November 2, 2012

Chandra S. Yadav
Project Manager
Texas Commission on Environmental Quality, MC 124
P.O. Box 13087
Austin, TX 78711-3087

Subject: **Response to Second Technical Notice of Deficiency (NOD)**
McCombs Municipal Landfill – El Paso County
Municipal Solid Waste (MSW) Permit No. 729B

Dear Mr. Yadav:

On behalf of the City of El Paso, SAIC Energy, Environment & Infrastructure, LLC (SAIC) is providing the information requested by the Texas Commission on Environmental Quality (TCEQ) second technical notice of deficiency (NOD) letter dated September 7, 2012. A time extension request was granted by the TCEQ for an additional 30 days to the original due date for submittal by November 6, 2012. The TCEQ comment is provided in *italic print* followed immediately by the response. Revised sections and appendices are included as an attachment to this letter and are identified as to the appropriate replacement location in the existing application. It should be noted that the attachment is ordered as to the location of replacement in the existing application, not based on the order of comments.

Furthermore, it should be noted that this major permit amendment also increases the permitted/facility area from 327.292 acres to 346.74 acres within Section 6, Block 80, Township 1, Texas and Pacific Railway Survey to include the site entrance facilities within the permitted/facility boundary. An updated metes and bounds is provided in Appendix 1C.

1. *The submittal includes the terms "existing and proposed" throughout the application, including on Drawing P0-2.0 (Abbreviations and Legend). The use of such terms will be confusing after an approval of the amendment application. Please ensure to revise such terms so that there will not be any confusion after approval.*

   The permit amendment has been updated throughout to remove the use of the word "proposed". The use of the word "existing" is still used in the document to describe existing conditions at the time of amendment preparation. All pages are dated to provide a time stamp on the "existing" terminology.

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2. *Drawing P0-2.0 (Abbreviations and Legend) does not provide a legend for the facility boundary. Also, it indicates a common legend for "buffer zone/waste limit." Please be informed that a buffer zone shall be free of municipal solid waste processing and disposal activities within and adjacent to the facility boundary on property owned or controlled by the owner or operator in accordance with Title 30 Texas Administrative Code (30 TAC) Section §330.3(19). Please provide cross sections to identify the buffer zone along the facility boundary for the locations proposed for the vertical expansion, and also provide appropriate legend to indicate the buffer zone, the facility boundary and the limit of waste.*

   The facility boundary has been updated to be synonymous with the property boundary. The existing waste limit permitted previously complies with the 50-foot buffer limit established under the previous rules. Any vertical expansion beyond the original permitted heights complies with the 125-foot buffer zone. Areas outside of the 125-foot buffer zone may contain waste (i.e., between the original permitted 50-foot buffer and the 125-foot buffer); however, no waste will exist between the 50-foot buffer zone and the property boundary. The cross-sections provided as Drawings P3-19 through P3-24 have been updated to portray the buffer zones. Drawing P0-2 has been updated to reflect these changes.

3. *Some of the attachments and appendices do not include cover page and table of contents (e.g., Appendices 3B, 3I and 3J). Please ensure to provide cover pages and table of contents, and also ensure to provide a page number for each page.*

   The cover page and table of contents for the appendices is inclusive of the associated attachments within those appendices. The table of contents has been updated to include further description on the attachments.

4. *The drawings are referenced in the text with their original Drawing Number (e.g., Drawing Number P2-7 on Page 2.3-2). But, the revised submittal includes a different number for the drawings (e.g., Drawing Number P2-7.1). Please revise the submittal to correct such discrepancies.*

   All drawings have been updated to remove the revision number from the drawing number (i.e., Drawing P2-7.1 has been updated to now read Drawing P2-7). Revisions to the drawings are indicated in the drawing title block. It should be noted that the revision to the drawing number was not highlighted as a change on the redline version of the drawings (and therefore, if that was the only change to the drawing, a redline version was not provided for review and only the final version was provided).

5. *Some of the labels on the drawings are not legible (e.g., Drawing Number P2-8.1). Please ensure to provide appropriate labels, and legend information on the drawings.*

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Drawing Number P2-8 has been updated to remove illegible background information and a legend has been provided for clarity.

6. *The revised submittal does not include an original certification statement per 30 TAC §305.44. Please ensure to provide certification statement (Page 10 of the Part I form).*

   An updated Part I form has been provided with this response to comments.

Part I

7. *The page for metes and bounds descriptions for the proposed easement area of 19.442 acres in Appendix 1C indicates a note on the left top corner as "McCombs Landfill+PSB Leased Area." Also, Drawing P0-2.0 indicates a legend for "PSB Lease Area." Please revise to delete "leased area" since the City owns the property.*

   An updated Metes and Bounds survey has been provided within Appendix 1C. It should be noted that the facility boundary has been revised to coincide with the property boundary (as indicated on Drawing P0-2 and associated drawings).

8. *Please ensure that the easement area is included within the property boundary, and ensure to revise the related drawings, including Drawing Number P2-8.1 as appropriate.*

   The drawings have been updated to either remove or enhance items screened within the background of the drawings. The cross-sections provided as Drawings P3-19 through P3-24 have been updated to portray the 50-foot and 125-foot buffer zones (easement areas) as described in the response to Comment #2.

Part II

9. *The site facility layout (Drawing Number P2-8.1) indicates a label as "New Site Entrance Facilities" within the proposed easement area of 19.442 acres. Please clarify if "New Site Entrance Facilities" includes a gate-house. Please note that a gate-house may not be allowed outside the facility/permit boundary. Please also ensure to identify the components of "New Site Entrance Facilities," and revise the site facility layout as appropriate.*

   The facility/permit boundary for the site has been updated to 347 acres as portrayed on Drawing Number P2-8. The new site entrance facility is shown in more detail on Drawing P3-17 (as indicated). The scale house indicated on the drawings is synonymous with a gate-house.

10. *The supplementary technical report indicates that the facility plans to accept Class 3 inert wastes on top of the existing unlined landfill. In accordance with 30 TAC §330.61(b)(1), the owner or operator shall identify the sources, characteristics and chemical composition of wastes proposed to be received for storage, processing, or disposal. Please revise Section 2.2 (Waste Acceptance Plan) to include the sources, characteristics and chemical composition of wastes.*

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Section 2.2 has been updated to include the sources, characteristics, and chemical composition of the wastes intended to be accepted at the McCombs Landfill. It should be noted that the Landfill intends to dispose of inert construction and demolition debris (Class 3 like); not actual Class 3 waste.

11. *Please clarify if the property boundary and the facility boundary are indicated synonymously on the drawings, including on Drawing P3-4. Please revise the drawings to make sure that the property boundary and the facility boundary are clearly defined. Please also update Drawing Number P0-2.0 (Abbreviations and Legend) as appropriate.*

    The facility boundary has been updated to coincide with the property boundary (347 acres) as indicated on the revised drawings.

12. *Please clarify if the facility will have a perimeter road, as the interior facility roadways for most of the units/cells are proposed to connect the perimeter of the landfill site. Also, the drawings (Drawing Numbers P2-11.1 through P2-18.1) do not show the continuity of roadways between the entrance gate and the interior facility roadways to access fill areas of the landfill units/cells. Please revise the drawings to provide the information as required by 30 TAC §330.61(d)(2).*

    Drawings P2-11 through P2-18 have been updated to better show the perimeter roads for the facility. The perimeter roads connect in with the proposed interior facility roadways as shown. In addition a legend has been added to the drawings to better indicate the existing roadways.

13. *Please identify the existing earthen berms as stated in Section 2.3.2 along the western and northern boundaries of the landfill, and provide a cross sectional details of the berms.*

    The existing earthen berms locations described in Section 2.3.2 are indicated on Drawings P3-19 and P3-22 within Appendix 3F.

Part III

14. *Please include the information that was provided as the response to Comment #15 of the first NOD in Part III of the application, and elaborate the narrative to comply with the rule requirements of 30 TAC Chapter 330, Subchapter M: Location Restrictions, as applicable to the facility.*

    The information provided as Comment #15 of the first technical NOD is included in Appendix 3K, Attachment 4. The memo within Appendix 3K, Attachment 4 has been expanded to include the referenced information.

15. *The revised application contains references to the existing permit (MSW Permit No. 729A) on cover pages, in headers and footers of pages, and in narratives of Appendix 3B, Appendix 3I and Appendix 3J. Please note, if this permit amendment application is approved, it will replace*

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document of Permit No. 729A. Please ensure to provide the proposed permit application number (MSW Permit No. 729B) on cover pages, in headers and footers of pages, and in narratives as appropriate.

Reference to MSW Permit No. 729A has been removed and replaced with MSW Permit No. 729B as applicable. Documents provided for reference only have been provided with a memo to explain the contents.

16. *Drawing C13 of the existing permit (MSW Permit No. 729A), prepared by Moreno Cardenas Inc. has been included in Appendix 3E of the submittal. Please update the drawing with the proposed permit application number (MSW Permit No. 729B).*

    Reference to MSW Permit No. 729A has been removed and replaced with MSW Permit No. 729B on Drawing C13.

17. *It is stated in the revised Section 3.3.1.3 that a stormwater basin will be developed as fill progresses and interim phases are built. Please identify location and a cross sectional details for the proposed basin, and discuss about the fate of the basin as fill progresses.*

    As described in Section 3.3.1.3, the mined pit area will act as a natural low-lying retention 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 drainage is away from the developed Sector, preventing run-on. The natural low-lying retention basins are not designed basins.

18. *Section 3.3.1.3 indicates that the site drainage collection, conveyance, and detention structures are designed to operate during all phases of landfill operation. Please identify the structures to be constructed for necessary drainage collection, conveyance, and detention structures during interim phases of landfill operation.*

    Calculations for soil loss and non-erodible velocities for the interim phases have been provided in Appendix 3B, Attachments 5 and 7, respectively. Interim structures include delineation (run-on, runoff) berms as identified on Drawing P3-29, Detail 4.

19. *The erosion and sedimentation control plan by Parkhill, Smith & Cooper, Inc. (revision 2 dated July 2009) included in Appendix 3B, Attachment 6 has been referenced in the application, including in Section 3B.4. Please ensure to update the cover page information, headers and footers, and the table of contents to show the proposed permit amendment application number (MSW Permit No. 729B).*

    Reference to MSW Permit No. 729A has been removed and replaced with MSW Permit No. 729B.

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20. *Please revise the drainage area identification (DA-1 through DA-8) provided in Attachment 1 of Appendix 3B to make it consistent with Drawing Numbers P3-4.1 and P3-6.1 which appears to be indicated on the drawings as EX-1 through EX-3 for existing conditions, and DEV-1 through DEV-8 for developed conditions.*

    The calculations provided in Attachment 1 of Appendix 3B have been updated to include the correct reference for the drainage areas. It should also be noted that the existing conditions drainage areas (EX-1, etc.) have been updated to include the 19.4 acre entrance facilities area. The new areas for the existing conditions are provided on Drawing P4-4. The developed conditions (DEV-1, etc.) are indicated on P3-6.

21. *Please provide a figure to explain the soil loss calculations with a reference to the types of cover and the length of slopes for the interim and final conditions for each drainage areas at the referenced landfill. Please ensure that the top surfaces and external embankment slopes of municipal solid waste landfill units must be designed to minimize erosion and soil loss through the use of appropriate side slopes, vegetation, and other structural and nonstructural controls during all phases of landfill operation in accordance with 30 TAC §330.305(d)(2).*

    Figure 1 and Figure 2 have been provided in Appendix 3B, Attachment 5 to portray the final and interim slope lengths utilized in the soil loss calculations and to calculate the non-erodible velocities.

22. *It is stated in Section 3.2.3 that "stormwater runoff from the waste mass will be collected in v-ditches around the perimeter of the landfill, and they are designed to convey the 25-year storm event for each drainage basin and will direct the stormwater runoff into existing stormwater retention ponds." Please clarify if the existing stormwater retention ponds are provided with a liner, and ensure that stormwater runoff from the waste mass is managed in compliance with the rule requirements of 30 TAC §330.207 (relating to Contaminated Water Management). Please revise the section as appropriate.*

    It should be noted that the text referenced in Section 3.2.3 is stormwater runoff from the covered waste mass (i.e., not contaminated water) and therefore the existing stormwater retention ponds are not provided with a liner. Section 3.2.3 has been updated for clarification.

    Stormwater runoff from the active waste mass is contained within site run-on/runoff berms as described in Appendix 3I, Attachment 3 – Raba Kistner Leachate and Contaminated Water Plan. In the event that stormwater comes into contact with the active working face and is not contained within the site run-on/runoff berms, it will be managed in accordance with Appendix 3I.3 – Contaminated Water Management.

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23. *Please provide a discussion regarding the fate of collected stormwater runoff into the retention ponds, and also ensure that the existing or permitted drainage patterns will not be adversely altered in accordance with 30 TAC §330.63(c)(1)(C).*

    As stated in Appendix 3B.1.2, the retention ponds on site do not have an outlet structure and water will drain down via infiltration or evaporation.

    As stated in Section 3.3.1.3, 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. Calculations are provided in Appendix 3B, Attachment 7.

24. *Since the proposed amendment application intends to replace the compacted "six-inch on-site caliche layer" with a geosynthetic clay liner (GCL), please revise the proposed SLQCP to delete the text related to the caliche layer, and replace with GCL as appropriate.*

    The updated Liner Quality Control Plan (LQCP) is provided as Appendix 3J. The updated LQCP includes description for quality assurance/quality control (QA/QC) procedures for three composite liner construction scenarios at the Landfill: one using caliche as the primary liner, one using GCL as the primary liner if caliche is not available for cell construction, and a third describing the "piggy-back" composite liner system for areas where cell construction is planned over existing unlined waste fill.

25. *Since the compacted "six-inch on-site caliche layer" has been proposed to be replaced with a geosynthetic clay liner (GCL), please revise Drawing P3-29.1 (Liner Details) to delete the details provided for the existing liner system. Please provide a constructed liner details, where applicable, shall be depicted on cross-sections of a typical cell showing the slope, widths, and thicknesses for compaction lifts in accordance with 30 TAC §330.339 (a)(1). The amount of compaction shall be expressed as a percentage of a predetermined laboratory density. Please revise the proposed SLQCP, including Drawing P3-29.1 as appropriate.*

    Drawing P3-29 has been updated to indicate the three potential composite liner construction scenarios at the Landfill. Compaction requirements are detailed in the updated LQCP, and summarized in Table 3J.1.

26. *Please ensure that Section 5.2 on page 2 of the proposed SLQCP provides correct information for the proposed leachate collection system, including the diameter of leachate collection perforated and non-perforated pipes.*

    Section 3J.5 of the updated LQCP includes leachate collection pipe diameters.

27. *Please identify "the construction drawing" that is referenced in the proposed SLQCP in Sections 5.3, 6.1 and 6.2.*

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The LQCP has been updated and is included as Appendix 3J. The LQCP references drawings included in this application submittal.

28. *30 TAC §330.339(b) requires that that the liner quality control plan shall specify materials, equipment, and construction methods for the compaction of clay soils to form impermeable liners. Please include the following information as appropriate.*

    A. *details for the overexcavation and recompaction of the in-situ soils, or the compaction of soils from a borrow source, shall be depicted on cross-sections of a typical cell showing the slope, widths, and thicknesses for compaction lifts; and*

    B. *procedures to be followed when excavations, cells, or disposal areas extend into or have the potential to extend into the groundwater shall be in accordance with the provisions provided in §330.337 of this title (relating to Special Liner Design Constraints).*

    The updated LQCP discusses scarifying and re-compacting in-situ soils in Section 3J.8. Composite liner details depicting as-built thickness, slope, widths, etc., is shown on Drawing P3-29.

    Hydrogeological reports for the site indicate the depth to groundwater is over 300-feet from the designed subgrade elevations. Therefore, discussion for ballast uplift support, de-watering activities, etc. is not necessary for cell construction at this site.

29. *The proposed SLQCP in Section 9.0 indicates that the drainage aggregate in leachate collection system as "2 inch concrete aggregate." This does not appear to be consistent with Drawing No. P3-31 (Leachate Collection System Details). Please revise the proposed SLQCP to ensure consistency within the application document.*

    The updated LQCP describes the drainage aggregate in the leachate collection system as depicted on Drawing No. P3-31.

30. *30 TAC §330.339(c)(4) requires that all soil tests performed on any in-situ or constructed soil liners shall be in accordance with the standards in subparagraphs 30 TAC §330.339(c)(4) (A) - (E). Please revise the proposed SLQCP, including Section 7.0 (Subgrade Placement and Compaction) to address these rule requirements.*

    Soil test requirements pertinent to the caliche layer (as described in 30 TAC §330.339(c)(4) (A) - (E)) are summarized in Table 3J.1 of the updated LQCP. It should be noted that the existing subgrade is not a component of the soil liner and therefore does not have the same testing requirements as the caliche layer. The prescriptive liner profile (caliche) is modeled in Appendix 3J, Attachment 2.

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31. *Please address the rule requirements of 30 TAC §330.339(c)(9) that all soil testing and evaluation of either in-situ soil or constructed soil liners shall be complete prior to installing the leachate collection system. Please revise the application as appropriate.*

    Soil test requirements are summarized in Table 3J.1 of the updated LQCP. The sections describing the components of the composite liner system detail that each layer of the liner system must be approved by the owner's project representative prior to installation of the subsequent layer.

32. *Please ensure that the test method (ASTM D2216) indicated for the moisture content determination in the proposed SLQCP in Table 3J-4 (Compacted Soil Liner Material Construction Tests) is correct.*

    Table 3J.1 of the updated LQCP lists ASTM D 2216 as the required moisture content determination test.

33. *Please address the rule requirements of 30 TAC §330.339 (e) and (f) that all constructed soil liners shall be keyed into an underlying formation of sufficient strength to ensure stability of the constructed lining, and each soil liner evaluation report shall be prepared in accordance with the approved liner quality control plan. Any deviation from the approved plan must have prior written approval from the executive director.*

    Soil liner construction is described in Section 3J.8.2 of the updated LQCP. Soil and geomembrane liner evaluation reports are described in Section 3J.8.8 of the updated LQCP.

34. *30 TAC §330.339 (g) requires that soil liners shall not be compacted with a bulldozer or any track-mobilized equipment unless it is used to pull a pad-footed roller. All soil liners shall be compacted with a pad-footed or prong-footed roller only. Please also ensure that in all cases soil clods shall be reduced to the smallest size necessary to achieve the coefficient of permeability reported by the testing laboratory and to destroy any macrostructure evidenced after the compaction of the clods under density-controlled conditions. Please revise the proposed SLQCP as appropriate.*

    Soil liner construction is described in Section 3J.8.2 of the updated LQCP.

35. *Please address the rule requirements of 30 TAC §330.341 (a) and (b) that prior to the disposal of solid waste in any cell, or on any area, excavation, or unprotected surface, a soil liner evaluation report and a geomembrane liner evaluation report shall be submitted to the executive director. Each soil liner evaluation report and geomembrane liner evaluation report shall be submitted in triplicate (including all attachments) to the executive director and shall be prepared in accordance with the methods and procedures contained in the approved liner quality control plan. Please revise the proposed SLQCP as appropriate.*

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The soil liner and geomembrane liner evaluation reports are described in Section 3J.8.8 of the updated LQCP.

36. *Please provide a statement in the proposed SLQCP that 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 in accordance with 30 TAC §330.341 (d). Please also include in the SLQCP that the liner surfaces not covered within six months shall be checked by the soil liner evaluation report evaluator, who shall then submit a letter report on the findings to the executive director. Any 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.*

    Soil liner construction is described in Section 3J.8.2 of the updated LQCP.

37. *Please replace "Texas National Resources Conservation Commission (TNRCC)" with "Texas Commission on Environmental Quality (TCEQ)" and "a permit modification" with "a permit amendment" in Attachment 1 (SLQCP) and Attachment 2 (Page 3J-1) in Appendix 3J respectively.*

    The updated LQCP refers to the "Texas Commission on Environmental Quality" as the regulatory agency. Attachment 2 of Appendix 3J is now included as Attachment 1 of Appendix 3J and has been updated to remove and replace the "permit modification" terminology.

38. *Since the proposed amendment application includes the existing soil liner quality control plan (SLQCP) as part of the proposed permit amendment application, please provide an evaluation for the proposed SLQCP, signed and sealed by a responsible engineer with a statement that the enclosed document (Appendix 3J, Attachment 1 – Soil and Liner Quality control Plan) addresses the current rule requirements of 30 TAC, Chapter 330, Subchapter H: Liner System Design and Operation, and will be applicable to the proposed site permit. Please also ensure to update the cover page, headers and footers, and the table of contents for the proposed SLQCP. Alternatively, as the comments #24 through 37 are regarding the proposed SLQCP, we recommend that you revise the proposed SLQCP and resubmit the updated version of the SLQCP with responsible engineer's seal and signature.*

    The updated LQCP complies with the rule requirements of 30 TAC 330, Subchapter H.

39. *The supplemental geotechnical evaluation report prepared by American Engineering Testing, Inc. (AET) in Section 3.0 indicates a factor of safety 1.33 for the assumed interface friction angle of 28° for a seepage flow parallel to the liner for a saturated depth of 0.49 feet (erosion layer side slopes) within the cover soil. The report also indicates that a factor of safety of 1.5 can be achieved for this seepage condition, if both the interface angle and the internal friction angle of the sand cover soils are at least 31°. The minimum factor of safety of 1.5 is considered*

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acceptable for any slope stability analysis. Please explain how the calculated factor of safety of 1.33 will be acceptable.

Based on the soil type needed to achieve a $5.8x10^{-3}$ cm/sec permeability (as modeled in the HELP model and identified in Appendix 3P, Table 3P-1 testing requirements), the erosion layer will also serve as a drainage layer above the geomembrane. As described in the AET Report Dated August 3, 2012, Section 3.0, a slope stability analysis was completed to evaluate the stability of the final cover system as proposed. Assuming the saturated depth of 0.49 feet (maximum calculated from the HELP model) and an internal friction angle of 28°, the factor of safety for the seepage condition would be 1.33. To achieve a FS of 1.5, the internal friction angle of the sand to be used for the soil erosion layer (prescriptive) needs to be 31°. Soils testing will be completed prior to construction to ensure that the internal friction angle of the sand is at least 31° to ensure the 1.5 factor of safety (as indicated in Appendix 3P, Table 3P-1). Published values for the internal friction angle of sand are 26° - 40° and should be readily obtainable from the material onsite.

40. *For the proposed alternate cover system, the AET report in Section 3.0 indicates a factor of safety as 1.41 for a no water flow condition for a friction angle of 25° for both 90% and 80% density sand. Also, it indicates a parallel seepage flow within the sand will lower the factor of safety below 1.0. The minimum factor of safety of 1.5 is considered acceptable for any slope stability analysis. Please explain how the calculated factor of safety of 1.41 and below 1.0 will be acceptable.*

    An internal friction angle of 27° for the sand to be used for the alternative cover 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 (as indicated in Appendix 3P, Table 3P-1). 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.

41. *The AET report includes two appendices as "Appendix D." Please ensure that the appendices of the AET report are provided with correct nomenclature and page number.*

    Two separate AET reports were prepared (dated June 1, 2011 and August 3, 2012) for this permit amendment. Updated AET reports with footers have been included along with attachment dividers to separate the two reports (Appendix 3G, Attachment 1 and 2, respectively). In addition, a cover page for Appendix 3G has been included.

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42. The calculations for "Anchor Trench Design for Pullout" and "Interface Liner System Stability" indicate the proposed factors of safety 1.1 and 1.37 respectively. Please explain how the calculated factor of safety of 1.1 and below 1.37 will be acceptable. Also, these calculations are not provided with a cover page and page number. Please provide a cover page, page number, and identify a location for these calculations in the proposed permit document.

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.

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.

Updated anchor trench calculations with pages numbers have been provided for the anchor trench calculations (Appendix 3G, Attachment 3) along with a cover page for Appendix 3G.

43. The memorandum, dated August 8, 2012 included in the submittal does not appear to include all the recommendations of AET report. Please provide a statement in the permit text that the recommendations of the AET report will be implemented in full, if the proposed permit is approved.

An updated memo has been included in Appendix 3G, Attachment 2 to state that all AET recommendations will be followed.

The following comments are provided by Mr. Jason Wang, P.G., of the Texas Commission on Environmental Quality, MSW Permits Section.

Part II

44. Section 2.3.2 Facility Layout Map - We have reviewed your response to our request for additional monitor wells to satisfy the 600 feet maximum spacing at the point of compliance in accordance with 30 TAC §330.403(a)(2). You have stated that a groundwater monitoring system will be submitted for our review once the groundwater assessment is complete. While this proposal is acceptable due to the recent installation of monitor wells PZ-4 and PZ-5 in June,

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2011 and the required one year monitoring period to determine the groundwater gradient; the assessment should have concluded at this time. Please submit the groundwater monitoring system design within 30 days of the date of this letter. Please note that the processing of this major amendment application cannot proceed until a complete permit amendment application has been submitted.

An updated Site Characteristics and Monitoring Plan has been prepared by Parkhill, Smith and Cooper and was submitted to the TCEQ on October 30, 2012. A copy of this submittal has been provided as Appendix 3K, Attachment 1 for your information.

Part III (Appendix 3P - Final Cover Construction Quality Control Plan)

45. *Please revise the proposed minimum test frequency at the borrow source from one test per soil type to one test per 1000 cubic yards of placed material to verify soil classification. In addition, the permeability testing should be conducted using undisturbed large block samples at a minimum frequency of one test per lift and one test per 10,000 cubic yards of placed material. Please refer to TCEQ Regulatory Guidance Document RG-494, Guidance for Requesting a Water Balance Alternative Final Cover for a Municipal Solid Waste Landfill, dated January, 2012.*

Appendix 3P has been updated to include the testing requirements as described above.

Part IV

46. *Section 4.9.3 Facility Hours – Please address the following:*

A. *The currently permitted (MSW Permit No.729A) waste acceptance hours for the facility is 7:00 a.m. to 4:00 p.m., six days a week as stated in the Site Operating Plan dated February 2007. If the facility's intention is to expand the waste acceptance hours to 6:00 a.m. to 7:00 p.m., seven days a week with this amendment application, please revise the sentence that starts with "However, the landfill may extend…" to state "The waste acceptance hours for the facility will be 6:00 a.m. to 7:00 p.m., seven days a week."*

B. *If the facility intends to post waste acceptance hours on the site sign which will be more restrictive than the waste acceptance hours and days that are proposed to be authorized, as stated in the first sentence of the referenced Section, please revise the sentence by stating "The waste acceptance hours that will be posted on the site sign will be 7:00 a.m. to 4:00 p.m., six days a week."*

C. *For clarity, please consider revising the order of the sentences (i.e. first stating the waste acceptance hours that will be authorized with this amendment and then stating the actual waste acceptance hours that will be posted on the site sign.)*

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Section 4.9.3 has been updated for clarity.

In addition, the following comments were received from the TCEQ on October 17, 2012 via email.

1. *If the facility intends to keep the liner system consisting of 6" of caliche layer and geomembrane, please ensure to address the rule requirements for an alternative liner (Comment #41 of the 1st NOD) under 30 TAC Section 330.335.*

   The original submittal of the alternative liner consisting of 6-inches of caliche has been included in Appendix 3J, Attachment 2. This submittal provides the HELP and Multimed model analyses for the caliche liner and conforms to 30 TAC §330.335. The previous approval letter from the TNRCC (now TCEQ) has also been provided for reference. It should be noted that throughout this submittal, the previously approved caliche liner is referred to as the "prescriptive" liner and the new proposed alternative liner (with GCL) is referred to as the alternative liner.

2. *Please revise the specs for the leachate collection system sand layer to maintain a hydraulic conductivity of $1x10^{-2}$ cm/s or greater. Please ensure to update the drawing P3-29 (Liner Details) and the text provided on Appendix 3I accordingly.*

   The leachate collection system sand layer (or protective sand layer) has been designed with a hydraulic conductivity of $1x10^{-3}$ cm/sec. HELP modeling of this sand layer (provided in Appendix 3I, Attachment 1) confirm that the specified hydraulic conductivity ($1x10^{-3}$ cm/sec) is sufficient to prevent a buildup of leachate on top of the geomembrane liner. Results of the HELP model analyses for different operating conditions are summarized in Table 3I-2.

3. *Also, please provide an appropriate Drainage Layer in between the proposed erosion layer and geomembrane for the prescriptive final cover system or provide justification on why it is not necessary.*

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As described in the response to Comment #39, based on the soil type needed to achieve a permeability of 5.8×10^{-3} cm/sec (as modeled in the HELP model and identified in Appendix 3P, Table 3P-1 testing requirements), the erosion layer will also serve as a drainage layer above the geomembrane. The internal friction angle of the sand to be used for the soil erosion layer (prescriptive) needs to be 31° to achieve a factor of safety of 1.5 for the slope stability analysis. Soils testing will be completed prior to construction to ensure that the internal friction angle of the sand is at least 31° to ensure the 1.5 factor of safety (as indicated in Appendix 3P, Table 3P-1). Published values for the internal friction angle of sand are 26° - 40° and should be readily obtainable from the material onsite.

4. *Please delete the provision to provide a final cover system "for the landfill area that do not include a synthetic bottom liner," as a piggyback liner system has been proposed for the unlined portions of the landfill.*

   There are portions of the Landfill area still existing that will receive the final cover profile without a synthetic bottom liner. These areas are identified on Drawing P3-28 and are the areas of the existing unlined landfill up to the start of the liner profile for the piggyback area. The area to receive the piggyback liner is approximately 78-acres.

Should you have any questions or required additional information during the review of this permit application, 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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August 9, 2012

Chandra S. Yadav
Project Manager
Texas Commission on Environmental Quality, MC 124
P.O. Box 13087
Austin, TX 78711-3087

Subject: **Response to First Notice of Deficiency (NOD)**
McCombs Municipal Landfill – El Paso County
Municipal Solid Waste (MSW) Permit No. 729B

Dear Mr. Yadav:

On behalf of the City of El Paso, SAIC Energy, Environment & Infrastructure, LLC (SAIC) is providing the information requested by the Texas Commission on Environmental Quality (TCEQ) first technical notice of deficiency (NOD) letter received March 19, 2012. A time extension request was granted by the TCEQ for an additional 90 days to the original due date for submittal by August 10, 2012. The TCEQ comment is provided in *italic print* followed immediately by the response. Revised sections and appendices are included as an attachment to this letter and are identified as to the appropriate replacement location in the existing application. It should be noted that the attachment is ordered as to the location of replacement in the existing application, not based on the order of comments.

The following Comments were provided by Mr. Chandra S. Yadav of the TCEQ:

1. *The application contains references to the existing permit (MSW Permit No. 729A) in several discussions and narratives (e.g., Part III, Section 3.3.2 for the permit modification dated April 24, 2002; Appendix 3B for the permit modification dated July 2009; Appendix 3J for the liner quality control plan dated August 7, 2002, etc.). If this permit amendment application is approved, will replace Permit No. 729A documents, and therefore, the permit amendment application for 729B must be a full permit application that contains all documents/information as required by the applicable rules without any reference to the Permit No. 729A. Please update the application as appropriate.*

   The above listed references (as well as others located) have been included in the Major Permit Amendment.

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2. *It appears that the following engineering documents are not provided with the responsible engineer's seal and signature in accordance with Texas Engineering Practice Act and Rules §137.33. Please ensure that the responsible engineer shall affix their seal and original signature or electronic seal and signature with the date on the final version of their engineering documents per rule requirements before such documents are released from their control.*

   a. traffic impact analysis in Appendix 2C;

   The TIA was completed and signed by the City of El Paso, an updated copy has been provided.

   b. soil loss calculations provided on Page 3B-1;

   Signed calculations have been provided.

   c. stormwater runoff, ditch sizing and culvert calculations provided in Appendix 3B, Attachments 1, 2 and 3 respectively;

   Signed calculations have been provided.

   d. pipe deflection calculations provided in Appendix 3I, Attachment 2;

   Signed calculations have been provided.

   e. Leachate and Contaminated Water Plan in Appendix 3I, Attachment 2; and

   A signed title page has been added to the Leachate and Contaminated Water Plan.

   f. Waste Mass Stability Report in Appendix 3G.

   The waste mass stability report is signed by AET on page ii of the report.

3. *The title pages of the submittal indicate "Technically Complete November 2011." Please remove such phrases from all the title pages.*

   The title pages have been updated and are provided in the Attachment.

Part I

4. *The title page indicates facility name as "McCombs Municipal Solid Waste Landfill", and Part I form indicates as "McCombs Municipal Landfill." Please ensure that the title page and Part I form indicate the correct name for the facility, and revise the pages as appropriate.*

   The title pages have been updated to be consistent with the Part I form and are provided in the Attachment.

5. *The metes and bounds description included in Section 1.4 (Appendix 1C) does not appear to identify the area specifically within the facility boundary, and is not signed and sealed by a registered professional land surveyor. Please address the rule requirements of 30 Texas*

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Administrative Code (TAC) Section (§)330.59(d)(1) and (2), and resubmit the facility boundary metes and bounds description signed and sealed by a registered professional land surveyor. An area indicated in Drawing P3-17 is not included within the property boundary, please ensure that the metes and bounds description are included in the submittal. In addition, please ensure that the metes and bounds description for the easement area indicated in Drawing P3-17 is included in the submittal and explain why this easement area, which is owned by the city of El Paso is not proposed to be included in the area within the property boundary.

Updated Metes and Bounds surveys for both the permitted boundary and for the permitted boundary plus the Public Drop-off Area are provided in Appendix 1C.

6. *Please include a statement to ensure that all maps updated in the application are the latest revision in accordance with 30 TAC §330.59(c)(2).*

   The map sources used for the Drawings are provided in the notes to the drawings. The maps used to provide information were the latest version available at the time of map development.

Part II

7. *General location maps. Please provide the following information as required by 30 TAC §330.61(c) to accurately show proximity to surrounding features. Please also revise Section 2.3.1 to provide a narrative and to identify the location for the following information as appropriate.*

   Section 2.3.1 has been updated to provide the location and description of the below referenced items.

   a. *the prevailing wind direction with a wind rose;*

   The wind rose provided from the 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.

   b. *all structures and inhabitable buildings within 500 feet of the proposed facility;*

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

   c. *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

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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.

d. 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 Drawing P2-1) are two-lane asphalt paved roads.

e. latitudes and longitudes;

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

f. area streams;

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

g. 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.

h. facility access control features;…

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 and as described in Section 3.2.1.

…and 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.

8. *Facility layout maps. Please revise the narrative in Section 2.3.2 to identify the maps that provide the information as required by 30 TAC §330.61(d)(1) through (9). It appears that the provided drawings do not indicate the interior facility roadways to provide access to fill areas and dimensions of landfill units/cells. Please include the interior facility roadways and dimensions of landfill units/cells in the facility layout drawings. Please also provide the following information as appropriate.*

Drawings P2-9 through P2-18 have been updated to indicate the potential interior facility roadways and dimensions of landfill units/cells.

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a. provisions for the maintenance of any natural windbreaks, such as greenbelts, where they will improve the appearance and operation of the facility and, where appropriate, plans for screening the facility from public view;

As described in Section 3.2.1, existing earthen berms along the western and northern boundaries of the Landfill provide a method of visual screening for the facility. This discussion has been included in Section 2.3.2.

b. sectors with appropriate notations to communicate the types of wastes to be disposed of in individual sectors; and

The type of waste to be received within each Sector has been updated on Drawings P2-9 through P2-18.

c. maximum waste elevations and final cover.

Maximum elevations for cell development are provided on Drawings P2-9 through P2-18. The actual waste elevation 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 (final cover profiles provided in Drawings P3-35 and P3-36) for prescriptive or alternative final cover, respectively.

9. *Drawing P3-17 indicates an entrance, a scale house, a public drop-off site, an above-ground fuel storage tank, an equipment maintenance building, and employee and public parking areas on the proposed easement area. But, the easement area and these features are not indicated on other appropriate drawings including the site layout plan. Please provide narrative to explain these features in the appropriate sections of the permit amendment application, and revise appropriate drawings, including the site layout plan.*

   The future site drawings have been updated to depict the entrance expansion area and the expansion area facilities are described in Section 3.2 and Section 4.1.

10. *Existing conditions summary. Please address the rule requirements of 30 TAC §330.61(a) that the owner or operator shall determine and report to the executive director any site-specific conditions that require special design considerations and possible mitigation of conditions identified in subsections §330.61 (h) - (o). The owner or operator may discuss any additional land-use, environmental, or special issues in an existing conditions summary.*

    Site specific conditions are summarized in Section 2.1.3. There are no existing site-specific conditions that require special design considerations or possible mitigation of conditions.

11. *The provided Flood Insurance Rate Map (FIRM) shows that some portions of the facility are in flood-prone areas that are inundated by the 100-year flood. Please provide information to*

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ensure that the waste disposal areas will be protected from the 100-year flood event. Please make sure to include engineering details, including cross-sections with freeboard information, for the floodplain mitigation structures. Please note that all berms/levees design to prevent the 100-year flood event should have a freeboard of at least three feet in accordance with 30 TAC §330.307(b)(1).

As discussed in Section 2.9.1, 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. Furthermore, as discussed in the referenced Section 3.3.2, the proposed Landfill development base elevations are above the base flood elevations (BFE's). 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. Cross sections for Pond A are provided in Drawing P3-8. Note from the high-water elevation provided on the cross sections, at least three feet of freeboard is provided. The Pond A berm height is also above the 100-year flood elevation.

12. *Please explain why the Flood Insurance Map included as Drawings P2-26 and P3-13 is identified as "Preliminary". Please ensure that the FIRM provided on Drawing P2-26 and P3-13 is the latest revision of the map. 30 TAC §330.59(c)(2) requires that all maps provided in the application must be the latest revision.*

    At the time of development of the drawings, the Preliminary Flood Insurance Rate Maps (FIRM) were provided on the City of El Paso website (http://www.elpasotexas.gov/engineering/floodzones.asp). Since that time, the Federal Emergency Management Agency (FEMA) has "officially placed the preliminary flood insurance rate map project for El Paso County on hold until future notice". The FIRM from June 15, 1988 has been provided in the Attachment as a replacement to Drawings P2-26 and P3-13. It should be noted that there was not any apparent changes between the 1988 FIRM and the proposed FIRM map for the McCombs Landfill area, and the 100-year floodplain extents delineated on other drawings within the permit modification are still relevant.

13. *The provided copy of the National Pollution Discharge Elimination System, Storm Water Multi-Sector General Permit appears to be dated June 22, 1998. Please provide the current information demonstrating how the facility will comply with applicable Texas Pollutant Discharge Elimination System (TPDES) storm water permitting requirements and the Clean Water Act, 402, as amended. In accordance with 30 TAC §330.61(k)(3), the facility may provide a certification statement indicating that the owner/operator will obtain the appropriate TPDES permit coverage when required; or a copy of the permit number for coverage under an individual wastewater permit.*

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As identified in Section 2.1.2, the Landfill currently holds a Texas Pollutant Discharge Elimination System (TPDES) Stormwater Permit (No. TXR05L795). Section 2.7.2 has been updated to include this permit number and an updated copy of the permit is provided in Appendix 2D.

Part III

14. *Please note, 30 TAC §305.45 requires a supplementary technical report submitted with an application. The report shall be prepared either by a Texas licensed professional engineer, a Texas licensed professional geoscientist, or by a qualified person who is competent and experienced in the field to which the application relates and thoroughly familiar with the operation or project for which the application is made. The report must include the following:*

    a. *a general description of the facilities and systems used for or in connection with the collection, transportation, treatment, and disposal of waste;*

    b. *for each place of disposal:*

        i) *the volume and rate of disposal of the defined waste, including appropriate averages, the maximum rates of disposal over representative periods of time, and detailed information regarding patterns of disposal; and*

        ii) *the physical, chemical, and radiological properties of the defined waste; the characteristics of the waste; the chemical, physical, thermal, organic, bacteriological, or radiological properties or characteristics, as applicable, described in enough detail to allow evaluation of the water and environmental quality considerations involved.*

    The supplementary technical report is included in Section 1.1.2 of the permit modification and has been updated to address the rule requirements.

15. *Please address the rule requirements of 30 TAC Chapter 330, Subchapter M: Location Restrictions, as applicable to the facility. Also, please provide a statement if any rules are not applicable to the facility. It is recommended to include the required information as appropriate in Part III of the application.*

    The rule requirements of 30 TAC §330, Subchapter M are identified and locations or addressed rules are provided 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.

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- 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.

- 30 TAC §330.545 - Airport Safety
  - Airport safety is addressed in Section 2.5.2.
- 30 TAC §330.547 - Floodplains
  - Floodplains are addressed in Section 2.9.1.
- 30 TAC §330.549 - Groundwater
  - Groundwater conditions at the site are described in Section 2.7.1. However, 30 TAC §330.549 does not apply as additional groundwater evaluation is not required for the proposed vertical expansion of this facility.
- 30 TAC §330.551 - Endangered or Threatened Species
  - Section 2.10 addresses endangered species.
- 30 TAC §330.553 – Wetlands
  - Wetlands are addressed in Section 2.9.2. However, 30 TAC §330.553 does not apply as additional wetland evaluation is not required for the proposed vertical expansion of this facility.
- 30 TAC §330.555 - Fault Areas
  - Fault areas are discussed in Section 2.6.4. However, 30 TAC §330.555 does not apply as additional fault area evaluation is not required for the proposed vertical expansion of this facility.
- 30 TAC §330.557 - Seismic Impact Zones
  - Seismic impact zones are discussed in Section 2.6.5. 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.
- 30 TAC §330.559 - Unstable areas
  - Unstable areas are addressed in Section 2.6.6.
- 30 TAC §330.561 - Coastal Areas is not applicable to this facility.
- 30 TAC §330.563 - Type I and IV Landfill Permit Issuance Prohibited

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- 30 TAC §330.563 does not apply to vertical expansions of landfills.

16. *Section "Bulky Items Storage" on Page 3.2-2 indicates that the large items will be stored at the referenced landfill until transported off-site. Please indicate a location where these items will be placed, and revise Drawings P3-2 and P3-17 as appropriate. Please ensure to provide schematic view drawings showing the various phases of collection, separation, and disposal as applicable for the types of wastes received at the facility including for the bulky items storage area as required by 30 TAC §330.63(b)(2)(B). Please revise the drawings as appropriate.*

    Drawing P3-17 has been updated to show bulky item storage locations within the public drop-off area.

17. *Section 3.2.2.1 on Page 3.2-2 indicates that the unloading area will include roll-off containers. However, the locations for roll-off containers are not indicated in the provided Drawing P3-2. Also, Drawing P3-2 does not appear to include generalized construction details for Public Drop-Off Area and it's cross-sectional details in accordance with 30 TAC §§330.63(b)(2)(D) and (E). Please provide a revised drawing.*

    Drawing P3-2 is meant to show the current conditions of the facility, and as the new facilities and entrance road have yet to be constructed, it is included in Drawing P3-17 (as referenced on Drawing P3-2, Note 5). The roll-off containers will be located in the z-depressions of the Public Drop-Off Site (and are called out on the updated Drawing P3-17 provided in the Attachment).

18. *Please identify all storage and processing components, and all loading and unloading areas (e. g. the public drop-off area, bulky items storage area, etc.) to provide a generalized process design and working plan for the facility. As required by 30 TAC §330.63(b)(2)(F), please provide locations and engineering design details of all containment dikes or walls (with indicated freeboard) proposed to enclose all storage and processing components and all loading and unloading areas. Please also revise appropriate drawings and Sections 3.2.2 and 3.2.3 accordingly.*

    The storage and processing components outside of the landfill disposal area are identified on Drawing P3-17. These include the public drop-off area and bulky items storage. Drawing C13 from the Moreno Cardenas submittal for the site development improvements has been included in Appendix 3E. The drawing indicates the ponding areas for the site entrance facilities as well as the high water elevations and top elevations of the containment ponds.

19. *It is stated in the fourth paragraph in Section 3.3.1.2 that the stormwater runoff is collected in a v-ditch around the perimeter of the landfill units. But, it appears (Drawing P3-4) that the v-ditch is provided only for some portions of the perimeter at the landfill. Please explain how the run-on (around the perimeter of the landfill) and run-off (especially from the existing conditions*

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drainage area, EX-3) are managed currently, and also identify the locations of the v-ditch on the drawing with legible legend information. Please ensure to address the rule requirements of 30 TAC §330.303(a) that a facility must be constructed, maintained, and operated to manage run-on and runoff during the peak discharge of a 25-year rainfall event and must prevent the off-site discharge of waste.

The statement provided in Section 3.3.1.2 is correct; the v-ditch collects stormwater around the perimeter of the existing landfill units and directs the stormwater into an existing stormwater pond. Drawing P3-4 has been updated to clearly show the v-ditch location around the existing facility and is provided in the Attachment. 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. This statement, as well as additional discussion of the stormwater run-on and runoff, has been added in Section 3.3.

20. *The permit boundary, and drainage area boundary lines/attributes on most drawings are overlapped, and form a solid line which makes it difficult to determine the actual permit boundary. Please revise these drawings including Drawing P3-4 to make sure that the permit boundary is clearly shown.*

    Due to the amount of different boundaries portrayed on each drawing, the predominant feature of the drawing was highlighted to be clear as to the intent and purpose of the drawing. Drawing P3-2 was developed to more clearly show the defined existing limits and boundaries of the facility and highlights the property boundary as well as the corner extents of the property (i.e., northing and easting). As to continue to clearly show the drainage areas on the stormwater drawings (i.e., P3-4), the drawings have not been updated.

21. *Please ensure to provide appropriate legend information on the drawings, including on Drawing P3-4 for the permit boundary and for the mined pit areas as referenced in the narrative provided in the fourth paragraph of Section 3.3.1.2. Please revise the drawing as appropriate.*

    Drawing legends for the entire drawing set are provided following the table of contents for each Part (Drawing P0-2). The current mined pit low areas are identified on Drawing P3-4 by the directional flow arrows. The majority of the site was originally a gravel mining pit; therefore specific areas are not delineated within the site. Current topography is provided in the background of the drawings to indicate high and low elevation areas.

22. *Please explain how the runoff being captured by the mined pit areas will continue during interim phase of landfill operation. Also, the last paragraph in Section 3.3.1.3 indicates that the landfill retains the stormwater onsite as well as receives some off-site run-on from the east. Please demonstrate that the runoff from the existing onsite drainage areas (EX-1, EX-2, EX-3), and run-on from the off-site areas will be provided with necessary drainage collection, conveyance, and*

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detention structures during all phases of landfill operation so that the existing or permitted drainage patterns will not be adversely altered in accordance with 30 TAC §330.305(a).

The mined pit areas will act as a sedimentation basin during interim phases of landfill operation. 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. All drainage calculations for the facility (both existing and future conditions) include the additional run-on from these off-site areas. 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). Stormwater calculations are provided in Appendix 3B, Attachment 7 – Drainage Calculations.

23. *Appendix 3I, Attachment 3 (Leachate and Contaminated Water Plan) appears to be a copy of the document prepared by the engineer on August 7, 2002 for the existing permit (MSW Permit 729A). Please ensure that the headers and footers are updated to indicate the appropriate permit number, consulting firm's name, and page number on the document. Please ensure to address the rule requirements of 30 TAC §330.305(b) and (c) that the owner or operator shall design, construct, and maintain a run-on control system capable of preventing flow onto the active portion of the landfill during the peak discharge from at least a 25-year rainfall event, and a runoff management system from the active portion of the landfill to collect and control at least the water volume resulting from a 24-hour, 25-year storm. Please submit the updated calculations with the responsible engineer's seal and signature.*

    Appendix 3I, Attachment 3 was developed by Raba-Kistner Consultants, Inc for MSW Permit No. 729A on April 24, 2002 (Revised July 29, 2002). The assumptions utilized in the Leachate and Contaminated Water Plan prepared by Raba-Kistner comply with the 30 TAC §330.305(b) and (c) and are still relevant for the site operating conditions. These calculations have not been updated; however, a memo has been included to better describe the contents of Appendix 3I, Attachment 3.

24. *The final cover plan (Drawing P3-33) indicates the top slopes with 7% and the side slopes with about 33.33%. Please provide an estimate for peak velocities at the top surfaces and external embankment slopes for the final and interim conditions, and ensure that the estimated peak velocities for top surfaces and external embankment slopes will be less than the permissible non-erodible velocities under similar conditions in accordance with 30 TAC §330.305(d)(1).*

    Appendix 3B.4 has been added to address non-erodible velocities as per 30 TAC §330.305(d)(1).

25. *Appendix 3B in Attachment 5 indicates that the previously approved permit modification explains values of "R, K, S, C and P" used in the soil loss calculations. Please include the referenced information into the current application to explain the soil loss calculations as*

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appropriate. Please explain the soil loss calculations, including the length of slope used in the calculations provided on Page 3B-1.

The referenced values for R, K, S, C, and P from the MSW Permit No. 729A prepared by Parkhill, Smith and Cooper, Inc. (revision 2 July 2009) have been included in the Attachment. The soil loss calculations were performed using the Revised Universal Soil Loss Equation (RUSLE) as provided by the National Resource Conservation Service (NRCE), El Paso office (described in Appendix 3B.3). The maximum top dome length is 1,158 ft (DEV-5) and the maximum side slope length is 759 ft is (DEV-1). Soil loss calculations have been updated to provide additional information.

26. *It appears that the provided soil loss calculations are for the final conditions at the landfill for a single slope length of 750 feet. It does not appear that the provided soil loss calculations include calculations for the interim phases of landfill operation. In accordance with 30 TAC §330.305(d)(2), the top surfaces and external embankment slopes of municipal solid waste landfill units must be designed to minimize erosion and soil loss through the use of appropriate side slopes, vegetation, and other structural and nonstructural controls during all phases of landfill operation. Please revise the soil loss calculations as appropriate.*

    Soil loss calculations have been updated and are provided in Appendix 3B, Attachment 5.

27. *Appendix 3B, Section 3B.2 indicates that structural controls may include berms, dikes, swales, and rip-rap, however their design details and specifications are not provided. Please provide engineering designs, cross sectional details, and specifications for the drainage structures to be constructed during the interim and the final phases of the landfill development. Please note, 30 TAC §330.305(e) requires that dikes, embankments, drainage structures, or diversion channels must be sized and graded to handle the design runoff. The slopes of the sides and toe must be graded to minimize the potential for erosion. The surface water protection and erosion control practices must maintain low non-erodible velocities, minimize soil erosion losses below permissible levels, and provide long-term, low maintenance geotechnical stability to the final cover. Please revise the application as appropriate.*

    Design details and specifications for structural controls (i.e., silt fence, earthen diversion berms and dikes, drainage swales, and rip-rap) are addressed in the Erosion and Sediment Control Plan developed by Parkhill, Smith and Cooper (revision 2 July 2009) and has been included in Appendix 3B, Attachment 6. Drainage structures and diversion channels are not proposed for the final cover design as calculated soil erosion are less than the permissible soil loss and calculated velocities are below the permissible non-erosion velocities. Soil loss equations are provided as Appendix 3B.3 and non-erodible velocities for all phases of construction are provided as Appendix 3B.4.

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28. *Please address the rule requirements of 30 TAC §330.305(e)(a) and (b) that the owner or operator shall maintain the collection, drainage, and/or storage units as designed, and shall restore and repair the drainage system in the event of washout or failure, and control erosion and sedimentation, including having interim controls for phased development.*

    The rule requirements have been addressed in Appendix 3B.2.

29. *Section 3B.2.2 and Drawing P3-11 indicate that the ditches having velocities that exceed four feet per second will be protected against erosion. Also, the cross sectional drawings for the proposed ditches are not provided. Please explain how the value for the permissible velocity has been determined, and provide drawings with cross sectional details of ditches.*

    As stated in Section 3.3.1.3, 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. This statement has been added to Appendix 3B.2.2 for clarification. Cross-sectional drawings for the proposed ditches have been provided within Appendix 3B, Attachment 2.

30. *It is stated in Section 3B.2.2 that the temporary and intermediate controls will be implemented for erosion and sedimentation management throughout the entire phasing of construction. However, details of control measures to be implemented for an erosion controls during interim phases of construction are not provided. It is recommended to follow the guidance documents "Guidance for Addressing Erosional Stability during All Phases of Landfill Operation" and "Outline of Requirements of The Erosion and Sediment Control (ESC) Measures for Landfill Facilities" to prepare an ESC Plan to address the rule requirements of 30 TAC §330.305. The guidance documents may be located on our website at the following internet address: http://www.tceq.state.tx.us/assets/public/permitting/waste/msw/interimdrainageguide.pdf*

    The "Guidance for Addressing Erosional Stability during All Phases of Landfill Operation" is a draft guidance document that should be followed in the development of an Erosion and Sediment Control plan. The second referenced document ("Outline of Requirements of The Erosion and Sediment Control (ESC) Measures for Landfill Facilities") is obsolete. Appendix 3B was updated to comply with the guidance document.

31. *Please address the rule requirements of 30 TAC §330.305 (g) that the owner or operator shall handle, store, treat, and dispose of surface or groundwater that has become contaminated by contact with the working face of the landfill or with leachate in accordance with 30 TAC §330.207 (relating to Contaminated Water Management). Storage areas for this contaminated water must be designed with regard to size, locations, and methods. Please also revise Section 3.2.3 as appropriate.*

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Contaminated Water Management is addressed in Appendix 3I.3 and Appendix 3I Attachment 3.

32. *Please provide a statement that the facility design complies with the requirements of 30 TAC §330.303 (relating to Surface Water Drainage for Municipal Solid Waste Facilities).*

    This statement has been added to Section 3.3.3.

33. *The cross sectional details, ditch grades and flowline elevations of the ditch are not provided in the submittal. In accordance with 30 TAC §330.63(c)(1)(B), please provide drawings to include designs of all drainage facilities within the facility area, including such features as typical cross-sectional areas, ditch grades, flow rates, water surface elevation, velocities, and flowline elevations along the entire length of the ditch.*

    As provided in the response to Comment 29, cross-sectional drawings (indicating slopes, design depths, and dimensions) for the proposed ditches have been provided within Appendix 3B Attachment 2. Design velocities are also included in the channel calculations.

34. *Please provide sample calculations to verify that existing drainage patterns will not be adversely altered in accordance with 30 TAC §330.63(c)(1)(C).*

    The overall site drainage boundary is not altered between existing and final conditions. For both the existing and final drainage conditions, no water leaves the site in the 100-year, 24-hour storm event. Calculations for the existing and final drainage conditions have been provided as Appendix 3B, Attachment 7 – Drainage Calculations.

35. *Structural design details for collection and conveyance systems for the runoff water along the top and side slopes are not provided. Please provide hydraulic calculations and designs for sizing the necessary collection and conveyance systems (e.g. berm, dike, chute, etc.), and identify their locations on appropriate drawings in accordance with 30 TAC §330.63(c)(1)(D)(iv). Please revise the drawings as appropriate.*

    Calculations for soil loss and peak velocities have been completed in accordance with 30 TAC §330.305(d) and are provided in Appendix 3B, Attachments 5 and 7, respectively. The calculations for soil erosion show that the potential soil loss is less than the permissible soil loss. The calculations for the velocities show that the peak velocities are less than the permissible non-erodible velocities. Structural designs for collection and conveyance along the top and side slopes (i.e., berms, dikes, chutes) are not proposed for the final cover design.

36. *In accordance with 30 TAC §330.63(c)(2)(C), please provide information detailing the specific flooding levels and other events that impact the flood protection of the facility. Data should be that required by §301.33 - 301.36 of this title (relating to Preliminary Plans: Data to be Submitted, Criteria for Approval of Preliminary Plans; Additional Information; Plans to Bear*

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Seal of Engineer). The owner or operator shall include cross-sections or elevations of landfill berms/levees shown tied into contours.

30 TAC §330.63(c)(2)(C) states that "if the site is located within the 100-year floodplain, provide information detailing the specific flooding levels and other events…that impact the flood protection of the facility." The only area of the facility that is located within the 100-year floodplain is the existing Pond A. No waste will be placed within the 100-year floodplain. This is further discussed in Section 3.3.2 – Flood Control and Analysis. Furthermore, cross sections of Pond A are provided in Drawing P3-8 and storage capacity calculations provided in Appendix 3B, Attachment 1 and 7. As indicated on the cross-section, the Pond A berm is higher than the 100-year BFEs.

37. *It appears that a retention pond and berms/levees were constructed to protect the facility from a 100-year frequency flood. Please include the information per the rule requirements of 30 TAC §330.63(c)(2)(D)(i)-(iv) for any construction in a floodplain, as applicable to the facility.*

    Retention Pond A was constructed under the facility permit 729A and was permitted under the previous rules and limited data exist for the construction of the floodplain. As the pond was already constructed (and no waste will be placed within the 100-year floodplain extents), no new information is pertinent to this request. The 100-year BFEs are indicated on Drawing P3-8.

38. *The provided rule citations in Sections 3.3.2 and 3.8 appear to be incorrect. Please ensure to provide the correct rule citations.*

    The sections have been updated with the correct rule citations.

39. *Please revise the provided landfill unit cross-sections (P3-19 through P3-24) to indicate maximum elevation of proposed fill, top of the wastes, gas vents or wells, and groundwater monitoring wells, plus the initial and static levels of any water encountered, in accordance with 30 TAC §330.63(d)(4)(E). Please also ensure to provide narrative in Section 3.4.1.5 as appropriate.*

    Groundwater monitoring well locations and maximum elevations for cell development are provided on Drawings P3-19 through P3-24. The actual waste elevation 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 (final cover profiles provided in Drawings P3-35 and P3-36) for prescriptive or alternative final cover, respectively. The drawings have been updated to include reference to other drawings for locations of gas vents or wells and the approximate water elevation. Section 3.4.1.5 has also been updated.

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40. *Please address the rule requirements of 30 TAC §330.63(d)(4)(F) to provide construction and design details of compacted perimeter or toe berms that are proposed in conjunction with aboveground (aerial-fill) waste disposal areas to be included in the fill cross-sections.*

    For design detail clarity, the cross-sectional view of the perimeter berm is provided as Detail 4 on Drawing P3-29.

41. *It appears that Appendix 3J has been provided to update (Pages 1 through 4) the existing liner quality control plan (MSW Permit No. 729A). Please submit a complete liner quality control plan to address the rule requirements of 30 TAC Chapter 330, Subchapter H: Liner System Design and Operation (30 TAC §330.331 through §330.341), including for the proposed piggy-back liner system as applicable for the facility. Also, please provide a statement if any rules are not applicable to the facility.*

    Rule requirements of 30 TAC §330.331 through §330.333 are addressed in Appendix 3I – Leachate and Contaminated Water Plan. The Proposed Alternative Liner discussion (in accordance with 30 TAC §330.335) is included in Appendix 3J with modeling results provided in Appendix 3I. Rule 30 TAC §330.337 does not apply to this facility. Rules 30 TAC §330.339 and §330.341 are addressed in Appendix 3J.

42. *It is stated in Section 3I.2.2 that the leachate collection system and piping must be designed to maintain "a minimum of 30-centimeteer"of leachate depth over the liner." Please revise the statement to state that a leachate collection system must be designed and constructed to maintain "less than a 30-centimeter" depth of leachate over the liner in accordance with 30 TAC §330.331(a)(2).*

    Appendix 3I.2.2 has been updated to reflect the statement above.

43. *Please discuss the calculations provided in Attachment 2 of Appendix 3I, and ensure that the rule requirements of 30 TAC §330.333(3)(A)-(G) are addressed. Please revise the narrative provided in Section 3I.2.2 to explain that the proposed leachate-collection and associated leachate-removal systems are provided with the pipe strength, pipe network spacing, collection sump materials and strength, drainage media performance, and demonstration that pipes and perforations will be resistant to clogging and can be cleaned.*

    Rule requirements of 30 TAC §330.333(3)(A)-(G) are addressed in Appendix 3I.2.2. This section has been updated to provide rule references throughout for easier identification of addressed rules.

44. *Please discuss the calculations provided in Appendix 3I, Attachment 2 to explain that the proposed leachate-collection and associated leachate-removal systems will be of sufficient strength and thickness to prevent collapse under the pressures exerted by overlying wastes,*

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waste cover materials, and by any equipment used at the landfill in accordance with 30 TAC §330.333(2). Please also revise the narrative in Section 3I.2.2 as appropriate.

Appendix 3I.2.2 has been updated to provide additional discussion on the equations provided in Appendix 3I, Attachment 2.

45. *Please note that the analysis of leachate generation should assume surface conditions that simulate the most infiltration for the available soil and vegetation cover type at the site, and the precipitation data used in the modeling is current and site-specific. The assumption of bare ground for "Help Modeling Methodology/Assumptions (Table 3I-1)" indicates maximum runoff and less infiltration. In accordance with 30 TAC §330.165(c), intermediate cover layers are expected to be vegetated within six months of installation, and therefore, assumption of bare ground for the system that will last for 20 years is inappropriate. Please ensure that the modeling performed is accurate and site specific.*

    Intermediate cover conditions were remodeled for poor grass ground cover (typical vegetative growth for the City of El Paso) and HELP model results are included in Appendix 3I, Attachment 1.

46. *Since a vertical expansion at the landfill has been proposed, please address the rule requirements of 30 TAC §330.333(2)&(3)(A)-(G) for the existing leachate-collection and associated leachate-removal systems in the existing Sector K at the landfill.*

    As per 30 TAC §330.333(3)(D) and (F), the leachate collection layer and spacing has been evaluated via the HELP model and model results are provided in Appendix 3I, Attachment 1. The minimum coefficient of permeability specified for Sector K construction (Phase I/II) meets the requirements specified in Appendix 3I.2.2. As per 30 TAC §330.333(2) and §330.333(3)(C),(E), and (G), pipe deflection calculations have been added to Appendix 3I, Attachment 2 to evaluate the existing leachate collection piping in Sector K. As per 30 TAC §330.333(3)(A) and (B), the leachate sump capacity has been evaluated and the estimated rate of leachate removal is discussed in Appendix 3I.2.2.

47. *The proposed alternative liner system for the vertical expansion over waste in existing Pre-Subtitle D areas at the site does not appear to meet regulatory requirements of the 30 TAC Chapter 330 rules. The planned piggy-back liner proposed to be constructed consists of 25-foot to 55-foot of construction and demolition (C&D) waste over the existing waste in the Pre-Subtitle D area before placement of the proposed liner system. This indicates placement of waste over existing waste in a Pre-Subtitle D area without installing an approved liner over the existing waste as required by rule provisions under 30 TAC §330.331. Please explain how the proposed configuration meets the rule.*

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The C&D waste placed prior to placement of the proposed liner system will consist of Class 3 inert waste (including, but not limited to, rock, brick, glass, dirt, certain plastics, rubber, and similar materials that are not readily decomposable). Section 1.1.2 (Supplementary Technical Report) has been updated to include this discussion.

48. *Please identify the components of the proposed alternative liner system and label coefficient of permeability values for soils to be used for constructed liners on related drawings including on P3-27 and P3-29. The soils must have a coefficient of permeability less than or equal to 1 x 10E-7 cm/sec to be used in constructed liners in accordance with 30 TAC §330.339(c)(5)(E). Please revise the appropriate drawings.*

    Drawing P3-29 has been updated to include the coefficient of permeability values on the details. Furthermore, these values are provided in Section 3.4, Tables 3.4-1 to 3.4-4. Drawing P3-27 has not been updated, as coefficient of permeability values are not applicable to the details provided on that drawing.

49. *It appears that an alternative liner system has been proposed in the application. Please discuss that the proposed alternative liner designs for the landfill includes a leachate management system with a demonstration by computerized design modeling that the maximum contaminant levels detailed in §330.331 of this title (relating to Design Criteria), Table 1 will not be exceeded at the point of compliance. Please also elaborate the narrative to explain the results of the Help Model included in Appendix 3I, Attachment 1.*

    The alternative liner design proposed in this application (Detail 2 on Drawing P3-29) is the replacement of the 6-inches of caliche with a geosynthetic clay liner. The replacement is detailed in Appendix 3J and modeled is included in Appendix 3I (HELP modeling) and Appendix 3J (MultiMed Model).

50. *A leachate collection sump appears to be located on the existing waste/intermediate cover within the Pre-Subtitle D area. In accordance with 30 TAC §330.167, ponding of water over waste (in active portion or on closed landfill) regardless of its origin is not allowed. A large-scale detail drawing of the locations of the leachate sumps, sump elevations, as well as details of the configuration of the leachate collection pipe inlet into the sumps needs to be provided to demonstrate compliance with the above-referenced rule.*

    The detail specific to the sump located on top of the piggyback of the Pre-Subtitle D area has been provided on Drawing P3-32, Section C. Note that the liner over the pre-subtitle D area will prevent water from entering the existing waste; furthermore, the water collected within the sump will be pumped out as needed to prevent standing water within the sump.

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51. *Please discuss the results of the waste mass stability analyses provided in Table C-2,3 and 4 of the report prepared by American Engineering Testing, Inc. (AET) considering the proposed landfill configuration presented in Drawing P3-16.*

    The initial waste mass stability analysis completed by AET evaluates the deep-seated stability of the waste and analyzes potential circular and block failure along cross-sectional planes "A", "B", and "E" (as provided in Appendix 3F). Table C-2 provides the results of these analyses using peak strength values; Table C-3 results are from completing a limited sensitivity analysis by varying the strength parameters from base conditions (i.e., reducing cohesion and interface friction angles independently). Table C-4 provides a secondary stability analysis using assumed large displacement interface shear strengths. The factor of safety values provided for peak and large displacement conditions are acceptable based on published information.

52. *The AET report estimates that a settlement due to compression of the existing waste from the new overlying waste could reach to 17.6 feet at station 25+00 along Cross-Section B. Please discuss if the recommended geosynthetic reinforcement "geogrid" (with a minimum design tensile strength of 3,500 pounds per foot at an allowable stress of 5% or less over the 50 year design life) will be sufficient for the stability of the piggy-back liner system along such cross-sections at the landfill.*

    Additional settlement evaluation has been provided in the Report of Supplemental Geotechnical Evaluation completed by AET (and provided in Appendix 3G). In summary, the maximum tensile strain calculated for the piggyback liner system 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.

53. *It appears that the AET report does not include analyses for potential failures of the proposed liner system, the proposed C&D waste mass, and existing waste mass. Also, the report does not appear to include the adequacy of anchor trench design system, stability of the underlying liner system, and stability of interim slopes. Please discuss if the provided stability analyses will be sufficient to ensure the overall stability during the interim phase, and for the final graded landfill at the maximum design height.*

    Additional discussion and calculations have been completed regarding waste mass stability and are included in Appendix 3G. Potential failures of the proposed liner system and C&D and MSW waste mass are provided in the Supplemental Geotechnical Evaluation completed by AET. Additionally, the supplemental report includes the stability of the underlying liner system and

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stability of the interim slopes. Anchor trench design calculations as well as veneer stability of liner materials during construction have also been provided in Appendix 3G.

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).

The stability analysis of the final cover system indicated that for the maximum calculated head on top of the LLDPE liner along 3H:1V side slopes (0.67-feet) and with seepage parallel to the liner, the calculated factor of safety is 1.33 and for gravity only conditions, the calculated factor of safety is 1.61.

54. *The AET report does not include settlement analyses for foundation soils. Please note, if the foundation soils settle excessively due to the additional waste overburden, the base liner system will be subjected to excessive tensile stress causing the geosynthetic liner to stretch beyond the allowable design strain. In addition, settlements of foundation soils may adversely affect the design grades of the existing leachate collection system in the existing Sector K. Therefore, the relationship between the additional piggy-back loading and foundation soils settlement needs to be evaluated. Please revise the submittal as appropriate.*

    Additional discussion and calculations have been completed regarding waste mass stability and are included in Appendix 3G. A settlement analysis for foundation soils has been included in the Supplemental Geotechnical Evaluation completed by AET. Results indicate that 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.

55. *Please provide a final cover system so that a clay-rich soil cover layer consisting of a minimum of 18 inches of earthen material with a coefficient of permeability no greater than 1 x 10^{-5} cm/sec will be overlain by a synthetic membrane. Please revise the application as appropriate, including Section 3.8 and Drawing P3-34 (Final Cover Details).*

    The prescriptive final cover profile has been updated in Section 3.8 and Drawing P3-34 to reflect the above comment.

56. *Please describe methods and procedures to be used to install the final cover in accordance with 30 TAC §330.457(e)(1).*

    The methods and procedures are provided in Appendix 3P – Final Cover Quality Control Plan in accordance with 30 TAC §330.457(e)(1).

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57. *Please revise Drawing P3-16 to provide the surface drainage features and the flood protection features for 100-year floodplain as required by 30 TAC §330.457(e)(5). Please also ensure to provide cross sectional details for any structural features to be constructed.*

    As discussed in the response to comment #35, the calculations for soil erosion show that the potential soil loss is less than the permissible soil loss and the calculations for the velocities show that the peak velocities are less than the permissible non-erodible velocities. Structural designs for collection and conveyance along the top and side slopes (i.e., berms, dikes, chutes) are not proposed for the final cover design. The 100-year floodplain location has been added to Drawing P3-6. Cross sectional details for Retention Pond A are provided on Drawing P3-8.

58. *Please revise Section 3.8.4 to address the rule requirements of 30 TAC §330.457(g) that the owner or operator shall submit a certified copy of the modified deed to the executive director and place a copy of the modified deed in the operating record within the specified time frame.*

    Section 3.8.4 has been updated to include this language.

59. *Please include a statement in Section 3.8.4 that the owner and operator shall submit to the executive director a certified copy of an "affidavit to the public" in accordance with the requirements of 30 TAC §330.19 and 30 TAC §330.457(g) (relating to Deed Recordation and Closure Requirements for Municipal Solid Waste Landfill Units that Receive Waste on or after October 9, 1993).*

    The language within Section 3.8.4 has been updated to clearly state the requirements of 30 TAC §330.457(g).

60. *Please note that the closure, post-closure, or corrective action cost estimate requirements apply to owners and operators of any municipal solid waste facility authorized under this chapter are required to have financial assurance. Please address the rule requirements of 30 TAC Chapter 330, Subchapter L: Closure, Post-Closure, and Corrective Action Cost Estimate (30 TAC §330.503, §330.507 and §330.509).*

    Closure cost estimates are provided in Section 3.8.6 and Appendix 3N, Attachment 3 in accordance with 30 TAC §330.503. Provisions for financial assurance have also been included in Appendix 3N, Attachment 3.

    Post-closure cost estimates are provided in Section 3.9.6 and Appendix 3O in accordance with 30 TAC §330.507. Provisions for financial assurance have been included in Appendix 3N, Attachment 3.

    The Landfill is not required to take corrective action under 30 TAC §330.415 as required by 30 TAC §330.509(a) and therefore is not required to establish a financial assurance fund for corrective action.

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The following comments are provided by Mr. Jason Wang, P.G., of the TCEQ:

Part II

61. *Section 2.3.2 Facility Layout Map – Location of Monitor Wells Map p2-7.0 indicated only 3 groundwater monitor wells MW-1, 2, and 3. Please propose additional monitor wells that will satisfy the 600 feet maximum spacing at the point of compliance in accordance with 30 TAC §330.403(a)(2).*

    The Landfill is currently in the process of determining the site specific groundwater characteristics. The Landfill installed two additional groundwater monitoring points last year (July 2011) and is in the process of completing a one-year monitoring and observation period to determine the predominant groundwater flow direction. Upon completion of the monitoring and observation period, the consulting engineer for that project will provide recommendations as to the future groundwater monitoring site development plan. Once the groundwater assessment is completed the groundwater monitoring system can be designed and provided to TCEQ for review.

62. *Section 2.8.1 Abandoned Oil and Water Wells – Please discuss if any of the existing water wells are located within the facility boundary.*

    There are no existing water wells located within the permitted boundary or the total area to be used for the Landfill.

Part III

Geology Report, Appendix 3K

63. *Section 3.5 Attachment 3, Borings – The soil boring information in the application is from 1983. The borings and the information they yielded may have been adequate for the existing landfill design at the time it was permitted; however, the application proposes excavation plans and depths, as shown in drawings P3-21.0 and P3-22.0, that are not part of the current permit. The original borings alone do not appear to be sufficient in number, distribution, and depth to meet current regulatory standards for characterizing a landfill site. Please review the requirements of 30 TAC §330.63(e)(4) and determine where supplemental borings may be needed to fulfill characterization needs and to comply with the current rule requirements. Please develop and provide an updated Soil Boring Plan for the site for our review and approval to meet the requirements of the referenced rule. Required additional borings and documentation of results should be completed and submitted with the response to this NOD letter or further review of the application will be suspended.*

    The base grades provided on Drawings P3-21 and P3-22 for the sectors that are not constructed were approved in the Permit No. 729A and under the previous rules. The Landfill is not

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requesting an increase in the landfill depth from the previous approval nor a lateral expansion to the permitted waste footprint. As per discussions with the TCEQ, an updated geology report is not necessary.

64. *Section 3.5– Please resubmit the entire Geology Report in a format that can be reviewed in accordance with 30 TAC §330.63(e)(1) through §330.63(e)(5)(F). The 1993 geology report by SHB AGRA Inc. is outdated and does not contain sufficient information to be reviewed under the current regulations. The data submitted are not organized into appropriate sections and do not follow the Municipal Solid Waste Permits Technical Review Checklist structure as presented in other portions of the major amendment application. Many of the photocopy pages of the 1993 report are illegible. The maps and drawings must be updated and resubmitted to be consistent with other figures presented in the major amendment application. All new geology maps, boring logs, and drawings must be sealed by a professional geologist.*

    An updated Section 3.5 detailing the contents of the Geology Report in Appendix 3K has been provided.

    The 2-mile water well search was updated for the first technical NOD response and is provided in Appendix 3K, Attachment 2. The scanned quality of the documents is as they were located on the Texas Water Development Board (TWDB) Water Information Integration and Dissemination (WIID) database and are considered the best version available.

Landfill Gas Management Plan

65. *Section 3.7– Please add text to include a backup plan that describes actions to be taken if the main gas monitoring and control system breaks down or becomes ineffective. This backup plan will be a separate subsection than the maintenance procedures.*

    In the event that the gas monitoring and control system becomes ineffective, actions will be taken in accordance with Section 3.7.7 – Remediation Plan. In the event that the gas monitoring and control system breaks down, procedures to initiate repairs will be taken in accordance with Section 3.7.8.

Appendix 3L - Groundwater Sampling and Analysis Plan

66. *Please indicate the location of proposed Point of Compliance on Figure P3-36.0.*

    See response to item 61. Once the groundwater assessment is completed, the groundwater monitoring system can be designed and provided to TCEQ for review.

67. *Please submit an analysis of the most likely pathway(s) for pollutant migration in the event the primary barrier liner system is penetrated as required under 30 TAC §330.63(f)(3).*

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See response to item 61. Once the groundwater assessment is completed, the groundwater monitoring system can be designed and provided to TCEQ for review.

68. *Please submit a documented certification signed by a qualified groundwater scientist that the facility is in compliance with the groundwater monitoring requirements.*

See response to item 61. Once the groundwater assessment is completed, the groundwater monitoring system can be designed and provided to TCEQ for review.

69. *Please propose additional monitor wells to be installed at the Point of Compliance. The current monitor well locations indicated on Figure P3-36.0 do not satisfy the maximum distance of 600 feet between wells at the Point of Compliance.*

See response to item 61. Once the groundwater assessment is completed, the groundwater monitoring system can be designed and provided to TCEQ for review.

70. *Please submit a plan for the design of the monitoring system that includes a thorough characterization of the parameters listed in 30 TAC §330.403(e)(1).*

See response to item 61. Once the groundwater assessment is completed, the groundwater monitoring system can be designed and provided to TCEQ for review.

Appendix 3N – Use of Alternative Cap

71. *The plant coverage was assumed to be 10% when the vegetative cover is established. Please provide a more detailed discussion to justify that the water balance alternative final cover design provides equivalent protection from wind and water erosion as the erosion layer specified in 30 TAC §330.457(a)(3).*

Due to the air conditions at the Landfill, the vegetative cover was removed from the alternative cap profile and replaced with 4-inches of rock armor. The rock armor will consist of graded material to provide an interlocking frame in order to help slope stability and minimize surface water erosion.

72. *Please explain how the Potential Evapotranspiration (PET) is calculated. If the PET is based on real weather data, please explain how the values are derived from seasonal variations.*

Site specific data for PET are not available and a sine function was used to distribute the PET. PET values are summarized in Table 3N-4 and weather data utilized for the 30-year modeling period are provided in Appendix 3N, Attachment 1.

73. *Please explain how the Transpiration and Evaporation values are derived for different supportive layer simulations.*

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Transpiration is calculated within the UNSAT-H model utilizing user provided "suction head values that define how the potential transpiration rate applied to a particular node is reduced" (UNSAT-H manual). The suction head values for the different soil parameters are provided in Table 3N-2. As shown in Table 3N-7, due to the lack of vegetation, the actual transpiration is zero for the 30-year model period.

Evaporation is calculated using "the PET concept. The user supplies…daily weather data, with which the code calculates daily PET values using the Penman equation. During each time step, the code attempts to apply the potential evaporation rate. If the soil surface dries to or above a user-defined matric potential limit, the time step is re-solved using a Dirichlet condition at the surface. In this situation, the surface potential is held constant at the matric potential limit and evaporation is set equal to the flux from below." (UNSAT-H manual). Weather data is provided in Appendix 3N, Attachment 1 and actual evaporation values for the UNSAT-H modeling are also provided in Table 3N-7.

74. *A mixture of Sideoats Grama, Blue Grama, Fourwing Saltbush, Sand Dropseed and Akali Sacaton is proposed to be used for the vegetative cap. The root penetration depth of 30 inches is expected. This would indicate root penetration into the intermediate cover. Please explain if this root depth is simulated in the model.*

    As described in response to comment #71, the vegetative cover was removed from the alternative cap modeling.

75. *Please clarify if the 12 inches of intermediate cover serves as a capillary break for the proposed ET cover. Please also provide the soil characteristics of the intermediate cover and explain if the 30 inches root depth will disrupt this capillary break.*

    As described in response to comment #71, the vegetative cover was removed from the alternative cap modeling; therefore the root depth will not disrupt the capillary break between the 18-inch erosion layer and 6-inch support layer.

76. *The UNSAT-H Model Summary Table seems to include 12 inches of intermediate cover as part of the ET cover in the titles. Please clarify if the simulations actually included the intermediate cover.*

    The intermediate cover is not part of the ET cover. The modeling of the alternative cap includes the 4-inch rock armor, 18-inch erosion layer and 6-inch support layer. The intermediate cover is part of the waste filling operations.

77. *Please specify the nodal spacing for the simulation from the surface to the bottom layer and justify the number of nodes used. Figure 1, Moisture Content Distribution, referenced UNSAT-H*

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results for the node information. This information has not been submitted in the major amendment application.

The input and output files for the UNSAT-H modeling have been provided. The nodal spacing utilized for the modeling is specified in Table 3N-1 (43 nodes).

78. *Please provide a table of input parameter summary for UNSAT H, in accordance with the user manual by Fayer (2000), with each parameter name, parameter description, range of values, and explanation of values used. This table should include options used, soil characteristics values, initial conditions, plant information, and boundary conditions.*

The summary of input parameters used for UNSAT-H modeling is provided as Table 3N-1.

79. *Please submit the model input and output files.*

UNSAT-H model input and output files have been included in Appendix 3N, Attachment 1.

80. *Tables 1-1 and 1-2 indicated extremely high saturated hydraulic conductivity values (25.8 cm/s and 20.5 cm/s). Please correct the units to match the values provided in the laboratory test results.*

All values have been updated to reflect the laboratory testing results provided in Appendix 3N, Attachment 2.

81. *Please submit soil water retention curves for 75%, 80%, and 85% compaction and their van Genuchten parameter values.*

Soil testing results have been provided in Appendix 3N, Attachment 2.

82. *Please submit graphs to represent moisture content versus hydraulic conductivity for 75%, 80%, and 85% compaction for the site soils.*

Soil testing results have been provided in Appendix 3N, Attachment 2.

83. *Please illustrate how the theoretical total water storage capacity of the proposed cover for the 12 inches topsoil vegetation layer and the 12 inches supportive layer is calculated.*

The moisture content varies greatly in the 18-inch erosion 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 (6-inch support soil), moisture values remain fairly constant. This demonstrates the suitability of the material as an ET cover in providing water storage in the cap. Water storage values for each year end are summarized in Table 3N-7. These values are calculated via the UNSAT-H model.

84. *Please list the numerical value used for each layer for the following parameters in a table format: measured saturated water content; field capacity water content; wilting point water*

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content, volumetric storage capacity; and layer storage. These values must be based on laboratory measured values from actual site soil samples and not based on soil classification and assumed values from U.S. EPA HELP Model.

The summary of the UNSAT-H parameters for the soil layers are provided in Table 3N-3.

85. *Please submit construction diagrams of the proposed ET cover, side slope, drainage divergence berms, and tie-ins to the existing composite cover.*

Details of the proposed ET cover are provided on Drawing P3-35.

86. *Please submit a slope stability demonstration showing the detailed calculations on how the factor of safety is derived using soil laboratory data. Please also indicate whether the calculated factor of safety also represents the worst case scenario.*

Slope stability analysis for the alternative final cover has been completed and is included in Appendix 3G. The calculations were completed using the soil testing results included in Appendix 3N, Attachment 2. The factor of safety calculated for the alternative final cover is 1.41 with no water flow.

87. *Please submit an Alternative Final Cover Construction Quality Control Plan. Please see TCEQ Regulatory Guidance Document RG-494, Guidance for Requesting a Water Balance Alternative Final Cover for a Municipal Solid Waste Landfill, dated January, 2012.*

A Final Cover Construction Quality Control Plan (including alternative final cover) has been prepared and is included in Appendix 3P.

Part IV

88. *Section 4.9.3 Facility Hours – Please provide more specific language on the operating hours. The proposed text "However, the Landfill may extend the operating hours to within 6:00 a.m. to 7:00 p.m., seven days a week in accordance with the hours permitted for the Landfill" is unclear.*

The section has been updated to clarify this language. The Landfill typically accepts wastes from 7 am to 4 pm six days a week; however, the Landfill has the option to extend the waste acceptance hours to within the hours of 6 am to 7 pm seven days a week per the permitted hours for the Landfill.

89. *Section 4.9.4 Site Sign – The TCEQ permit number will be MSW 729B once the major amendment is issued. Please make the correction from MSW 729A.*

This section has been updated to include the correct reference.

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90. *Section 4.9.6 Easements and Buffer Zones – Please note that for vertical expansion, in accordance with 30 TAC §330.543(b)(2)(B), requires a 125-foot buffer zone instead of the proposed 50-foot minimum buffer zone. Please revise the proposed text.*

    The text has been revised to include the correct buffer zone language.

91. *Section 4.9.7 Landfill Markers and Benchmark – Please add text to reflect rule requirements under 30 TAC §330.143(b)(5) that intermediate markers for the grid system must be installed, where feasible.*

    The section has been updated to include reference to the rule.

92. *Section 4.9.7 Landfill Markers and Benchmark – Please add text to reflect rule requirements under 30 TAC §330.143(b)(6) that area markers will not be placed inside constructed soil liner or geomembrane area.*

    The section has been updated to include reference to the rule.

93. *Section 4.9.15 Landfill Gas Control – The landfill gas monitoring report form submitted in Appendix 4A listed GMP numbers that do not match the GMP numbers listed in Table 3.7-1 of the Landfill Gas Management Plan. Please make the necessary corrections to ensure consistency.*

    The form located within Appendix 4A have been updated to correctly list the landfill gas wells located onsite.

94. *Section 4.9.16 Oil, Gas and Water Wells – Please include language to reflect rule requirements under 30 TAC §330.161(a) that the notification of discovery of a water well within the facility boundary is submitted within 30 days of its discovery along with the well plugging certification.*

    The section has been updated to reflect the referenced rule.

95. *Section 4.9.18.3 Alternative Material Daily Cover – Please add text to include 30 TAC §330.165(d)(5) requirement that alternative daily cover must not exceed constituent limitations imposed on waste authorized to be disposed at the facility.*

    The section has been updated to reflect the referenced rule.

96. *Section 4.9.18.6 Erosion of Cover – Please add text to specify frequency of inspection of final cover and methods for documenting repairs in the cover inspection records.*

    The section has been updated to reflect 30 TAC §330.463(a)(1).

97. *Section 4.9.19 Ponded Water – Please explain how the water that has contacted waste and contaminated water will be disposed of properly. Please also explain how the water that may*

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pond at the working face will be removed and disposed properly. The explanation must include detailed description on each step of removal, transfer, and disposal.

Contaminated Water Management is addressed in Appendix 3I.3 and Appendix 3I Attachment 3.

Should you have any questions or required additional information during the review of this permit application, 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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SAIC

January 18, 2012

Eric Reese
Team Leader
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

Subject: **Major Permit Amendment Administrative NOD**
McCombs Municipal Solid Waste Landfill Permit No. 729B

Dear Mr. Reese:

On behalf of the City of El Paso, SAIC Energy, Environment & Infrastructure, LLC (SAIC) is providing the information requested by the Texas Commission on Environmental Quality (TCEQ) administrative notice of deficiency (NOD) letter received December 22, 2011. The TCEQ comment is provided in *italic print* followed immediately by the response.

- *Please revise and resubmit the Title Pages to show the Municipal solid waste permit application number; the name of the owner and operator; the location by city and county the date the part was prepared; including a current Professional Engineers (P.E.) Seal on each page and, if appropriate, the number and date of the revision. 30 TAC 330.57 (g) (2). The permit application number should be written as 729B.*

  The updated Title Pages and Table of Contents are provided in Attachment 1. Please remove and replace the previously provided pages with the updated pages. Additionally, updated cover pages and side labels have been provided that show the correct application number for your convenience.

- *Please provide the name for the public place in the county where the facility is, or will be located for review and copying by the public and resubmit page 3 with the correct site location information.*

  The updated page 3 of the TCEQ-0650, Part I Application Form is provided in Attachment 2 (along with the entirety of the Part I Application Form). Please remove and replace the previously provided page 3 with the updated page 3.

- *Please provide publicly accessible internet Web site, the Web address link for the application materials. This internet posting is for informational purposes only.*

  The internet access website is the same as previously provided. The City has uploaded the Major Permit Amendment Application with the Revision 1 changes to this website.

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- *Please provide the name and mailing address for the current State Senator in the district in which the facility is or will be located. Either local district addresses or capital addresses are acceptable. Please review and resubmit page 5 with the correct information. 30 TAC §39.103(b).*

  The updated page 5 of the TCEQ-0650, Part I Application Form is provided in Attachment 2 (along with the entirety of the Part I Application Form). Please remove and replace the previously provided page 5 with the updated page 5.

- *Please submit the name of the individual who will be responsible for publishing newspaper notice to the public, include the complete mailing address, telephone number, and fax number. Please provide an e-mail address for that individual as well, if available. 30 TAC §39.501(c).*

  The individual responsible for publishing newspaper notice to the public has been provided in Attachment 3. Please add the additional information page to the major permit amendment application following the Part 1 Application Form.

- *Please submit the name and mailing address of the mayor and city health authority of the municipality in whose territorial limits or extraterritorial jurisdiction the facility is or will be located. In addition, please provide the name and mailing address of the county judge and the health authority of the county in which the facility is located, if applicable. 30 TAC §39.103(c).*

  The name and mailing address of the mayor, city health authority, and county judge have been provided in Attachment 3. The health authority of the county is appointed through the City; and therefore does not exist. Please add the additional information page to the major permit amendment application following the Part 1 Application Form.

- *Please submit an electronic copy of the names and addresses of the adjacent landowners only, in the proper format. It must be submitted on a separate CD using Microsoft Word processing software of a 100% compatible format containing* ***3 columns per page and 10 names per column****. Each name and address must be typed in the format that meets the United States Postal Service requirements for machine readability.* ***Each letter in the name and address much be capitalize, contain no punctuation, and the appropriate two-character abbreviation must be used for the state.*** *Alternatively you may submit* ***four complete set of pre-printed labels of this mailing list****. If you wish to provide the list on printed labels, please use sheets of labels that have 30 labels to a page, 3 columns per page and 10 names per column. Omit permit number and applicant's name on the top line when sending labels. 30 TAC §281.5, 30 TAC §330.59(c), (3)(B) and 30 TAC §305.-45(a)(6)(D); 281.5(6).*

  The mailing labels have been formatted as requested and are provided in Attachment 4 of the original document. Actual mailing labels are intentionally not provided in the three (3) application revision copies.

- *Please submit current documentation of coordination with the Texas Department of Transportation (TXDOT) for traffic and location restrictions. The letter should have a current date in context to the application date. A copy of your letter requesting the information from*

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TXDOT is sufficient, at this time. When a response from the TXDOT is received, please forward a copy for inclusion into the permit application. 30 TAC §330.61(i)(4).

A copy of the letter submitted to the TxDOT has been provided in Attachment 5. Please add this letter to Appendix 2C of the major permit amendment application. It is important to note that the referenced Attachment 1 in the letter to the TxDOT has not been provided to the TCEQ as it contains the information already provided in Appendix 2C.

- *Please submit current documentation of coordination with the United States Fish and Wildlife Service and Texas Parks and Wildlife Department. The letter should have a current date in context to the application date. A copy of the applicant's cover letter to the Texas Parks and Wildlife Department and United States Fish and Wildlife Service requesting this evaluation is sufficient, at this time. When a response from the United States Fish and Wildlife Service and Texas Parks and Wildlife Department is received, please forward a copy for inclusion into the permit application. 30 TAC §330.61(n)(1)(2).*

  Copies of the letters submitted to the Texas Parks and Wildlife Department and the U.S. Fish and Wildlife Service have been provided in Attachment 6. Please add these letters to Appendix 2F of the major permit amendment application. It is important to note that the referenced Attachment 1 in the letters have not been provided to the TCEQ as they contain the information already provided in Appendix 2F. Additionally, Section 2.10 (Revision 1) has been updated to reflect this correspondence and is provided in Attachment 7. Please remove and replace the previously provided Section 2.10.

- *Please submit documentation of coordination with the Federal Aviation Administration for compliance with airport location restrictions. A copy of the applicant's cover letter to the Federal Aviation Administration requesting this evaluation is sufficient, at this time. 30 TAC §330.61(i)(5). & 30 TAC §330.545(a).*

  A copy of the letter submitted to the FAA has been provided in Attachment 5. Please add this letter to Appendix 2C of the major permit amendment application. Additionally, Section 2.5 (Revision 1) has been updated to reflect this correspondence and is provided in Attachment 8. Please remove and replace the previously provided Section 2.5.

- *Please resubmit map or maps of the facility which clearly shows the information specified in 30 TAC §330.57(h)(5). Specifically, north arrow, base map source, legends, dates, and P.E. Seal, if applicable.*

  The updated maps have been provided in Attachment 9. Please note that a general facility legend is provided as part of the TOC of each section as Drawing No. P0-2.0. Please remove and replace the previously provided maps with the updated maps as indicated.

- *Please submit a complete Core Data Form.*

  The updated Core Data Form is provided in Attachment 10. Please remove and replace the previously provided form with the updated pages.

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- *Please submit an original response and three (3) copes of your application revisions, including new signature pages with current dates for the Part I application.*

  The updated Part I application is provided in Attachment 2. One original plus three copies of all requested materials have been provided for the TCEQ (with the exception of the mailing labels, which are only provided in the original application revision).

Should you have any questions or required additional information during the review of this permit application, 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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SAIC

November 22, 2011

Texas Commission on Environmental Quality
Attention: Waste Permits Division, MC 126
P.O. Box 13087
Austin, Texas 78711-3087

Subject: **Major Permit Amendment**
McCombs Municipal Solid Waste Landfill Permit No. 729A

Dear Waste Permit Division:

On behalf of the City of El Paso, SAIC Energy, Environment and Infrastructure, LLC (SAIC) is submitting the original application plus three copies of the enclosed document entitled, "Major Permit Amendment, McCombs Municipal Solid Waste Landfill Permit No. 729A", prepared by SAIC, and dated November 2011. The application includes Parts I through IV as required by the Texas Commission on Environmental Quality (TCEQ). In addition, SAIC is providing the TCEQ with twelve (12) additional copies of Part I: General Information, of the application and a CD containing an electronic mailing list of the adjacent landowners.

The completed TCEQ Core Data Form and TCEQ Permit Application Form for Part I are provided immediately after this cover letter. Payment documentation can be located in the Part I, Section 1.8.

It should be noted that a signed approval letter from the Rio Grande Council of Governments (COG) will be provided upon receipt (anticipated in January 2012) and that the letter provided in Part II, Appendix 2H is a draft letter that was provided by the COG until a signed original is received.

Should you have any questions during the review of this permit application, please contact Fred Doran at (651) 994-8415 or fredric.j.doran@saic.com and/or Scott Pasternak at (512) 651-6405 or scott.r.pasternak@saic.com.

Sincerely,

SAIC Energy, Environment & Infrastructure, LLC

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

Scott R. Pasternak
Assistant Vice President

c w/encl: Miguel Parra, City of El Paso
Sarah Kutnink, P.E., SAIC

9631500115-6000 | Cover Letter.docx

TCEQ Use Only

TCEQ Core Data Form

For detailed instructions regarding completion of this form, please read the Core Data Form Instructions or call 512-239-5175.

SECTION I: General Information

1. Reason for Submission *(If other is checked please describe in space provided)*

☐ New Permit, Registration or Authorization *(Core Data Form should be submitted with the program application)*

☐ Renewal *(Core Data Form should be submitted with the renewal form)* ☒ Other **Major Permit Amendment**

2. Attachments — Describe Any Attachments: *(ex. Title V Application, Waste Transporter Application, etc.)*

☒ Yes ☐ No — Municipal Solid Waste Major Permit Amendment Application

3. Customer Reference Number *(if issued)*	Follow this link to search for CN or RN numbers in Central Registry**	4. Regulated Entity Reference Number *(if issued)*
CN **601410244**		RN **100215599**

SECTION II: Customer Information

5. Effective Date for Customer Information Updates (mm/dd/yyyy): No Change

6. Customer Role (Proposed or Actual) – *as it relates to the Regulated Entity listed on this form. Please check only one of the following:*

☐ Owner ☐ Operator ☒ Owner & Operator
☐ Occupational Licensee ☐ Responsible Party ☐ Voluntary Cleanup Applicant ☐ Other: _____

7. General Customer Information

☐ New Customer ☐ Update to Customer Information ☐ Change in Regulated Entity Ownership
☐ Change in Legal Name (Verifiable with the Texas Secretary of State) ☒ No Change**

If "No Change" and Section I is complete, skip to Section III – Regulated Entity Information.

8. Type of Customer:			
☒ City Government	☐ County Government	☐ Federal Government	☐ State Government
☐ Other Government	☐ General Partnership	☐ Limited Partnership	☐ Other:

9. Customer Legal Name *(If an individual, print last name first: ex: Doe, John)* — *If new Customer, enter previous Customer below* — *End Date:*

No Change (Items 9 - 21)

10. Mailing Address:

City		State		ZIP		ZIP + 4	

11. Country Mailing Information *(if outside USA)*	12. E-Mail Address *(if applicable)*

13. Telephone Number	14. Extension or Code	15. Fax Number *(if applicable)*
( ) -		( ) -

16. Federal Tax ID *(9 digits)*	17. TX State Franchise Tax ID *(11 digits)*	18. DUNS Number *(if applicable)*	19. TX SOS Filing Number *(if applicable)*

20. Number of Employees: ☐ 0-20 ☐ 21-100 ☐ 101-250 ☐ 251-500 ☐ 501 and higher

21. Independently Owned and Operated? ☐ Yes ☐ No

SECTION III: Regulated Entity Information

22. General Regulated Entity Information *(If 'New Regulated Entity" is selected below this form should be accompanied by a permit application)*

☐ New Regulated Entity ☐ Update to Regulated Entity Name ☐ Update to Regulated Entity Information ☒ No Change** *(See below)*

**If "NO CHANGE" is checked and Section I is complete, skip to Section IV, Preparer Information.

23. Regulated Entity Name *(name of the site where the regulated action is taking place)*

No Change (Items 23 - 34)

24. Street Address of the Regulated Entity: *(No P.O. Boxes)*							
	City		**State**		**ZIP**		**ZIP + 4**
25. Mailing Address:							
	City		**State**		**ZIP**		**ZIP + 4**

26. E-Mail Address:		
27. Telephone Number	**28. Extension or Code**	**29. Fax Number** *(if applicable)*
( ) -		( ) -

30. Primary SIC Code (4 digits)	**31. Secondary SIC Code** (4 digits)	**32. Primary NAICS Code** (5 or 6 digits)	**33. Secondary NAICS Code** (5 or 6 digits)

34. What is the Primary Business of this entity? *(Please do not repeat the SIC or NAICS description.)*

Questions 34 – 37 address geographic location. Please refer to the instructions for applicability.

35. Description to Physical Location:	No Change (Items 34 - 38)

36. Nearest City	**County**	**State**	**Nearest ZIP Code**

37. Latitude (N) In Decimal:			**38. Longitude (W) In Decimal:**		
Degrees	Minutes	Seconds	Degrees	Minutes	Seconds

39. TCEQ Programs and ID Numbers Check all Programs and write in the permits/registration numbers that will be affected by the updates submitted on this form or the updates may not be made. If your Program is not listed, check other and write it in. See the Core Data Form instructions for additional guidance.

☐ Dam Safety	☐ Districts	☐ Edwards Aquifer	☐ Industrial Hazardous Waste	☒ Municipal Solid Waste
				729A
☐ New Source Review – Air	☐ OSSF	☐ Petroleum Storage Tank	☐ PWS	☐ Sludge
☐ Stormwater	☐ Title V – Air	☐ Tires	☐ Used Oil	☐ Utilities
☐ Voluntary Cleanup	☐ Waste Water	☐ Wastewater Agriculture	☐ Water Rights	☐ Other:

SECTION IV: Preparer Information

40. Name:	Fred Doran	**41. Title:**	Project Manager

42. Telephone Number	**43. Ext./Code**	**44. Fax Number**	**45. E-Mail Address**
(651) 289-2508	N/A	(651) 994-8396	fredric.j.doran@saic.com

SECTION V: Authorized Signature

46. By my signature below, I certify, to the best of my knowledge, that the information provided in this form is true and complete, and that I have signature authority to submit this form on behalf of the entity specified in Section II, Field 9 and/or as required for the updates to the ID numbers identified in field 39.

(See the Core Data Form instructions for more information on who should sign this form.)

Company:	City of El Paso	**Job Title:**	Director of Environmental Services
Name *(In Print)*:	Ellen A. Smyth	**Phone:**	(915) 621-6719
Signature:		**Date:**	01/13/12

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. 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.
www.elpasotexas.gov/environmental_services

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, Ellen A. Smyth,
(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."

Ellen A Smyth — (Owner signature)

10-30-12 — (Date)

Signature Page

I, Ellen A. Smyth (Operator), Director, Environmental Services (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: Ellen A Smyth Date: 10-30-2012

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 Ellen A. Smyth

On this 30th day of October, 2012

My commission expires on the 26th day of January, 2014

BLANCA A. IRROBALI
Notary Public, State of Texas
My Commission Expires
JANUARY 26, 2014

Blanca A Irrobali
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 November 2012, Revision 3

SAIC

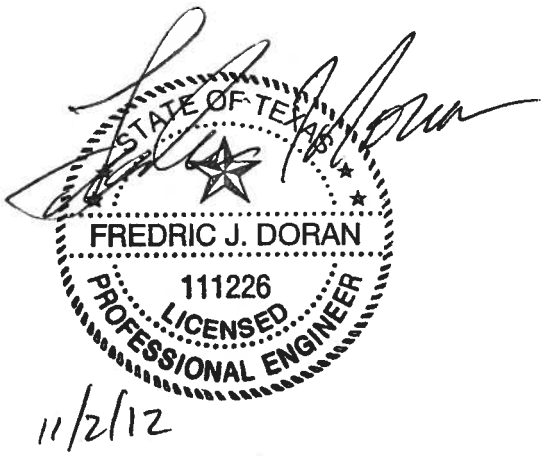
McCombs Municipal Landfill
El Paso County, Texas
TCEQ MSW Permit No. 729B

Major Permit Amendment Application
Part I

Prepared for

City of El Paso

Updated November 2012, Revision 3



11/2/12

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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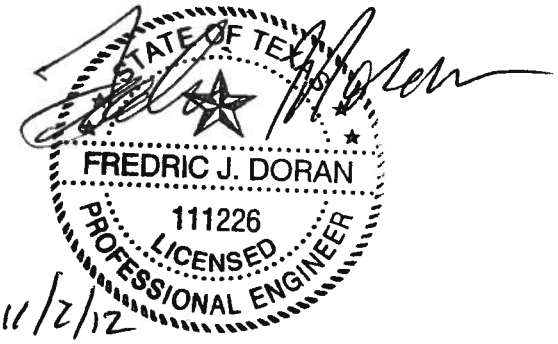

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This report has been prepared for the use of the client for the specific purposes identified in the report. The conclusions, observations and recommendations contained herein attributed to SAIC constitute the opinions of SAIC. To the extent that statements, information and opinions provided by the client or others have been used in the preparation of this report, SAIC has relied upon the same to be accurate, and for which no assurances are intended and no representations or warranties are made. SAIC makes no certification and gives no assurances except as explicitly set forth in this report.

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76	P3–43	3M	LANDFILL GAS MONITORING PROBE PLAN
77	P3–44	3M	LANDFILL GAS MONITORING PROBE DETAILS
78	P3–45	3N	LARGEST AREA REQUIRING FINAL CLOSURE

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2	11/2/12	TLK	FJD	SECOND TECHNICAL NOD
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THE CITY OF EL PASO TEXAS

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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
	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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DRAWN	CAD
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ABBREVIATIONS AND LEGEND

PROJECT NUMBER: 9631500115
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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 46,148,275 cubic yards (CY) from a previously permitted volume of 22,348,549 CY to a new permitted volume of 68,496,824 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 either the prescriptive final cover or alternative final cover). The maximum rate of disposal is estimated to be approximately 2,694,000 tons per year (2059). 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 major permit amendment 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 consist of (Class 3 like) inert wastes including (but not limited to) rock, brick, glass, dirt, certain plastics, rubber, and similar materials that are not readily decomposable. 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 2041.

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 permitted/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.

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

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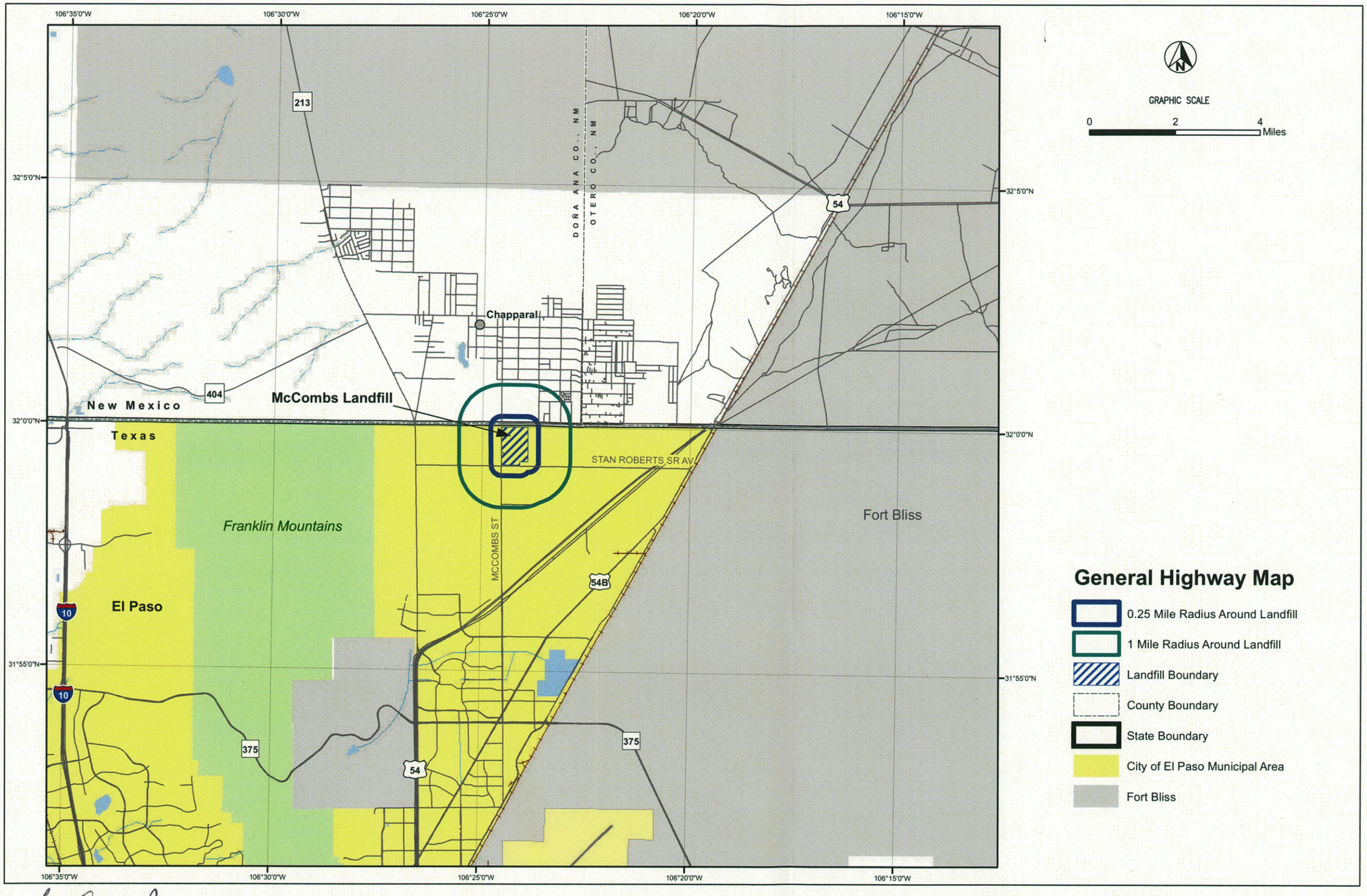

GRAPHIC SCALE

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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11/2/12

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0 1"

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1	1/13/12	FJD	CGL	ADMINISTRATIVE NOD
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GENERAL HIGHWAY MAP

PROJECT NUMBER: 9631500115
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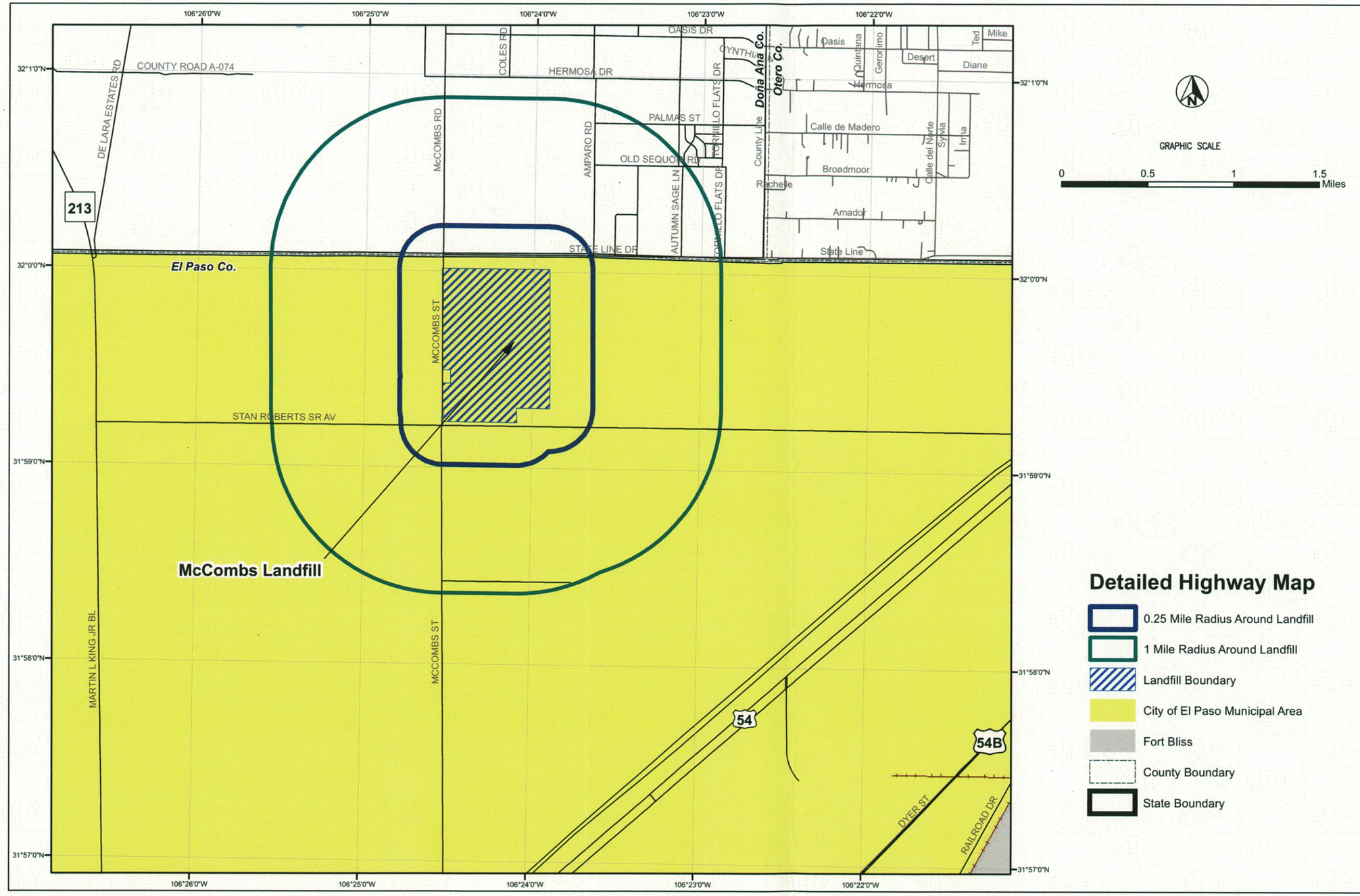
NOTES

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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DETAILED HIGHWAY MAP

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

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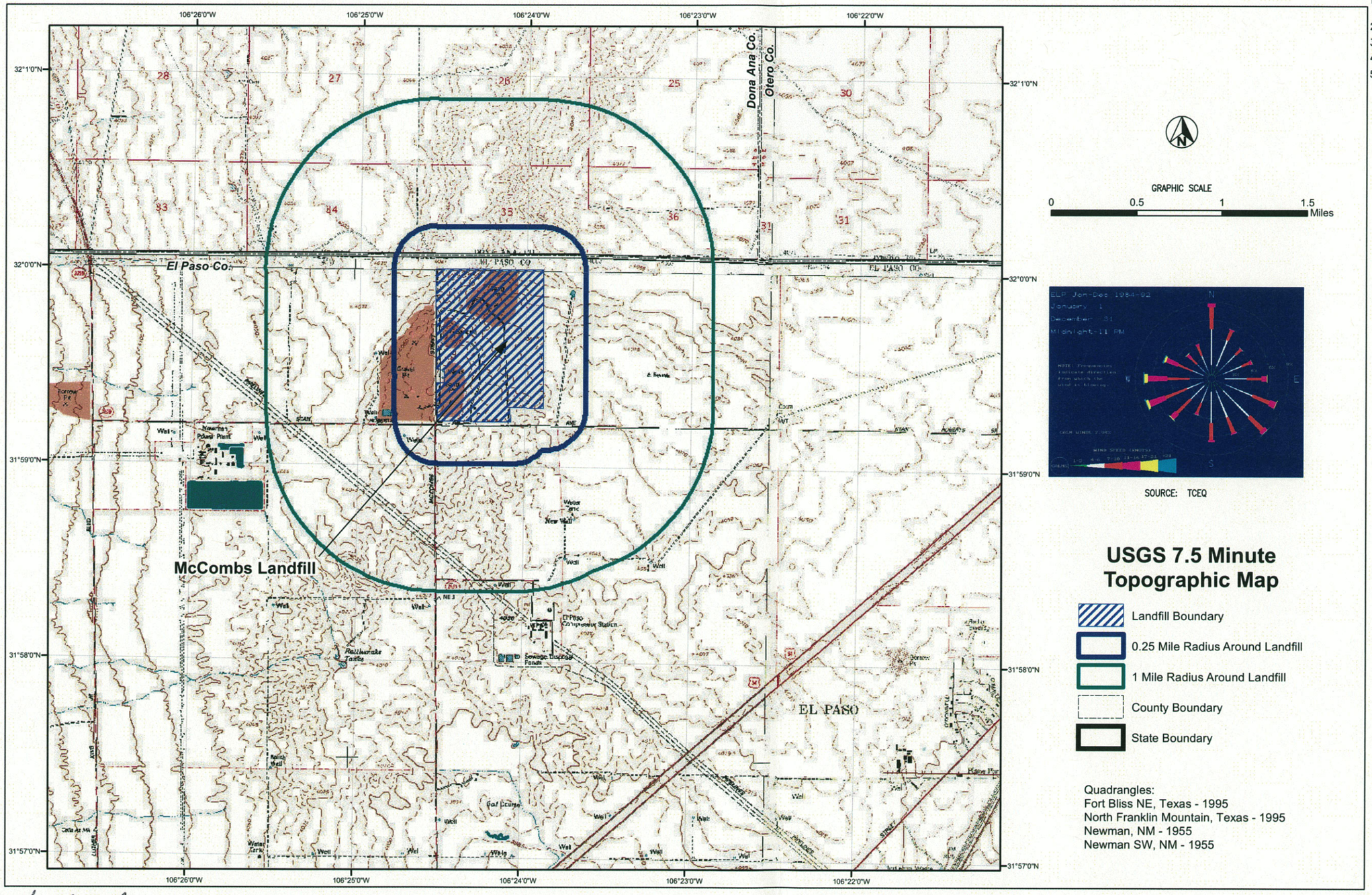
NOTES

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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GENERAL TOPOGRAPHIC MAP

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

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Appendix 1B
Land Owner Map and Land Owners List

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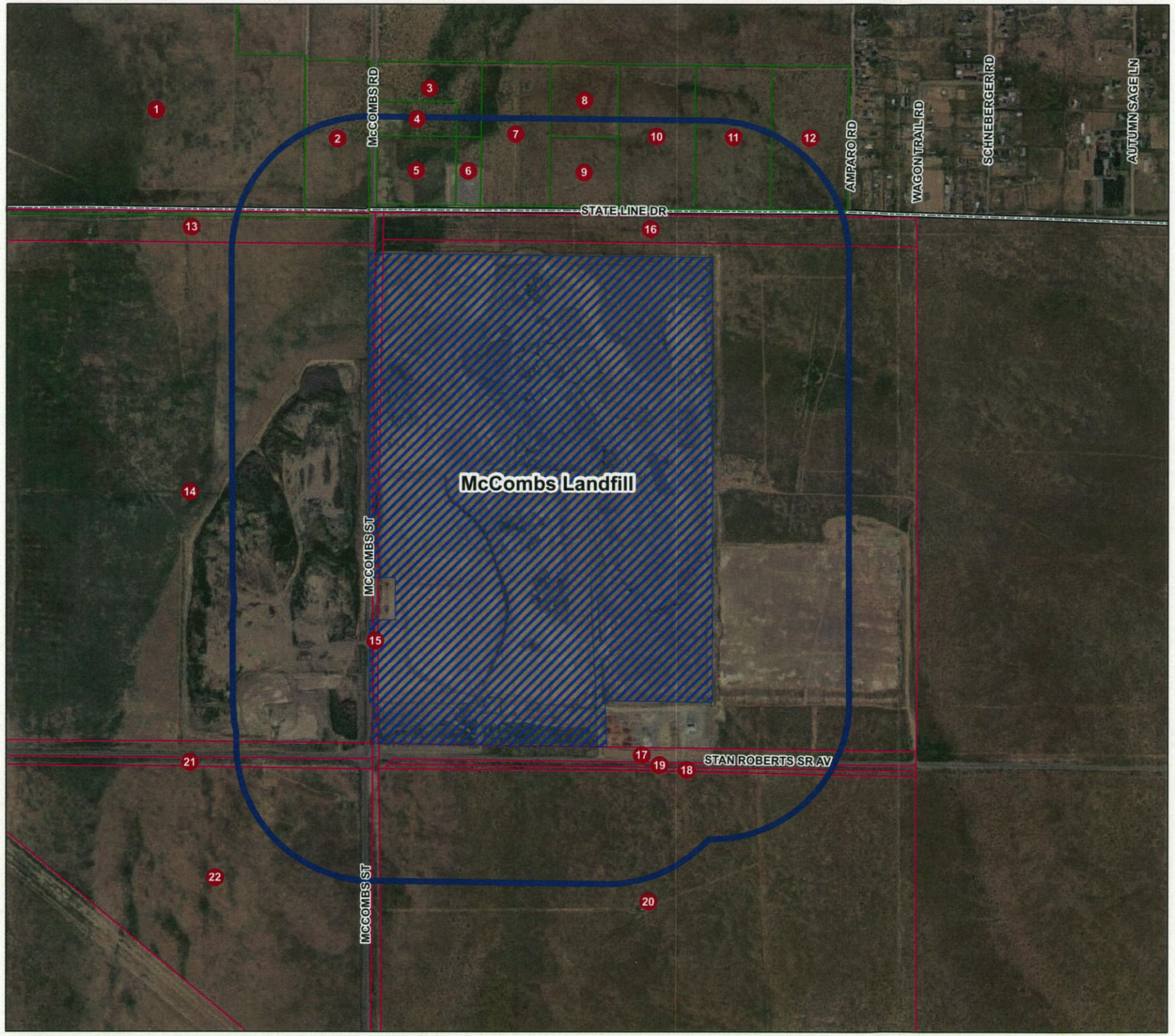
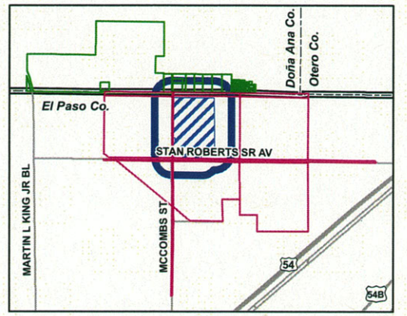


GRAPHIC SCALE

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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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

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;

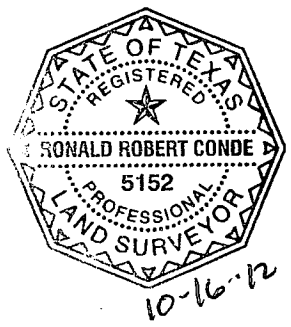
Thence, North 02°33'30" East a distance of 399.85 feet to a point;

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.

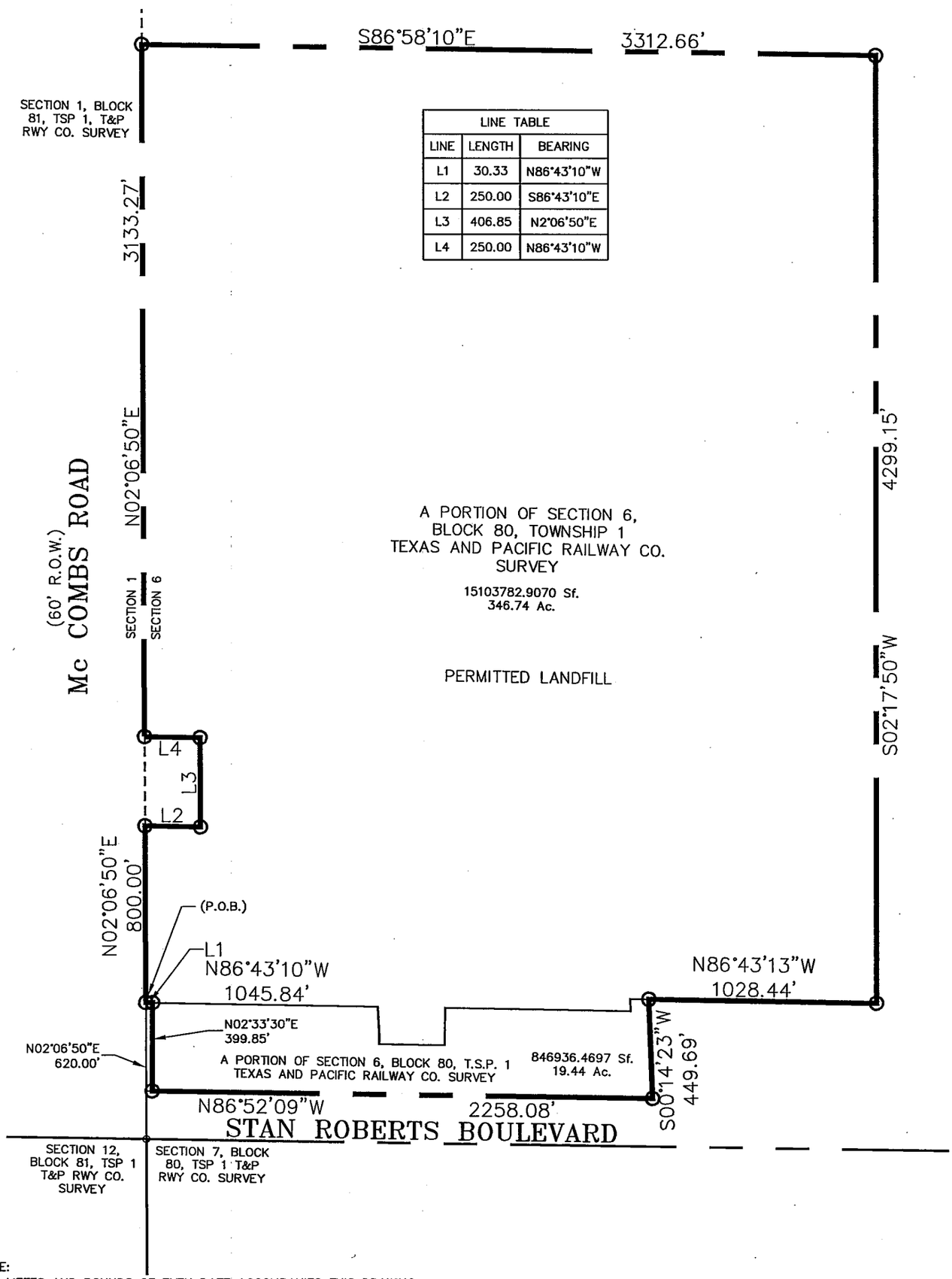
A drawing of even date accompanies this description.

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. Minimum 1 year landfill operation experience. 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) 5 (1501 tpd – 2500 tpd) 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) 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) 2 (1501 tpd–3500 tpd)	240 HP or greater	Waste and soil spreading and compaction
Scraper	1 or more (0 tpd–1500 tpd) 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) 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

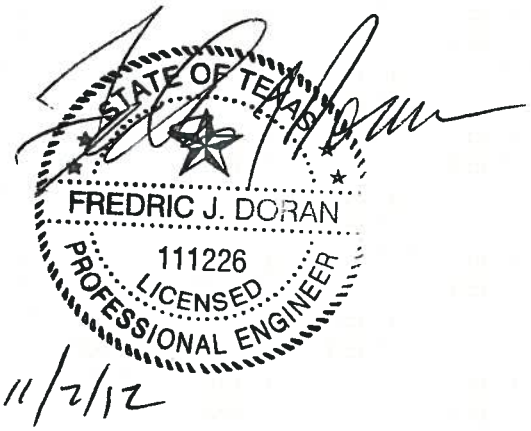
From: Fred J. Doran, SAIC

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

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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
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Payment Method:	CC - Authorization 0000002259
Amount:	$50.00
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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

Close

Last Modified 12/4/08

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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 November 2012, Revision 3

SAIC

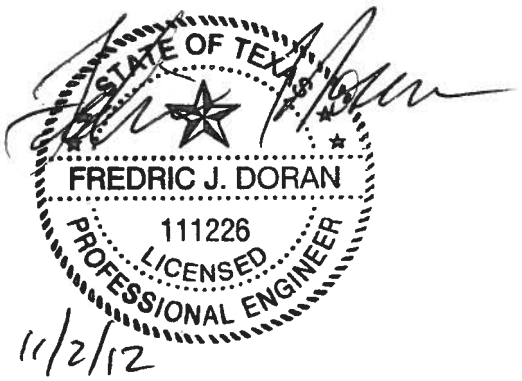
McCombs Municipal Landfill
El Paso County, Texas
TCEQ MSW Permit No. 729B

Major Permit Amendment Application
Part II

Prepared for

City of El Paso

Updated November 2012, Revision 3



Prepared by

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

Texas Board of Professional Engineers
Firm Registration No. 3823

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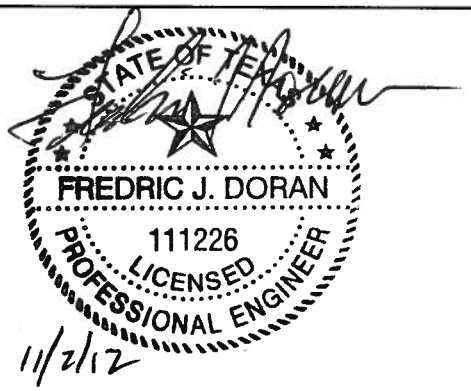

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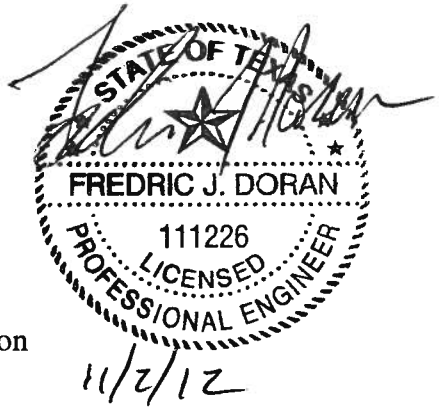

This report has been prepared for the use of the client for the specific purposes identified in the report. The conclusions, observations and recommendations contained herein attributed to SAIC constitute the opinions of SAIC. To the extent that statements, information and opinions provided by the client or others have been used in the preparation of this report, SAIC has relied upon the same to be accurate, and for which no assurances are intended and no representations or warranties are made. SAIC makes no certification and gives no assurances except as explicitly set forth in this report.

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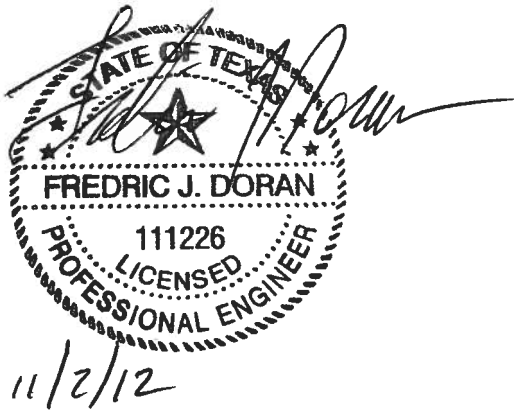

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STATE OF TEXAS
FREDRIC J. DORAN
111226
REGISTERED PROFESSIONAL ENGINEER
11/2/12

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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MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

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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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FREDRIC J. DORAN
111226
REGISTERED PROFESSIONAL ENGINEER
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DESIGNED	TLK
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VERIFY SCALE	BAR IS ONE INCH ON ANSI "D" DRAWING
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MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

ABBREVIATIONS AND LEGEND

PROJECT NUMBER: 963150D115
SHT. 2 OF: 78
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, the City plans to return the Landfill to active status and begin accepting MSW in 2014. 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);
- Siding (vinyl, masonite, aluminum, and steel);
- Duct work;
- Plumbing fixtures;
- Ceramic items;
- Conduit and pipes;
- Glass;
- Inert Plastics;
- Molded fiberglass;
- Rubber;
- Metal;
- Vinyl flooring; and
- Similar materials that are not readily decomposable.

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 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 62,532,764 cubic yards (CY) of soil and waste. This will allow the Landfill to have adequate capacity through approximately 2059, 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.

Section 2.6
GENERAL GEOLOGY AND SOILS STATEMENT
30 TAC §330.61(j)

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.

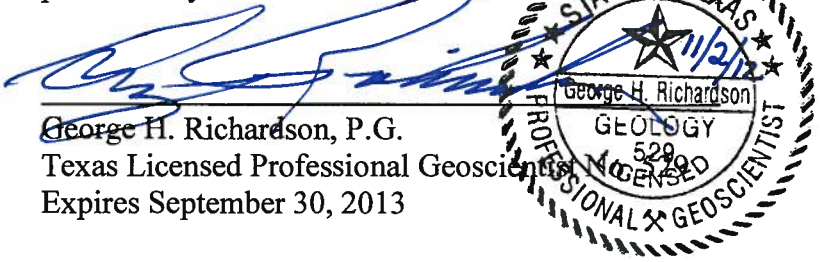
2.6.3 General Soils

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.usgu.gov/research/hazmap/

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.

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).

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).

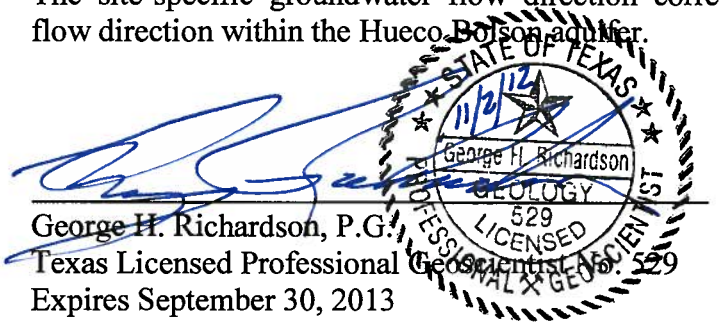
Based on available information, regional groundwater flow direction in the McCombs Landfill area is to the south-southeast. Groundwater movement in the area is generally less than 1.0 feet per day (White, 1987). EPWU groundwater data indicate that the static groundwater elevation in the area is between 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, 2012) recently completed 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 Attachment 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.

2.12.1 Rio Grande Council of Governments

As per 30 TAC §330.61(p), Parts I and II of the permit amendment application were submitted for review to the Rio Grande Council of Governments (RGCOG) to determine compliance with the regional solid waste management plan. Documentation of coordination with RGCOG is provided in Appendix 2H – RGCOG Review.

2.12.2 City of El Paso

Because the City owns and operates the Landfill, this permit amendment application has been prepared to meet the City's solid waste needs and comply with the City's long-term solid waste management plan.

Appendix 2A
Maps

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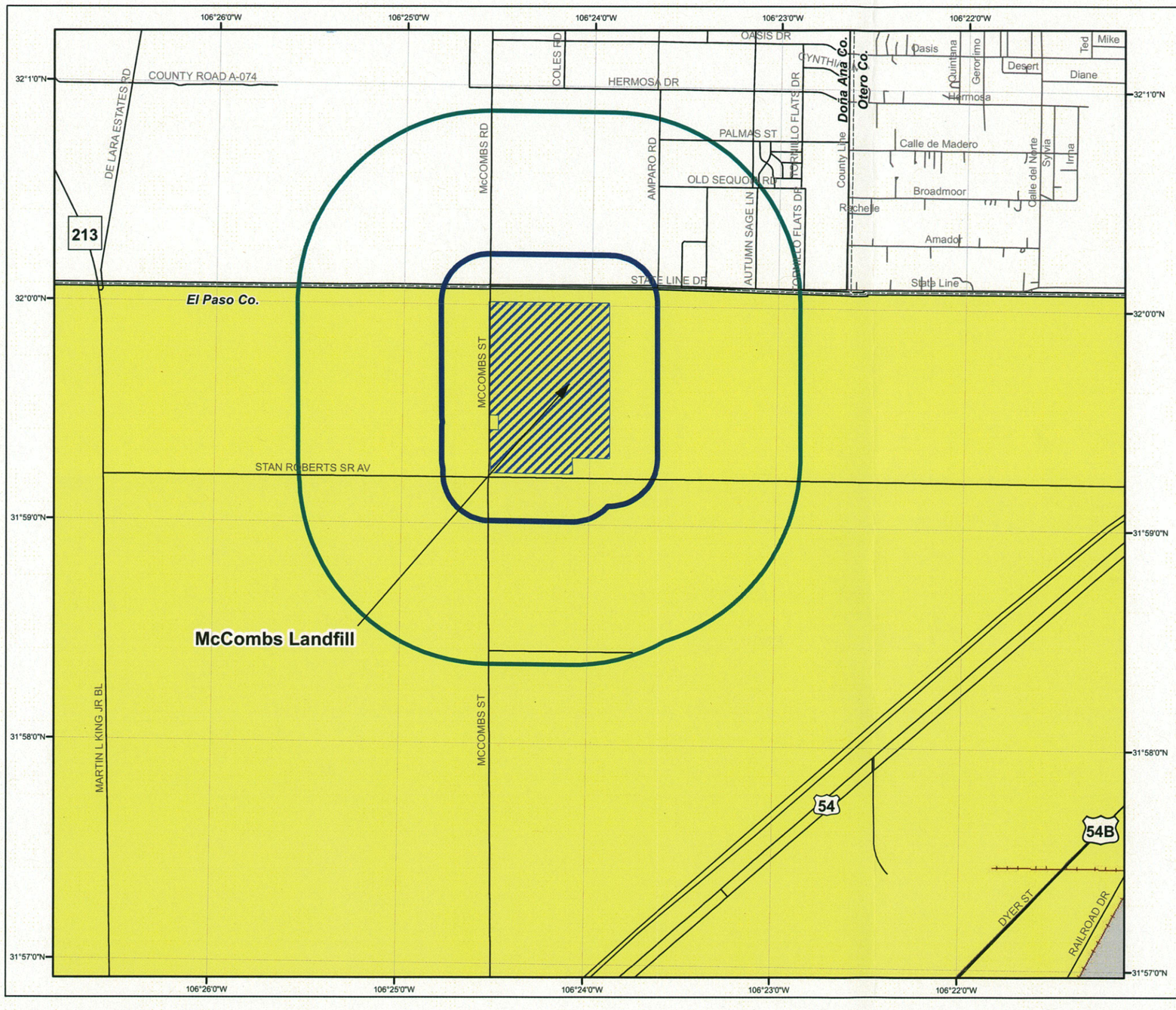

GRAPHIC SCALE

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

THE CITY OF EL PASO TEXAS

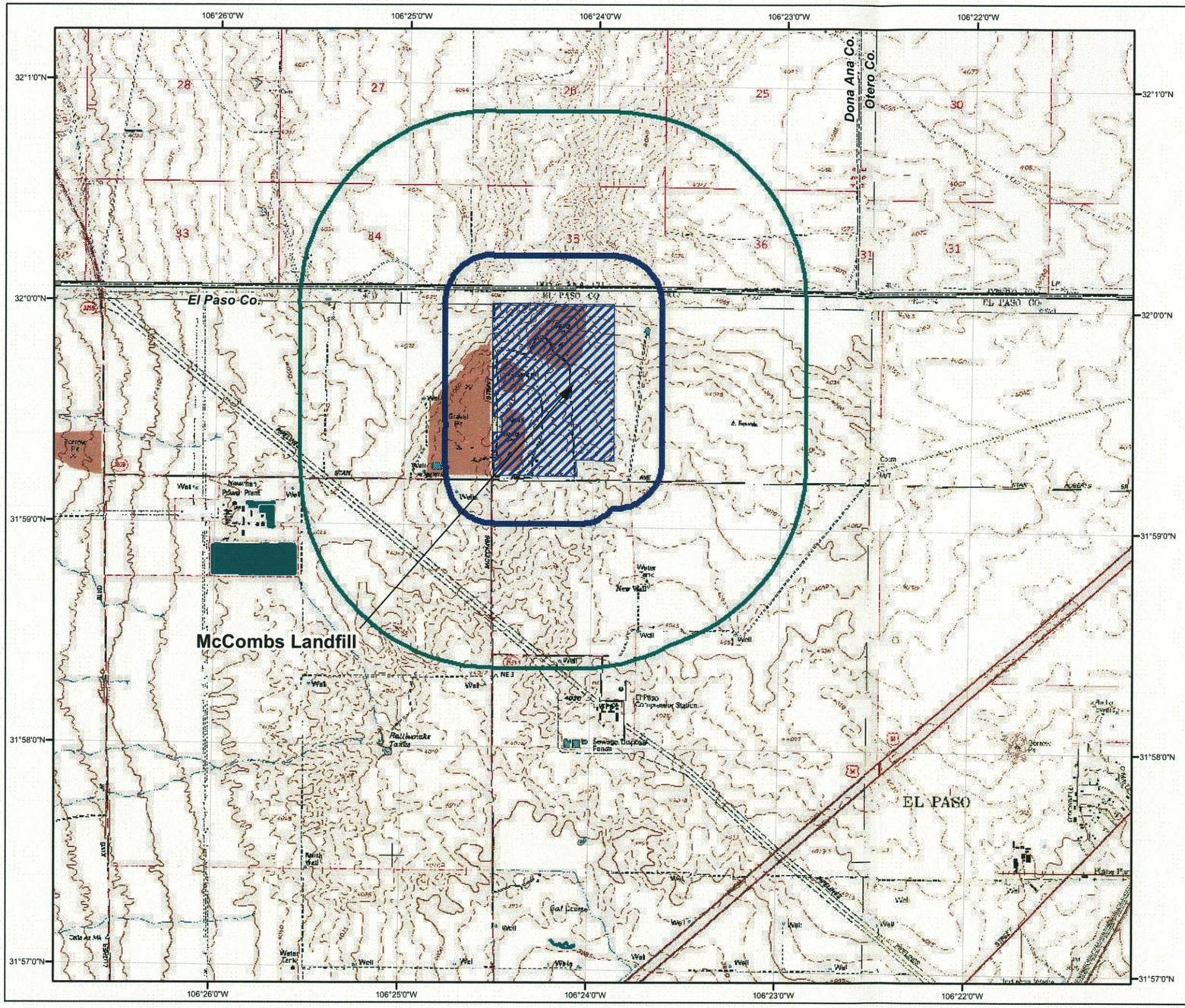
SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve
Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

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

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 P1-3.0 FOR WIND ROSE.

