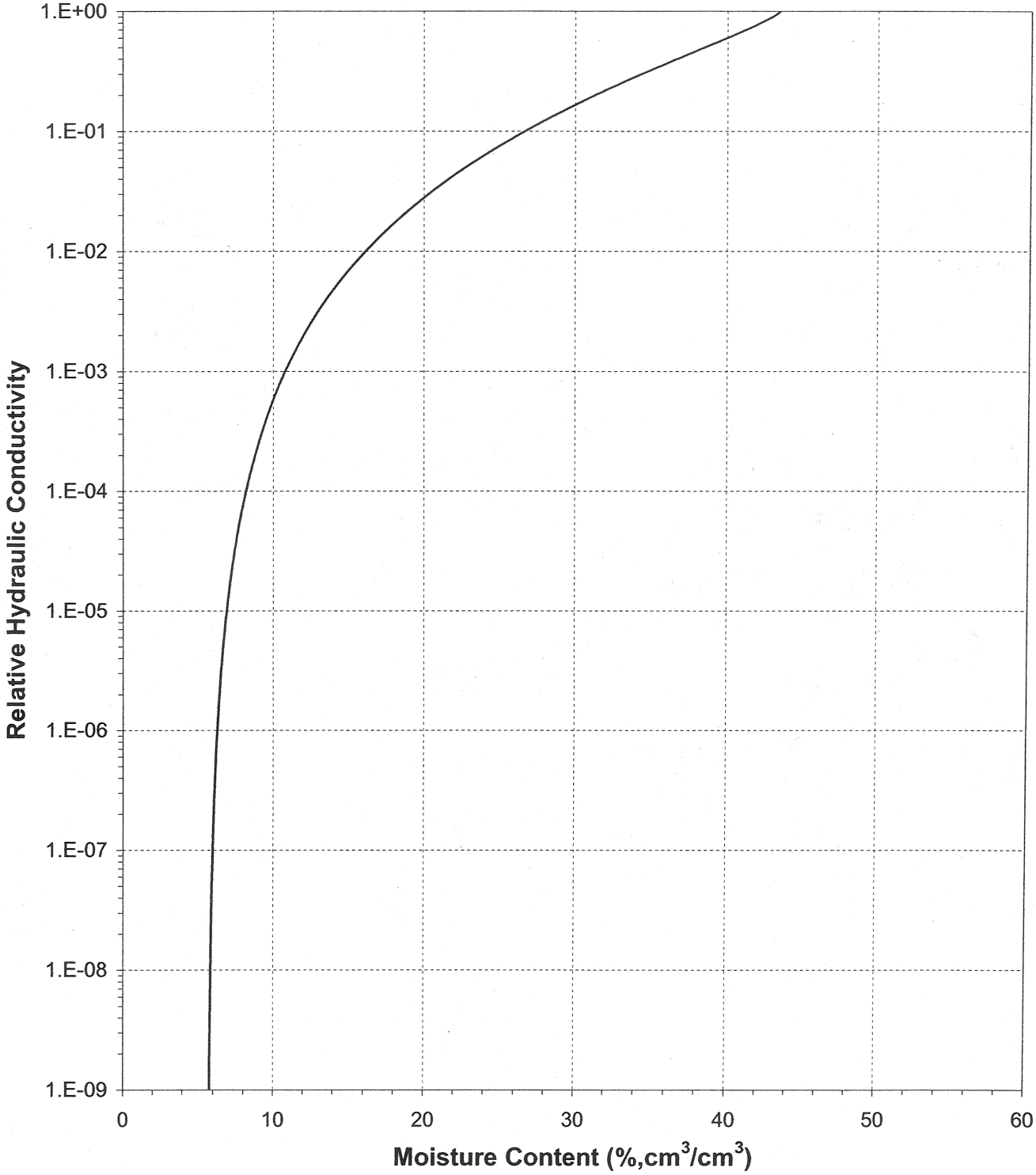
## Predicted Water Retention Curve and Data Points

*Sample Number: El Paso 80%*



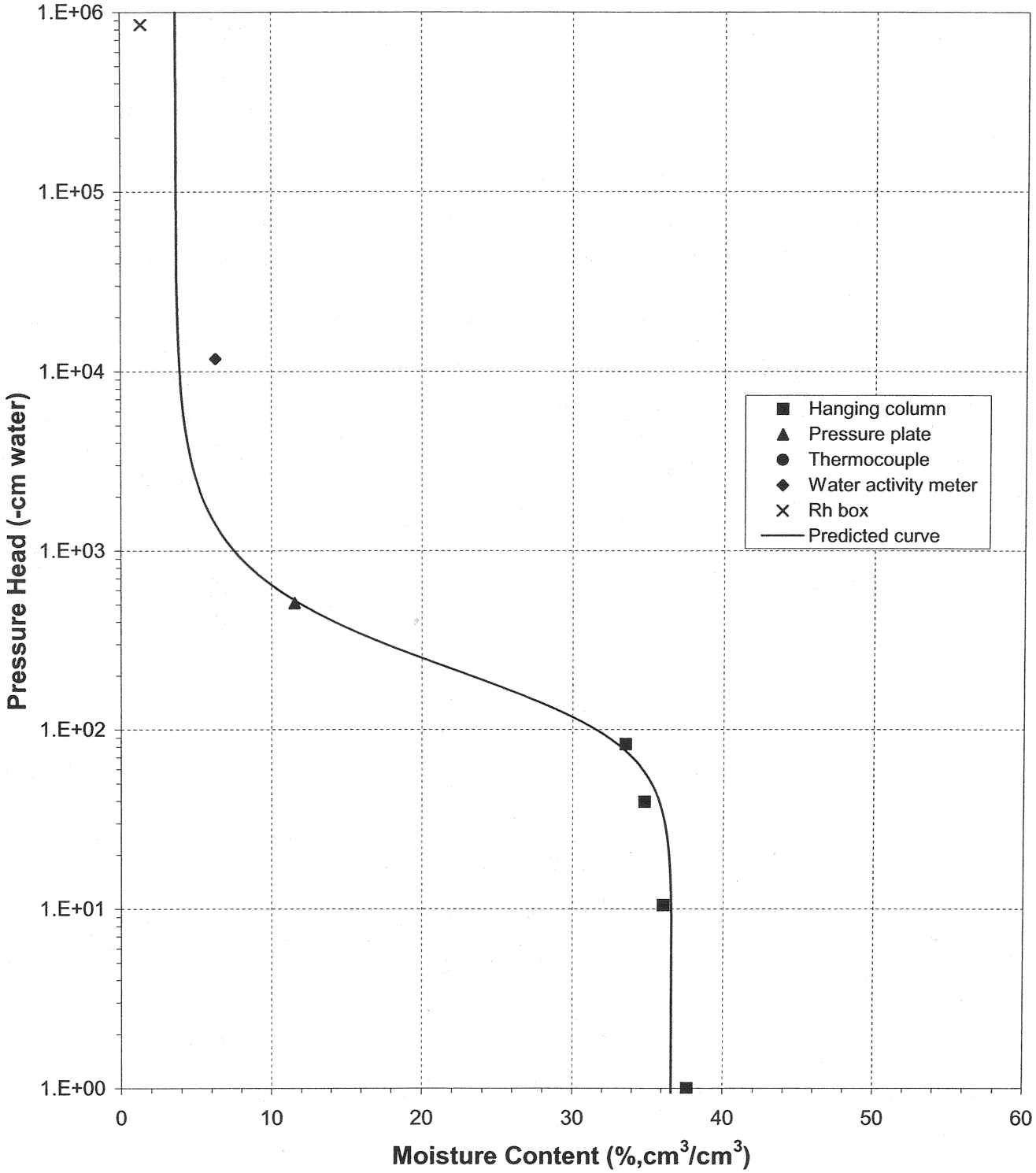
## Plot of Relative Hydraulic Conductivity vs Moisture Content

*Sample Number: El Paso 80%*



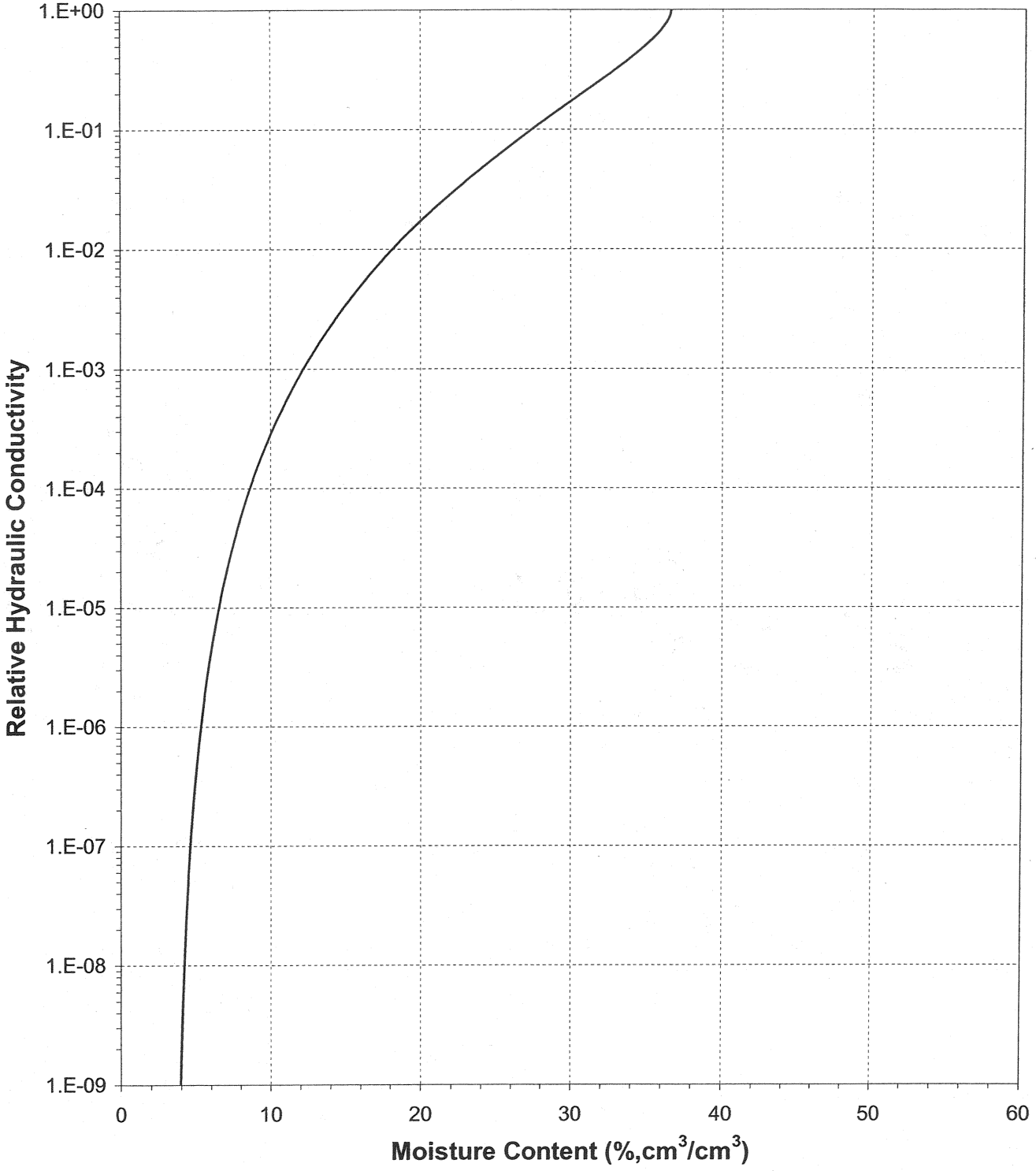
## Predicted Water Retention Curve and Data Points

*Sample Number: El Paso 90%*



## Plot of Relative Hydraulic Conductivity vs Moisture Content

*Sample Number: El Paso 90%*



# Appendix 3N – Attachment 3
# Closure Cost Estimates

SAIC®

**Table 1 - Closure Cost Estimate, McCombs Landfill - Vegetative Cover**

| Description | Unit | Quantity | Unit Cost | Total |
|---|---|---|---|---|
| 1 - Mobilization | | | | |
| Mobilization (5% or maximum $473200) | % | 5 | N/A | $ 473,200 |
| | | | Subtotal Mobilization | $ 473,200 |
| 2 - TESC | | | | |
| Dust Control | LS | 1 | $ 23,660.00 | $ 23,660 |
| Erosion and Sediment Control | LS | 1 | $ 11,830.00 | $ 11,830 |
| | | | Subtotal TESC | $ 35,490 |
| 3 - Final Cover | | | | |
| Lined: | | | | |
| Vegetation | AC | 152 | $ 1,458.00 | $ 221,616 |
| Top Soil (6") | CY | 122,613 | $ 4.86 | $ 595,901 |
| Erosion Layer (12") | CY | 245,227 | $ 4.86 | $ 1,191,802 |
| 40 mil LLDPE Geomembrane | SF | 6,621,120 | $ 0.43 | $ 2,815,631 |
| Infiltration Layer (offsite $1x10^{-5}$ cm/sec, 18") | CY | 367,840 | $ 26.73 | $ 9,832,363 |
| Site Preparation | AC | 152 | $ 911.25 | $ 138,510 |
| Unlined: | | | | |
| Vegetation | AC | 71 | $ 1,458.00 | $ 103,226 |
| Top Soil (6") | CY | 57,112 | $ 4.86 | $ 277,564 |
| Infiltration Layer (offsite $1x10^{-5}$ cm/sec, 18") | CY | 171,336 | $ 26.73 | $ 4,579,811 |
| Site Preparation | AC | 71 | $ 911.25 | $ 64,517 |
| | | | Subtotal Final Cover | $ 19,820,941 |
| 4 - Stormwater Management | | | | |
| Stormwater Management Improvements | LS | 1 | $ 828,100.00 | $ 828,100 |
| | | | Subtotal Stormwater Management | $ 828,100 |
| 5 - Landfill Gas Control | | | | |
| Gas Control Wells | EA | 115 | $ 9,112.50 | $ 1,047,938 |
| Gas Header Piping | LF | 4,450 | $ 19.44 | $ 86,508 |
| Gas Lateral Piping | LF | 35,000 | $ - | $ - |
| Flare Station Modifications | LS | 1 | $ 60,750.00 | $ 60,750 |
| Condensate Sumps | EA | 5 | $ 9,112.50 | $ 45,563 |
| | | | Subtotal Landfill Gas Control | $ 1,240,758 |
| 6 - Environmental Monitoring Systems | | | | |
| No additional monitoring systems at closure | | | | $ - |
| | | | Subtotal Environmental Monitoring Systems | $ - |
| 7 - Site Security | | | | |
| No additional site security costs at closure | | | | $ - |
| | | | Subtotal Site Security | $ - |
| | | | Subtotal | $ 22,398,489 |
| 8 - Engineering and Surveying | | | 8% | $ 1,791,879 |
| 9 - Construction Management | | | 4% | $ 895,940 |
| 10 - Contingency | | | 10% | $ 2,239,849 |
| | | | **Total Closure Costs** | $ 27,326,157 |
| | | | **Total Closure Costs per Acre** | $ 122,649 |

| | |
|---|---|
| Acre | AC |
| Cubic Yard | CY |
| Each | EA |
| Linear Foot | LF |
| Lump Sum | LS |
| Square Feet | SF |
| Square Yard | SY |
| Tons | TN |

| | |
|---|---|
| Expansion Area | 176 |
| Filled Area | 20 |
| Total Crown Acreage | 80 |
| Total Sideslope Acreage | 122.3 |
| Total Acreage Lined | 152 |
| Total Acreage Unlined | 70.8 |
| Total Acreage | 222.8 |

**Table 2 - Closure Cost Estimate, McCombs Landfill - Rock Side Slope Cover (Veg Crown)**

| Description | Unit | Quantity | Unit Cost | Total |
|---|---|---|---|---|
| 1 - Mobilization | | | | |
| Mobilization (5% or maximum $473200) | % | 5 | N/A | $ 473,200 |
| | | | Subtotal Mobilization | $ 473,200 |
| 2 - TESC | | | | |
| Dust Control | LS | 1 | $ 17,745.00 | $ 17,745 |
| TESC | LS | 1 | $ 8,872.50 | $ 8,873 |
| | | | Subtotal TESC | $ 26,618 |
| 3 - Final Cover | | | | |
| Lined Sideslopes: | | | | |
| Rock Armoring (4") | TN | 121,675 | $ 24.30 | $ 2,956,700 |
| Erosion Layer (12") | CY | 197,311 | $ 4.86 | $ 958,930 |
| 40 mil LLDPE Geomembrane | SF | 5,327,388 | $ 0.43 | $ 2,265,472 |
| Infiltration Layer (offsite $1x10^{-5}$ cm/sec, 18") | CY | 295,966 | $ 26.73 | $ 7,911,171 |
| Buffer Layer (6" sand) | CY | 98,655 | $ 2.43 | $ 239,732 |
| Site Preparation | AC | 122 | $ 911.25 | $ 111,446 |
| Lined Crown: | | | | |
| Vegetation | AC | 80 | $ 1,458.00 | $ 116,640 |
| Top Soil (6") | CY | 64,533 | $ 4.86 | $ 313,632 |
| Erosion Layer (12") | CY | 129,067 | $ 4.86 | $ 627,264 |
| 40 mil LLDPE Geomembrane | SF | 3,484,800 | $ 0.43 | $ 1,481,911 |
| Infiltration Layer (offsite $1x10^{-5}$ cm/sec, 18") | CY | 193,600 | $ 26.73 | $ 5,174,928 |
| Site Preparation | AC | 80 | $ 911.25 | $ 72,900 |
| Unlined: | | | | |
| Vegetation | AC | 71 | $ 1,458.00 | $ 103,226 |
| Top Soil (6") | CY | 57,112 | $ 4.86 | $ 277,564 |
| Infiltration Layer (offsite $1x10^{-5}$ cm/sec, 18") | CY | 171,336 | $ 26.73 | $ 4,579,811 |
| Site Preparation | AC | 71 | $ 911.25 | $ 64,517 |
| | | | Subtotal Final Cover | $ 27,255,845 |
| 4 - Stormwater Management | | | | |
| Stormwater Management Improvements | LS | 1 | $ 828,100.00 | $ 828,100 |
| | | | Subtotal Stormwater Management | $ 828,100 |
| 5 - Landfill Gas Control | | | | |
| Gas Control Wells | EA | 115 | $ 9,112.50 | $ 1,047,938 |
| Gas Header Piping | LF | 4,450 | $ 19.44 | $ 86,508 |
| Gas Lateral Piping | LF | 35,000 | $ - | $ - |
| Flare Station Modifications | LS | 1 | $ 60,750.00 | $ 60,750 |
| Condensate Sumps | EA | 5 | $ 9,112.50 | $ 45,563 |
| | | | Subtotal Landfill Gas Control | $ 1,240,758 |
| 6 - Environmental Monitoring Systems | | | | |
| No additional monitoring systems at closure | EA | | | $ - |
| | | | Subtotal Environmental Monitoring Systems | $ - |
| 7 - Site Security | | | | |
| No additional site security costs at closure | | | | $ - |
| | | | Subtotal Site Security | $ - |
| | | | Subtotal | $ 29,824,521 |
| 8 - Engineering and Surveying | | | 8% | $ 2,385,962 |
| 9 - Construction Management | | | 4% | $ 1,192,981 |
| 10 - Contingency | | | 10% | $ 2,982,452 |
| | | | **Total Closure Costs** | $ 36,385,915 |
| | | | **Total Closure Costs per Acre** | $ 163,312 |

| | |
|---|---|
| Acre | AC |
| Cubic Yard | CY |
| Each | EA |
| Linear Foot | LF |
| Lump Sum | LS |
| Square Feet | SF |
| Square Yard | SY |
| Tons | TN |

| | |
|---|---|
| Expansion Area | 176 |
| Filled Area | 20 |
| Total Crown Acreage | 80 |
| Total Sideslope Acreage | 122.3 |
| Total Acreage Lined | 152 |
| Total Acreage Unlined | 70.8 |
| Total Acreage | 222.8 |

**Table 3 - Closure Cost Estimate, McCombs Landfill - ET Cover**

| Description | Unit | Quantity | Unit Cost | | Total |
|---|---|---|---|---|---|
| 1 - Mobilization | | | | | |
| Mobilization (5% or maximum $473200) | % | 5 | N/A | $ | 473,200 |
| | | | Subtotal Mobilization | $ | 473,200 |
| 2 - TESC | | | | | |
| Dust Control | LS | 1 | $ 23,660.00 | $ | 23,660 |
| Erosion and Sediment Control | LS | 1 | $ 11,830.00 | $ | 11,830 |
| | | | Subtotal TESC | $ | 35,490 |
| 3 - Final Cover | | | | | |
| Rock Armoring (4") | TN | 221,661 | $ 24.30 | $ | 5,386,368 |
| Erosion Layer, 18" (offsite Alt CAP) | CY | 539,176 | $ 14.58 | $ | 7,861,186 |
| Support Layer, 6" (offsite Alt CAP) | CY | 179,725 | $ 14.58 | $ | 2,620,395 |
| Site Preparation | AC | 223 | $ 911.25 | $ | 203,027 |
| | | | Subtotal Final Cover | $ | 16,070,976 |
| 4 - Stormwater Management | | | | | |
| Stormwater Management Improvements | LS | 1 | $ 828,100.00 | $ | 828,100 |
| | | | Subtotal Stormwater Management | $ | 828,100 |
| 5 - Landfill Gas Control | | | | | |
| Gas Control Wells (0.8 wells per acre) | EA | 115 | $ 9,112.50 | $ | 1,047,938 |
| Gas Header Piping | LF | 4,450 | $ 19.44 | $ | 86,508 |
| Gas Lateral Piping | LF | 35,000 | $ - | $ | - |
| Flare Station Modifications | LS | 1 | $ 60,750.00 | $ | 60,750 |
| Condensate Sumps | EA | 5 | $ 9,112.50 | $ | 45,563 |
| | | | Subtotal Landfill Gas Control | $ | 1,240,758 |
| 6 - Environmental Monitoring Systems | | | | | |
| No additional monitoring systems at closure | | | | $ | - |
| | | | Subtotal Environmental Monitoring Systems | $ | - |
| 7 - Site Security | | | | | |
| No additional site security costs at closure | | | | $ | - |
| | | | Subtotal Site Security | $ | - |
| | | | Subtotal | $ | 18,648,524 |
| 8 - Engineering and Surveying | | | | 8% | $ 1,491,882 |
| 9 - Construction Management | | | | 4% | $ 745,941 |
| 10 - Contingency | | | | 10% | $ 1,864,852 |
| | | | **Total Closure Costs** | $ | 22,751,199 |
| | | | **Total Closure Costs per Acre** | $ | 102,115 |

| | |
|---|---|
| Acre | AC |
| Cubic Yard | CY |
| Each | EA |
| Linear Foot | LF |
| Lump Sum | LS |
| Square Feet | SF |
| Square Yard | SY |
| Tons | TN |

| | |
|---|---|
| Expansion Area | 176 |
| Filled Area | 20 |
| Total Crown Acreage | 80 |
| Total Sideslope Acreage | 122.3 |
| Total Lined Acreage | 202.3 |
| Total Unlined Acreage | 20.5 |
| Total Acreage | 222.8 |

## Memorandum

To: TCEQ

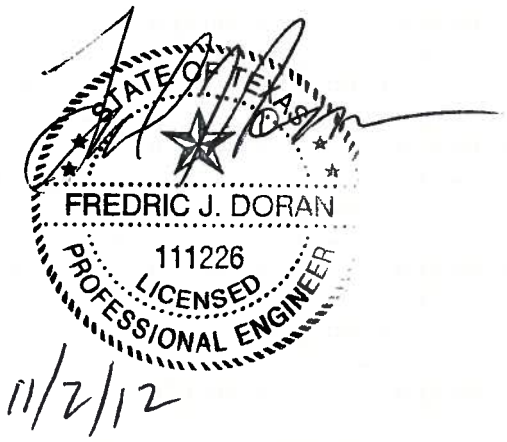
From: Fred J. Doran, SAIC

Subject: Appendix 3N Financial Assurance Letter

Date: November 2, 2012

The attached letter dated March 27, 2012 references MSW Permit No. 729A. It should be noted that the attached results are applicable to MSW Permit No. 729B and should be referenced within the document as part of MSW Permit No. 729B.

TLK






SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI

March 27, 2012

Mark R. Vickery, P.G.
Executive Director
Texas Commission on Environmental Quality
PO Box 13087
Austin, TX 78711-3087

I am the chief financial officer of the City of El Paso, Texas with offices at #2 Civic Center Plaza, El Paso, TX 79901. This letter is in support of the local government's use of the financial test to demonstrate financial assurance, as specified in 30 Texas Administrative Code (TAC) Chapter 37 (relating to Financial Assurance).

1. This local government is the owner or operator of the following facilities for which financial assurance for closure, post closure, or corrective action is demonstrated through the financial test specified in 30 TAC section 37.271 (relating to Local Government Financial Test). The current cost estimates covered by the test are shown for each facility:

| Permit Number | Closure | Post-Closure | Total |
|---|---|---|---|
| MSW 1482 | $ 14,961,270 | $ 14,824,710 | $ 29,785,980 |
| MSW 729XB | $ 42,927,074 | $ 5,585,299 | $ 48,512,373 |
| MSW 728 | $ 39,828 | $ 289,560 | $ 329,388 |
| MSW 2284 | $ 9,851,367 | $ 3,173,197 | $ 13,024,564 |

2. This local government guarantees, through the guarantee specified in 30 TAC section 37.281 (relating to Local Government Guarantee), the following closures, post closure, or corrective action cost estimates of the following facilities owned or operated by the City of El Paso. The current cost estimates so guaranteed are shown for each facility: NONE

The fiscal year of this local government ends on August 31. The figures for the following items marked with an asterisk are derived from this local government's independently audited, year-end financial statements for the latest completed fiscal year, August 31, 2011.

Mayor
John F. Cook

City Council

*District 1*
Ann Morgan Lilly

*District 2*
Susie Byrd

*District 3*
Emma Acosta

*District 4*
Carl L. Robinson

*District 5*
Dr. Michiel R. Noe

*District 6*
Eddie Holguin Jr.

*District 7*
Steve Ortega

*District 8*
Cortney Carlisle Niland

City Manager
Joyce A. Wilson

RATIO INDICATORS OF FINANCIAL STRENGTH

| | | |
|---|---|---|
| 1. | Sum of current cost estimates | $ 92,652,305 |
| *2. | Sum of cash and marketable securities | $ 162,794,862 |
| *3. | Total expenditures | $ 577,561,622 |
| *4. | Annual debt Service | $ 84,575,952 |
| 5. | Environmental obligations assured by a financial test to demonstrate financial assurance in the following amounts under commission regulations and the Code of Federal Regulations (CFR) or state equivalent rules: | |
| | (a) Municipal Solid Waste under 30 TAC Chapter 330 and 40 CFR Part 258 | $ 91,652,305 |
| | (b) Hazardous waste treatment, storage and disposal facilities under 30 TAC Chapter 335 and 40 CFR Parts 264 and 265 | NONE |
| | (c) Petroleum underground storage tanks under 30 TAC Chapter 334 and 40 CFR Part 280 | 1,000,000 |
| | (d) Underground Injection Control System facilities under 30 TAC Chapter 331 and 40 CFR Part 144 | NONE |
| | (e) Polychlorinated biphenyl (PCB) commercial storage facilities under 40 CFR Part 761 | NONE |
| | (f) Additional environmental obligations not shown above | NONE |
| | Total (a)-(f) | $ 92,652,305 |
| *6. | Total Annual Revenue | $ 625,429,832 |

Indicate either "yes" or "no" to the following questions.

| | | |
|---|---|---|
| 7. | Is line 2 divided by line 3 greater than or equal to 0.05? | yes |
| 8. | Is line 4 divided by line 3 less than or equal to 0.20? | yes |
| 9. | Is line 5 divided by line 6 less than or equal to 0.43? | yes |

BOND RATING INDICATOR OF FINANCIAL STRENGTH

| | | | |
|---|---|---|---|
| 1. | Sum of current cost estimates (total of all cost estimates shown in the paragraphs above) | $ | 92,652,305 |
| 2. | List the following information on all the outstanding, rated, unsecured general obligation bonds issued to the local government: | | |
| | Current bond rating of most recent issuance and name of rating service | | Fitch AA / S&P AA |
| | Date of issuance of bond | | 11/1/2010 |
| | Date of maturity of bond | | 8/15/2025 |
| 3. | Environmental obligations assured by a financial test to demonstrate financial assurance in the following amounts under commission regulations and the Code of Federal Regulations (CFR) or state equivalent rules: | | |
| | (a) Municipal Solid Waste under 30 TAC Chapter 330 and 40 CFR Part 258 | $ | 91,652,305 |
| | (b) Hazardous waste treatment, storage and disposal facilities under 30 TAC Chapter 335 and 40 CFR Parts 264 and 265 | | NONE |
| | (c) Petroleum underground storage tanks under 30 TAC Chapter 334 and 40 CFR Part 280 | | 1,000,000 |
| | (d) Underground Injection Control System facilities under 30 TAC Chapter 331 and 40 CFR Part 144 | | NONE |
| | (e) PCB commercial storage facilities under 40 CFR Part 761 | | NONE |
| | (f) Additional environmental obligations not shown above | | NONE |
| | Total (a)-(f) | $ | 92,652,305 |
| *4. | Total Annual Revenue | $ | 625,429,832 |

Indicate either "yes" or "no" to the following question.

| | | |
|---|---|---|
| 5. | Is line 3 divided by line 4 less than or equal to 0.43? | yes |

I hereby certify that the wording of this letter is identical to the wording specified in 30 TAC section 37.371 as such regulations were constituted on the date shown immediately below. I further certify the following: that the local government's financial statements are prepared in conformity with Generally Accepted Accounting Principles for governments, including conformance with General Accounting Standards Board Statement 18, and its financial statements have been audited by an independent Certified Public Accountant (CPA); that the local government has not operated at a deficit equal to 5.0% or more of total annual revenue in each of the past two fiscal years; that the local government is not in default on any outstanding general obligation bonds; that the local government does not have outstanding general obligations rated lower than Baa as issued by Moody's or BBB as issued by Standard and Poor's; and that the local government has not received an adverse opinion, disclaimer of opinion, or other qualified opinion from the independent CPA.

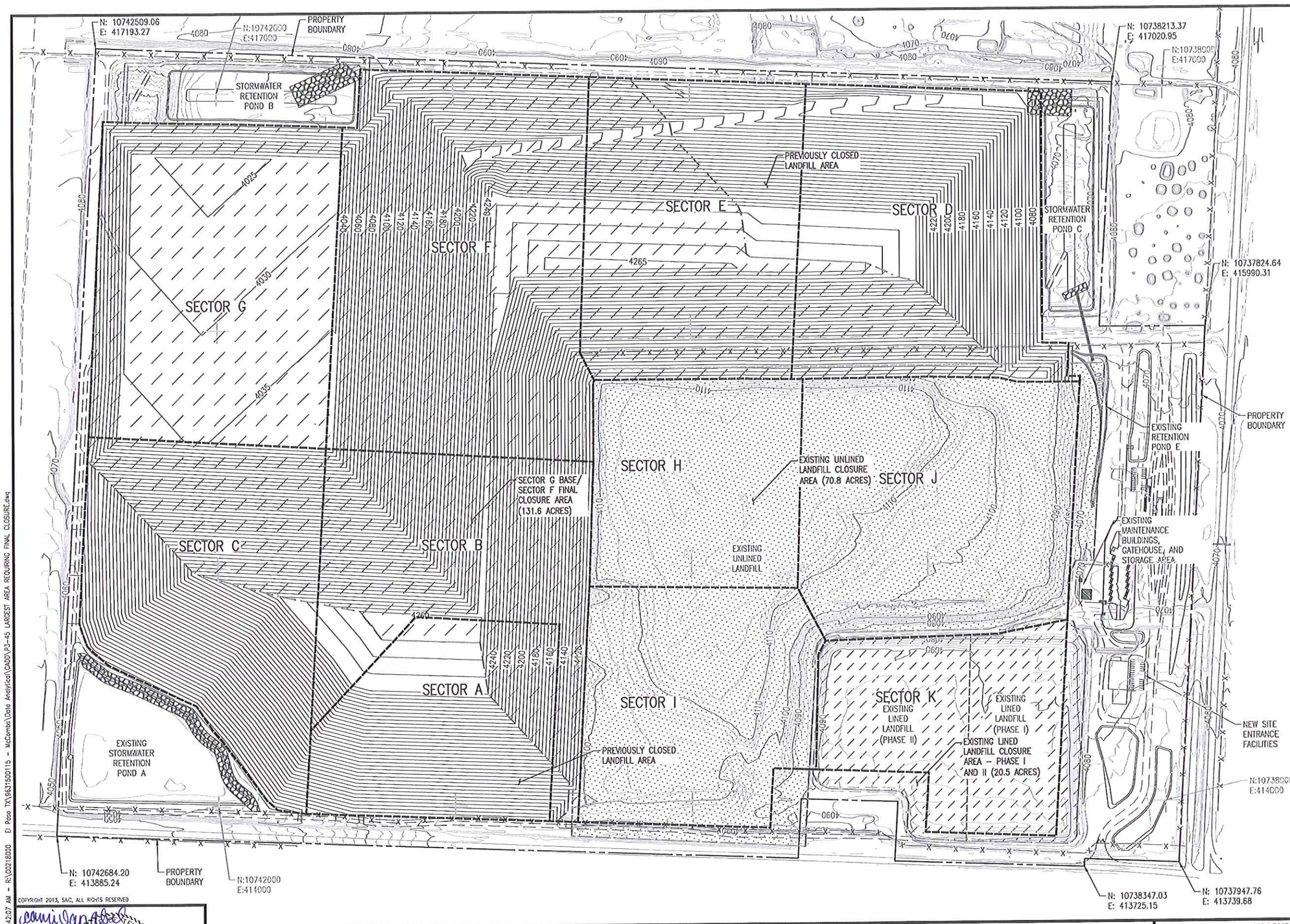
Carmen Arrieta Candelaria

Carmen Arrieta-Candelaria, CPA
Chief Financial Officer, City of El Paso

March 27, 2012

# Appendix 3N – Attachment 4
# Largest Area Requiring Final Cover

SAIC®




## NOTES

1. THE LARGEST AREA OPEN AREA AT ANY GIVEN TIME THAT WOULD REQUIRE FINAL CLOSURE IS DURING SECTOR F FINAL ELEVATIONS/SECTOR G DEVELOPMENT. THE AREA THAT REQUIRE CLOSURE DURING THIS TIME IS 152.1 ACRES REQUIRING FINAL COVER WITH A GEOMEMBRANE LINER (SECTORS A THROUGH G, PLUS THE EXISTING LINED AREA – PHASE I AND II) AND 70.8 ACRES REQUIRING FINAL COVER WITHOUT A GEOMEMBRANE LINER (EXISTING UNLINED AREA).

   IT SHOULD BE NOTED THAT THIS AREA ANALYSIS IS ONLY APPLICABLE FOR DETERMINING THE LARGEST AREA OPEN AT ANY TIME FOR FINANCIAL ASSURANCE. IT IS NOT THE INTENT TO CLOSE THE EXISTING UNLINED AREA PRIOR TO PLACING THE PIGGY BACK LINER (REFER TO DRAWING P3-33B FOR THE FINAL CLOSURE AREA ANALYSIS). THE FINAL COVER IS PROVIDED TO THE EXISTING AND FUTURE LANDFILL LIMITS (I.E., EXISTING UNLINED AREA AND EXISTING PHASE I/II). THE PROPOSED SECTORS ARE INSIDE THE CURRENT WASTE BOUNDARY LIMITS TO COMPLY WITH THE 125-FOOT BUFFER REQUIREMENT.

   THE AREAS OF SECTORS A, C, D AND E THAT ARE INDICATED AS PREVIOUSLY CLOSED ARE THE AREAS ANTICIPATED TO ALREADY BE CLOSED AT THE TIME OF SECTOR G DEVELOPMENT.

2. CONTOURS SHOWN IN SECTORS A THROUGH H REPRESENT THE DESIGNED PHASING CONTOURS. DESIGN CONTOUR INTERVAL IS FIVE FEET.
3. DIGITIZED TOPOGRAPHY FROM AERIAL SURVEY COMPLETED IN FEBRUARY 2011 BY COOPER AERIAL SURVEYS COMPANY, TUCSON, AZ. TOPOGRAPHY PROVIDED BY FRANK X. SPENSER & ASSOCIATES, INC., EL PASO, TEXAS.
4. COORDINATES ARE BASED ON THE TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NAD 83. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM. NAVD 88 DATUM TO NGVD 29 DATUM, SUBTRACT 1.99-FEET. NGVD 29 DATUM TO CITY OF EL PASO DATUM, ADD 27.65-FEET.
5. EXISTING CONTOUR INTERVAL IS TWO FEET.
6. SITE TOPOGRAPHY MAY VARY DUE TO OWNER'S OPERATIONS.

## LEGEND

- AREA REQUIRING FINAL COVER WITH A GEOMEMBRANE LINER OR ALTERNATIVE COVER
- AREA REQUIRING FINAL COVER WITHOUT A GEOMEMBRANE LINER
- BUILDING/STRUCTURE
- RIPRAP
- 4050 — ELEVATION CONTOURS
- FACILITY/PROPERTY BOUNDARY
- EXISTING SECTOR BOUNDARIES
- FUTURE SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- LANDFILL ACCESS ROAD
- CLOSURE DELINEATION BOUNDARY

GRAPHIC SCALE

1"=200'-0" Scale: 200 0 200 400 Feet

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CAMI VAN ABEL
STATE OF TEXAS
113723
REGISTERED PROFESSIONAL ENGINEER
3/15/13

| DESIGNED | DRAWN | VERIFY SCALE |
|---|---|---|
| TLK | CAD | BAR IS ONE INCH ON ANSI "D" DRAWING (0 — 1") |

| REV | DATE | CHK'D | APP'D | REVISION DESCRIPTION |
|---|---|---|---|---|
| 3 | 3/15/13 | TLK | CAV | THIRD TECHNICAL NOD |
| 2 | 11/2/12 | TLK | FJD | SECOND TECHNICAL NOD |
| 1 | 8/9/12 | TLK | FJD | FIRST TECHNICAL NOD |
| 0 | 11/22/11 | FJD | SEK | MAJOR PERMIT AMENDMENT |

THE CITY OF EL PASO TEXAS

SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve
Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

LARGEST AREA REQUIRING FINAL CLOSURE

PROJECT NUMBER: 9631500115
SHT. 78 OF: 78
DRAWING NUMBER: P3-45

Rev. Jacob S. 3/13/2013 10:42:07 AM - R:\00218000 El Paso TX\9631500115 - McCombs\Data Analysis\CAD\P3-45 LARGEST AREA REQUIRING FINAL CLOSURE.dwg

# Appendix 3O
# Post-Closure Details

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**Table 1 - Post-Closure Cost Estimate, McCombs Landfill with Vegetation**

| Description | Unit | Quantity | Unit Cost | Total |
|---|---|---|---|---|
| 1 - Site Inspection | | | | |
| Visual Inspections/Reporting | HR | 96 | $ 60.75 | $ 5,832 |
| Subtotal Site Inspection | | | | $ 5,832 |
| 2 - General Site Maintenance | | | | |
| Perimeter Fence & Gates | LS | 1 | $ 1,215.00 | $ 1,215 |
| Access Roads | LS | 1 | $ 2,430.00 | $ 2,430 |
| Vegetation | LS | 1 | $ 1,215.00 | $ 1,215 |
| Illegal Dumping Control | HR | 192 | $ 60.75 | $ 11,664 |
| Subtotal General Site Maintenance | | | | $ 16,524 |
| 3 - Final Cover System Maintenance | | | | |
| Drainage Improvements/Repairs | | | | |
| Labor | HR | 144 | $ 59.15 | $ 8,518 |
| Heavy Equipment | HR | 72 | $ 121.50 | $ 8,748 |
| Erosion Control Maintenance | AC | 277 | $ 145.80 | $ 40,387 |
| Vegetation | LS | 1 | $ 4,860.00 | $ 4,860 |
| Subtotal Final Cover System Maintenance | | | | $ 62,512 |
| 4 - Environmental Control System Maintenance | | | | |
| LFG System Maintenance | LS | 1 | $ 2,366.00 | $ 2,366 |
| LFG System Operations | LS | 1 | $ 5,915.00 | $ 5,915 |
| Groundwater Monitoring Well Maintenance | LS | 1 | $ 1,822.50 | $ 1,823 |
| Stormwater System | LS | 1 | $ 1,822.50 | $ 1,823 |
| Leachate System | LS | 1 | $ 6,075.00 | $ 6,075 |
| Leachate Disposal | GAL | 50,000 | $ 0.06 | $ 3,038 |
| Subtotal Environmental Control System Maintenance | | | | $ 21,039 |
| 5 - Environmental Monitoring | | | | |
| Groundwater | | | | |
| Sampling/Analysis (each well semi-annually) | EA | 6 | $ 1,822.50 | $ 10,935 |
| Evaluation and Reporting | LS | 1 | $ 2,430.00 | $ 2,430 |
| Landfill gas | EA | 4 | $ 1,215.00 | $ 4,860 |
| Surface water | EA | 4 | $ 1,458.00 | $ 5,832 |
| Subtotal Environmental Monitoring | | | | $ 24,057 |
| Subtotal | | | | $ 129,964 |
| 6 - Engineering Support | | | 10% | $ 12,996 |
| 7 - Contingency | | | 10% | $ 12,996 |
| Annual Post-Closure Costs | | | | $ 155,956 |
| 30-Year Post-Closure Costs (Present Value)* | | | | $ 4,678,693 |

| Description | Unit | Quantity | Unit Cost | Total |
|---|---|---|---|---|
| 8 - Abandonment of Monitoring Systems | | | | |
| Abandonment | EA | 3 | $ 4,258.80 | $ 12,776 |
| 9 - Contingency | | | 10% | $ 1,278 |
| Costs of Post-Closure Well Abandonment (Present Value)* | | | | $ 12,145 |

| | |
|---|---|
| **Total Post-Closure Costs (Present Value)*** | $ 4,690,838 |
| **Total Post-Closure Costs per Acre (Present Value)*** | $ 16,934 |

*Present value calculations assume that the savings rate equals the inflation rate.

| | |
|---|---|
| Total Acres | 277 |
| | |
| Lump Sum | LS |
| Hours | HR |
| Acres | AC |
| Each | EA |
| Gallon | GAL |

**Table 2 - Post-Closure Cost Estimate, McCombs Landfill with Rock Armoring on Side Slopes**

| Description | Unit | Quantity | Unit Cost | Total |
|---|---|---|---|---|
| 1 - Site Inspection | | | | |
| Visual Inspections/Reporting | HR | 96 | $ 60.75 | $ 5,832 |
| Subtotal Site Inspection | | | | $ 5,832 |
| 2 - General Site Maintenance | | | | |
| Perimeter Fence & Gates | LS | 1 | $ 1,215.00 | $ 1,215 |
| Access Roads | LS | 1 | $ 2,430.00 | $ 2,430 |
| Vegetation | LS | 1 | $ 1,215.00 | $ 1,215 |
| Illegal Dumping Control | HR | 192 | $ 60.75 | $ 11,664 |
| Subtotal General Site Maintenance | | | | $ 16,524 |
| 3 - Final Cover System Maintenance | | | | |
| Drainage Improvements/Repairs | | | | |
| Labor | HR | 144 | $ 59.15 | $ 8,518 |
| Heavy Equipment | HR | 72 | $ 121.50 | $ 8,748 |
| Erosion Control Maintenance | AC | 80 | $ 145.80 | $ 11,664 |
| Vegetation | LS | 1 | $ 1,215.00 | $ 1,215 |
| Subtotal Final Cover System Maintenance | | | | $ 30,145 |
| 4 - Environmental Control System Maintenance | | | | |
| LFG System Maintenance | LS | 1 | $ 2,366.00 | $ 2,366 |
| LFG System Operations | LS | 1 | $ 5,915.00 | $ 5,915 |
| Groundwater Monitoring Well Maintenance | LS | 1 | $ 1,822.50 | $ 1,823 |
| Stormwater System | LS | 1 | $ 1,822.50 | $ 1,823 |
| Leachate System | LS | 1 | $ 6,075.00 | $ 6,075 |
| Leachate Disposal | GAL | 50,000 | $ 0.06 | $ 3,038 |
| Subtotal Environmental Control System Maintenance | | | | $ 21,039 |
| 5 - Environmental Monitoring | | | | |
| Groundwater | | | | |
| Sampling/Analysis (each well semi-annually) | EA | 6 | $ 1,822.50 | $ 10,935 |
| Evaluation and Reporting | LS | 1 | $ 2,430.00 | $ 2,430 |
| Landfill gas | EA | 4 | $ 1,215.00 | $ 4,860 |
| Surface water | EA | 4 | $ 1,458.00 | $ 5,832 |
| Subtotal Environmental Monitoring | | | | $ 24,057 |
| Subtotal | | | | $ 97,596 |
| 9 - Engineering Support | | | 10% | $ 9,760 |
| 10 - Contingency | | | 10% | $ 9,760 |
| Annual Post-Closure Costs | | | | $ 117,115 |
| 30-Year Post-Closure Costs (Present Value)* | | | | $ 3,513,460 |

| Description | Unit | Quantity | Unit Cost | Total |
|---|---|---|---|---|
| 11 - Abandonment of Monitoring Systems | | | | |
| Abandonment | EA | 3 | $ 4,258.80 | $ 12,776 |
| 12 - Contingency | | | 10% | $ 1,278 |
| Costs of Post-Closure Well Abandonment (Present Value)* | | | | $ 12,145 |

| | |
|---|---|
| **Total Post-Closure Costs (Present Value)*** | $ 3,525,605 |
| **Total Post-Closure Costs per Acre (Present Value)*** | $ 12,728 |

*Present value calculations assume that the savings rate equals the inflation rate.

| | |
|---|---|
| Total Acres | 277 |
| | |
| Lump Sum | LS |
| Hours | HR |
| Acres | AC |
| Each | EA |
| Gallon | GAL |

**Table 3 - Post-Closure Cost Estimate, McCombs Landfill with ET Cap**

| Description | Unit | Quantity | Unit Cost | Total |
|---|---|---|---|---|
| 1 - Site Inspection | | | | |
| Visual Inspections/Reporting | HR | 96 | $ 60.75 | $ 5,832 |
| | | | Subtotal Site Inspection | $ 5,832 |
| 2 - General Site Maintenance | | | | |
| Perimeter Fence & Gates | LS | 1 | $ 1,215.00 | $ 1,215 |
| Access Roads | LS | 1 | $ 2,430.00 | $ 2,430 |
| Vegetation | LS | 1 | $ 1,215.00 | $ 1,215 |
| Illegal Dumping Control | HR | 192 | $ 60.75 | $ 11,664 |
| | | | Subtotal General Site Maintenance | $ 16,524 |
| 3 - Final Cover System Maintenance | | | | |
| Drainage Improvements/Repairs | | | | |
| Labor | HR | 144 | $ 59.15 | $ 8,518 |
| Heavy Equipment | HR | 72 | $ 121.50 | $ 8,748 |
| Erosion Control Maintenance | AC | 0 | $ 145.80 | $ - |
| | | | Subtotal Final Cover System Maintenance | $ 17,266 |
| 4 - Environmental Control System Maintenance | | | | |
| LFG System Maintenance | LS | 1 | $ 2,366.00 | $ 2,366 |
| LFG System Operations | LS | 1 | $ 5,915.00 | $ 5,915 |
| Groundwater Monitoring Well Maintenance | LS | 1 | $ 1,822.50 | $ 1,823 |
| Stormwater System | LS | 1 | $ 1,822.50 | $ 1,823 |
| Leachate System | LS | 1 | $ 6,075.00 | $ 6,075 |
| Leachate Disposal | GAL | 50,000 | $ 0.06 | $ 3,038 |
| | | | Subtotal Environmental Control System Maintenance | $ 21,039 |
| 5 - Environmental Monitoring | | | | |
| Groundwater | | | | |
| Sampling/Analysis (each well semi-annually) | EA | 6 | $ 1,822.50 | $ 10,935 |
| Evaluation and Reporting | LS | 1 | $ 2,430.00 | $ 2,430 |
| Landfill gas | EA | 4 | $ 1,215.00 | $ 4,860 |
| Surface water | EA | 4 | $ 1,458.00 | $ 5,832 |
| | | | Subtotal Environmental Monitoring | $ 24,057 |
| | | | Subtotal | $ 84,717 |
| 9 - Engineering Support | | | 10% | $ 8,472 |
| 10 - Contingency | | | 10% | $ 8,472 |
| | | | Annual Post-Closure Costs | $ 101,661 |
| | | | 30-Year Post-Closure Costs (Present Value)* | $ 3,049,816 |

| Description | Unit | Quantity | Unit Cost | Total |
|---|---|---|---|---|
| 11 - Abandonment of Monitoring Systems | | | | |
| Abandonment | EA | 3 | $ 4,258.80 | $ 12,776 |
| 12 - Contingency | | | 10% | $ 1,278 |
| | | | Costs of Post-Closure Well Abandonment (Present Value)* | $ 12,145 |

| | |
|---|---|
| **Total Post-Closure Costs (Present Value)*** | $ 3,061,961 |
| **Total Post-Closure Costs per Acre (Present Value)*** | $ 11,054 |

*Present value calculations assume that the savings rate equals the inflation rate.

| | |
|---|---|
| Total Acres | 277 |
| | |
| Lump Sum | LS |
| Hours | HR |
| Acres | AC |
| Each | EA |
| Gallon | GAL |

# Appendix 3P
# Final Cover Quality Control Plan

SAIC®

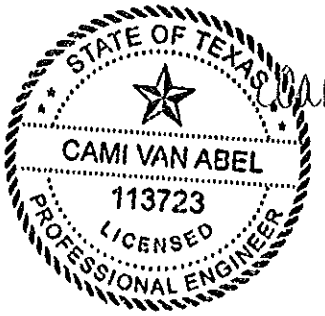
# McCombs Municipal Landfill
# El Paso County, Texas
# TCEQ MSW Permit No. 729B

# Part III
# Appendix 3P
# Final Cover Quality Control Plan

Prepared for

**City of El Paso**

Updated June 2013, Revision 2




Cami Vanabel
6/13/13

Prepared by

**SAIC**
5806 Mesa Drive, Suite 310 ♦ Austin, Texas 78731 ♦ 512.450.0991

Texas Board of Professional Engineers
Firm Registration No. 3823

# Part III

# Appendix 3P – Final Cover Quality Control Plan

## City of El Paso

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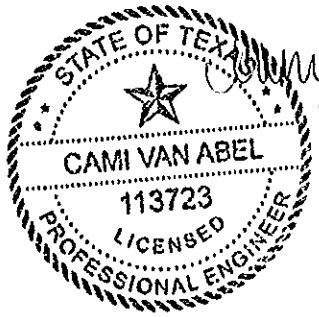


# Appendix 3P
# Final Cover Quality Control Plan
30 TAC §330.457

## 3P.1 Introduction

This Final Cover Quality Control Plan (FCQCP) has been prepared in accordance with 30 TAC §330.457. The purpose of the FCQCP is to determine by direct inspection and testing that the project installation and construction complies with contract requirements and current Texas Commission on Environmental Quality (TCEQ) rules.