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

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MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

GENERAL TOPOGRAPHIC MAP

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

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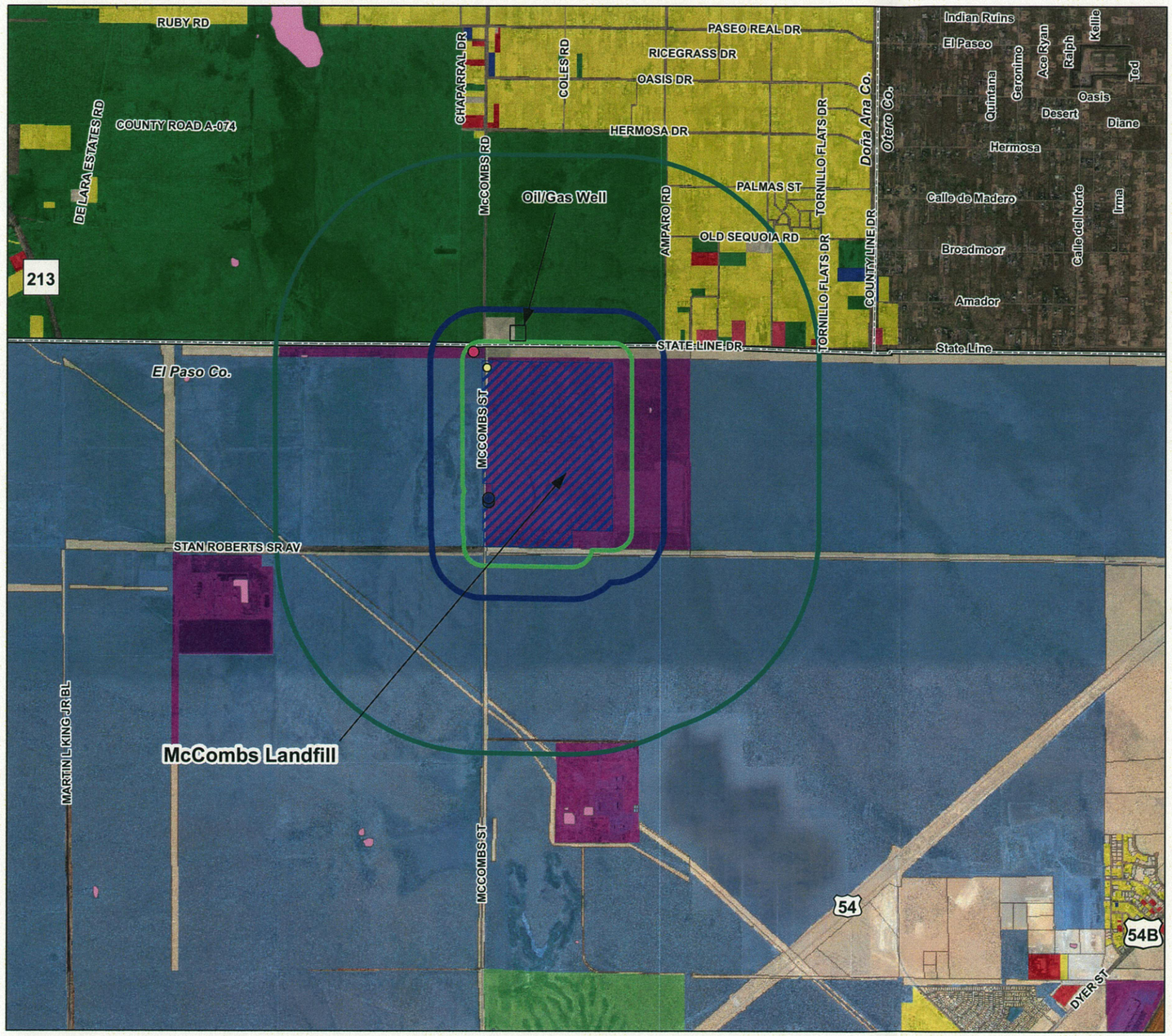

GRAPHIC SCALE
0 0.5 1 1.5 Miles

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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DESIGNED TLK
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REV	DATE	CHK'D	APP'D	REVISION DESCRIPTION
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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

THE CITY OF EL PASO TEXAS

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1380 Corporate Center Curve
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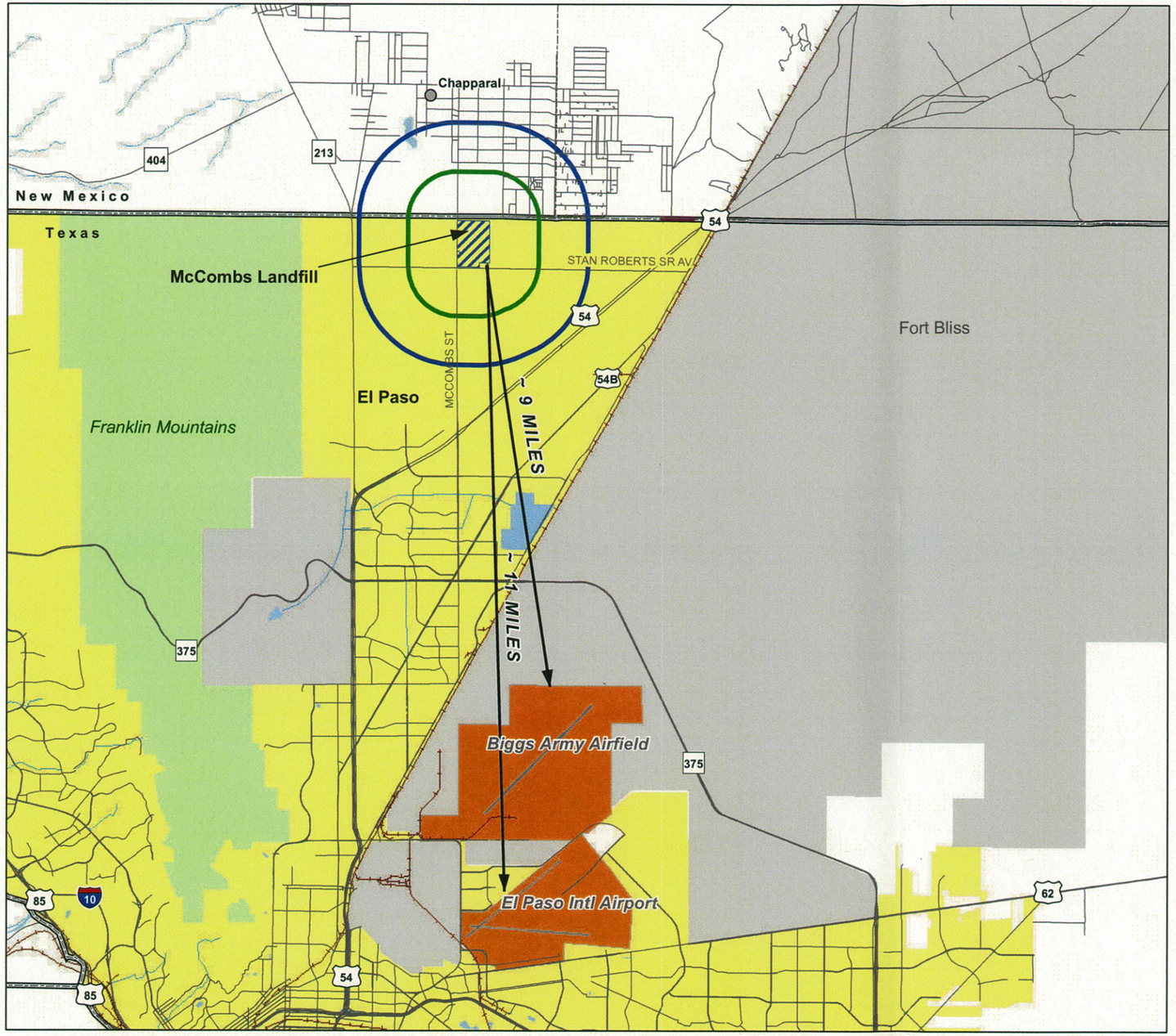
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

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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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	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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111226
REGISTERED PROFESSIONAL ENGINEER
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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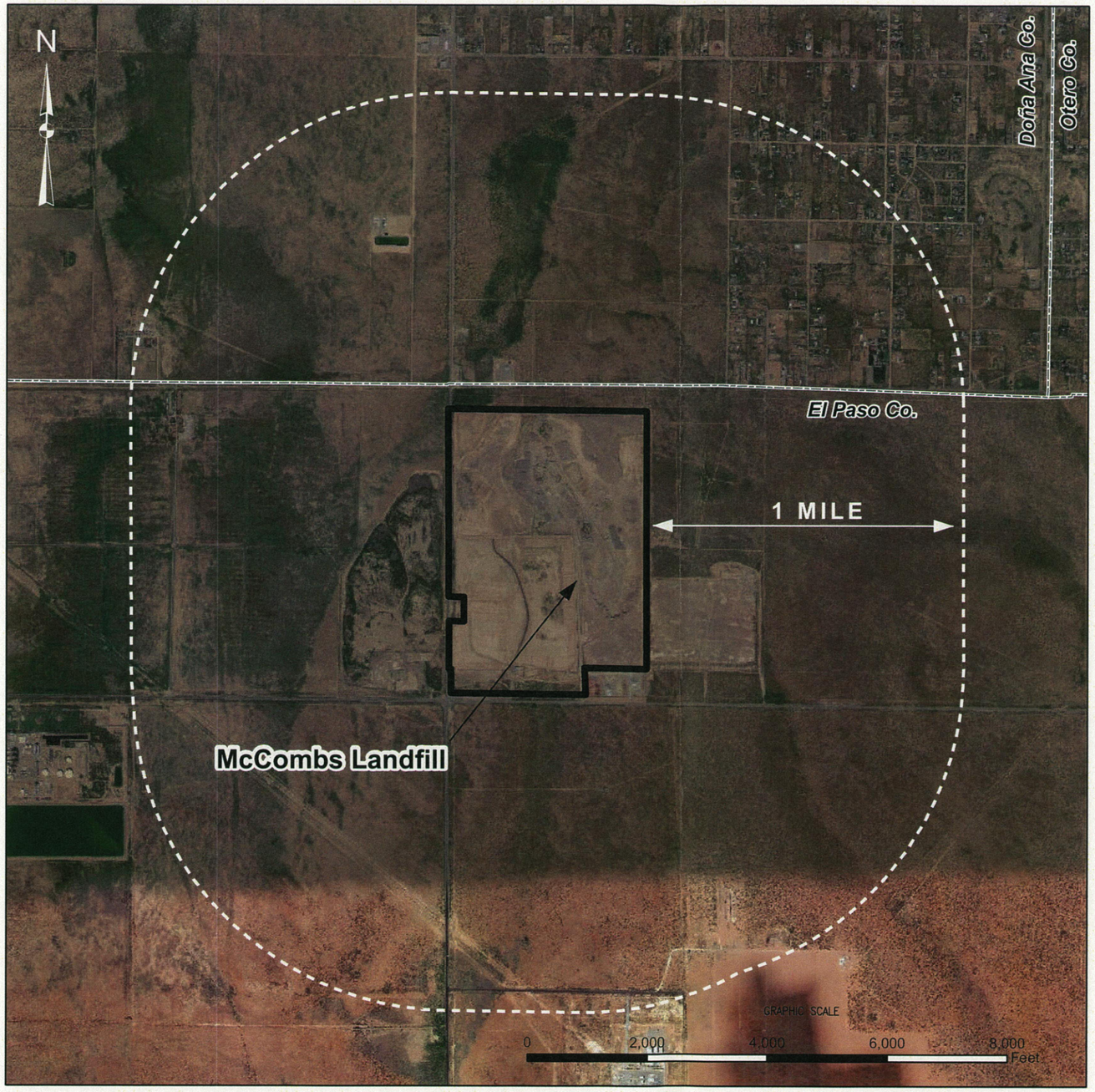
AERIAL PHOTOGRAPH

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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REGISTERED PROFESSIONAL ENGINEER
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REV	DATE	CHK'D	APP'D	REVISION DESCRIPTION
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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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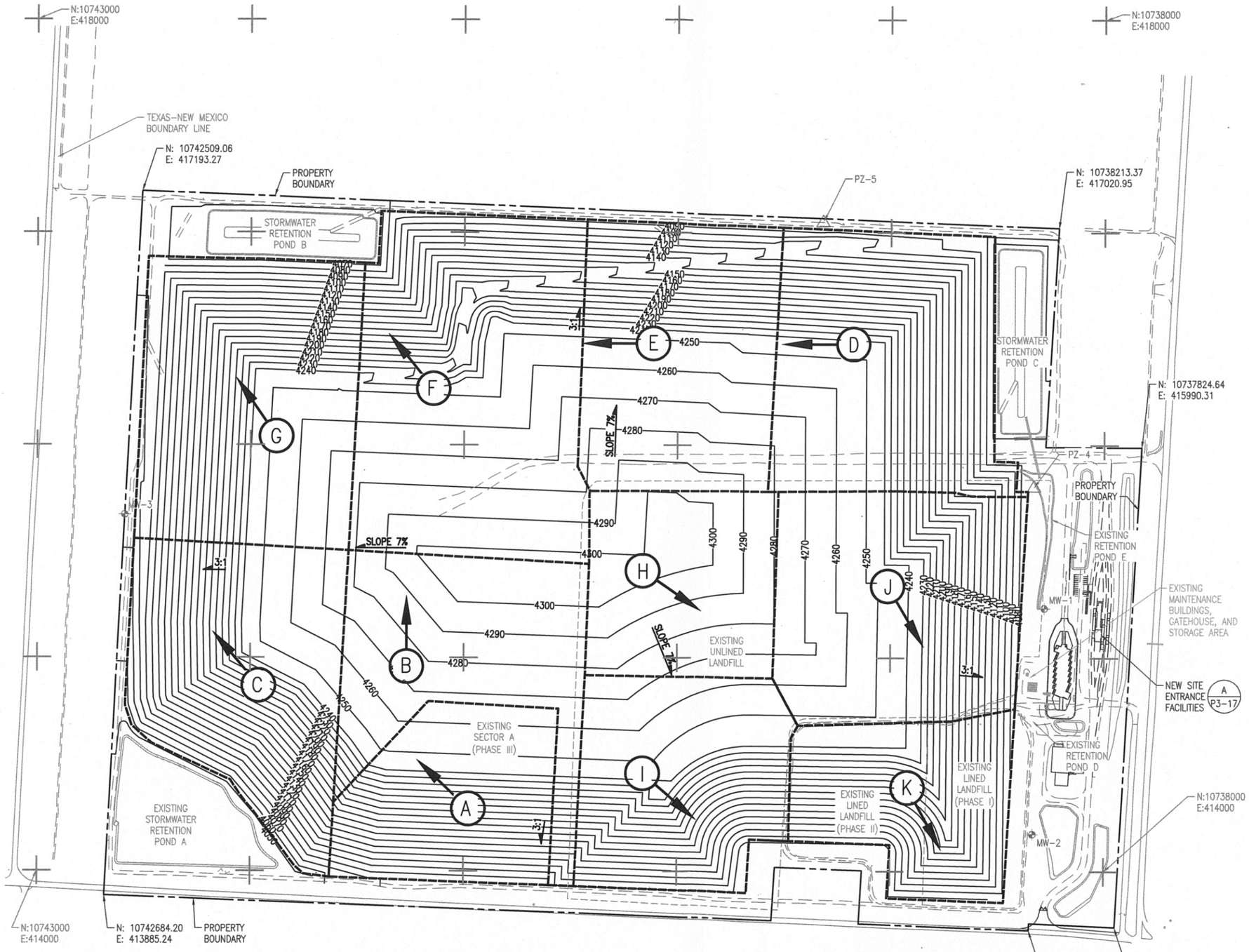
SITE LAYOUT PLAN – CURRENT CONDITIONS

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.
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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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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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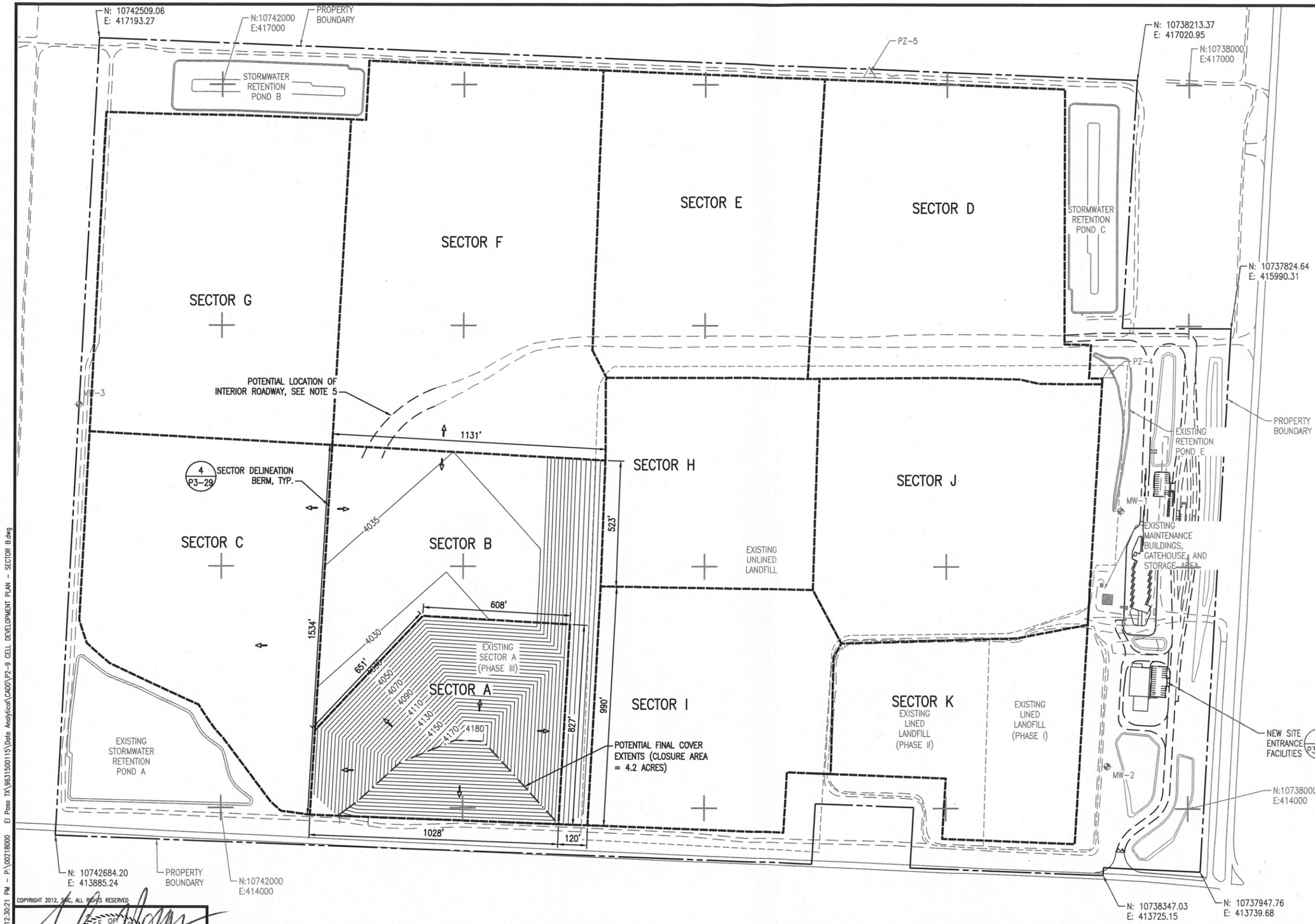
SITE FACILITY LAYOUT

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

Keller, Tonya L. 10/16/2012 11:19:13 AM – p:\00218000 el paso tx\9631500115\data analytical\CADD\P2–8 SITE FACILITY LAYOUT.dwg



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" Scale — 200 0 200 400 Feet

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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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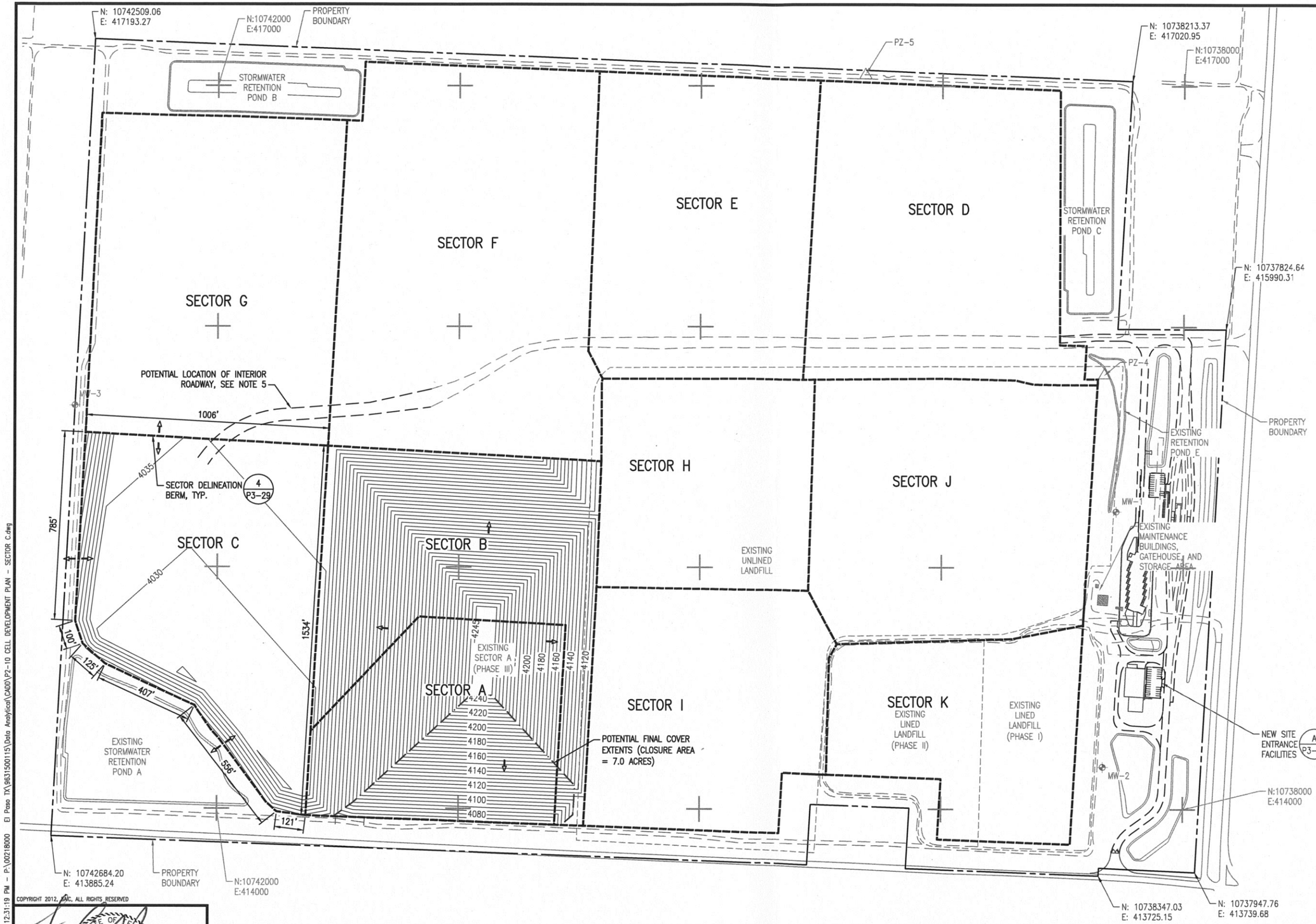
CELL DEVELOPMENT PLAN – SECTOR B

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

Keller, Tonya L 10/16/2012 12:30:21 PM – P:\00218000 El Paso TX\9631500115\Data Analytical\CADD\P2-9 CELL DEVELOPMENT PLAN – SECTOR B.dwg



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

GRAPHIC SCALE

1"=200'-0" Scale — 200 0 200 400 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
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 C

PROJECT NUMBER: 9631500115
SHT. 16 OF: 78
DRAWING NUMBER: P2-10

Keller, Tonya L. 10/16/2012 12:31:19 PM – P:\00218000 El Paso TX\9631500115\Data Analytical\CAD\P2-10 CELL DEVELOPMENT PLAN – SECTOR C.dwg

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

N: 10742509.06
E: 417193.27

N:10742000
E:417000

PROPERTY BOUNDARY

STORMWATER RETENTION POND B

PZ-5

994'

N: 10738213.37
E: 417020.95

N:10738000
E:417000

POTENTIAL LOCATION OF INTERIOR ROADWAY, SEE NOTE 5

SECTOR DELINEATION BERM, TYP.

4 P3-29

SECTOR E

SECTOR D

SECTOR F

SECTOR G

1244'

225'

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

4260

EXISTING SECTOR A (PHASE III)

4200

4180

4160

4140

4120

POTENTIAL FINAL COVER EXTENTS (CLOSURE AREA = 32.4 ACRES)

SECTOR A

4240
4220
4200
4180
4160
4140
4120
4100
4080

SECTOR I

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

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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
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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
MAJOR PERMIT AMENDMENT

CELL DEVELOPMENT PLAN – SECTOR D

PROJECT NUMBER: 9631500115
SHT. 17 OF: 78
DRAWING NUMBER: P2-11

Kolter, Tonya L. 10/16/2012 12:32:30 PM – P:\00218000 El Paso TX\9631500115\Data Analytical\CADD\P2-11 CELL DEVELOPMENT PLAN – SECTOR D.dwg

N: 10742509.06
E: 417193.27

PROPERTY BOUNDARY

STORMWATER RETENTION POND B

SECTOR G

SECTOR F

SECTOR C

SECTOR B

SECTOR A

SECTOR E

SECTOR D

SECTOR H

SECTOR J

SECTOR I

SECTOR K
EXISTING LINED LANDFILL (PHASE II)

EXISTING LINED LANDFILL (PHASE I)

EXISTING UNLINED LANDFILL

EXISTING STORMWATER RETENTION POND A

EXISTING SECTOR A (PHASE III)

SECTOR DELINEATION BERM, TYP.

4
P3-29

POTENTIAL LOCATION OF INTERIOR ROADWAY, SEE NOTE 5

920'

1162'

1244'

129'

834'

4025

4030

4040 4060 4080 4100 4120 4140 4160 4180 4200 4220

4260 4240 4220 4200 4180 4160 4140 4120 4100 4080

STORMWATER RETENTION POND C

POTENTIAL FINAL COVER EXTENTS (CLOSURE AREA = 13.6 ACRES)

POTENTIAL FINAL COVER EXTENTS (CLOSURE AREA = 32.4 ACRES)

PZ
N:10738000
E:417000

N: 10738213.37
E: 417020.95

N: 10737824.64
E: 415990.31

PZ-4

PROPERTY BOUNDARY

EXISTING RETENTION POND E

EXISTING MAINTENANCE BUILDINGS, GATEHOUSE, AND STORAGE AREA

NEW SITE ENTRANCE FACILITIES
A
P3-17

MW-3

MW-1

MW-2

N:10738000
E:414000

N: 10742684.20
E: 413885.24

PROPERTY BOUNDARY

N: 10738347.03
E: 413725.15

N: 10737947.76
E: 413739.68

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

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TLK	CAD	BAR IS ONE INCH ON ANSI "D" DRAWING 0 — 1"

REV	DATE	CHK'D	APP'D	REVISION DESCRIPTION
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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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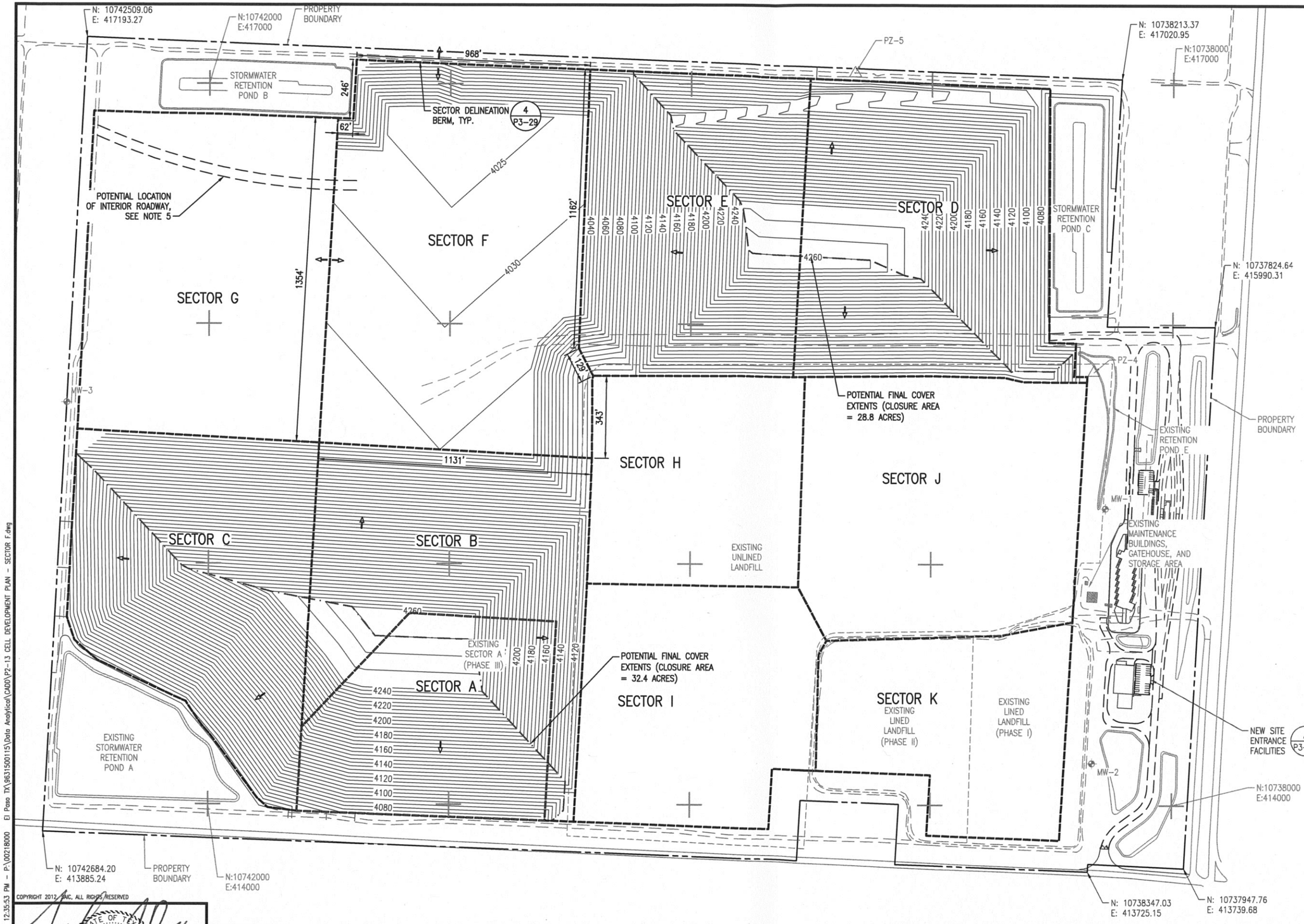
MAJOR PERMIT AMENDMENT

CELL DEVELOPMENT PLAN – SECTOR E

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

Keller, Tonya L. 10/16/2012 12:34:39 PM – P:\00218000 El Paso TX\9631500115\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" Scale — 200 0 200 400 Feet

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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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CELL DEVELOPMENT PLAN – SECTOR F

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

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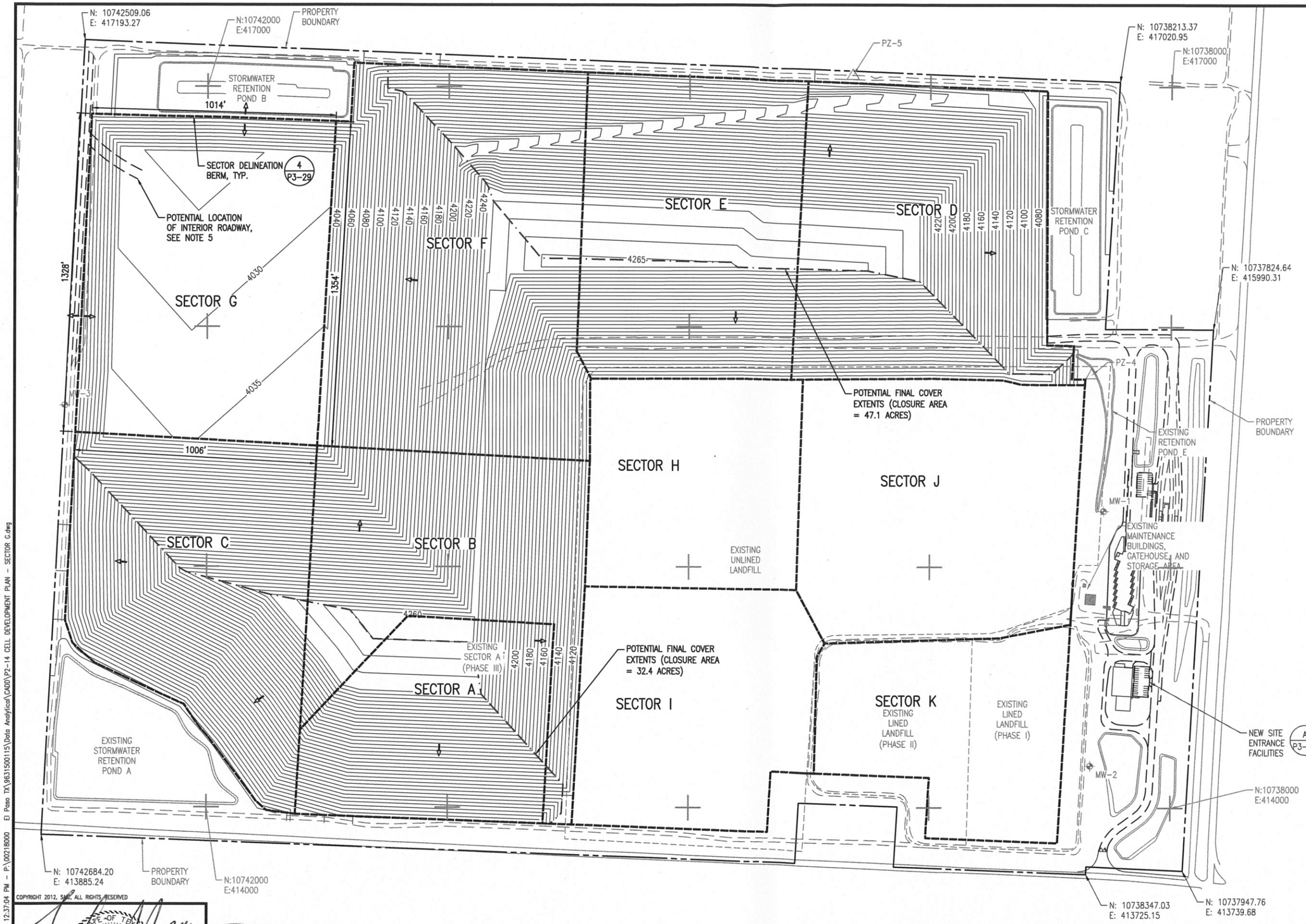

NOTES

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

GRAPHIC SCALE

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CELL DEVELOPMENT PLAN – SECTOR G

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

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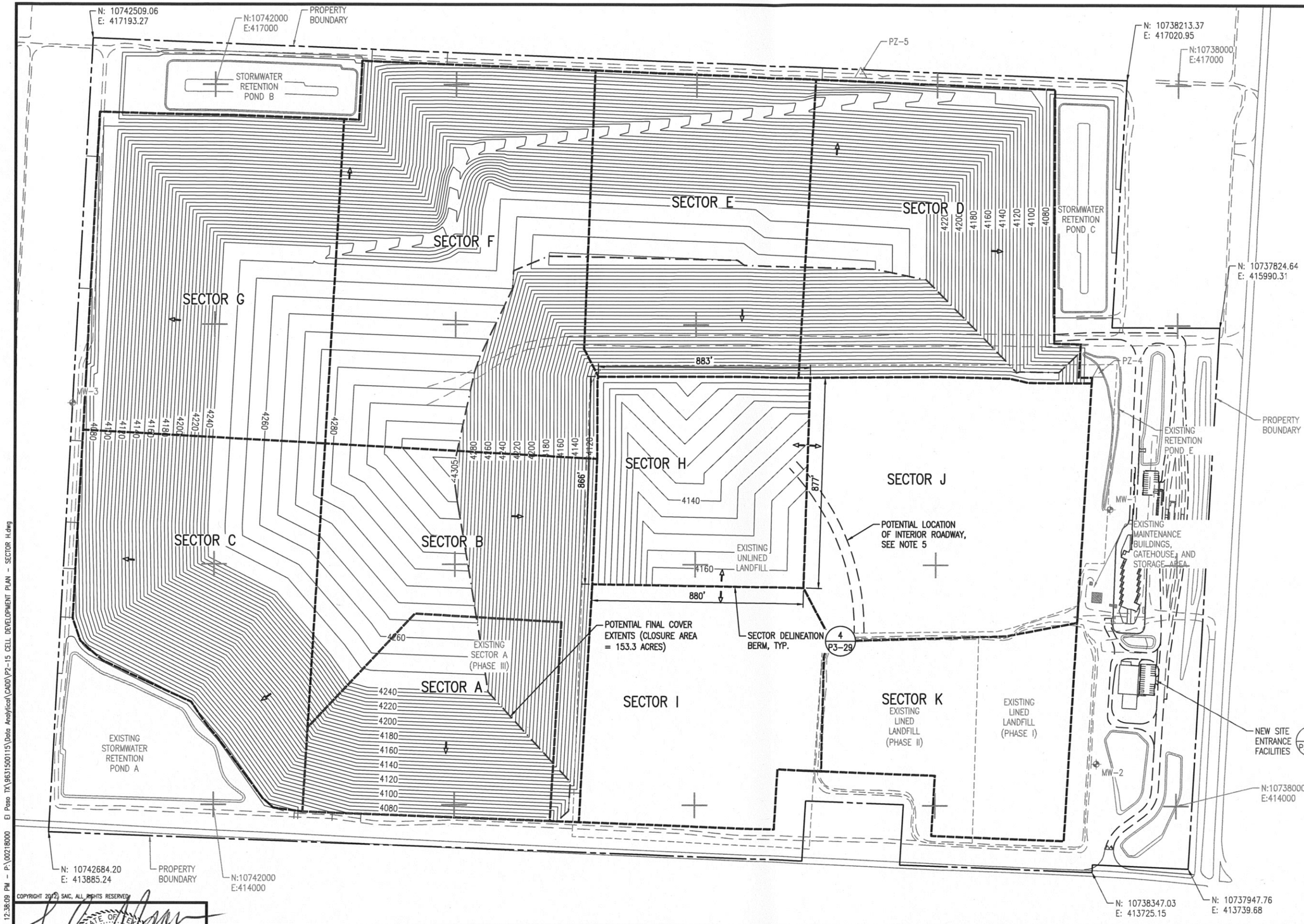

NOTES

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
- 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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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

Koller, Tonya L. 10/16/2012 12:38:09 PM – P:\00218000 El Paso TX\9631500115\Data Analytical\CAD\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:10738000
E:417000

STORMWATER RETENTION POND C

N: 10737824.64
E: 415990.31

SECTOR E

SECTOR D

SECTOR F

SECTOR G

MW-3

PZ-4

PROPERTY BOUNDARY

POTENTIAL FINAL COVER EXTENTS (CLOSURE AREA = 168.2 ACRES)

EXISTING RETENTION POND E

SECTOR H

SECTOR J

MW-1

EXISTING MAINTENANCE BUILDINGS, GATEHOUSE, AND STORAGE AREA

SECTOR C

SECTOR B

EXISTING UNLINED LANDFILL

880'

POTENTIAL LOCATION OF INTERIOR ROADWAY, SEE NOTE 5

251'

4160

4260

EXISTING SECTOR A (PHASE III)

66'

4140

WASTE DELINEATION BERM, TYP.

SECTOR A1

4240
4220
4200
4180
4160
4140
4120
4100
4080

990'

SECTOR I

SECTOR K
EXISTING LINED LANDFILL (PHASE II)

EXISTING LINED LANDFILL (PHASE I)

482'

NEW SITE ENTRANCE FACILITIES
A
P3-17

EXISTING STORMWATER RETENTION POND A

4
P3-29
SECTOR DELINEATION BERM, TYP.

182'

250'

MW-2

N:10738000
E:414000

813'

N: 10742684.20
E: 413885.24

PROPERTY BOUNDARY

N:10742000
E:414000

N: 10738347.03
E: 413725.15

N: 10737947.76
E: 413739.68

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" Scale: 200 0 200 400 Feet

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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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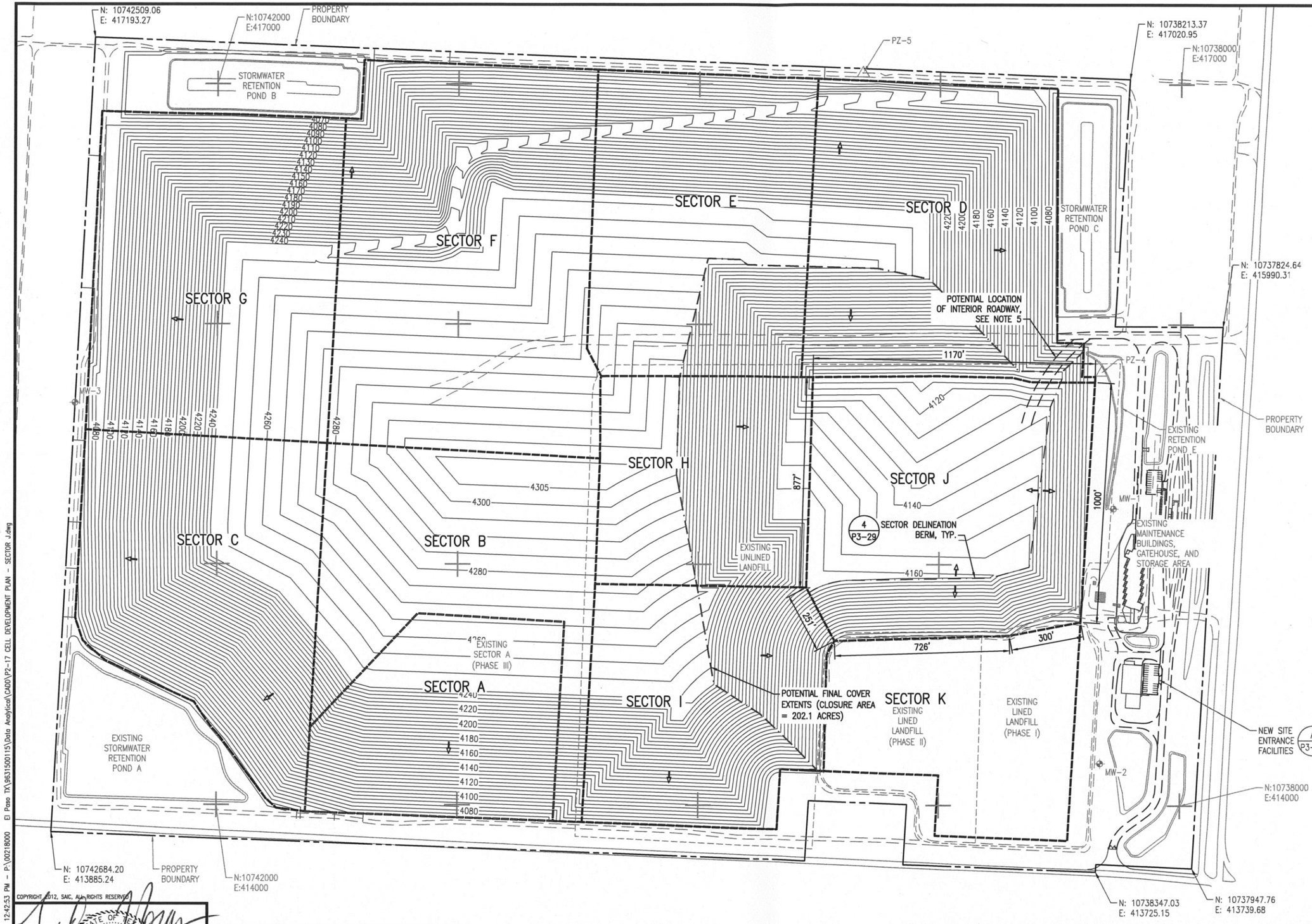
CELL DEVELOPMENT PLAN – SECTOR I

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

Keller, Tonya L. 10/16/2012 12:41:10 PM – P:\00218000 El Paso TX\9631500115\Data Analytical\CAD\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" Scale — 200 0 200 400 Feet

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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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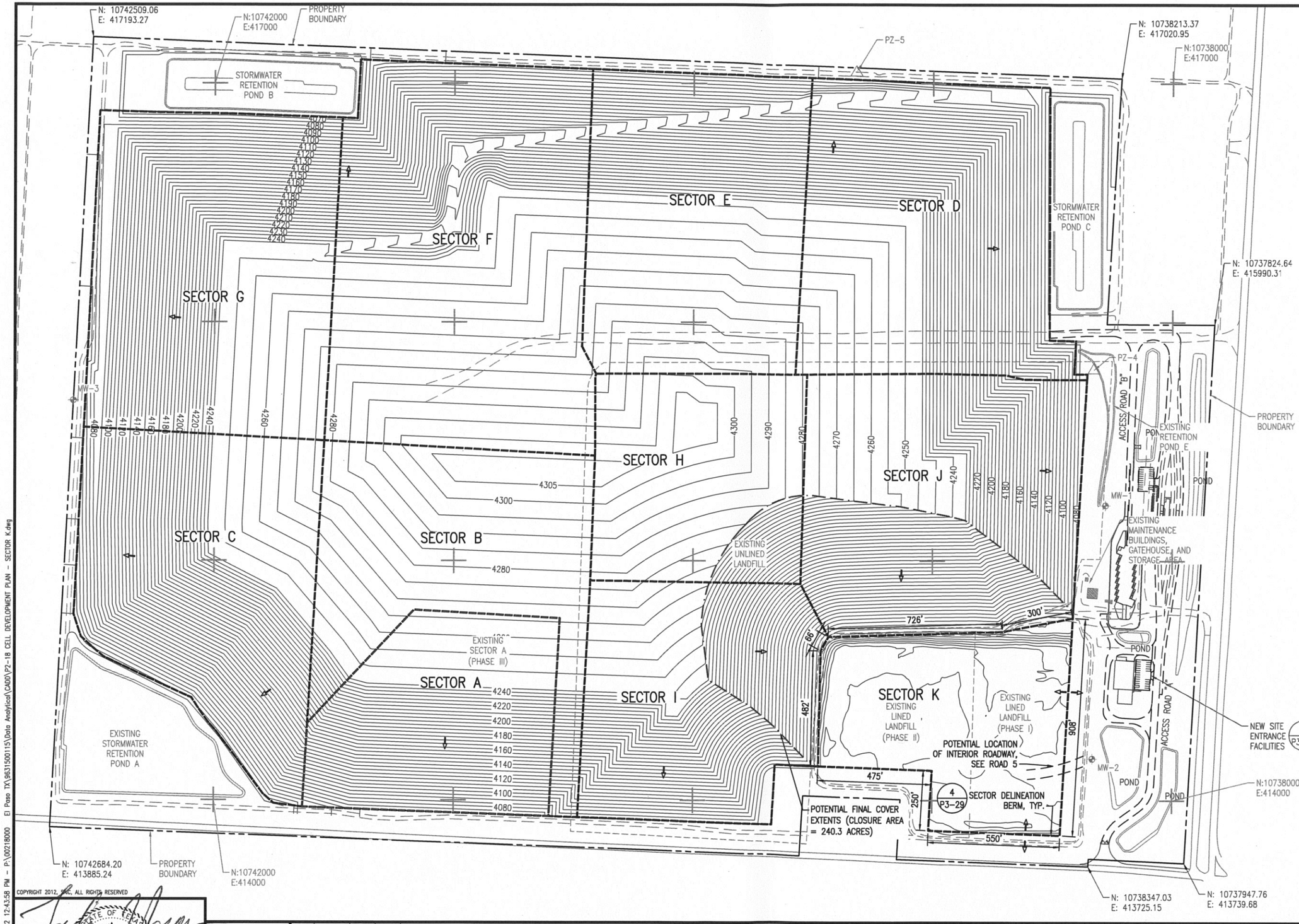
CELL DEVELOPMENT PLAN – SECTOR J

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

Koller, Tonya L. 10/16/2012 12:42:53 PM – P:\00218000 El Paso TX\9631500115\Data Analytical\CADD\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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11/1/12

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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CELL DEVELOPMENT PLAN – SECTOR K

PROJECT NUMBER: 9631500115
SHT. 24 OF: 78
DRAWING NUMBER: P2-18

Keller, Tonya L 10/16/2012 12:43:58 PM – P:\0021800 El Paso TX\9631500115\Data Analytical\CAD\P2-18 CELL DEVELOPMENT PLAN – SECTOR K.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

STORMWATER RETENTION POND C

N: 10737824.64
E: 415990.31

SECTOR E

SECTOR D

SECTOR F

SECTOR G

MW-3

PZ-4

PROPERTY BOUNDARY

EXISTING RETENTION POND E

FINAL COVER EXTENTS
(CLOSURE AREA = 276.9 ACRES)

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)

SECTOR A

SECTOR I

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

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

GRAPHIC SCALE

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

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11/2/12

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DRAWN: CAD
VERIFY SCALE
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0 1"

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CELL DEVELOPMENT PLAN – FINAL GRADES

PROJECT NUMBER: 9631500115
SHT. 25 OF: 78
DRAWING NUMBER: P2-19

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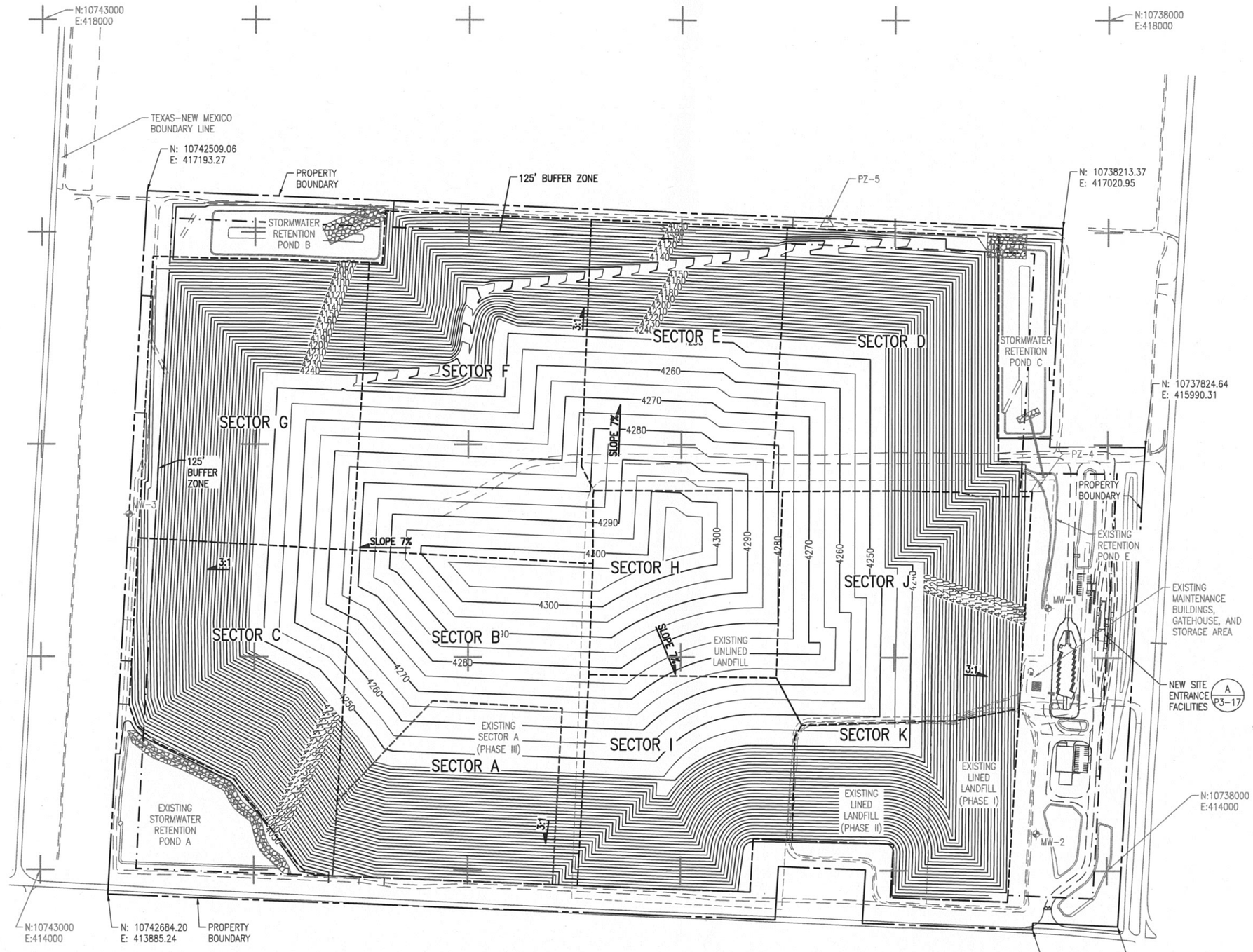

NOTES

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. 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 Feet)

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0 1"

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0	11/22/11	FJD	SEK	MAJOR PERMIT AMENDMENT

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LANDFILL COMPLETION PLAN

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

Keller, Tonya L. 10/16/2012 11:45:41 AM — P:\00218000 El Paso TX\9631500115\Data Analytical\CADD\P2–20 LANDFILL COMPLETION PLAN.dwg

Appendix 2B
Land Use Analysis

SAIC®

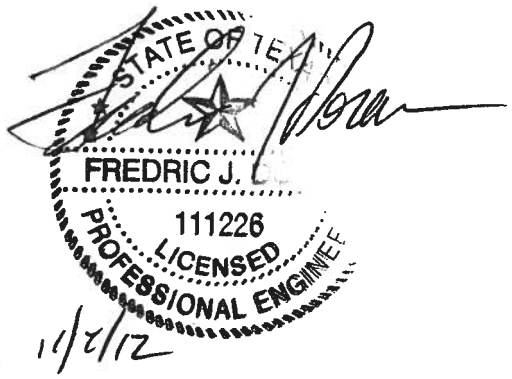
McCombs Municipal Landfill
El Paso County, Texas
TCEQ MSW Permit No. 729B

Part II
Appendix 2B
Land Use Analysis

Prepared for

City of El Paso

Updated August 2012, Revision 1



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.5 Proximity to Residences and Other Uses 2B-3
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Table 2B-1 Land Use Within One Mile of McCombs Landfill 2B-2
Table 2B-2 Growth Trends Within Five Miles of McCombs Landfill 2B-3

This report has been prepared for the use of the client for the specific purposes identified in the report. The conclusions, observations and recommendations contained herein attributed to SAIC constitute the opinions of SAIC. To the extent that statements, information and opinions provided by the client or others have been used in the preparation of this report, SAIC has relied upon the same to be accurate, and for which no assurances are intended and no representations or warranties are made. SAIC makes no certification and gives no assurances except as explicitly set forth in this report.

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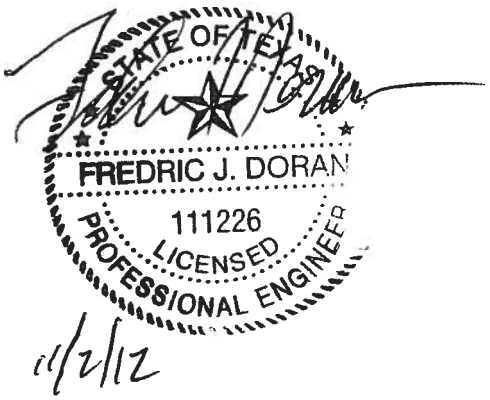


2B.1 Introduction

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 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 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 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

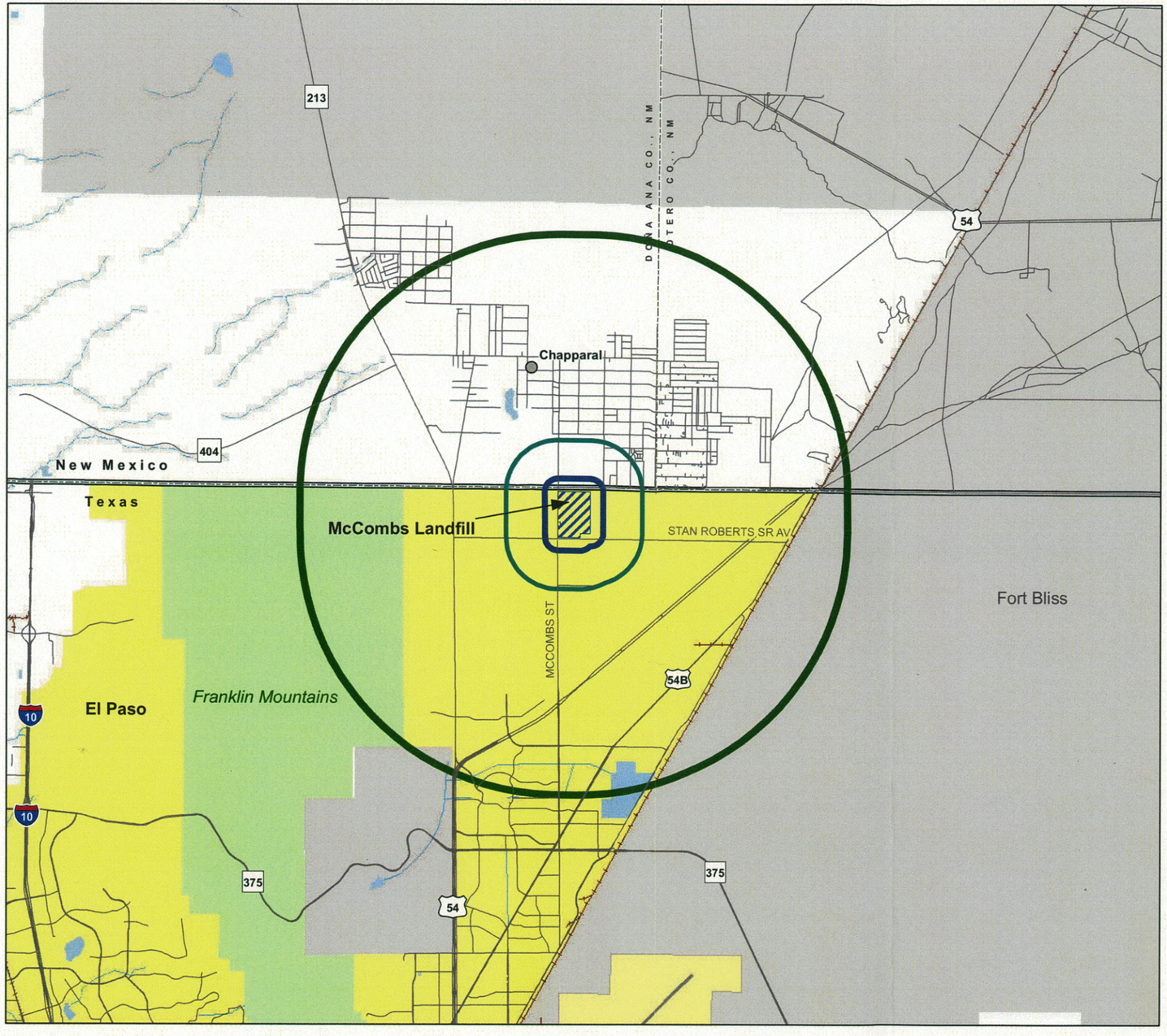
[1] Most recent data available from the United States Census Bureau is for 2009.

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

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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

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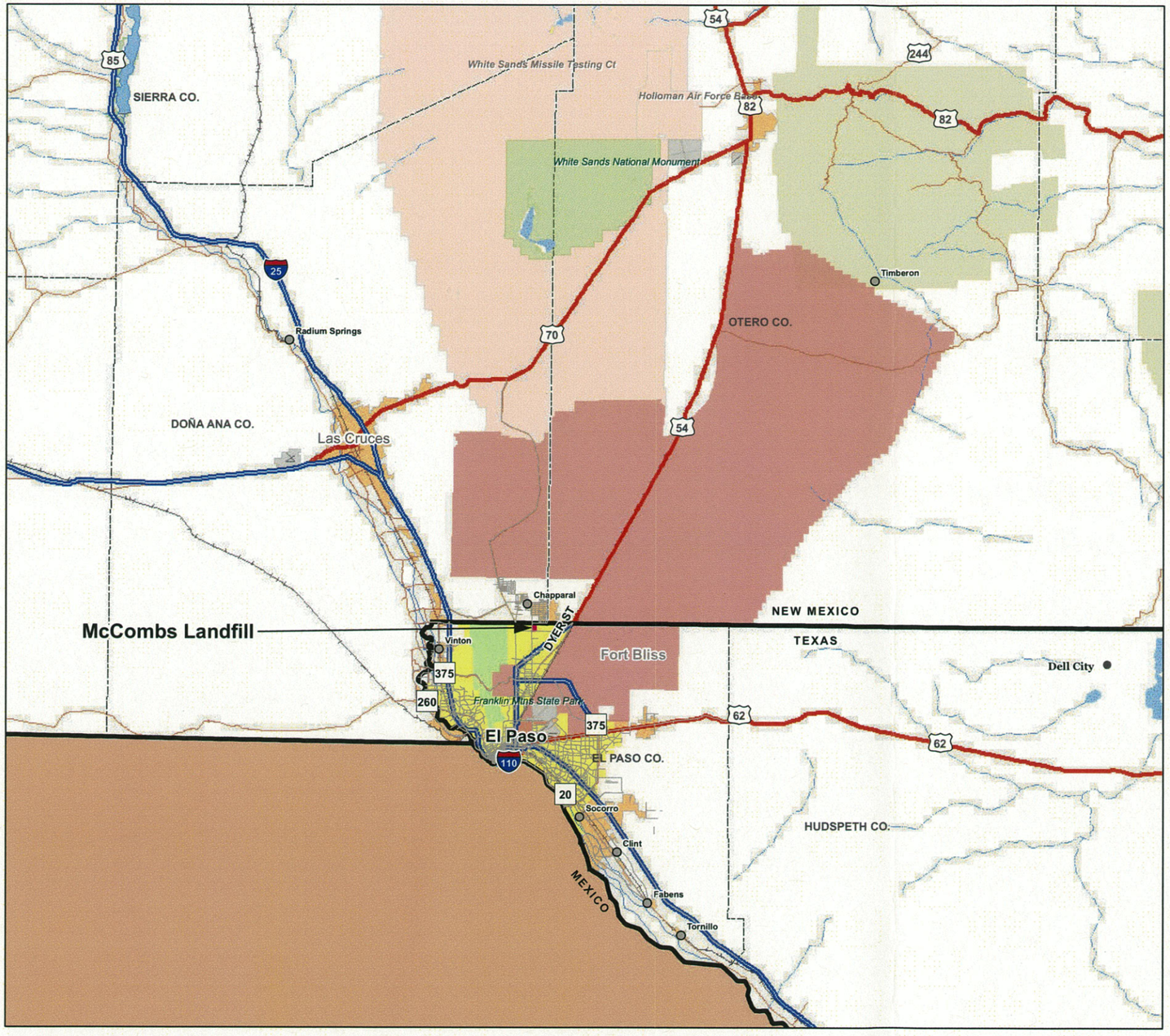
REGIONAL MAP – FIVE MILE RADIUS

PROJECT NUMBER: 9631500115
SHT. 27 OF: 78
DRAWING NUMBER: P2–21

Keller, Tonya L. 10/29/2012 11:01:47 AM – P:\0021800 el paso tx\9631500115\data analytical\CADD\P2-21 REGIONAL MAP – FIVE MILE RADIUS.dwg



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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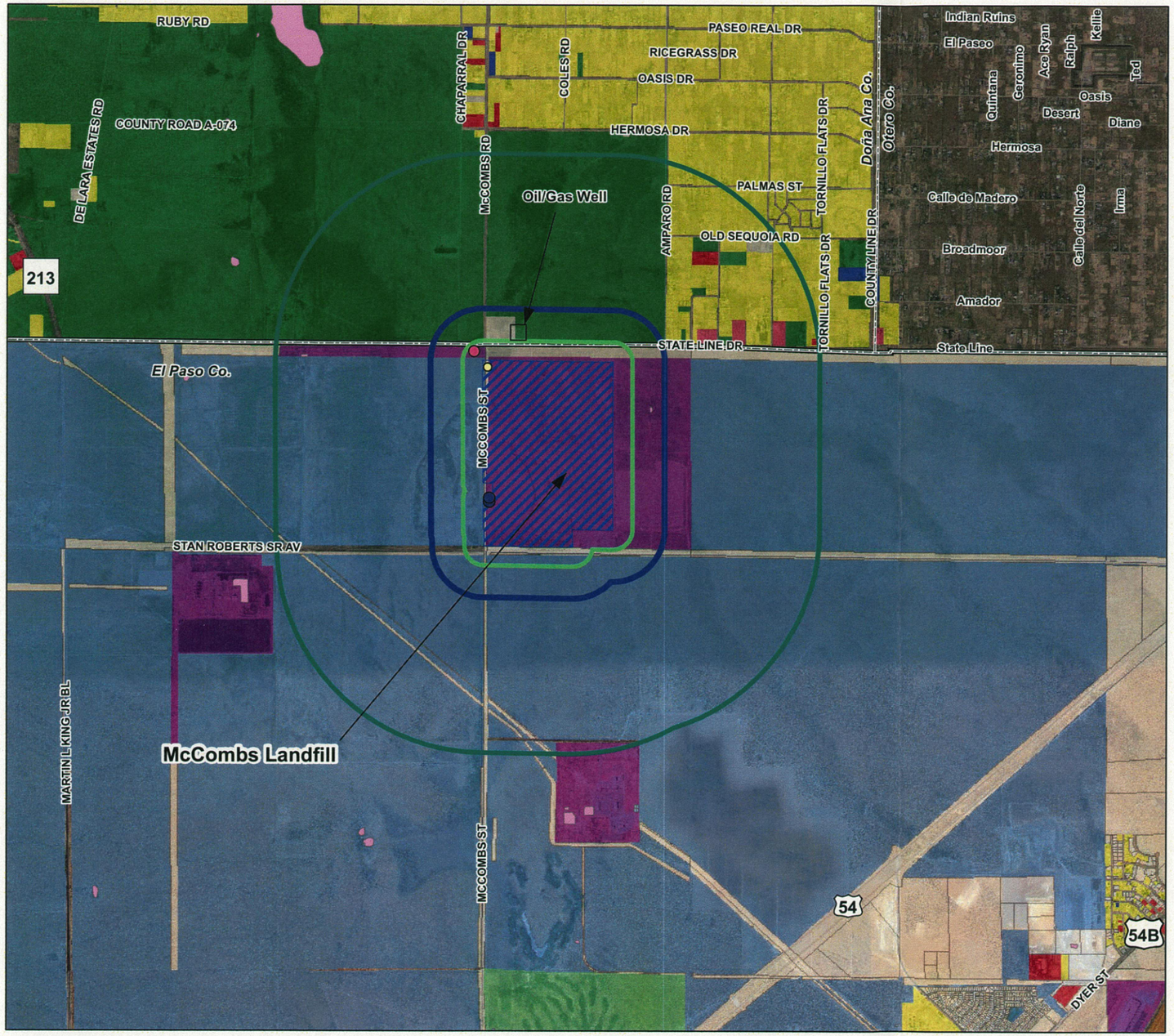
REGIONAL MAP – EL PASO COUNTY

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

Keller, Tonya L. 10/29/2012 11:03:26 AM – P:\00218000 el paso tx\9631500115\data analytical\CAD\P2-22 REGIONAL MAP – EL PASO COUNTY.dwg



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
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DRAWING NUMBER: P2-23

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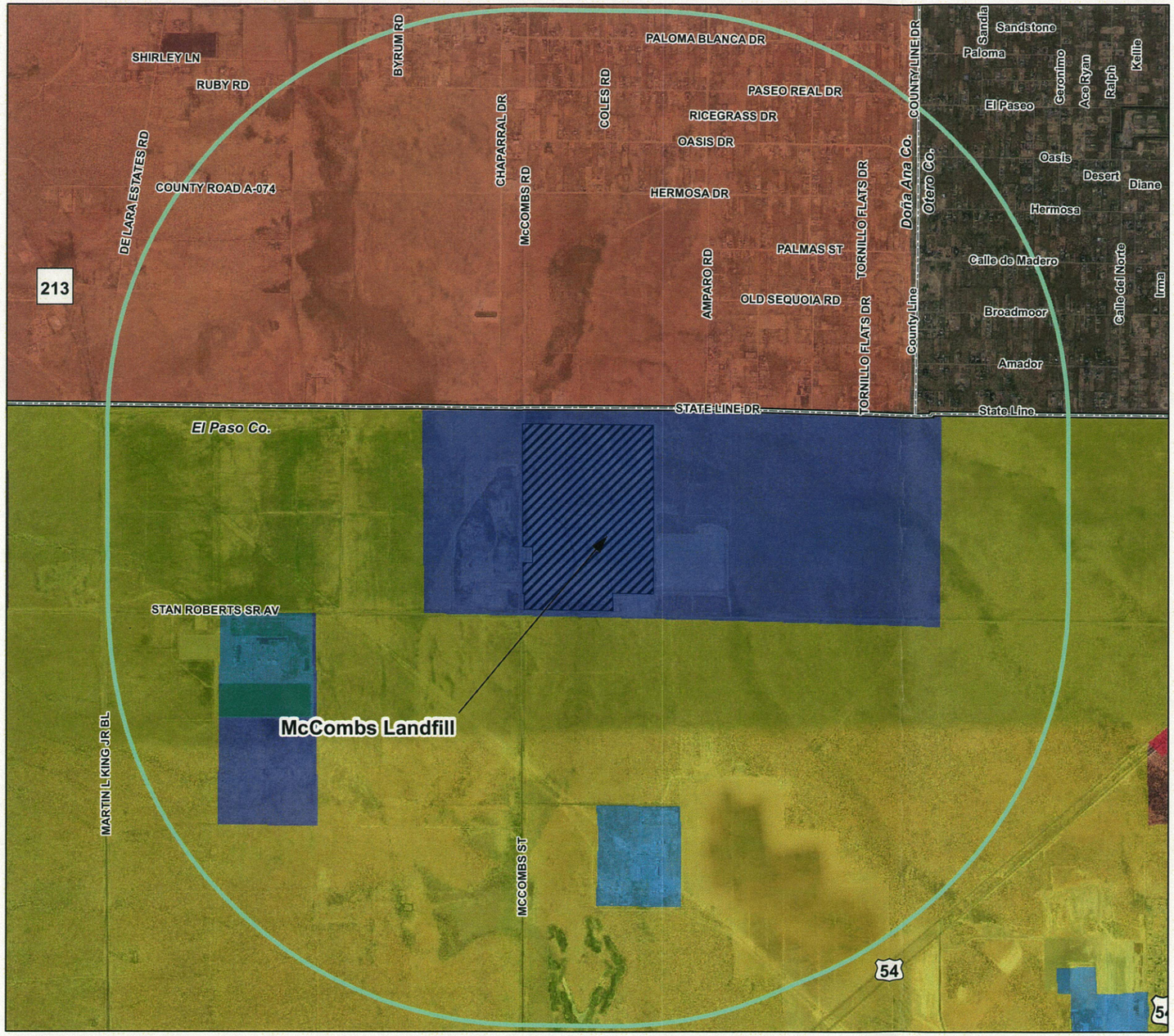

GRAPHIC SCALE

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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ZONING MAP

PROJECT NUMBER: 9631500115
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DRAWING NUMBER: P2-24

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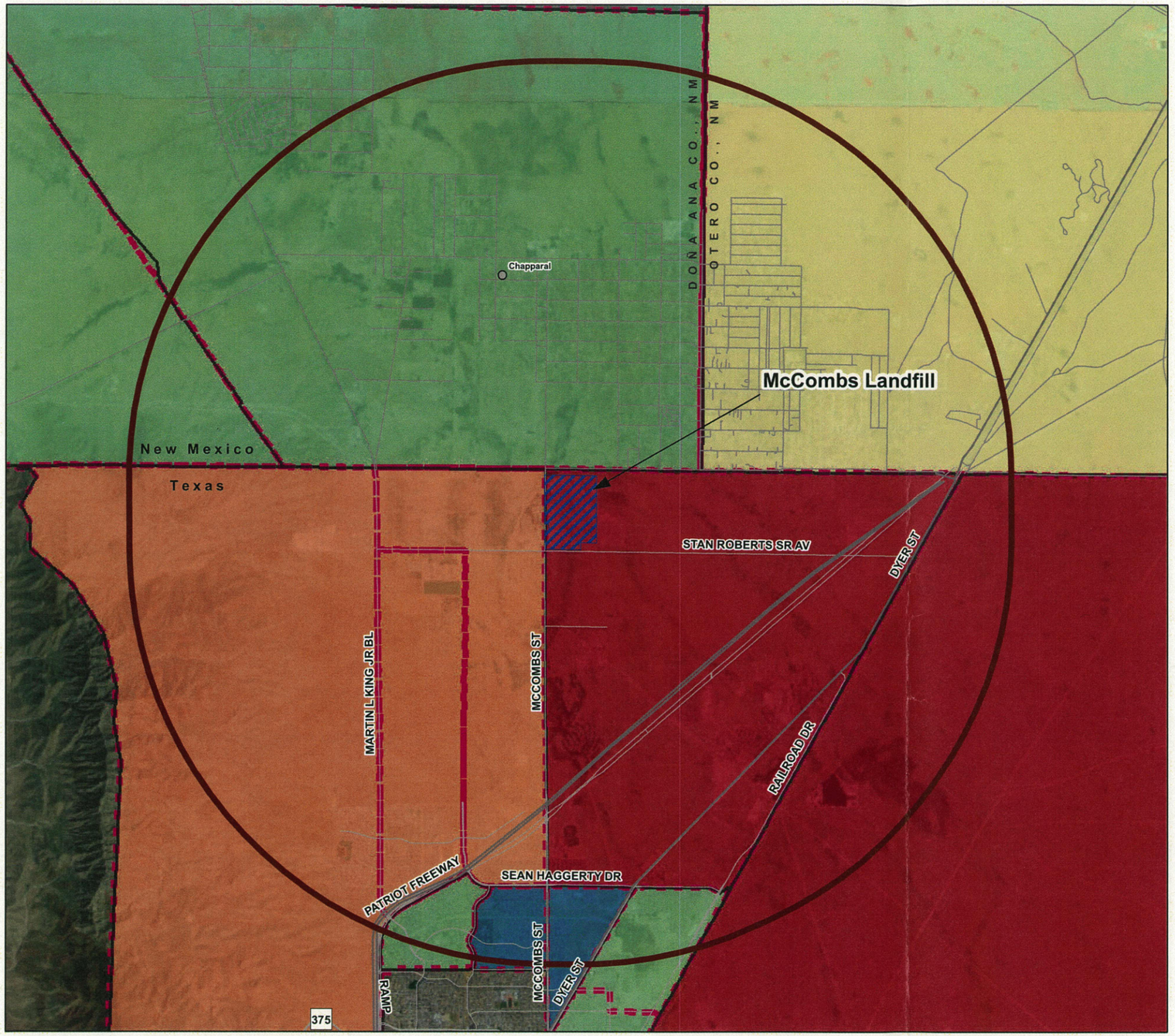

GRAPHIC SCALE

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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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

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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.

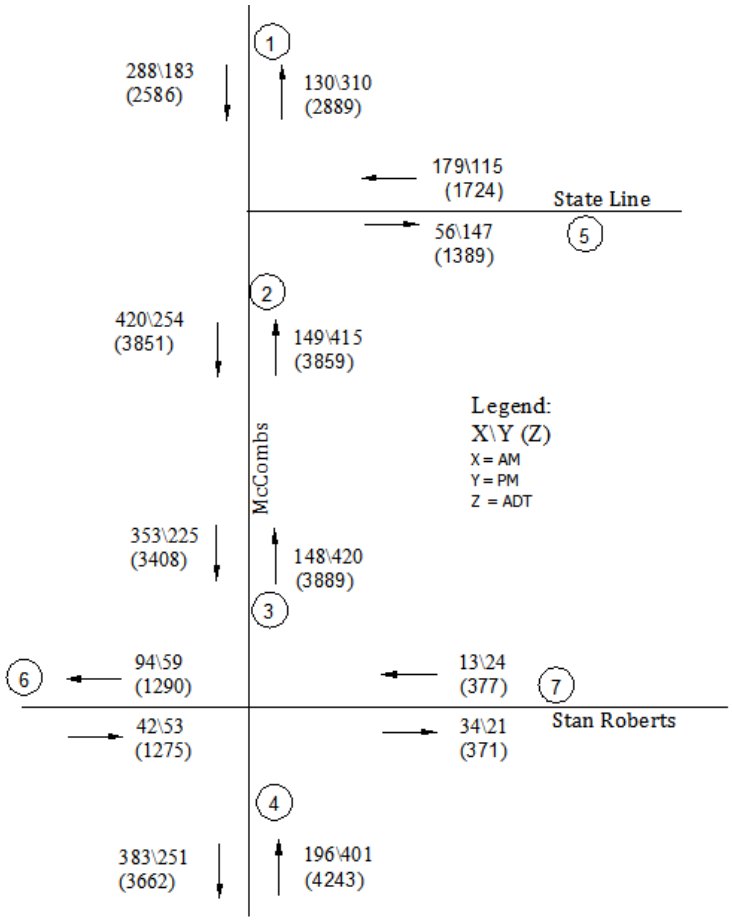


Figure 2: Existing AM\PM and ADT roadway count volumes (2010)

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

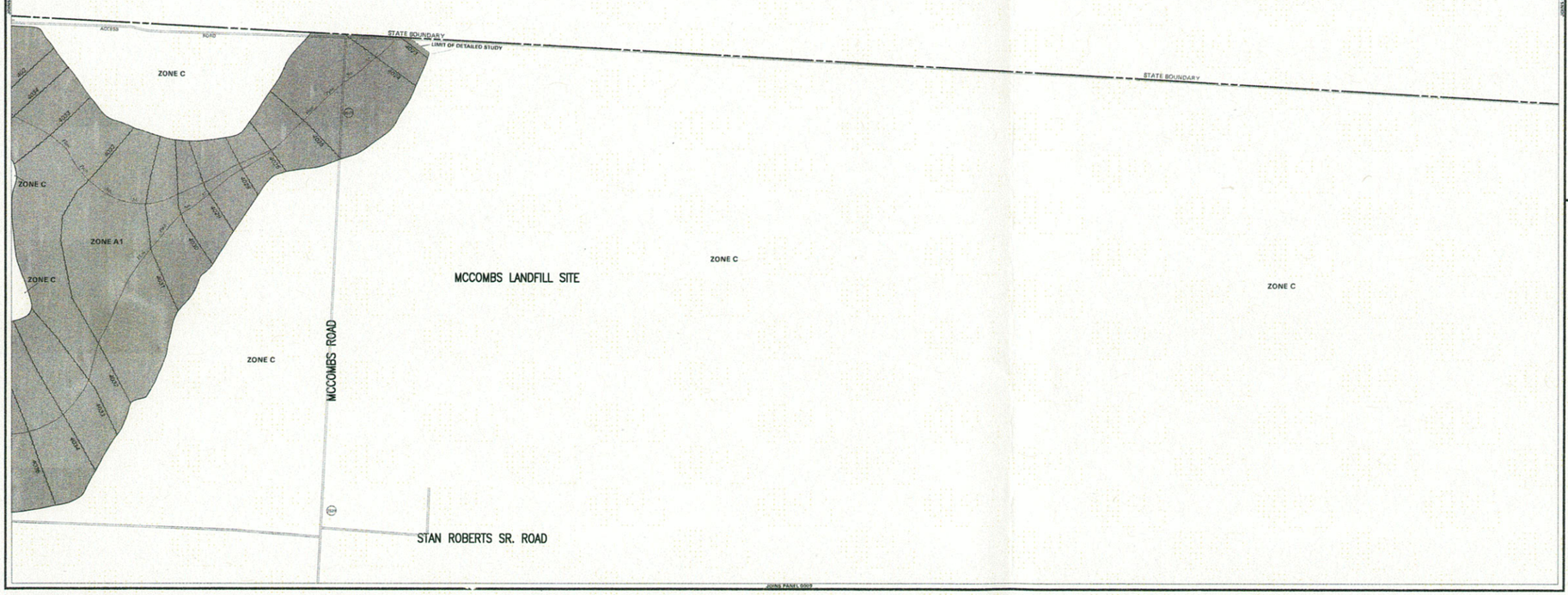
This permit expires on August 14, 2016, unless otherwise amended. If you have any questions related to processing you may contact the Storm Water Processing Center by **email at SWPERMIT@tceq.texas.gov or by telephone at (512) 239-3700**. For technical issues, you may contact the storm water technical 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 AS
100-Year Flood Boundary	ZONE B
500-Year Flood Boundary	
Base Flood Elevation Line With Elevation In Feet**	512
Base Flood Elevations In Feet Where Uniform Within Zone**	(EL 957)
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 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 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, 1982

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 1000 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. 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.

GRAPHIC SCALE: NTS

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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

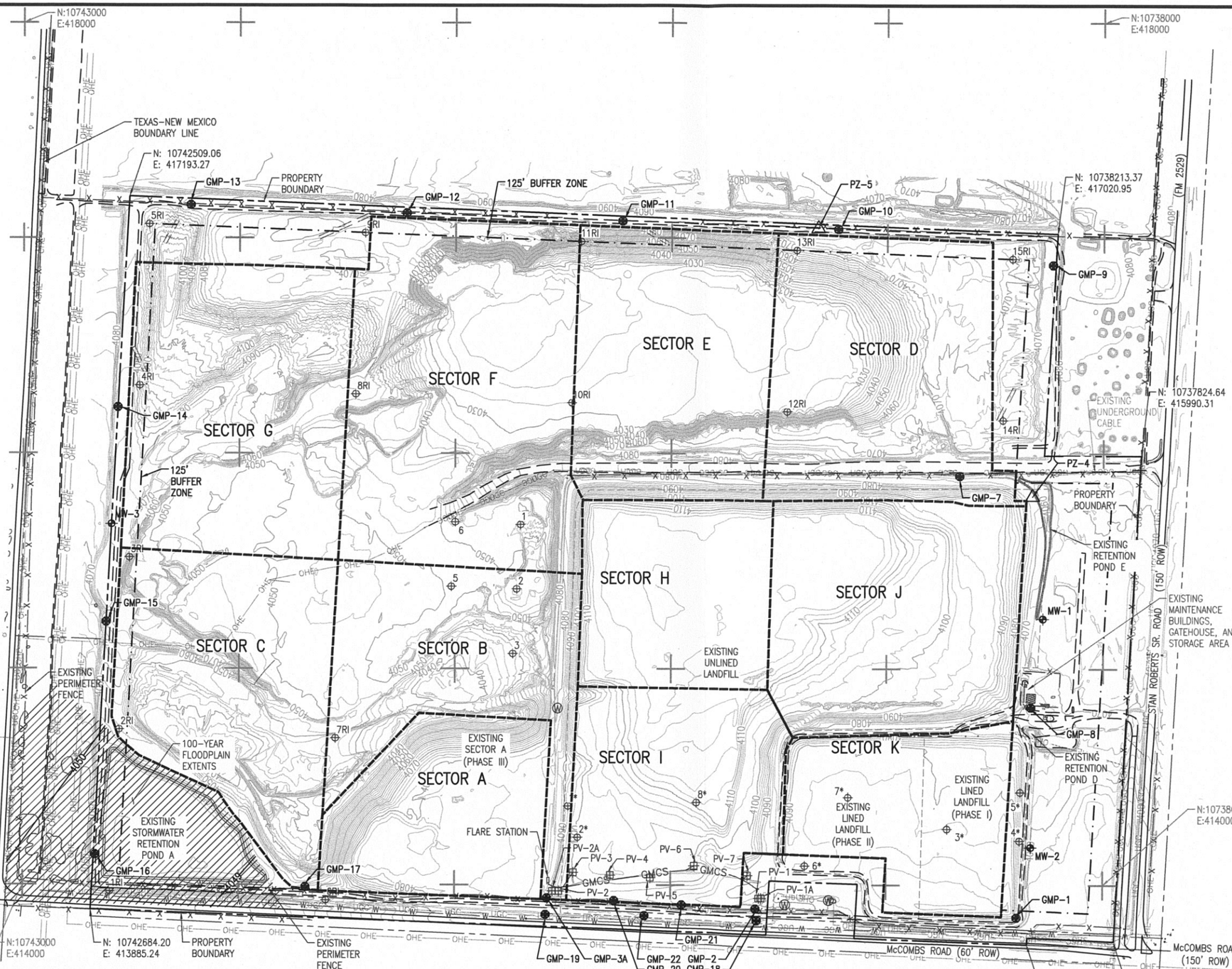
SAIC
SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve
Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

FLOOD INSURANCE RATE MAP

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

Keller, Tonya L. 10/16/2012 1:03:43 PM – P:\00218000 el paso tx\9631500115\data analytical\CADD\P2-26 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, 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

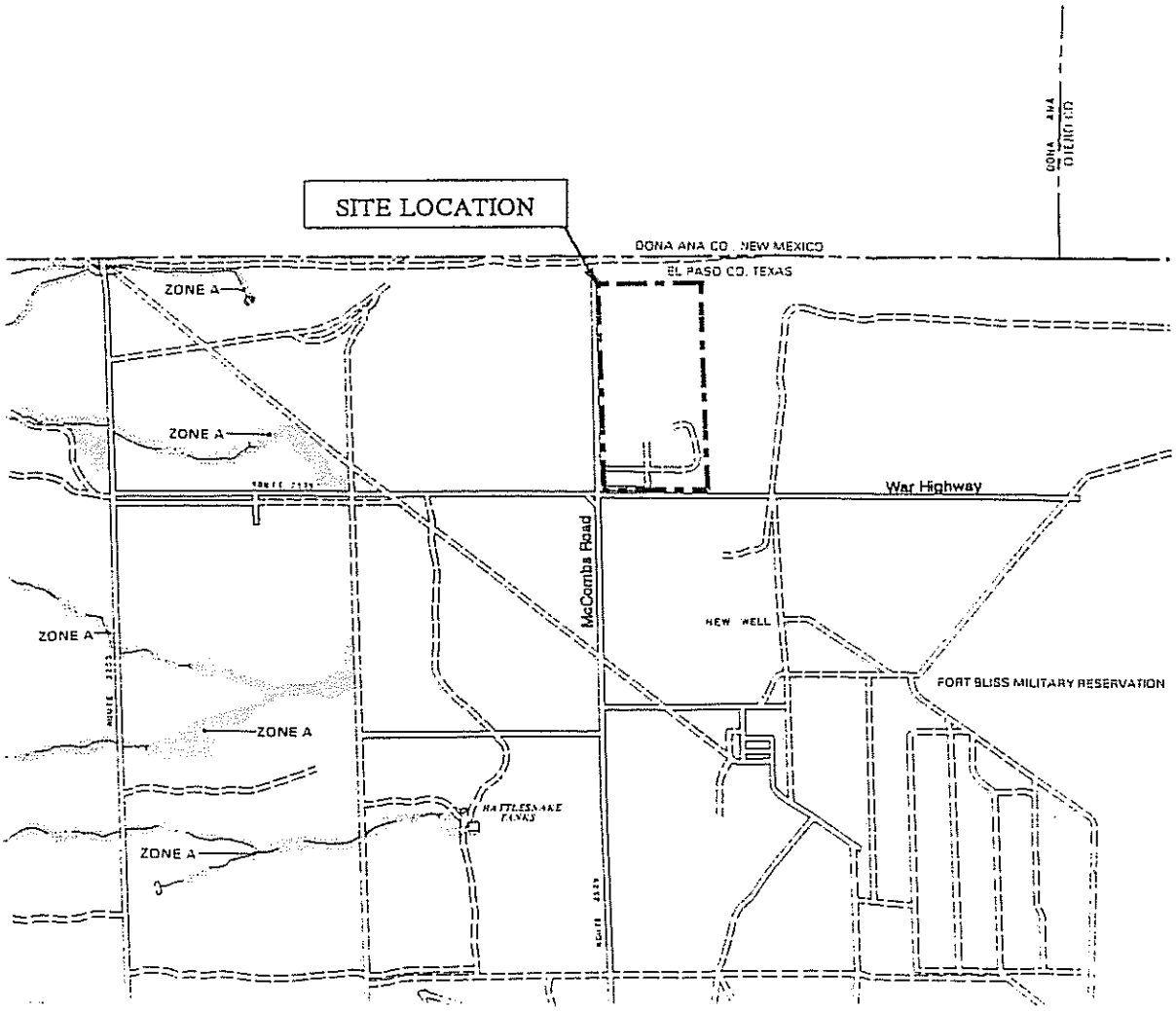
SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve
Suite 305
St. Paul, MN 55121
(651) 994-8415

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

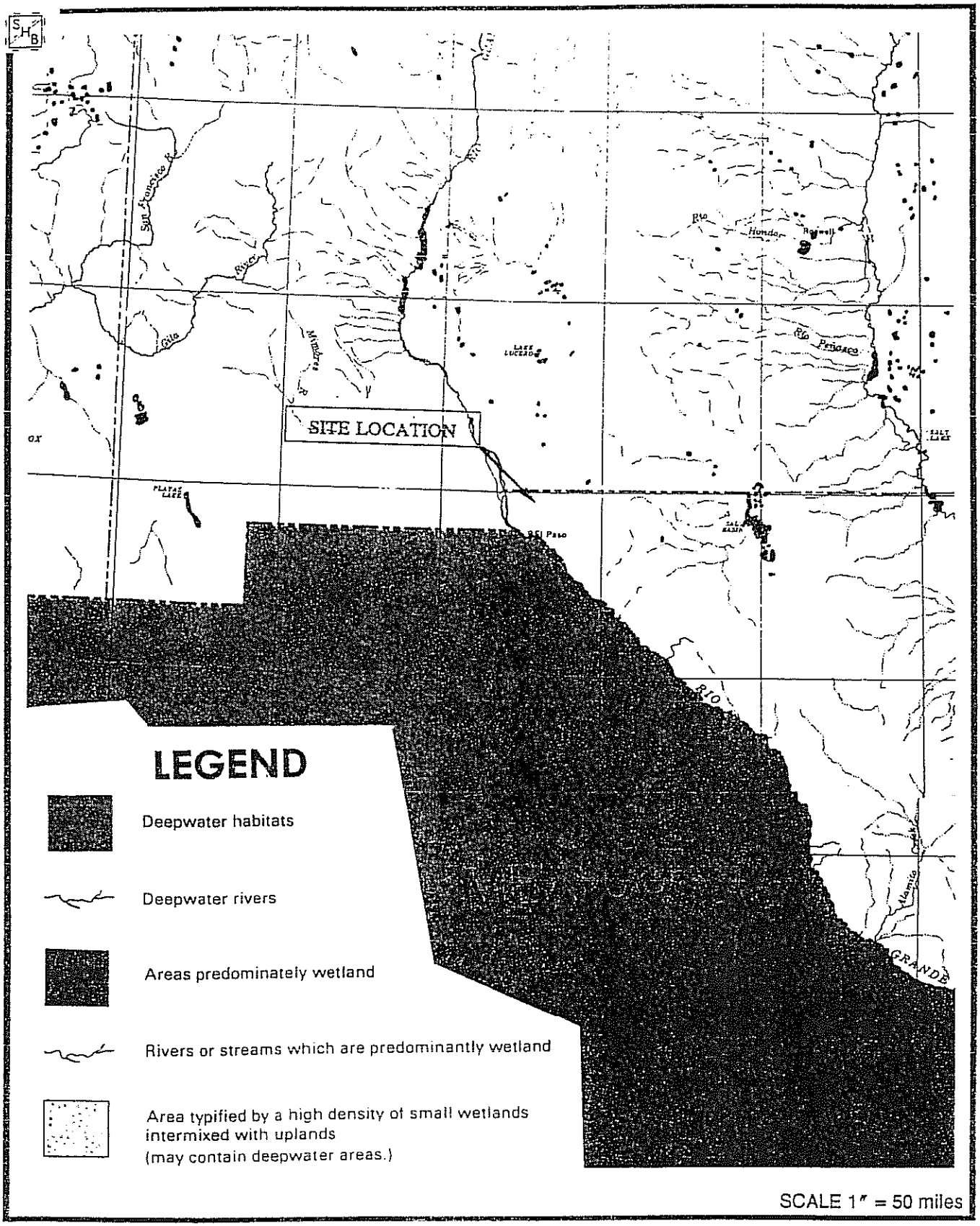
Approximate Scale 1" = 4000'

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

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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.

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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?

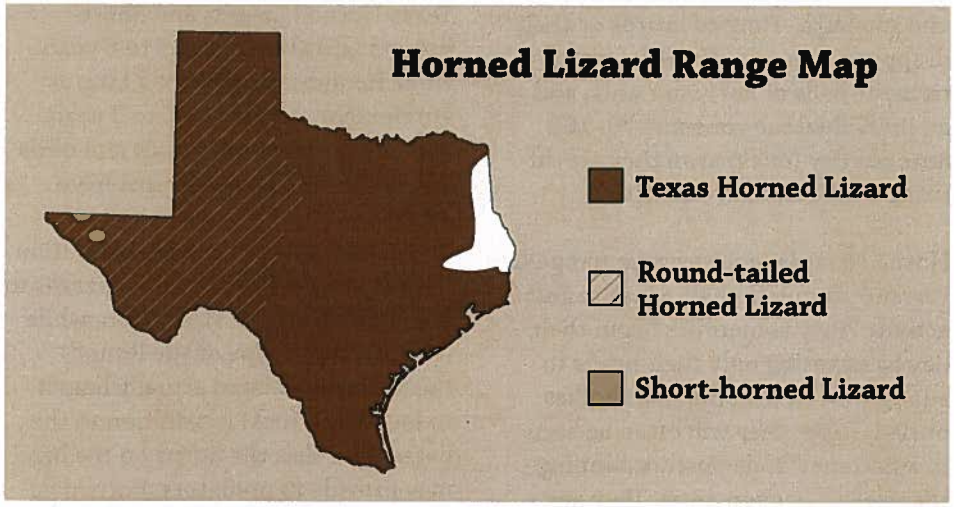
Harvester ants belong to the genera *Pogonomyrmex* or *Ephebomyrmex*. Twelve species of harvester ants are found in Texas, and the Red Harvester Ant (*Pogonomyrmex barbatus*) is the most widespread. Red harvester ants are easily identified by their large size (up to a half inch) and generally conspicuous 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.

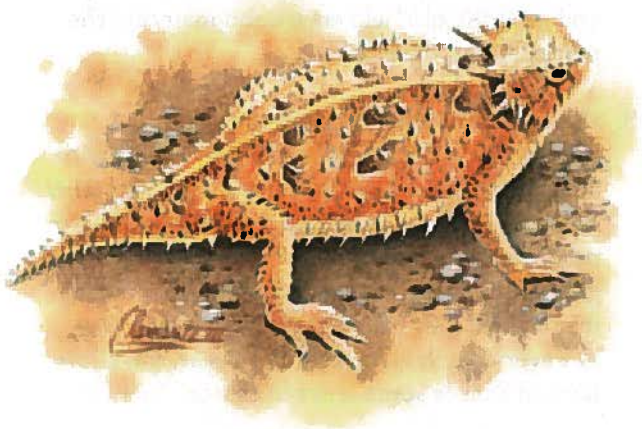
3. **Use prescribed fires to remove ground litter** – Horned lizards usually avoid areas with substantial dead vegetation on the ground (also called litter) because the litter can impede their movement. Burning is a useful tool to decrease ground litter and create open ground. Burning in small patches 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

[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:

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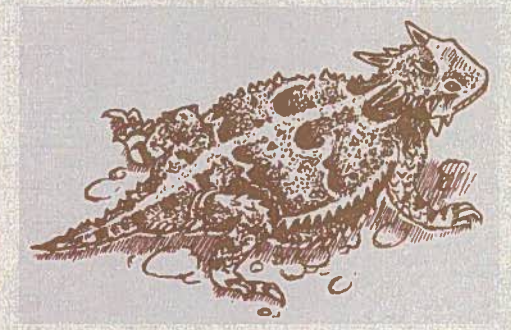
PWD 1280B–W7000 (2/10)

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.

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.

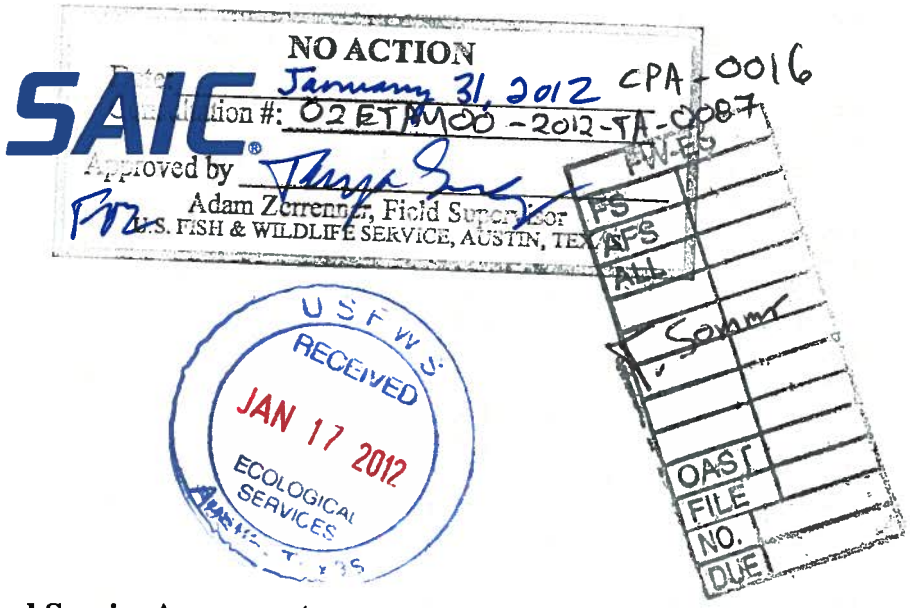
Sincerely,

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 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

SAIC®

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

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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

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

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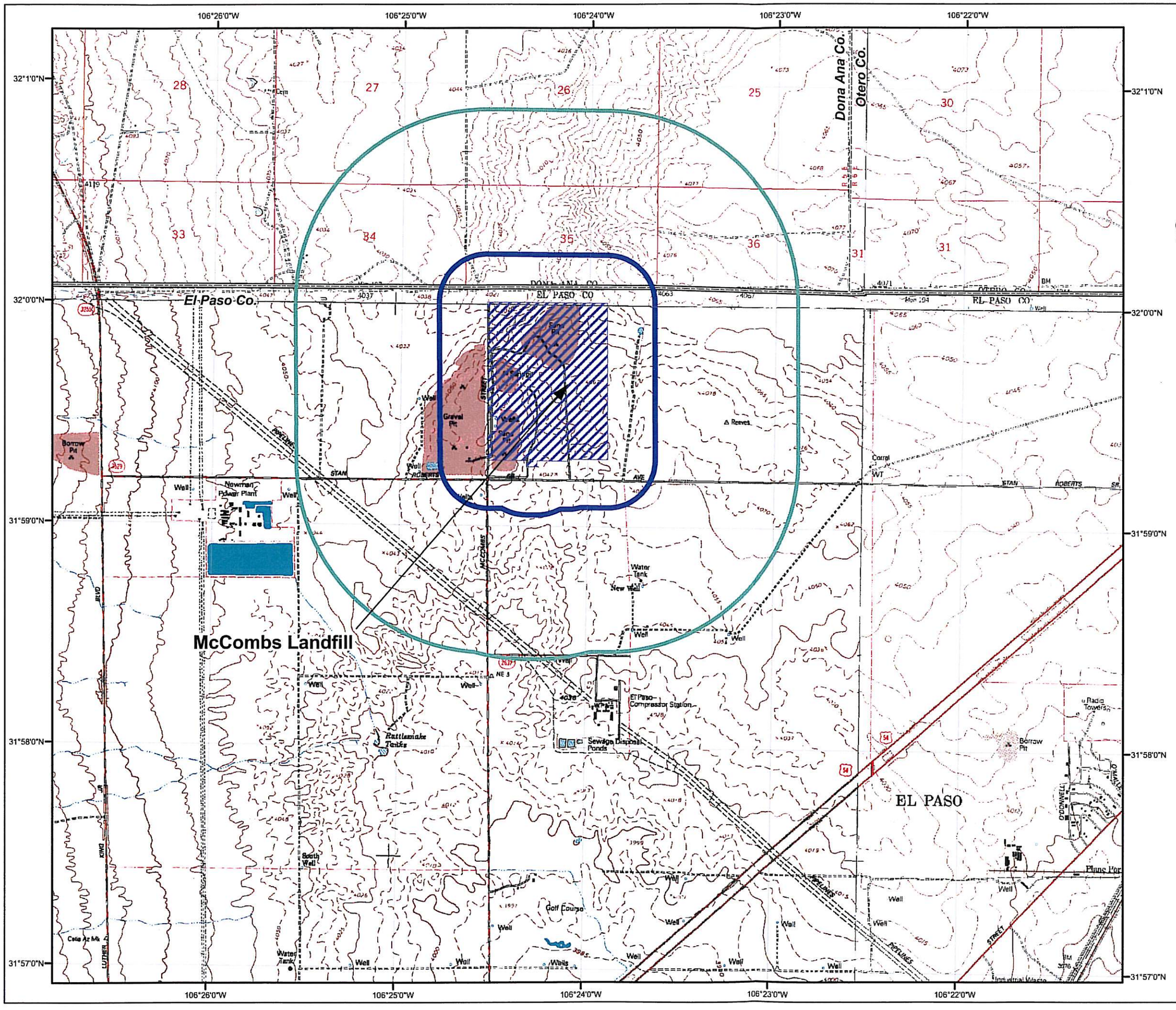


USGS 7.5 Minute Topographic Map

- 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

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®
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

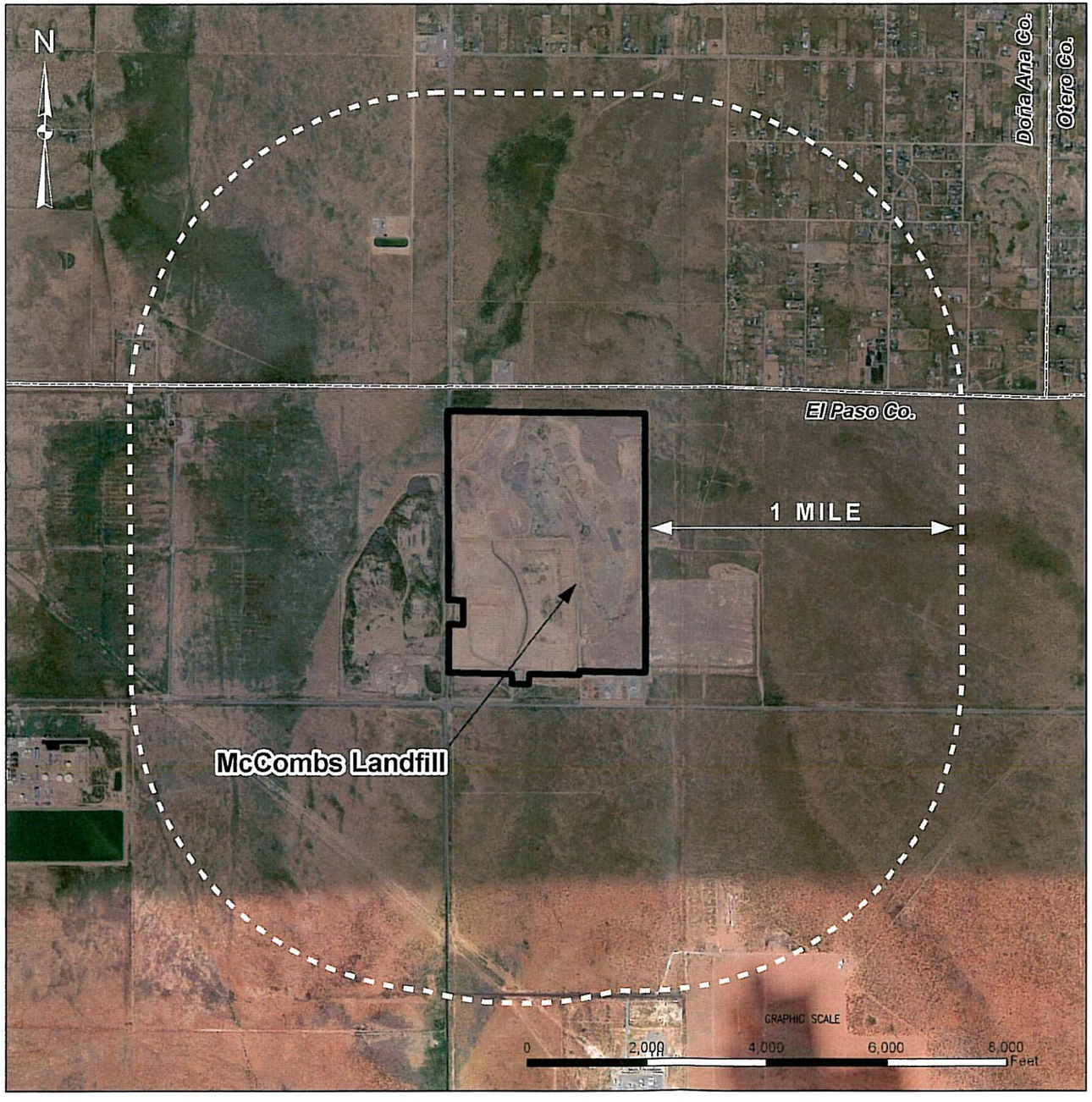
PROJECT NUMBER 9631500115

SHT 1 OF 2

DRAWING NUMBER Attachment 4A

NOTES

1. MAP CREATED USING ARCGIS SOFTWARE VERSION 9.2.



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®

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 – 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

SAIC®

Memorandum

SAIC

To: TCEQ

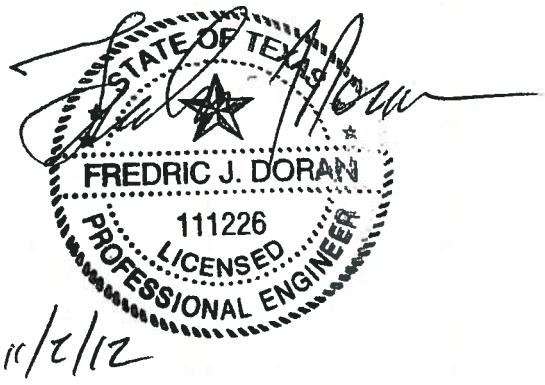
From: Fred J. Doran, SAIC

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
John F. Cook

City Council

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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

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

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

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 November 2012, Revision 3

SAIC

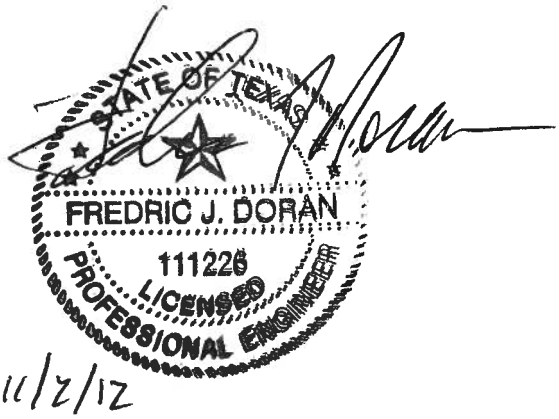
McCombs Municipal Landfill
El Paso County, Texas
TCEQ MSW Permit No. 729B

Major Permit Amendment Application
Part III
Volume I

Prepared for

City of El Paso

Updated November 2012, Revision 3

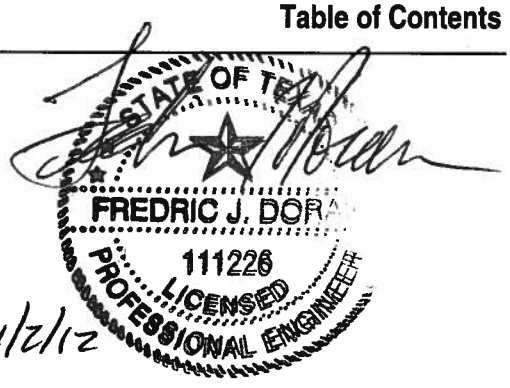


Prepared by

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 III
McCombs Municipal Landfill Permit No. 729B
City of El Paso



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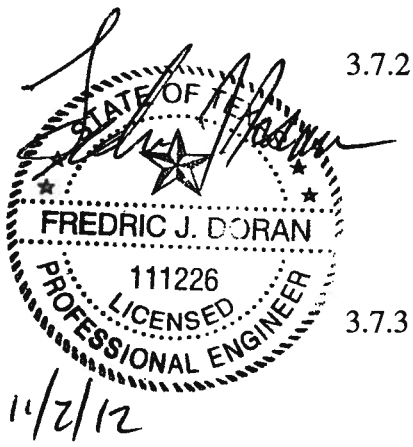

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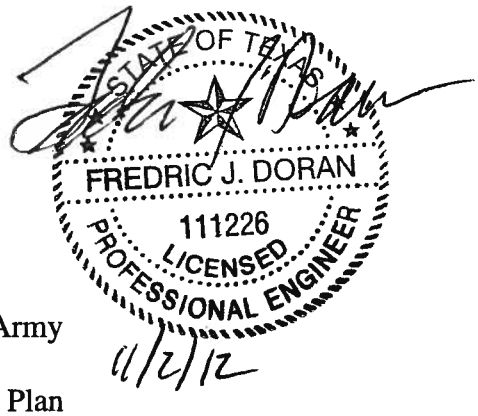

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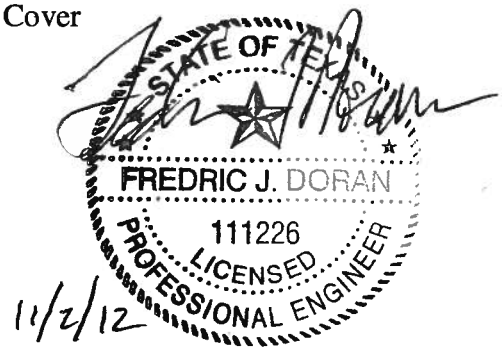

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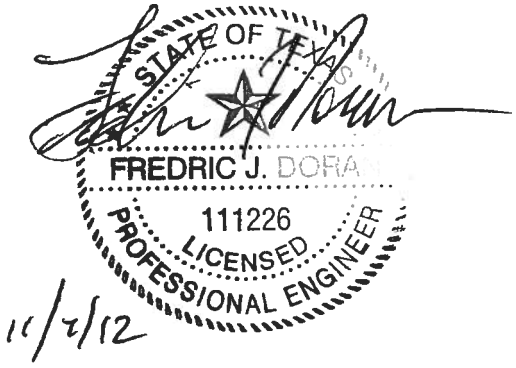

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STATE OF TEXAS
FREDRIC J. DORAN
111226
REGISTERED PROFESSIONAL ENGINEER
11/2/12

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

CITY OF EL PASO, TEXAS

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MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

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PROJECT NUMBER: 963150D115
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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
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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

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

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 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.

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 46,148,275 CY from a previously permitted volume of 22,348,549 CY to a new permitted volume of 68,496,824 CY. The expansion will apply to all areas of the landfill, including the previously-filled 95 acre area in the southwest corner. 78-acres of this 95-acre area will have a piggyback liner, as described in Section 3.4. The remaining 17-acres (currently Subtitle D lined) will

continue to be used for MSW disposal (including RACM disposal as described in Section 4.9.22), but at an increased elevation.

This vertical expansion will not involve excavation below the previous permitted elevations for the Landfill.

This MPA also increases the permitted/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.

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 Line Road and Stan Roberts Sr. Road is projected to reach "serious" LOM by the year 2040 as a result of the continuing background traffic growth.

With the addition of traffic generated by the Landfill, the volume to capacity (V/C) ratio increases, but does not result in worse LOM rankings. Because the Landfill does not adversely affect the LOM ranking for the roadway, it is recommended that the improvements to McCombs Road are implemented as recommended in the City's Metropolitan Transportation Plan (MTP).

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 7 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 7 – 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 7 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 62,532,764 CY, which provides a site life until 2059. 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. 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 prescriptive composite liner system are listed from top to bottom in Table 3.4-1 and components of the alternative composite liner system are listed from top to bottom in Table 3.4-2. For ease of distinguishing the difference between the two alternative liners for the facility, the previously permitted alternative liner will be referenced as the "prescriptive liner" throughout this permit and the new alternative liner will be referred to as the "alternative liner". It should be noted that the modeling results for both the previously approved prescriptive liner and the new alternative liner are provided in Appendix 3J. The components for the expansion piggyback onto the existing 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 78 acres). Detail drawings of the liner system are located in Appendix 3G - Construction Design Details, Drawing P3-28 – Landfill Base Plan

Table 3.4-1
Components of the Prescriptive Composite 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	60 mil
Composite 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 Alternative Composite 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	60 mil
Composite Liner	Geosynthetic Clay Liner (GCL) with a coefficient of permeability less than or equal to $5x10^{-9}$ cm/sec	NA
Compacted Soil Liner	Compacted Native Soil or Interim Cover Soil	6 inches

Table 3.4-3
Components of the Composite Liner System for the Expansion Piggyback Liner 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	60 mil
Composite Liner	Geosynthetic Clay Liner (GCL) with a coefficient of permeability less than or equal to $5x10^{-9}$ cm/sec	NA
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 of which 277-acres will be available for waste placement. 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 outside of the property boundary (Drawing P3-17 in Appendix 3E).

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

As stated previously, 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 outside of the property boundary (Drawing P3-17 in Appendix 3E). Any new landfill structures will be monitored similarly to the existing structures located within the property boundary.

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.

3.8.1.2 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 1×10^{-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 P3-28 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.

3.8.1.3 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.

3.8.1.4 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.

3.8.1.5 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.

3.8.1.6 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 total final cover area at the McCombs Landfill 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.

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 62,532,764 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 68,496,824 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

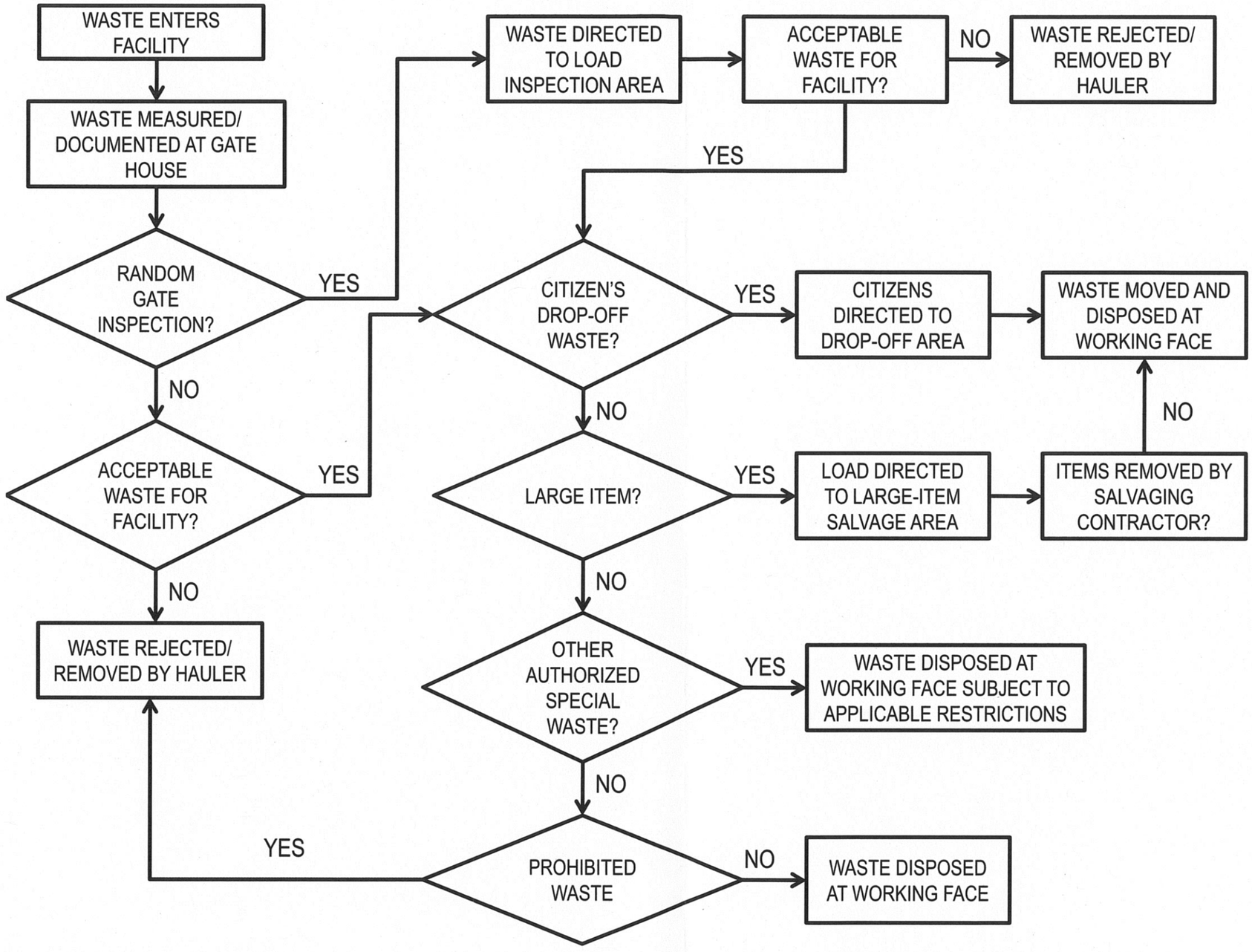
30 TAC §330.507

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

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

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

WASTE MOVEMENT FLOW CHART

PROJECT NUMBER: 9631500115
SHT. 34 OF: 78
DRAWING NUMBER: P3-1

Koller, Tonya L 10/17/2012 8:19:14 AM – P:\00218000 el paso tx\9631500115\data analytical\CADD\P3-1 WASTE MOVEMENT FLOW CHART.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. 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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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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MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

WASTE DISPOSAL, PROCESSING, AND STORAGE SCHEMATIC

PROJECT NUMBER: 9631500115
SHT. 35 OF: 78
DRAWING NUMBER: P3–2

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Appendix 3B
Surface Water Drainage Analysis

SAIC®

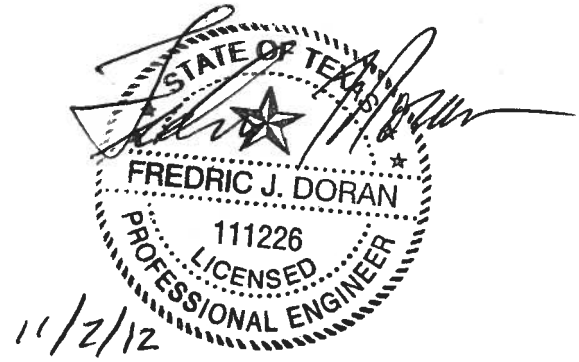
McCombs Municipal Landfill
El Paso County, Texas
TCEQ MSW Permit No. 729B

Part III
Appendix 3B
Erosion and Sediment Control Plan

Prepared for

City of El Paso

Updated November 2012, Revision 2



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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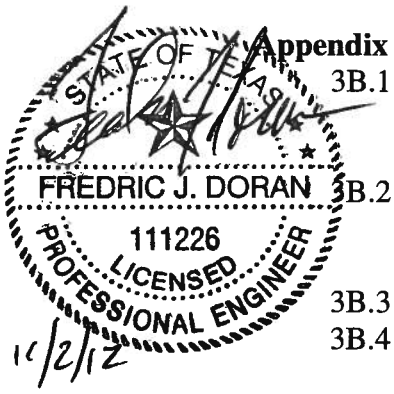

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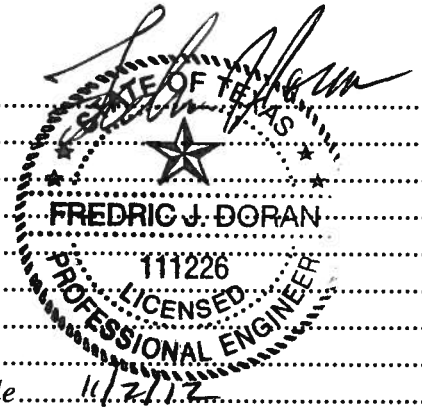

This report has been prepared for the use of the client for the specific purposes identified in the report. The conclusions, observations and recommendations contained herein attributed to SAIC constitute the opinions of SAIC. To the extent that statements, information and opinions provided by the client or others have been used in the preparation of this report, SAIC has relied upon the same to be accurate, and for which no assurances are intended and no representations or warranties are made. SAIC makes no certification and gives no assurances except as explicitly set forth in this report.

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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)

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.

- 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.
- 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.
- 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.
- Structural control parameters for the installation of structural controls as established in the permit revision 2 dated July 2009 by Parkhill, Smith & Cooper, Inc. in the Erosion and Sedimentation Control Plan, Table 6-E-1, are still applicable to this permit revision. The erosion and sediment control plan is provided in Appendix 3B, Attachment 6.

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 provided in the permit revision 2 dated July 2009 by Parkhill, Smith & Cooper, Inc. in the Erosion and Sedimentation Control Plan, Tables 6-E-2 and 6-E-3 respectively (Appendix 3B, Attachment 6), are still applicable to this permit revision. It is the Site Supervisors responsibility to ensure that these maintenance activities are completed and controls are in place and operational.

As per 30 TAC §330.305(e) the Landfill will be maintained such that:

1) *"The owner or operator shall maintain the collection, drainage, and/or storage units as designed, and shall restore and repair the drainage system in the event of washout or failure; and*
2) *The Owner or operator shall control erosion and sedimentation, including having interim controls for phased development."*

3B.3 Soil Loss Calculation

Calculations for soil loss have been performed using the Revised Universal Soil Loss Equation (RUSLE) as provided by the National Resource Conservation Service (NRCS), El Paso office. This calculation demonstrates long-term erosion stability of the Landfill and an estimation of soil loss as required by the TCEQ Solid Waste Regulations. Calculations can be seen in Appendix 3B, Attachment 5 – Closure Soil Loss Calculations. The utilized soil loss RUSLE values are provided in Appendix 3B,

Attachment 5 as well as in the Erosion and Sedimentation Control Plan completed by Parkhill, Smith & Cooper, Inc. (revision 2 dated July 2009) included in Appendix 3B, Attachment 6. It should be noted that the rainfall value "R" has been updated from previous calculations provided to the TCEQ, as it appears the value previously used was incorrect for the City of El Paso.

The soil loss calculations for final cover conditions and intermediate cover conditions are summarized below in Table 3B-1.

Table 3B-1
Soil Loss Calculation Results

Cover Conditions	Location	Cover Type	Soil Loss (tons/acre-year)
Interim Cover	Side Slope	N/A[C]	7.43[B]
Intermediate Cover	Side Slope	N/A[C]	6.48[B]
Final Cover	Side Slope	Vegetation	1.12[A]
Final Cover	Side Slope	Rock Cover	0.27[A]
Intermediate Cover	Top Dome	N/A[C]	1.10[B]
Final Cover	Top Dome	Vegetation	0.19[A]
Final Cover	Top Dome	Rock Cover	0.05[A]

[A] – TCEQ maximum recommended loss for final cover conditions is 2 tons/acre-year.
[B] – TCEQ maximum recommended loss for intermediate cover conditions is 50 tons/acre-year.
[C] – It is assumed that the interim and intermediate cover will have no ground cover.

3B.4 Non-Erodible Velocities

In accordance with 30 TAC §330.305(d)(1), estimated peak velocities for top surfaces and external embankment slopes have been compared to the permissible non-erodible velocities under similar conditions. The permissible non-erodible velocities were obtained from the Erosion and Sedimentation Control Plan by Parkhill, Smith & Cooper, Inc. (revision 2 dated July 2009) included in Appendix 3B, Attachment 6. Top surfaces and external embankment slopes were designed to minimize erosion and soil loss through the use of appropriate side slopes, vegetation, and other structural and non-structural controls during all phases of Landfill operation in accordance with 30 TAC §330.305(d)(2). Table 3B-2 provides the maximum velocity for each service compared to the permissible velocity for the cover condition. Calculations for each drainage area are provided in Appendix 3B, Attachment 7 – Drainage Calculations.

Table 3B-2
Non-Erodible Velocities

Flow Surface	Condition	Max Velocity (fps)	Max Non-Erodible Velocity (fps)	Acceptable
Intermediate Cover				
Interim Side Slope (3:1)	Non-Vegetated	1.19	1.5	Yes
External Side Slope (3:1)	Non-Vegetated	1.24	1.5	Yes
Top Dome (7%)	Non-Vegetated	0.69	1.5	Yes
Final Cover				
External Side Slope (3:1)	Vegetated	1.55	4.0	Yes
Top Dome (7%)	Vegetated	1.15	4.0	Yes
External Side Slope (3:1)	Rock Armored	3.09	20	Yes
Top Dome (7%)	Rock Armored	2.30	20	Yes
Channels				
Channel 1	Rip Rap	4.40	20.0	Yes
Channel 2	Concrete	6.74	20.0	Yes
Channel 3	Rip Rap	4.69	20.0	Yes
Channel 4	Vegetated	3.42	4.0	Yes
Channel 5	Rip Rap	4.07	20.0	Yes

Appendix 3B - Attachment 1
Stormwater Calculations

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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	82.06	0.4	73	3.70	0.93	1.42	32.82	149.4	0.83	27	0.99	33	6.33	9.72
DEV-2	37.14	0.4	73	3.70	0.93	1.42	14.86	44.7	1.99	30	2.41	36	2.87	4.40
DEV-3	33.23	0.4	73	3.70	0.93	1.42	13.29	18.0	3.41	45	4.22	56	2.56	3.93
DEV-4	38.02	0.4	73	3.70	0.93	1.42	15.21	38.1	2.21	34	2.68	41	2.93	4.50
DEV-5	53.21	0.4	73	3.70	0.93	1.42	21.28	26.0	2.80	59	3.42	73	4.10	6.30
DEV-6	14.89	0.4	73	3.70	0.93	1.42	5.96	42.0	2.08	12	2.52	15	1.15	1.76
DEV-7	37.45	0.4	73	3.70	0.93	1.42	14.98	51.0	1.83	27	2.20	33	2.89	4.43
DEV-8	35.26	0.4	73	3.70	0.93	1.42	14.10	23.6	2.95	42	3.62	51	2.72	4.17

* 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 various frequencies of the 24 hour storm event

Calculation by:	JSR	11/02/12
Checked by:	FJD	11/02/12

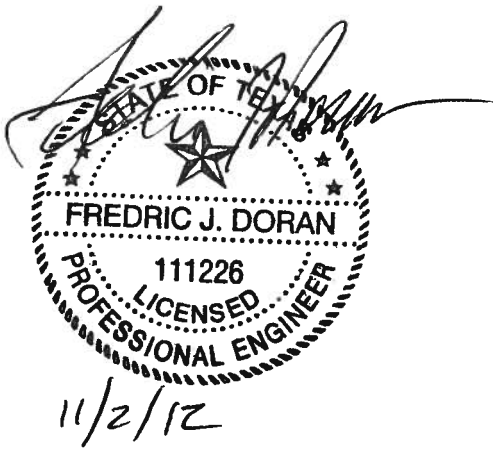
STATE OF TEXAS
FREDRIC J. DORAN
111226
LICENSED
PROFESSIONAL ENGINEER
11/2/12

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



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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

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McCombs Landfill
MSW Permit No. 729B Major Permit Amendment
Calculation for Ditch Sizing

Channel 1

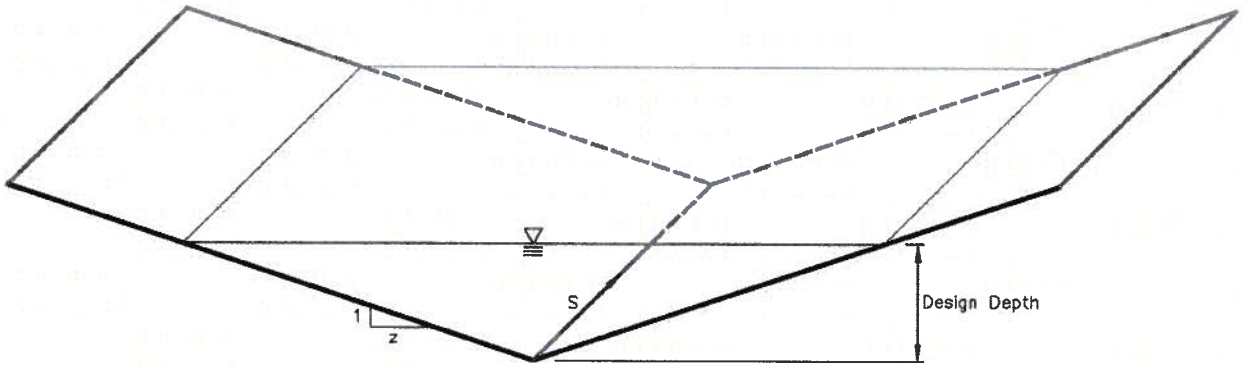
Design Depth

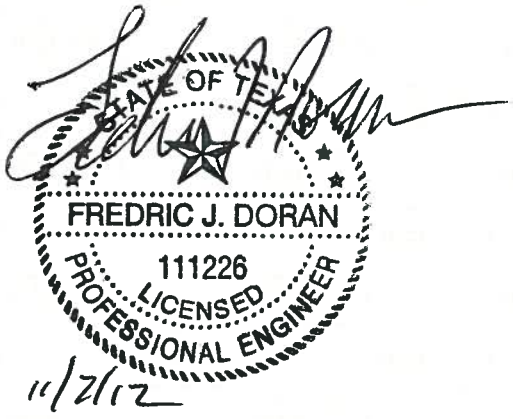
DEV-1										
25-year										
Q	n	S	z	d	A	Pw	R	V	Qcheck	Design Depth (ft.)
41	0.03	0.01	3	1.76	9.29	11.13	0.83	4.40	40.91	2.26
100-year check										
Q	n	S	z	d	A	Pw	R	V	Qcheck	Overtops?
48.77	0.03	0.01	3	1.88	10.58	11.88	0.89	4.60	48.66	no

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

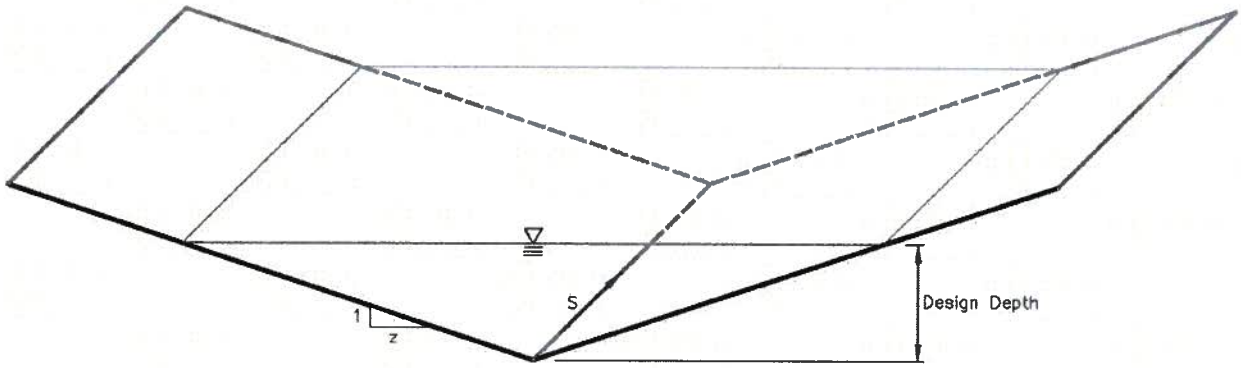
Design Depth

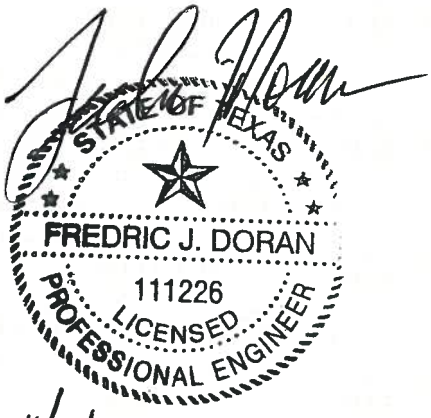
DEV-2										
25-year										
Q	n	S	z	d	A	Pw	R	V	Qcheck	Design Depth (ft.)
48	0.03	0.028	3	1.54	7.11	9.74	0.73	6.74	47.89	2.04
100-year check										
Q	n	S	z	d	A	Pw	R	V	Qcheck	Overtops?
59	0.03	0.028	3	1.66	8.30	10.52	0.79	7.09	58.87	no

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)	$V = (1.49/n)*R^{2/3}*\sqrt{s}$





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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

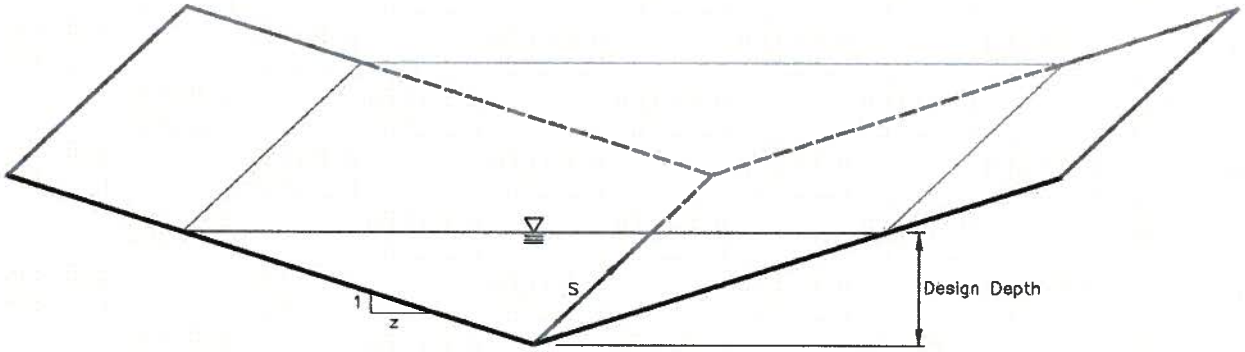
Design Depth

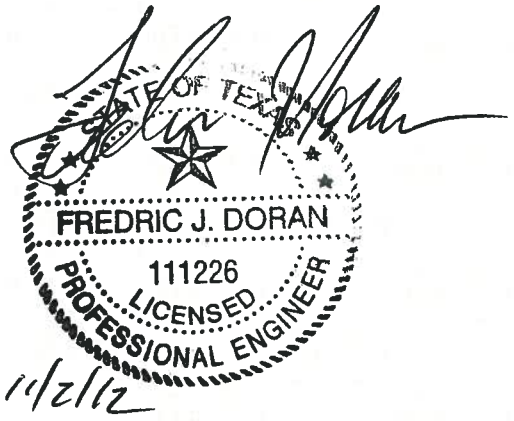
DEV-4										
25-year										
Q	n	S	z	d	A	Pw	R	V	Qcheck	Design Depth (ft.)
32	0.03	0.014	3	1.51	6.80	9.52	0.71	4.69	31.93	2.01
100-year check										
Q	n	S	z	d	A	Pw	R	V	Qcheck	Overtops?
39	0.03	0.014	3	1.62	7.89	10.26	0.77	4.93	38.91	no

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

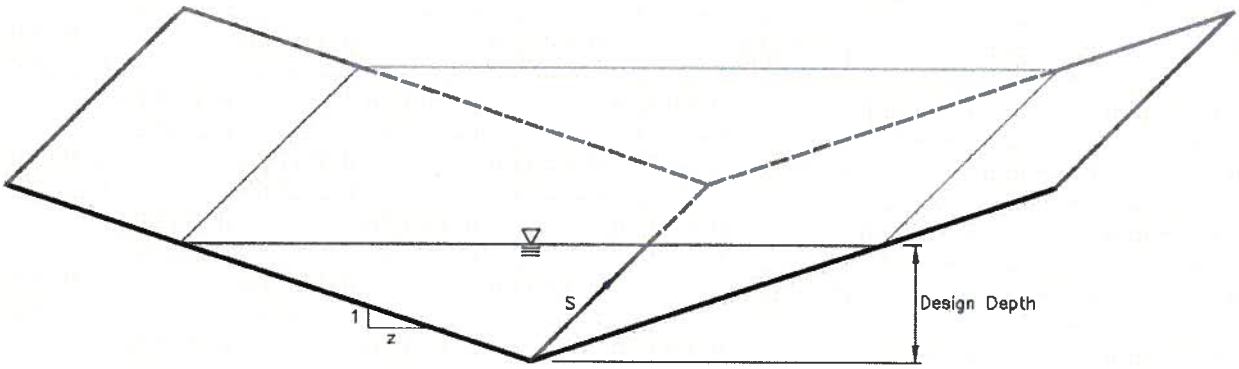
Design Depth

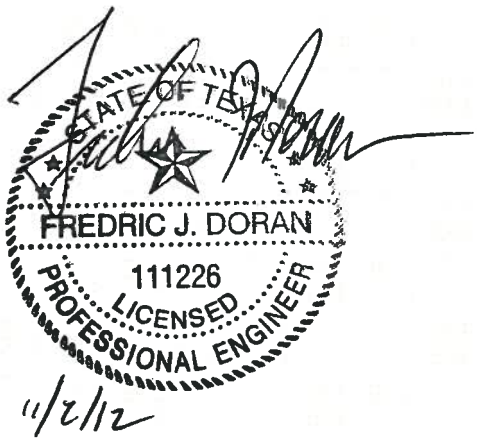
DEV-6										
25-year										
Q	n	S	z	d	A	Pw	R	V	Qcheck	**Design Depth (ft.)**
15	0.03	0.01	3	1.21	4.37	7.63	0.57	3.42	14.97	**1.71**
100-year check										
Q	n	S	z	d	A	Pw	R	V	Qcheck	**Overtops?**
19	0.03	0.01	3	1.32	5.22	8.34	0.63	3.63	18.96	**no**

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

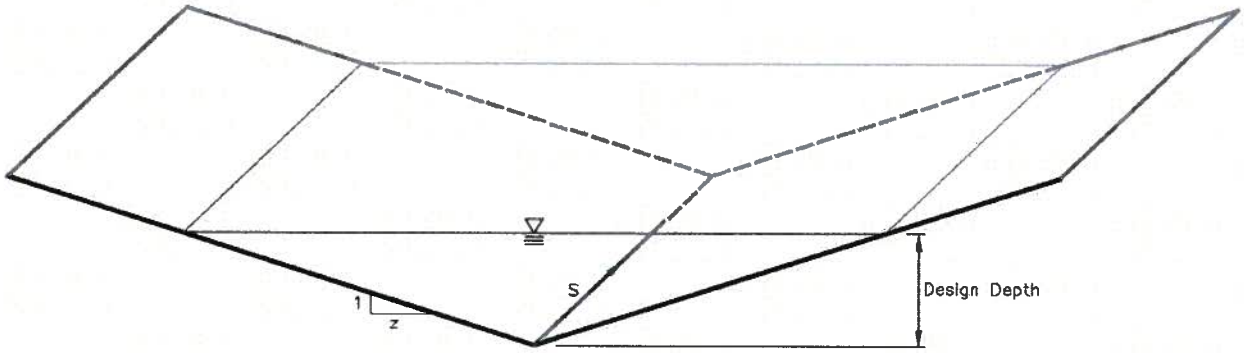
Design Depth

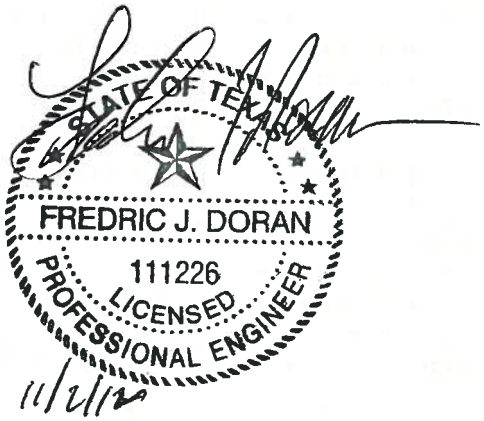
DEV-7										
25-year										
Q	n	S	z	d	A	Pw	R	V	Qcheck	**Design Depth (ft.)**
30	0.03	0.01	3	1.57	7.35	9.90	0.74	4.07	29.93	**2.07**
100-year check										
Q	n	S	z	d	A	Pw	R	V	Qcheck	**Overtops?**
36	0.03	0.01	3	1.68	8.43	10.60	0.80	4.26	35.92	**no**

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

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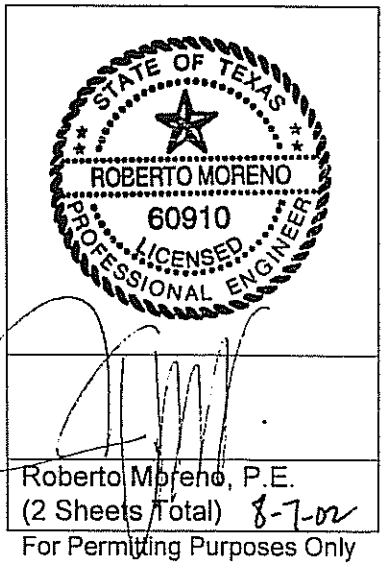
APPENDIX 6-C
Culvert Calculations



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

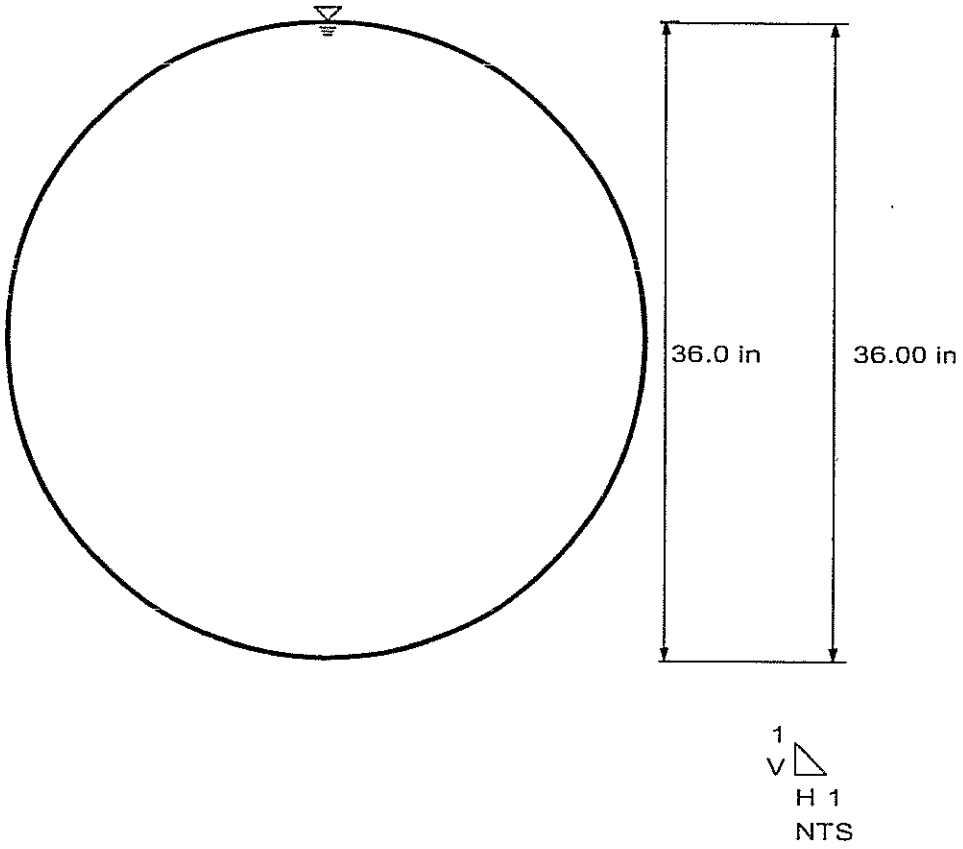
Input Data		
Mannings Coefficient	0.013	
Channel Slope	1.0000	%
Depth	36.0	in
Diameter	36.00	in

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

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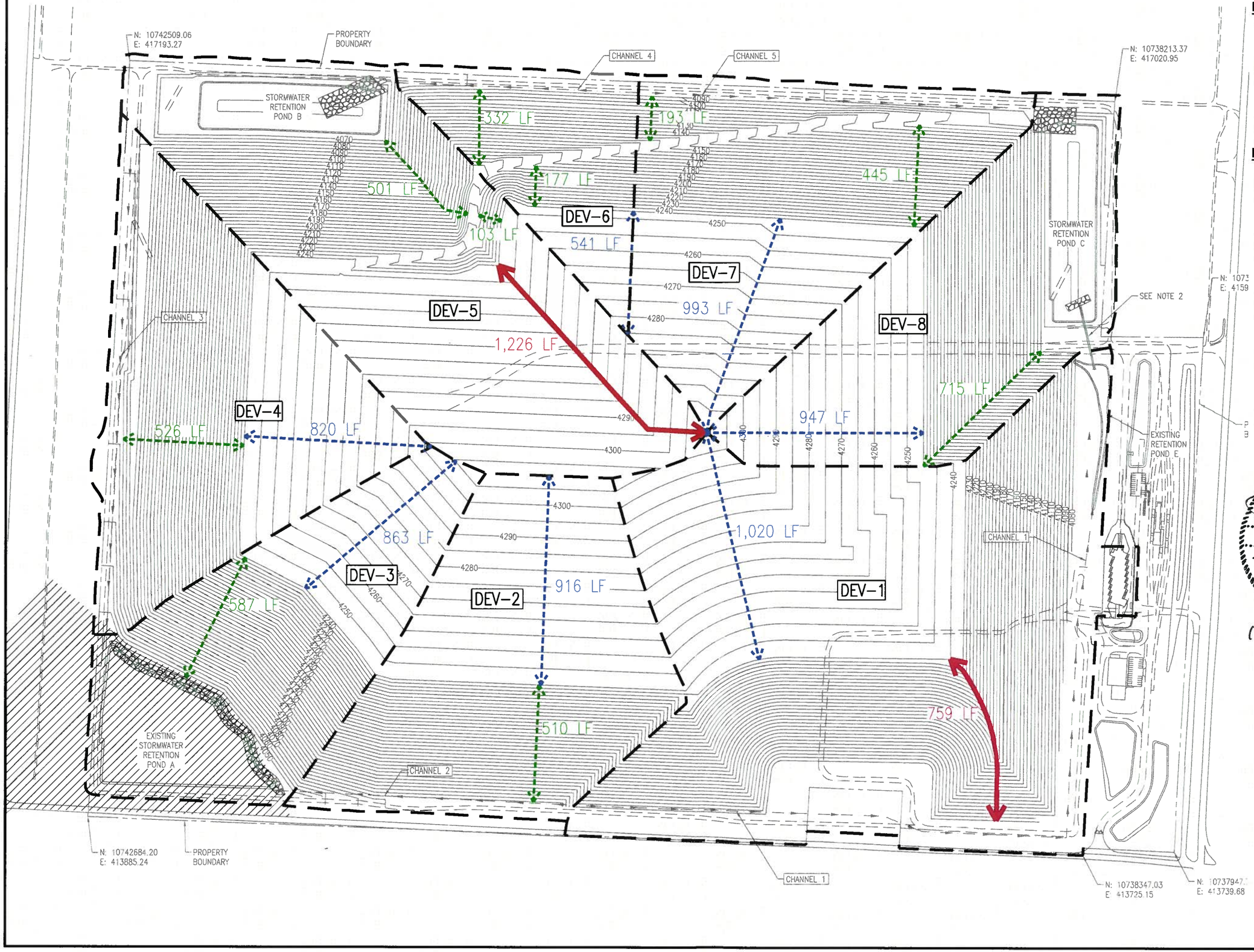


NOTES

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

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 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

= $(\ell/72.6)^m$ — ℓ = horizontal slope length in feet

ℓ = 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

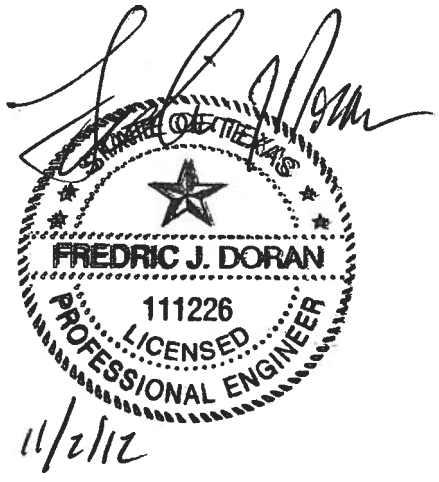
Conservative Value - from Parkhill, Smith & Cooper, Inc. Revision 2 July 2009

= 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

= $(\ell/72.6)^m$ — ℓ = horizontal slope length in feet

ℓ = 759 feet (Value from Figure 1)

m = 0.66 for 30% slope with moderate rill to interill erosion

= 4.71

C Cover Management Factor

Value from Parkhill, Smith & Cooper, Inc. Revision 2 July 2009

= 0.110

P Support Practices Factor

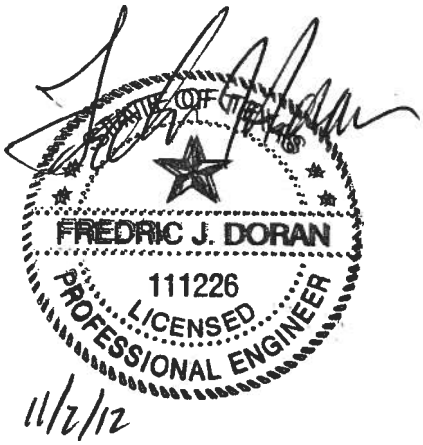
Conservative Value - from Parkhill, Smith & Cooper, Inc. Revision 2 July 2009

= 1

A Calculated Soils Loss (ton/acre/year)

= R*K*S*L*C*P

= **6.48** (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 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
= $(\ell/72.6)^m$ — ℓ = horizontal slope length in feet
ℓ = 759 feet (Value from Figure 1)
m = 0.66 for 30% slope with moderate rill to interill erosion
= 4.71

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
= **1.12** (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

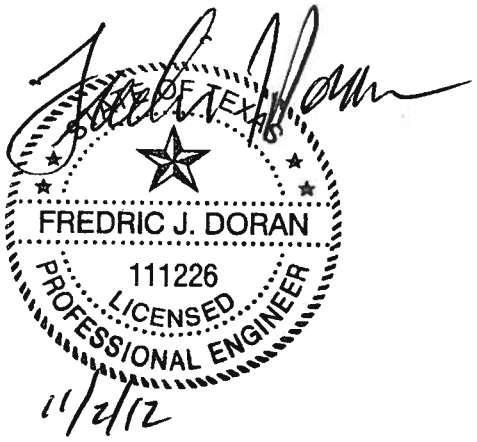
S Slope Factor
Calculated Above
= 4.81

L Slope Length Factor
Calculated Above
= 4.71

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
= **0.27** (to meet soil erosion criterion in 30 TAC 330.305 (d)(2), A ≤ 2 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

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

= $(10.8 \sin \Theta) + 0.3$ for slopes where $\sin \Theta > 0.09$

Θ = slope angle

$\Theta = 4.00^{\circ}$

= 1.05

L Slope Length Factor

= $(\ell/72.6)^m$

ℓ = horizontal slope length in feet

ℓ = 1226 feet (Value from Figure 1)

m = 0.46 for 7% slope with moderate rill to interill erosion

= 3.67

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

= **1.10** (to meet soil erosion criterion in 30 TAC 330.305 (d)(2), A ≤ 50 tons/acre/year)

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

Calculation by:	JSR	11/02/2012
Checked by:	FJD	11/02/2012

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
$= (\ell/72.6)^m$ — ℓ = horizontal slope length in feet
ℓ = 1226 feet (Value from Figure 1)
m = 0.46 for 7% slope with moderate rill to interill erosion
= 3.67

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
= **0.19** (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

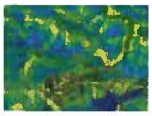
L Slope Length Factor
Calculated Above
= 3.67

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
= **0.05** (to meet soil erosion criterion in 30 TAC 330.305 (d)(2), A ≤ 2 tons/acre/year)

Calculation by:	JSR	11/02/2012
Checked by:	FJD	11/02/2012



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

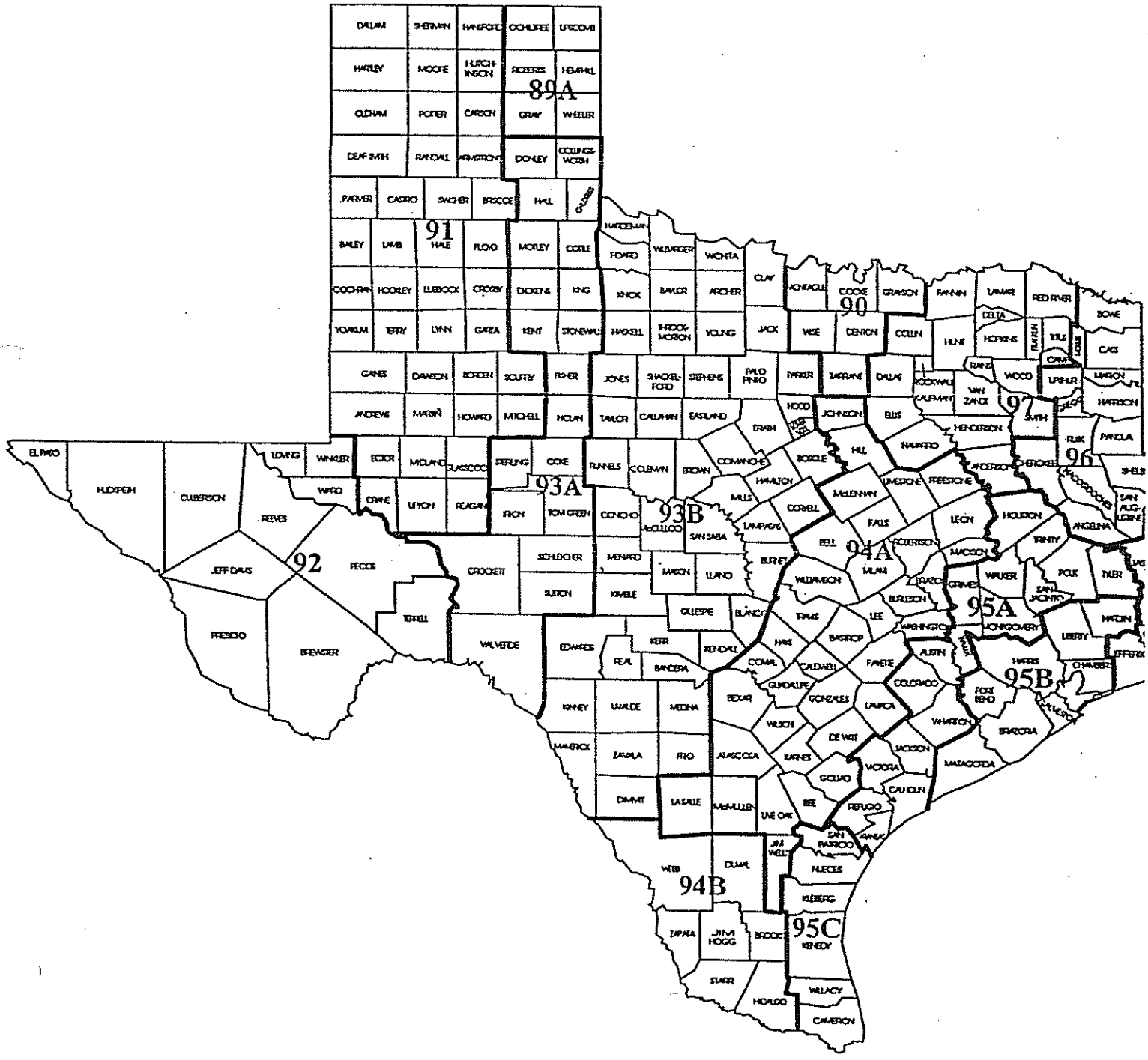
Map Unit Symbol	Component Name	Surface Texture	Percent of Map Unit	Hyd. Grp.	Kf	T	Rock Cover %
AGB	AGUSTIN	GR-L	100	B	.24	5	25
An	ANAPRA	SICL	90	B	.43	3	0
BA	BADLANDS	VAR	100	D	.43	2	NO DATA
BPC	BLUEPOINT	LFS	100	A	.17	5	0
BUC	BLUEPOINT GRAVEL	GR-FS	100	A	.20	5	30
Br	BRAZITO	LFS	90	A	.20	5	5
DCB	DELNORTE	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.