This FCQCP includes construction quality assurance (CQA) procedures for both the conventional, prescriptive final cover and the alternative evapotranspiration (ET) cover. The conventional, prescriptive final cover for the Landfill includes (in descending order):

- 6-inch thick topsoil or 4-inch thick rock armor
- 12-inch thick erosion layer
- 40 mil LLDPE geomembrane
- 18-inch thick infiltration layer
- 12-inch thick daily/intermediate cover layer

The ET cover for the Landfill includes (in descending order):

- 4-inch thick rock armor
- 18-inch thick erosion layer
- 6-inch thick support layer
- 12-inch thick daily/intermediate cover layer

The purpose of the FCQCP will be to determine by direct inspection and testing that the project installation and construction complies with the contract requirements and applicable regulations and guidelines. The FCQCP will generally consist of:

- Review of contractor, geosynthetic manufacturer and geosynthetic installer (where applicable) qualifications;
- Review of shop drawings;
- Documentation of construction progress and testing by experienced professionals;
- A laboratory and field testing program for measuring performance standards of soils and geosynthetics; and,
- Meetings with the Contractor, Owner, and Owner's Representative (OR).

The Construction Quality Assurance Professional of Record (POR) will be responsible for all CQA activities for the project. The POR must be registered as a Professional Engineer in Texas. The POR must also have competency and experience in similar projects.

The OR will be responsible for the implementation of field inspection and testing activities. The Contractor, with oversight by the OR, will obtain soil and geosynthetic samples for third-party analysis. Laboratory and field tests are identified in Table 3P-1. The table presents testing requirements for pre-construction borrow source acceptance, placement requirements and post-placement requirements, where applicable. Additional tests may be required or recommended by the POR/OR prior to material acceptance. Minimum passing criteria may be modified based on the site design considerations (i.e. available borrow source material, unforeseen site conditions) during the preparation of the project plans and specifications. Other tests and services normally provided by inspection and testing agencies may also be conducted as the POR/OR directs.

The CQA Program also includes a pre-construction meeting and regularly scheduled meetings with the Contractor and subcontractors to review contract requirements and maintain communication among involved parties. Shop drawing review will complete the quality assurance/quality control (QA/QC) process of verifying that the equipment and material proposed by the Contractor meets the requirements of the Contract Documents. Shop drawing requirements will be included in the technical specifications and are not included in this permit modification.

Table 3P.1
Laboratory and Field QA/QC Testing

| | Material | Test | Test Method | Minimum Test Frequency | Minimum Passing Requirements |
|---|---|---|---|---|---|
| 1. | INFILTRATION LAYER (PRESCRIPTIVE) | | | At Borrow Source | |
| | | Plasticity Index | ASTM D 4318 | 1 Test/Source | PI: ≥ 15 |
| | | Liquid Limit | ASTM D 4318 | 1 Test/Source | LL: ≥ 30 |
| | | Particle Size Distribution | ASTM D 422<br>ASTM D 1140 | 1 Test/Source | 100% Passing 1”<br>Min 30% Passing #200 |
| | | Moisture/Density Relationship | ASTM D 698 | 1 Test/Source | NA |
| | | Permeability | ASTM D 5084 | 1 Test/Source | Coefficient of Permeability: ≤ 1 x $10^{-5}$ |
| | | | | In-Place Soil Testing | |
| | | In-Place Soil Density | ASTM D 6938 | 1/8,000 SF per 6-in Lift | ≥ 95% Max Dry Density |
| | | Plasticity Index | ASTM D 4318 | 1 Test/Acre | PI: ≥ 15 |
| | | Liquid Limit | ASTM D 4318 | 1 Test/Acre | LL: ≥ 30 |
| | | Permeability | ASTM D 5084 | 1 Test/Acre | Coefficient of Permeability: ≤ 1 x $10^{-5}$ |
| 2. | GEOMEMBRANE (PRESCRIPTIVE) | | | Material Conformance | |
| | | Specific Gravity (Relative Density) | ASTM D 792 | 1/100,000 SF or 1/lot | LLDPE: 0.935 g/$cm^3$ |
| | | Sheet Thickness | ASTM D 5994 (textured) | 1/100,000 SF or 1/lot | LLDPE: 40 mil ± 10% |
| | | Tensile Strength Break | ASTM D 638<br>NSF Modified | 1/100,000 SF or 1/lot | LLDPE: 60 lb/in |
| | | Elongation at Break | ASTM D 638<br>NSF Modified | 1/100,000 SF or 1/lot | LLDPE: ≥250% |
| | | Carbon Black Content | ASTM D 3015/1603<br>NSF Modified | 1/100,000 SF or 1/lot | A1 |
| | | | | Seam | |
| | | Shear Strength | ASTM D 4437 | 1/500 feet of seam length | LLDPE: ≥60 lb/in |
| | | Peel Strength | ASTM D 4437 | 1/500 feet of seam length | LLDPE (Extrusion): ≥44 lb/in<br>LLDPE (Wedge): ≥50 lb/in |

Table 3P.1
Laboratory and Field QA/QC Testing

| | Material | Test | Test Method | Minimum Test Frequency | Minimum Passing Requirements |
|---|---|---|---|---|---|
| 3. | EROSION LAYER (PRESCRIPTIVE) | | | At Borrow Source | |
| | | Particle Size Distribution | ASTM D 422 | 1 Test/Source | NA |
| | | Soil Classification | ASTM D 2487 | 1 Test/Source | NA |
| | | Permeability | AST D 2434 | 1 Test/Source | ≥5.8 x$10^{-3}$ cm/sec |
| | | Direct Shear | ASTM D 3080 | 1 Test/Source | ≥31° for internal friction angle |
| | | Large-Scale Direct Shear | ASTM D 5321 | 1 Test/Source | ≥28° interface friction angle between the erosion layer and the 40 mil LLDPE geomembrane layer |
| 4. | TOPSOIL (PRESCRIPTIVE) | | | At Borrow Source | |
| | | Particle Size Distribution | ASTM D 422 | 1 Test/Source | Min 90% Passing #10 |
| | | Soil Classification | ASTM D 2487 | 1 Test/Source | NA |
| 5. | EROSION/ SUPPORT LAYER (ALTERNATIVE) | | | At Borrow Source | |
| | | Particle Size Distribution | ASTM D 422 | 1 Test/Soil Type | Maximum particle size ≤2 inches |
| | | Soil Classification | ASTM D 2487 | 1 Test/1,000 CY | Classification as silty sand with gravel (SM main classification) so that other properties will be similar to those assumed in design and modeling. |
| | | Permeability | ASTM D 2434 | 1 Test/Soil Type | ≤6.6 x$10^{-3}$ cm/sec for erosion layer<br>≤1.3 x$10^{-3}$ cm/sec for support layer |
| | | Moisture Density Relationship | ASTM D 698 | 1 Test/Soil Type | Used for placement testing of density and moisture content. Samples are remolded to 90% (for erosion) or 80% (for support) for the placement testing to match the ET cover construction requirements. |
| | | Moisture Content | ASTM D 2216 | 1 Test/Soil Type | The moisture content must meet the required values so that at re-compacted densities the moisture retention characteristics meet ET cover construction requirements. |
| | | Direct Shear | ASTM D 3080 | 1 Test/Soil Type | ≥27° for internal friction angle for both 80% and 90% |

Table 3P.1
Laboratory and Field QA/QC Testing

| | Material | Test | Test Method | Minimum Test Frequency | Minimum Passing Requirements |
|---|---|---|---|---|---|
| 5. | EROSION/ SUPPORT LAYER (ALTERNATIVE) | | | During Placement | |
| | | Permeability (Large Block) | ASTM D7015 and D5084 | 1 Test/lift<br>1 Test/10,000 CY | ≤6.6 x$10^{-3}$ cm/sec for erosion layer<br>≤1.3 x$10^{-3}$ cm/sec for support layer |
| | | In-Place Soil Density | ASTM D 6938 | 1 Test/50,000 $ft^2$/lift | 80% Max Dry Density for Support Layer; 90% Max Dry Density for Erosion Layer |

## 3P.2 Prescriptive Final Cover System

The following provides a general sequencing plan for the prescriptive final cover system installation for the Landfill areas that include a synthetic bottom liner:

- Apply the final six inches of daily cover, and if not closed within 180 days apply six inches of intermediate cover;
- Place 18 inches of earthen material (with a coefficient of permeability less than or equal to 1 X $10^{-5}$ cm/sec) that will serve as the infiltration layer;
- Place 40 mil LLDPE geomembrane;
- Place 12 inches of earthen material that will serve as the erosion layer;
- Place the 6 inch minimum earthen vegetative layer that is capable of supporting and sustaining native plant growth (or place 4 inches of crushed rock or river rock armoring in lieu of 6 inch earthen vegetative layer); and
- Refer to Drawing P3-34 in Appendix 3G for details of this final cover system design.

The following provides a general sequencing plan for the prescriptive final cover system installation for the McCombs Landfill areas that do not include a synthetic bottom liner:

- Apply the final six inches of daily cover, and if not closed within 180 days apply six inches of intermediate cover;
- Place 18 inches of earthen material (with a coefficient of permeability less than or equal to 1 X $10^{-5}$ cm/sec) that will serve as the infiltration layer;
- Place the 6 inch minimum earthen vegetative layer that is capable of supporting and sustaining native plant growth (or place 4 inches of crushed rock or river rock armoring in lieu of 6 inch earthen vegetative layer);
- Refer to Drawing P3-34 in Appendix 3G for details of this final cover system design.

### 3P.2.1 Infiltration Layer

The infiltration layer is 18-inches thick and placed above the intermediate cover layer (refer to details). This layer shall be composed of soil that is free of organics, fines and debris and be a cohesive material capable of achieving a coefficient of permeability less than or equal 1 X $10^{-5}$ cm/sec. The infiltration layer shall be placed in maximum 8-inch loose lifts and compacted to a thickness of approximately 6-inches.

Field testing and inspection of the infiltration layer shall consist of:

- Observation to ensure the infiltration layer is as specified and that it does not contain objects that would damage or alter the overlying geomembrane.
- Observation to ensure the infiltration layer is graded smooth and free of depressions that could potentially cause damage to the geomembrane.

- Measurements of the surface elevation of each lift through field survey.
- Observation of the compaction process and testing of the compacted layer to ensure compliance with the specifications.

### 3P.2.2 Geomembrane Layer

The FCQCP requires that the geomembrane manufacturer and installer present qualifications. The qualifications will be evaluated to determine the potential ability of the manufacturer and installer to meet the technical specifications and applicable regulations and guidelines. The evaluation will be based on the following criteria:

- Sufficient production capacity and qualified personnel to meet the demands of the work.
- Approval or licensing of the geomembrane installer by the geomembrane manufacturer.
- Proven qualifications by personnel performing the seaming operation by successfully passing seaming tests.
- A minimum of one million square feet (SF) of experience by the Master Seamer seaming geomembrane using the same type of seaming apparatus to be used for this work.

During construction, the OR will observe the construction procedures used for installation of the geomembrane liner and document the construction using field notes, surveys, and photographs. Field and laboratory testing as well as passing criteria of the geomembrane are specified in Table 3P.1.

#### *3P.2.2.1 Geomembrane Placement*

Field testing and inspection of the geomembrane installation will include:

- Receipt of certification signed by the Contractor and Installer stating the prepared surface is satisfactory.
- Receipt of manufacturer's certification that material meets specifications.
- Visual inspection of the storage area for the geomembrane material to ensure the area has a stable surface that is well drained.
- Visual inspection of material handling upon delivery to the Landfill.
- Visual inspection of material for damage upon receipt and for manufacturer's identification to verify the proper material was received. Non-conforming damaged material will be immediately segregated and tagged "Do Not Use."
- Visual inspection of prepared subgrade for rocks, other foreign material, and general condition prior to installation of the geomembrane; including receipt of subgrade certification by installer.
- Observation to ensure the geomembrane placement plan (as approved in the shop drawing submittal) was followed.

- Observation to ensure the unrolled geomembrane has adequate and appropriate ballast to prevent uplift from the wind without causing damage to the geomembrane.
- Observation of the weather conditions (i.e., temperature, humidity, precipitation, and wind) to ensure they are acceptable for geomembrane placement and seaming.
- Inspection to ensure the leading edge excavation of the anchor trench excavation is rounded and the dimensions are as specified.
- Inspection to verify proper slack is incorporated into liner sheet installation.
- Completion of applicable forms.

#### *3P.2.2.2 Geomembrane Seaming*

The FCQCP for geomembrane seaming included preparing trial seams prior to seaming each day as well as throughout the day, inspection and testing of field seams, and repairing seams that fail testing criteria.

Trial seams should be performed three times daily for each welding machine: before the day's field seaming begins, and once every four hours (a minimum of three times per day). Trial seam welds will be inspected by liner manufacturer's site personnel to allow for determination of the optimum welding process parameters based on the prevailing ambient conditions. Trial welds should be at least five feet long, and 1½-feet wide. Each trial weld should be marked with the date, time, ambient temperature, number of seaming unit, name of seamer, pass or fail designation, and peel and sheer strength values. The peel and sheer strength values are to be determined using the installer's supplied digital electronically operated tensiometer testing device operated by the installer's personnel and monitored by the OR. Three peel tests will be performed on each trial seam weld and recorded on the trial seam. The results will be documented and filed on the report forms, and each trial seam will be stored by the Owner until the Final Cover Evaluation Report is approved by the TCEQ.

The entire length of each field seam weld will be visually inspected immediately after production by the OR and the installer's representative. In addition, the entire length of each seam weld will be nondestructively tested and certified for continuity and water-tightness in the presence of the OR using air pressure or other appropriate methods. The results will be recorded daily on a Seam Testing Information form.

Destructive seam testing may be performed per the specification. The destructive test samples should be cut at least three feet in length and 1½-feet wide to provide three relatively equal samples: one for the independent laboratory to test in peel and shear; one for the installer to check in the field' and one for the Owner's archive sample. The seam should be field tested in peel at the time the sample is taken.

If the field test fails, the seam can either be reconstructed between the failed field test location and any previous passed seam location, or the installer can move to either side of the failed seam location (ten-foot minimum), and take another sample for field testing. If the sample passes the field test, a destructive sample is taken from that location and sent for laboratory tests. If the laboratory sample passes the test, the seam is reconstructed between the two passing tests. If the laboratory tests fail, the process is repeated until both the field and laboratory samples pass the tests at a

location. The seam is then reconstructed in this zone between two passed test reconstructed seams. All acceptable seams must be bound by two passed tests.

Any samples or in-place destructive testing of geomembrane will require that the area affected be repaired or replaced with material of equal or better quality. Such repair or placement is subject to the same nondestructive testing as other geomembrane liner seams.

To meet the seaming requirement discussed above, field testing and inspection of geomembrane seaming will include:

- Observation to ensure the seaming materials and equipment are as specified.
- Observation to ensure the start-up seams prepared by the installer and their testing meet the requirements of the specifications prior to actual seaming.
- Observation to ensure the geomembrane is free from dirt, dust, and moisture.
- Inspection to ensure the overlap of the sheets composing the seam is in conformance with specifications.
- Measurement of the curing time between seaming and seam testing to ensure that it is as specified (when applicable).
- Observation to ensure that all seams are free from visible discontinuities in the seam or any other noticeable defects. Defective areas shall be marked on the liner and on the construction inspection form. All defective areas are required to be repaired in accordance with the specifications.
- Observation of air pressure or other appropriate methods of nondestructively testing field seams to ensure the testing is completed as specified.
- Observation of destructive test sampling to ensure samples are taken at the location and frequency specified.
- Walk-through inspection of the liner after placement of the geomembrane to ensure that the geomembrane has not been damaged by equipment or personnel during the seaming process.
- Completion of applicable forms.

### 3P.2.3 Erosion Layer

The minimum thickness of the erosion layer will be 12-inches. This layer acts: 1) to minimize root penetration into the drainage barrier layers; and 2) to maximize evapotranspiration potential, adding stability to the topsoil layer.

Field testing and inspection of the erosion layer material will include:

- Observation during the placement process to ensure the Contractor's equipment does not damage the geomembrane and the minimum thickness of cover over the geomembrane is as specified for the type of equipment in use.
- Observation to ensure the erosion layer is as specified and does not contain objects that would damage or alter the underlying geomembrane.

- Measurement of the thickness of the erosion layer and observation to ensure the specified coverage is achieved as it is placed.

The OR shall ensure that the erosion layer is placed on top of the geomembrane in a manner that minimizes the potential to damage the geomembrane. The erosion layer will be spread in one lift and will not be compacted. Contractor shall track cleat marks perpendicular to slope direction. Contractor shall act to minimize wrinkles in the geomembrane during placement of the erosion layer.

### 3P.2.4 Topsoil Layer

The 6-inch topsoil provides a medium for establishing vegetation and storing moisture. This limits runoff from the final landfill surface and reduces infiltration rates to the underlying layers. The topsoil layer for the prescriptive final cover will not be compacted. All objectionable matter will be removed prior to placement of seed and fertilizer.

During construction, the OR inspection activities will include the following:

- Observation to ensure the uniformity of the application process.
- Observation to ensure the soil is not overly compacted during the placement procedure.
- Observation to ensure cobbles and other debris are removed from the topsoil.
- Survey of the thickness and slope of the topsoil layer.
- Completion of specified testing.
- Observation to ensure care is taken in the vicinity of gas extraction wells and other protrusions, to prevent damage by construction equipment.

## 3P.3 Alternative Final Cover

The following provides a general sequencing plan for the alternative final cover system installation for the McCombs Landfill areas (both with and without a synthetic bottom liner:

- Apply the final six inches of daily cover, and if not closed within 180 days apply six inches of intermediate cover;
- Apply 6 inches of support soil at 80% compaction (coefficient of permeability less than $6.6 \times 10^{-3}$ cm/sec;
- Apply 18 inches of erosion layer soil at 90% compaction (coefficient of permeability less than $1.3 \times 10^{-3}$ cm/sec;
- Apply 4 inches of rock armor;
- Refer to Drawing P3-35 - Alternative Cover Details, in Appendix 3G for details of this final cover system design.

Density testing is especially important during the placement of the ET cover materials to ensure parameters for soil water storage are met as anticipated in the ET design. IF a density test fails, additional tests may be performed to delineate the over or under compacted areas. The area(s) will be re-worked between passing test locations.

### 3P.3.1 Support Layer

The support layer is 6-inches thick and placed above the intermediate cover layer (refer to details). Pre-construction testing of the soils in this layer will be performed according to the schedule in Table 3P-1. This layer shall be composed of soil that is free of organics, fines and debris and be a cohesive material capable of achieving a maximum permeability of $6.6 \times 10^{-3}$ cm/sec. The support layer shall be placed in one loose lift and compacted to a thickness of 6-inches. The support layer for the alternative final cover shall be compacted to 80%. The OR will verify the soil being placed is of the same color, texture and physically observable characteristics as the material approved in the borrow source testing. Additional testing may be required of any changes in soil physical properties are observed during placement.

Field testing and inspection of the support layer shall consist of:

- Observation to ensure the uniformity of the application process.
- Observation to ensure the material is free of rocks greater than 2 inches in diameter and free of clods greater than 4 inches in diameter.
- Observation and testing to ensure the soil is compacted to specifications.
- Survey of the thickness and slope of the support layer.
- Completion of specified testing.
- Observation to ensure care is taken in the vicinity of gas extraction wells and other protrusions, to prevent damage by construction equipment.

### 3P.3.2 Erosion Layer

The 18-inch erosion layer is place directly on top of the support layer. The erosion layer for the alternative final cover shall have a maximum permeability of $1.3 \times 10^{-3}$ cm/sec and be compacted to 90%. The erosion layer shall be placed in 8-inch loose lifts and compacted to a thickness of approximately 6-inches.

During construction, the OR inspection activities will include the following:

- Observation to ensure the uniformity of the application process.
- Observation and testing to ensure the soil is compacted to specifications.
- Survey of the thickness and slope of the erosion layer.
- Completion of specified testing.
- Observation to ensure care is taken in the vicinity of gas extraction wells and other protrusions, to prevent damage by construction equipment.

### 3P.3.3 Rock Armor

The 4-inch rock armor layer shall be placed on top of the erosion layer. The rock armor will consist of graded material to provide an interlocking frame in order to help slope stability and minimize surface water erosion. The rock armor shall be placed in one lift.

During construction, the OR inspection activities will include the following:

- Observation to ensure the uniformity of the application process.

- Survey of the thickness and slope of the rock armor.
- Observation to ensure care is taken in the vicinity of gas extraction wells and other protrusions, to prevent damage by construction equipment.

## 3P.4 Documentation Procedures

### 3P.4.1 Document Control

The OR will be responsible for the overall administration and control of the project CQA documents. The OR will verify that a CQA filing and routing system is implemented, and includes:

- Final copy of the FCQCP;
- Field and laboratory test results of synthetic and soil materials;
- Certifications by material suppliers and contractors relating to the FCQCP;
- Photographic construction documentation;
- Daily field reports;
- Minutes of construction meetings; and
- Construction schedule.

A filing index will be prepared to expedite retrieval of documents.

### 3P.4.2 Project Files

Project files will be updated on a regular basis, as new data becomes available. All documents generated by the OR will be filed in both the project file and in the on-site CQA file. The Owner will receive copies of the appropriate file material. Record drawings and acceptance reports will be transmitted as part of the Final Cover Evaluation Report.

### 3P.4.3 Daily Field Report

The OR will complete a daily field report and submit his report to the POR at the end of each day. The daily field reports will be numbered consecutively, starting with the first day of construction activities. The daily field report will consist of a written description of the individual's activities, observations, discussions, and any problems or conflicts occurring during that day. The daily field report will also include a discussion/description of resolutions to problems or conflicts. The field report will emphasize date, time, and sequence of key events pertinent to the construction project. This report will be a narrative and will not be used to record construction documentation data.

### 3P.4.4 Project-Related Communications

Test data, lab results, verbal instructions, and/or changes to the design will be recorded on the appropriate forms.

All project-related directions, instructions, changes, deletions, additions, or any other discussions important to the project between the Contractor, the Owner, the POR, and the OR will be properly documented by a transmittal letter, memorandum, or electronic mail with copies distributed to and signed off by all concerned parties. The

OR will maintain a file of all such correspondence, which will be part of the project file.

Distribution of any information, reports, or data from the POR or OR will have a transmittal letter attached, and a copy of the distribution will be filed in the field by the OR and in the POR's office as part of the project file.

The OR will maintain a copy of the most current plans and specifications for the project and update as required. An index of the plans and specifications will be created and will include information that indicates the most current drawings or specifications.

The OR will copy and maintain a file of all construction meeting notes, including pre-construction, construction start-up, progress, scheduling, coordination, or weekly meetings.

The OR will maintain an up-to-date construction schedule. This schedule and updates will be provided by the Contractor.

### 3P.4.5 Construction Photographs

Construction photographs provide an effective record of the project and are used to complement daily field reports. The OR will record, by photograph, key construction activities. The OR will log all photos in the project file until such time as they are needed in the Final Cover Evaluation Report.

## 3P.5 Final Cover Evaluation Report

Upon completion of construction activities, a Final Cover Evaluation Report will be prepared and submitted to the TCEQ under the seal of a professional engineer registered in the State of Texas. The purpose of the Final Cover Evaluation Report is to document the testing procedures and construction methods used during construction and to ensure compliance with the FCQCP.

The Final Cover Evaluation Report shall include the following:

- A summary of all construction activities;
- A description of all significant issues that arose during construction and the solutions to these issues;
- Photographs of the various installation techniques and the completed installation for all construction activities;
- Geomembrane documentation procedures (for prescriptive cover only) including, but not limited to: record drawing of panel locations, seam locations, destructive testing locations, and field logs of seaming activities.
- A summary of all laboratory and field testing methods, results, and locations;
- As-built and record drawings (including layer thickness verifications);
- A statement documenting compliance with the FCQCP; and
- Signed and sealed by the POR, in accordance with the Texas Engineering Practice Act (§1001.401).

Report

# Major Permit Amendment – Part IV
# McCombs Municipal Landfill
# El Paso County, Texas
# TCEQ MSW Permit No. 729B

Prepared for: City of El Paso

Revised July 2013, Revision 5

SAIC

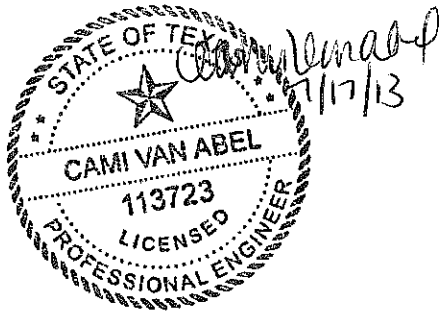
# McCombs Municipal Landfill
# El Paso County, Texas
# TCEQ MSW Permit No. 729B

# Major Permit Amendment Application
# Part IV

Prepared for

**City of El Paso**

Updated July 2013, Revision 5

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Texas Board of Professional Engineers
Firm Registration No. 3823

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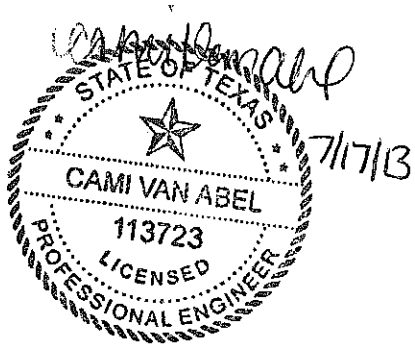


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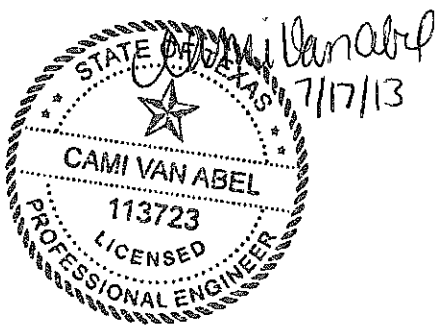

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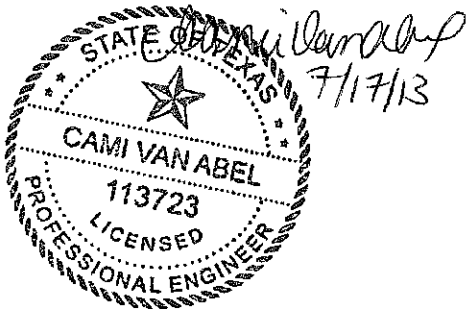


# Section 4.1
# SITE OPERATING PLAN INTRODUCTION
30 TAC §330.65

The Landfill is located approximately 20 miles northeast of downtown El Paso near the intersection of McCombs Road and Stan Roberts (FM 2529). The Landfill is owned and operated by the City of El Paso. The limits of the facility are approximately defined as McCombs Road to the west, Stan Roberts (FM 2529) to the south, State Highway / County Road 293 to the north, and vacant desert land to the east.

The Landfill was originally permitted on August 13, 1976 under Permit No. 729 for operation on 25 acres. A permit amendment was issued on May 30, 1984 which increased the total permitted area from 25 acres to 327 acres (327.292 acres in Section 6, Block 80, Township 1, Texas and Pacific Railway Survey, per the site legal description). The facility ceased regular solid waste disposal activities on February 3, 2005 and has only received limited waste since this time from City clean-up projects and storm events. Prior to landfilling operations, the site was owned by Prices Producers, Inc (Prices). The City of El Paso purchased the property from Prices in September 1954. The site was subsequently leased to El Paso Sand Products to be used for aggregate mining.

Previous landfill activities were confined to approximately 95 acres of land on the southwest quadrant of the permitted facility. A paved access road just north of the intersection of McCombs Road and Stan Roberts (FM 2529) provides access to the landfill facility.

The entrance facilities will include a scale house and scales, a public drop-off site, an above-ground fuel storage tank, an equipment maintenance building and employee parking. The entrance facility improvements will be located outside the permitted boundary, within land owned by the City of El Paso as shown on Drawing P3-17, Appendix 3E. No waste will be disposed of within this area. The land title was transferred to the City for the construction of the site improvements. The Texas Commission on Environmental Quality (TCEQ) will have jurisdiction for landfill improvements located outside of the permitted area. This MPA increases the permitted/facility area from 327.292 acres to 346.74 acres to include the entrance facilities within Section 6, Block 80, Township 1, Texas and Pacific Railway Survey.

The facility is located in a generally undeveloped area north of the City of El Paso. There are no drains or surface areas at the site known to be connected to navigable waters of the U.S. In general, the site topography of the entire Landfill is designed so as not to allow any run-off from the property. The site has been designed with retention ponds and stormwater diverters to restrict any outflows. The facility and surrounding areas exhibit a gradual slope to the southeast.

This Site Operating Plan (SOP) is intended to provide guidance from the design engineer to the site management and operating personnel. It will facilitate site operation in compliance with applicable TCEQ regulations and current standards of practice in the industry, compatible with the design of the facility. The Landfill

operations reflect current standards of practice in the solid waste industry and is compatible with the facility's permitted design. This SOP will also serve as a reference source and is to be used as a training tool for Landfill personnel.

Plans and procedures are referenced in this SOP that are either included as Attachments to the City's permit application or other permit documents. These documents as modified from time to time and approved by the TCEQ are made a part of this SOP by reference. Compliance with these plans and procedures is required by this SOP.

# Section 4.2
# RECORDKEEPING REQUIREMENTS
30 TAC §330.65

During the active life of the facility, a copy of the permit, the approved Site Development Plan, the Site Operating Plan, the Final Closure Plan, the Post-closure Maintenance Plan, the Landfill Gas Management Plan, and any other required plan or other related document will be maintained at the landfill facility and at the following location:

Environmental Services
City of El Paso
7968 San Paulo Dr.
El Paso, Texas 79907

During the inactive life of the facility, the above records will be maintained at the Environmental Services office only. These plans and documents are part of the Site Operating Record.

The following records will be also be kept, maintained and filed as part of a facilities' Site Operating Record at the landfill during the active life of the facility. Log books and schedules may be used to record these activities.

- Access Control Inspection and Maintenance
- Daily Litter Pickup
- Windblown Waste and Litter Control Operations
- Management and Disposal of Large Items
- Dust Nuisance Control Efforts
- Access Roadway Regrading
- Salvaged Material Storage Nuisance Control Efforts
- Special Waste Contingency Plan Compliance, if applicable
- Access Control Breach and Repair Notices, if applicable
- Fire Occurrence Notices, if applicable
- Documentation of Compliance with Approved Odor Management Plan
- Ponding Prevention Compliance Documentation
- Special Waste Operational Plan Compliance Documentation

In addition to the plans and documents listed above, the information listed in Table 4.2-1 will be recorded and retained in the Site Operating Record. This information will be placed in the Site Operating Record within seven working days of completion or receipt of analytical data, as appropriate. The Executive Director will be notified in writing annually of each significant addition to the Site Operating Record.

The Site Operating Record will be maintained in an organized format which allows the information to be easily located and retrieved. All information contained in the Site Operating Record will be furnished upon request to the TCEQ executive director and will be made available for inspection by the executive director.

All information contained within the Site Operating Record and the different required plans will be retained for the active life of the facility including the post-closure care period.

Table 4.2-1
Recordkeeping Schedule

| Records To Be Maintained | Frequency | Rule Citation |
|---|---|---|
| Any and all location restriction demonstrations. | As it occurs | §330.125(b)(1) |
| Inspection records, training procedures, and notification procedures relating to excluding the receipt of prohibited waste. | Inspection Records – Daily, Training – Annually, Notification – As it occurs | §330.125(b)(2) |
| All results from gas monitoring and any remediation plans relating to explosive and other gases (if required). | Quarterly | §330.125(b)(3) |
| Unit design documentation for leachate or gas condensate placement. | As it occurs | §330.125(b)(4) |
| Groundwater monitoring and corrective action demonstration, certification, monitoring, testing, and analytical data | Background – Quarterly Detection - Semi-annual | §330.125(b)(5) |
| Closure and post-closure care plans and any monitoring, testing, or analytical data relating to post-closure requirements. | As it occurs | §330.125(b)(6) |
| Any and all cost estimates and financial assurance documentation relating to financial assurance for closure and post-closure. | Annually | §330.125(b)(7) |
| Any and all information demonstrating continued compliance with the small community exemption criteria. | As it occurs | §330.125(b)(8) |
| Copies of all correspondence and responses relating to the operation of the facility, modifications to the permit, approvals, and other matters pertaining to technical assistance. | As it occurs | §330.125(b)(9) |
| Any and all documents, manifests, trip tickets, etc., involving special waste. | As it occurs | §330.125(b)(10) |
| For any spray-applied alternative daily cover (ADC) material, records of the application rate and total amount ADC applied to the working face on those days in which ADC is applied. | As it occurs | §330.125(b)(11) |
| Any other document(s) as specified by the approved permit or by the executive director. | As it occurs | §330.125(b)(12) |
| Personnel training records (335.586(d) and (e)) | Annually | §330.125(e) |
| Personnel operator licenses | As it occurs | §330.125(f) |
| Alternative schedules and notification requirements if applicable. | As it occurs | §330.125(g) |
| Records to document the annual waste acceptance rate, quarterly solid waste summary reports and the annual solid waste summary reports required by 30 TAC §330.675. | Quarterly and Annually | §330.125(h) |
| Load inspection records. | Daily | §330.127(5)(B) |
| Fire occurrence notices. | As it occurs | §330.129 |

Table 4.2-1
Recordkeeping Schedule

| Records To Be Maintained | Frequency | Rule Citation |
|---|---|---|
| Inspection records and training procedures relating to fire prevention and site safety. | Annually | §330.129 |
| Access control breach and repair notices. | As it occurs | §330.131 |
| All site inspection and maintenance documentation. | As it occurs | §330.131 |
| Record(s) of each unauthorized material removal event. | As it occurs | §330.133(b) |
| Record of alternative operating hours if applicable. | As it occurs | §330.135(d) |
| Water, crude oil and/or natural gas well location and plugging reports if applicable. | As it occurs | §330.161(a)-(c) |
| Cover inspection records. | Monthly and within 72 hours of a rainfall event of 0.5 inches or more. | §330.165(h) |

# Section 4.3
# WASTE ACCEPTANCE RATES
30 TAC §330.65

As discussed in Section 2.2 – Waste Acceptance Plan from the SDP, the Landfill will continue only accepting minimal waste from 2011 through 2013. Beginning in 2014, the Landfill will resume full waste disposal activities. Based on research of the current waste stream and conversations with City staff, SAIC estimates that the Landfill may receive approximately 497,309 tons per year (TPY) starting in 2014. In general, this acceptance rate will likely increase by approximately 2 percent per year over the life of the Landfill due to the expected increase in the population served, but may vary due to conditions in the solid waste market. Unusual events such as extreme storms may cause temporary increases in the quantity of waste received. The estimated annual waste acceptance rate for the Landfill projected for five years is summarized in Table 4.3-1.

Table 4.3-1
Estimated Maximum Annual Waste Acceptance (FY 2011 to FY 2015)

| FY | Estimated Maximum Waste Acceptance Rate (Tons) |
|---|---|
| 2011 | 3,000 |
| 2012 | 3,000 |
| 2013 | 3,000 |
| 2014 | 497,309 |
| 2015 | 507,255 |

The annual waste acceptance rate for the facility will be documented on the quarterly and annual solid waste summary reports required by §330.675. Whenever the annual waste acceptance rate based on the preceding four quarters exceeds the rate estimated in the Site Development Plan and the waste is not due to a temporary occurrence, a permit modification will be filed within 90 days of the exceedance to revise the waste acceptance rate included in the permit. At that time the procedures established in the SOP will be evaluated to determine if changes are needed to manage the increased waste acceptance.

## 4.4.1 Landfill Personnel

Table 4.4-1 summarizes personnel types and descriptions during the active life of the facility. The number of employees will be increased as indicated in the table as the annual waste acceptance rate increases over the life of the permit as discussed in Section 4.3 – Waste Acceptance Rates.

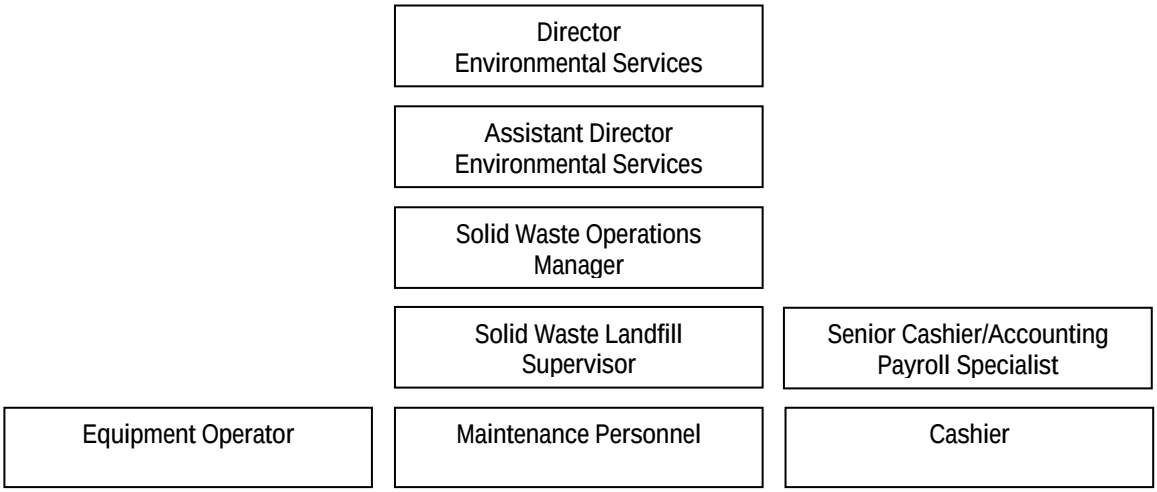
Table 4.4-1
Personnel Types and Descriptions

| Position | Number of Employees | Minimum Qualifications | Position Function |
|---|---|---|---|
| Director of Environmental Services | 1 | Must hold and maintain Landfill Operator license Class A. Minimum 1 year landfill operation. | Serves in landfill manager capacity when landfill manager is unavailable. |
| Solid Waste Operations Manager | 1 | Must hold and maintain Landfill Operator license Class A. Minimum 1 year landfill operation. | Manages all landfill activities. |
| Solid Waste Division Supervisor | 1 | Must hold and maintain Landfill Operator license Class B.<br>Minimum 1 year landfill operation experience.<br>Training by the Solid Waste Operations Manager in the SOP requirements. | Responsible for managing work face and daily fill and cover placement operations, landfill equipment maintenance and repair, and personnel safety during waste and cover construction. |
| Equipment Operator | 4 (0 tpd – 1500 tpd)<br>5 (1501 tpd – 2500 tpd)<br>6 (2501 tpd – 3500 tpd) | 6 months minimum experience in equipment operation or on the job training by experienced equipment operators and training by Landfill Manager in SOP requirements for daily cover and unauthorized waste. | Grading and excavating, necessary equipment maintenance, waste leveling and compaction, application of daily cover, and general site road maintenance. Operators are also responsible for keeping the working face in the smallest area practical and screening for unauthorized waste. |
| Senior Cashier/Accounting Payroll Specialist | 1 | Training by Solid Waste Operations Manager in the SOP rules and waste screening training course (e.g., I.I.E.D.) | Providing oversight for and filling in for the landfill cashiers as needed. |

Table 4.4-1
Personnel Types and Descriptions

| Position | Number of Employees | Minimum Qualifications | Position Function |
|---|---|---|---|
| Cashiers | 2 or more | Training by Solid Waste Operations Manager in the SOP rules, and waste screening training course (e.g., I.I.E.D.) | Levies fees on landfill customers. Operates the scale, keeps appropriate records, controls site access screens for unauthorized waste, and provides general customer direction and information. |
| Maintenance Personnel | 2 (0 tpd – 1500 tpd)<br>3 (1501 tpd – 3500 tpd) | Internal safety training and personal protective equipment training | General facility maintenance. Picks up windblown litter as directed. Directs traffic at disposal area. |

An organizational chart for the solid waste operations is presented below:




## 4.4.2 Landfill Equipment

Table 4.4-2 summarizes the equipment used at the facility during its active life. The equipment type, number, size and function are also included. The number of equipment will be increased as indicated in the table as the annual waste acceptance rate increases over the life of the permit as discussed in Section 4.3 – Waste Acceptance Rates.

Table 4.4-2
Landfill Facility Equipment List

| Equipment Type | Number (Minimum) | Typical Size | Function |
|---|---|---|---|
| Dozers (tractor) | 1 (0 tpd–1500 tpd)<br>2 (1501 tpd–3500 tpd) | 240 HP or greater | Waste and soil spreading and compaction |
| Scraper | 1 or more (0 tpd–1500 tpd)<br>2 or more (1501 tpd–3500 tpd) | Greater than 20 cubic yards (cy) | Transportation of daily cover, fire fighting support |
| Compactor | 1 or more (0 tpd–1500 tpd)<br>2 or more (1501 tpd–3500 tpd | Greater than 80,000 lbs | Waste spreading and compaction |
| Water Truck | 1 | At least 5,000 gallons | Dust control, fire fighting support |
| Diesel Fuel Tank | 1 | 10,500 gallons | Vehicle fueling |
| Street Sweeper or sweeper attachment brush for loader | 1 | 5 foot broom | Cleaning of paved on-site roads |
| Portable Litter Screens | 4 or more | 10 feet by 10 feet | Active face litter control |
| Road Grader or Maintainer | 1 | Size varies | Grading of access roads, soil spreading |
| Bucket Loader | 1 | 25 cubic yards | Earth moving |
| Submersible Leachate Pumps | 1 per sump | | Transfer of leachate from sumps |
| Electronic liquid level indicators | 1 per sump | | Monitor leachate level in sumps |

In addition to the above list, miscellaneous pickups, and other light utility vehicles as well as various water pumps, instruments, and safety and training equipment will be on-site as necessary for operational efficiency. A gasoline generator for power outages will also be kept on site.