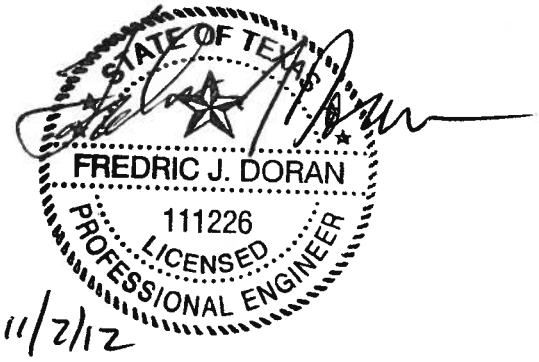
Appendix 3B – Attachment 6
PSC Erosion and Sediment Control Plan

SAIC®

Part III
Site Development Plan
Attachment No. 6
Appendix 6-F

Erosion and Sediment Control Plan
For

McCombs Landfill
MSW Permit No. 729B
City of El Paso
El Paso County, Texas
Revised July 2009

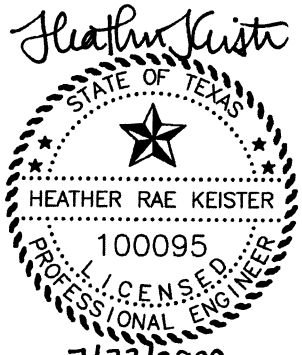


The attached document was modified from its original form only to modify the MSW Permit No. 729A to 729B. Portions of the original document are still applicable to the MSW Permit Amendment 729B as described in the Appendix 3B Erosion and Sediment Control Plan prepared by SAIC.

PART III
SITE DEVELOPMENT PLAN
ATTACHMENT NO. 6
APPENDIX 6-F

EROSION AND SEDIMENTATION CONTROL PLAN
FOR

McCOMBS LANDFILL
MSW PERMIT No. 729AB
CITY OF EL PASO
EL PASO COUNTY, TEXAS
REVISED JULY 2009



Firm Registration # 560

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Figure Att6-F-2 – Erosion Control Details
Figure Att6-F-2a-Erosion Control Details

7/23/2009
Firm Registration # 560

A. INTRODUCTION

This Erosion and Sedimentation Control Plan was developed to provide control measures for existing and proposed on-site gradient slopes and drainage. The control measures will provide for the care and management of soil erosion and control of sedimentation due to stormwater runoff.

B. EXISTING SITE CONDITIONS

The McCombs Landfill site is located in Section 6, Block 80, Township 1. The landfill is located within the City limits of El Paso and is within one mile south of the Texas-New Mexico State Line. It is situated in the northeast corner of the intersection of McCombs Road and Stan Roberts Sr. Road (FM 2529). The site encompasses a total of 327 acres.

Site vegetation consists of sparse desert shrubs. The predominant soil association in the proposed landfill area is the Turney-Berino Association, described as moderately deep over soft caliche, in the Hueco Bolson. The soils are characterized with moderate permeability, high water-holding capacity, and slow runoff rate. Caliche covers the entire Bolson surface and ranges in thickness from paper-thin or in nodules up to 8-feet thick.

C. EXISTING DRAINAGE CONDITIONS

The drainage area for the site totals 327 acres. There is approximately 218 acres of off-site drainage areas as mentioned before in this report. The existing drainage areas are delineated and shown in Figure Att6-2a&b. The figure contains a table, which summarizes all existing drainage areas and their contributing flows.

D. DEVELOPED DRAINAGE CONDITIONS

During the construction of the McCombs Landfill Units, temporary dikes and drainage swales will be constructed to protect open areas from on-site surface water. Upon final closure of the site, perimeter swales and ponding areas will control stormwater runoff. Stormwater controls are shown in Figure Att6-F1. Erosion control details are shown in Figure Att6-F2.

E. EROSION AND SEDIMENT CONTROLS

The control and prevention of erosion and soil loss during the construction of the landfill is the primary goal. During the phasing of construction activities temporary measures will be implemented to minimize the area of disturbance. Implementation of intermediate and permanent erosion control practices throughout the entire phasing of the landfill is key.

E.1. Structural Controls

Structural controls will be implemented as necessary during the development of the landfill to minimize erosion. The structural controls shall include silt fences, hay bales, rock filter dams, ditch checks, sediment logs, and various channel lining material for drainage swales and channels,

Perimeter channels/swales will be constructed around the landfill area as landfill cells are developed, to divert stormwater runoff to retention ponds, as shown in Figure Att6-2a&b. Velocities that exceed 4 feet per second (fps) within any channel/swale will be lined with gabions, concrete, or concrete stabilized rip-rap for protection against erosion. There are two areas having computed velocities which exceed 4 fps within the proposed ditches. These ditches are located along the west side of DA-B and the north side of DA-C and will require lining. The channel on the west side of DA-B is currently lined with concrete stabilized rip-rap.

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 have 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 as 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 receive the final cover system, proper care will be taken to ensure that the vegetative layer is maintained to support native plant growth as per the SDP, Attachment 12, Final Closure Plan or that the 4-inch rock layer or equivalent 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 but will not require the 4-inch rock layer. The site will stockpile excess soil that will be used for operations at the landfill, and thus willvegetat ea portion of the stockpile material to prevent soil erosion due to wind and water along with silt fencing measures.

Prior to the construction of the vegetative layer, several representative soil samples should be collected and analyzed for nutrient content. Sample collection and analysis should be done in accordance with the procedures recommended by the Texas Agricultural Extension Service. If samples are found to be nutrient deficient, provisions will be made for appropriate fertilization. Areas requiring intermediate vegetative cover for erosion protection during cool seasons will be mulched and seeded with a fast germinating 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 fences, earthen berms, or sediment logs will be installed around the base of stockpile areas, active excavation and construction areas, and any other areas that may contribute silt from

stormwater runoff. During the development of the landfill, silt fences, hay bales, rock filter dams, ditch checks, and sediment logs will be necessary to control erosion and silting of drainage structures. No controls will be required to be placed on sections of daily cover.

Silt fences, 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 place such to keep the flow velocity below 1 fps. The structural controls will be checked for sediment build-up as specified in Table 6-E-3.

Parameters for the installation of the structural controls can be found in the Table below.

Table 6-E-1 Structural Control Parameters

Control	Typical Placement	Max Spacing/ Max Drainage Area	Slope Restrictions
Silt Fence	Downstream of disturbed area which has not received perament erosional controls	100 ft 75 ft 50 ft 25 ft	3%-5% 5%-10% 10%-20% 20%-50%
Hay Bales	Downstream of disturbed area which has not received perament 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.

E.2. Non-Structural Controls

Maintenance of erosion and sedimentation controls is an integral part of the daily operation of the landfill and is the responsibility of the Site Supervisor to ensure that these controls are met. 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 6-E-2 lists suggested maintenance and inspection schedule for the landfill.

Table 6-E-2: Structural Control Inspection Parameters

Inspection Site	Frequency	Corrective Action
Intermediate Cover	Biweekly or after storm event	Place additional soil in areas of erosional loss, reseed any areas with insufficient vegetative cover, use temporary controls to protect areas of severe erosional damage
Silt Fence and Sediment Log	Weekly or after storm event	Repair any damage and remove collected sediment
Hay Bales	Weekly or after storm event	Repair any damage, replace worn bales, and remove excess sediment
Final Cover - Rock Armoring	Monthly or after storm event	Repair any damage with more rock, consider placement of permanent controls to protect areas of reoccurring damage
Final Cover - Vegetative Cover	Monthly or after storm event	Reseed and fertilize any areas of insufficient cover, consider placement of permanent controls to areas of reoccurring erosional damage
Drainage Channels and Detention Ponds	Monthly or after storm event	Remove any areas of sediment buildup, reseed areas of insufficient vegetative cover, and repair damage to structural lining.
Culverts	Monthly or after storm event	Remove any areas of sediment buildup.
Outflow Points	During Storm Event	Note sediment load off-site, and adjust on-site controls appropriately.
Ditch Check	Monthly or after storm event	Remove accumulated sediment, remove collected debris, repair any damage.
Sediment Collection System	On schedule with type of structure	Remove collected sediment and place on upstream section of cover. Ensure sediment collection capability is not compromised.
Sediment Trap	Monthly or after each storm event	Remove collected sediment where collected to 50% of capacity. Repair trap if needed.

E.3. Controls Installation Schedule

As the development of the landfill progresses, the effectiveness of the erosion controls is highly dependent upon the controls being installed at the appropriate time in the development. Timely installation of needed erosional controls will protect against significant erosion damage. Table 6-E-3 contains the installation time requirements for both required and optional controls.

Table 6-E-3: Controls Installation Schedule

Control	Installation Timeframe
Silt Fence	In concurrence with upstream disturbance
Vegetative Cover (intermediate)	Within 180 days of placement of section of intermediate cover
Vegetative cover (final)	Within 180 days of placement of final contours
Rock Armoring	Within 180 days of placement of final contours
Diversion Berms	In concurrence with development of final contours
Channel Protection (Gabion, rip-rap, ditch check, or equivalent)	In concurrence with development of drainage channels
Filter dam	In concurrence with upstream disturbance
Sediment Capture System	Within 180 days of placement of intermediate cover upstream

E.4. Wind Erosion Control

The historical wind speed in the City of El Paso averages 8.8-miles per hour and site soils are classified as having a high potential for erosion. As a result, wind erosion will need to be controlled during all phases of landfill development. This will be achieved with the intermediate phase of landfill development. This will be achieved with the intermediate phase of landfill development mainly through non-structural controls. Non-Structural controls to be used at the site include limiting the amounts of disturbed ground, to the smallest area necessary to perform

current activities, prompt stabilization of disturbed ground, and inspection and repair of disturbed ground after a windy day or specific event. One control that will be utilized specifically to limit wind erosion will be the wetting of access road and disturbed ground by a water truck.

F. SOIL LOSS CALCULATION

Final Cover

Soil loss calculations have been performed using the RUSLE as provided by the National Resource Conservation Service (NRCS), El Paso office, which demonstrates the interm and long-term erosional stability of the landfill, and estimation of soil loss as required by the TCEQ Solid Waste Regulation330.305 (d).

Based on the RUSLE, it is anticipated that an average of approximately 0.66 tons of soil per acre per year will erode from external embankment side slopes using a vegetative cover. Refer to Table 6-F-1 for calculation.

Table 6-F-1 RUSLE Soil Erosion Calculations (Using Vegetative Cover) – Side Slopes

R	**Rainfall value**
=	20.0 for this area
K	**Soil erodibility factor**
=	0.26 for Turney-Berino Soil Association
L	**Slope length factor**
=	$(1/72.6)^m$ l – horizontal slope length in feet l – 120 feet m=0.66 for 30% slope with moderate rill to interill erosion
=	1.39
S	**Slope factor**
=	(16.8 sin Q) – 0.5 for slopes sin Q>0.09 Q=slope angle Q=18.43°
=	4.81
C	**Cover management factor**
=	0.019 See C factor calculation sheet
P	**Support practices factor**
=	1.0 conservative estimate
A	**Calculated Soils loss in tons/acre-year**
=	RKLSCP
=	0.66 Tons/Acre/Year

- Equations and Factors gathered from the NRCS, El Paso Office. Refer to Appendix 6-G for RUSLE information.

Based on the RUSLE, it is anticipated that an average of approximately 0.16 tons of soil per acre per year will erode from external embankment side slopes using a rock cover. Refer to Table 6-F-2 for calculations. Rock cover protects the surface from raindrop impact. Rock fragments are not usually moved by water from inter-rill areas but remain behind on the soil surface and act as armor. Less erosion is expected if the option of the rock layer is used.

Table 6-F-2 RUSLE Soil Erosion Calculations (Using Rock Cover) – Side Slopes

R	**Rainfall value**
=	20.0 for this area
K	**Soil erodibility factor**
=	0.17 for Rock Cover Layer
L	**Slope length factor**
=	$(1/72.6)^m$ l – horizontal slope length in feet l – 120 feet m=0.66 for 30% slope with moderate rill to interill erosion
=	1.39
S	**Slope factor**
=	(16.8 sin Q) – 0.5 for slopes sin Q>0.09 Q=slope angle Q=18.43°
=	4.81
C	**Cover management factor**
=	0.007 See C factor calculation sheet
P	**Support practices factor**
=	1.0 conservative estimate
A	**Calculated Soils loss in tons/acre-year**
=	RKLSCP
=	0.16 Tons/Acre/Year

- Equations and Factors gathered from the NRCS, El Paso Office. Refer to Appendix 6-G for RUSLE information.

Based on the RUSLE, it is anticipated that an average of approximately 0.05 tons of soil per acre per year will erode from the top dome surfaces using a vegetative cover. Refer to Table 6-F-3 for calculations.

Table 6-F-3 RUSLE Soil Erosion Calculations (Using Vegetative Cover) – Top Dome Surfaces

R	**Rainfall value**
=	20.0 for this area
K	**Soil erodibility factor**
=	0.26 for Turney-Berino Soil Association
L	**Slope length factor**
=	$(1/72.6)^m$ l – horizontal slope length in feet l – 1850feet m= 0.24 for 30% slope with moderate rill to interill erosion
=	2.17
S	**Slope factor**
=	10.8 sin Q + 0.03 for slopes sin Q < 0.09 Q=slope angle Q= 1.145°
=	0.24
C	**Cover management factor**
=	0.019 See C factor calculation sheet
P	**Support practices factor**
=	1.0 conservative estimate
A	**Calculated Soils loss in tons/acre-year**
=	RKLSCP
=	0.05Tons/Acre/Year

- Equations and Factors gathered from the NRCS, El Paso Office. Refer to Appendix 6-G for RUSLE information.

Based on the RUSLE, it is anticipated that an average of approximately 0.01 tons of soil per acre per year will erode from the top dome surfaces using a rock cover. Refer to Table 6-F-4 for calculations.

Table 6-F-4 RUSLE Soil Erosion Calculations (Using Rock Cover) – Top Dome Surfaces

R	**Rainfall value**
=	20.0 for this area
K	**Soil erodibility factor**
=	0.17 for Rock Cover Layer
L	**Slope length factor**
=	$(1/72.6)^m$ l – horizontal slope length in feet l – 1850 feet m= 0.24 for 2% slope with moderate rill to interill erosion
=	2.17
S	**Slope factor**
=	10.4 sin Q + 0.03 for slopes sin Q < 0.09 Q=slope angle Q= 1.145°
=	0.24
C	**Cover management factor**
=	0.007 See C factor calculation sheet
P	**Support practices factor**
=	1.0 conservative estimate
A	**Calculated Soils loss in tons/acre-year**
=	RKLSCP
=	0.01Tons/Acre/Year

- Equations and Factors gathered from the NRCS, El Paso Office. Refer to Appendix 6-G for RUSLE information.

Intermediate Cover:

Based on the RUSLE, it is anticipated that an average of approximately 3.82 tons of soil per acre per year will erode from the external embankment slopes with intermediate cover. Refer to Table 6-F-5 for calculations. Due to the arid climate and sparse native vegetation of the area, it is conservatively assumed that the intermediate cover will have no ground cover. The estimated soil loss is well below the TCEQ recommended maximum loss from intermediate cover of 50 tons/are/year. Even though losses from the intermediate cover are within permissible ranges, structural and non structural controls will still be used due to the typical intensity of the storm events that occur in the region.

Table 6-F-5 RUSLE (Using Intermediate Cover) – External Embankment Side Slopes

R	**Rainfall value**
=	20.0 for this area
K	**Soil erodibility factor**
=	0.26 for Turney-Berino Soil Association
L	**Slope length factor**
=	$(1/72.6)^m$ l – horizontal slope length in feet l – 120 feet m= 0.66 for 30% slope with moderate rill to interill erosion
=	1.39
S	**Slope factor**
=	(16.8 sin Q) - 0.5 for slopes sin Q > 0.09 Q=slope angle Q= 18.43°
=	4.81
C	**Cover management factor**
=	0.110 See C factor calculation sheet
P	**Support practices factor**
=	1.0 conservative estimate
A	**Calculated Soils loss in tons/acre/year**
=	RKLSCP
=	3.82Tons/Acre/Year

- Equations and Factors gathered from the NRCS, El Paso Office. Refer to Appendix 6-G for RUSLE information.

Based on the RUSLE, it is anticipated that an average of approximately 0.30 tons of soil per acre per year will erode from the top dome surfaces with intermediate cover. Refer to Table 6-F-6 for calculations.

Table 6-F-6 RUSLE (Using Intermediate Cover) – Top Dome Surfaces

R	**Rainfall value**
=	20.0 for this area
K	**Soil erodibility factor**
=	0.26 for Turney-Berino Soil Association
L	**Slope length factor**
=	$(1/72.6)^m$ l – horizontal slope length in feet l – 1850 feet m= 0.24 for 2% slope with moderate rill to interill erosion
=	2.17
S	**Slope factor**
=	10.8 sin Q + 0.03 for slopes sin Q < 0.09 Q=slope angle Q= 1.145°
=	0.24
C	**Cover management factor**
=	0.110 See C factor calculation sheet
P	**Support practices factor**
=	1.0 conservative estimate
A	**Calculated Soils loss in tons/acre-year**
=	RKLSCP
=	0.30Tons/Acre-Year

Equations and Factors gathered from the NRCS, El Paso Office. Refer to Appendix 6-G for RUSLE information.

Effectiveness of Structural Controls

TCEQ guidelines set acceptable soil loss rates at 2 tons/acre-year for final cover and 50 tons/acre-year for intermediate cover. In section F of this attachment it is determined that the maximum soil loss during final cover will be 0.16 tons/acre-year, and the maximum soil loss for the intermediate cover will be 3.82 tons/acre-year. Due to the arid nature of the region these values fall well below the acceptable values. The following table, Table 6-F-7, shows the effectiveness of the controls used in the final cover system.

Table 6-F-7: Control Effectiveness

Structural Control	Soil Loss
Rock Armoring	0.16 ton/acre/year
Vegetative Cover	0.66 tons/acre/year
No Cover	3.82 tons/acre/year

Both the rock armoring and the vegetative cover are effective in keeping the soil loss to an acceptable level, but the rock armoring has been chosen due to its superior long term erosional stability, as well as controlling local vegetative establishment.

For the intermediate cover, the Revised Universal Soil Loss Equation (RUSLE) calculations were made assuming a zero percent vegetative ground cover while still keeping soil loss rates at an acceptable value. Therefore either a vegetative cover or a sediment capture and replenishment system with velocity control may be used on intermediate cover side slopes.

G. NON-ERODIBLE VELOCITIES

In accordance with 30 TAC §330.305(d)(l), peak velocities have been compared to permissible non-erodible velocities under similar conditions at the site.

The permissible non-erodible velocities have been found for intermediate and final cover conditions as published by the USDA.

The maximum velocity over each surface has been compared to the permissible velocity for its cover condition. Table 6-F-8 shows the comparison for each surface type.

Table 6-F-8: Non-Erodible Velocities

Flow Surface	Condition	Max Velocity (fps)	Max Non-erodible Velocity (fps)	Acceptable
Intermediate Cover				
External Side Slope (3:1)	Non-vegetated	2.87	1.5	No
External Side Slope (3:1)	Vegetated	0.72	4.0	Yes
Top Dome (2%)	Non-vegetated	0.71	1.5	Yes
Top Dome (2%)	Vegetated	0.23	4.0	Yes
Final Cover				
External Side Slope (4:1)	Rock armored	3.21	20.0	Yes
Top Dome (3%)	Rock armored	1.05	20.0	Yes
Channels				
McCombs 1	Vegetated	2.66	4.0	Yes
McCombs 2	Vegetated	2.93	4.0	Yes
McCombs 3	Vegetated	2.93	4.0	Yes
McCombs 4	Gabion Lined	4.74	20.0	Yes
McCombs 5	Gabion Lined	5.62	20.0	Yes
McCombs 6	Vegetated	3.08	20.0	Yes

Table 6-F-8 shows the maximum non-erodible velocity and calculated maximum velocity for each flow surface and cover condition. The purpose of the table is to show each option for velocity control, and to aid the facility in choosing the best control option for each location. A condition may also be chosen which will either appropriately increase the maximum non-erodible velocity or decrease the maximum flow velocity on the surface. For example in channel McCombs 1, instead of vegetative cover, a concrete lining may be used which will bring the non-erodible velocity of the cover to well above the 266 peak in the channel. Also in McCombs 1, a velocity reduction system using ditch checks or sediment logs may be used in favor of vegetation to reduce the peak velocity in the channel to below the 1.5 fps max non-erodible velocity for bare ground channels.

For intermediate cover conditions the non-vegetated cover on the external side slopes does not provide a sufficient maximum non-erodible velocity for the flow conditions. Therefore if a non-vegetative cover condition is used for intermediate cover velocity control devices will be used on the side slopes to keep the flow velocity below 1.5 fps.

Xrefs: XTB-SI24-MCMBS

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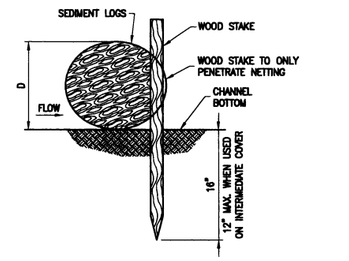
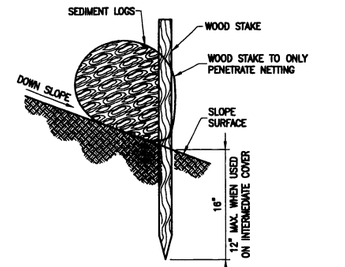
PROFESSIONAL ENGINEER
7/23/2009



C4 STAKE DETAILS (NO TRENCH)
NO SCALE



C5 STAKE DETAILS (ON BARE SOIL)
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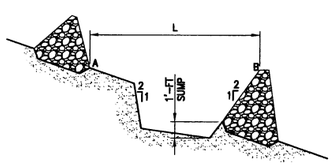
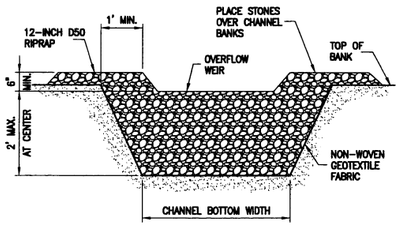
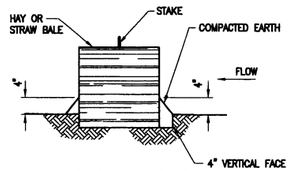


NOTE:
L = THE DISTANCE SUCH THAT POINTS A & B ARE OF EQUAL ELEVATION

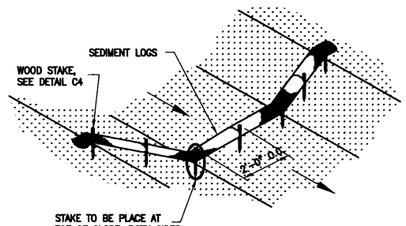
B1 SPACING BETWEEN DITCH CHECK
NO SCALE



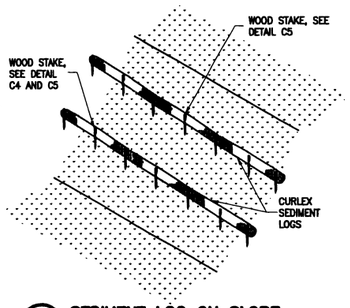
B2 CROSS SECTION A-A
NO SCALE



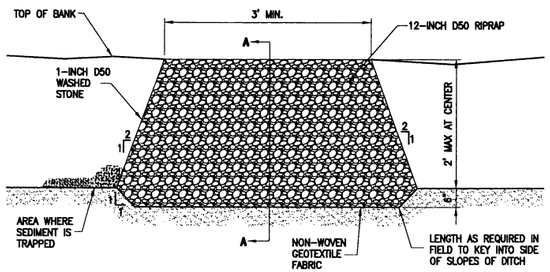
SECTION B-B
NO SCALE



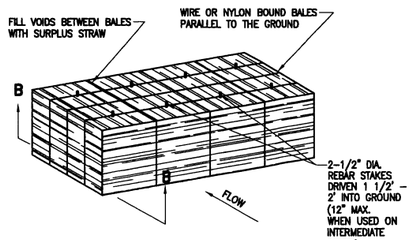
B4 SEDIMENT LOG IN CHANNEL
NO SCALE



B5 SEDIMENT LOG ON SLOPE
NO SCALE



A1 TYPICAL DITCH CHECK SECTION
NO SCALE



A3 STRAW BALE BARRICADE
NO SCALE

[DISTANCE BETWEEN CHANNEL BOTTOM AND TOP OF INSTALLED SEDIMENT LOGS (D)(ft) / CHANNEL GRADIENT (%)] X 100 = SEDIMENT LOGS SPACING (ft)

NOTES:
TRENCH OPTION IS MOST APPLICABLE IN LOOSE, UNCONSOLIDATED SOILS.

1 1/2" X 1 1/2" X 30" WOODEN STAKES ARE RECOMMENDED FOR 6", 9", AND 12" SEDIMENT LOGS.

1 1/2" X 1 1/2" 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	HK

PARKHILL, SMITH & COOPER, INC.
ENGINEERS · ARCHITECTS · PLANNERS
890 E. YANDELL EL PASO, TX. 79902 (915)533-0891

ENGINEER'S SEAL

SCALE
Hor. AS SHOWN
Ver. AS SHOWN
DATE 03-18-09
DESIGN BY
DRAWN BY
CHKD. BY
APPD. BY

PROJECT NAME
McCOMBS LANDFILL
TCEQ MSW PERMIT NO. 729AB
UPDATE GROUNDWATER/
SURFACE WATER
PROTECTION PLAN

CITY OF EL PASO

SHEET TITLE
EROSION CONTROL DETAILS

DRAWING:
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Appendix 3B – Attachment 7
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

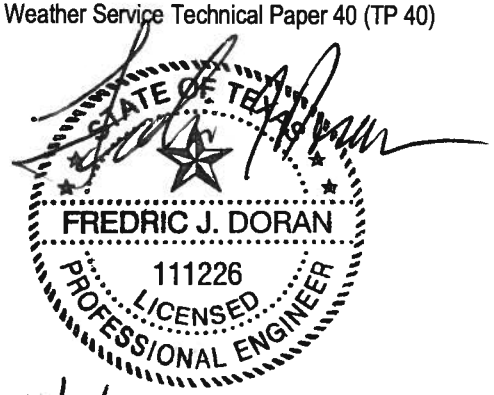
I_{25} = 25-year Intensity (in/hr)
$= b / (T_c + d)^e$

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

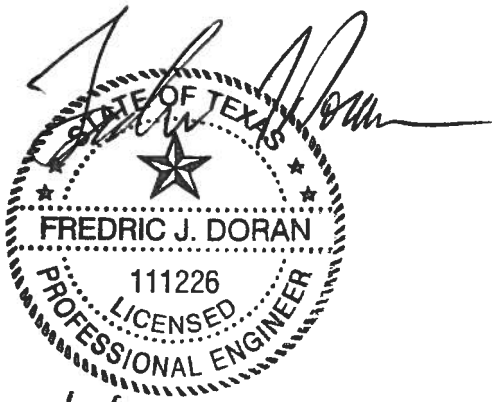
McCombs Landfill
MSW Permit No. 729B Major Permit Amendment
Non-Erodible Velocities - Interim Side Slopes

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

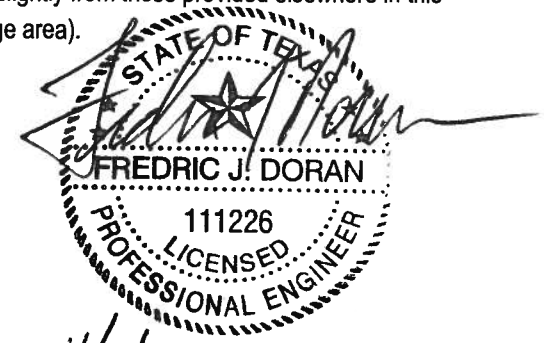
External Side Slope - Non-Vegetated (3:1)						
Drainage Area ID	Max Length (/)	C value	Description	T_c [A, B]	I_{25} (in/hr) [B]	V_{25} (ac-ft) [B]
DEV-1	759	0.20	Sandy Soil, Steep (Range: 0.15 - 0.20)	5.4	5.39	1.08
DEV-2	510	0.20	Sandy Soil, Steep (Range: 0.15 - 0.20)	3.9	5.81	1.16
DEV-3	587	0.20	Sandy 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

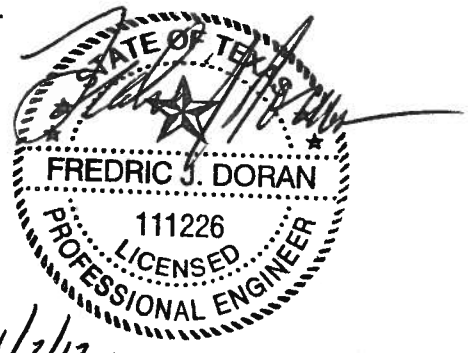
Top Dome - Non-Vegetated (7%)						
Drainage Area ID	Max Length (/)	C value	Description	T_c [A, B]	I_{25} (in/hr) [B]	V_{25} (ac-ft) [B]
DEV-1	1,020	0.15	Sandy Soil, Average (Range: 0.10 - 0.15)	15.0	3.73	0.56
DEV-2	916	0.15	Sandy Soil, Average (Range: 0.10 - 0.15)	13.8	3.88	0.58
DEV-3	863	0.15	Sandy 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

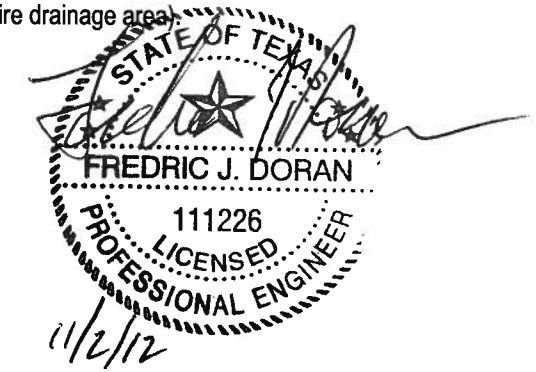
Final Cover - Rock Armor (3:1)						
Drainage Area ID	Max Length (/)	C value	Description	T_c, [A, B]	I_{25} (in/hr) [B]	V_{25} (ac-ft) [B]
DEV-1	759	0.50	Shallow Soil on Rock (0.50)	5.4	5.39	2.70
DEV-2	510	0.50	Shallow Soil on Rock (0.50)	3.9	5.81	2.91
DEV-3	587	0.50	Shallow Soil on Rock (0.50)	4.4	5.67	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

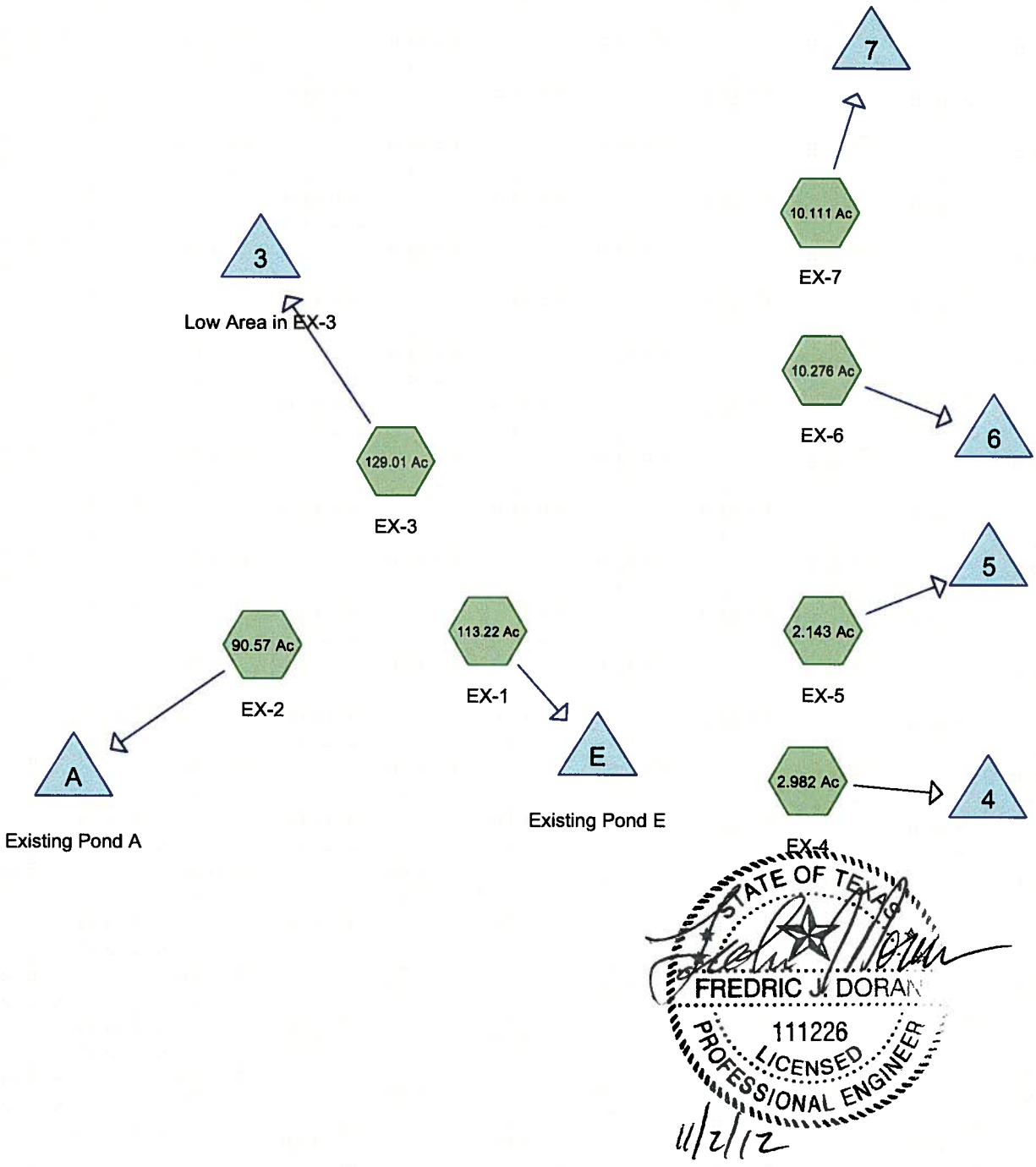
Final Cover - Rock Armor (7%)						
Drainage Area ID	Max Length (/)	C value	Description	T_c, [A, B]	I_{25} (in/hr) [B]	V_{25} (ac-ft) [B]
DEV-1	1,020	0.50	Shallow Soil on Rock (0.50)	15.0	3.73	1.86
DEV-2	916	0.50	Shallow Soil on Rock (0.50)	13.8	3.88	1.94
DEV-3	863	0.50	Shallow Soil on Rock (0.50)	13.1	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

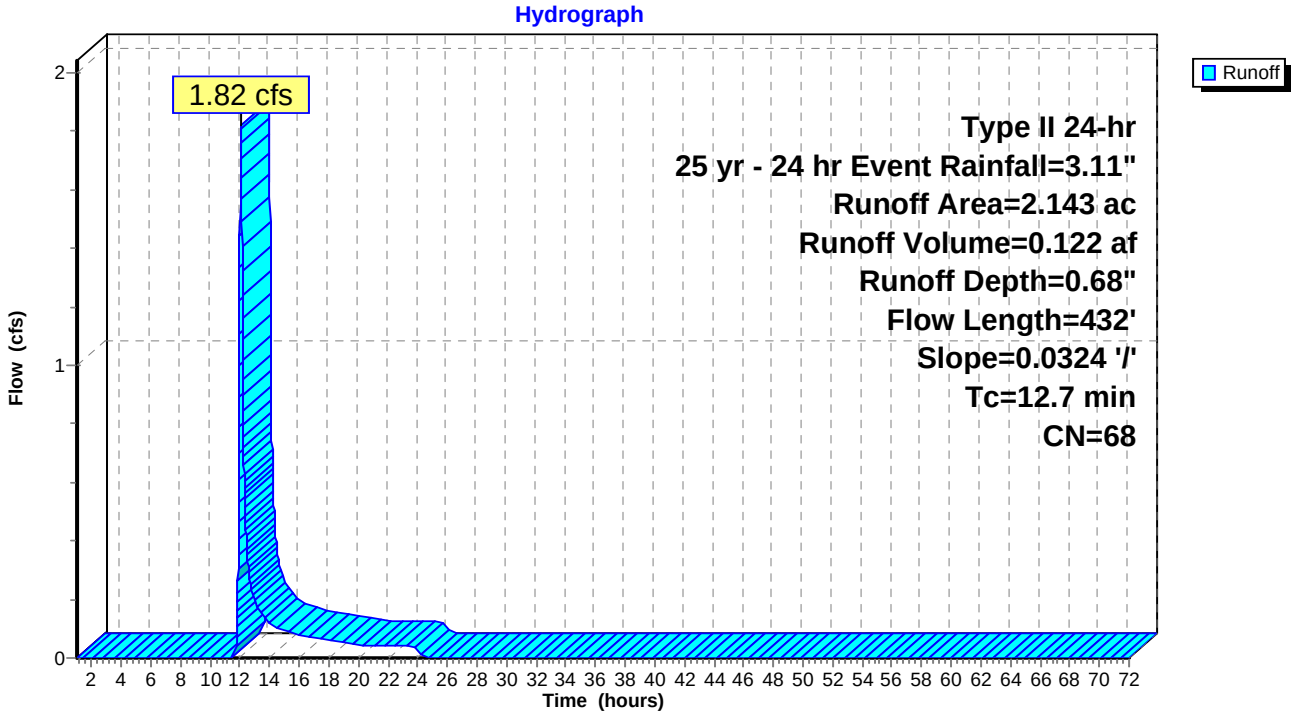
Runoff = 1.82 cfs @ 12.06 hrs, Volume= 0.122 af, Depth= 0.68"

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

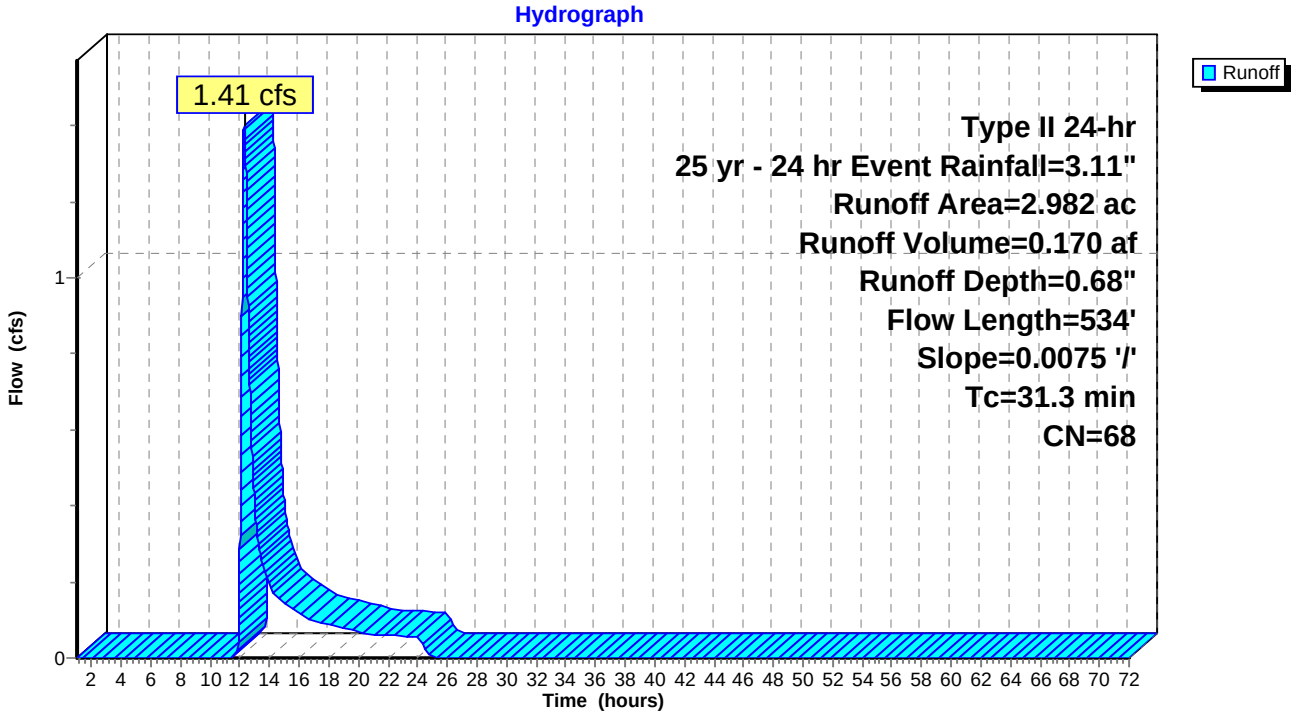
Runoff = 1.41 cfs @ 12.31 hrs, Volume= 0.170 af, Depth= 0.68"

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

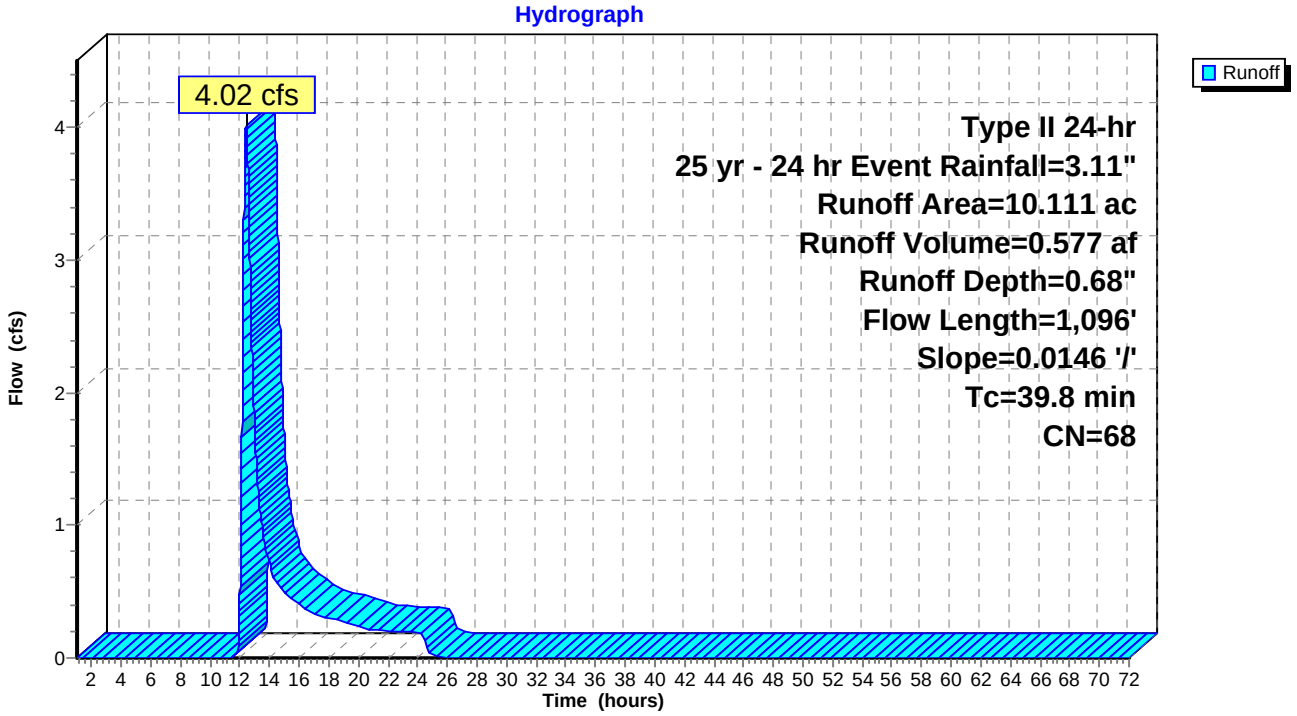
Runoff = 4.02 cfs @ 12.43 hrs, Volume= 0.577 af, Depth= 0.68"

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

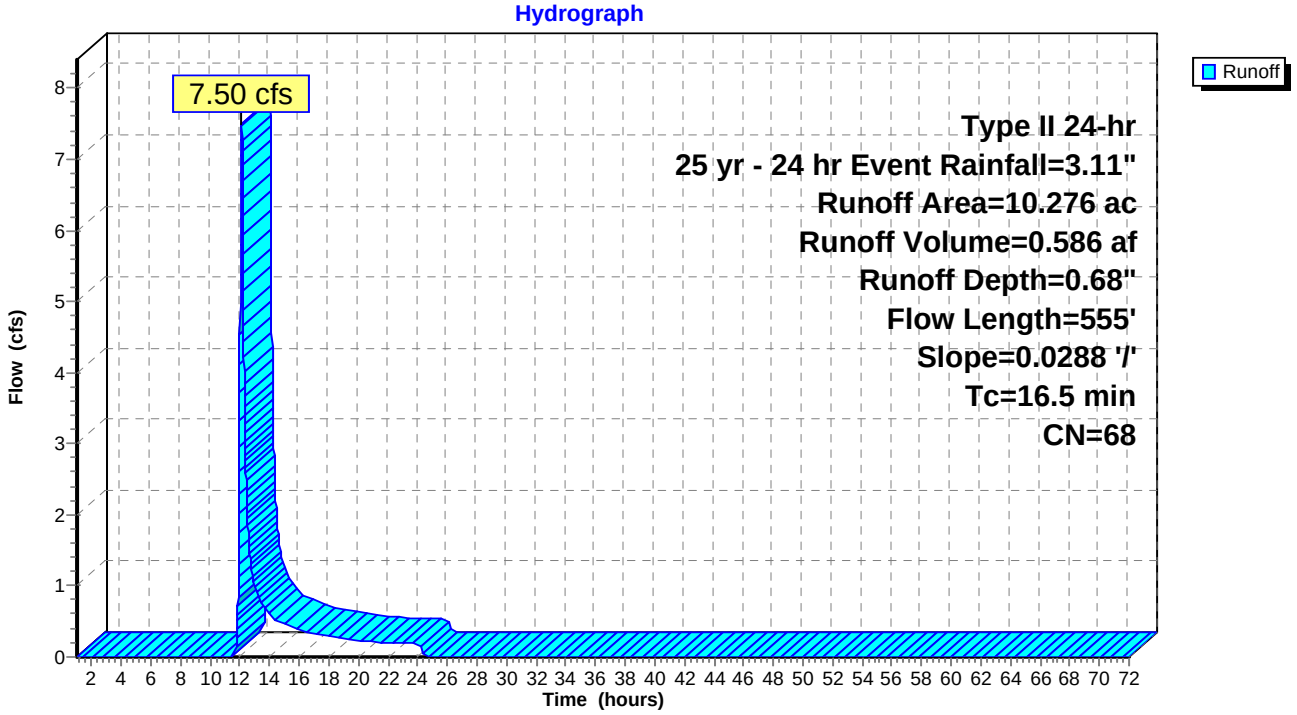
Runoff = 7.50 cfs @ 12.11 hrs, Volume= 0.586 af, Depth= 0.68"

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

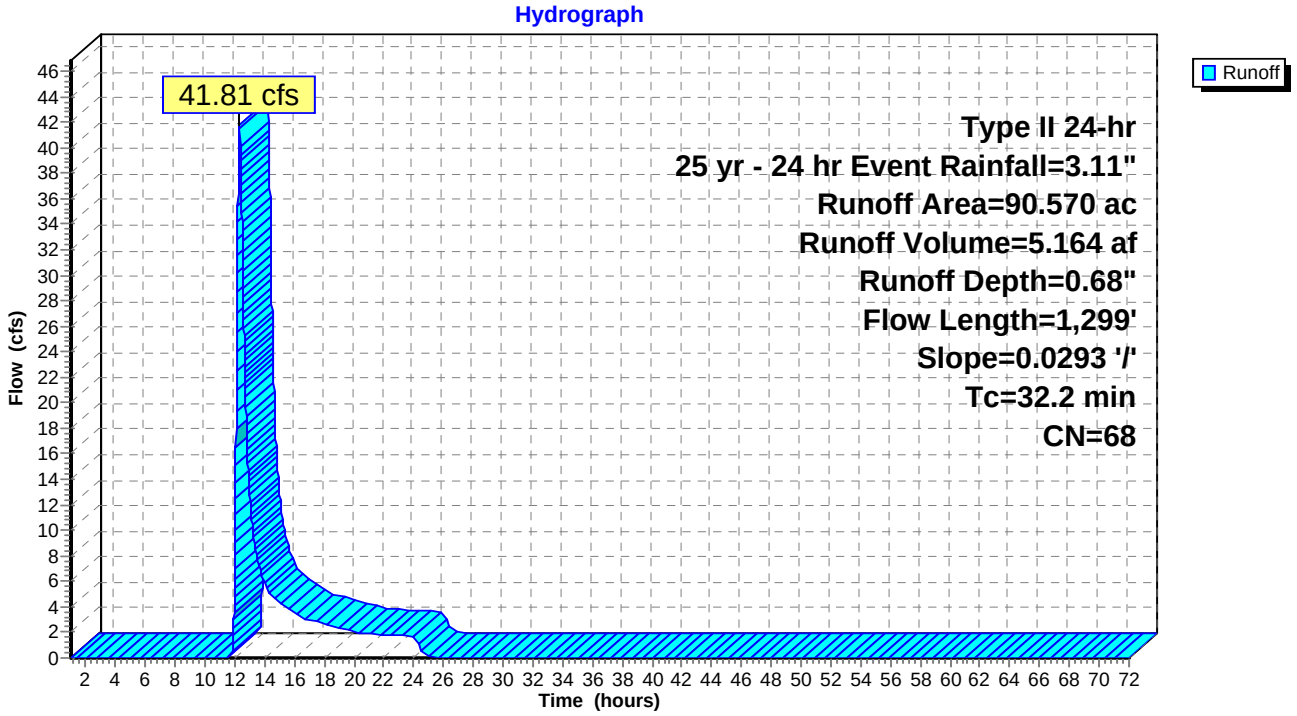
Runoff = 41.81 cfs @ 12.31 hrs, Volume= 5.164 af, Depth= 0.68"

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

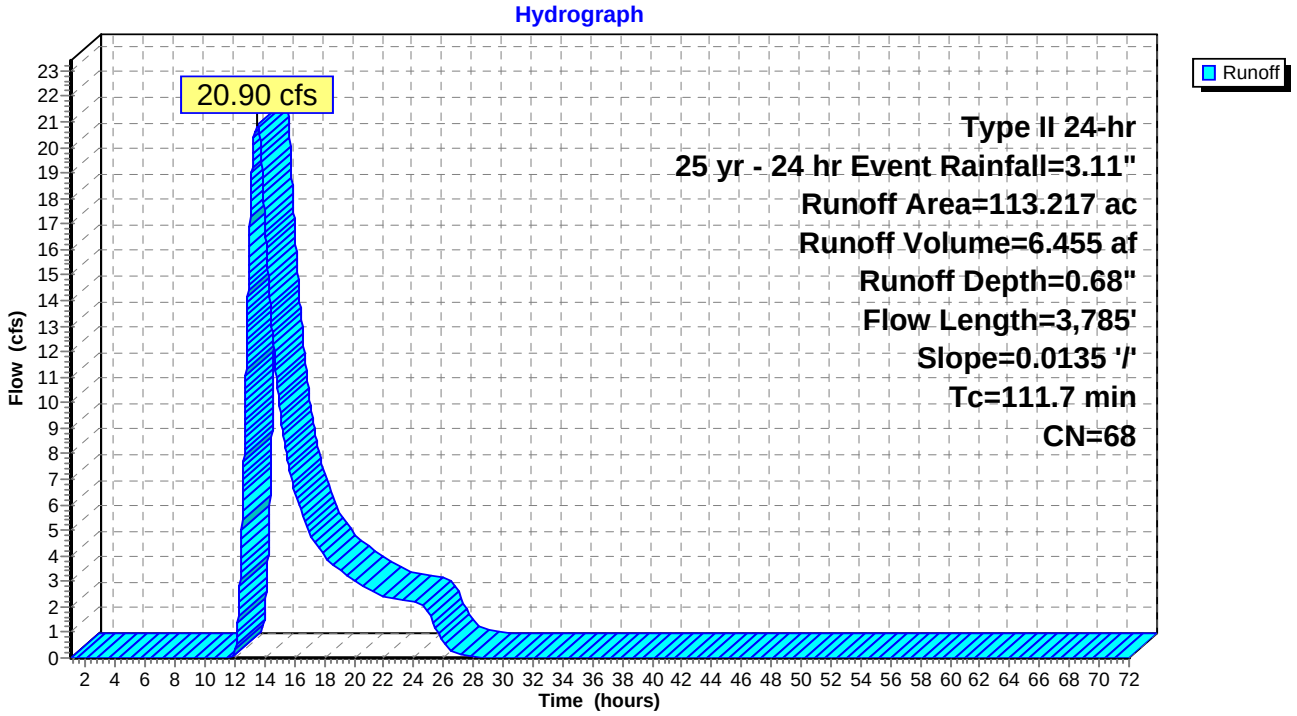
Runoff = 20.90 cfs @ 13.52 hrs, Volume= 6.455 af, Depth= 0.68"

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

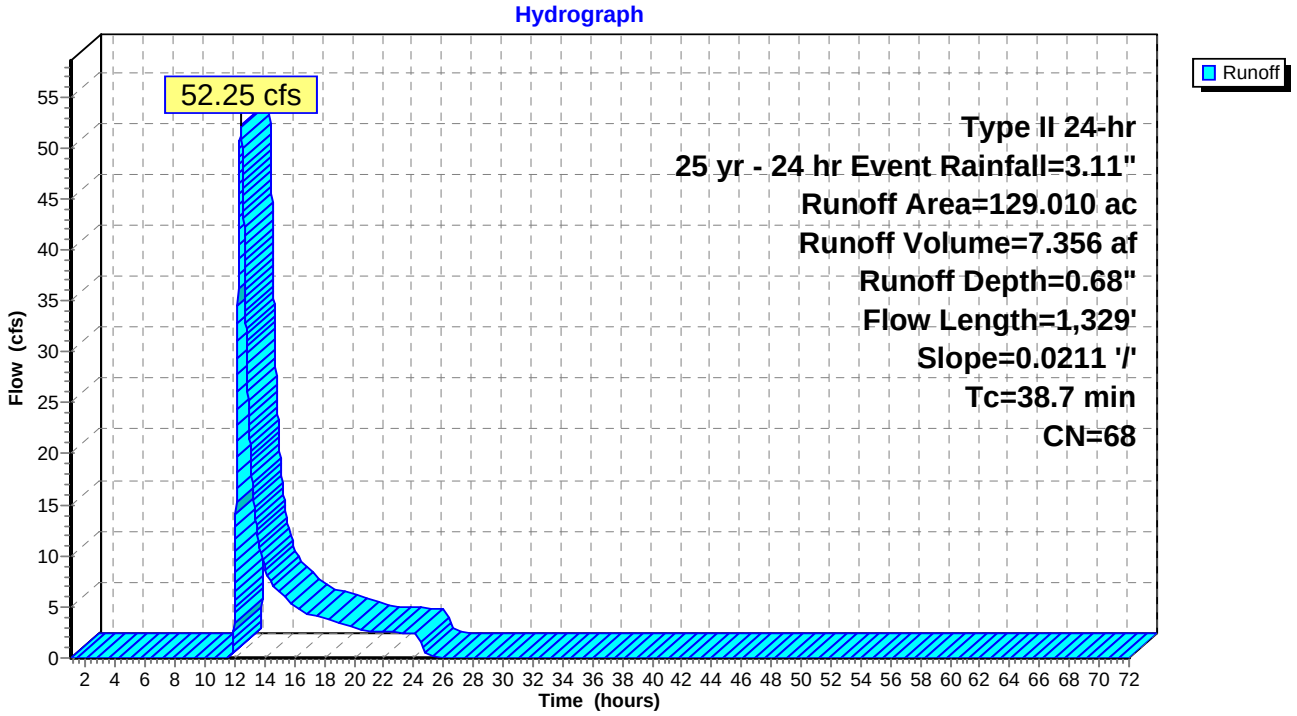
Runoff = 52.25 cfs @ 12.42 hrs, Volume= 7.356 af, Depth= 0.68"

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

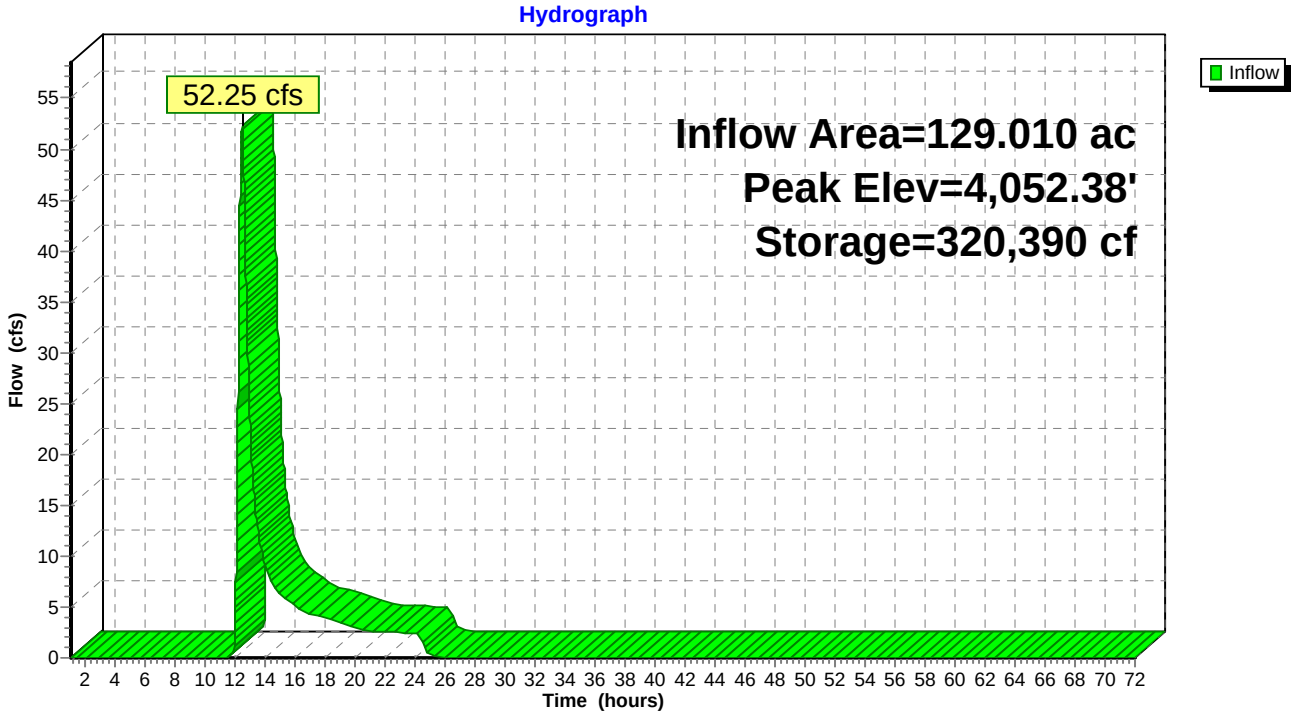
Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,052.38' @ 26.24 hrs Surf.Area= 57,729 sf Storage= 320,390 cf

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

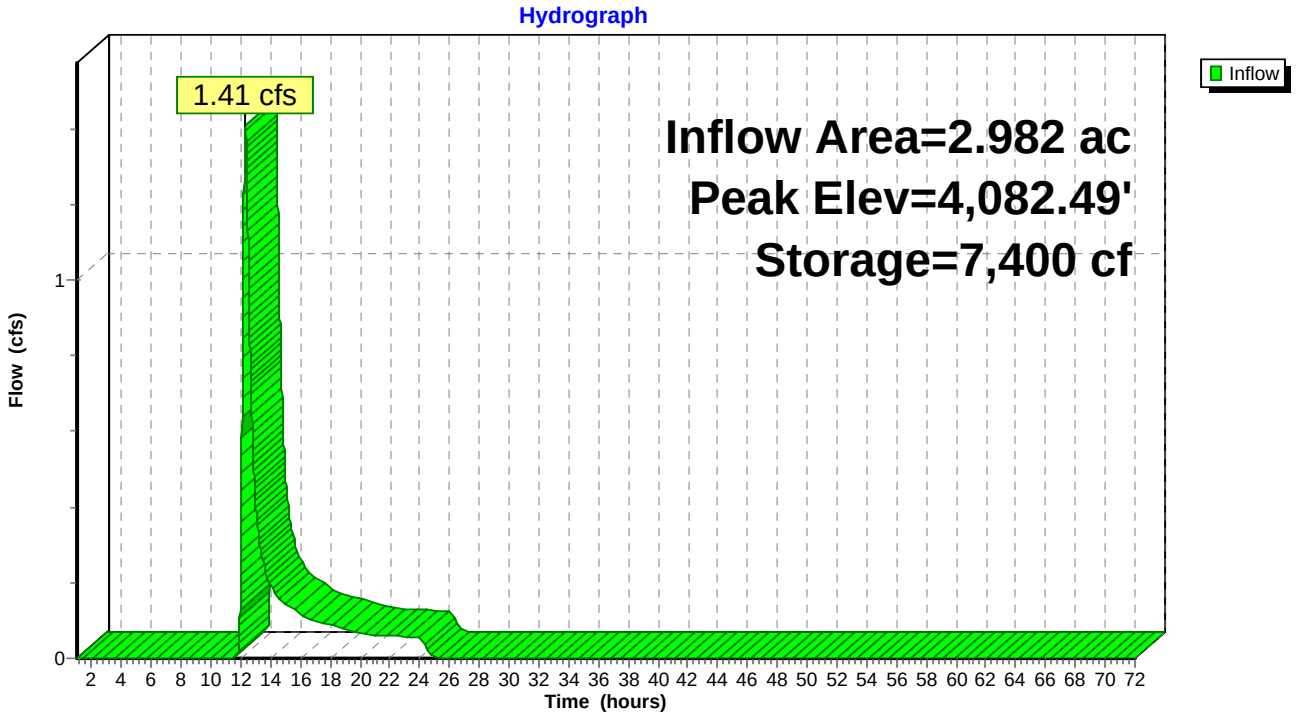
Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,082.49' @ 25.81 hrs Surf.Area= 21,043 sf Storage= 7,400 cf

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

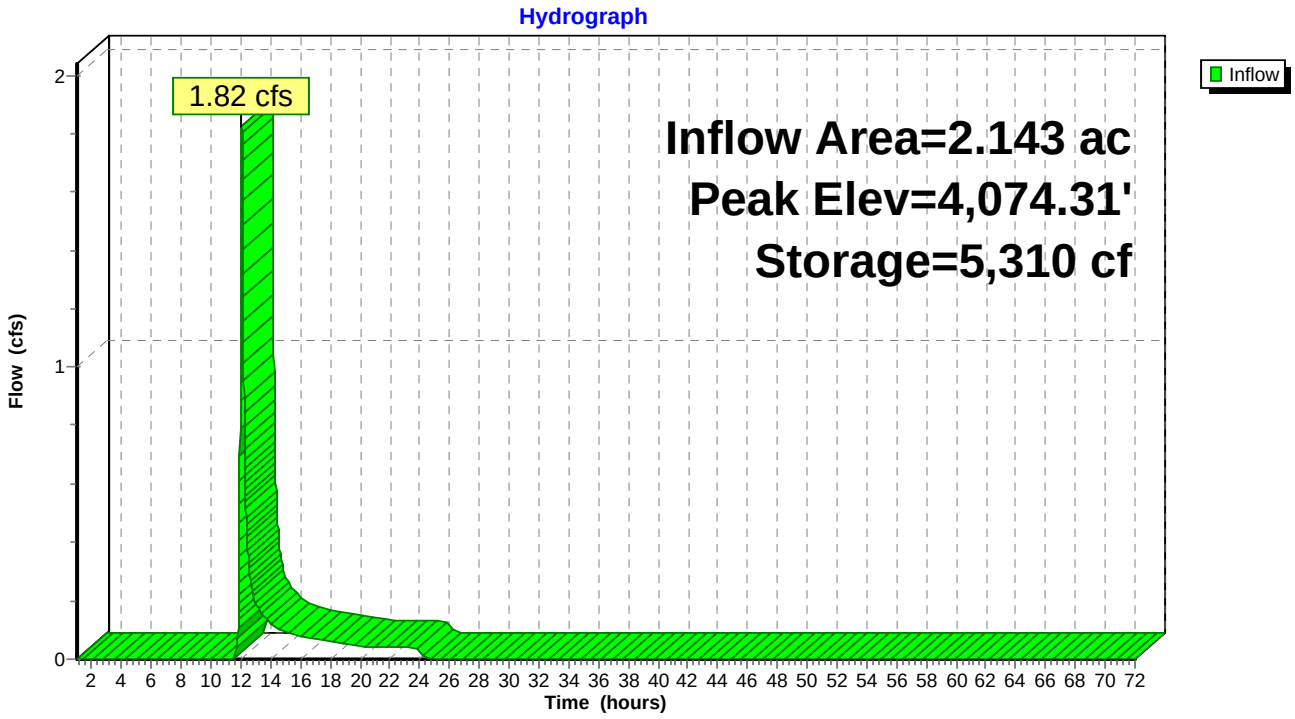
Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,074.31' @ 24.73 hrs Surf.Area= 18,595 sf Storage= 5,310 cf

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

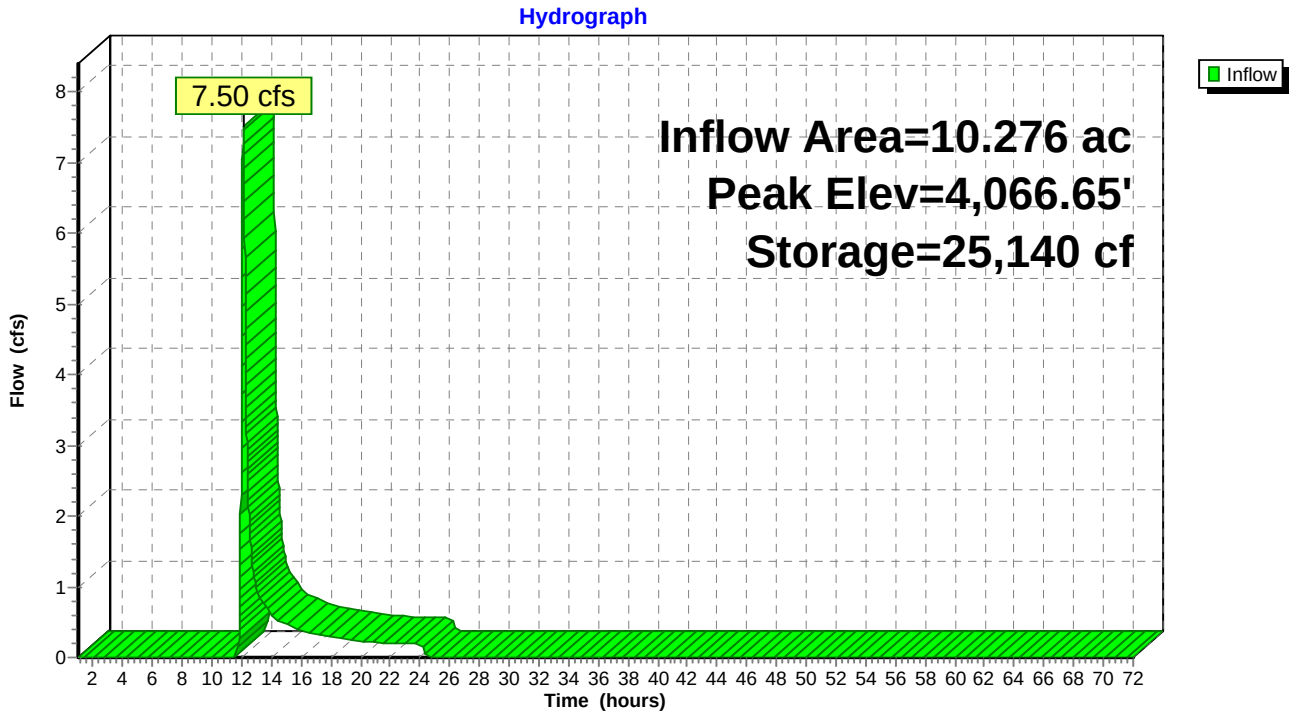
Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,066.65' @ 24.94 hrs Surf.Area= 70,878 sf Storage= 25,140 cf

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

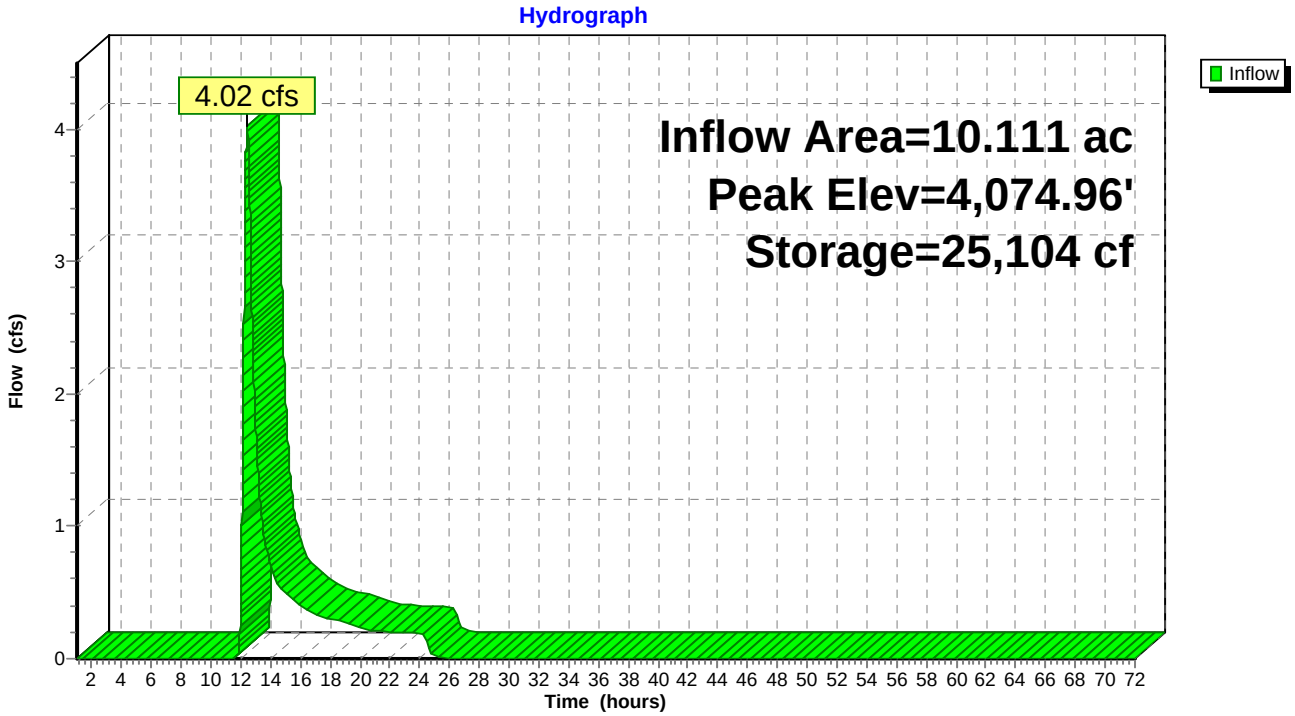
Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,074.96' @ 26.28 hrs Surf.Area= 45,915 sf Storage= 25,104 cf

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

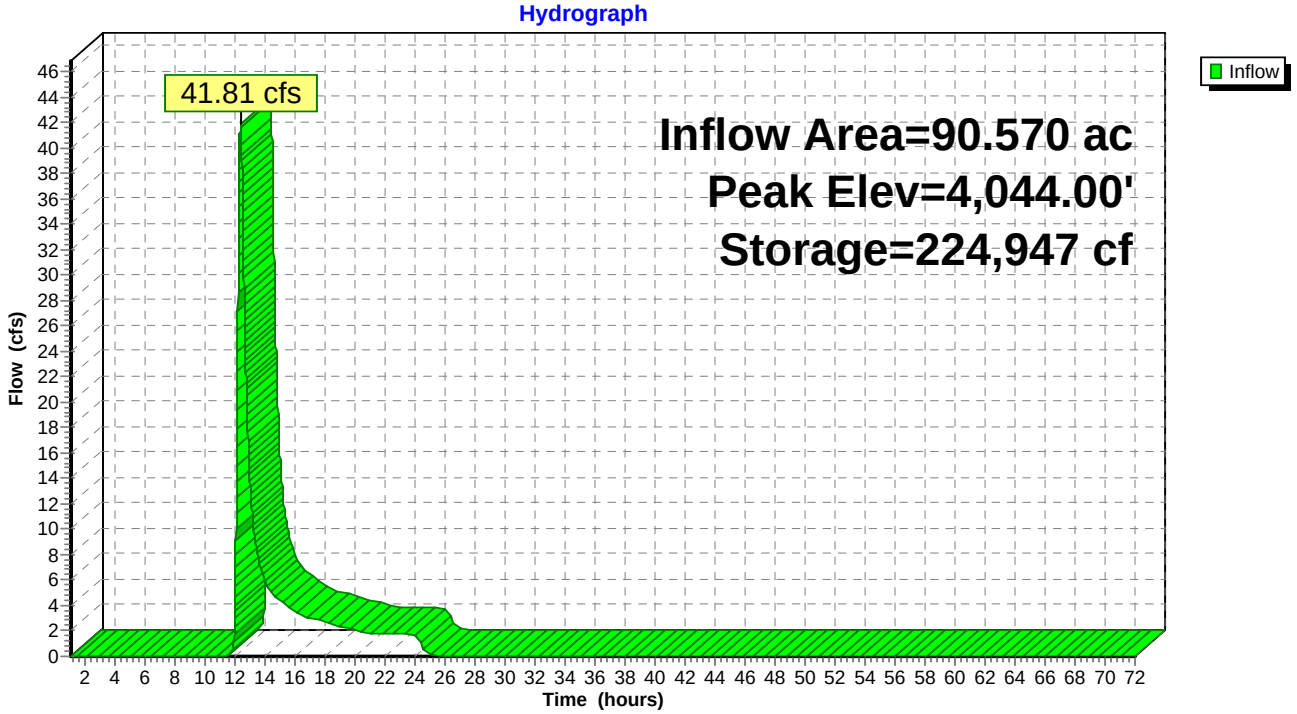
Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,044.00' @ 25.84 hrs Surf.Area= 234,888 sf Storage= 224,947 cf

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

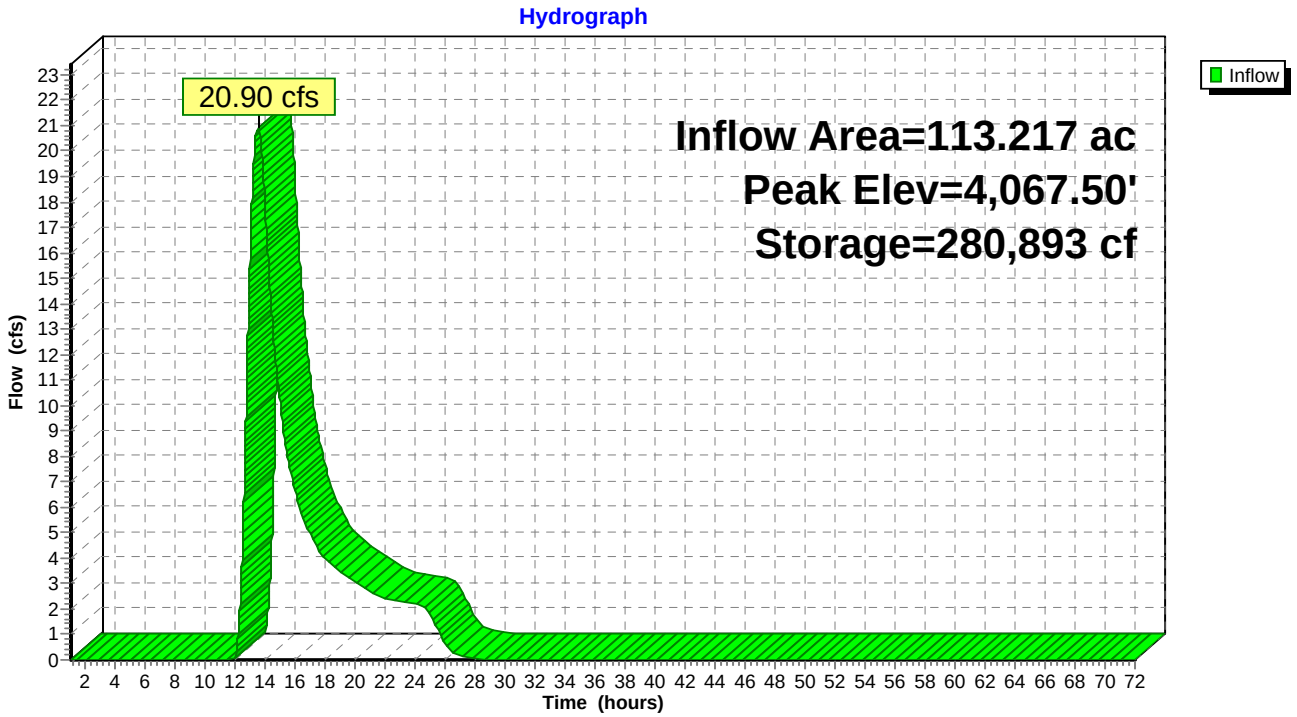
Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,067.50' @ 30.29 hrs Surf.Area= 272,616 sf Storage= 280,893 cf

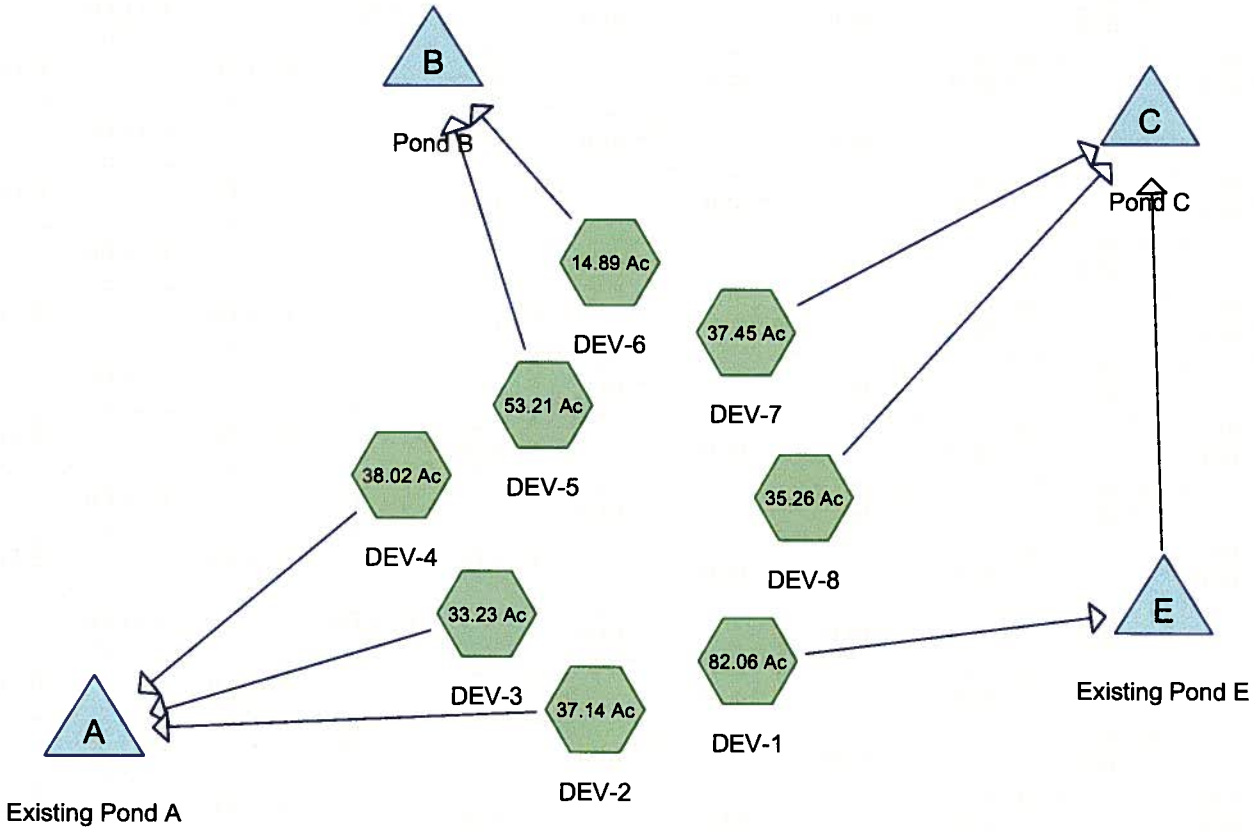
Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

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

Subcat Reach Pond Link

Routing Diagram for McCombs Landfill - Final 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)
331.260	73	(14.89 Ac, 33.23 Ac, 35.26 Ac, 37.14 Ac, 37.45 Ac, 38.02 Ac, 53.21 Ac, 82.06 Ac)
331.260	**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	
331.260	Other	14.89 Ac, 33.23 Ac, 35.26 Ac, 37.14 Ac, 37.45 Ac, 38.02 Ac, 53.21 Ac, 82.06 Ac
331.260		**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	331.260	331.260		14.89 Ac, 33.23 Ac, 35.26 Ac, 37.14 Ac, 37.45 Ac, 38.02 Ac, 53.21 Ac, 82.06 Ac
0.000	**0.000**	**0.000**	**0.000**	**331.260**	**331.260**	**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 14.89 Ac: DEV-6 Runoff Area=14.890 ac 0.00% Impervious Runoff Depth=1.42"
Flow Length=2,205' Tc=42.0 min CN=73 Runoff=13.84 cfs 1.763 af

Subcatchment 33.23 Ac: DEV-3 Runoff Area=33.230 ac 0.00% Impervious Runoff Depth=1.42"
Flow Length=1,450' Tc=17.8 min CN=73 Runoff=54.54 cfs 3.934 af

Subcatchment 35.26 Ac: DEV-8 Runoff Area=35.260 ac 0.00% Impervious Runoff Depth=1.42"
Flow Length=1,811' Tc=24.0 min CN=73 Runoff=48.31 cfs 4.175 af

Subcatchment 37.14 Ac: DEV-2 Runoff Area=37.140 ac 0.00% Impervious Runoff Depth=1.42"
Flow Length=2,570' Tc=44.7 min CN=73 Runoff=33.08 cfs 4.397 af

Subcatchment 37.45 Ac: DEV-7 Runoff Area=37.450 ac 0.00% Impervious Runoff Depth=1.42"
Flow Length=2,707' Tc=51.0 min CN=73 Runoff=30.33 cfs 4.434 af

Subcatchment 38.02 Ac: DEV-4 Runoff Area=38.020 ac 0.00% Impervious Runoff Depth=1.42"
Flow Length=2,295' Tc=37.9 min CN=73 Runoff=38.10 cfs 4.501 af

Subcatchment 53.21 Ac: DEV-5 Runoff Area=53.210 ac 0.00% Impervious Runoff Depth=1.42"
Flow Length=2,013' Tc=26.9 min CN=73 Runoff=67.60 cfs 6.300 af

Subcatchment 82.06 Ac: DEV-1 Runoff Area=82.060 ac 0.00% Impervious Runoff Depth=1.42"
Flow Length=4,673' Tc=149.4 min CN=73 Runoff=29.15 cfs 9.716 af

Pond A: Existing Pond A Peak Elev=4,045.36' Storage=558,984 cf Inflow=95.53 cfs 12.833 af
Outflow=0.00 cfs 0.000 af

Pond B: Pond B Peak Elev=4,052.91' Storage=351,185 cf Inflow=78.16 cfs 8.063 af
Outflow=0.00 cfs 0.000 af

Pond C: Pond C Peak Elev=4,058.56' Storage=798,155 cf Inflow=65.26 cfs 18.324 af
Outflow=0.00 cfs 0.000 af

Pond E: Existing Pond E Peak Elev=4,061.19' Storage=7,866 cf Inflow=29.15 cfs 9.716 af
36.0" Round Culvert x 3.00 n=0.013 L=289.0' S=0.0484 '/' Outflow=29.06 cfs 9.715 af

Total Runoff Area = 331.260 ac Runoff Volume = 39.220 af Average Runoff Depth = 1.42"
100.00% Pervious = 331.260 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 14.89 Ac: DEV-6

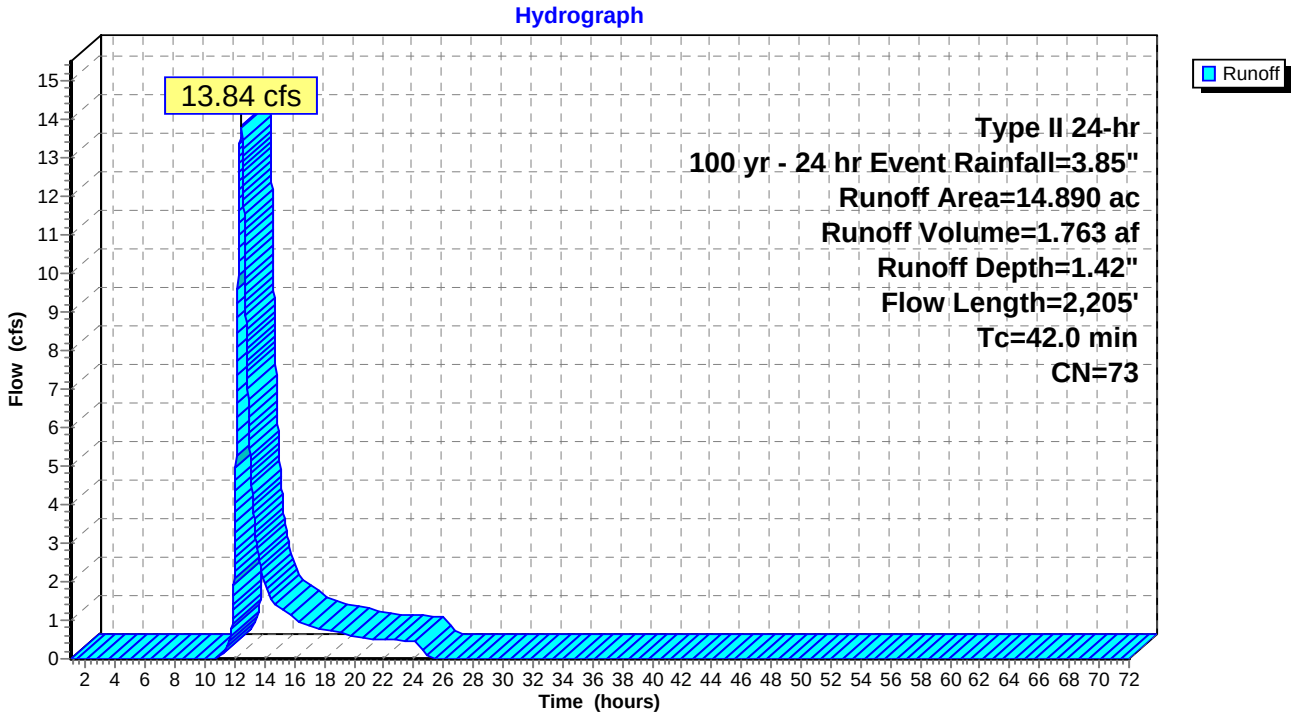
Runoff = 13.84 cfs @ 12.41 hrs, Volume= 1.763 af, Depth= 1.42"

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
*	14.890	73	
	14.890		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	541	0.0827	1.09		**Lag/CN Method, Top Dome**
4.3	520	0.2884	2.01		**Lag/CN Method, Side Slope**
29.4	1,144	0.0219	0.65		**Lag/CN Method, Ditch**
42.0	2,205	Total			

Subcatchment 14.89 Ac: DEV-6



Summary for Subcatchment 33.23 Ac: DEV-3

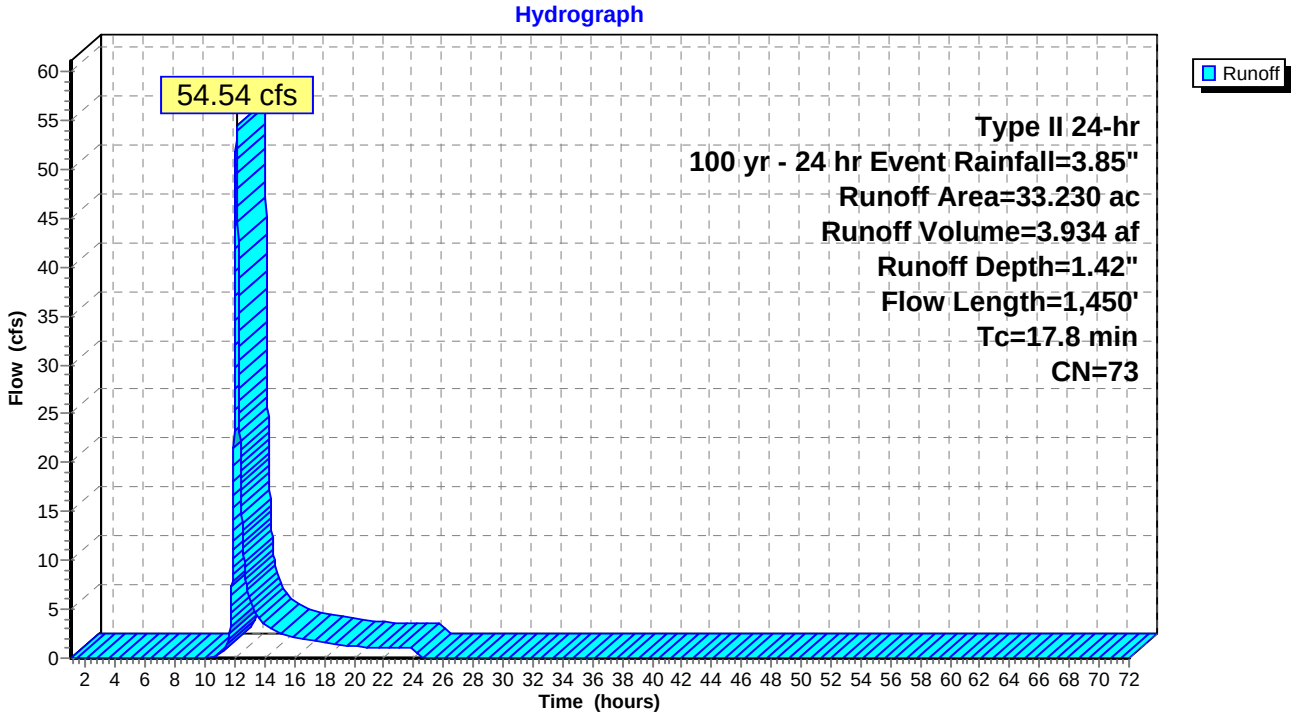
Runoff = 54.54 cfs @ 12.11 hrs, Volume= 3.934 af, Depth= 1.42"

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
*	33.230	73	
	33.230		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.3	863	0.0676	1.08		**Lag/CN Method, Top Dome**
4.5	587	0.3216	2.18		**Lag/CN Method, Side Slope**
17.8	1,450	Total			

Subcatchment 33.23 Ac: DEV-3



Summary for Subcatchment 35.26 Ac: DEV-8

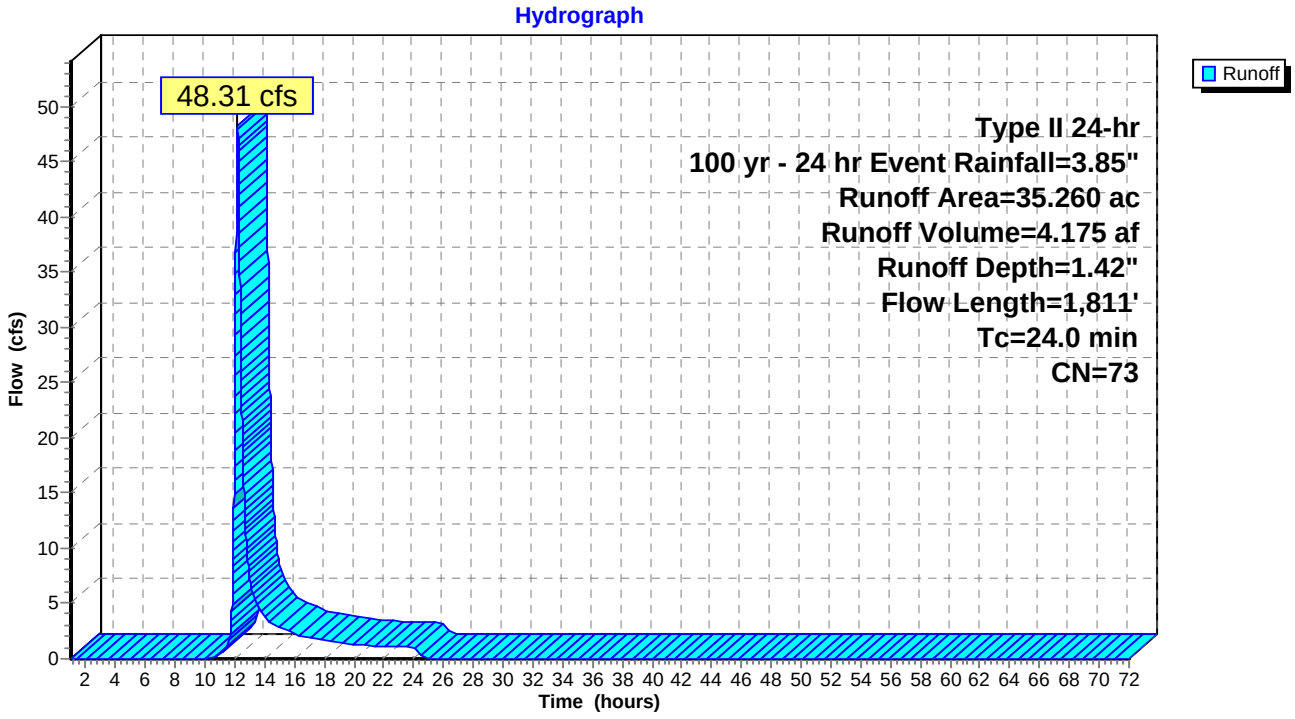
Runoff = 48.31 cfs @ 12.19 hrs, Volume= 4.175 af, Depth= 1.42"

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
*	35.260	73	
	35.260		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 35.26 Ac: DEV-8



Summary for Subcatchment 37.14 Ac: DEV-2

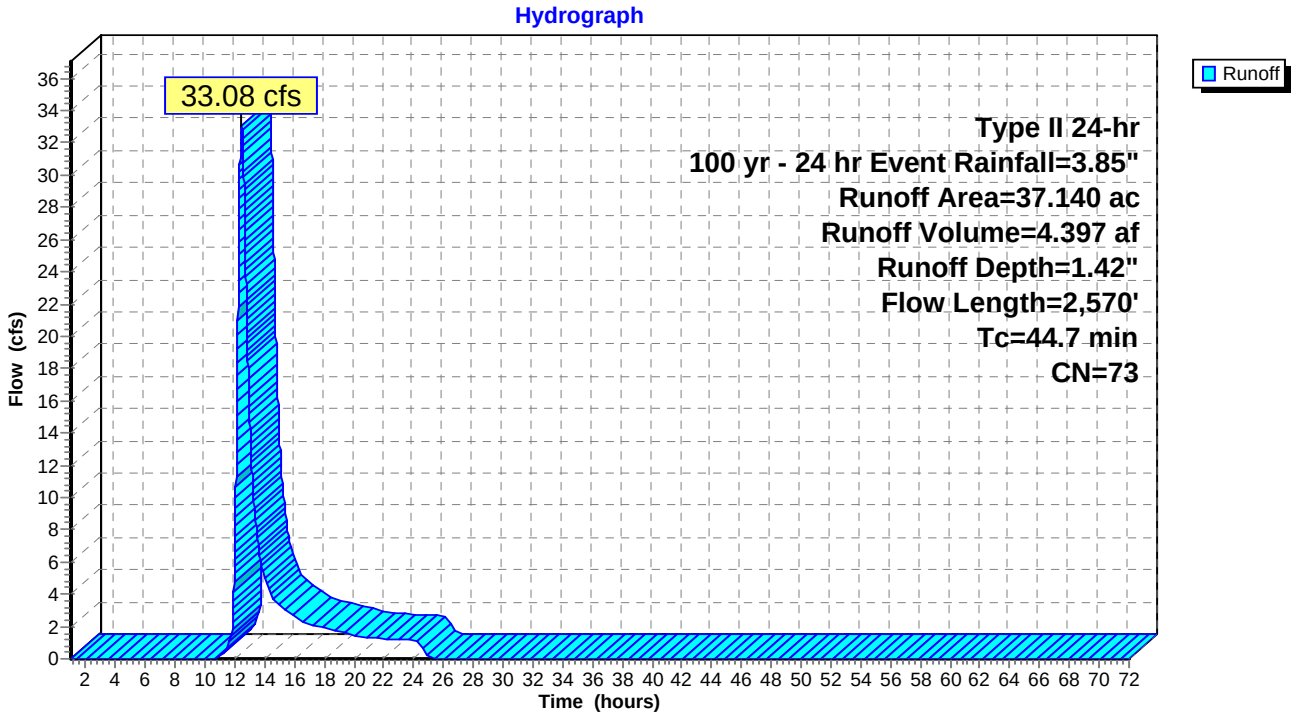
Runoff = 33.08 cfs @ 12.46 hrs, Volume= 4.397 af, Depth= 1.42"

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
*	37.140	73	
	37.140		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.9	916	0.0688	1.10		**Lag/CN Method, Top Dome**
3.9	510	0.3333	2.15		**Lag/CN Method, Side Slope**
26.9	1,144	0.0262	0.71		**Lag/CN Method, Ditch**
44.7	2,570	Total			

Subcatchment 37.14 Ac: DEV-2



Summary for Subcatchment 37.45 Ac: DEV-7

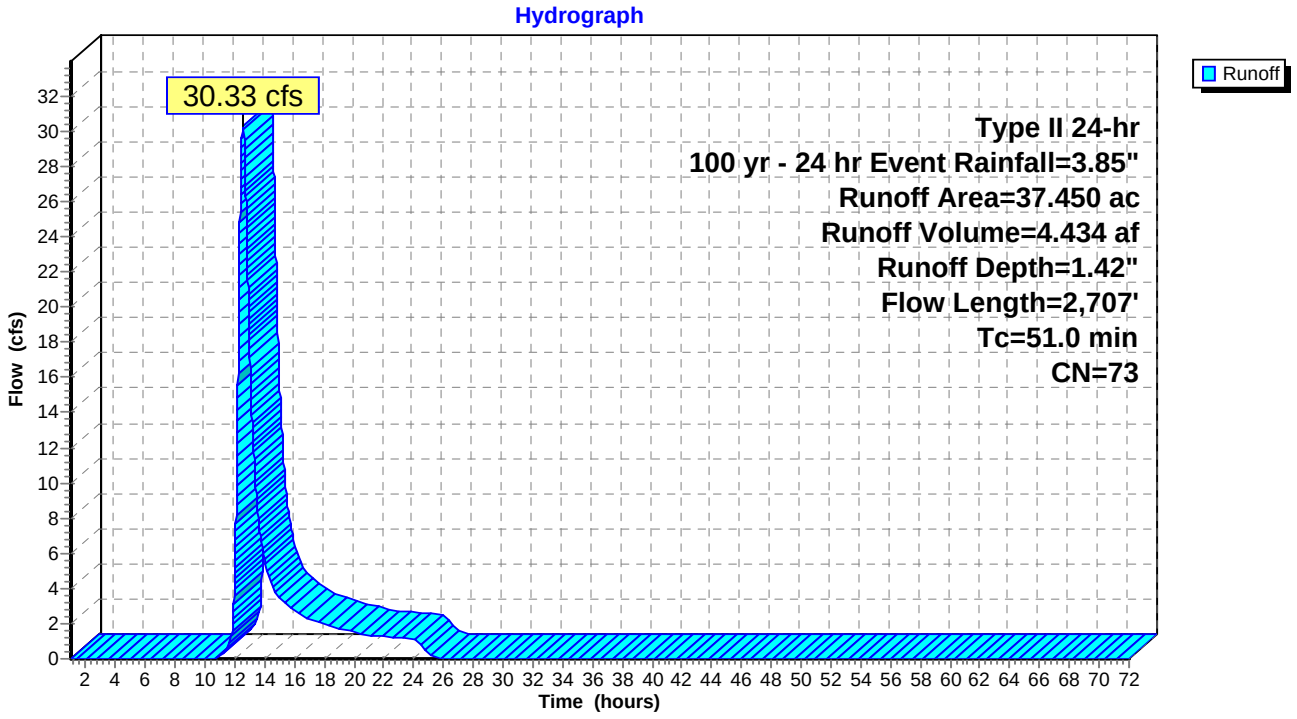
Runoff = 30.33 cfs @ 12.53 hrs, Volume= 4.434 af, Depth= 1.42"

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
*	37.450	73	
	37.450		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	993	0.0605	1.05		**Lag/CN Method, Top Dome**
4.3	526	0.2945	2.04		**Lag/CN Method, Side Slope**
30.9	1,188	0.0211	0.64		**Lag/CN Method, Ditch**
51.0	2,707	Total			

Subcatchment 37.45 Ac: DEV-7



Summary for Subcatchment 38.02 Ac: DEV-4

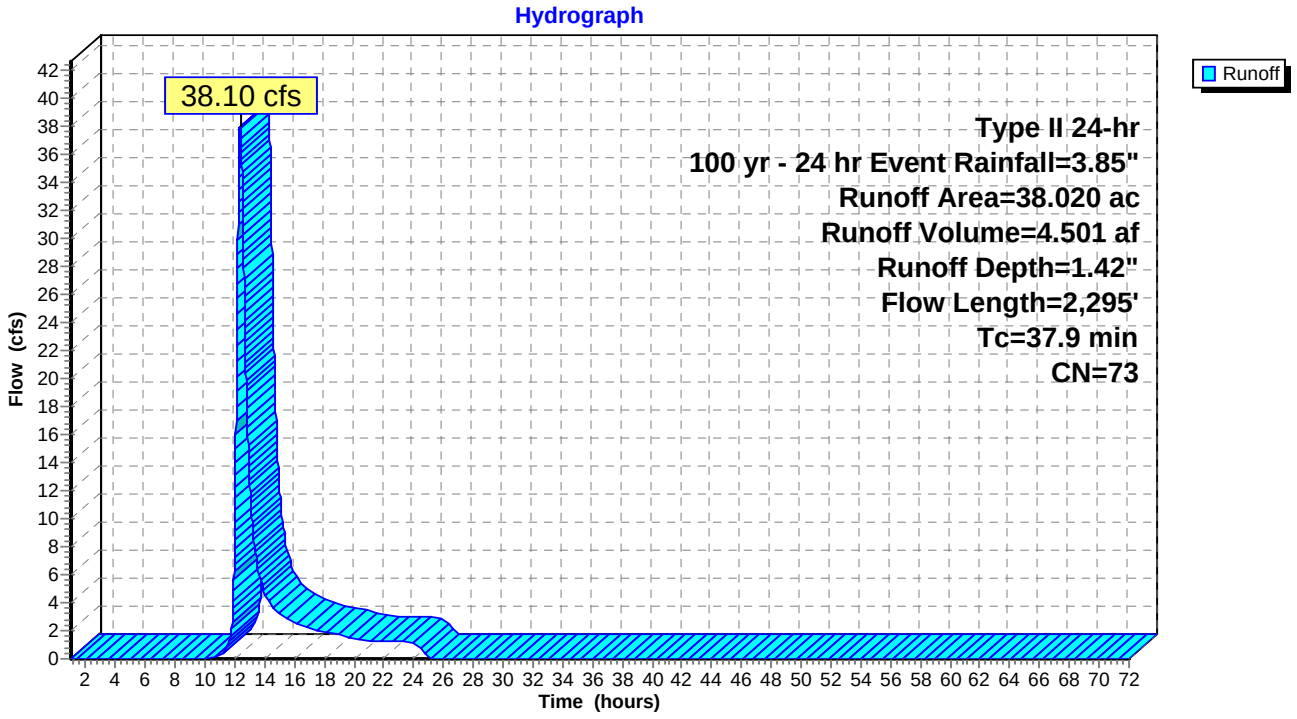
Runoff = 38.10 cfs @ 12.34 hrs, Volume= 4.501 af, Depth= 1.42"

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
*	38.020	73	
	38.020		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.6	820	0.0695	1.08		**Lag/CN Method, Top Dome**
4.2	526	0.3150	2.11		**Lag/CN Method, Side Slope**
21.1	949	0.0316	0.75		**Lag/CN Method, Ditch**
37.9	2,295	Total			

Subcatchment 38.02 Ac: DEV-4



Summary for Subcatchment 53.21 Ac: DEV-5

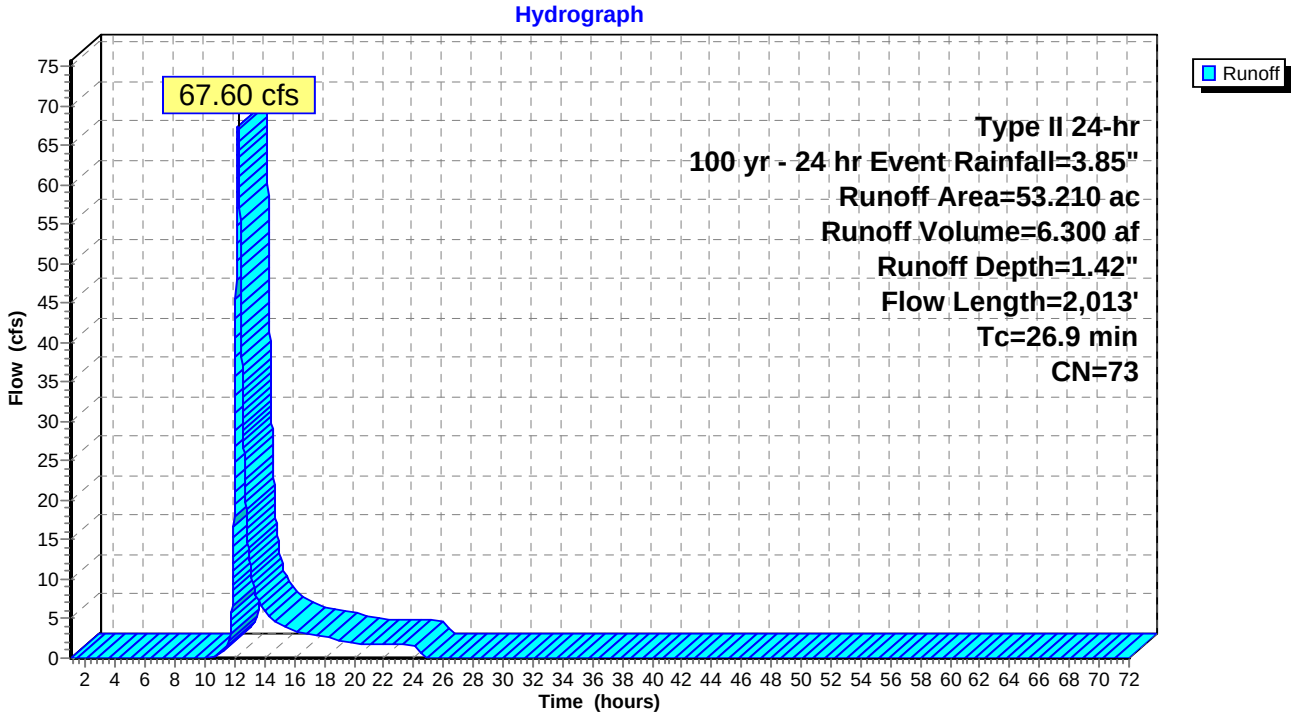
Runoff = 67.60 cfs @ 12.22 hrs, Volume= 6.300 af, Depth= 1.42"

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
*	53.210	73	
	53.210		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.2	1,226	0.0518	1.01		**Lag/CN Method, Top Dome**
6.7	787	0.2288	1.95		**Lag/CN Method, Side Slope**
26.9	2,013	Total			

Subcatchment 53.21 Ac: DEV-5



Summary for Subcatchment 82.06 Ac: DEV-1

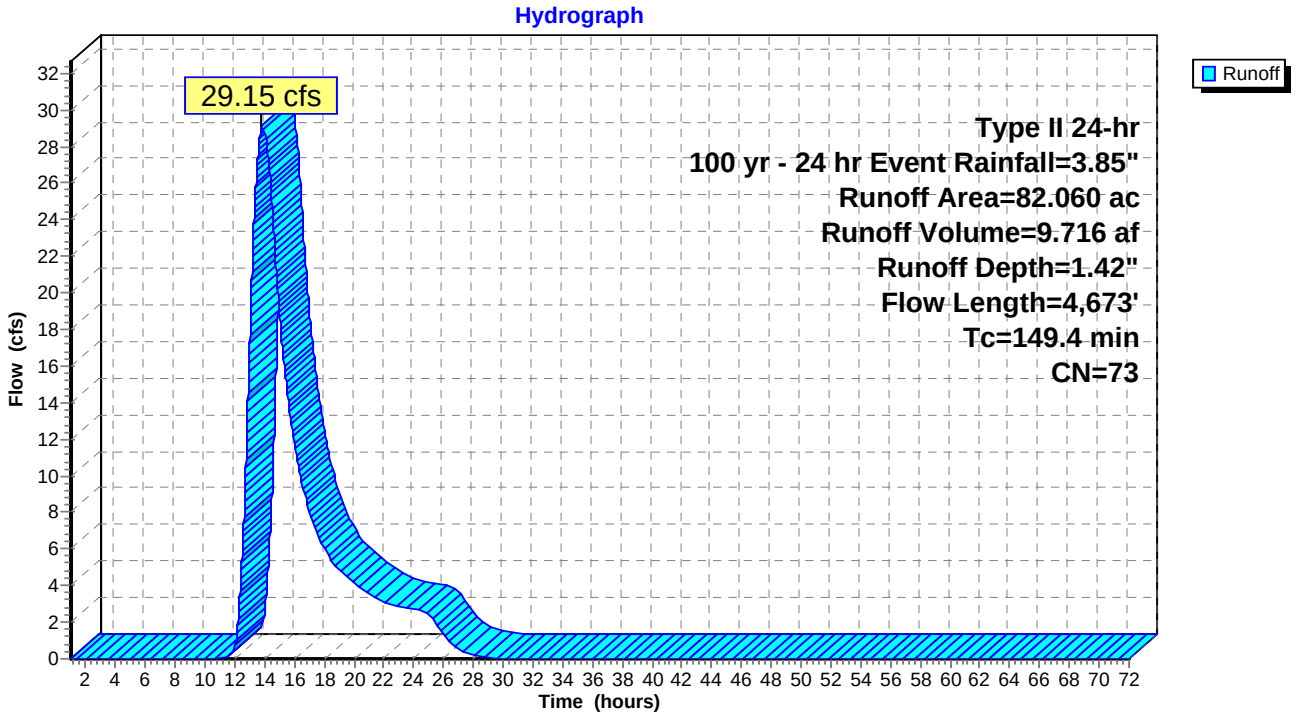
Runoff = 29.15 cfs @ 13.78 hrs, Volume= 9.716 af, Depth= 1.42"

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
*	82.060	73	
	82.060		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.7	1,020	0.0637	1.08		**Lag/CN Method, Top Dome**
7.0	759	0.1976	1.80		**Lag/CN Method, Side Slope**
126.7	2,894	0.0052	0.38		**Lag/CN Method, Ditch**
149.4	4,673	Total			

Subcatchment 82.06 Ac: DEV-1



Summary for Pond A: Existing Pond A

Inflow Area = 108.390 ac, 0.00% Impervious, Inflow Depth = 1.42" for 100 yr - 24 hr Event event
Inflow = 95.53 cfs @ 12.21 hrs, Volume= 12.833 af
Outflow = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

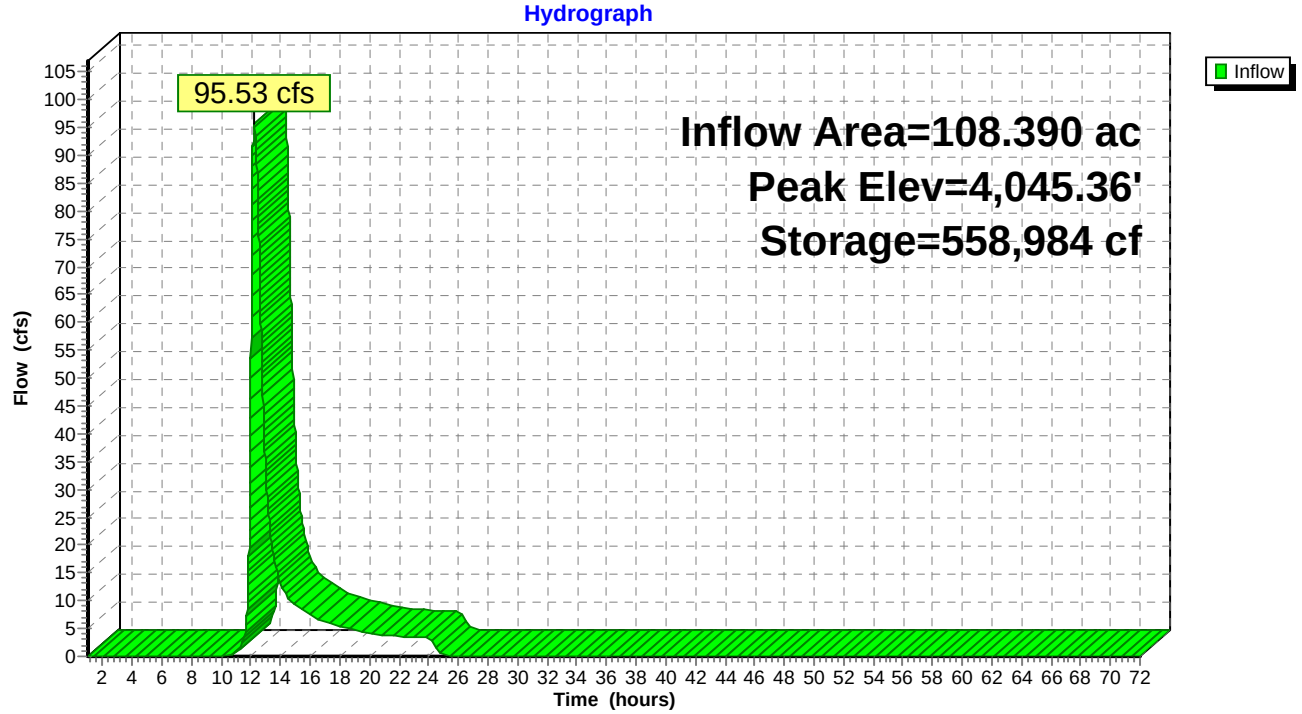
Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,045.36' @ 26.53 hrs Surf.Area= 258,042 sf Storage= 558,984 cf

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 = 68.100 ac, 0.00% Impervious, Inflow Depth = 1.42" for 100 yr - 24 hr Event event
Inflow = 78.16 cfs @ 12.23 hrs, Volume= 8.063 af
Outflow = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

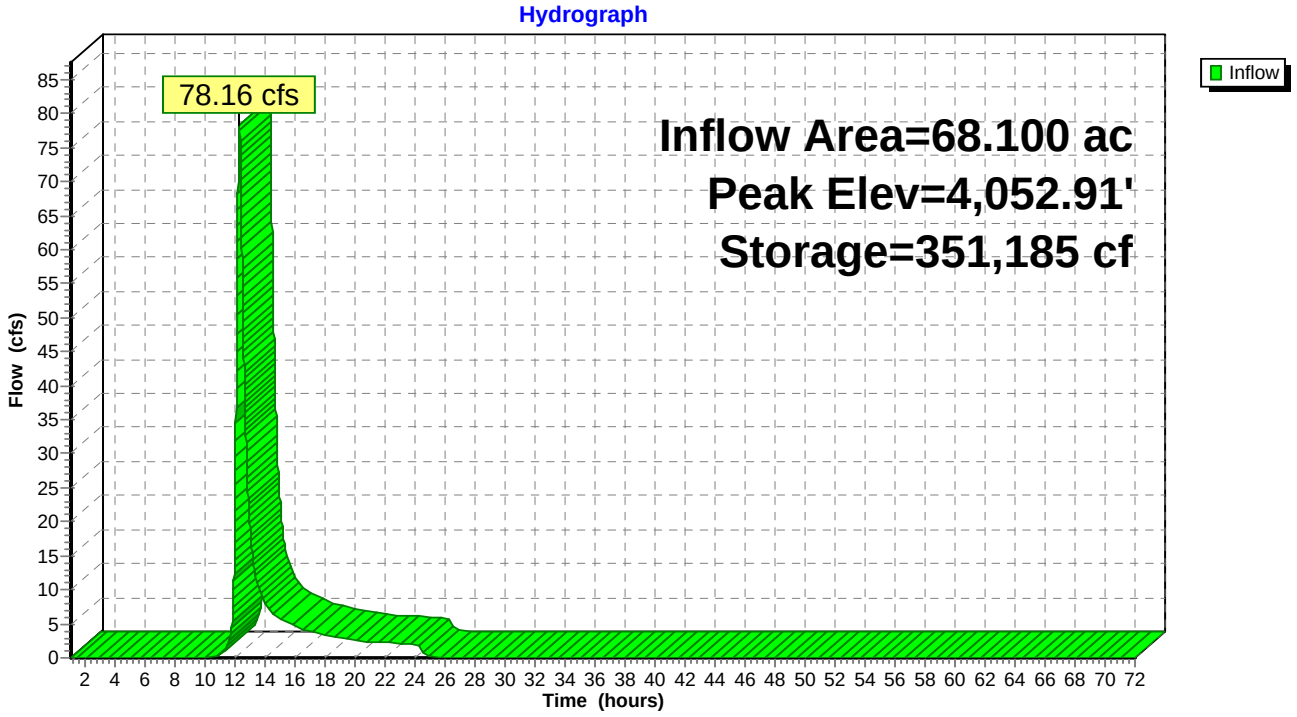
Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,052.91' @ 26.42 hrs Surf.Area= 59,860 sf Storage= 351,185 cf

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 = 154.770 ac, 0.00% Impervious, Inflow Depth = 1.42" for 100 yr - 24 hr Event event
Inflow = 65.26 cfs @ 12.24 hrs, Volume= 18.324 af
Outflow = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

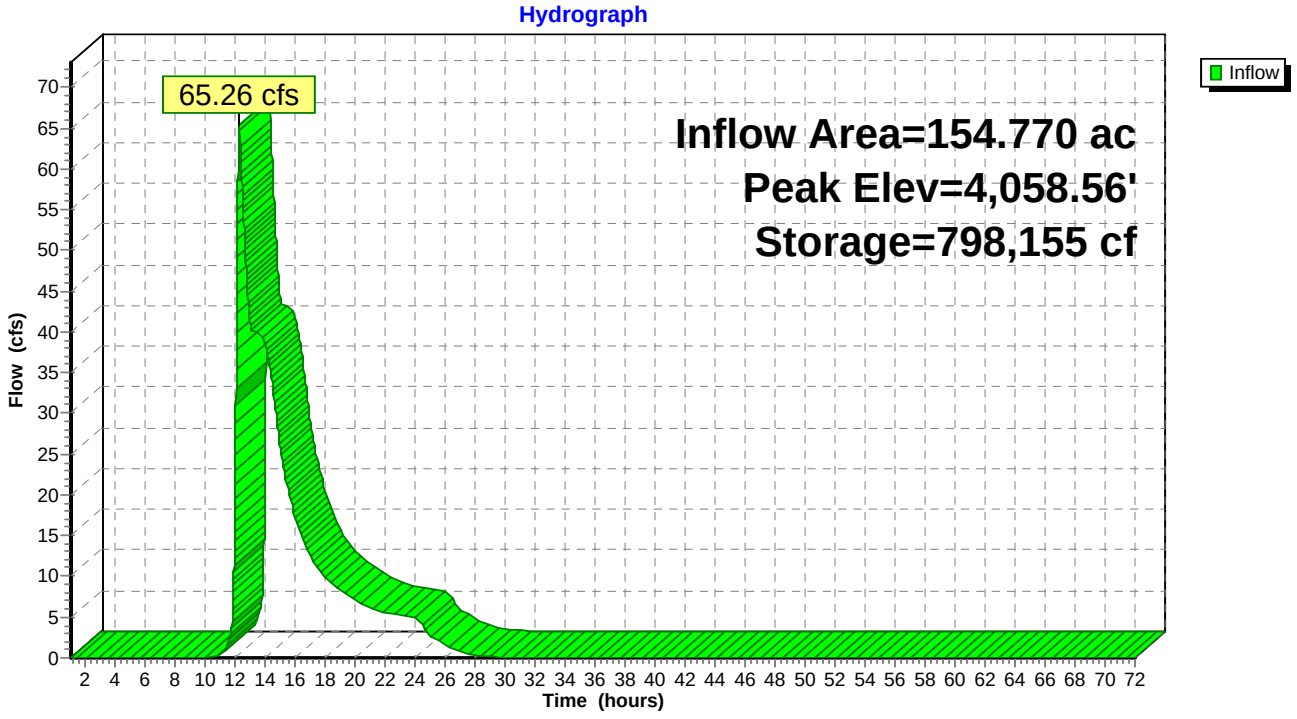
Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,058.56' @ 72.00 hrs Surf.Area= 88,781 sf Storage= 798,155 cf

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 = 82.060 ac, 0.00% Impervious, Inflow Depth = 1.42" for 100 yr - 24 hr Event event
Inflow = 29.15 cfs @ 13.78 hrs, Volume= 9.716 af
Outflow = 29.06 cfs @ 13.86 hrs, Volume= 9.715 af, Atten= 0%, Lag= 4.5 min
Primary = 29.06 cfs @ 13.86 hrs, Volume= 9.715 af

Routing by Sim-Route method, Time Span= 1.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,061.19' @ 13.86 hrs Surf.Area= 7,353 sf Storage= 7,866 cf

Plug-Flow detention time= 7.6 min calculated for 9.714 af (100% of inflow)
Center-of-Mass det. time= 7.7 min (990.5 - 982.8)

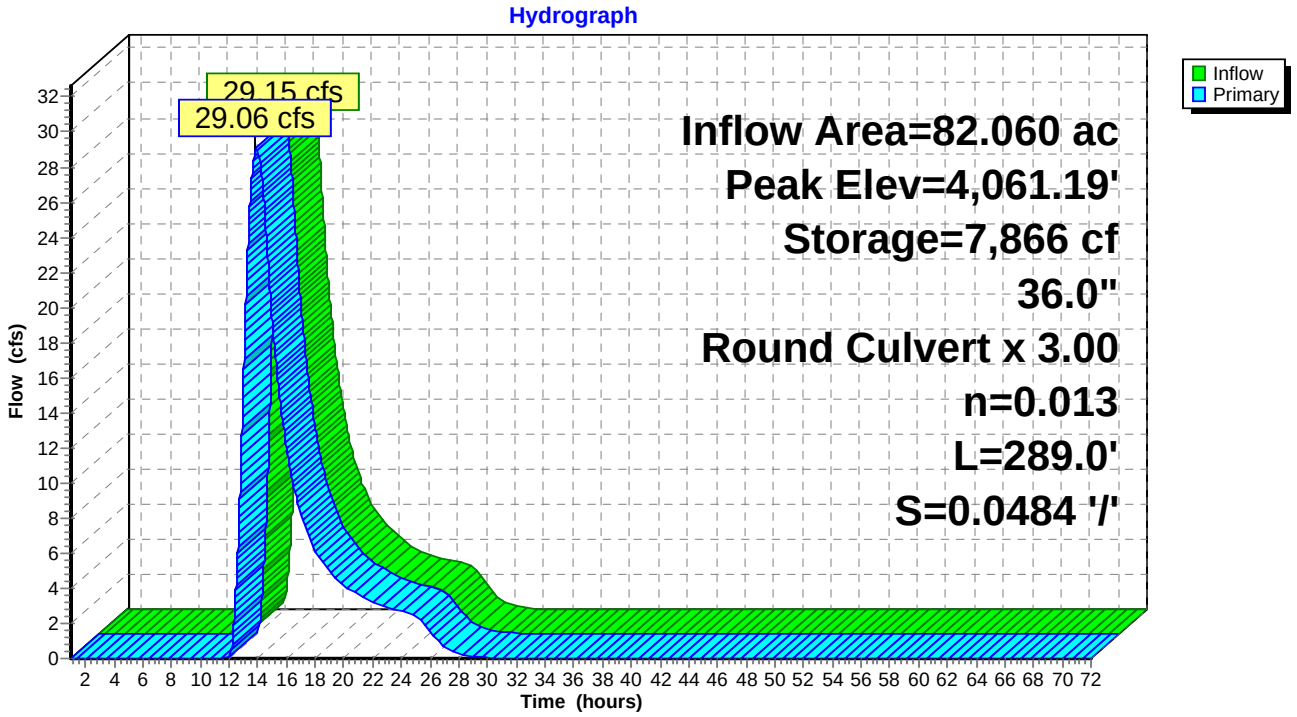
Volume	Invert	Avail.Storage	Storage Description
#1	4,060.00'	63,844 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

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** L= 289.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 4,060.00' / 4,046.00' S= 0.0484 '/' Cc= 0.900 n= 0.013, Flow Area= 7.07 sf

Primary OutFlow Max=29.06 cfs @ 13.86 hrs HW=4,061.19' TW=4,052.19' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 29.06 cfs @ 3.71 fps)

Pond E: Existing Pond E



Appendix 3C
Surface Water Drainage Plans

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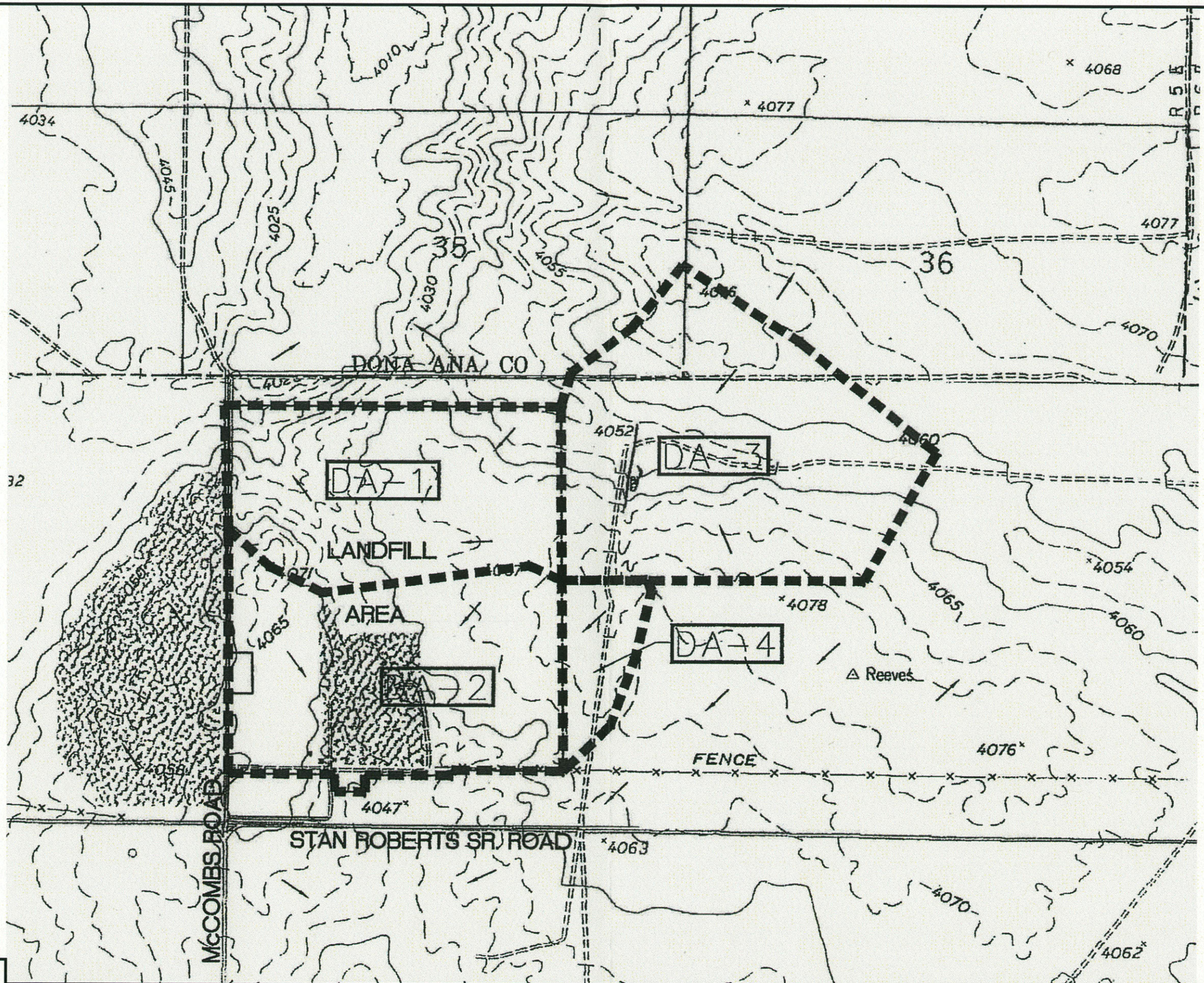

NOTES

1. DRAWING FROM PERMIT DATED APRIL 2002, BY MORENO CARDENAS, INC.
2. DRAINAGE AREA VALVES 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
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

SAIC®

SAIC Energy, Environment & Infrastructure, LLC
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

Keller, Tonya L. 10/18/2012 7:02:40 AM - P:\00218000 el paso tx\9631500115\data analytical\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

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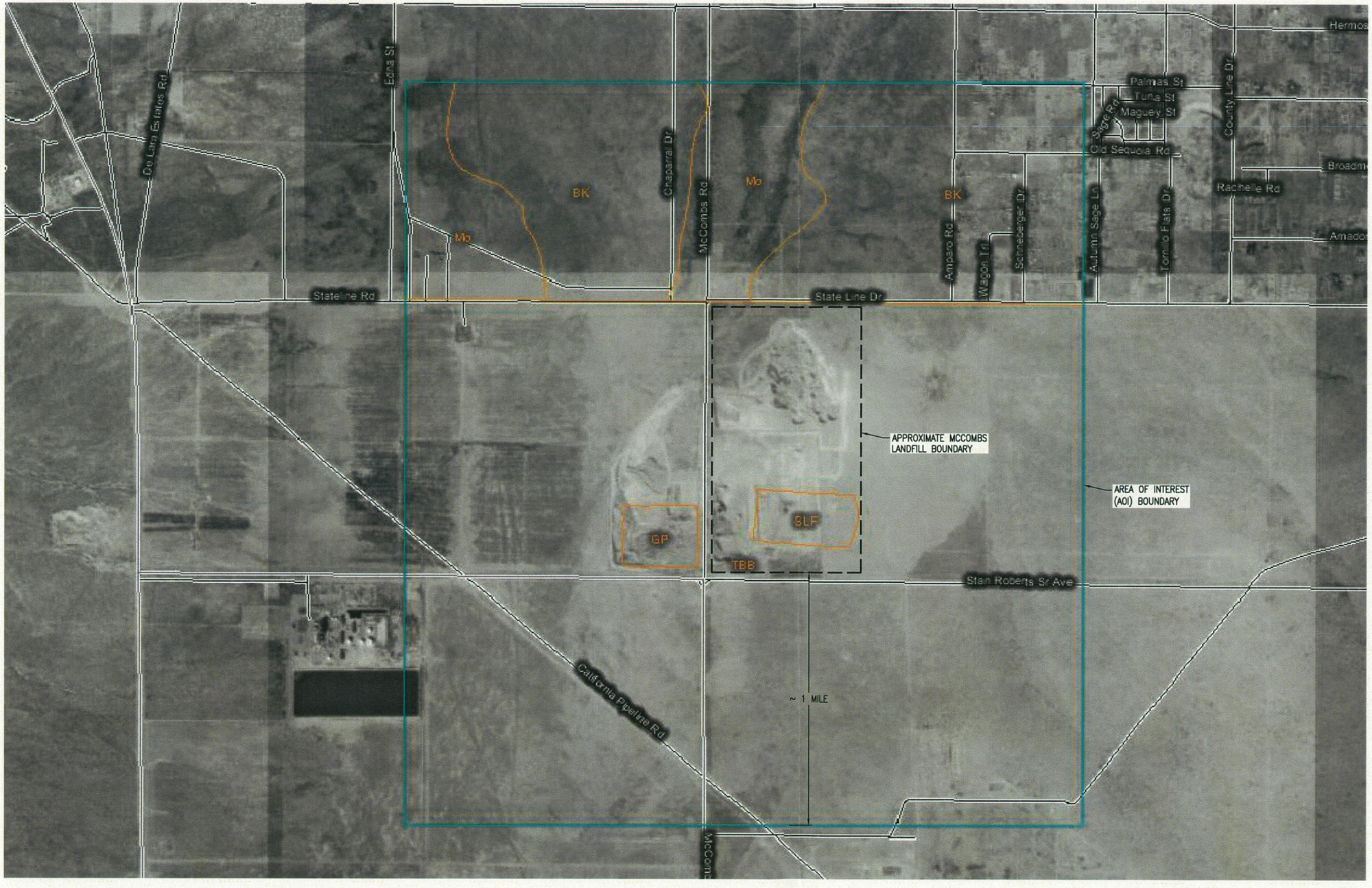
EXISTING DRAINAGE CONDITIONS

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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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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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

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

F P3-8

N: 10742684.20
E: 413885.24

PROPERTY BOUNDARY

N: 10738347.03
E: 413725.15

N: 10737947.76
E: 413739.68

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	82.06	27
DEV-2	37.14	30
DEV-3	33.23	45
DEV-4	38.02	34
DEV-5	53.21	59
DEV-6	14.89	12
DEV-7	37.45	27
DEV-8	35.26	42

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

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VERIFY SCALE
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0 1"

REV	DATE	CHK'D	APP'D	REVISION DESCRIPTION
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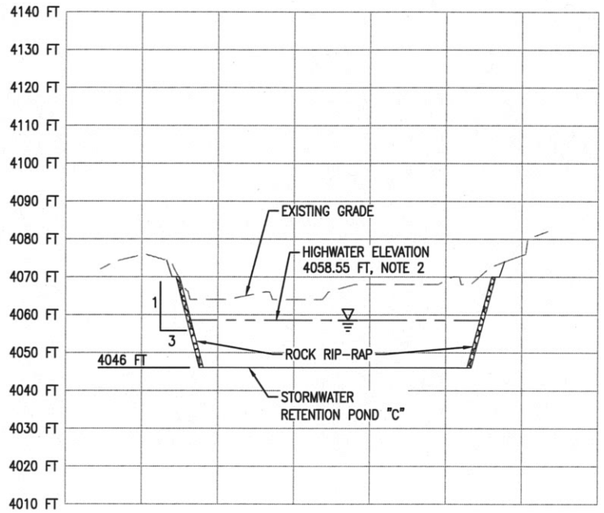
FINAL DRAINAGE CONDITIONS

PROJECT NUMBER: 9631500115
SHT. 39 OF: 78
DRAWING NUMBER: P3-6

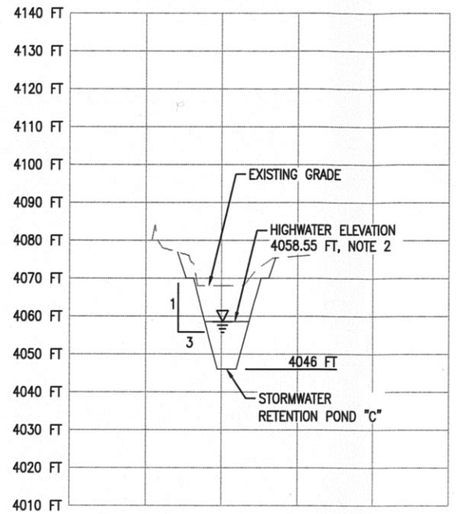
Koller, Tonya L. 11/1/2012 9:33:05 AM - P:\00218000 el paso tx\9631500115\data analytical\CADD\P3-6 FINAL DRAINAGE CONDITIONS.dwg

NOTES

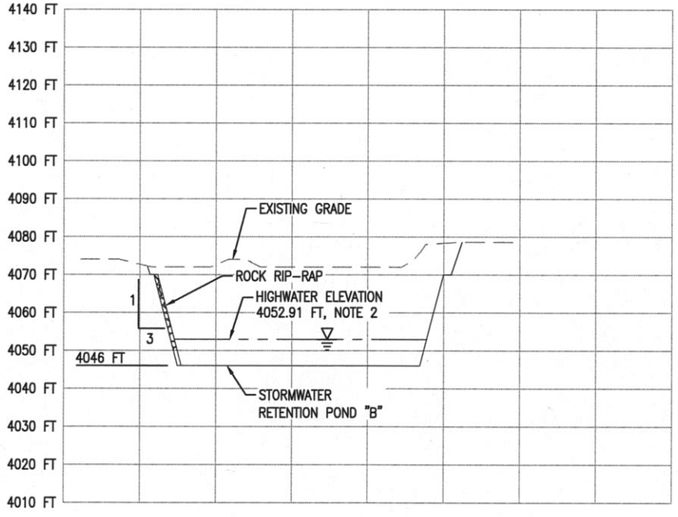
1. POND DESIGN CAPACITIES PROVIDED BY PREVIOUS PERMIT, DATED APRIL 2002, BY MORENO CARDENAS; AND UPDATE TO GROUNDWATER/SURFACE WATER PROTECTION PLAN, DATED MARCH 2009, BY PARKHILL, SMITH & COOPER, INC.
2. POND HIGH WATER ELEVATIONS ARE 100 YEAR, 24 HOUR STORM EVENT VOLUMES FOR THE FINAL DRAINAGE CONDITIONS SHOWN ON P3–6.
3. ELEVATIONS ARE CITY OF EL PASO VERTICAL DATUM.



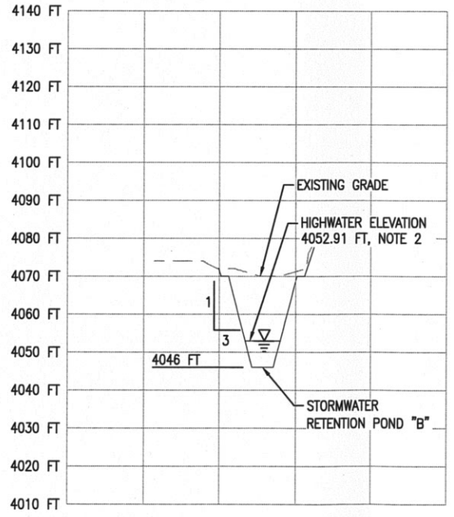
SECTION A P3–6
RETENTION POND C
VERTICAL SCALE: 1"=20'
HORIZONTAL SCALE: 1"=200'



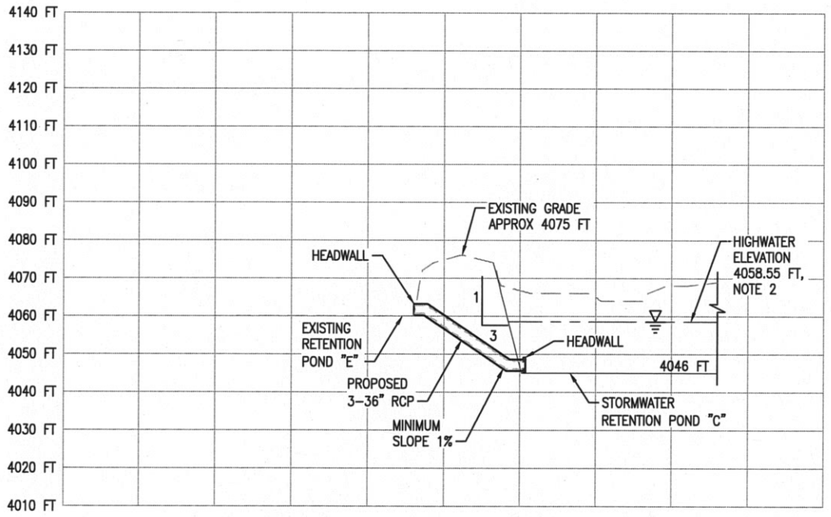
SECTION B P3–6
RETENTION POND C
VERTICAL SCALE: 1"=20'
HORIZONTAL SCALE: 1"=200'



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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0 1"

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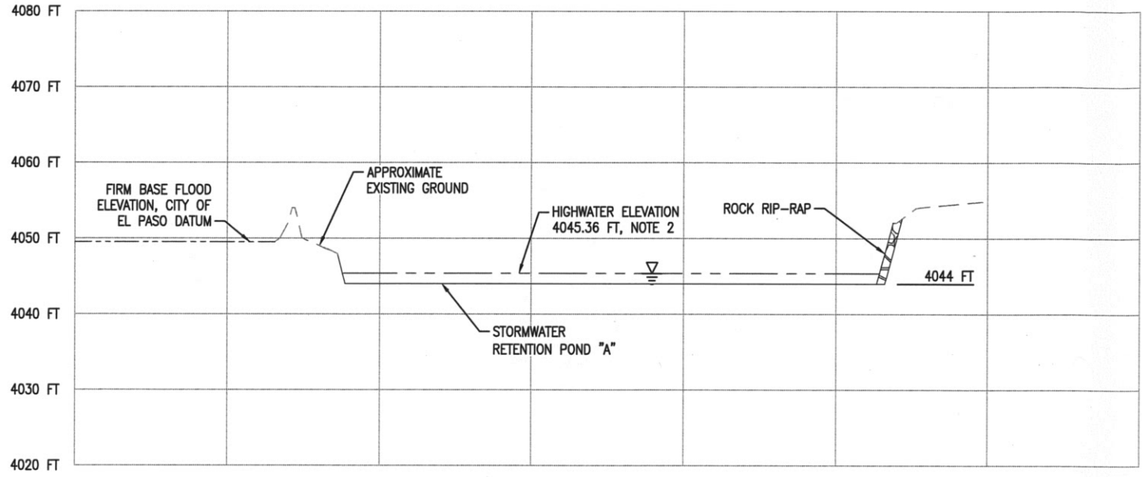
PONDING AREA CROSS SECTIONS, SHEET 1 OF 2

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

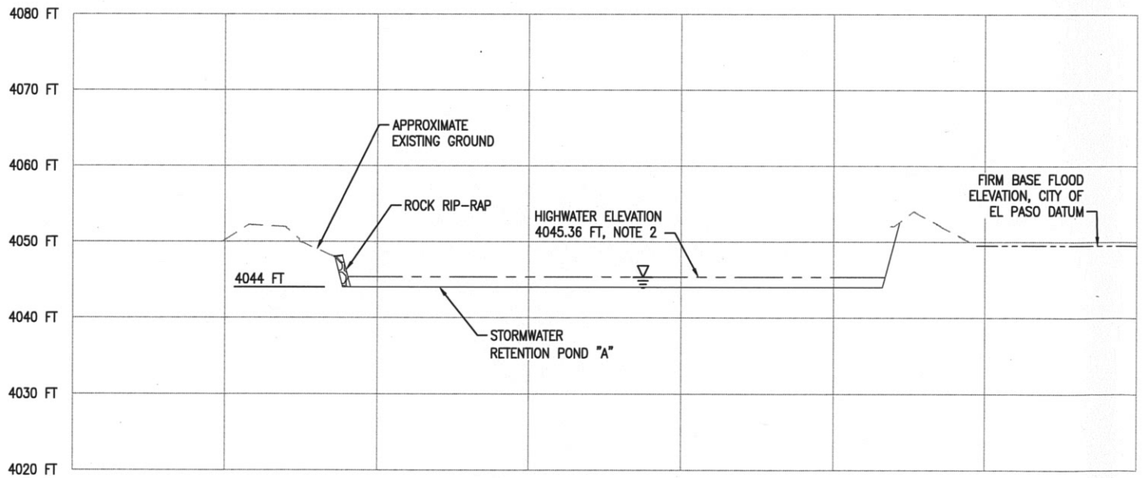
NOTES

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

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1	8/9/12	TLK	FJD	FIRST TECHNICAL NOD
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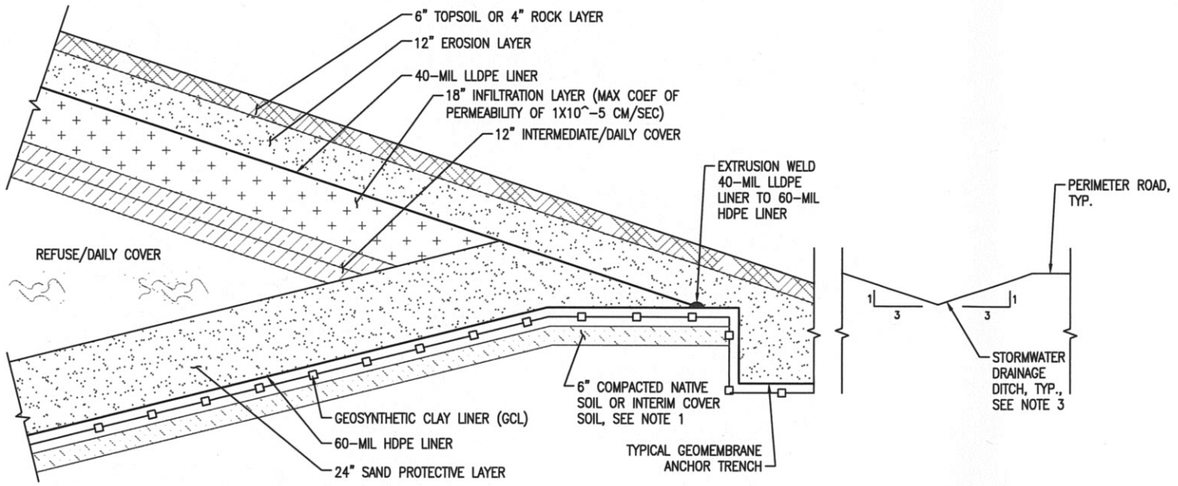
PONDING AREA CROSS SECTIONS, SHEET 2 OF 2

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

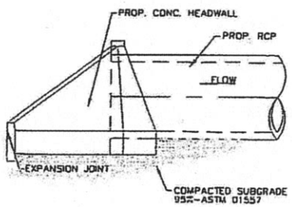
TYPICAL PERIMETER STORMWATER DITCH
SCALE: 1/2"=1'-0"

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.