Backup equipment will be available at the site or kept at a location that is within two hours drive time, one-way, from the site. The minimum types of machinery listed above should be operable at all times at the site. Backup equipment is available through the City of El Paso and includes one of each of the items listed above.

In the event of equipment repairs or during equipment maintenance periods, the facility will obtain equipment from other facilities, contractors, or local rental companies to avoid interruption of waste services.

# Section 4.5
# SITE INSPECTION AND MAINTENANCE LIST REQUIREMENTS
30 TAC §330.65

Table 4.5-1 outlines the site inspection and maintenance list of the facility. The Item, Task, Frequency, Inspector and Inspection Documentation are also included.

Table 4.5-1
Site Inspection and Maintenance List – Operational Requirements

| Item | Task | Frequency | Inspector | Inspection Documentation |
|---|---|---|---|---|
| Fence/Gates | Inspect perimeter fence and gates for damage. Make repairs if necessary | Weekly | Solid Waste Operations Manager or Designee | Document inspection in the Site Operating Record |
| Windblown Waste | Police working face area, wind fences, access roads, entrance areas, and perimeter fence for loose trash. Clean up as necessary. | Daily as specified in Section 4.9.5. | Solid Waste Operations Manager or Designee | Document inspection in the Site Operating Record |
| Waste Spilled on Route to the Site | Police and clean up the entrance areas and all roads at least 2 miles from the site entrances for loose trash. | Daily as specified in Section 4.9.8. | Solid Waste Operations Manager or Designee | Document inspection in the Site Operating Record |
| Landfill Markers | Inspect all landfill markers for damage, color-coding, and general location. Correct or replace damaged markers within 15 days of discovery. | Monthly | Solid Waste Operations Manager or Designee | Document inspection in the Site Operating Record |
| Site Access Road | Inspect site access road for damage from vehicle traffic, erosion, or excessive mud accumulation. Maintain as needed. Grading equipment will be used to control or remove mud accumulations on roads as well as minimize depressions, ruts, and potholes. | Inspect Daily – more often during wet weather or extended dry weather periods. Grade Weekly or as required. | Solid Waste Operations Manager or Designee | Document inspection and repairs in the Site Operating Record |
| Daily Cover | Inspect for proper placement, thickness, and compaction. Correct problems as needed. Verify that vectors are not an issue. | Daily at the active face and all daily cover areas will be inspected. | Solid Waste Operations Manager or Designee | Document inspection in the Site Operating Record |
| Intermediate Cover | Inspect for proper placement, thickness, erosion, and compaction and for presence of waste or other contamination. Correct problems as needed. | Monthly and within 72-hours of a rainfall event of 0.5 inches or more. | Solid Waste Operations Manager or Designee | Document in the Site Operating Record |

Table 4.5-1
Site Inspection and Maintenance List – Operational Requirements

| Item | Task | Frequency | Inspector | Inspection Documentation |
|---|---|---|---|---|
| Final Cover | Inspect for proper placement, thickness, compaction, slope, settlement and erosion. Maintenance will be ongoing throughout post closure care period. Correct problems as needed. | Monthly and within 72-hours of a rainfall event of 0.5 inches or more. | Solid Waste Operations Manager or Designee | Document in the Site Operating Record |
| Site Signs | Inspect all site signs for damage, general location, and accuracy of posted information. | Weekly | Solid Waste Operations Manager or Designee | Document in the Site Operating Record |
| Ponded Water | Inspect site for unauthorized ponded water areas as described in Section 4.9.19. Correct problems as needed. | Monthly and within 72-hours of a rainfall event of 0.5 inches or more. | Solid Waste Operations Manager or Designee | Document in the Site Operating Record |
| Leachate Monitoring | Active cells with daily cover: check leachate levels within sump and recirculate when levels exceed 12 inches on the liner.<br>Inactive cells with intermediate cover: leachate is recirculated automatically when the leachate levels exceed 12 inches on the liner. | Active cells: Monitor leachate levels daily. If levels do not exceed 12 inches after 3 consecutive days, monitor leachate levels weekly. If levels do not exceed 12 inches after 3 consecutive weeks, monitor leachate levels monthly.<br>Inactive cells: Monitor leachate levels quarterly. | Solid Waste Operations Manager or Designee | Document in the Site Operating Record |
| Odor | Inspect the perimeter of the site to access the performance of site operations to control odor. | Daily | Solid Waste Operations Manager or Designee | Document in the Site Operating Record |
| Perimeter Channels/Ponds | Inspect perimeter channels and detention ponds to verify that they are functioning as designed (e.g., excess sediment removed, outlet structures intact, erosion control measures intact). | Monthly and within 72-hours of a rainfall event of 0.5 inches or more. | Solid Waste Operations Manager or Designee | Document in the Site Operating Record |

Personnel training records will be maintained in accordance with 30 TAC §335.586(d) and (e). Landfill personnel will maintain operator licenses issued in accordance with 30 TAC, Subchapter F (relating to Municipal Solid Waste Facility Supervision), as required.

Table 4.6-1 lists the applicable training requirements per 30 TAC §335.586(a) and (c) by position.

Table 4.6-1
Job Positions and Training Requirements

| Position | Job Description | Training | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Site Orientation | Site Operations | Endangered Species | Haz Waste Identification | Safety (job specific) | Fire Prevention | Load Inspection | Prohibited Wastes | SPCC | Emergency Response | LF License | Commercial Driver License B | Litter Control | Random Inspections | SWPP |
| Solid Waste Operations Manager | Responsible for all activities; ensure adequate staffing and inspections | X | X | X | X | X | X | X | X | X | X | A | | X | X | X |
| Facility Supervisor | Manage LF staff and waste operations. Maintain Site Operating Record. | X | X | X | X | X | X | X | X | X | X | A | | X | X | X |
| Cashier/ Senior Cashier or Accounting / Payroll Specialist | Take receipts; Visual inspection of loads; Handle fee transactions; Maintain operating records. | X | X | | X | X | X | X | X | | X | | | | X | |
| Equipment Operator | Compact waste, apply daily cover, and maintain drainage ditches and ponding areas. | X | X | X | X | X | X | X | X | X | X | | X | | X | X |
| Maintenance Personnel | Directs vehicles to unloading areas; Other duties as assigned | X | X | X | X | X | X | X | X | X | X | | | X | X | X |

Note: More detailed job descriptions along with written descriptions of the type and amount of introductory and continued training provided to each employee will be maintained in the facility Site Operating Record.

The City of El Paso will ensure that the Landfill Manager at the site is knowledgeable in the proper operation of a municipal solid waste landfill and the current operational standards required by the TCEQ. The Landfill Manager will be an experienced manager and will maintain a Class A license as defined in 30 TAC §30.210. It will be the responsibility of the Landfill Manager to ensure that all landfill personnel are properly trained and are operating the landfill in accordance with this SOP and operation standards required by the permit and the TCEQ municipal solid waste regulations.

The personnel training program will be directed by a person trained in waste management procedures, and will include instruction that teaches facility personnel waste management procedures and contingency plan implementation relevant to the positions in which they are employed.

New employees will receive a comprehensive overview of all aspects of landfill operations, focusing on information that is necessary to protect the health and welfare of the new employee and enable them to perform their duties in accordance with this SOP and operational standards required by the permit and the TCEQ municipal solid waste regulations. Following initial training, new employee training will continue during periodic training sessions consisting of on-the-job training.

Training meetings will be scheduled and conducted for all employees at least once per month. If a regular monthly meeting is cancelled, it will be rescheduled or combined with the scheduled training the next month. Training sessions will be scheduled to allow all site operations to be uninterrupted. Records of personnel attending each training session and the topics covered will be maintained at the site. Topics for training may vary monthly, but will be conducted annually for the following:

- Safety
- Fire protection, prevention, and evacuation
- Fire extinguisher use
- Emergency response
- Litter control and windblown waste pick-up
- Hazardous waste and PCB waste detection and control (waste screening), if applicable
- Prohibited waste management
- Properties of methane gas and safety procedures for methane gas, if applicable
- Random inspection procedures

Facility personnel will take part in an annual review of their initial training in accordance with 30 TAC §335.586(c). A written description of the type and amount of introductory and continued training provided to each employee will be maintained in the facility Site Operating Record.

# Section 4.7
# DETECTION AND PREVENTION OF THE DISPOSAL OF PROHIBITED WASTES
30 TAC §330.65

## 4.7.1 Disposal of Wastes

Below is a description of landfill operations in accordance to 30 TAC §330.127(5).

The acceptance and disposal of the following prohibited wastes will not be allowed at this site:

- Class I Industrial Solid Waste.
- Regulated Hazardous Waste.
- Polychlorinated Biphenyls (PCBs) wastes, as defined under 40 Code of Federal Regulations (CFR), Part 761, will not be accepted for disposal or disposed.
- Lead acid storage batteries will not be intentionally or knowingly accepted for disposal.
- Do-it-Yourself (DIY) used motor vehicle oil will not be intentionally or knowingly accepted for disposal.
- Used-oil filters from internal combustion engines will not be intentionally or knowingly accepted for disposal.
- Whole used or scrap tires will not be accepted for disposal or disposed.
- Items containing chlorinated fluorocarbons (CFCs), such as refrigerators, freezers, and air conditioners, will only be accepted at the site if the generator or transporter provides written certification that the CFC has been evacuated from the unit and that it was not knowingly allowed to escape into the atmosphere. The site operator will verify that the refrigerant has been evacuated from the appliance or shipment of appliances previously. Such verification will include a signed statement from the person from whom the appliance or shipment of appliances is obtained that all refrigerant that had not leaked previously has been recovered from the appliance or shipment of appliances in accordance with 40 CFR §82.156 (g) or (h) as applicable. This statement will include the name and address of the person who recovered the refrigerant and the date the refrigerant was recovered or a contract that refrigerant will be removed prior to delivery. The facility will notify persons who may deliver such items of the requirement to verify evacuation of refrigerant by signage or letter.
- Liquid waste (any waste material that is determined to contain "free liquids" as deemed by EPA Method 9095 (Paint Filter Test), as described in "Test Methods for Evaluating Solid Wastes, Physical chemical Methods" (EPA Publication Number SW-846)) will not be disposed of unless it is:
  - Bulk or non-containerized liquid waste that is:

  - Household waste other than septic waste; or
- Contained liquid waste; and
  - The container is a small container similar in size to that normally found in household waste;
  - The container is designated to hold liquids for use other than storage; or the waste is a household waste.
- Leachate and landfill gas condensate if authorized under Section 32.0.
- Septic tank waste.
- Non-stabilized sludge.

### 4.7.1.1 Measures for Controlling Prohibited Wastes

Procedures to detect and control the receipt of prohibited wastes include:

1. Informing facility customers of prohibited wastes by posting one or more signs at the facility entrance listing prohibited wastes.
2. Providing customers (regular and one-time or occasional) with a written list of prohibited wastes.
3. Informing all drivers of incoming waste hauling vehicles and operators of any transfer stations of prohibited wastes by:
   - Posting one or more signs at the facility entrance listing prohibited wastes.
   - Providing all vehicle drivers and transfer station operators with a written list of prohibited wastes.
4. Facility personnel training and activities:
   - Training for appropriate facility personnel responsible for inspecting or observing incoming loads to recognize regulated hazardous waste and PCB waste.
   - Random inspections of incoming loads in accordance with procedures described in this section.
   - Maintaining records of all inspections.
   - Notification of the executive director of any incident involving a regulated hazardous waste or a PCB waste at the Landfill.
   - Remediation of any regulated hazardous waste or PCB waste discovered at the site in accordance with 30 TAC §335.349.

Facility personnel will check for indications of prohibited waste as detailed below.

An important aspect of controlling the receipt of prohibited waste at the landfill is by the control of access into the facility by unauthorized vehicles. This issue is addressed in 30 TAC §330.131 Access Control. Facility personnel will be trained to inspect vehicles and identify regulated hazardous waste, polychlorinated biphenyl (PCB) waste and other prohibited wastes. At a minimum, the cashiers and equipment

operators at the working face will be trained in inspection procedures for prohibited waste. The personnel will be trained on an on-the-job basis by their supervisors. Records of employee training on prohibited waste control procedures will be maintained in the facility Site Operating Record. The personnel will be trained to look for the following indications of prohibited waste:

- Yellow hazardous waste or PCB labels
- DOT hazard placards or markings
- Liquids
- 55-gallon drums
- 85-gallon overpack drums
- Powders or dusts
- Odors or chemical fumes
- Bright or unusual colored wastes
- Sludges

If landfill personnel identify any of the above indications with an incoming load, then that load will be directed to an area out of the flow of traffic, and the personnel will further assess the load. If the load is determined to contain prohibited waste or if there is any possibility that it may be prohibited waste, the load will be rejected and directed back to the generator. All landfill personnel will be diligent in looking for trucks bringing in waste loads from potential sources of prohibited waste such as industrial facilities, microelectronics manufacturers, electronic companies, metal plating industry, automotive and vehicle repair service companies, and dry cleaning establishments.

### 4.7.1.2 Random Inspections

Incoming waste is controlled in three ways to preclude the inadvertent receipt of prohibited wastes. One level of control is to inform customers of the types of waste that are to be excluded. A second control is to inform all vehicle drivers and transfer station operators of the restrictions. Key personnel will be informed of the typical visible characteristics of these materials. A third control is provided by the landfill personnel through random inspections.

Random inspections by the landfill site personnel will be made daily of no less than one percent (1%) of incoming loads. At least one vehicle per day will be randomly inspected. For a random inspection, the cashier will select an incoming vehicle for inspection, notify the equipment operator, and direct the selected load to the area of the working face or public drop-off area (PDA). Inspections based on internal profiling procedures will count towards the total of random inspections. Once the selected load arrives at the working face or PDA, the equipment operator will direct the vehicle to a separate location of the working face or PDA and out of the flow of normal landfill traffic. As the load is dumped, the equipment operator will visually inspect the contents.

Records of all inspections will be maintained as part of the Site Operating Record. The results of these inspections will be documented on the Load Inspection Report Form. The reports will include the date and time of inspection, the name and address of the hauling company and driver, the type of vehicle, the size and source of the load, contents of the load, indicators of prohibited waste, and results of the inspection.

If identified, unauthorized wastes shall be removed from the working face or PDA immediately after identified and placed back in the offending transporter's vehicle, if possible. If returning the material to the offending transporter's vehicle is not possible, the unauthorized waste will be placed in a suitable collection bin or otherwise contained until removed from the site for proper disposal. All events related to unauthorized waste at the facility will be documented in the facility's operating record. TCEQ will be notified of any incident involving the receipt or disposal of regulated hazardous waste or PCB waste at the landfill. Records of the notification will be kept in the site operating record and will include the date and time of notification, the individual contacted, and the information reported.

## 4.8.1 Fire Protection Plan

The following steps are taken regularly at the facility by designated personnel to prevent fires from Landfill operations:

- Prohibiting open burning of waste all times at the Landfill.
- Preventing burning waste from incoming waste loads from being dumped in the active area of the Landfill. The cashiers and equipment operators will be alert for signs of burning waste such as smoke, steam, or heat being released from incoming waste loads.
- Fuel spills will be contained and cleaned up immediately. Soil contaminated with spilled fuel will be excavated and, if authorized, disposed of at the working face. Contaminated soils may be excavated using a shovel for small areas or with heavy equipment as appropriate.
- Landfill equipment will not remain in the vicinity of exposed waste overnight.
- Equipment that is used at the working face will be routinely cleaned. The high pressure water or steam cleaning will remove combustible waste and caked material which can cause equipment overheating and increase of fire potential.
- Dead trees, brush, or vegetation adjacent to the Landfill will be removed immediately, and grass and weeds mowed at least semi-annually, if necessary, so that grass or brush fires cannot spread to the Landfill or off-site.
- Smoking is not permitted at the Landfill except for within a 25 ft radius of the Landfill break room.
- Soil cover or non-flammable alternate covers will be used on a daily basis.

Other operational activities where combustible materials are stored or processed are briefly described below. Specific fire protection measures for each of these activities have also been identified in accordance with 30 TAC §330.129.

- Brush Collection and Mulching Area: When the Landfill is active, the City may designate a separate area at the Landfill where tree limbs will be accepted and stockpiled prior to mulching. The City will mulch the tree limbs and stockpile the mulch for the public to pick up at no charge. Specific fire protection measures for this area include prohibiting smoking in this area and having a fire extinguisher available at this location. The procedures to follow in the event of a fire will be as specified in Section 4.8.2 below.
- Used Oil Storage Area: Used oil resulting from the maintenance of Landfill equipment will be stored at the Landfill's maintenance building and storage area. Specific fire protection measures for this area include prohibiting smoking and having a fire extinguisher available at this location. Any oil spills that occur will

be contained and cleaned up immediately. Soil contaminated with spilled oil will be excavated and, if authorized, disposed of at the working face. Contaminated soils may be excavated using a shovel for small areas or with heavy equipment as appropriate.

## 4.8.2 Procedures in the Event of a Fire

Landfill staff will take the following steps if a fire is discovered:

- Contact the Local Fire Department by dialing 911. The nearest Fire Station at 10820 McCombs (Station 28) shall also be contacted by telephone at (915) 857-4011.
- Alert other facility personnel.
- Contact the Director and Assistant Director of the City of El Paso Environmental Services.
- Assess extent of fire, possibilities for the fire to spread, and alternatives for extinguishing the fire.
- Immediately direct vehicles out of the fire area, and prevent unnecessary vehicles from entering the area.
- If it appears that the fire can be safely fought with available fire fighting devices until arrival of the Local Fire Department, attempt to contain or extinguish the fire.
- Upon arrival of Local Fire Department personnel, direct them to the fire and provide assistance as appropriate.
- Do not attempt to fight the fire alone. Do not attempt to fight the fire without adequate personal protective equipment. Be familiar with the use and limitations of firefighting equipment available onsite.

## 4.8.3 Fire Fighting Methods

Firefighting methods for burning solid waste include smothering with soil, separating burning material from other waste, spraying with water if available from an on-site water truck or detention pond. Small fires might be controlled with hand-held extinguishers. If the fire is at an active disposal area, if possible, the burning waste will be isolated or pushed away immediately before the fire can spread or firebreaks will be cut around the fire before it can spread. If moving the waste is not possible, or if it is unsafe, efforts will be made to cover the working face with earth immediately to smother the fire. The faster that soil can be placed over the fire, the more effective this method will be in controlling and extinguishing the fire. If a fire is in the working face, the burning area will be isolated and pushed away from the working face quickly, or firebreaks will be cut around the fire before it can spread. If this is not possible or this is unsafe, efforts to cover the working face with earth will be initiated immediately to smother the fire. The stockpiled daily earthen cover material may be used for firefighting purposes.

If a fire occurs on a vehicle or piece of equipment, the equipment operator will bring the vehicle or equipment to a safe stop. If the safety of personnel will allow, the

vehicle will be parked away from fuel supplies, uncovered solid wastes, and other vehicles. The engine will be shut off and the brake engaged to prevent movement of the vehicle or piece of equipment.

### 4.8.3.1 Earthen Material Coverage

A stockpile of earthen material adequately sized to cover the working face will be maintained at all times within 2,000 feet of the working face or active disposal area. The source will be sized to cover the working face with a six-inch layer of earthen material. Earthen material coverage calculations are presented below.

Typical size of working face = 15,000 sq. ft.
Required stockpile = 15,000 sq. ft. x 0.5 ft. x (cubic yd/27 cubic ft.) = 278 cubic yards

The operator will, at all times, maintain sufficient equipment for moving the soil stockpile and placing a six-inch soil cover over the working face within one hour of detecting a fire at the working face.

### 4.8.3.2 Demonstration of Stockpile Accuracy

The typical size of the working face will be approximately 15,000 square feet. For covering this size of working face, the required stockpile will be 278 cubic yards.

This earthen volume would be distributed across the working face by one of the earthmovers required on-site (a front-end loader or bulldozer. See equipment list of this SOP). Additional equipment will be used, if applicable, to smother the fire within one hour of being detected.

### 4.8.3.3 Example Calculations:

| | | |
|---|---|---|
| Volume of Daily Cover: | 278 | CY |
| Size of Haul Trucks: | 20 | CY |
| Number of Haul Trucks: | 2 | CY |
| Number of Loads: | 7 | |
| Time to Load: | 5 | min |
| Average Truck Speed: | 15 | mph |
| Average Truck Speed: | 1320 | fpm |
| Average Truck Time Round Trip: | 3 | min |
| Length of Time to Cover Working Face: | 56 | min |
| Distance from Working Face: | 2000 | ft |

## 4.8.4 Fire Equipment

The site will be equipped with fire extinguishers of a type, size, location, and number as recommended by the local fire department. The fee station, maintenance area, brush collection and mulching area, all Landfill equipment, and all Landfill vehicles will be equipped with fire extinguishers. Each fire extinguisher will be fully charged and ready for use at all times. Each extinguisher will be inspected on an annual basis and recharged as necessary. A qualified service company will perform these inspections, and all extinguishers will display a current inspection tag. Inspection and recharging will be performed following each use. Landfill equipment and vehicle

shall not return to work if the equipped fire extinguisher(s) was used and has not been replaced or refilled.

## 4.8.5 Fire Protection Training

Training of on-site personnel in firefighting techniques, fire prevention, response, and fire protection aspects of the SOP will be provided by established professionals on an annual basis and within 30 days of initial hire. Personnel will be familiar with the use and limitations of firefighting equipment available on-site and how to evaluate the type and extent of a fire and its potential for spreading. Records of this training will be included in this Site Operating Record for this facility.

## 4.8.6 TCEQ Notification

After any fire (related to waste management activities that cannot be extinguished within 10 minutes of discovery) occurs, the TCEQ regional office will be contacted. The notification to the regional office will include:

- Contact by telephone as soon as possible, but no later than four hours following the fire discovery, and
- Provide a written description of the cause and extent of the fire and the resulting fire response within 14 days of fire detection.

Landfill fires frequently cause concern on the part of nearby landowners, who turn to the TCEQ's regional office for information. Because of this, the facility will provide to the appropriate TCEQ regional office as much information as possible regarding the fire and firefighting efforts, as soon as possible after the fire occurs.

The fire prevention and fire control procedures for the facility will be revisited following the occurrence of a significant fire to determine if modifications are warranted.

## 4.9.1 Access Control

Uncontrolled access to the Landfill shall be prevented. Public access to the Landfill will be controlled by means of signs, barriers or a combination of both, appropriate to protect human health and safety to the environment. The following access controls are in place at the Landfill.

### 4.9.1.1 Site Security

Public access will be controlled to minimize unauthorized vehicular traffic, unauthorized and illegal dumping, and public exposure to hazards associated with landfills. Fences and gates will be used to control access to the site. The property owned by the City (the existing and expansion Landfill facilities) is enclosed by a barbed wire fence. Also, a barbed wire fence is located along the entrance road to the quarry currently located within the Landfill permitted area. The barbed wire fence is intended to prevent access to the site. The Landfill is also enclosed by earthen berms located along the western and northern sides of the Landfill boundary. These berms minimize access to the site as well as provide visual screening to the active area of the Landfill. Conspicuous warning signs (NO TRESPASSING) legible from a distance of at least 25 feet will be placed at intervals surrounding the site.

The site access road (Landfill entrance) and access gate is located at McCombs Road, East of the intersection of McCombs Road and Stan Roberts Sr. Road (FM 2529). This access road will handle all traffic to and from the site. A cashier will control vehicle access to the Landfill at the fee collection station located at the scale house during operating hours. An emergency access gate is located along McCombs Road. This emergency gate will remain locked at all times.

During non-operating hours, the access gate is to remain locked and secured, and security guard service must be present. The fee collection station, scale house, scales, public drop-off site, above-ground fuel storage tank, employee parking and maintenance facility must be lighted after sunset.

### 4.9.1.2 Vehicle Access

Public access roads to the Landfill are paved, all-weather roads as described in Section 4.9.12, Site Access Roads. Only vehicles authorized by the Landfill manager, Landfill construction vehicles, Landfill personnel vehicles, and authorized haul vehicles have access beyond the fee collection station. Only authorized haul vehicles or vehicles authorized by the manager or designee are allowed access to the working face. Signage will provide direction to customers and the public to the public entrances of the Landfill. Speed limit and directional signs will also be placed. Additional signs

will warn of traffic, wet conditions and of contractors operating at the site, when applicable. On-site signage within the facility will provide direction to public unloading areas.

Vehicles with solid waste arriving at the waste disposal working face will be directed to an unloading area by on-site personnel or signage. Operations at the working face will be conducted in a manner that allows the prompt and efficient unloading of waste. The approach to the unloading area will be wide enough to safely unload at least two vehicles side-by-side.

The facility will comply with the schedule and notification requirements outlined in Table 4.9-1 for any access breach.

Table 4.9-1
Access Breach Schedule and Notification Requirements

| Requirements | Access Breach Repaired within 8 hours | Access Breach Not permanently repaired in 8 hours |
|---|---|---|
| Notify TCEQ Regional Office of breach and repair schedule | Not required | Within 24 hours |
| Make temporary repairs | Not required | Within 24 hours |
| Make permanent repairs | Within 8 hours | Within schedule submitted to regional office in initial notice |
| Notify TCEQ Regional Office when permanent repair completed | Not required | Within schedule submitted to regional office in initial notice |

## 4.9.2 Unloading of Waste

The unloading of solid waste is to be confined to as small an area as practical. The maximum size of the working face will be 150 feet in length by 100 feet in depth. Residential customers and some commercial haulers will dispose of their waste at the public drop off site.

The unloading of waste in unauthorized areas is prohibited. Any waste deposited in an unauthorized area will be removed immediately and disposed of properly. A trained employee will be present at the fee station at all times during operating hours to monitor all incoming loads of waste, and will direct traffic to the appropriate unloading area. Trained maintenance personnel will also be on duty during operating hours at the working face to direct and monitor unloading of solid waste.

Cashiers and equipment operators will monitor the incoming waste. These personnel will be familiar with the rules and regulations governing the various types of waste that can or cannot be accepted into the facility, including knowledge of 30 TAC §330.133. The personnel will also have the basic understanding of both industrial and hazardous waste and their transportation and disposal requirements. The facility is not required to accept any solid waste that may cause problems in maintaining full and continuous compliance with the permit.

Certain wastes are prohibited from disposal at this facility. Prohibited wastes are described in Section 4.7 of this plan. The unloading of prohibited wastes at the facility

will not be allowed. Necessary steps will be taken by the Landfill operator to ensure compliance. Landfill personnel have the authority and responsibility to reject unauthorized loads, have unauthorized material removed by the transporter, and/or assess appropriate surcharges. Any unauthorized waste discovered after unloading will be placed back in the offending transporter's vehicle, if possible, or otherwise returned promptly to the transporter or generator of the waste. The driver may be advised where the waste may be disposed of legally and will be responsible for the proper disposal of this rejected waste.

In the event the unauthorized waste is not discovered until after the vehicle that delivered it is gone, the waste will be segregated and controlled as necessary. An effort will first be made to identify the entity that deposited the prohibited waste and have them return to the site and properly dispose of the waste. In the event that identification is not possible, the Landfill manger will notify the TCEQ and seek guidance on how to dispose of the waste as soon as practical. A record of unauthorized material removal will be maintained in the Site Operating Record.

Only those persons operating vehicles that comply with the following requirements will be authorized to dispose of waste at this site:

- All vehicles and equipment used for collection and transportation of waste will be operated and maintained to prevent loss of waste material and to limit health and safety hazards to Landfill personnel and the public.
- Collection vehicles and equipment will be maintained in a sanitary condition to preclude odors and fly breeding.
- Collection vehicles not equipped with an enclosed transport body will use other devices such as nets or tarpaulins to preclude additional spillage.

Landfill personnel will keep vigilant watch for compliance with operating requirements. Signs with directional arrows and/or portable traffic barricades will help to restrict traffic to designated disposal locations. Signs will be placed along the access route to the current disposal area. In addition, rules for waste disposal and prohibited waste will be prominently displayed on signs at the site entrance.

Waste such as tree limbs and bulky items shall be placed in a separate location. The City mulches tree limbs and stockpiles the mulch for the public to pick up at no charge. Bulky items will be handled as addressed under Section 4.9.9.

## 4.9.3 Facility Operating Hours

The hours of waste operation are to be as follows:

- The waste acceptance hours for the facility will be 6:00 a.m. to 7:00 p.m., seven days a week. The current operating hours (which may be more restrictive than the permitted waste acceptance hours) will be posted on a sign at the entrance to the Landfill (e.g., the Landfill is open to the public from 7:00 a.m. to 4:00 p.m., six days a week).
- Transportation of materials and heavy equipment will not be conducted between the hours of 9:00 p.m. and 5:00 a.m.

- In accordance with 30 TAC §330.135(b) the permit may include alternative operating hours of up to five days in a calendar-year period to accommodate special occasions, special purpose events, holidays, or other special occurrences. The facility will request temporary authorization from TCEQ, if alternative operating hours for any of these reasons are required.
- In accordance with 30 TAC §330.135(c), TCEQ may allow additional temporary waste acceptance hours to address disasters, other emergency situations, or other unforeseen circumstances that could result in the disruption of waste management services in the area. In the event that alternative operating hours are required for any of these reasons, the facility will request temporary authorization from TCEQ.
- Alternative operating hours when used will be recorded in the site operating record and will include the dates, times, and duration.

### 4.9.3.1 Severe Weather Plan

The purpose of the Severe Weather Plan is to guide the Landfill facility as to the proper severe weather preparation or closure procedure of the facility during severe weather conditions. It is important that severe weather conditions be assessed scrupulously in order to ensure the safety of customers and Landfill personnel.

During periods of severe weather conditions, the Landfill manager is responsible for assessing the severity of the conditions at the facility. Severe weather includes, but is not limited to, heavy rainfall, heavy snow or ice, and blowing dust. The Landfill manager shall assess the weather conditions at the active cell and at any location accessible to customers and employees. The facility must be checked for any conditions that pose a safety hazard to customers and employees. These conditions include, but are not limited to, hazardous road conditions such as muddy or slick roadways, and reduced and/or zero visibility due to blowing dust or snow conditions.

After a weather assessment has been completed, the Landfill manager will make one of two decisions. The first decision will be the option to attempt a preparation of all access roads and accessible areas to Landfill personnel. All areas of the facility must be deemed safe. Postponement of the scheduled opening and/or a temporary closing of the facility may be necessary to prepare the facility. The second decision will be to close the facility. Once the conditions are considered hazardous, the Environmental Services Director and/or Assistant Director must be notified in order to approve the closure.

Once approved, the Landfill manager will instruct a qualified cashier to close the entry gates. The cashier will man the gates until all customers have been assisted out of the facility. The Landfill will then be closed, utilizing only the Site Operating Plan guidelines that do not pose a safety threat to employees due to the existing severe weather conditions.

Daily cover will be applied as soon as possible, but not more than one hour after closure to the public on the working face.

## 4.9.4 Site Sign

A conspicuous sign measuring a minimum four feet by four feet will be maintained at the public entrance to the site. The sign states, in letters at least three inches high, the following information:

- Type of MSW Facility;
- Authorized by TCEQ Permit Number: MSW 729B;
- Hours of Operation;
- Emergency 24-hour Contact Number; and
- Local Emergency Fire Department Number.

The sign will be visible and readable from the facility entrance. A sign prohibiting receipt of hazardous waste or closed drums and a no-smoking sign will be posted near the facility entrance or gatehouse. A sign will be prominently displayed at the facility entrance stating that all loads will be properly covered or otherwise secured.

Signs for traffic flow shall be placed as needed inside the facility. The Landfill Manager shall periodically inspect the signs and authorize maintenance as needed.

## 4.9.5 Control of Windblown Solid Waste and Litter

Windblown waste and litter will be controlled through several methods, including proper transport, unloading, compaction, and cover procedures. The use of portable litter control fences and adequate staffing will provide control of windblown waste and litter. Portable fencing will be utilized along the down-wind side of the active disposal area if the wind exceeds ten miles per hour. The portable fences will be at least ten feet high. The City also proposes to install new perimeter debris netting along portions of the boundary of the Landfill, as needed. The location of the perimeter netting will be based on active areas and prevailing winds.

All disposal vehicles shall have properly secured loads before being allowed to enter the facility. Personnel will police the Landfill site, including fences, access roads, and the entrance gate, every operating day to pick up and return windblown waste and litter to the active working face and perform such other litter control measures, as necessary.

Daily cover will be placed on top of the waste lift as soon as it is practical for any portion of the lift that reaches recommended lift height. The working face will be covered daily.

## 4.9.6 Easements and Buffer Zones

A 300-ft wide easement, owned by the El Paso Electric Company, is located adjacent and along the northern portion of the Landfill site. The easement is located outside of the permitted Landfill boundary. Contact information for the easement is:

El Paso Electric Company
P.O. Box 982
El Paso, TX 79960
(915) 543-4025 during work hours
(915) 543-5720 or (915) 543-6464 Emergency and after hours

The quarry operation is currently within the permitted Landfill boundary, but will move to the south and then to the adjacent eastern property upon development of future Landfill sectors. The quarry is currently using a 10-ft wide recorded easement, owned by the El Paso Electric Company, which is located north and within the permitted Landfill boundary, for delivery of power. This easement will be abandoned prior to the development of Landfill Sector C. The quarry is also currently using a telephone line located south of the Landfill running in a northern direction along the future Landfill sectors. This telephone line will be removed prior to the development of Landfill Sectors E, F, and G. There is no recorded easement for the existing telephone line.

No solid waste unloading, storage, disposal, or processing operations will occur within any easement, buffer zone, or right-of-way that crosses the site. No solid waste disposal will occur within 25 feet of the center line of any utility line or pipeline easement, unless otherwise authorized by the executive director. All pipeline and utility easements will be clearly marked with posts which extend at least six feet above ground level, spaced at intervals no greater than 300 feet.

The buffer zones may vary around the perimeter of the site, but in no case will they be less than 50 feet for previously permitted waste boundaries. For the vertical expansion of the Landfill, the buffer zone is 125-feet from the Landfill boundary in accordance with 30 TAC §330.543(b)(2)(B). All buffer zones, as depicted in the site design, will be clearly marked as specified in Section 4.9.7. Perimeter roads, which provide space for the safe passage and movement of operations and emergency fire fighting and other vehicles, are located within the buffer zone area. Drainage structures, berms, and landscaping as necessary for visual screening are also located in the buffer zone area.

## 4.9.7 Landfill Markers and Benchmark

Landfill markers clearly mark significant features as described in 30 TAC §330.143(b). The markers are steel or wooden posts (or other TCEQ approved material) and extend at least 6 feet above the ground surface. The markers will be maintained unobscured by vegetation and will be placed in sufficient numbers to clearly indicate the required boundaries. Markers that are removed or destroyed will be replaced within 15 days of their removal or destruction. Landfill markers will be inspected on a monthly basis and will be maintained and repaired on a scheduled basis. Markers are repainted, repaired, or replaced to maintain visibility within 15 days.

Where feasible, intermediate markers will be placed on a grid system no greater than 100 feet apart measured along perpendicular lines to encompass at least the area expected to be filled within the next three-year period.

Soil liner or geomembrane liner makers will be placed so that the areas for the submitted soil liner evaluation report or geomembrane liner evaluation report are easily determinable. The locations of the markers will be reported on each submitted report. The markers will be located so that they tie into the existing landfill grid system and will be placed so that they are not destroyed during operations until the operations extend into the next constructed area. The area markers will not be placed inside constructed areas.

Guidelines for type, placement, and color coding of markers are provided in Table 4.9-2.

Table 4.9-2
Color and Placement of Site Markers

| Marker | Color | Placement |
|---|---|---|
| Site Boundary | Black | At each corner and along boundary in 300 ft. intervals. |
| Buffer Zone | Yellow | Along buffer zone at each corner and in 300 ft. intervals. |
| Easements | Green | Along the centerline of an easement and along boundary of right-of-way at each corner and intersection with the facility boundary. |
| Grid System | White | 100 ft. interval (may be placed along buffer zone boundary). |
| SLER/GLER | Red | Tied into Landfill grid system and indicated in SLER/GLER reports. |
| Floodplain | Blue | 300 ft. interval or less if necessary to retain visual continuity. |

A permanent benchmark has been established at the site in an area that is readily accessible, but not used for disposal. The benchmark shall be a bronze survey marker set in concrete and shall have the benchmark elevation and survey date stamped on it. The benchmark elevation shall be surveyed from a known United States Coast and Geodetic Survey benchmark or other reliable benchmark. The location and elevation of the reference benchmark and the permanent benchmark shall be identified on a map and shall be included in the Site Development Plan.

## 4.9.8 Materials Along the Route to the Site

The Landfill will take steps to encourage that vehicles hauling waste to the Landfill properly secure the load in order to prevent the escape of any part of the load by blowing or spilling. The Landfill will take actions such as posting signs, reporting offenders to proper law enforcement officers, adding surcharges, or similar measures. On a daily basis, Landfill maintenance personnel will clean up waste materials spilled along and within the right-of-way of public access roads serving the facility for a distance of two miles in the eastern, western, and southern direction from the facility entrance. Off-site litter located north to the State line will be picked up for a distance of 4,800 feet from the entrance of the facility and taken to the active disposal area. The Landfill will consult with the Texas Department of Transportation or county and/or local governments with maintenance authority over the roads, concerning cleanup of public access roads and rights-of-way.

## 4.9.9 Disposal of Large Items

Large, heavy, or bulky items which cannot be incorporated in the regular spreading, compaction, and covering operations at the Landfill will be recycled. A special area will be established to collect these items. This special collection area will be designated as a large-item salvage area. A permitted salvage company under contract with the City will remove the items from the site often enough to prevent these items from becoming a nuisance and to preclude the discharge of any pollutants from the area.

Items classified as large, heavy or bulky can include, but are not limited to, white goods, (household appliances), air conditioner units, metal tanks, large metal pieces, and automobiles. Refrigerators, freezers, air conditioners, and any other items containing chlorinated fluorocarbon (CFC) will be handled in accordance with 40 CFR §82.156(f), as amended. Refrigerators, freezers, air condition units, or other items containing CFC refrigerant will not be accepted unless the CFC contained in the item has been captured and sent to an approved CFC disposal site or recycling facility. The generator or transporter must provide written certification that the CFC has been evacuated from the unit prior to acceptance or disposal. Items such as electrical equipment, which contain PCBs should be excluded from waste fill.

Large items that the salvaging contractor does not remove will be reduced in size at the working face. Special care will be taken to achieve the maximum practical compaction of these items prior to placement of the next layer of waste in the lift. Care should be taken during disposal of large items to ensure that:

- Large items are excluded from the initial 5 feet of waste placed over the protective cover of a liner;
- Large items are placed such that they do not interfere with continued waste filling; and
- That other, smaller municipal solid waste is placed and compacted around them.

## 4.9.10 Odor Management Plan

The Landfill will comply with all applicable rules concerning burning and air pollution control. The Landfill will ensure that any unit of the municipal solid waste (MSW) facility does not violate any applicable requirement of the approved state implementation plan developed under the Federal Clean Air Act, §110, as amended, and 30 TAC §330.15(d) of this title (relating to General Prohibitions), which prohibits the open burning of waste at any MSW landfill facility.

The Landfill will ensure that the municipal solid waste facility does not violate any applicable air quality requirement in Section 3.7 – Landfill Gas Management Plan.

The site will be operated in accordance with the New Source Performance Standards (NSPS) for MSW landfills. Odors will be controlled at the site, and if they occur, will be reduced in accordance with the Odor Management Plan.

### 4.9.10.1 Sources of Odor

Potential odor sources associated with a MSW landfill facility include the wastes being delivered to the Landfill, the open working face, ponded water, leachate, and landfill gas. Many of the wastes received at a landfill are a source of odor upon receipt, such as sludges and dead animals. Other wastes have the potential for becoming sources as they biodegrade during the decomposition process. Ponded water and landfill gas could become sources of odor as well.

### 4.9.10.2 Odor Control

Methods used to control odors include waste management procedures, the placement of cover materials, the control of ponded water, and landfill gas control.

Wastes will be deposited at the working face, spread into layers that can be readily compacted, and covered with a minimum of six inches of soil with an approved alternate daily cover material. Dead animals will be covered immediately upon placement into the working face with three feet of waste or two feet of soil. Waste that is identified as particularly odorous by the gate attendant or equipment operator will be buried immediately upon receipt in the working face with prompt compaction and covered with incoming waste and/or daily cover.

If these methods are unsuccessful, additional measures may include limiting the size of the working face, increasing the thickness or daily cover, identifying wastes streams that require special attention, and evaluation of the use of misters or chemical deodorizers. If misters or chemical deodorizers are determined to be necessary, a permit modification will be requested and approval obtained before use.

## 4.9.11 Disease Vector Control

The need for control of vectors such as rodents, flies, and mosquitoes at the Landfill will be minimized through daily site operations, which include the application of daily cover and adequate compaction. The Landfill will also minimize the extent of the working face to control vectors.

If necessary, a licensed pest control professional will be summoned to apply pesticides for the control of vectors.

## 4.9.12 Site Access Roads

The entrance road to the site extends easterly from McCombs Road approximately 1,500 feet to the fee collection station located at the scale house. The approximate 1,500 foot section continues an additional 1,050 feet and consists of asphalt paved surface. The remainder of the road entering the Landfill consists of a dirt surface. Access into the public drop-off site consists of approximately 750 feet of asphalt paved surface. Topping and compacting the dirt portion of the site access road with caliche material will minimize the tracking of mud and trash onto the asphalt paved portion of the entrance road and public roadways from the Landfill. In the unlikely event these measures do not prove sufficient during the inclement periods of wet

weather, the top wet surface will be removed and replaced with dry caliche material and overlaid by a layer of sand material. This road will handle all traffic to and from the site. As fill progresses, new roads will be constructed to connect the access road to the working face. These roads will be constructed to the same standard as the access road.

The Landfill will abide by the following aspects regarding site access roads, and will keep records to demonstrate compliance:

- Tracked mud and associated debris, at the entrance to the facility and on the public roadway at the entrance to the facility, and trash on public roadways will be removed at least once per day on days when mud and associated debris are being tracked onto the public roadway from the Landfill.
- Dust from on-site and other access roadways will not become a nuisance to surrounding areas. For dust from on-site and other access roadways, the Landfill haul roads and access roads will be maintained in a reasonable dust-free condition by periodic spraying from a water truck. Water shall be applied via the water wagon to all areas that may present a blowing dust problem. Under no circumstances shall the water be applied so as to create puddles on the floor of the Landfill. If this occurs, the ponded water shall be spread over the surface or pumped out to eliminate these conditions.
- Litter and any other debris on-site and other access roadways will be picked up at least daily and taken to the disposal area.
- For tracking of mud and trash onto public roadways, the paved entrance road and dry caliche surface on dirt roads will provide mud control for the waste hauling vehicles prior to exiting the site and returning to public access roads. Street sweeper type equipment will be used to remove mud accumulations on asphalt paved roads.
- Grading equipment will be used as necessary to control or remove mud accumulations on roads, minimize depressions, ruts, and potholes on a weekly basis.

## 4.9.13 Salvaging and Scavenging

Salvaging will not be allowed to interfere with prompt sanitary disposal of solid waste or to create public health nuisances. Salvaging of materials from the Landfill is permitted only by salvaging contractor(s) under contract with the City of El Paso. Salvaged materials will be considered as potential recyclable materials and will be stored in a designated collection area. The collection area will be identified in the site operating record. Salvaged items will be removed from the site and recycled often enough to prevent an excessive accumulation of the material at the site to prevent odor or other nuisance conditions from developing and to eliminate the risk of discharge of pollutants.

Pesticide, fungicide, rodenticide, and herbicide containers will not be salvaged unless they are salvaged through a state-supported recycling program. Salvaging of special

waste will be prohibited. Salvaging of wastes will not occur where waste has been covered with daily cover.

Scavenging is considered to be searching for and removing materials from the waste deposited at the working face. Scavenging will not be allowed under any circumstances.

## 4.9.14 Endangered Species Protection

Refer to Appendix 4B – Endangered Species Documentation for a US Fish and Wildlife Service letter dated August 13, 1982, which documents that the Landfill area is not a habitat for the endangered species identified in El Paso County, Texas. This letter was previously included in both the 1984 and 2002 permit amendment application**s** for the Landfill. Additionally, current correspondence between the Texas Parks and Wildlife Department and the U.S. Fish and Wildlife Service is also provided in Appendix 4B.

The letter states that the American Peregrine Falcon may use the project site as a feeding area or pass through the area during migration. According to information provided on the U.S. Fish & Wildlife Service website, the American Peregrine Falcon was delisted from the federal endangered species list on August 25, 1999. The American Peregrine Falcon remains a State of Texas protected species. A copy of the U.S. Fish & Wildlife Service species profile is also provided in Appendix 4B – Endangered Species Documentation.

As indicated in the 1982 US Fish and Wildlife letter, it is unlikely that the Landfill will have any effect on this species. However, if the American Peregrine Falcon were to be observed within the permitted Landfill area, the employees will be instructed to follow the steps listed below:

1. Avoid contact with the bird;
2. Temporarily halt or move site operations to an area away from the bird's location to prevent disrupting the bird's activities while feeding or passing by the site;
3. Wait until the bird abandons the site on its own will; and
4. Resume normal site operations once the bird has taken flight.

In addition, Landfill personnel will be trained regarding the bird's physical characteristics and appearance in order to be able to identify it at once and with certainty during operations. This training will prevent unnecessary and unwarranted disruptions of site activities due to the presence of birds that may look similar to the American peregrine falcon.

According to the 2012 TPWD response letter, the following species have been listed as threatened or endangered under the Endangered Species Act (ESA) and have the potential to occur in El Paso County:

- Least Tern – Listed 08/28/1985
- Northern Aplomado Falcon – Listed 02/25/1986
- Mexican Spotted Owl – Listed 03/16/1993

- Southwestern Willow Flycatcher – Listed 02/27/1995

The following are state-listed threatened species that could potentially occur in the area:

- Texas Horned Lizard
- Mountain Short-Horned Lizard

The following are state-listed species of concern that could potentially occur in the area:

- Western Burrowing Owl
- Desert Night-Blooming Cereus

Further information regarding these species, their suitable habitats, and avoidance procedures are included in Appendix 4B.

## 4.9.15 Landfill Gas Control

Landfill gases will be monitored in accordance with the approved Landfill Gas Management Plan (Section 3.7) in accordance with 30 TAC §330.371. The results of any gas monitoring will be documented on the Quarterly Methane Monitoring Form included in Appendix 4A - Forms. The required reports and other submittals will be included in the Site Operating Record of the facility and submitted to TCEQ.

## 4.9.16 Oil, Gas and Water Wells

There are no known crude oil or natural gas wells within the permitted site boundary. If any such wells are discovered during the development or facility operations, the TCEQ will be notified in writing within thirty days. Wells that are not authorized in accordance with 30 TAC §330.161 will be capped, plugged and closed in accordance with all applicable rules.