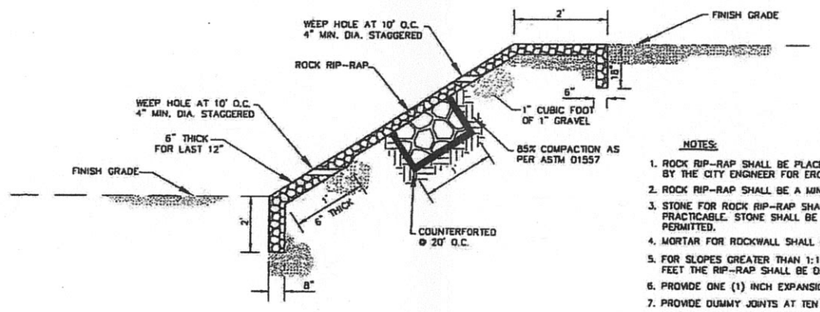
LEGEND

- 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
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DRAINAGE DETAILS, SHEET 1 OF 2

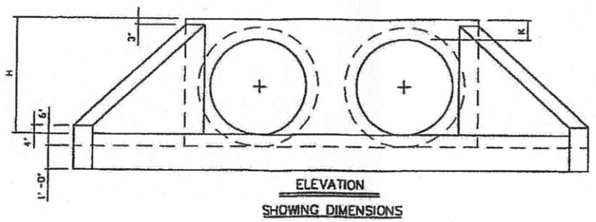
PROJECT NUMBER: 9631500115
SHT. 42 OF: 78
DRAWING NUMBER: P3-9

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

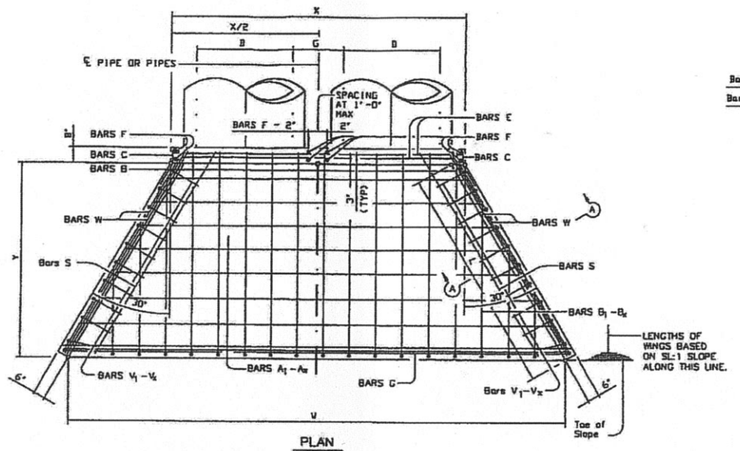
TABLE OF VARIABLE DIMENSIONS AND QUANTITIES FOR ONE HEADWALL

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

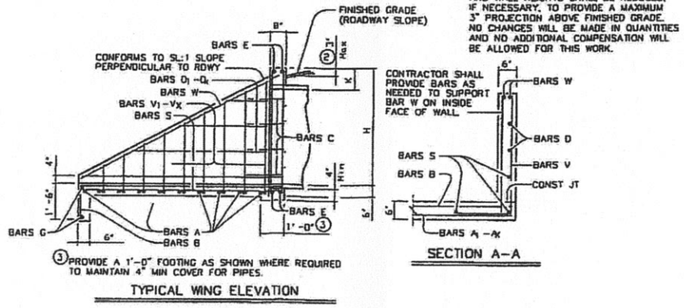
(1) QUANTITIES INCREASE SLIGHTLY FOR METAL PIPE INSTALLATIONS.



ELEVATION
SHOWING DIMENSIONS



PLAN



(3) PROVIDE A 1'-0" FOOTING AS SHOWN WHERE REQUIRED TO MAINTAIN 4" MIN COVER FOR PIPES.

TYPICAL WING ELEVATION

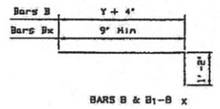
SECTION A-A

(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.

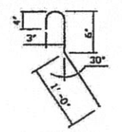
(4) TABLE OF REINFORCING STEEL			
Bar	Size	Spa	No.
A	# 4	1'-0"	~
B	# 3	1'-6"	~
C	# 4	1'-0"	~
D	# 3	1'-0"	~
E	# 5	~	4
F	# 5	~	~
G	# 3	~	2
S	# 4	~	6
V	# 4	1'-0"	~
W	# 5	~	4

(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"



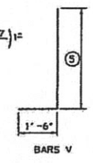
BARS B & B1 - B6 x



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

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

MCCOMBS LANDFILL
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

N: 10742509.06
E: 417193.27

PROPERTY BOUNDARY

ROCK RIP RAP SEE NOTE 1

SEE NOTE 7.

STORMWATER DRAINAGE CHANNEL

RIP RAP IN CHANNEL. SEE NOTE 3

ROCK RIP RAP

N: 10738213.37
E: 417020.95

STORMWATER RETENTION POND B

STORMWATER RETENTION POND C

ROCK RIP RAP AT INLET. SEE NOTE 1

RIP RAP IN CHANNEL. SEE NOTE 3

SLOPE 7%

SLOPE 7%

SLOPE 7%

3:1

3:1

3:1

3:1

3:1

EXISTING RETENTION POND E

ROCK RIP RAP SEE NOTE 1

EXISTING STORMWATER RETENTION POND A

CURRENTLY CONCRETE RIP RAP IN CHANNEL. SEE NOTE 1.

STORMWATER DRAINAGE CHANNEL

RIP RAP IN CHANNEL SEE NOTE 3

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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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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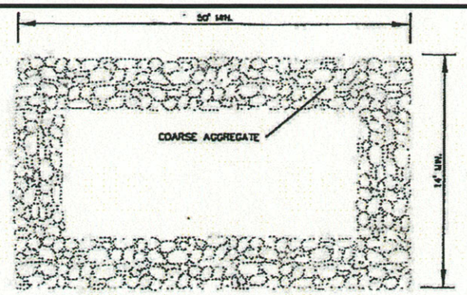
MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

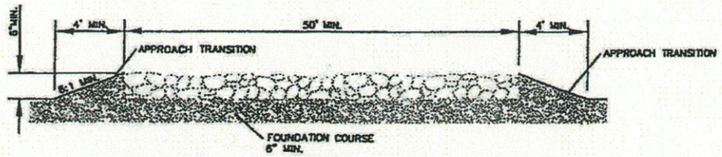
EROSION CONTROL PLAN

PROJECT NUMBER: 9631500115
SHT. 44 OF: 78
DRAWING NUMBER: P3-11

Keller, Tonya L. 10/18/2012 11:48:43 AM — P:\00218000 el paso \x\9631500115\data analytical\CADD\P3-11 EROSION CONTROL PLAN.dwg



PLAN

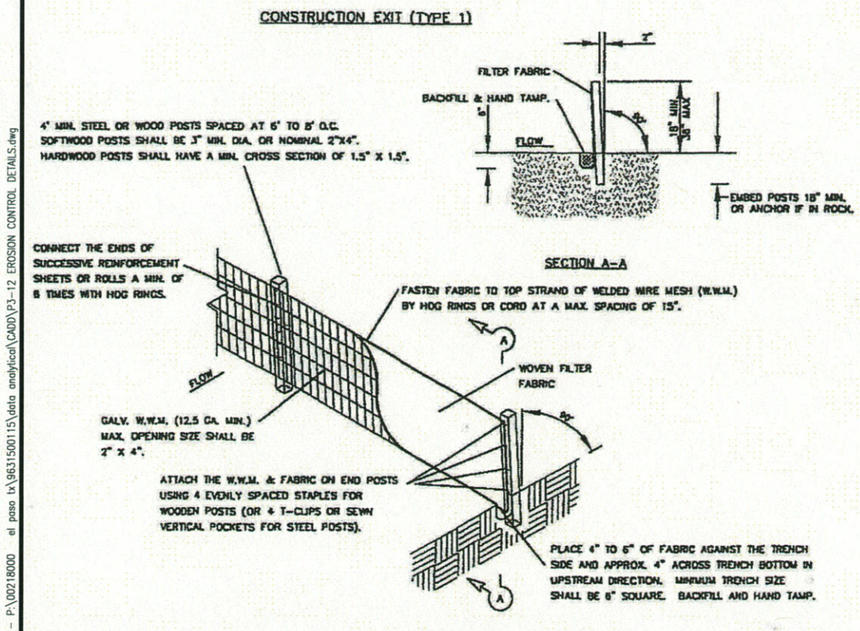


PROFILE

GENERAL NOTES

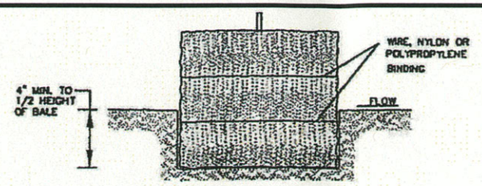
1. THE LENGTH OF THE TYPE 1 CONSTRUCTION EXIT SHALL BE AS INDICATED ON THE PLANS, BUT NOT LESS THAN 50'.
2. THE COARSE AGGREGATE SHOULD BE OPEN GRADED WITH A SIZE OF 4" TO 8".
3. THE APPROACH TRANSITIONS SHOULD BE NO STEEPER THAN 6:1 AND CONSTRUCTED AS DIRECTED BY THE ENGINEER.
4. THE CONSTRUCTION EXIT 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)

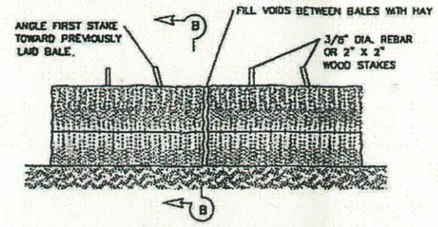


SECTION A-A

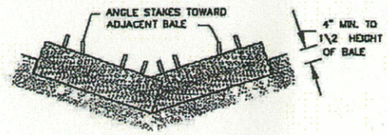
TEMPORARY SEDIMENT CONTROL FENCE



SECTION B-B



BALED HAY FOR EROSION CONTROL



PROFILE VIEW

BALED HAY USAGE GUIDELINES

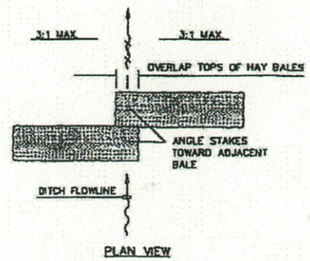
A BALED HAY INSTALLATION MAY BE CONSTRUCTED NEAR THE DOWNSTREAM PERIMETER OF A DISTURBED AREA ALONG A CONTOUR TO INTERCEPT SEDIMENT FROM OVERLAND RUNOFF. A TWO YEAR STORM FREQUENCY MAY BE USED TO CALCULATE THE FLOW RATE TO BE FILTERED. THE INSTALLATION SHOULD BE SIZED TO FILTER A MAXIMUM FLOW THRU RATE 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

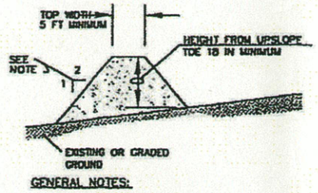
GENERAL NOTES

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

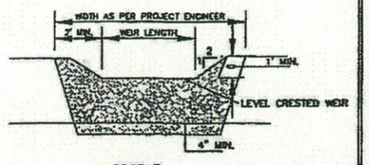
1. DETAILS PROVIDED IN PREVIOUS PERMIT, DATED APRIL 2002, BY MORENO CARDENAS, INC., SIGNED BY ROBERTO MORENO, P.E.



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

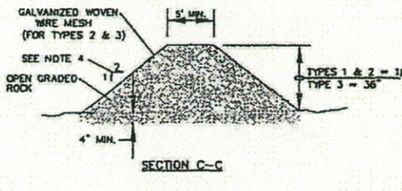
ROCK FILTER DAMS SHOULD BE CONSTRUCTED DOWNSTREAM FROM DISTURBED AREAS TO INTERCEPT SEDIMENT FROM OVERLAND RUNOFF AND/OR CONCENTRATED FLOW. THE DAMS SHOULD BE SIZED TO FILTER A MAXIMUM FLOW THROUGH RATE OF 40 GPM/FT^2 OF CROSS SECTIONAL AREA. A 2 YEAR STORM FREQUENCY MAY BE USED TO CALCULATE THE FLOW 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.

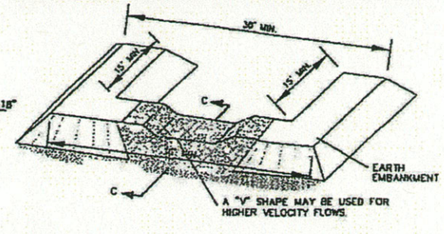
TYPE 2 (18" HIGH WITH WIRE MESH): TYPE 2 MAY BE USED IN DITCHES AND AT DIKE OR SWALE OUTLETS.

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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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
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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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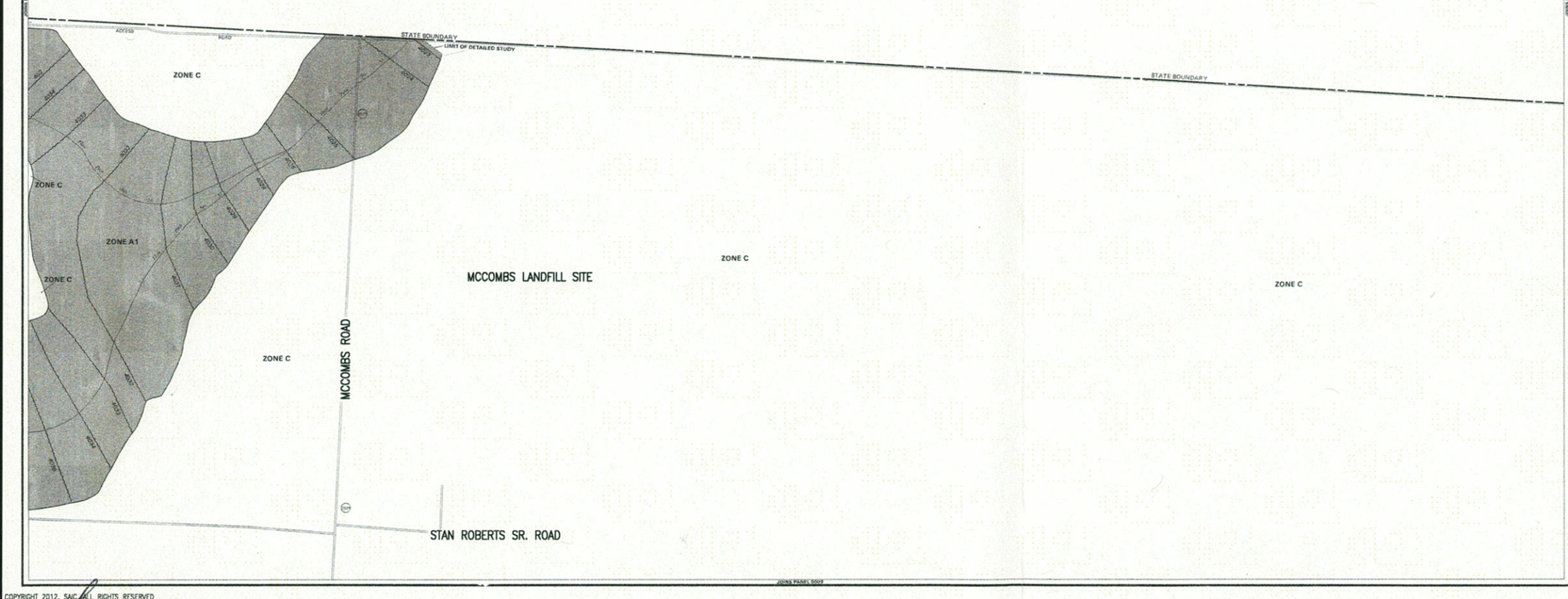

KEY TO MAP

100-Year Flood Boundary	ZONE B
100-Year Flood Boundary	ZONE A1
Zone Designations*	ZONE AE
100-Year Flood Boundary	ZONE B
500-Year Flood Boundary	
Base Flood Elevation Line With Elevation In Feet**	513
Base Flood Elevations 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 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 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, 1982

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 1000 2000 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. 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.

GRAPHIC SCALE: NTS

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PROFESSIONAL ENGINEER
11/2/12

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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
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

Koller, Tonya L. 10/18/2012 1:20:23 PM — P:\00218000 el paso tx\9631500115\data analytical\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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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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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®

N:10743000
E:418000

N:10738000
E:418000

TEXAS–NEW MEXICO
BOUNDARY LINE

N: 10742509.06
E: 417193.27

PROPERTY
BOUNDARY

N: 10738213.37
E: 417020.95

STORMWATER
RETENTION
POND B

STORMWATER
RETENTION
POND C

N: 10737824.64
E: 415990.31

PROPERTY
BOUNDARY

EXISTING
RETENTION
POND E

EXISTING
MAINTENANCE
BUILDINGS,
GATEHOUSE, AND
STORAGE AREA

NEW SITE
ENTRANCE
FACILITIES

EXISTING
RETENTION
POND D

EXISTING
PERIMETER
FENCE

EXISTING
UNLINED
LANDFILL

EXISTING
SECTOR A
(PHASE III)

EXISTING
STORMWATER
RETENTION
POND A

EXISTING
LINED
LANDFILL
(PHASE II)

EXISTING
LINED
LANDFILL
(PHASE I)

N:10738000
E:414000

N:10743000
E:414000

N: 10742684.20
E: 413885.24

PROPERTY
BOUNDARY

EXISTING
PERIMETER
FENCE

N: 10738347.03
E: 413725.15

N: 10737947.76
E: 413739.68

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
- —X—X—X— 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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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 EXCAVATION PLAN

PROJECT NUMBER: 9631500115
SHT. 48 OF: 78
DRAWING NUMBER: P3–15

Keller, Tonya L. 10/18/2012 1:55:47 PM – P:\00218000 el paso tx\9631500115\data analytical\CADD\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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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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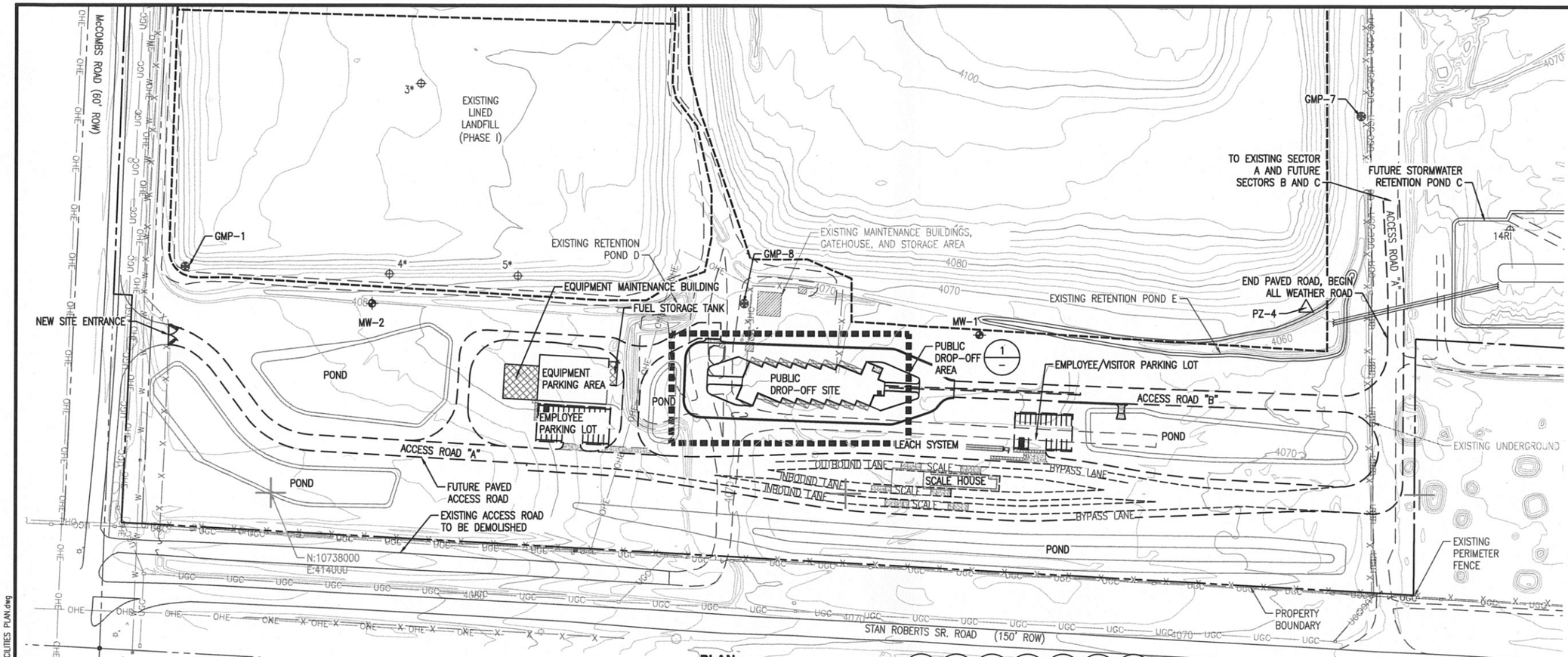
MAJOR PERMIT AMENDMENT

LANDFILL COMPLETION PLAN

PROJECT NUMBER: 9631500115
SHT. 49 OF: 78
DRAWING NUMBER: P3–16

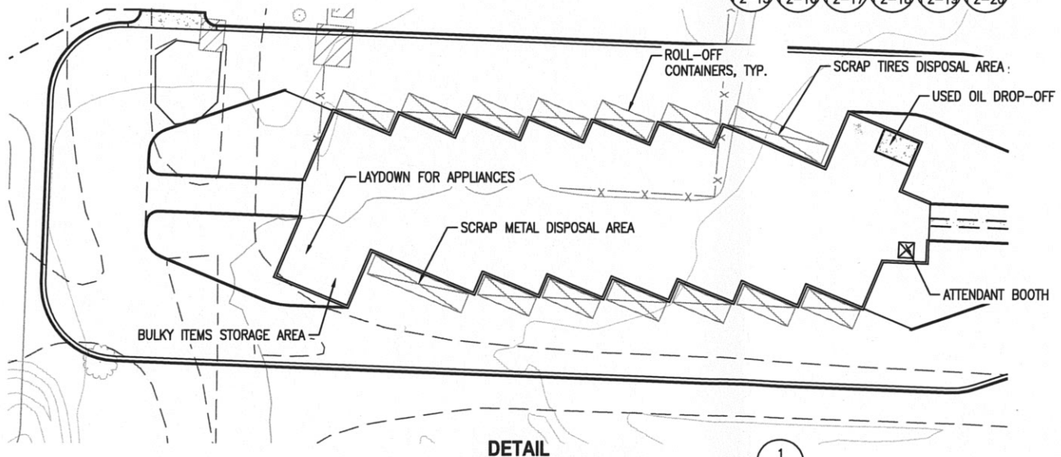
Keller, Tonya L. 10/18/2012 2:29:53 PM – P:\00218000 el paso tx\9631500115\data analysis\CADD\P3-16 LANDFILL COMPLETION PLAN.dwg



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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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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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) $Q_{100} = C \times A \times I$

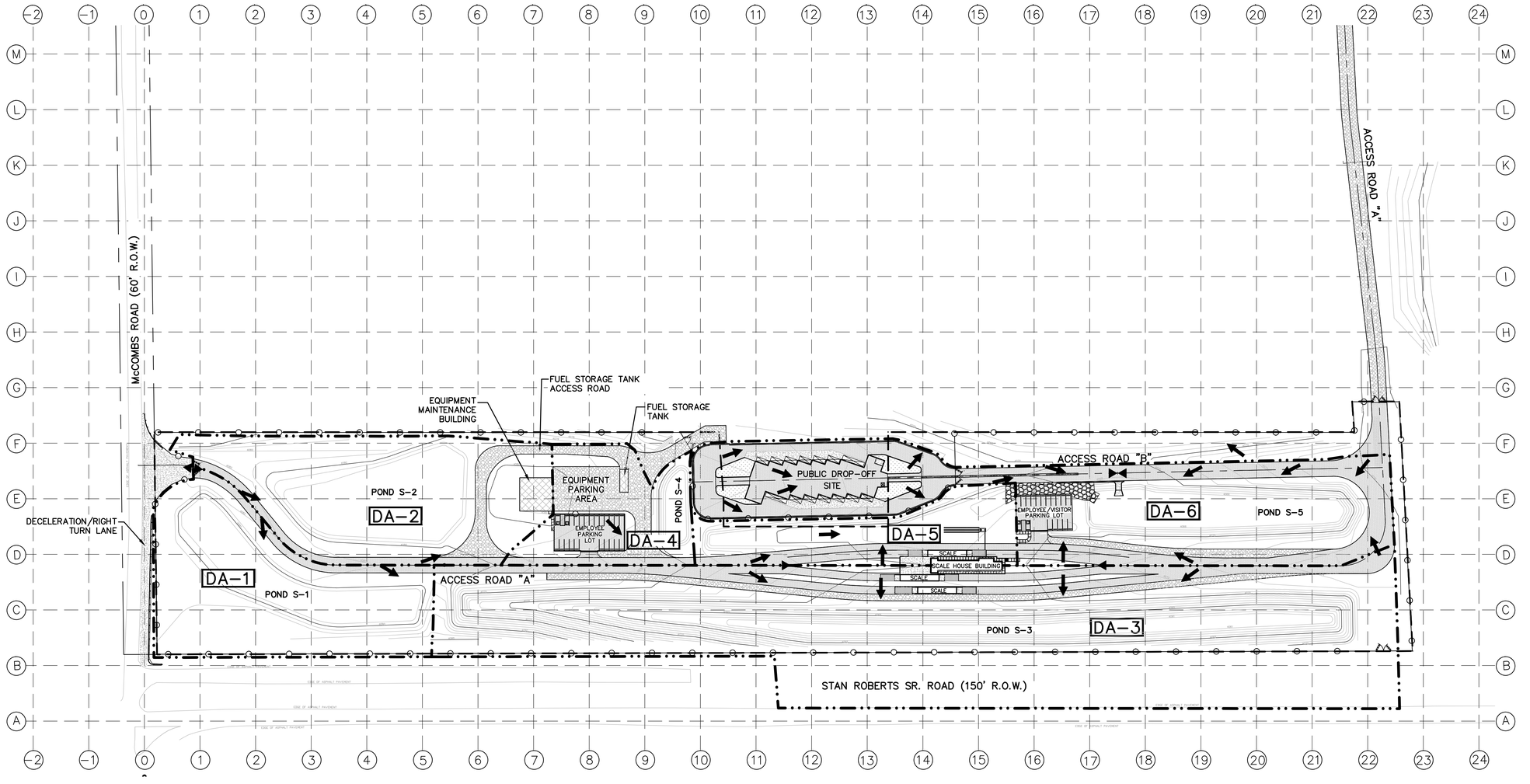
RETENTION POND COMPUTATIONS

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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ALTERATION OF A SEALED DOCUMENT WITHOUT PROPER NOTIFICATION TO THE RESPONSIBLE ENGINEER IS AN OFFENSE UNDER THE TEXAS ENGINEERING PRACTICE ACT"

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

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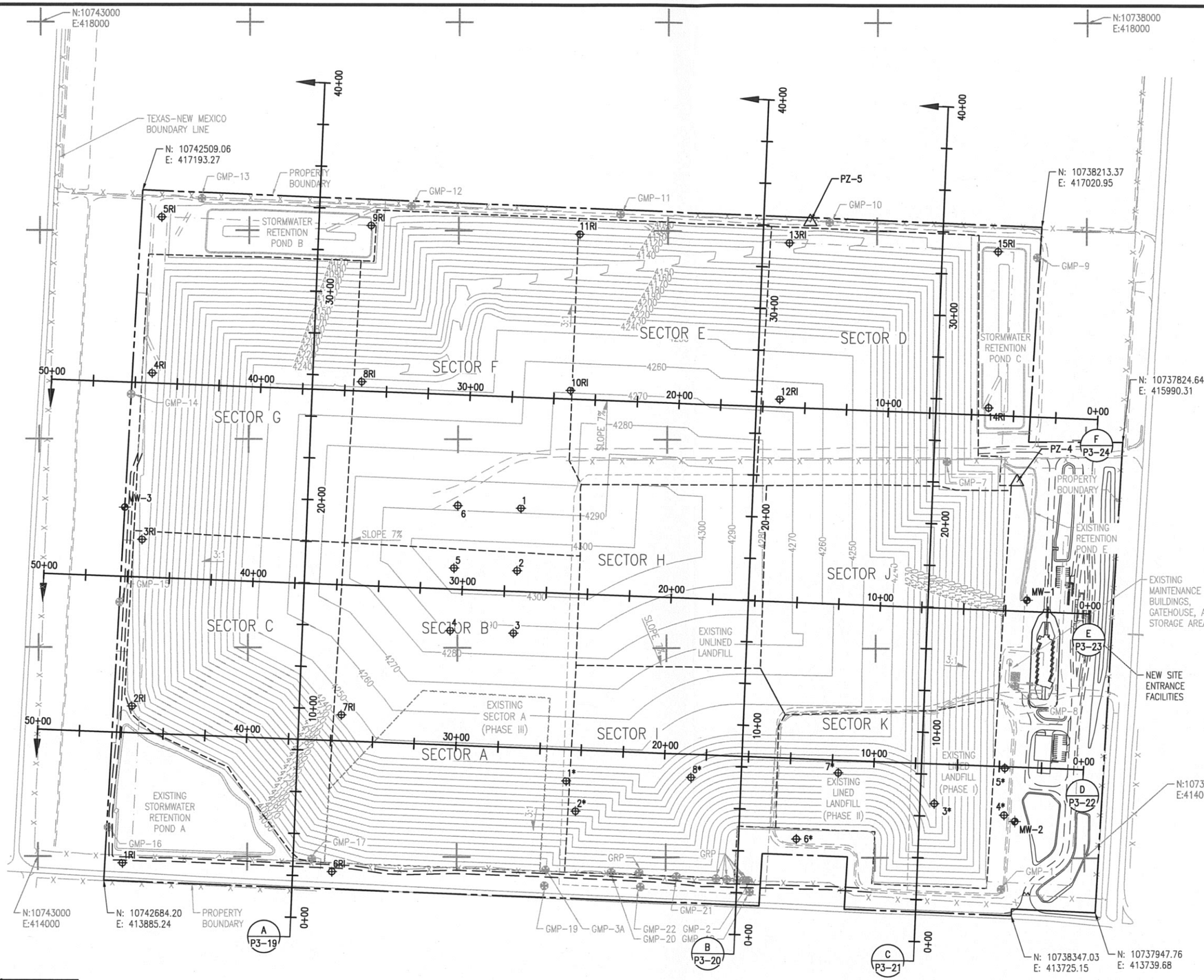

NOTES

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
- 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
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REV	DATE	CHK'D	APP'D	REVISION DESCRIPTION
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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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MAJOR PERMIT AMENDMENT

SECTION LAYOUT PLAN

PROJECT NUMBER: 9631500115
SHT. 51 OF: 78
DRAWING NUMBER: P3–18

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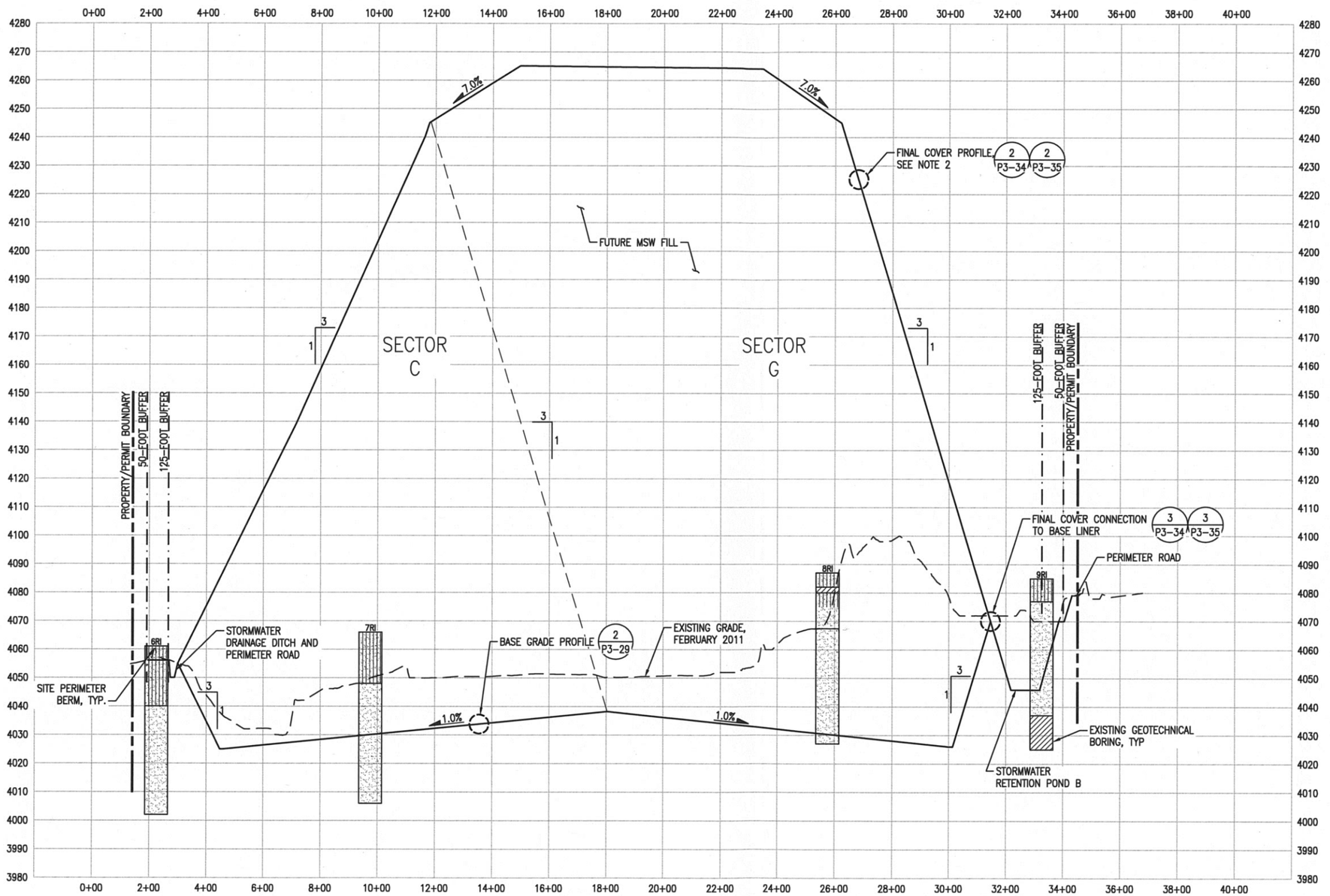

SECTION

TYPICAL LANDFILL
VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 200'

A
P3–18
A
P3–26

NOTES

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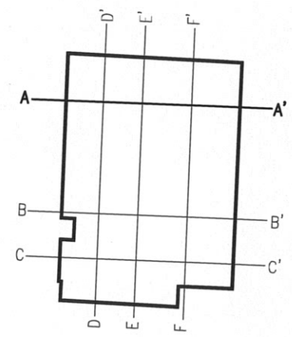

KEY MAP
SCALE: NTS

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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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1	8/9/12	TLK	FJD	FIRST TECHNICAL NOD
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TYPICAL LANDFILL SECTION A

PROJECT NUMBER: 9631500115
SHT. 52 OF: 78
DRAWING NUMBER: P3–19

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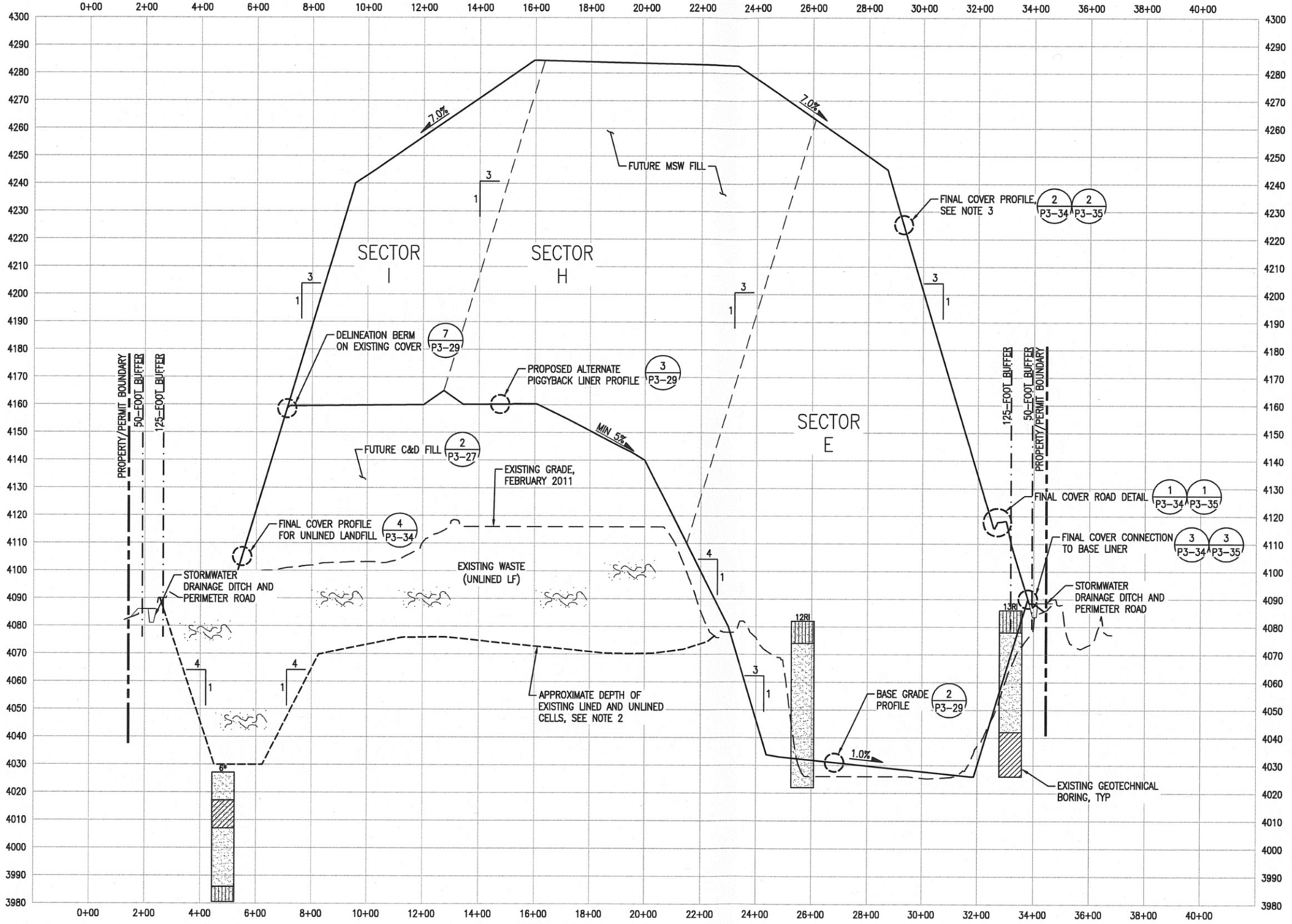

SECTION

B P3-18 B P3-26

TYPICAL LANDFILL
VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 200'

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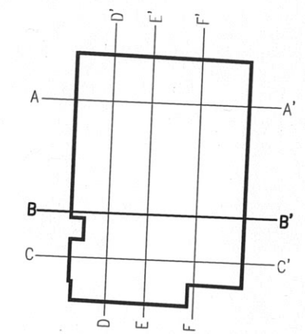

KEY MAP

SCALE: NTS

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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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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

TYPICAL LANDFILL SECTION B

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SHT. 53 OF: 78
DRAWING NUMBER: P3-20

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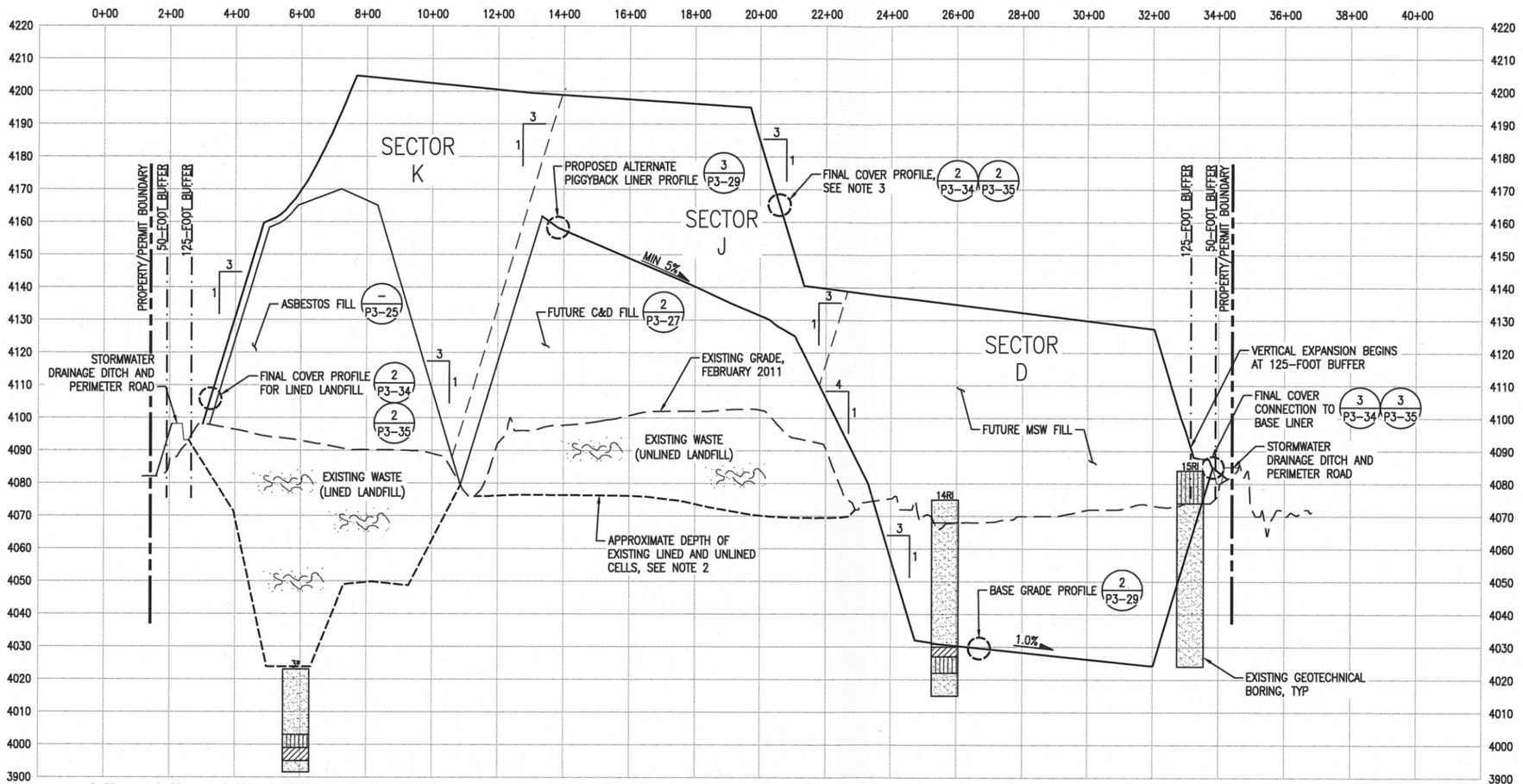

SECTION C P3-18 C P3-26

TYPICAL LANDFILL
VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 200'

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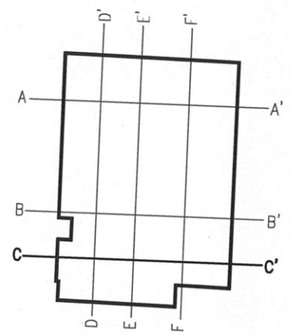

KEY MAP
SCALE: NTS

LEGEND

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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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11/2/12

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DRAWN CAD
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1	8/9/12	TLK	FJD	FIRST TECHNICAL NOD
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MAJOR PERMIT AMENDMENT

TYPICAL LANDFILL SECTION C

PROJECT NUMBER: 9631500115
SHT. 54 OF: 78
DRAWING NUMBER: P3-21

Keller, Tonya L. 10/22/2012 11:04:56 AM – P:\0021B000 el paso tx\9631500115\data analytical\CADD\P3-21 TYPICAL LANDFILL SECTION C.dwg

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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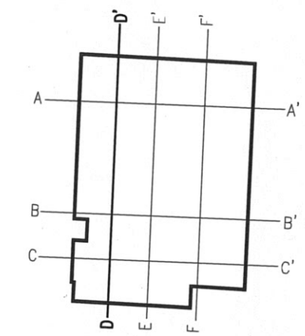

KEY MAP
SCALE: NTS

LEGEND

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- ⊕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

SECTION D (P3-18 / P3-26)

TYPICAL LANDFILL
VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 200'

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111226
REGISTERED
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DESIGNED TLK
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VERIFY SCALE
BAR IS ONE INCH ON ANSI "D" DRAWING
0 1"

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MAJOR PERMIT AMENDMENT

TYPICAL LANDFILL SECTION D

PROJECT NUMBER: 9631500115
SHT. 55 OF: 78
DRAWING NUMBER: P3-22

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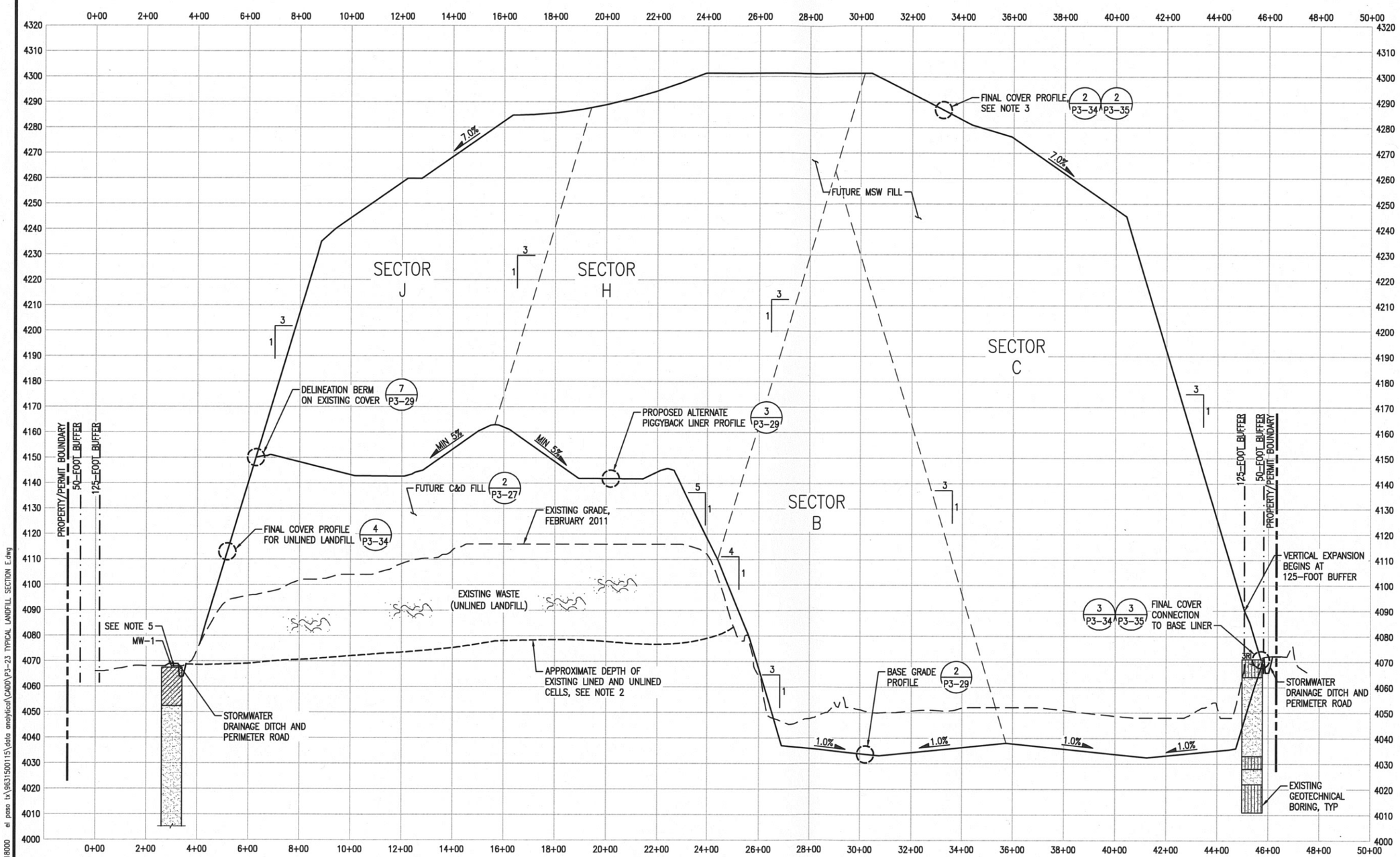

SECTION

TYPICAL LANDFILL
VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 200'

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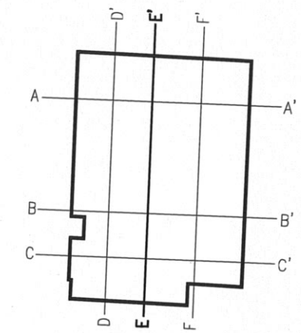

KEY MAP
SCALE: NTS

LEGEND

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SAND
SILTY SAND
CLAYEY SAND
SILT

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1"=20'-0" 20 0 20 40 Scale Feet

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0	11/22/11	FJD	SEK	MAJOR PERMIT AMENDMENT

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TYPICAL LANDFILL SECTION E

PROJECT NUMBER: 9631500115
SHT. 56 OF: 78
DRAWING NUMBER: P3-23

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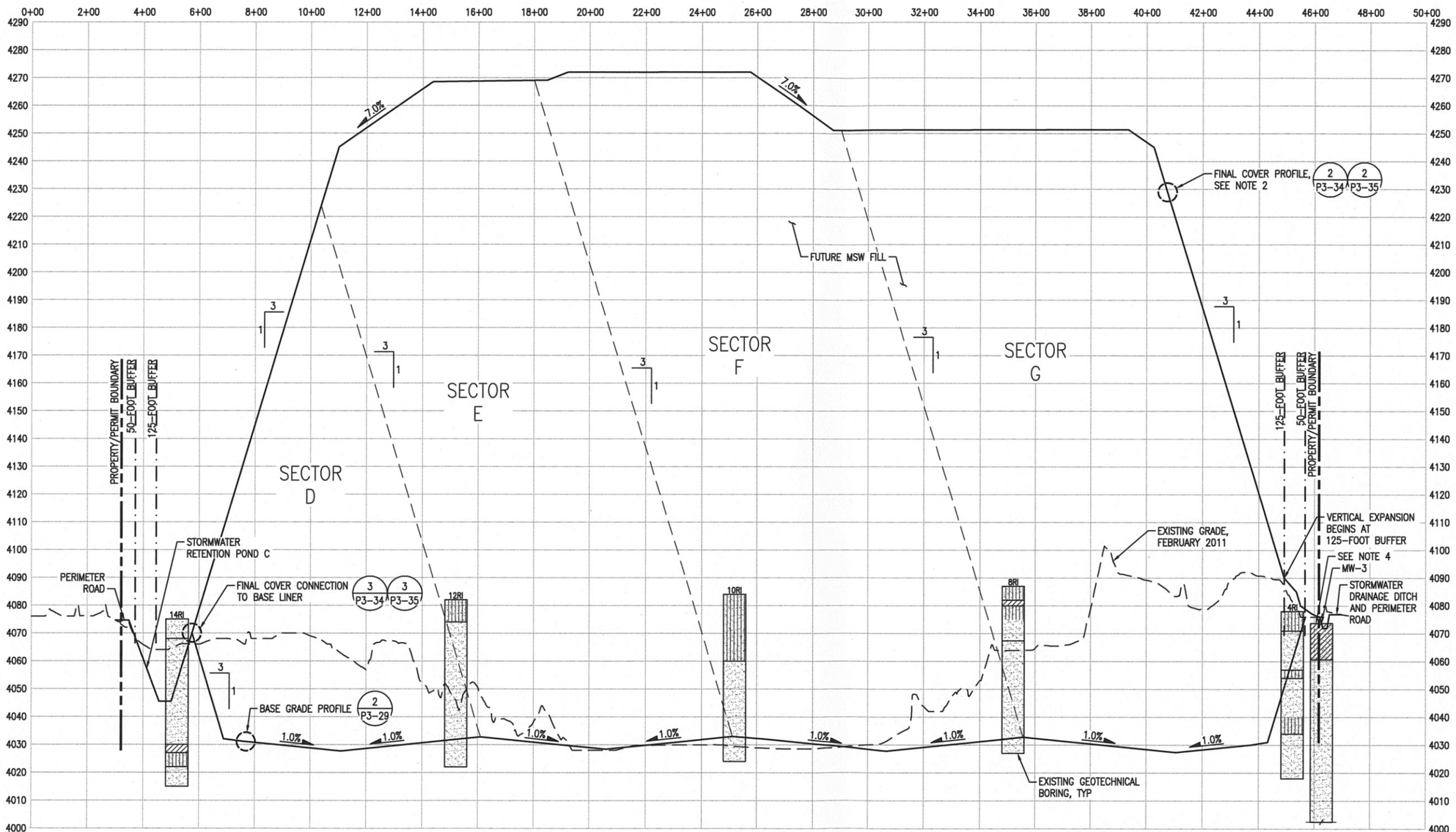

SECTION F P3-18 F P3-26

TYPICAL LANDFILL
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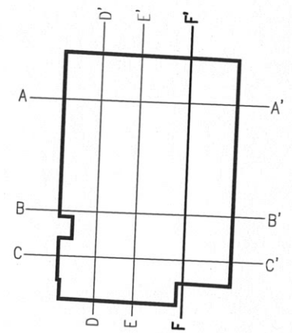

KEY MAP
SCALE: NTS

LEGEND

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SILTY SAND
CLAYEY SAND
SILT

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TYPICAL LANDFILL SECTION F

PROJECT NUMBER: 9631500115
SHT. 57 OF: 78
DRAWING NUMBER: P3-24

Keller, Tonya L. 10/22/2012 11:14:54 AM – P:\00218000 el paso tx\9631500115\data analytical\CADD\P3-24 TYPICAL LANDFILL SECTION F.dwg

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 November 2012

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

Table of Contents

List of Attachments

Attachment 1 – AET Report June 1, 2011

AET Report of Waste Mass Stability Memo I
Husker Fortrac 80MP Specification II
AET Report of Waste Mass Stability
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Signature Page ..... *ii*
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2.0 Scope of Services *1*
3.0 Project Information *1*
4.0 Vertical Landfill Expansion *2*
4.1 Settlement of Existing Waste *2*
4.2 Reinforcement Design *3*
5.0 Waste Mass Stability *5*
5.1 Background Information *5*
5.2 Assumed Parameters *6*
5.3 Analysis and Results *6*
5.4 Conclusions *7*
6.0 Limitations *8*
7.0 References *8*
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Appendix B – Settlement of Existing Waste *17*
Appendix C – Waste Mass Stability *19*
Appendix D – Geotechnical Report Limitations and Guidelines for Use *40*

Attachment 2 – AET Report August 3, 2012

AET Report of Supplemental Geotechnical Evaluation and Anchor Trench Stability Calculations Memo i
AET Supplemental Geotechnical Evaluation Report
1.0 Scope of Supplemental Services *1*
2.0 Supplemental Waste Mass Stability Analysis *1*
2.1 Discussion *1*
2.2 Waste Mass Stability *2*

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

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3.0 Stability Analysis of Final and Alternate Cover Systems *3*
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This report has been prepared for the use of the client for the specific purposes identified in the report. The conclusions, observations and recommendations contained herein attributed to SAIC constitute the opinions of SAIC. To the extent that statements, information and opinions provided by the client or others have been used in the preparation of this report, SAIC has relied upon the same to be accurate, and for which no assurances are intended and no representations or warranties are made. SAIC makes no certification and gives no assurances except as explicitly set forth in this report.

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Appendix 3G, Attachment 1
AET Report June 1, 2011

SAIC®

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
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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.

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AMERICAN ENGINEERING TESTING, INC.

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- GEOTECHNICAL
- 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

AMERICAN ENGINEERING TESTING, INC.

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• MATERIALS
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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
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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_α', 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

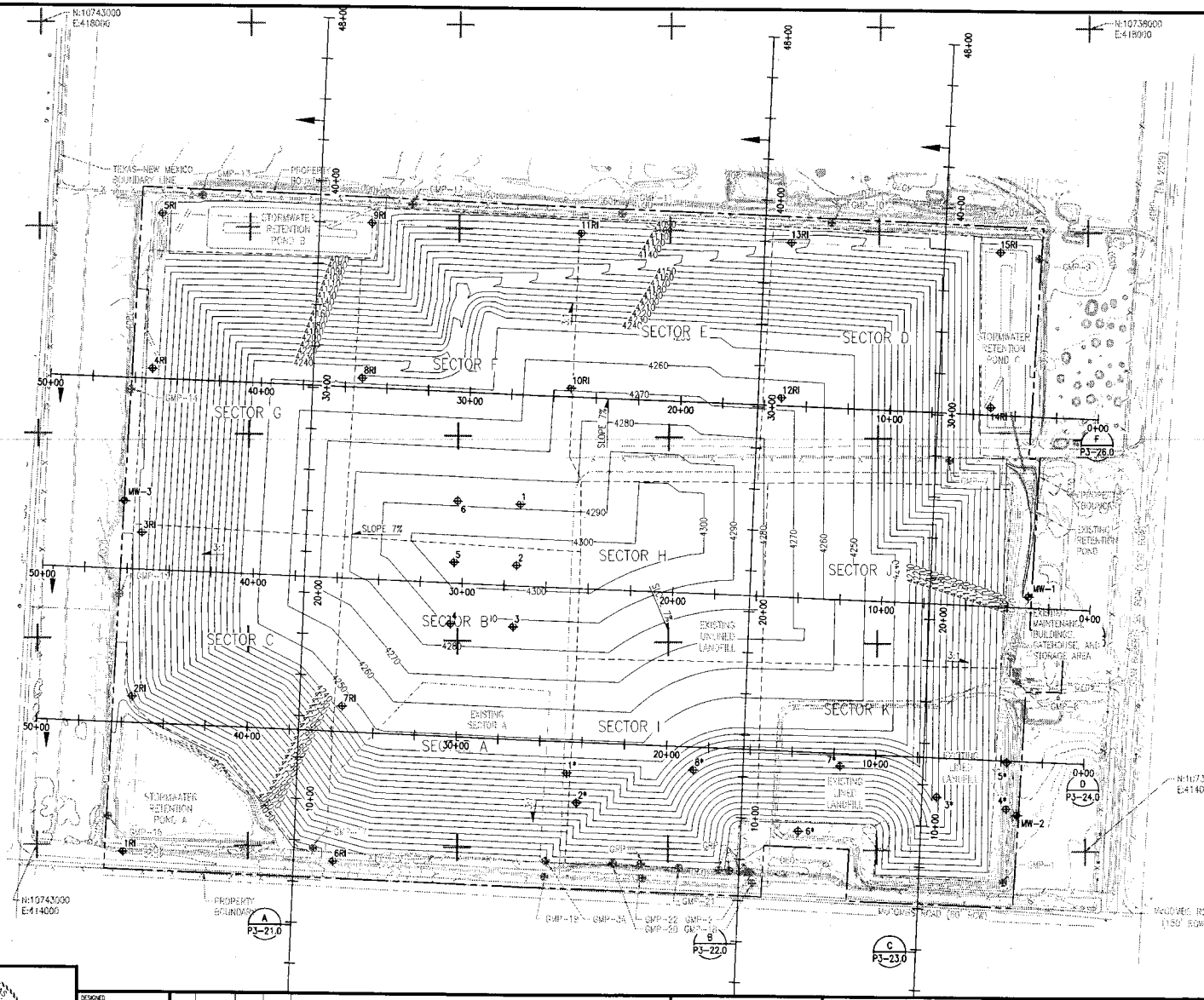
Within the limitations of scope, budget, and schedule, we have endeavored to provide our services according to generally accepted geotechnical engineering practices at this time and location. Other than this, no warranty, either express or implied, is intended.

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
name
number
REGISTERED PROFESSIONAL ENGINEER

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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

SECTION LAYOUT PLAN

PROJECT NUMBER: 9631500115
SHT 53 OF XX
DRAWING NUMBER: P3-20.0

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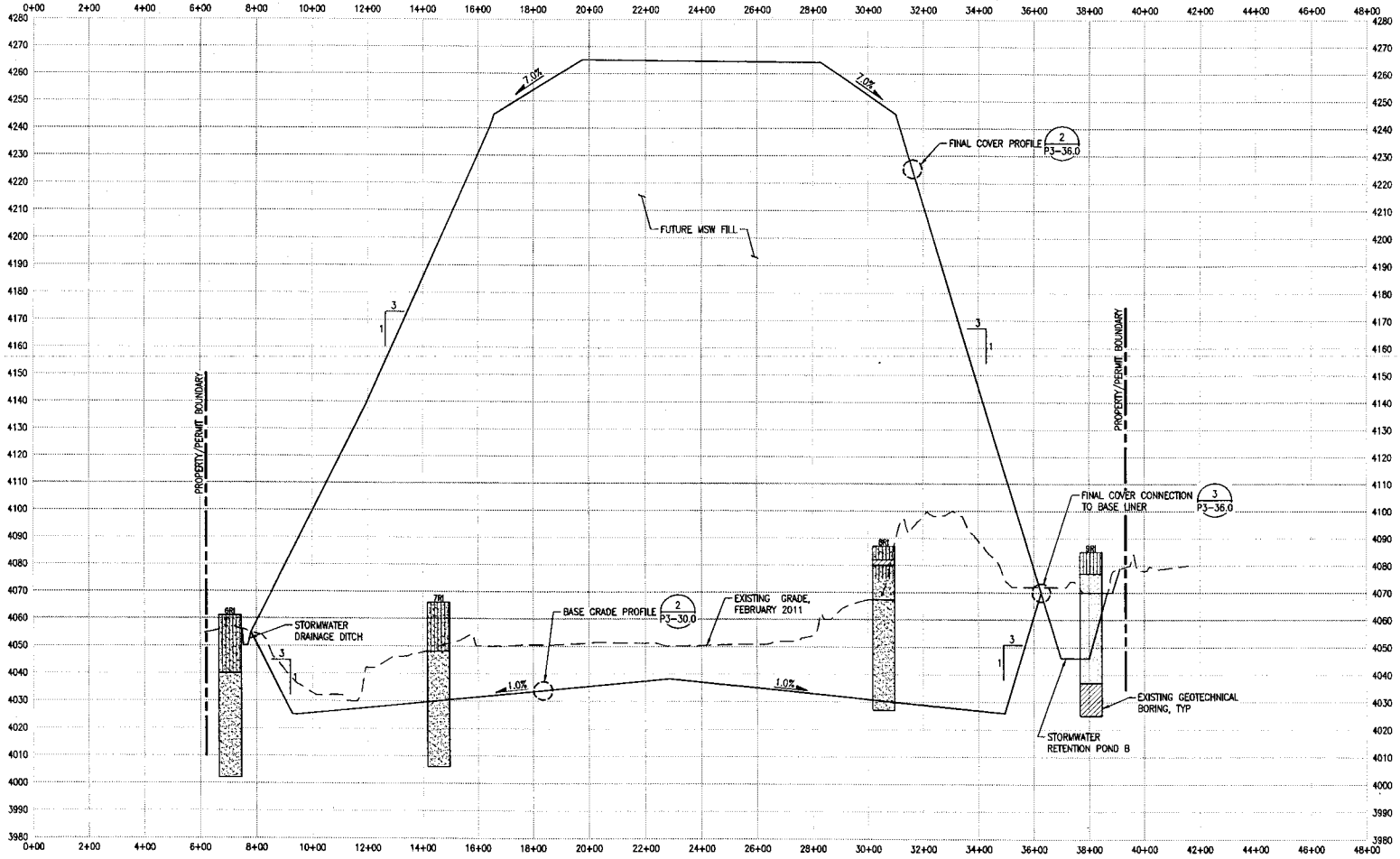
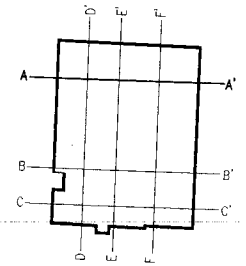


SECTION A P3-20.0
TYPICAL LANDFILL
VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 200'

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.

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

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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 – 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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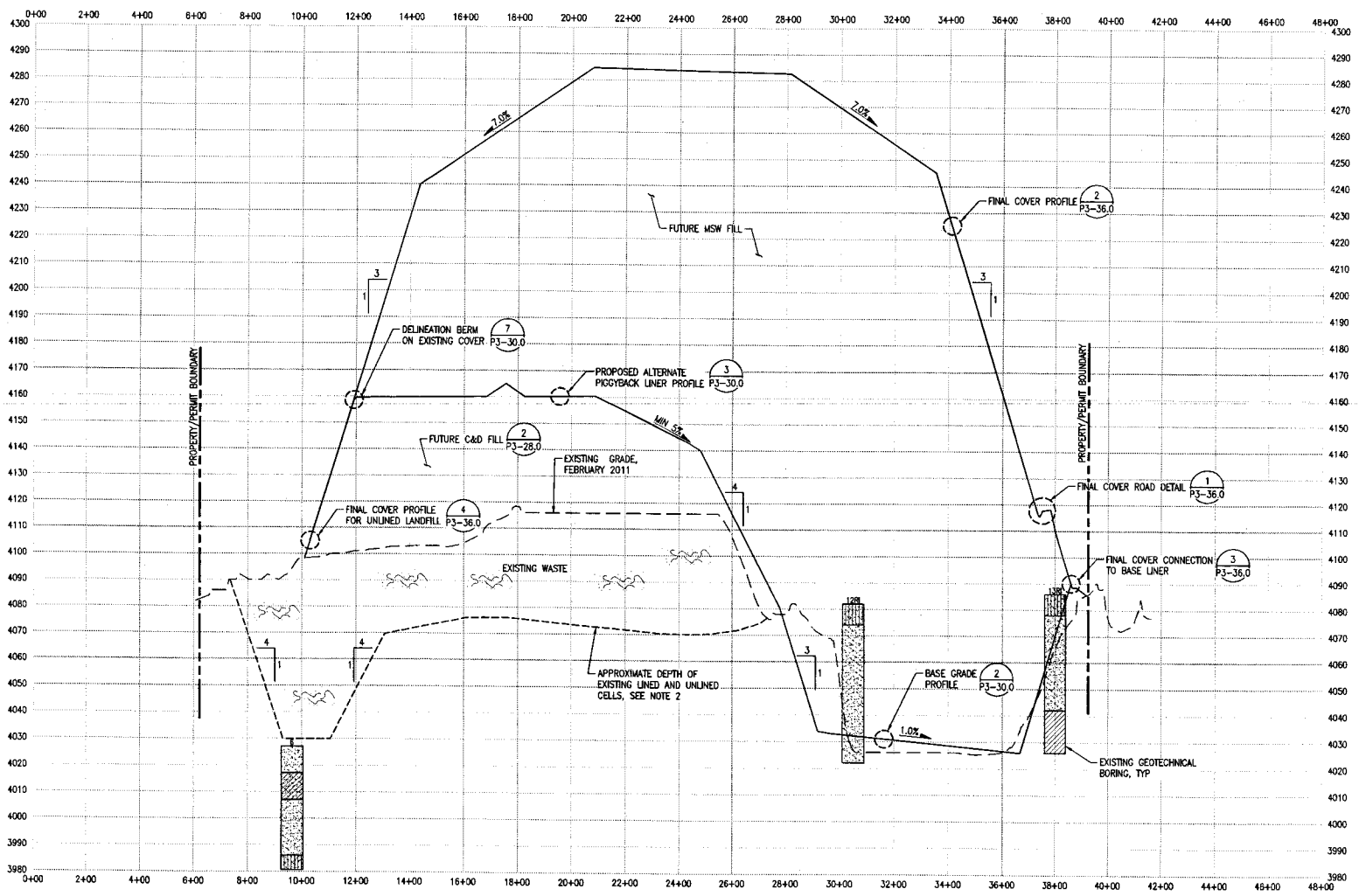


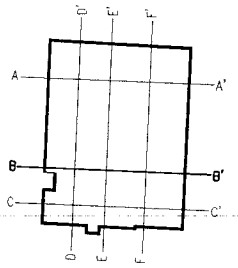
SECTION B P3-20.0

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

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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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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

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 – 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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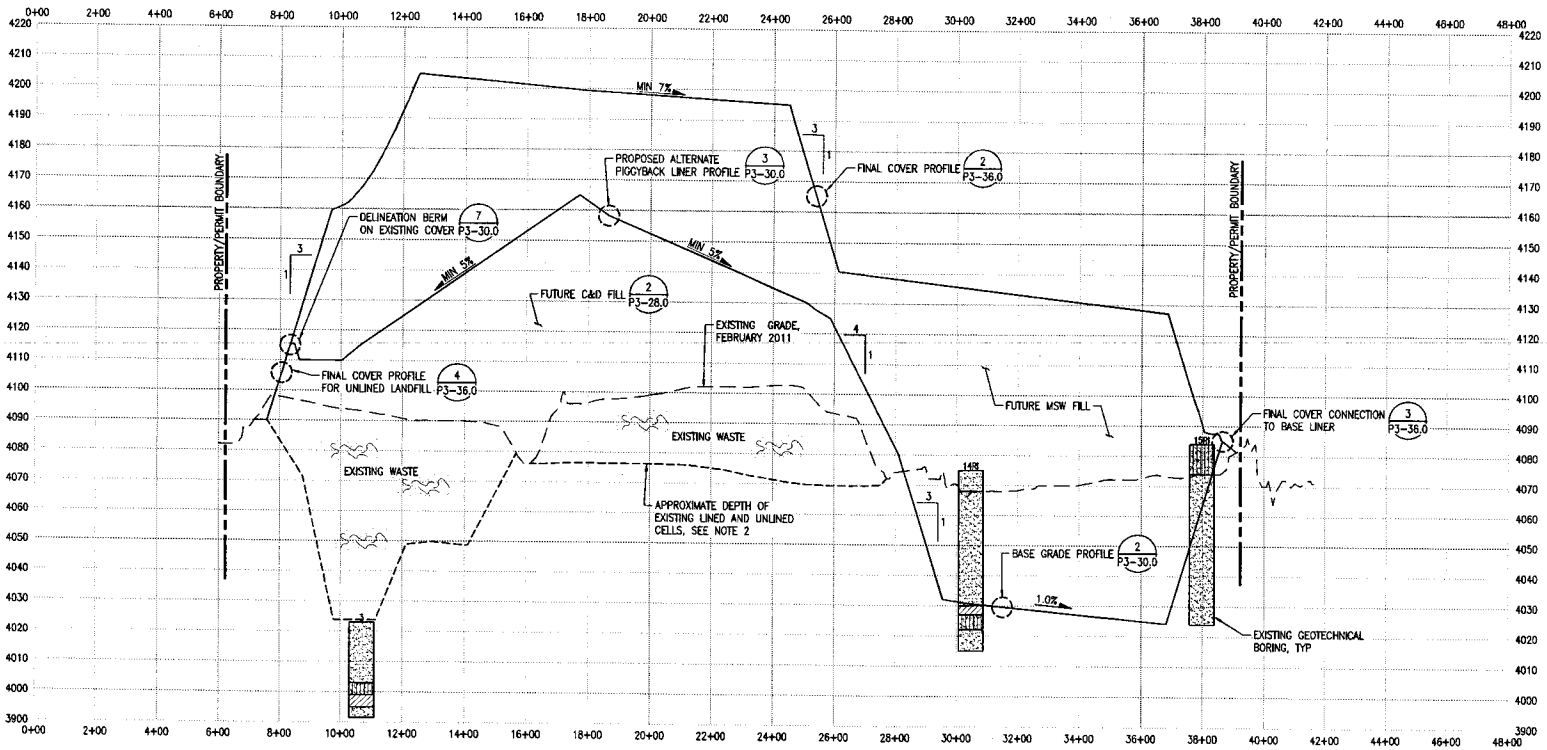

SECTION C P3-20.0

TYPICAL LANDFILL
VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 200'

NOTES

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.

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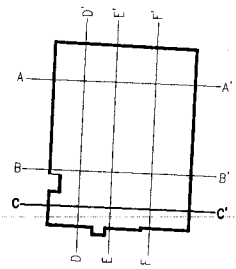
04/13/2011



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)
- ⊕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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DRAWN CAD
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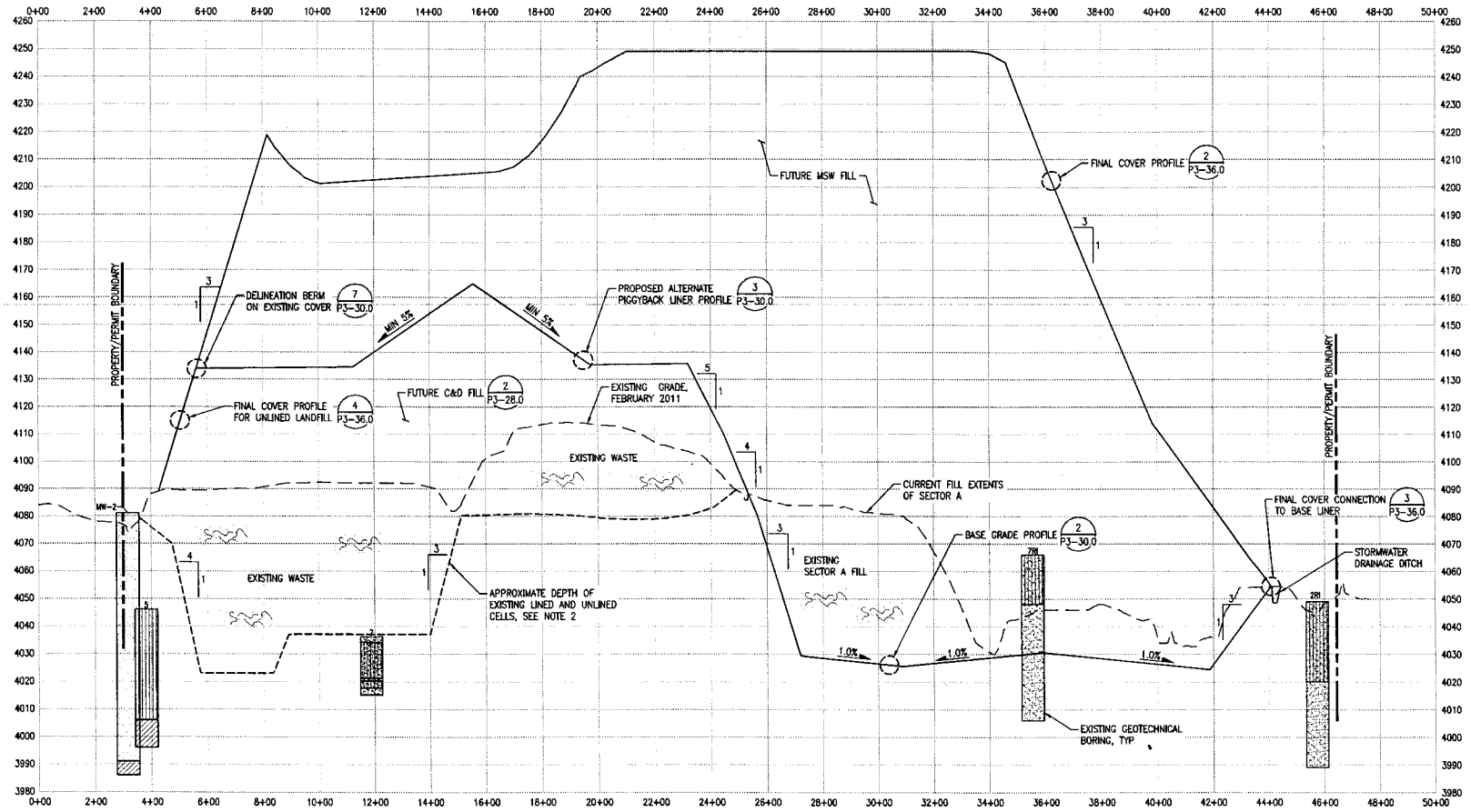
TYPICAL LANDFILL SECTION C

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.
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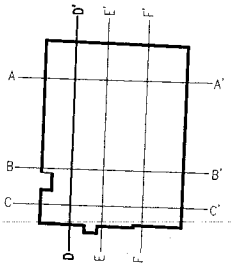
04/13/2011



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)
- ⊕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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TYPICAL LANDFILL SECTION D

PROJECT NUMBER: 9631500115
SHT. 57 OF: XX
DRAWING NUMBER: P3-24.0

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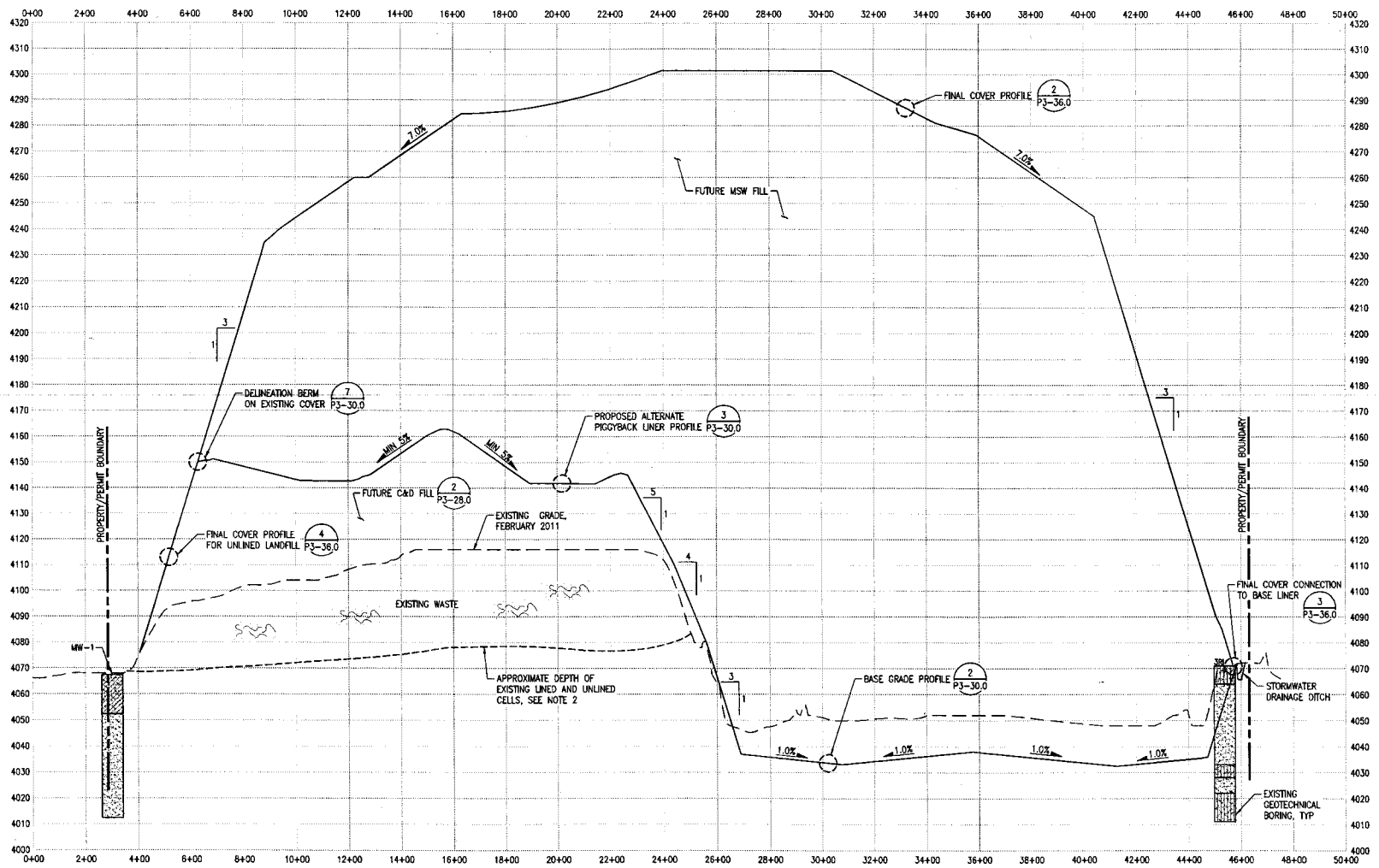

SECTION E P3-20.0

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.
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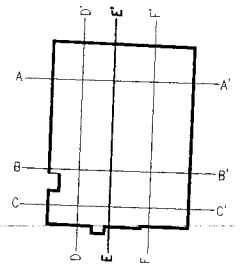

KEY MAP
SCALE: NTS

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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DRAWN	CAD
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TYPICAL LANDFILL SECTION E

PROJECT NUMBER: 9631500115
SHT. 58 OF: XX
DRAWING NUMBER: P3-25.0

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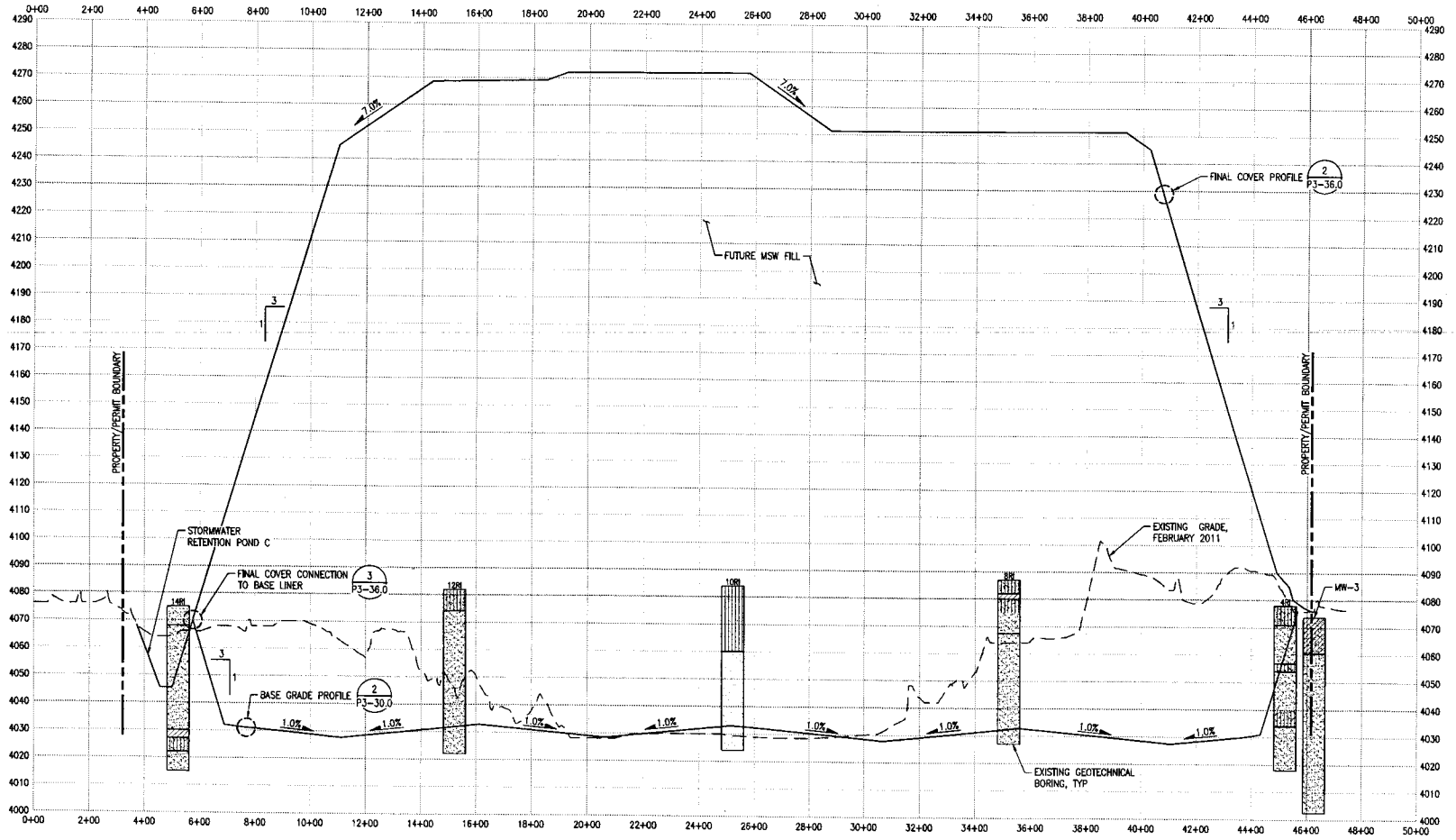

SECTION

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.

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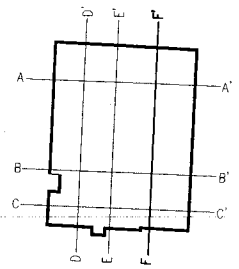
04/13/2011



KEY MAP
SCALE: NTS

LEGEND

- ⊕1* – BORING LOCATION AND NUMBER PER DRA CONSULTANTS (MAY 1983)
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SILTY SAND
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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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TYPICAL LANDFILL SECTION F

PROJECT NUMBER: 9631500115
SHT. 59 OF XX
DRAWING NUMBER: P3-26.0

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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_α'=0.03			C_c'=0.36, C_α'=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_α'=0.03			C_c'=0.36, C_α'=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 ϕ'(degrees)	Effective Friction Angle, L.D.[1] ϕ'(degrees)	Unit Weight, γ (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	γ (pcf)	ϕ' (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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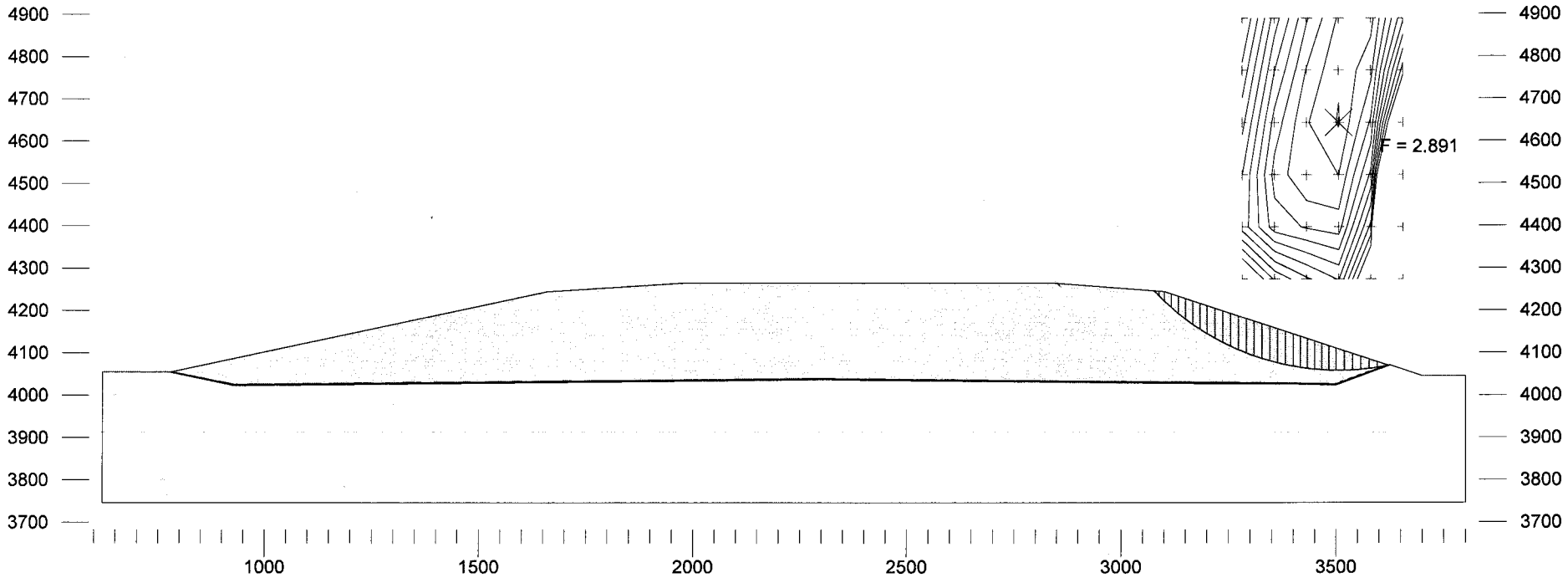
April 2011
Section A



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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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McCombs Landfill Expansion
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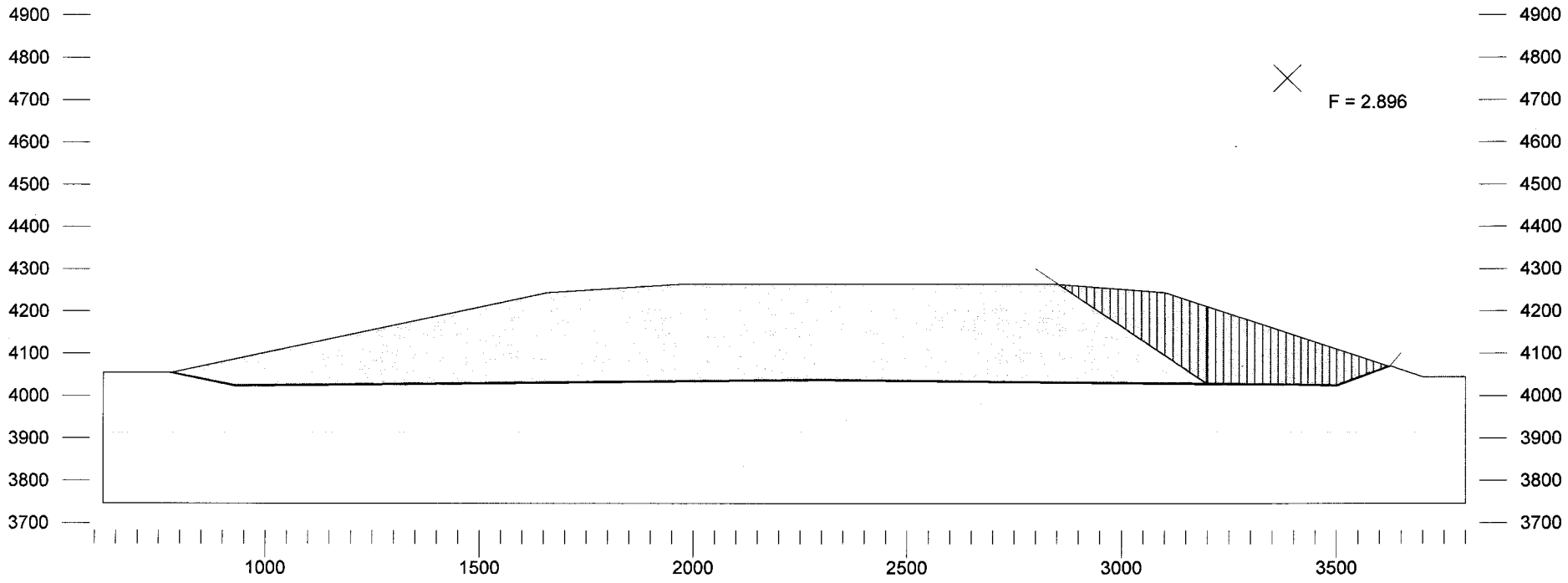
Section A



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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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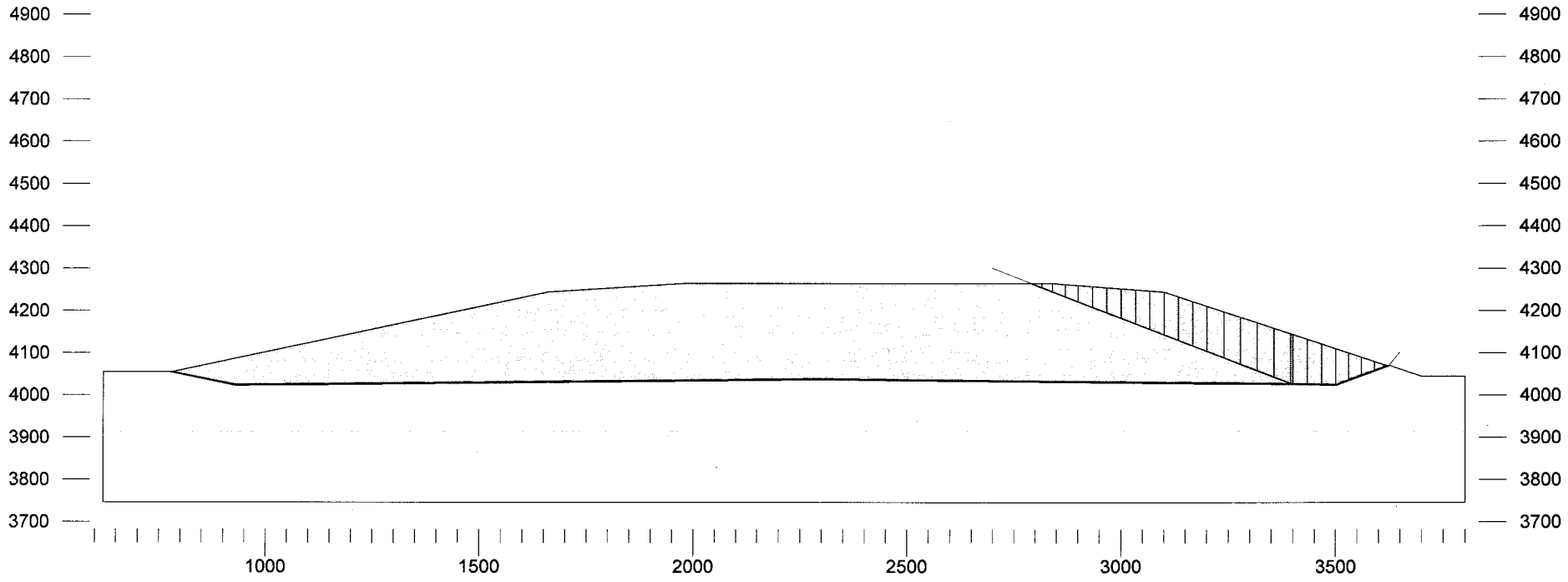
April 2011
Section A

F = 2.058



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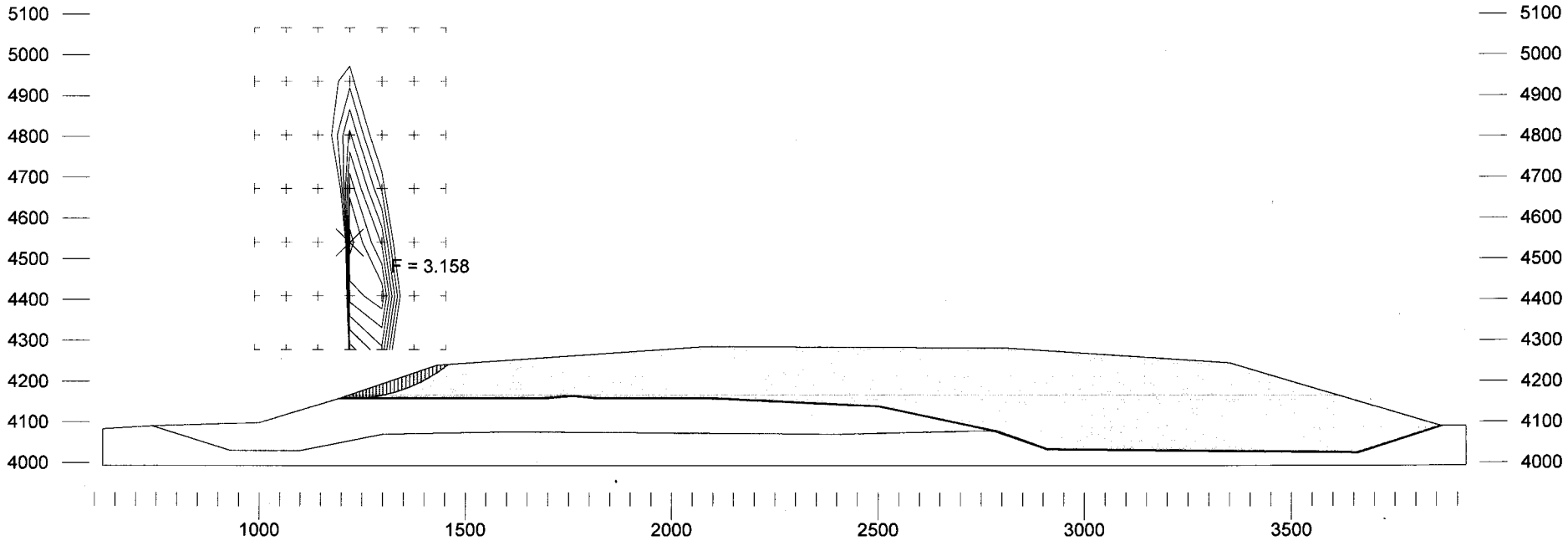
	Gamma pcf	C psf	Phi deg	Piezo Surf.
MSW Waste	65	525	35	0
Sand Cover	110	0	29	1
Textured HDPE	110	0	30	1
Exist.Waste/Fut.C&D	110	10000	35	0
Foundation Soils	125	10000	35	0

American Engineering Testing - St. Paul, MN
01-05106
McCombs Landfill Expansion
April 2011
Section B



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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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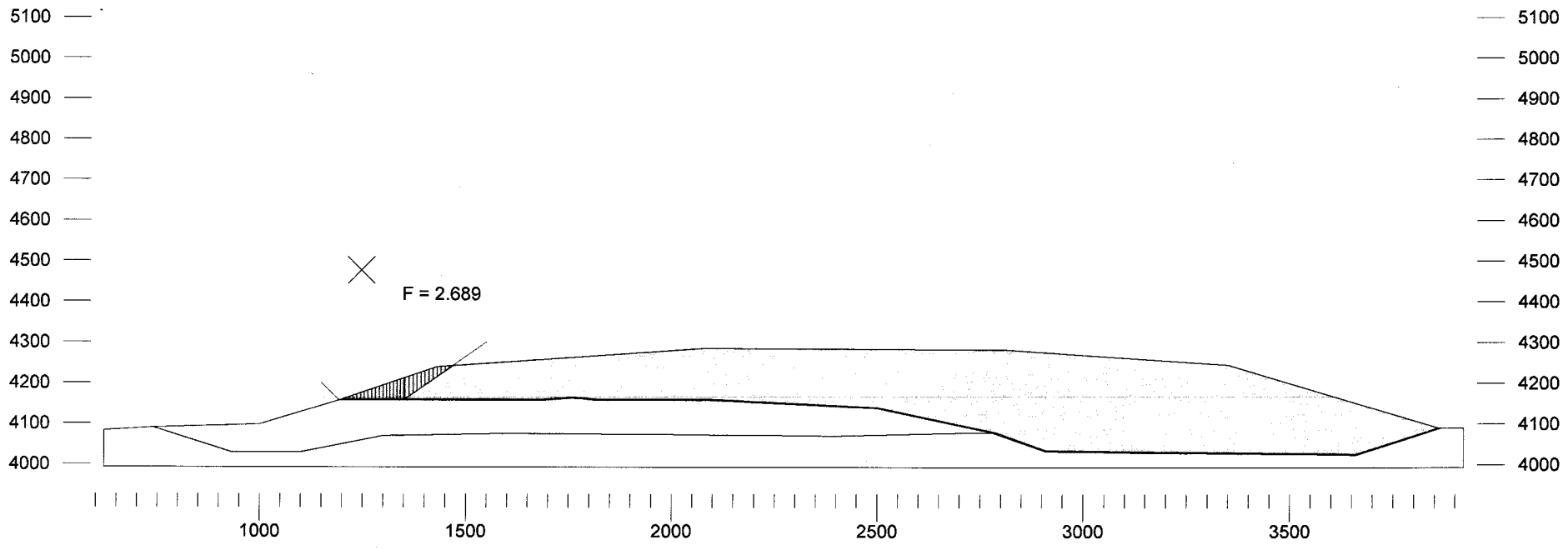
01-05106
McCombs Landfill Expansion
April 2011
Section B



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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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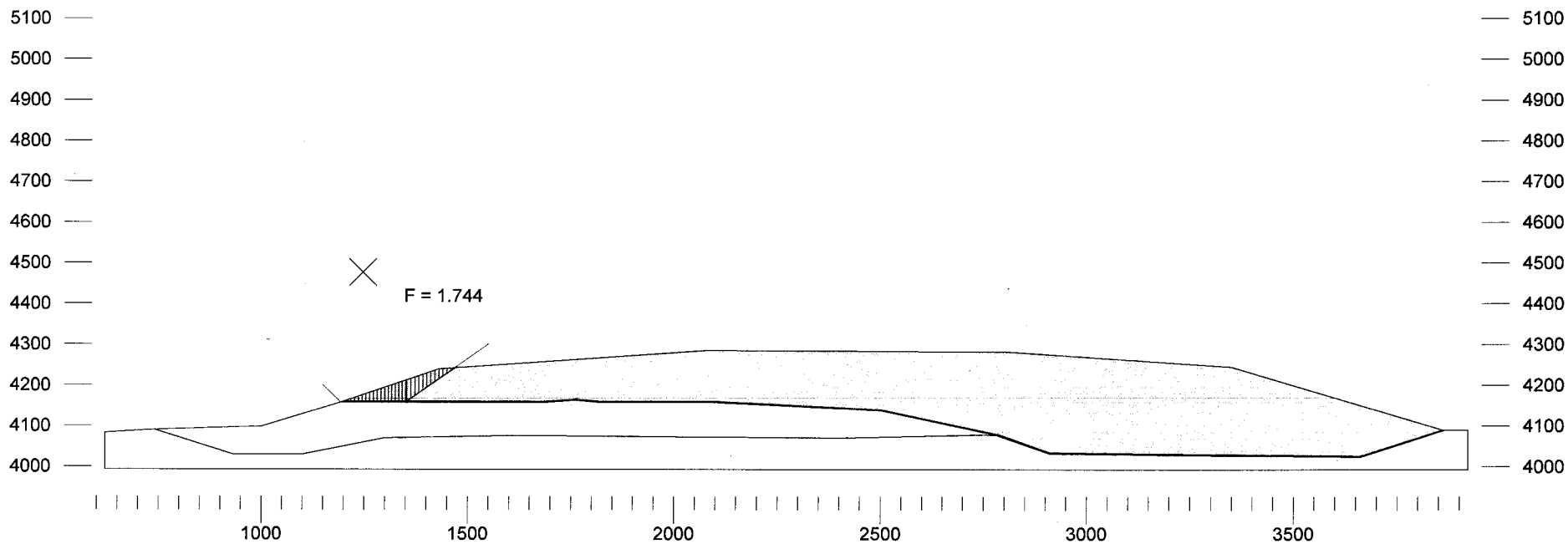
April 2011
Section B



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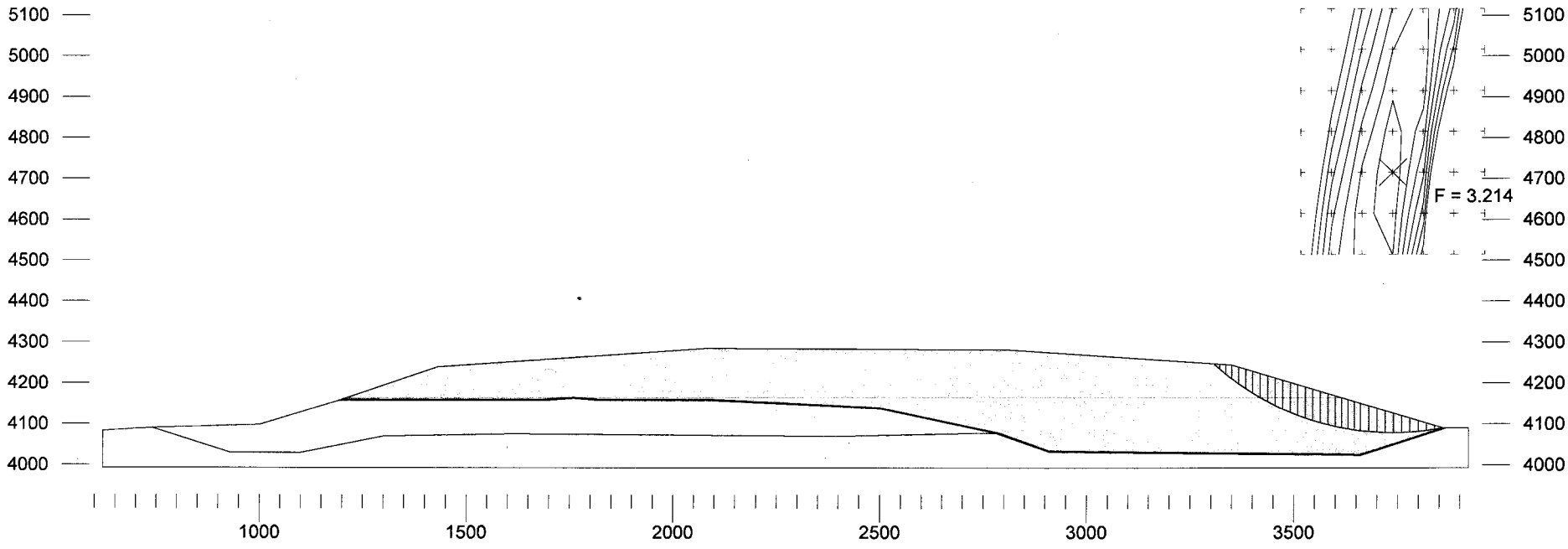
Sand Cover	110	0	29	1
Textured HDPE	110	0	30	1
Exist.Waste/Fut.C&D	110	10000	35	0
Foundation Soils	125	10000	35	0

American Engineering Testing - St. Paul, MN
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

American Engineering Testing - St. Paul, MN
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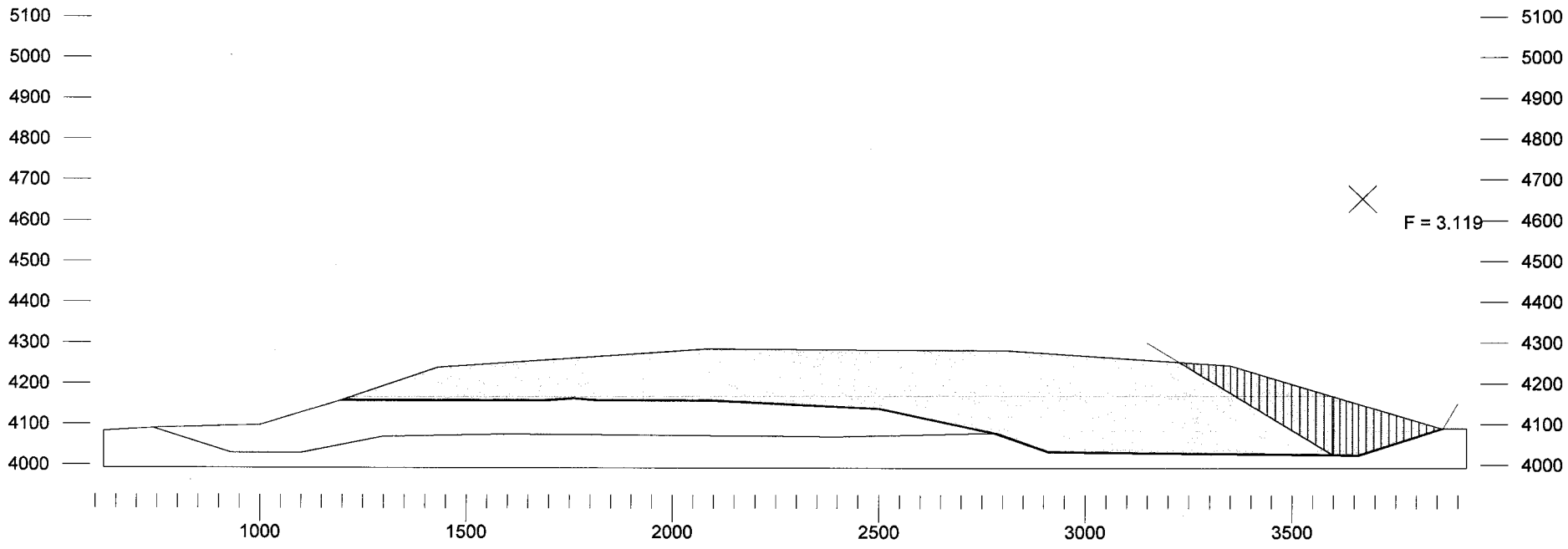
McCombs Landfill Expansion
April 2011
Section B



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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	110	10000	35	0
Foundation Soils	125	10000	35	0

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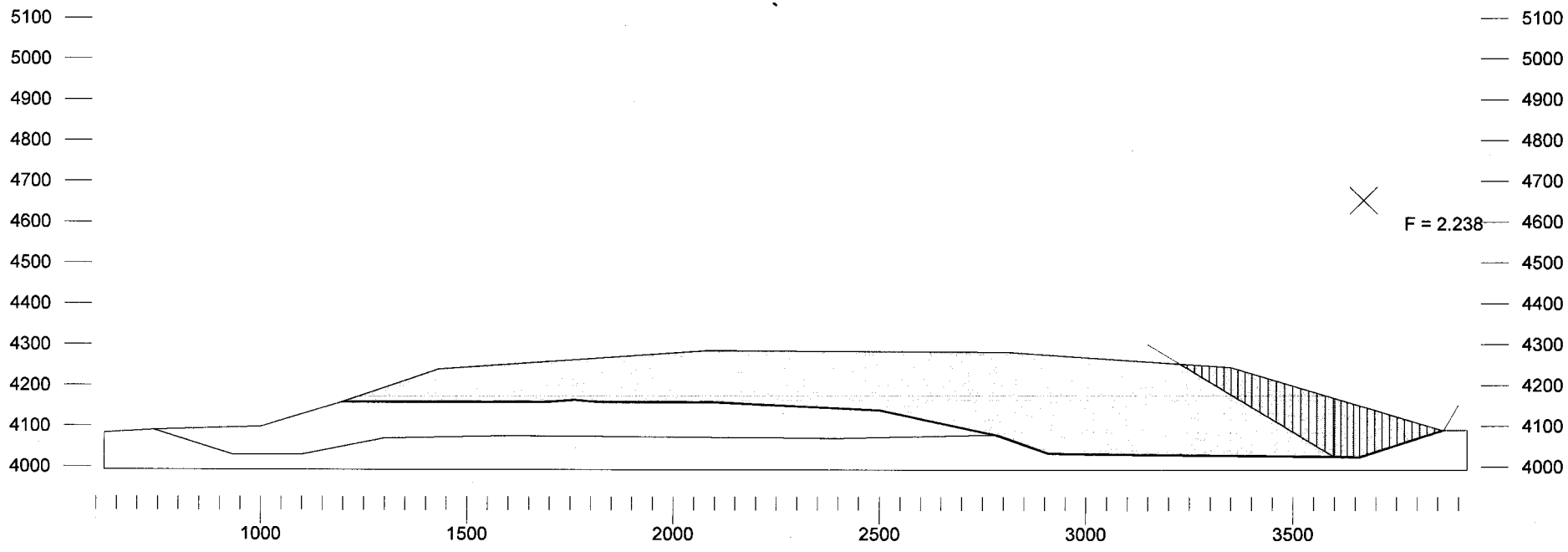
Section B



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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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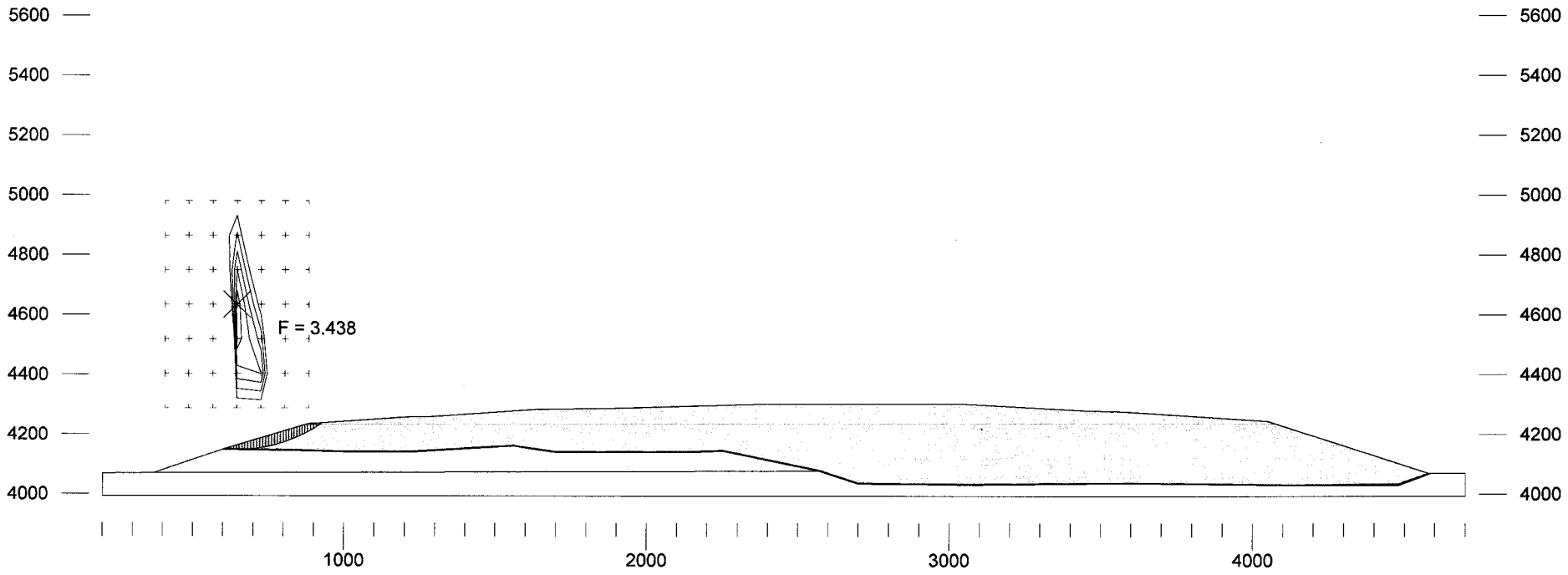
Section E



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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	125	10000	35	0
Foundation Soils	125	10000	35	0

American Engineering Testing - St. Paul, MN
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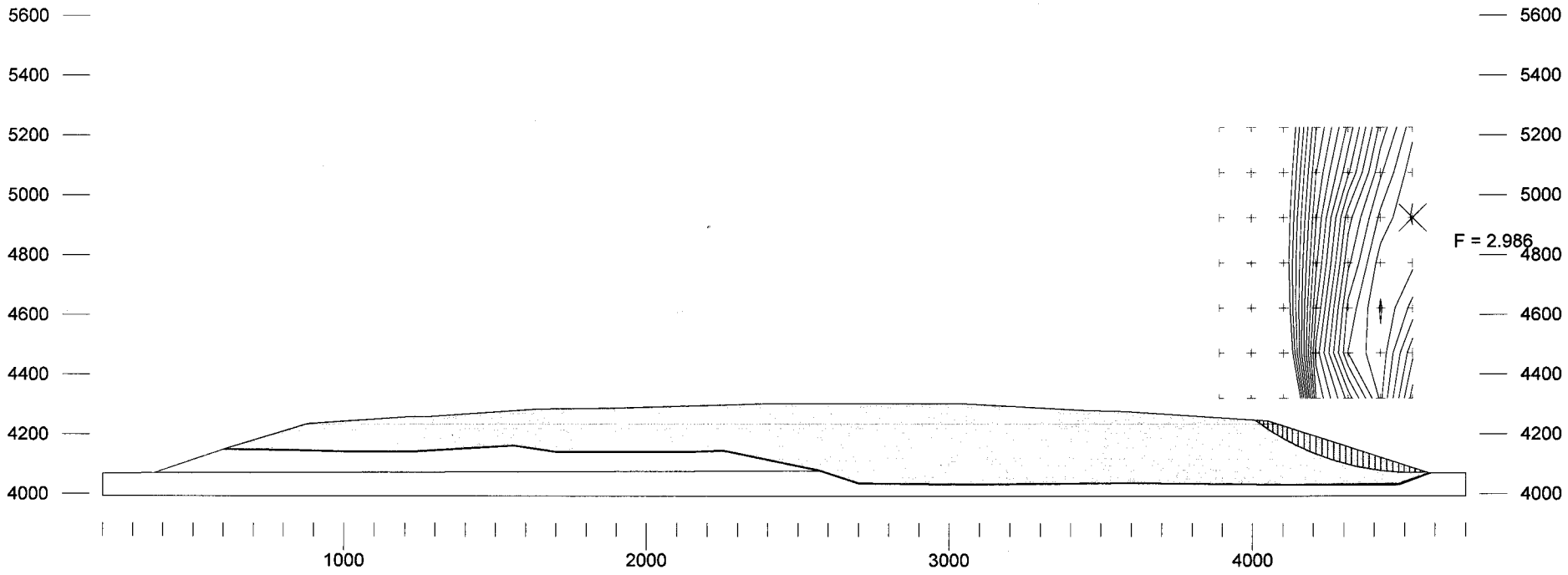
Section E



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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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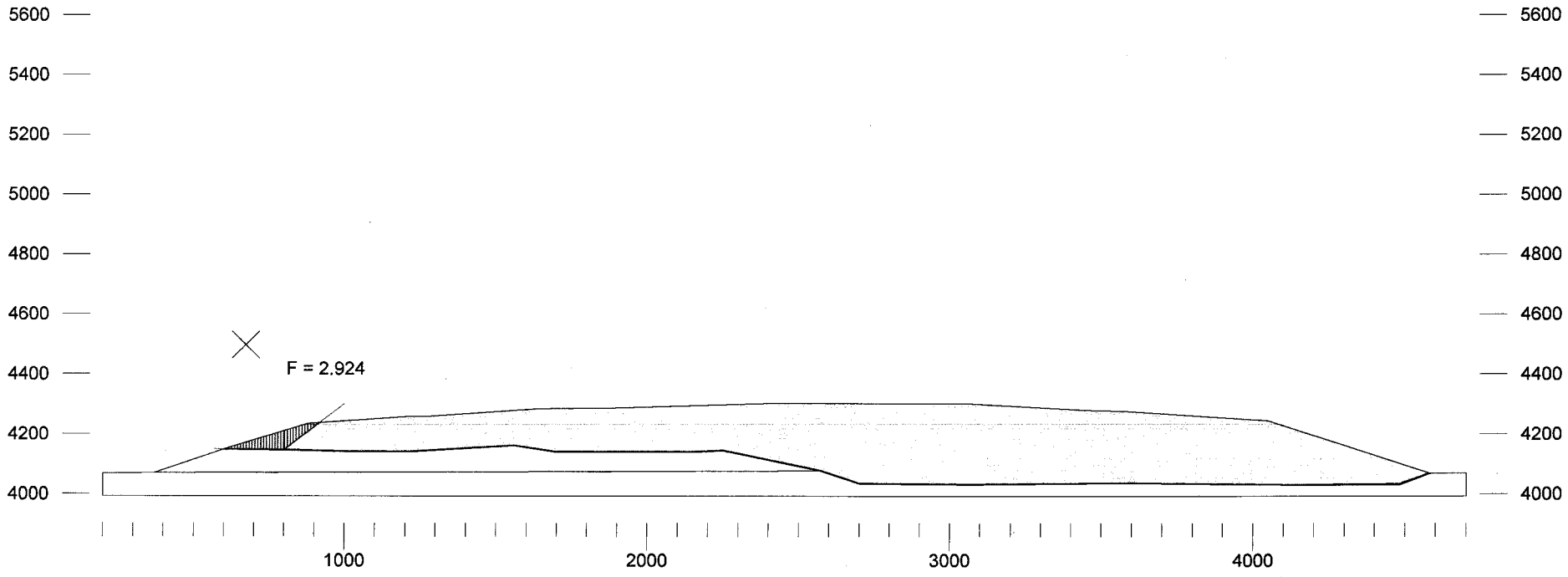

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MSW Waste	65	525	35	0
Sand Cover	110	0	29	1
Textured HDPE	110	0	30	1
Exist.Waste/Fut.C&D	125	10000	35	0
Foundation Soils	125	10000	35	0

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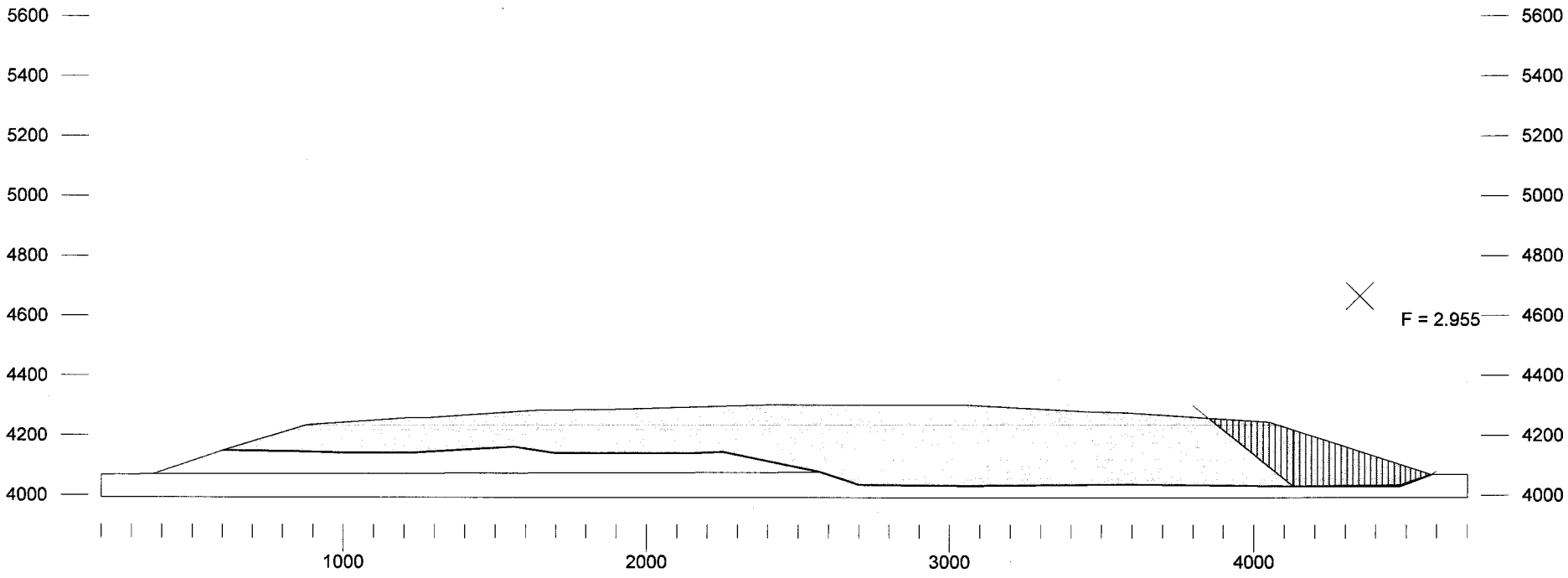

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MSW Waste	65	0	28	0
Sand Cover	110	0	29	1
Textured HDPE	110	0	25	1
Exist.Waste/Fut.C&D	125	10000	35	0
Foundation Soils	125	10000	35	0

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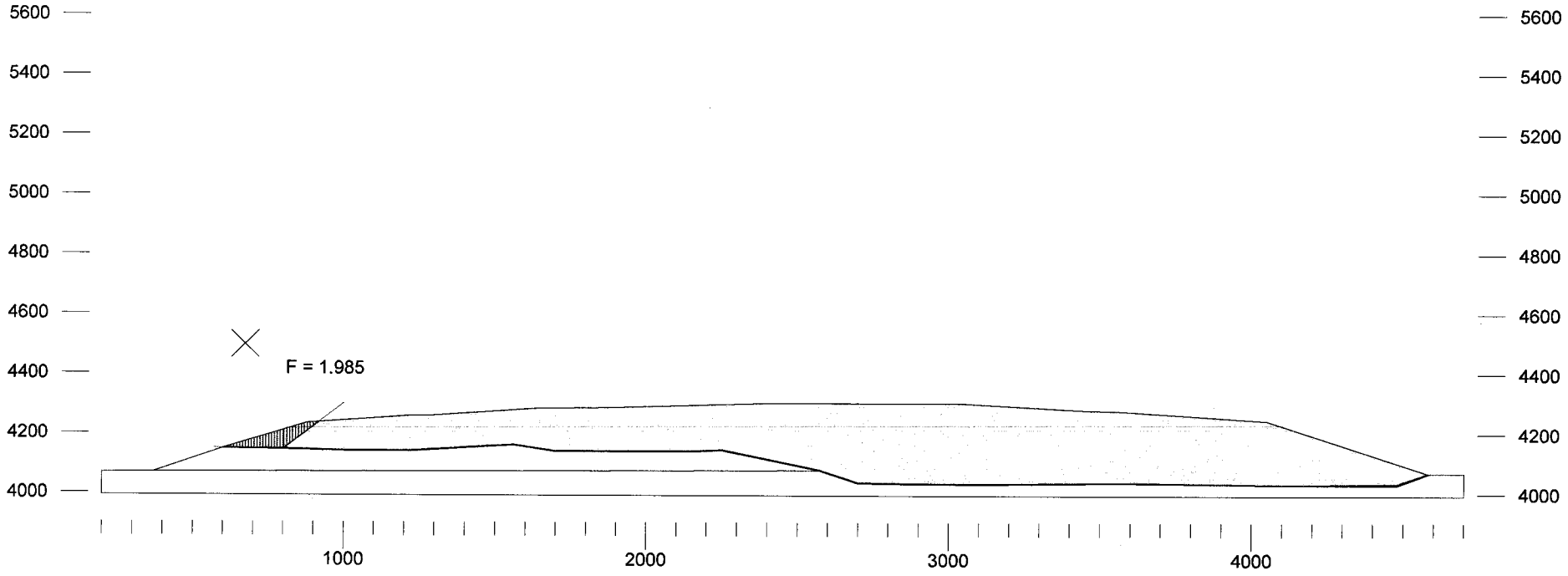

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MSW Waste	65	0	28	0
Sand Cover	110	0	29	1
Textured HDPE	110	0	25	1
Exist.Waste/Fut.C&D	125	10000	35	0
Foundation Soils	125	10000	35	0

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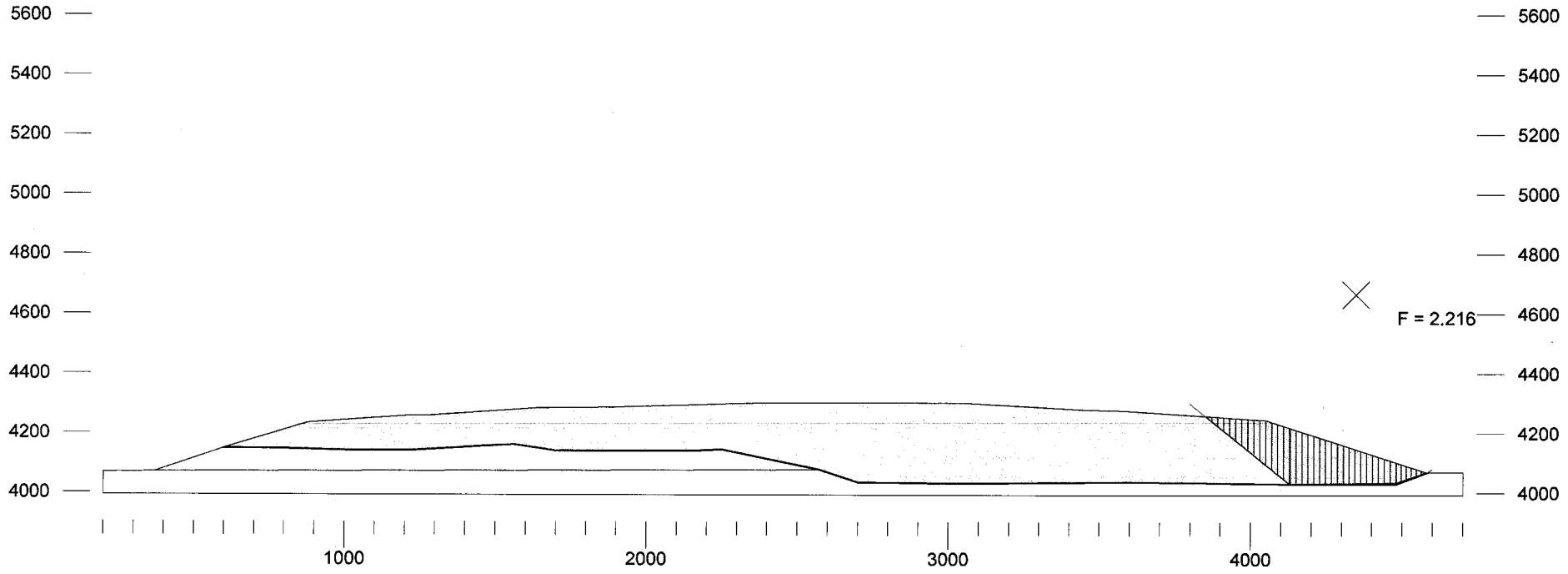

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Sand Cover	110	0	29	1
Textured HDPE	110	0	30	1
Exist.Waste/Fut.C&D	110	10000	35	0
Foundation Soils	125	10000	35	0

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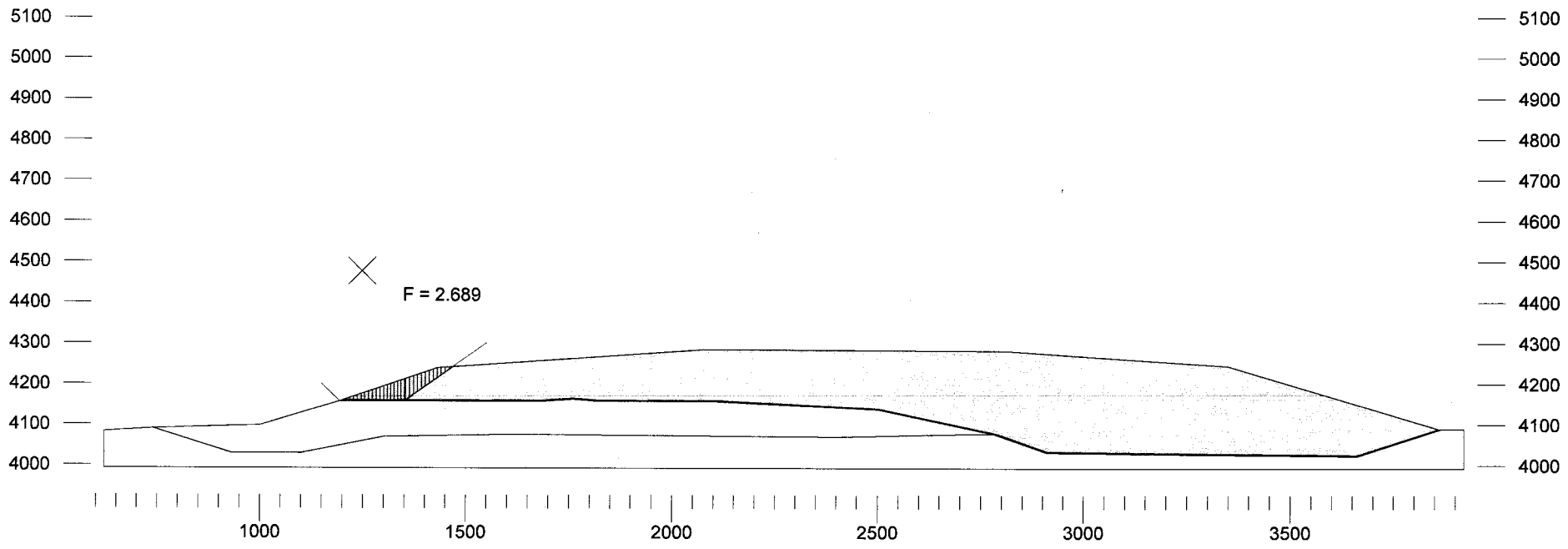
Section B
Sensitivity Analysis



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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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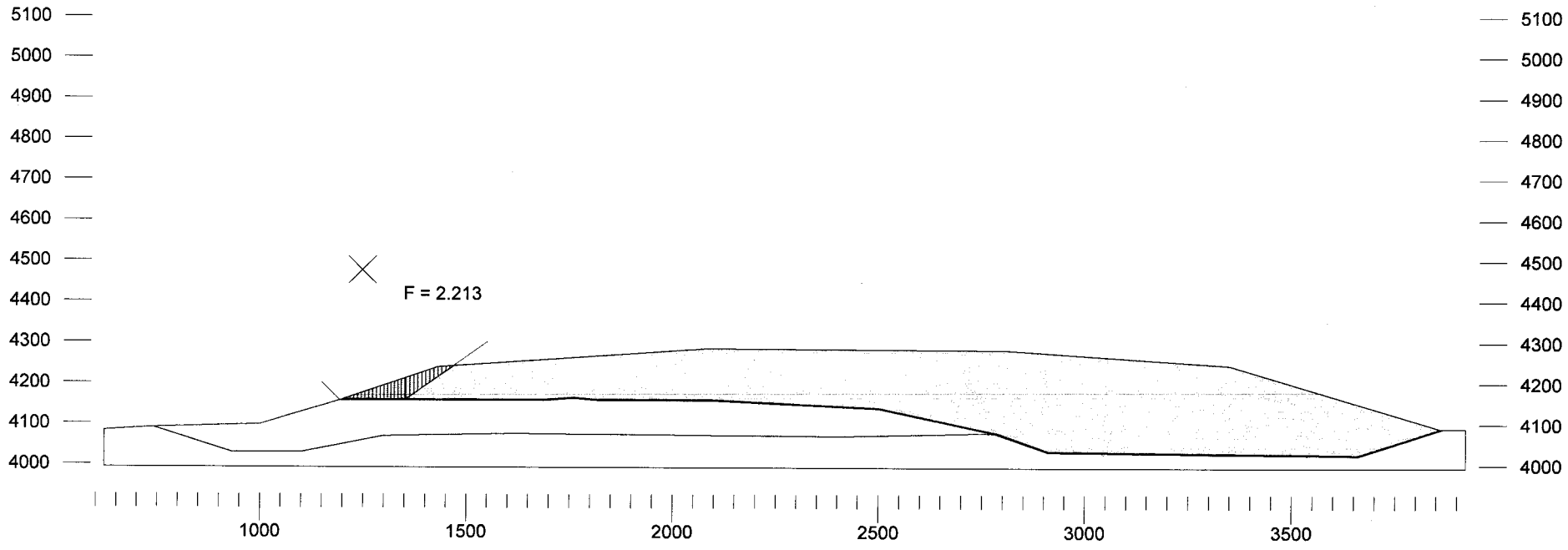
Section B
Sensitivity Analysis



	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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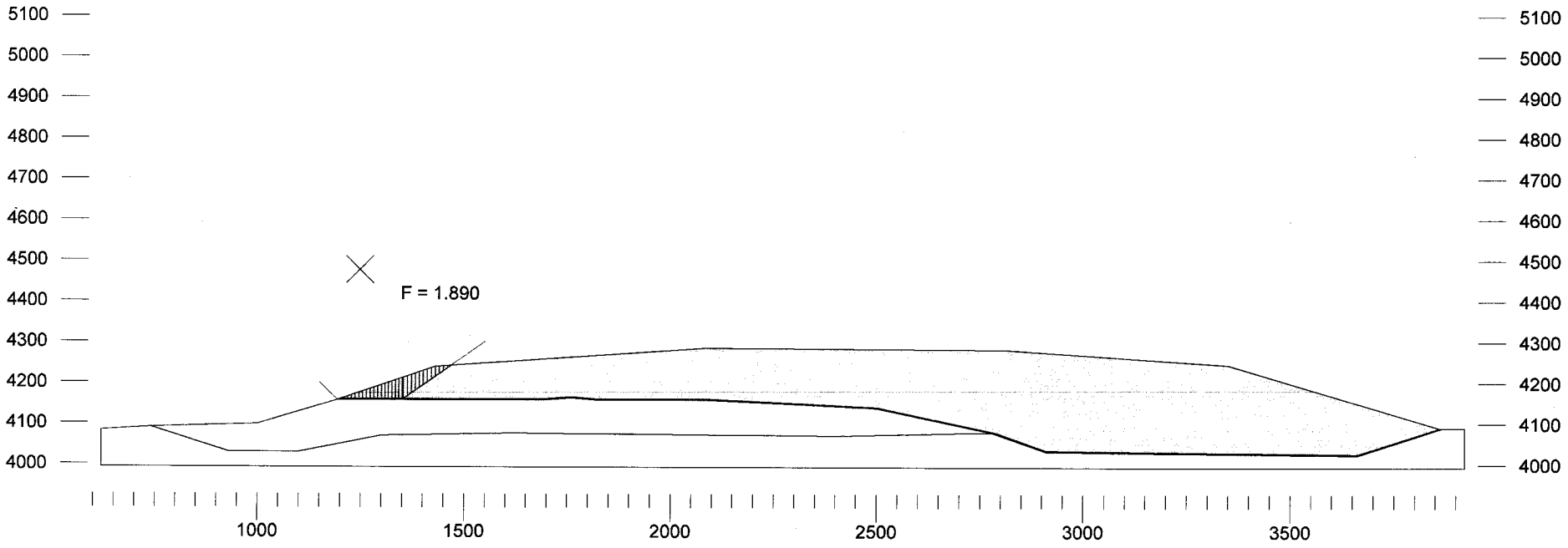
Section B
Sensitivity Analysis



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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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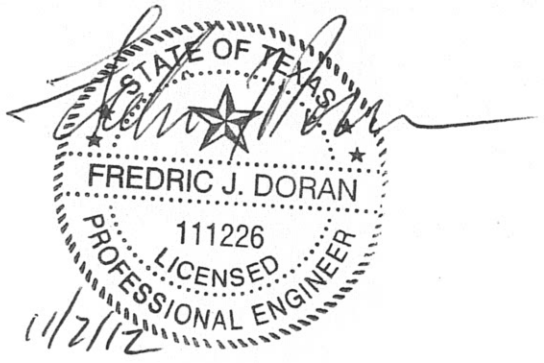
Additionally, anchor trench stability calculations with regards to pullout and the interface liner system stability for gravity and equipment conditions were completed by SAIC and are included in Appendix 3G, Attachment 3. Results indicate the following factors of safety:

- 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 ϕ'(degrees)	Effective Friction Angle, L.D.[1] ϕ'(degrees)	Unit Weight, γ (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.

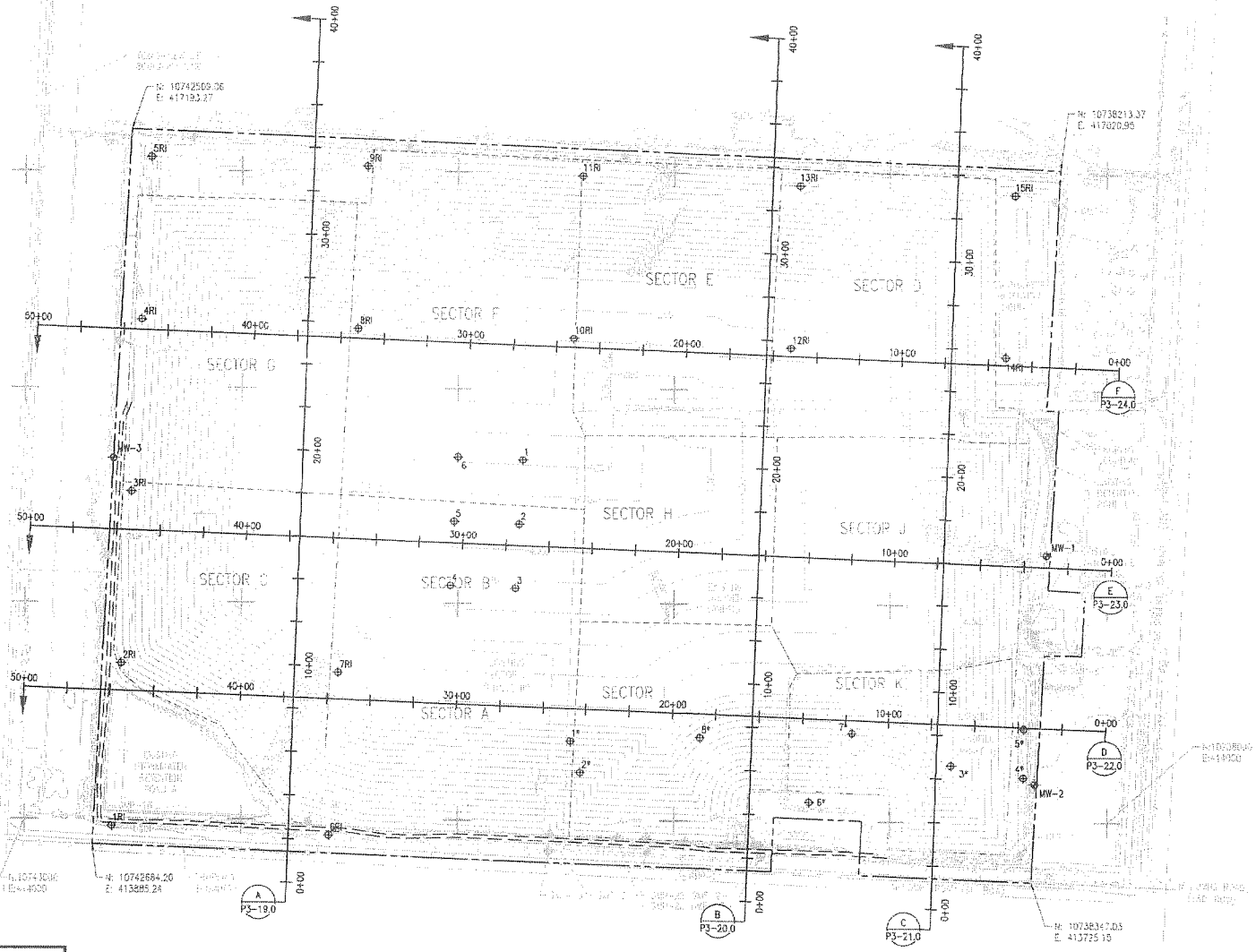
Eid, H.T., Stark, T.D., Evans, W.D., and Sherry, P.E. (2000). "Municipal Solid Waste Slope Failure I: Waste and Foundation Soil Properties," *Journal of Geotechnical and Geoenvironmental Engineering*, ASCE, 126(5): 397-407

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



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3. COORDINATES ARE BASED ON THE TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NAD 83. ELEVATIONS ARE NAVD 88 VERTICAL DATUM.

LEGEND

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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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SECTION LAYOUT PLAN

PROJECT NUMBER 9631500115
SHT 51 OF 78
DRAWING NUMBER P3-18.0

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SECTOR C
SECTOR G
FUTURE MSW FILL
FINAL COVER PROFILE 2/P3-34.0 2/P3-35.0
FINAL COVER CONNECTION TO BASE LINER 3/P3-34.0 3/P3-35.0
PERIMETER ROAD
PROPERTY/PERMIT BOUNDARY
STORMWATER DRAINAGE DITCH AND PERIMETER ROAD
BASE GRADE PROFILE 2/P3-29.0
EXISTING GRADE, FEBRUARY 2011
EXISTING GEOTECHNICAL BORING, TYP
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TYPICAL LANDFILL
VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 200'
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SCALE: NTS
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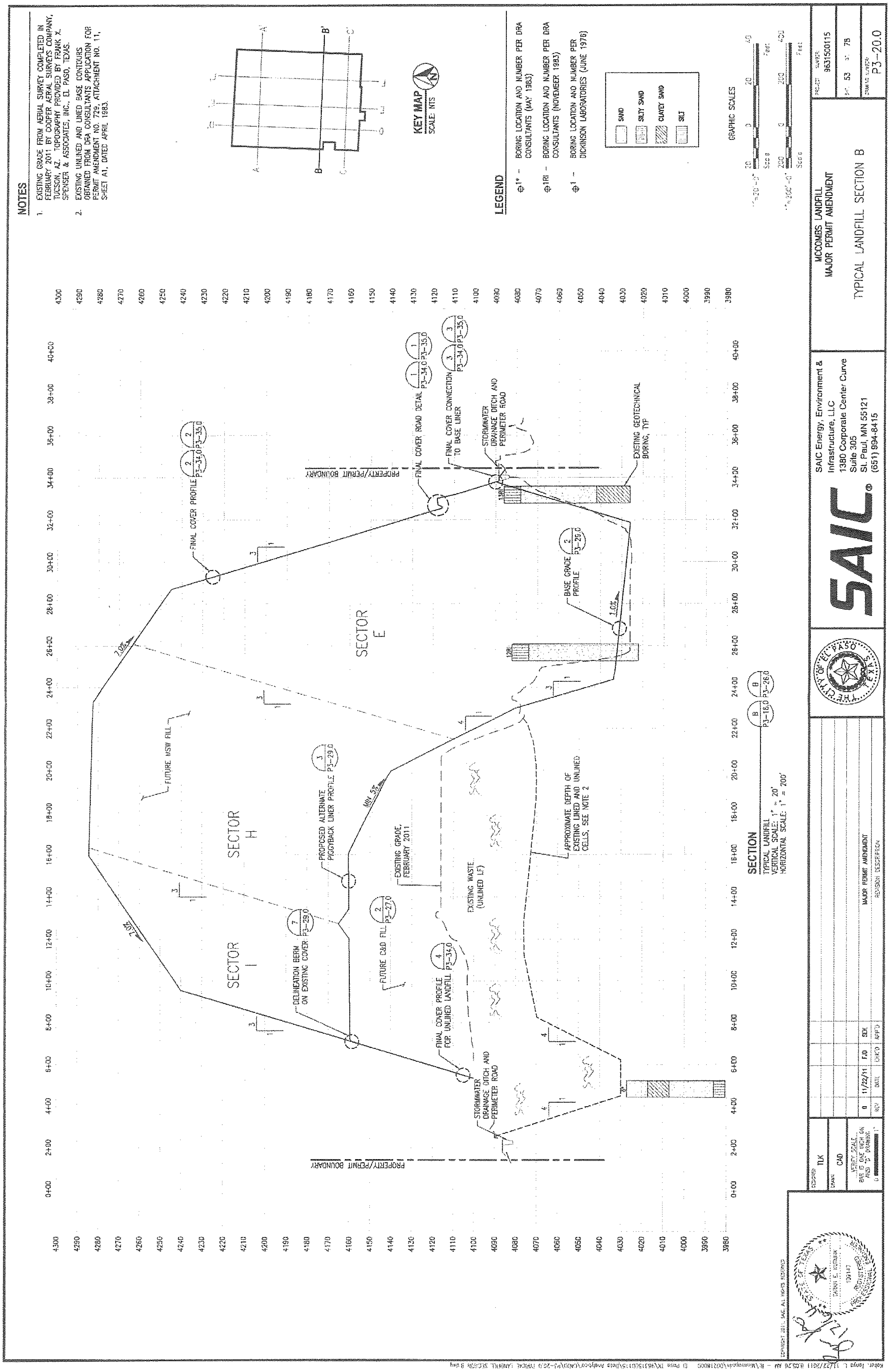
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2. EXISTING UNLINED AND LINED BASE CONTOURS OBTAINED FROM DRA CONSULTANTS APPLICATION FOR PERMIT AMENDMENT NO. 729, ATTACHMENT NO. 11, SHEET A1, DATED APRIL 1983.
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BORING LOCATION AND NUMBER PER DICKINSON LABORATORIES (JUNE 1976)
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GRAPHIC SCALES
SECTOR I
SECTOR H
SECTOR E
FUTURE MSW FILL
FUTURE C&D FILL
EXISTING WASTE (UNLINED LF)
EXISTING GRADE, FEBRUARY 2011
PROPOSED ALTERNATE PIGGYBACK LINER PROFILE
DELINEATION BERM ON EXISTING COVER
FINAL COVER PROFILE FOR UNLINED LANDFILL
STORMWATER DRAINAGE DITCH AND PERIMETER ROAD
APPROXIMATE DEPTH OF EXISTING LINED AND UNLINED CELLS, SEE NOTE 2
BASE GRADE PROFILE
FINAL COVER PROFILE
FINAL COVER ROAD DETAIL
FINAL COVER CONNECTION TO BASE LINER
EXISTING GEOTECHNICAL BORING, TYP
PROPERTY/PERMIT BOUNDARY
SECTION
TYPICAL LANDFILL
VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 200'
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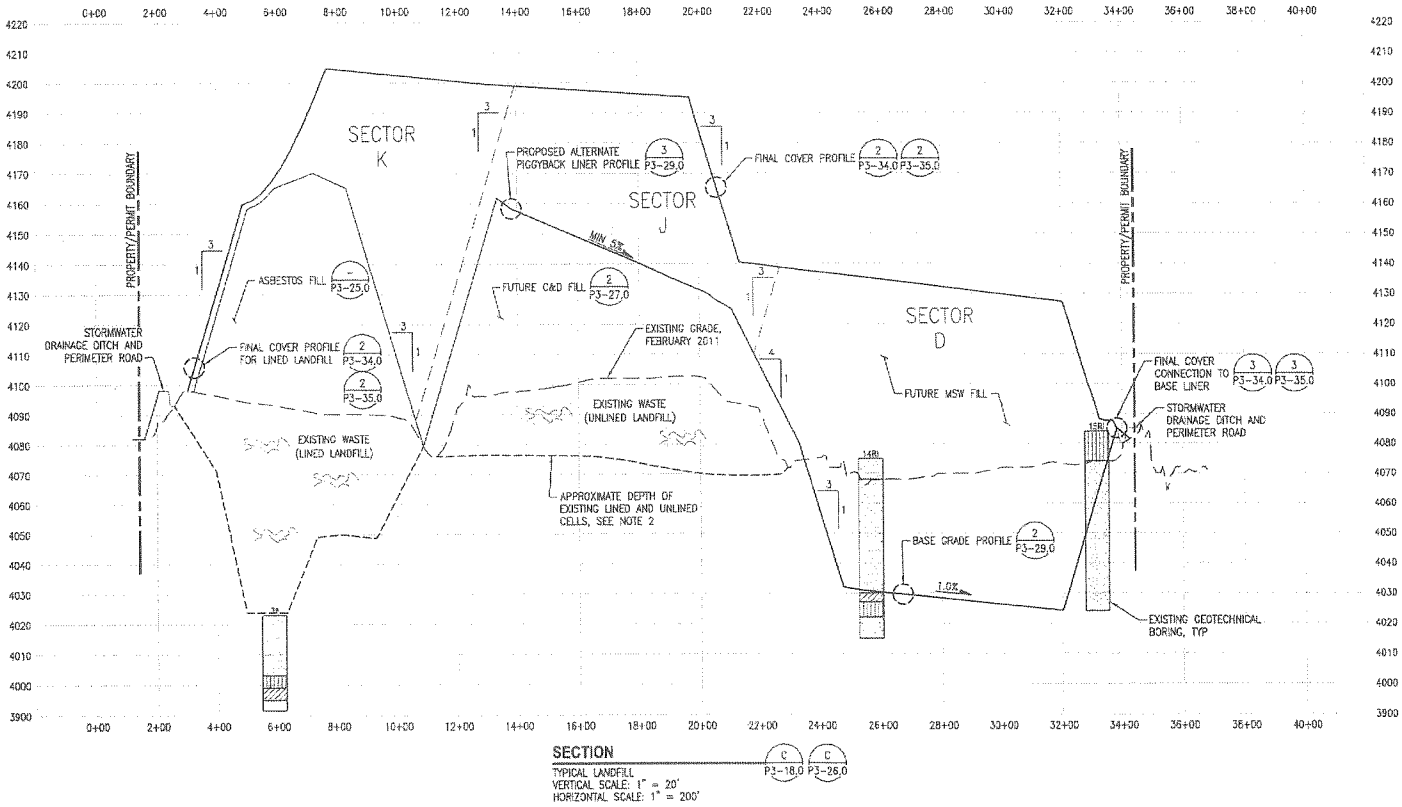

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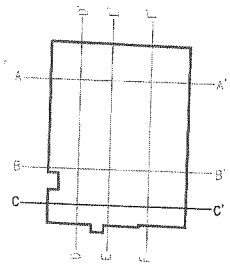

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- ⊕1RI – BORING LOCATION AND NUMBER PER DRA CONSULTANTS (NOVEMBER 1983)
- ⊕1 – BORING LOCATION AND NUMBER PER DICKINSON LABORATORIES (JUNE 1976)

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GRAPHIC SCALES
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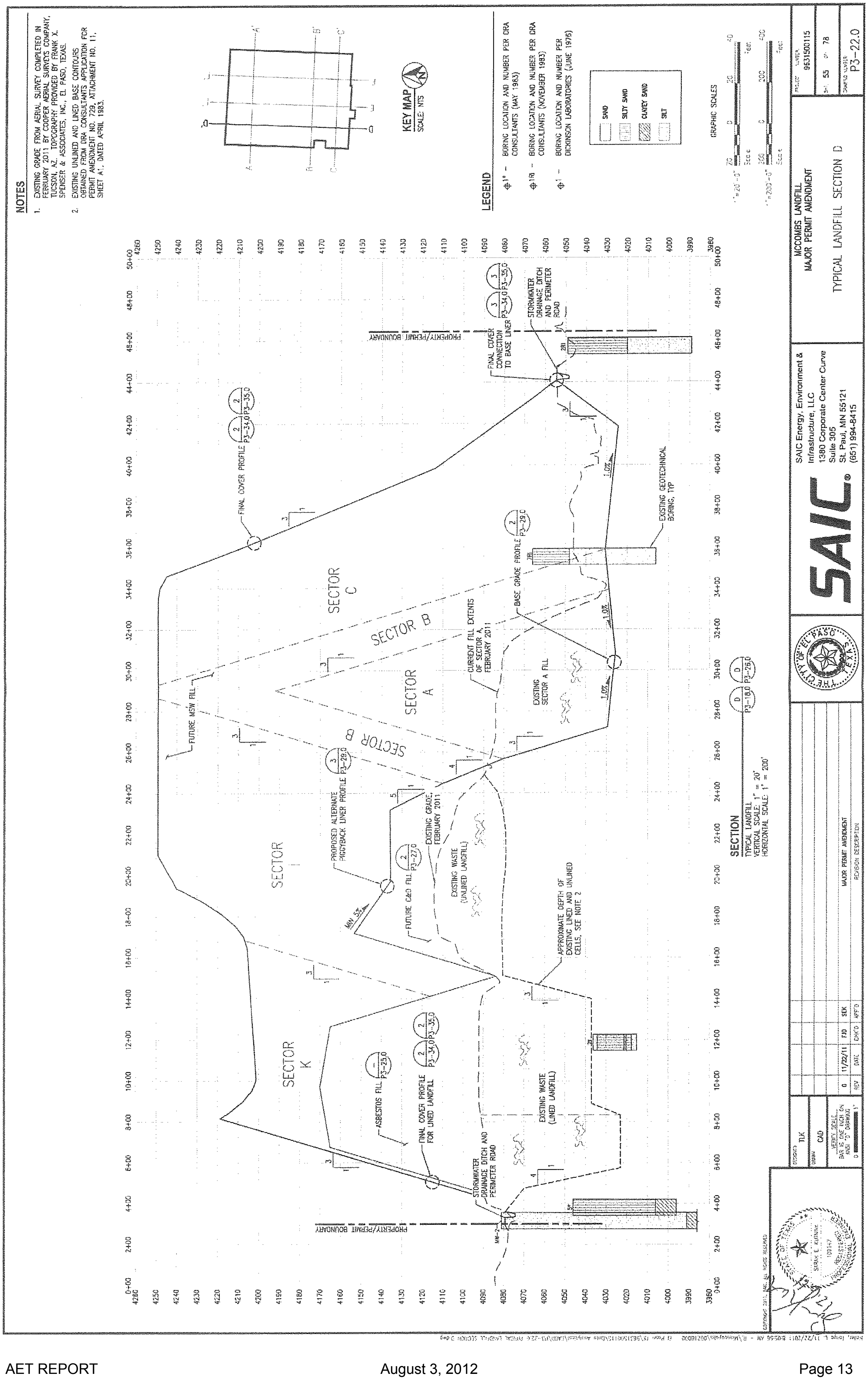
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SECTOR K
SECTOR I
SECTOR A
SECTOR B
SECTOR C
FINAL COVER PROFILE
FUTURE MSW FILL
CURRENT FILL EXTENTS OF SECTOR A, FEBRUARY 2011
EXISTING SECTOR A FILL
BASE GRADE PROFILE
EXISTING GEOTECHNICAL BORING, TYP
FINAL COVER CONNECTION TO BASE LINER
STORMWATER DRAINAGE DITCH AND PERIMETER ROAD
PROPERTY/PERMIT BOUNDARY
PROPOSED ALTERNATE PIGGYBACK LINER PROFILE
EXISTING GRADE, FEBRUARY 2011
FUTURE C&D FILL
EXISTING WASTE (UNLINED LANDFILL)
APPROXIMATE DEPTH OF EXISTING LINED AND UNLINED CELLS, SEE NOTE 2
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FINAL COVER PROFILE FOR LINED LANDFILL
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SECTION
TYPICAL LANDFILL
VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 200'
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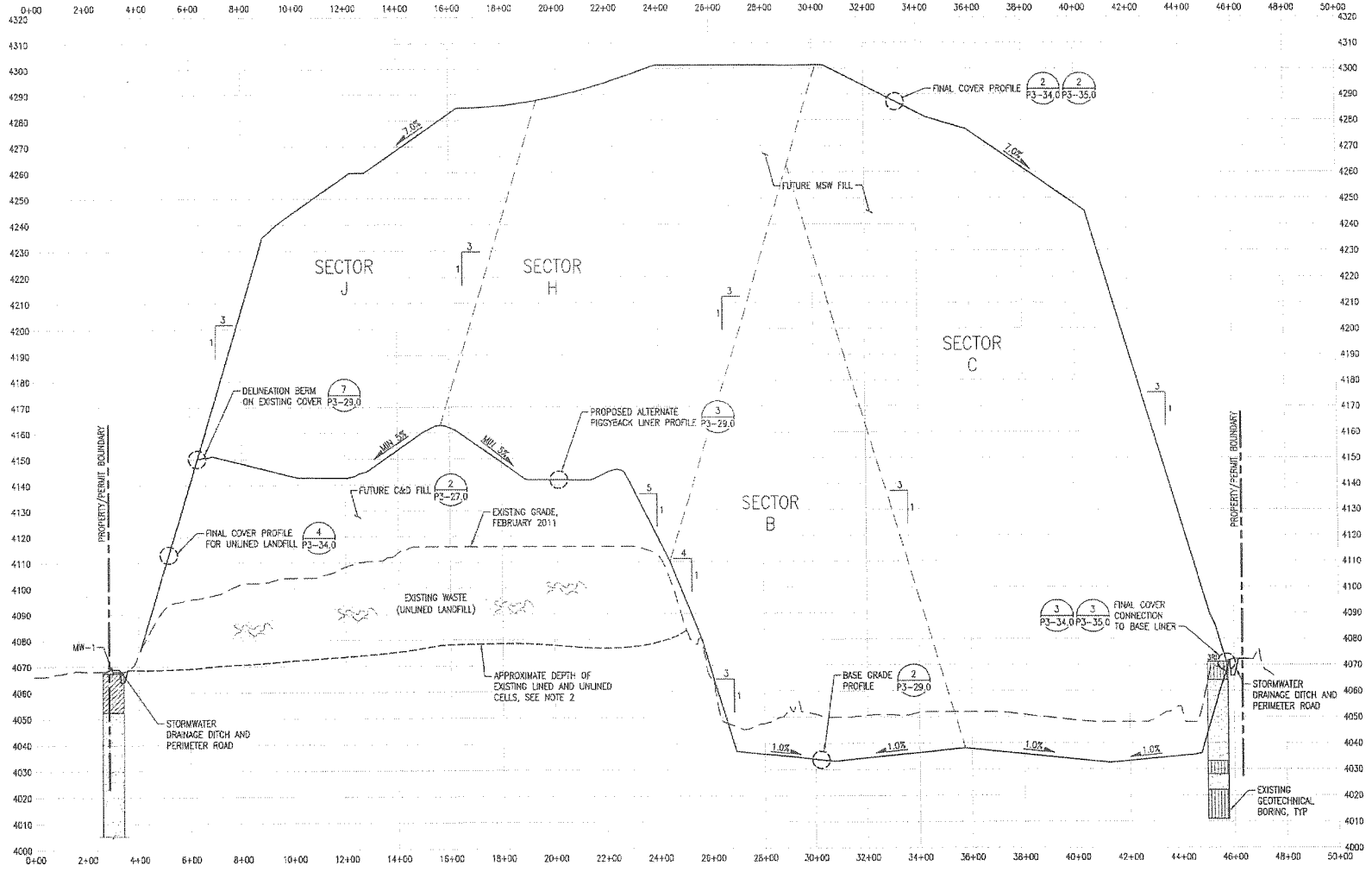

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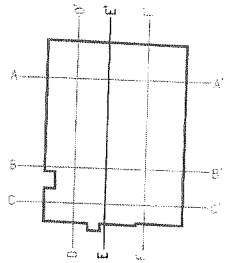

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GRAPHIC SCALES
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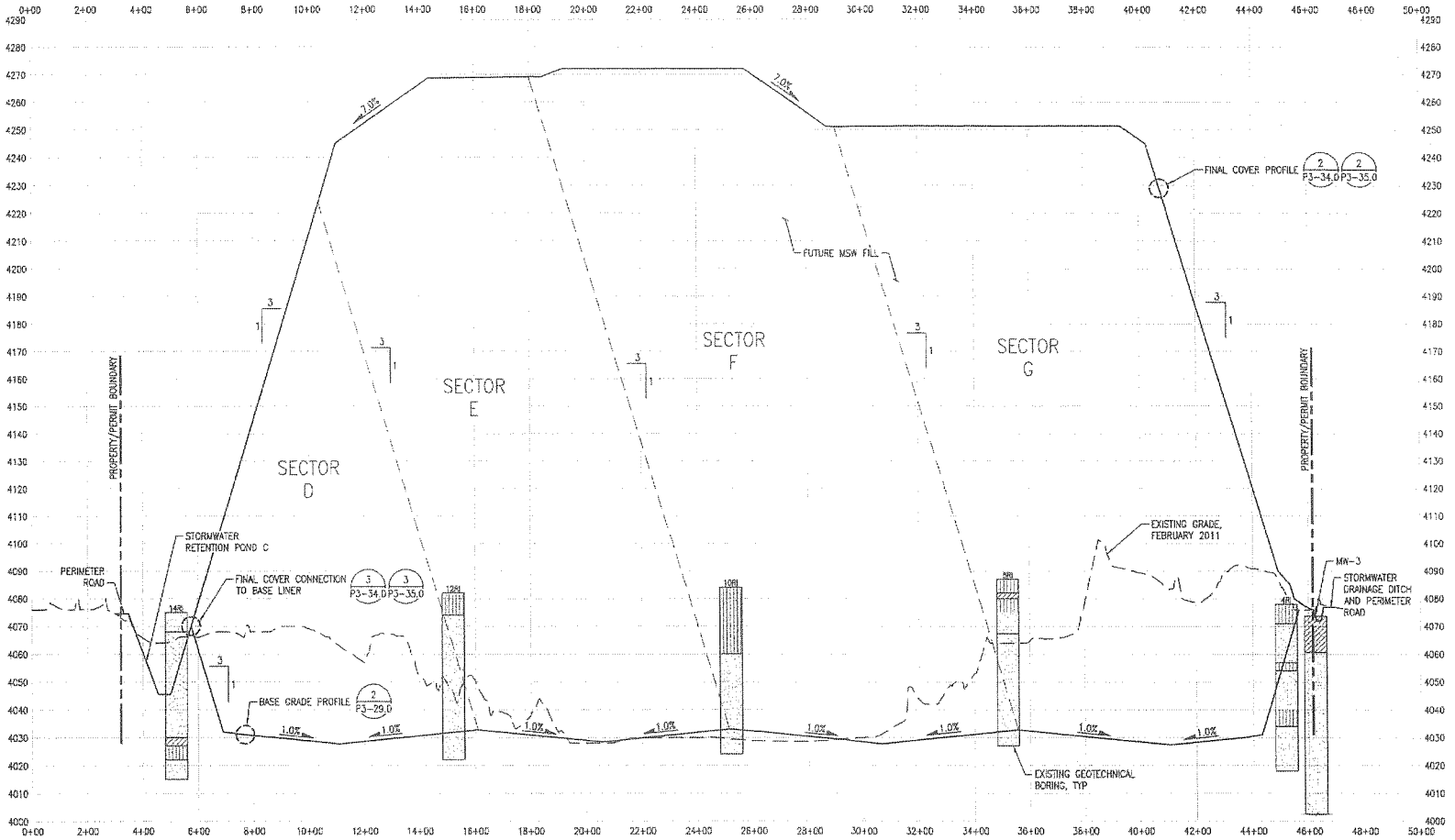

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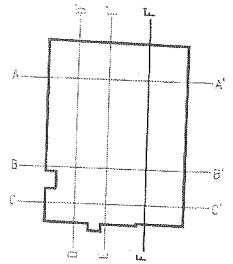

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GRAPHIC SCALES

1"=20'-0" 20 0 20 40 Scale Feet

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PROJECT NUMBER 9631500115
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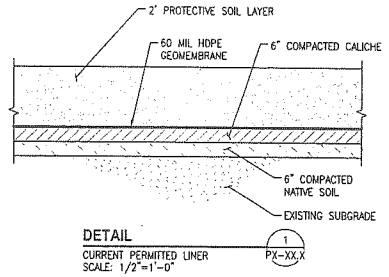

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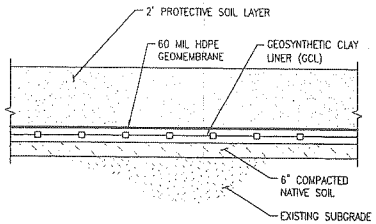
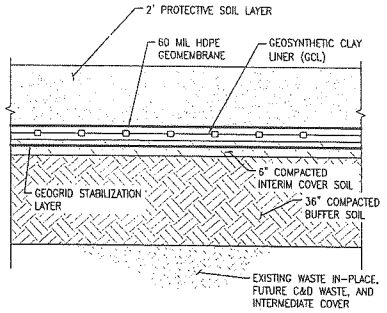


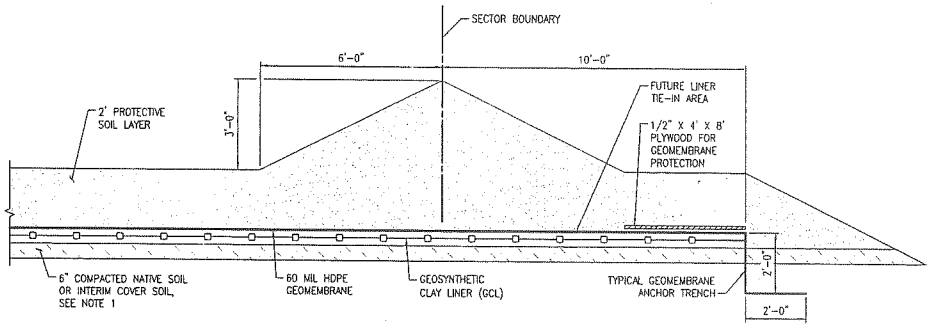
DETAIL 2 PX-XX.X
PROPOSED ALTERNATIVE LINER
SCALE: 1/2"=1'-0"



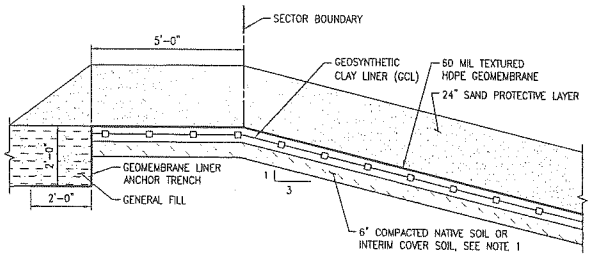
DETAIL 3 PX-XX.X
PROPOSED ALTERNATIVE PIGGYBACK LINER
SCALE: 1/2"=1'-0"

NOTES

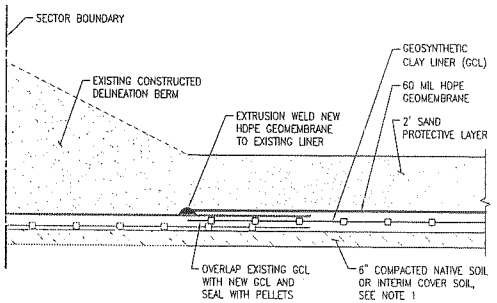
1. FOR THE PROPOSED ALTERNATIVE PIGGYBACK, THE COMPACTED INTERIM COVER SOIL SHALL CONTAIN A GEOGRID STABILIZATION LAYER AS SHOWN ON DETAIL 3.



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

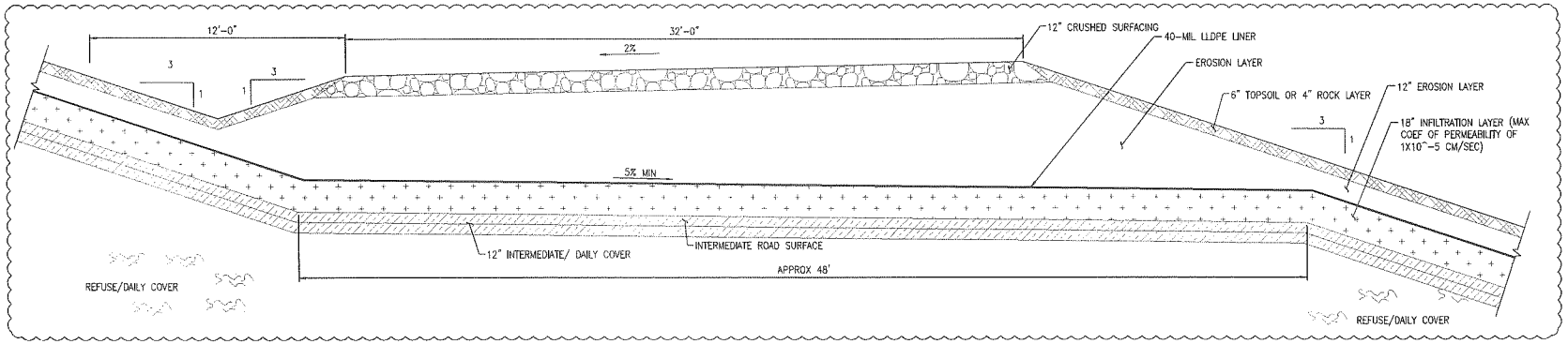
LINER DETAILS

PROJECT NUMBER: 9631500115
SHT. 62 OF XX
DRAWING NUMBER: P3-30.0

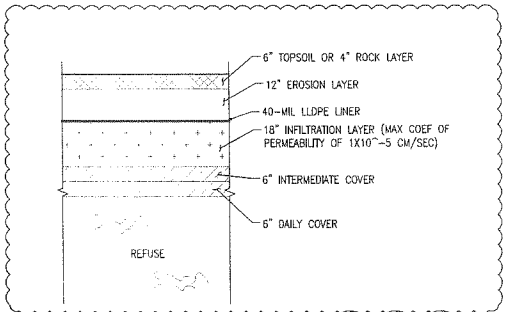
Keller, Joyce L. 3/20/2012 7:27:18 AM - R:\Minneapolis\9631500115\Data Analysis\CAD\P3-30.0 LINER DETAILS.dwg

NOTES

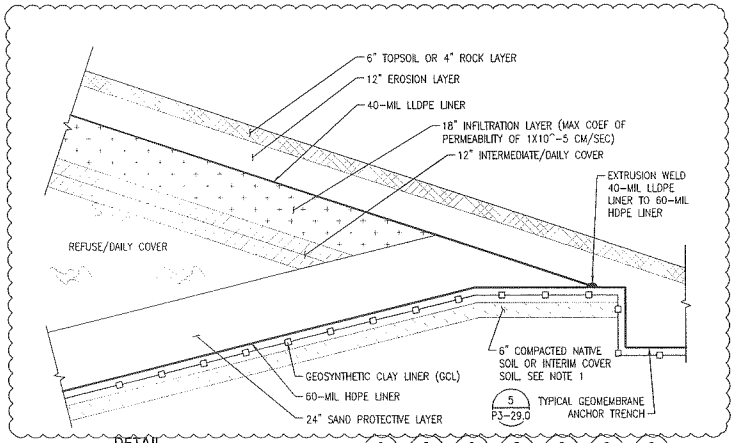
1. FOR THE PROPOSED ALTERNATIVE PIGGYBACK DESIGN, THE INTERIM COVER SOIL LAYER SHALL UNDERLAY GEOGRID STABILIZATION LAYERS AS SHOWN ON DETAIL 3, DWG P3-29.0.



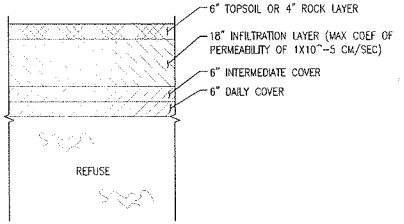
DETAIL — TYPICAL ROAD DETAIL (1 P3-20.0, 1 P3-33.0)
SCALE: 3/8"=1'-0"



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

SAIC®

SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve
Suite 305
St. Paul, MN 55121
(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

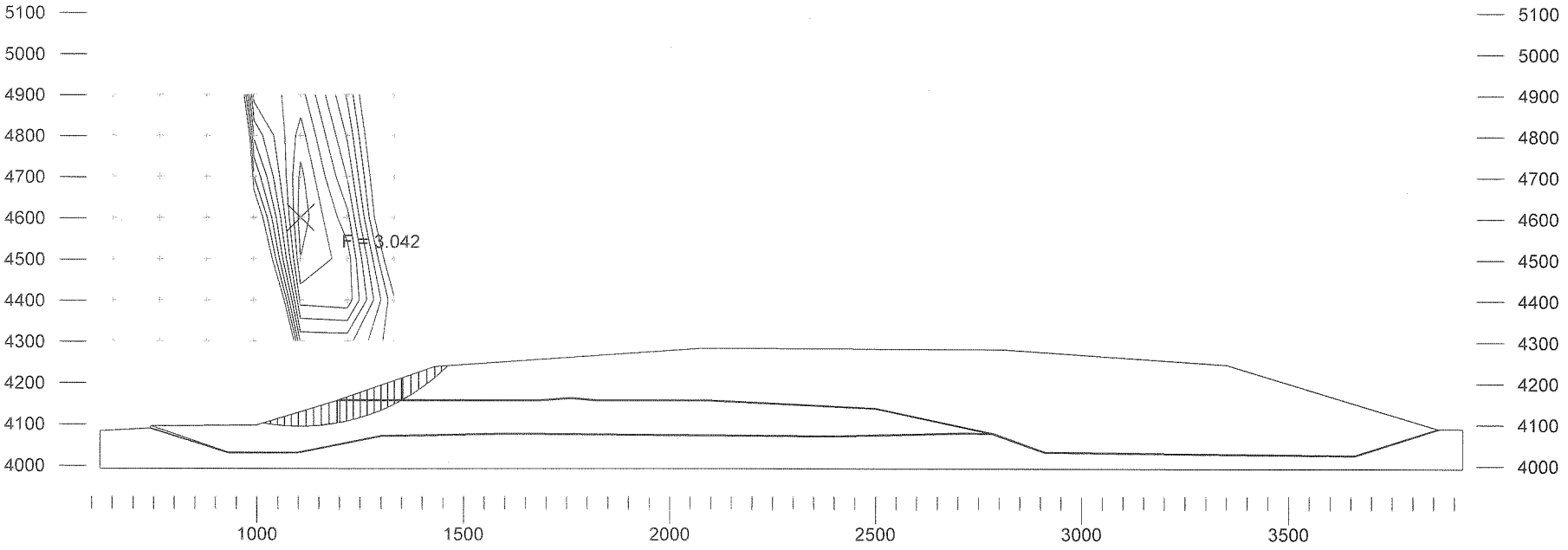
TABLE B-2 : RESULTS OF WASTE MASS STABILITY ANALYSIS – SENSITIVITY ANALYSIS, CROSS SECTION E					
Condition	γ' (pcf)	ϕ' (deg.)	c' (psf)	Factor of Safety	
				Circular	Block
Base	65	35	525	2.78	2.56
1	65	35	0	2.10	2.18
2	65	26	0	1.47	1.80

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

American Engineering Testing - St. Paul, MN
01-05106
McCombs Landfill Expansion
July 2012
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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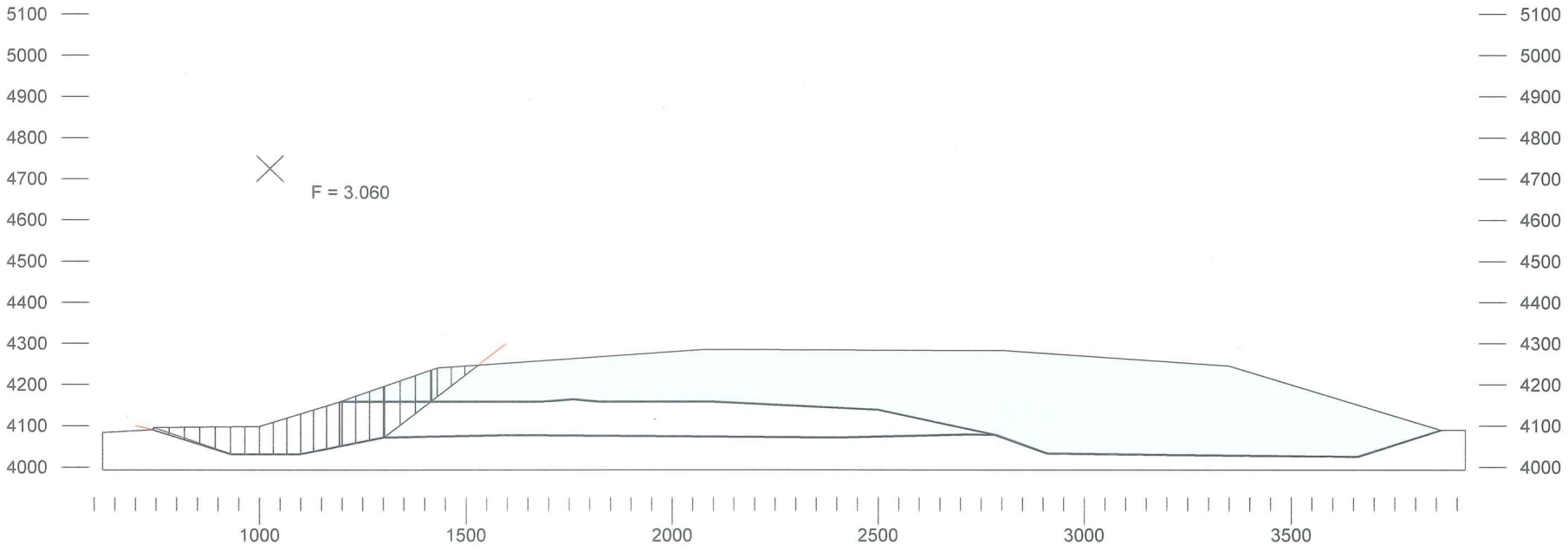
01-05106
McCombs Landfill Expansion
July 2012
Section B



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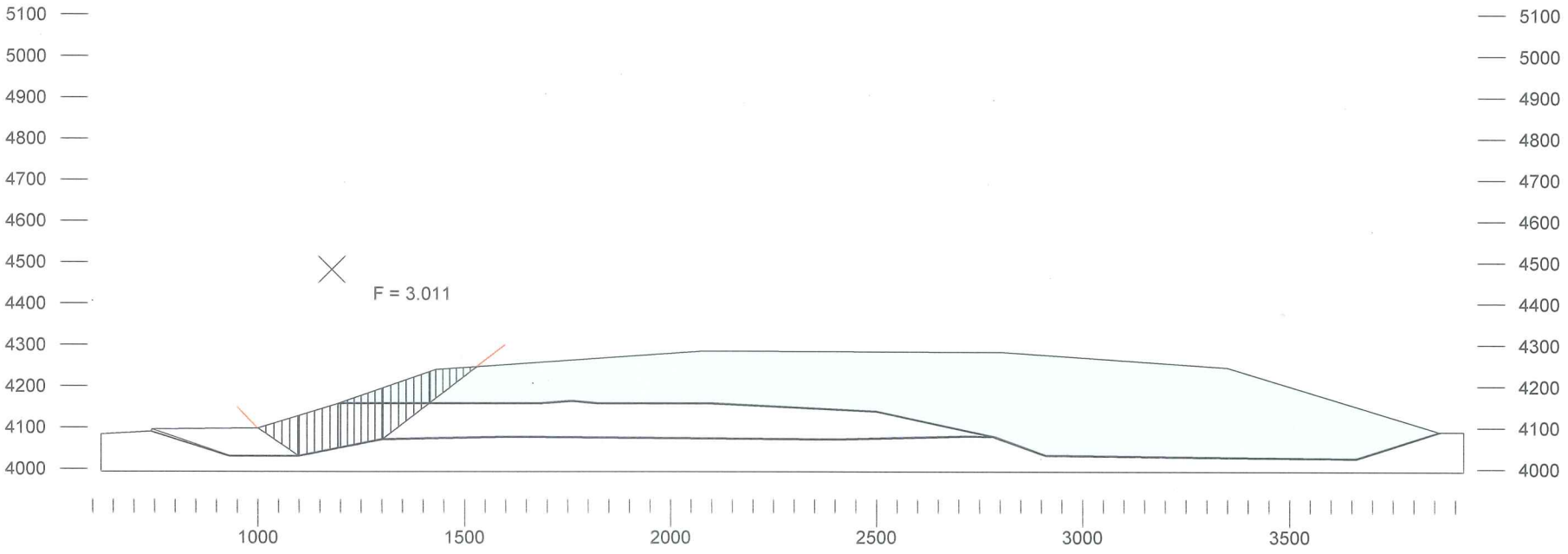
	Gamma pcf	C psf	Phi deg	Piezo Surf.
MSW Waste	65	525	35	0
Sand Cover	110	0	29	1
Textured HDPE	110	0	30	1
Exist.Waste/Fut.C&D	65	525	35	0
Exist. Sand Cover	110	0	29	2
Exist. HDPE	110	0	30	2
Foundation Soils	125	0	32	0

American Engineering Testing - St. Paul, MN
01-05106
McCombs Landfill Expansion
July 2012
Section B



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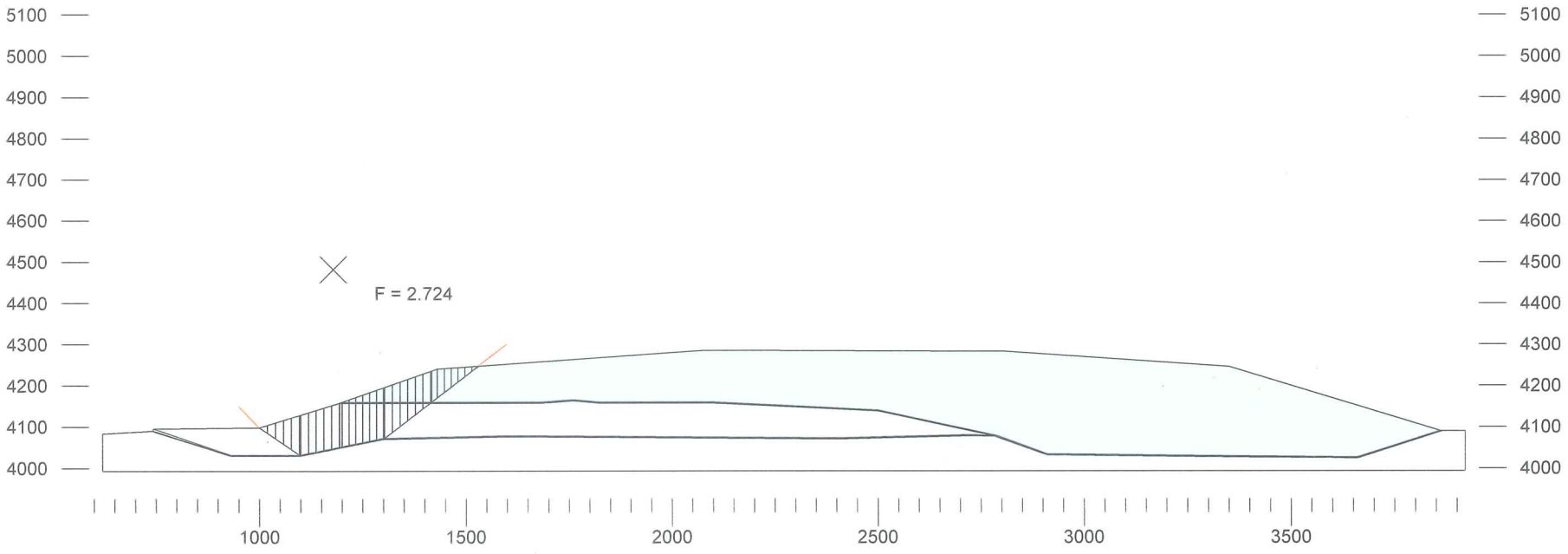
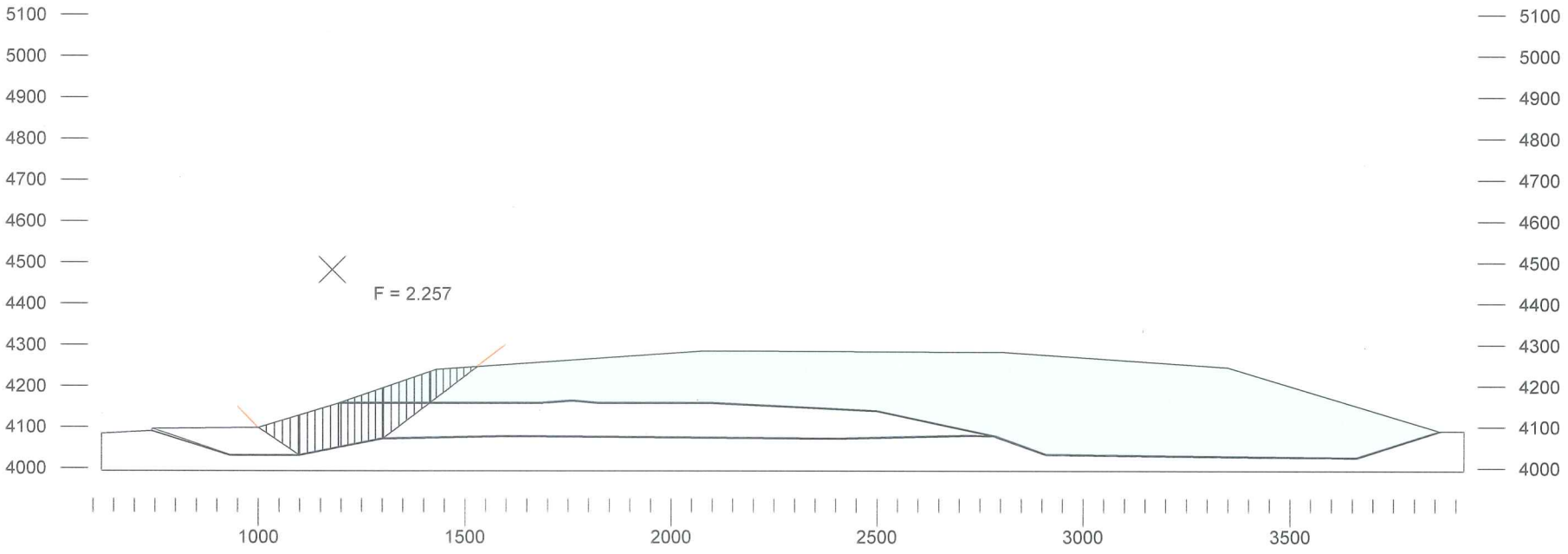
	Gamma pcf	C psf	Phi deg	Piezo Surf.
MSW Waste	65	0	35	0
Sand Cover	110	0	29	1
Textured HDPE	110	0	30	1
Exist.Waste/Fut.C&D	65	0	35	0
Exist. Sand Cover	110	0	29	2
Exist. HDPE	110	0	30	2
Foundation Soils	125	0	32	0

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

American Engineering Testing - St. Paul, MN
01-05106
McCombs Landfill Expansion
July 2012
Section B
Sensitivity Analysis - Case 2



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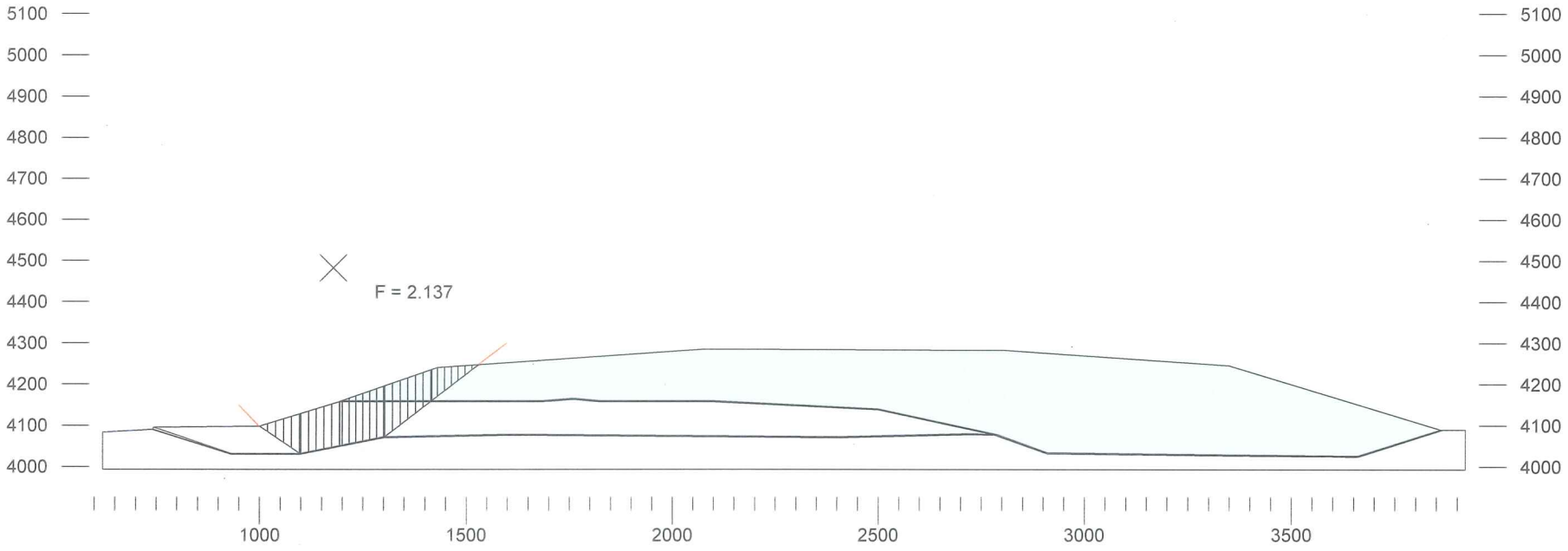
	Gamma pcf	C psf	Phi deg	Piezo Surf.
MSW Waste	65	0	28	0
Sand Cover	110	0	29	1
Textured HDPE	110	0	25	1
Exist.Waste/Fut.C&D	65	0	28	0
Exist. Sand Cover	110	0	29	2
Exist. HDPE	110	0	25	2
Foundation Soils	125	0	32	0

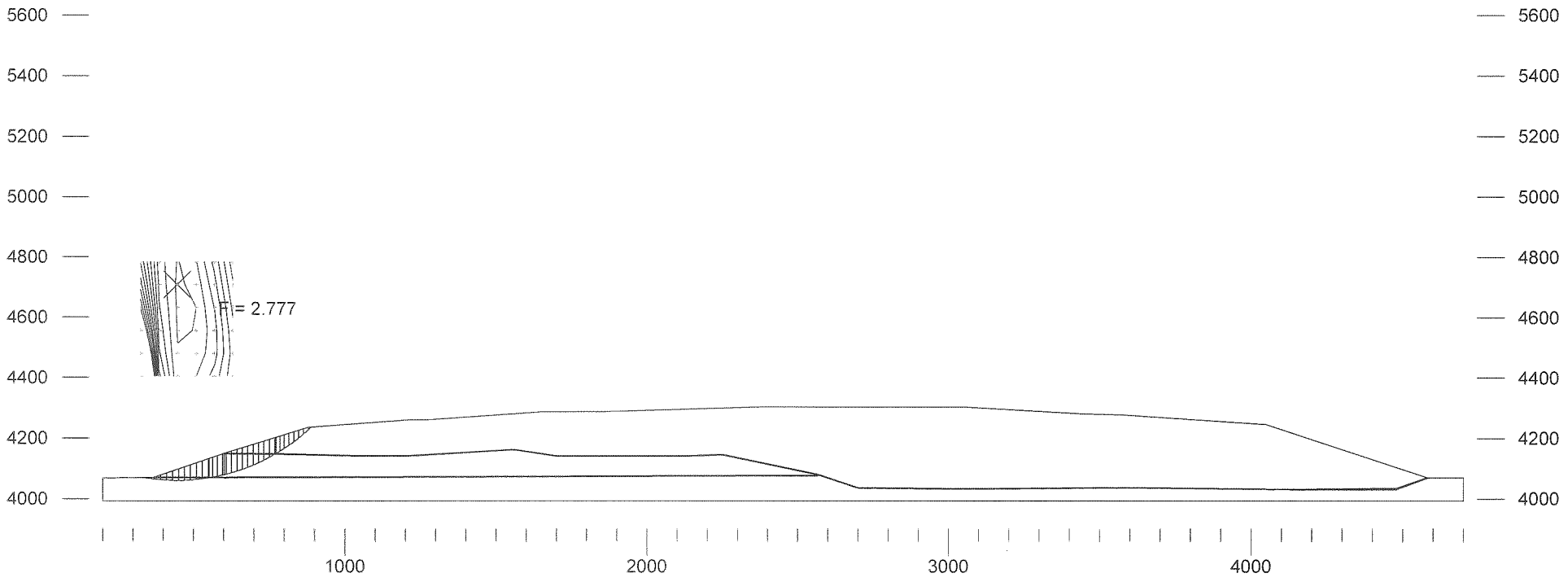
American Engineering Testing - St. Paul, MN
01-05106
McCombs Landfill Expansion
July 2012
Section B
Large Displacement Parameters



SECTION E

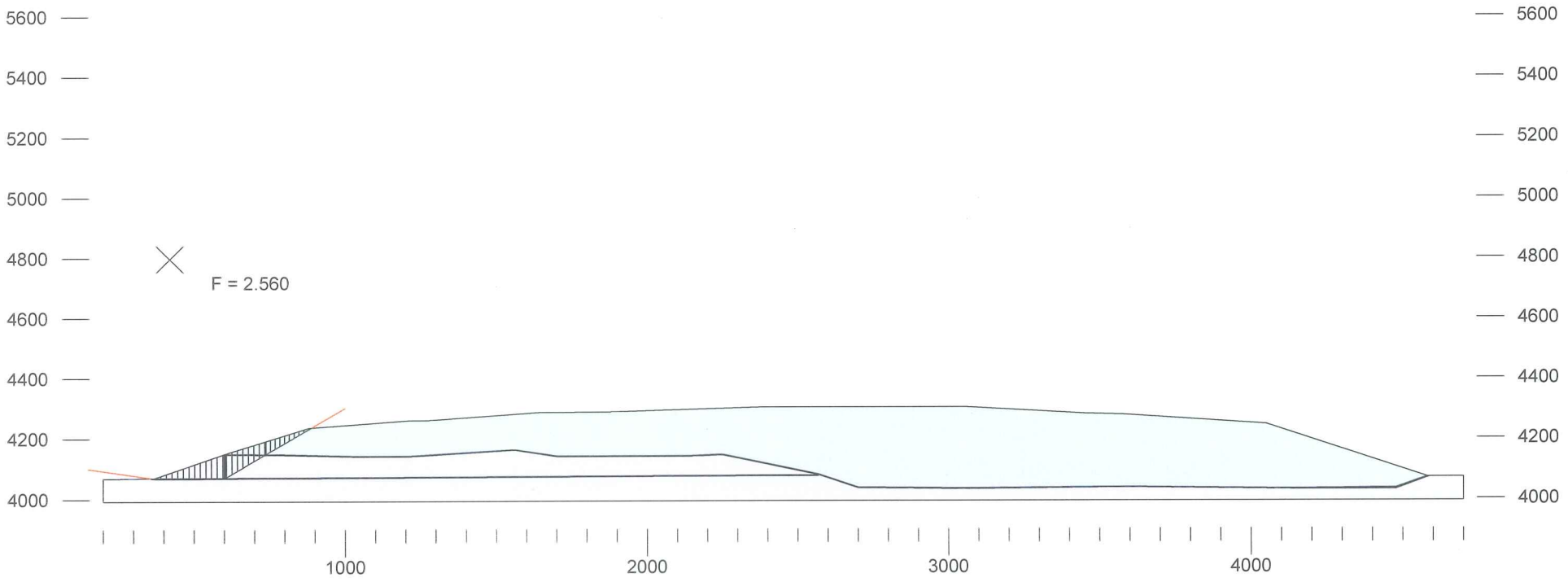
	Gamma pcf	C psf	Phi deg	Piezo Surf.
MSW Waste	65	525	35	0
Sand Cover	110	0	29	1
Textured HDPE	110	0	30	1
Exist.Waste/Fut.C&D	65	525	35	0
Exist. Sand Cover	110	0	29	2
Exist. HDPE	110	0	30	2
Foundation Soils	125	0	32	0

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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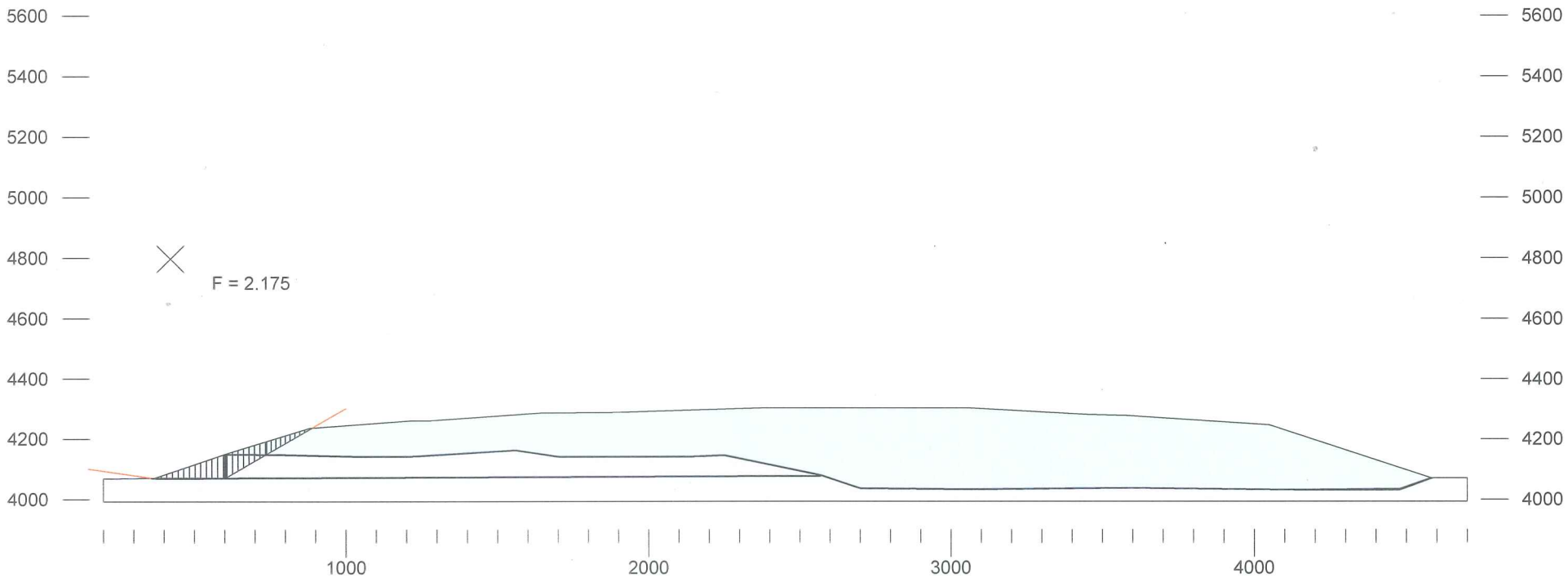
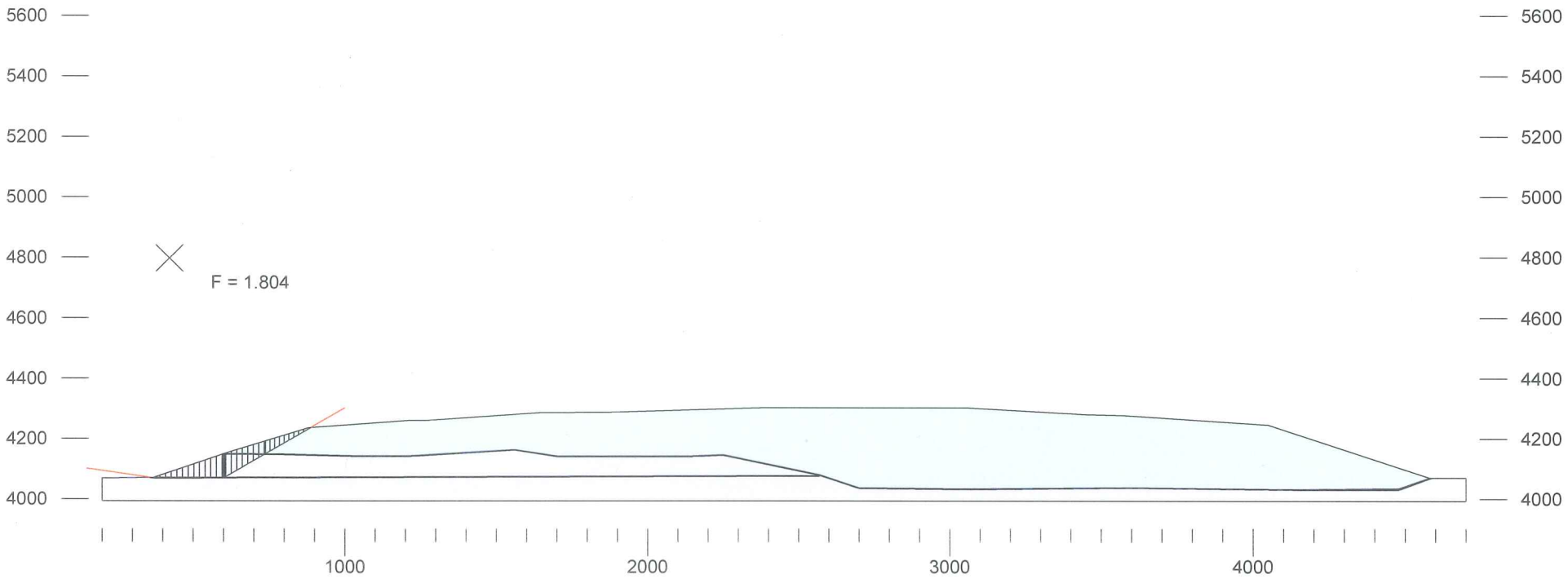
	Gamma pcf	C psf	Phi deg	Piezo Surf.
MSW Waste	65	0	35	0
Sand Cover	110	0	29	1
Textured HDPE	110	0	30	1
Exist.Waste/Fut.C&D	65	0	35	0
Exist. Sand Cover	110	0	29	2
Exist. HDPE	110	0	30	2
Foundation Soils	125	0	32	0

American Engineering Testing - St. Paul, MN
01-05106
McCombs Landfill Expansion
July 2012
Section E
Sensitivity Analysis - Case 1



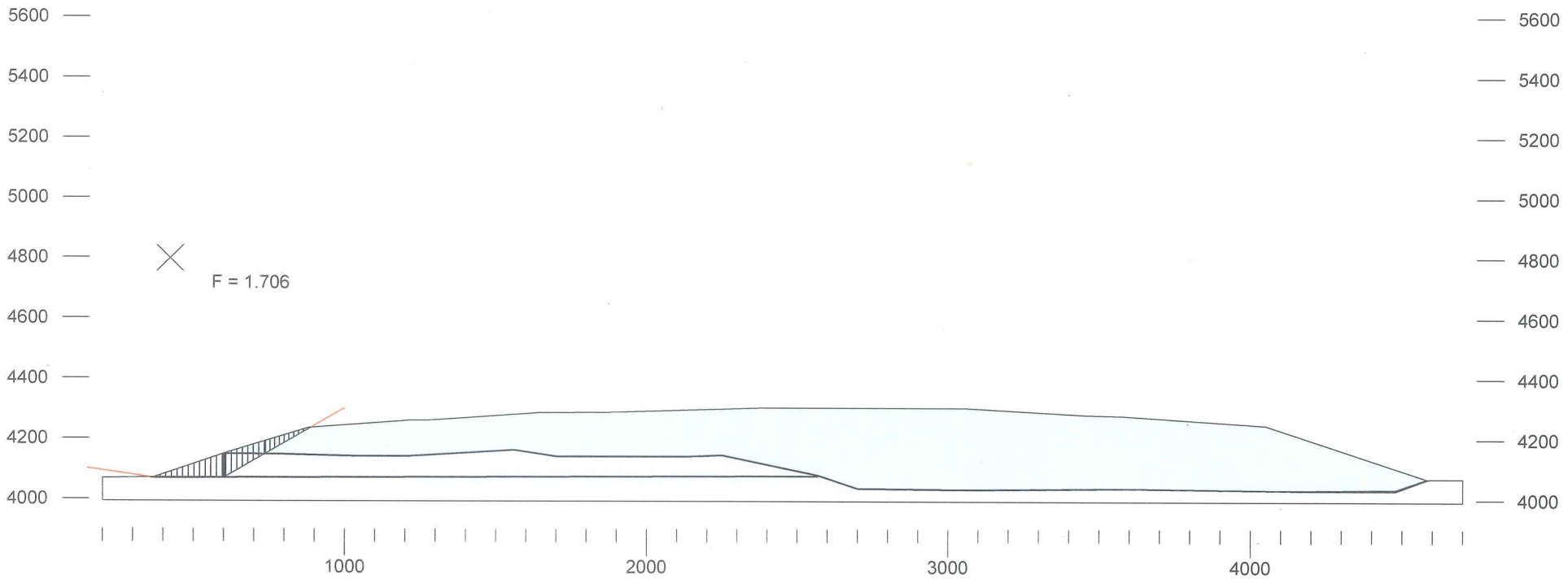
	Gamma pcf	C psf	Phi deg	Piezo Surf.
MSW Waste	65	0	26	0
Sand Cover	110	0	29	1
Textured HDPE	110	0	30	1
Exist.Waste/Fut.C&D	65	0	26	0
Exist. Sand Cover	110	0	29	2
Exist. HDPE	110	0	30	2
Foundation Soils	125	0	32	0

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

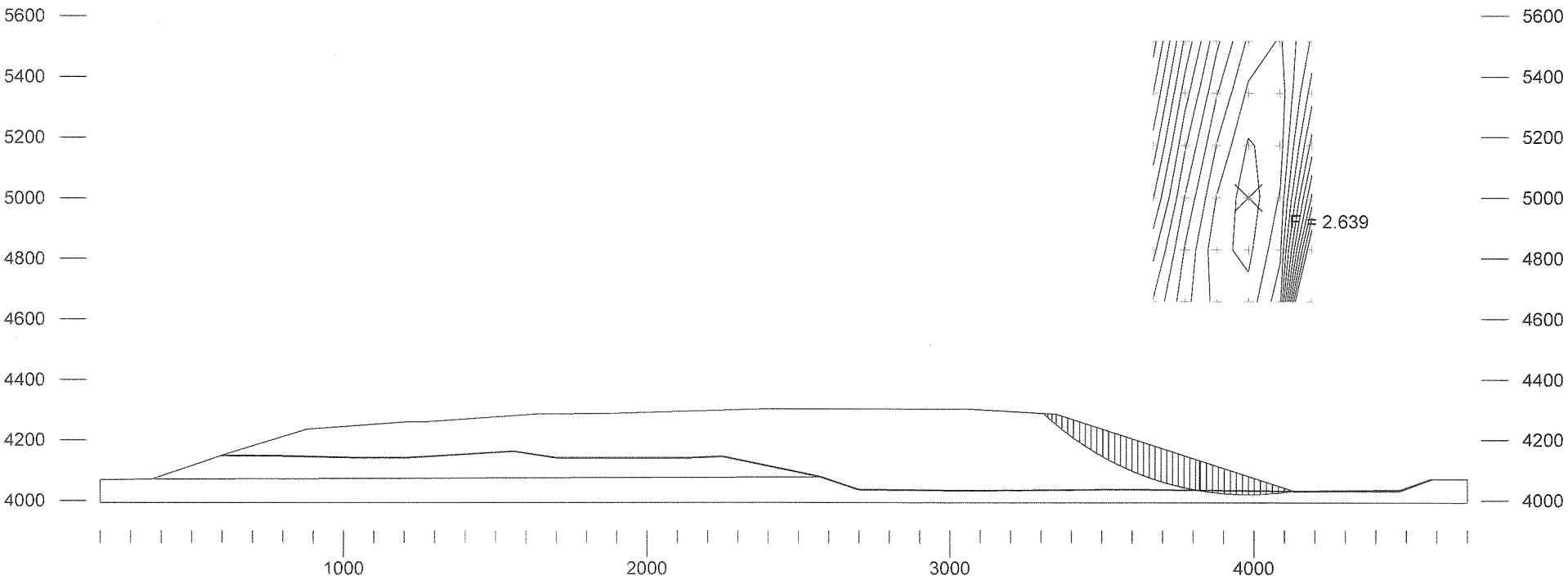
TABLE C-2: RESULTS OF WASTE MASS STABILITY ANALYSIS – INTERIM SLOPE, SENSITIVITY ANALYSIS, CROSS SECTION E					
Condition	γ' (pcf)	ϕ' (deg.)	c' (psf)	Factor of Safety	
				Circular	Block
Base	65	35	525	2.64	2.42
1	65	35	0	2.10	2.19
2	65	26	0	1.47	1.85

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

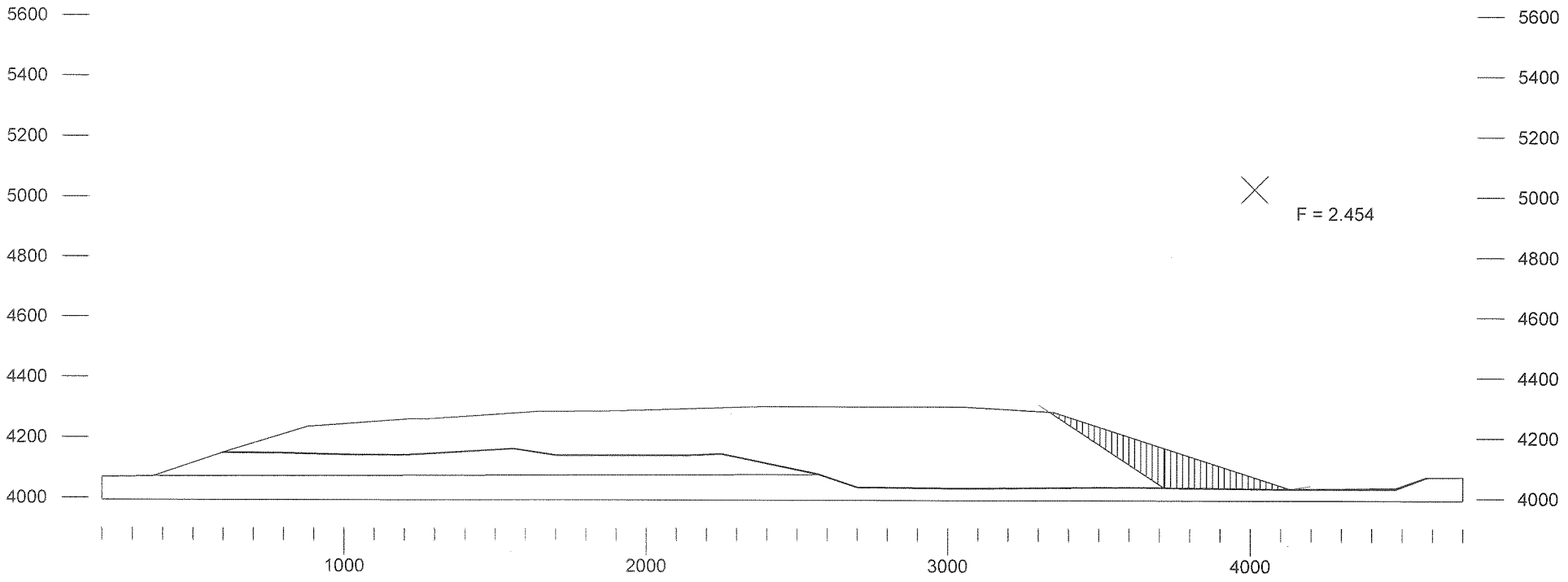
	Gamma pcf	C psf	Phi deg	Piezo Surf.
MSW Waste	65	525	35	0
Sand Cover	110	0	29	1
Textured HDPE	110	0	30	1
Exist.Waste/Fut.C&D	125	0	35	0
Foundation Soils	125	0	32	0

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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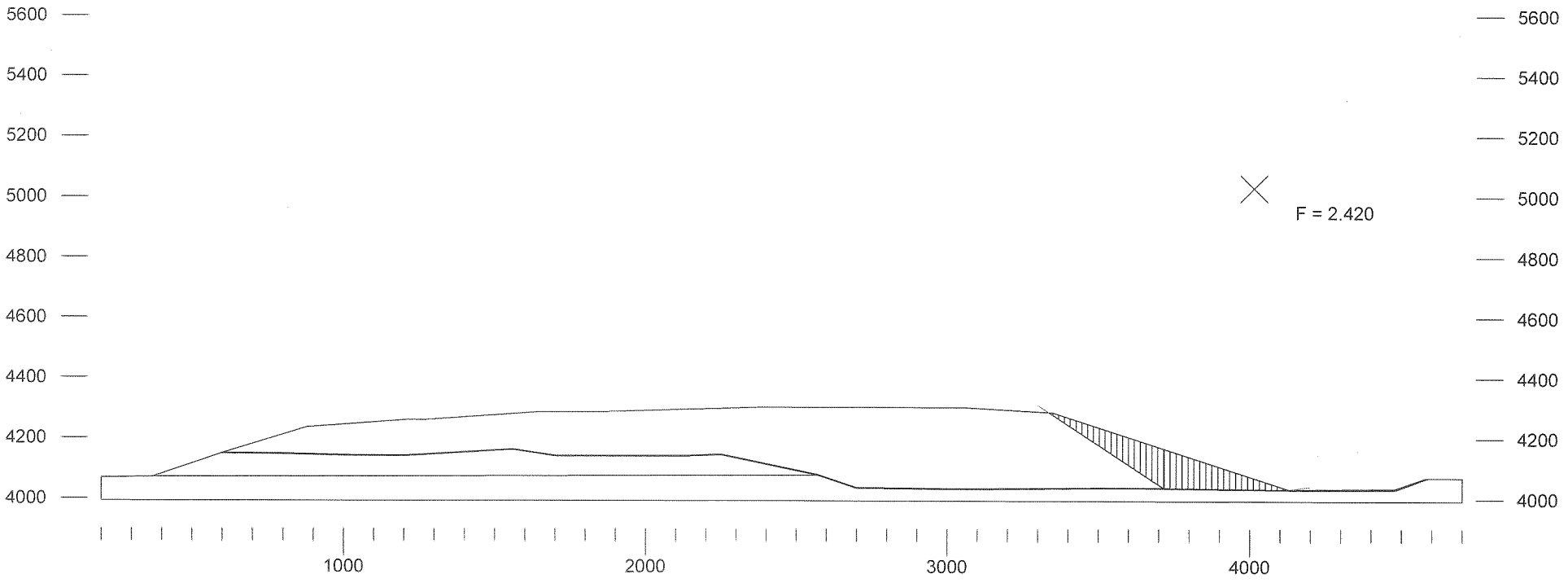
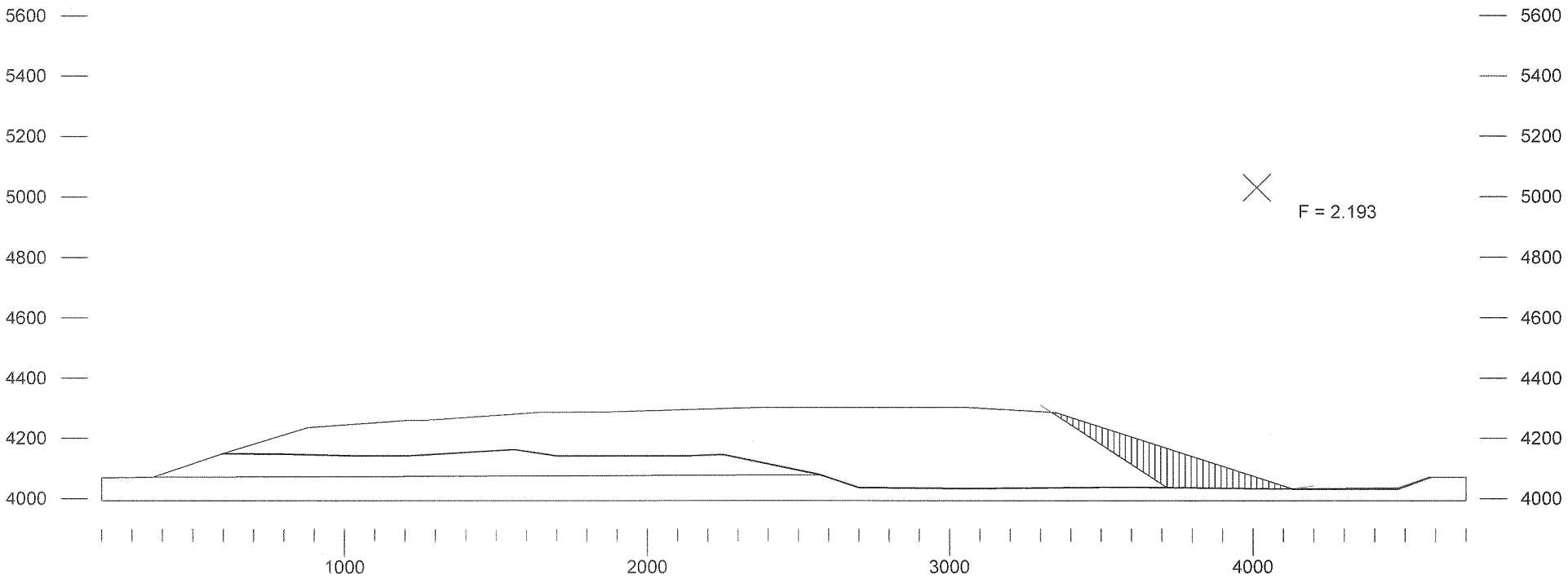
	Gamma pcf	C psf	Phi deg	Piezo Surf.
MSW Waste	65	525	35	0
Sand Cover	110	0	29	1
Textured HDPE	110	0	30	1
Exist.Waste/Fut.C&D	125	0	35	0
Foundation Soils	125	0	32	0

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



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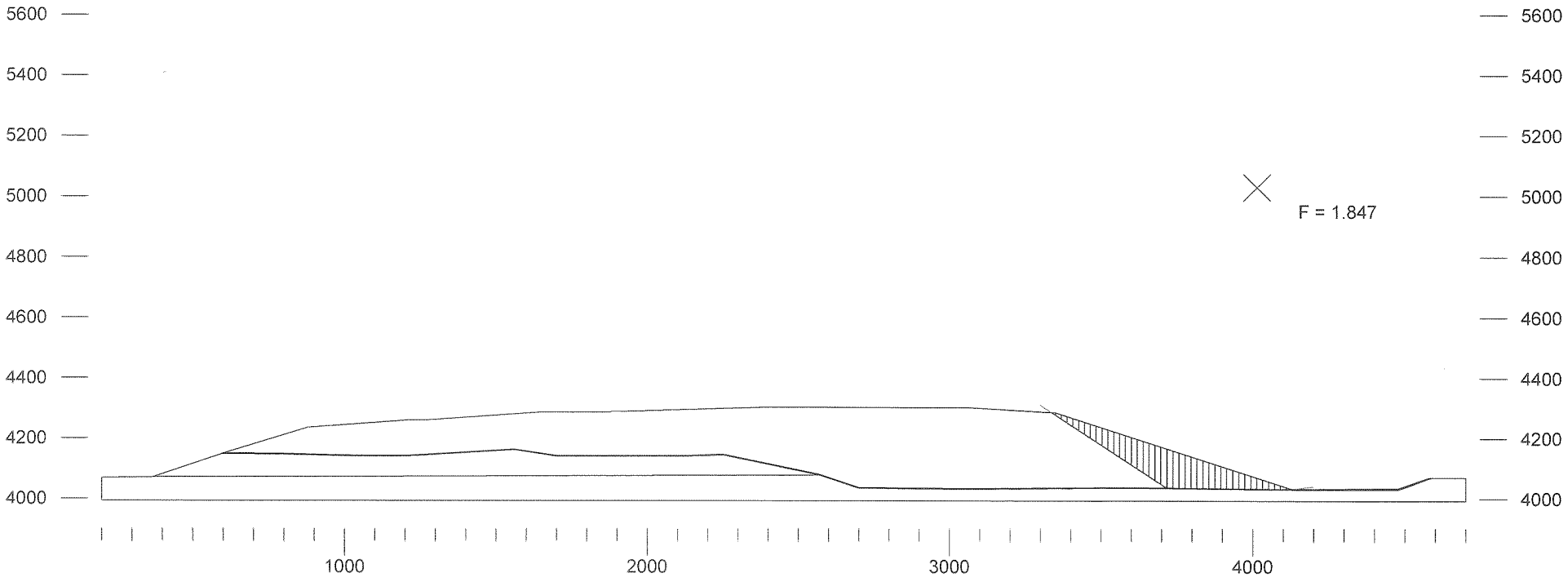
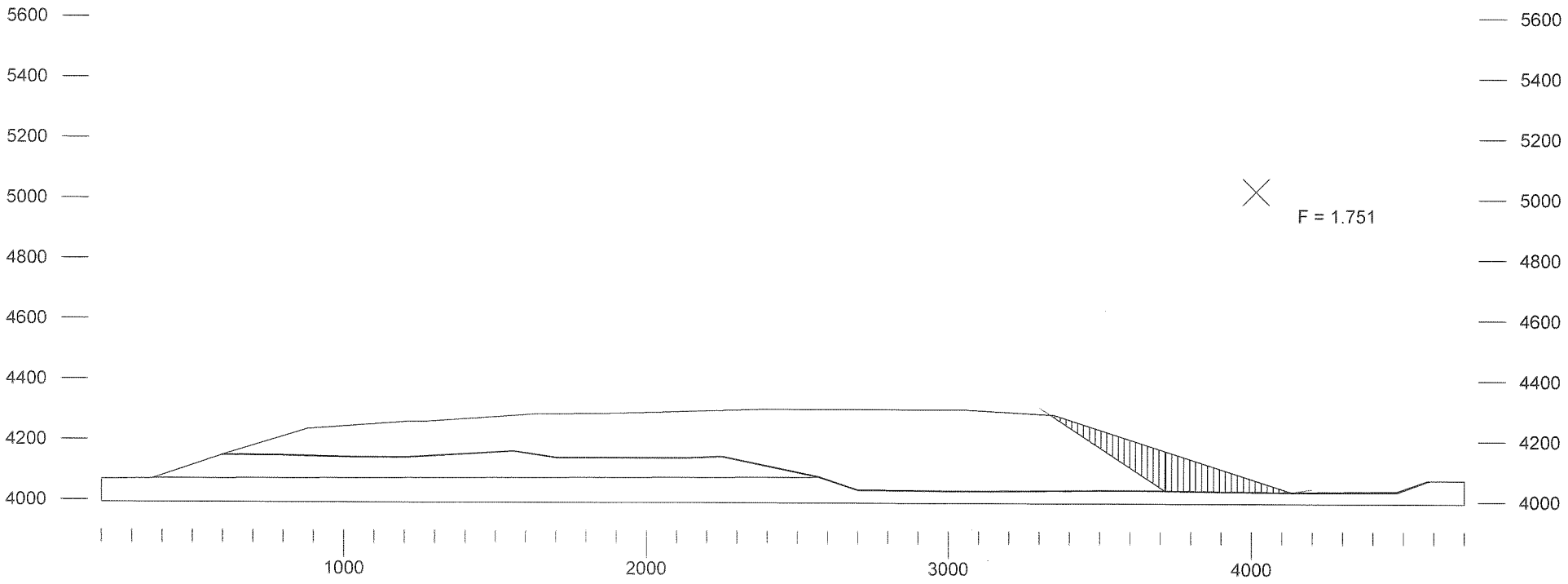
	Gamma pcf	C psf	Phi deg	Piezo Surf.
MSW Waste	65	0	26	0
Sand Cover	110	0	29	1
Textured HDPE	110	0	30	1
Exist.Waste/Fut.C&D	125	0	26	0
Foundation Soils	125	0	32	0

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

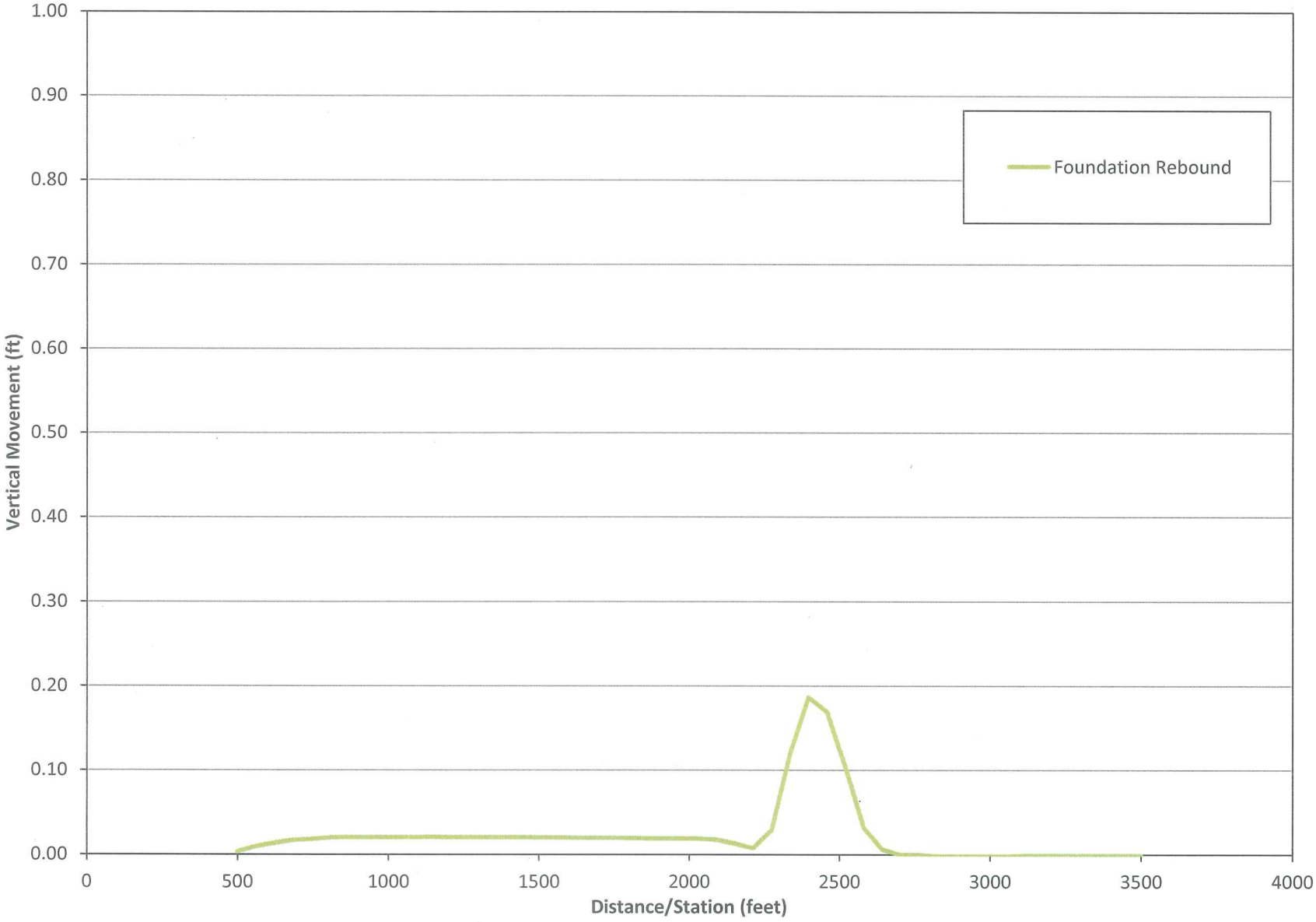
AMERICAN ENGINEERING TESTING, INC.
TEXAS REGISTERED ENGINEERING FIRM F-10340

McCombs Landfill
American Engineering Testing, Inc.
AET No. 01-05106

PREDICTED FOUNDATION HEAVE DUE TO EXCAVATION
AND
PREDICTED FOUNDATION SETTLEMENT

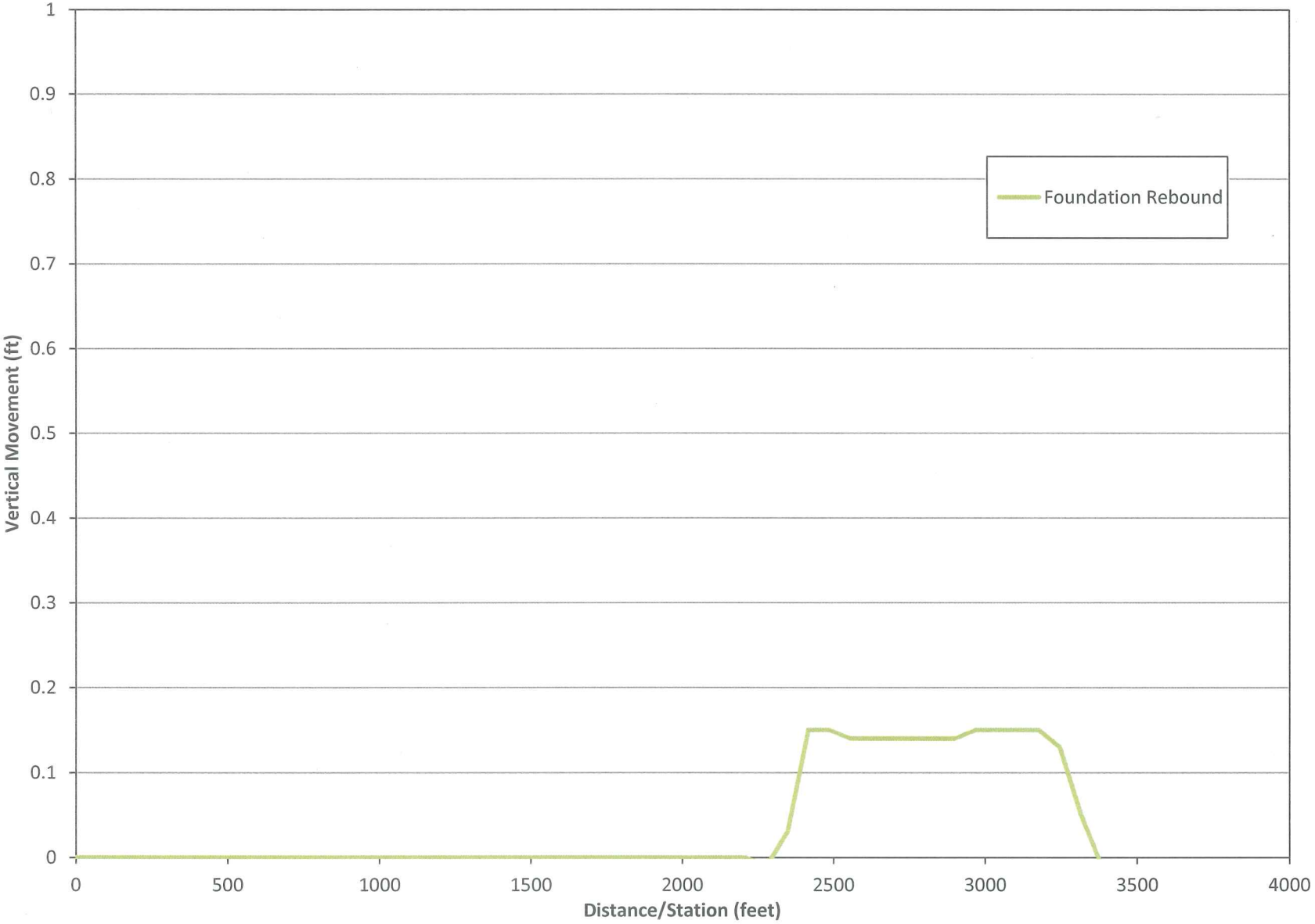
McCombs Landfill
American Engineering Testing, Inc.
AET No. 01-05106

Section B, Elastic Rebound
McCombs Landfill; El Paso, TX



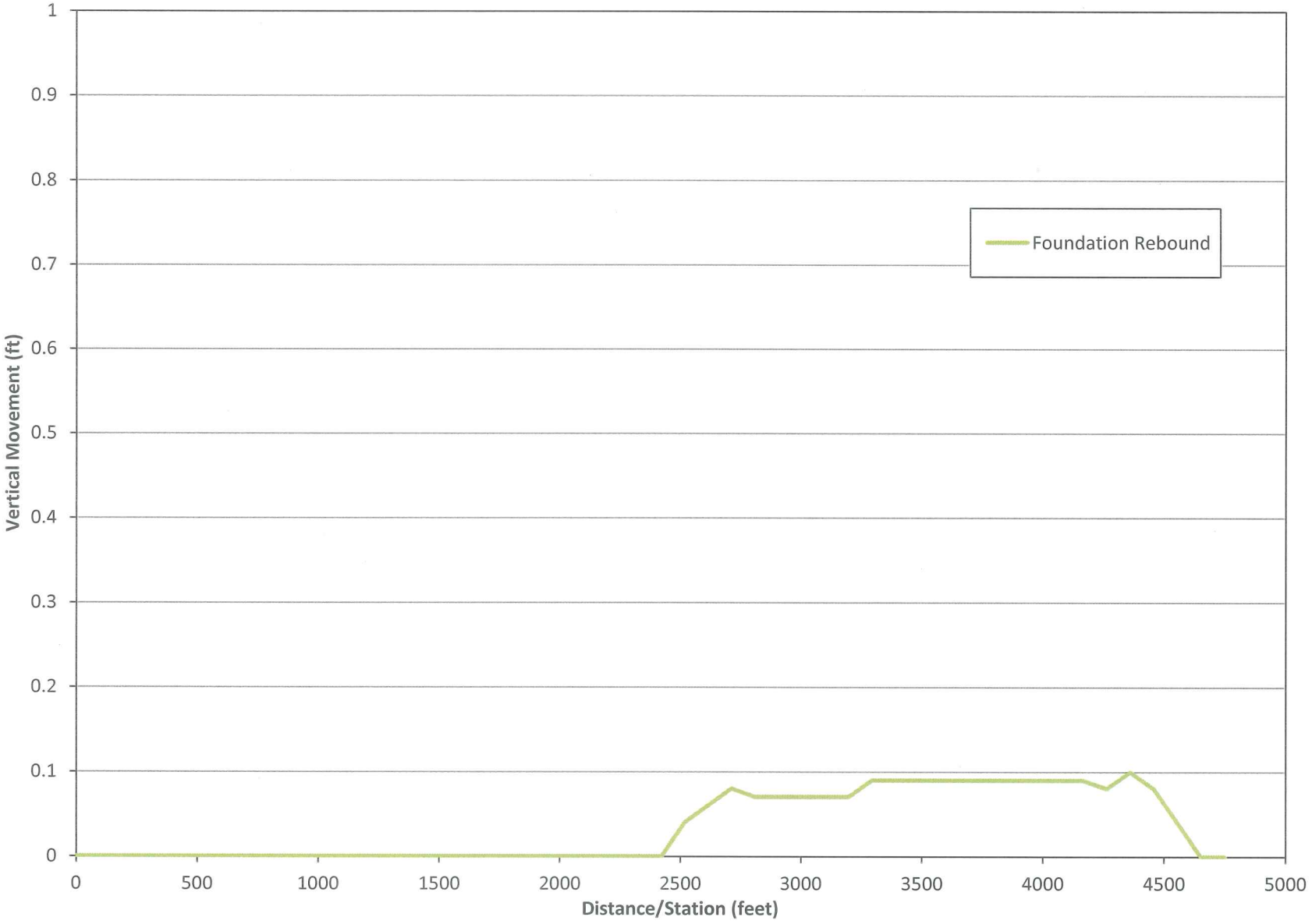
American Engineering Testing, Inc.
AET Project No. 01-05106

Section C, Elastic Rebound
McCombs Landfill; El Paso, TX



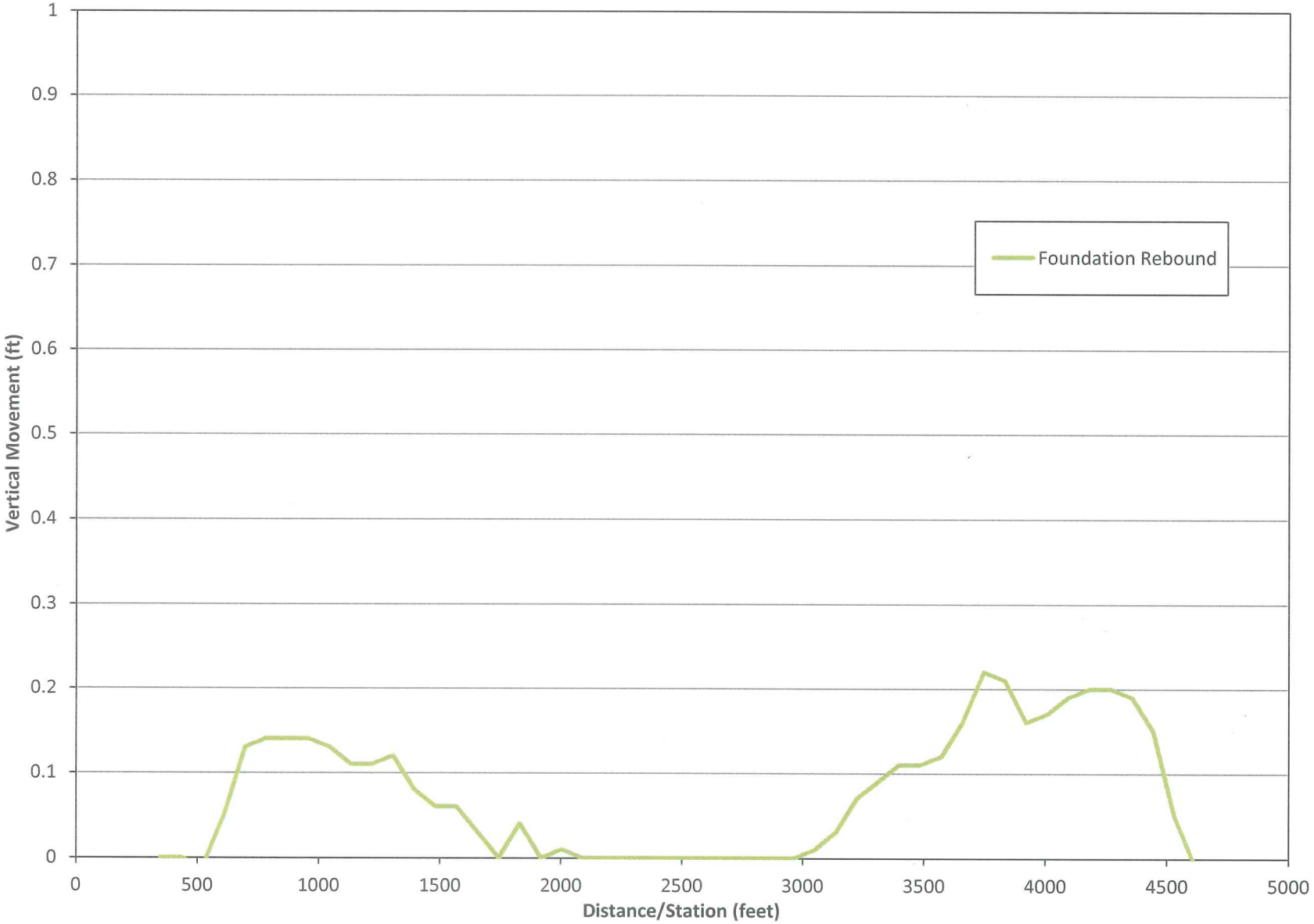
American Engineering Testing, Inc.
AET Project No. 01-05106

Section E, Elastic Rebound;
McCombs Landfill; El Paso, TX

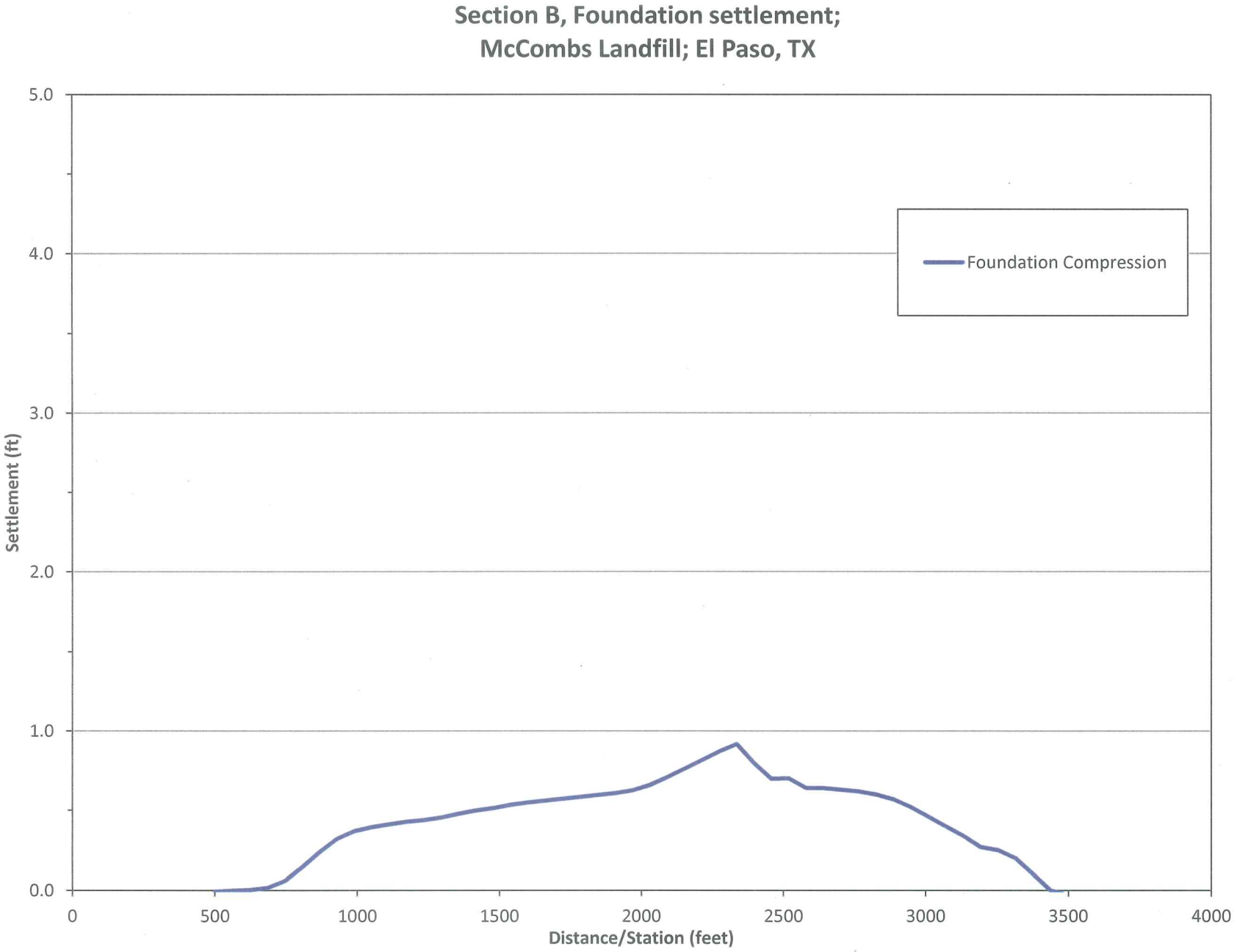


American Engineering Testing, Inc.
AET Project No. 01-05106

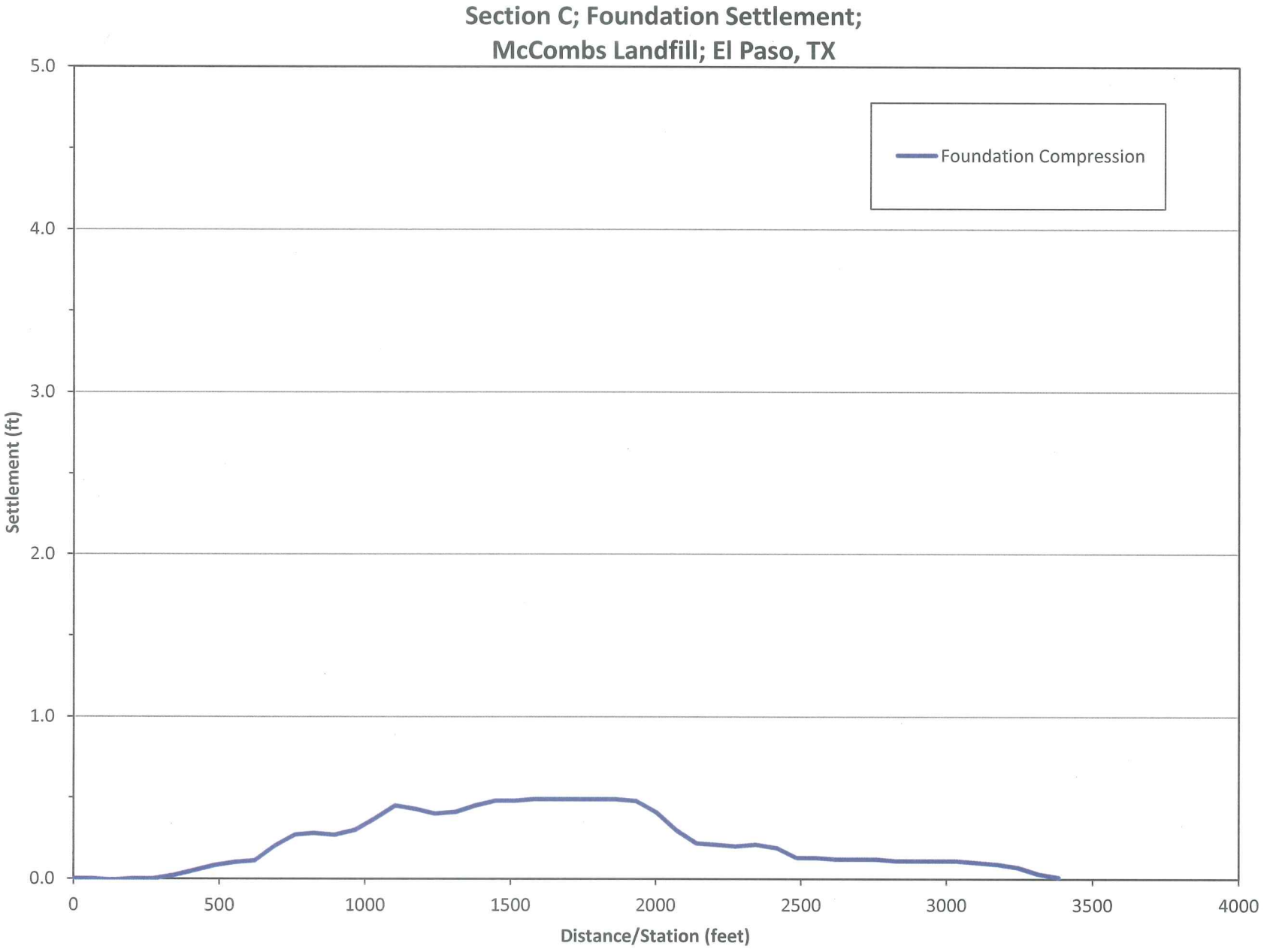
Section F, Elastic Rebound;
McCombs Landfill; El Paso, TX

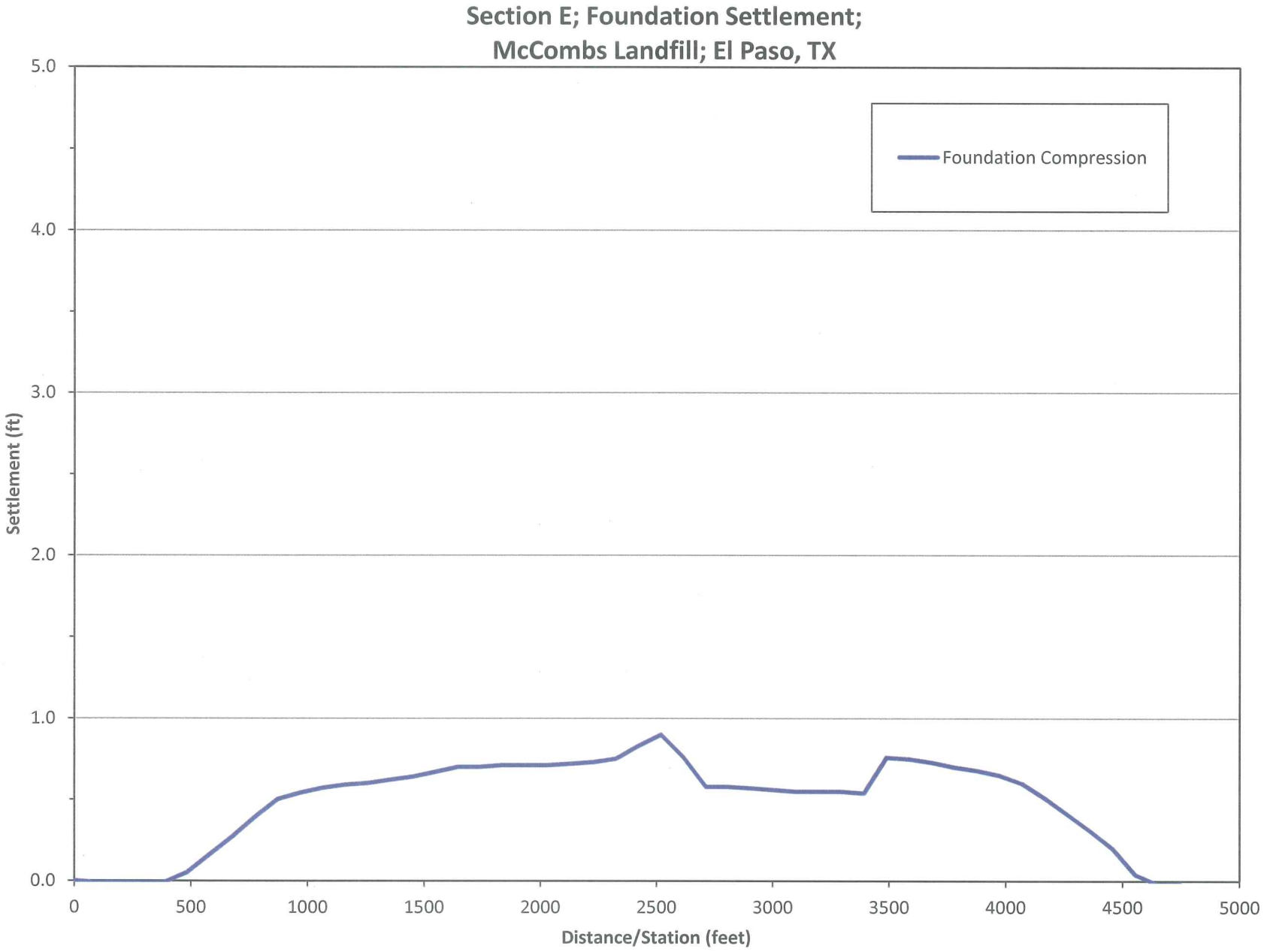


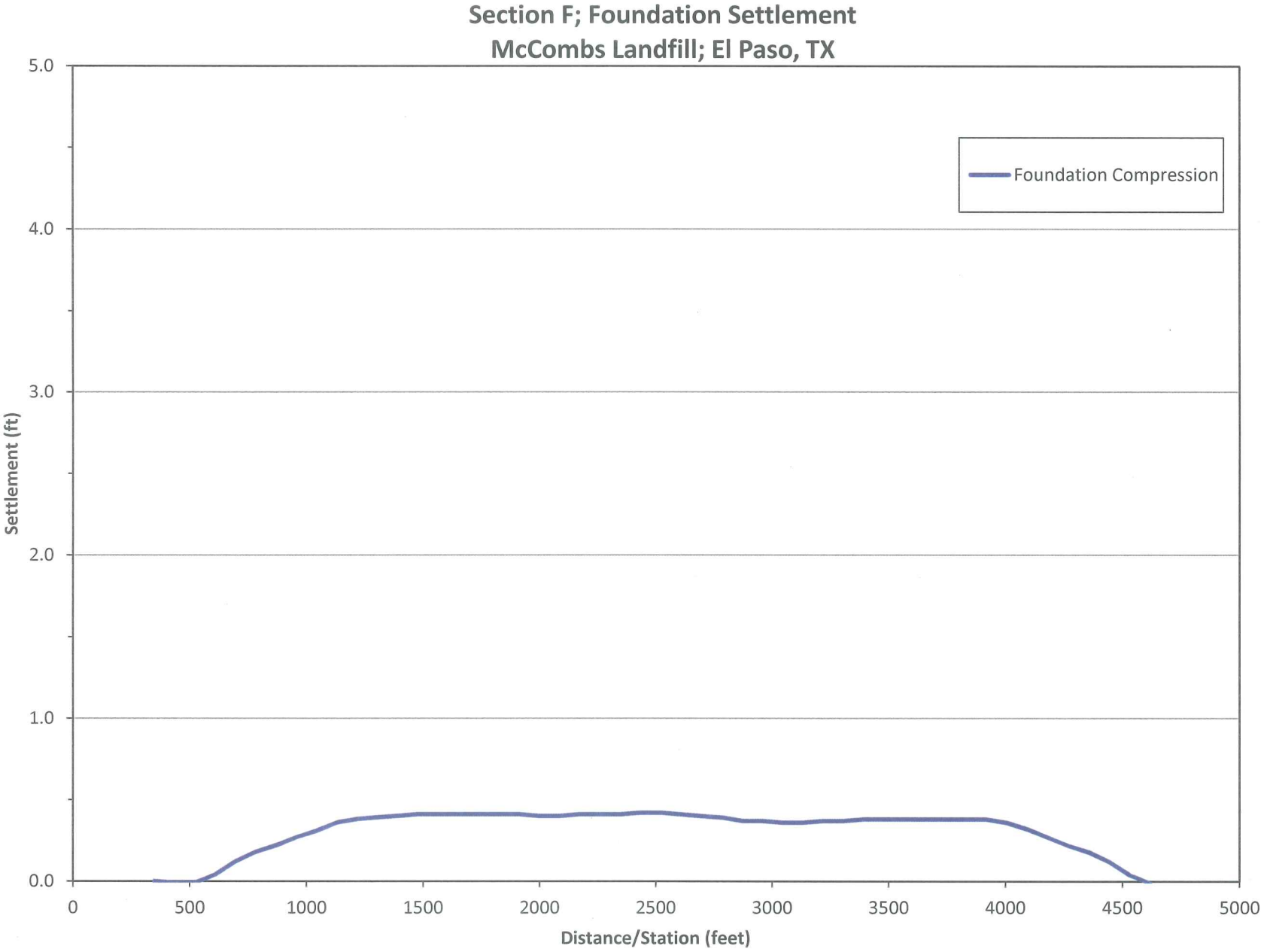
American Engineering Testing, Inc.
AET Project No. 01-05106



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

$\Delta Z_c = C_c' \times H_o \times \log (\sigma_o + \Delta\sigma / \sigma_o)$

ΔZ_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
σ_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

$\Delta Z_\alpha = C_\alpha' \times H_o \times \log (t2 / t1)$

ΔZ_α = secondary settlement of existing landfill
H_o = initial thickness of the waste layer before starting secondary settlement
C_α' = modified secondary compression index. C_α' = 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.	σ_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

$\Delta Z_c = C_c' \times H_o \times \log (\sigma_o + \Delta\sigma / \sigma_o)$

ΔZ_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
σ_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

$\Delta Z_\alpha = C_\alpha' \times H_o \times \log (t2 / t1)$

ΔZ_α = secondary settlement of existing landfill
H_o = initial thickness of the waste layer before starting secondary settlement
C_α' = modified secondary compression index. C_α' = 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.	σ_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

$\Delta Z_c = C_c' \times H_o \times \log (\sigma_o + \Delta\sigma / \sigma_o)$

ΔZ_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
σ_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

$\Delta Z_\alpha = C_\alpha' \times H_o \times \log (t2 / t1)$

ΔZ_α = secondary settlement of existing landfill
H_o = initial thickness of the waste layer before starting secondary settlement
C_α' = modified secondary compression index. C_α' = 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.	σ_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

$\Delta Z_c = C_c' \times H_o \times \log (\sigma_o + \Delta\sigma / \sigma_o)$

ΔZ_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
σ_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

$\Delta Z_\alpha = C_\alpha' \times H_o \times \log (t2 / t1)$

ΔZ_α = secondary settlement of existing landfill
H_o = initial thickness of the waste layer before starting secondary settlement
C_α' = modified secondary compression index. C_α' = 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.	σ_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

$\Delta Z_c = C_c' \times H_o \times \log (\sigma_o + \Delta\sigma / \sigma_o)$

ΔZ_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
σ_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

$\Delta Z_\alpha = C_\alpha' \times H_o \times \log (t2 / t1)$

ΔZ_α = secondary settlement of existing landfill
H_o = initial thickness of the waste layer before starting secondary settlement
C_α' = modified secondary compression index. C_α' = 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.	σ_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

$\Delta Z_c = C_c' \times H_o \times \log (\sigma_o + \Delta\sigma / \sigma_o)$

ΔZ_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
σ_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

$\Delta Z_\alpha = C_\alpha' \times H_o \times \log (t2 / t1)$

ΔZ_α = secondary settlement of existing landfill
H_o = initial thickness of the waste layer before starting secondary settlement
C_α' = modified secondary compression index. C_α' = 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.	σ_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

$\Delta Z_c = C_c' \times H_o \times \log (\sigma_o + \Delta\sigma / \sigma_o)$

ΔZ_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
σ_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

$\Delta Z_\alpha = C_\alpha' \times H_o \times \log (t2 / t1)$

ΔZ_α = secondary settlement of existing landfill
H_o = initial thickness of the waste layer before starting secondary settlement
C_α' = modified secondary compression index. C_α' = 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.	σ_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

$\Delta Z_c = C_c' \times H_o \times \log (\sigma_o + \Delta\sigma / \sigma_o)$

ΔZ_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
σ_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

$\Delta Z_\alpha = C_\alpha' \times H_o \times \log (t2 / t1)$

ΔZ_α = secondary settlement of existing landfill
H_o = initial thickness of the waste layer before starting secondary settlement
C_α' = modified secondary compression index. C_α' = 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.	σ_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

β =	18.4	slope angle from horiz. (degrees)	cotan β =	3.0		
δ =	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
ϕ =	29	friction angle of cover soil (degrees)			Na =	1568.06
γ =	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

β =	18.4	slope angle from horiz. (degrees)					
δ =	28	interface friction angle between cover and landfill mass (degrees)				Wa =	5654.15
ϕ =	29	friction angle of cover soil (degrees)				Wp=	6.49
γ =	117	Unit Weight of partially saturated cover soil (pcf)	18.4	(kN/m^3)		Un=	902.67
γ_{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
γ_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

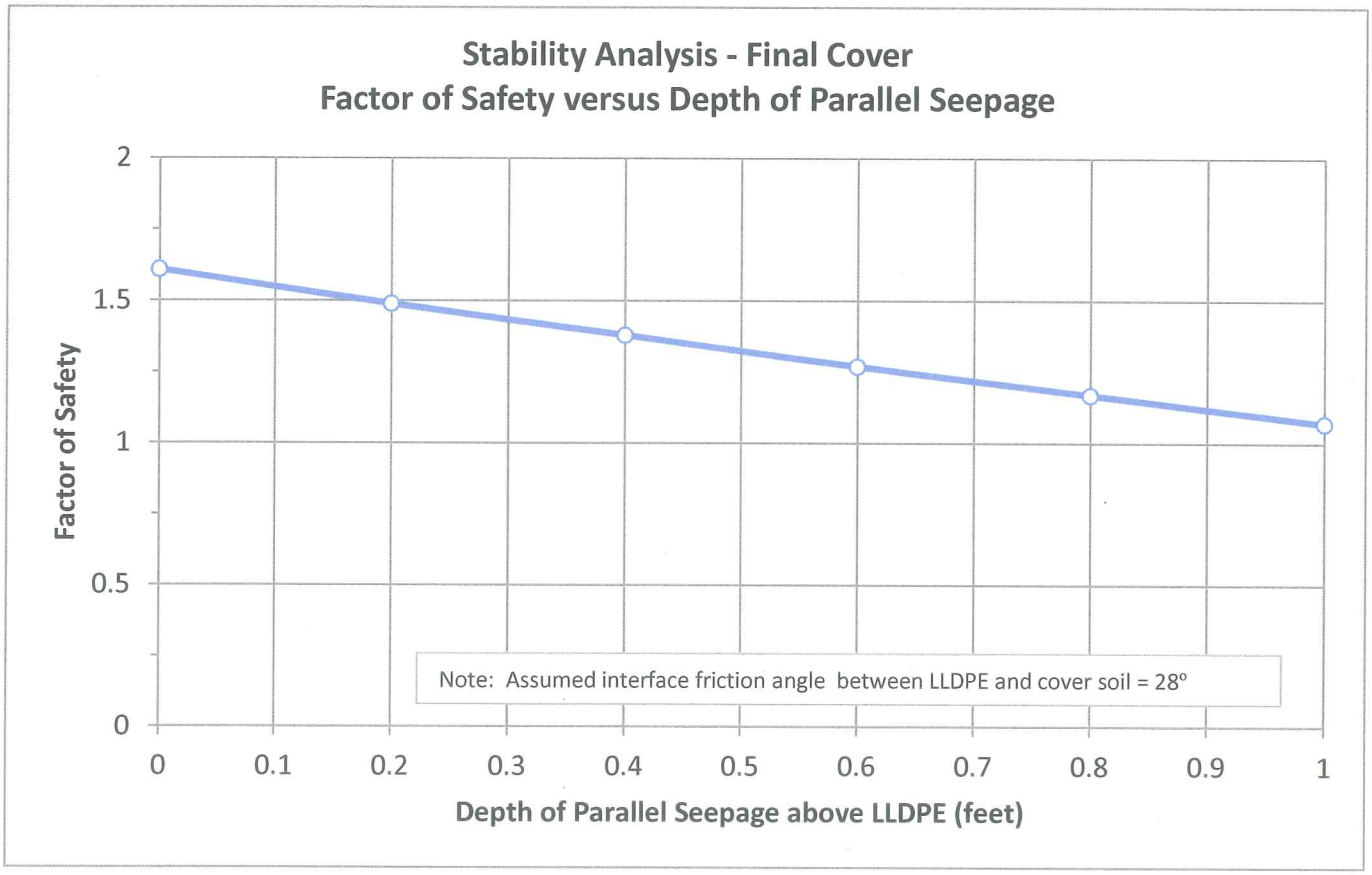
Case: Sliding along cover & LLDPE — Gravity plus Seismic

Cs =	0.09	seismic coefficient			Wa =	1652.55
β =	18.4	slope angle from horiz. (degrees)			Wp=	6.41
δ =	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
ϕ =	23	friction angle of cover soil (degrees)			C =	0
γ =	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

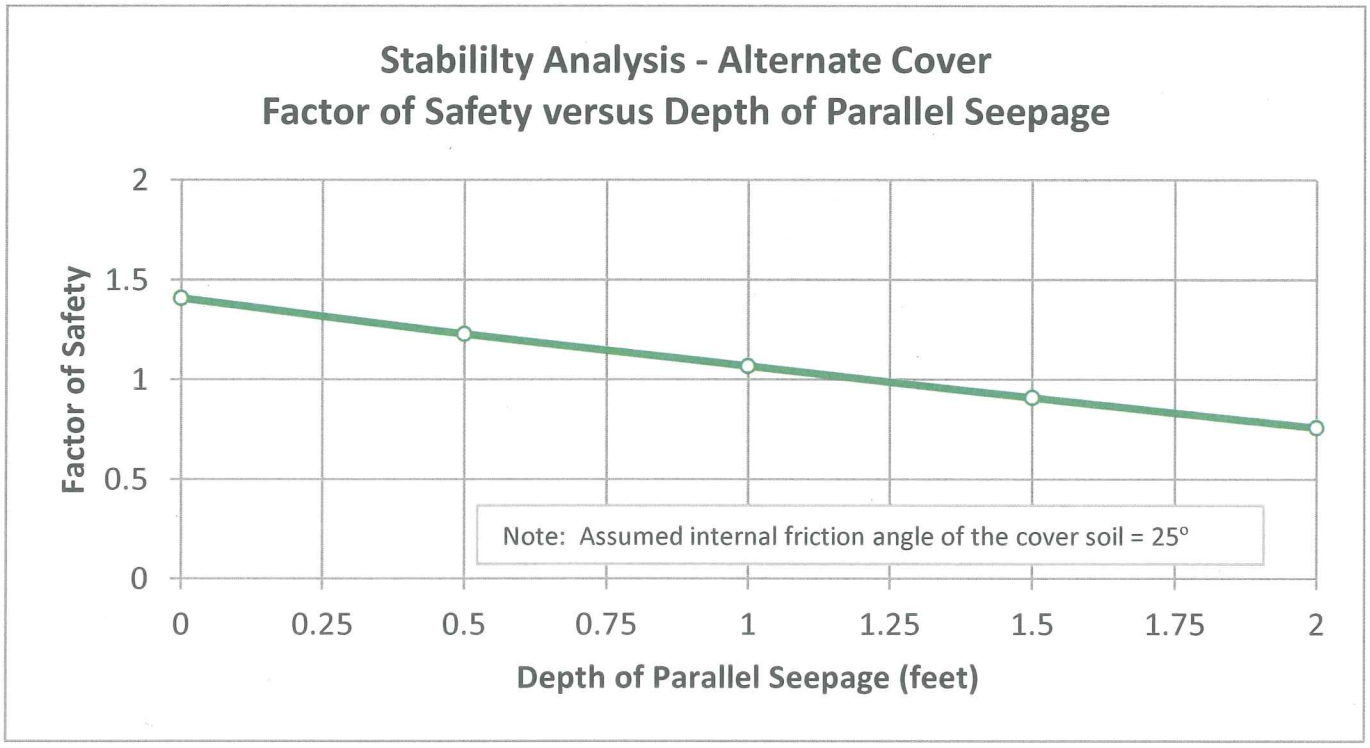
Project: McCombs LF, El Paso, TX

Job #: 01-05106

Case: Sliding within 6 inch intermediate cover material Gravity Only

β =	18.4	slope angle from horiz. (degrees)	cotan β =	3.0		
δ =	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
ϕ =	25	friction angle of cover soil (degrees)			Na =	2227.94
γ =	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.

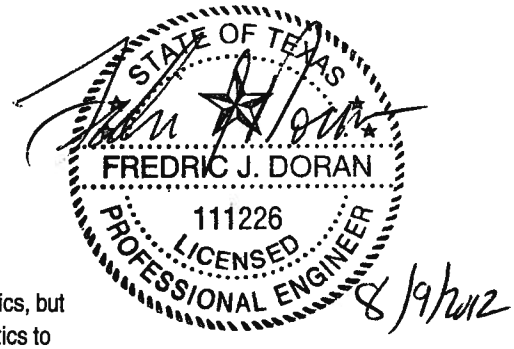
- Interface liner system stability (equipment): 1.31 and 1.36

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
γ_{cs} =	110	pcf	Unit weight of protective cover of anchor trench, assumed value
L_{RO} =	4	ft	Runout length with soil cover, design value
ϕ_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
ϕ_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
γ_{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
γ_{cs} =	110	pcf	Unit weight of protective cover of anchor trench, assumed value
ϕ_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
ϕ_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
γ_{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
γ_{cs} =	110	pcf	Unit weight of protective cover of anchor trench, assumed value
ϕ_2 =	24	°	Most critical friction angle below geomembrane (woven geotextile to soil, assumed value)
	0.42	radians	
F_{AT2} =	**878.9**	**lb/ft**	Calculated

$F_{BU} = \gamma_{cs}(d_{AT} + d_{cs})d_{BT} * \tan\phi_1$

γ_{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
ϕ_1 =	25	°	Most critical friction angle above geomembrane (sand to textured geomembrane, assumed value)
	0.44	radians	
F_{BU} =	**0**	**lb/ft**	Calculated

$F_{BL} = \gamma_{cs}(d_{AT} + d_{cs})d_{BT} * \tan\phi_2$

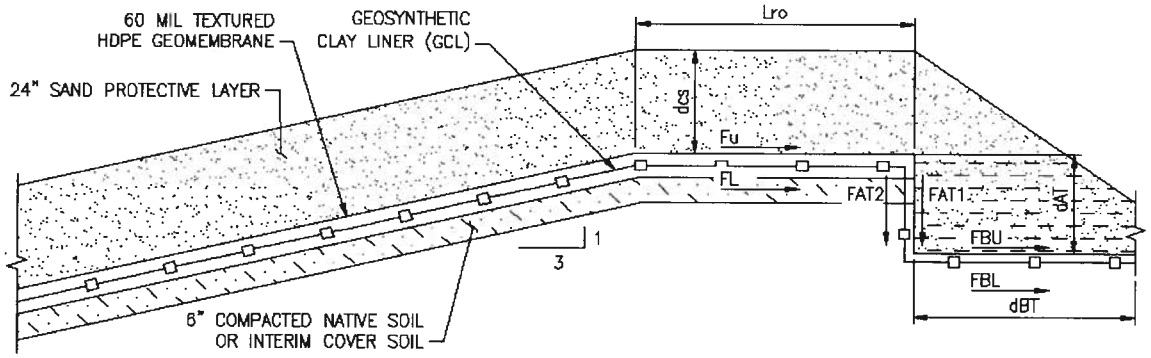
γ_{cs} =	110	pcf	Unit weight of protective cover of anchor trench, assumed value
d_{AT} =	2	ft	Depth of ancor trench, design value
d_{cs} =	2	ft	Depth of protective cover on the liner runout, design value
d_{BT} =	0	ft	Runout length at base of anchor trench, design value
ϕ_2 =	24	°	Most critical friction 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**



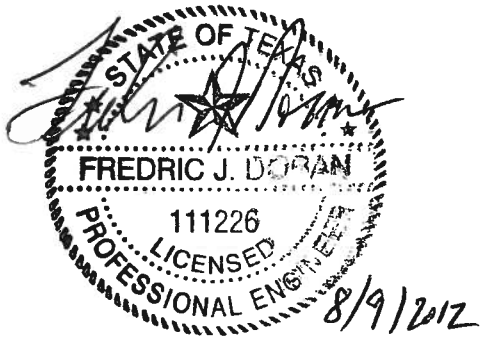
References:

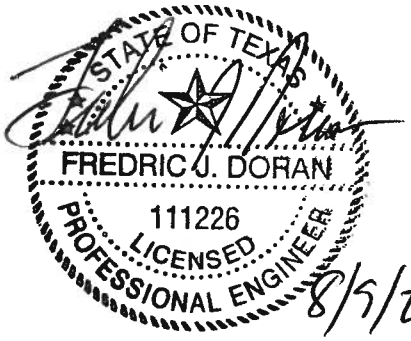
Koerner, Robert M, *Designing with Geosynthetics*, 5th Edition, 2005.

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

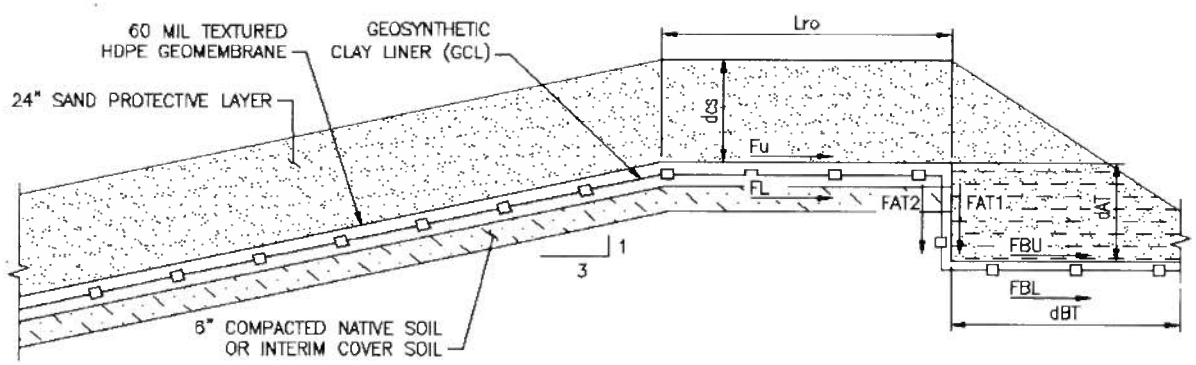
Problem Statement:

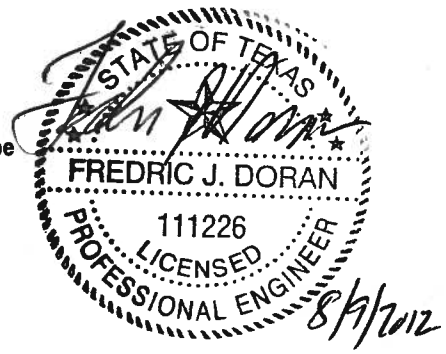
In order to determine the required tensile strength of the geosynthetics to be placed as the liner beneath the protective soil, it is necessary to calculate the tensile forces placed on the liner system. After determining the tensile forces present in the cover liner system, it would be possible to define 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

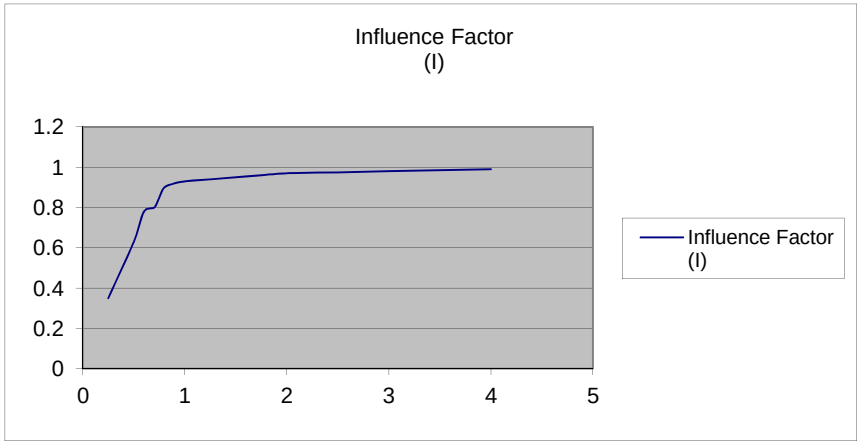
Conclusions

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

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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. 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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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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MCCOMBS LANDFILL
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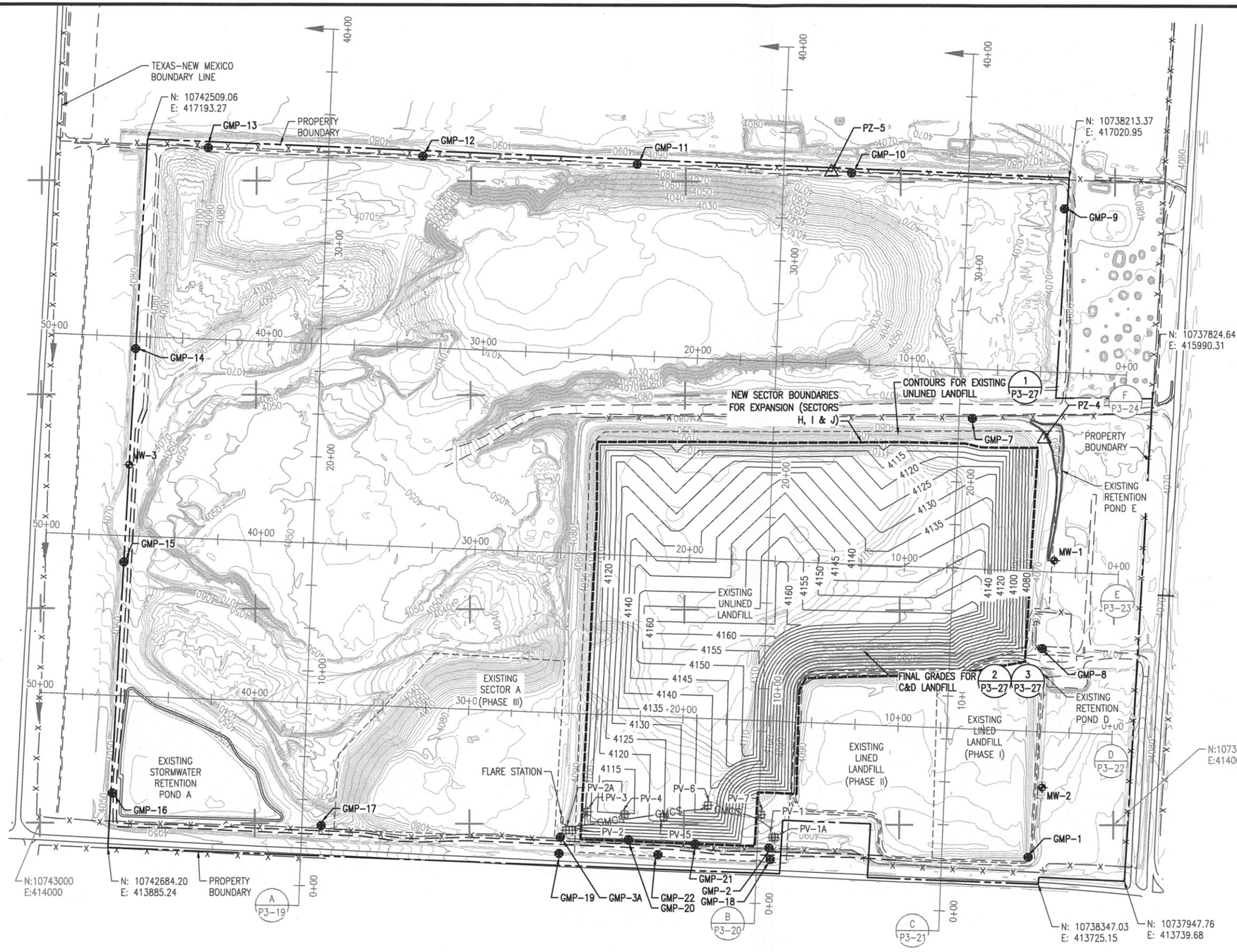
ASBESTOS LOCATION AND FINAL GRADES

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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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 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.

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
	STORMWATER RETENTION POND BOUNDARY
	HIGHWAY
	LANDFILL ACCESS ROAD

GRAPHIC SCALE

1"=250'–0" 250 0 250 500 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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1	8/9/12	TLK	FJD	FIRST TECHNICAL NOD
0	11/22/11	FJD	SEK	MAJOR PERMIT AMENDMENT

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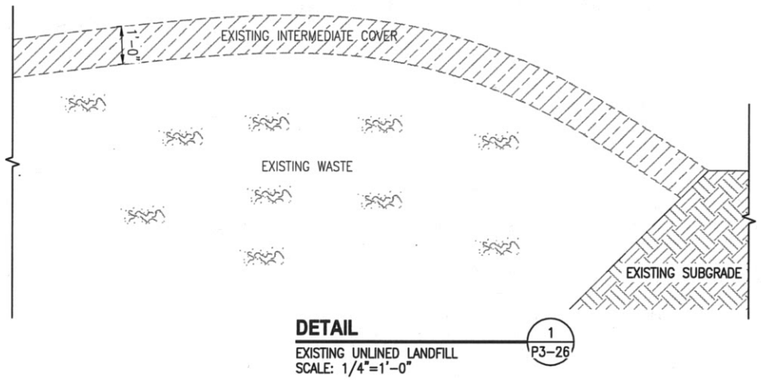
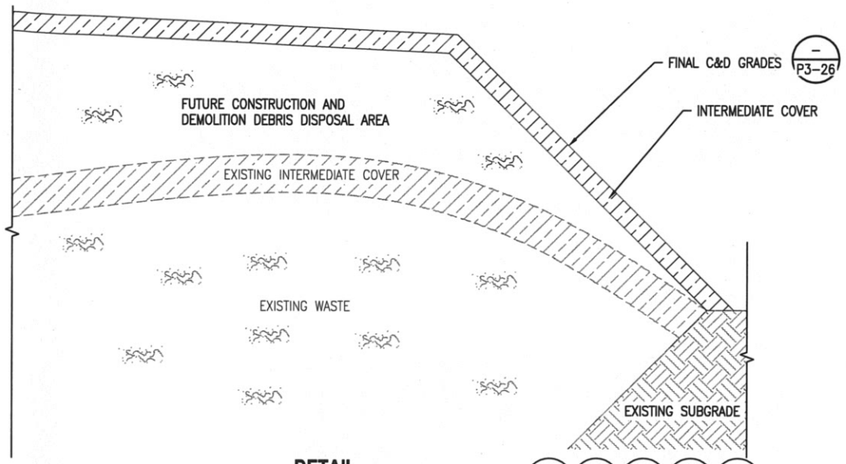
C&D FINAL GRADES

PROJECT NUMBER: 9631500115
SHT. 59 OF: 78
DRAWING NUMBER: P3–26

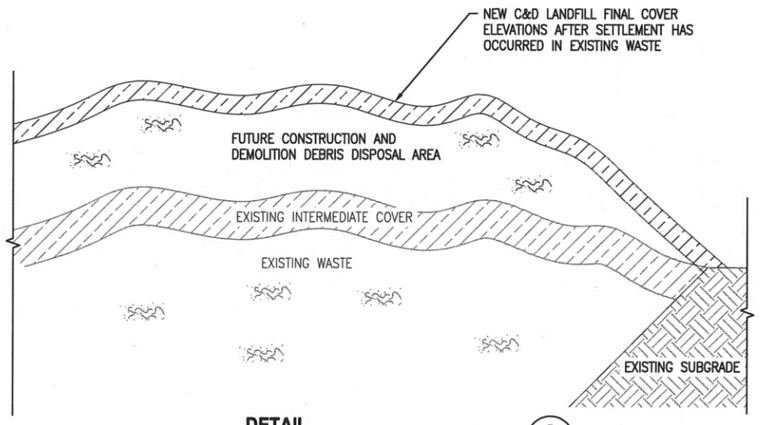
Keller, Tonya L. 11/1/2012 9:25:27 AM – P:\00218000 el paso tx\9631500115\data analytical\CADD\P3–26 C&D FINAL GRADES.dwg



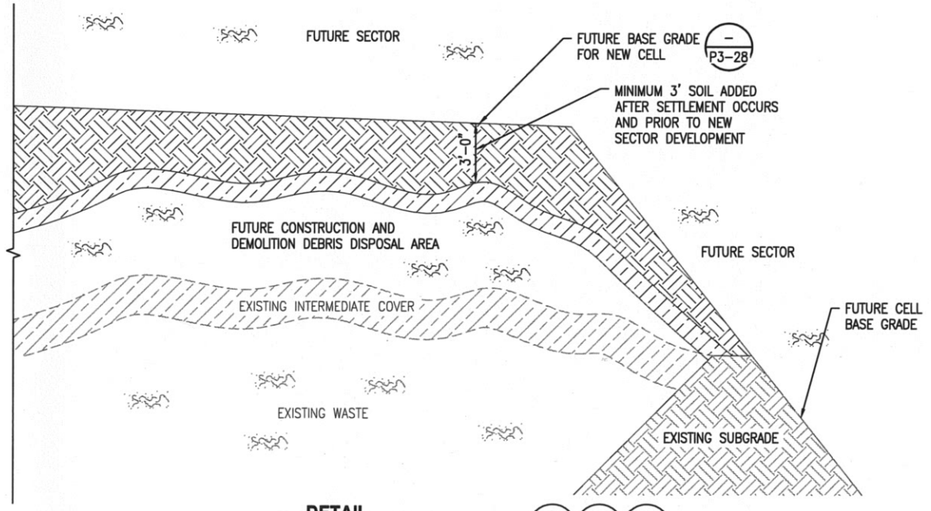
DETAIL 1 / P3–26
EXISTING UNLINED LANDFILL
SCALE: 1/4"=1'-0"



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"



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"

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.

LEGEND

- EXISTING SUBGRADE
- FUTURE BASE GRADE
- DAILY/INTERMEDIATE COVER
- REFUSE

GRAPHIC SCALE
1/4"=1'-0" 2 0 2 4 6 8 10
Scale Feet

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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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MCCOMBS LANDFILL
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PIGGYBACK DESIGN OVER EXISTING LANDFILL

PROJECT NUMBER: 9631500115
SHT. 60 OF: 78
DRAWING NUMBER: P3–27

Keller, Tonya L. 10/22/2012 3:20:47 PM – P:\0021800 el paso tx\9631500115\data analytical\CADD\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. SECTORS H, I, AND J WILL RECEIVE THE PIGGYBACK LINER AS PORTRAYED ON DRAWING P3-29.

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

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11/1/12

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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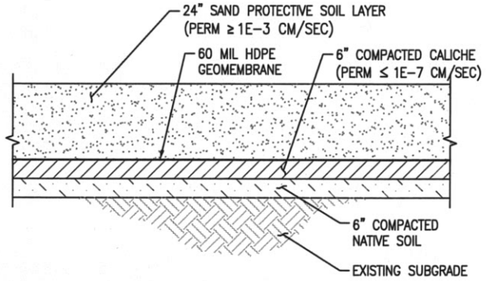
MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

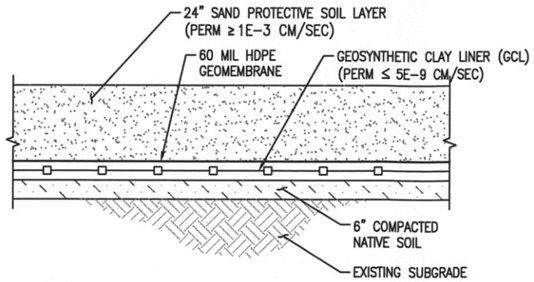
LANDFILL BASE PLAN

PROJECT NUMBER: 9631500115
SHT. 61 OF: 78
DRAWING NUMBER: P3-28

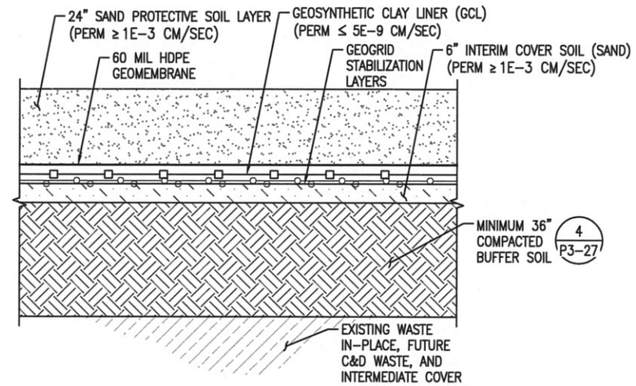
Keller, Tonya L. 11/1/2012 9:28:41 AM – P:\00218000 el paso tx\9631500115\data analytical\CADD\P3-28 LANDFILL BASE PLAN.dwg



DETAIL (1 / –)
CURRENT PERMITTED (PRESCRIPTIVE) LINER
SCALE: 1/2"=1'-0"



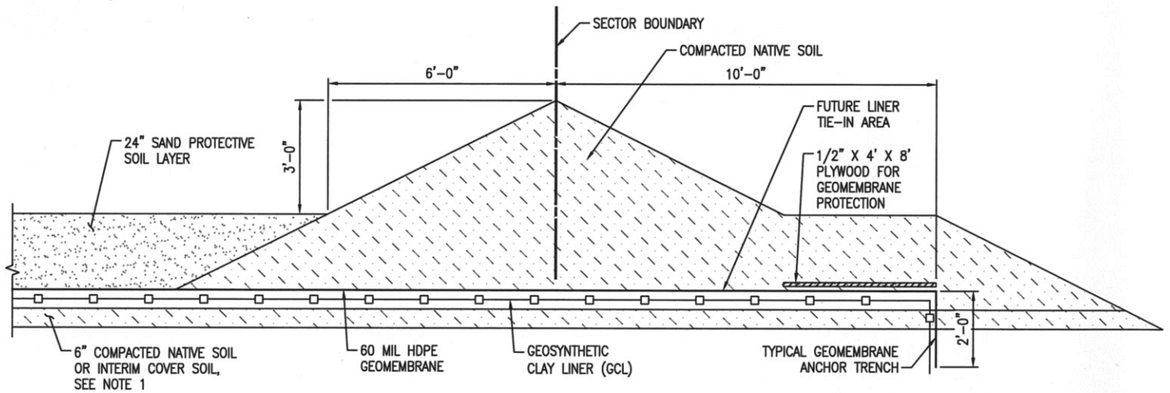
DETAIL (2 / P3-19, 2 / P3-20, 2 / P3-21, 2 / P3-22, 2 / P3-23, 2 / P3-24)
NEW ALTERNATIVE LINER
SCALE: 1/2"=1'-0"



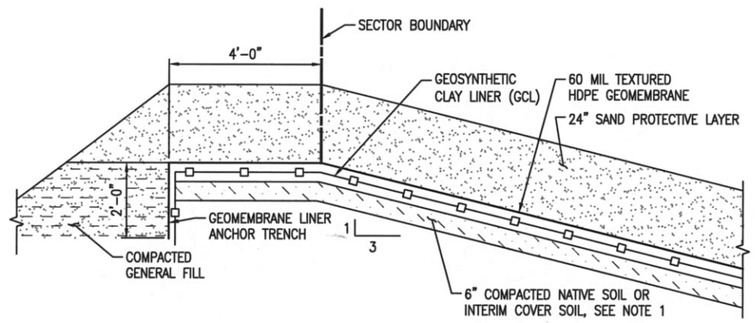
DETAIL (3 / – , 3 / P3-20, 3 / P3-21, 3 / P3-22, 3 / P3-23, 3 / P3-31, 3 / P3-32, 3 / P3-34)
ALTERNATIVE PIGGYBACK LINER
SCALE: 1/2"=1'-0"

NOTES

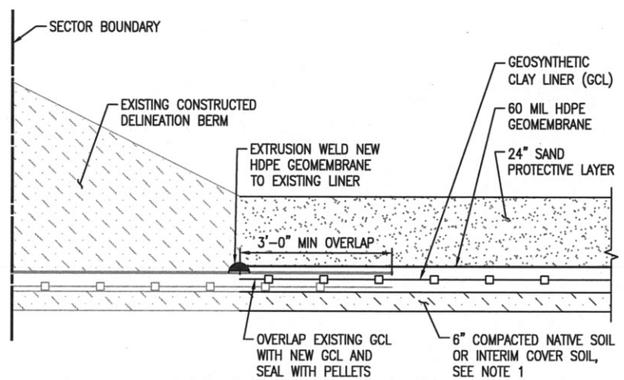
1. FOR THE ALTERNATIVE PIGGYBACK, THE INTERIM COVER SOIL LAYER SHALL UNDERLAY GEOGRID STABILIZATION LAYERS AS SHOWN ON DETAIL 3.
2. DETAIL SHOWN FOR DELINEATION BERM OVER UNLINED LANDFILL. IF THE VERTICAL EXPANSION AREA IS OVER THE EXISTING LINED LANDFILL, THE FINAL COVER GRADE TO MATCH DETAIL 2, SHEET 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.