Water wells that are used for supply will comply with all applicable regulations and be approved by the TCEQ. Water wells that are abandoned and any water wells discovered during development or facility operations will be capped, plugged and closed in accordance with all applicable rules. If any such wells are discovered during the development or facility operations, the TCEQ will be notified in writing within thirty days.

Wells of other types such as gas and groundwater monitoring wells that are under the jurisdiction of the TCEQ and are taken out of service will be capped, plugged and closed in accordance with all applicable rules.

The TCEQ will be notified of any well discoveries within thirty days of discovery. Well plugging reports will be submitted to appropriate agencies and a copy of each well plugging report will be submitted to the TCEQ with thirty days of discovery and of capping, plugging and closing the well in accordance with all applicable rules and regulations of the commission or other state agency. Any water well used for supply at the facility may remain in use as long as it is located outside the waste footprint, is not impacted by Landfill operations, and can be demonstrated that the well design and

installation will prevent any cross-contamination from the waste management unit to the water well production zone and between any water bearing zones, and an approved sampling plan (including frequency and parameters) is in place. The executive director shall approve any well used to supply water at the facility that is located within the permit boundary.

## 4.9.17 Compaction

Solid waste brought into the active cell will be placed as follows:

- Waste will be unloaded and placed at the top or toe of the working surface.
- Waste will be spread into a thin layer, approximately three feet in depth.
- Waste will be compacted by the Landfill equipment or by running a dozer over the waste layer three to five times until the anticipated density is achieved (no less than 1,000 lb/cy). The compaction rate takes into account the following:
  - Amount of solid waste entering the Landfill;
  - Space utilization; and
  - Daily cover.

## 4.9.18 Landfill Cover

### 4.9.18.1 Daily Cover

The Landfill will apply six inches of well-compacted earthen material not previously mixed with garbage, rubbish, or other solid waste, or alternate daily cover, at the end of each operating day to control disease vectors, fires, odors, windblown litter or waste, and scavenging, unless TCEQ requires a more frequent interval to control disease vectors, fires, odors, windblown litter or waste, and scavenging. Runoff from areas that have intact daily cover will not be considered as having come into contact with the working face or leachate.

### 4.9.18.2 Intermediate Cover

All areas that have received waste but will be inactive for longer than 180 days will require intermediate cover. Intermediate cover will include six inches of well-compacted earthen material not previously mixed with garbage, rubbish, or other solid waste for a total of not less than 12 inches of cover. Due to the desert climate of the area, the intermediate cover will not be seeded or sodded following its application. Erosion control will be accomplished through structural controls, which may include silt fences, hay bales, earth diversion berms and dikes, drainage swales and channels, retention ponds, and riprap for gradients with excessive sloping in accordance with the Erosion and Sedimentation Control Plan included in Appendix 3B – Surface Water Drainage Analysis. The intermediate cover will be graded to prevent ponding of water, and plant growth or other erosion control features will be maintained. Runoff

from areas which have intact intermediate cover will not be considered as having come into contact with the working face or leachate.

### 4.9.18.3 Alternative Material Daily Cover

The Alternative Daily Cover (ADC) Plan for the Landfill is included in Appendix 4C – ADC Plan. ADC was previously authorized for the Landfill. Use of alternative daily cover is limited to a 24-hour period after which either waste or daily cover is placed. ADC shall not be allowed when the Landfill is closed for a period greater than 24 hours, unless the Executive Director approves an alternate length of time. In accordance with 30 TAC §330.165(d)(5), ADC will not exceed constituent limitations imposed on waste authorized to be disposed at the facility.

A status report on the ADC will be submitted on a two-month basis to the Executive Director and shall describe the following details: effectiveness of the alternative material, any problems that may have occurred, and corrective actions required as a result of such problems. If no unresolved problems have occurred within four consecutive two-month periods of use, status reports may no longer be required.

Other types of alternative daily cover may only be allowed by a temporary authorization under §305.70(m) followed by a major amendment or a modification in accordance with §305.70(k)(1) in accordance with §330.165(d).

### 4.9.18.4 Final Cover

The Landfill will install final cover for the Landfill in accordance with Section 3.8 – Final Closure Plan of the SDP and Subchapter K of 30 TAC Chapter §330 (relating to Closure and Post-Closure).

### 4.9.18.5 Alternative Final Cover

The Landfill may install an alternative final cover for the Landfill in accordance with Section 3.8 – Final Closure Plan and Appendix 3N – Use of Alternative Cap.

### 4.9.18.6 Erosion Of Cover

An Erosion and Sedimentation Control Plan, included in Appendix 3B – Surface Water Drainage Analysis, was developed to provide control measures for existing and future on-site gradient slopes and drainage. Erosion of final or intermediate cover will be repaired within five days of detection by restoring the cover material, grading, compacting, and seeding unless the commission's regional office approves otherwise, based on the extent of the damage requiring more time to repair or the repairs are delayed because of weather conditions. The periodic inspections and restorations are required during the entire operational life and for the post-closure maintenance period and will be conducted in accordance with 30 TAC §330.463(a)(1).

### 4.9.18.7 Cover Inspection Record

The Landfill will keep a cover application record on-site readily available for inspection by TCEQ representatives and authorized agents or employees of local

governments having jurisdiction. This record will specify the date cover (no exposed waste) was accomplished, how it was accomplished, and the last area covered. This applies to daily, intermediate, and alternate daily cover. For final cover, this record will specify the area covered, the date cover was applied, and the thickness applied that date. Each entry will be certified by the signature of the Facility Supervisor that the work was accomplished as stated in the record.

## 4.9.19 Ponded Water

Ponding of water over waste on the Landfill unit shall be prevented by proper grading. In the event ponded water occurs in the active sector, it will be eliminated as quickly as practical and the area in which the ponding occurred shall be filled in and regraded within seven days of the occurrence. Ponded water that occurs over waste filled areas will be removed quickly, and the affected area will be regraded within seven days of occurrence of ponding.

Water that ponds in excavated areas that does not come into contact with waste, contaminated water or contaminated soil will be allowed to evaporate, be drained or pumped into drainage ditches or detention ponds, or be pumped out and used for dust suppression. Water that has contacted waste, contaminated water or contaminated soil will be disposed of properly in accordance with the Leachate and Contaminated Water Plan located in Appendix 3I. Contaminated water will not be discharged without specific written authorization from the TCEQ.

The City will manage the working face to prevent water from collecting and ponding through the use of run-on berms and temporary toe berms as specified in Appendix 3I Leachate and Contaminated Water Plan of the Site Development Plan. Water that may pond at the working face will be removed and disposed of properly. Following major rain events, the City will assess the site to identify areas of potential or actual ponding. Corrective work will be performed as required by this SOP.

Within seven days of extended wet weather conditions, the City will assess the site to determine where ponding has occurred and take corrective action as required by this SOP.

Site assessment events, discoveries of ponding, and corrective actions will be documented. Documentation will be kept in the Site Operating Record.

## 4.9.20 Disposal of Special Wastes

The acceptance and/or disposal of a special waste as defined in §330.3 will be conducted in accordance with the Special Waste Acceptance Plan included in Appendix 4D – Special Waste Acceptance Plan. The disposal of special waste covered by this plan was previously authorized by TCEQ. The purpose of this plan is to set forth specific operational and technical procedures to be utilized at the Landfill for the acceptance and management of special wastes. These procedures will be adhered to during the handling, treatment, and/or disposal of special wastes.

## 4.9.21 Disposal of Industrial Wastes

The Landfill will not accept any Class I Industrial Solid Wastes. Refer to Section 4.7 for the handling of unauthorized waste. Class II Industrial Solid Waste will be accepted in accordance with the facility's Special Waste Acceptance Plan included in Appendix 4D.

## 4.9.22 Disposal of Regulated Asbestos Containing Waste

It is the intent of the Landfill to begin accepting RACM in accordance with §330.171. RACM will be placed within the existing lined Landfill Phases I and II as shown on Drawing P3-25. This permit amendment serves as the written notification to the TCEQ of the intent to accept RACM. The TCEQ Air General Operating Permit No. 517 – Checklist for Asbestos Handling is included in Appendix 4E.

In accordance with §330.171(c)(3)(B), the area to receive RACM was surveyed and the area to receive the RACM is identified on Drawing P3-25 (located in Appendix 3G). The operator will maintain a record of each load of RACM accepted and will document the location, depth, and volume of material received.

In accordance with §330.171(c)(3)(C), upon closure of a unit that has received RACM, a notation that the facility received RACM will be placed in the deed records for the facility with a diagram depicting the disposal areas. A copy of the documentation will be submitted to the executive director at this time.

In accordance with §330.171(c)(3)(D) and (E), the delivery of RACM will be coordinated with the on-site supervisor. Only RACM that is in tightly closed and unruptured containers or bags will be accepted. RACM may also be accepted if it has been wrapped with at least six-mil polyethylene.

In accordance with §330.171(c)(3)(F), RACM that is placed above natural grade will be located so that it is at least 20-feet from any final side slope of the unit and ten feet below the final surface of the unit at the time of closure.

In accordance with §330.171(c)(3)(G), containers or bags containing RACM will be carefully unloaded and placed in the final disposal location upon receipt. The RACM will be immediately covered with 12-inches of earthen material or three-feet of solid waste upon receipt. Care will be taken to ensure that the bags or containers are not ruptured.

In accordance with §330.171(c)(3)(H), the following contingency plan has been developed for the acceptance of RACM. All personnel responsible for handling RACM will be trained in the acceptance of RACM including the procedures to be followed if an accidental spill (e.g., ruptured bags or containers). The contingency action plan is as follows:

1. An accidental spill (e.g., ruptured bag or container) at the working face will be immediately wetted to prevent air emissions. After the asbestos has been wetted, the RACM will be immediately covered with non-asbestos containing material.
2. If the spill occurs elsewhere than the working face, the Landfill supervisor will be notified for cleanup. For the cleanup of RACM outside the working face, facility

personnel will don personal protective equipment (PPE) to protect themselves from exposure to the RACM prior to the start of cleanup. PPE may include (but is not limited to) Tyvek suits, rubber gloves, and respirators. Facility personnel will be trained in the cleanup of the RACM, PPE and will be fit tested for the respirators. Any persons that are not trained and do not have the proper PPE will be removed from the area. The spilled asbestos will be wetted to prevent fugitive emissions from the RACM. The asbestos will then be placed in a container of appropriate size and be immediately taken to the RACM working face. The RACM will be immediately covered with non-asbestos containing material.

In accordance with §330.171(c)(3)(I), RACM that has been designated as a Class 1 industrial waste may be disposed of at the facility provided that the RACM is handled in accordance with §330.171(c) and §330.173(g)-(h). Any Class 1 RACM must be accompanied by a manifest (waste-shipping control ticket) as required by the commission. The Landfill operator shall sign the manifest and retain the disposal facility copy of the manifest for a period of three years. After receipt of the Class 1 RACM, the facility must submit to the executive director a written report of the Class 1 RACM received. The report must be submitted no later than the 25$^{th}$ day of the month following the month that the waste was received. Reports must be submitted on commission provided forms and must include all information required.

In accordance with §330.171(c)(4), non-regulated asbestos-containing materials (non-RACM) may be accepted and disposed of provided that the wastes are placed on the active working face and covered immediately. Non-RACM will not be disposed of by means which the materials could crumble into a friable state.

## 4.9.23 Visual Screening of Deposited Waste

The Landfill will visually screen any deposited waste materials where the Executive Director determines that screening is necessary or where permit or design requirements so dictate. Berms located along the western and northern sides of the Landfill provide visual screening from motorists to the Landfill.

## 4.9.24 Leachate and Gas Condensate Recirculation

In accordance with Appendix 3I – Leachate and Contaminated Water Plan of the Site Development Plan for the Landfill, leachate may be recirculated over the daily or intermediate cover of the filled Landfill cells. For Landfill cells consisting of daily cover, leachate levels will be observed daily through the LED monitor on the leachate sump control panel. If the levels exceed the level of the invert of the collection line, the sumps will be pumped out and the leachate will be sprayed/recirculated over the active cell with daily cover. If after three (3) successive days, the leachate has not exceeded this level, the frequency of inspecting the pumps will be reduced to weekly. If after three (3) successive weeks the leachate has not exceeded this level, the inspection frequency will be reduced to monthly. During inactive periods at the facility or for filled Landfill cells consisting of intermediate cover, the leachate levels will be recirculated automatically when the leachate levels exceeds 12 inches on the liner. The leachate will be recirculated by a pump operated by a pressure transducer

and will be distributed by a piping system on top of the filled cell with intermediate cover. An electronic totalizer will track all leachate pumped out and will be checked quarterly. Leachate levels will also be checked quarterly. The Landfill operator shall keep all the leachate measurement records in the Site Operating Record and report the results to TCEQ.

Gas condensate, if produced, will also be recirculated in accordance with the Leachate and Contaminated Water Plan (Appendix 3I).

# Appendix 4A
# Forms

SAIC®

# FORMS

# TABLE OF CONTENTS

MCCOMBS LANDFILL – QUARTERLY METHANE MONITORING REPORT

MCCOMBS LANDFILL – GMP MONITORING

MCCOMBS LANDFILL – QUARTERLY LANDFILL GAS MONITORING PROBE VISUAL INSPECTION CHECKLIST

MCCOMBS LANDFILL – QUARTERLY METHANE MONITORING REPORT

MCCOMBS LANDFILL – LEACHATE MONITORING

LOAD INSPECTION REPORT

WASTE CHARATERIZATION DATA SHEET

**DEPARTMENT OF SOLID WASTE MANAGEMENT CONTROL**
**McCOMBS LANDFILL QUARTELY METHANE MONITORING REPORT**

| | |
|---|---|
| REPORT COMPLETED BY: | |
| WEATHER STATION DATA | |
| TEMPERATURE: | BAROMETRIC PRESSURE: |
| ATMOSPHERIC CONDITIONS: | |
| CUMULATIVE RAINFALL SINCE LAST MONITORING EVENT: | |
| AMBIENT CONDITIONS (WEATHER): | Dew Point: |
| METHANE MONITOR CHARGE CHECK: | METHANE MONITOR CALIBRATION CHECK: |

**PERMANENT ENCLOSED STRUCTURE MONITORING**

| STRUCTURE | METHANE READINGS (RANGE % LEL) | CH4 (% VOLUME) | COMMENTS |
|---|---|---|---|
| FEE COLLECTION BUILDING | | | |
| MAINTENANCE BUILDING | | | |
| WOODEN STORAGE BUILDING | | | |
| METAL BUILDING | | | |

**ADDITIONAL COMMENTS**

**GMP MONITORING - McCombs**

| GMP NUMBER | TIME | BAROMETRIC PRESSURE (" Hg) | GAS PROBE PRESSURE (INCHES H20) | GMP STEADY STATE METHANE READING (% LEL) | GMP STEADY STATE METHANE READING (% VOLUME) |
|---|---|---|---|---|---|
| 1A | | | | | |
| 1B | | | | | |
| 1C | | | | | |
| 2A | | | | | |
| 2B | | | | | |
| 2C | | | | | |
| 3A | | | | | |
| 3B | | | | | |
| 3C | | | | | |
| 4A | Dismantled and capped since 11/24/03 | | | | |
| 4B | Dismantled and capped since 11/24/03 | | | | |
| 4C | Dismantled and capped since 11/24/03 | | | | |
| 5A | Dismantled and capped since 11/24/03 | | | | |
| 6A | Dismantled and capped since 11/24/03 | | | | |
| 7A | | | | | |
| 8A | | | | | |
| 8B | | | | | |
| 8C | | | | | |
| 9A | | | | | |
| 9B | | | | | |
| 9C | | | | | |
| 10A | | | | | |
| 10B | | | | | |
| 10C | | | | | |
| 11A | | | | | |
| 11B | | | | | |
| 11C | | | | | |
| 12A | | | | | |
| 12B | | | | | |
| 12C | | | | | |
| 13A | | | | | |
| 13B | | | | | |
| 13C | | | | | |
| 14A | | | | | |
| 14B | | | | | |
| 14C | | | | | |
| 15A | | | | | |
| 15B | | | | | |
| 15C | | | | | |
| 16A | | | | | |
| 16B | | | | | |
| 16C | | | | | |
| 17A | | | | | |
| 17B | | | | | |
| 17C | | | | | |
| 18A | | | | | |
| 18B | | | | | |
| 18C | | | | | |
| 19A | | | | | |
| 19B | | | | | |
| 19C | | | | | |
| 20A | | | | | |
| 20B | | | | | |
| 20C | | | | | |
| 21A | | | | | |
| 21B | | | | | |
| 21C | | | | | |
| 22A | | | | | |
| 22B | | | | | |
| 22C | | | | | |

**McCombs Landfill**
**Quarterly Landfill Gas Monitoring Probe**
**Visual Inspection Checklist**

Inspected By: _____

| GMP # | Clearly Labeled | Steel Collar Condition | Concrete Pad Condition | Lock in Place | Casing Capped | Fitting in Good Condition | Comments |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |
| 10 | | | | | | | |
| 11 | | | | | | | |
| 12 | | | | | | | |
| 13 | | | | | | | |
| 14 | | | | | | | |
| 15 | | | | | | | |
| 16 | | | | | | | |
| 17 | | | | | | | |
| 18 | | | | | | | |
| 19 | | | | | | | |
| 20 | | | | | | | |
| 21 | | | | | | | |
| 22 | | | | | | | |

## LEACHATE MONITORING
## McCOMBS LANDFILL

**Date:** **Technician:**

| MONITORING WELL # | LEACHATE DEPTH (IN.) | REMARKS |
|---|---|---|
| Well # 1 | | |
| Well # 2 | | |
| Well # 3 | | |
| Well # 4 | | |

| | |
|---|---|
| Start Meter Reading: | |
| End Meter Reading: | |
| **Total gallons pumped:** | |

Monitoring Well #1: Leachate sump closest to Southwest corner
Monitoring Well #2: Leachate sump closest to middle of cell
Monitoring Well #3: Leachate sump closest to Northwest corner
Monitoring Well #4: Leachate sump on (phase III A) active since 5/19/03

## LOAD INSPECTION REPORT

Date and Time of Inspection: _____

Inspector's Name: _____

Name of Hauling Company: _____ Phone Number: _____

Address: _____ City: _____ State: _____ Zip: _____

Driver's Name: _____ Vehicle License Number: _____

Type of Vehicle: _____ (e.g., roll-of, from leader, dump truck)

Size of Load, yards: _____ Sources of Wastes: _____

### LOAD OF CONTENTS

| Waste | Est. % by Vol. | Waste | Est. % by Vol. |
|---|---|---|---|
| Household wastes | | Yard, waste, brush, stumps | |
| Wood | | Containers | |
| Metal | | Bulk liquids | |
| Paper, cardboard | | Powders, gusts | |
| Plastic, rubber, glass | | Soil | |

### PROHIBITED WASTE INDICATORS

| | Yes | No |
|---|---|---|
| Labeled hazardous waste | | |
| Batteries | | |
| Oil | | |
| Medical | | |
| Radioactive | | |
| Ashes | | |
| Soils | | |
| Odors, unusual | | |
| Colors, unusual | | |
| Heat, excessive | | |
| Smoke | | |

### INSPECTION RESULTS

Prohibited wastes identified? _____

Further action required? (e.g., none, lab tests, notification) _____

Samples sent to lab? _____ Lab Name: _____ Phone: _____

Tests required: _____

_____ _____

Driver Signature Load Inspector Signature

## WASTE CHARACTERIZATION DATA SHEET (WCDS)

**WASTE APPROVAL REQUEST/SIGN-OFF WCD NO.: TX_____**

IESI to complete this section.

Action Requested: [ ] New Waste Approval
IESI Initial Contact: _____ [ ] Up-Date Approval–Previous Number: _____
Location: _____ Disposal Site(s) Requested: _____
Tel: ( ) _____ Fax: ( ) _____ Management Method Requested: [ ] Landfill [ ] Hauling
Date: _____ [ ] Solidification [ ] Bioremediation [ ] Other

Authorizing Manager's Signature: _____ Title: _____ Date:

### 1. GENERATOR INFORMATION

a) Generator's Name: _____ e) State/Provincial/Local Registration No._____
b) Generating Facility's Address_____ f) Hazardous Waste Generator Status [ ] LOG [ ] SQC [ ] CESQG [ ] NA
City _____ State ____ Zip Billing Information
c) Generator's Representative g) Customer's Name:_____
Company/Title h) Customer's Mailing Address
Tel. ( ) _____ Fax ( ) _____
d) Emergency Information Contact_____ City_____ Sate: ____ Zip:_____

### 2. PERSONAL PROTECTION EQUIPMENT

a) Recommended personal protection equipment
Respiratory Protection [ ] None [ ] Cartridge ____ type [ ] Dust/Asbestos [ ]Supplied Air
Skin Protection [ ] Work uniform/leather gloves [ ] Tyvek™ Suit [ ] Encapsulated suit
[ ] Gloves _____ material [ ] Eye Protection [ ] Safety Glasses [ ] Goggles [ ] Other (See attached Material Safety Data Sheets (MSDS))
Additional Comments: _____
_____

### 3. GENERAL WASTE STREAM INFORMATION

a) Name/Description of the Waste _____
_____
b) Detailed Description of Process Generating the Waste (include Process Schematic as Necessary)
_____
_____
c) Waste Properties at 72 F
Physical State [ ] Solid [ ] Semi-Solid [ ] Powder [ ] Free Liquid [ ] Combination (Describe)
Reactivity: [ ]Water Reactive [ ]Acid Reactive [ ]Alkaline Reactive [ ]Oxidizer [ ]Autopolymerizable [ ] Pyrophoric [ ] Explosive [ ]] Thermally Sensitive [ ] Shock Sensitive [ ] None of the Above
Flash Point F[ ]>72 [ ]73-100 [ ]101-139(D001) [ ]140-200 [ ]>201 [ ]N/A Solid (passes paint filter test

PH [ ]<2(D002) [ ]2.1-5.0 [ ]5.1-9.0 [ ] 9.1-12.4 [ ]>12.5(D002) [ ] N/A Solid (passes paint filter test)
Odor [ ] None [ ] Mild [ ] Strong (Describe):

Estimated volume _____ [ ] Cubic yards [ ] Tons [ ] Gallons [ ] Cubic meters [ ] Tonnes (metric) [ ] Other
Per: [ ] Year [ ] Month [ ] Week [ ] Day [ ] One time [ ] Other_____

d) Waste stream characterization is based on the following:

[ ] Laboratory analysis (Copy attached): [ ] Yes [ ] No Name of Lab/Date of Report
[ ] Generator's process knowledge [ ] MSDS (Copy attached): [ ]Yes [ ]No Date of MSDS
[ ] Other documentation. (Describe and attach as necessary)

e) Is this waste a characteristically hazardous waster per 40 CFR 261.21-247 [ ] Yes [ ] No [ ] Excluded – Citation_____.

f) Is this waste an F, K, P, U listed hazardous waster as per 40 CFR 261.32-337 [ ] Yes [ ] No [ ] Excluded – Citation_____.

g)(i) Is this waste a treatment residue of a waste which was previously a characteristically hazardous waste or a treated hazardous debris residue? [ ] Yes (answer g)(ii)). If yes, describe the waste applicable code(s) and the process generating the waste prior to treatment:

g)(ii) If yes, does the waste meet all applicable land disposal restriction treatment standards founder under 40 CFR 268, an applicable state, local and provincial regulations? [ ] Yes [ ] No

h) Is this a "Hazardous Waste" as defined by state, provincial, or local regulations? [ ] Yes [ ] No If yes, enter the waste identification number if one has been assigned:

## 4. WASTE COMPOSITION

Please provide a breakdown of the waste stream based upon generator knowledge of the waste and the process(es) generating the waste stream.

| Components/Contaminants | Range(%)/ppm |
|---|---|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

Does this waste contain any of the following:

[ ] Organic Solvents
[ ] OSHA Substances
[ ] Radioactive Materials
[ ] Virgin Oils
[ ] Used Oils
[ ] Etiological/Infectious Agents
[ ] PCBs (if checked, complete attach PCB questionnaire
[ ] Free Sulfides
[ ] Free Cyanides
[ ] Free Ammonia
[ ] None of the Above

**If any of the above are marked they must also be included in waste breakdown at left.**

## 5. TRANSPORTATION INFORMATION

If the waste is a DOT Hazardous Material, complete the following
Proper USDOT Shipping Name _____
USDOT Hazard Class _____ UN or NA Number _____
PG _____ CERCLA _____

## 6. GENERATOR'S WARRANTY AND INDEMNITY

Generator warrants and agrees that (1) all of the information above and provided pursuant hereto is tru, correct and complete, and all known or suspected hazards have been disclosed, (2) all analytical results submitted are accurate and representative of the waste pursuant to SW846), (3) the waste is not a hazardous waste as defined, characterized or regulated by the USEPA or applicable state, provincial or other authority, and does not contain PCBs regulated by TSCA (40 CFR 761) that are prohibited for disposal in a landfill regulated by 40 CFR 257 or 258, or any provincial or other authority, (4) Generator shall immediately give written notice to IESI of a new or newly discovered material property, characteristic or condition pertaining to the waste not provided herein. Generator shall indemnify IESI and it affiliates against all claims, actions, penalties, liabilities and expenses (including legal expenses) resulting from breach or misrepresentation under the foregoing warranty and agreement. All warranties and indemnifications herein shall survive any termination of services by IESI or related agreements.

**GENERATOR'S AUTHORIZED SIGNATORY.**
The undersigned individual warranty that he/she is authorized to sign this document on behalf of the Generator

PRINT NAME _____ SIGNATURE: _____
TITLE:_____ COMPANY:_____ DATE_____
TELEPHONE: _____ FAX:_____

# Appendix 4B
# Endangered Species Documentation

SAIC®

TEXAS PARKS & WILDLIFE

Life's better outside.®

Commissioners

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Fort Worth

Carter P. Smith
Executive Director

July 5, 2012

Mr. Fredric J. Doran
SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve, Suite 305
St. Paul, MN 55121

RE: McCombs Municipal Solid Waste Landfill Vertical Expansion; El Paso County

Dear Mr. Doran:

Texas Parks and Wildlife Department (TPWD) received the request for information regarding listed threatened or endangered species within or near the above-referenced proposed project. TPWD staff has reviewed the information provided and offers the following comments and recommendations concerning this project.

Please be aware that a written response to a TPWD recommendation or informational comment received by a state governmental agency may be required by state law. For further guidance, see the Texas Parks and Wildlife Code, Section 12.0011, which can be found online at http://www.statutes.legis.state.tx.us/Docs/PW/htm/PW.12.htm#12.0011. For tracking purposes, please refer to TPWD project number 16900 in any return correspondence regarding this project.

Project Description

The proposed project entails the vertical expansion of an existing landfill to increase the height from the currently permitted elevation of 4,125 feet to 4,305 feet. The existing permitted boundary of the landfill is 327 acres and is not proposed to increase. No other information about the proposed project was provided with the request.

Federal Laws

*Endangered Species Act*

Federally-listed animal species and their habitats are protected from "take" on any property by the Endangered Species Act (ESA). Take of a federally-listed species can be allowed if it is "incidental" to an otherwise lawful activity and

4200 SMITH SCHOOL ROAD
AUSTIN, TEXAS 78744-3291
512.389.4800
www.tpwd.state.tx.us

must be permitted in accordance with Section 7 or 10 of the ESA. Federally-listed plants are not protected from take except on lands under federal/state jurisdiction or for which a federal/state nexus (i.e., permits or funding) exists. Any take of a federally-listed species or its habitat without the required take permit (or allowance) from the U.S. Fish and Wildlife Service (USFWS) is a violation of the ESA.

A record of consultation with the USFWS in 1982 was provided with the request. That correspondence addressed potential impacts to species that were listed as threatened or endangered at the time the landfill was constructed. Please note that since 1982 the following species have been listed as threatened or endangered under the ESA and have the potential to occur in El Paso County:

| **Species** | **Date Listed** |
|---|---|
| Least tern (*Sterna antillarum*) | 05/28/1985 |
| Northern Aplomado Falcon (*Falco femoralis septentrionalis*) | 02/25/1986 |
| Mexican Spotted Owl (*Strix occidentalis lucida*) | 03/16/1993 |
| Southwestern Willow Flycatcher (*Empidonax trailii extimus*) | 02/27/1995 |

It is the responsibility of the project proponent to determine if adverse impacts federally-listed species are expected to occur as a result of the proposed project and consult with the appropriate agency concerning those impacts.

**Recommendation:** TPWD recommends SAIC assess the proposed project for potential impacts to species that are protected by the ESA. Brief descriptions of suitable habitats for these species are provided on the attached TPWD El Paso County list. If potential impacts to federally listed species are anticipated, TPWD recommends SAIC contact the USFWS Austin Ecological Services Field office at (512) 490-0057.

*Migratory Bird Treaty Act*

The Migratory Bird Treaty Act (MBTA) prohibits taking, attempting to take, capturing, killing, selling/purchasing, possessing, transporting, and importing of migratory birds, their eggs, parts and nests, except when specifically authorized by the Department of the Interior. This protection applies to most native bird species, including ground nesting species. The US Fish and Wildlife Service (USFWS) Migratory Bird Office can be contacted at (505) 248-7882 for more information on potential impacts to migratory birds.

**Recommendation:** If migratory bird species are found nesting on or adjacent to the project area, they must be dealt with in a manner consistent with the MBTA. TPWD recommends excluding vegetation clearing activities during the general bird nesting season, March through August, to avoid adverse impacts to this group. If clearing vegetation during the migratory bird nesting season is unavoidable, TPWD recommends the facility survey the area proposed for disturbance to ensure that no nests with eggs or young will be disturbed by operations. Any vegetation (trees, shrubs, and grasses) where occupied nests are located should not be disturbed until the eggs have hatched and the young have fledged.

State Laws

*Parks and Wildlife Code, Section 68.015*

Section 68.015 of the Parks and Wildlife Code regulates state-listed species. Please note that there is no provision for take (incidental or otherwise) of state-listed species. A copy of *TPWD Guidelines for Protection of State-Listed Species*, which includes a list of penalties for take of species, is attached for your reference. State-listed species may only be handled by persons with a scientific collection permit obtained through TPWD. For more information on this permit, please contact the Wildlife Permits Office at (512) 389-4647.

Sparse vegetation consisting of grass, cactus, and scattered brush possibly found in the project area could potentially support the following state-listed threatened species:

- Texas horned lizard (*Phrynosoma cornutum*)
- Mountain short-horned lizard (*P. hernandesi*).

An additional indication of suitable habitat for the Texas horned lizard would be the presence of its primary food source, the Harvester ant (*Pogonomyrmex* sp.). Texas horned lizards and Mountain short-horned lizards are generally active in this part of Texas from March through September.

**Recommendation:** TPWD recommends avoiding disturbance of the Mountain short-horned lizard, Texas horned lizard, and colonies of the Harvester ant during clearing and construction. TPWD recommends a biological monitor be present during construction to try to relocate protected species if found. If the presence of a biological monitor during construction is not feasible, state-listed threatened species observed during construction should be allowed to safely leave the site.

A mixture of cover, food sources, and open ground is important to the Mountain short-horned lizard, Texas horned lizard, and Harvester ant. Disturbed areas within suitable habitat for these species should be revegetated with site-specific native, patchy vegetation rather than sod-forming grasses. TPWD recommends review and implementation of the attached monitoring and management guidelines for horned lizards.

Species of Concern

In addition to state- and federally-protected species, TPWD tracks special features, natural communities, and rare species that are not listed as threatened or endangered. These species and communities are tracked in the Texas Natural Diversity Database (TXNDD), and TPWD actively promotes their conservation. TPWD considers it important to evaluate and, if necessary, minimize impacts to rare species and their habitat to reduce the likelihood of endangerment.

Based on the project description, site location, a review of the TXNDD, and publicly-available aerial photographs, the following species of concern could be impacted as a result of the proposed project:

- Western Burrowing Owl (*Athene cunicularia hypugaea*)
- Desert night-blooming cereus (*Peniocereus greggii* var *greggii*)

A record of the Desert night-blooming cereus has been documented possibly within 1.5 miles of the project site. A printout of this occurrence record is attached for your reference.

**Recommendation:** If during construction the project area is found to contain rare species, natural plant communities, or special features, TPWD recommends that precautions be taken to avoid impacts to them.

Western Burrowing Owls reside primarily in open areas with short vegetation and bare ground, sometimes including areas near human habitation. They are dependent on the presence of fossorial (digging and burrowing) mammals, such as prairie dogs and ground squirrels, whose burrows are used for nesting and roosting. Burrowing owls residing in El Paso and surrounding counties are not only summer (breeding) residents but many owls stay in the El Paso region as winter residents. As stated above, the MBTA prohibits the intentional and unintentional take of migratory birds (including ground nesting species), their nests, and eggs. If mammal burrows would be disturbed as a result of the proposed project, TPWD recommends they be surveyed for burrowing owls. If nesting owls are found, disturbance should be avoided until the eggs have hatched and the young have fledged.

Please note that absence of TXNDD information in an area does not imply that a species is absent from that area. Given the small proportion of public versus private land in Texas, the TXNDD does not include a representative inventory of rare resources in the state. Although it is based on the best data available to TPWD regarding rare species, the data from the TXNDD do not provide a definitive statement as to the presence, absence or condition of special species, natural communities, or other significant features within your project area. These data are not inclusive and **cannot be used as presence/absence data.** They represent species that could potentially be in your project area. This information cannot be substituted for on-the-ground surveys. The TXNDD is updated continuously. As the project progresses and for future projects, please request the most current and accurate information at txndd@tpwd.state.tx.us.

**Recommendation:** Please review the attached TPWD county list of rare and protected species for El Paso County, as rare species in addition to those discussed above could be present depending upon habitat availability. These lists are also available online at http://www.tpwd.state.tx.us/landwater/land/maps/gis/ris/endangered_species/. The USFWS should be contacted for species occurrence data, guidance, permitting, survey protocols, and mitigation for federally listed species. For the USFWS rare species lists by county please visit http://www.fws.gov/endangered/.

Determining the actual presence of a species in a given area depends on many variables including daily and seasonal activity cycles, environmental activity cues, preferred habitat, transiency and population density (both wildlife and human). The absence of a species can be demonstrated only with great difficulty and then only with repeated negative observations, taking into account all the variable factors contributing to the lack of detectable presence. If encountered during construction, measures should be taken to avoid impacting wildlife.

I appreciate the opportunity to review and comment on this project. Please call me at (512) 389-4579 if we may be of further assistance.

Sincerely,

Julie C. Wicker

Julie C. Wicker
Wildlife Habitat Assessment Program
Wildlife Division

JCW:16900

Attachments (4)

Protection of State-Listed Species
Texas Parks and Wildlife Department Guidelines

## Protection of State-Listed Species

State law prohibits any take (incidental or otherwise) of state-listed species. State-listed species may only be handled by persons possessing a **Scientific Collecting Permit** or a **Letter of Authorization** issued to relocate a species.

- **Section 68.002 of the Texas Parks and Wildlife (TPW) Code** states that species of fish or wildlife indigenous to Texas are endangered if listed on the United States List of Endangered Native Fish and Wildlife or the list of fish or wildlife threatened with statewide extinction as filed by the director of Texas Park and Wildlife Department. Species listed as Endangered or Threatened by the Endangered Species Act are protected by both Federal and State Law. The State of Texas also lists and protects additional species considered to be threatened with extinction within Texas.

- **Animals** - Laws and regulations pertaining to state-listed endangered or threatened animal species are contained in **Chapters 67 and 68 of the Texas Parks and Wildlife (TPW) Code** and **Sections 65.171 - 65.176 of Title 31 of the Texas Administrative Code (TAC).** State-listed animals may be found at **31 TAC §65.175 & 176.**

- **Plants** - Laws and regulations pertaining to endangered or threatened plant species are contained in **Chapter 88 of the TPW Code and Sections 69.01 - 69.9 of the TAC.** State-listed plants may be found at **31 TAC §69.8(a) & (b).**

## Prohibitions on Take of State Listed Species

**Section 68.015 of the TPW Code** states that no person may capture, trap, take, or kill, or attempt to capture, trap, take, or kill, endangered fish or wildlife.

**Section 65.171 of the Texas Administrative Code** states that except as otherwise provided in this subchapter or **Parks and Wildlife Code, Chapters 67 or 68,** no person may take, possess, propagate, transport, export, sell or offer for sale, or ship any species of fish or wildlife listed by the department as endangered or threatened.

"Take" is defined in **Section 1.101(5) of the Texas Parks and Wildlife Code** as:

> *"Take," except as otherwise provided by this code, means collect, hook, hunt, net, shoot, or snare, by any means or device, and includes an attempt to take or to pursue in order to take.*

## Penalties

The penalties for take of state-listed species **(TPW Code, Chapter 67 or 68)** are:

- 1ST Offense = Class C Misdemeanor:
  $25-$500 fine

- One or more prior convictions = Class B Misdemeanor
  $200-$2,000 fine and/or up to 180 days in jail.

- Two or more prior convictions = Class A Misdemeanor
  $500-$4,000 fine and/or up to 1 year in jail.

Restitution values apply and vary by species. Specific values and a list of species may be obtained from the TPWD Wildlife Habitat Assessment Program.

TEXAS PARKS & WILDLIFE

# MANAGEMENT AND MONITORING PACKET

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## WHAT'S HAPPENED TO ALL THE HORNY TOADS?

Everyone loves horny toads, but for many Texans, the fierce-looking, yet amiable, reptiles are only a fond childhood memory. Once common throughout most of the state, horned lizards have disappeared from many parts of their former range.

A statewide survey conducted by the Horned Lizard Conservation Society in 1992 confirmed many Texans' personal experiences—in the latter part of the 20th century the Texas Horned Lizard nearly disappeared from the eastern third of Texas and many respondents reported that horned lizards were increasingly rare in Central and North Texas. Only in West and South Texas do populations seem somewhat stable.

Many factors have been proposed as culprits in the disappearance of horned lizards, often fondly called "horny toads," including collection for the pet trade, spread of the red imported fire ant, changes in agricultural land use, habitat loss and fragmentation as a result of urbanization, and environmental contaminants. For the most part, however, the decline of horned lizards has remained a mystery with little understanding of management actions that could be taken to reverse it. Even less is known about the status of our other two horned lizard species—the Round-tailed Horned Lizard and the Greater Short-horned Lizard.

But you can help! Through participation in Texas Horned Lizard Watch as a citizen scientist, you can collect data and observations about the presence or absence of horned lizards and habitat characteristics on your monitoring site. The data you provide to TPWD, ***even if you don't find horned lizards***, will help us understand how they are doing and offer some insights for people wishing to manage habitats for horned lizards. If you are a property owner, then keeping these management guidelines in mind can help you to enhance or perhaps even recruit horned lizard populations on your property, while at the same time benefitting other native wildlife. There's something everyone can do to help out horny toads!

*Texas Horned Lizard*

SEGHERS

*Round-tailed Horned Lizard*

D. MARTIN

*Greater Short-horned Lizard*

D. MARTIN

# ABOUT HORNED LIZARDS

## Appearance

Horned lizards are named for the crown of horns found on their heads, the size and number of which vary among species. Although often called horned toads, horny toads, or even horned frogs because of their wide, flattened bodies (their scientific name *Phrynosoma* actually means "toad-body"), they are not amphibians like other toads, but are reptiles with scales, claws and young produced on land. More than a dozen different species of horned lizards are found throughout western North America.

Three horned lizard species call Texas home, with the most widespread being the Texas Horned Lizard, or the familiar "horny toad." The geographic range of these species can overlap in West Texas, but they can each be readily distinguished from each other by the following characteristics.

LEE ANN LINAM

D. MARTIN

D. MARTIN

### Texas Horned Lizard

*Phrynosoma cornutum*

**Horns** – two prominent horns at the rear and center of the skull
**Scales** – two rows of spiky fringe scales on the side of the body
**Coloring** – gray to brown to rust, with dark spots in rows down the back, a light central stripe, and dark lines radiating from the eye.
**Length** – 3.5 to 5 inches
**Range** – most of Texas, though now nearly gone from the eastern third

### Round-tailed Horned Lizard

*Phrynosoma modestum*

**Horns** – four horns of medium length lined up on the back of the head
**Scales** – few enlarged scales on the body, sides without spiky fringe
**Coloring** – white to gray, brown or pink, with dark blotches at the legs and neck; bands on tail
**Length** – 3 to 4 inches
**Range** – rocky areas in the western third of Texas

### Greater Short-horned Lizard

*Phrynosoma hernandesi*

**Horns** – robust head that is wider than long and heart-shaped, back of the head is tipped only with small horns
**Scales** – one row of spiky fringe scales along the side of the body
**Coloring** – variable colors and patterns ranging from simple brown or grey to intricate patterns of bright colors including orange, yellow, white, red, blue and green
**Length** – 3.5 to 6 inches
**Range** – only higher elevations, in the forests of the Davis and Guadalupe mountains of West Texas

## TEXAS SPINY LIZARD

Another similar group of lizards occurs in Texas, the spiny lizards. Spiny lizards are sometimes confused with horned lizards because of the spiky scales found on their bodies and heads; however, the spiny lizards are much more slender with a longer tail. In addition, they tend to spend more time climbing, whereas horned lizards spend most of their time on the ground.

## Life History

Horned lizards are usually found in flat, open terrain, with sparse plant cover, although in the eastern portion of their distribution, vegetation cover may be somewhat thicker. They utilize mammal burrows, rock piles or clumps of vegetation for cover and may excavate shallow burrows in loose soils or scoop out a shallow depression in which to hide.

Horned lizards primarily eat harvester ants (also called big red ants), but their diet also includes termites, other native ants, other insects, spiders and sowbugs. Horned lizards or their droppings can sometimes be found near the beds of harvester ants, and an individual can consume 70–100 ants per day (one reason they are difficult to maintain in captivity!).

Horned lizards require warm temperatures to stimulate their appetite and activity. They sometimes begin their day by exposing only their heads to sunlight while keeping their bodies buried. Later, they will often be seen in a flattened body posture sunning themselves in open areas. They are not usually active at night or when temperatures fall below 75° F. In general, they are seen only in late spring through early fall and tend to hibernate a few inches underground from September/October to March/April.

Mating occurs soon after emergence from hibernation. The female digs a hole 6 to 8 inches deep and lays 13 to 50 eggs (6 to 18 for Round-tailed Horned Lizards), which are incubated by the warmth of the soil. Depending on ground temperatures, young horned lizards about 3/4-inch in length may begin to hatch 5 to 9 weeks later. The Greater Short-horned Lizard, which lives in cooler, higher-altitude climates, is unique among our species in giving birth to live young!

Texas Horned Lizards and Short-horned Lizards may live 5 to 8 years, while Round-tailed Horned Lizards are thought to live only 2 to 3 years. Although snakes, mammals and birds prey on them, horned lizards have developed some unique defenses. Their spiky appearance and coloration help Texas and Short-horned lizards to blend into the local vegetation, while the color and shape of the Round-tailed Horned Lizard actually help it to look like a rock! In addition to the deterrence that the horns on the head may provide to predators, horned lizards can inflate themselves to a larger apparent size or may tilt their body to appear larger. Finally, the horned lizard is renowned for its ability to shoot

## WHAT ARE HARVESTER ANTS?

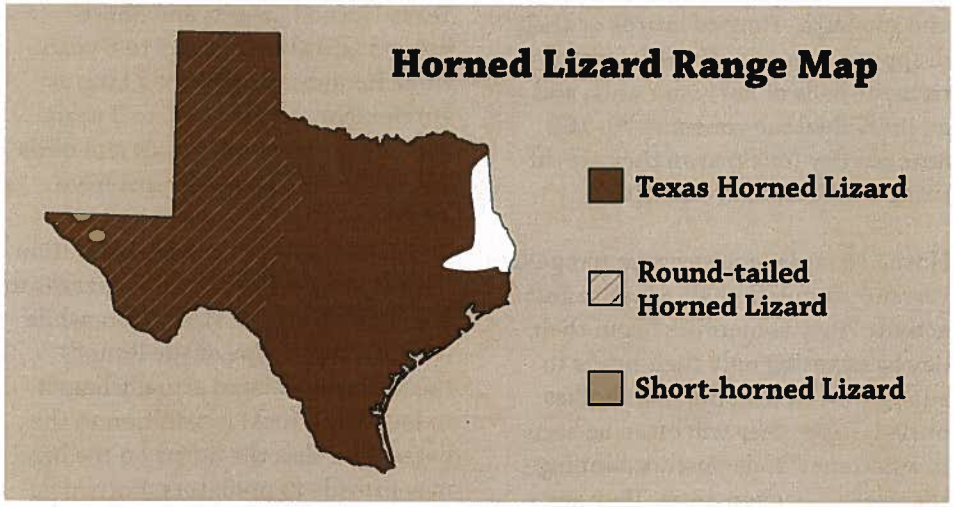
Harvester ants belong to the genera *Pogonomyrmex* or *Ephebomyrmex*. Twelve species of harvester ants are found in Texas, and the Red Harvester Ant (*Pogonomyrmex barbatus*) is the most widespread. Red harvester ants are easily identified by their large size (up to a half inch) and generally conspicuous mound. These ants clear vegetation, forming a large circular pattern of bare ground around their nest. This bare ground is often covered with small pebbles dug from within the nest itself. The mound usually has one main entrance/exit hole in the center of the cleared area. Extending in various directions from the main mound are foraging trails leading to various foraging zones. Harvesters, as the name implies, harvest seeds. Grass seeds make up the majority of their diet, and the husks of harvested seeds often surround harvester ant mounds.

MAYO

a stream of blood from its eye when under extreme stress (actually from ruptured blood vessels in the sinuses near the eyes). A chemical in the blood is especially distasteful to canine predators. Texas Horned Lizards and Short-horned Lizards are known to engage in blood-squirting, while the Round-tailed Horned Lizard does not.

Sometimes a horned lizard sign such as scat (or droppings) is much more visible than the species itself. Horned lizard scat is a dark brown oblong pellet that is straight or slightly curved. A white uric acid tip is often very prominent. Ant heads and other body parts are noticeable in the scat, especially when the scat is broken apart. The scat usually looks very large in relation to the lizard from which it came, ranging from 1/2 to 1-1/2 inches in length and 1/4 to 3/8 inch in diameter. Scat of other lizards have the uric acid tip; however, the shape of the scat is much less symmetrical and it will not contain a high percentage of ants.

NEWSOM




## Protected Status

Texans have a long history of concern for horned lizards. In 1967, the state legislature protected Texas Horned Lizards from the pet trade (horned lizards do not survive well in captivity), and in 1977, Texas Parks and Wildlife Department placed both the Texas Horned Lizard and the Greater Short-horned Lizard on the state threatened species list. In 1993, a group of schoolchildren successfully petitioned the Texas Legislature to name the Texas Horned Lizard the official state reptile. Though not listed as threatened or endangered, Round-tailed Horned Lizards receive some attention/regulation through the state's nongame permit process.

# MANAGEMENT OF HORNED LIZARDS

Many Texans are interested in having more horned lizards on their property. Although many people inquire about translocating or breeding horned lizards for release, unfortunately, initial research has not been very successful with these efforts and additional conservation questions need to be answered. In addition, because Texas Horned Lizards and Short-horned Lizards are listed as threatened species, anyone handling these species or attempting to do this must obtain a scientific permit. Horned lizards cannot survive and thrive without appropriate habitat, and probably the best strategy for bringing back horned lizards is to first restore or create suitable habitat that can support and conserve native ant populations as well as horned lizards.

Horned lizards in Texas can be found in a variety of habitats; however, researchers have noted several similarities among occupied habitat.

- First, horned lizards tend to be found in "patchy" habitat that is characterized by areas of bare ground (~40 percent) interspersed with native vegetation. This open ground allows horned lizards room for movement and basking, and it provides ants open areas for colony establishment.
- Second, Texas Horned Lizards seem to prefer sandy loam soils that are more than 2/3 sand and less than 15 percent clay. Loose, well-drained soils are more suitable for burrowing, hibernating and nesting.
- Third, horned lizards in Texas are usually found where native ants are abundant. Harvester (or "red") ants in the genus *Pogonomyrmex* are often very evident, although horned lizards also eat other native ants and insects.

One horned lizard can use five to six acres of habitat over the course of its activities, often feeding at a number of different harvester ant mounds. There is a minimal amount of overlap with other adult horned lizards. A viable population of horned lizards may thus require a substantial amount of suitable habitat.

## MANAGEMENT GUIDELINES

**The following management guidelines for horned lizards are adapted from a 1998 publication, *Management of Texas Horned Lizards*, written by Scott E. Henke and Wm. Scott Fair, and published by the Caesar Kleberg Wildlife Research Institute of Texas A&M University–Kingsville as Wildlife Management Bulletin No. 2.**

1. **Develop and maintain a habitat that contains a diversity of native plant species –** A diverse community of native plants will attract a diverse community of invertebrates. Such a variety of insects may be especially important to juvenile horned lizards. If you are interested in reclaiming a previous agricultural area or in landscaping at your residence, focus on native bunchgrasses, such as bluestems, forbs and shrubs. Bunchgrasses form clumps that allow horned lizards to easily move among the grass clumps; whereas carpet grasses form a thick mat that can impede horned lizard movement. Native grasses also produce seeds that are good food sources for harvester ants.

2. **Create a mosaic habitat of open areas intermixed within more dense cover –** Such a patchy environment will give horned lizards areas in which to warm or cool themselves, allow them room for movement, and offer sufficient escape cover from predators. You may also wish to create 1-square-yard areas devoid of any vegetation and ground litter. These spots may serve as valuable basking areas for horned lizards, and newly fertilized harvester ant queens need bare ground in which to establish new colonies. Grazing, burning, mowing, and scraping can help create and maintain the mosaic habitat desired.

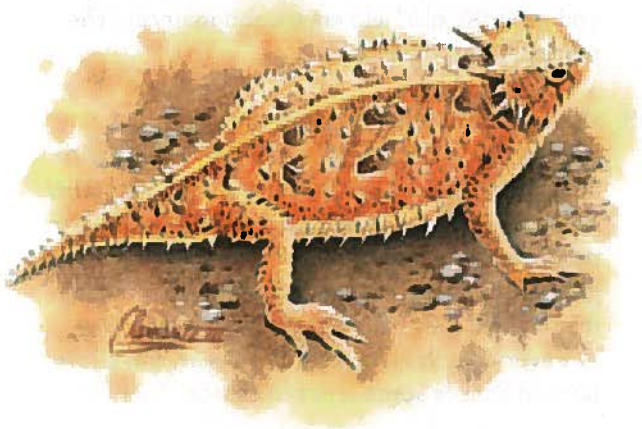
3. **Use prescribed fires to remove ground litter** – Horned lizards usually avoid areas with substantial dead vegetation on the ground (also called litter) because the litter can impede their movement. Burning is a useful tool to decrease ground litter and create open ground. Burning in small patches on a rotational basis, so that not every patch is burned every year, can allow horned lizards some areas to escape. In addi-

tion, conducting burns during the cool season (late winter/early spring) results in cooler fires, and research suggests that hibernating lizards can survive such fires while burrowed underground. Local Natural Resource Conservation Service staff can provide site-specific guidance on prescribed burning.

4. **Avoid overgrazing by livestock** – Horned lizards do not appear to be negatively affected by low to moderate grazing of livestock, and grazing may help increase some plant diversity and open areas. On the other hand, very heavy stocking rates can reduce needed cover and result in direct mortality of horned lizards. Use of a rotational grazing scheme can help create the desired mosaic of open areas and vegetative cover.

5. **Avoid road maintenance and limit traffic during the horned lizard active season** – Horned lizards make frequent use of roadsides, especially unpaved secondary roads, for basking, resting, and bedding sites. If possible, avoid disking or grading roads between mid-March and mid-October. In addition, vehicular strikes can be a significant mortality factor for horned lizards. Slower speeds and caution should be exhibited during the active season for horned lizards, especially in the mornings and late afternoons. If drivers are cautious, however, road-cruising can be a valuable way to survey horned lizard populations.

6. **Avoid the use of broadcast pesticides** – Pesticides could kill horned lizards directly by accumulating toxins within their body or indirectly by killing harvester ants and other valuable insects. If pesticides are needed, then spot treatment is recommended rather than broadcast application.



7. **Manage ant populations** – Findings from Texas Horned Lizard Watch indicate that efforts should be made to encourage native ant populations and discourage red imported fire ants. The first step should be to reduce red imported fire ant populations; however, fire ant control methods should be chosen carefully, as some pesticides used to kill fire ants can also kill native ants and other insects. In a small area, individual fire ant mound treatments, either with pesticides, organic mixes or soapy boiling water, can be used. When baits are used, application late in the day on the fire ant mound can increase the chances that fire ants will pick up bait and native ants will not. On larger acreages or with severe infestations, a broadcast treatment may be needed; however, steps can be taken to minimize the impact of such treatments on native ants. Try to find a bait that uses an active ingredient, such as Spinosad, that does not affect harvester ants. Several researchers suggest placing broadcast pesticides in small containers, such as film canisters that have small holes drilled in the container or its lid. The holes should be no larger than 1/16-inch in diameter so that fire ants can enter the container, but harvester ants cannot.

   As noted above, native ants can be encouraged by establishing native grasses and scattered patches of bare ground. Some landowners also choose to "feed" their harvester ant populations by providing native seed, oat flakes, crushed peanuts, or similar items within the foraging area of the mound.

8. **Remove feral domesticated predators** – Feral cats and dogs, along with pets, are predators of horned lizards. Keep pets from "hunting" in horned lizard habitat. Feral animals can be removed; you may wish to contact the Humane Society for assistance or suggestions. Keep in mind that wild avian predators, such as roadrunners or shrikes, are protected by federal law and cannot be killed or trapped; however, providing plenty of escape cover can help horned lizards survive among these natural predators.

# HOW TO MONITOR HORNED LIZARDS

**There are two ways you can participate in Texas Horned Lizard Watch, either by searching a site or setting up a transect. Please note that each survey type has its own unique data form.**

## Site Surveys

Site surveys can take place anywhere, from your backyard to your hunting ranch to your favorite state park. The enclosed data sheet asks you to provide information about the site location and its habitat and then provides a table where you can list information about each horned lizard (or horned lizard scat) seen. Feel free to submit maps or photos to supplement your information and to make copies of the data sheet if needed. You can survey as many different sites as you like; simply fill out a separate site form for each site.

For best results, we recommend that you visit your site at least five times between May and September; however, we are happy to accept data from sites that you visit less often. You can even fill out this form when you happen to spot a horned lizard by chance. Simply let us know how many hours you spent visiting the site, so that we can get an idea of the survey effort.

## Transects

Transects are a more quantitative method for monitoring species and require a more formal survey effort. The benefits of transects are that we can convert results to density estimates and thus compare horned lizard populations at different sites.

To conduct a Texas Horned Lizard transect you need to set up a route that is at least 3 miles long. The route can follow unpaved roads or trails or be of your own design. Walk, ride or drive the route, recording all Texas horned lizards and ant beds that occur within 3 feet of your route on either side. (If driving, be sure to keep speeds under 15 mph and stop and check the identification of any horned lizards seen.) Mark your transect location on a map if possible. Transects should be conducted at least five times between May and September if possible.

## Submitting Data

Data forms can be mailed, faxed, or scanned and e-mailed. We would like to receive your datasheet *even if you do not see horned lizards*. Not finding horned lizards is as important as finding them, because that helps us understand the types of sites or conditions where horned lizards are missing.

## Additional Monitoring Notes

Certain conditions apply to both methods. You should try to make sure that your surveys are conducted under sunny, or partly sunny, dry weather conditions when temperatures are 80-95° F and winds are light or moderate. One good indicator of horned lizard activity is to check to see whether harvester ants are active. Ideally, your five survey efforts should be at least several weeks apart (although you may conduct additional surveys more frequently). If you do visit a site more frequently, then you may want to collect any horned lizard scat you encounter so that you don't recount it on subsequent visits. Scat can also be sent in with your data sheets as verification.

The Texas Horned Lizard and the Short-horned Lizard are listed as threatened by Texas Parks and Wildlife, primarily to protect them from commercial exploitation. Because of this designation, you should not collect or move horned lizards that you encounter on your survey efforts.

Finally, be sure to send in your survey forms, even if you do not see any horned lizards. If you have any uncertainty about identification of the lizards or scat you see, don't hesitate to take a photo and send it to us.

### IMPORTANT:

### ABOUT THE LANDOWNER ACCESS REQUEST FORM

Texas Parks and Wildlife cannot use data collected from private land unless written permission is received from the landowner.

All Texas Horned Lizard Watch volunteers must send in a completed Landowner Access Request Form for any data collected from private land. This applies even if you are monitoring your own property.

Please respect the rights of private property owners during the course of your volunteer efforts.

TEXAS PARKS & WILDLIFE

**Texas Horned Lizard Watch**

# Landowner Access Request Form

To the landowner:

_____ (volunteer name) is participating as a volunteer in Texas Horned Lizard Watch. Texas Horned Lizard Watch is a monitoring program that uses citizen volunteers to gather data about the status and health of our state reptile. Texas Parks and Wildlife is very pleased to have the assistance of concerned Texans in watching over the health of the horny toad.

We have, however, instructed our volunteers that they cannot collect data on private land without the approval of the private landowner. Accordingly, we have prepared this form for your approval. The sections described below are the releases that we and our volunteers are required to obtain from you under Section 12.103 of the Texas Parks and Wildlife Code. If you are willing, then please sign one or both sections and provide a copy to our volunteer.

1. **Use of information**
   This documents my approval for TPWD volunteers and employees to use site-specific information from the property I own or manage. This may include placing that information onto a topographic map and entering the information into a department database. Thus, the information could be viewed by the public.

   _____ _____
   (Landowner or authorized agent signature) (Date)

2. **Reporting information**
   This also documents my approval for TPWD volunteers and employees to report (such as in publications or technical reports) the above approved information in a manner that permits identification of the location of the specific parcel of property that I own or manage.

   _____ _____
   (Landowner or authorized agent signature) (Date)

3. **Other Conditions**
   If there are any conditions that apply to this approval, please specify and initial below.

   _____
   _____
   _____

**Name and Address:** (of landowner or authorized agent)

Name _____
Address _____
City/ST/Zip _____
Phone _____
Phone _____

**Optional:**

Ranch or Tract Name _____
_____
County _____
Acreage _____
Location _____

Texas Parks and Wildlife Department maintains the information collected through this form. With few exceptions, you are entitled to be informed about the information we collect. Under Sections 552.021 and 552.023 of the Texas Government Code, you are also entitled to receive and review the information. Under Section 559.004, you are also entitled to have this information corrected. TPWD, 4200 Smith School Road, Austin, TX 78744. (800) 792-1112.
PWD 1280–W7000 (2/10)

TEXAS PARKS & WILDLIFE

**Texas Horned Lizard Watch**

# Site Survey Data Form

Complete a separate data form for each site

Name _____

Address _____

_____

_____

Phone _____

E-mail _____

Site Name _____

County _____

Lat-Long or distance and direction from nearest town

_____

*Please mark location on map if available.*

Approximate area of site _____ acre(s)

Are harvester ants present? ☐ Yes ☐ No

Are red imported fire ants present? ☐ Yes ☐ No

**Dominant habitat type**

- ☐ native grassland (n)
- ☐ improved grasses (i)
- ☐ mixed grass/shrubs (m)
- ☐ predominantly shrubland (s)
- ☐ woodland/forest (w)
- ☐ desert scrub (d)
- ☐ agriculture (a)

**Dominant land use**

- ☐ residential
- ☐ ranching
- ☐ agriculture
- ☐ park land/preserve
- ☐ not in current use

**Dominant soil type**

- ☐ rocky
- ☐ sandy
- ☐ clay
- ☐ loam (intermediate between sand/clay)

Approximate time (# people X # hours) spent searching this site this year: _____

## Horned Lizard Sightings (includes scat)

| Date | Time | Temp (F) | HL species[1] | Approxi-mate size (in.) | # HL scat (droppings) seen | Habitat[2] | Comments |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
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| | | | | | | | |
| | | | | | | | |

[1]Indicate whether lizard was a Texas Horned Lizard (TLH), Round-tailed Horned Lizard (RTHL) or Short-horned Lizard (SHL).
[2]Indicate the habitat type where the lizard was seen (based on habitat types listed above).

Continue on additional pages if needed.

Send completed form(s) and map to:

**Please submit all forms by October 31**

Texas Horned Lizard Watch, Texas Parks and Wildlife Dept.
4200 Smith School Road, Austin, TX 78744
hornedlizards@tpwd.state.tx.us

Texas Parks and Wildlife Department maintains the information collected through this form. With few exceptions, you are entitled to be informed about the information we collect. Under Sections 552.021 and 552.023 of the Texas Government Code, you are also entitled to receive and review the information. Under Section 559.004, you are also entitled to have this information corrected. TPWD, 4200 Smith School Road, Austin, TX 78744. (800) 792-1112.
PWD 1280A–W7000 (2/10)

TEXAS PARKS & WILDLIFE

**Texas Horned Lizard Watch**

# Transect Data Form

Complete a separate data form for each transect

Name _____

Address _____

_____

_____

Phone _____

E-mail _____

Transect name _____

County _____

Lat-Long or distance and direction from nearest town

_____

*Please mark location on map if available.*

Length of transect _____ miles

Transect was: ☐ walked ☐ driven ☐ other

Maximum number of harvester ant beds _____

Maximum number of fire ant beds _____

**Dominant habitat type**

- ☐ native grassland (n)
- ☐ improved grasses (i)
- ☐ mixed grass/shrubs (m)
- ☐ predominantly shrubland (s)
- ☐ woodland/forest (w)
- ☐ desert scrub (d)
- ☐ agriculture (a)

**Dominant land use**

- ☐ residential
- ☐ ranching
- ☐ agriculture
- ☐ park land/preserve
- ☐ not in current use
- ☐ road right-of-way

**Dominant soil type**

- ☐ rocky
- ☐ sandy
- ☐ clay
- ☐ loam (intermediate between sand/clay)

Approximate time (# people X # hours) spent searching this transect this year: _____

## Horned Lizard Sightings (includes scat)

| Date | Time | Temp (F) | HL species[1] | Approxi-mate size (in.) | # HL scat (droppings) seen | Habitat[2] | Comments |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

[1]Indicate whether lizard was a Texas Horned Lizard (TLH), Round-tailed Horned Lizard (RTHL) or Short-horned Lizard (SHL).
[2]Indicate the habitat type where the lizard was seen (based on habitat types listed above).

Continue on additional pages if needed.

Send completed form(s) and map to:

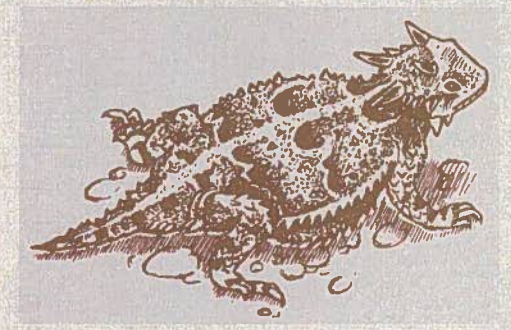
**Please submit all forms by October 31**

Texas Horned Lizard Watch, Texas Parks and Wildlife Dept.
4200 Smith School Road, Austin, TX 78744
hornedlizards@tpwd.state.tx.us

Texas Parks and Wildlife Department maintains the information collected through this form. With few exceptions, you are entitled to be informed about the information we collect. Under Sections 552.021 and 552.023 of the Texas Government Code, you are also entitled to receive and review the information. Under Section 559.004, you are also entitled to have this information corrected. TPWD, 4200 Smith School Road, Austin, TX 78744. (800) 792-1112.

PWD 1280B–W7000 (2/10)

# NOW GET OUT THERE AND COUNT YOUR HORNY TOADS!



**If you have questions or need more information:**

Texas Horned Lizard Watch, 4200 Smith School Road, Austin, TX 78744

hornedlizards@tpwd.state.tx.us

www.tpwd.state.tx.us/hornytoads/

## NONGAME AND ENDANGERED SPECIES CONSERVATION FUND

The "Special Fund" was created by the Texas Legislature in 1983 to underwrite the conservation and management work performed on Texas' nongame and endangered wildlife. This fund, sustained entirely by voluntary contributions, has provided support for a variety of projects benefiting nongame and endangered species. For more information on this fund, call the TPWD Wildlife Diversity program at (800) 792-1112.

Texas conservation license plates help fund conservation efforts in the state. The most popular plate features a Texas horned lizard and provides funding for wildlife diversity projects, including horned lizard research. **http://conservation-plate.org/**

## FOR MORE INFORMATION CHECK OUT THE FOLLOWING REFERENCES


Davis, John M. Management of the Red Harvester Ant (*Pogonomyrmex barbatus*). Texas Parks and Wildlife Department. 9 pp.

Donaldson, W., A.H. Price, and J. Morse. 1997. The current and future prospects of the Texas horned lizard (*Phrynosoma cornutum*) in Texas. Texas Journal of Science 46:97-113.

Fisher, B. L. and Stefan P. Cover. 2007. Ants of North America: A Guide to the Genera. University of California Press. Berkeley. +193 pp.

Henke, S. E. and W. S. Fair. 1998. Management of Texas Horned Lizards. Wildlife Management Bulletin 2, Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville. 7 pp.

Horned Lizard Conservation Society (www.hornedlizards.org).

Manaster, J. 2002. Horned Lizards. Texas Tech University Press. 84 pp.

Sherbrooke, W. 2003. Introduction to Horned Lizards of North America. University of California Press. 178 pp.

Texas Imported Fire Ant Research and Management Project (http://fireant.tamu.edu/).



TEXAS PARKS & WILDLIFE

PWD BK W7000-038 (2/10)

4200 Smith School Road
Austin, TX 78744
www.tpwd.state.tx.us



TPWD receives federal assistance from the U.S. Fish and Wildlife Service and other federal agencies. TPWD is therefore subject to Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, Title II of the Americans with Disabilities Act of 1990, the Age Discrimination Act of 1975, Title IX of the Education Amendments of 1972, in addition to state anti-discrimination laws. TPWD will comply with state and federal laws prohibiting discrimination based on race, color, national origin, age, sex or disability. If you believe that you have been discriminated against in any TPWD program, activity or event, you may contact the U.S. Fish and Wildlife Service, Division of Federal Assistance, 4401 N. Fairfax Drive, Mail Stop: MBSP-4020, Arlington, VA 22203, Attention: Civil Rights Coordinator for Public Access.

# Element Occurrence Record

**Scientific Name:** *Peniocereus greggii var. greggii* **Occurrence #:** 12 **Eo Id:** 6446

**Common Name:** desert night-blooming cereus **TX Protection Status:** **ID Confirmed:** Y

**Global Rank:** G3G4T2 **State Rank:** S2 **Federal Status:**

## Location Information:

**Latitude:** 315702N **Longitude:** 1062631W

| Watershed Code: | Watershed Description: |
|---|---|
| 13030102 | El Paso-Las Cruces |
| 13050003 | Tularosa Valley |
| 13040100 | Rio Grande-Fort Quitman |

| County Code: | County Name: | Mapsheet Code: | Mapsheet Name: | State: |
|---|---|---|---|---|
| TXELPA | El Paso | 31106-H4 | North Franklin Mountain | TX |
| | | 31106-H5 | Canutillo | TX |
| | | 31106-G4 | El Paso | TX |
| | | 31106-G5 | Smeltertown | TX |

**Directions:**

DESERT SURROUNDING FRANKLIN MOUNTAINS

## Survey Information:

**First Observation:** **Survey Date:** **Last Observation:** 19??

**Eo Type:** **EO Rank:** **EO Rank Date:**

**Observed Area (acres);** **Estimated Representation Accuracy:**

## Comments:

**General Description:**

**Comments:** SEE ALSO CHAMPIE, C. 1973. STRANGERS IN THE FRANKLINS, P.40.

**Protection Comments:**

**Management Comments:**

## Data:

**EO Data:** RARE; FLOWERS IN APRIL

## Managed Area:

**Managed Area Name:** **Managed Area Type:**

# Element Occurrence Record

## Reference:

**Full Citation:**

CHAMPIE, C. 19??. CACTI AND SUCCULENTS OF EL PASO. ABBEY GARDEN PRESS, SANTA BARBARA, CA. 100 PP.

CHAMPIE, C. 1973. STRANGERS IN THE FRANKLINS.

## Specimen:

## Associated Species:

| Species Name | Type | Comments |
|---|---|---|

# Code Key for Printouts from
# Texas Parks and Wildlife Department
# Texas Natural Diversity Database (TXNDD)

This information is for your assistance only; due to continuing data updates, vulnerability of private land to trespass and of species to disturbance or collection, **please refer all requesters to our office to obtain the most current information available.** Also, please note, identification of a species in a given area does not necessarily mean the species currently exists at the point or area indicated.

## LEGAL STATUS AND CONSERVATION RANKS

**FEDERAL STATUS** (as determined by the US Fish and Wildlife Service)

| | |
|---|---|
| **LE** | Listed Endangered |
| **LT** | Listed Threatened |
| **PE** | Proposed to be listed Endangered |
| **PT** | Proposed to be listed Threatened |
| **PDL** | Proposed to be Delisted (Note: Listing status retained while proposed) |
| **SAE, SAT** | Listed Endangered on basis of Similarity of Appearance, Listed Threatened on basis of Similarity of Appearance |
| **DL** | Delisted Endangered/Threatened |
| **C** | Candidate. USFWS has substantial information on biological vulnerability and threats to support proposing to list as threatened or endangered. Data are being gathered on habitat needs and/or critical habitat designations. |
| **C*** | C, but lacking known occurrences |
| **C**** | C, but lacking known occurrences, except in captivity/cultivation |
| **XE** | Essential Experimental Population |
| **XN** | Non-essential Experimental Population |
| **Blank** | Species is not federally listed |

**TX PROTECTION** (as determined by the Texas Parks and Wildlife Department)

| | |
|---|---|
| **E** | Listed Endangered |
| **T** | Listed Threatened |
| **Blank** | Species not state-listed |

**GLOBAL RANK** (as determined by NatureServe)

| | |
|---|---|
| **G1** | Critically imperiled globally, extremely rare, typically 5 or fewer viable occurrences |
| **G2** | Imperiled globally, very rare, typically 6 to 20 viable occurrences |
| **G3** | Very rare and local throughout range or found locally in restricted range, typically 21 to 100 viable occurrences |
| **G4** | Apparently secure globally |
| **G5** | Demonstrably secure globally |
| **GH** | Of historical occurrence through its range |
| **GU** | Possibly in peril range-wide, but status uncertain |
| **G#G#** | Ranked within a range as status uncertain |
| **GX** | Apparently extinct throughout range |
| **Q** | Rank qualifier denoting taxonomic assignment is questionable |
| **#?** | Rank qualifier denoting uncertain rank |
| **C** | In captivity or cultivation only |
| **G#T#** | "G" refers to species rank; "T" refers to variety or subspecies rank |

**STATE (SUBNATIONAL) RANK** (as determined by the Texas Parks and Wildlife Department)

| | |
|---|---|
| **S1** | Critically imperiled in state, extremely rare, vulnerable to extirpation, typically 5 or fewer viable occurrences |
| **S2** | Imperiled in state, very rare, vulnerable to extirpation, typically 6 to 20 viable occurrences |
| **S3** | Rare or uncommon in state, typically 21 to 100 viable occurrences |
| **S4** | Apparently secure in State |
| **S5** | Demonstrably secure in State |
| **S#S#** | Ranked within a range as status uncertain |
| **SH** | Of historical occurrence in state and may be rediscovered |
| **SU** | Unrankable – due to lack of information or substantially conflicting information |
| **SX** | Apparently extirpated from State |
| **SNR** | Unranked – State status not yet assessed |
| **SNA** | Not applicable – species id not a suitable target for conservation activities |
| **?** | Rank qualifier denoting uncertain rank in State |

Revised 1 Apr 2008

## ELEMENT OCCURRENCE RECORD

**Element Occurrence Record (EOR)** Spatial and tabular record of an area of land and/or water in which a species, natural community, or other significant feature of natural diversity is, or was, present and associated information; may be a single contiguous area or may be comprised of discrete patches or subpopulations

**Occurrence #** Unique number assigned to each occurrence of each element when added to the NDD

## LOCATION INFORMATION

**Watershed Code** Eight digit numerical code determined by US Geological Survey (USGS)

**Watershed** Name of watershed as determined by USGS

**Quadrangle** Name of USGS topographical map

**Directions** Directions to geographic location where occurrence was observed, as described by observer or in source

## SURVEY INFORMATION

**First/Last Observation** Date a particular occurrence was first/last observed; refers only to species occurrence as noted in source and does not imply the first/last date the species was present

**Survey Date** If conducted, date of survey

**EO Type** State rank qualifiers:

- **M** Migrant – species occurring regularly on migration at staging areas, or concentration along particular corridors; status refers to the transient population in the State
- **B** Qualifier indicating basic rank refers to the breeding population in State
- **N** Qualifier indicating basic rank refers to the non-breeding population in State

**EO Rank**

| | | | |
|---|---|---|---|
| **A** | Excellent | **AI** | Excellent, Introduced |
| **B** | Good | **BI** | Good, Introduced |
| **C** | Marginal | **CI** | Marginal, Introduced |
| **D** | Poor | **DI** | Poor, Introduced |
| **E** | Extant/Present | **EI** | Extant, Introduced |
| **H** | Historical/No Field Information | **HI** | Historical, Introduced |
| **X** | Destroyed/Extirpated | **XI** | Destroyed, Introduced |
| **O** | Obscure | **OI** | Obscure, Introduced |

**EO Rank Date** Latest date EO rank was determined or revised

**Observed Area** Acres, unless indicated otherwise

## COMMENTS

**Description** General physical description of area and habitat where occurrence is located, including associated species, soils, geology, and surrounding land use

**Comments** Comments concerning the quality or condition of the element occurrence at time of survey

**Protection Comments** Observer comments concerning legal protection of the occurrence

**Management Comments** Observer comments concerning management recommendations appropriate for occurrence conservation

## DATA

**EO Data** Biological data; may include number of individuals, vigor, flowering/fruiting data, nest success, behaviors observed, or unusual characteristic, etc.

## SITE

**Site Name** Title given to site by surveyor

## MANAGED AREA INFORMATION

**Managed Area Name** Place name or (on EOR printout) name of area when the EO is located within or partially within an area identified for conservation, such as State or Federal lands, nature preserves, parks, etc.

**Alias** Additional names the property is known by

**Acres** Total acreage of property, including non-contiguous tracts

**Manager** Contact name, address, and telephone number for area or nearest area land steward

Please use one of the following citations to credit the source for the printout information:

Texas Natural Diversity Database. [year of printouts]. Wildlife Diversity Program of Texas Parks & Wildlife Department. [day month year of printouts].

Texas Natural Diversity Database. [year of printouts]. Element occurrence printouts for [scientific name] *records # [occurrence number(s)]. Wildlife Diversity Program of Texas Parks & Wildlife Department. [day month year of printouts]. *Use of record #'s is optional.

Revised 1 Apr 2008

# EL PASO COUNTY

## AMPHIBIANS

| | | Federal Status | State Status |
|---|---|---|---|
| **Northern leopard frog** | *Rana pipiens* | | |

streams, ponds, lakes, wet prairies, and other bodies of water; will range into grassy, herbaceous areas some distance from water; eggs laid March-May and tadpoles transform late June-August; may have disappeared from El Paso County due to habitat alteration

## BIRDS

| | | Federal Status | State Status |
|---|---|---|---|
| **American Peregrine Falcon** | *Falco peregrinus anatum* | DL | T |

year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.

| | | | |
|---|---|---|---|
| **Arctic Peregrine Falcon** | *Falco peregrinus tundrius* | DL | |

migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.

**Baird's Sparrow** *Ammodramus bairdii*

shortgrass prairie with scattered low bushes and matted vegetation; mostly migratory in western half of State, though winters in Mexico and just across Rio Grande into Texas from Brewster through Hudspeth counties

**Ferruginous Hawk** *Buteo regalis*

open country, primarily prairies, plains, and badlands; nests in tall trees along streams or on steep slopes, cliff ledges, river-cut banks, hillsides, power line towers; year-round resident in northwestern high plains, wintering elsewhere throughout western 2/3 of Texas

| | | | |
|---|---|---|---|
| **Interior Least Tern** | *Sterna antillarum athalassos* | LE | E |

subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish and crustaceans, when breeding forages within a few hundred feet of colony

| | | | |
|---|---|---|---|
| **Mexican Spotted Owl** | *Strix occidentalis lucida* | LT | T |

remote, shaded canyons of coniferous mountain woodlands (pine and fir); nocturnal predator of mostly small rodents and insects; day roosts in densely vegetated trees, rocky areas, or caves

**Montezuma Quail** *Cyrtonyx montezumae*

open pine-oak or juniper-oak with ground cover of bunch grass on flats and slopes of semi-desert mountains and hills; travels in pairs or small groups; eats succulents, acorns, nuts, and weed seeds, as well as various invertebrates

# EL PASO COUNTY

## BIRDS

| | | Federal Status | State Status |
|---|---|---|---|
| **Northern Aplomado Falcon** | *Falco femoralis septentrionalis* | LE | E |

open country, especially savanna and open woodland, and sometimes in very barren areas; grassy plains and valleys with scattered mesquite, yucca, and cactus; nests in old stick nests of other bird species

| | | | |
|---|---|---|---|
| **Peregrine Falcon** | *Falco peregrinus* | DL | T |

both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.

**Prairie Falcon** *Falco mexicanus*

open, mountainous areas, plains and prairie; nests on cliffs

**Snowy Plover** *Charadrius alexandrinus*

formerly an uncommon breeder in the Panhandle; potential migrant; winter along coast

| | | | |
|---|---|---|---|
| **Southwestern Willow Flycatcher** | *Empidonax traillii extimus* | LE | E |

thickets of willow, cottonwood, mesquite, and other species along desert streams

| | | |
|---|---|---|
| **Sprague's Pipit** | *Anthus spragueii* | C |

only in Texas during migration and winter, mid September to early April; short to medium distance, diurnal migrant; strongly tied to native upland prairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.

**Western Burrowing Owl** *Athene cunicularia hypugaea*

open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows

**Western Snowy Plover** *Charadrius alexandrinus nivosus*

uncommon breeder in the Panhandle; potential migrant; winter along coast

| | | |
|---|---|---|
| **Western Yellow-billed Cuckoo** | *Coccyzus americanus occidentalis* | C;NL |

status applies only to western population beyond the Pecos River Drainage; breeds in riparian habitat and associated drainages; springs, developed wells, and earthen ponds supporting mesic vegetation; deciduous woodlands with cottonwoods and willows; dense understory foliage is important for nest site selection; nests in willow, mesquite, cottonwood, and hackberry; forages in similar riparian woodlands; breeding season mid-May-late Sept

## FISHES

| | | Federal Status | State Status |
|---|---|---|---|
| **Bluntnose shiner** | *Notropis simus simus* | | T |

extinct; Rio Grande; main river channel, often below obstructions over substrate of sand, gravel, and silt; damming and irrigation practices presumed major factors contributing to decline

# EL PASO COUNTY

## FISHES

| | | Federal Status | State Status |
|---|---|---|---|
| **Rio Grande silvery minnow** | *Hybognathus amarus* | LE | E |

extirpated; historically Rio Grande and Pecos River systems and canals; reintroduced in Big Bend area; pools and backwaters of medium to large streams with low or moderate gradient in mud, sand, or gravel bottom; ingests mud and bottom ooze for algae and other organic matter; probably spawns on silt substrates of quiet coves

## INSECTS

| | | Federal Status | State Status |
|---|---|---|---|
| **A Royal moth** | *Sphingicampa raspa* | | |

woodland - hardwood; with oaks, junipers, legumes and other woody trees and shrubs; good density of legume caterpillar foodplants must be present; Prairie acacia (Acacia augustissima) is the documented caterpillar foodplant, but there could be a few other woody legumes used

**A tiger beetle** *Cicindela hornii*

grassland/herbaceous; burrowing in or using soil; dry areas on hillside or mesas where soil is rocky or loamy and covered with grasses, invertivore; diurnal, hibernates/aestivates, active mostly for several days after heavy rains. the life cycle probably takes two years so larvae would always be present in burrows in the soil

**Barbara Ann's tiger beetle** *Cicindela politula barbarannae*

limestone outcrops in arid treeless environments or in openings within less arid pine-juniper-oak communities; open limestone substrate itself is almost certainly an essential feature; roads and trails

**Poling's hairstreak** *Fixsenia polingi*

oak woodland with Quercus grisea as substantial component, probably also uses Q. emoryi; larvae feed on new growth of Q. grisea, adults utilize nectar from a variety of flowers including milkweed and catslaw acacia; adults fly mid May - Jun, again mid Aug - early Sept

## MAMMALS

| | | Federal Status | State Status |
|---|---|---|---|
| **Big free-tailed bat** | *Nyctinomops macrotis* | | |

habitat data sparse but records indicate that species prefers to roost in crevices and cracks in high canyon walls, but will use buildings, as well; reproduction data sparse, gives birth to single offspring late June-early July; females gather in nursery colonies; winter habits undetermined, but may hibernate in the Trans-Pecos; opportunistic insectivore

| | | | |
|---|---|---|---|
| **Black bear** | *Ursus americanus* | T/SA;NL | T |

bottomland hardwoods and large tracts of inaccessible forested areas; due to field characteristics similar to Louisiana Black Bear (LT, T), treat all east Texas black bears as federal and state listed Threatened

| | | | |
|---|---|---|---|
| **Black-footed ferret** | *Mustela nigripes* | LE | |

extirpated; inhabited prairie dog towns in the general area

**Black-tailed prairie dog** *Cynomys ludovicianus*

dry, flat, short grasslands with low, relatively sparse vegetation, including areas overgrazed by cattle; live in large family groups

# EL PASO COUNTY

## MAMMALS

Federal Status State Status

**Cave myotis bat** *Myotis velifer*

colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (Hirundo pyrrhonota) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum cave of Panhandle during winter; opportunistic insectivore

**Desert pocket gopher** *Geomys arenarius*

cottonwood-willow association along the Rio Grande in El Paso and Hudspeth counties; live underground, but build large and conspicuous mounds; life history not well documented, but presumed to eat mostly vegetation, be active year round, and bear more than one litter per year

**Fringed bat** *Myotis thysanodes*

habitat variable, ranging from mountainous pine, oak, and pinyon-juniper to desert-scrub, but prefers grasslands at intermediate elevations; highly migratory species that arrives in Trans-Pecos by May to form nursery colonies; single offspring born June-July; roosts colonially in caves, mine tunnels, rock crevices, and old buildings

**Gray wolf** *Canis lupus* LE E

extirpated; formerly known throughout the western two-thirds of the state in forests, brushlands, or grasslands

**Long-legged bat** *Myotis volans*

in Texas, Trans-Pecos region; high, open woods and mountainous terrain; nursery colonies (which may contain several hundred individuals) form in summer in buildings, crevices, and hollow trees; apparently do not use caves as day roosts, but may use such sites at night; single offspring born June-July

**Pale Townsend's big-eared bat** *Corynorhinus townsendii pallescens*

roosts in caves, abandoned mine tunnels, and occasionally old buildings; hibernates in groups during winter; in summer months, males and females separate into solitary roosts and maternity colonies, respectively; single offspring born May-June; opportunistic insectivore

**Pecos River muskrat** *Ondatra zibethicus ripensis*

creeks, rivers, lakes, drainage ditches, and canals; prefer shallow, fresh water with clumps of marshy vegetation, such as cattails, bulrushes, and sedges; live in dome-shaped lodges constructed of vegetation; diet is mainly vegetation; breed year round

**Western red bat** *Lasiurus blossevillii*

roosts in tree foliage in riparian areas, also inhabits xeric thorn scrub and pine-oak forests; likely winter migrant to Mexico; multiple pups born mid-May - late Jun

**Western small-footed bat** *Myotis ciliolabrum*

mountainous regions of the Trans-Pecos, usually in wooded areas, also found in grassland and desert scrub habitats; roosts beneath slabs of rock, behind loose tree bark, and in buildings; maternity colonies often small and located in abandoned houses, barns, and other similar structures; apparently occurs in Texas only during spring and summer months; insectivorous

# EL PASO COUNTY

## MAMMALS

| | | Federal Status | State Status |
|---|---|---|---|
| **Yuma myotis bat** | *Myotis yumanensis* | | |

desert regions; most commonly found in lowland habitats near open water, where forages; roosts in caves, abandoned mine tunnels, and buildings; season of partus is May to early July; usually only one young born to each female

## MOLLUSKS

| | | Federal Status | State Status |
|---|---|---|---|
| **Franklin Mountain talus snail** | *Sonorella metcalfi* | | |

terrestrial; bare rock, talus, scree; inhabits igneous talus most commonly of rhyolitic origin

**Franklin Mountain wood snail** *Ashmunella pasonis*

terrestrial; bare rock, talus, scree; talus slopes, usually of limestone, but also of rhyolite, sandstone, and siltstone, in arid mountain ranges

## REPTILES

| | | Federal Status | State Status |
|---|---|---|---|
| **Big Bend slider** | *Trachemys gaigeae* | | |

almost exclusively aquatic, sliders (Trachemys spp.) prefer quiet bodies of fresh water with muddy bottoms and abundant aquatic vegetation, which is their main food source; will bask on logs, rocks or banks of water bodies; breeding March-July

| | | | |
|---|---|---|---|
| **Chihuahuan Desert lyre snake** | *Trimorphodon vilkinsonii* | | T |

mostly crevice-dwelling in predominantly limestone-surfaced desert northwest of the Rio Grande from Big Bend to the Franklin Mountains, especially in areas with jumbled boulders and rock faults/fissures; secretive; egg-bearing; eats mostly lizards

| | | | |
|---|---|---|---|
| **Mountain short-horned lizard** | *Phrynosoma hernandesi* | | T |

diurnal, usually in open, shrubby, or openly wooded areas with sparse vegetation at ground level; soil may vary from rocky to sandy; burrows into soil or occupies rodent burrow when inactive; eats ants, spiders, snails, sowbugs, and other invertebrates; inactive during cold weather; breeds March-September

**New Mexico garter snake** *Thamnophis sirtalis dorsalis*

nearly any type of wet or moist habitat; irrigation ditches, and riparian-corridor farmlands, less often in running water; home range about 2 acres; active year round in warm weather, both diurnal and nocturnal, more nocturnal during hot weather; bears litter July-August

| | | | |
|---|---|---|---|
| **Texas horned lizard** | *Phrynosoma cornutum* | | T |

open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September

# EL PASO COUNTY

## PLANTS

Federal Status State Status

**Comal snakewood** *Colubrina stricta*

in El Paso County, found in a patch of thorny shrubs in colluvial deposits and sandy soils at the base of an igneous rock outcrop; the historic Comal County record does not describe the habitat; in Mexico ,found in shrublands on calcareous, gravelly, clay soils with woody associates; flowering late spring or early summer

**Desert night-blooming cereus** *Peniocereus greggii var greggii*

Chihuahuan Desert shrublands or shrub invaded grasslands in alluvial or gravelly soils at lower elevations, 1200-1500 m (3900-4900 ft), on slopes, benches, arroyos, flats, and washes; flowering synchronized over a few nights in early May to late June when almost all mature plants bloom, flowers last only one day and open just after dark, may flower as early as April

**Hueco rock-daisy** *Perityle huecoensis*

north-facing or otherwise mostly shaded limestone cliff faces within relatively mesic canyon system; flowering spring-fall

**Sand prickly-pear** *Opuntia arenaria*

deep, loose or semi-stabilized sands in sparsely vegetated dune or sandhill areas, or sandy floodplains in arroyos; flowering May-June

**Sand sacahuista** *Nolina arenicola*

Texas endemic; mesquite-sand sage shrublands on windblown Quarternary reddish sand in dune areas; flowering time uncertain May-June, June-September

**Sneed's pincushion cactus** *Escobaria sneedii var sneedii* LE E

xeric limestone outcrops on rocky, usually steep slopes in desert mountains, in the Chihuahuan Desert succulent shrublands or grasslands; flowering April-September (peak usually in April, sometimes opportunistically after summer rains; fruiting August - November

**Texas false saltgrass** *Allolepis texana*

sandy to silty soils of valley bottoms and river floodplains, not generally on alkaline or saline sites; flowering (May-) July-October depending on rainfall

**Wheeler's spurge** *Chamaesyce geyeri var wheeleriana*

sparingly vegetated, loose eolian quartz sand on reddish sand dunes or coppice mounds; flowering and fruiting at least August-September, probably earlier and later, as well

## Notes for
## County Lists of Texas' Special Species

The Texas Parks and Wildlife (TPWD) county lists **include**:

**Vertebrates, Invertebrates, and Vascular Plants** identified as being of conservation concern by TPWD within Texas. These special species lists are comprised of species, subspecies, and varieties that are federally listed; proposed to be federally listed; have federal candidate status; are state listed; or carry a global conservation status indicating a species is critically imperiled, very rare, vulnerable to extirpation, or uncommon.

The TPWD county lists **do not include**:

**Natural Plant Communities** such as Little Bluestem-Indiangrass Series (native prairie remnant), Water Oak-Willow Oak Series (bottomland hardwood community), Saltgrass-Cordgrass Series (salt or brackish marsh), Sphagnum-Beakrush Series (seepage bog).

**Other Significant Features** such as bird rookeries, migratory songbird fallout areas, comprehensive migratory bird information, bat roosts, bat caves, invertebrate caves, and prairie dog towns.

**These lists are not all inclusive for all rare species distributions.** The lists were compiled, developed, and are updated based on field guides, staff expertise, scientific publications, and the TPWD Texas Natural Diversity Database (TXNDD) (formerly the Biological and Conservation Data System) occurrence data. Historic ranges for some state extirpated species, full historic distributions for some extant species, accidentals and irregularly appearing species, and portions of migratory routes for particular species are not necessarily included. Species that appear on county lists do not all share the same probability of occurrence within a county. Some species are migrants or wintering residents only. Additionally, a few species may be historic or considered extirpated within a county.

TPWD includes the Federal listing status for your convenience and makes every attempt to keep the information current and correct. However, the US Fish and Wildlife Service (FWS) is the responsible authority for Federal listing status. The TPWD lists do not substitute for contact with the FWS and federally listed species county ranges may vary from the FWS county level species lists because of the inexact nature of range map development and use.

Status Key:

| | |
|---|---|
| LE, LT - | Federally Listed Endangered/Threatened |
| PE, PT - | Federally Proposed Endangered/Threatened |
| SAE, SAT - | Federally Listed Endangered/Threatened by Similarity of Appearance |
| C - | Federal Candidate for Listing; formerly Category 1 Candidate |
| DL, PDL - | Federally Delisted/Proposed for Delisting |
| NL - | Not Federally Listed |
| E, T - | State Listed Endangered/Threatened |
| NT - | Not tracked or no longer tracked by the State |
| "blank" - | Rare, but with no regulatory listing status |

This information is specifically for your assistance only; due to continuing data updates, **please do not redistribute the lists**, instead refer all requesters to the web site at: http://www.tpwd.state.tx.us/landwater/land/maps/gis/ris/endangered_species/ or to our office for the most current information available. For questions regarding county lists, please call (512) 389-4571.

Please use the following citation to credit the source for this county level information:

Texas Parks and Wildlife Department, Wildlife Division, Diversity and Habitat Assessment Programs. County Lists of Texas' Special Species. [county name(s) and revised date(s)].

SAIC

January 11, 2012

Texas Parks and Wildlife Department
Wildlife Division Wildlife Habitat Assessment Program
4200 Smith School Road
Austin, Texas 78744

Subject: **Threatened and Endangered Species Assessment**
**McCombs Municipal Solid Waste Landfill, El Paso, Texas**

Dear Wildlife Division:

The McCombs Municipal Solid Waste Landfill (Landfill) located in El Paso, Texas (City) is proposing a vertical expansion of the existing Landfill footprint to provide additional capacity. The Landfill is located in El Paso County within the El Paso city limits and serves the waste needs of the City and the surrounding area. The Landfill is an existing Type 1 MSW disposal facility owned and operated by the City. The Landfill is located at the northeast corner of the intersection of McCombs Road and Stan Roberts Road (FM 2529) in El Paso, Texas. The address of the Landfill is 13660 McCombs Road.

The proposed vertical expansion will increase the height of the Landfill from the currently permitted elevation of 4,125 feet mean sea level (MSL) to 4,305 feet MSL. The existing permitted boundary of the Landfill is currently 327 acres (permitted in 1984), and is not proposed to increase. The primary use for this facility will remain dedicated for disposal of municipal solid waste.

A letter dated August 13, 1982 from the United States Fish and Wildlife Service (USFWS) has been included in Attachment 1. According to the USFWS letter, the American Peregrine Falcon may use the project site as a feeding area or pass through the area during migration. According to the information provided on the USFWS website, the American Peregrine Falcon was delisted from the federal endangered species list on August 25, 1999. However, the American Peregrine Falcon remains a State of Texas protected species.