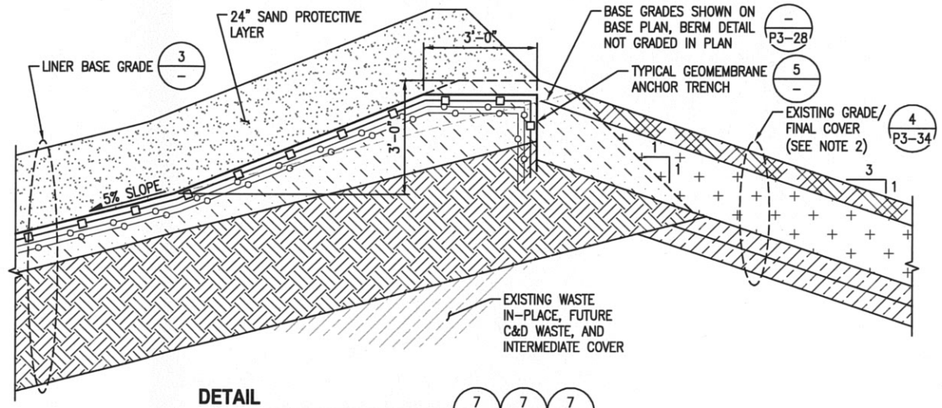
DETAIL (4 / P2-9, 4 / P2-10, 4 / P2-11, 4 / P2-12, 4 / P2-13, 4 / P2-14, 4 / P2-15, 4 / P2-16, 4 / P2-17, 4 / P2-18, 4 / P3-28)
TYPICAL SECTOR DELINEATION BERM
SCALE: 1/2"=1'-0"



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" 1 0 1 2 3 4 5
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
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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LINER DETAILS

PROJECT NUMBER: 9631500115
SHT. 62 OF: 78
DRAWING NUMBER: P3-29

Kolter, Tonya L. 11/1/2012 9:51:05 AM – P:\0021B000 el paso tx\9631500115\data analytical\CADD\P3-29 LINER DETAILS.dwg

N: 10742509.06
E: 417193.27

N:10742000
E:417000

PROPERTY BOUNDARY

STORMWATER RETENTION POND B

B P3-32

TYPICAL LEACHATE COLLECTION SUMP A P3-32

N: 10738213.37
E: 417020.95

N:10738000
E:417000

SECTOR F

SECTOR E

SECTOR D

STORMWATER RETENTION POND C

A P3-31

1% MIN

SECTOR G

TYPICAL LEACHATE CLEANOUT ON SECTOR DELINEATION BERM 4 P3-31

N: 10737824.64
E: 415990.31

PROPERTY BOUNDARY

EXISTING RETENTION POND E

SECTOR H

SECTOR J

5% MIN

TYPICAL LEACHATE COLLECTION LINE 1 P3-31

SECTOR C

SECTOR B

EXISTING UNLINED LANDFILL

EXISTING MAINTENANCE BUILDINGS, GATEHOUSE, AND STORAGE AREA

3:1

4:1

5:1

EXISTING SECTOR A (PHASE III)

SECTOR A

SECTOR I

SECTOR K

EXISTING LINED LANDFILL (PHASE II)

EXISTING LINED LANDFILL (PHASE I)

APPROX LOCATIONS OF EXISTING LEACHATE COLLECTION SYSTEMS FOR LINED LANDFILL PHASES I & II

NEW SITE ENTRANCE FACILITIES

EXISTING STORMWATER RETENTION POND A

LEACHATE COLLECTION SUMP FOR PIGGYBACK C P3-32

TYPICAL LEACHATE LATERAL CLEANOUT 3 P3-31

N: 10742684.20
E: 413885.24

PROPERTY BOUNDARY

N:10742000
E:414000

N:107380C
E:414000

N: 10738347.03
E: 413725.15

N: 10737947.76
E: 413739.68

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
- 5-FOOT ELEVATION CONTOURS
- 1-FOOT ELEVATION CONTOURS
- CHAIN LINK OR OTHER FENCE
- FACILITY/PROPERTY BOUNDARY
- SECTOR BOUNDARIES
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- LANDFILL ACCESS ROAD
- SECTOR BOUNDARIES
- LEACHATE CLEANOUT
- LEACHATE SUMP AND EXTRACTION PIPE

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

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

REV	DATE	CHK'D	APP'D	REVISION DESCRIPTION
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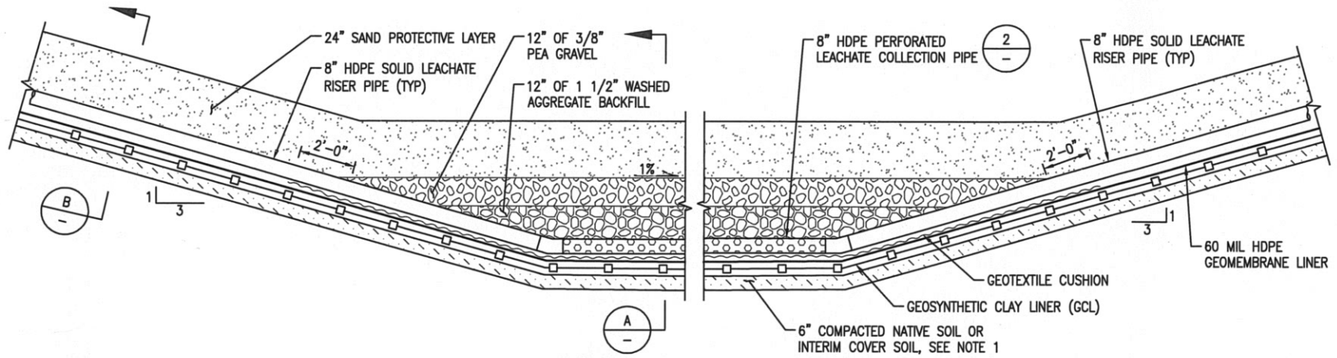
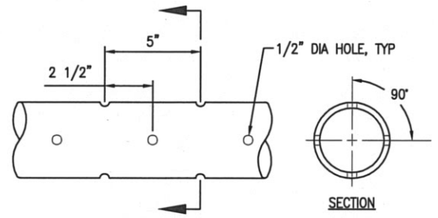
SECTOR LEACHATE COLLECTION SYSTEM PLAN

PROJECT NUMBER: 9631500115
SHT. 63 OF: 78
DRAWING NUMBER: P3-30

Koller, Tonya L. 10/23/2012 9:40:34 AM – P:\00218000 el paso, tx\9631500115\data analytical\CADD\P3-30 SECTOR LEACHATE COLLECTION SYSTEM PLAN.dwg



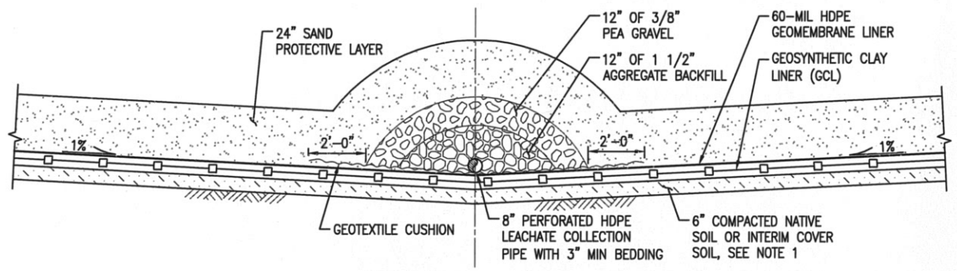
DETAIL 1 / P3–30
TYPICAL LEACHATE COLLECTION LINE
SCALE: 3/8"=1'–0"



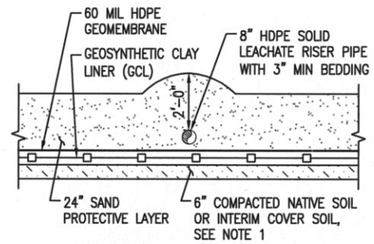
DETAIL 2 / – — 2 / P3–32
PIPE PERFORATION
SCALE: 3"=1'–0"

NOTES

1. FOR THE ALTERNATIVE PIGGYBACK, THE INTERIM COVER SOIL LAYER SHALL UNDERLAY GEOGRID STABILIZATION LAYERS AS SHOWN ON DETAIL 3, DWG P3–29.



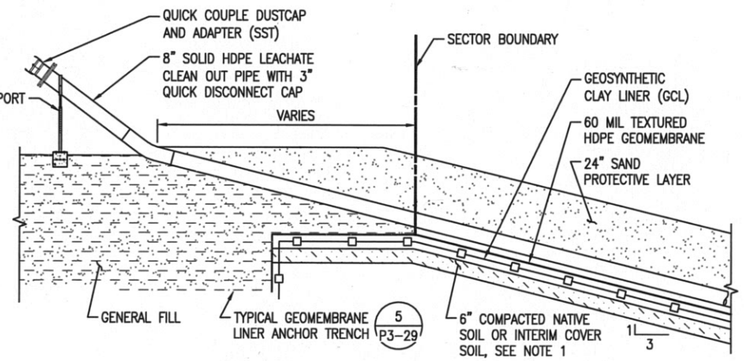
SECTION A / – — A / P3–30
TYPICAL LEACHATE COLLECTION LINE
SCALE: 3/8"=1'–0"



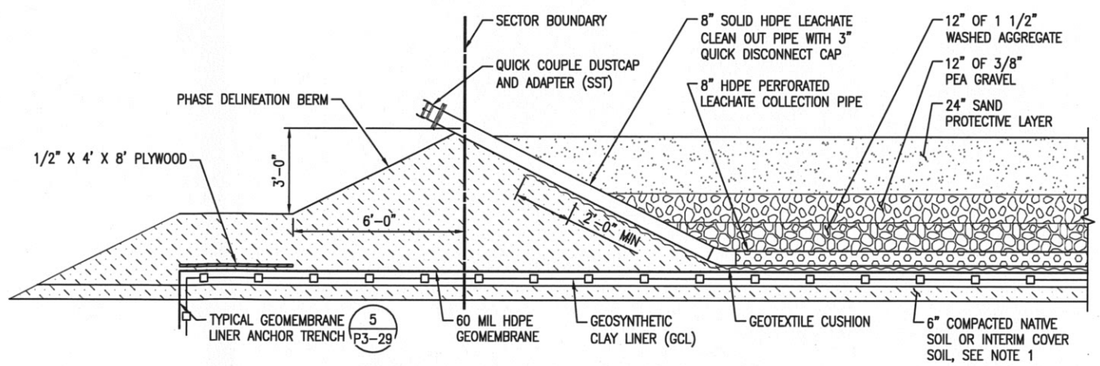
SECTION B / –
TYPICAL LEACHATE CLEANOUT RISER
SCALE: 3/8"=1'–0"

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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111226
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11/2/12

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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
1	11/2/12	TLK	FJD	SECOND TECHNICAL NOD
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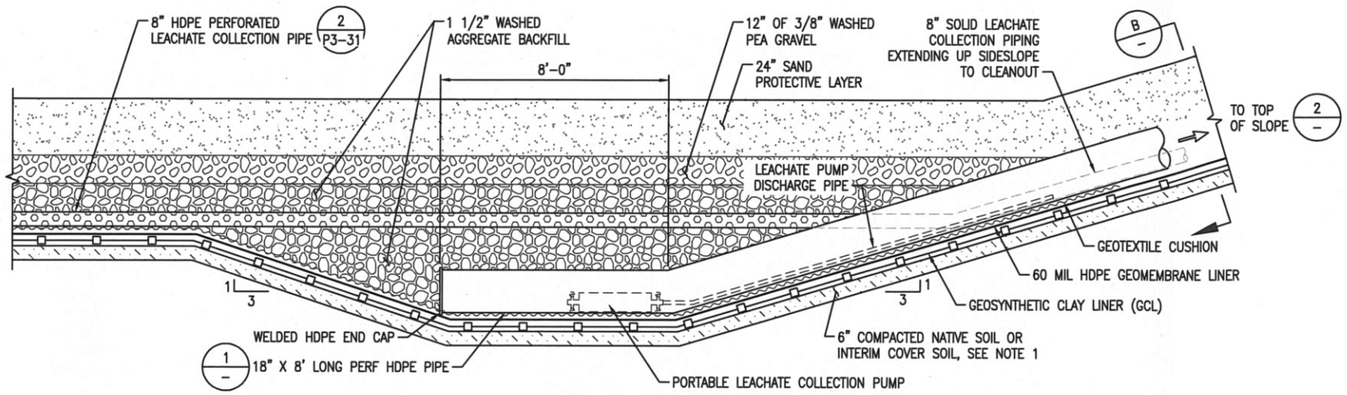
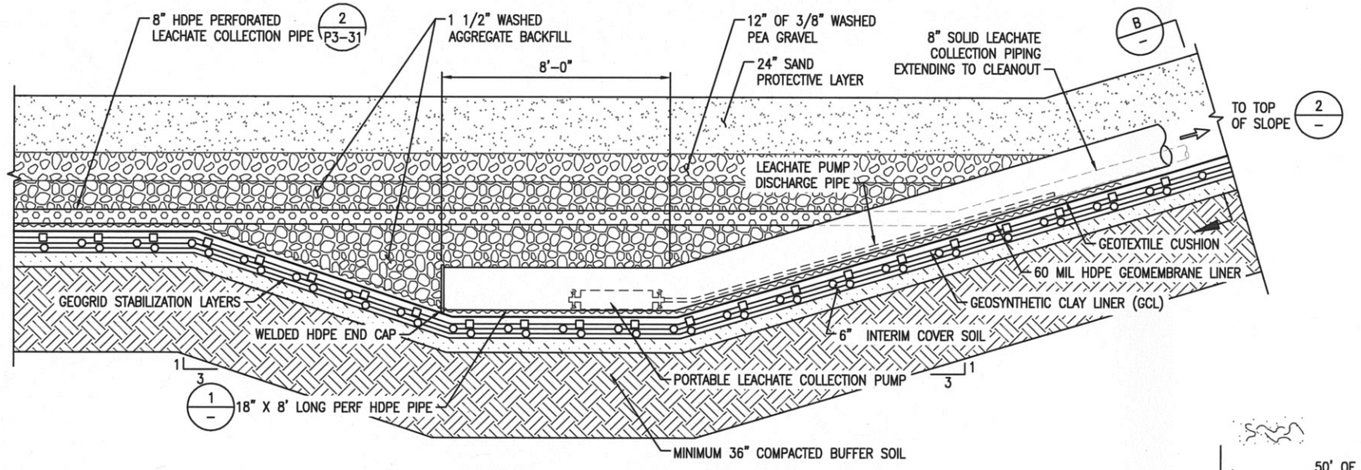
LEACHATE COLLECTION SYSTEM DETAILS

PROJECT NUMBER: 9631500115
SHT. 64 OF: 78
DRAWING NUMBER: P3–31

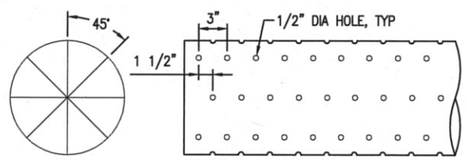
Keller, Tonya L 11/1/2012 9:52:29 AM – P:\0021800 el paso tx\9631500115\data analytical\CADD\P3-31 LEACHATE COLLECTION SYSTEM DETAILS.dwg



SECTION
LEACHATE COLLECTION SUMP
SCALE: 3/8"=1'-0"
A P3-28 A P3-30



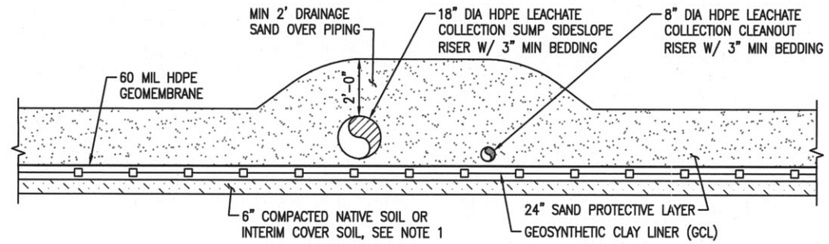
SECTION
LEACHATE COLLECTION SUMP OVER PIGGYBACK LINER
SCALE: 3/8"=1'-0"
C P3-28 C P3-30



DETAIL
LEACHATE SUMP PIPE PERFORATION
SCALE: 1 1/2"=1'-0"
1 –

NOTES

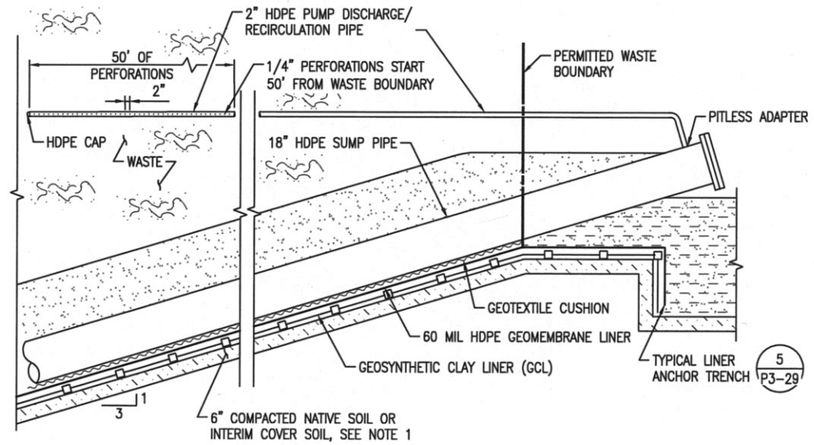
1. FOR THE ALTERNATIVE PIGGYBACK DESIGN, THE INTERIM COVER SOIL LAYER SHALL UNDERLAY GEOGRID STABILIZATION LAYERS AS SHOWN ON DETAIL 3, DWG P3-29.



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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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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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. 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
- STORMWATER RETENTION POND BOUNDARY
- HIGHWAY
- LANDFILL ACCESS ROAD

GRAPHIC SCALE

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
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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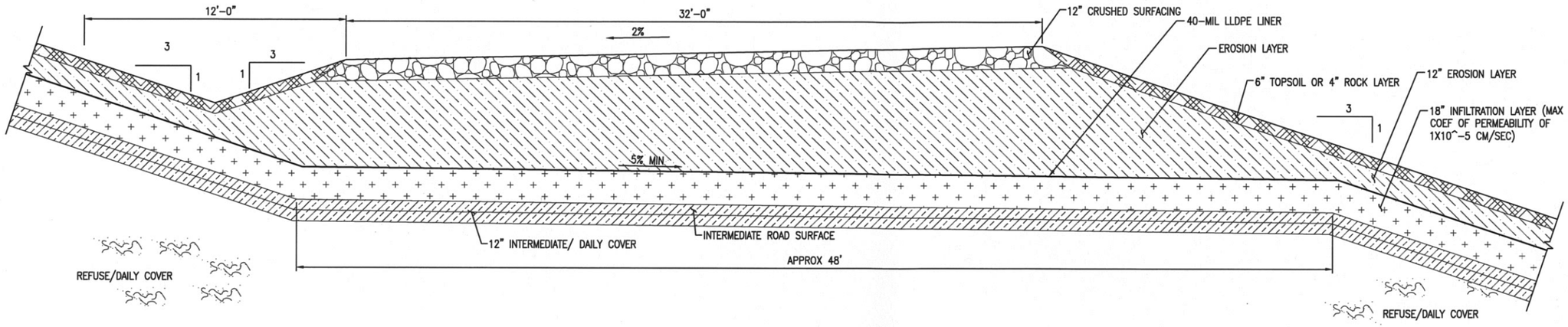
FINAL COVER PLAN

PROJECT NUMBER: 9631500115
SHT. 66 OF: 78
DRAWING NUMBER: P3-33

Keller, Tonya L. 10/23/2012 10:37:56 AM – P:\0021800 el paso tx\96315001\5\data analysis\CAD\P3-33 FINAL COVER PLAN.dwg

NOTES

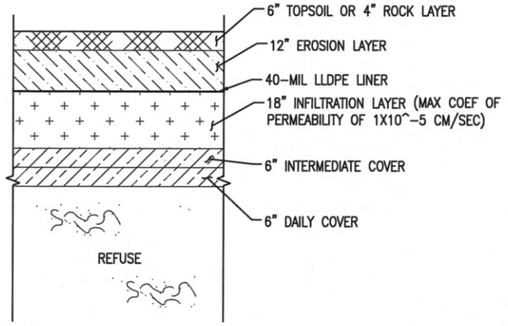
1. FOR THE ALTERNATIVE PIGGYBACK DESIGN, THE INTERIM COVER SOIL LAYER SHALL UNDERLAY GEOGRID STABILIZATION LAYERS AS SHOWN ON DETAIL 3, DWG P3–29.



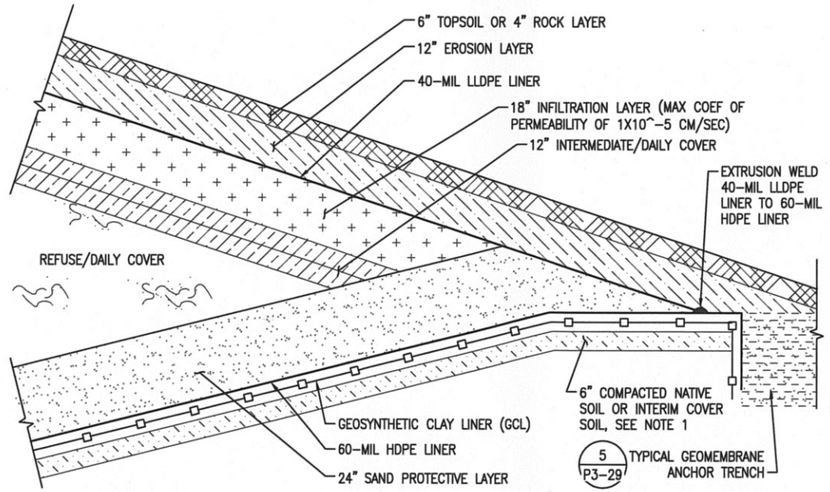
DETAIL 1 P3–20 / 1 P3–33
TYPICAL ROAD DETAIL
SCALE: 3/8"=1'–0"

LEGEND

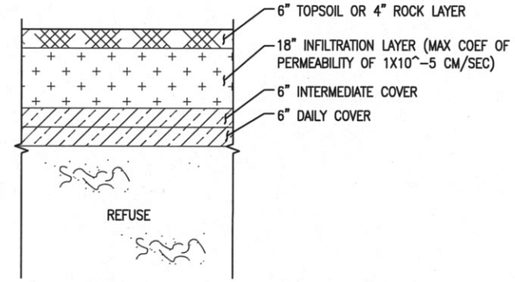
- COMPACTED NATIVE SOIL
- SAND PROTECTIVE LAYER
- TOPSOIL
- DAILY/INTERMEDIATE COVER
- INFILTRATION LAYER
- REFUSE
- GENERAL FILL
- EROSION LAYER
- 12" CRUSHED SURFACING
- GEOMEMBRANE LINER
- GEOSYNTHETIC CLAY LINER (GCL)



DETAIL 2 P3–19 / 2 P3–20 / 2 P3–21 / 2 P3–22 / 2 P3–23 / 2 P3–24 / 2 P3–29 / 2 P3–33
TYPICAL FINAL COVER PROFILE FOR SIDESLOPE OR CROWN
SCALE: 1/2"=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 4 P3–20 / 4 P3–23 / 4 P3–29
FINAL COVER PROFILE FOR UNLINED LANDFILL
SCALE: 1/2"=1'–0"

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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REGISTERED PROFESSIONAL ENGINEER
11/2/12

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0 1"

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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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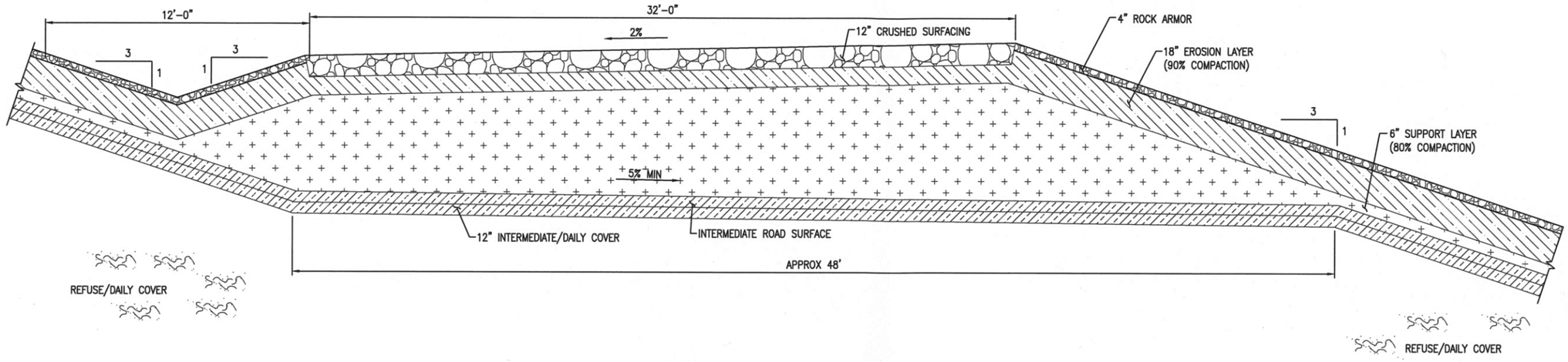
FINAL COVER DETAILS

PROJECT NUMBER: 9631500115
SHT. 67 OF: 78
DRAWING NUMBER: P3–34

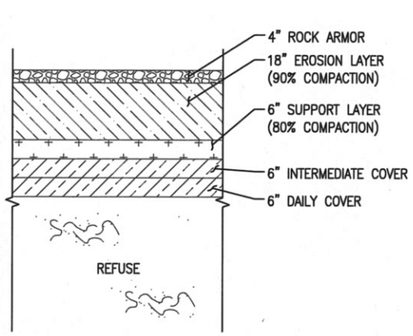
Koller, Tonya L. 11/1/2012 9:54:30 AM – P:\00218000 el paso tx\9631500115\data analytical\CADD\P3–34 FINAL COVER DETAILS.dwg

NOTES

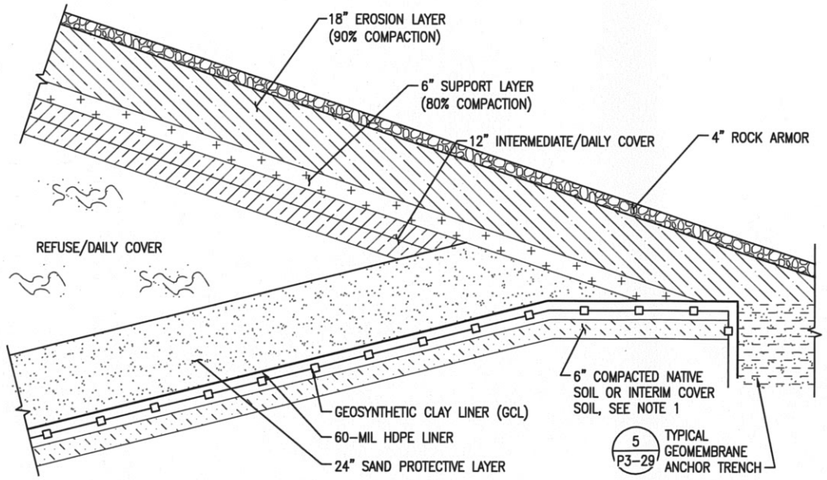
1. FOR THE ALTERNATIVE PIGGYBACK DESIGN, THE INTERIM COVER SOIL LAYER SHALL UNDERLAY GEOGRID STABILIZATION LAYERS AS SHOWN ON DETAIL 3, DWG P3–29.



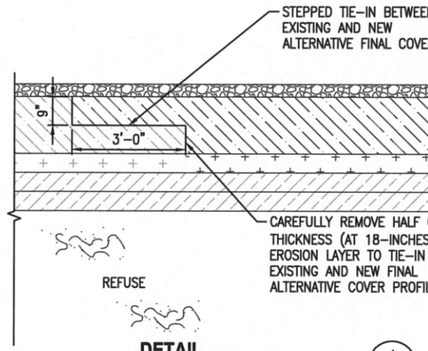
DETAIL
TYPICAL ROAD DETAIL
SCALE: 3/8"=1'–0"
1 P3–20 | 1 P3–33



DETAIL
TYPICAL FINAL COVER PROFILE FOR SIDESLOPE OR CROWN
SCALE: 1/2"=1'–0"
2 P3–19 | 2 P3–20 | 2 P3–21 | 2 P3–22 | 2 P3–23 | 2 P3–24 | 2 P3–29 | 2 P3–33



DETAIL
FINAL COVER CONNECTION TO EXISTING BASE LINER
SCALE: 1/2"=1'–0"
3 P3–19 | 3 P3–20 | 3 P3–21 | 3 P3–22 | 3 P3–23 | 3 P3–24 | 3 P3–29



DETAIL
STEPPED FINAL COVER TIE–IN, TYP.
SCALE: 1/2"=1'–0"
4 –

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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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
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

ALTERNATIVE FINAL COVER DETAILS

PROJECT NUMBER: 9631500115
SHT. 68 OF: 78
DRAWING NUMBER: P3–35

Keller, Tonya L. 11/1/2012 9:55:36 AM – P:\00218000 el paso tx\9631500115\data analytical\CADD\P3–35 ALTERNATIVE FINAL COVER DETAILS.dwg

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 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 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. 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	
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

Year	Tons/Year	CY/Year	Cumulative CY	Remaining CY	
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-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-4
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®

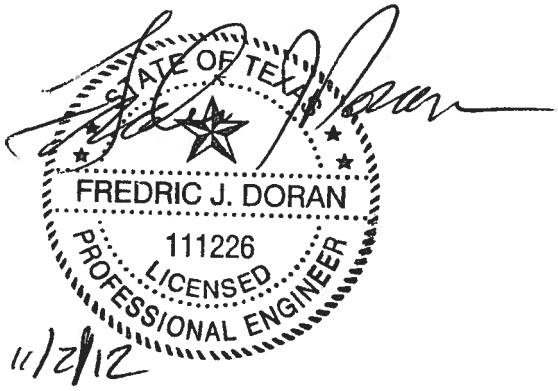
McCombs Municipal Landfill
El Paso County, Texas
TCEQ MSW Permit No. 729B

Part III
Appendix 3I
Leachate and Contaminated Water Plan

Prepared for

City of El Paso

Updated November 2012, Revision 2



Prepared by

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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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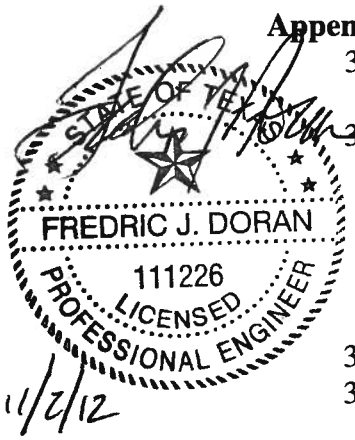

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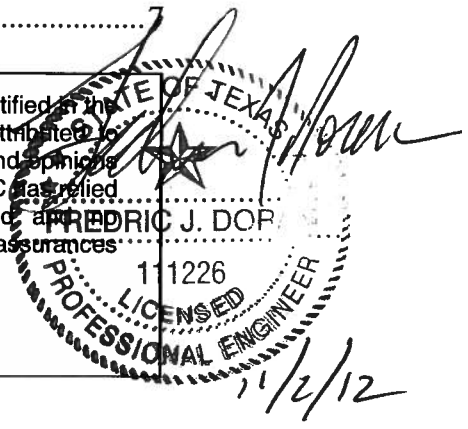

3I.1 Introduction

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 (1.0×10^{-3} cm/sec)	2-Feet Drainage Sand (1.0×10^{-3} cm/sec)	2-Feet Drainage Sand (1.0×10^{-3} cm/sec)	2-Feet Drainage Sand (1.0×10^{-3} cm/sec)	2-Feet Drainage Sand (5.8×10^{-3} cm/sec)	2-Feet Drainage Sand (5.8×10^{-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 (1×10^{-5} cm/sec)	18-Inch Layer (1×10^{-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 – Prescriptive Liner with Barrier Soil	2.216	3.677
Open Condition – Alternative Liner with GCL	3.594	5.607
Intermediate Cover Condition	0.407	0.765
Final Cover Condition (Crown)	0.011	0.021
Final Cover Condition (Side Slopes)	0.003	0.007
Final Cover Condition (Crown) – Alternative Cap	0.016	0.031
Final Cover Condition (Side Slopes) – Alternative Cap	0.032	0.064

1. 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 1.0×10^{-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 1.0×10^{-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

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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\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

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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	=	0.2097	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

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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	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: 14:33 DATE: 8/ 8/2012

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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

Page 1

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	=	0.2698 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	=	0.1072 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	=	0.0927 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 17

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.	=	0.300000003000E-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	=	3.847	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	29010.303	98.06
RECIRCULATION INTO LAYER 1	0.073986	268.568	0.91
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 4	0.073986	268.568	0.91
PERC./LEAKAGE THROUGH LAYER 6	0.000126	0.458	0.00

AVG. HEAD ON TOP OF LAYER 5	1.2502		
PERC./LEAKAGE THROUGH LAYER 7	0.004953	17.978	0.06
CHANGE IN WATER STORAGE	0.153	555.930	1.88
SOIL WATER AT START OF YEAR	36.576	132770.516	
SOIL WATER AT END OF YEAR	36.729	133326.453	
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	0.292	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	9.145	33194.809	107.33
RECIRCULATION INTO LAYER 1	0.088793	322.318	1.04
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 4	0.088793	322.318	1.04
PERC./LEAKAGE THROUGH LAYER 6	0.000155	0.561	0.00
AVG. HEAD ON TOP OF LAYER 5	1.5019		
PERC./LEAKAGE THROUGH LAYER 7	0.004322	15.687	0.05
CHANGE IN WATER STORAGE	-0.629	-2282.902	-7.38
SOIL WATER AT START OF YEAR	36.729	133326.453	
SOIL WATER AT END OF YEAR	36.100	131043.547	
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 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.09	36626.703	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	7.846	28480.980	77.76
RECIRCULATION INTO LAYER 1	0.100780	365.832	1.00
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 4	0.100780	365.832	1.00
PERC./LEAKAGE THROUGH LAYER 6	0.000180	0.653	0.00
AVG. HEAD ON TOP OF LAYER 5	1.7033		
PERC./LEAKAGE THROUGH LAYER 7	0.003822	13.872	0.04
CHANGE IN WATER STORAGE	2.240	8131.151	22.20
SOIL WATER AT START OF YEAR	36.100	131043.547	
SOIL WATER AT END OF YEAR	37.857	137419.531	
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	0.700	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	29962.191	108.18
RECIRCULATION INTO LAYER 1	0.197383	716.502	2.59
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 4	0.197383	716.502	2.59
PERC./LEAKAGE THROUGH LAYER 6	0.000403	1.464	0.01
AVG. HEAD ON TOP OF LAYER 5	3.3287		
PERC./LEAKAGE THROUGH LAYER 7	0.003249	11.795	0.04

CHANGE IN WATER STORAGE	-0.627	-2277.627	-8.22
SOIL WATER AT START OF YEAR	37.857	137419.531	
SOIL WATER AT END OF YEAR	37.713	136897.078	
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	0.540	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	2.689	0.883	0.421	0.505
STD. DEVIATIONS	0.179	0.251	0.312	0.115	0.071	0.329
	0.945	0.593	0.939	0.406	0.043	0.046
LATERAL DRAINAGE RECIRCULATED INTO LAYER 1						
TOTALS	0.0085	0.0080	0.0090	0.0090	0.0095	0.0094
	0.0098	0.0099	0.0097	0.0105	0.0106	0.0114
STD. DEVIATIONS	0.0039	0.0040	0.0045	0.0047	0.0050	0.0049
	0.0051	0.0051	0.0049	0.0049	0.0047	0.0050
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	0.0085	0.0080	0.0090	0.0090	0.0095	0.0094
	0.0098	0.0099	0.0097	0.0105	0.0106	0.0114
STD. DEVIATIONS	0.0039	0.0040	0.0045	0.0047	0.0050	0.0049
	0.0051	0.0051	0.0049	0.0049	0.0047	0.0050

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	0.0004	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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	1.6953	1.7401	1.7900	1.8540	1.8980	1.9281
	1.9506	1.9679	1.9886	2.1000	2.1746	2.2654
STD. DEVIATIONS	0.7724	0.8307	0.9051	0.9595	0.9876	1.0043
	1.0128	1.0158	1.0105	0.9685	0.9611	0.9993

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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	8.309	(0.5820)	30162.07	96.646
DRAINAGE RECIRCULATED INTO LAYER 1	0.11524	(0.05585)	418.305	1.34034
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.00000	(0.00000)	0.000	0.00000

DRAINAGE RECIRCULATED FROM LAYER 4	0.11524 (0.05585)	418.305	1.34034
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00022 (0.00013)	0.784	0.00251
AVERAGE HEAD ON TOP OF LAYER 5	1.946 (0.940)		
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00409 (0.00072)	14.833	0.04753
CHANGE IN WATER STORAGE	0.284 (1.3549)	1031.64	3.306

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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	0.00058	2.11307
DRAINAGE COLLECTED FROM LAYER 4	0.00000	0.00000
DRAINAGE RECIRCULATED FROM LAYER 4	0.00058	2.11307
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000001	0.00440
AVERAGE HEAD ON TOP OF LAYER 5	3.594	
MAXIMUM HEAD ON TOP OF LAYER 5	5.607	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	77.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000015	0.05312
SNOW WATER	0.56	2033.9432

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3071
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1215

*** 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	0.7856	0.1309
2	32.8165	0.2735
3	1.4893	0.1241
4	2.0905	0.1742
5	0.0000	0.0000
6	0.1800	0.7500
7	0.3508	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               **
**                                                                           **
**                                                                           **
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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\ALIN_INT.D10
OUTPUT DATA FILE:           C:\PROGRAM\ELPASO\ALIN_INT.OUT


TIME:  14:36     DATE:   8/ 8/2012


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     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
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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

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 17

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.	=	0.300000003000E-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

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

	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	49.561	0.17
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 5	0.013653	49.561	0.17
PERC./LEAKAGE THROUGH LAYER 7	0.000022	0.078	0.00
AVG. HEAD ON TOP OF LAYER 6	0.2306		
PERC./LEAKAGE THROUGH LAYER 8	0.005012	18.195	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	-0.244	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	0.020299	73.686	0.24
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 5	0.020299	73.686	0.24
PERC./LEAKAGE THROUGH LAYER 7	0.000032	0.117	0.00
AVG. HEAD ON TOP OF LAYER 6	0.3432		
PERC./LEAKAGE THROUGH LAYER 8	0.004381	15.904	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	0.145	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	0.023070	83.746	0.23
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 5	0.023070	83.746	0.23
PERC./LEAKAGE THROUGH LAYER 7	0.000037	0.133	0.00
AVG. HEAD ON TOP OF LAYER 6	0.3902		
PERC./LEAKAGE THROUGH LAYER 8	0.003888	14.112	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	0.110	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	0.024023	87.203	0.31
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 5	0.024023	87.203	0.31
PERC./LEAKAGE THROUGH LAYER 7	0.000038	0.138	0.00
AVG. HEAD ON TOP OF LAYER 6	0.4053		
PERC./LEAKAGE THROUGH LAYER 8	0.003500	12.705	0.05
CHANGE IN WATER STORAGE	-0.658	-2388.156	-8.62
SOIL WATER AT START OF YEAR	808.140	2933547.750	
SOIL WATER AT END OF YEAR	807.966	2932914.750	
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	-0.0001	-0.208	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	0.023819	86.464	0.26
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 5	0.023819	86.464	0.26
PERC./LEAKAGE THROUGH LAYER 7	0.000038	0.137	0.00
AVG. HEAD ON TOP OF LAYER 6	0.4029		
PERC./LEAKAGE THROUGH LAYER 8	0.003164	11.487	0.04
CHANGE IN WATER STORAGE	0.933	3386.508	10.34
SOIL WATER AT START OF YEAR	807.966	2932914.750	
SOIL WATER AT END OF YEAR	808.898	2936301.250	

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	0.079	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	0.023106	83.874	0.29
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 5	0.023106	83.874	0.29
PERC./LEAKAGE THROUGH LAYER 7	0.000037	0.133	0.00
AVG. HEAD ON TOP OF LAYER 6	0.3909		
PERC./LEAKAGE THROUGH LAYER 8	0.002892	10.499	0.04
CHANGE IN WATER STORAGE	-0.700	-2541.709	-8.77
SOIL WATER AT START OF YEAR	808.898	2936301.250	
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	-0.171	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	0.022073	80.124	0.33
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 5	0.022073	80.124	0.33
PERC./LEAKAGE THROUGH LAYER 7	0.000035	0.127	0.00
AVG. HEAD ON TOP OF LAYER 6	0.3734		
PERC./LEAKAGE THROUGH LAYER 8	0.002662	9.662	0.04
CHANGE IN WATER STORAGE	0.503	1826.078	7.43
SOIL WATER AT START OF YEAR	808.198	2933759.500	
SOIL WATER AT END OF YEAR	808.701	2935585.750	
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	0.208	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	0.020930	75.975	0.40
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 5	0.020930	75.975	0.40
PERC./LEAKAGE THROUGH LAYER 7	0.000033	0.120	0.00
AVG. HEAD ON TOP OF LAYER 6	0.3531		
PERC./LEAKAGE THROUGH LAYER 8	0.002470	8.966	0.05
CHANGE IN WATER STORAGE	0.327	1186.219	6.27
SOIL WATER AT START OF YEAR	808.701	2935585.750	
SOIL WATER AT END OF YEAR	809.028	2936772.000	
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	-0.184	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	27770.992	95.51
RECIRCULATION INTO LAYER 2	0.019602	71.157	0.24
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 5	0.019602	71.157	0.24
PERC./LEAKAGE THROUGH LAYER 7	0.000031	0.112	0.00
AVG. HEAD ON TOP OF LAYER 6	0.3316		
PERC./LEAKAGE THROUGH LAYER 8	0.002291	8.318	0.03
CHANGE IN WATER STORAGE	0.357	1296.777	4.46
SOIL WATER AT START OF YEAR	809.028	2936772.000	
SOIL WATER AT END OF YEAR	809.385	2938068.750	
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	0.211	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	25677.576	104.03
RECIRCULATION INTO LAYER 2	0.018325	66.520	0.27

DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 5	0.018325	66.520	0.27
PERC./LEAKAGE THROUGH LAYER 7	0.000029	0.105	0.00
AVG. HEAD ON TOP OF LAYER 6	0.3100		
PERC./LEAKAGE THROUGH LAYER 8	0.002141	7.772	0.03
CHANGE IN WATER STORAGE	-0.276	-1001.219	-4.06
SOIL WATER AT START OF YEAR	809.385	2938068.750	
SOIL WATER AT END OF YEAR	809.109	2937067.500	
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	-0.133	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	0.017076	61.986	0.24
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 5	0.017076	61.986	0.24
PERC./LEAKAGE THROUGH LAYER 7	0.000027	0.098	0.00
AVG. HEAD ON TOP OF LAYER 6	0.2889		
PERC./LEAKAGE THROUGH LAYER 8	0.002008	7.290	0.03
CHANGE IN WATER STORAGE	-0.545	-1976.959	-7.64
SOIL WATER AT START OF YEAR	809.109	2937067.500	
SOIL WATER AT END OF YEAR	808.565	2935090.500	
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	-0.060	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	0.015920	57.791	0.32
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 5	0.015920	57.791	0.32
PERC./LEAKAGE THROUGH LAYER 7	0.000025	0.091	0.00
AVG. HEAD ON TOP OF LAYER 6	0.2686		
PERC./LEAKAGE THROUGH LAYER 8	0.001895	6.880	0.04
CHANGE IN WATER STORAGE	0.172	624.128	3.40
SOIL WATER AT START OF YEAR	808.565	2935090.500	
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	-0.069	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	30576.117	100.76
RECIRCULATION INTO LAYER 2	0.014743	53.516	0.18
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 5	0.014743	53.516	0.18

PERC./LEAKAGE THROUGH LAYER 7	0.000023	0.085	0.00
AVG. HEAD ON TOP OF LAYER 6	0.2494		
PERC./LEAKAGE THROUGH LAYER 8	0.001784	6.477	0.02
CHANGE IN WATER STORAGE	-0.065	-235.959	-0.78
SOIL WATER AT START OF YEAR	808.737	2935714.750	
SOIL WATER AT END OF YEAR	808.672	2935478.750	
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	0.166	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	6.659	24172.803	94.86
RECIRCULATION INTO LAYER 2	0.013682	49.665	0.19
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 5	0.013682	49.665	0.19
PERC./LEAKAGE THROUGH LAYER 7	0.000022	0.079	0.00
AVG. HEAD ON TOP OF LAYER 6	0.2315		
PERC./LEAKAGE THROUGH LAYER 8	0.001689	6.133	0.02
CHANGE IN WATER STORAGE	0.359	1303.867	5.12
SOIL WATER AT START OF YEAR	808.672	2935478.750	
SOIL WATER AT END OF YEAR	809.031	2936782.500	
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	-0.204	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	18067.002	104.12
RECIRCULATION INTO LAYER 2	0.012695	46.083	0.27
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 5	0.012695	46.083	0.27
PERC./LEAKAGE THROUGH LAYER 7	0.000020	0.073	0.00
AVG. HEAD ON TOP OF LAYER 6	0.2148		
PERC./LEAKAGE THROUGH LAYER 8	0.001604	5.821	0.03
CHANGE IN WATER STORAGE	-0.199	-721.613	-4.16
SOIL WATER AT START OF YEAR	809.031	2936782.500	
SOIL WATER AT END OF YEAR	808.832	2936061.000	
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	0.189	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	0.011813	42.882	0.14
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 5	0.011813	42.882	0.14
PERC./LEAKAGE THROUGH LAYER 7	0.000019	0.068	0.00

AVG. HEAD ON TOP OF LAYER 6	0.1993		
PERC./LEAKAGE THROUGH LAYER 8	0.001530	5.552	0.02
CHANGE IN WATER STORAGE	0.034	122.964	0.41
SOIL WATER AT START OF YEAR	808.832	2936061.000	
SOIL WATER AT END OF YEAR	808.866	2936184.000	
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	-0.117	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	0.010939	39.707	0.19
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 5	0.010939	39.707	0.19
PERC./LEAKAGE THROUGH LAYER 7	0.000017	0.063	0.00
AVG. HEAD ON TOP OF LAYER 6	0.1851		
PERC./LEAKAGE THROUGH LAYER 8	0.001454	5.278	0.02
CHANGE IN WATER STORAGE	-0.461	-1673.646	-7.84
SOIL WATER AT START OF YEAR	808.866	2936184.000	
SOIL WATER AT END OF YEAR	808.405	2934510.250	
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	-0.137	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	24916.809	104.16
RECIRCULATION INTO LAYER 2	0.010166	36.902	0.15
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 5	0.010166	36.902	0.15
PERC./LEAKAGE THROUGH LAYER 7	0.000016	0.059	0.00
AVG. HEAD ON TOP OF LAYER 6	0.1720		
PERC./LEAKAGE THROUGH LAYER 8	0.001389	5.041	0.02
CHANGE IN WATER STORAGE	-0.276	-1000.333	-4.18
SOIL WATER AT START OF YEAR	808.405	2934510.250	
SOIL WATER AT END OF YEAR	808.129	2933510.000	
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	0.183	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	6.136	22272.645	94.98
RECIRCULATION INTO LAYER 2	0.009458	34.331	0.15
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 5	0.009458	34.331	0.15
PERC./LEAKAGE THROUGH LAYER 7	0.000015	0.055	0.00
AVG. HEAD ON TOP OF LAYER 6	0.1600		
PERC./LEAKAGE THROUGH LAYER 8	0.001329	4.824	0.02

CHANGE IN WATER STORAGE	0.323	1172.483	5.00
SOIL WATER AT START OF YEAR	808.129	2933510.000	
SOIL WATER AT END OF YEAR	808.452	2934682.500	
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	-0.150	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	7.496	27208.945	99.94
RECIRCULATION INTO LAYER 2	0.008833	32.062	0.12
DRAINAGE COLLECTED FROM LAYER 5	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 5	0.008833	32.062	0.12
PERC./LEAKAGE THROUGH LAYER 7	0.000014	0.051	0.00
AVG. HEAD ON TOP OF LAYER 6	0.1490		
PERC./LEAKAGE THROUGH LAYER 8	0.001277	4.635	0.02
CHANGE IN WATER STORAGE	0.003	11.299	0.04
SOIL WATER AT START OF YEAR	808.452	2934682.500	
SOIL WATER AT END OF YEAR	808.456	2934693.750	
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	0.116	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	0.276	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	0.2815	0.2820	0.2824	0.2827	0.2829	0.2830
	0.2830	0.2829	0.2828	0.2825	0.2822	0.2818
STD. DEVIATIONS	0.0900	0.0890	0.0883	0.0879	0.0877	0.0876
	0.0878	0.0880	0.0883	0.0887	0.0891	0.0896

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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)	26007.73	98.721
DRAINAGE RECIRCULATED INTO LAYER 2	0.01671	(0.00518)	60.662	0.23026
LATERAL DRAINAGE COLLECTED FROM LAYER 5	0.00000	(0.00000)	0.000	0.00000
DRAINAGE RECIRCULATED FROM LAYER 5	0.01671	(0.00518)	60.662	0.23026
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00003	(0.00001)	0.096	0.00036
AVERAGE HEAD ON TOP OF LAYER 6	0.282	(0.088)		
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00242	(0.00108)	8.778	0.03332
CHANGE IN WATER STORAGE	0.090	(0.6420)	328.23	1.246

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ALIN_INT.OUT

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	0.23901
DRAINAGE COLLECTED FROM LAYER 5	0.00000	0.00000
DRAINAGE RECIRCULATED FROM LAYER 5	0.00007	0.23901
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00038
AVERAGE HEAD ON TOP OF LAYER 6	0.407	
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	0.05359
SNOW WATER	0.56	2033.9432

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3075
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1015

*** 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	734.7697	0.2509
3	70.0800	0.2920
4	0.8629	0.0719
5	0.7979	0.0665

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6	0.0000	0.0000
7	0.1800	0.7500
8	0.3182	0.0530
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: 11:55 DATE: 8/ 8/2012

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TITLE: CLOSED CONDITIONS - PRESCRIBED FINAL COVER

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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	=	0.2639 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 17

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.	=	0.300000003000E-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	0.009	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	0.069	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	0.010	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0042		
PERC./LEAKAGE THROUGH LAYER 12	0.004403	15.983	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	14.188	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	0.219	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	0.000490	1.777	0.01
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 9	0.000490	1.777	0.01
PERC./LEAKAGE THROUGH LAYER 11	0.000003	0.011	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0083		
PERC./LEAKAGE THROUGH LAYER 12	0.003518	12.770	0.05
CHANGE IN WATER STORAGE	-0.953	-3457.615	-12.48
SOIL WATER AT START OF YEAR	816.463	2963761.500	
SOIL WATER AT END OF YEAR	815.994	2962059.000	
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	-0.224	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	2.105	0.01
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 9	0.000580	2.105	0.01
PERC./LEAKAGE THROUGH LAYER 11	0.000003	0.011	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0098		
PERC./LEAKAGE THROUGH LAYER 12	0.003178	11.538	0.04
CHANGE IN WATER STORAGE	0.641	2326.798	7.11
SOIL WATER AT START OF YEAR	815.994	2962059.000	
SOIL WATER AT END OF YEAR	816.635	2964385.750	
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	0.271	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	0.011	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0103		
PERC./LEAKAGE THROUGH LAYER 12	0.002903	10.536	0.04
CHANGE IN WATER STORAGE	-0.762	-2764.375	-9.54
SOIL WATER AT START OF YEAR	816.635	2964385.750	
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	-0.0001	-0.272	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	0.011	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0089		
PERC./LEAKAGE THROUGH LAYER 12	0.002669	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	0.000449	1.628	0.01
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 9	0.000449	1.628	0.01
PERC./LEAKAGE THROUGH LAYER 11	0.000003	0.011	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	0.000382	1.385	0.00
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 9	0.000382	1.385	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	1.182	0.00
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00

RECIRCULATION FROM LAYER 9	0.000325	1.182	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000003	0.010	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	0.000278	1.008	0.00
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 9	0.000278	1.008	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000003	0.010	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0047		
PERC./LEAKAGE THROUGH LAYER 12	0.002005	7.279	0.03
CHANGE IN WATER STORAGE	-0.473	-1717.072	-6.63
SOIL WATER AT START OF YEAR	816.540	2964042.000	
SOIL WATER AT END OF YEAR	816.067	2962324.750	
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	-0.017	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	0.010	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0040		
PERC./LEAKAGE THROUGH LAYER 12	0.001891	6.863	0.04
CHANGE IN WATER STORAGE	0.686	2489.200	13.58
SOIL WATER AT START OF YEAR	816.067	2962324.750	
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	-0.0001	-0.283	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	-1630.886	-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	0.098	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	0.624	0.00
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00

RECIRCULATION FROM LAYER 9	0.000172	0.624	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	0.001682	6.107	0.02
CHANGE IN WATER STORAGE	0.481	1744.545	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	0.0000	0.009	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	0.532	0.00
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 9	0.000146	0.532	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	0.454	0.00
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 9	0.000125	0.454	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	-315.941	-1.06
SOIL WATER AT START OF YEAR	816.459	2963745.000	
SOIL WATER AT END OF YEAR	816.372	2963429.000	
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	-0.133	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	-1311.843	-6.15
SOIL WATER AT START OF YEAR	816.372	2963429.000	
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	0.176	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	0.009	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0015		
PERC./LEAKAGE THROUGH LAYER 12	0.001379	5.006	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	-0.026	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	0.009	0.00
AVG. HEAD ON TOP OF LAYER 10	0.0013		
PERC./LEAKAGE THROUGH LAYER 12	0.001319	4.787	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

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	0.009	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	0.042	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	4.226	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	0.094	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	0.144	0.00
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 9	0.000040	0.144	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

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	0.000034	0.122	0.00
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 9	0.000034	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	1881.910	8.70
SOIL WATER AT START OF YEAR	816.283	2963108.000	
SOIL WATER AT END OF YEAR	816.802	2964990.000	
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	-0.444	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	0.001040	3.777	0.01
CHANGE IN WATER STORAGE	-0.311	-1130.165	-4.30
SOIL WATER AT START OF YEAR	816.802	2964990.000	
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	0.174	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	3.646	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	0.175	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	0.215	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	0.042	0.00
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 9	0.000011	0.042	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	3.199	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)	0.709	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)	0.709	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)	6.6 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 **
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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\FINCOVSS.D10
OUTPUT DATA FILE: C:\PROGRAM\ELPASO\FINCOVSS.OUT

TIME: 13:43 DATE: 8/ 8/2012

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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 17

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.	=	0.300000003000E-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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	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	0.009	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	0.592	0.00

DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 9	0.000163	0.592	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	14.189	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	-0.138	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	-2025.467	-7.31
SOIL WATER AT START OF YEAR	662.919	2406397.000	
SOIL WATER AT END OF YEAR	662.845	2406126.750	
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	-0.012	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	0.367	0.00
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 9	0.000101	0.367	0.00
PERC./LEAKAGE THROUGH LAYER 11	0.000003	0.009	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	2050.294	6.26
SOIL WATER AT START OF YEAR	662.845	2406126.750	
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	0.250	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	0.009	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	0.009	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	0.000053	0.191	0.00
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 9	0.000053	0.191	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	0.137	0.00
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 9	0.000038	0.137	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	0.116	0.00
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 9	0.000032	0.116	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	0.082	0.00
DRAINAGE COLLECTED FROM LAYER 9	0.0000	0.000	0.00

RECIRCULATION FROM LAYER 9	0.000022	0.082	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	0.001595	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	0.000002	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	1978.731	8.44
SOIL WATER AT START OF YEAR	662.615	2405291.750	
SOIL WATER AT END OF YEAR	663.160	2407270.500	
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 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	4.597	0.02
CHANGE IN WATER STORAGE	0.064	233.079	0.86
SOIL WATER AT START OF YEAR	663.160	2407270.500	
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	0.439	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	0.000099	0.358	0.00
CHANGE IN WATER STORAGE	-0.567	-2056.498	-6.16
SOIL WATER AT START OF YEAR	663.581	2408798.000	
SOIL WATER AT END OF YEAR	663.014	2406741.500	
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	0.132	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	2406741.500	
SOIL WATER AT END OF YEAR	663.010	2406724.500	
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	0.037	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)	6.901	0.02623
CHANGE IN WATER STORAGE	-0.022 (0.5287)	-78.71	-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	0.007	
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	0.3090	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               **
**                                                                           **
**                                                                           **
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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_ECOV.D10
OUTPUT DATA FILE:           C:\PROGRAM\ELPASO\FIN_ECOV.OUT


TIME:  10: 9     DATE:   8/ 8/2012


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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
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MATERIAL TEXTURE NUMBER 0

THICKNESS	=	18.00	INCHES
POROSITY	=	0.3400	VOL/VOL
FIELD CAPACITY	=	0.0830	VOL/VOL
WILTING POINT	=	0.0570	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	=	0.3400	VOL/VOL
FIELD CAPACITY	=	0.0830	VOL/VOL
WILTING POINT	=	0.0570	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	=	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 # 8
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	=	0.2920 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 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 # 5.

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 17

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.	=	0.300000003000E-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 BARE GROUND CONDITIONS, A SURFACE SLOPE OF 7.% AND A SLOPE LENGTH OF 1019. FEET.

SCS RUNOFF CURVE NUMBER	=	68.70	
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	=	8.388	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.192	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	806.200	INCHES
TOTAL INITIAL WATER	=	806.200	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	5.842	21206.738	71.68
RECIRCULATION INTO LAYER 5	0.000096	0.347	0.00
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000096	0.347	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.009	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0016		
PERC./LEAKAGE THROUGH LAYER 11	0.005029	18.256	0.06

CHANGE IN WATER STORAGE	2.303	8359.369	28.26
SOIL WATER AT START OF YEAR	806.200	2926506.250	
SOIL WATER AT END OF YEAR	808.503	2934865.750	
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	0.138	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	5.770	20945.678	67.72
RECIRCULATION INTO LAYER 5	0.000266	0.967	0.00
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000266	0.967	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.010	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0045		
PERC./LEAKAGE THROUGH LAYER 11	0.004403	15.983	0.05
CHANGE IN WATER STORAGE	2.745	9965.883	32.22
SOIL WATER AT START OF YEAR	808.503	2934865.750	
SOIL WATER AT END OF YEAR	811.248	2944831.500	
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	0.058	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	6.513	23642.871	64.55
RECIRCULATION INTO LAYER 5	0.000409	1.484	0.00
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000409	1.484	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.011	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0069		
PERC./LEAKAGE THROUGH LAYER 11	0.003908	14.188	0.04
CHANGE IN WATER STORAGE	3.573	12969.748	35.41
SOIL WATER AT START OF YEAR	811.248	2944831.500	
SOIL WATER AT END OF YEAR	814.338	2956046.000	
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	-0.102	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	5.986	21730.336	78.46
RECIRCULATION INTO LAYER 5	0.000529	1.922	0.01
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000529	1.922	0.01
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.011	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0089		
PERC./LEAKAGE THROUGH LAYER 11	0.003518	12.770	0.05
CHANGE IN WATER STORAGE	1.640	5953.931	21.50

SOIL WATER AT START OF YEAR	814.338	2956046.000	
SOIL WATER AT END OF YEAR	816.461	2963755.250	
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	-0.137	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	6.373	23133.828	70.65
RECIRCULATION INTO LAYER 5	0.000627	2.274	0.01
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000627	2.274	0.01
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.011	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0106		
PERC./LEAKAGE THROUGH LAYER 11	0.003178	11.537	0.04
CHANGE IN WATER STORAGE	2.644	9597.211	29.31
SOIL WATER AT START OF YEAR	816.461	2963755.250	
SOIL WATER AT END OF YEAR	819.105	2973352.500	
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	0.029	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	5.656	20532.469	70.88
RECIRCULATION INTO LAYER 5	0.000708	2.570	0.01
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000708	2.570	0.01
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.012	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0120		
PERC./LEAKAGE THROUGH LAYER 11	0.002903	10.536	0.04
CHANGE IN WATER STORAGE	2.321	8424.507	29.08
SOIL WATER AT START OF YEAR	819.105	2973352.500	
SOIL WATER AT END OF YEAR	821.426	2981777.000	
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	-0.106	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	4.708	17089.816	69.54
RECIRCULATION INTO LAYER 5	0.000775	2.812	0.01
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000775	2.812	0.01
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.012	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0131		
PERC./LEAKAGE THROUGH LAYER 11	0.002668	9.686	0.04
CHANGE IN WATER STORAGE	2.059	7475.354	30.42
SOIL WATER AT START OF YEAR	821.426	2981777.000	
SOIL WATER AT END OF YEAR	823.485	2989252.250	

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	0.246	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	3.474	12610.683	66.68
RECIRCULATION INTO LAYER 5	0.000831	3.018	0.02
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000831	3.018	0.02
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.012	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0140		
PERC./LEAKAGE THROUGH LAYER 11	0.002474	8.980	0.05
CHANGE IN WATER STORAGE	1.734	6292.680	33.27
SOIL WATER AT START OF YEAR	823.485	2989252.250	
SOIL WATER AT END OF YEAR	825.219	2995545.000	
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 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	8.01	29076.297	100.00
RUNOFF	0.000	0.000	0.00

EVAPOTRANSPIRATION	5.978	21700.906	74.63
RECIRCULATION INTO LAYER 5	0.000873	3.169	0.01
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000873	3.169	0.01
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.012	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0148		
PERC./LEAKAGE THROUGH LAYER 11	0.002292	8.321	0.03
CHANGE IN WATER STORAGE	2.029	7366.791	25.34
SOIL WATER AT START OF YEAR	825.219	2995545.000	
SOIL WATER AT END OF YEAR	827.248	3002911.750	
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	0.280	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	4.805	17442.879	70.66
RECIRCULATION INTO LAYER 5	0.000908	3.296	0.01
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000908	3.296	0.01
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.012	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0154		
PERC./LEAKAGE THROUGH LAYER 11	0.002140	7.767	0.03
CHANGE IN WATER STORAGE	1.993	7233.413	29.30
SOIL WATER AT START OF YEAR	827.248	3002911.750	
SOIL WATER AT END OF YEAR	829.241	3010145.250	
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	-0.064	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	4.917	17849.160	68.96
RECIRCULATION INTO LAYER 5	0.000867	3.148	0.01
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000867	3.148	0.01
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.012	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0147		
PERC./LEAKAGE THROUGH LAYER 11	0.002005	7.278	0.03
CHANGE IN WATER STORAGE	2.211	8025.925	31.01
SOIL WATER AT START OF YEAR	829.241	3010145.250	
SOIL WATER AT END OF YEAR	831.452	3018171.000	
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	-0.462	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	3.496	12692.270	69.24
RECIRCULATION INTO LAYER 5	0.000743	2.696	0.01

DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000743	2.696	0.01
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.012	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0125		
PERC./LEAKAGE THROUGH LAYER 11	0.001891	6.863	0.04
CHANGE IN WATER STORAGE	1.552	5632.216	30.72
SOIL WATER AT START OF YEAR	831.452	3018171.000	
SOIL WATER AT END OF YEAR	833.004	3023803.250	
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	0.149	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	5.994	21759.877	71.70
RECIRCULATION INTO LAYER 5	0.000632	2.294	0.01
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000632	2.294	0.01
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.012	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0107		
PERC./LEAKAGE THROUGH LAYER 11	0.001778	6.456	0.02
CHANGE IN WATER STORAGE	2.364	8580.483	28.27
SOIL WATER AT START OF YEAR	833.004	3023803.250	
SOIL WATER AT END OF YEAR	835.367	3032383.750	
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	-0.013	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	4.999	18144.934	71.21
RECIRCULATION INTO LAYER 5	0.000539	1.958	0.01
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000539	1.958	0.01
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.011	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0091		
PERC./LEAKAGE THROUGH LAYER 11	0.001682	6.107	0.02
CHANGE IN WATER STORAGE	2.020	7331.563	28.77
SOIL WATER AT START OF YEAR	835.367	3032383.750	
SOIL WATER AT END OF YEAR	837.387	3039715.250	
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	-0.006	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	3.538	12844.733	74.03
RECIRCULATION INTO LAYER 5	0.000460	1.671	0.01
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00

RECIRCULATION FROM LAYER 8	0.000460	1.671	0.01
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.011	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0078		
PERC./LEAKAGE THROUGH LAYER 11	0.001596	5.792	0.03
CHANGE IN WATER STORAGE	1.240	4501.165	25.94
SOIL WATER AT START OF YEAR	837.387	3039715.250	
SOIL WATER AT END OF YEAR	838.627	3044216.500	
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	-0.291	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	5.758	20903.115	70.22
RECIRCULATION INTO LAYER 5	0.000394	1.429	0.00
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000394	1.429	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.011	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0066		
PERC./LEAKAGE THROUGH LAYER 11	0.001521	5.521	0.02
CHANGE IN WATER STORAGE	2.440	8856.987	29.76
SOIL WATER AT START OF YEAR	838.627	3044216.500	
SOIL WATER AT END OF YEAR	841.067	3053073.500	
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	0.380	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	4.203	15257.111	71.48
RECIRCULATION INTO LAYER 5	0.000335	1.216	0.01
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000335	1.216	0.01
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.010	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0057		
PERC./LEAKAGE THROUGH LAYER 11	0.001445	5.245	0.02
CHANGE IN WATER STORAGE	1.675	6081.978	28.49
SOIL WATER AT START OF YEAR	841.067	3053073.500	
SOIL WATER AT END OF YEAR	842.743	3059155.500	
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	0.062	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	4.471	16230.129	67.85
RECIRCULATION INTO LAYER 5	0.000286	1.037	0.00
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000286	1.037	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.010	0.00

AVG. HEAD ON TOP OF LAYER 9	0.0048		
PERC./LEAKAGE THROUGH LAYER 11	0.001379	5.007	0.02
CHANGE IN WATER STORAGE	2.118	7686.720	32.13
SOIL WATER AT START OF YEAR	842.743	3059155.500	
SOIL WATER AT END OF YEAR	844.860	3066842.250	
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	-0.155	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	4.462	16198.187	69.08
RECIRCULATION INTO LAYER 5	0.000244	0.884	0.00
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000244	0.884	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.010	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0041		
PERC./LEAKAGE THROUGH LAYER 11	0.001319	4.788	0.02
CHANGE IN WATER STORAGE	1.996	7246.928	30.90
SOIL WATER AT START OF YEAR	844.860	3066842.250	
SOIL WATER AT END OF YEAR	846.857	3074089.000	
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	-0.100	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	5.813	21099.502	77.50
RECIRCULATION INTO LAYER 5	0.000208	0.756	0.00
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000208	0.756	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.010	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0035		
PERC./LEAKAGE THROUGH LAYER 11	0.001267	4.598	0.02
CHANGE IN WATER STORAGE	1.686	6120.972	22.48
SOIL WATER AT START OF YEAR	846.857	3074089.000	
SOIL WATER AT END OF YEAR	848.543	3080210.000	
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	-0.076	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	3.702	13439.385	74.79
RECIRCULATION INTO LAYER 5	0.000177	0.642	0.00
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000177	0.642	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.010	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0030		

PERC./LEAKAGE THROUGH LAYER 11	0.001212	4.399	0.02
CHANGE IN WATER STORAGE	1.247	4524.871	25.18
SOIL WATER AT START OF YEAR	848.543	3080210.000	
SOIL WATER AT END OF YEAR	849.789	3084735.000	
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	-0.154	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	5.755	20889.730	69.84
RECIRCULATION INTO LAYER 5	0.000151	0.547	0.00
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000151	0.547	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.010	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0025		
PERC./LEAKAGE THROUGH LAYER 11	0.001164	4.227	0.01
CHANGE IN WATER STORAGE	2.484	9017.174	30.15
SOIL WATER AT START OF YEAR	849.789	3084735.000	
SOIL WATER AT END OF YEAR	852.273	3093752.250	
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	0.064	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	4.594	16677.281	69.51
RECIRCULATION INTO LAYER 5	0.000128	0.466	0.00
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000128	0.466	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.010	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0022		
PERC./LEAKAGE THROUGH LAYER 11	0.001120	4.066	0.02
CHANGE IN WATER STORAGE	2.015	7312.730	30.48
SOIL WATER AT START OF YEAR	852.273	3093752.250	
SOIL WATER AT END OF YEAR	854.288	3101064.750	
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	0.223	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	4.383	15911.482	73.55
RECIRCULATION INTO LAYER 5	0.000109	0.397	0.00
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000109	0.397	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.010	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0018		
PERC./LEAKAGE THROUGH LAYER 11	0.001082	3.928	0.02
CHANGE IN WATER STORAGE	1.576	5719.288	26.44

SOIL WATER AT START OF YEAR	854.288	3101064.750	
SOIL WATER AT END OF YEAR	855.863	3106784.250	
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	0.100	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	5.052	18338.018	69.78
RECIRCULATION INTO LAYER 5	0.000093	0.337	0.00
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000093	0.337	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.009	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0016		
PERC./LEAKAGE THROUGH LAYER 11	0.001041	3.777	0.01
CHANGE IN WATER STORAGE	2.187	7939.517	30.21
SOIL WATER AT START OF YEAR	855.863	3106784.250	
SOIL WATER AT END OF YEAR	858.051	3114723.750	
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	-0.111	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	6.474	23502.141	73.32
RECIRCULATION INTO LAYER 5	0.000079	0.287	0.00
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000079	0.287	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.009	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0013		
PERC./LEAKAGE THROUGH LAYER 11	0.001005	3.647	0.01
CHANGE IN WATER STORAGE	2.354	8546.807	26.66
SOIL WATER AT START OF YEAR	858.051	3114723.750	
SOIL WATER AT END OF YEAR	860.405	3123270.500	
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	0.308	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	4.345	15772.594	68.75
RECIRCULATION INTO LAYER 5	0.000067	0.243	0.00
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000067	0.243	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.009	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0011		
PERC./LEAKAGE THROUGH LAYER 11	0.000971	3.525	0.02
CHANGE IN WATER STORAGE	1.974	7165.838	31.24
SOIL WATER AT START OF YEAR	860.405	3123270.500	

SOIL WATER AT END OF YEAR	862.379	3130436.250	
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	-0.355	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	5.055	18350.609	73.26
RECIRCULATION INTO LAYER 5	0.000057	0.207	0.00
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000057	0.207	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.009	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0010		
PERC./LEAKAGE THROUGH LAYER 11	0.000942	3.419	0.01
CHANGE IN WATER STORAGE	1.844	6692.812	26.72
SOIL WATER AT START OF YEAR	862.379	3130436.250	
SOIL WATER AT END OF YEAR	864.223	3137129.250	
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	0.160	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	6.309	22900.508	68.57
RECIRCULATION INTO LAYER 5	0.000048	0.175	0.00
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000048	0.175	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.009	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0008		
PERC./LEAKAGE THROUGH LAYER 11	0.000910	3.302	0.01
CHANGE IN WATER STORAGE	2.890	10492.082	31.42
SOIL WATER AT START OF YEAR	864.223	3137129.250	
SOIL WATER AT END OF YEAR	867.113	3147621.250	
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	0.115	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	5.396	19586.801	67.03
RECIRCULATION INTO LAYER 5	0.000041	0.148	0.00
DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 8	0.000041	0.148	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000003	0.009	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0007		
PERC./LEAKAGE THROUGH LAYER 11	0.000882	3.200	0.01
CHANGE IN WATER STORAGE	2.653	9631.774	32.96
SOIL WATER AT START OF YEAR	867.113	3147621.250	
SOIL WATER AT END OF YEAR	869.767	3157253.000	
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	-0.278	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	0.344	0.256	0.183	0.163	0.201	0.381
	0.996	0.781	0.856	0.473	0.230	0.265
STD. DEVIATIONS	0.341	0.300	0.160	0.198	0.201	0.342
	0.712	0.420	0.644	0.431	0.312	0.185
LATERAL DRAINAGE RECIRCULATED INTO 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 COLLECTED FROM LAYER 8						
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 8						
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	0.0000	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	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066
	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066
STD. DEVIATIONS	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050

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	5.127 (0.9268)	18612.79	70.740
DRAINAGE RECIRCULATED INTO LAYER 5	0.00039 (0.00029)	1.413	0.00537
LATERAL DRAINAGE COLLECTED FROM LAYER 8	0.00000 (0.00000)	0.000	0.00000
DRAINAGE RECIRCULATED FROM LAYER 8	0.00039 (0.00029)	1.413	0.00537
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.00000 (0.00000)	0.011	0.00004
AVERAGE HEAD ON TOP	0.007 (0.005)		

OF LAYER 9

PERCOLATION/LEAKAGE THROUGH LAYER 11	0.00196	(0.00111)	7.106	0.02701
CHANGE IN WATER STORAGE	2.119	(0.4974)	7691.56	29.233

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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	0.00000	0.00920
DRAINAGE COLLECTED FROM LAYER 8	0.00000	0.00000
DRAINAGE RECIRCULATED FROM LAYER 8	0.00000	0.00920
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.000000	0.00003
AVERAGE HEAD ON TOP OF LAYER 9	0.016	
MAXIMUM HEAD ON TOP OF LAYER 9	0.031	
LOCATION OF MAXIMUM HEAD IN LAYER 8 (DISTANCE FROM DRAIN)	0.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 11	0.000015	0.05369
SNOW WATER	0.56	2033.9432

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.1671

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0497

*** 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	1.2532	0.0696
3	1.1173	0.1862
4	1.2312	0.1026
5	794.0572	0.2712
6	70.0800	0.2920
7	0.7440	0.0620
8	0.7442	0.0620
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:  15:13     DATE:   8/ 8/2012


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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
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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 17

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.	=	0.300000003000E-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	29.871	0.10
DRAINAGE COLLECTED FROM LAYER 7	0.0015	5.271	0.02
RECIRCULATION FROM LAYER 7	0.008229	29.871	0.10
PERC./LEAKAGE THROUGH LAYER 9	0.000004	0.015	0.00
AVG. HEAD ON TOP OF LAYER 8	0.0283		
PERC./LEAKAGE THROUGH LAYER 10	0.005028	18.251	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	0.170	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	23.912	0.08
DRAINAGE COLLECTED FROM LAYER 7	0.0012	4.220	0.01
RECIRCULATION FROM LAYER 7	0.006587	23.912	0.08
PERC./LEAKAGE THROUGH LAYER 9	0.000004	0.014	0.00
AVG. HEAD ON TOP OF LAYER 8	0.0226		
PERC./LEAKAGE THROUGH LAYER 10	0.004402	15.981	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	-0.264	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	0.003342	12.130	0.03
DRAINAGE COLLECTED FROM LAYER 7	0.0006	2.141	0.01
RECIRCULATION FROM LAYER 7	0.003342	12.130	0.03
PERC./LEAKAGE THROUGH LAYER 9	0.000003	0.012	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	11183.994	30.54
SOIL WATER AT START OF YEAR	657.014	2384959.750	
SOIL WATER AT END OF YEAR	659.611	2394388.500	
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	-0.196	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	0.001340	4.863	0.02
DRAINAGE COLLECTED FROM LAYER 7	0.0002	0.858	0.00
RECIRCULATION FROM LAYER 7	0.001340	4.863	0.02
PERC./LEAKAGE THROUGH LAYER 9	0.000003	0.010	0.00
AVG. HEAD ON TOP OF LAYER 8	0.0046		
PERC./LEAKAGE THROUGH LAYER 10	0.003518	12.772	0.05
CHANGE IN WATER STORAGE	-0.424	-1539.148	-5.56
SOIL WATER AT START OF YEAR	659.611	2394388.500	
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	0.0000	-0.004	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	0.342	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	11.540	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	0.771	0.00
DRAINAGE COLLECTED FROM LAYER 7	0.0000	0.136	0.00
RECIRCULATION FROM LAYER 7	0.000212	0.771	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	0.002903	10.539	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	9.689	0.04
CHANGE IN WATER STORAGE	1.079	3918.468	15.94
SOIL WATER AT START OF YEAR	660.437	2397387.500	
SOIL WATER AT END OF YEAR	661.517	2401306.000	
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	0.101	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	8.982	0.05
CHANGE IN WATER STORAGE	-0.637	-2313.948	-12.24
SOIL WATER AT START OF YEAR	661.517	2401306.000	
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	-0.106	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	0.000	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	7.769	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	0.001043	3.787	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	0.149	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	4738.231	18.59
SOIL WATER AT START OF YEAR	662.257	2403993.000	
SOIL WATER AT END OF YEAR	663.562	2408731.250	
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	-0.076	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	-1840.036	-10.60
SOIL WATER AT START OF YEAR	663.562	2408731.250	
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	-0.125	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	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	759.500	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	-0.152	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	3610.946	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	0.154	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	-146.006	-0.61
SOIL WATER AT START OF YEAR	666.787	2420437.500	
SOIL WATER AT END OF YEAR	666.747	2420291.500	
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	0.026	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	2420291.500	
SOIL WATER AT END OF YEAR	666.603	2419767.250	
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	-0.031	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	2940.513	11.19
SOIL WATER AT START OF YEAR	666.603	2419767.250	
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	-0.104	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

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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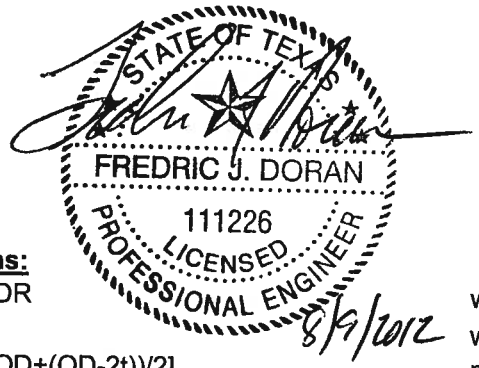
Pipe Deflection Calculations
McCombs Landfill - 4/15/11 (SSK)



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

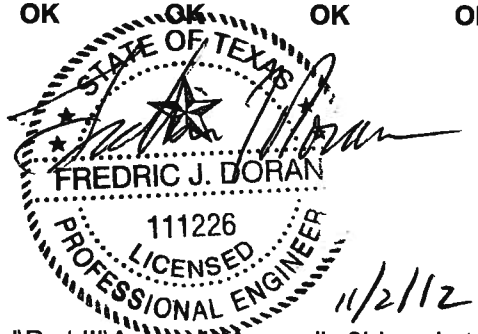
OD (in.) =	8.625	
K =	0.1	pipe bedding constant (0.1)
D =	1.0	deflection lag factor (1.0)
E (psi) =	133,000	Pipe Mod of Elasticity
E' (psi) =	3,000	Soil Mod of Reaction
Soil Cover Depth (ft.) =	8	
Waste Depth (ft.) =	264	
Soil Cover Dens. (pcf) =	120	
Waste Dens. (pcf) =	66.7	
D_p =	0.5	diameter of perforation (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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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 =	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

$$\varepsilon_s = \frac{w * H}{144 * E_s}$$

ε_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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6/7/2012

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

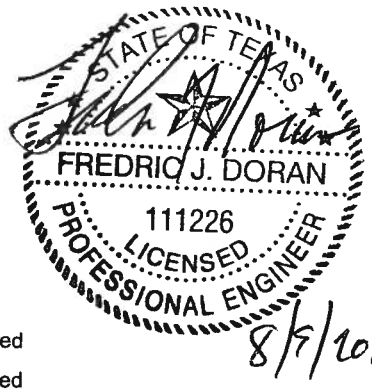
A = profile wall average cross-sectional area, in2/in, or wall thickness (in) for DR pipe

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

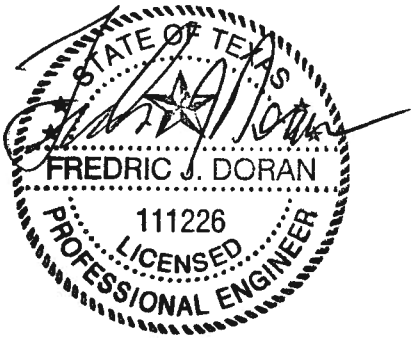
$$\varepsilon_s = \frac{w * H}{144 * E_s}$$

ε_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

$$\varepsilon_s = \frac{w * H}{144 * E_s}$$

ε_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

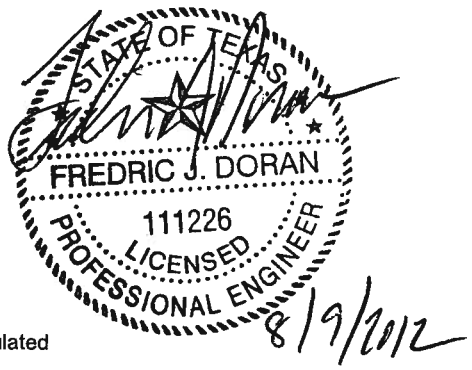
A = profile wall average cross-sectional area, in2/in, or wall thickness (in) for DR pipe

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

$$\varepsilon_s = \frac{w * H}{144 * E_s}$$

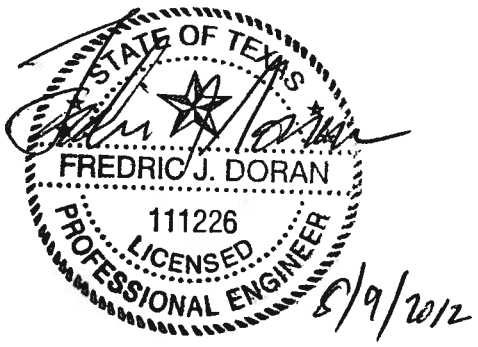
ε_s = 4.91% Soil Strain, Calculated

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

$$\varepsilon_s = \frac{w * H}{144 * E_s}$$

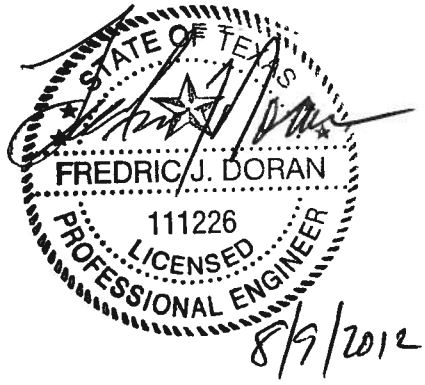
ε_s = 4.91% Soil Strain, Calculated

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)

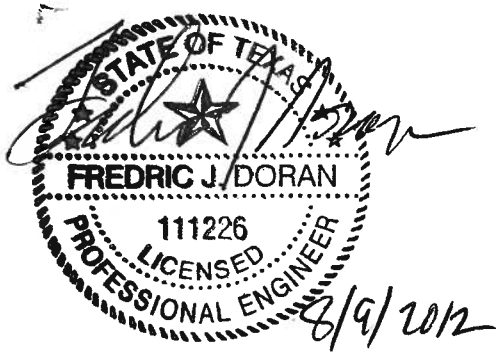
P_c (Driscopipe)= $\frac{2.32 * E}{(SDR)^3}$

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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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

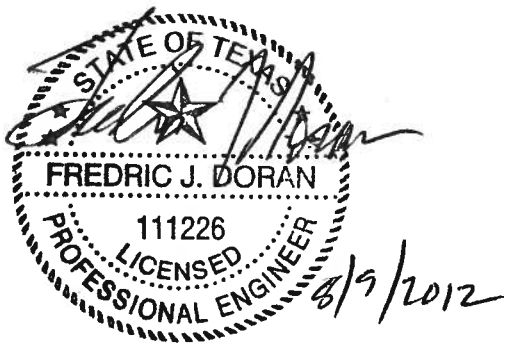
$$S_a = \frac{(SDR - 1)}{2} * P_t$$

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

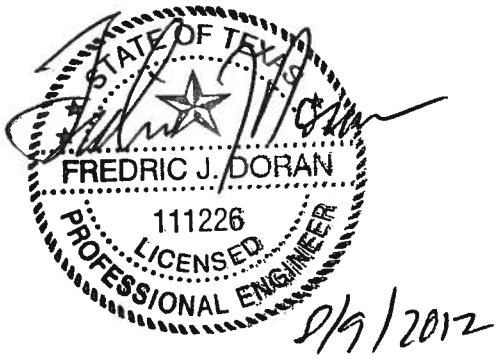
$$S_a = \frac{(SDR - 1)}{2} * P_t$$

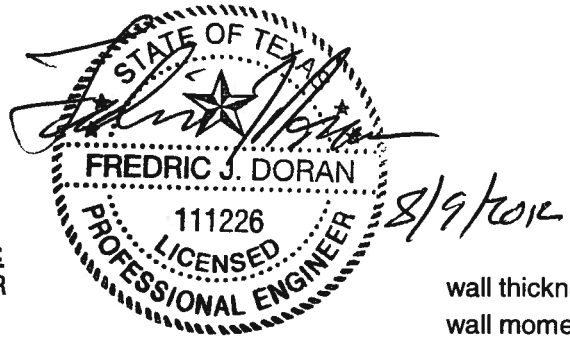
S_a =	**644.75 PSI**	Calculated

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

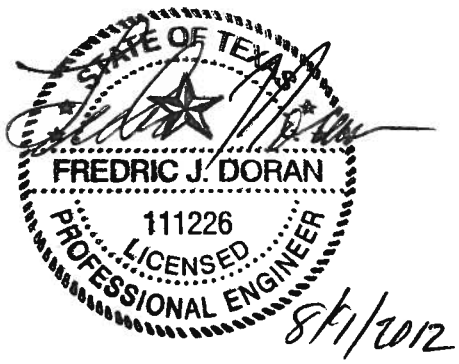
$$S_a = \frac{(SDR - 1)}{2} * P_t$$

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
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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

$$\varepsilon_s = \frac{w * H}{144 * E_s}$$

ε_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

STATE OF TEXAS
FREDRIC J. DORAN
111226
LICENSED
PROFESSIONAL ENGINEER
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:

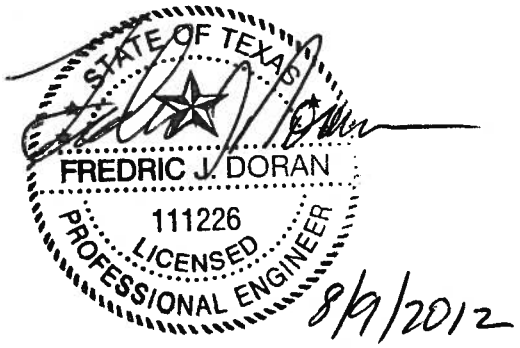
t = OD/SDR	wall thickness
$I = t^3/12$	wall moment of inertia
R = 0.5[(OD+(OD-2t))/2]	mean radius
W = OD*[(Soil PSI)+(EQ PSI)]/14	vertical stress
$Wp = (W*12)/(12-(D_p*N))$	modified vertical stress
$x = (D*K*W*R^3) / [(E*I) + (0.061*E'*R^3)]$	deflection
Deflection % = x/(2*R)	

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:

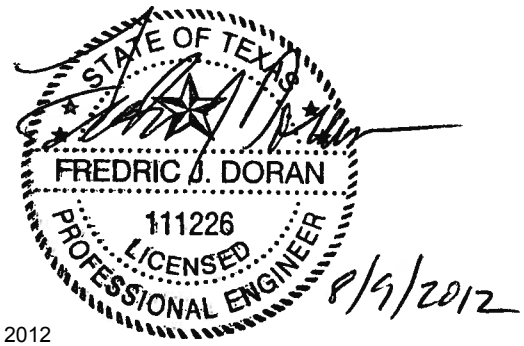
t = OD/SDR	wall thickness
$I = t^3/12$	wall moment of inertia
R = 0.5[(OD+(OD-2t))/2]	mean radius
W = OD*[(Soil PSI)+(EQ PSI)+(W	vertical stress
$Wp = (W*12)/(12-(D_p*N))$	modified vertical stress
$x = (D*K*W*R^3) / [(E*I) + (0.061*E'*R^3)]$	deflection
Deflection % = x/(2*R)	

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:

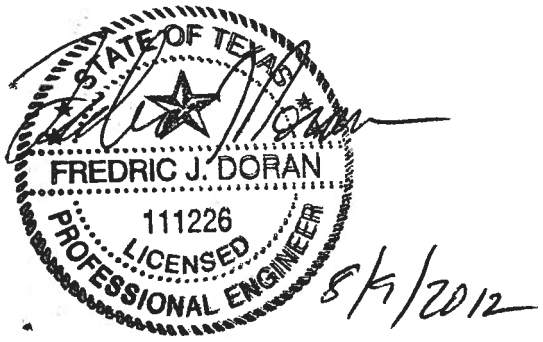
t = OD/SDR	wall thickness
$I = t^3/12$	wall moment of inertia
R = 0.5[(OD+(OD-2t))/2]	mean radius
W = OD*[(Soil PSI)+(EQ PSI)]/14	vertical stress
$Wp = (W*12)/(12-(D_p*N))$	modified vertical stress
$x = (D*K*W*R^3) / [(E*I) + (0.061*E'*R^3)]$	deflection
Deflection % = x/(2*R)	

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:

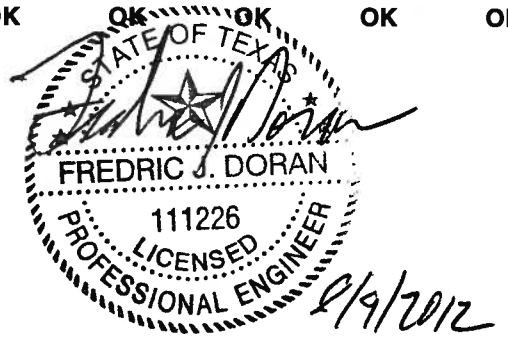
t = OD/SDR	wall thickness
$I = t^3/12$	wall moment of inertia
R = 0.5[(OD+(OD-2t))/2]	mean radius
W = OD*[(Soil PSI)+(EQ PSI)+(W	vertical stress
$Wp = (W*12)/(12-(D_p*N))$	modified vertical stress
$x = (D*K*W*R^3) / [(E*I) + (0.061*E'*R^3)]$	deflection
Deflection % = x/(2*R)	

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

SAIC®

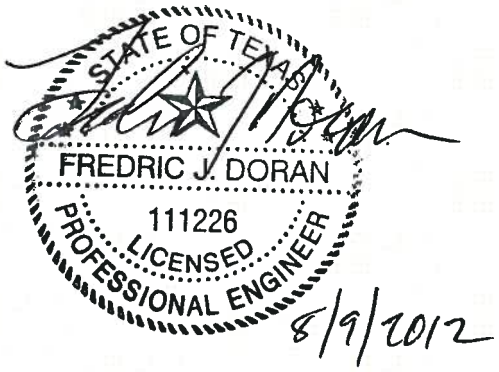
To: TCEQ

From: Fred J. Doran, P.E.

Subject: Raba Kistner Leachate and Contaminated Water Plan

Date: May 11, 2012

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
Attachment 15
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.

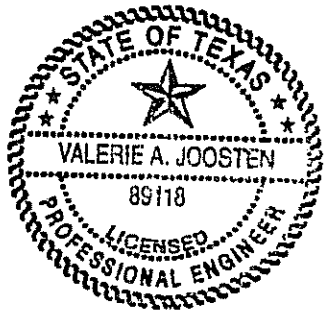
11/2/12

PART III
SITE DEVELOPMENT PLAN
ATTACHMENT 15
LEACHATE AND CONTAMINATED WATER PLAN

McCOMBS LANDFILL
MSW PERMIT NO. 729AB
CITY OF EL PASO
EL PASO COUNTY, TEXAS

Prepared by:

Raba Kistner



APRIL 24, 2002
REVISION 1 - JULY 29, 2002

Valerie Joosten 8/7/02

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NOT FOR CONSTRUCTION

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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 Joosten 8/7/02

STATE OF TEXAS
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 ft^2
Total rainfall volume = 75,000 ft^2 x .25 ft = 18,750 ft^3
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 ft^3

26,500 ft^3 retention volume/18,750 ft^3 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.

Stormwater shall be discharged in accordance with the site NPDES permit (See Figure Att15-2). Stormwater monitoring shall be conducted in accordance with the Stormwater Pollution Prevention Plan located in the Site Operating Plan.

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

Valerie Joosten 8/7/02

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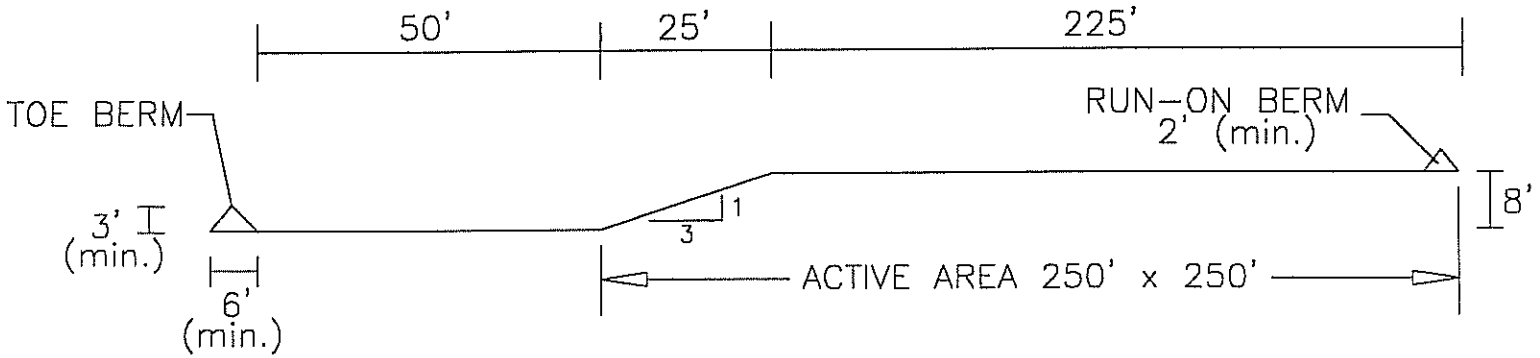
FIGURES



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

$$= 2'(50'x250') + \frac{2'(3'x2')}{2} \times 250' = 26{,}500\ ft^3$$

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

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4/25/02

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CNTRLBRM.DWG

REVISIONS			
NO.	BY	DATE	APPD

Raba Kistner

Engineers, Geologists, Hygienists and Environmental Scientists

CONTROL BERM AT WORKING FACE
McCOMBS LANDFILL – MSW PERMIT No. 729KB
EL PASO COUNTY, TEXAS

SCALE: N.T.S.	PROJECT NO.: ASF02-045-00	FIGURE ATT15-1
DRAWN BY: TW	CHK. BY: VJ	APPD.: FC	DATE: 4/05/02

APPENDIX Att15-A

Rainfall Frequency Maps

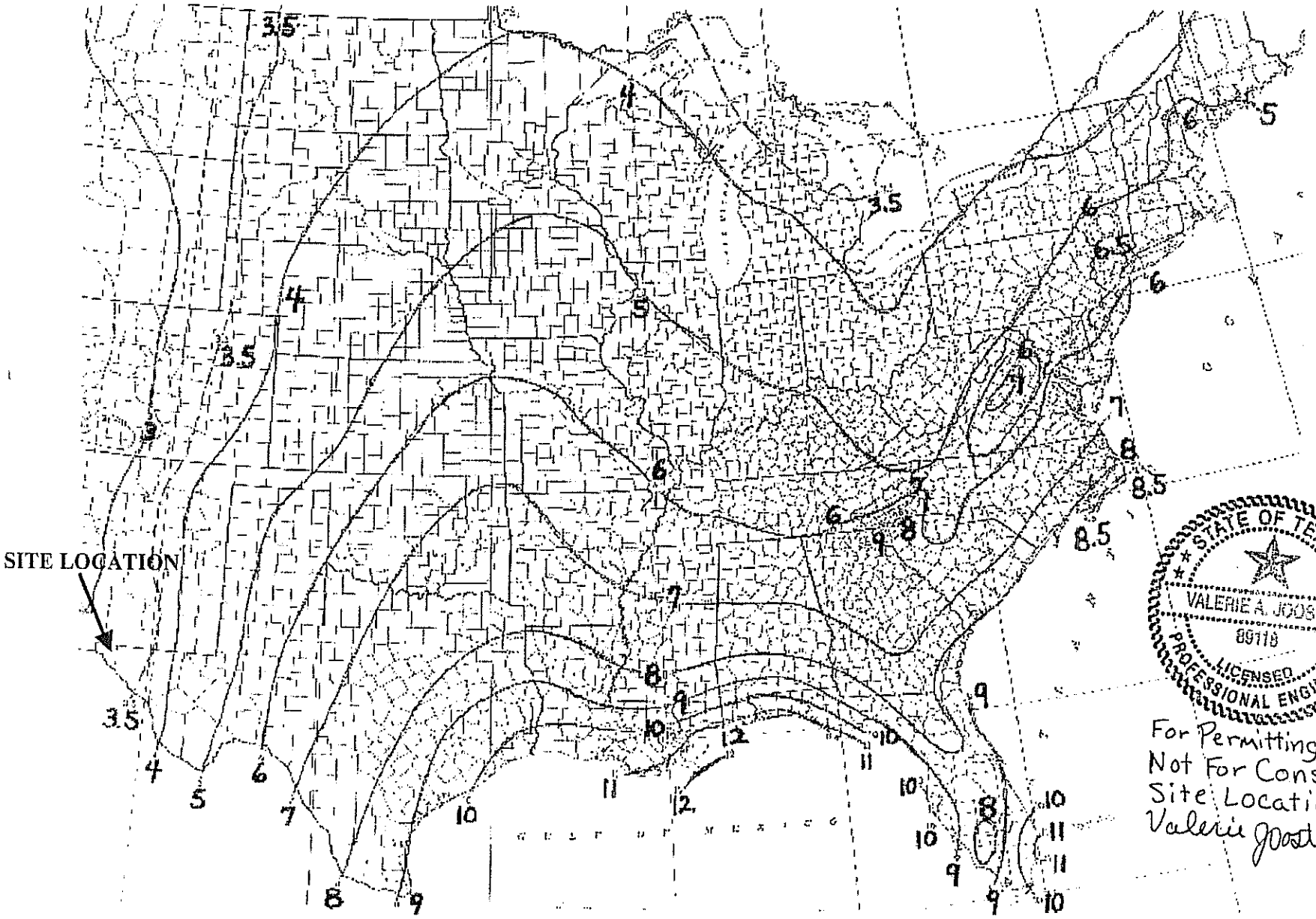

Plate 1

SOURCE: NMS Technical Paper 40, Rainfall Frequency Atlas of the United States

Project #: ASF02-045-00

SCALE: NO SCALE

APPD.:

CHK. BY: VJ

DATE: 2/19/02

GRAPHICS BY: AA

Precipitation Frequency Map
25 Year, 24 Hour Rainfall Event
McCombs Landfill
MSW Permit No. 729AB
El Paso County, Texas

Raba-Kistner
Engineers Geologists Scientists Chemists
Raba-Kistner Consultants (SW), Inc.
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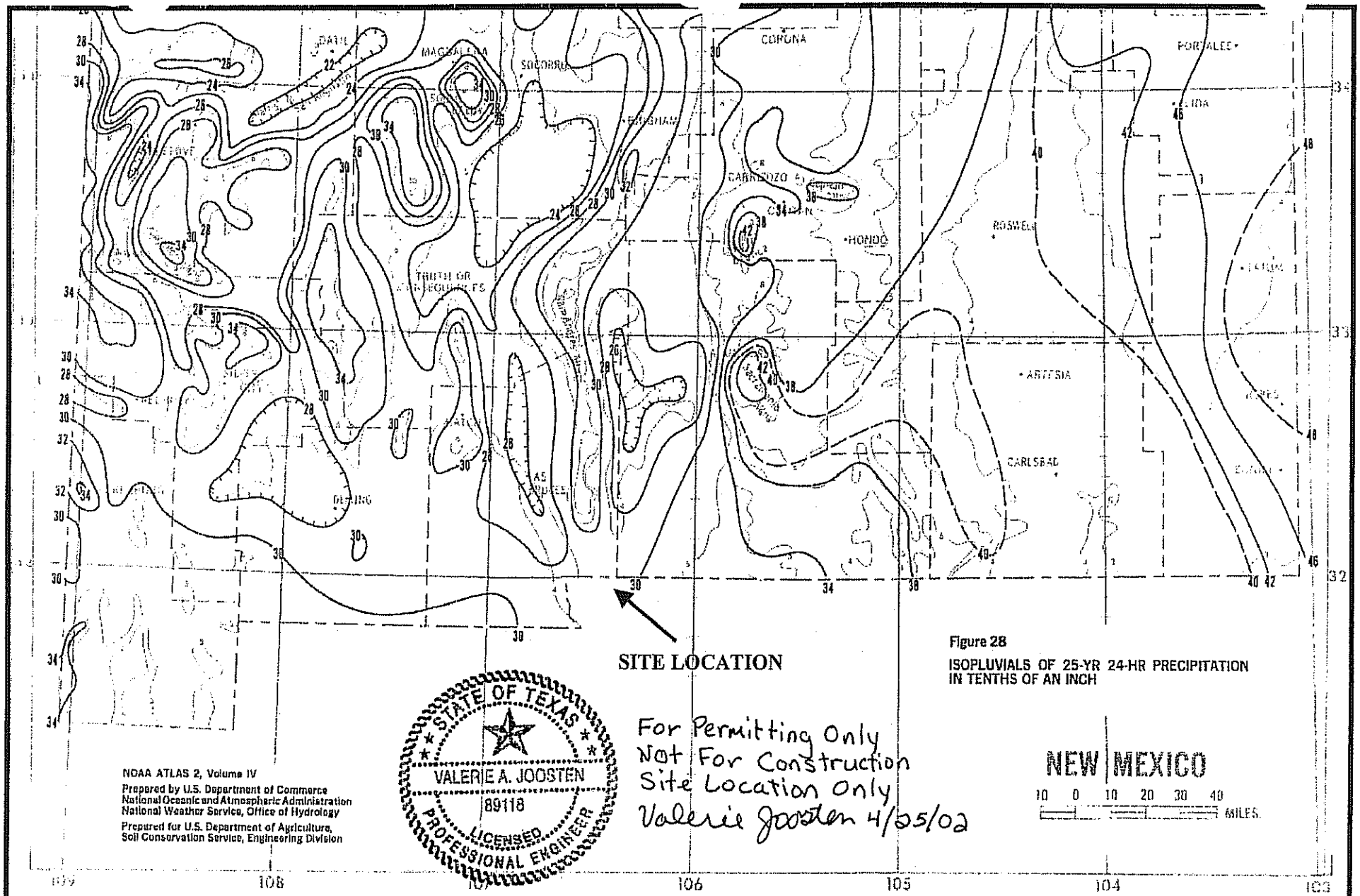

Figure 28

ISOPLUVIALS OF 25-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume IV

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

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Plate 2

SOURCE: NOAA Atlas 2 Published in 1973

Project #: ASF02-045-00

SCALE: NO SCALE

APPD.:

CHK. BY: VJ

DATE: 2/19/02

GRAPHICS BY: AA

Precipitation Frequency Map
25 Year, 24 Hour Rainfall Event
McCombs Landfill
MSW Permit No. 729A
El Paso County, Texas

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Appendix 3J
Liner Quality Control Plan

SAIC®

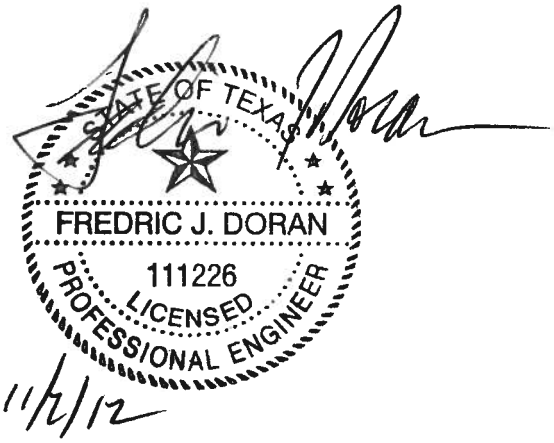
McCombs Municipal Landfill
El Paso County, Texas
TCEQ MSW Permit No. 729B

Part III
Appendix 3J
Liner Quality Control Plan

Prepared for

City of El Paso

Updated November 2012, Revision 2



Prepared by

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Texas Board of Professional Engineers
Firm Registration No. 3823

Part III

Appendix 3J – Liner Quality Control Plan

City of El Paso

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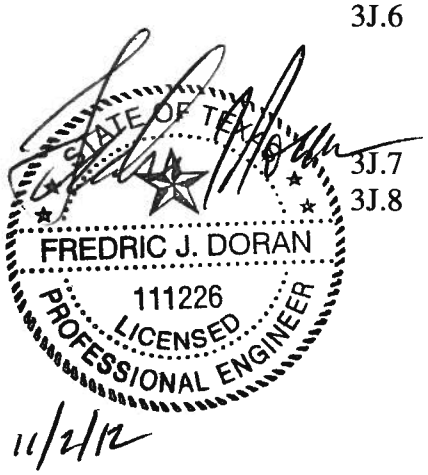

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This report has been prepared for the use of the client for the specific purposes identified in the report. The conclusions, observations and recommendations contained herein attributed to SAIC constitute the opinions of SAIC. To the extent that statements, information and opinions provided by the client or others have been used in the preparation of this report, SAIC has relied upon the same to be accurate, and for which no assurances are intended, and no representations or warranties are made. SAIC makes no certification and gives no assurances except as explicitly set forth in this report.

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11/2/12

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 Owner's Representative (OR) will be responsible for the implementation of field inspection and testing activities, under the direction of the POR. The OR 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.

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 composite 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 OR 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 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 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 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 and/or OR 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	N/A
		Moisture Content	ASTM D 2216	1 test/material type	NA
				In-Place	
		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	N/A
		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
				In-Place	
		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 Methodology[1]	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
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	Weekly	$1x10^{-8}$ m^3/m^2/sec
		GCL Permeability[5]	ASTM D 5084	Weekly	≤ $5x10^{-9}$ cm/sec
		GCL Hydrated Internal Shear Strength[6]	ASTM D 5321	Periodic	500 lbs./ft^2
		Direct Shear (GCL/Geomembrane)	ASTM D 5321	1/Material Type	Min 24 degrees[7]
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.
		% 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%

Table 3J.1
Laboratory and Field QA/QC Testing

	Material	Test	Test Method	Minimum Test Frequency	Minimum Passing Requirements
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	
		Sheet Thickness	ASTM D 5994	1/50,000 ft^2 and every resin lot	60 mil ± 10%
		Specific Gravity	ASTM D 1505	1/100,000 ft^2 and every resin lot	0.935 to 0.95 g/cm^3
		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 lbs./in (wedge method) [9]
				As-Built Integrity	
		Electric Conductance	ASTM D 6747	Geomembrane Area	N/A

Table 3J.1
Laboratory and Field QA/QC Testing

	Material	Test	Test Method	Minimum Test Frequency	Minimum Passing Requirements
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 ASTM D 3042[10]	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

Notes:

N/A – Not Applicable
MARV – Minimum Average Roll Value
[1] Permeability testing methodology described in 30 TAC §330.339 (c)(4)(A).
[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: $D_{15\ (lower)}/D_{15\ (upper)} < 20$

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.

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.

The OR will observe the subgrade preparation to ensure suitability for cell liner construction. The OR 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). 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-1 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".

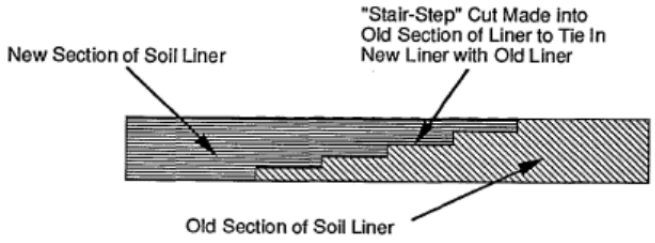

Figure 3J-1: Tie-in of Soil Liner System (Typical)
Source of Figure: Figure 2.2, Quality Assurance and Quality Control for Waste Containment Facilities, EPA Technical Guidance Document 600/R-93/182, September 1993, p. 22

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 OR, who shall then submit a letter report on the findings to the TCEQ. Required repairs shall be performed promptly. A new SLER 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 OR will inspect the delivered geogrid to verify it is the proper and intended material. The OR 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 OR will also oversee the installation of the geogrid and approve connection methods. If additional conformance testing is required, the OR will oversee sample collection, frequency and testing methodology.

3J.8.5 Secondary Liner – 60 mil HDPE Geomembrane

The composite 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 OR 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 OR will inspect the delivered rolls and will be provided with a roll inventory from the contractor. The POR or OR 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 OR, 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 OR 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 composite 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 OR 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 OR 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 OR 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 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 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 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 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 OR. 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 OR, 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 OR 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 OR will observe protective sand layer placement and document construction activities using field notes, surveys and photographs. The OR 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 OR 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. 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 OR 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 OR 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 OR 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 OR will review material data sheets to ensure the intended pipe meets construction specifications. During the installation of the pipe, the POR and/or OR 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 Division (MSWD). 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;
- Detailed description of temporary dewatering activities as necessary; and,
- Seal and signature of POR and, if applicable, OR, 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 alternate liner 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 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.

The combination of HDPE geomembrane liner with GCL provides a less permeable barrier system than the currently designed geomembrane and compacted caliche composite liner system.

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 S70º 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, 125 feet 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 and 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 22.61 acres in area or 91,500 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 fo 0.000015 inches per day*acre or 0.000314 meters per year (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) – The Koc is used to estimate the contaminant distribution coefficient for the unsaturated zone. This value, 152, was taken from Table 10.5 of Applied Hydrogeology, second edition (Fetter, C.W.), the Koc for trichloroethylene.
- 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 – Default value for sand (29.7 cm/hr). Table B - Texas Water Commission, Alternative Liner Design Handbook, Version 1, 1993.
- Effective Porosity – Default value for coarse sand (0.34). Table B - Texas Water Commission, Alternative Liner Design Handbook, Version 1, 1993.
- 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 – Default value for Group A: deep sand (0.11). Table K - Texas Water Commission, Alternative Liner Design Handbook, Version 1, 1993.
- Bulk Density – Default value for coarse sand (average of range 1.58). 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 50 meters was used.
- Mixing Zone Thickness – Derived by MultiMed Model.
- Effective Porosity – This value (0.30) was data provided in: Permit Modification, McCombs Landfill – MSW 729A, Groundwater Monitoring System, Task 5, Submittal, prepared by Parkhill, Smith and Cooper and dated July 2009.

- Bulk Density – Default value for coarse sand (average of range 1.58). Table G - Texas Water Commission, Alternative Liner Design Handbook, Version 1, 1993.
- Saturated Hydraulic Conductivity – This value (6,307 m/y) was data provided in: Permit Modification, McCombs Landfill – MSW 729A, Groundwater Monitoring System, Task 5, Submittal, prepared by Parkhill, Smith and Cooper and dated July 2009.
- Hydraulic Gradient – This value (0.0042) was data provided in: Permit Modification, McCombs Landfill – MSW 729A, Groundwater Monitoring System, Task 5, Submittal, prepared by Parkhill, Smith and Cooper and dated July 2009.
- 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) – Calculated: foc = OM% / (100 x 1.72); foc =11% / (100 x 1.72).
- 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 125 feet (38 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 mode. The model parameters reflect a conservative analysis and assume no retardation or degradation. Therefore, the results for both modes are the same, showing no retardation or degradation in the unsaturated zone. The predicted concentration of trichloroethylene at the point of compliance is 0.003412 mg/l, a monitoring point 125 feet directly downgradient of the waste limit boundary. If the model is run with the point of compliance set at one meter from the waste limit boundary, the predicted concentration for TCE is 0.003475 mg/l. Both results are below the established standard, US EPA maximum contaminant level (MCL) of 0.005 mg/l.

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.

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

1

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

MultiMed Model Results
McCombs Landfill HELP Model

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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\ALIN10DC.D10
OUTPUT DATA FILE: C:\PROGRAM\ELPASO\ALIN10DC.OUT

TIME: 14:33 DATE: 8/ 8/2012

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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	=	0.2698	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	=	0.1072	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	=	0.0927	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 17

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.	=	0.300000003000E-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	=	3.847	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	29010.303	98.06
RECIRCULATION INTO LAYER 1	0.073986	268.568	0.91
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 4	0.073986	268.568	0.91
PERC./LEAKAGE THROUGH LAYER 6	0.000126	0.458	0.00

AVG. HEAD ON TOP OF LAYER 5	1.2502		
PERC./LEAKAGE THROUGH LAYER 7	0.004953	17.978	0.06
CHANGE IN WATER STORAGE	0.153	555.930	1.88
SOIL WATER AT START OF YEAR	36.576	132770.516	
SOIL WATER AT END OF YEAR	36.729	133326.453	
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	0.292	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	9.145	33194.809	107.33
RECIRCULATION INTO LAYER 1	0.088793	322.318	1.04
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 4	0.088793	322.318	1.04
PERC./LEAKAGE THROUGH LAYER 6	0.000155	0.561	0.00
AVG. HEAD ON TOP OF LAYER 5	1.5019		
PERC./LEAKAGE THROUGH LAYER 7	0.004322	15.687	0.05
CHANGE IN WATER STORAGE	-0.629	-2282.902	-7.38
SOIL WATER AT START OF YEAR	36.729	133326.453	
SOIL WATER AT END OF YEAR	36.100	131043.547	
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 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.09	36626.703	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	7.846	28480.980	77.76
RECIRCULATION INTO LAYER 1	0.100780	365.832	1.00
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 4	0.100780	365.832	1.00
PERC./LEAKAGE THROUGH LAYER 6	0.000180	0.653	0.00
AVG. HEAD ON TOP OF LAYER 5	1.7033		
PERC./LEAKAGE THROUGH LAYER 7	0.003822	13.872	0.04
CHANGE IN WATER STORAGE	2.240	8131.151	22.20
SOIL WATER AT START OF YEAR	36.100	131043.547	
SOIL WATER AT END OF YEAR	37.857	137419.531	
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	0.700	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	29962.191	108.18
RECIRCULATION INTO LAYER 1	0.197383	716.502	2.59
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
RECIRCULATION FROM LAYER 4	0.197383	716.502	2.59
PERC./LEAKAGE THROUGH LAYER 6	0.000403	1.464	0.01
AVG. HEAD ON TOP OF LAYER 5	3.3287		
PERC./LEAKAGE THROUGH LAYER 7	0.003249	11.795	0.04

CHANGE IN WATER STORAGE	-0.627	-2277.627	-8.22
SOIL WATER AT START OF YEAR	37.857	137419.531	
SOIL WATER AT END OF YEAR	37.713	136897.078	
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	0.540	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	2.689	0.883	0.421	0.505
STD. DEVIATIONS	0.179	0.251	0.312	0.115	0.071	0.329
	0.945	0.593	0.939	0.406	0.043	0.046
LATERAL DRAINAGE RECIRCULATED INTO LAYER 1						
TOTALS	0.0085	0.0080	0.0090	0.0090	0.0095	0.0094
	0.0098	0.0099	0.0097	0.0105	0.0106	0.0114
STD. DEVIATIONS	0.0039	0.0040	0.0045	0.0047	0.0050	0.0049
	0.0051	0.0051	0.0049	0.0049	0.0047	0.0050
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	0.0085	0.0080	0.0090	0.0090	0.0095	0.0094
	0.0098	0.0099	0.0097	0.0105	0.0106	0.0114
STD. DEVIATIONS	0.0039	0.0040	0.0045	0.0047	0.0050	0.0049
	0.0051	0.0051	0.0049	0.0049	0.0047	0.0050

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	0.0004	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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	1.6953	1.7401	1.7900	1.8540	1.8980	1.9281
	1.9506	1.9679	1.9886	2.1000	2.1746	2.2654
STD. DEVIATIONS	0.7724	0.8307	0.9051	0.9595	0.9876	1.0043
	1.0128	1.0158	1.0105	0.9685	0.9611	0.9993

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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	8.309	(0.5820)	30162.07	96.646
DRAINAGE RECIRCULATED INTO LAYER 1	0.11524	(0.05585)	418.305	1.34034
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.00000	(0.00000)	0.000	0.00000

DRAINAGE RECIRCULATED FROM LAYER 4	0.11524 (0.05585)	418.305	1.34034
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00022 (0.00013)	0.784	0.00251
AVERAGE HEAD ON TOP OF LAYER 5	1.946 (0.940)		
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00409 (0.00072)	14.833	0.04753
CHANGE IN WATER STORAGE	0.284 (1.3549)	1031.64	3.306

****

****

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	0.00058	2.11307
DRAINAGE COLLECTED FROM LAYER 4	0.00000	0.00000
DRAINAGE RECIRCULATED FROM LAYER 4	0.00058	2.11307
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000001	0.00440
AVERAGE HEAD ON TOP OF LAYER 5	3.594	
MAXIMUM HEAD ON TOP OF LAYER 5	5.607	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	77.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000015	0.05312
SNOW WATER	0.56	2033.9432

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3071
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1215

*** 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	0.7856	0.1309
2	32.8165	0.2735
3	1.4893	0.1241
4	2.0905	0.1742
5	0.0000	0.0000
6	0.1800	0.7500
7	0.3508	0.0585
SNOW WATER	0.000	

****

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Appendix 3J – Attachment 2
Alternative Liner Modeling ("Prescriptive Liner")

SAIC®

Memorandum

SAIC

To: TCEQ

From: Fred J. Doran, SAIC

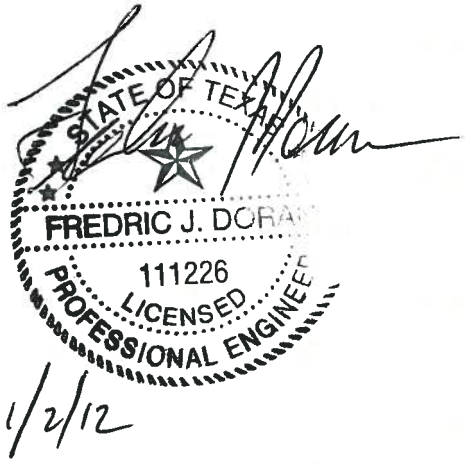
Subject: Appendix 3J, Attachment 2 – Alternative Liner Modeling ("Prescriptive Liner")

Date: November 2, 2012

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". 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



11/2/12

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

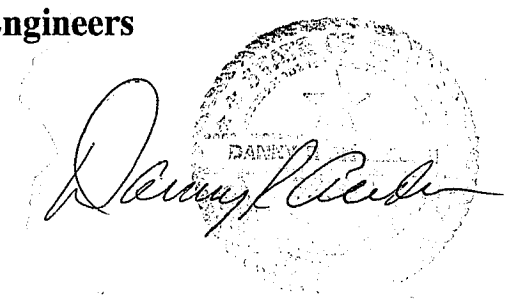
McCOMBS LANDFILL

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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APPENDIX A	Location of Boring and Boring Logs and Boring Logs From Three Existing Wells.
APPENDIX B	HELP Model Simulation Output.
APPENDIX C	Calculation of Leachate Rates.
APPENDIX D	Multi-Media Subtitale D Model Simulation Output.
APPENDIX E	Multi-Media Generic Model Simulation Output.
APPENDIX F	Climatological Data.
APPENDIX G	Other Supporting Data.

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

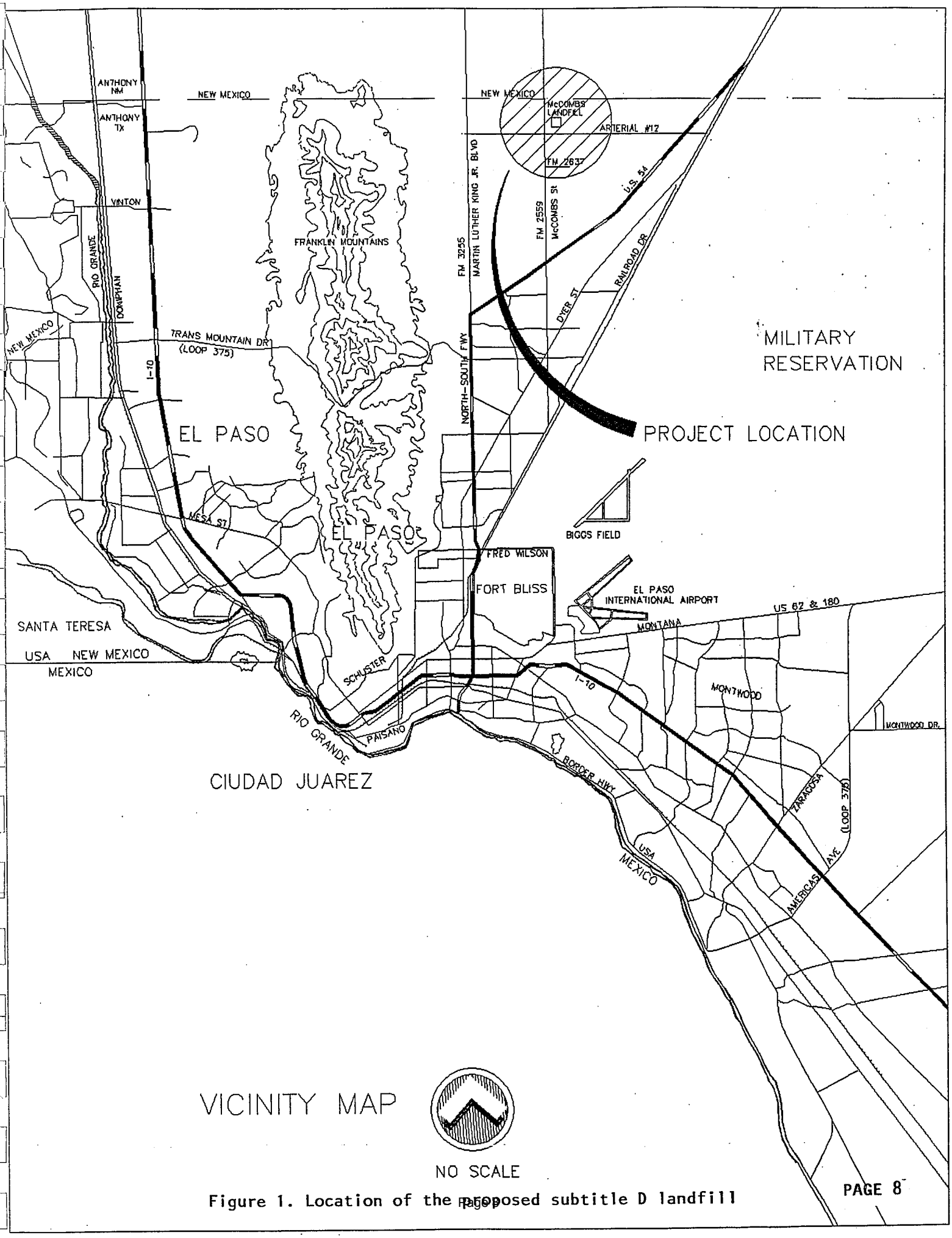

Figure 1. Location of the proposed subtitle D landfill

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

Page 9

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS
EL PASO, TEXAS 79903 (915) 532-7566

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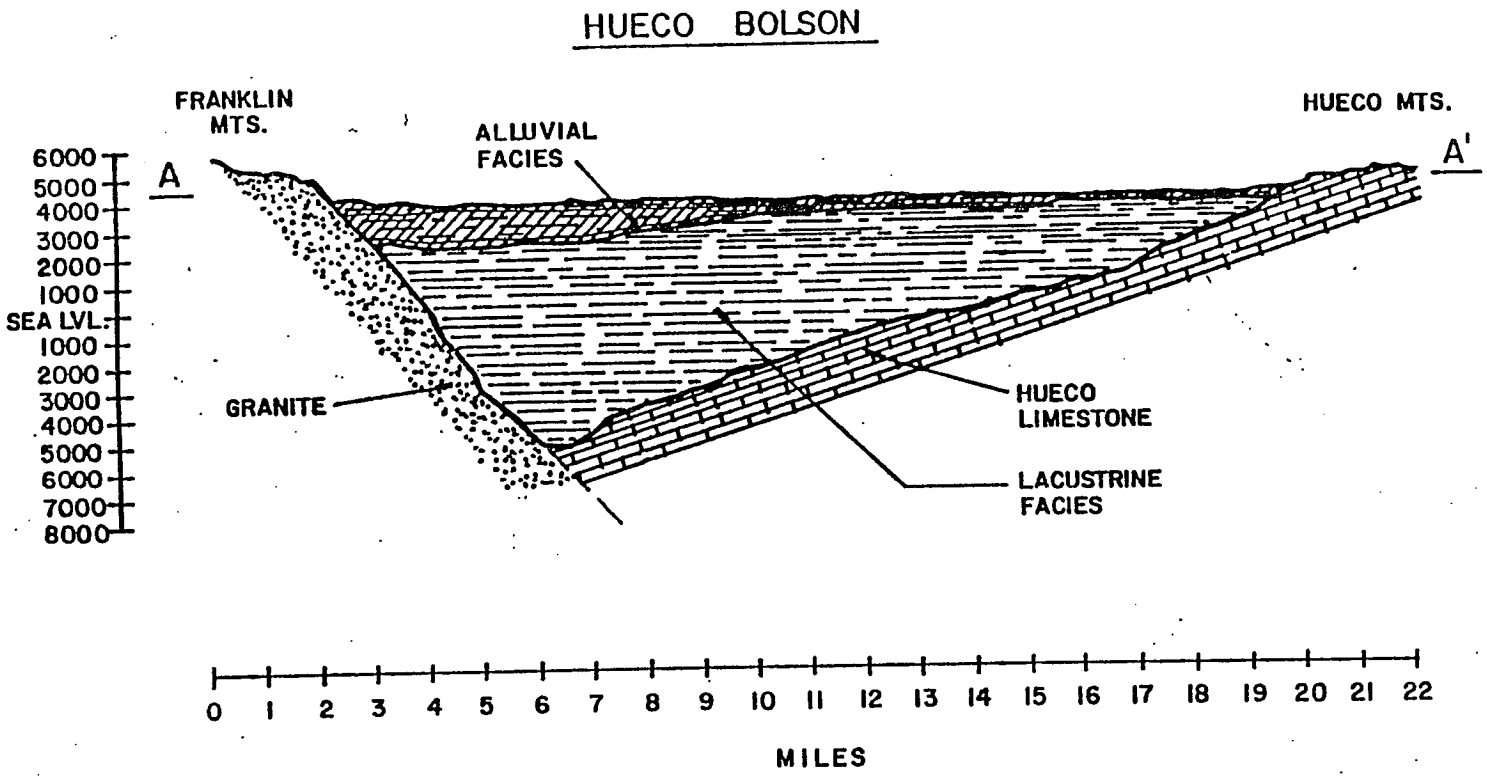

FIG. 2 A WEST - EAST GEOLOGIC CROSS-SECTION OF THE HUECO BOLSON.

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.

Page 11

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

Page 12

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

Page 13

(1.79 gal/min); specific capacity of wells averages 0.5m^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

Page 14

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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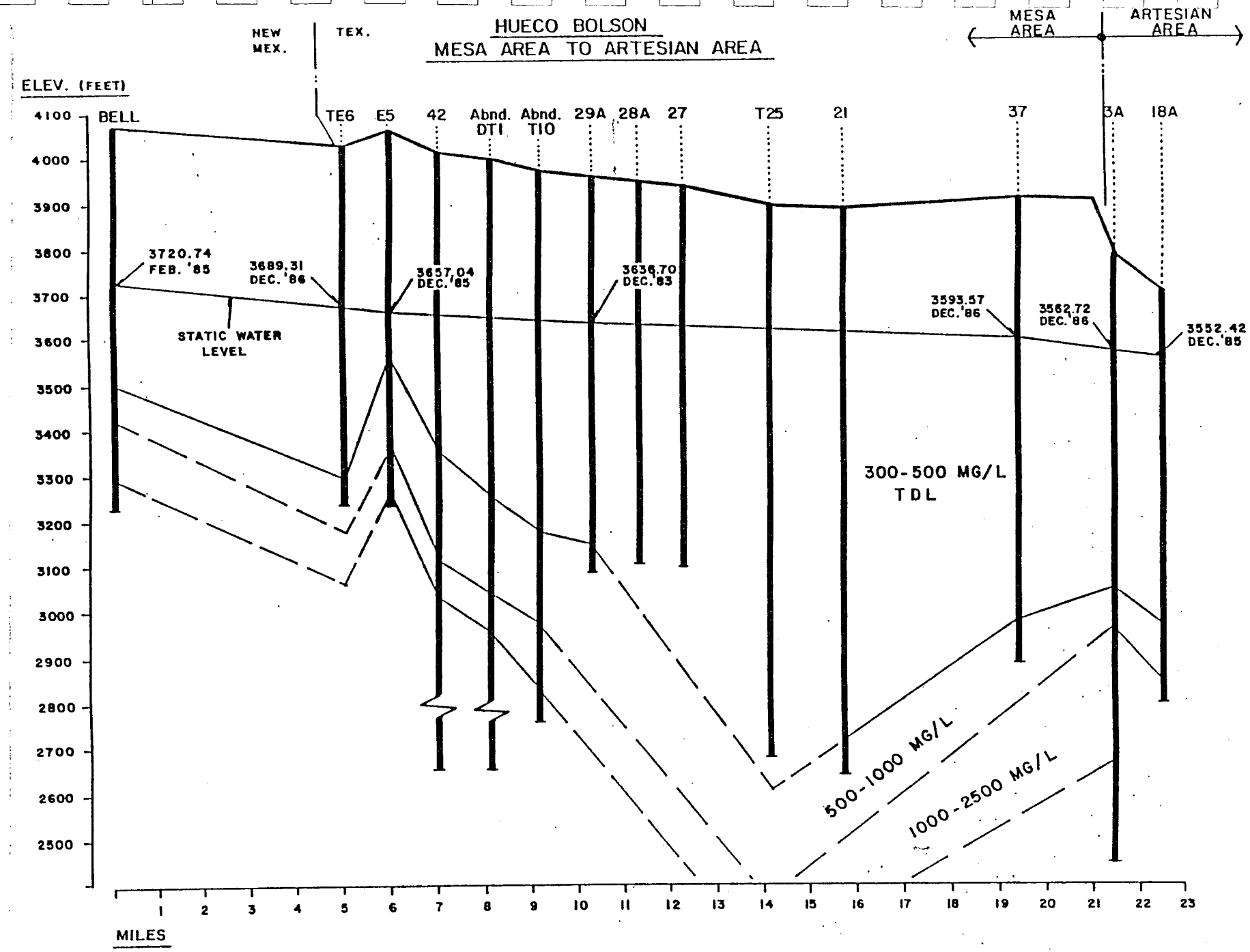

INFORMATION PROVIDED BY
ROGER SPERKA, EL PASO WATER UTILITIES

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.

DANNY R. ANDERSON CONSULTANTS, INC.
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS
NOV. 11, '87 — DRWN BY D.E. — PROJECT McCOMBS SLUDGE DISP. LDFILL — FILE NO. 87194
Page 16
Page 16

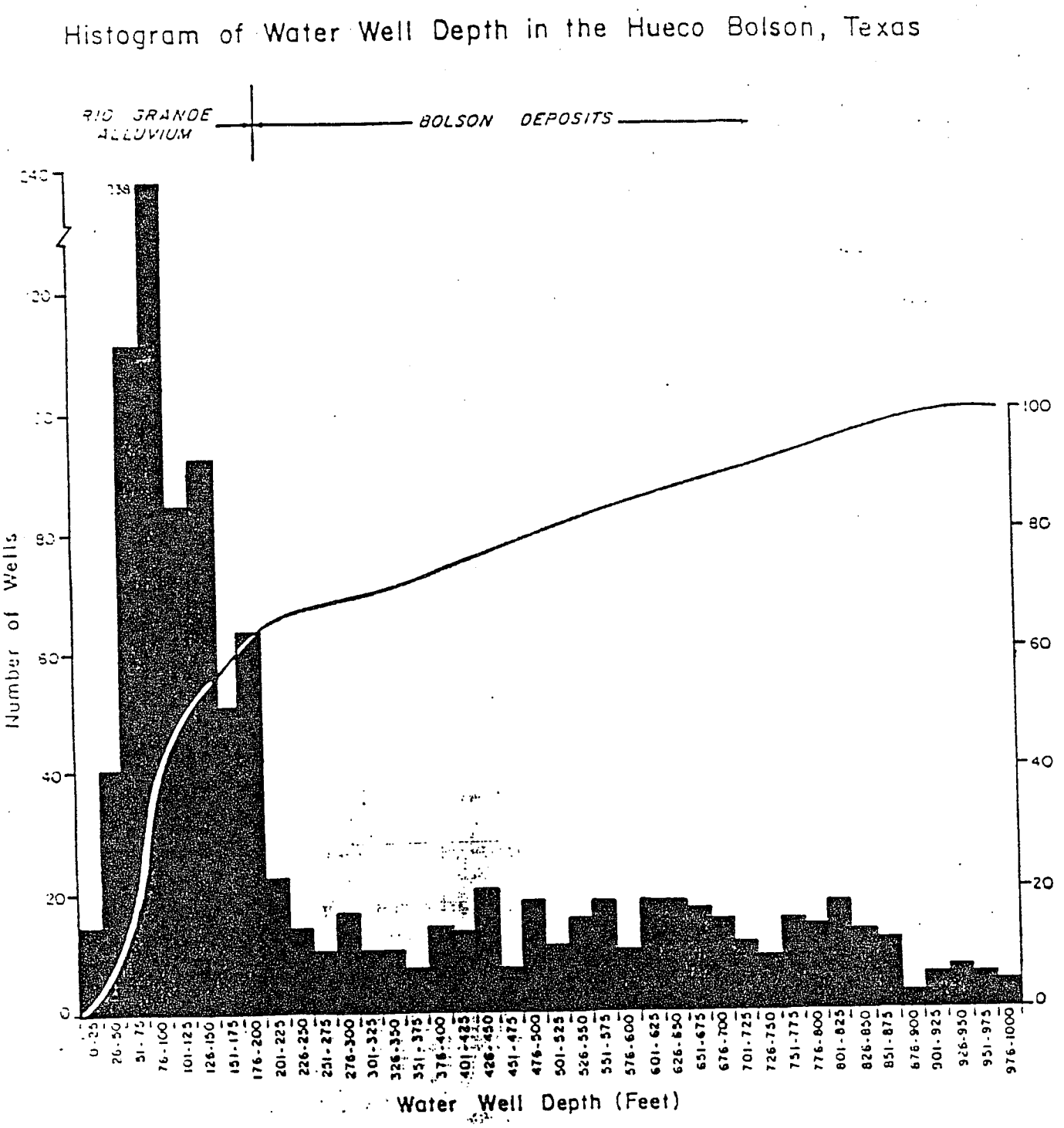

Figure 4. Histogram of water well depth in the Hueco Bolson, El Paso County, Texas. Wells of depth less than 79 meters (260 feet) depth are pumping water from the Rio Grande alluvium in the El Paso Valley. Wells of depth greater than 79 meters are pumping water from either the City Artesian Area (below the Rio Grande alluvium between El Paso and Ysleta) or the Mesa area.

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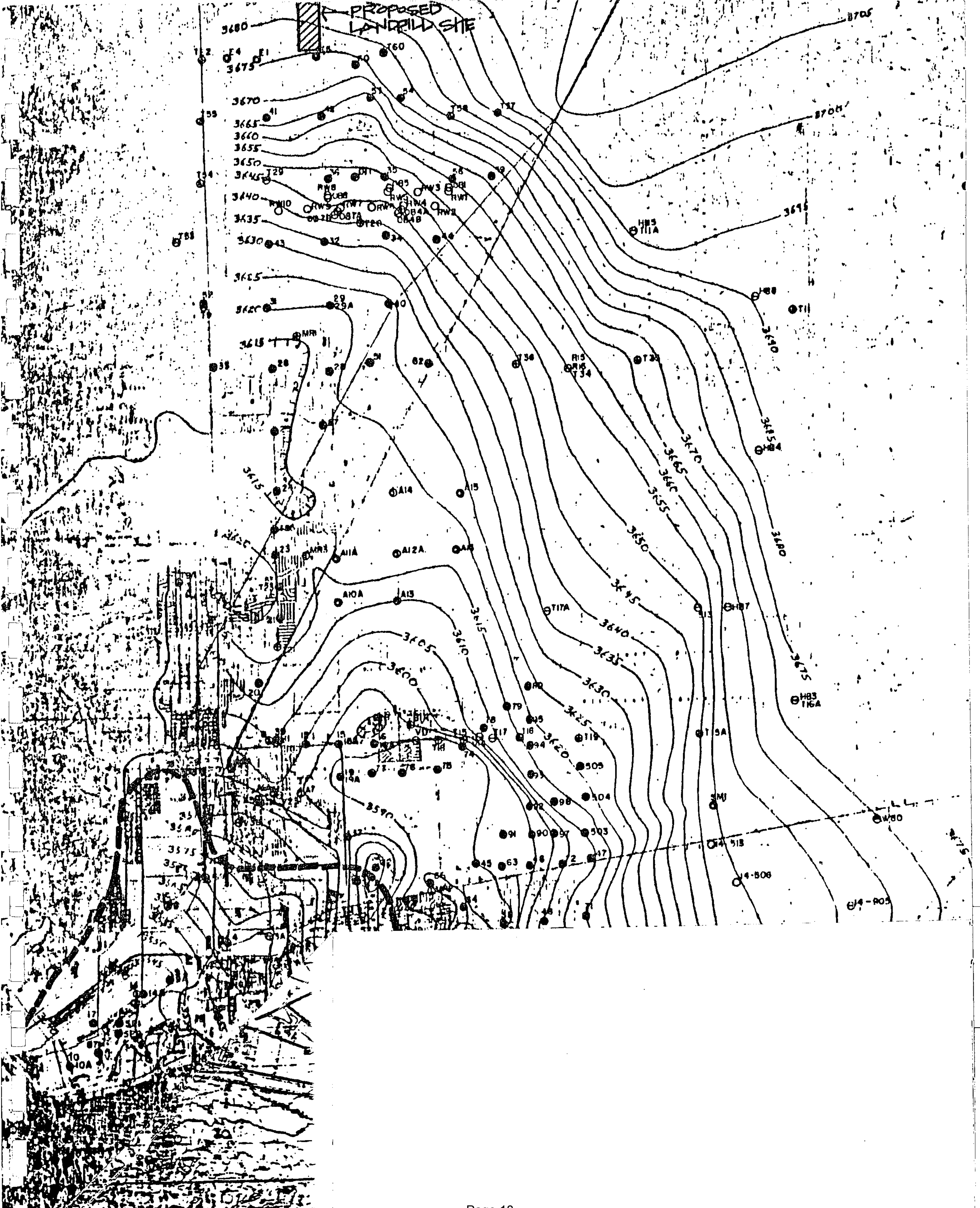
PROPOSED LANDFILL SITE
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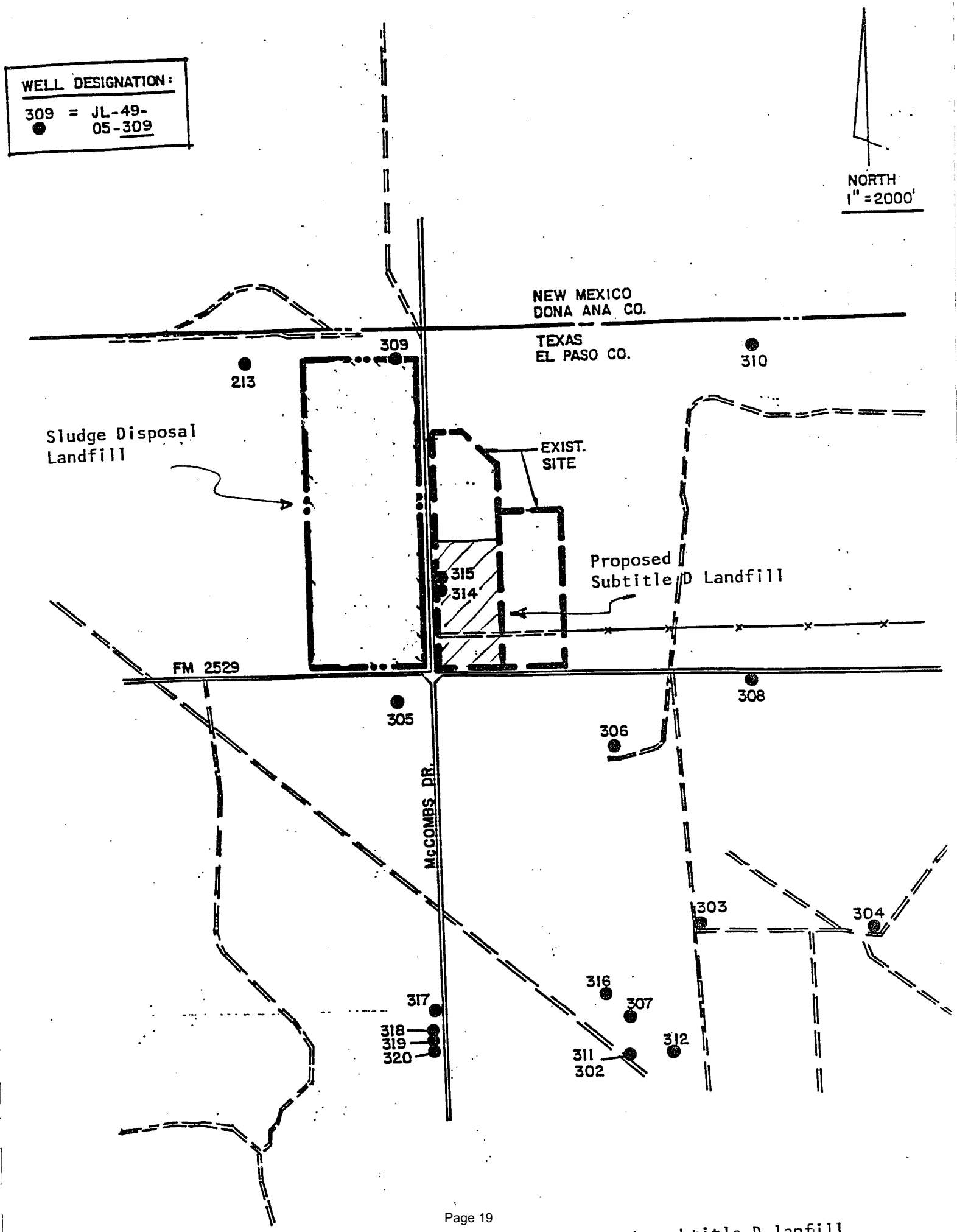

Figure 6. Existing wells on the proposed subtitle D lanfill and the existing sludge disposal landfill.

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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

Page 25

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	0.698×10^{-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

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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	0.698×10^{-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 1×10^{-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

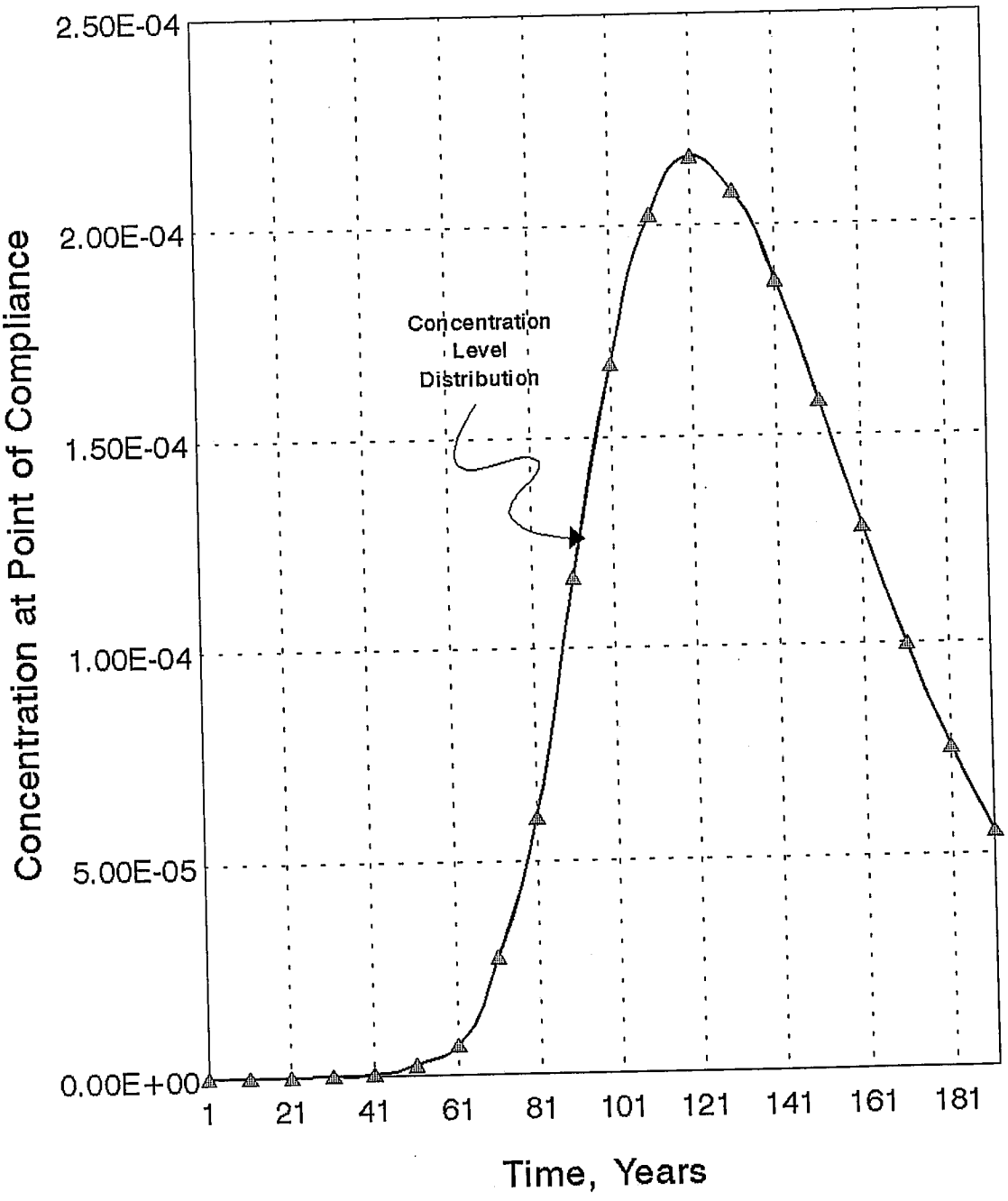

Figure 7. Concentration at Point of Compliance relative to Time

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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

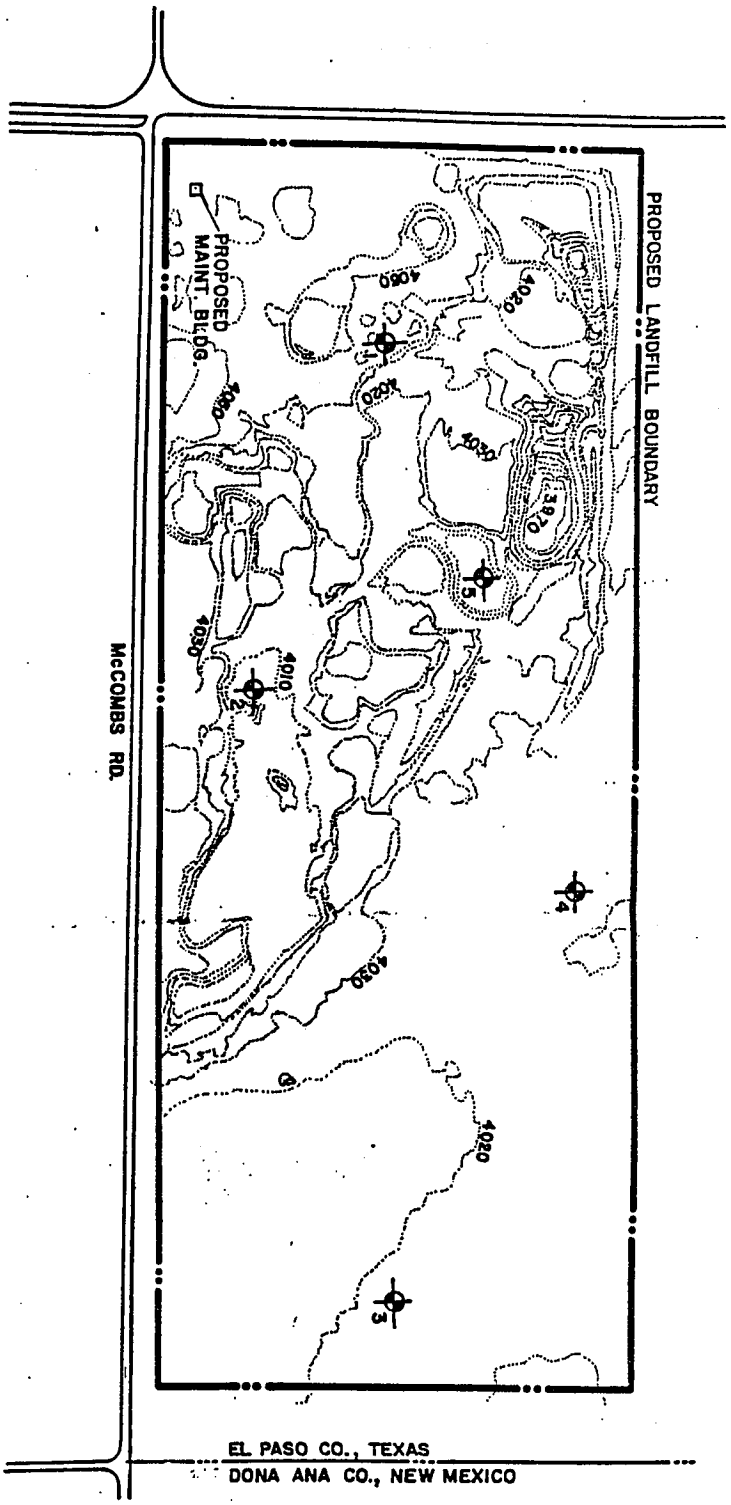
TABLE III

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 = 114.3×10^{-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 = 1×10^{-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 = (5×10^{-9} cm/sec = 5×10^{-11} m/s).

μ^{25} = Viscosity of water at 25°C = 0.000890 (N s/m²)

μ^{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

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

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

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	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;
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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

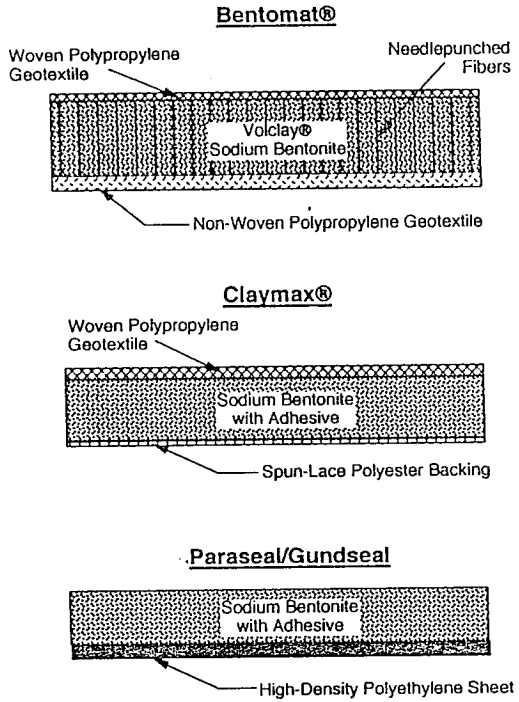

FIG. 1. Geosynthetic Clay Liners

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[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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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

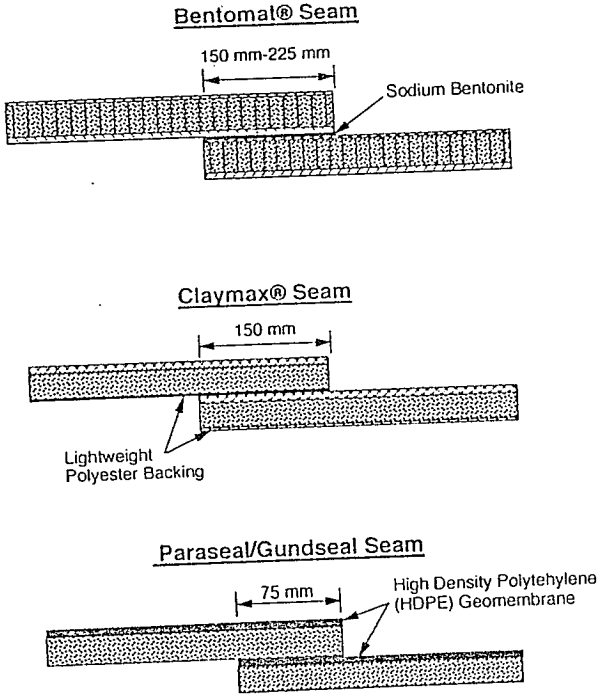

FIG. 2. Configuration of Overlapped Seams with Manufacturers' Minimum Recommended Overlap Width

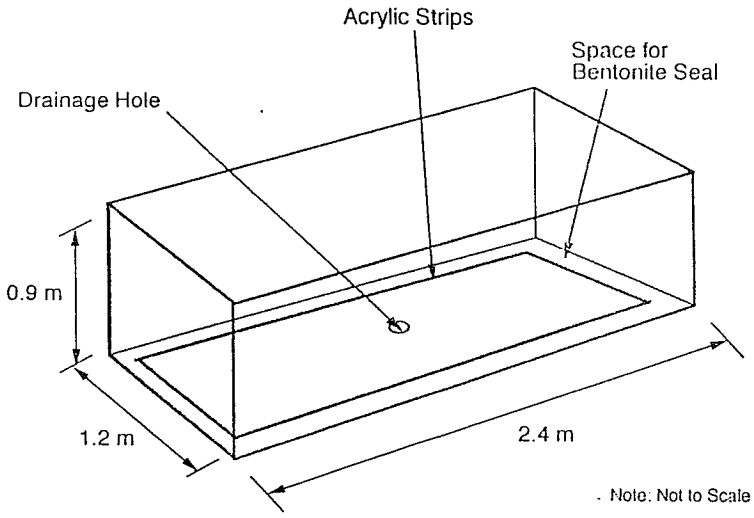

FIG. 3. Orthogonal View of Tank Used for Bench-Scale Hydraulic Conductivity Tests

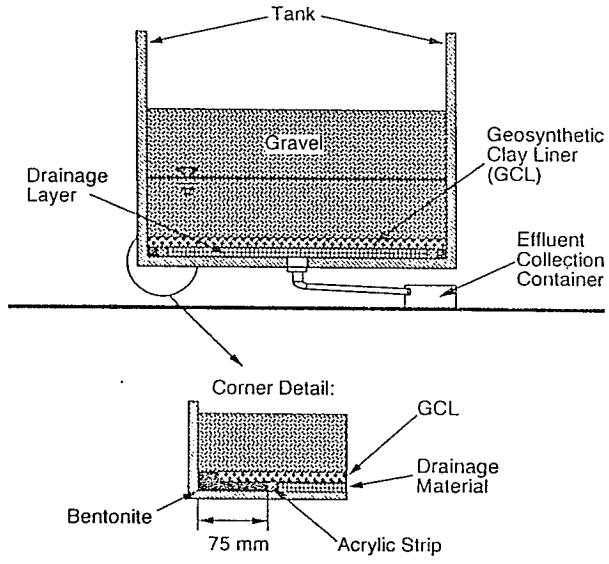

FIG. 4. Cross-Sectional View of Configuration of Materials in Tanks

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.

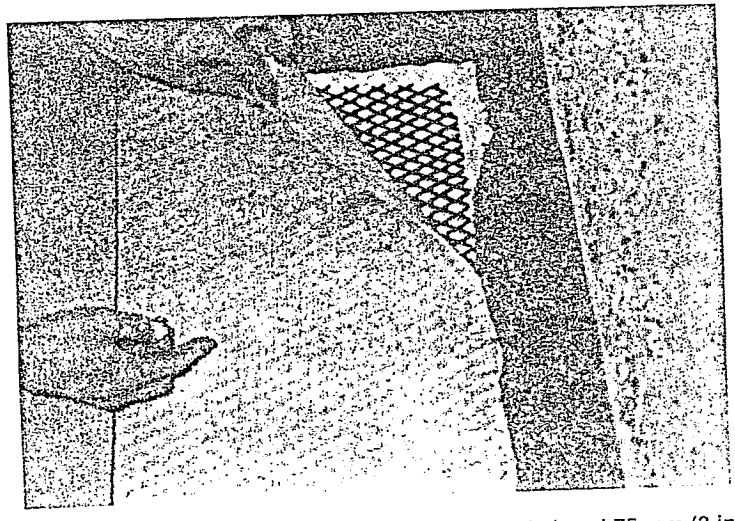

FIG. 5. Drainage Material (Geotextile/Geonet Composite) and 75 mm (3 in.) Wide Bentonitic Edge Seal

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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-

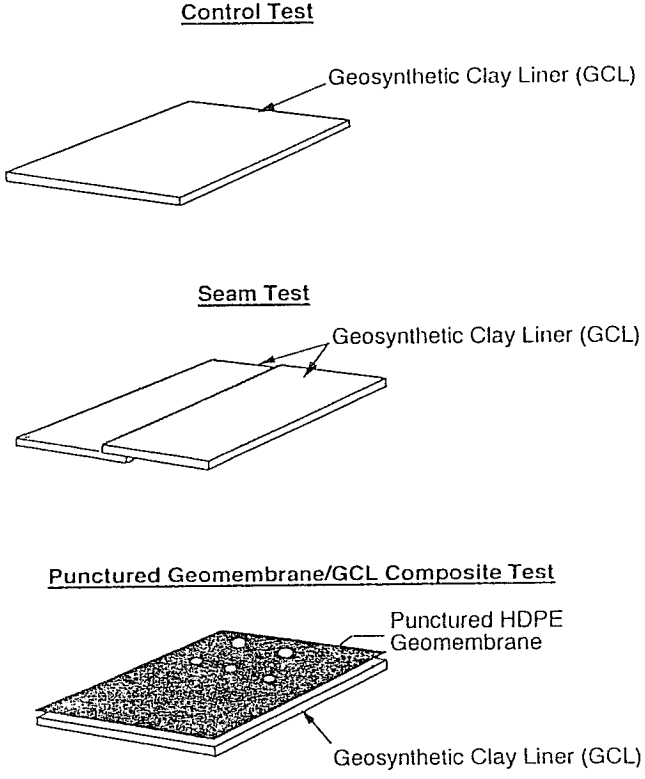

FIG. 6. Schematic Diagram of Types of Tests Performed in Tanks

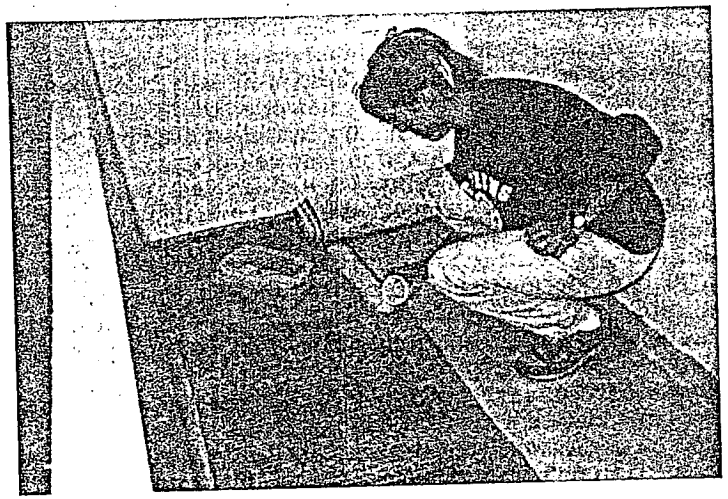

FIG. 7. Placement of Bentomat with Overlapped Seam (Note Spreading of Granular Bentonite along Overlapped Zone)

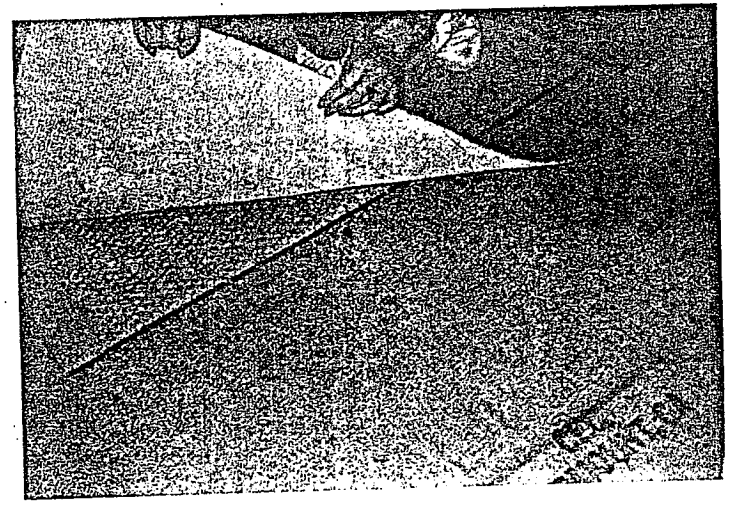

FIG. 8. Placement of Claymax with Overlapped Seam

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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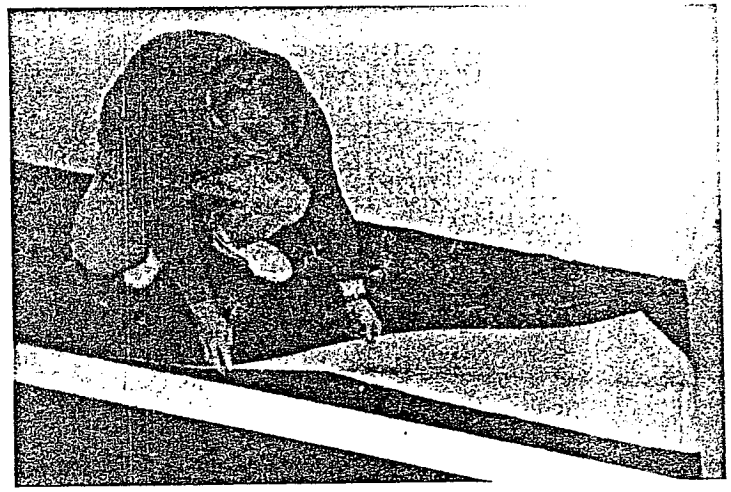

FIG. 9. Placement of Gundseal with Overlapped Seam

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 3×10^{-10} to 6×10^{-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	1×10^{-9}
	J&L Testing Co. (1990)	56	8.2	6×10^{-9}
		73	10.6	1×10^{-9}
		91	13.2	1×10^{-9}
	This study	14	2	3×10^{-9}
		34	5	3×10^{-9}
		69	10	1×10^{-9}
Claymax	Chen-Northern (1988)	24	3.5	2×10^{-9}
	Geoservices (1988)	200	29	4×10^{-10}
	Geoservices (1989)	207	30	8×10^{-10}
		207	30	3×10^{-10}
		207	30	7×10^{-10}
	Geoservices (1990)	207	30	3×10^{-10}
	GeoSyntec (1990)	6.9	1	2×10^{-9}
	GeoSyntec (1990)	10.3	1.5	4×10^{-9}
	Shan (1990)	14	2	2×10^{-9}
		34	5	1×10^{-9}
		69	10	6×10^{-10}
		138	20	3×10^{-10}
Gundseal	GeoSyntec (1991b)	14	2	2×10^{-9}
	Shan and Daniel (1991)	14	2	2×10^{-9}
	GeoSyntec (1991c)	34	5	1×10^{-9}

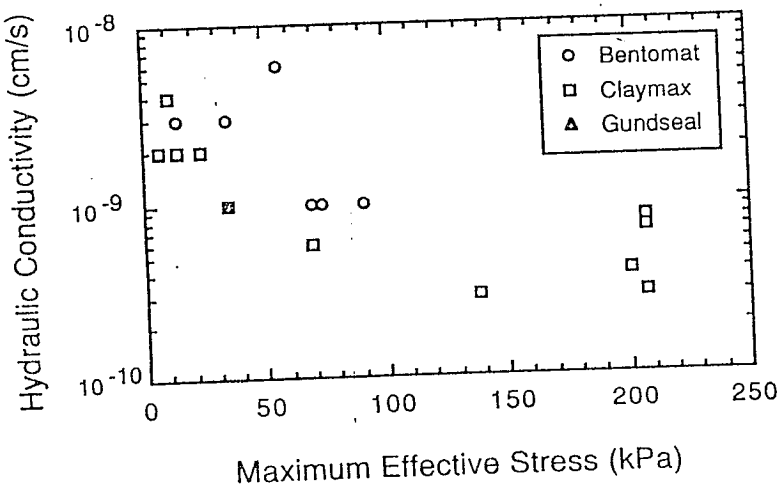

FIG. 10. Results of Flexible-Wall Hydraulic Conductivity Tests

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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	4×10^{-10}	4×10^{-9}
Bentomat	9	1.3	4×10^{-10}	4×10^{-9}
Claymax	6	0.9	1×10^{-8}	3×10^{-9}
Claymax	6	0.9	8×10^{-9}	3×10^{-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	4×10^{-10}	4×10^{-10}	1×10^{-9}
	2	8	10	4×10^{-10a}	—	—
Claymax	1	3	9	1×10^{-8}	3×10^{-8}	9×10^{-8}
	2	8	10	8×10^{-9}	9×10^{-9}	1×10^{-8}
	3	8	10	7×10^{-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

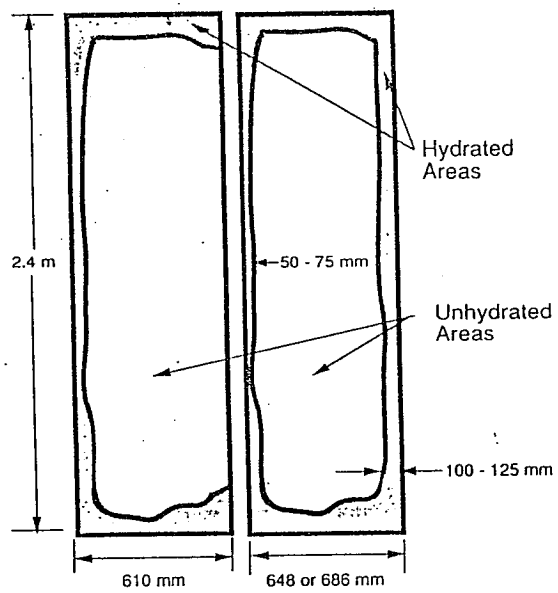

FIG. 11. Pattern of Wetting of Bentonite in Overlapped Gundseal when HDPE Faced Upward

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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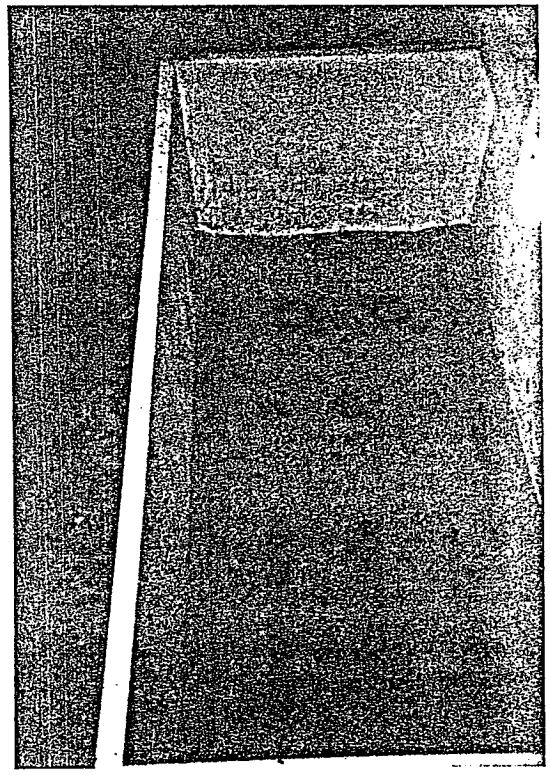

FIG. 12. Pattern of Wetting of Bentonite in Gundseal after Overlying Gravel and Punctured Geomembrane had been Removed from Tanks

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	4×10^{-10}	6×10^{-10}	1.5
Claymax	7×10^{-9}	7×10^{-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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Acknowledgments

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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

Introduction

I. General Information

II. HELP and Multimed
- o Acquisition of HELP and Multimed
- o Leachate Production and Leakage Using Hydrological Evaluation Of Landfill Performance (HELP) Model
  - -Thickness of Leachate on Liners
  - -Evaluation of Leakage Through a Composite Liner
  - -Evaluation of Leakage Through a Clay Liner
- o Leachate Migration Using Multimedia Exposure Assessment (Multimed) Model

III. Recommended Minimum Requirements for Evaluation of Alternate Liners using HELP and Multimed

Conditions of Multimed
- o Alternate Liner Scenarios
- o Standardized Model Input Data
- o Submodules of Multimed
  - Unsaturated Zone Flow
  - Unsaturated Zone Transport
  - Saturated Transport Module
- o Input Leachate Requirements

IV. Order of Report
- o Landfill Cell Orientation

Alternate Design Example

Appendix A

Specific Input Requirements
- o Chemical-Specific Variable Data
- o Source-Specific Data
- o Unsaturated Zone Flow
- o Aquifer-Specific Variable Data
- o Unsaturated Zone Transport

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).

Appendix 3K
Geology

SAIC®

Appendix 3K – Attachment 1
Site Characteristics and Monitoring Plan

SAIC®

Memorandum

SAIC

To: TCEQ

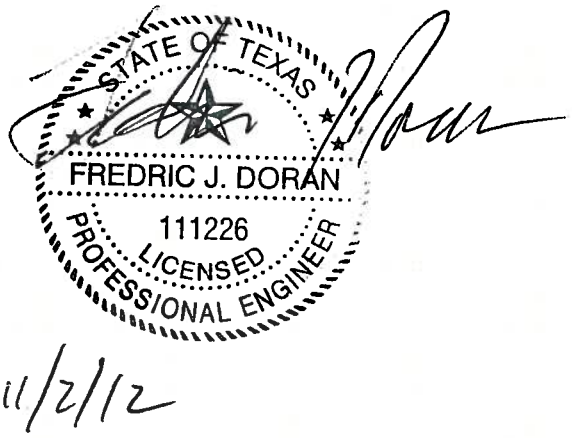
From: Fred J. Doran, SAIC

Subject: Appendix 3K, Attachment 1 – Site Characteristics and Monitoring Plan

Date: November 2, 2012

SAIC Energy, Environment & Infrastructure, LLC (SAIC) has included the Site Characteristics and Monitoring Plan (Plan) prepared by Parkhill, Smith & Cooper, Revised October 2012 as Appendix 3K, Attachment 1 for your information. This plan was submitted to the TCEQ on October 30, 2012 and it is understood that review will be performed by the permit review team that began the Subchapter J modification review for the McCombs Landfill in 2009.

TLK



11/2/12

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

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

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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

January 13, 2010
Project No. 09-12-35

Arten J. Avakian, P.G., Project Manager
MC-124
Municipal Solid Waste Division
Texas Commission on Environmental Quality (TCEQ)
P.O. Box 13087
Austin, TX 78711-3087

Re: Response to TCEQ Letter Dated December 14, 2009, City of El Paso McCombs Municipal Landfill - MSW Permit No. 729A, El Paso County, Permit Modification - Groundwater Monitoring System, WWC No. 12904919; RN100215599 / CN601410244

Dear Mr. Avakian:

On behalf of the City of El Paso (McCombs), this letter provides a response to the comments in a Texas Commission on Environmental Quality (TCEQ) letter dated December 14, 2009. The letter requested that the TCEQ comments be addressed within 30 days (January 13, 2010). The TCEQ's comments are provided below in italics and our responses immediately follow.

Comment 1: *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.*

Response: As requested monitoring will be performed 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 note that we will have to bid the construction for the new piezometers in order to comply with state bidding requirements. We will begin this month preparing plans and specifications which we will provide to the city purchasing department. The project will advertise in the local newspaper and opened sometime in late February or early March. We would see construction beginning in early May completing sometime in June. The wells may not be ready prior to

4222 85th Street Lubbock, Texas 79423 806.473.2200 Fax 806.473.3500

the next monitoring event, but we will strive to make that deadline if possible. We will keep you apprised as the project develops.

We trust this information is acceptable. Please call undersigned if you have any questions. A revised permit modification is attached.

Sincerely,
THE CAREL COPORATION

Steven J. Wimmer
Remedial and Environmental Services Manager

Kevin T. Carel, P.G.
President

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST

1-13-10

PARKHILL, SMITH & COOPER, INC.

Robert H. (Holly) Holder, P.E.
Principal

cc: Kent Waggoner - TCEQ Region 6 Office
Ellen Smyth – City of El Paso
Miguel Parra, P.E. – City of El Paso
Cristian Benitez – City of El Paso
Kevin T. Carel, P.G. – The Carel Corporation

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

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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.

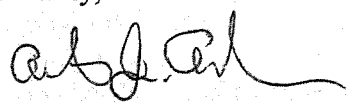
We therefore are modifying the request in our letter dated October 8, 2009, and ask that you begin monitoring in accordance with the facility GWSAP in existing monitor wells MW-1, 2, and 3, and in piezometer PZ-5 at the first event following the installation of PZ-5.

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

November 6, 2009
Project No. 09-10-21

Arten J. Avakian, P.G., Project Manager
MC-124
Municipal Solid Waste Division
Texas Commission on Environmental Quality (TCEQ)
P.O. Box 13087
Austin, TX 78711-3087

Re: Response to TCEQ Letter Dated October 8, 2009, City of El Paso McCombs Municipal Landfill - MSW Permit No. 729A, El Paso County, Permit Modification - Groundwater Monitoring System, WWC No. 12831440; RN100215599 / CN601410244

Dear Mr. Avakian:

On behalf of the City of El Paso (McCombs), this letter provides a response to the comments in a Texas Commission on Environmental Quality (TCEQ) letter dated October 8, 2009. The letter requested that the TCEQ comments be addressed within 30 days (November 7, 2009). The TCEQ's comments are provided below in italics and our responses immediately follow.

Comment 1: *Interim groundwater monitoring*

When you receive confirmation that the GWSAP modification has been issued, please begin monitoring for the standard list of detection monitoring constituents (volatile organic compounds, and total concentrations of metals) identified in 30 TAC Chapter 330, Section (§)330.419 in existing monitor wells MW-1, 2, and 3. Please also begin monitoring for the same constituents in piezometers PZ-4 and 5 at the first event following their installation. At the outset, you may need to conduct quarterly background monitoring for total metals concentrations if you do not already have background data sets for total metals. Monitoring results from wells that are downgradient from waste should be evaluated after each sampling event during the background data collection period, for evidence of releases from the facility.

Response: Detection monitoring constituents will be collected from existing monitor wells MW-1, 2, and 3 following issuance of the GWSAP as requested.

A representative of the facility contacted the TCEQ on October 28, 2009 to discuss the proposed status of PZ-4 and PZ-5. A brief summary of the telephone

4222 85th Street Lubbock, Texas 79423 806.473.2200 Fax 806.473.3500

conversation is as follows. Proposed piezometers PZ-4 and PZ-5 shall be installed to determine the groundwater flow direction towards the east/southeast boundaries of the landfill. The facility representative proposed that monthly water levels be collected from PZ-4 and PZ-5 as part of the additional groundwater investigation in an effort to confirm or disprove their hydraulic position. PZ-4 and PZ-5 will be constructed to monitor well standards identified in 30 TAC §330.421. In the event PZ-4 and PZ-5 are concluded to be hydraulically downgradient from water levels collected during the additional groundwater investigation, appropriate response actions such as collecting detection monitoring parameters will commence. The facility officially and respectfully requests the approval of the above stated proposition.

Comment 2: *Additional groundwater investigation*

Please proceed with your plan for an additional groundwater investigation, while taking into account the following:

a. *As you conduct the additional groundwater investigation, please be prepared to adjust the scope and detail of the investigation to ensure conclusive results. If in the end the results of the investigation are inconclusive, further investigations could be necessary.*

b. *We recommend that you measure water levels in the monitor wells and piezometers more frequently than quarterly (at least monthly, or even more frequently) to improve the ability to capture short-term changes in groundwater levels.*

c. *We also suggest that you prepare and include several cross sections in the report for the additional investigation, to help illustrate the configuration of the facility, and the essential geological and hydrogeological features of the site.*

Response: The TCEQ comments and suggestions are duly noted. In regards to Comment 2b, monthly water levels will be measured in the monitor wells and piezometers.

Comment 3: *Revisions to SCMP*

a. *Please revise the last bullet of Section 5 (Conclusions) of the SCMP ("After at least one year of....") to strike the words "at least," so the sentence will be consistent with information in the response letter and Sections 4.7.5, 6 and 6.1 of the SCMP (which state "After one year of....).*

b. *Please revise Figures 15, 16, and 17 to update the symbols used to represent wells JL49-05-314 (plugged extraction well) and JL49-05-315 (existing extraction well).*

Response: Our records indicate that the last bullet of Section 5 (Conclusions) of the SCMP states "After one year of.....", which was submitted in September 2009. An additional page 20 has been attached. The map symbols have also been revised as requested. Appropriate replacement pages are attached to this letter.

We trust this information is acceptable. Please call undersigned if you have any questions. A revised permit modification is attached.

Sincerely,
THE CAREL COPORATION

Steven Wimmer

Steven J. Wimmer
Remedial Services Manager

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST

Kevin T. Carel, P.G.
President
11·6·09

PARKHILL, SMITH & COOPER, INC.

Robert Holly Holder

Robert H. (Holly) Holder, P.E.
Principal

Att 1: Revised Pages of the Site Characterization and Monitoring Plan
Att 2: Certification Statement

cc: Kent Waggoner - TCEQ Region 6 Office
Ellen Smyth – City of El Paso
Miguel Parra, P.E. – City of El Paso
Cristian Benitez – City of El Paso
Kevin T. Carel, P.G. – The Carel Corporation

PSC CAREL CORPORATION

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

PSC The CAREL CORPORATION

September 10, 2009
Project No. 09-07-34

Arten J. Avakian, P.G., Project Manager
MC-124
Municipal Solid Waste Division
Texas Commission on Environmental Quality (TCEQ)
P.O. Box 13087
Austin, TX 78711-3087

Re: Response to TCEQ Letter Dated July 27, 2009, City of El Paso McCombs Municipal Landfill - MSW Permit No. 729A, El Paso County, Permit Modification - Groundwater Monitoring System, WWC No. 11969813, 12746249, and 12747611; RN100215599 / CN601410244

Dear Mr. Avakian:

On behalf of the City of El Paso (McCombs), this letter provides a response to the comments in a Texas Commission on Environmental Quality (TCEQ) letter dated July 27, 2009. The letter requested that the TCEQ comments be addressed within 45 days (September 10, 2009). The TCEQ's comments are provided below in italics and our responses immediately follow.

GWSAP *(comments by Eleanore Whitworth; page numbers refer to the marked copy of the document)*

Comment 1: *Page 11-i, Contents, gives the subtitle as "LIST OF FIGURES, TABLES, AND APPENDICES" but the 2002 version gives the subtitle in a different format, namely, "SECTION." Please be reminded that changes should be indicated with redline / strikeout format on page 11-i and 11-iii.*

Response: Page 11-i has been revised accordingly and the revised page is attached.

Comment 2: *Page 11-9, Section 6.4, Types of Sample Containers, Metals, states that no field filtering of the groundwater samples may be performed. Please clarify that 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.*

Response: Section 6.4 has been revised as requested and revised pages are attached.

Comment 3: *Page 11-21, Section 11, Detection Monitoring, please revise the GWSAP to provide for notification of a statistically significant increase (SSI) in any constituent in any on-site well in accordance with §330.407(b).*

Response: The following sentence has been added to Section 11: "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))." Revised pages are attached.

Comment 4: *Page 11-13, Section 7, Analytical Parameters, references Table Att11-2. Table Att11-2 contains reporting limits. Please remove all language concerning "reporting limits" from the GWSAP. The facility reporting limits should be the analytical laboratory practical quantitation limits (PQLs). Please revise Section 3.3 to include the following language regarding standards for PQLs, in accordance with 30 TAC §330.405(f)(5):.....*

Response: All language concerning "reporting limits" has been removed from the GWSAP. Also, the requested language has been added to Section 7, not Section 3.3, which contains information regarding gas monitoring and water level measurements. Revised pages are attached.

Comment 5: *Page 11-16, Section 9, Laboratory Procedures and Performance Standards, in the first paragraph states that "Laboratory data and analyses will be performed and submitted in accordance with §330 Subchapter F, Analytical Quality Assurance and Quality Control, until its expiration on January 1, 2009, at which time 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)." Please remove all subsequent references to Chapter 330 Subchapter F.*

Response: All references to Chapter 330 Subchapter F have been removed from the GWSAP.

Comment 6: *Page 11-19, Section 10, Background Samples, please add a section to clarify that 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. Include a reference in this paragraph to the list of water quality parameters in the appropriate table.*

Response: Section 10 has been revised as requested. No reference is provided to a list of water quality parameters due to the need for these has yet to be determined.

Comment 7: *Page 11-19, Section 10, Background Samples, includes the following language "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." Please add language stating that 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.*

Response: The following language has been added to Section 10: "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."

Comment 8: *Page 11-21, Section 11, Detection Monitoring, contains an occurrence of the former term "SSC." Pursuant to 30 TAC §330.407(b), any instances of the phrase "statistically significant change" or "SSC" that remain in the GWSAP should be changed to "statistically significant increase" or "SSI."*

Response: The term "statistically significant change" or "SSC" has been revised to "statistically significant increase" or "SSI" throughout the GWSAP.

Comment 9: *Page 11-26, Section 14, Statistical Methods, states that "Pursuant to 30 TAC §330.405, statistical treatment of analytical data is required as part of the groundwater sampling and analysis plan." but does not state that 30 TAC §330.405 will be followed in meeting this requirement. Please add language stating that statistical analysis will be provided in accordance with 30 TAC §330.405.*

Response: The following language has been added to Section 14: "Statistical analysis will be provided in accordance with 30 TAC §330.405."

Comment 10: *Please revise this language to state that "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 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."*

Response: See response to comment 7.

Comment 11: *Page 11-29, Section 15, Reporting and Submittals, second sentence: After "a notice in writing to the executive director," please insert the phrase "and any local pollution agency with jurisdiction that has requested to be notified."*

Response: The requested phrase has been added to Section 15.

Comment 12: *Page 11-30, Section 15, Reporting and Submittals, contains reference to 30 TAC §330.407(k)(1) to (6); this appears to be a typographical error. Please change §330.407 to §330.409 if that was intended, or explain the meaning of the reference.*

Response: The reference to 30 TAC §330.407(k)(1) to (6) in Section 15 has been revised to 30 TAC §330.409(k)(1) to (6).

Comment 13: *Page 11-30, Section 15, Reporting and Submittals, contains reference to 30 TAC §330.409, and states that in the event the facility is in assessment monitoring, an annual assessment monitoring report will be submitted to TCEQ no later than sixty (60) days after the facility's last groundwater sampling event in a calendar year. 30 TAC §330.409 states that the assessment monitoring report shall be submitted within 60 days after the facility's second semiannual groundwater monitoring event. Please revise this section to provide for assessment monitoring reports to be submitted in accordance with the timeframes specified in §330.407(b).*

Response: Section 15 has been revised to provide for assessment monitoring reports to be submitted in accordance with the timeframes specified in §330.407(b).

SCMP *(comments by Arten Avakian)*

Comment 14: *Point of compliance (POC) and additional groundwater investigation*

In our letter dated May 4, 2009, we commented that you may wish to install one or more piezometers and conduct additional groundwater investigations to improve the understanding of groundwater flow directions in the vicinity of the landfill. The response indicates you will be submitting a proposal soon to install a piezometer and conduct an additional investigation as suggested in our letter. We appreciate your cooperation and willingness to pursue the investigation; however, the available data suggest that one piezometer may not be adequate to conclusively determine groundwater flow directions on the south side of the facility. Information in the application that relates to this concern includes:

- *The discussion in Section 4.4 of the SCMP notes that regional groundwater flow in the McCombs Landfill area is generally to the south-southeast.*

- *The SCMP states that recent data indicate flow in the immediate vicinity of the facility is easterly; however, the observations that apparently led to that statement span a relatively short period (one set of observations in July 2007, and two in November 2007, according to Figures 15, 16, and 17). The observations include four off-site wells in the area west of the facility, but no off-site wells in the area to the south, and no on-site or off-site wells on the east side of the facility. The flow directions estimated from this limited observation period and distribution of wells may not be representative. A comparison of Figure 15 with Figure 14C in Appendix C shows what a big effect a few data points can have on a groundwater contour map and implied flow directions. Even with the shortcomings, the limited observations indicate groundwater flow directions vary and are affected by wells in the surrounding area.*

- *The SCMP documents 41 wells within two miles of the facility (including 10 wells within approximately one-half mile and several immediately adjacent). Some of the wells are observation wells, but others may be used for water supply or for recharge. The operation of the water supply wells and recharge wells may cause groundwater flow directions to vary with time.*

The information reported so far suggests that the POC should encompass most or all of the south side and east side of the landfill. Please revise the application to extend the POC fully along the south and east sides of the landfill, or provide additional information to characterize short and long term groundwater flow directions with greater certainty if you believe the POC is shorter.

Response: Your comment concerning the need for more piezometers is noted. The City does not disagree that more piezometers would be beneficial to the design of the groundwater monitoring system. For this reason, the City proposes to install two additional piezometers designated at PZ-4 and PZ-5 to aid in the determination of groundwater flow and the extent of the POC. It is noted that based on the flow directions illustrated on Figures 15, 16, and 17, the south side of the site is not downgradient of the landfill. PZ-4 is proposed to determine whether drawdown is being induced by the extraction well (i.e. CEMEX well) located south of the facility and north of Stan Roberts Road. If drawdown is occurring from the CEMEX well, then the POC should extend along at least a portion of the south side of the site. PZ-4 will be installed to monitor well standards and will be located appropriately to function as a monitor well. Similarly, PZ-5 will be constructed to monitor well standards. Based on the groundwater contours depicted in Figures 15 through 17, PZ-5 would be located downgradient of the existing in place waste and positioned along the anticipated point of compliance. Piezometers PZ-4 and PZ-5 will be installed within one hundred twenty (120) days of TCEQ approval. If approved, these two piezometers will be installed and water levels measured quarterly (along with MW-1, MW-2, MW-3, and EPWU-1 through -4). After one year of groundwater level measurements have been collected from both piezometers, the facility will submit a permit modification within ninety (90) days to extend the point of compliance as necessary and to install additional groundwater monitoring wells. The SCMP has been revised to incorporate the above information and revised pages are attached.

Comment 15: *Measuring well spacing*

Please document the distance between monitor wells, as measured along the POC (rather than perpendicular to flow lines). As a reminder, in accordance with 30 TAC §330.403(a)(2), well spacing shall not exceed 600 feet without an applicable site-specific technical demonstration. Measuring along the POC will ensure that spacing will not exceed the design spacing, no matter how groundwater flow directions vary in the future.

Response: The permit modification discussed in the response to Comment 14 will provide for new wells that will be spaced no more than 600 feet apart as measured along the POC.

Comment 16: *Provisions for replacing wells that go dry*

Because the amount of future groundwater decline is uncertain and monitor wells may go dry, the SCMP should include provisions for replacing wells that go dry.

Response: PZ-4 will be installed approximately 50 feet into the saturated zone to account for potential drawdown induced by the CEMEX well. As water-levels are measured in the future, the potential for dry wells will be better understood and future monitor wells will be designed to account for groundwater decline.

Comment 17: *Miscellaneous items*

a. *Plugging reports were added to Appendix A in response to comment 1.f in our letter dated May 4, 2009, regarding former well JL-49-05-315. However, the added reports leave some doubt whether the well(s) in the reports are the same well as 49-05-315. The well identification on one of the plugging reports is incomplete (49-05-3), and the identification does not seem to be present at all on the other; also, the total depth on the reports (442 feet) does not match the total depth reported for 49-05-315 (598 feet) in Table 1 of the SCMP. Please provide additional information to resolve these concerns.*

Response: The TCEQ's comment is duly noted and appreciated. Upon further review of the plugging report and driller's logs it is concluded that JL-49-05-315 was not plugged and abandoned; rather, JL-49-05-314 was plugged and abandoned in October 2007. The driller's logs have been added to Appendix A of the Site Characterization and Monitoring Plan, text in Local Well Data section of the Site Characterization and Monitoring Plan has been revised accordingly, and Figure 4 of the Site Characterization and Monitoring Plan has also been revised accordingly.

Details of this conclusion are as follows. JL-49-05-314 was drilled and installed in June 1973 to a total depth of 465 feet. The plugging report submitted with previous NOD response letter lists the location of the well on 6010 Stan Roberts Drive and the total depth as 442 feet. Stan Roberts Sr. Ave. is located immediately adjacent to the McCombs Landfill. The total depths differ by 23 feet; however, the date of installation was approximately 34 years earlier than the date of plugging and abandonment. The total depth listed on the plugging report may have been the result of a field measurement error or the accumulation of formation material within the well casing over the 34 year period. Additionally, the remarks section of the log for JL-49-05-315 states the well was drilled approximately 150 feet north of JL-49-05-314 and that JL-49-05-315 replaced JL-49-05-314.

b. *Please revise Table 1 to indicate which of the wells correspond to the wells also identified as EPWU-1, 2, 3, and 4 in the text and figures.*

Response: Table 1 has been revised as requested.

c. *Please revise Table to include information about wells 1 and 2 northeast of the site (in New Mexico).*

Response: Table 1 has been revised as requested. New Mexico Declaration of Owner of Underground Water Right forms have been added to Appendix A of the Site Characterization and Monitoring Plan. New Mexico well 1 (HU-1) was drilled to a depth of 670 feet on April 10, 1959. According to the forms, an additional well (New Mexico well 2) was drilled to a depth of 780 feet in March 1960.

d. *Two sections of the SCMP are numbered as Section 4.2 (one titled "Climate," the other "Topography"). Please correct the section numbers in the table of contents and text, and revise references to any affected and subsequent sections accordingly.*

Response: Section 4.2, Topography has been changed to Section 4.3, Topography. The table of contents and text has been revised accordingly.

e. Please show the existing and proposed leachate sump locations on the drawing showing the proposed monitoring network (Figure 19).

Response: Existing and proposed leachate sump locations are shown on Figures 15, 16, and 17. The Proposed Monitoring Network (Figure 19) is not being submitted at this time. A Proposed Monitoring Network will be submitted after one year. See response to comment 14.

Comment 18: *Internet posting*

Please document the Internet address (URL) for the posting of this application on page 4 of the Part I form that you will be providing with the response to this letter. As a reminder, the posting should include cover letters, forms, and any other documents in the application, and must be updated to include all revisions and supplements to the application.

Response: The Internet address (URL) for the posting of this application has been added to page 4 of the Part I Form.

We trust this information is acceptable. Please call undersigned if you have any questions. A revised permit modification is attached.

Sincerely,
THE CAREL COPORATION

Steven J. Wimmer
Geologist

Kevin T. Carel, P.G.
President

PARKHILL, SMITH & COOPER, INC.

Robert H. (Holly) Holder, P.E.
Principal

Att 1: Strikeout/Underline Pages of the Site Characterization and Monitoring Plan
Att 2: Revised Pages of the Site Characterization and Monitoring Plan

cc: Kent Waggoner - TCEQ Region 6 Office
Ellen Smyth – City of El Paso
Miguel Parra, P.E. – City of El Paso
Cristian Benitez – City of El Paso
Kevin Carel, P.G. – The Carel Corporation

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

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

July 27, 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 / Sampling and Analysis – Notice of Deficiency
Tracking Nos. 11969813, 12746249, and 12747611; 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, requesting changes to the Site Characterization and Monitoring Plan (SCMP) and Groundwater Sampling and Analysis Plan (GWSAP) for the referenced facility. The application was submitted on your behalf by Parkhill, Smith & Cooper, Inc., Lubbock, Texas. The purpose of the requested 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).

Our review indicates that additional information is needed to demonstrate compliance with 30 TAC Chapter 305, Section (§)305.70 and Chapter 330, §330.403. Therefore, we are unable to complete processing of your request at this time. Please review and address the following comments:

GWSAP (comments by Eleanore Whitworth; page numbers refer to the marked copy of the document)

1. Page 11-i , Contents, gives the subtitle as "LIST OF FIGURES, TABLES, AND APPENDICES" but the 2002 version gives the subtitle in a different format, namely, "SECTION." Please be reminded that changes should be indicated with redline / strikeout format on page 11-i and 11-iii.

2. Page 11-9, Section 6.4, Types of Sample Containers, Metals, states that no field filtering of the groundwater samples may be performed. Please clarify that 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.

3. Page 11-21, Section 11, Detection Monitoring, please revise the GWSAP to provide for notification of a statistically significant increase (SSI) in any constituent in any on-site well in accordance with §330.407(b).

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6. Page 11-19, Section 10, Background Samples, please add a section to clarify that 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. Include a reference in this paragraph to the list of water quality parameters in the appropriate table.

7. Page 11-19, Section 10, Background Samples, includes the following language "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." Please add language stating that 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.

8. Page 11-21, Section 11, Detection Monitoring, contains an occurrence of the former term "SSC." Pursuant to 30 TAC §330.407(b), any instances of the phrase "statistically significant change" or "SSC" that remain in the GWSAP should be changed to "statistically significant increase" or "SSI."

9. Page 11-26, Section 14, Statistical Methods, states that "Pursuant to 30 TAC §330.405, statistical treatment of analytical data is required as part of the groundwater sampling and analysis plan." but does not state that 30 TAC §330.405 will be followed in meeting this requirement. Please add language stating that statistical analysis will be provided in accordance with 30 TAC §330.405.

10. Please revise this language to state that "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 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. Page 11-29, Section 15, Reporting and Submittals, second sentence: After "a notice in writing to the executive director," please insert the phrase "and any local pollution agency with jurisdiction that has requested to be notified."

12. Page 11-30, Section 15, Reporting and Submittals, contains reference to 30 TAC §330.407(k)(1) to (6); this appears to be a typographical error. Please change §330.407 to §330.409 if that was intended, or explain the meaning of the reference.

13. Page 11-30, Section 15, Reporting and Submittals, contains reference to 30 TAC §330.409, and states that in the event the facility is in assessment monitoring, an annual assessment monitoring report will be submitted to TCEQ no later than sixty (60) days after the facility's last groundwater

15. Measuring well spacing

Please document the distance between monitor wells, as measured along the POC (rather than perpendicular to flow lines). As a reminder, in accordance with 30 TAC §330.403(a)(2), well spacing shall not exceed 600 feet without an applicable site-specific technical demonstration. Measuring along the POC will ensure that spacing will not exceed the design spacing, no matter how groundwater flow directions vary in the future.

16. Provisions for replacing wells that go dry

Because the amount of future groundwater decline is uncertain and monitor wells may go dry, the SCMP should include provisions for replacing wells that go dry.

17. Miscellaneous items

a. Plugging reports were added to Appendix A in response to comment 1.f in our letter dated May 4, 2009, regarding former well JL-49-05-315. However, the added reports leave some doubt whether the well(s) in the reports are the same well as 49-05-315. The well identification on one of the plugging reports is incomplete (49-05-3), and the identification does not seem to be present at all on the other; also, the total depth on the reports (442 feet) does not match the total depth reported for 49-05-315 (598 feet) in Table 1 of the SCMP. Please provide additional information to resolve these concerns.

b. Please revise Table 1 to indicate which of the wells correspond to the wells also identified as EPWU-1, 2, 3, and 4 in the text and figures.

c. Please revise Table to include information about wells 1 and 2 northeast of the site (in New Mexico).

d. Two sections of the SCMP are numbered as Section 4.2 (one titled "Climate," the other "Topography"). Please correct the section numbers in the table of contents and text, and revise references to any affected and subsequent sections accordingly.

e. Please show the existing and proposed leachate sump locations on the drawing showing the proposed monitoring network (Figure 19).

18. Internet posting

Please document the Internet address (URL) for the posting of this application on page 4 of the Part I form that you will be providing with the response to this letter. As a reminder, the posting should include cover letters, forms, and any other documents in the application, and must be updated to include all revisions and supplements to the application.

July 6, 2009
Project No. 09-05-23

Arten J. Avakian, P.G., Project Manager
MC-124
Municipal Solid Waste Division
Texas Commission on Environmental Quality (TCEQ)
P.O. Box 13087
Austin, TX 78711-3087

Re: Response to TCEQ Letter Dated May 4, 2009, City of El Paso McCombs Municipal Landfill - MSW Permit No. 729A, El Paso County, Permit Modification - Groundwater Monitoring System, WWC No. 11969813; RN10021559 / CN601410244

Dear Mr. Avakian:

On behalf of the City of El Paso (McCombs), this letter provides a response to the comments in a Texas Commission on Environmental Quality (TCEQ) letter dated May 4, 2009. The TCEQ's comments are provided below in italics and our responses immediately follow.

Comment 1: *Well data*

(a) Please restore Table 1 (Water Well Inventory) and revise the table to include entries for additional wells that have been identified in the study area since the original inventory.

(b) Please revise Figure 4 (Water Wells Search) to show the outline of the site (the permit boundary). Please also add an envelope drawn at one mile distance from the permit boundary, to clarify which wells are within 1 mile of the boundary and help demonstrate compliance with 30 TAC §330.63(e)(3)(J).

(c) Please include the December 18, 2003, Groundwater Monitoring system Installation Report by Raba-Kistner as an appendix to the Site Characterization and Monitoring Plan.

(d) Please include the well completion information for the water well near the southeast corner of the site, mentioned in fourth bullet in Section 4.6 of the Site Characterization and Monitoring Plan, in an appendix to the plan. Please also include the data in the restored Table 1 (Water Well Inventory). If the well is the same that is labeled "CEMEX" in Figure 4, please make that clear in the application.

(e) Please revise Figure 4 (Water Well Search) to show the locations of wells RW-11 (mentioned in the fifth paragraph of Section 4.4 of the text) and JL-49-05-314 (mentioned in Section 4.5). Please also include entries for these wells in the restored Table 1 (Water Well Inventory).

(f) The last sentence of Section 4.5 states that a copy of the plugging report for former well JL-49-05-315 is included in Appendix A; however, we were unable to locate the report in our copy of the modification application. Please revise the application to include the referenced report.

(g) Please revise Section 4.6 to include the identities of the wells referred to in each bullet.

Response: (a): Table 1 has been restored as requested and placed in front of Figure 4 as in the previous Site Characterization and Monitoring Plan. Additional wells that have been identified in the study area since the original inventory have been added to Table 1. Additionally, information for water well 49-06-105 and water well RW-11 has also been added to Table 1.

(b): Figure 4 has been revised as requested.

(c): The December 18, 2003 Groundwater Monitoring System Installation Report by Raba-Kistner has been added as Appendix B to the Site Characterization and Monitoring Plan as requested.

(d): The well completion information for the water well near the southeast corner of the site has been added to Appendix A and Table 1 of the Site Characterization and Monitoring Plan. The aforementioned water well is labeled "CEMEX".

(e): A typographical error was listed on Figure 4. The well designated and labeled as 315 should have been listed as 314. The figure has been revised accordingly. The location of RW-11 has been illustrated on Figure 4 and Table 1 has been updated as requested. Section 4.4 has also been revised to include recent information obtained from El Paso Water Utilities (EPWU).

(f): The plugging report of former well JL–49-05-315 has been added to Appendix A of the Site Characterization and Monitoring Plan as requested.

(g): Section 4.6 has been revised as requested.

Comment 2: *Groundwater contour maps*

The Second-to-the-last paragraph of Section 4.4 of the revised Site Characterization and Monitoring Plan states that regional groundwater flow in the area of the landfill is generally to the south-southeast, but that recent data indicated groundwater flow in the immediate vicinity of the landfill is easterly.

Please further evaluate and discuss potential groundwater flow directions and their bearing on the determination of the point of compliance. Please be sure to address the following factors and observations:

- *What effect injection wells and pumping wells in the area of the landfill have on groundwater elevations measured in facility monitor wells (and the "EPWU" monitor wells at the adjacent sludge disposal facility, shown on Figures 15, 16, 17, and 18). Be sure to include information about when these wells are operated, and the volumes pumped.*

- *The water levels reported on Figure 17 for wells EPWU-1 and 2 measured November 21, 2007, are approximately 11 feet higher than the levels measured only 12 days earlier on November 9, 2007.*

You may wish to install one or more piezometers and conduct additional groundwater investigations to improve the understanding of the groundwater flow directions in the vicinity of the landfill, before determining the final design for the groundwater monitoring system.

Response: The City of El Paso McCombs Landfill proposes the installation of a piezometer potentially in the vicinity of the CEMEX well to further evaluate the effects of the well on the groundwater flow direction. The actual location of the piezometer will be proposed to the TCEQ in a separate submittal which is forthcoming. Pending TCEQ approval, water levels will be collected from the piezometer on a monthly basis for a period of one year. Following the collection and analysis of the water level elevations, the groundwater flow directions and their bearing on the determination of the point of compliance will be evaluated and reported to the TCEQ within 90 days of the final monthly groundwater level measurement.

The piezometer listed in the above paragraph will be built to monitor well standards and converted into a facility groundwater monitoring well in the future, if needed. Otherwise, the piezometer will be plugged and abandoned in accordance with 30 TAC§330.421 (g).

Upon review of the TCEQ comment it was discovered that the listed water levels for EPWU-1 and EPWU-2 on Figure 16 were incorrect. A revised Figure 16 is provided to include in the Site Characterization and Monitoring Plan. The correct version of Figure 16 indicates the water levels measured in EPWU-1 and EPWU-2 on November 9 and 21, 2007 were essentially identical.

Comment 3: *Point of Compliance (POC) and well spacing*

(a) Please note that we will evaluate the proposed POC after we receive your response to this technical review letter.

(b) Section 6 of the Site Characterization and Monitoring Plan indicates that spacing between monitor wells was measured perpendicular to flow lines ("effective" well spacing). Please document the distance between monitor wells as measured along the point of compliance (POC), following any curves, turns, and corners in the POC, and bearing in mind that in accordance with 30 TAC §330.403(a)(2), the spacing shall not exceed 600 feet without a site-specific technical demonstration.

Response: Comment 3 will be addressed in the report submitted to the TCEQ within 90 days of the final monthly groundwater level measurement.

Comment 4: *HELP modeling*

Please delete from the Site Characterization and Monitoring Plan the appendix containing detailed output from the HELP model (excerpted from Attachment 15 of the permit), and delete references to the appendix. It is not apparent how the HELP modeling relates to the groundwater monitoring system design.

The third-to-the-last sentence in Section 6.1.3 states that "Data from HELP modeling indica[t]e that leachate will not impact groundwater in a 40[-year] site life." Please be aware that to be able to make such a statement, one must first demonstrate pursuant to 30 TAC §330.403(d) that there is no potential for migration of hazardous constituents from a solid waste management unit to the uppermost aquifer during the active life and the closure and post-closure care period of the unit. One must therefore demonstrate that travel time from the bottom of the landfill to the top of the groundwater is longer than the time representing the active life and closure and post-closure care period. The versions of the HELP model we are familiar with are not able to calculate this travel time. To calculate travel time from the bottom of the landfill to the top of the groundwater, one must use a program capable of modeling flow and travel time through the unsaturated zone beneath a site (for example, the U.S. Environmental Protection Agency's MultiMed model).

Response: Appendix B and all references to the HELP modeling relating to the groundwater monitoring system design have been deleted from the Site Characterization and Monitoring Plan as requested.

Comment 5: *Phase installation*

Section 6.2 of the Site Characterization and Monitoring Plan that some proposed monitor wells will not be installed until a later time, "before waste disposal operations commence" in a sector of the landfill. Please provide a more explicit timetable for installation of proposed wells, indicating, for example, how long before commencement of operations in a sector, and how that will be anticipated.

Response: Comment 5 will be addressed in the report submitted to the TCEQ within 90 days of the final monthly groundwater level measurement.

Comment 6: *Monitor well construction*

The Site Characterization and Monitoring Plan indicated that groundwater decline in this area has been significant (approximately 50 feet decline in 70 years). You may wish to consider designing monitor wells with screen lengths longer than the 10 feet proposed, to ensure that you will continue to be able to reach and sample the groundwater.

Response: The TCEQ's comment is duly noted. The screen lengths have been increased to 20 feet.

Comment 7: *Internet posting of application*

According to 30 TAC §330.401(b), this modification request to revise well spacing will require public notice. The rule in to TAC §330.57(i) requires the facility owner or operator to provide on a publicly accessible Internet site a complete copy of any application that requires public notice. The posting should include cover letters, the Part I form, and any narrative describing the application. The posting must also be updated to include all revisions and supplements to the application. Please post the original application and the revisions, and provide the web address in the revised application.

Response: The original application and revisions will be posted on a publicly accessible Internet site as requested. The web address has been added to the application.

Comment 8: *Miscellaneous items*

(a) This application appears to modify parts of Appendix ATT4-A of Attachment 4 (Geology Report), as established by the Subtitle D permit modification issued August 22, 2002. Please verify whether that is correct.

(b) Some of the section and subsection number in the Site Characterization and Monitoring Plan appear to have been repeated, and others may have been skipped. In addition, the section numbering in the "clean" copy of the revised document differs slightly from the copy that is marked to highlight the revisions. Also, in the text of the document, some of the references to appendices still refer to the appendix letter that existed before revision. Please revise the table of contents and text in the "clean" and marked copies to correct discrepancies.

(c) Please include a north arrow on all maps, in accordance with 30 TAC §330.57(h)(5).

Response: (a): The TCEQ's comment is correct. Appendix ATT-4A was modified.

(b): The discrepancies have been corrected.

(c): A north arrow has been included on all maps.

We trust this information is acceptable. Please call undersigned if you have any questions. A revised permit modification is attached.

Sincerely,

THE CAREL COPORATION

Steven J. Wimmer
Geologist

Kevin T. Carel, P.G.
President

PARKHILL, SMITH & COOPER, INC.

Robert H. (Holly) Holder, P.E.
Principal

Att 1: Strikeout/Underline Pages of the Site Characterization and Monitoring Plan
Att 2: Revised Pages of the Site Characterization and Monitoring Plan

cc: Kent Waggoner - TCEQ Region 6 Office
Ellen Smyth – City of El Paso
Miguel Parra, P.E. – City of El Paso
Cristian Benitez – City of El Paso

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

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

May 4, 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. 11969813; RN100215599 / CN601410244

Dear Ms. Smyth:

We have reviewed your application for a municipal solid waste (MSW) permit modification dated January 2, 2008, requesting changes to the groundwater monitoring system and the Groundwater Sampling and Analysis Plan (GWSAP) for the referenced facility. The application was signed by you and submitted on your behalf by Mr. Robert H. Holder, P.E., of Parkhill, Smith & Cooper, Inc., Lubbock, Texas. The purpose of the requested 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).

Thank you for the submittal. This letter addresses the Site Characterization and Monitoring Plan (the portion of the modification regarding the groundwater monitoring system); comments regarding the GWSAP were provided earlier in a separate letter. Our review of the Site Characterization and Monitoring Plan indicates that additional information is needed to demonstrate compliance with 30 TAC Chapter 305, Section (§)305.70 and 30 TAC §330.403. Please address the following comments:

1. Well data

   a. Please restore Table 1 (Water Well Inventory) and revise the table to include entries for additional wells that have been identified in the study area since the original inventory.

   b. Please revise Figure 4 (Water Well Search) to show the outline of the site (the permit boundary). Please also add an envelope drawn at one mile distance from the permit boundary, to clarify which wells are within 1 mile of the boundary and help demonstrate compliance with 30 TAC §330.63(e)(3)(J).

   c. Please include the December 18, 2003, Groundwater Monitoring System Installation Report by Raba-Kistner as an appendix to the Site Characterization and Monitoring Plan. According to Section 4.6.1 of the text, the report provides the logs and construction details for existing monitor wells MW-1, 2, and 3.

   d. Please include the well completion information for the water well near the southeast corner of the site, mentioned in fourth bullet in Section 4.6 of the Site Characterization

4. HELP modeling

Please delete from the Site Characterization and Monitoring Plan the appendix containing detailed output from the HELP model (excerpted from Attachment 15 of the permit), and delete references to the appendix. It is not apparent how the HELP modeling relates to the groundwater monitoring system design.

The third-to-the-last sentence in Section 6.1.3 states that "Data from HELP modeling indica[t]e that leachate will not impact groundwater in a 40[-year] site life." Please be aware that to be able to make such a statement, one must first demonstrate pursuant to 30 TAC §330.403(d) that there is no potential for migration of hazardous constituents from a solid waste management unit to the uppermost aquifer during the active life and the closure and post-closure care period of the unit. One must therefore demonstrate that travel time from the bottom of the landfill to the top of the groundwater is longer than the time representing the active life and closure and post-closure care period. The versions of the HELP model we are familiar with are not able to calculate this travel time. To calculate travel time from the bottom of the landfill to the top of the groundwater, one must use a program capable of modeling flow and travel time through the unsaturated zone beneath a site (for example, the U.S. Environmental Protection Agency's MultiMed model).

5. Phased installation

Section 6.2 of the Site Characterization and Monitoring Plan that some proposed monitor wells will not be installed until a later time, "before waste disposal operations commence" in a sector of the landfill. Please provide a more explicit timetable for installation of proposed wells, indicating, for example, how long before commencement of operations in a sector, and how that will be anticipated.

6. Monitor well construction

The Site Characterization and Monitoring Plan indicated that groundwater decline in this area has been significant (approximately 50 feet decline in 70 years). You may wish to consider designing monitor wells with screen lengths longer than the 10 feet proposed, to ensure that you will continue to be able to reach and sample the groundwater.

7. Internet posting of application

According to 30 TAC §330.401(b), this modification request to revise well spacing will require public notice. The rule in 30 TAC §330.57(i) requires the facility owner or operator to provide on a publicly accessible Internet site a complete copy of any application that requires public notice. The posting should include cover letters, the Part I form, and any narrative describing the application. The posting must also be updated to include all revisions and supplements to the application. Please post the original application and the revisions, and provide the web address in the revised application

8. Miscellaneous items

a. This application appears to modify parts of Appendix ATT4-A of Attachment 4 (Geology Report), as established by the Subtitle D permit modification issued August 22, 2002. Please verify whether that is correct.

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MAR 8 - 2008
RECEIVED
PSC

Buddy Garcia, *Chairman*
Larry R. Soward, *Commissioner*
Bryan W. Shaw, Ph.D., *Commissioner*
Glenn Shankle, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

March 3, 2008

Ms. Ellen Smyth
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 (MSW) – MSW Permit No. 729A
Permit Modification – Groundwater Monitoring – Suspension of Review
WWC No. 11969813; RN100215599 / CN601410244

Dear Ms. Smyth:

On January 3, 2008, the Texas Commission on Environmental Quality, Municipal Solid Waste Permits Section received a permit modification application to address recent revisions to Title 30 Texas Administrative Code, Chapter 330, Subchapter J. The application was signed by you and submitted on your behalf by Mr. Robert H. Holder, P.E., of Parkhill, Smith & Cooper, Inc., Lubbock, Texas, under a cover letter dated January 2, 2008.

Thank you for your application. During the past several months, representatives of the MSW Permits Section met with facility owners and operators, and consultants to discuss issues related to the implementation of the revised Subchapter J rule requirements. We are now preparing guidelines to help ensure consistent review and processing of applications that address Subchapter J.

Please be advised that we are suspending review of your application until the guidelines are established. We will contact you when we resume the review.

You do not need to respond to this letter, however, if you have any questions about this or other MSW matters, please contact me by phone at (512) 239-6228, or in writing at the address on our letterhead (please include our mail code, MC 124 in the address).

Sincerely,

Jeff Davis, P.G., Team Leader
Municipal Solid Waste Permits Section
Waste Permits Division

JRD/AJA/ff

cc: Mr. Robert H. Holder, P.E., Parkhill, Smith & Cooper, Inc., Lubbock

SITE CHARACTERIZATION AND MONITORING PLAN

McCOMBS LANDFILL
EL PASO, TEXAS

PREPARED FOR:

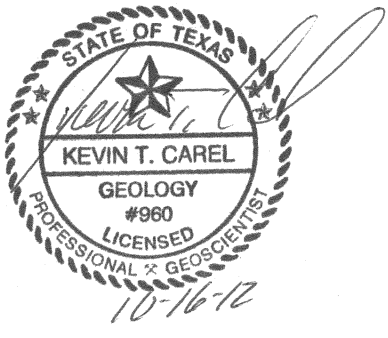
CITY OF EL PASO
EL PASO, TEXAS

AND

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
AUSTIN, TEXAS

OCTOBER 11, 1993

REVISED: October 2012



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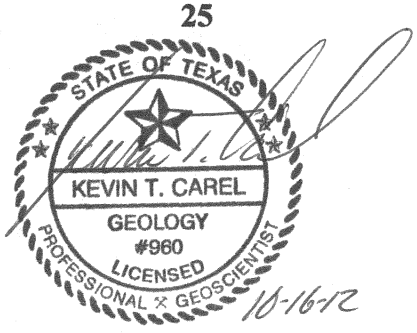

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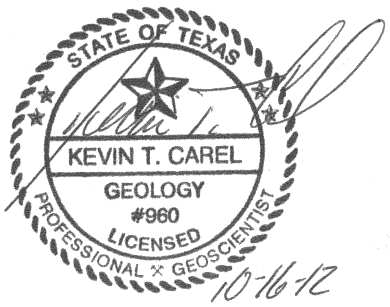

EXECUTIVE SUMMARY

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 1.0×10^{-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-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. 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. Existing and proposed monitoring wells, the POC, and landfill Sectors are depicted on Figure 20.

Proposed wells 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). The POC will also include existing monitoring wells MW-1 and MW-2. 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
MW-1	Existing	POC
MW-2	Existing	POC
MW-3	Existing	Background
PZ-4	Existing (Convert to MW-4)	POC
PZ-5	Existing (Convert to MW-5)	POC
MW-6	New	POC
MW-7	New	POC
MW-8	New	POC
MW-9	New	POC
MW-10	Potential (Install if landfill expands to Sector B)	POC
MW-11	Potential (Install if landfill expands to Sector C)	POC
MW-12	Potential (Install if landfill expands to Sector C)	POC
MW-13	Potential (Install if landfill expands to Sector D)	POC
MW-14	Potential (Install if landfill expands to Sector D)	POC

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 as follows:

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. 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

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

A
West

A'
East

Elevation (ft)

4,100
4,000
3,900
3,800
3,700
3,600
3,500

EPWU-2
MW-2
MW-1
PZ-4
PZ-5

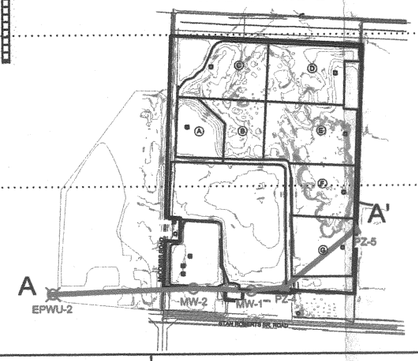
Ground Surface

Groundwater Surface

Spontaneous Potential
Resistivity
Gamma Ray
Resistivity
Gamma Ray
Resistivity

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST
10/16/12

INDEX MAP



LITHOLOGY GRAPHICS

- USCS Low Plasticity Clay
- USCS Poorly-graded Gravelly Sand
- USCS Well-graded Gravelly Sand
- Well-graded Gravelly Sand with Tuff
- USCS Poorly-graded Sandy Gravel
- USCS Poorly-graded Sand with Clay
- USCS Poorly-graded Sand
- USCS Low Plasticity Gravelly Clay

LEGEND

- USCS Clayey Gravel
- USCS Poorly-graded Gravel
- USCS Poorly-graded Sand with Silt
- USCS Well-graded Sand
- USCS Low Plasticity Sandy Clay
- Massive Sand or Sandstone
- USCS Low Plasticity Silty Clay
- Water Level Measured July 3, 2012

SCALE (feet)
100'
0
1,000'

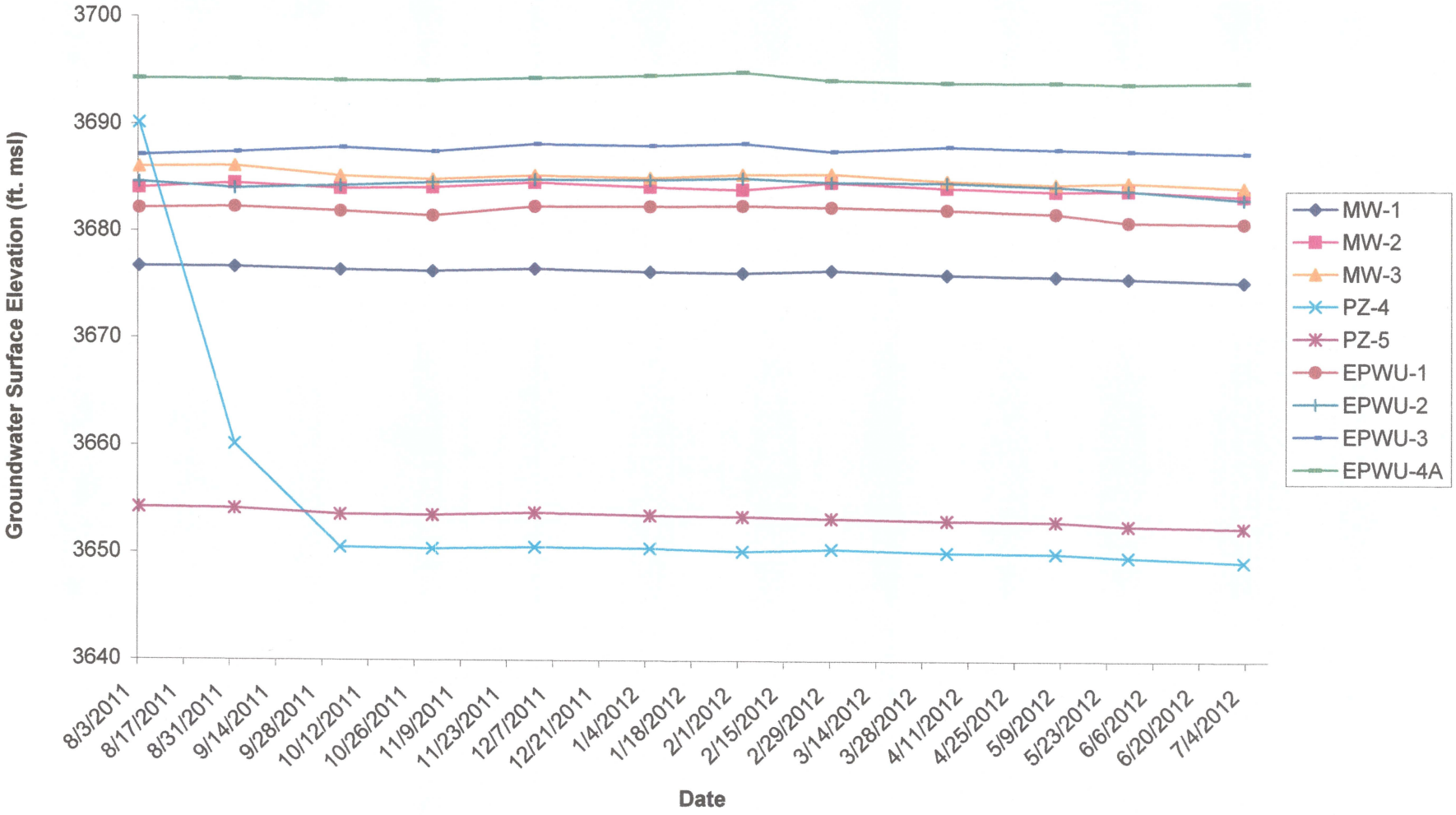
The CAREL CORPORATION
136 Pecan Street, Keller, TX 76248

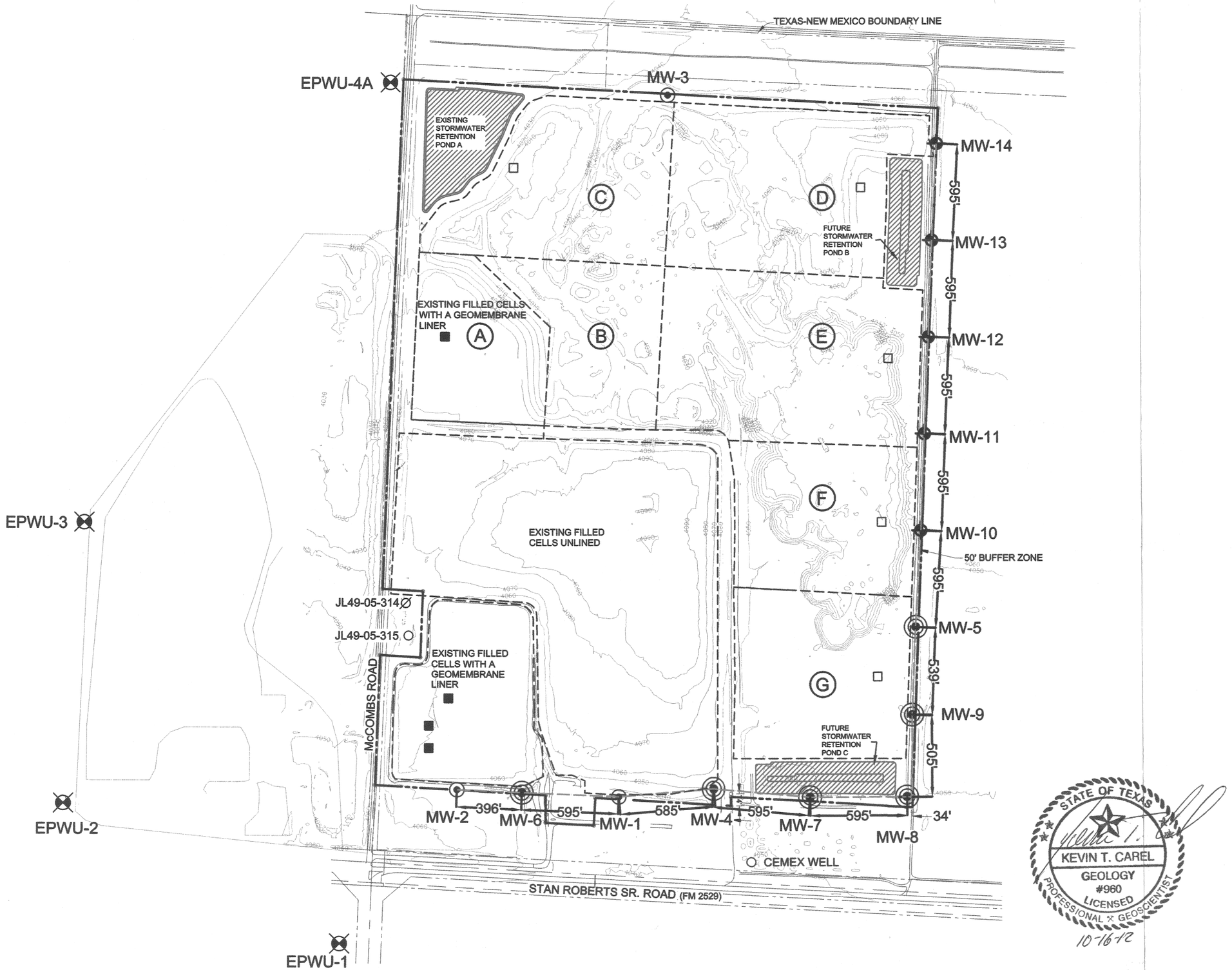
GEOLOGIC CROSS SECTION A-A'

MCCOMBS LANDFILL
El Paso, Texas

DATE: September 17, 2012	REV. NO: 2
FILENAME: K:\TEXAS\McCombs\Permit Mod\2012\CROSS SECTION A-A' 9.14.dwg	
DESIGNED BY: KTC	FIGURE: 18
DRAWN BY: SMG	
CHECKED BY: SJW	
APPROVED BY: KTC	

Figure 19
McCombs Landfill
Groundwater Surface Elevation Hydrograph





Parkhill, Smith & Cooper, Inc.
Engineers • Architects • Planners
Lubbock El Paso Midland Amarillo Odessa

The CAREL CORPORATION

136 Pecan Street, Keller, TX 76248

SCALE

0 300 600
FEET

PROPOSED GROUNDWATER MONITORNG NETWORK

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 GROUNDWATER MONITORING WELL
- FUTURE GROUNDWATER MONITORING WELL
- POINT OF COMPLIANCE
- POINT OF COMPLIANCE TURNING POINT
- (E) SECTOR DENOMINATION
- SECTOR BOUNDARY

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST
10-16-12

DATE DRAFTED: September 14,2012 | REV. # 2

FILENAME: K:\TEXAS\McCombs\Permit Mod2012\Proposed GW Monitoring Network.dwg

DRAWN BY: KTC

DRAFTED BY: SMG

FIGURE: **20**

APPENDIX A

EL PASO WATER UTILITIES WELL REPORTS AND GEOPHYSICAL LOGS

EL PASO WATER UTILITIES

E-LOG

WELL NO. [illegible] DATE [illegible] TRP G.L. ELEV. [illegible]

LOCATION [illegible] DRILLER [illegible]

OWNER P.S.E. MEAS. REF. [illegible]

TD LOGGER [illegible] TD DRILLER [illegible] OPERATOR [illegible]

MUD TYPE [illegible]

MUD DENS. [illegible] LB/GAL RES. SCALE [illegible]

MUD VISC. [illegible] SEC. SPAN [illegible]

MUD WL [illegible] CC/30 MIN. S.P. SCALE [illegible]

MUD CAKE [illegible] SPAN [illegible]

BIT SIZE [illegible]

S.P. MILLIVOLTS	DEPTH	RESISTIVITY OHMS M²/M 16" NORMAL 64" NORMAL
[illegible]		[illegible]

50

100

150

200

250

300

350

400

450

500

TD logger = 519'

Stuck logging at 510

EPWU-1

EL PASO WATER UTILITIES

E-LOG

WELL NO. EPWU-2 DATE Sept. 13 1955 G.L. ELEV. 4065.0

LOCATION SE¼ SW¼ SE¼ Sec. 1 Blk. BL T&P Co. DRILLER Calvin Jones

OWNER EPWD MEAS. REF. Ground Level

TD-LOGGER 518 TD-DRILLER 520 OPERATOR RS

MUD TYPE Native Water

MUD DENS. 8.5 LB/GAL

MUD VISC. 30 SEC.

MUD RM 9.12 @ 84° °F

CIRC. TEMP. 87° F

RES. SCALE 100

SPANS Full

S.P. SCALE 50

GAIN 2 scale (5 div. max.)

BIT SIZE 12¼

S.P. MILLIVOLTS

DEPTH

RESISTIVITY OHMS M²/M

16" NORMAL

64" NORMAL

50

100

150

200

250

300

350

400

450

500

TD Logger = 518'

Start logging at 518'

EPWU-2

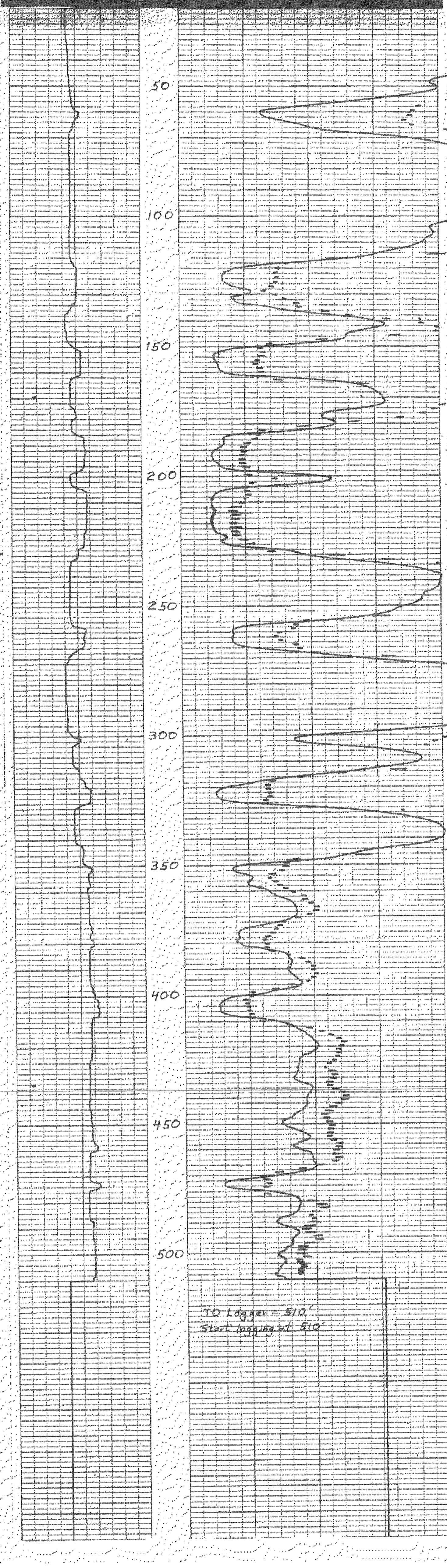
EPWU-3

EL PASO WATER UTILITIES
E-LOG

WELL NO. [illegible] DATE [illegible] G.L. ELEV. [illegible]
LOCATION [illegible] DRILLER [illegible]
OWNER [illegible] MEAS. REF. [illegible]
TD LOGGER 510 TD DRILLER 510 OPERATOR KS

MUD TYPE [illegible] RES. SCALE 100 [illegible]
MUD DENS. [illegible] LB/GAL SPAN [illegible]
MUD VISC. [illegible] SEC S.P. SCALE [illegible]
MUD RM [illegible] @ °F SPAN [illegible]
CIRC. TIME [illegible] BIT SIZE [illegible]

S.P.	DEPTH	RESISTIVITY
MILLIVOLTS		OHMS M²/M 16" NORMAL 64" NORMAL



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

LOCATION
Lat N31 Deg 59' 17.9" Long W 106 Deg 24' 14.5"

SEC TWP RGE

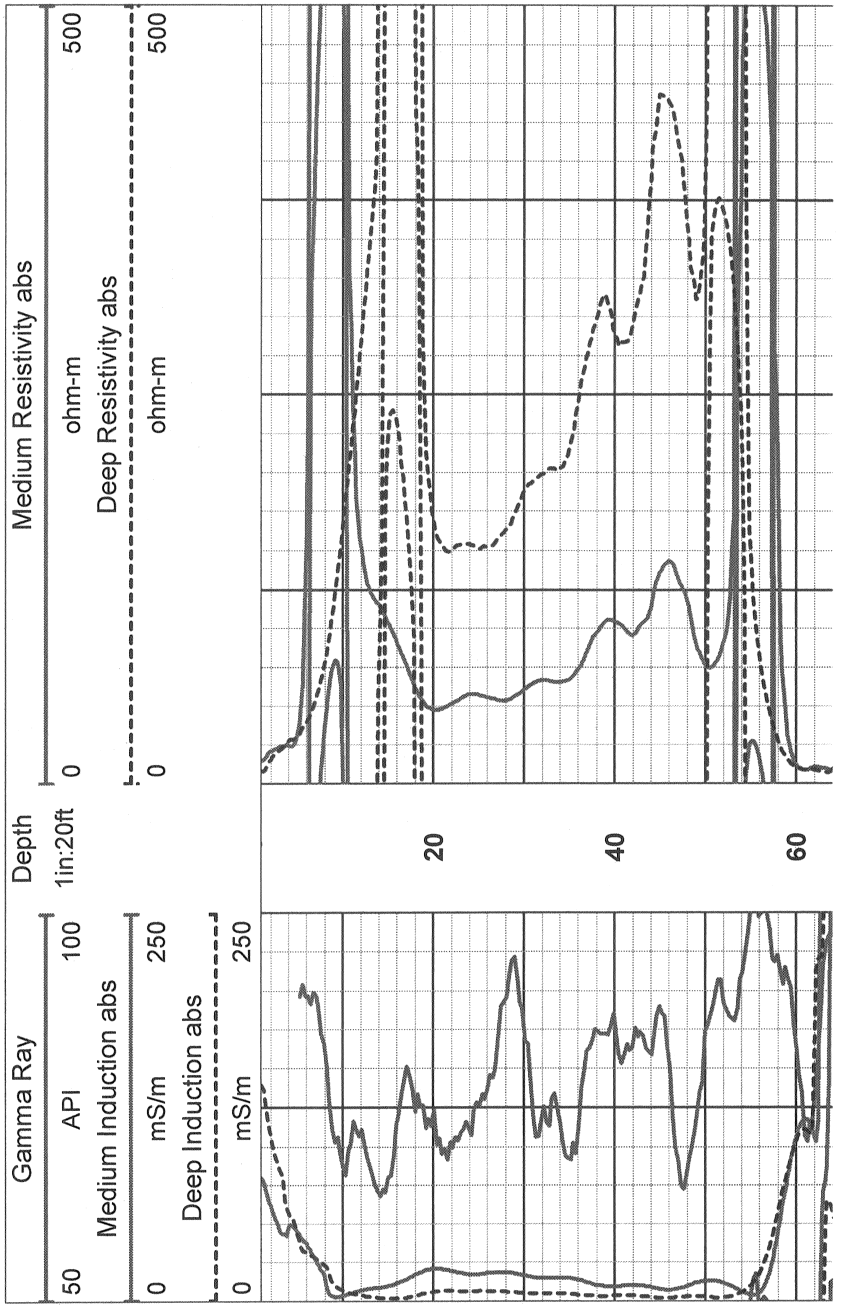
OTHER SERVICES
NONE

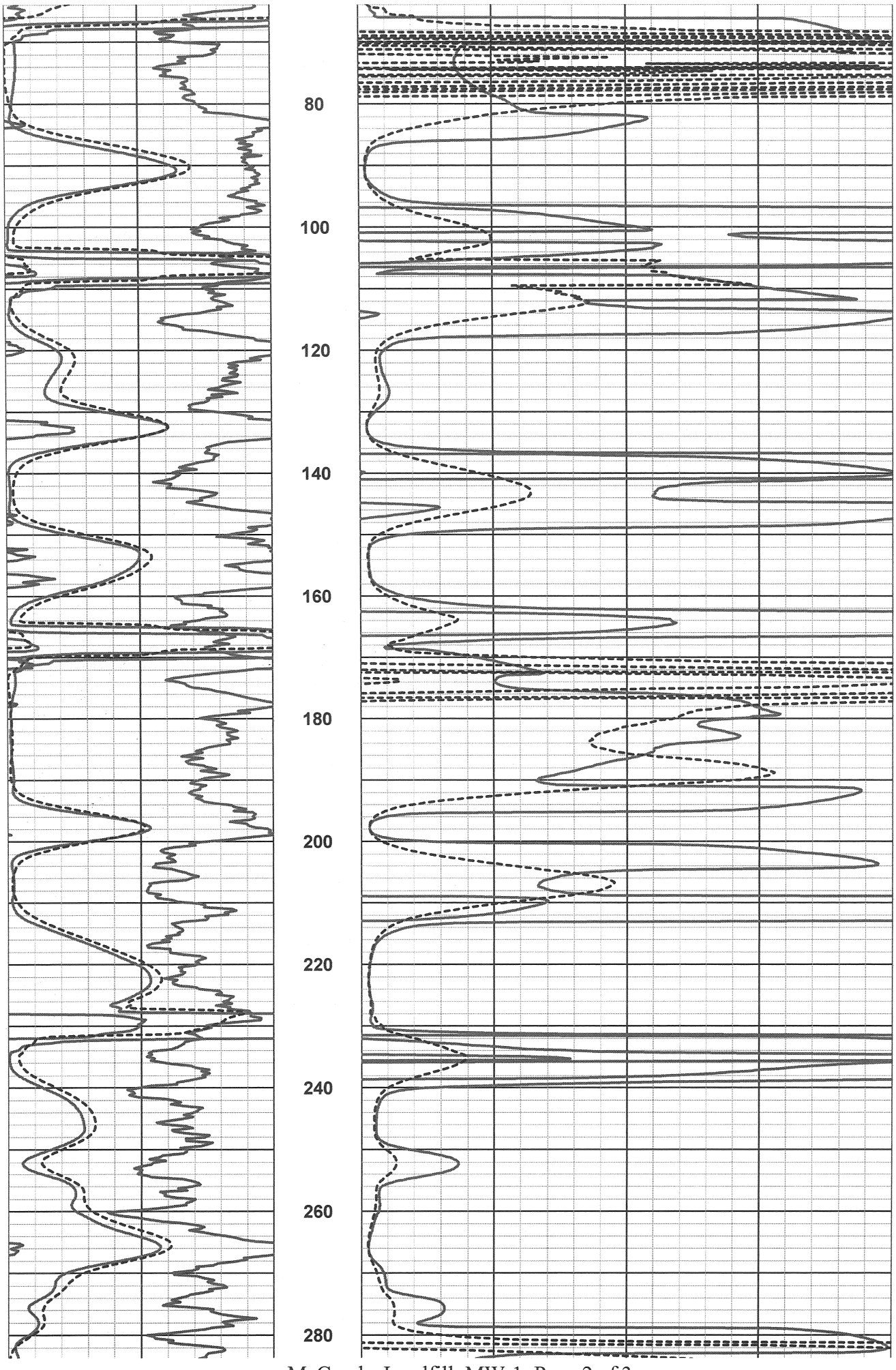
PERMANENT DATUM	TOP OF CASING	ELEVATION	4070.23'MSL	K.B.
LOG MEAS. FROM	TOP OF CASING	ABOVE PERM. DATUM		D.F.
DRILLING MEAS. FROM				G.L.

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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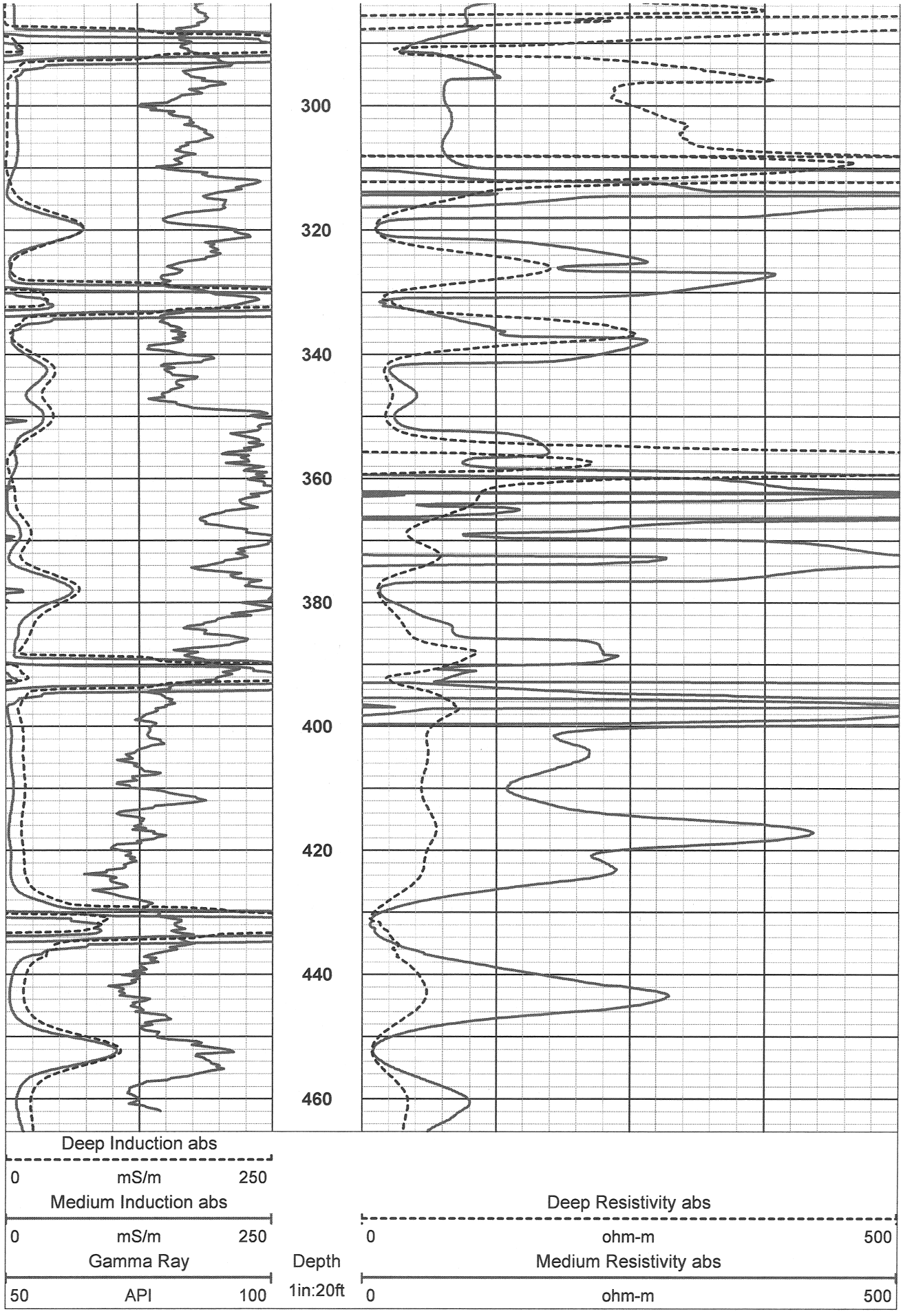
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250
Gamma Ray
50
API
100
Depth
1in:20ft
Deep Resistivity abs
0
ohm-m
500
Medium Resistivity abs
0
ohm-m
500

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

OTHER SERVICES
NONE

LOCATION
Lat N 31 Deg 59' 0.5" Long W 106 Deg 24' 25.6"

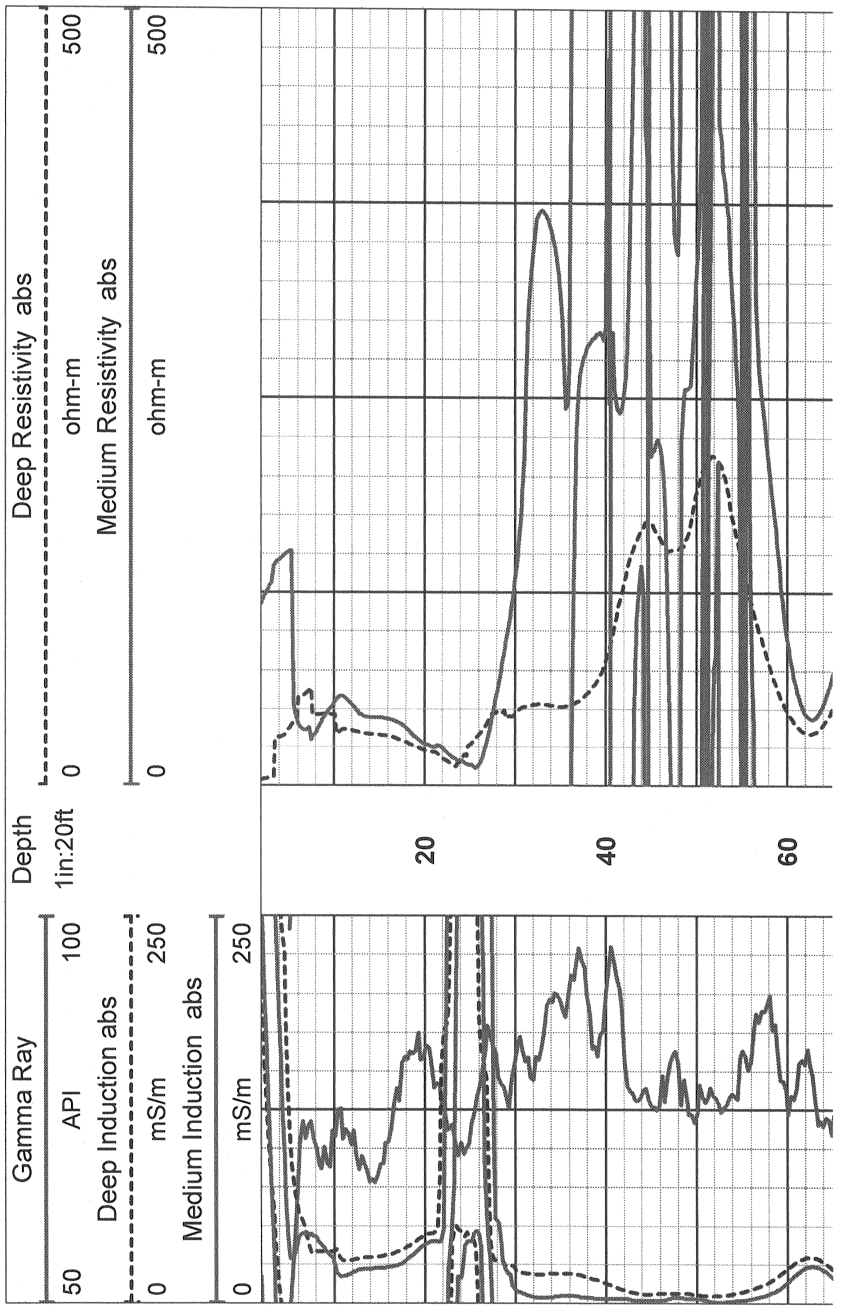
SEC TWP RGE

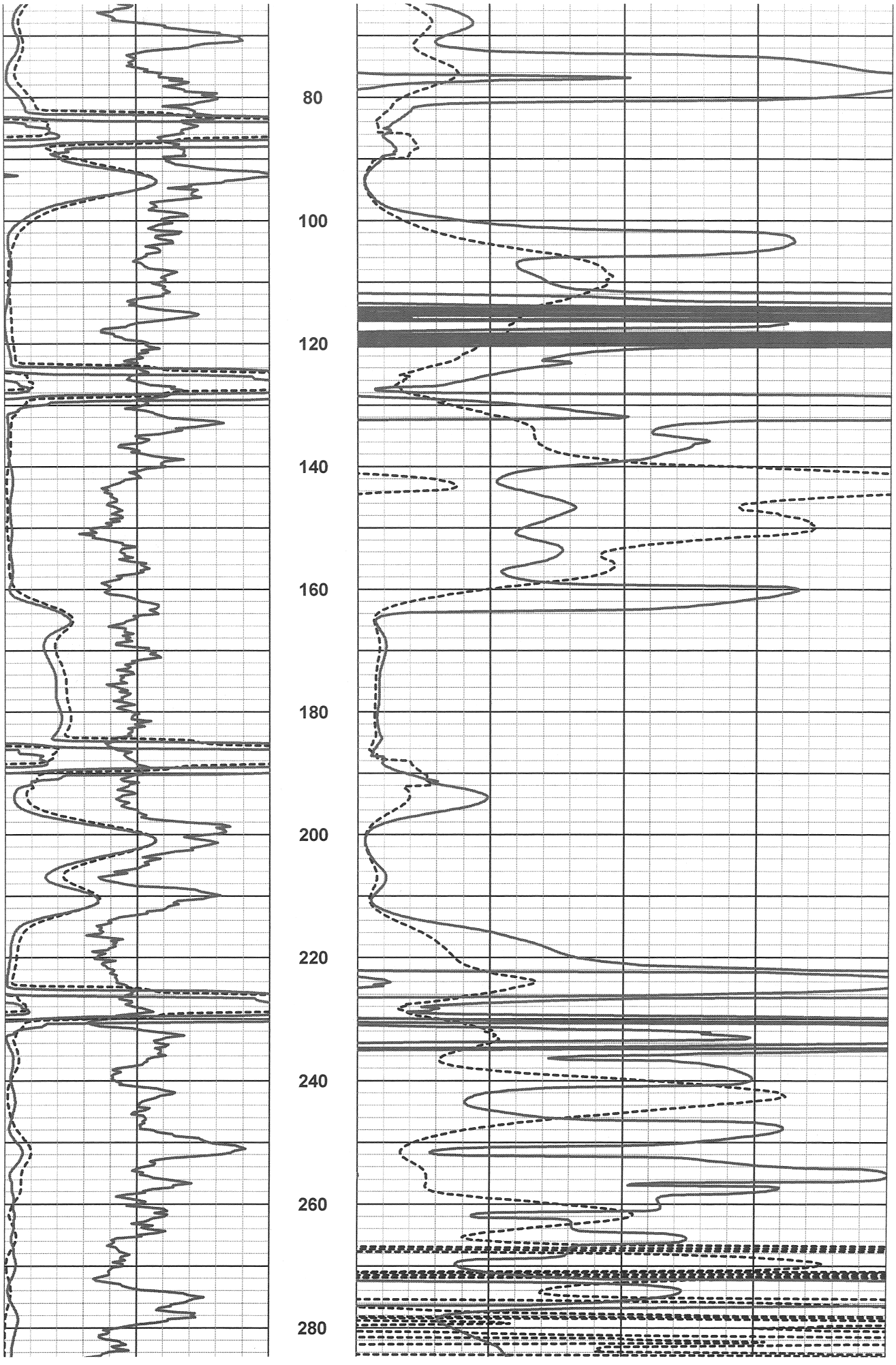
PERMANENT DATUM	TOP OF CASING	ELEVATION 4083.89'MSL	K.B.
LOG MEAS. FROM	TOP OF CASING	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.

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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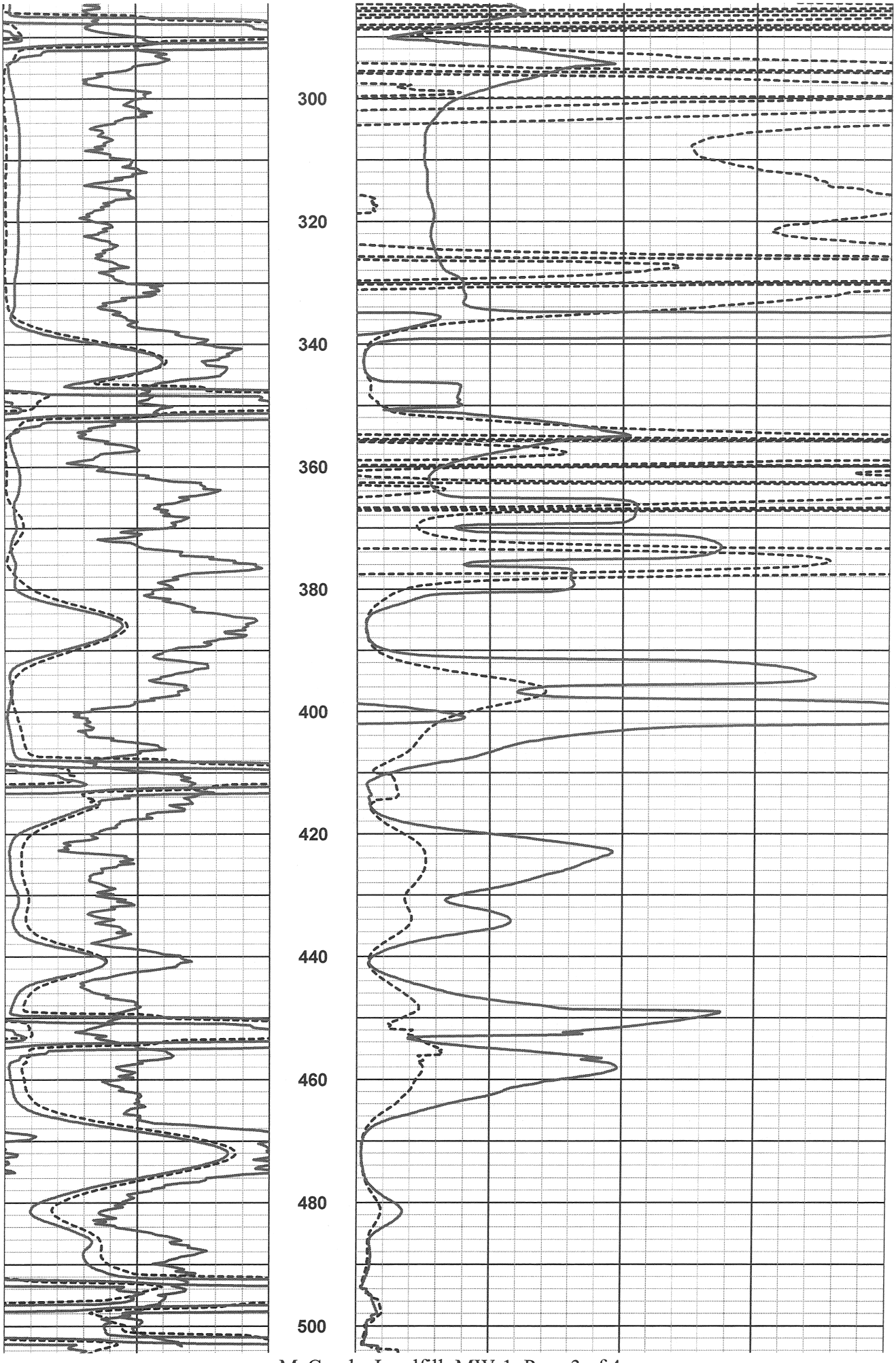
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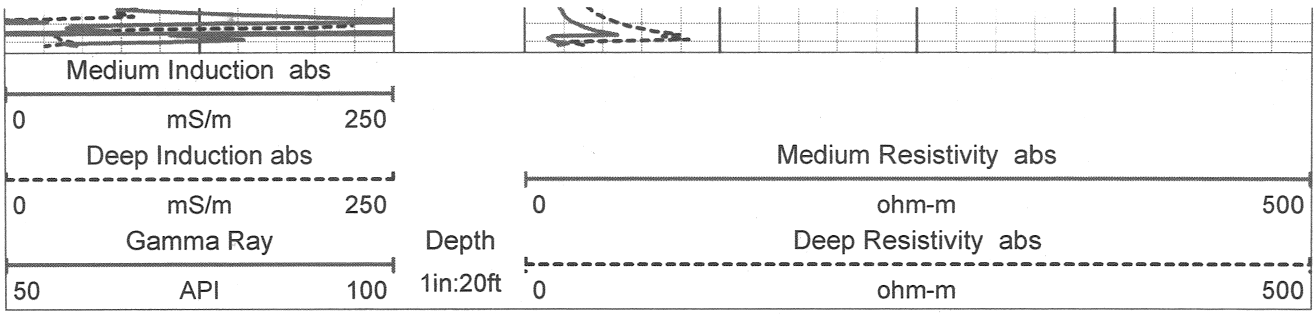
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mS/m
250
Deep Induction abs
0
mS/m
250
Gamma Ray
50
API
100
Depth
1in:20ft
Medium Resistivity abs
0
ohm-m
500
Deep Resistivity abs
0
ohm-m
500

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

OTHER SERVICES
NONE

LOCATION
Lat N 31 Deg 59' 43.4" Long W 106 Deg 24' 13.3"

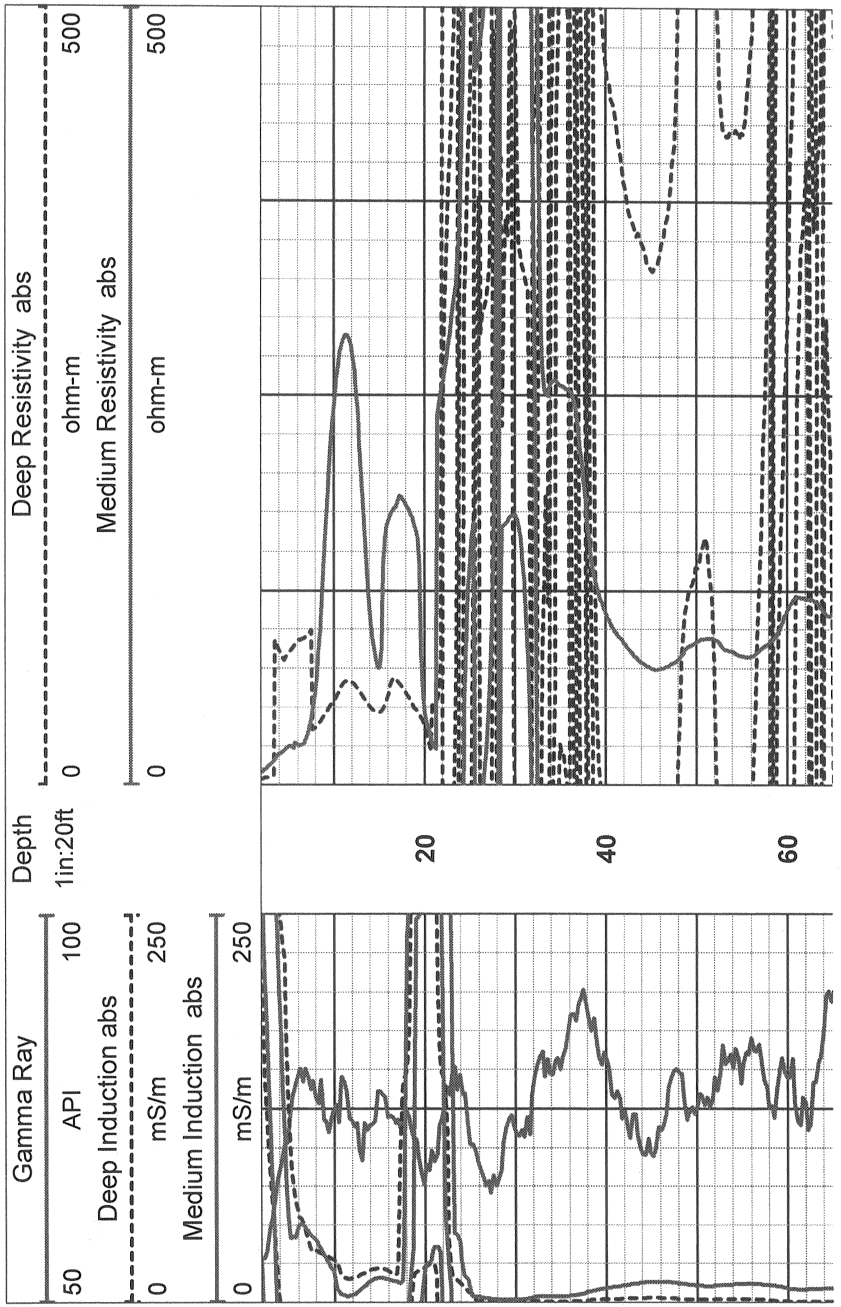
SEC TWP RGE

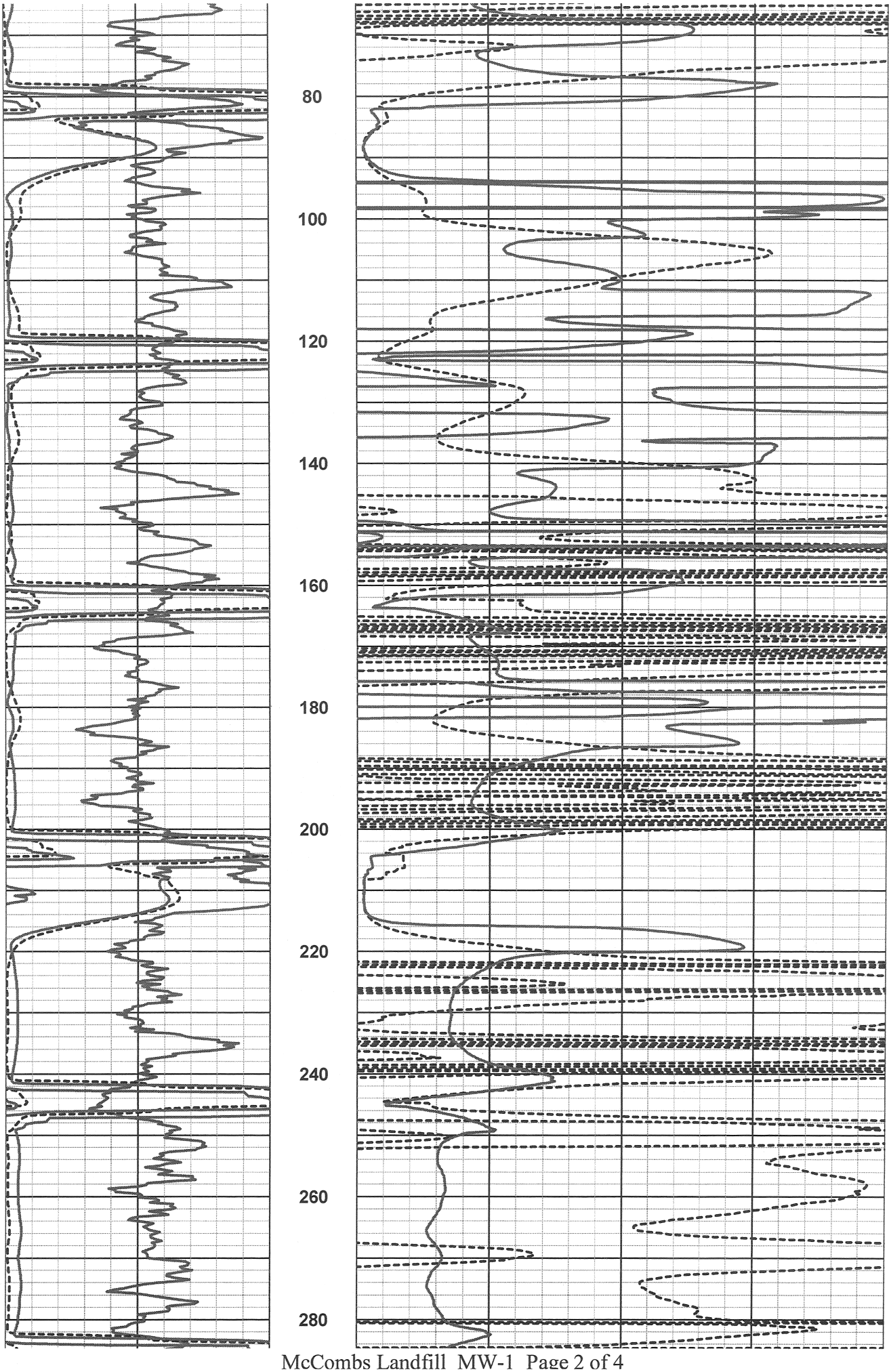
PERMANENT DATUM	TOP OF CASING	ELEVATION 4076.70'MSL	K.B.
LOG MEAS. FROM	TOP OF CASING	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.

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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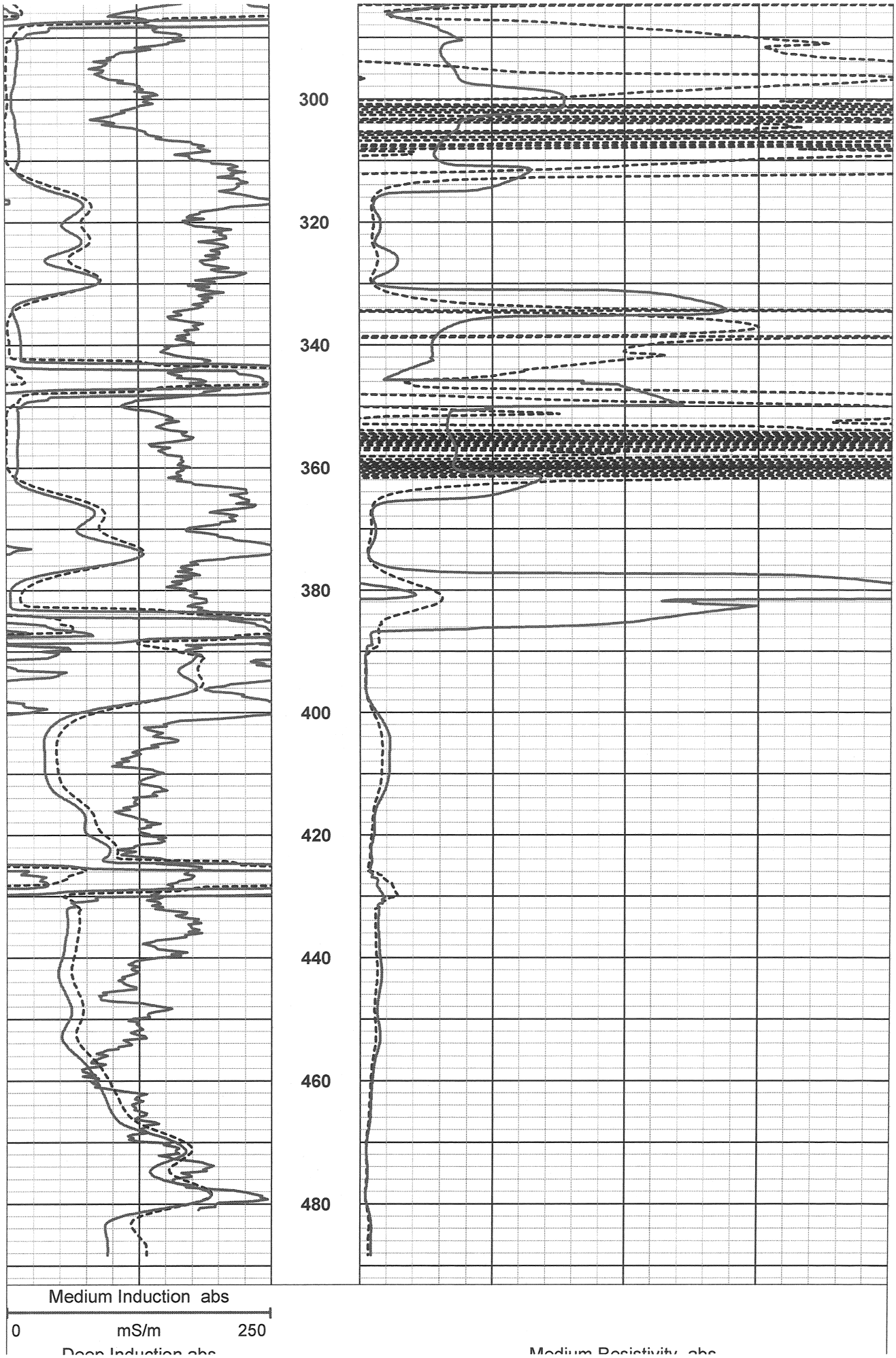
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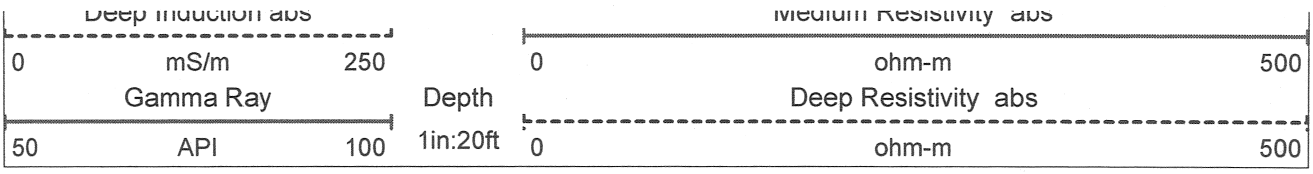
mS/m
250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Gamma Ray
50
API
100
Depth
1in:20ft
Medium Resistivity abs
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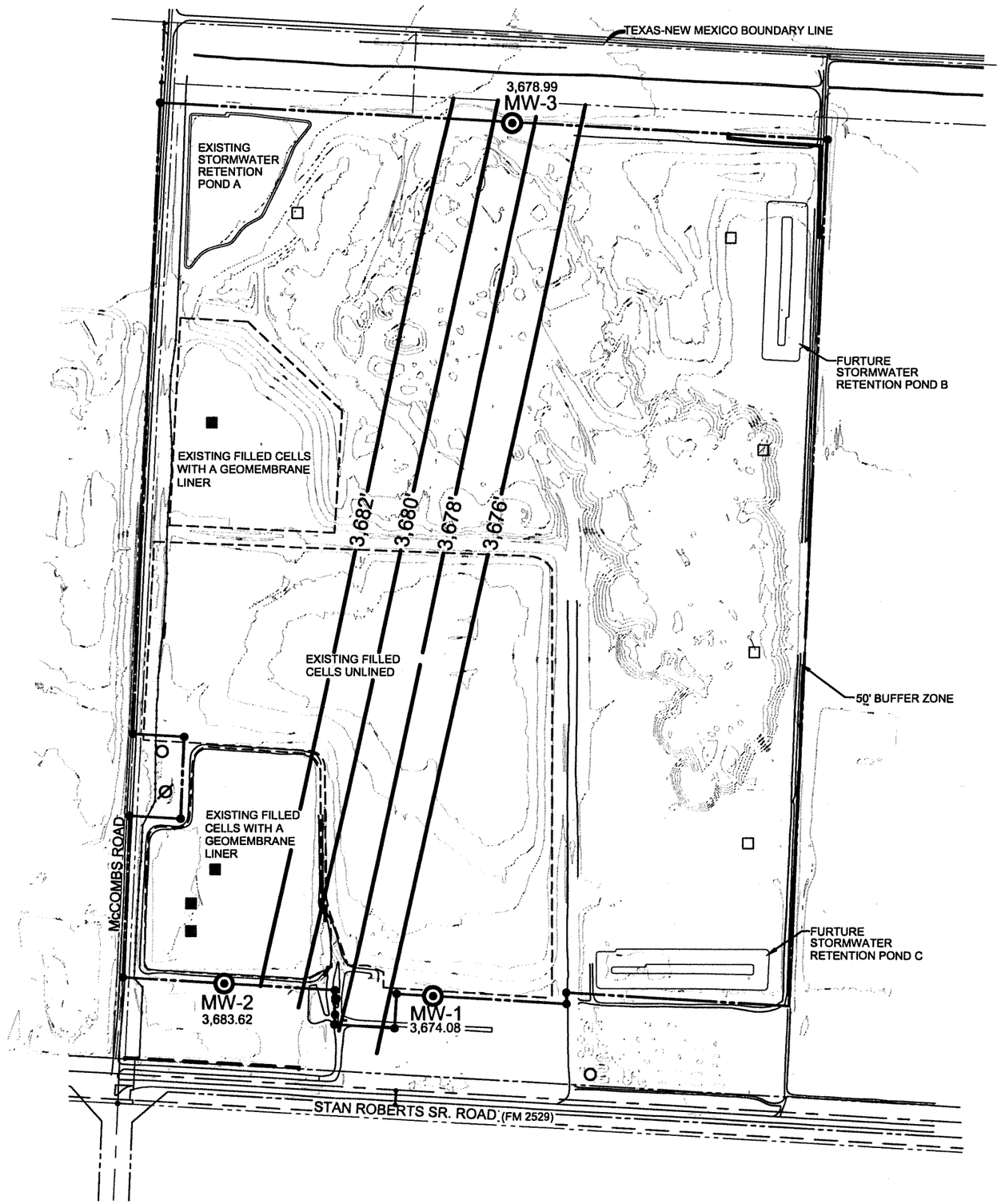
500
Deep Resistivity abs
0
ohm-m
500

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

0 300 600
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	MOD 1 RESPONSE

ISSUING OFFICE: CITY PROJECT NO: 07-07-35

DATE DRAFTED: October 12, 2007

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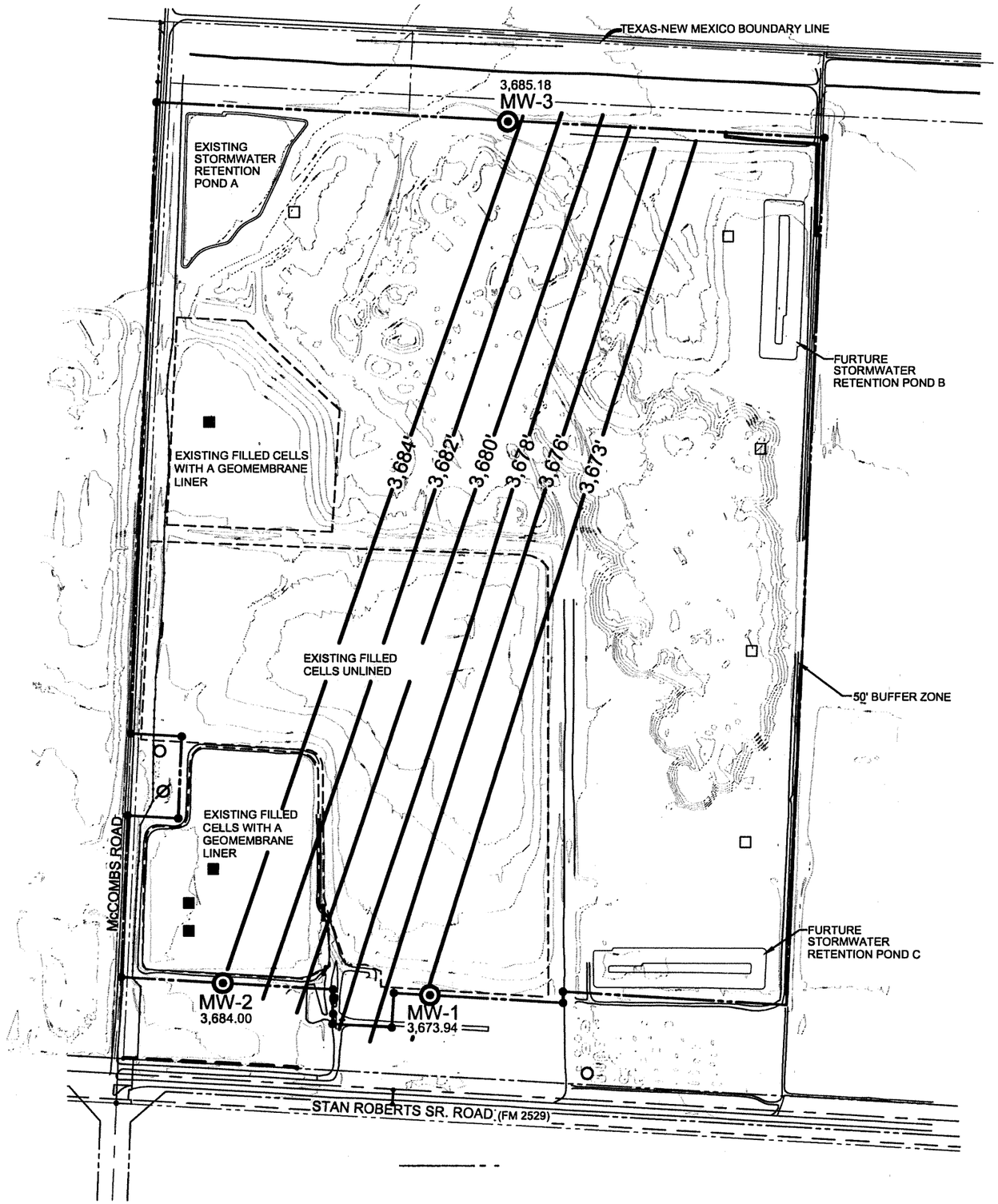
DRAFTED BY: FGK

FIGURE: **1C**



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7-6-2009

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PARKHILL SMITH & COOPER

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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	7/8/2009	NOD 1 RESPONSE

ISSUING OFFICE: CITY PROJECT NO: 07-07-35

DATE DRAFTED: October 12, 2007

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DRAFTED BY: FGK

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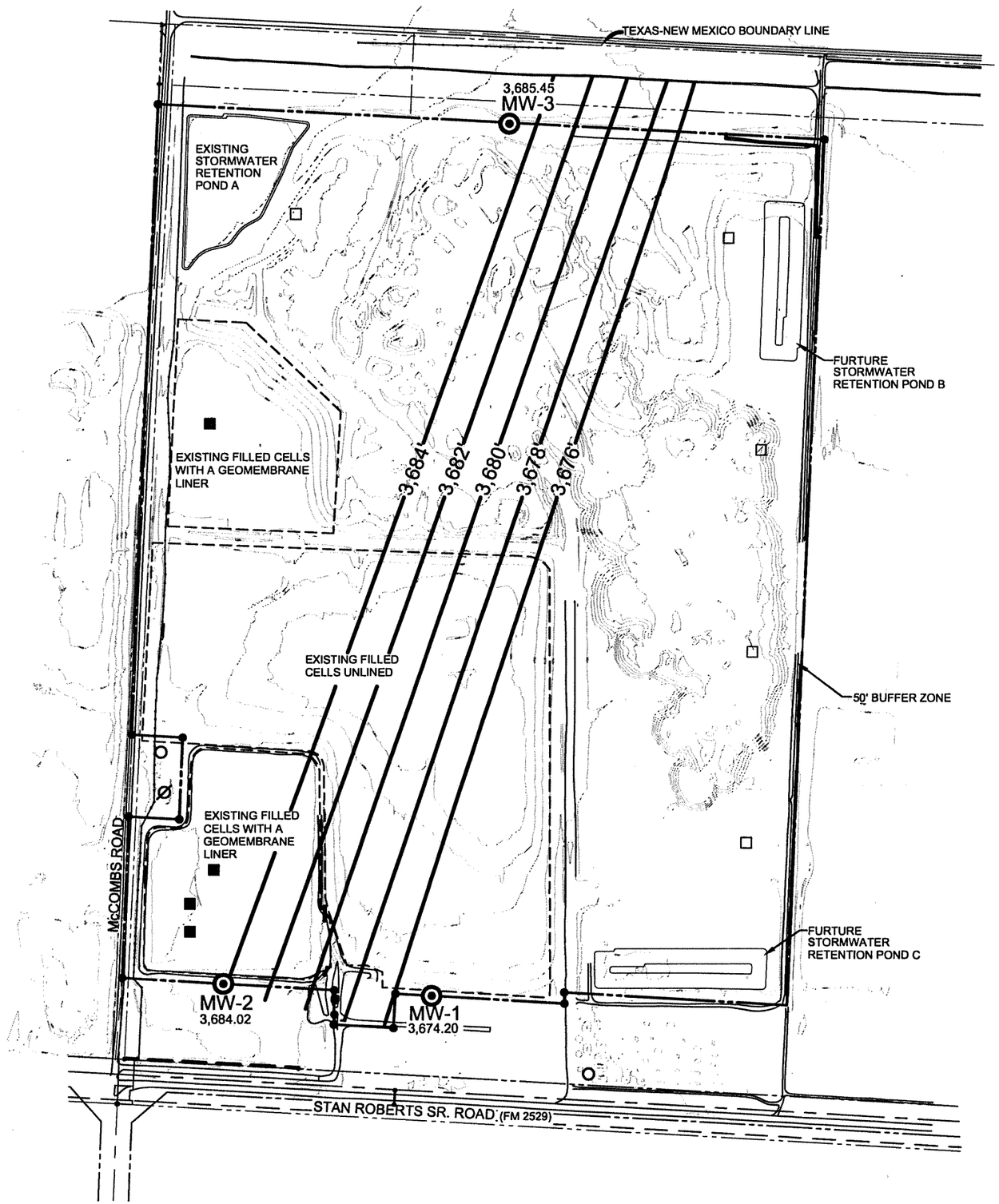

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7-6-2009

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The CAREL CORPORATION

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REGISTRATION NUMBER F-560

CAREL CORPORATION 50137

SCALE

0 300 600

FEET

GROUNDWATER CONTOUR MAP NOVEMBER 18, 2003

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: CITY PROJECT NO: 07-07-35

DATE DRAFTED: October 12, 2007

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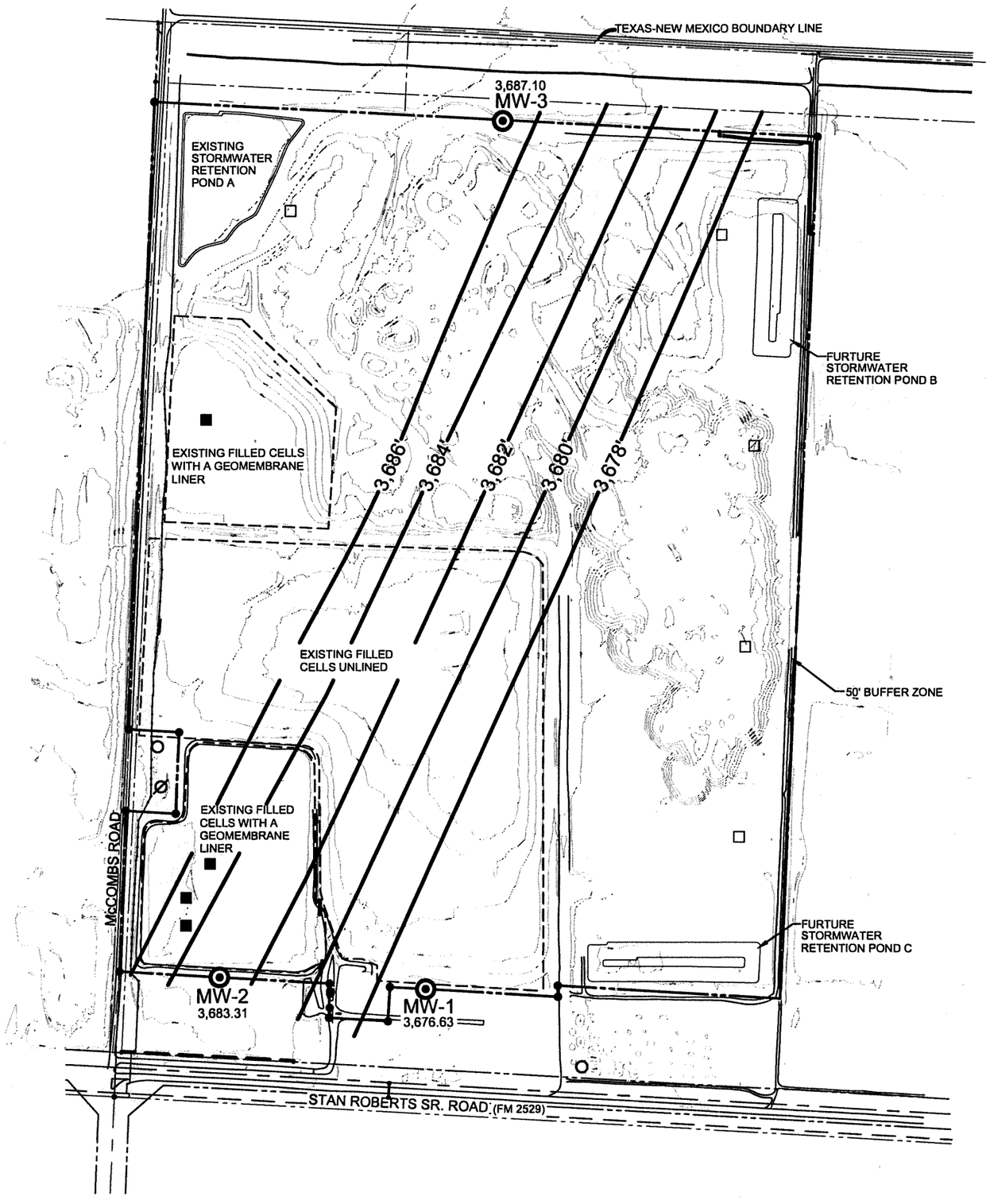
DRAFTED BY: FGK

FIGURE: 3C



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REGISTRATION NUMBER F-560

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

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	7/8/2009	HOD 1 RESPONSE

ISSUING OFFICE: CITY PROJECT NO: 07-07-35

DATE DRAFTED: October 12, 2007

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DRAFTED BY: FGK

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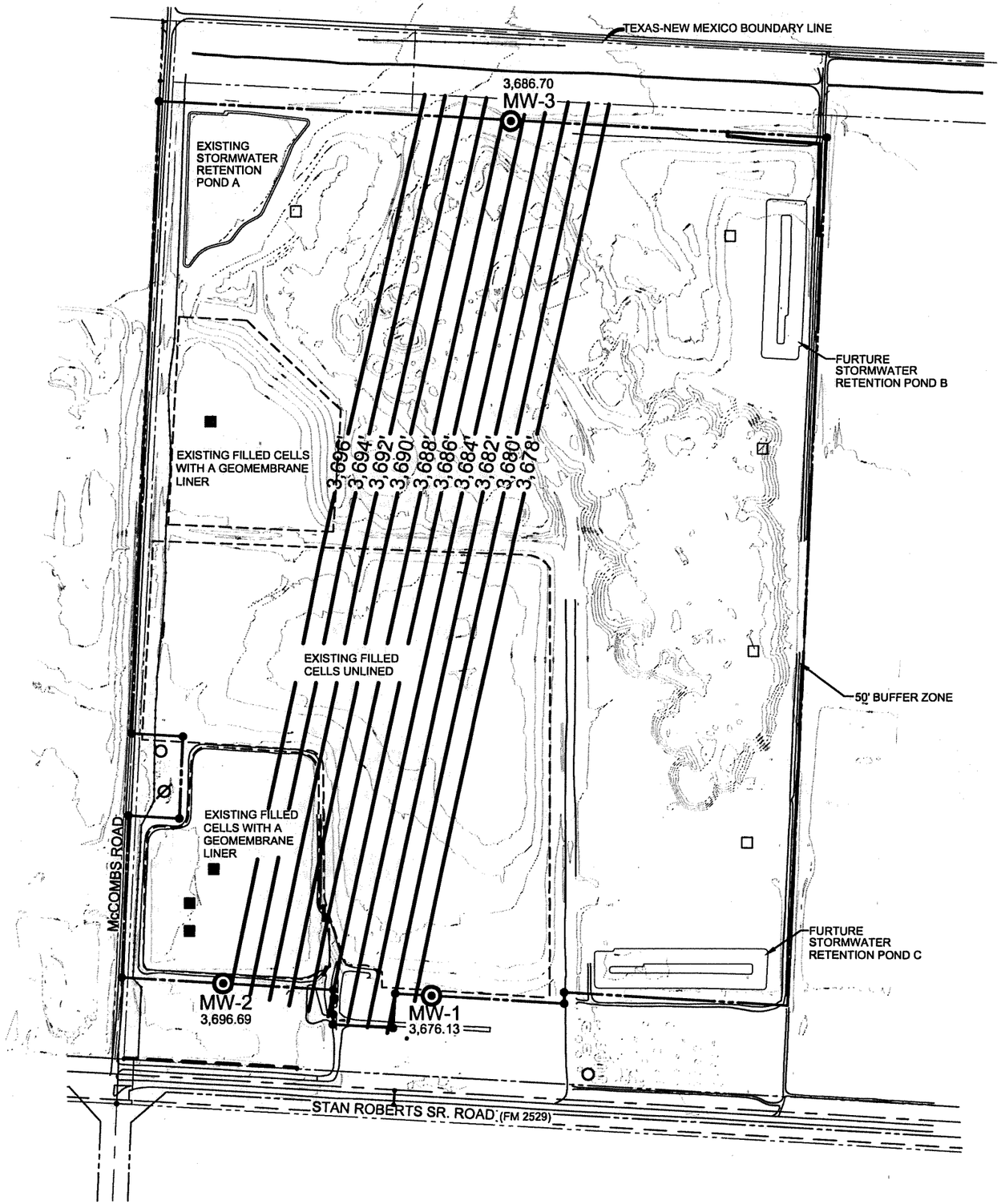

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136 Pecan Street, Keller, TX 76248

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	NOD 1 RESPONSE

ISSUING OFFICE: CITY PROJECT NO: 07-07-35

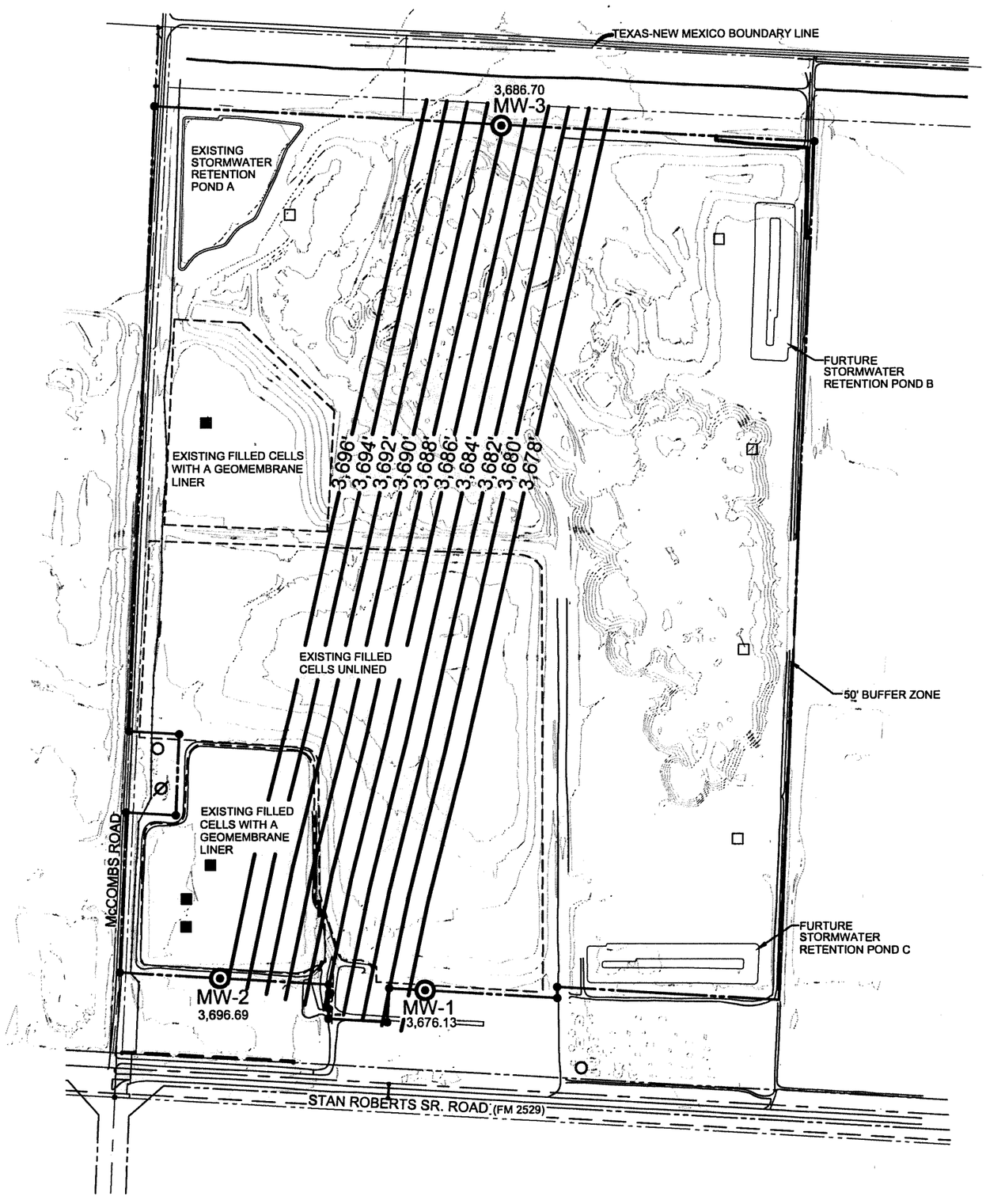
DATE DRAFTED: October 12, 2007

FILENAME: L:\TEXAS\McCombs\MCCOMBSpoc.dwg

DRAWN BY: FGK

DRAFTED BY: FGK

FIGURE: **5C**



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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 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

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ISSUING OFFICE: CITY PROJECT NO: 07-07-35

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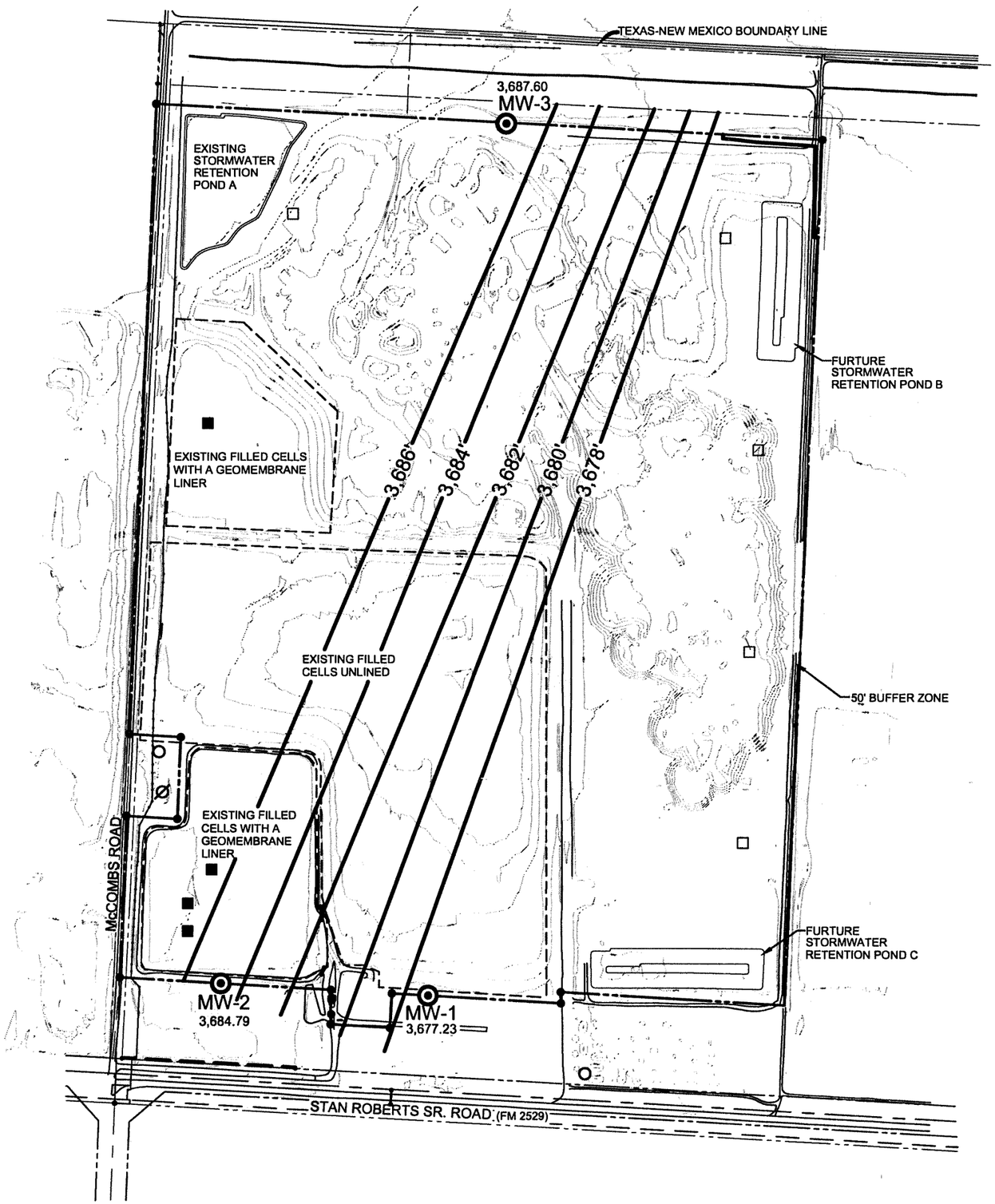
DRAFTED BY: FGK

FIGURE: **6C**



STATE OF TEXAS
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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 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	7/6/2009	NOD 1 RESPONSE