As indicated in the USFWS letter, it is unlikely that the Landfill will have any effect on this species. However, if the American Peregrine Falcon were to be observed within the permitted Landfill area, the employees will be instructed to follow the steps listed below:

1. Avoid contact with the bird;
2. Temporarily halt or move site operations to an area away from the bird's location to prevent disrupting the bird's activities while feeding or passing by the site;



*SAIC Energy, Environment & Infrastructure, LLC*
*1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI*

3. Wait until the bird abandons the site on its own will; and
4. Resume normal site operations once the bird has taken flight.

In addition, Landfill personnel will be trained regarding the bird's physical characteristics and appearance in order to be able to identify it at once and with certainty during operations. This training will prevent unnecessary and unwarranted disruptions of site activities due to the presence of birds that may look similar to the American Peregrine Falcon.

We are requesting information regarding any listed threatened or endangered species or their critical habitat within range of the project site. This information is required by Texas Administrative Code Chapter 330 (30 TAC §330.61 (n)).

If you have any questions or require additional information, please contact me at 651-994-8415 or fredric.j.doran@saic.com.

Sincerely,

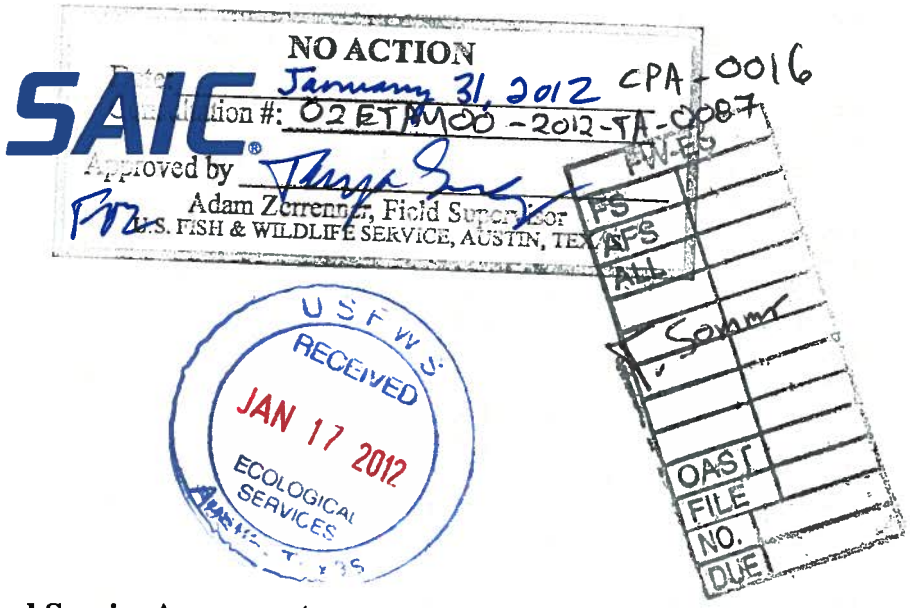
**SAIC Energy, Environment & Infrastructure, LLC**

Fredric J. Doran, P.E.
Senior Environmental Engineer

c w/ encl: Miguel Parra, City of El Paso
Scott R. Pasternak, SAIC



*SAIC Energy, Environment & Infrastructure, LLC*
*1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI*







January 11, 2012

U.S. Fish and Wildlife Service
Ecological Services
10711 Burnet Road, Suite 200
Austin, Texas 78758-4460

Subject: **Threatened and Endangered Species Assessment**
**McCombs Municipal Solid Waste Landfill, El Paso, Texas**

Dear Ecological Services:

The McCombs Municipal Solid Waste Landfill (Landfill) located in El Paso, Texas (City) is proposing a vertical expansion of the existing Landfill footprint to provide additional capacity. The Landfill is located in El Paso County within the El Paso city limits and serves the waste needs of the City and the surrounding area. The Landfill is an existing Type 1 MSW disposal facility owned and operated by the City. The Landfill is located at the northeast corner of the intersection of McCombs Road and Stan Roberts Road (FM 2529) in El Paso, Texas. The address of the Landfill is 13660 McCombs Road.

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As indicated in the USFWS letter, it is unlikely that the Landfill will have any effect on this species. However, if the American Peregrine Falcon were to be observed within the permitted Landfill area, the employees will be instructed to follow the steps listed below:

1. Avoid contact with the bird; 31.982554 -106.408597
2. Temporarily halt or move site operations to an area away from the bird's location to prevent disrupting the bird's activities while feeding or passing by the site;



*SAIC Energy, Environment & Infrastructure, LLC*
*1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI*

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We are requesting information regarding any federally listed threatened or endangered species or their critical habitat within range of the project site. This information is required by Texas Administrative Code Chapter 330 (30 TAC §330.61 (n)).

If you have any questions or require additional information, please contact me at 651-994-8415 or fredric.j.doran@saic.com.

Sincerely,

**SAIC Energy, Environment & Infrastructure, LLC**

Fredric J. Doran, P.E.
Senior Environmental Engineer

c w/ encl: Miguel Parra, City of El Paso
Scott R. Pasternak, SAIC



*SAIC Energy, Environment & Infrastructure, LLC*
*1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI*

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Ecological Services
c/o CCSU, Campus Box 338
6300 Ocean Drive
Corpus Christi, Texas 78412

August 13, 1982

Rosemary Staley
Department of Planning,
Research and Development
#2 Civic Center Plaza - 5th Floor
El Paso, Texas 79999

Dear Ms. Staley:

By letter dated August 4, 1982, you provided the U.S. Fish and Wildlife Service (FWS) with maps showing the location of a proposed sanitary landfill at the intersection of McCombs Road and FM 2529 and requested information concerning endangered species. The proposed landfill would generally utilize an abandoned quarry adjacent to an existing landfill.

Federally listed endangered species present in El Paso County are the American peregrine falcon (Falco peregrinus anatum) and Sneed pincushion cactus (Coryphantha sneedii var. sneedii). It is unlikely that expanding the sanitary landfill would have any effect on the above listed species because the cactus is confined to the Franklin Mountains as is the nesting habitat of the peregrine falcon. The peregrine may use the project site as a feeding area or pass through the area during migration.

The letter describing the site contained insufficient information to assess the effect leaching from the landfill would have on ground water quality. The bottom of the abandoned quarry may need to be sealed to prevent contamination of ground water resources. If this is not a problem, the FWS believes that the proposed landfill site is a good location for expanding the City's waste disposal capability.

We appreciate the opportunity to review your project. If we may be of further assistance please, contact Don A. Meineke or me (Telephone 512/888-3346).

Sincerely yours,

ROGELIO PEREZ
Field Supervisor

RECEIVED
AUG 16 1982
PLANNING DEPARTMENT

Federal Register

Wednesday
August 25, 1999

## Part III

# Department of the Interior

**Fish and Wildlife Service**

**50 CFR Part 17**

**Endangered and Threatened Wildlife and Plants; Final Rule To Remove the American Peregrine Falcon From the Federal List of Endangered and Threatened Wildlife, and To Remove the Similarity of Appearance Provision for Free-Flying Peregrines in the Conterminous United States; Final Rule**

**DEPARTMENT OF THE INTERIOR**

**Fish and Wildlife Service**

**50 CFR Part 17**

**RIN 1018–AF04**

# Endangered and Threatened Wildlife and Plants; Final Rule To Remove the American Peregrine Falcon From the Federal List of Endangered and Threatened Wildlife, and To Remove the Similarity of Appearance Provision for Free-Flying Peregrines in the Conterminous United States

**AGENCY:** Fish and Wildlife Service, Interior.

**ACTION:** Final rule.

**SUMMARY:** We, the U.S. Fish and Wildlife Service (Service), have determined that the American peregrine falcon (*Falco peregrinus anatum*) is no longer an endangered or threatened species pursuant to the Endangered Species Act of 1973, as amended (Act). This determination is based on available data indicating that this subspecies has recovered following restrictions on organochlorine pesticides in the United States and Canada, and following the implementation of successful management activities. This action will remove the American peregrine falcon (*Falco peregrinus anatum*) throughout its range as an endangered species from the Federal List of Endangered and Threatened Wildlife, thereby removing all protections provided by the Act. It also will remove the designation of ''endangered due to similarity of appearance'' for any free-flying peregrine falcons within the 48 conterminous United States. It will not affect protection provided to this species by the Migratory Bird Treaty Act (MBTA), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), or state laws and regulations, nor will it affect the endangered listing status of the Eurasian peregrine falcon (*Falco peregrinus peregrinus*) under the Act.

**EFFECTIVE DATE:** August 25, 1999.

**ADDRESSES:** The administrative file for this rule is available for inspection, by appointment, during normal business hours at the U.S. Fish and Wildlife Service, Ventura Fish and Wildlife Office, 2493 Portola Road, Suite B, Ventura, California 93003 (telephone (805) 644–1766/facsimile 805/644–3958).

**FOR FURTHER INFORMATION CONTACT:** Robert Mesta at the above address for further information on the removal of the peregrine falcon from the endangered species list.

**SUPPLEMENTARY INFORMATION:**

## Background

The peregrine falcon (*Falco peregrinus*) is a medium-sized raptor weighing approximately 1,000 grams (36 ounces) and having a wing span of 112 centimeters (44 inches). The adult peregrine falcon has a dark gray back and crown, dark bars or streaks on a pale chest and abdomen, and heavy malar (cheek) stripes on the face. Immature falcons are buff-colored in front and have dark brown backs; adults are white or buff in front and bluish-gray on their backs. Peregrines prey almost entirely on other birds, and occasionally on bats, caught in midair (Hickey and Anderson 1969).

The peregrine falcon has an almost worldwide distribution, with three subspecies recognized in North America (Brown and Amadon 1968). The Peale's falcon (*F. p. pealei*) is a year-round resident of the northwest Pacific coast from northern Washington through British Columbia to the Aleutian Islands. The Arctic peregrine falcon (*F. p. tundrius*) nests in the tundra of Alaska, Canada, and Greenland, and is typically a long-distance migrant, wintering as far south as South America. The American peregrine falcon (*F. p. anatum*) occurs throughout much of North America from the subarctic boreal forests of Alaska and Canada south to Mexico. The American peregrine falcon nests from central Alaska, central Yukon Territory, and northern Alberta and Saskatchewan, east to the Maritimes and south (excluding coastal areas north of the Columbia River in Washington and British Columbia) throughout western Canada and the United States to Baja California, Sonora, and the highlands of central Mexico (48 FR 8799). American peregrine falcons that nest in subarctic areas generally winter in South America, while those that nest at lower latitudes exhibit variable migratory behavior; some are nonmigratory (Yates *et al.* 1988).

Since the early 1970s, efforts to reestablish peregrine falcons in the eastern and midwestern United States have successfully returned this species to areas from which it was extirpated (See ''Eastern United States'' under ''Peregrine Falcon Recovery''). Peregrine falcons are now found nesting in all States within their historical range east of the 100th meridian, except for Rhode Island, West Virginia, and Arkansas.

Peregrine falcons declined precipitously in North America following World War II (Kiff 1988). Research implicated organochlorine pesticides, mainly 1,1,1-trichloro-2,2-bis(p-chlorophenyl)-ethane (DDT), applied in the United States and Canada during this same period, as causing the decline (for a review, see Risebrough and Peakall 1988). Use of these chemicals peaked in the 1950s and early 1960s and continued through the early 1970s. Organochlorines and their metabolites, including DDT and its principal metabolite DDE (1,1-dichloro-2,2-bis(*p*-chlorophenyl)-ethylene), aldrin, dieldrin, and others, are stable, persistent compounds that are stored in the fatty tissues of animals ingesting contaminated food (Fyfe *et al.* 1988).

Organochlorines can affect peregrine falcons either by causing direct mortality or by adversely affecting reproduction. Because mortality in wild birds is difficult to study, the effect of organochlorines on mortality is not as well known as the effects on reproduction. Organochlorines can adversely affect reproduction by causing egg breakage, addling, hatching failure, and abnormal reproductive behavior by the parent birds (Risebrough and Peakall 1988). DDE prevents normal calcium deposition during eggshell formation, resulting in thin-shelled eggs that are susceptible to breakage during incubation. In general, populations laying eggs with shells that averaged more than 17 percent thinner than pre-DDT eggs had such high rates of reproductive failure that the number of peregrine falcon pairs declined (Peakall and Kiff 1988).

During the period of DDT use in North America, eggshell thinning and nesting failures were widespread in peregrine falcons, and in some areas, successful reproduction virtually ceased (Hickey and Anderson 1969). As a result, there was a slow but drastic decline in the number of peregrine falcons in many areas of North America. The degree of exposure to these pesticides varied among regions, and peregrine falcon numbers in more contaminated areas suffered greater declines. Peregrine falcons that nested outside of agricultural and forested areas where DDT was heavily used were affected less, although some of these individuals were still exposed to DDT when wintering in areas of pesticide use. Presumably all peregrine falcon individuals have eaten some migratory prey containing organochlorines (for reviews, see Hickey and Anderson 1969; Kiff 1988; Peakall and Kiff 1988).

Peregrine falcons nesting in the agricultural and forested areas east of the Mississippi River in the United States and in eastern Canada south of the boreal forest were the most heavily contaminated and were essentially

extirpated by the mid-1960s (Berger *et al.* 1969). Peregrine falcons in the Great Plains states east of the Rocky Mountains and south of the boreal forest in Canada and the United States were also extirpated in the DDT-era (Cade 1975; Enderson *et al.* 1995). No active eyries (nests) were found in surveys of 133 formerly used peregrine falcon eyries in the latter part of the 1964 nesting season in the eastern United States and the Maritime Provinces in Canada (Berger *et al.* 1969). By 1975, there were only three peregrine falcon pairs in Alberta, and no other peregrine falcon pairs were found south of latitude 60 degrees North and east of the Rocky Mountains in Canada (Erickson *et al.* 1988).

West of the 100th meridian, peregrine falcons were significantly reduced; only 33 percent of historical nest sites in the Rocky Mountains were still occupied by 1965 (Enderson 1969). The peregrine falcon disappeared as a breeding species from southern California, and major declines also occurred in other parts of the western United States and in much of southern Canada and the Northwest Territories (Kiff 1988). In contrast, peregrine falcons in most areas of the Pacific coast of Alaska remained fairly stable during this period, due to their lower exposure to organochlorine pesticides. The exact degree of local declines in much of western North America remains somewhat speculative due to a lack of accurate pre-pesticide era census data. For example, in the southwestern United States and mainland Mexico, peregrine falcons were not censused until after the beginning of the use of organochlorines (Kiff 1988).

**Previous Federal Actions**

Population declines due to negative impacts of DDT and its metabolites on peregrine falcon reproduction and survival led us to list two of the three North American subspecies, the Arctic peregrine falcon and the American peregrine falcon, as endangered in 1970 under the Endangered Species Conservation Act of 1969 (Public Law 91–135, 83 Stat. 275). Arctic and American peregrine falcons were included in the United States' list of endangered foreign species on June 2, 1970 (35 FR 8491) under the Endangered Species Conservation Act of 1969, and the native list of endangered species on October 13, 1970 (35 FR 16047). Upon passage of the Endangered Species Act of 1973, as amended (Act) (16 U.S.C. 1531 *et seq.*), the native and foreign species lists were combined into a single list of endangered and threatened species. Both the American and Arctic peregrine falcon subspecies were listed as endangered throughout their respective ranges. The Peale's peregrine falcon was not listed because it was reproducing at near normal levels with only traces of DDT.

On March 1, 1983, we published a proposed rule to (1) reclassify the Arctic peregrine falcon from endangered to threatened; (2) clarify the status of the American peregrine falcon (*Falco peregrinus anatum*) in some areas of its range; and (3) designate all free-flying peregrine falcons in the 48 conterminous United States as endangered under the similarity of appearance provisions of section 4(e) of the Act (48 FR 8796). A final rule was published on March 20, 1984 (49 FR 10520). Pursuant to the similarity of appearance provisions, species that are not considered to be endangered or threatened are treated as such for the purpose of providing protection to a species that is biologically endangered or threatened.

On June 12, 1991, we announced in the **Federal Register** a Notice of Status Review of American and Arctic peregrines (56 FR 26969). The Arctic peregrine was removed as a threatened species from the Federal List of Endangered and Threatened Wildlife on October 5, 1994 (59 FR 50796) but was still regulated under the Act in the lower 48 United States due to the similarity of appearance provision for all *Falco peregrinus* peregrine falcons. The similarity of appearance provision was maintained because the American peregrine falcon was still listed as endangered.

We published an Advanced Notice of a Proposal to Remove the American Peregrine Falcon from the Federal List of Endangered and Threatened Wildlife on June 30, 1995 (60 FR 34406). This was based on data indicating this subspecies was recovered following restrictions on the use of organochlorine pesticides in the United States and Canada and because of successful management activities, including the reintroduction of captive-bred and relocated wild hatchling peregrine falcons. Current data provides additional support for recovery of all North American peregrine falcons, including the American peregrine falcon subspecies. We published a proposed rule to remove the peregrine falcon in North America from the Federal List of Endangered and Threatened Wildlife on August 26, 1998, based on continuing data indicating this species was recovered (63 FR 45446).

The processing of this final rule conforms with our listing priority guidance published on May 8, 1998 (63 FR 25502). This guidance clarifies the order in which we will process rulemakings, giving highest priority to handling emergency situations (Tier 1) and second highest priority (Tier 2) to resolving the listing status of outstanding proposed listings, resolving the conservation status of candidate species, processing administrative findings on petitions to add species to the lists or reclassify species from threatened to endangered status, and delisting or reclassifying actions. The lowest priority actions, processing critical habitat designations, are in Tier 3. Processing of this final rule is a Tier 2 action.

**Peregrine Falcon Recovery**

Section 4(f) of the Act directs us to develop and implement recovery plans for listed species. In some cases, we appoint experts to recovery teams to assist in the writing of recovery plans. Between 1974 and 1975 we formed recovery teams consisting of Service, State, and other experts. In cooperation with us, these recovery teams produced four regional recovery plans: three for the American peregrine falcon (Alaska, Rocky Mountains/Southwest United States, and the Pacific Coast of the United States), and one for the peregrine falcon in the eastern United States. Although no United States recovery plans established recovery criteria for peregrine falcons nesting outside of the United States, the Canadian Wildlife Service published an *Anatum* Peregrine Falcon Recovery Plan (Erickson *et al.* 1988) establishing recovery criteria for American peregrine falcons in Canada. Recovery plans for peregrine falcons called for captive rearing and release of birds in several areas of North America. In the eastern United States, where peregrine falcons were extirpated, the initial recovery objective was to reestablish peregrine falcons through the release of offspring from a variety of wild stocks being held in captivity by falconers. The first experimental releases of captive-produced young occurred in 1974 and 1975 in the United States. Since then, approximately 6,000 falcons were released throughout its historic range in North America. These releases helped to re-establish breeding pairs in areas where the species was extirpated, and accelerated the recovery of the species.

Later, reintroduction was also pursued in eastern Canada using only *F. p. anatum* breeding stock from the boreal regions of the subspecies' range. All peregrine falcons released to augment wild populations in western North America west of the 100th meridian, where small numbers of

American peregrines survived the pesticide era, were derived from western *anatum* stock (Enderson *et al.* 1995).

The most significant factor in the recovery of the peregrine falcon was the restriction placed on the use of organochlorine pesticides. Use of DDT was banned in Canada in 1970 and in the United States in 1972 (37 FR 13369). Restrictions that controlled the use of aldrin and dieldrin were imposed in the United States in 1974 (39 FR 37246). Since implementation of these restrictions, residues of the pesticides have significantly decreased in many regions where they were formerly used. Consequently, reproductive rates in most surviving peregrine falcon populations in North America improved, and numbers began to increase (Kiff 1988; Enderson *et al.* 1995).

In Alaska and northwest Canada, American peregrine falcon populations were locally depressed, but enough individuals survived the pesticide era to allow populations to expand without the need for release of captive-bred falcons. Likewise, in the southwestern United States, very few captive-bred birds were released, and populations recovered naturally following restrictions on the use of organochlorine pesticides. In southwest Canada, the northern Rocky Mountain States, and the Pacific Coast States, however, local populations were greatly depressed or extirpated, and over 3,400 young American peregrine falcons were released to promote recovery in those areas (Enderson *et al.* 1995).

American peregrine falcon population growth was noted in Alaska in the late 1970s (Ambrose *et al.* 1988b), and, by 1980, population growth was found in many other areas (Enderson *et al.* 1995). The rate of increase varied among regions of North America, undoubtedly influenced by variation in patterns of pesticide use, potential differences in the rate of pesticide degradation, and the degree to which local populations had declined. Populations in some portions of the range of American peregrine falcons, such as Alaska, northwest Canada, and southwestern United States, reached densities several years ago that suggested recovery was approaching completion (Ambrose *et al.* 1988b; Mossop 1988; Geoff Holroyd, Canadian Wildlife Service, *in litt.* 1993; Enderson *et al.* 1995). Residual organochlorine pesticide contamination continues to affect eggshells in some areas, such as portions of coastal California (Jarman 1994) and western Texas (Bonnie McKinney, Texas Parks and Wildlife Department, pers. comm. 1997), but these effects are localized. Despite these localized effects and the variation in the rate of increase among regions, local populations throughout North America have increased in size, and positive trends in nearly all areas suggest that an extensive recovery of American peregrine falcons has taken place.

**Recovery Status**

To aid in assessing peregrine falcon recovery, the current status was compared to specific recovery plan objectives for American peregrine falcons in (1) Alaska, (2) Canada, (3) the Pacific Coast, (4) the Rocky Mountains and the Southwest, and for the peregrine falcon in, and (5) the eastern United States. The current status of the subspecies in Mexico is discussed below, although no recovery plan or recovery objectives are established for Mexico.

*Alaska*

The Peregrine Falcon Recovery Plan, Alaska Population (Alaska Recovery Plan) (U.S. Fish and Wildlife Service 1982a) includes both Arctic and American peregrine falcons nesting in Alaska. The following discussion relates only to provisions regarding the American peregrine falcon, as the Arctic peregrine falcon was delisted on October 5, 1994 (59 FR 50796).

The Alaska Recovery Plan established recovery objectives based on four measurements for assessing the status of American peregrine falcons including population size, reproductive performance, pesticide residues in eggs, and eggshell thickness. The recovery objectives included:

(1) 28 nesting pairs in 2 specified study areas (16 in upper Yukon and 12 in upper Tanana);

(2) An average of 1.8 young per territorial pair;

(3) Average organochlorine concentration in eggs of less than 5 parts per million (ppm) (wet weight basis DDE); and

(4) Eggshells no more than 10 percent thinner than pre-DDT era eggshells.

The Alaska Recovery Plan suggested that these objectives be maintained in the specified study areas for 5 years before reclassifying from endangered to threatened status, and remain constant or improve for an additional 5 years before delisting.

Surveys were conducted in the upper Yukon and Tanana Rivers, for which historical population data were available, using consistent methodology from 1973 to the present so trends would be discernable. Surveys conducted between 1966 and 1998 along the upper Yukon River demonstrated increases in the number of occupied nesting territories from a low of 11 known pairs in 1973 to 46 pairs in 1998 (Ambrose *et al.* 1988b; Robert Ambrose, U.S. Fish and Wildlife Service, *in litt.* 1997a, 1999). Similarly, along the upper Tanana River, the number of occupied nesting territories increased from 2 in 1975 to 33 in 1998 (R. Ambrose, *in litt.* 1997a; 1999). The recovery objective of 28 occupied nesting territories in the two study areas was first achieved (post-DDT) in 1988, with 23 nesting territories on the Yukon River and 12 on the Tanana River. The number has increased steadily since that time to the current level of 79 occupied nesting territories in 1998, with 46 pairs on the Yukon River and 33 pairs on the Tanana River (R. Ambrose, *in litt.* 1999). Thus, the recovery objective of 28 occupied nesting territories was achieved and surpassed for 10 years. A minimum of 301 breeding pairs of American peregrine falcons currently nest in Alaska.

Productivity measured along the upper Yukon and Tanana Rivers fell to a low of about 1.0 young per territorial pair per year (yg/pr) in the late 1960s, but began to increase in the mid-1970s. By 1982, productivity exceeded the objective of 1.8 yg/pr, and varied between 1.6 and 3.0 yg/pr in the years since. Between 1994 and 1998, productivity averaged 2.0 yg/pr (sample size (N) = 362 nests/pairs). Overall, between 1982 and 1998, the Yukon River study area averaged 1.79 yg/pr, and the Tanana River study area averaged 1.85 yg/pr (R. Ambrose, *in litt.* 1999). It is expected that there are yearly variations in productivity, which most wildlife species experience. However, average productivity for the peregrine falcon was constant or improving, thus meeting the goal of at least 1.8 yg/pr over the last 10 years as recommended by the Alaska Recovery Plan.

Mean concentrations of DDE in peregrine falcon eggs in excess of 15–20 ppm are associated with nesting failure, whereas productivity is usually sufficient to maintain population size if residues average less than this concentration (Peakall *et al.* 1975, as cited in Peakall and Kiff 1988; Newton *et al.* 1989). In Alaska, average DDE residues in American peregrine falcons averaged 12.2 ppm from 1979 through 1984, 5.8 ppm from 1988 through 1991, and 3.5 ppm from 1993 through 1995 (R. Ambrose, *in litt.* 1997b). Current data suggest that the concentrations of less than 5 ppm DDE residue levels in peregrine falcon eggs have improved in the last 10 years (R. Ambrose *in litt.* 1997b). As a result of lowered DDE

concentrations, there was consistent population growth during that time.

In Alaska, eggshells were as much as 20–22 percent thinner than pre-DDT era shells in the mid-1960s (Cade *et al.* 1988). By the early 1980s, shells were about 14 percent thinner than before the DDT era (Ambrose *et al.* 1988a). Eggshells averaged 13.0 percent thinner from 1979 through 1984, 13.1 percent thinner from 1988 through 1991, and 12.1 percent thinner from 1993 through 1995 (R. Ambrose, *in litt.* 1997b). The average thickness of pre-DDT American peregrine falcon eggs from Alaska is not precisely known, so current estimates of thinning could be inaccurate. While average eggshell thinning has not yet reached the level of 10 percent or less of the pre-DDT era, it has improved over the last 10 years. Also, reproduction was sufficient to allow consistent population growth since the late 1970s, and productivity has, on average, exceeded its stated recovery objective for 17 years.

In summary, based on the most current information (1998 survey and early 1990s contamination data), we conclude that goals underlying all four objectives were met or exceeded. On average, the number of pairs occupying nesting territories in the two study areas and productivity exceeded the recovery objectives for the past 17 years. Neither DDE residues in eggs nor eggshell thinning has prevented a dramatic population growth since the late 1970s.

*Canada*

The 1988 *Anatum* Peregrine Falcon Recovery Plan for Canada (Canadian Recovery Plan) (Erickson *et al.* 1988) categorized the historical range of the American peregrine falcon throughout Canada into three regions, which include the Western Mountains, Interior Plains, and the Eastern Seaboard and Great Lakes. These regions were subdivided into nine zones on the basis of historical population levels, habitat, political boundaries, and restoration needs. The zones are (1) Maritime, (2) Great Lakes, (3) Prairies, (4) Mackenzie River Valley, (5) Northern Mountains, (6) Southern Mountains, (7) Eastern Mackenzie Watershed, (8) Western Canadian Shield, and the (9) Eastern Canadian Shield. Coastal British Columbia was excluded from consideration in the Canadian Recovery Plan because that area is occupied by *F.p. pealei.*

The goal of the Canadian Recovery Plan was to increase the wild American peregrine falcon population in Canada so the subspecies is no longer considered endangered or threatened by the Committee on the Status of Endangered Wildlife in Canada. The proposed objectives were (1) to establish by 1992 a minimum of 10 territorial American peregrine falcon pairs in each of Zones 1 to 6, and (2) to establish by 1997, in each of 5 of these 6 zones, a minimum of 10 pairs naturally fledging 15 (1.5 yg/pr) or more young annually, measured as a 5-year average beginning in 1993. No recovery objectives were established for Zones 7, 8, and 9. The Canadian Recovery Plan did not contain separate objectives for reclassification of the subspecies in Canada from its current endangered status to threatened.

Starting in 1990, the Canadian Wildlife Service has coordinated and published a national range-wide peregrine falcon population survey once every 5 years. The results of the 1995 national population survey were used in the following status summary of the American peregrine falcon in Canada (Ursula Banasch, Canadian Wildlife Service, *in litt.* 1997).

There were 98 known nest sites in Zones 1 and 2 (southern Ontario and Quebec, northern Great Lakes, Bay of Fundy and Labrador), and surveys located 64 pairs. There were 98 known nest sites in Zone 3 (Manitoba, Saskatchewan and Alberta), and surveys located 41 pairs. There were 117 known nest sites in Zone 4 (eastern N.W. Territories), and surveys located 83 pairs. There were 125 known nest sites in Zone 5 (Yukon), and surveys located 113 pairs. There were 50 known nest sites in Zone 6 (Interior British Columbia), and surveys located 18 pairs. The total known number of pairs for all six zones in 1995 was 319, with minimum objectives achieved for every recovery zone.

The only comprehensive range-wide productivity surveys available to us were the national population surveys coordinated by the Canadian Wildlife Service in 1990 and 1995 (U. Banasch, *in litt.* 1997; Holroyd and Banasch 1996). Surveys conducted in the intervening years were not nationally coordinated, and therefore not complete. Thus, we used the combined average annual productivity data collected in the 1990 and 1995 surveys to address this recovery objective.

In Zones 1 and 2, average productivity was 1.7 yg/pr (N=104 nests). In Zone 3, average productivity was 1.5 yg/pr (N=55). In Zone 4, average productivity was 2.0 yg/pr (N=171). In Zone 5, average productivity was 1.8 yg/pr (N=626). No productivity data were available for Zone 6. The 2-year average annual productivity for the Canadian population of American peregrine falcons was 1.8 yg/pr.

Although the Canadian Recovery Plan did not identify recovery objectives for pesticide residue or eggshell thinning levels, 205 eggs and 62 samples from 28 specimens of peregrine falcons were collected in Canada between 1965 and 1987 to assess organochlorine residue concentrations. In all three subspecies (*F.p. anatum, F.p. tundrius, F.p. pealei*), the proportion of specimens having residue concentrations above established critical values (concentration at which egg failure occurs, which varies among organochlorine contaminants) had decreased and was inversely correlated with improvements in the reproductive success of the population (Peakall *et al.* 1990).

In summary, the Canadian Recovery Plan identified two objectives to determine recovery for the American peregrine falcon population in Canada. Based on current available information, both objectives were met. The total number of pairs for all six zones in 1995 was 319, with minimum objectives achieved for every recovery zone. This count exceeds the total recovery objective of 60 pairs by 259 pairs. The average annual productivity data for 1990 and 1995 either met or exceeded objectives in five of the six zones with an average annual productivity of 1.8 yg/pr for the American peregrine falcon population in Canada.

*Pacific Coast*

To reclassify the American peregrine falcon from endangered to threatened, the Pacific Coast Recovery Plan (Pacific Population Plan) (U.S. Fish and Wildlife Service 1982b) recommended that 122 pairs be established in a specified distribution spanning California, Washington, Oregon, and Nevada. The distribution goals were based on 22 management units distributed throughout the historic range of the Pacific Coast peregrine falcon population. For each management unit, the population must achieve a specified minimum number of active pairs before downlisting can be considered. The Pacific Population Plan also recommended that with attainment of 185 wild, self-sustaining pairs (California 120, Oregon 30, Washington 30, and Nevada 5 pairs) and an average productivity of 1.5 yg/pr for a 5-year period, the subspecies could be considered for delisting. Since this final rule addresses the delisting of the peregrine falcon, only the latter two objectives are discussed in this section. The Pacific Population Plan defined a ''self-sustaining'' population as one whose natural productivity without human management is equal to or greater than its mortality.

By 1976, no American peregrine falcons were found at 14 historical nest sites in Washington, and Oregon had also lost most of its peregrine falcons. In addition, only 1 or 2 pairs remained on the California coast, with no more than 10 nest sites known to be occupied in the entire State (Cade 1994). A steadily increasing number of American peregrine falcon pairs breeding in Washington, Oregon, and Nevada was indicated by surveys from 1991 through 1998. Known pairs in Washington increased from 17 to 45, in Oregon from 23 to 51, and in Nevada from 3 to 6 (Gary Herron, Nevada Division of Wildlife, pers. comm. 1997; Martin Nugent, Oregon Department of Fish and Wildlife, *in litt.* 1999; David Anderson, Washington Department of Fish and Game, *in litt.* 1997). The number of American peregrine falcons in California increased from an estimated low of 5 to 10 breeding pairs in the early 1970s (Herman 1971), to a minimum of 167 occupied sites in 1998 (Janet Linthicum, Santa Cruz Predatory Bird Research Group, *in litt.* 1999). The increase in California was concurrent with the restriction of DDT and management that included the release of over 750 American peregrine falcons, including captive-reared and relocated wild hatchlings, through 1997 (Walton 1997). Recovery of American peregrine falcons in some areas of California, however, was impeded by continuing elevated DDT levels (Jarman 1994; Walton 1997).

The recovery of the peregrine falcon could be the result of a lower than expected first-year mortality of released birds from the augmentation program, which accelerated the growth of the Pacific population (Brian Walton, Santa Cruz Predatory Bird Research Group, pers. comm. 1997). As a result, intensive human management has essentially ended, and the release of captive-bred American peregrine falcons was suspended in Nevada in 1989, in California in 1992 (although the relocation of wild hatchlings continues), and in Oregon and Washington in 1995. Based on available information, the first recovery objective was met; a minimum known population of 270 pairs exceeds the delisting goal of 185 by 85 pairs. Also, the distribution goals for the Pacific Coast population was met in all four States. Surveys conducted from 1991 through 1998 demonstrate a steadily increasing number of American peregrine falcon pairs, indicating that natural productivity is greater than mortality in this recovery region.

Productivity measured in Washington between 1993 and 1998 ranged from 1.3 to 1.8 yg/pr, with an average of 1.5 yg/pr (N=204) (D. Anderson, *in litt.* 1999). In Oregon, productivity between 1993 and 1998 ranged from 0.8 to 1.9 yg/pr, with an average of 1.3 yg/pr (N=178) (M. Nugent, *in litt.* 1997; David Peterson, U.S. Fish and Wildlife Service, *in litt.* 1999). Between 1993 and 1998, productivity in California ranged from 1.4 to 1.7 yg/pr (N=523), with an average of 1.6 yg/pr (J. Linthicum *in litt.* 1999). No productivity data were available for Nevada.

Productivity, an important measure of population health, can be difficult to determine in wide-ranging species nesting in remote landscapes that are often difficult to access. However, available data indicate that the average productivity from 1993 through 1998 in Washington, Oregon and California was 1.5 yg/pr (D. Anderson, *in litt.* 1999; M. Nugent, *in litt.* 1997; David Peterson, U.S. Fish and Wildlife Service, *in litt.* 1999; J. Linthicum *in litt.* 1999). Therefore, we consider this objective to be met.

The Pacific Population Plan did not identify recovery objectives for pesticide residue or eggshell thinning levels. However, organochlorine residues and eggshell thinning were measured in California starting in the early 1970s. Jarman (1994) reported DDE concentrations in 105 peregrine eggs collected from California from 1987 to 1992, and 11 eggs from Oregon from 1990 through 1993. Data collected in nine study regions in California (Jarman 1994) indicated the highest concentrations of DDE were found in California eggs from the Channel Islands and mid-coast with 21 and 13 ppm, respectively. The southern coast and San Francisco regions had the lowest concentrations of 5.5 and 4.3 ppm, respectively. The DDE concentrations in eggs collected along the coast of California (between San Francisco Bay and 34° N) did not decrease between 1969 and 1992 (Jarman 1994). Eggs from Oregon contained DDE levels of 10 ppm.

Eggshells from coastal California continued to show thinning. In northern and central coastal California, eggshells collected between 1975 and 1995 averaged 17.7 and 19.1 percent thinner than pre-DDT era, respectively (J. Linthicum, *in litt.* 1996). In northern interior California, where 104 of the 186 sites were active at least once from 1975–1993, eggshells averaged 15.6 percent thinner than pre-DDT era shells (J. Linthicum, *in litt.* 1996). Eggshells collected on the Channel Islands off the southern coast of California in 1992–1995 averaged 19.4 percent thinner than those collected in California prior to 1947 (J. Linthicum, *in litt.* 1996). In montane California, the average was 15 percent thinner than normal, and in the southern interior (coastal mountains) the average was 17.9 percent thinner than normal (J. Linthicum, *in litt.* 1996). Urban pairs experienced eggshell thinning averaging 8.7 percent in the San Francisco area and 10.9 percent in the Los Angeles/Orange County area. A summary of 633 clutch mean measurements representing 1,237 samples of one or more eggshells collected between 1975 and 1995 from the historical range of the American peregrine falcon in California averaged 16.1 percent thinner (J. Linthicum, *in litt.* 1996). However, current reproduction indicates an expanding population in most areas despite high organochlorine residue concentrations and associated eggshell thinning in some areas of the Pacific population.

*Rocky Mountain/Southwest*

The American Peregrine Falcon Rocky Mountain/Southwest Population Recovery Plan (U.S. Fish and Wildlife Service 1984) established three objectives for delisting, including (1) increasing the *Falco peregrinus anatum* population in the Rocky Mountain/Southwest region to a minimum of 183 breeding pairs and the following distribution: Arizona (46), Colorado (31), Idaho (17), Montana (20), Nebraska (1), New Mexico (23), North Dakota (1), South Dakota (1), Texas (8), Utah (21), and Wyoming (14); (2) sustaining a long-term average production of 1.25 yg/pr without manipulation by 1995; and (3) observing eggshell thinning of no more than 10 percent from the pre-DDT era for a 5-year span.

The prairie States of North Dakota, South Dakota, Nebraska, Kansas, and Oklahoma contain little peregrine falcon habitat, and historical data are incomplete. No recovery goals for a specific number of peregrine falcon pairs were set for Kansas or Oklahoma; nesting peregrine falcons are not known from Oklahoma. Currently, South Dakota, Nebraska and Kansas each have one peregrine falcon pair (Mark Martell, The Raptor Center, pers. comm. 1998; Tordoff *et al.* 1997); no peregrine falcon pairs are currently known to occur in North Dakota or Oklahoma.

The Rocky Mountain/Southwest population of the American peregrine falcon has made a profound comeback since the late 1970s when surveys showed no occupied nest sites in Idaho, Montana, or Wyoming and few pairs in Colorado, New Mexico, and the Colorado Plateau, including parts of southern Utah and Arizona (Cade 1994). Surveys conducted from 1991 through 1998 indicated that the number of American peregrine falcon pairs in the

Rocky Mountain/Southwest population is steadily increasing. In 1991, this population supported 367 known pairs; in 1998 the number of pairs increased to 535 (Robert Mesta, U.S. Fish and Wildlife Service, *in litt.* 1999). Surveys conducted from 1992 through 1998 showed that, with the exception of North Dakota, all States within the Rocky Mountain/Southwest population have met or exceeded their specific delisting goals for breeding pairs.

The current minimum known number of peregrine falcon pairs for each State include Arizona 159, Colorado 89, Idaho 17, Montana 18, Nebraska 1, New Mexico 32, North Dakota 0, South Dakota 1, Texas 11, Utah 164, Wyoming 42, and Kansas 1 (Greg Beatty, Arizona Game and Fish Department, *in litt.* 1997; James Enderson, Western Peregrine Falcon Recovery Team, pers. comm. 1999; Dennis Flath, Montana Department of Fish and Parks, *in litt.* 1999; Frank Howe, Utah Division of Wildlife Resources, *in litt.* 1999; Levine *et al.* 1998; McKinney 1994; B. McKinney, pers. comm. 1999; Robert Oakleaf, Wyoming Game and Fish Department, *in litt.* 1999; Sator O. Williams III, New Mexico Department of Game and Fish, *in litt.* 1999). The current Rocky Mountain/Southwest population is 535, which surpasses the objective of 183 by 352 pairs.

In Arizona , productivity from 1989 through 1997 ranged from 0.9 to 1.8 yg/yr, with an average productivity of 1.1 yg/pr (N=294). Recent average productivity (1994–1997) is 0.9 yg/pr (N=194) (Ward and Siemens 1995; G. Beatty, *in litt.* 1997).

In 1973, 1974, and 1975, productivity in Colorado was 0.2 (N=11), 1.9 (N=8), and 0.7 yg/pr (N=8), respectively, reflecting the irregular and generally poor productivity typical of the 1970s (Platt and Enderson 1988). Long term productivity measured in Colorado from 1985 through 1998 ranged from 1.2 to 1.9 yg/pr, with an average of 1.6 yg/pr (N=753) (Gerry Craig, Colorado Division of Wildlife, *in litt.* 1999; J.H. Enderson, pers. comm. 1999). Recent productivity from 1994 through 1998, averaged 1.6 yg/pr (N=395) (G. Craig, *in litt.* 1999).

In Idaho, productivity recorded from 1989 through 1998 ranged from 0 to 2.5 yg/pr, with an average of 1.6 yg/pr for this 10-year period (N=120). Recent productivity from 1994 through 1998 averaged 1.4 yg/pr (N=75) (Levine *et al.* 1998). In Montana, productivity between 1984 and 1998 ranged from 0.3 to 3.0 yg/pr, with an average of 1.7 yg/pr for the 15-year period (N=137). Recent productivity from 1994 through 1998 averaged 1.5 yg/pr (N=91) (D. Flath, *in litt.* 1999). In Nebraska, productivity between 1992 and 1998 for a single pair ranged from 0 to 5.0 yg/pr, with an average of 1.7 yg/pr for the 7-year period (N=7) (Lloyd Kiff, The Peregrine Fund, *in litt.* 1997; Tordoff *et al.* 1998).

For the period 1986 through 1998, New Mexico experienced a 12-year average productivity of 1.6 yg/pr (N=278). Recent productivity from 1995 through 1998 averaged 1.4 yg/pr (N=131) (S. Williams, *in litt.* 1997, 1999). In Texas, long term productivity recorded from 1975 through 1998 ranged from 0 to 2.3 yg/pr, with an average of 0.9 yg/pr (N=185) for the 23-year period. Recent productivity from 1994 through 1998 averaged 0.5 yg/pr (N=69) (McKinney 1994; B. McKinney, pers. comm. 1999).

In Utah, between 1985 and 1987, productivity averaged 0.8 yg/pr (N=117). From 1991 through 1996, productivity ranged from 0.9 to 2.0 yg/pr, with an average of 1.3 yg/pr (N=629) for the 6-year period (Bunnell 1994; F. Howe, *in litt.* 1997). In Wyoming, productivity between 1984 and 1998 ranged from 0.9 to 3.0 yg/pr, with an average of 1.7 yg/pr (N=282) for the 15-year period. Recent productivity between 1994 and 1998 averaged 1.8 yg/pr (N=179) (Joe White, Wyoming Game and Fish Department, *in litt.* 1995; R. Oakleaf, *in litt.* 1999).

In Kansas, productivity between 1993 and 1998 ranged from 0 to 3.0 yg/pr, with an average of 1.0 yg/pr (N=6) for the 4-year period (L. Kiff, *in litt.* 1997; Tordoff *et al.* 1998). In 1998, the first pair of peregrine falcons were located in South Dakota; they produced no young.

Although Texas and Arizona have exceeded their goals for number of pairs, current productivity is below the goal of 1.25 yg/pr and below their long term productivity averages by 44 and 18 percent respectively. Heavy metal contamination, particularly mercury, in adults and nestlings may be depressing productivity in Texas (Andrew Sansom, Texas Parks and Wildlife Department, *in litt.* 1995). Residual mercury contamination from mines operated along the Rio Grande River in the early 1900s is the suspected cause (B. McKinney, pers. comm. 1997). The current productivity level in Arizona is not fully understood, but may be a continuation of the variability exhibited in productivity between 1989 and 1995 (Garrison and Spencer 1996; Bruce Taubert, Arizona Game and Fish Department, pers. comm. 1999).

Kansas and South Dakota are two more States that currently have not met the productivity goal of 1.25 yg/pr. Kansas has had only one peregrine falcon pair since 1992, and breeding is sporadic each year.

Average productivity for the 11 States supporting breeding populations is 1.3 yg/pr, exceeding the goal of 1.25 yg/pr goal. Even though Texas, Kansas, South Dakota and Arizona currently have not met the productivity goal, productivity throughout the Rocky Mountain/Southwest region is more than sufficient for recruitment to exceed mortality, so dramatic population growth has resulted.

In Arizona, eggshells collected between 1978 and 1983 averaged 14.2 percent thinner, and 20 eggshell replicates collected from 1989 through 1994 averaged 13 percent thinner, than pre-DDT era eggshells (Ellis *et al.* 1989, Ward and Siemens 1995). In Colorado and New Mexico, shells from 260 eggs laid between 1977 and 1985 averaged 12 percent thinner than pre-DDT eggshells (Enderson *et al.* 1988). In another analysis of eggs from New Mexico, eggshells collected in 1977 averaged 20 percent thinner than pre-DDT eggshells, but in 1985 averaged only 14 percent thinner (Ponton *et al.* 1988). Eggshells collected in Colorado from 1973 through 1997 were as much as 25.1 percent thinner and at least 6.0 percent thinner than pre-DDT eggshells, with an average thinning of 13.5 percent. Only Colorado has achieved the objective for eggshell thickness. Sampling in Colorado in 1990, 1991, 1992, 1993, and 1994 produced measurements of 10.6, 11.7, 8.6, 8.1, and 6.0 percent thinning respectively, with an average annual mean of 9.0 percent thinning for this period (G. Craig, *in litt.* 1995). Although the recovery objective was not met in other States in the region, there is a general trend toward thicker eggshells in measurements taken since the mid-1970s (L. Kiff, pers. comm. 1995).

The Rocky Mountain/Southwest Recovery Plan did not identify a recovery objective for pesticide residue levels. However, organochlorine pesticide residues in American peregrine falcon eggs measured in Colorado and New Mexico between 1973 and 1979 averaged 26 ppm DDE, but the average declined to 15 ppm by 1980–1983 (Enderson *et al.* 1988). The average DDE concentration in 5 eggs collected in Colorado from 1986 through 1989 was 11 ppm (Jarman *et al.* 1993).

In summary, the first recovery objective in the Rocky Mountain/Southwest Recovery Plan was met; the current population of 535 pairs exceeds the goal of 183 pairs by 352 pairs. These pairs are distributed throughout the Rocky Mountain/Southwest States, meeting or exceeding the population goals in 10 of the 13 States in this

region. The second objective of sustaining a long-term average production of 1.25 yg/pr without manipulation by 1995 was met by all Rocky Mountain/Southwest States that have breeding American peregrine falcons except Texas, Kansas, South Dakota, and Arizona. By the mid-1980s the practice of fostering young into active nests was terminated, therefore, the long-term average productivity this recovery region has experienced was accomplished without nest manipulation. The current reproductive level in the 11 States with breeding populations is 1.3 yg/pr, exceeding the second objective of 1.25 yg/pr. Therefore, we consider the intent of this objective met. Based on the degree of recovery achieved, the third objective, that average eggshell thinning be no more than 10 percent from the pre-DDT era average for 5 years, appears to be conservative. The increase in numbers of American peregrine falcons indicates the subspecies has recovered without the necessity of reaching this specific recovery objective.

*Eastern United States*

The eastern peregrine population has a unique history and complex status under the Act. As stated previously, peregrine falcons were extirpated in the eastern United States and southeastern Canada by the mid-1960s. In 1974, shortly after the passage of the Act, the National Audubon Society sponsored a meeting of experts in peregrine biology, including representatives from the Service, to address the conservation of the species in North America (U.S. Fish and Wildlife Service 1991). This sparked the beginning of an effort to reestablish the peregrine in the eastern United States through the introduction of offspring from parents of multiple subspecies. Peregrine falcons were raised in captivity from parent subspecies then listed as endangered (*Falco peregrinus anatum, F. p. tundrius, F. p. peregrinus*), unlisted subspecies (*F. p. pealei, F. p. brookei, etc.*), and combinations of these subspecies. The first experimental releases of captive-produced young in the eastern States occurred in 1974 and 1975 (Cade 1994). These and future releases, coordinated by the Service, State fish and wildlife agencies, and representatives of The Peregrine Fund, demonstrated that hacking, the practice of retaining and feeding young captive-bred birds in partial captivity until they learn to fly and hunt on their own, was an effective method of introducing captive-bred peregrines to the wild (U.S. Fish and Wildlife Service 1991).

In 1978, we issued a policy statement confirming support for the use of North American peregrines to establish an eastern peregrine falcon population, supported with endangered species funds, and the use of peregrines from other geographic areas for specific research purposes. The policy applied only to peregrine falcons in the east (Keith M. Schreiner, U.S. Fish and Wildlife Service, *in litt.* 1978).

Thus, notwithstanding the similarity of appearance designation, we have continued to fully support the restoration of the eastern peregrine falcon under the 1991 revised Peregrine Falcon Eastern Population Recovery Plan. We have given the eastern peregrine falcon equal consideration with the American peregrine falcon with respect to recovery.

The Peregrine Falcon Eastern Population Recovery Plan (Eastern Plan), first published in 1979, and revised in 1985 and 1991 (U.S. Fish and Wildlife Service 1991), addressed the recovery of the peregrine falcon in the Eastern United States, a population re-established beginning in 1974 and 1975 by releasing captive-bred peregrine falcons of mixed genetic heritage. The recovery plan established two recovery objectives (1) establish a minimum of 20–25 nesting pairs in each of 5 recovery units and sustained them for a minimum of 3 years; and (2) an overall minimum of 175'200 pairs demonstrating successful, sustained nesting. The five recovery units are (1) Mid-Atlantic Coast, (2) Northern New York and New England, (3) Southern Appalachians, (4) Great Lakes, and (5) Southern New England/Central Appalachians.

The first recovery objective is nearly achieved, with three of the five recovery units (Mid-Atlantic Coast, Northern New York and New England, and Great Lakes) surpassing 20 to 25 nesting pairs of peregrine falcons for 3 years. The Mid-Atlantic Coast unit had 65 pairs fledging 110 young in 1998 and averaged 62 pairs and 90 fledglings annually from 1996 through 1998. The Northern New York and New England unit had 50 pairs fledging 70 young in 1998 and averaged 47 pairs and 61 fledglings annually from 1996 through 1998. The Great Lakes unit had 44 pairs fledging 95 young in 1998 and averaged 40 pairs and 74 fledglings from 1996 through 1998. The Southern Appalachians unit had 14 pairs fledging seven young in 1998, and averaged 11 pairs fledging 14 young from 1996 through 1998. The Southern New England and Central Appalachians unit had 20 pairs fledging 26 young in 1998 and averaged 15 pairs fledging 22 young from 1996 through 1998 (L. Kiff, *in litt.* 1997; David Flemming, U.S. Fish and Wildlife Service, *in litt.* 1997; Mike Amaral, U.S. Fish and Wildlife Service, *in litt.* 1999). In 1998, there was a total of 193 pairs counted in the five eastern State recovery units, which was the upper minimum recovery level of the Eastern Plan. The recovery goal, however, was probably met in 1997, because up to 10 percent of territorial pairs in any given year are believed to escape detection and are not counted (Cade *et al.* 1988). Importantly, the number of territorial pairs recorded in the eastern peregrine falcon recovery area has increased an average of 10 per cent annually for the past 7 years (1992–1998). Equally important is that the productivity of these pairs during the same 7-year period has averaged 1.5 yg/pr, thus demonstrating sustained successful nesting.

As of 1998, there were at least 32 nesting peregrine pairs in six midwestern States, which is outside the recovery area delineated in the 1991 Eastern Plan. The birds are nesting successfully in a larger area than was believed likely in 1991. Peregrine falcons now found in midwestern States are the result of captive-reared and released birds, and others that probably came from the peregrine falcons released in the eastern States. However, there appears to be a zone of no nesting in the northeastern Great Plains that separates the western American peregrine falcons from the introduced eastern peregrine falcons (Chuck Kjos, U.S. Fish and Wildlife Service, pers. comm. 1997). There are now more than 225 pairs of peregrine falcons in the midwestern and eastern States where peregrine falcons were extirpated.

*Mexico*

None of the existing recovery plans written for peregrine falcons in North America established recovery criteria for birds that nest in Mexico. There is very little historical or recent information on peregrine falcons in Mexico to accurately assess their current status in Mexico.

Porter *et al.* (1988) reported 42 known nesting territories on the western side of the Baja California Peninsula. From 1966 through 1971, only three pairs occurred in this region and none were found in 1976 (Porter *et al.* 1988), indicating a substantial decline had occurred by the mid-1970s. Most of these territories apparently were checked since that time, but seven pairs were located between 1985 and 1992 in areas not occupied in previous years (Massey and Palacios 1994).

In 1993, three active American peregrine falcon nests were discovered in Ojo de Liebre (Scammon's Lagoon) on the western side of the Baja California Peninsula in an area without historical nesting records (Castellanos *et al.* 1994). The central west coast of the Baja California Peninsula was an important breeding area with a historical population of about 13 pairs (Banks 1969). Between 1980 and 1994, Castellanos *et al.* (1997) conducted breeding surveys of American peregrine falcons in this area of the coast and found 10 nesting pairs. Castellanos *et al.* (1997) studied the reproductive success of three pairs in 1993 and five pairs in 1994 located at Ojo de Liebre and San Ignacio Lagoons. An average of three eggs, 1.8 nestlings, and 1.6 fledglings were produced per nest. This productivity appears to be within the range of normal productivity for healthy populations (Cade *et al.* 1988). These observations suggest some recent recovery on the west coast of the Baja California Peninsula.

On the western (Gulf of California) side of mainland Mexico, Porter *et al.* (1988) reported 23 historical nest sites. A number of new nest sites were found in this area between 1966 and 1984, increasing the number of known nest sites to 51. Territory occupancy averaged about 82 percent between 1967 and 1971 and 77 percent between 1971 through 1975, indicating that territory occupancy in that area never declined as significantly as on the west side of the Baja California Peninsula. Porter and Jenkins (1988) believed that the number of occupied territories in the Gulf area increased after 1967 following a reduction in DDE residues in prey.

Between 1989 and 1997, Robert Mesta, (*in litt.* 1997) found three pairs of American peregrine falcons, one pair on the Rio Aros and two on the Rio Yaqui, Sonora. Hunt *et al.* (1988) found 14 occupied nesting territories in the highlands of northeast Mexico in 1982. In this area and adjacent west Texas, territory occupancy averaged about 70 percent during 1973–1985.

Most of what is known about productivity and pesticide residues in Mexico comes from the western mainland near the Gulf of California. Porter *et al.* (1988) found that productivity along the Gulf of California between 1965 and 1984 was ''somewhat less than normal,'' and five addled eggs collected between 1976 and 1984 averaged 12.8 ppm DDE with a range of 2.4 to 25.0 ppm (Porter and Jenkins 1988). DDE residues in prey in the Gulf area declined from the 1960s to the 1980s, and this decline correlated with increases in productivity and the number of breeding pairs (Porter and Jenkins 1988). Some prey, however, still contained high pesticide residues, and reproduction appeared to be affected by organochlorine at three of 15 nests examined (Porter and Jenkins 1988).

Hunt *et al.* (1988) found that only five of 14 pairs produced young in northeast Mexico in 1982. Hunt *et al.* (1988) reported significant DDE residues in peregrine falcon prey species in western Texas in the mid 1980s, but prey species in Mexico were not sampled.

In summary, there was little research on the distribution, numbers, and status of American peregrine falcons in Mexico, and most research took place in the Baja California Peninsula and the Gulf of California regions. Numbers on the west coast of the Baja California Peninsula declined significantly (Porter *et al.* 1988), but observations suggest that numbers may have increased in recent years (Massey and Palacios 1994; Castellanos *et al.* 1994; and Castellanos *et al.* 1997). In the Gulf of California area, territory occupancy never was known to drop below 77 percent (Porter *et al.* 1988), and it increased in the 1970s and 1980s (Porter and Jenkins 1988).

No information on population trends for American peregrine falcons in Mexico is available. However, the status of the Mexican population may be similar to that of the population occupying similar habitat in nearby Arizona (G. Hunt, pers. comm. 1997). Exposure to organochlorine-based pesticides by Mexico nesting populations continues to be a concern. In 1997, as part of the North American Agreement for Environmental Cooperation, a parallel agreement to the North American Free Trade Agreement between the United States, Canada, and Mexico, the Commission for Environmental Cooperation (CEC) established a North American Regional Action Plan (NARA) on DDT. Mexico, a member nation of the CEC, proposes a phased reduction of DDT (Philip Johnson, U.S. Fish and Wildlife Service, pers. comm. 1999). Specific goals of this reduction are: (1) Reduce the use of DDT for malaria control in Mexico by 80 percent in 5 years (beginning in 1997); (2) eliminate the illegal use of DDT in agriculture in Mexico; (3) develop a cooperative approach to minimize movement of malaria-infected mosquitos across borders and reduce the illegal importation of DDT; and (4) advance global controls on DDT production, export and use.

Adverse effects of organochlorine pesticides in the environment remains an international concern for peregrine falcons nesting in Mexico, and for peregrine falcons wintering in or migrating through Latin America. By undertaking the steps proposed in the NARA, the United States, Canada, and Mexico are committing to ongoing cooperative activities and yearly reporting on progress made on these initiatives and objectives. Annual reports will be submitted to the North American Working Group for the Sound Management of Chemicals and subsequently disseminated to the Council of the Commission for Environmental Cooperation and the public.

*Summary of Peregrine Falcon Recovery*

Five regional peregrine falcon recovery plans, four for American peregrine falcons in Canada and the western United States, and one for the eastern United States introduced peregrine falcon population, were written to guide recovery efforts and establish criteria to be used in measuring recovery. These recovery plans included objectives for population size and reproductive performance. Only two of the recovery plans included specific objectives that applied to pesticide residues in eggs and eggshell thinning. The combined breeding population size goal for the four American peregrine falcon recovery plans is 456 pairs. Currently, a minimum of 1,425 pairs occupy the range of the American peregrine falcon in Alaska, Canada, and the western United States. There are 193 peregrine falcon pairs in the five recovery units included in the Eastern Plan, and an additional 32 peregrine falcon pairs occur in midwestern States in areas not included in the Eastern Plan recovery units. In 1998, the total known breeding population of peregrine falcons was 1,650 pairs in the United States and Canada.

Productivity is an important measure of population health, and each of the four American peregrine falcon recovery regions met or exceeded their respective productivity goals, as did the eastern peregrine population.

Other objectives, including those for pesticide residues in eggs and the degree to which eggshells are thinner than pre-pesticide era eggshells, vary among the plans. In the case of eggshell thinning, current measurements obtained in some areas fall short of recovery objectives. Eggshell thinning was originally suggested by recovery teams as an indicator of whether organochlorine contamination was preventing species recovery. Despite the failure of populations in localized areas to meet recovery objectives, overall, populations of American peregrine

falcons have increased considerably. This increase continues to occur even after reintroduction efforts were curtailed. The consistent and geographically widespread trends in increasing population size demonstrate that current levels of reproductive failure, pesticide residues, and eggshell thinning still affecting American peregrine falcons in some areas have not prevented recovery of the subspecies in North America.

Table 1 summarizes the recovery plan goals for each of the regions and Canada, as well as the current recovery status.

TABLE 1.—AMERICAN PEREGRINE FALCON RECOVERY PLAN GOALS AND CURRENT (1998) RECOVERY STATUS.

| Recovery plan | Delisting goal | Current status | Comments/degree to which delisting goals are met |
|---|---|---|---|
| Alaska: | | | |
| Pairs | 28 pairs in study areas. | 79 pairs in study areas. | Exceeded goal by 51 pairs in study areas. Approximately 301 pairs known State-wide. |
| Productivity (young/pair) | 1.8 yg/pr | 1.9 yg/pr | Exceeded goal. |
| DDT (parts per million) | less than 5 ppm | 3.5 ppm | Exceeded goal. |
| Eggshell thinning | less than 10 percent. | 12.1 percent | Goal not met, but has not prevented recovery; goal probably too conservative. |
| Canada: | | | |
| Pairs | 60 pairs (10 each in 6 zones). | 319 pairs | Exceeded goal by 259 pairs. |
| Productivity | 1.5 yg/pr | 1.8 yg/pr | Exceeded goal. |
| Pacific Coast: | | | |
| Pairs | 185 pairs | 270 pairs | Exceeded goal by 85 pairs. |
| Productivity | 1.5 yg/pr | 1.5 yg/pr | Goal met. |
| Rocky Mountain/Southwest: | | | |
| Pairs | 183 pairs | 535 pairs | Exceeded goal by 352 pairs. |
| Productivity | 1.25 yg/pr | 1.3 yg/pr | Exceeded goal. |
| Eggshell thinning | less than 10 percent. | | Goal measured by only a few States; cannot be assessed. |
| Eastern/Great Lakes: | | | |
| Pairs | 175–200 pairs (with no fewer than 20–25 in each of 5 recovery zones). | 193 pairs | Exceeded goal in 3 zones; goals in other 2 zones probably were met; an additional 32 peregrine falcon pairs occur in several Midwestern States not included under the Eastern Plan. |

**Summary of Issues and Recommendations**

In the August 26, 1998, proposed rule (63 FR 45446), we requested that all interested parties provide information and comments on the status of and proposal to delist the American peregrine falcon. Announcements of the proposed rule were sent to Federal, State, county, and city-elected officials, Federal and State agencies, interested private citizens, and local area newspapers and radio stations. We provided the governments of Canada and Mexico with the proposed rule, and both countries responded with comments. We held public hearings on December 3, 1998, in Wisconsin and December 8, 1998, in New Hampshire. In addition, we solicited formal scientific peer review of the proposal in accordance with our July 1, 1994, Interagency Cooperative Policy for Peer Review in Endangered Species Act Activities (59 FR 34270). We requested three individuals, who possess expertise in peregrine falcon biology, to review the proposed rule by the close of the comment period. All three individuals responded to our request and their comments were incorporated into this final rule.

We considered all comments, including oral testimony at the public hearings. We received a total of 29 oral comments and 893 comment letters from 49 States, and the District of Columbia, Canada, Mexico, Germany, Bali, four Federal agencies, 27 State resource agencies, 305 falconry associations or individual falconers, and 40 conservation organizations. Of the comments received, 633 supported the proposal to delist, 266 opposed the proposal, 11 supported downlisting, and 12 letters duplicated comments from individuals who previously provided oral comments.

Because many respondents offered similar comments, those comments of a similar nature are grouped. These comments, and our responses, are presented below.

*Issue 1:* In the Midwest, delisting will result in less cooperation by building owners and managers to protect peregrine falcons nesting on their buildings.

*Our Response:* Currently, 28 States in the midwestern and eastern United States support nesting peregrine falcons. Approximately 87 percent of the midwestern pairs and 33 percent of the eastern pairs are nesting on manmade structures: bridges, buildings and smokestacks (Martell and McNicoll 1999). Currently, there are 117 nests on nest boxes or trays in 19 States and the District of Columbia. Should delisting the peregrine falcon act as a disincentive for owners and managers to protect nesting peregrine falcons on their buildings, the long-term security of this urban population could be threatened (Martell and McNicoll 1999).

Between January and March of 1999, 75 people with information on 95 of the 117 nest sites were asked if delisting would affect their current management strategies. Responses were overwhelmingly in favor of continuing to manage for the presence of nesting pairs for some of the following reasons: pigeon control, good public relations, positive effect on building employees, and good environmental stewardship (Martell and McNicoll 1999). Survey results do not suggest that delisting of the peregrine falcon would result in widespread removal of nest boxes and trays or discouragement of nesting on manmade structures. Furthermore, the survey found the public widely appreciated and accommodated

peregrines at the manmade structures on which they nest (Martell and McNicoll 1999).

*Issue 2:* Disturbance due to recreational rock climbing poses a threat to nesting peregrine falcons.

*Our Response:* The increasing popularity of rock climbing throughout North America, particularly in the northeast, is becoming a serious problem for land managers trying to protect nesting peregrine falcons. Unlike the western landscape that provides rock climbers with more and larger cliffs and thus some alternatives to conflicts with nesting peregrine falcons, the smaller and limited cliffs of the northeast present fewer alternatives to peregrine/climber conflicts.

The peregrine falcon will still be protected by the MBTA. Additional protection is provided by other laws such as the National Forest Management Act (16 U.S.C. 1600) and the Federal Land Management and Policy Act (43 U.S.C. 1701). These continued protections are adequate to address this threat. See Factor D under Summary of Factors Affecting the Species.

In addition, we are aware of several very effective raptor management plans that were cooperatively developed by land managers, representatives of the climbing community, and other interested parties (plans that contain effective public education components). Some examples include plans developed by the Prescott National Forest in Arizona, Yosemite National Park in California, Adirondack State Park in New York, Zion National Park in Utah, Smith Rock State Park in Oregon, the Nantahala National Forest in North Carolina, and the Colorado National Monument in Colorado. All of these plans include seasonal rock climbing restrictions to prevent disturbance of raptor nests from rock climbing activities. The development of more of these partnerships is essential to the preservation of the peregrine falcon and the sport of rock climbing. Organizations like the Access Fund which represent the climbing community have continued to express a strong desire to work with both private and public land managers to resolve any conflicts originating from the use of cliffs by climbers.

*Issue 3:* The Act's section 6 funds currently being used by States to support peregrine falcon monitoring programs will not be available once the peregrine is delisted.

*Our Response:* We are authorized through the Secretary of the Interior to provide grants to States to assist in monitoring the status of recovered species pursuant to section 4(g) under section 6 of the Act. Existing and future Federal assistance in the form of section 6 funding to States for conservation work will not be affected by the delisting, as long as States continue to identify monitoring peregrine falcons as a high priority.

*Issue 4:* The data do not support delisting the American peregrine falcon throughout its range in the United States. The Service should consider downlisting the American peregrine falcon to threatened rather than delisting.

*Our Response:* Recent data show improvements in numbers of breeding pairs of peregrine falcons and productivity (Refer to Table 1, ''Recovery Status,'' and ''Summary of Peregrine Falcon Recovery''), and demonstrate that goals set for numbers and productivity for the American peregrine falcon recovery plans were met or exceeded. The combined population size goal for the four American peregrine falcon recovery plans is 456 pairs. Currently, a minimum of 1,425 known pairs occupy sites in Alaska, Canada, and the western United States, and a number of additional pairs have probably gone undetected. Overall average productivity goals in all four American peregrine falcon recovery plans, using productivity as a recovery criterion, were met or exceeded.

Only the Alaska recovery plan set a goal for DDT levels, and only two recovery plans (Alaska and Rocky Mountain/Southwest) specified objectives for eggshell thinning. The Alaska Recovery Plan set a delisting goal of less than 5 ppm DDT and less than 10 percent eggshell thinning. Recent data for American peregrine falcon eggs in Alaska indicate DDT levels at less than 3.5 ppm, exceeding that goal, and eggshell thinning is at 12.1 percent. Measurements for eggshell thinning were not consistently taken in the Rocky Mountain/Southwest States. Colorado has met the recovery plan eggshell thinning goal of less than 10 percent; the average of the annual means for 1990–1994 was 9.0 percent. Data for other States show a general trend toward thicker eggshells since the mid-1970s (refer to Rocky Mountain/Southwest section under Recovery Status).

Three of 5 peregrine falcon recovery units in the eastern United States have met recovery goals, and 193 pairs documented in 1998 indicate the overall recovery goal of 175–200 pairs was met. In addition, another 32 pairs are nesting in areas of the Midwest outside the recovery units specified in the Eastern Plan but nevertheless contribute to overall restoration goals.

We believe that the species has essentially achieved the goals established for recovery and, in many areas, has exceeded the goals. We believe the available information supports full delisting of the species throughout its range, and the species clearly is not in danger of extinction, is not likely to become endangered within the foreseeable future throughout a significant portion of its range, and warrants full delisting.

*Issue 5:* American peregrine falcons should not be delisted because they are not restored throughout the historical range.

*Our Response:* We have determined the American peregrine falcon has recovered throughout its historical range. Restoration of the American peregrine falcon within every area throughout its historical range is not required by the Act, is not required for recovery, nor was it a goal of any of the recovery plans. Generally, the goal of a recovery program is to restore the species to a point at which protection under the Act is no longer required. To be recovered, a species must not be endangered with extinction, or be likely to become endangered within the foreseeable future. Although a few, localized areas have not quite met their numerical recovery goals, the overall status of the American peregrine falcon has improved significantly such that it is considered recovered and warrants delisting. As a species recovers in numbers and populations expand, more of the historical range can be re-occupied where appropriate habitat remains.

*Issue 6:* There are gaps in the scientific knowledge about American peregrine falcon biology. A population viability analysis was not done, and genetic diversity, viable population size, population dynamics, and long-term stability of populations have not been determined.

*Our Response:* A complete understanding of the biology of a species is not required to determine a species' conservation status under the Act. Population viability analyses are important tools for attempting to quantify threats to a species, particularly those facing loss and fragmentation of habitat, and the consequences of conservation actions, as well as aiding in identifying critical factors for study, management, and monitoring. These analyses are not always essential, however, to determine when a species has achieved recovery, particularly in the case of the American peregrine falcon. It is evident that

recovery of this subspecies was largely achieved by eliminating the use of DDT and by successful management activities, including the reintroduction of captive-bred American peregrine falcons. Recovery goals established for the species were met or exceeded, with few exceptions.

*Issue 7:* Organochlorine pesticides still persist within the breeding range of the American peregrine falcon and continue to depress natural productivity.

*Our Response:* We recognize that although the peregrine falcon has made a dramatic recovery throughout its historical range in the United States, the presence of environmental contaminants is still affecting the productivity of certain regional populations. Eggs collected on the eastern shore of Virginia and Maryland had slightly elevated levels of DDE, dieldrin, and mercury, which was associated with reproductive problems (U.S. Fish and Wildlife Service 1994). On the Channel Islands in California, particularly Catalina, populations are still affected by organochlorine residues and eggshell thinning (Jarman 1994). In west Texas, heavy metal contamination, particularly mercury may be depressing productivity (A. Sansom, *in litt.*1995). Residual mercury from mines operated along the Rio Grande River in the early 1900s is the suspected source of this contamination (B. McKinney, pers. comm. 1997). We recognize the possible threat that environmental contaminants pose to the sustained recovery of this species and therefore, will include a contaminant monitoring component in the post-delisting monitoring plan. Refer to Factor E under Summary of Factors Affecting the Species, for an in-depth discussion of contaminants. See also our response to issue 8.

*Issue 8:* The continued unrestricted use of organochlorine pesticides in Latin America places the American peregrine falcon at risk of contamination while on migration and on its wintering grounds.

*Our Response:* Comparisons of blood samples collected during fall and spring migration indicate that, although migrant peregrine falcons are known to accumulate pesticides while wintering in Latin America, DDE residues in the blood taken from female peregrine falcons captured during spring migration at Padre Island, Texas decreased between 1978 and 1994 below levels that would affect reproduction (Henny *et al.* 1996). Despite the use of organochlorines in Latin America, the American peregrine falcon has recovered over its historical range, and Arctic peregrine falcons, which also winter in Latin America, were delisted due to their recovery. Refer to Factor E under Summary of Factors Affecting the Species for an in-depth discussion. The North American Working Group for the Sound Management of Chemicals promotes a regional perspective that encourages the active involvement of Central and South American countries in the implementation of the North American Regional Action Plan on DDT, and is facilitating international cooperation on combating malaria in these regions without the continued use of organochlorine pesticides. This effort could eventually eliminate or reduce one source of DDT in Central and South American countries.

*Issue 9:* The take of American peregrine falcons for falconry after its delisting will create an additional threat to the subspecies.

*Our Response:* Delisting the American peregrine falcon will not affect the protection given to all migratory bird species, including the peregrine falcon, under the MBTA. The regulations issued pursuant to the MBTA allow for issuance of permits to take raptors for falconry and other purposes provided the taking will not threaten wildlife populations (50 CFR 21.28 and 13.21(b)). Currently we are working with State wildlife agencies to develop biological criteria and two management plans to govern the issuance of permits for take of peregrine falcons to ensure the taking does not negatively impact wild populations, particularly those in need of further restoration. The first management plan will deal with the take of eyas (nestling) peregrines. A second management plan will deal with the take of passage (migrating first-year) peregrines. The management plans will include criteria for harvest, implementation criteria, and procedures for evaluating effects of the harvest. They will pertain to the take of all wild peregrine falcons in the U.S., including the American peregrine falcon, and will apply to all falconry, raptor propagation, and scientific collecting permits. Take will not be permitted under the MBTA until the draft management plans undergo public review, are approved, finalized, and published in the **Federal Register**. Some exceptions may be made on a case-by-case basis for scientific purposes. The effects of take for all purposes will be assessed during the monitoring period following delisting. Refer to Factor D under the Summary of Factors Affecting the Species section and the Effects of This Rule section for further information.

*Issue 10:* The Canadian Wildlife Service has expressed concern that American peregrine falcons breeding in Canada but migrating to or through the United States will be taken for falconry purposes.

*Our Response:* Canada's recovery program for American peregrine falcons is still in progress and the Canadian government is concerned that any take of American peregrines migrating from Canada could impact recovery. We are working with the governments of Canada and Greenland in considering the appropriateness of harvest of peregrines migrating through the United States. If take of these passage birds is approved, it would be designed to avoid take of American peregrines originating in Canada and instead target the more abundant Arctic peregrines from northern Alaska, Canada, and Greenland.

*Issue 11:* The Service cannot consider delisting the American peregrine falcon until all recovery goals in the four existing recovery plans for this subspecies are met or exceeded.

*Our Response:* Section 4(f) of the Act directs us to develop and implement recovery plans for species of animals or plants listed as endangered or threatened. Recovery is the process by which the decline of an endangered or threatened species is arrested or reversed and threats to its survival are neutralized so that long-term survival in nature can be ensured. The goal of this process is the maintenance of secure, self-sustaining wild populations of species with the minimum investment of resources. One of the main purposes of the recovery plan is to enumerate goals (guidelines) that will help us to determine when recovery for a particular species is achieved. Meeting or exceeding all of the specific recovery goals for a listed species is not required by the Act before delisting can occur.

We determine whether recovery is achieved based on a species' performance relative to the goals set in its recovery plan and the best available scientific information. A species is considered recovered when it is no longer in danger of extinction (i.e., endangered), or likely to become endangered within the foreseeable future throughout all or a significant portion of its range (i.e., threatened). The American peregrine falcon has either met, exceeded, or is very close to meeting the recovery goals set for this subspecies throughout its range. We believe that the intent of all the objectives are met and that the recovery of the subspecies justifies delisting.

*Issue 12:* The eastern peregrine falcon population has not met the recovery goals set forth in the Eastern Recovery

Plan and, therefore, should remain on the endangered species list.

*Our Response:* The eastern peregrine falcon population is protected only due to the similarity of appearance to *F. p. anatum*, which has protected individual eastern peregrine falcons from direct take. Thus, their status with respect to recovery has no direct impact on the decision to delist the American peregrine falcon. Nevertheless, we have supported and still fully support the restoration of this population.

Data through 1998 on the status of the eastern peregrine falcon population indicate that the intent of the recovery goals set for this population are met. The recovery plan established 2 recovery objectives including (1) a minimum of 20–25 nesting pairs in each of 5 recovery units which are established and sustained for a minimum of 3 years, and (2) an overall minimum of 175–200 pairs demonstrating successful, sustained nesting. Three of the five recovery units (Mid-Atlantic Coast, Northern New York and New England, and Great Lakes) have surpassed the nesting pair goal for 3 years. The Southern Appalachians and Southern New England/Central Appalachians units may not yet have achieved the goals established for the number of breeding pairs for those areas. However, the overall minimum of 175–200 successful pairs in the eastern region was achieved, and over the past 6 years (1992–1998), the number of territorial pairs has increased an average of 10 percent annually. There are now at least 193 pairs of peregrine falcons in the eastern States where falcons were extirpated, and pairs are successfully nesting throughout a greater range than was anticipated. We believe the intent of the recovery objectives are satisfied and that recovery of the peregrine in the eastern United States is sufficiently established. Refer to the Recovery Status section for additional discussion on this subject.

*Issue 13:* The status of the American peregrine falcon in Mexico was not adequately addressed.

*Our Response:* While population status and trends for falcons nesting in Mexico are not well known, American peregrine falcon populations in the United States and Canada, including those migrating to and from Latin America, have met or exceeded their criteria for delisting. Restoration of the American peregrine falcon within every area throughout its historical range is not required by the Act, nor is it required for recovery. Mexico's proposed phased reduction of DDT under the North American Regional Action Plan will make a significant contribution toward increasing peregrine falcon populations in Mexico. Refer to the Mexico section under Recovery Status for additional discussion on this subject.

*Issue 14:* The Service's delisting proposal is not supported by an adequate scientific review.

*Our Response:* The proposed rule to remove the peregrine falcon in North America from the Federal List of Endangered and Threatened Wildlife received reviews from a variety of scientific institutions and individual scientists. Two examples are the Ornithological Council and the Raptor Research Foundation. The Ornithological Council consists of nine leading scientific ornithological societies: the American Ornithologists' Union, Association of Field Ornithologists, Consejo Internacional para la Preservaciòn de las Aves, Cooper Ornithological Society, Colonial Waterbird Society, Pacific Seabird Group, Raptor Research Foundation, Society of Caribbean Ornithology, and Wilson Ornithological Society. Together it has a membership of approximately 6,500 ornithologists. One of its primary missions is to provide scientific information about birds to legislators, regulatory agencies, industry decision makers, conservation organizations and others, and to promote the use of scientific information in the making of policies that affect birds.

The task of evaluating the proposed rule on behalf of the Ornithological Council was accepted by a committee of Raptor Research Foundation scientists. The Raptor Research Foundation is a scientific society that represents professional raptor scientists and managers throughout North America and around the world. This committee of raptor scientists reviewed the available data and submitted a report that was endorsed by both the Ornithological Council and the Raptor Research Foundation as their position on the proposed rule. This report underwent peer review and was published in the Wildlife Society Bulletin (Millsap *et al.*, 1998, WSB 26(3); 522–538). While expressing some concern about the status of the eastern peregrine population, the authors concurred with our position that the peregrine falcon warranted delisting range-wide.

*Issue 15:* Recovery plans used to evaluate the recovery of the peregrine falcon are out of date and need to be revised to reflect more accurate contemporary goals and the Service should not misrepresent the goals in the current plans.

*Our Response:* As addressed in our response to Issue 11, section 4(f) of the Act directs us to develop and implement recovery plans for species of animals or plants listed as endangered or threatened. Recovery is the process by which the decline of an endangered or threatened species is arrested or reversed and threats to its survival are neutralized so that long-term survival in nature can be ensured. One of the main purposes of the recovery plan is to enumerate goals (guidelines) that will help us to determine when recovery of a particular species is achieved. Meeting or exceeding all of the specific recovery goals for a listed species before it can be delisted is not required by the Act. Section 4 of the Act and regulations (50 CFR Part 424) promulgated to implement the listing provisions of the Act, establish the procedures for listing, reclassifying, and delisting species. We may list a species if one or more of the five factors described in section 4(a)(1) of the Act threatens the continued existence of the species. A species may be delisted, according to 50 CFR 424.11(d), if the best scientific and commercial data available substantiate that the species is neither endangered or threatened because of (1) extinction, (2) recovery, or (3) the original data for classification of the species were in error. We have determined that substantial peregrine falcon recovery has taken place, and none of the five factors addressed in section 4(a)(1) of the Act is currently negatively affecting the peregrine falcon to the degree that the species is endangered or threatened.

*Issue 16:* Post-delisting monitoring for at least 5 years is essential.

*Our Response:* We agree. Section 4(g)(1) of the Act requires the Secretary to implement a system, in cooperation with the States, to monitor for not less than 5 years the status of all species which have recovered to the point that protection of the Act is no longer required (section 4(g)). If it becomes evident during the course of the post-delisting monitoring that the species again requires the protection of the Act, it would be relisted.

**Summary of Factors Affecting the Species**

Section 4 of the Act and regulations (50 CFR Part 424) promulgated to implement the listing provisions of the Act, set forth the procedures for listing, reclassifying, and delisting species on the Federal lists. We may list a species if one or more of the five factors described in section 4(a)(1) of the Act threatens the continued existence of the species. A species may be delisted, according to 50 CFR 424.11(d), if the

best scientific and commercial data available substantiate that the species is neither endangered or threatened because of (1) extinction, (2) recovery, or (3) the original data for classification of the species were in error.

After a thorough review of all available information, we have determined that substantial peregrine falcon recovery has taken place since the early 1980s. We determined that none of the five factors addressed in section 4(a)(1) of the Act, and discussed below, is currently affecting the species, including the American peregrine falcon subspecies and introduced peregrine falcon populations, such that the species is no longer endangered (in danger of extinction throughout all or a significant portion of its range) or threatened (likely to become endangered in the foreseeable future throughout all or a significant portion of its range). These factors and their application to the peregrine falcon in North America are as follows:

*A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range*

Peregrine falcons occupy a variety of habitat types and nest from the boreal forest region of Alaska and Canada, through much of Canada and the western United States, south to parts of central and western Mexico. Nesting habitat includes cliffs and bluffs in boreal forests, coastal cliffs and islands, urban skyscrapers and other structures, and cliffs and buttes in southwestern deserts. In some breeding areas, such as the southern United States, some or all of the birds remain year-round on their nesting territories. In other breeding areas, particularly in high latitudes, many or all of the individuals are highly migratory; these individuals occupy a number of regions and habitat types throughout the year as they nest, migrate to and from wintering areas, and occupy their wintering ranges. Due to the extensive geographic distribution of the peregrine falcon, the wide variety of habitat types in which the species nests, and the immense area that some of the more migratory individuals occupy during a year, the peregrine falcon occupies an extremely broad array of areas and habitats throughout its range. As a result, the degree to which peregrine falcons were affected by human-caused habitat modification varies widely by region, habitat type, and individual falcons within the population.

As the human population has grown in North America, the rate of habitat alteration has unquestionably increased. Certainly some peregrine falcon habitat was destroyed, such as the many wetlands drained in recent years that were previously used by peregrine falcons for foraging or as migratory staging areas during spring and fall. But peregrine falcons have colonized many cities in North America due to the abundance of nest sites on buildings and the abundance of prey, such as rock doves (*Columba livia*), that thrive in urban areas. Therefore, some forms of habitat modification have negatively affected peregrine falcons while other forms have benefited them. It would be burdensome to estimate the net, overall effect of habitat modification on the species throughout North America.

Although the rate of habitat modification in North America has increased in recent decades, the number of American peregrine falcons occupying the region has increased substantially since the late 1970s or early 1980s. In several parts of their range, including parts of Alaska, the Yukon and Northwest Territories, California, and the southwestern United States, the number of breeding pairs has increased rapidly in recent years, and some local populations now occur at very high densities (R. Ambrose, pers. comm. 1997; G. Holroyd, pers. comm. 1997; Enderson *et al.* 1995). Because these rapid population growth rates and high densities were achieved despite habitat modification in North America, we conclude that habitat modification or destruction was not a limiting factor in peregrine recovery. It does not currently threaten the existence of the American peregrine falcon nor is it likely to in the foreseeable future.

*B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes*

Delisting the peregrine falcon will not result in overutilization because the delisting will not affect protection provided the peregrine falcon by the MBTA. The take of all migratory birds, including peregrine falcons, is governed by the MBTA's regulations on the taking of migratory birds for educational, scientific, and recreational purposes and requiring harvest be limited to levels that prevent overutilization (See Factor D).

*C. Disease or Predation*

Peregrine falcons are susceptible to a number of diseases and parasites such as tapeworms, mites, ticks, botulism, fowl pox, and viral encephalitis (U.S. Fish and Wildlife Service 1982b; Trainer (1969) as cited in U.S. Fish and Wildlife Service 1984). However, these organisms are not known to affect the peregrine falcon at the population level.

Mammals and other raptors are known to prey on peregrine falcons, including such species as the great horned owl (*Bubo virginianus*), red-tailed hawk (*Buteo jamaicensis*), raccoon (*Procyon lotor*), and coyote (*Canis latrans*) (U.S. Fish and Wildlife Service 1982b, 1984). For example, great horned owls are natural predators of peregrine falcons (U.S. Fish and Wildlife Service 1991) and are possibly responsible for the slow recovery of peregrine falcons in the two northern recovery areas in the reestablished eastern population (M. Amaral *in litt.* 1995). Great horned owl predation was not documented as a significant cause of the decline in peregrine falcons and has not affected the species' overall recovery.

Golden eagles (*Aquila chrysaetos*) are also known to prey on young peregrine falcons. Barbara Behan (U.S. Fish and Wildlife Service, pers. comm. 1999) witnessed a golden eagle prey on young peregrine falcons at a hack site in Colorado, stooping and footing one of the falcons, and leaving the area with it in its talons. The same eagle, or another, returned numerous times over the next several days, and the other four falcons disappeared in that time, despite efforts by the hack site attendants to scare the eagles away from the site.

Though the peregrine falcon is occasionally preyed upon, this factor is not known to affect the peregrine falcon at the population level.

*D. The Inadequacy of Existing Regulatory Mechanisms*

Protection from take and commerce for the peregrine falcons under the Endangered Species Act will be removed upon delisting. However, peregrine falcons are still protected by the MBTA. Section 704 of the MBTA states that the Secretary of the Interior is authorized and directed to determine if, and by what means, the take of migratory birds is allowed and to adopt suitable regulations permitting and governing the take. In adopting regulations, the Secretary is to consider such factors as distribution and abundance to ensure that take is compatible with the protection of the species.

The MBTA and its implementing regulations (50 CFR Parts 20 and 21) prohibit take, possession, import, export, transport, selling, purchase, barter, or offering for sale, purchase or barter, any migratory bird, their eggs, parts, and nests, except as authorized under a valid permit (50 CFR 21.11). Regulations at 50 CFR 21.28 and 21.30 authorize the issuance of permits to take, possess, transport and engage in

commerce with raptors for falconry and for propagation. Other regulations authorize the issuance of permits for scientific collecting (50 CFR 21.23), special purposes such as rehabilitation or education (50 CFR 21.27), and depredation (50 CFR 21.41). Prior to issuance of these permits, meeting certain criteria is required, including a requirement that the issuance will not threaten a wildlife population (50 CFR 13.21(b)(4)). In cooperation with State wildlife agencies we will develop draft biological criteria for management of take of wild peregrines under the MBTA. The resulting management plans will include biological criteria for take, implementation criteria, and procedures for evaluating the effects of the taking. It will pertain to the take of peregrines in the United States for falconry and other purposes. With limited exceptions, take will not be permitted under MBTA until the draft management plans undergo public review, are approved, finalized, and published in the **Federal Register**. In addition to considering the effect on wild populations, issuance of raptor propagation permits requires that we consider whether suitable captive stock is available and whether wild stock is needed to enhance the genetic variability of captive stock (50 CFR 21.30(c)(4)).

These existing regulatory provisions will adequately protect against excessive take of peregrine falcons. If necessary, protective measures could be expanded by promulgation of a regulation under the MBTA. We have both the legal authority and the obligation to regulate take of peregrines under the MBTA (see additional discussion of the MBTA in the Effects of this Rule section below).

In the absence of habitat protection under the Act, there are no other existing Federal laws that specifically protect the habitat of this species (see ''Critical Habitat''). However, loss of habitat was not identified as a threat to the species and was not a factor identified as contributing to the species' listing.

An important regulatory mechanism affecting peregrine falcons is the requirement that pesticides be registered with the Environmental Protection Agency (EPA). Under the authority of the Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 136), the EPA requires environmental testing of all new pesticides. Testing the effects of pesticides on representative wildlife species prior to pesticide registration is specifically required. This protection from effects of pesticides are not altered by delisting the peregrine falcon.

On July 1, 1975, peregrine falcons were included in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora. This treaty was established to prevent international trade that may be detrimental to the survival of plants and animals. Generally, both import and export permits are required by the importing and exporting countries before an Appendix I species may be shipped, and Appendix I species may not be imported for primarily commercial purposes. Although CITES does not itself regulate take or domestic trade, CITES permits may not be issued if the export will be detrimental to the survival of the species or if the specimens were not legally acquired. This protection is not be altered by delisting the peregrine falcon under the Act.

Peregrine falcons are still afforded some protection by land management agencies under laws such as the National Forest Management Act (16 U.S.C. 1600) and the Federal Land Management and Policy Act (43 U.S.C. 1701). National Forest Management Act regulations specify that ''fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area.'' (36 CFR 219.19). Guidelines for each planning area must provide for a diversity of plant and animal communities based on the suitability of a specific land area. United States Forest Service regional foresters are responsible for identifying sensitive species occurring within their Region. Sensitive species are those that may require special management emphasis to ensure their viability and to preclude trends toward endangerment that would result in the need for Federal listing. The delisting of the peregrine falcon will require Federal land managers to consider the need for designating the peregrine falcon as a sensitive species to ensure that forest management activities do not contribute to a need for relisting. The Federal Land Policy and Management Act requires that public lands be managed to protect the quality of scientific, ecological, and environmental qualities, among others, and to preserve and protect certain lands in their natural condition to provide food and habitat for fish and wildlife.

Federal delisting of the peregrine falcon will not remove the peregrine falcon from State threatened and endangered species lists, or suspend any other legal protections provided by State law. States may have more restrictive laws protecting wildlife, including restrictions on use for falconry, and may retain State threatened or endangered status for the peregrine falcon (see 50 CFR 21.28). Depending on the biological status, States generally list peregrine falcons as endangered, threatened, critically imperiled or as a species of concern. Currently, the peregrine falcon is State-listed in 38 of the 40 States that have nesting pairs. The two States that do not have the species listed—Colorado and Arizona—removed the peregrine falcon from their lists due to its recovery in those States. However, both will continue to regulate take for falconry and other purposes. In many States, falconry is administered cooperatively by the Service and the States.

*E. Other Natural or Manmade Factors Affecting Its Continued Existence*

Egg collecting, shooting, harvest for falconry, habitat destruction, climate change, and the extinction of passenger pigeons were all considered as possible factors causing or contributing to the decline in peregrine falcon populations in North America; however, no evidence supports any of these factors as causing the widespread reproductive failure and population decline that occurred. In contrast, an overwhelming body of evidence has accumulated showing that organochlorine pesticides affected survival and reproductive performance sufficiently to cause the decline. There currently is no question within the scientific community that contamination with organochlorines was the principal cause for the drastic declines and extirpations in peregrine falcon populations that took place in most parts of North America (Kiff 1988).

Although the use of all organochlorine pesticides causing reproductive failure in peregrine falcons was restricted in the United States and Canada in the early 1970s, their use continues in some areas of Latin America. It was shown, by comparing blood samples collected during fall and spring migration, that migrant peregrine falcons accumulate organochlorines while wintering in Latin America (Henny *et al.* 1982). Henny *et al.* (1996) demonstrated that DDE residues in the blood taken from female peregrine falcons captured during spring migration at Padre Island, Texas decreased between 1978 and 1994. In second-year peregrines, residues dropped from 1.43 ppm between 1978 and 1979 to only 0.25 ppm in 1994 and from 0.88 to 0.41 ppm for older peregrines; these levels are well below those that would affect reproduction (Henny *et al.* 1996).

The widespread reproductive failure and population decline of peregrine

falcons in North America coincided with the period of heavy organochlorine use in the United States. Although there was not an immediate lowering of pesticide residues in eggs following restrictions on the use of organochlorines north of Mexico (Enderson *et al.* 1995), residues gradually declined following the restrictions (Ambrose *et al.* 1988b; Enderson *et al.* 1988; Peakall *et al.* 1990), and most surviving populations began to increase in size thereafter. Despite the continued use of organochlorines in Latin America, populations of American peregrine falcons in North America have recovered substantially in recent years. In fact, Arctic peregrine falcons that winter predominantly in Latin America recovered to the point that the subspecies was removed from the Federal List of Threatened and Endangered Wildlife on October 4, 1994 (59 FR 50796).

Additionally, some of the avian prey used during the nesting season by peregrine falcons throughout North America also winter in Latin America. Many of these prey return to their nesting areas with pesticide residues accumulated during the winter (Fyfe *et al.* 1990). Peregrine falcons preying upon these birds during the summer are further exposed to Latin American pesticides. Overall, pesticide use in Latin America does not appear to have adversely affected reproductive success in American peregrine falcon populations in North America.

We recognize that certain populations of American peregrine falcons have recovered to a lesser degree, and that in some of these populations organochlorine residues are still high and reproductive rates remain lower than normal. Populations on the Channel Islands off southern California are still affected by high organochlorine residues and eggshell thinning (Jarman 1994). This is a localized threat, and the result of using offshore islands as DDT disposal areas during the 1940s. Despite the residual effects of organochlorines on the Channel Islands, this population is continuing to increase, although some of the increase could be the result of the release of a significant number of captive-bred young or dispersal from other areas where recovery is greater (B. Walton, pers. comm. 1997). Based on published values in the literature, detected concentrations of DDT in peregrine falcon eggs collected in New Jersey were sufficient to impact reproduction. Productivity and eggshell thinning data, however, did not support a conclusion of reproductive impairment due to DDT contamination (U.S. Fish and Wildlife Service and New Jersey Department of Environmental Protection 1997). Jarman (1994) suggested that these locally higher egg residues result from a local source of DDT or DDE. As a result, the effects are localized, and the observations do not reflect the current status of peregrine falcons as a whole. In recent years, numbers of peregrine falcons have increased significantly throughout their historical range despite the effects of localized organochlorine residues.

Similarly, American peregrine falcons in southwest Canada have not recovered as well as in most other regions of North America. Despite the release of several hundred captive-bred young in the prairie Provinces and western Canada (Holroyd and Banasch 1990), the number of pairs occupying territories is still well below the number of known historical nest sites (G. Holroyd, *in litt.* 1993). In southern Canada, including the prairie region, the proportion of reintroduced young that entered the breeding population was considerably lower than in the United States (Peakall 1990; Enderson *et al.* 1995). The factor or factors causing this lower recruitment rate remain unknown, but survivorship of peregrine falcons released into this area may be lower than in adjacent portions of the subspecies' range. Pesticide residues in American peregrine falcon eggs do not appear to be higher in southwest Canada than in the United States (Peakall *et al.* 1990). Therefore, higher residual organochlorine contamination is apparently not responsible, and the number of pairs occupying this region continues to increase.

Exposure to organochlorine pesticides caused drastic population declines in peregrine falcons. Following restrictions on the use of organochlorines in the United States and Canada, residues in eggs declined and reproduction rates improved. Improved reproduction, combined with the release of thousands of captive-reared young and relocated wild hatchlings, allowed the American peregrine falcon to recover and peregrine falcons to be successfully reestablished in those areas of the historical range from which the species was extirpated. Pesticide residues, reproductive rates, and the rate of recovery have varied among regions within the vast range of this species. In some areas, such as the Channel Islands off the southern coast of California, the lingering effects of DDT have caused reproductive rates to remain low. Local source contamination may even cause continued reproductive problems in the Channel Islands. In southwest Canada, the rate of recovery, or onset of recovery, apparently lagged behind most other areas, but recent trends suggest that historical nest sites will continue to be gradually re-colonized.

The peregrine falcon has recovered throughout its historical range. Although the recovery is slow in a few parts of the historical range, these areas represent a small portion of the species' overall range. Furthermore, evidence collected in recent years shows that a combination of lingering residues of organochlorines in North America and contamination resulting from the continued use of organochlorines in Latin America has not prevented a widespread and substantial recovery of peregrine falcons, as numbers of peregrine falcons continue to increase. We conclude, therefore, that the continued existence of the American peregrine falcon is no longer threatened by exposure to organochlorine pesticides.

In summary, due to the reduction in the effects of pesticides and widespread positive trends in population size, we have determined that the American peregrine falcon has recovered and is no longer endangered with extinction, or likely to become endangered within the foreseeable future throughout all or a significant portion of its range. We considered the alternative of downlisting the species, but recent data show improvements in breeding pair numbers and productivity, demonstrating that the delisting goals set for the American peregrine falcon in recovery plans were met or exceeded. We believe this available information supports the full delisting of the species throughout its range. Therefore, we are removing the peregrine falcon from the Federal List of Endangered and Threatened Wildlife, thus, removing endangered status for the American peregrine falcon throughout its range, and the similarity of appearance provision for all free-flying peregrine falcons within the 48 conterminous United States.

In accordance with 5 U.S.C. 553(d), we have determined that this rule relieves an existing restriction and good cause exists to make the effective date of this rule immediate. Delay in implementation of this delisting would cost government agencies staff time and monies conducting formal section 7 consultation on actions which may affect species no longer in need of the protections under the Act. Relieving the existing restriction associated with this listed species will enable Federal agencies to minimize any further delays in project planning and implementation for actions that may affect peregrine falcons.

**Effects of This Rule**

This final rule will affect the protection afforded to North American peregrine falcons under the Act. It will not affect the status of the Eurasian peregrine falcon (*F. p. peregrinus*), currently listed under the Act as endangered wherever it occurs. The endangered designation under the Act for the American peregrine falcon will be removed and the designation of endangered due to similarity of appearance for all free-flying peregrine falcons found within the 48 conterminous United States, including the Arctic and Peale's peregrine falcons, and the reestablished eastern and midwestern populations, will be removed. Therefore, taking, interstate commerce, import, and export of North American peregrine falcons will no longer be prohibited under the Act. In addition, Federal agencies will no longer be required to consult with the Service under section 7 of the Act in the event activities they authorize, fund or carry out adversely affect peregrine falcons. However, as previously discussed, removal of the protection of the Act will not affect the protection afforded all peregrine falcons under the MBTA.

The take and use of peregrine falcons must comply with appropriate State regulations. State regulations applying to falconry vary among States and are subject to change over time. The applicable State regulations may be more but not less restrictive than Federal regulations.

This rule will not affect the peregrine falcon's Appendix I status under CITES, and CITES permits will still be required to import and export peregrine falcons to and from the United States. CITES permits will not be granted if the export will be detrimental to the survival of the species or if the falcon was not legally acquired.

**Critical Habitat**

Critical habitat for the American peregrine falcon includes five areas in northern California (50 CFR 17.95). The Act defines critical habitat as ''specific areas within the geographical area occupied by the species, at the time it is listed on which are found those physical or biological features essential to the conservation of the species and which may require special management considerations or protection.'' Since critical habitat can be designated only for species listed as endangered or threatened under the Act, all currently designated American peregrine falcon critical habitat will be removed upon publication of this final rule.

**Monitoring**

Section 4(g)(1) of the Act requires us to monitor a species for at least 5 years after delisting. A monitoring plan was provided in the proposed delisting rule on August 26, 1998 (63 FR 45446). We are currently developing a revised monitoring plan which will be made available for public review in the **Federal Register** in the near future.

**Take for Falconry and Other Purposes**

Wild American and Arctic peregrine falcons were unavailable for falconry and raptor propagation in the contiguous United States since these two subspecies of peregrine falcons were listed under the Act in 1970. In Alaska, the Arctic peregrine became available for take in 1994 when it was delisted, but take of this subspecies was still restricted in the contiguous United States pursuant to the similarity of appearance provision of the Act. Take of Peale's peregrines also was restricted in the contiguous United States since 1984 pursuant to the similarity of appearance provisions of the Act.

With this delisting, which removes protection of the Act, regulation and management of peregrine falcons in the United States will fall primarily under the MBTA and State regulations. In anticipation of delisting, we are working with the State wildlife agencies to develop draft biological criteria for management of take of peregrines. These criteria will serve as the basis for discussions with authorities in Canada and Greenland to identify appropriate limits for take of passage birds. We will then prepare environmental assessments on the management of nestlings and passage birds and solicit public comment. The resulting management plans will include biological criteria for harvest, implementation criteria, and procedures for evaluating the harvest. One objective of the plans is to allow a level of take that does not compromise continuing restoration of peregrine falcons in North America. We expect to complete the management plan for nestlings by the Spring of 2000, and the management plan for passage birds by the Fall of 2000. Take of peregrine falcons in the conterminous United States is not permitted under the MBTA until the management plans undergo public review and are finalized, approved, and published in the **Federal Register**. Some permit exceptions may be made for scientific research. In Alaska, take of American peregrine falcons is not permitted but take of Peale's and Arctic peregrines may be authorized.

**Executive Order 12866**

This rule was not reviewed by the Office of Management and Budget under Executive Order 12866.

**Paperwork Reduction Act**

Office of Management and Budget (OMB) regulations at 5 CFR 1320, which implement provisions of the Paperwork Reduction Act, require that interested members of the public and affected agencies have an opportunity to comment on agency information collection and recordkeeping activities (see 5 CFR 1320.8(d)). We cannot conduct or sponsor, and a person is not required to respond to a collection of information, unless we are in possession of a current OMB Control Number. We intend to collect information from the public during the post-delisting monitoring period. A description of the information that will be collected was provided in the proposed delisting rule. We are revising the monitoring plan that was described in the proposed delisting rule, and will obtain a revised OMB Control Number for, and request public comment on, the revised monitoring plan in the **Federal Register** in the near future.

**National Environmental Policy Act**

We have determined that an environmental assessment or environmental impact statement, as defined under the authority of the National Environmental Policy Act of 1969, need not be prepared in connection with regulations adopted pursuant to section 4(a) of the Endangered Species Act of 1973, as amended. We published a notice outlining our reasons for this determination in the **Federal Register** on October 25, 1983 (48 FR 49244).

**References Cited**

A list of all references cited herein is available upon request from the Ventura Fish and Wildlife Office (see **ADDRESSES** section).

**Author**

The primary author of this proposed rule is Robert Mesta, U.S. Fish and Wildlife Service, Ventura Fish and Wildlife Office (see **ADDRESSES** section).

**List of Subjects in 50 CFR Part 17**

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.

**Regulation Promulgation**

For the reasons set out in the preamble, we hereby amend part 17, subchapter B of chapter I, Title 50 of the

Code of Federal Regulations, as set forth below:

## PART 17—[AMENDED]

1. The authority citation for part 17 continues to read as follows:

**Authority:** 16 U.S.C. 1361–1407; 16 U.S.C. 1531–1544; 16 U.S.C. 4201–4245; Pub. L. 99–625, 100 Stat. 3500; unless otherwise noted.

**§ 17.11 [Amended]**

2. Section 17.11(h) is amended by removing the entries for ''Falcon, American peregrine, *Falco peregrinus anatum*'' and ''Falcon, peregrine, *Falco peregrinus*'' under ''BIRDS'' from the List of Endangered and Threatened Wildlife.

**§ 17.95 [Amended]**

3. Section 17.95(b) is amended by removing the critical habitat entry for ''American Peregrine Falcon.''

Dated: August 17, 1999.

**Jamie Rappaport Clark,**

*Director, U. S. Fish and Wildlife Service.*

[FR Doc. 99–21959 Filed 8–20–99; 8:45 am]

BILLING CODE 4310–55–P

# Appendix 4C
# ADC Plan

SAIC®

# ALTERNATE DAILY COVER PLAN

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# ALTERNATE DAILY COVER PLAN

## INTRODUCTION

This Alternate Daily Cover Plan has been prepared as per 30 TAC 330.165(d). The plan will become a part of the site operating plan and kept with the operating record of the site.

## DESCRIPTION AND THICKNESS OF THE ALTERNATIVE MATERIAL

Fabrene, Inc.'s woven coated polyethylene fabric, or equivalent, will be used as tarps. These tarps are available in 12 mil, 16 mil and 20 mil thickness.

In addition, petroleum contaminated soils that are authorized by TCEQ for disposal and/or use as daily cover material, may be applied as daily cover. This soil or a combination of this soil and clean soil will be applied in at least a 6" thickness. A copy of the requirements for acceptance of petroleum contaminated soils is included in Attachment A.

## EFFECT ON VECTORS, FIRES, ODORS, AND WINDBLOWN LITTER

Tarps will provide for adequate waste coverage ensuring effective protection against windblown waste, vectors, odors or fires. When the tarps are spread over waste and properly anchored: 1) windblown wastes will be prevented; 2) objectionable odors will be prevented from escaping; 3) vectors will not be attracted and if random vectors discover the landfill, the strength of the tarp will discourage access to the waste below the tarp; and 4) winds will be prevented from fanning sparks from waste with "hot spots" and stray sparks from other fires will not come in contact with the waste.

Petroleum contaminated soils will provide the same effective control as clean soil ensuring protection from vectors, fires, odors, and windblown litter and waste. No petroleum contaminated soils will be used if they in themselves would create nuisance odors. These soils will be used to cover waste for periods of time greater than 24 hours since they provide coverage equivalent to clean soil.

## OPERATIONAL METHODS UTILIZED AT THE SITE WHEN USING THE ALTERNATIVE METHOD

The tarps will be placed over the waste using standard landfill equipment and site personnel and will be secured along the sides and ends with soil, rock, or other heavy items. The tarps will be removed in the mornings using landfill equipment and site personnel.

Petroleum contaminated soils will be stockpiled adjacent to the active face and applied to the active face using standard landfill equipment.

## CHEMICAL COMPOSITION OF THE MATERIAL AND MATERIAL SAFETY DATA SHEET(S) FOR THE ALTERNATIVE MATERIAL

Material and material safety data sheets (MSDS) information sheets for the tarp are included in Attachment B.

All soils used as alternate daily cover material will meet the TCEQ soils policies applicable to the site at the time of application, or that have been specifically authorized for use as an alternative cover material by TCEQ. Due to the low concentrations of foreign constituents in contaminated soils that meet the TCEQ policies for use as alternate daily cover, the soils do not require a specific MSDS. As a precautionary measure, landfill operators should avoid soil contact with eyes and bare skin.

## OTHER PERTINENT CHARACTERISTICS, FEATURES, OR OTHER FACTORS RELATED TO THE USE OF THE ALTERNATIVE MATERIAL

Diversion berms and toe berms will be used where applicable to ensure stormwater is properly managed in areas having only daily cover.

There are no other pertinent characteristics, features, or other factors related to the use of these alternative materials.

## REPORTING

Reporting regarding the use of ADC will be submitted on a two-month basis to the TCEQ and will include information regarding the effectiveness of the alternative material, any problems that may have occurred, and corrective actions required as a result of such problems. The reports will be discontinued after four consecutive two-month periods of ADC use with no problems.

## LANDFILL CLOSURES GREATER THAN 24 HOURS

Alternate Daily Cover shall not be used when the landfill is closed for a period greater than 24 hours, unless the executive director approves an alternative length of time.

# ATTACHMENT A

## Requirements for Acceptance of Petroleum Contaminated Soils

## REQUIREMENTS FOR ACCEPTANCE OF PETROLEUM CONTAMINATED SOILS

The McCombs Landfill will accept petroleum contaminated soils without specific approval from TCEQ as follows:

- Automotive gasoline contaminated soils
  Soils which have a total petroleum hydrocarbon (TPH) concentration of less than 1,500 ppm; and a TCLP benzene concentration of less than 0.5 mg/l, and if leaded gasoline, a TCLP lead concentration of less than 1.5 mg/l.

- Diesel fuel contaminated soils
  Soils which have a TPH concentration of less than 1,500 ppm; and a TCLP benzene concentration of less than 0.5 mg/l.

- Used motor oil contaminated soils
  Soils which have a TCLP lead concentration of less than 1.5 mg/l; a TPH concentration of less than 1,500 ppm, total organic halogen (TOX) concentration of less than 50 ppm and a TCLP benzene concentration of less than 0.5 mg/l.

- Soil contaminated with hydrocarbon fuels (fuel oil, crude oil, etc.)
  Soils which have a TPH concentration of less than 1,500 ppm; a TCLP benzene concentration of less than 0.5 mg/l, and if applicable, a TCLP lead concentration of less than 1.5 mg/l.

- Soil contaminated with any other petroleum products
  Soils contaminated with any other petroleum based product other than hydrocarbon fuels or used motor oil must have written approval from TCEQ before acceptance at the McCombs Landfill.

- Petroleum contaminated soil to be used as Alternate Daily Cover
  Petroleum contaminated soil to be used as Alternative Daily Cover (ADC) must first meet the acceptance criteria specified here, and will then be evaluated for acceptability under this Plan.

NOTES:

1. If total lead concentration is less than or equal to 30 ppm, TCLP lead will not be required.
2. If total benzene concentration is less than or equal to 10 ppm, TCLP benzene will not be required.
3. Should the TCEQ revise acceptable concentration of contaminants, the revised limits will replace the above stated concentrations acceptable for disposal.

# ATTACHMENT B

## Material Information Sheets
## Woven Coated Polyethylene Tarps

Bodycote MATERIALS TESTING ORTECH LABORATORY

BODYCOTE ORTECH INC. • 2395 SPEAKMAN DRIVE MISSISSAUGA ONTARIO, CANADA L5K 1B3 • TEL (905) 822 4111 • FAX (905) 823-1446

# NFPA 701-1989 Large Scale Flame Resistance of Fabrene® L257 Coated Polyethylene Fabric

| | |
|---|---|
| A Report To: | Fabrene Inc.<br>P.O. Box 4040, 240 DuPont Road<br>North Bay, Ontario<br>P1B 9B4 |
| Attention: | Mr. Todd Travis |
| Submitted By: | Fire & Flammability. |
| Report No. | 99-J52-87-3-320(A)<br>1 page + 1 page appendix |
| Date. | June 23, 1999 |

Bodycote Ortech Inc.

NFPA 701-1989 Large Scale Flame Resistance of Fabrene® L257 Coated Polyethylene Fabric Page 1 of 1

For: Fabrene Inc. Report No. 99-J52-87-3-320(A)

ACCREDITATION Standards Council of Canada, Registration #1.

REGISTRATION ISO 9002-1994, registered by QMI, Registration #001109.

SPECIFICATIONS OF ORDER

Determine flame resistance in accordance with the NFPA 701-1989 Large Scale Test, as per our quotation approved June 1, 1999 and your P.O. #062364 dated June 4, 1999.

IDENTIFICATION (Bodycote ORTECH Inc. identification number 99-J52-S0320)

Coated woven polyethylene fabric identified as Fabrene® L257.

TEST RESULTS NFPA 701-1989 Large Scale Test

Tested as-received and in single sheet configuration

| | Char length (inches) | Afterflame Time (s) | Flaming Drips? | |
|---|---|---|---|---|
| Machine 1: | 2.8 | 0.0 | No | |
| 2: | 2.6 | 0.0 | No | |
| 3: | 3.0 | 0.0 | No | |
| 4: | 2.1 | 0.0 | No | |
| 5: | 2.5 | 0.0 | No | |
| Cross 6: | 2.0 | 0.0 | No | |
| 7: | 2.9 | 0.0 | No | |
| 8: | 3.1 | 0.0 | No | |
| 9: | 1.9 | 0.0 | No | |
| 10: | 2.0 | 0.0 | No | |
| Average: | 2.5 | | | |
| Maxima Specified by NFPA 701 Large Scale Test: | 10.0 (above tip of flame) | 2.0 | No | (individual) |

CONCLUSIONS

When tested in the as-received condition, the coated polyethylene fabric identified in this report meets the flammability requirements of the NFPA 701-1989 Large Scale Test.

R.A. Carleton,
Fire & Flammability.

E.W. Simmons,
Fire & Flammability

Bodycote Ortech Inc.

NFPA 701-1989 Large Scale Flame Resistance of Fabrene® L257 Coated Polyethylene Fabric

For Fabrene Inc Report No. 99-J52-87-3-320(A)

APPENDIX
(1 Page)

Summary of Test Procedure

Bodycote Ortech Inc.

## NFPA 701 - 1989

Standard Methods of Tests for
Flame-Resistant Textiles and Films

Large Scale Test

For conducting flame tests of fabrics in single sheets, the NFPA 701 Large Scale Test specifies at least ten specimens, 5 inches by 7 feet. The specimens are conditioned at 140 - 145°F for 1 to 1½ hours or, if distortion or melting occurs at these temperatures, 60 - 80°F at 25 - 50% relative humidity for 24 hours.

Each specimen is removed from the conditioning chamber individually, and immediately suspended in a steel stack 12 inches square and 7 feet high, the said stack being open both top and bottom and supported 1 foot above the floor. The lower edge of the specimen is positioned 4 inches above the tip of a gas burner which is inclined at 25° to the vertical. The burner, which has been adjusted to yield a flame 11 inches in height is ignited and inserted directly beneath the specimen for 2 minutes. Char length is measured from the tip of the flame, upwards.

For conducting flame tests of fabrics hung in folds, at least four specimens 25 inches by 7 feet are required. Each specimen is folded longitudinally to form four folds.

Flame Resistance Requirements:

| Specimen Configuration | Maximum Char Length or Destroyed Material Length (inches) | Maximum Afterflame Time (s) | Flaming Drips on Floor of Tester? |
|---|---|---|---|
| Single sheets | 10 | 2 | No |
| Folded | 35 | 2 | No |

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# FABRENE®

## INDUSTRIAL SYNTHETIC FABRICS

### TYPE L257

Made from high density polyethylene tapes, coated on both sides with low density polyethylene. Contains a flame retardant additive

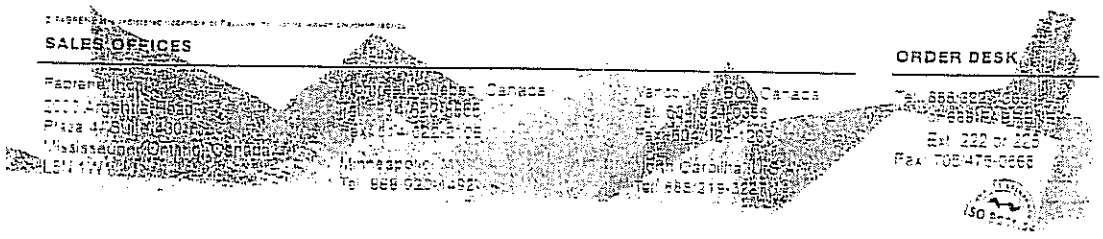
| PROPERTY | UNIT | | VALUES | TEST METHOD |
|---|---|---|---|---|
| Construction | Tapes/in | Warp | 23.9 | ASTM D3775 |
| | | Weft | 16 | |
| Unit Weight | oz/yd2 | | 9.4 | ASTM D3775 |
| Tensile Grab Strength | lbf | Warp | 495 | ASTM D1682-64 |
| | | Weft | 342 | |
| Tear Strength * (tongue) | lbf | Warp | 137 | ASTM D2261-71 |
| Tear Strength * (tongue) | lbf | Weft | 124 | ASTM D2261-71 |
| Coating Thickness | mil | Light Yellow2 | | ASTM D1777 MOD |
| | mil | Light Yellow2 | | |
| Mullen Burst Strength | psi | | 660 | ASTM D751-73 |
| Widths | in | up to | 144 | |

* Includes force to shift tapes - Tear may be crosswise to direction of force.

Fabrene® L257 contains some ultraviolet inhibitors
For further information, contact your FABRENE Inc. representative.

Suggested Applications: General purpose tarps. Daily Landfill Covers.

NOTE: These values are typical data and are not intended as limiting specifications. Date 99/09/07



Bodycote MATERIALS TESTING ORTECH LABORATORY

BODYCOTE ORTECH INC • 2395 SPEAKMAN DRIVE, MISSISSAUGA ONTARIO CANADA L5K 1B3 • TEL (905) 822-4111 • FAX (905) 823-1446

# Surface Burning Characteristics of Fabrene® L257 Fabric

| | |
|---|---|
| A Report To: | Fabrene Inc.<br>P O Box 4040<br>240 DuPont Road<br>North Bay, Ontario<br>P1B 9B4 |
| Attention: | Todd Travis |
| Submitted by: | Fire & Flammability |
| Report No | 99-J52-87-3-320(C)<br>3 Pages |
| Date | June 22, 1999 |

Bodycote Ortech Inc.

Surface Burning Characteristics of Fabrene® L257 Fabric — Page 1 of 3

For Fabrene Inc — Report No. 99-J52-87-3-320(C)

ACCREDITATION Standards Council of Canada, Registration #1

REGISTRATION ISO 9002-1994, registered by QMI, Registration #001109

## SPECIFICATIONS OF ORDER

Determine the Flame Spread and Smoke Developed Indices based upon a single test conducted in conformance with ASTM E 84, as per our quotation accepted June 1, 1999 and your P O. # 062364

## SAMPLE IDENTIFICATION

Coated split-tape polyethylene fabric identified as Fabrene® L257

(Bodycote Ortech Inc. sample identification number 99-J52-S0320)

## TEST PROCEDURE

The method, designated as ASTM E 84-97a, "Standard Method of Test for Surface Burning Characteristics of Building Materials", is designed to determine the relative surface burning characteristics of materials under specific test conditions. Results are expressed in terms of flame spread index (FSI) and smoke developed (SD).

Although the procedure is applicable to materials, products and assemblies used in building construction for development of comparative surface spread of flame data, the test results may not reflect the relative surface burning characteristics of tested materials under all building fire conditions.

## SAMPLE PREPARATION

The sample was conditioned to constant mass at a temperature of 73°F and a relative humidity of 50% prior to testing. During testing, the sample was supported with 2 inch hexagonal wire mesh and ¼ inch diameter steel rods spaced at 2 foot intervals.

## SUMMARY OF TEST PROCEDURE

The tunnel is preheated to 150°F, as measured by the floor-embedded thermocouple located 23 25 ft downstream of the burner ports, and allowed to cool to 105°F, as measured by the floor-embedded thermocouple located 13 ft. from the burners. At this time the tunnel lid is raised and the test sample is placed along the ledges of the tunnel so as to form a continuous ceiling 24 ft. long, 12 inches above the floor. The lid is then lowered into place.

Boaycote Ortech Inc.

Surface Burning Characteristics of Fabrene® L257 Fabric — Page 2 of 3

For Fabrene Inc — Report No 99-J52-87-3-320(C)

## SUMMARY OF TEST PROCEDURE (continued)

Upon ignition of the gas burners, the flame spread distance is observed and recorded every 15 seconds Flame spread distance versus time is plotted ignoring any flame front recessions. If the area under the curve (A) is less than or equal to 97.5 min·ft, FSI = 0 515·A; if greater, FSI = 4900/(195-A). Smoke developed is determined by comparing the area under the obscuration curve for the test sample to that of inorganic reinforced cement board and red oak, arbitrarily established as 0 and 100, respectively.

## TEST RESULTS

| SAMPLE | FSI | SD |
|---|---|---|
| Fabrene® L257 split-tape polyethylene fabric (supported on wire mesh) | 5 | 20 |

### Observations of Burning Characteristics

- Melting and dripping of the fabric was observed immediately upon exposure to the test flame. The sample began to ignite and propagate flame after approximately 15 seconds.
- The flame front propagated to a maximum distance of 1.0 foot during the first 60 seconds of the test and then receded to the baseline for the remainder of the 10 minute test period.
- During the flame propagation, flaming pieces of molten material were observed hanging from the supporting mesh and dripping to the floor of the test chamber The molten material continued to burn on the floor for a brief period.
- A slight increase in smoke developed was recorded during the initial minutes of the test Smoke production appeared to emanate from the smouldering molten material hanging on the support mesh and on the floor of the chamber (see accompanying charts).

### Authorities having jurisdiction usually refer to these categories:

| | Flame-Spread Index | Smoke Development |
|---|---|---|
| Class 1 or A | 0 - 25 | 450 Maximum |
| Class 2 or B | 25 - 75 | 450 Maximum |
| Class 3 or C | 75 - 200 | 450 Maximum |

Richard J Lederle
Fire & Flammability

E W Simmons
Fire & Flammability

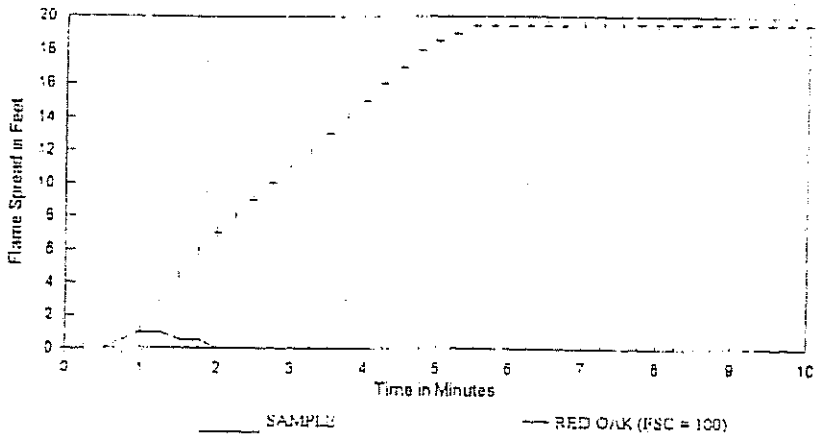
Bodycote Ortech Inc.

Surface Burning Characteristics of Fabrene® L257 Fabric — Page 3 of 3

For Fabrene Inc — Report No 99-J52-87-3-320(C)

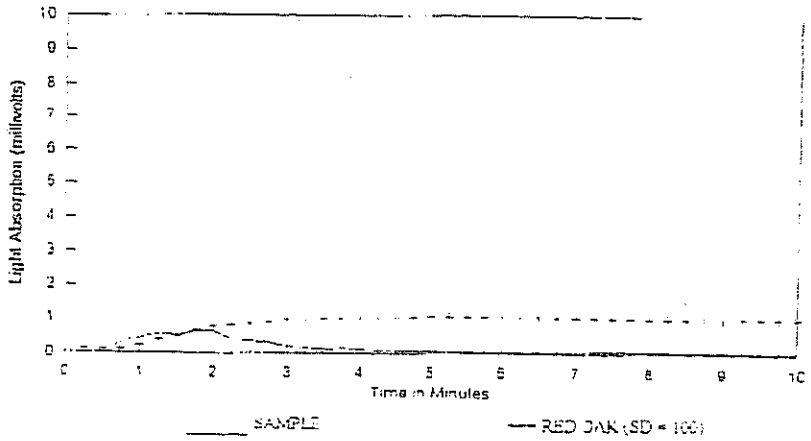
FLAME SPREAD INDEX

Fabrene® L257 split-tape polyethylene fabric




SMOKE DEVELOPED

Fabrene® L257 split-tape polyethylene fabric




| FSI | SD |
|---|---|
| 5 | 20 |

# Appendix 4D
# Special Waste Acceptance Plan

SAIC®

# SPECIAL WASTE ACCEPTANCE PLAN

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# SPECIAL WASTE ACCEPTANCE PLAN

## A. INTRODUCTION

The Texas Commission on Environmental Quality (TCEQ) solid waste regulations define a special waste as "solid waste or combination of solid wastes that because of its quantity, concentration, physical or chemical characteristics, or biological properties requires special handling and disposal to protect the human health or the environment". (30 TAC § 330.3)

### A.1 Purpose and Objectives

The purpose of this plan is to set forth specific operational and technical procedures to be utilized at the McCombs Landfill for the acceptance and management of special wastes. These procedures will be adhered to during the handling, treatment, and/or disposal of special wastes.

### A.2 Definition

For the purposes of this plan, special wastes shall be defined as any waste specifically defined in the (TCEQ) regulations as a "special waste" under 30 TAC § 330.3; and any waste that if improperly handled, transported, stored, processed, or disposed of or otherwise managed, may pose a present or potential danger to the human health or the environment.

Wastes containing free liquids (as determined using the EPA Method 9095 Paint Filter Liquids Test) will be required to be stabilized to pass the paint filter test prior to acceptance and disposal in the landfill. The chemical description of the wastes to be accepted under this plan is that the waste is not a "regulated hazardous waste" as defined in 30 TAC § 330.3, (i.e., hazardous as defined in 40 CFR 261.3, and that is not excluded from regulation as a hazardous waste under 40 CFR 261.4(b) and not generated by a Conditional Exempt Small Quantity Generator (CESQG)). If the waste is from an industrial source, it will not exhibit a concentration of any constituent greater than the concentration allowed for a waste to be classified as a Class 2 waste under the TCEQ rules, excluding asbestos.

### A.3 Special Wastes Covered by This Plan

1. Industrial Waste – Industrial Class 2 wastes (includes processed grease/grit trap wastes).
2. Municipal Commercial Waste – Treated medical waste, processed grease/grit trap waste, dead animals, slaughterhouse wastes and (petroleum-product and crude oil contaminated soil (Outlined in Appendix C of the Site Operating Plan (SOP), Attachment A, Requirements for Acceptance of Contaminated Soils)).

Wastes specifically prohibited from landfill disposal under Federal, State and local rules and regulations will not be disposed of at this facility. All liquids must be stabilized and pass the EPA Paint Filter Liquids Test (EPA Method 9095) prior to acceptance and disposal in the landfill.

## B. AUTHORIZATION OF SPECIAL WASTE MANAGEMENT

### B.1 Management Procedures identified by Regulation (30 TAC § 330.171(c))

The receipt of the following wastes does not specifically require written authorization for their acceptance provided the wastes are handled in accordance with the noted provisions for each waste identified in 30 TAC § 330.171(c). These wastes include treated medical waste, dead animals, processed grease/grit trap waste.

Haulers of non-hazardous industrial processed grease/grit trap waste that is considered a Class 2 industrial waste are not required to be registered. However, haulers of Class 1 non-hazardous processed grease/grit trap waste or any other Class 1 non-hazardous liquid waste from industrial sources must be registered in accordance with Subchapter A of 30 TAC Chapter 335 (Section 335.11). Responsibilities of the hauler of Class 1 non-hazardous industrial waste transporter include, but are not limited to, the following:

- Have a current registration for the company's operation.
- Obtain a manifest (trip ticket) completed and signed by the generator of the waste in accordance with 335.10.
- Sign and date the manifest (trip ticket) upon receipt and before shipment, acknowledging the acceptance of the waste from the generator.
- Return a signed copy of the manifest (trip ticket) to the generator before leaving the generator's property.
- Upon delivery of the waste to the storage, processing, or disposal facility designated on the manifest (trip ticket), complete the date of delivery and obtain the signature of the owner or operator.
- Retain a copy of the completed manifest (trip ticket), give one copy to the owner or operator or the receiving facility, and return one copy to the generator.

Grease/grit trap waste will be accepted for disposal only if the material has been, or is to be, treated or processed and the treated/processed material has been tested, in accordance with the Method 9095 (Paint Filter Liquids Test), as described in "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods" (EPA Publication Number SW-846), as amended, and is certified to contain no free liquids. Prior to treatment or process of this waste at the landfill, the owner or operator shall submit written notification to the Executive Director of the liquids processing activity as required in § 330.11 of this title (relating to Notification Requirements).

### B.2 Management Requiring Executive Director Approval (30 TAC § 330.171 (b) (1))

This plan has been developed in order to receive "site specific" written authorization to accept special wastes including Class 2 industrial wastes for landfill disposal as per 30 TAC § 330.171 (b). According to 30 TAC § 330.171 (b)(1), approvals will be waste specific and/or site specific. Conformance with this plan will constitute the prior written approval from the Executive

Director for each waste stream. Since this facility is a Subtitle D facility, the approval is "site specific" rather than "waste specific."

### B.3 Waste Acceptance Criteria

If the waste is industrial Class 2 waste by the TCEQ waste classification criteria (30 TAC Chapter 335, Subchapter R) then it will be managed under this acceptance plan.

## C. EVALUATION OF WASTE CHARACTERISTICS (30 TAC § 330.171 (b)(2)(A))

The primary evaluation criteria for special waste intended for landfill management is to screen out regulated hazardous waste as defined by 30 TAC § 330.3 and 40 CFR 261. Secondary evaluation criteria are: proper waste classification of industrial wastes (refer to classification as per 30 TAC 335, Subchapter R), compliance with state waste disposal policy letters (soil, etc.), and internal waste acceptance guidelines.

### C.1 Waste Stream Approval Procedures

All waste subject to this plan will be evaluated by means of analytical tests and/or process knowledge and approved for disposal utilizing the following evaluation guidelines:

- The potential generator will complete and sign a Waste Characterization Data (WCD) sheet, which identifies the characteristics, origin and estimated quantity of the waste stream.

- The WCD and supporting documentation will be forwarded to the special waste approval staff assigned by the owner/operator for the subject facility. The approval staff will have been given approval by the owner/operator to implement the procedures identified within this Special Waste Acceptance Plan, including the review and approval of special wastes based upon his/her/their training and qualifications.

- Analytical data, or process knowledge certification, confirming conformance with this Plan, shall be required. Any analytical data submitted for use in the waste evaluation process shall meet the following criteria.

  - Analytical data must be less than eighteen (18) months old;
  - The analytical report must be a final copy, legible, complete and signed,
  - The analytical data must "tie" with information of the WCD sheet.
  - The number of samples tested, and the number of parameters analyzed must fully characterize the waste and be an accurate representation of the waste stream;
  - The results must have the unit of measure identified.
  - The detection levels must be included for results that are "non-detected".
  - The reference of methods employed must accompany the analytical data.

- Any laboratory QA/QC information must accompany the data submitted and may include; chain of custody records, data on standards, duplicate analyses, spikes, and blanks, and other pertinent statistical information.

- The approval staff will review the WCD and supporting documentation and will issue an approval or denial based upon the waste streams conformance to Federal, State and Permit-specific conditions and this Plan.

  Each WCD approval will be given an expiration date depending on the specific longevity of the generating process but shall not be more than three (3) years. Upon expiration, or earlier if the generating process changes materially affecting the characteristics of the waste, the WCD may be re-certified by the generator and re-evaluated by the approval staff upon the submission of current additional information.

- The approval or denial of the WCD will be communicated both verbally and in writing to the disposal facility and to the waste stream generator. A copy of the decision, WCD and supporting information will be maintained within the facility's Operating Record for at least three years. If approved, any special handling procedures, personal protective equipment requirements or on-site emergency equipment requirements applicable to handling the waste stream will be documented on the WCD and communicated to the appropriate landfill personnel.

## C.2 Documentation

The following forms and/or documentation will be required under this acceptance plan.

- **TCEQ Notification / Registration / Waste Classification**

  Industrial waste generators will be required to document on the WCD that their facility has registered with TCEQ and that their waste is Class 2 waste. Confirmation of the waste classification is to include analytical reports and/or process knowledge.

- **Waste Characterization Data (WCD) Sheet**

  All generators of industrial waste and generators of special wastes are required to complete and sign a WCD sheet. This WCD sheet requires specific information regarding the waste. The generator is required to certify by signature that all information is true and correct. A WCD is not required for dead animals and food service grease trap wastes. An example of a WCD is included in the SOP, Appendix A, Forms. Modifications may be made to this WCD without specific TCEQ authorization, provided the new WCD provides the information necessary to fully document the characteristics of the waste streams.

- **Additional Information**

This includes any information that may assist in evaluating a special waste for management. Such information may include analytical data. Material Safety Data Sheets (MSDS), additional waste composition data, pertinent letters or memos, or any other applicable information.

## D WASTE ACCEPTANCE OPERATIONAL PROCEDURES (30 TAC § 330.171 (b)(2)(C))

The Procedures outlined below must be followed in order to accept special waste for disposal.

### D.1. Quality Assurance/Quality Control

Each load of special waste delivered to the landfill for disposal will receive a visual QA/QC inspection to verify contents and characteristics of the waste. In addition to visual QA/QC inspections, additional QA/QC testing, such as pH, ignitability, and reactivity with water, may be performed on representative samples of the waste. QA/QC results will be recorded and maintained at the landfill office.

### D.2 Waste Handling & Precautions

Wastes containing free liquids (as determined using the EPA Method 9095 Paint Filter Liquids Test) will be required to be stabilized to pass the pain filter test prior to acceptance and disposal in the landfill.

Wastes with strong odors, which may include dead animals and slaughterhouse wastes, shall be placed in a select area at the working face and covered with at least three feet of other solid waste or two feet of soil immediately upon receipt.

### D.3 Unauthorized & Rejected Waste Procedures

A discrepancy report will be placed in the site operating record when one or more of the following occurs:

- An industrial or special waste arrives without a required waste manifest.
- An industrial or special waste arrives and the waste material does not match the description on the waste manifest.
- An industrial or special waste arrives and the waste differs from the approved waste based upon QA/QC review or other monitoring.
- The volume of the waste is not consistent with the manifest for the load.

The cashier, landfill manager and waste generator shall work together to try and resolve waste discrepancies. All discrepancies must be resolved before the waste may be accepted for disposal.

In the event that a special waste load at the landfill gate is detained for possible rejection, it will be detained at the landfill entrance. If the discrepancies cannot be resolved with the generator,

the load will be rejected. The generator is then fully responsible for the load and its management.

In the event that a special waste load is found to be unauthorized upon its unloading, the waste will be segregated and/or isolated. The generator will be contacted to remove the unauthorized waste and any other material contaminated by the unloading of the waste. If the rejected load could jeopardize the protection of human health or the environment, immediate containment and isolation of the waste will be conducted. The generator will be notified and the TCEQ Regional Office will be informed. Both the generator and the TCEQ will be involved in preparing the removal and remedial action plan.

### D.4 Employee Training

Landfill personnel will be trained in special waste handling procedures as outlined in this Plan. Training will also include such elements as the proper use and storage of personal protective equipment and on-site emergency equipment. All landfill personnel will be trained on, and be familiar with the site's emergency preparedness and spill contingency procedures described below. Copies of personnel training records will be maintained at the site.

## E. EMERGENCY & SPILL CONTINGENCY SUMMARY (30 TAC § 330.171 (b)(2)(D))

The following summary is presented for actions to be taken with respect to the possible special waste spills and/or emergency situations:

In the event that a special waste load is spilled in an area that is not the approved disposal area, the waste will be segregated and/or isolated. If the waste is approved for disposal, on-site equipment will be utilized to reload the spilled waste and any ground surface contaminated by the waste, and transported to the approved disposal area. If the waste is found to be an unauthorized waste for disposal, the generator will be contacted to remove the unauthorized waste and any other contamination caused by its spilling. If the spilled waste could jeopardize the protection of human health or the environment, immediate containment and isolation of the waste will be conducted. The generator will be notified, a record will be made in the SOP and the TCEQ Regional Office will be informed. Both the generator and the TCEQ will be involved in preparing the removal and remedial action plan.

## F. EXECUTIVE DIRECTOR APPROVALS NOT BINDING (30 TAC § 330.171 (b)(5))

The Executive Director may authorize the receipt of special waste with a written concurrence from the owner/operator: however, the owner/operator is not required to accept the waste. The owner/operator further reserves the right to refuse acceptance of any waste load, either special waste or other waste, at its sole discretion.

## G. EXECUTIVE DIRECTOR MAY REVOKE AUTHORIZATION (30 TAC § 330.171 (b)(6))

It is understood that the executive director may revoke an authorization to accept special waste if the owner/operator does not maintain compliance with 30 TAC § 330 or conditions imposed in the authorization to accept special waste.

## H. RECORD KEEPING AND REPORTING

Any and all documents, manifests, shipping documents, trip tickets, etc. involving special waste shall be maintained in the Site Operating Record.

Additionally, required reports will be submitted to the TCEQ.

# Appendix 4E
# Checklist for Asbestos Handling

SAIC®

# Municipal Solid Waste Landfill (MSWLF) and Transfer Stations
# Air General Operating Permit (GOP) No. 517
# Checklist for Asbestos Handling

EPN(s): NA  Unit Name(s): Phase I and Phase II of Existing Lined Landfill

RN No.: RN10021599  Site Name: McCombs Municipal Landfill  Date Completed: 8-19-11

This checklist will ONLY apply to your MSWLF site if asbestos (in any form or state) is handled or stored at your site. Only parts of this checklist will apply to your MSWLF. Asbestos requirements at a MSWLF can be found in 40 Code of Federal Regulations 61, Subpart M-National Emission Standards for Asbestos.

This checklist replaces the need for a submittal of any Unit Attribute (UA) forms. This checklist is based on the official version of the new GOP 517 dated April 7, 2006, effective November 1, 2006. The statements or questions in the second column correspond to rules listed in the last column "Citations" and the "GOP Index" Number listed in the first column.

| GOP Index | Applicable Requirements | Response | Citations |
|---|---|---|---|
| Question 1 | Is the MSWLF using the daily cover requirements of 40 CFR § 61.154 (c) (1or 2)<br>If **YES** go to question number 2 below.<br>If **NO** comply with GOP Index 517-19-002. | ☒ YES ☐ NO | Section 4.9.22 |
| Question 2 | Is the MSWLF complying with the requirements of 30 TAC Chapter 330, subchapter D (§330.171) for asbestos?<br>IF **YES** comply with GOP Index 517-19-001.<br>If **NO** comply with GOP Index 517-19-002. | ☒ YES ☐ NO | |
| 517-19-001 | At the end of each operating day, or, if asbestos-containing material has been deposited within previous 24-hour period, is any asbestos-containing material at this MSWLF covered by <u>at least</u> 6 inches of compacted, non-asbestos-containing material? | ☒ YES ☐ NO | § 61.154 |
| | Is there a natural barrier which adequately deters access to this MSWLF by the general public? *(<u>Note</u>: Not required if, at the end of each operating day, or at least once every 24-hour period while the site is in continuous operation, the asbestos-containing waste material that has been deposited at the site during the operating day or previous 24-hour period is covered with at least 6 inches of compacted non-asbestos-containing material.)* | ☐ YES ☒ NO | |
| | Is there a <u>fence</u> around this MSWLF with prominent, easily read warning signs, at all entrances and at intervals not greater than 330 feet? *(<u>Note</u>: Not required if, at the end of each operating day, or at least once every 24-hour period while the site is in continuous operation, the asbestos-containing waste material that has been deposited at the site during the operating day or previous 24-hour period is covered with at least 6 inches of compacted non-asbestos-containing material.)* | ☐ YES ☒ NO | |

# Municipal Solid Waste Landfill (MSWLF) and Transfer Stations
# Air General Operating Permit (GOP) No. 517
# Checklist for Asbestos Handling

| GOP Index | Applicable Requirements | Response | Citations |
|---|---|---|---|
| | The facility identified is subject to, and it is complying with, Recordkeeping and Reporting requirements listed under "Citations" | ☒ YES ☐ NO | § 61.153 |
| | Is the MSWLF complying with the requirements of Questions 1 and 2, above?<br><br>*If the answer is NO, then the facility is required to select one of the periodic monitoring requirements listed under "Citations"* | ☒ YES ☐ NO | Periodic Monitoring – pick which one of the following options used:<br>PMG-LF-P-001<br>PMG-LF-P-004 |
| | The facility identified is subject to, and it is complying with, Recordkeeping and Reporting requirements listed under "Citations" | ☒ YES ☐ NO | § 61.153 |
| **Discrepancies: Discovery and Resolution** | | | |
| 517-19-002 | Upon discovering a discrepancy between the quantity of waste designated on the waste shipment records and the quantity your MSWLF actually receives, will you attempt to reconcile the discrepancy with the waste generator? | ☒ YES ☐ NO | § 61.154 |
| **GOP Index** | **Applicable Requirements** | **Response** | **Citations** |
| 517-19-002 | If the discrepancy is not resolved within 15 days after receiving the waste, will you immediately report, in writing, to the local, State, or EPA Regional Office with jurisdiction over both, the waste generator (identified in the waste shipment record), and, if different, the disposal site? | ☒ YES ☐ NO | § 61.154 |
| 517-19-002 | The discrepancy report will include (a) a description of the discrepancy, (b) the attempts to reconcile it, and (c) a copy of the waste shipment record. | ☒ YES ☐ NO | § 61.154 |
| 517-19-002 | The facility identified is subject to, and it is complying with, Recordkeeping and Reporting requirements listed under "Citations." | ☐ YES ☒ NO | Periodic Monitoring - any one of the following options may be used:<br>PMG-LF-P-001<br>PMG-LF-P-004 |