ISSUING OFFICE: CITY PROJECT NO: 07-07-35

DATE DRAFTED: October 12, 2007

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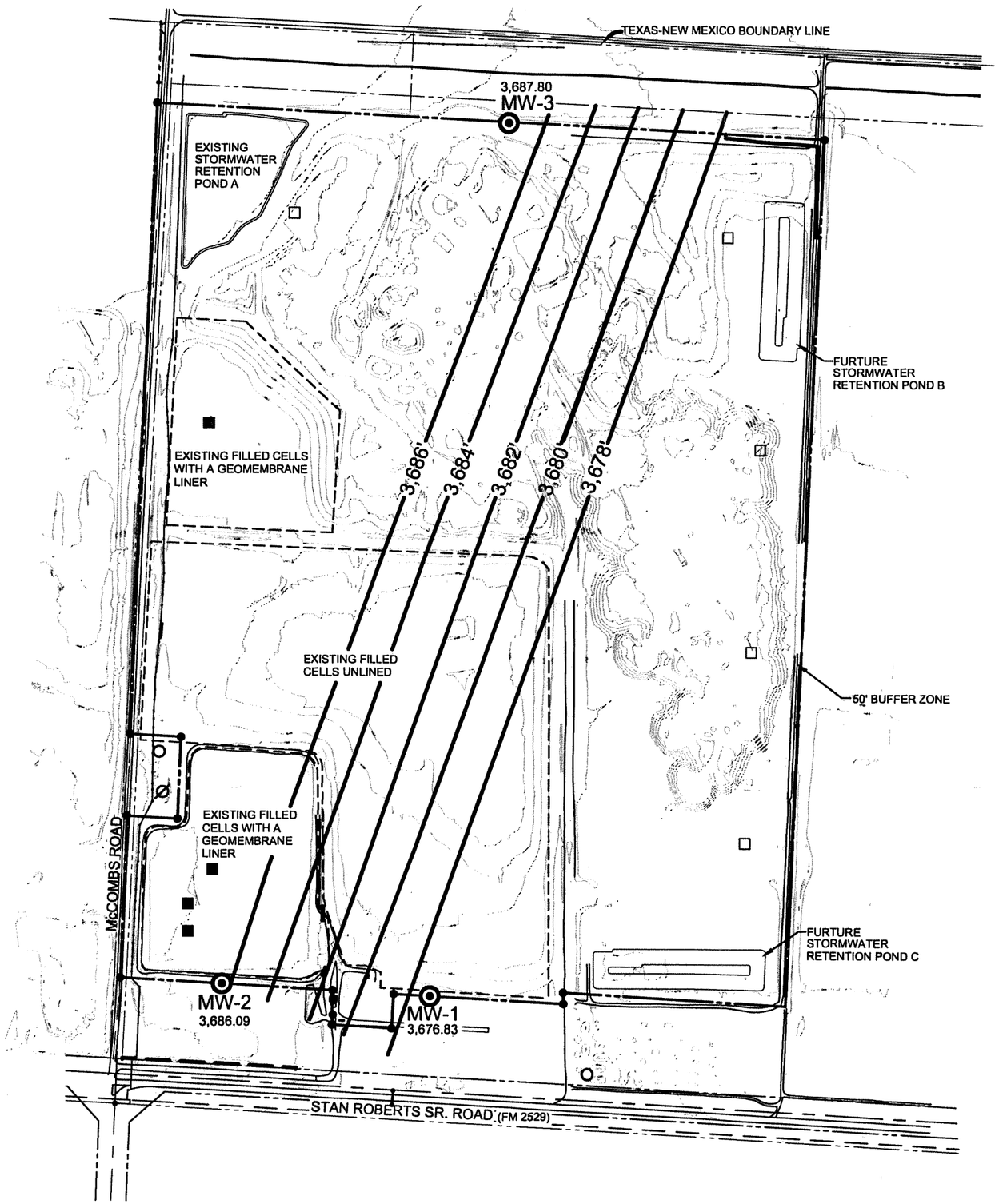
DRAWN BY: FGK

DRAFTED BY: FGK

FIGURE: **7C**



STATE OF TEXAS
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GEOLOGY
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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 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	7/8/2009	NOD 1 RESPONSE

ISSUING OFFICE: CITY PROJECT NO: 07-07-35

DATE DRAFTED: October 12, 2007

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DRAFTED BY: FGK

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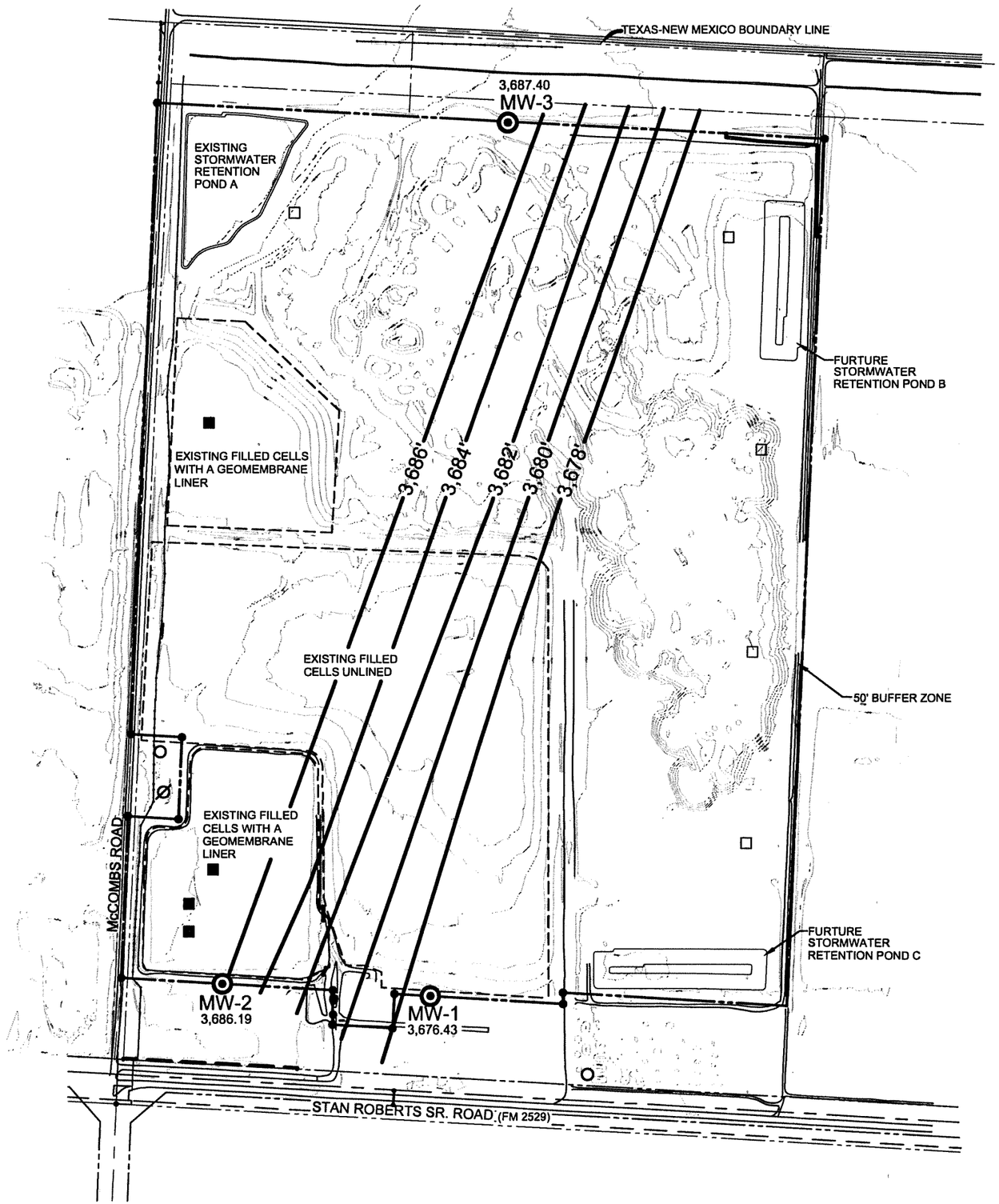

STATE OF TEXAS
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GEOLOGY
960
LICENSED
PROFESSIONAL GEOSCIENTIST

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 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	7/8/2009	NOD 1 RESPONSE

ISSUING OFFICE: CITY PROJECT NO: 07-07-35

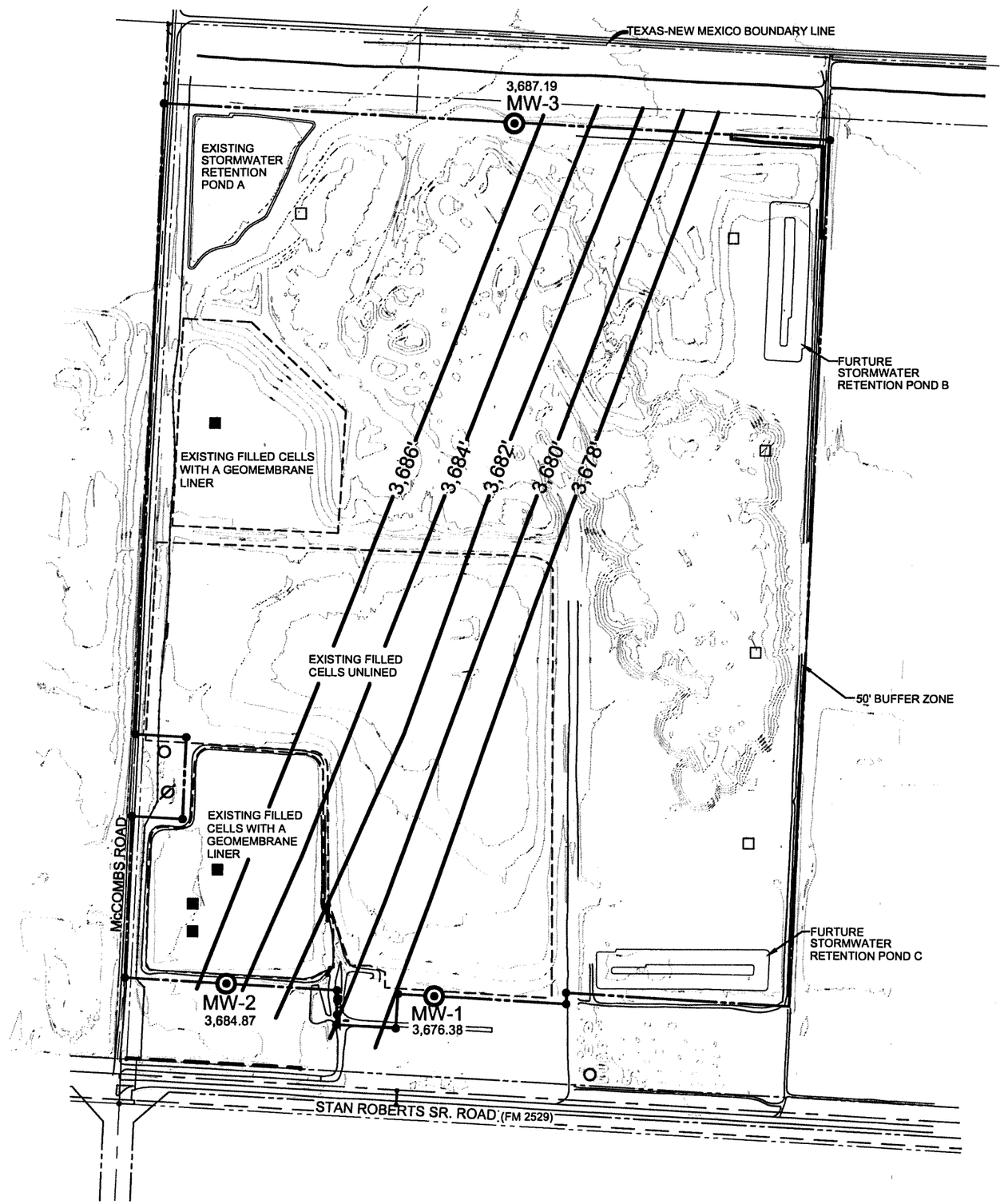
DATE DRAFTED: October 12, 2007

FILENAME: L:\TEXAS\McCombs\MCCOMBSpoc.dwg

DRAWN BY: FGK

DRAFTED BY: FGK

FIGURE: **9C**



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 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

NO	DATE	DESCRIPTION
1	7/6/2009	MOD 1 RESPONSE

ISSUING OFFICE: CITY PROJECT NO: 07-07-35

DATE DRAFTED: October 12, 2007

FILENAME: L:\TEXAS\McCombs\MCCOMBSpoc.dwg

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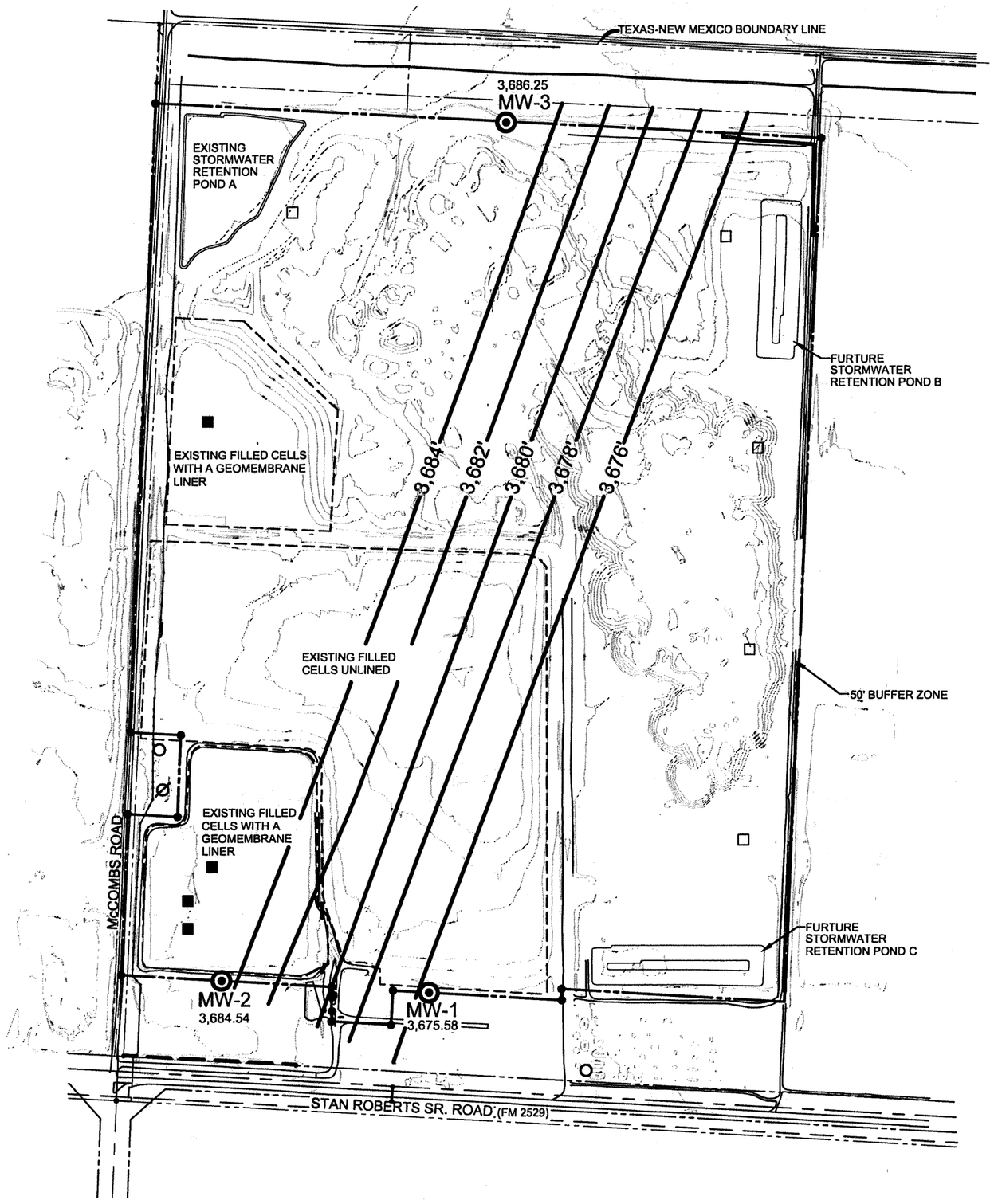
DRAFTED BY: FGK

FIGURE: **10C**



STATE OF TEXAS
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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 OCTOBER 31, 2006 - NOVEMBER 2, 2006

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	7/8/2009	MOD 1 RESPONSE

ISSUING OFFICE: CITY PROJECT NO: 07-07-35

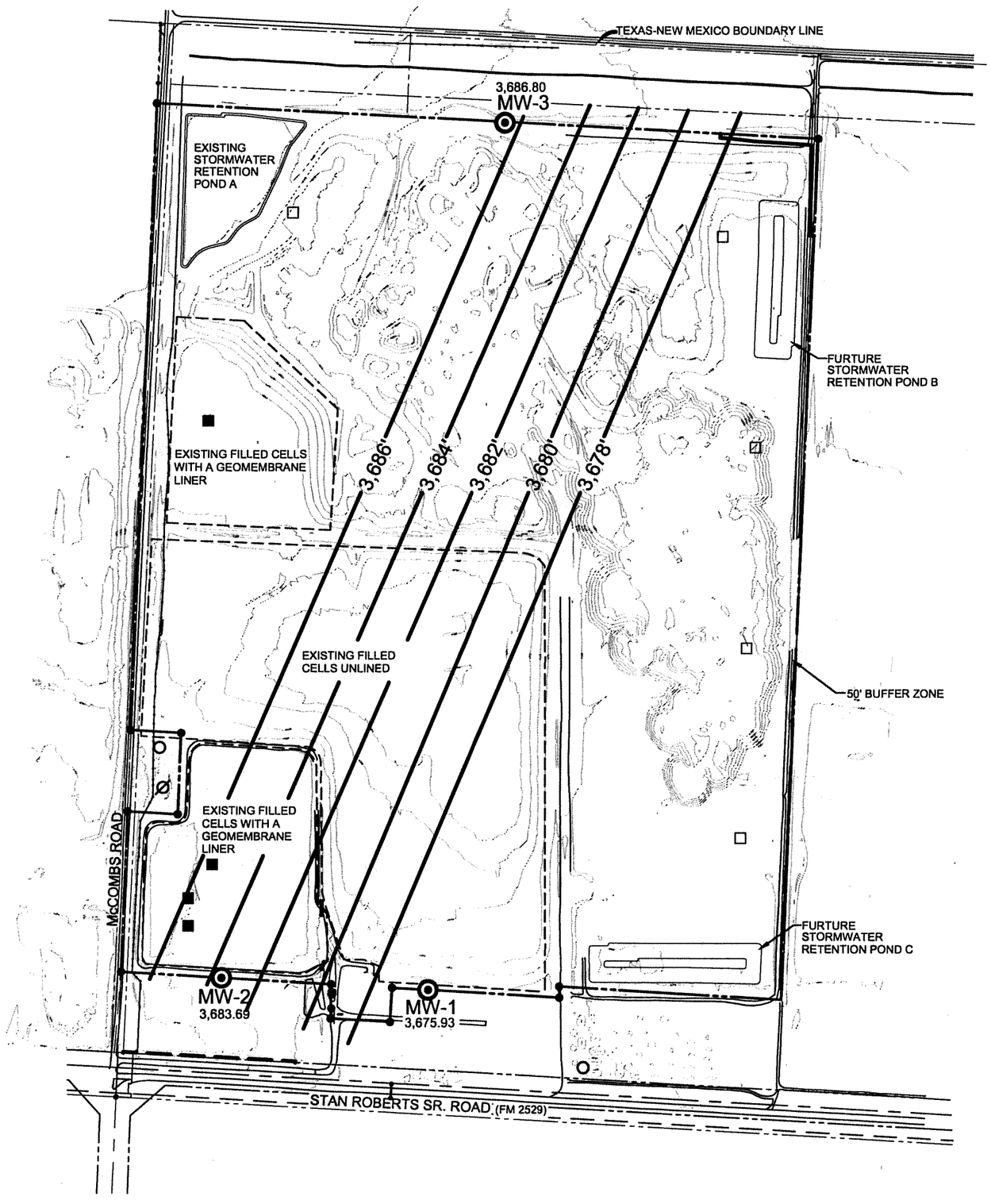
DATE DRAFTED: October 12, 2007

FILENAME: L:\TEXAS\McCombs\MCCOMBSpoc.dwg

DRAWN BY: FGK

DRAFTED BY: FGK

FIGURE: 11C



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136 Pecan Street, Keller, TX 76248

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

N

NO	DATE	DESCRIPTION
1	7/8/2009	NOD 1 RESPONSE

ISSUING OFFICE: CITY PROJECT NO: 07-07-35

DATE DRAFTED: October 12, 2007

FILENAME: L:\TEXAS\McCombs\MCCOMBSpoc.dwg

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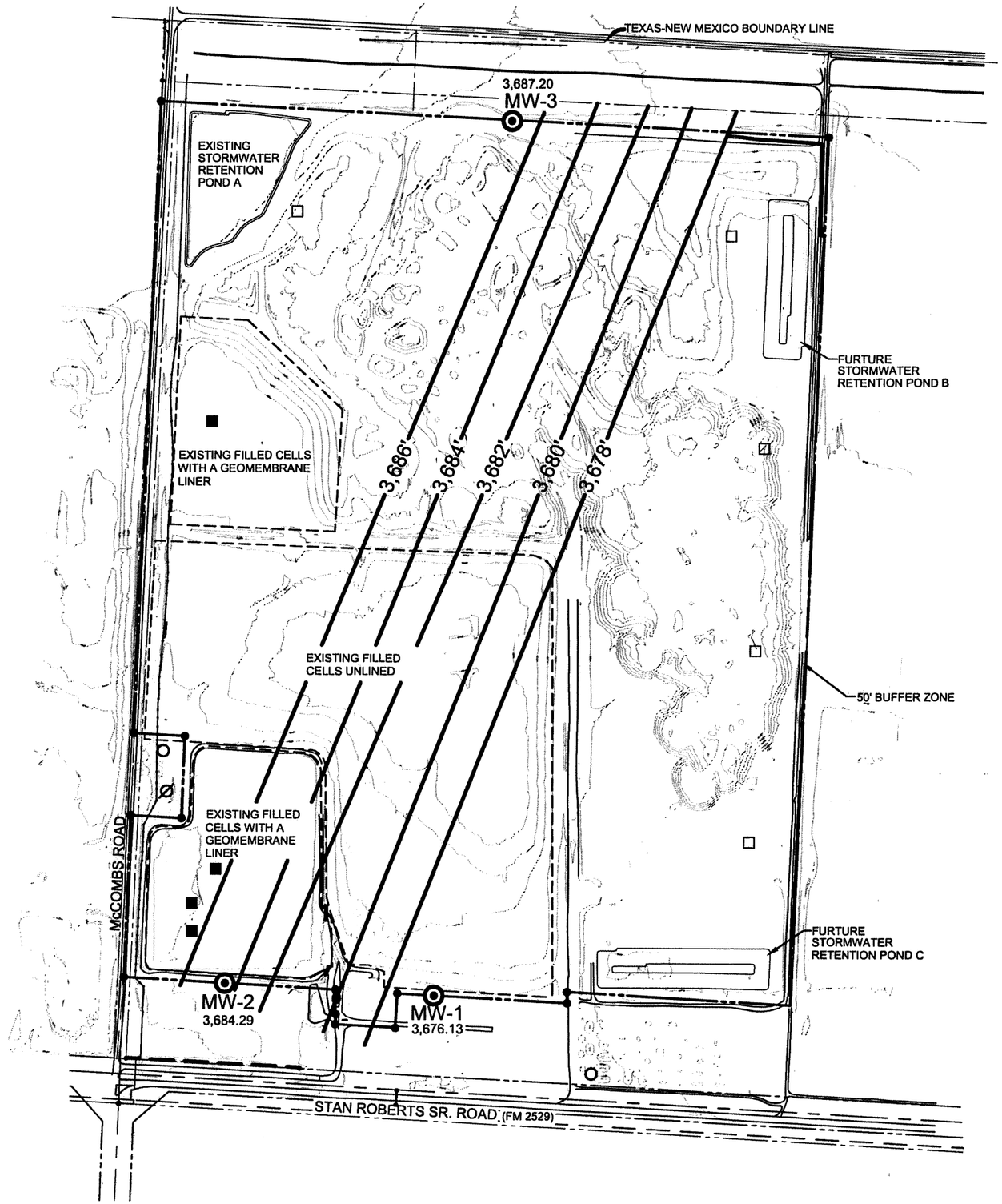
DRAFTED BY: FGK

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

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

ISSUING OFFICE: CITY PROJECT NO: 07-07-35

DATE DRAFTED: October 12, 2007

FILENAME: L:\TEXAS\McCombs\MCCOMBSpoc.dwg

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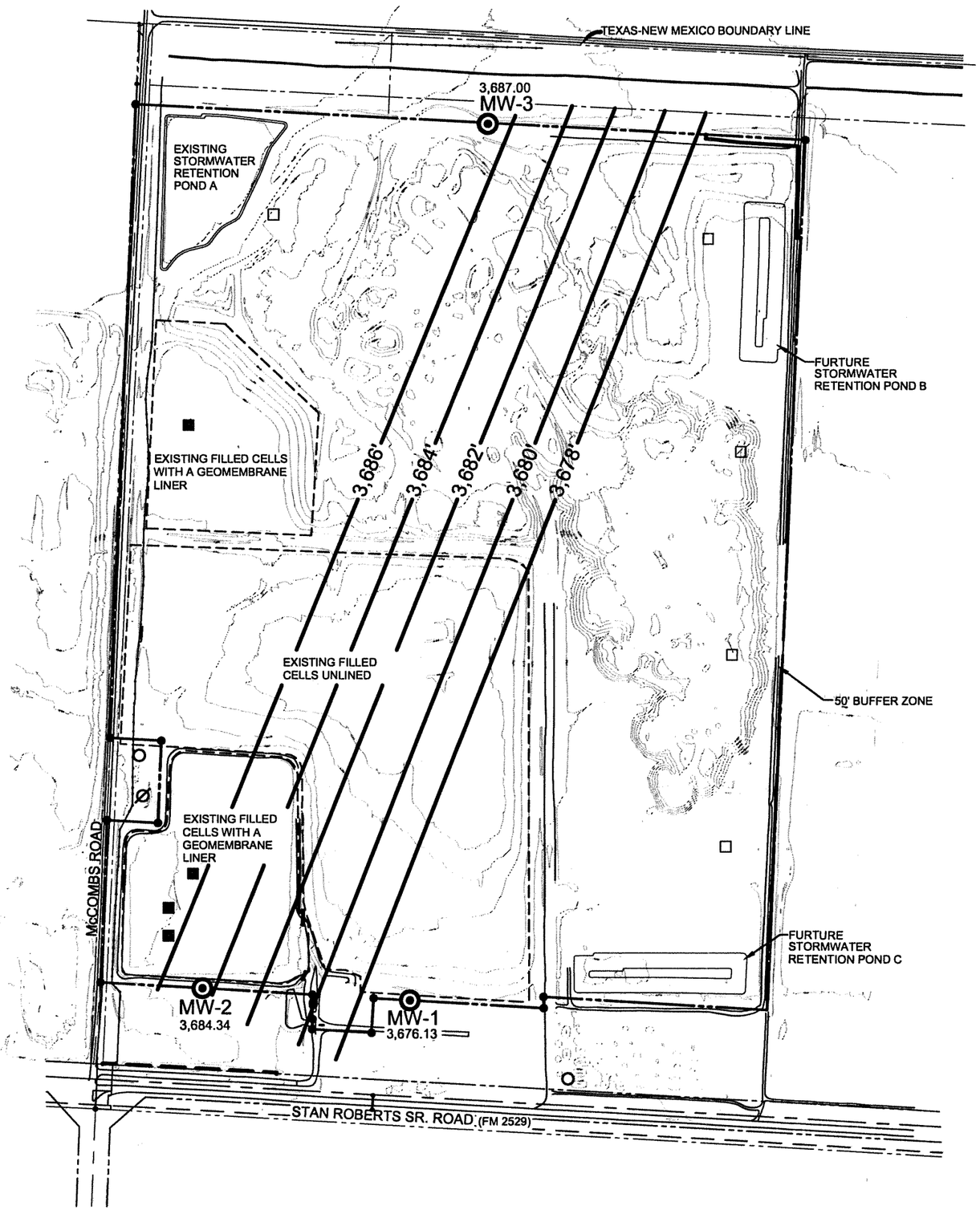
FIGURE: **13C**



STATE OF TEXAS
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PROFESSIONAL GEOSCIENTIST

7-6-2009

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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 JULY 25, 2007

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	7/8/2009	NOD 1 RESPONSE

ISSUING OFFICE: CITY PROJECT NO: 07-07-35

DATE DRAFTED: October 12, 2007

FILENAME: L:\TEXAS\McCombs\MCCOMBSpoc.dwg

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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	5/13/2004	<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	580	<50	2.5	<50	5	1.4	76.3	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	4/1/2005	<5.0	8.8	112	<2.0	<5.0	<50	<2.0	<50	<50	<50	<5.0	<50	<2	20.2	<50	383	<50	2.97	<50	5.16	1.26	95.7	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	270	<50	3.38	<50	4.41	1.33	85.4	60.4	<50	67.3	284	<0.1	444	310	8.09	8.38
MW-1	4/8/2006	<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	4.86	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	8.8	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	76.5	284	N/A	471	486	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	5/13/2004	<360	<190	100	<2.0	<26	<150	<60	<170	<440	<90	<320	<50	<300	<70	<50	<70	<50	3.7	<50	4.3	1.25	64.7	<50	<50	80.7	259	0.2	356	N/A	7.9	7.8
MW-2	9/28/2004	<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	708	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	5	1.37	75.8	57.8	<50	83	255	<0.2	500	559	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	15.3	<50	<50	<50	4.3	<50	<1.0	1.37	71.6	62.6	<50	298	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	4.35	<50	4.74	1.41	66.4	61.3	<50	86.6	276	<0.1	427	211	7.86	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	64.2	61.9	<50	77	263	<0.1	444	459	7.86	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	1.68	67.2	63	<50	79	256	0.11J	449	511	7.89	8.23
MW-2	11/5/2006	<5.0	9	106	<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	65.9	60.9	<50	75.4	259	N/A	451	441	7.9	8.5
MW-2	5/22/2007	<5.0	9.6	106	<2.0	<5.0	<50	<2.0	<50	<50	<50	<5.0	<50	<2.0	21.3	<50	79.1	<50	4.18	<50	5.49	1.7	69.1	59.3	<50	76.8	280	<0.1	455	474	8	8.39
MW-3	5/12/2004	<360	<190	370	<2.0	<26	<150	<60	<170	<440	<90	<320	<50	<300	<70	<50	<70	<50	16.7	122	10.7	0.74	708	377	<50	51.8	1260	0.3	2120	N/A	7.8	7.8
MW-3	9/29/2004	<360	<190	370	<2.0	<26	<150	<60	<170	<440	<90	<320	<100	<300	<70	<50	2560	<50	18	121	14.3	0.77	718	293	<50	57.4	1400	<0.2	2390	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	379	<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	0.88	189	302	<50	203	1180	<0.2	2340	2292	7.6	7.8
MW-3	1/10/2006	<5.0	<5.0	363	<2.0	<5.0	<50	<2.0	<50	<50	<50	<5.0	<50	<2.0	8.7	<50	124B	<50	14.5	99.3	9.07	0.68	717	310	<50	54.3	1180	0.15J	2150	1106	7.69	7.76
MW-3	4/5/2006	<5.0	<5.0	421	<2.0	<5.0	<50	<2.0	<50	<50	<50	<5.0	<50	<2.0	8	<50	167	<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	9.38	<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	46.4	1690	N/A	2310	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	17.9	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	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	<10.0	<20.0	<1.0	N/A	<1.0	<1.0	<5.0	<1.0	<1.0	<5.0	<1.0	<1.0	N/A	<2.0	<1.0	<1.0	N/A	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<5.0	<10.0	<5.0	<2.0	<10.0	<10.0	N/A	N/A	<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	<10.0	<20.0	<1.0	N/A	<1.0	<1.0	<5.0	<1.0	<1.0	<5.0	<1.0	<1.0	N/A	<2.0	<1.0	<1.0	N/A	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<5.0	<10.0	<5.0	<2.0	<10.0	<10.0	N/A	N/A	<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	<10.0	<20.0	<1.0	N/A	<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	<1.0	<1.0	<1.0	<5.0	<10.0	<5.0	<2.0	<10.0	<10.0	N/A	N/A	<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	<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	<1.0	<1.0	<1.0	<5.0	<10.0	<5.0	<2.0	<10.0	<10.0	N/A	<5.0	<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	<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	<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	<2.0	<1.0	<10.0	<2.0	
MW-1	4/8/2006	<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	<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	<2.0	<1.0	<10.0	<2.0	
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	<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	<2.0	<1.0	<10.0	<2.0	
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	<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	<2.0	<1.0	<10.0	<2.0	
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	<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	<2.0	<1.0	<10.0	<2.0	
MW-2	5/13/2004	<10.0	<20.0	<1.0	N/A	<1.0	<1.0	<5.0	<1.0	<1.0	<5.0	<1.0	<1.0	N/A	<2.0	<1.0	<1.0	N/A	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<5.0	<10.0	<5.0	<2.0	<10.0	<10.0	N/A	N/A	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<5.0	<1.0	<10.0	<5.0	<3.0
MW-2	9/28/2004	<10.0	<20.0	<1.0	N/A	<1.0	<1.0	<5.0	<1.0	<1.0	<5.0	<1.0	<1.0	N/A	<2.0	<1.0	<1.0	N/A	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<5.0	<10.0	<5.0	<2.0	<10.0	<10.0	N/A	N/A	<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	<10.0	<20.0	<1.0	N/A	<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	<1.0	<1.0	<1.0	<5.0	<10.0	<5.0	<2.0	<10.0	<10.0	N/A	<5.0	<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	<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	<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	<5.0	<1.0	<10.0	<5.0	
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	<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	<2.0	<1.0	<10.0	<2.0	
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	<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	<2.0	<1.0	<10.0	<2.0	
MW-2	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	<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	<2.0	<1.0	<10.0	<2.0	
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	<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	<2.0	<1.0	<10.0	<2.0	
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	<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	<2.0	<1.0	<10.0	<2.0	
MW-3	5/12/2004	<10.0	<20.0	<1.0	N/A	<1.0	<1.0	<5.0	<1.0	<1.0	<5.0	<1.0	<1.0	N/A	<2.0	<1.0	<1.0	N/A	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<5.0	<10.0	<5.0	<2.0	<10.0	<10.0	N/A	N/A	<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	<10.0	<20.0	<1.0	N/A	<1.0	<1.0	<5.0	<1.0	<1.0	<5.0	<1.0	<1.0	N/A	<2.0	<1.0	<1.0	N/A	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<5.0	<10.0	<5.0	<2.0	<10.0	<10.0	N/A	N/A	<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	<10.0	<20.0	<1.0	N/A	<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	<1.0	<1.0	<1.0	<5.0	<10.0	<5.0	<2.0	<10.0	<10.0	N/A	N/A	<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	<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	<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	<5.0	<1.0	<10.0	<5.0	
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	<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	<2.0	<1.0	<10.0	<2.0	
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	<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	<2.0	<1.0	<10.0	<2.0	
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	<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	<2.0	<1.0	<10.0	<2.0	
MW-3	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	<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	<2.0	<1.0	<10.0	<2.0	
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	<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	<2.0	<1.0	<10.0	<2.0	<3.0

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			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

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

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Completion Depth: 466 feet
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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					

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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					

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Project No.: 10-01-22

Groundwater Observations	
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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

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CAREL CORPORATION

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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					
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
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

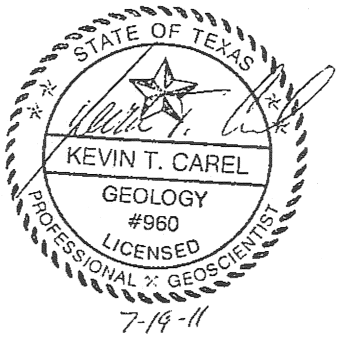
Project Description: 2011 McCombs Landfill Piezometer Installations

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
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					



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.

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: _____

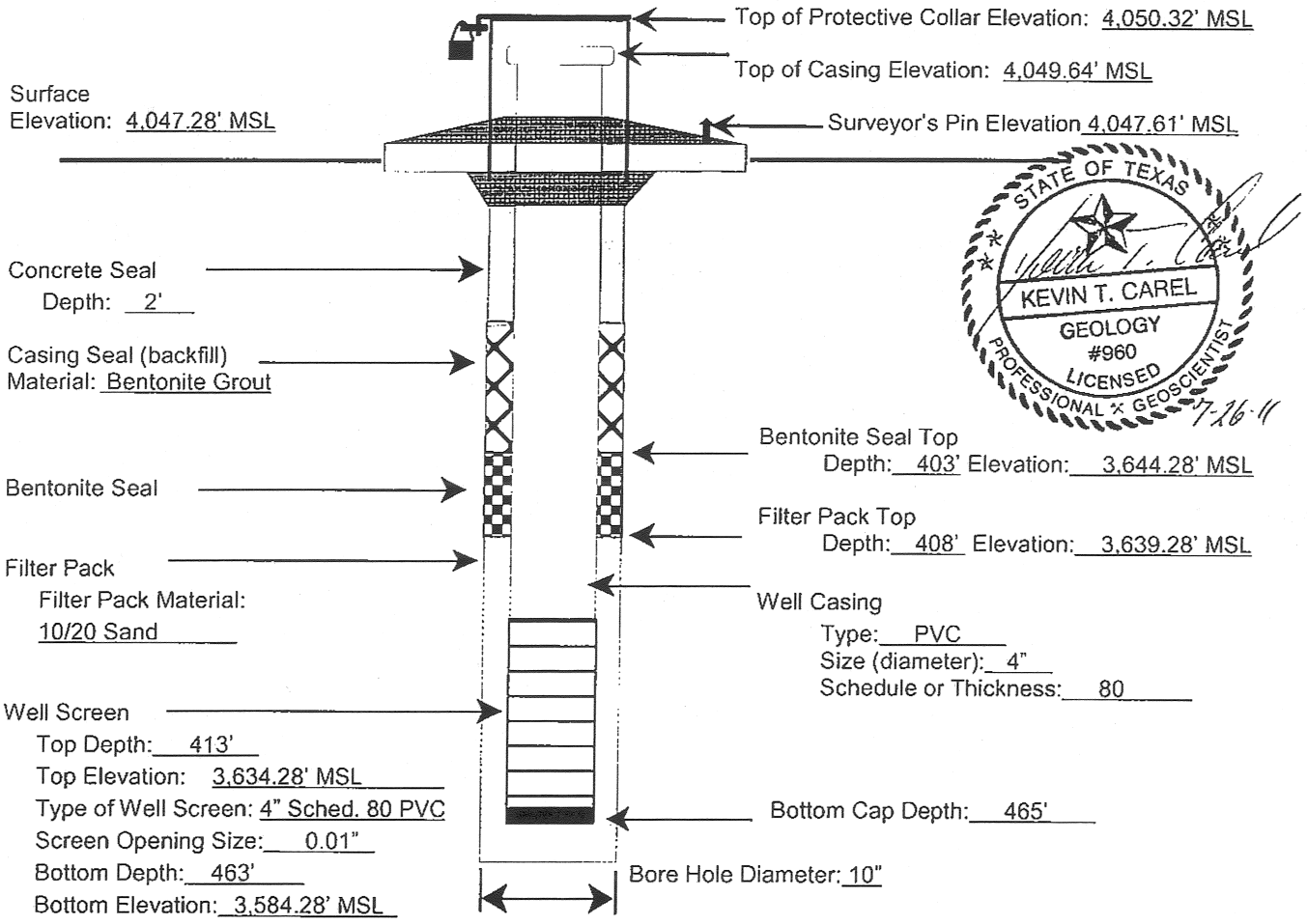
MSW Permit No.: 729A
Monitor Well I.D. No.: PZ-4
Date of Monitor Well Development: June 8, 2011
Monitor Well Driller Name: William B. Bludworth
License No. 4885

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
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					
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
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Sampling Method: Cuttings
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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 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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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

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
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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.

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: _____

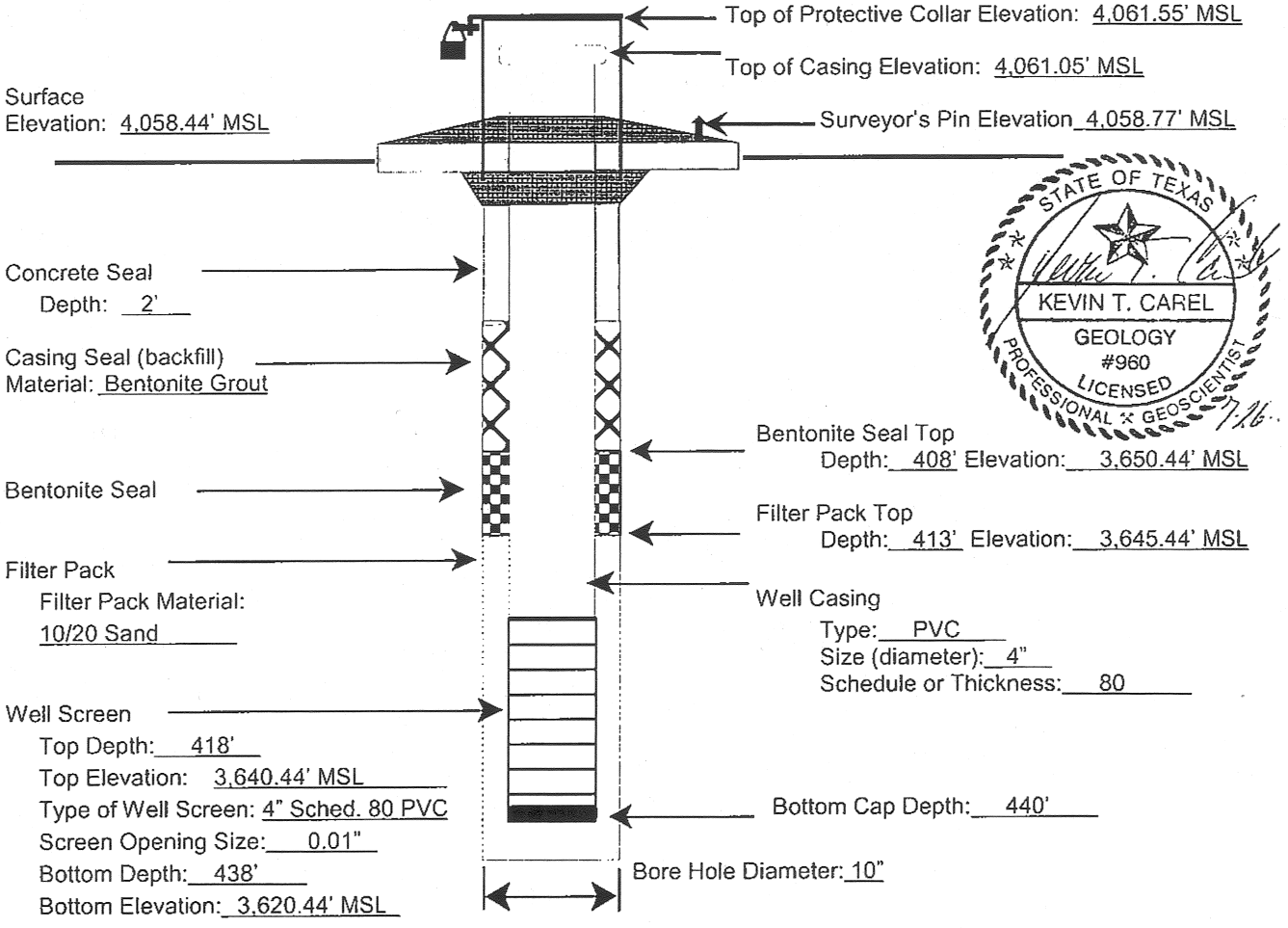
MSW Permit No.: 729A
Monitor Well I.D. No.: PZ-5
Date of Monitor Well Development: June 7, 2011
Monitor Well Driller Name: William B. Bludworth
License No. 4885

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

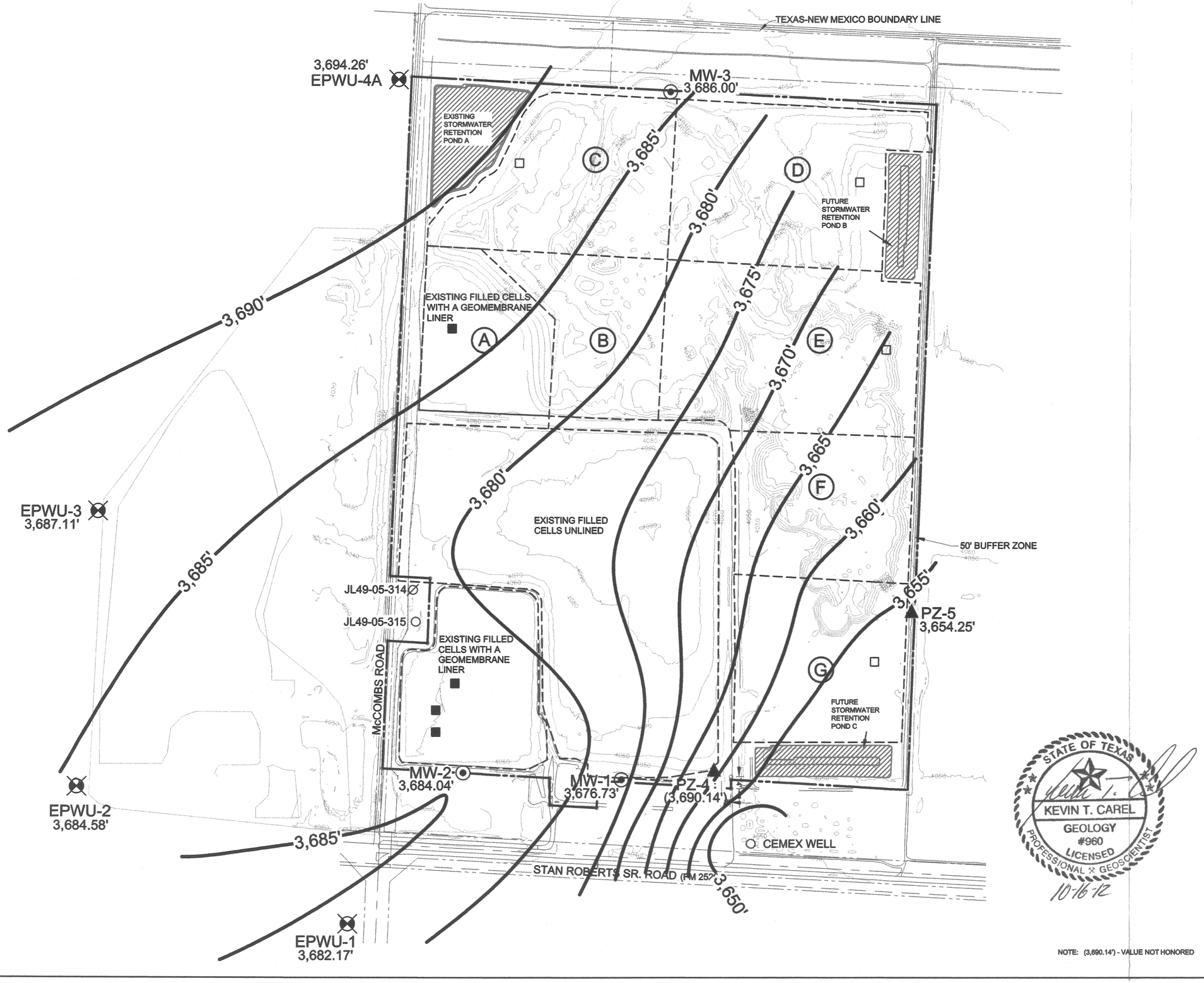
Type of Locking Device: Pad Lock
Type of Casing Protection: 6" x 6" x 5' Steel
Concrete Surface Pad (with steel reinforcement) Dimensions: 4' x 4' x 6"



TCEQ-10308

APPENDIX F

GROUNDWATER CONTOUR MAPS, AUGUST 2011 TO JULY 2012



NOTE: (3,690.14') - VALUE NOT HONORED

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST
10-16-12

Parkhill, Smith & Cooper, Inc.
Engineers • Architects • Planners
Lubbock El Paso Midland Amarillo Odessa

The CAREL CORPORATION
136 Pecan Street, Keller, TX 76248

SCALE
0 300 600
FEET

GROUNDWATER CONTOUR MAP 08/03/2011

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

DATE DRAFTED: August 14,2012	REV. # 2
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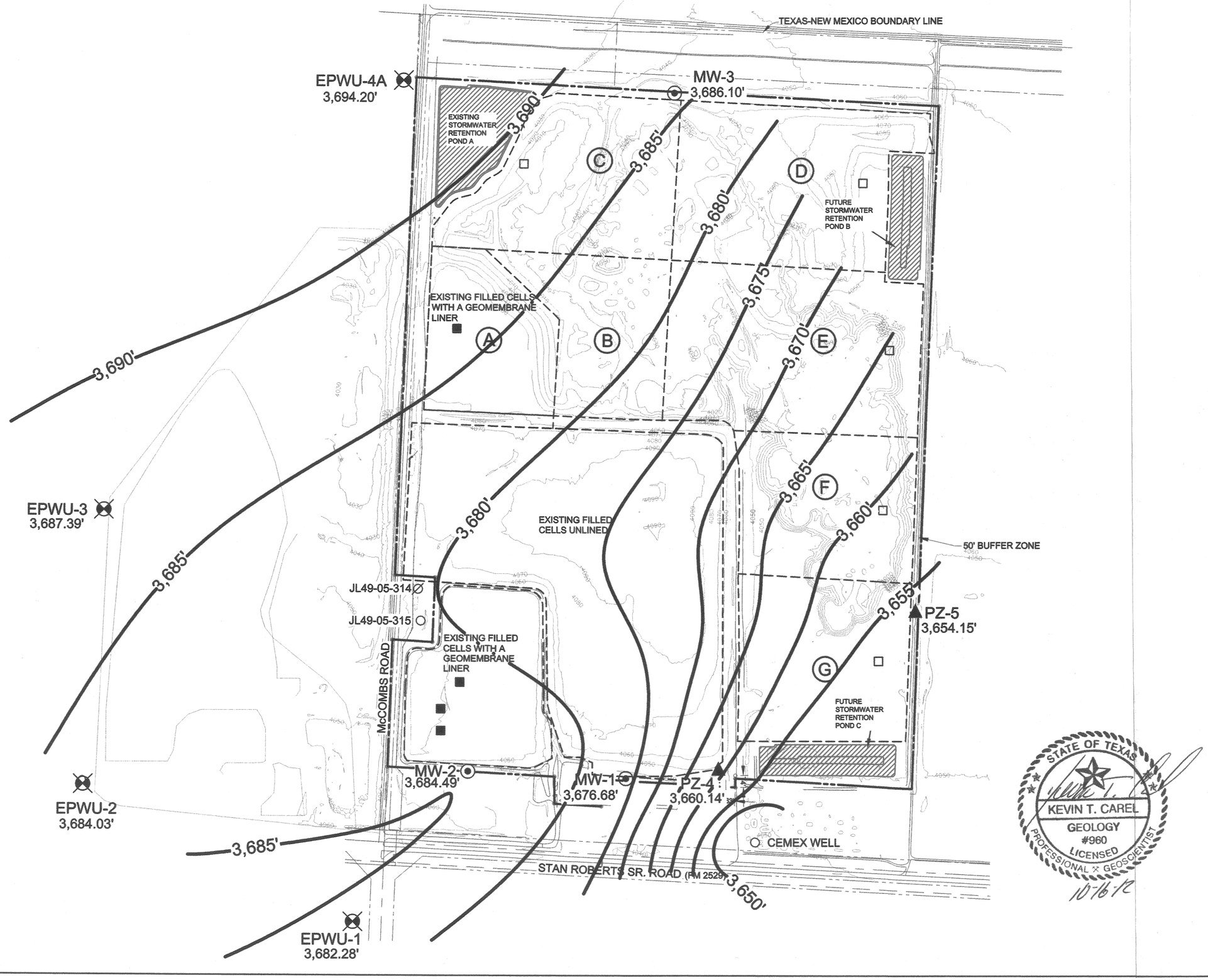
DRAFTED BY: SMG	



Parkhill, Smith & Cooper, Inc.
Engineers • Architects • Planners
Lubbock El Paso Midland Amarillo Odessa

The CAREL CORPORATION

136 Pecan Street, Keller, TX 76248

SCALE

0 300 600

FEET

GROUNDWATER CONTOUR MAP 09/01/2011

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

N

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST

10/16/12

DATE DRAFTED: August 14,2012	REV. # 2
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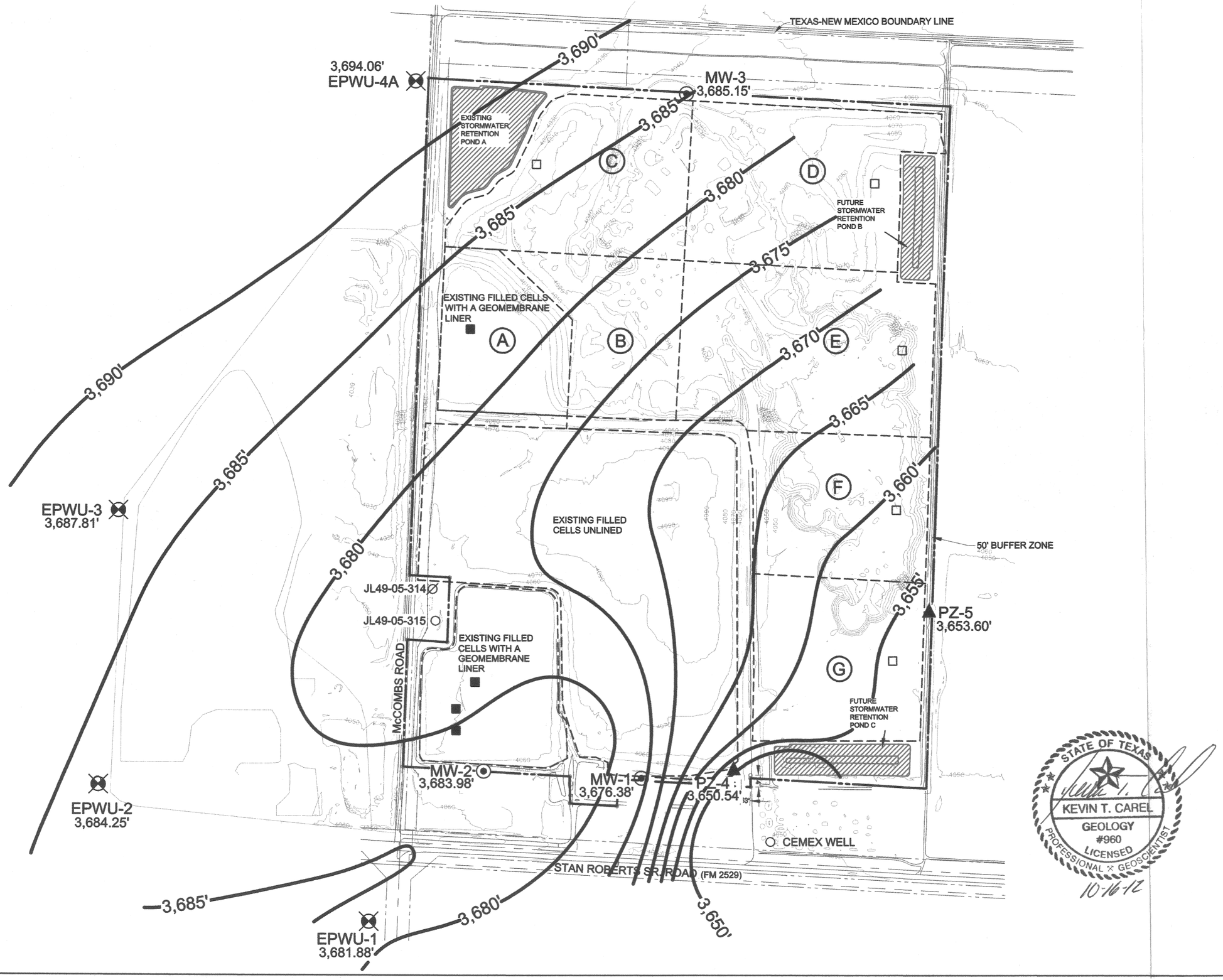
DRAWN BY: KTC	FIGURE: F-2
DRAFTED BY: SMG	



Parkhill, Smith & Cooper, Inc.
Engineers • Architects • Planners
Lubbock El Paso Midland Amarillo Odessa

The CAREL CORPORATION

136 Pecan Street, Keller, TX 76248

SCALE

0 300 600

FEET

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
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST
10-16-12

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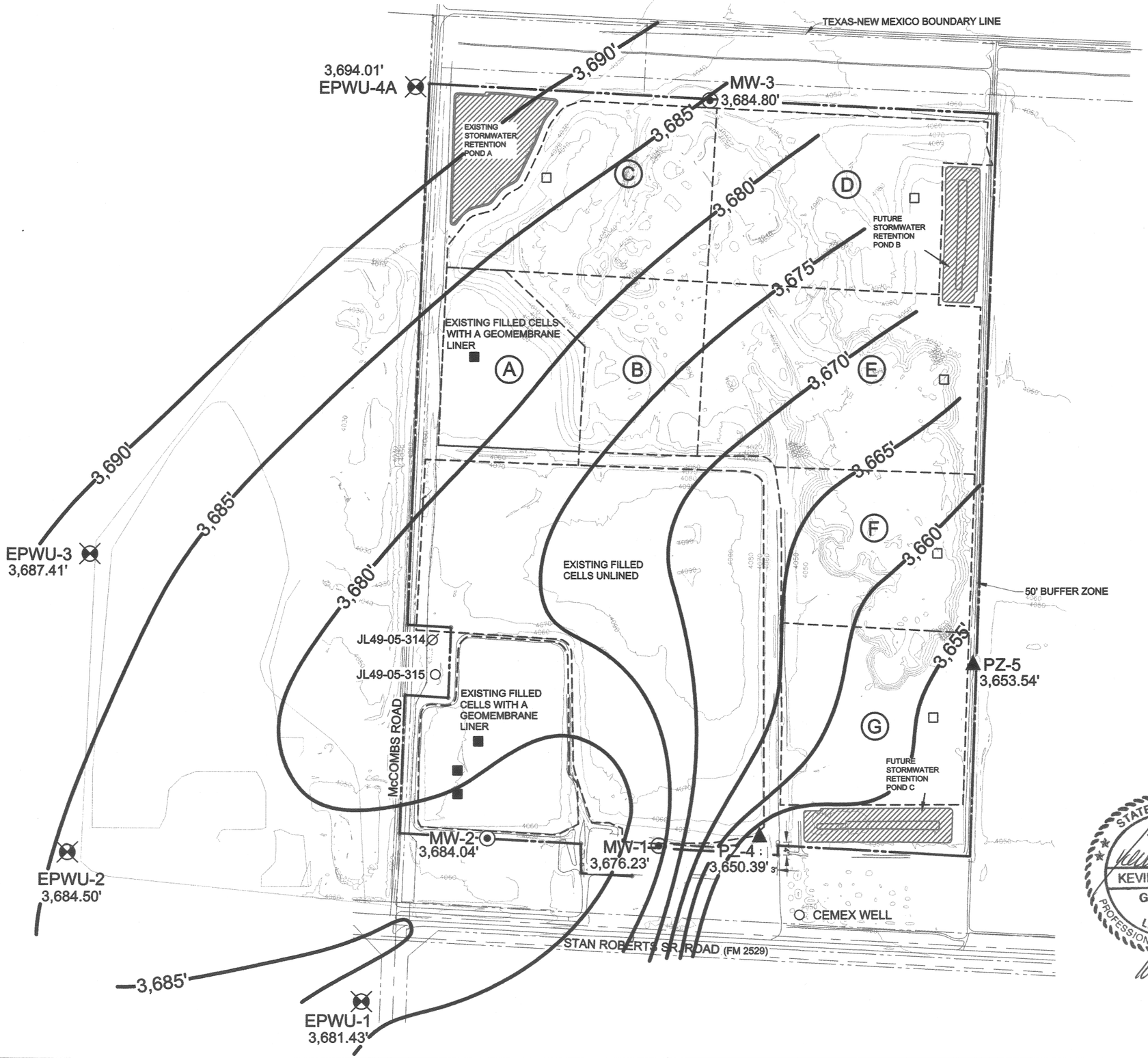

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SCALE
0 300 600
FEET

GROUNDWATER CONTOUR MAP 10/31/2011

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
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- NM NOT MEASURED/OBSTRUCTED
- PIEZOMETER
- FUTURE GROUNDWATER MONITORING WELL
- (E) SECTOR DENOMINATION
- SECTOR BOUNDARY

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DRAWN BY: KTC	FIGURE: F-4
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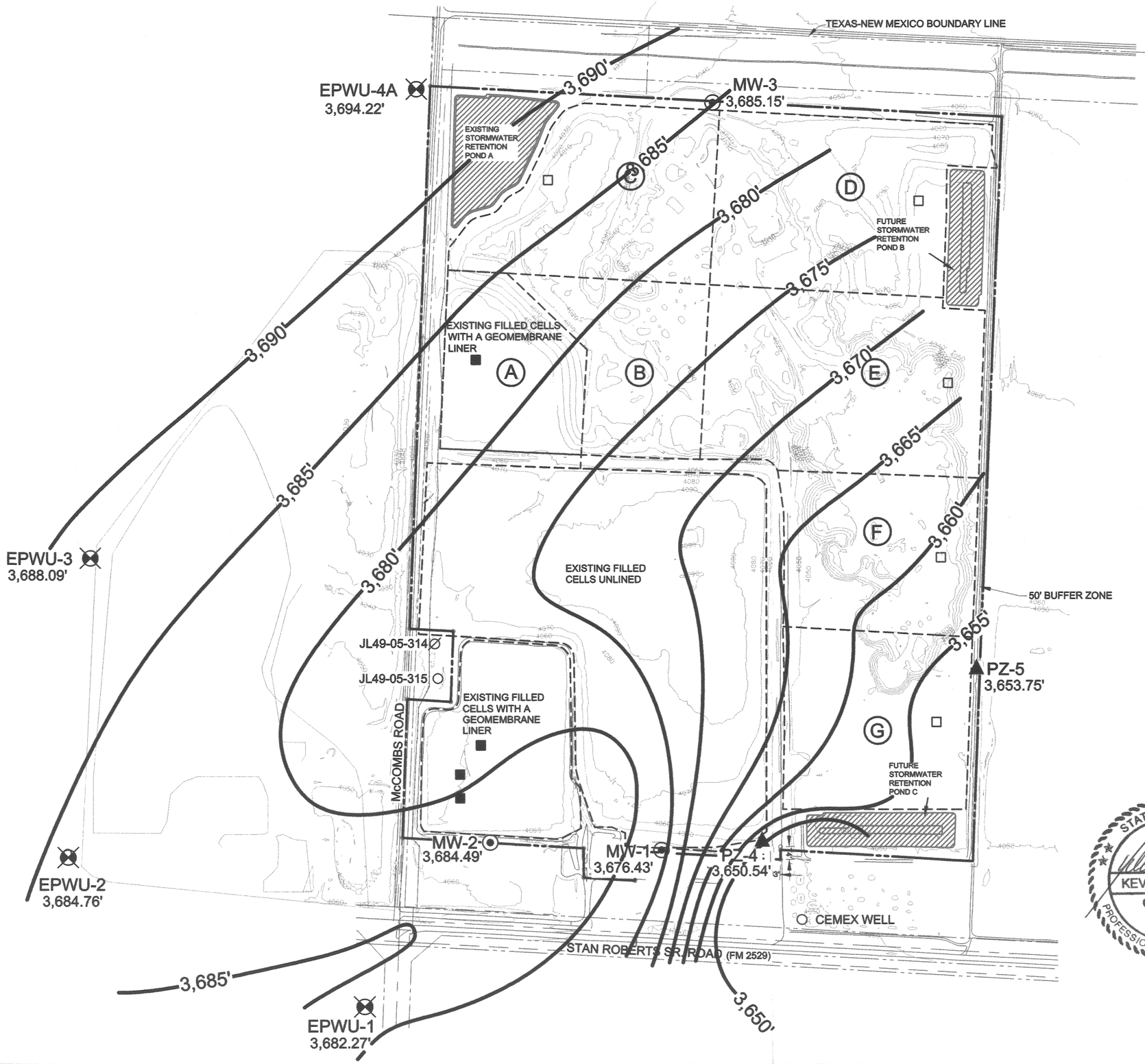

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GROUNDWATER CONTOUR MAP 12/01/2011

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
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- GROUNDWATER EXTRACTION WELL
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- SECTOR BOUNDARY

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GEOLOGY
#960
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PROFESSIONAL GEOSCIENTIST
10-16-12

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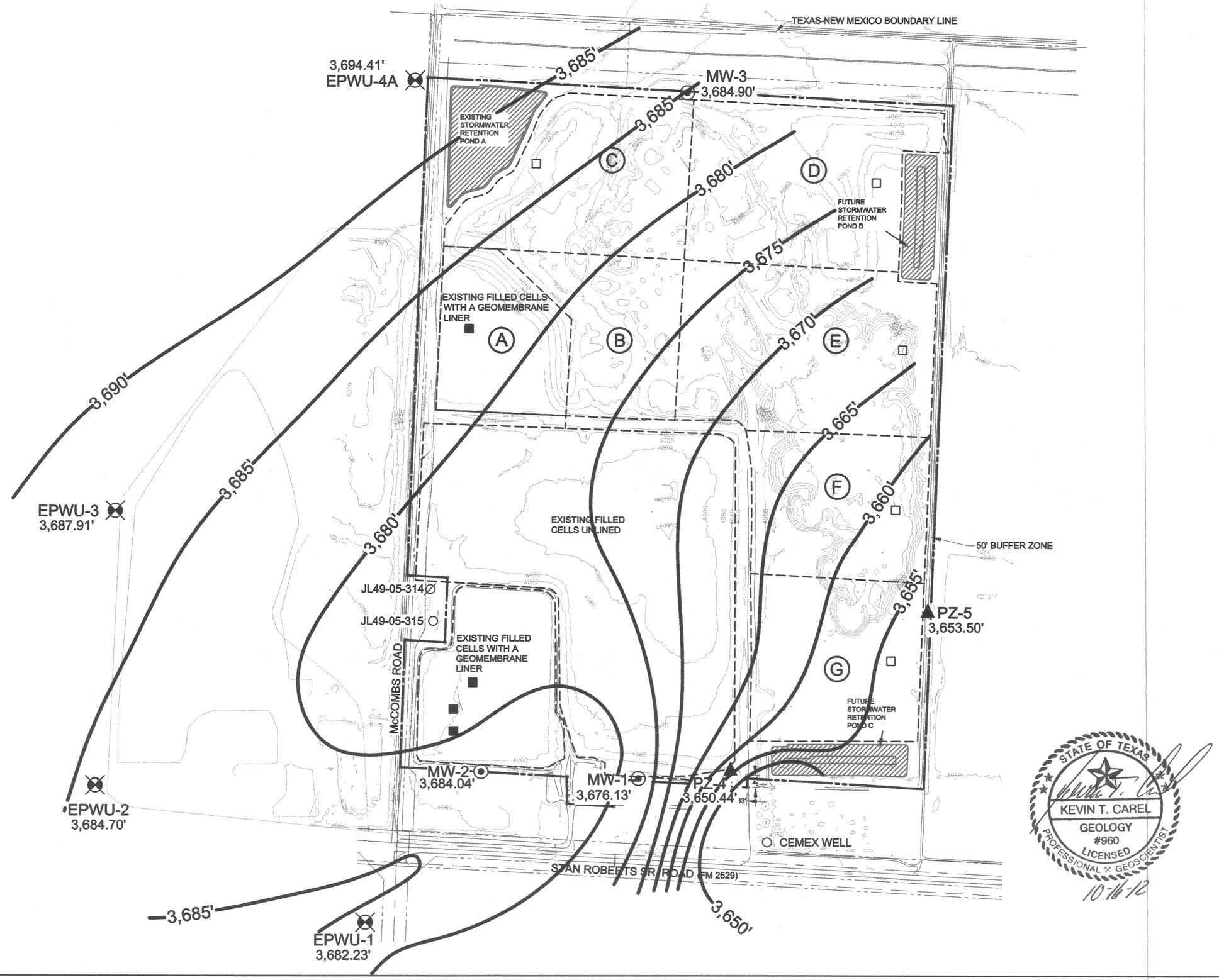

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GROUNDWATER CONTOUR MAP 01/05/2012

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
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STATE OF TEXAS
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10-16-12

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DRAWN BY: KTC	FIGURE: F-6
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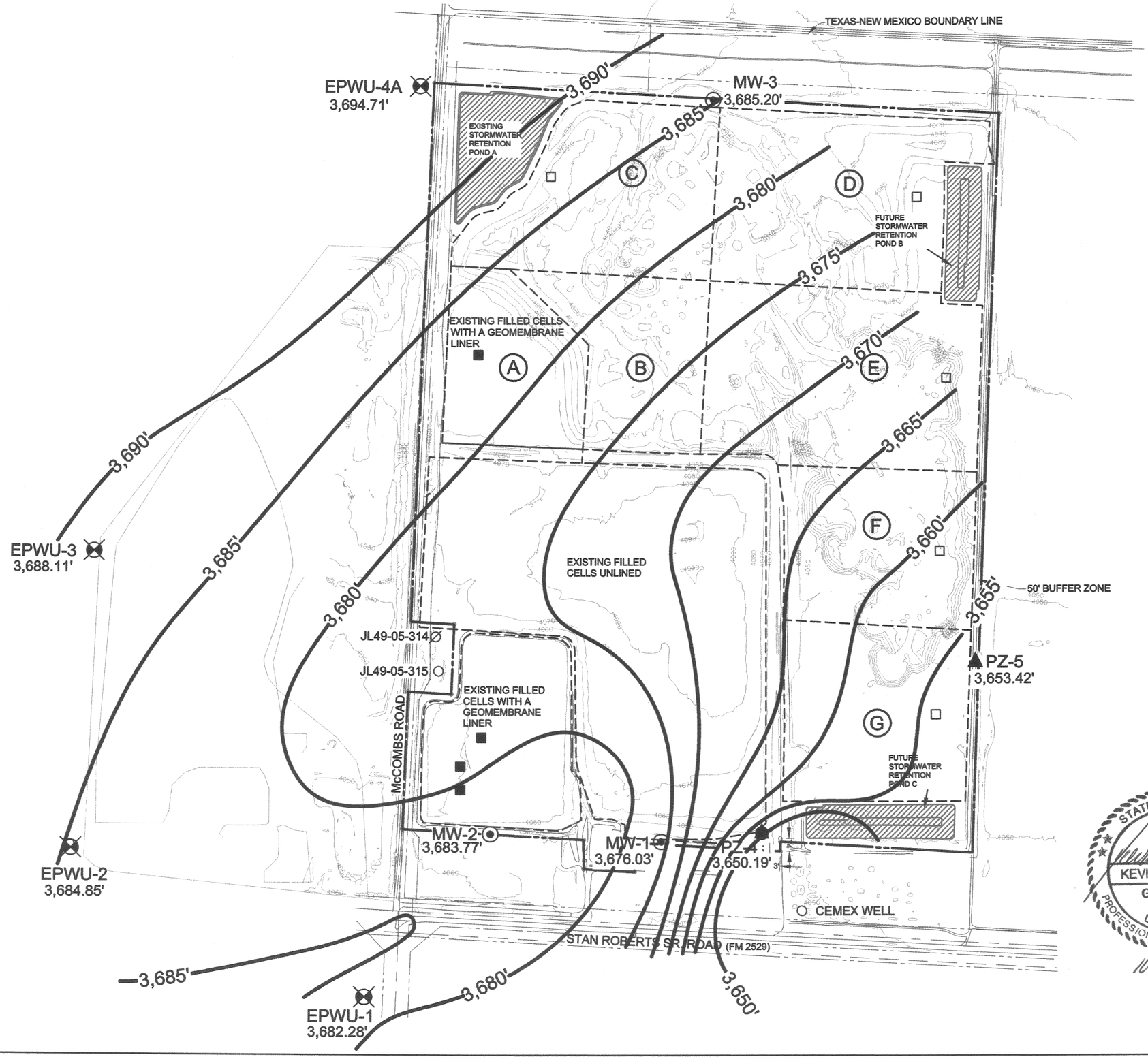

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GROUNDWATER CONTOUR MAP 02/02/2012

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
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- (E) SECTOR DENOMINATION
- SECTOR BOUNDARY

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STATE OF TEXAS
KEVIN T. CAREL
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#960
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PROFESSIONAL GEOSCIENTIST
10-16-12

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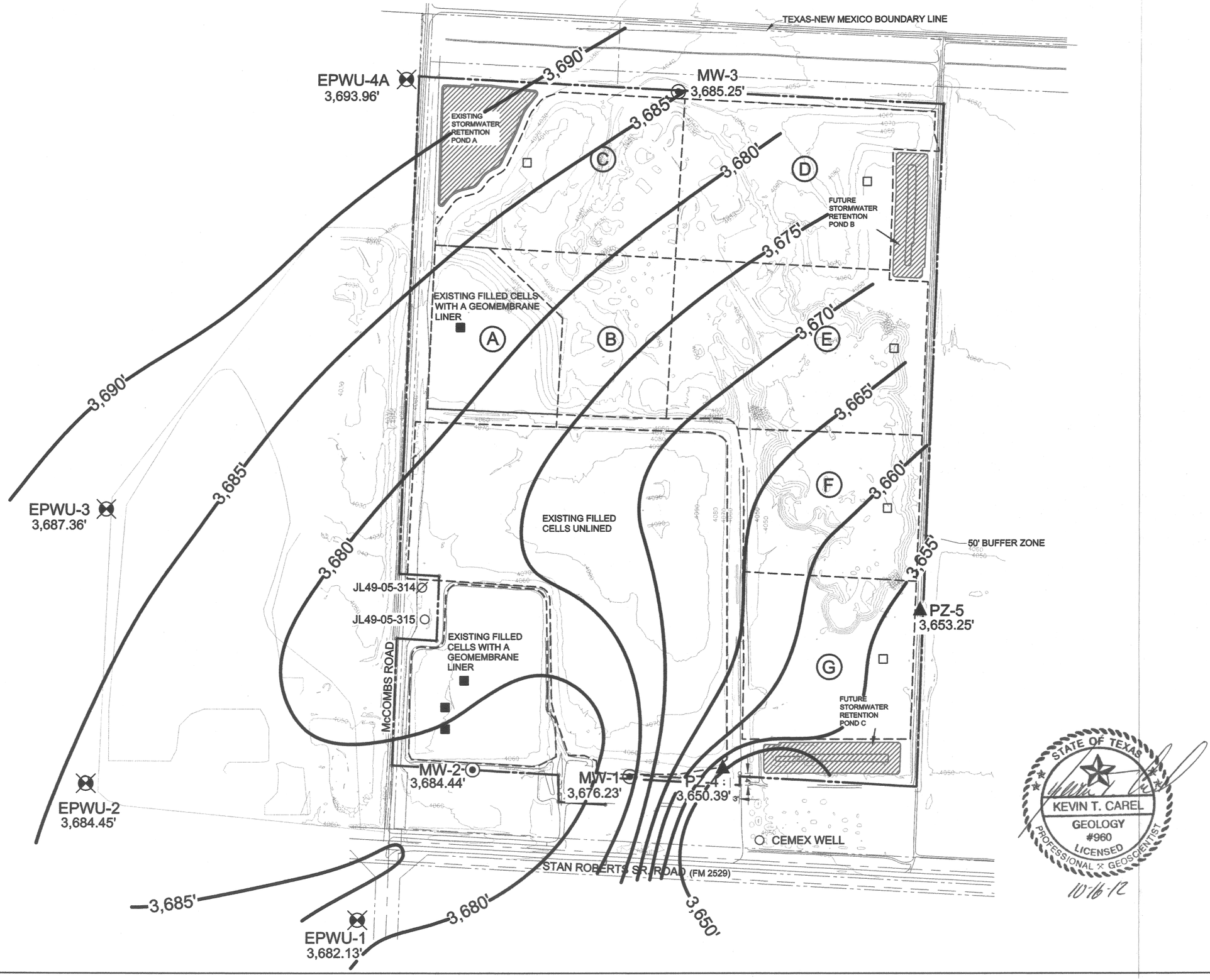
DRAFTED BY: SMG	



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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
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- (E) — SECTOR DENOMINATION
- SECTOR BOUNDARY

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STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
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10-16-12

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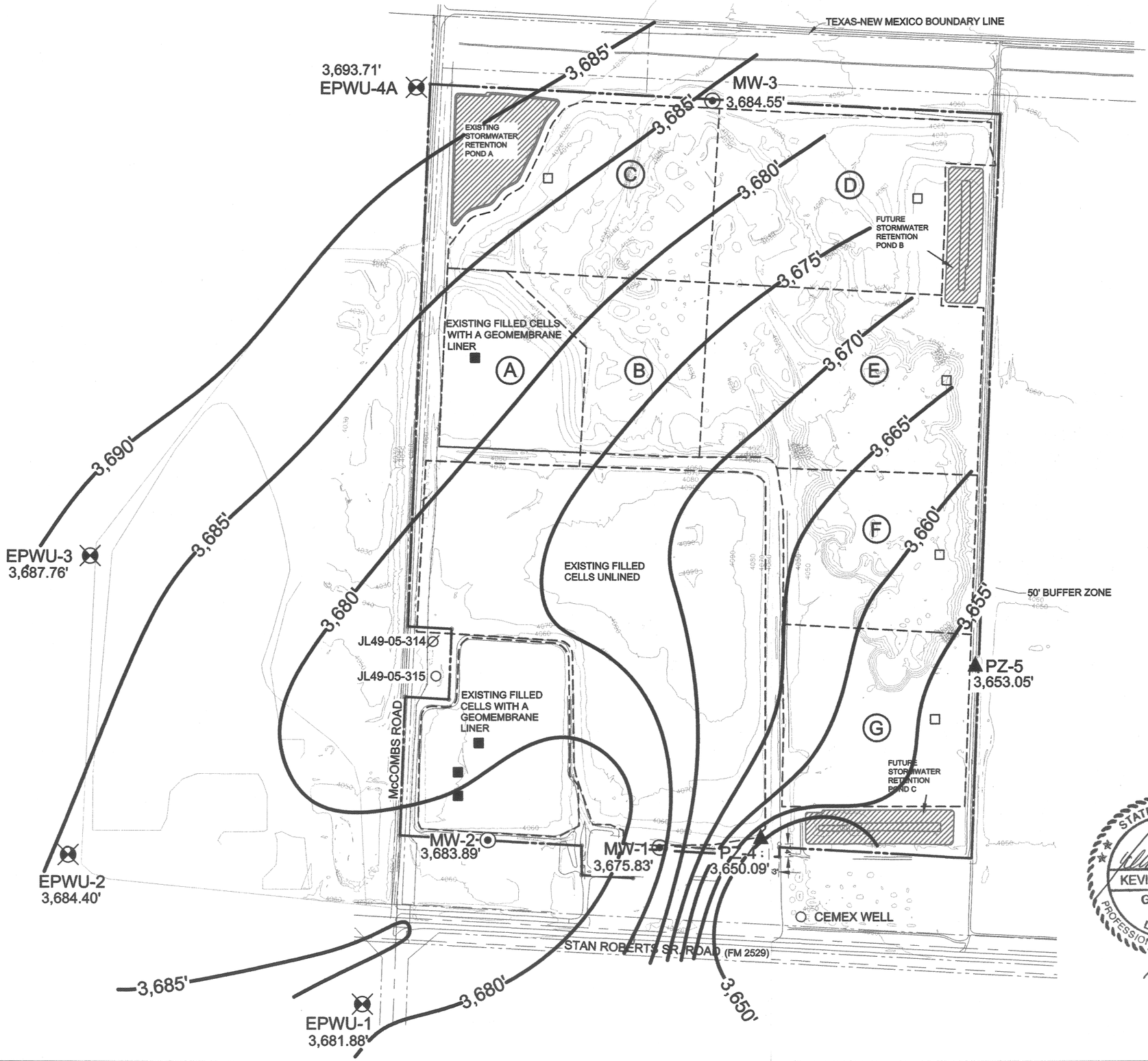

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GROUNDWATER CONTOUR MAP 04/04/2012

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
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STATE OF TEXAS
KEVIN T. CAREL
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LICENSED
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10-16-12

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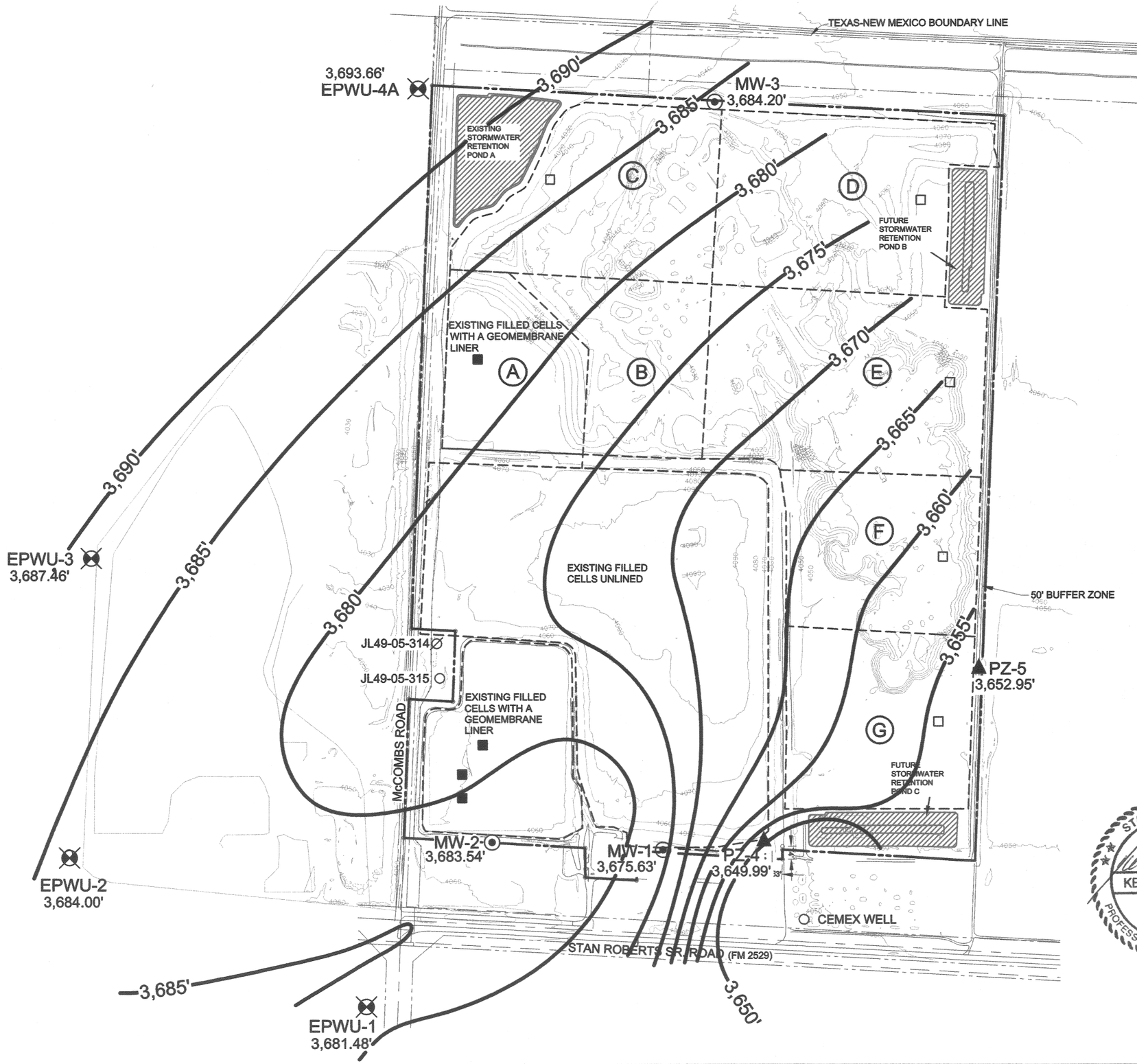

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GROUNDWATER CONTOUR MAP 05/07/2012

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:

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STATE OF TEXAS
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10-16-12

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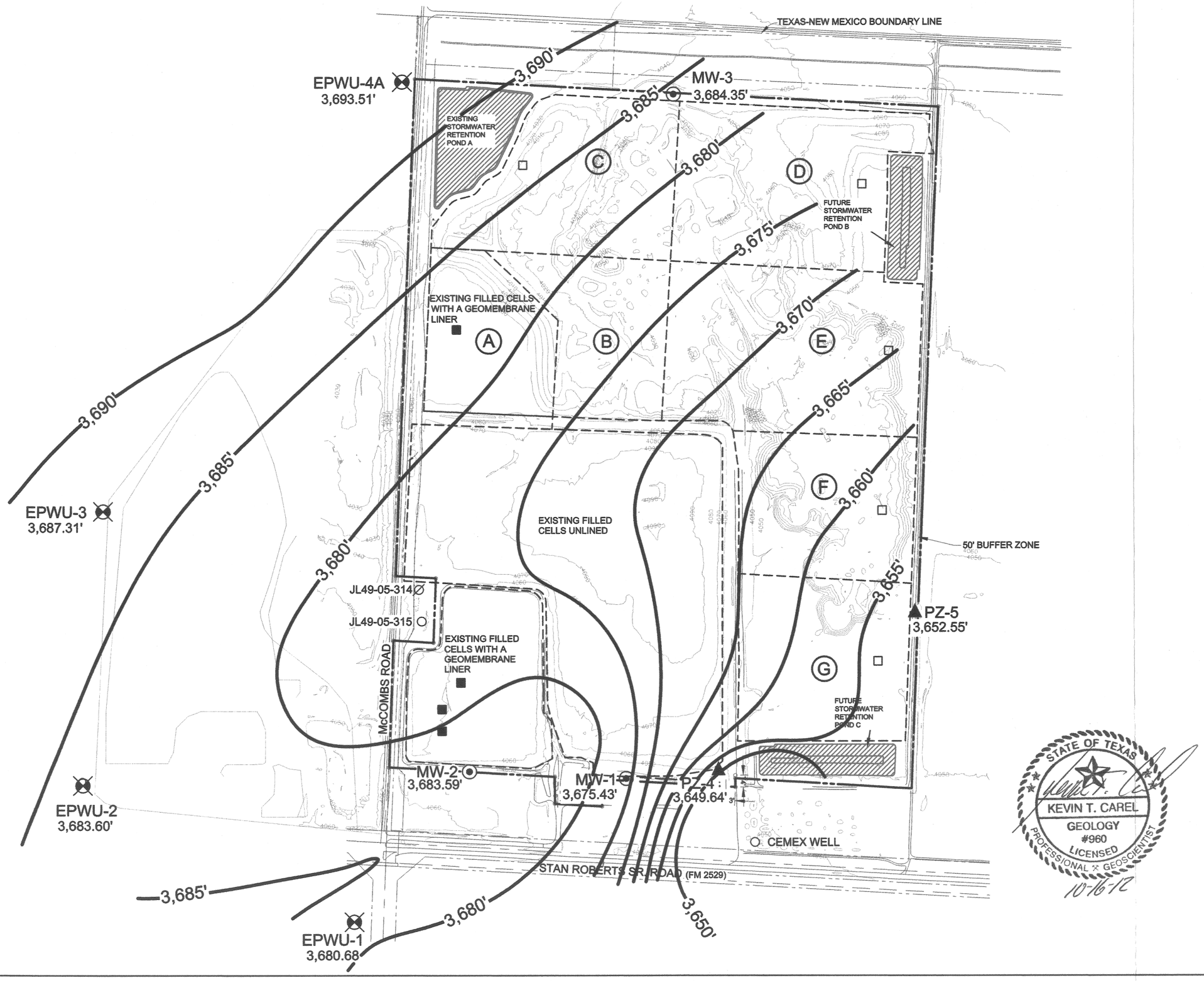

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GROUNDWATER CONTOUR MAP 05/29/2012

CITY OF EL PASO GROUNDWATER PERMIT MODIFICATIONS FOR McCOMBS LANDFILL

7969 SAN PAULO DRIVE
EL PASO, TEXAS 79907

LEGEND:

- PROPERTY\PERMIT BOUNDARY
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STATE OF TEXAS
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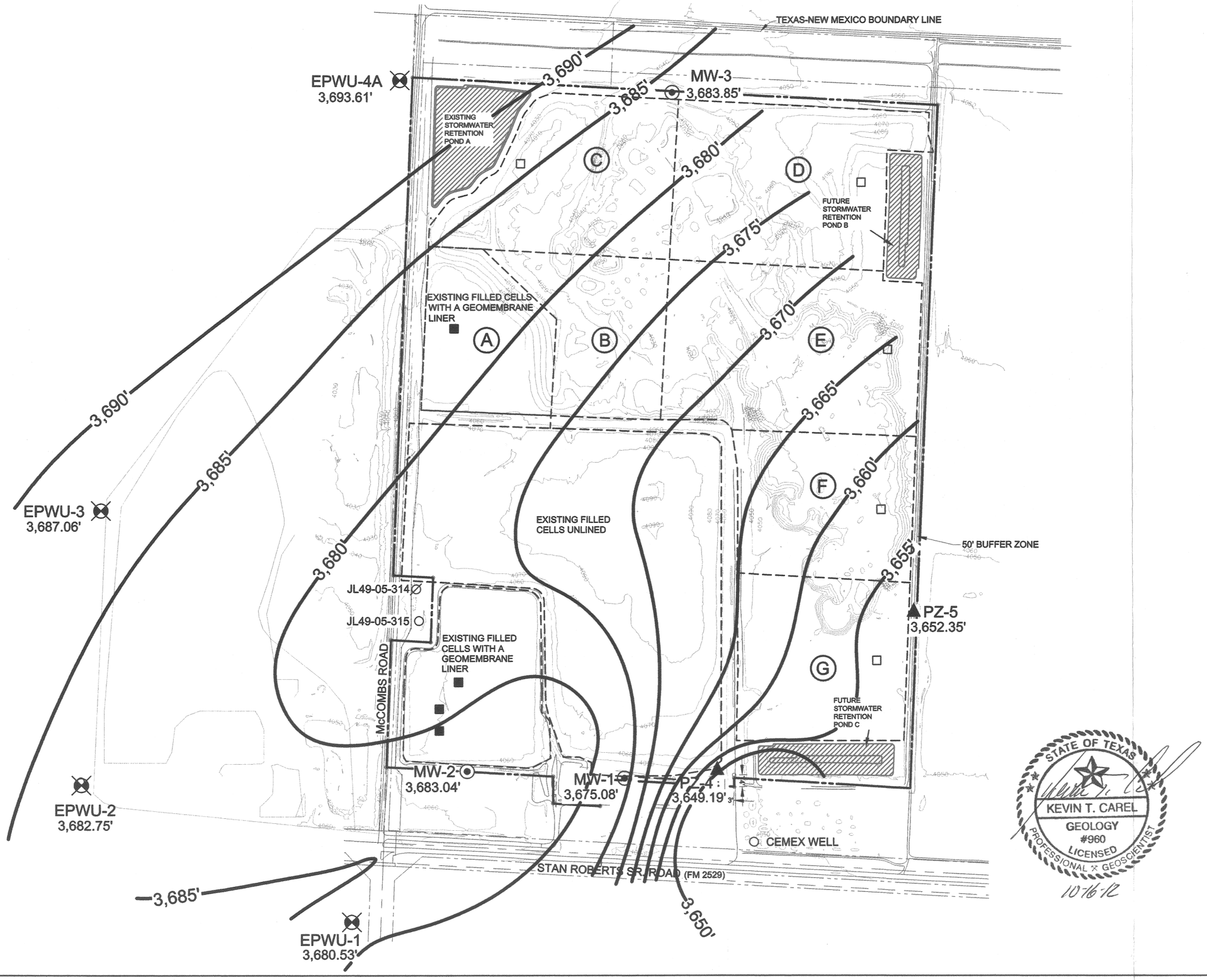

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SCALE

0 300 600
FEET

GROUNDWATER CONTOUR MAP 07/03/2012

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
- EPWU MONITORING WELL
- GROUNDWATER EXTRACTION WELL
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- SECTOR BOUNDARY

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST
10-16-12

DATE DRAFTED: August 14,2012	REV. # 2
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DRAFTED BY: SMG	

APPENDIX G

GROUNDWATER MONITORING SYSTEM DESIGN CERTIFICATION

GROUNDWATER MONITORING SYSTEM DESIGN CERTIFICATION

General Site Information

Site: McCombs Landfill

Site Location: 13600 McCombs Road, El Paso, Texas 79924

MSW Permit No.: 729A

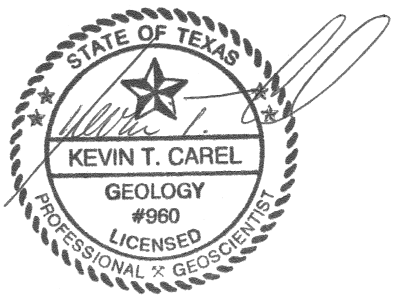
Qualified Groundwater Scientist Statement

I, Kevin T. Carel, am a licensed professional geoscientist in the State of Texas and a qualified groundwater scientist as defined in 30 TAC §330.3. I have reviewed the ground water monitoring system and supporting data contained herein. In my professional opinion, the ground water monitoring system is in compliance with the ground water monitoring requirements specified in 30 TAC §330.401 through §330.421 (March 27, 2006 rule references) (March 27, 2006 rule references). This system has been designed for specific application to the City of El Paso McCombs Landfill (Permit No. MSW-729A). The only warranty made by me in connection with this document is that I have used that degree of care and skill ordinarily exercised under similar conditions by reputable members of my profession, practicing in the same or similar locality. No other warranty, expressed or implied, is intended.

Firm/Address: The Carel Corporation
136 Pecan Street
Keller, Texas 76248

Signature: _____

Kevin T. Carel, P.G.
No. 960-Texas



Date: 10-16-12

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.

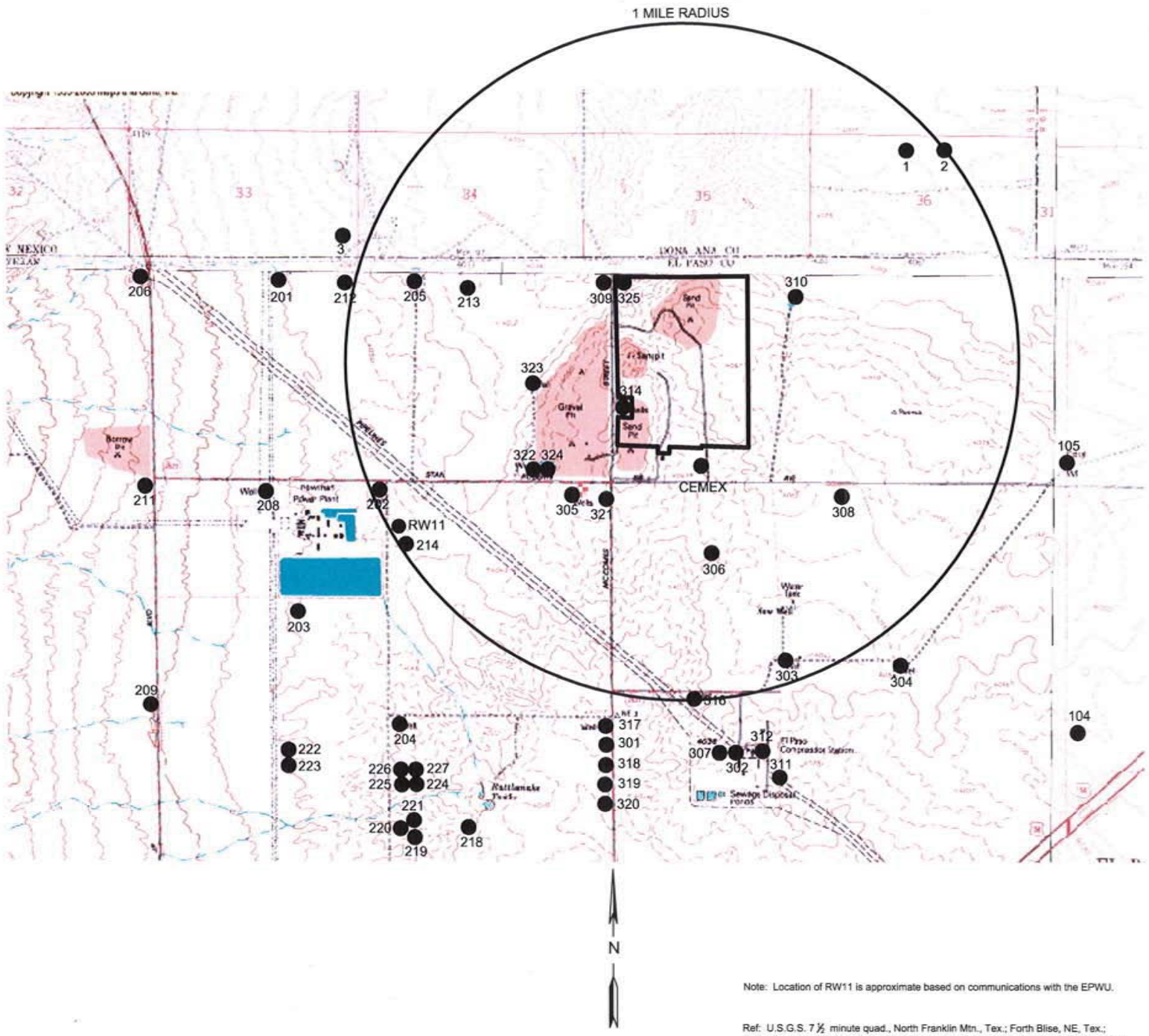
RJS

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

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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

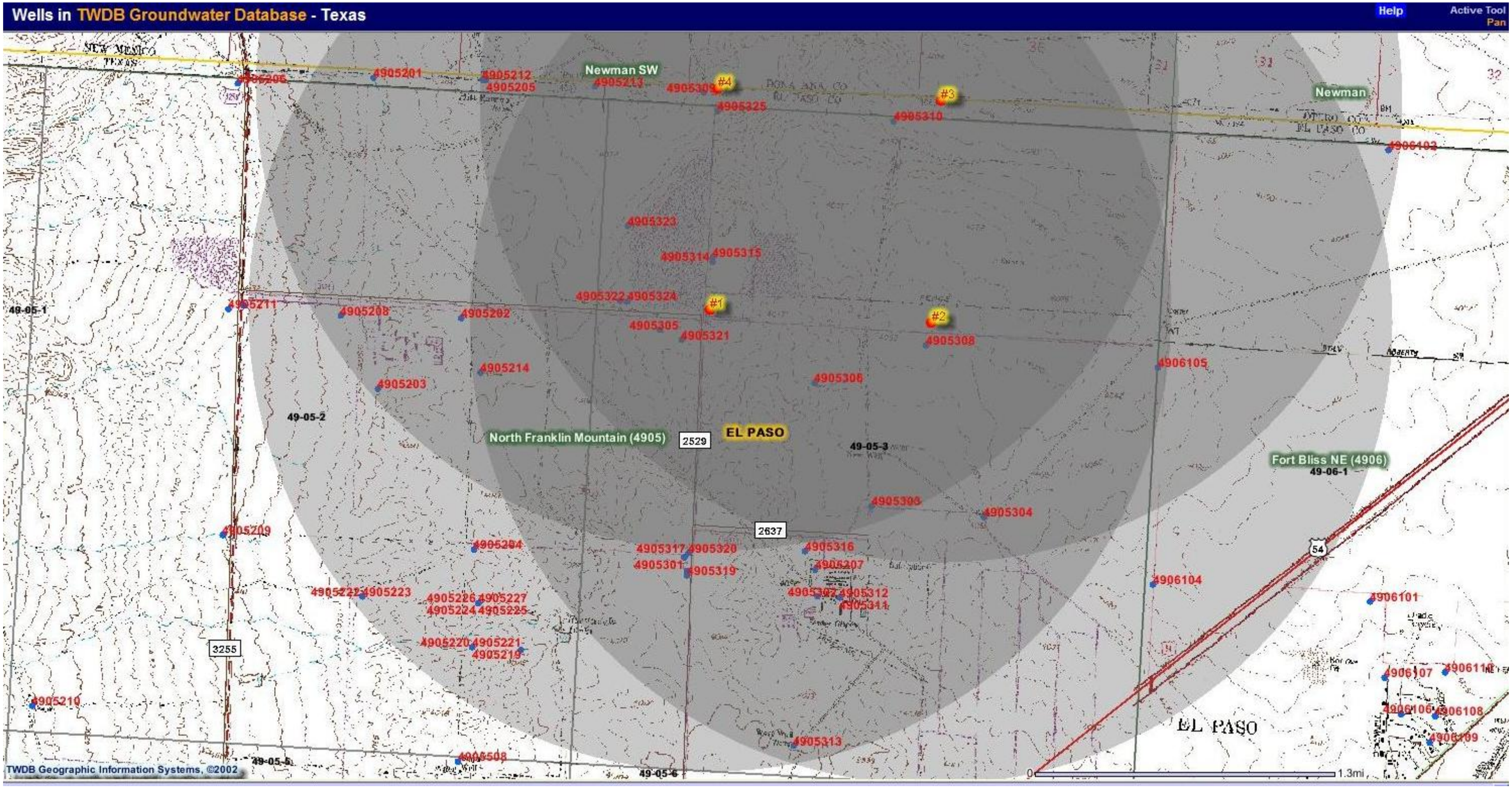
DATE DRAFTED: November 29, 2007

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, _____

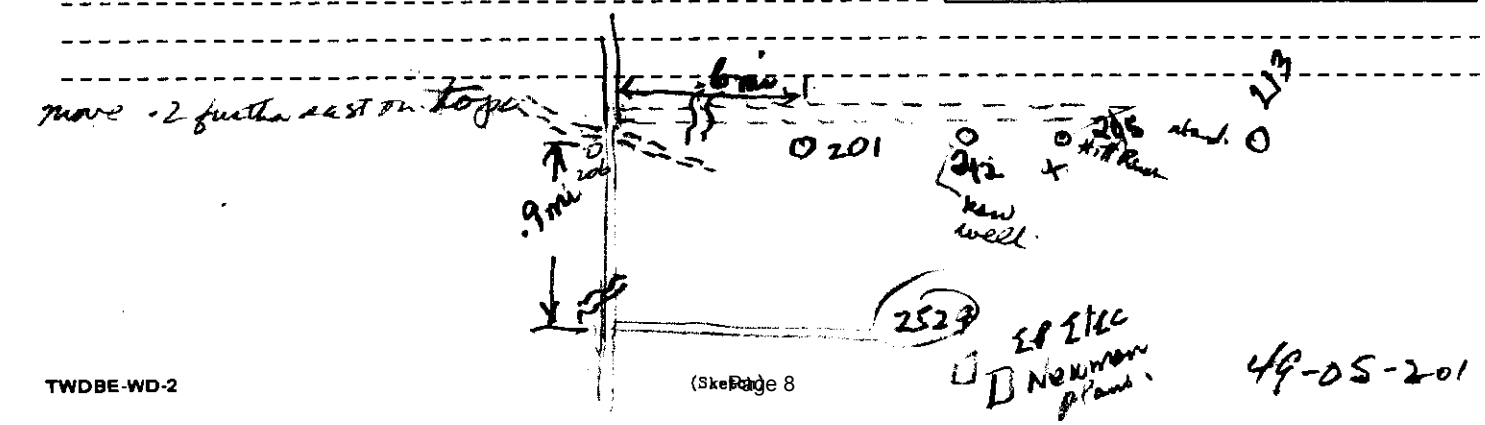
15. Record by: TWDB Date 7/20 1975

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 _____

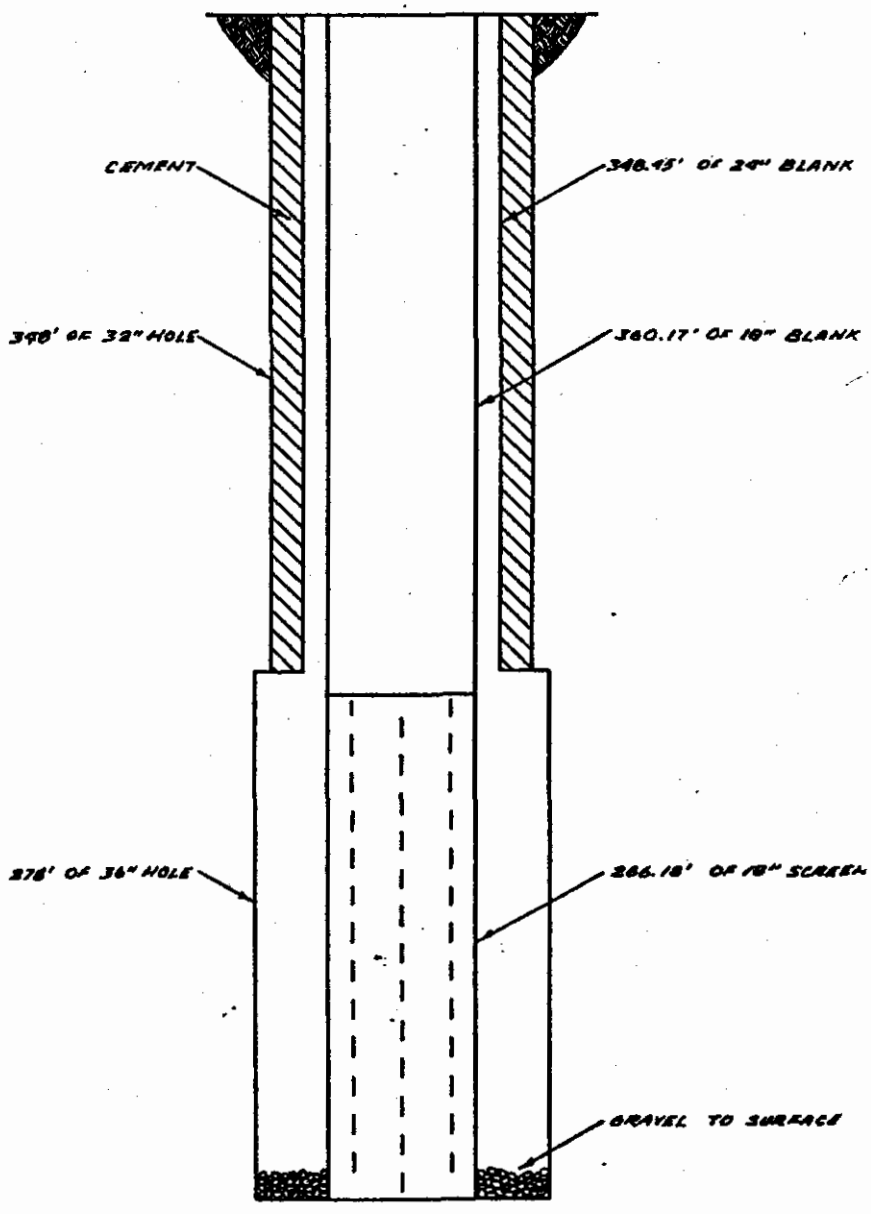
Date Installed _____

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'.

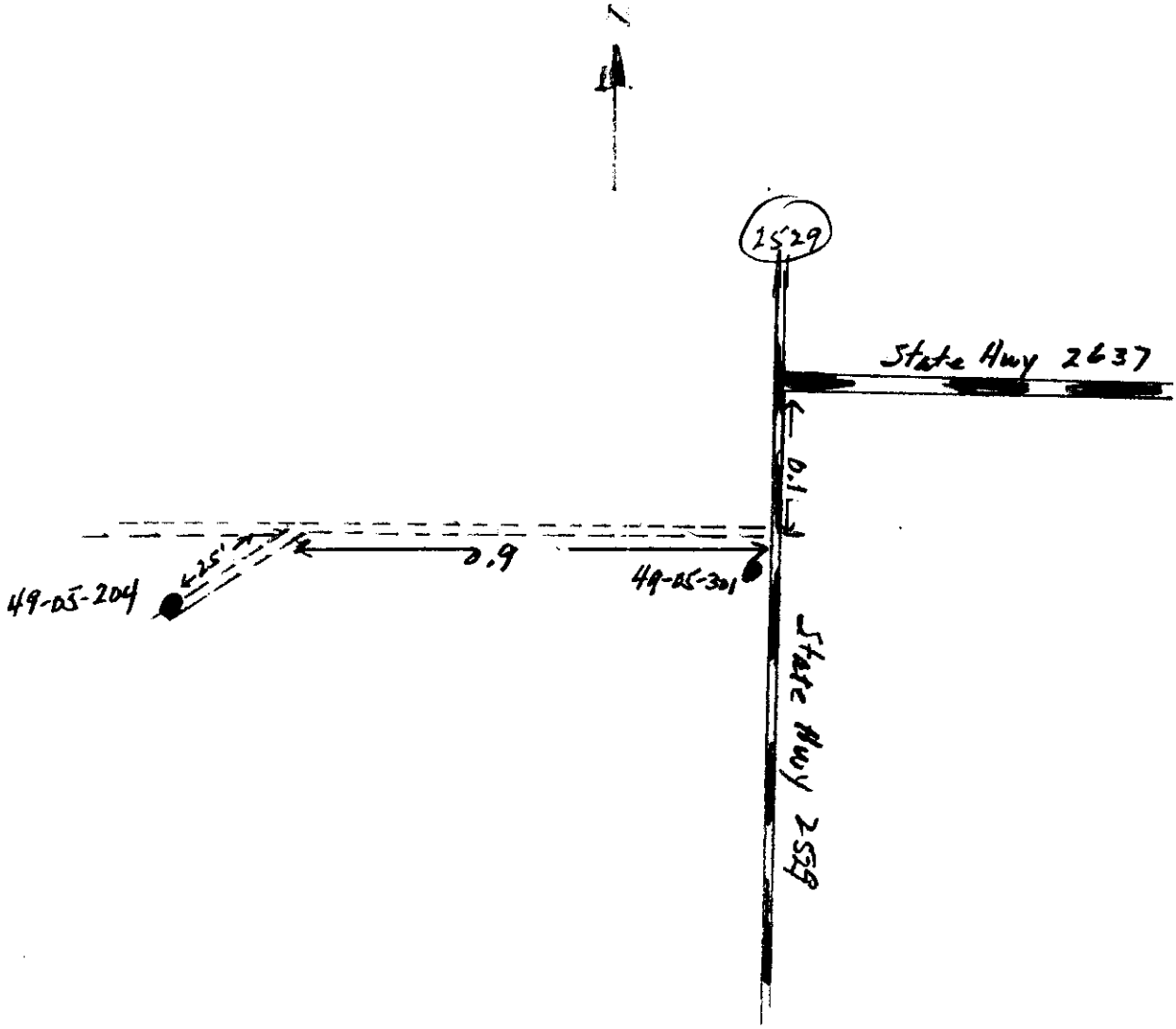
Plugged back to 515'

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

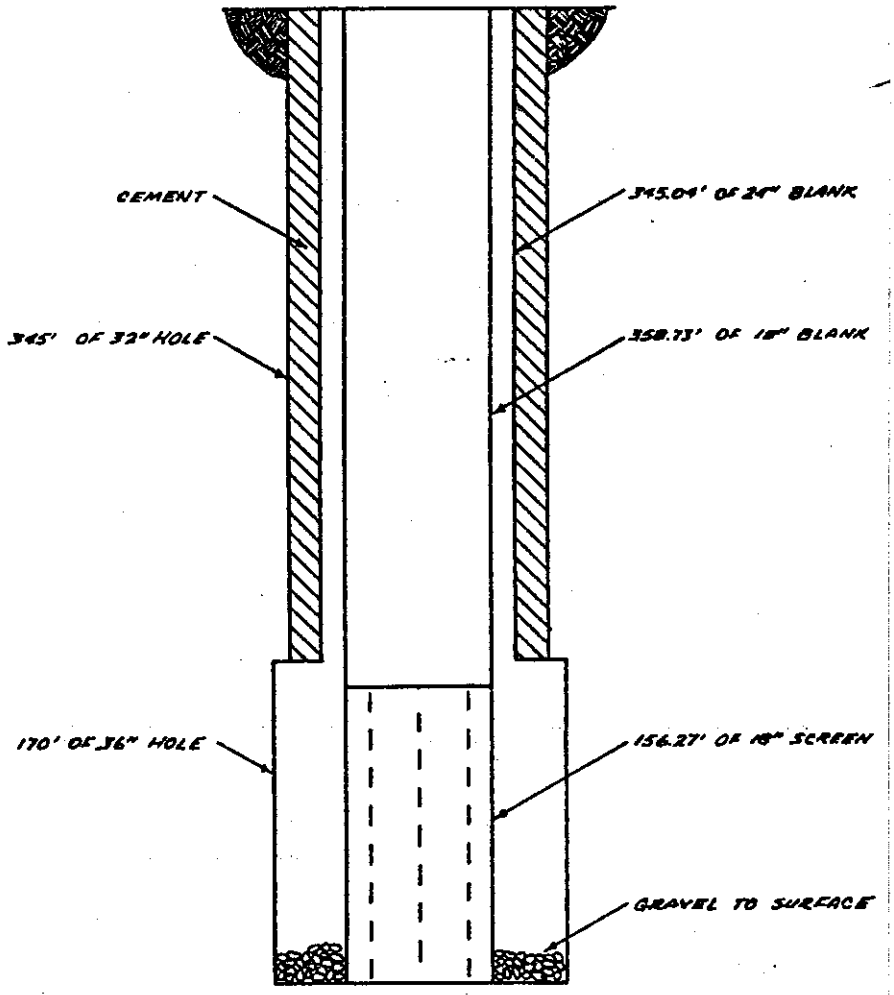
Date Installed

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

ΣANIONS - ΣCATIONS = ± (0.1065 + 0.0155 ΣANIONS)

-0.0971 =< ± ISD = 0.2228

Analyst

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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 _____

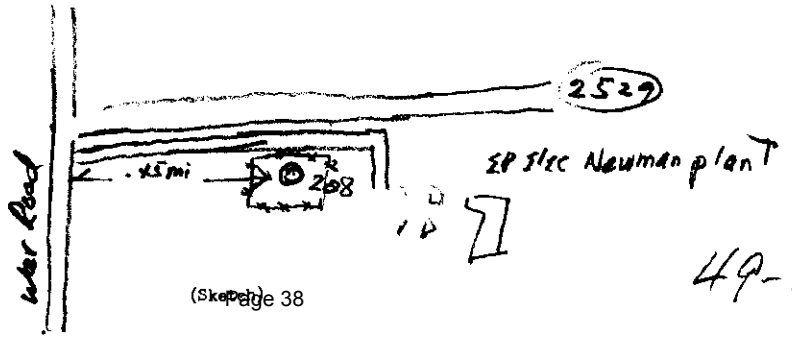
Diam. (in.)	Type	Setting, ft. from	to
18	Slotted -150 Series	376	665

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 _____

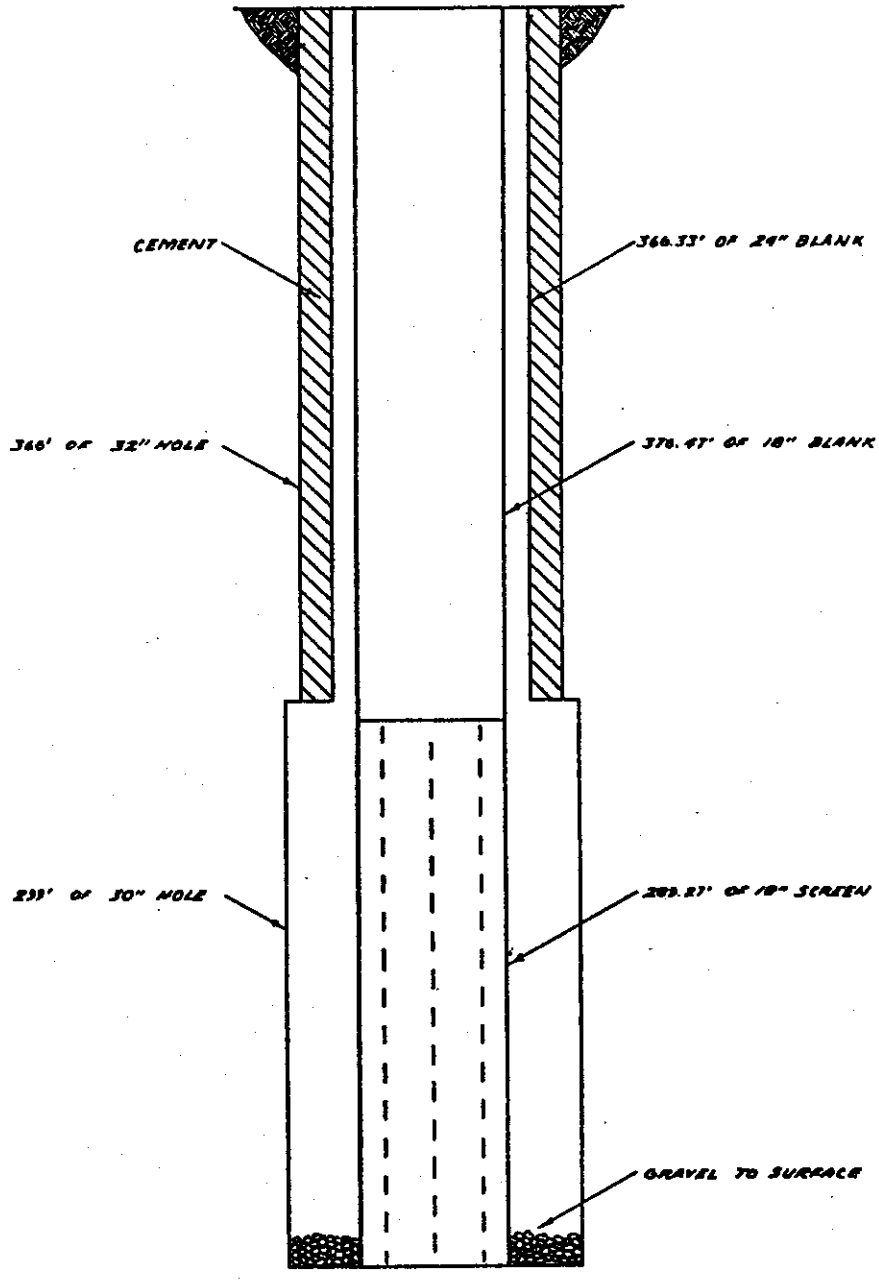
Date Installed _____

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 _____

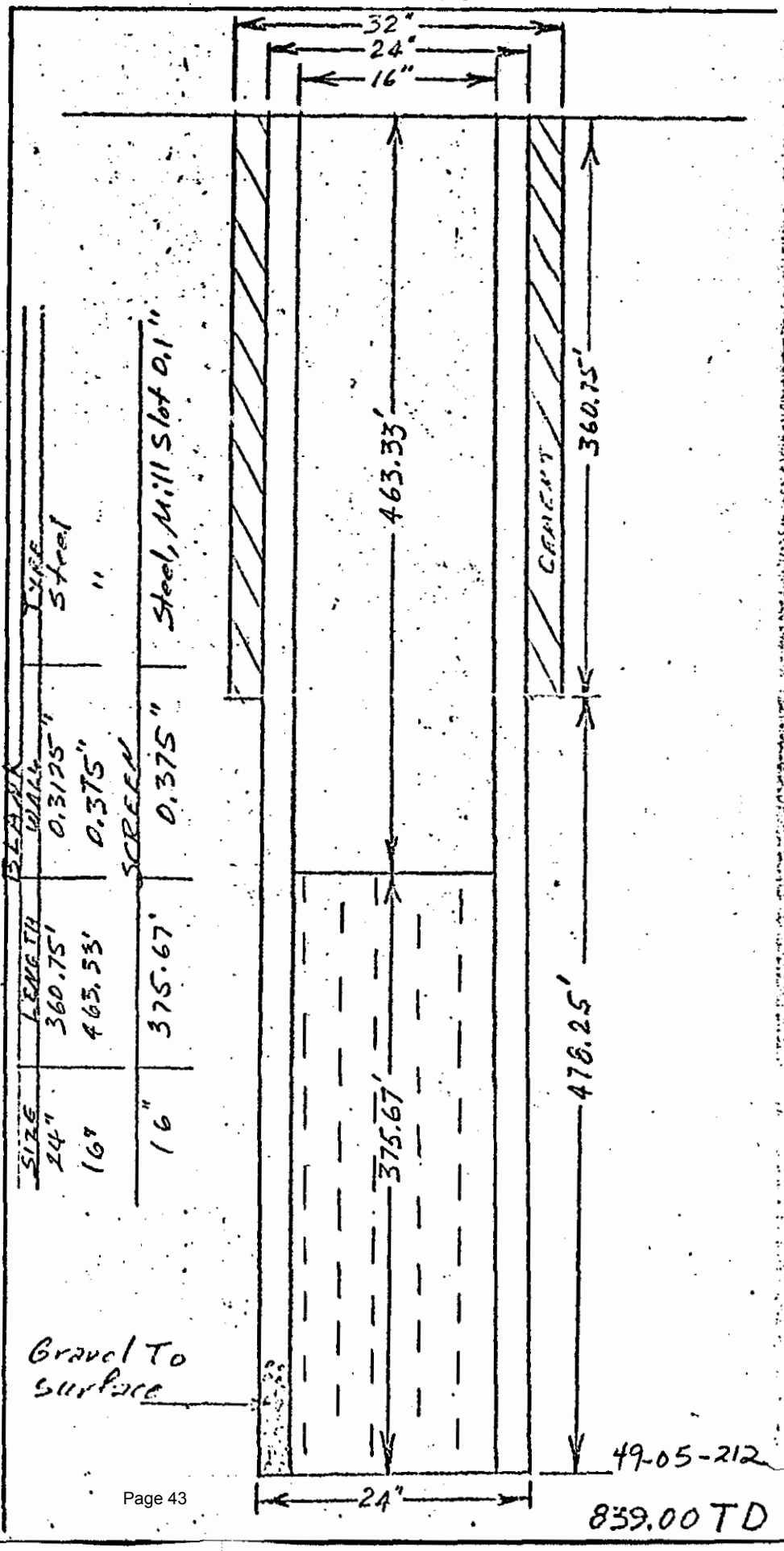
Date Installed _____

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°						
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 _____

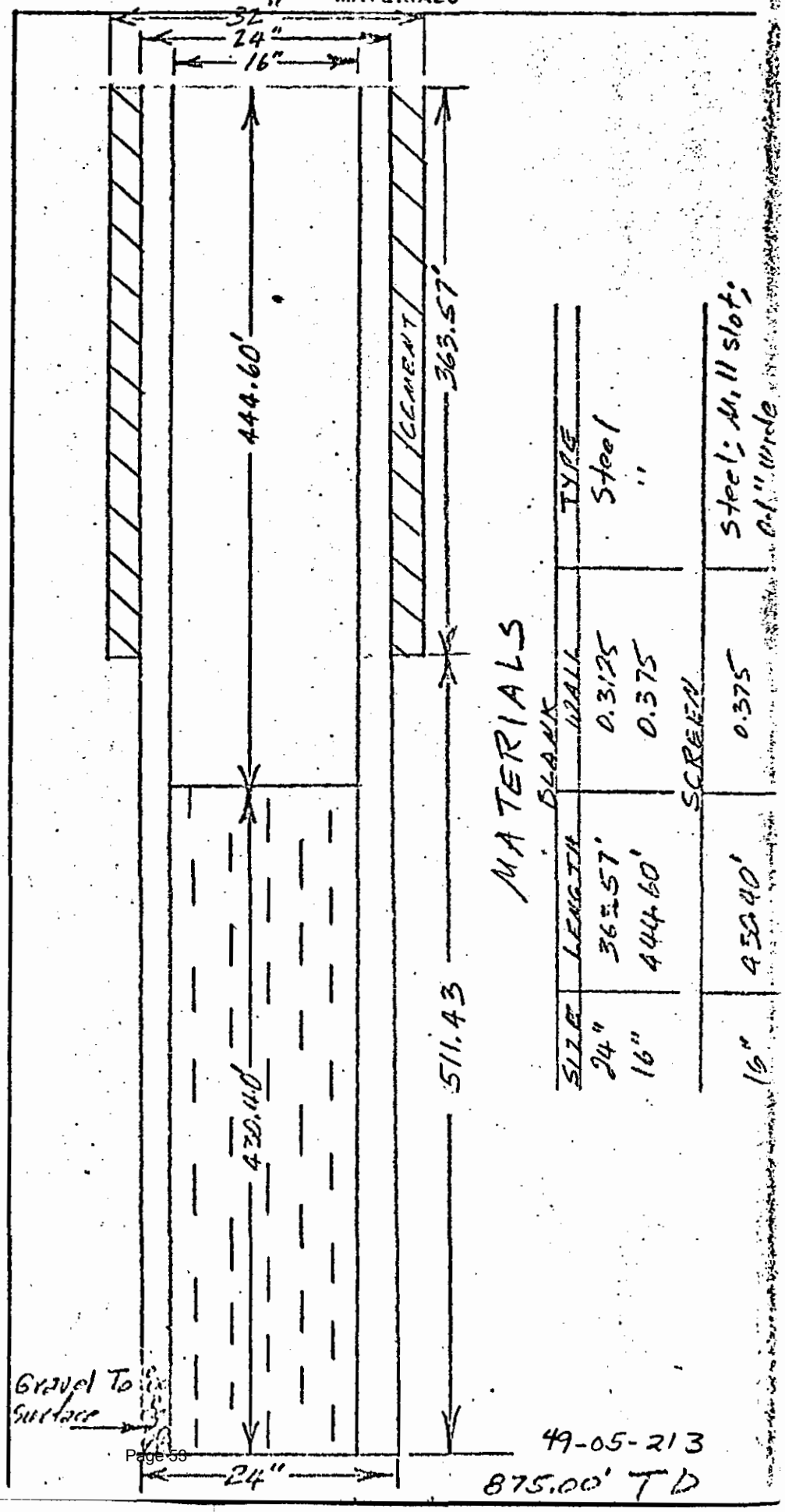
Date Installed _____

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-49-05-214

Latitude-longitude 31 58 58 (d m s) / 106 25 29.1 (d m s)

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, (Φ) offshore, (P) pediment, (S) hillside, (T) terrace, (U) undulating, (V) valley flat ____

MAJOR AQUIFER: TERT. QUAT. PLIO-PLEIST [AQ] (system, series) HUECO BOLSON [BN] (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 _____

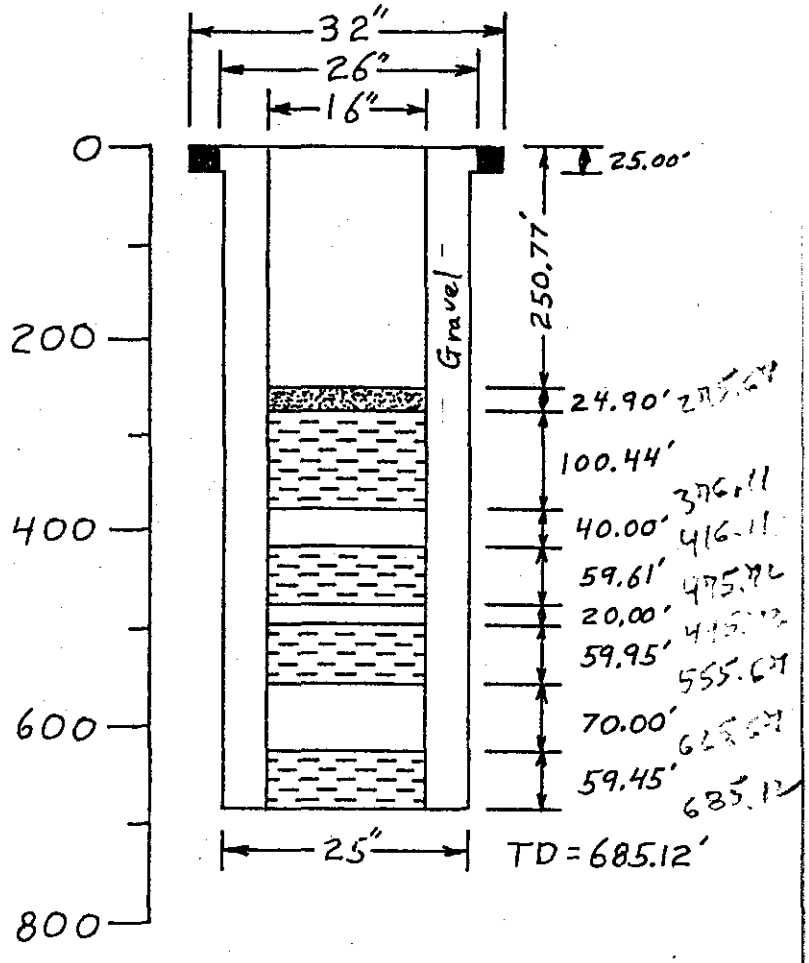
Date Installed _____

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

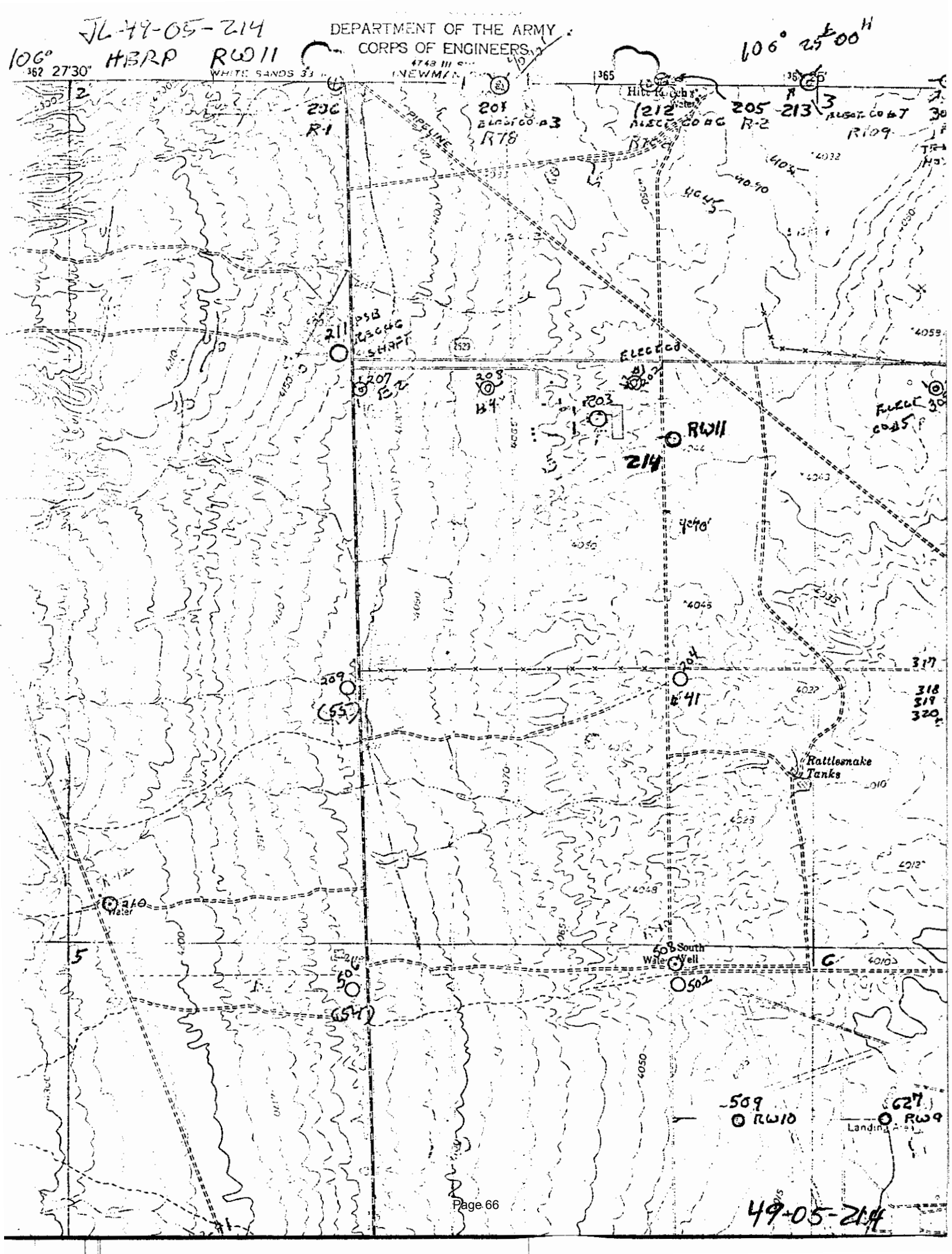
KEY PUNCHED

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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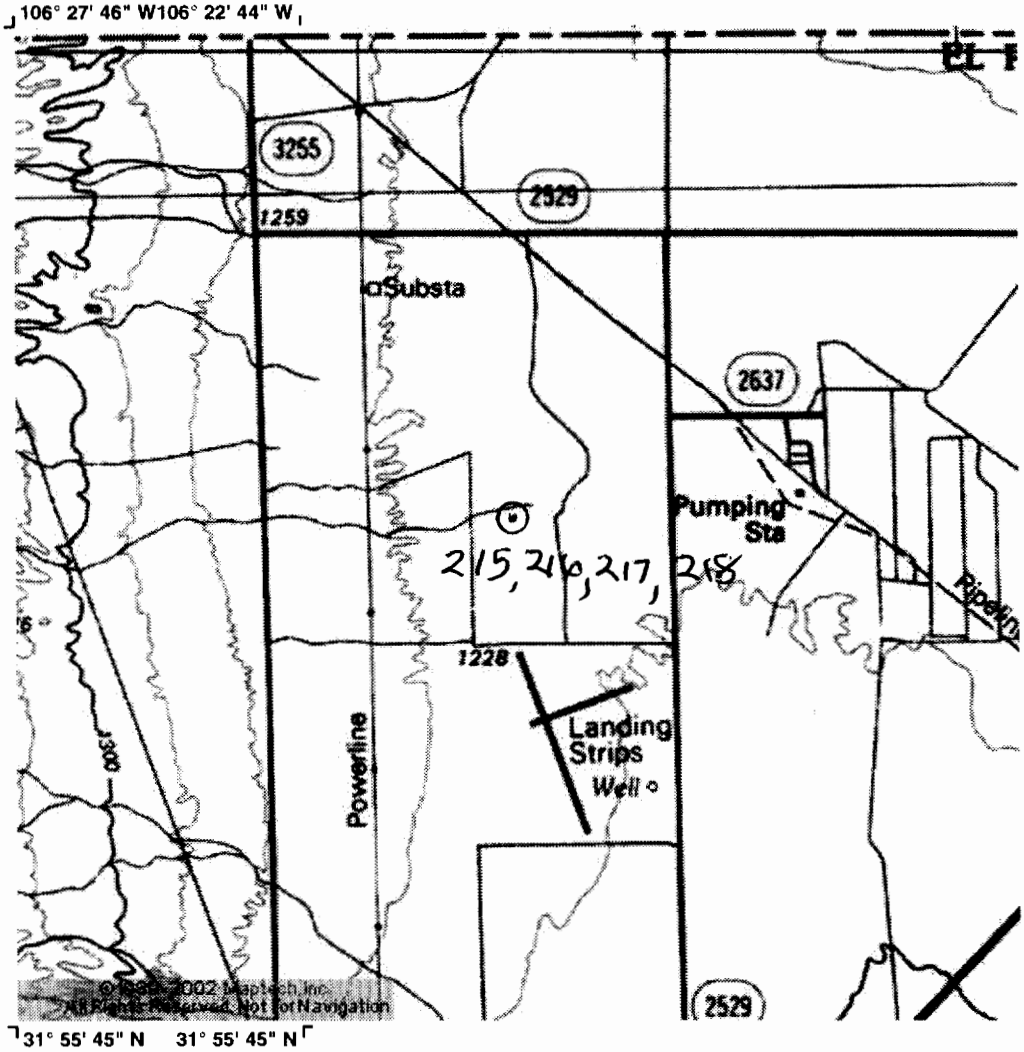

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Texas Water Development Board

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			
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

49-05-216
Well Number

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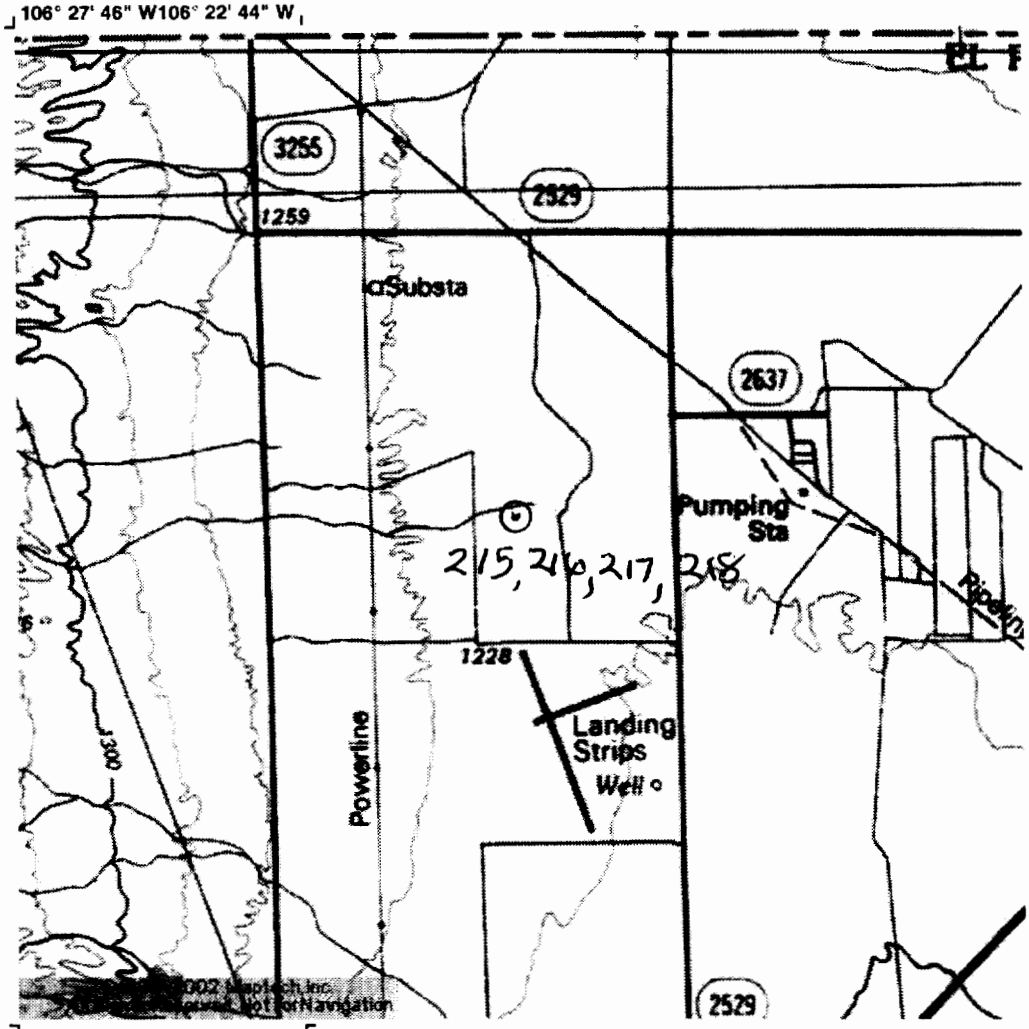

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Texas Water Development Board

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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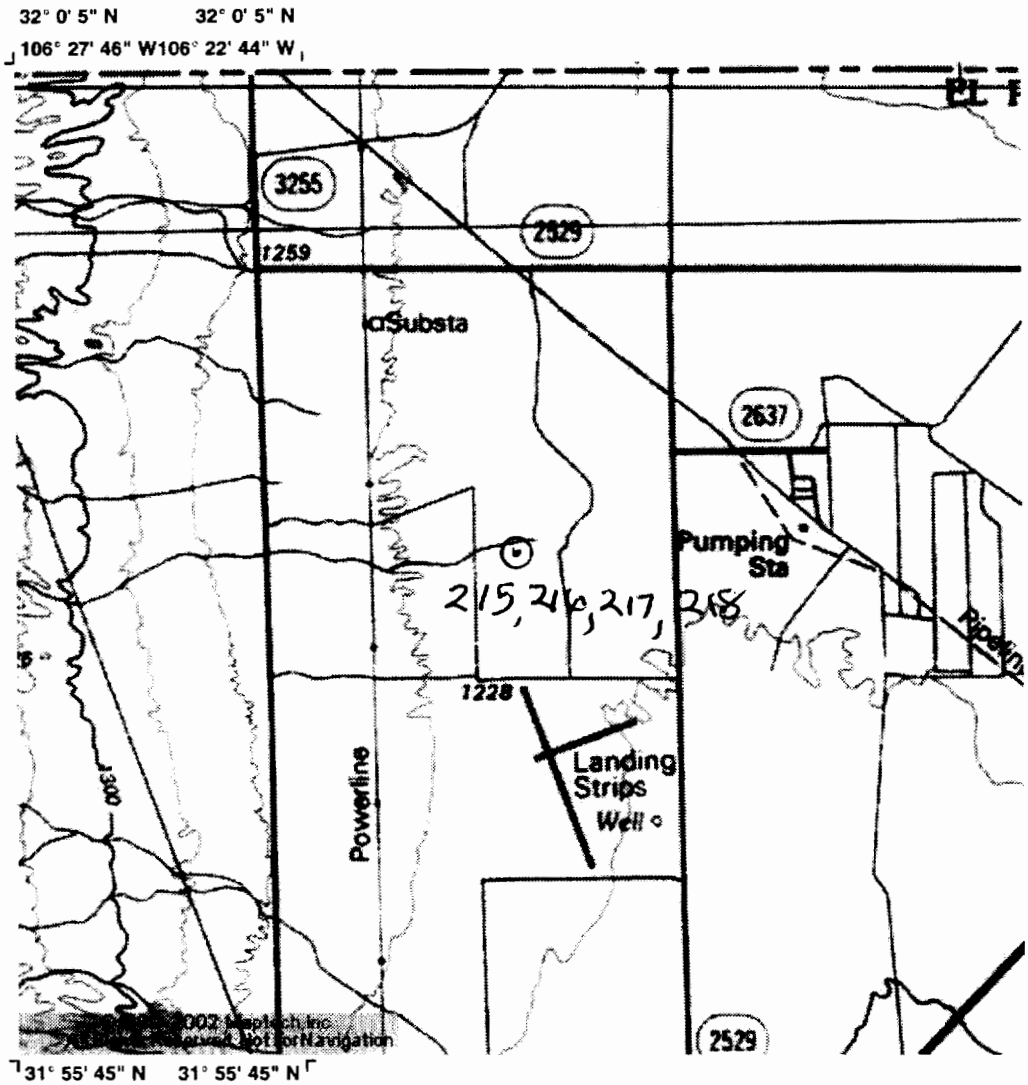

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Texas Water Development Board

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.
3
4
5
6

Aquifer

49-05-218

Well Number

Form at: V:/HEMon/Share/forms/WellSchedule

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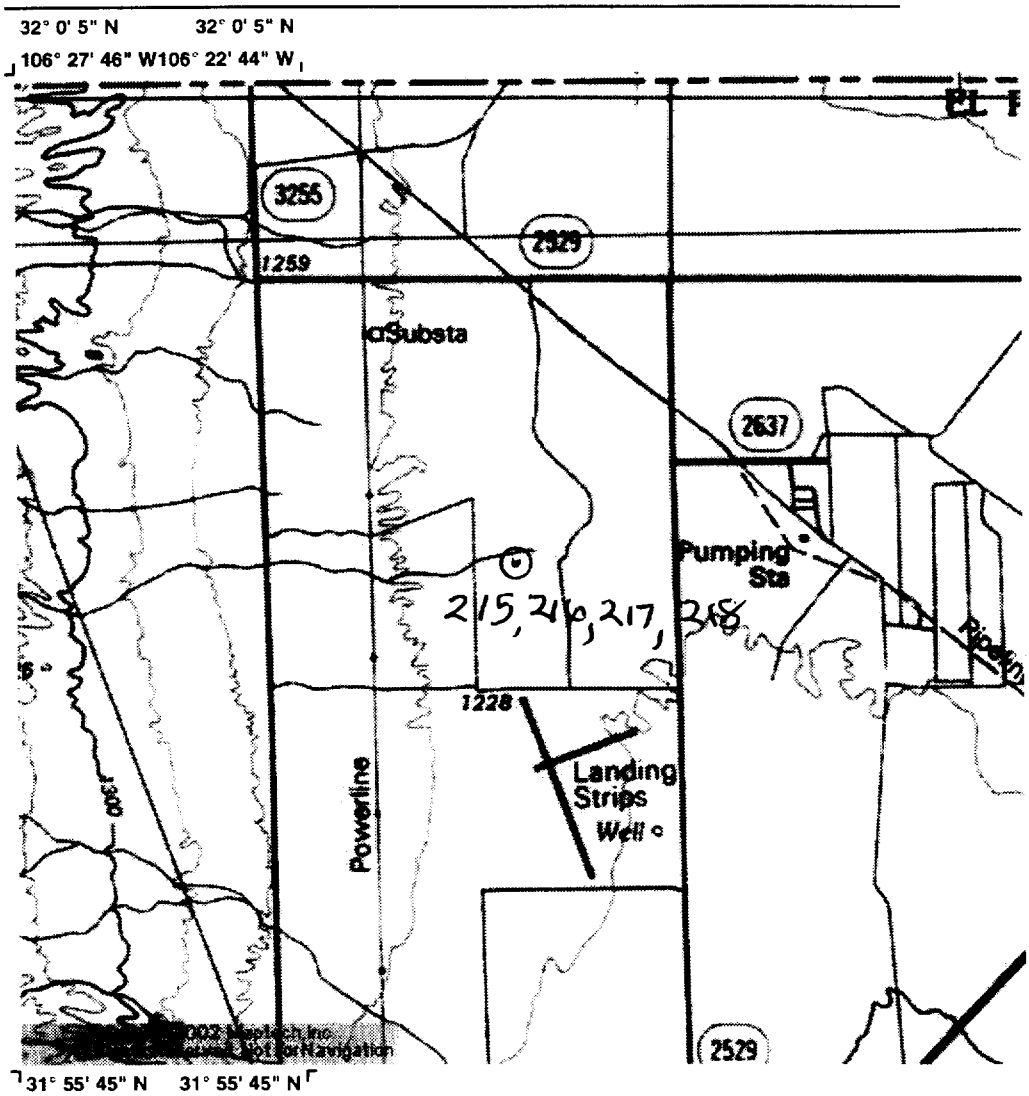

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Texas Water Development Board
Well Schedule

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
4
5
6

Aquifer

49-05-219

Well Number

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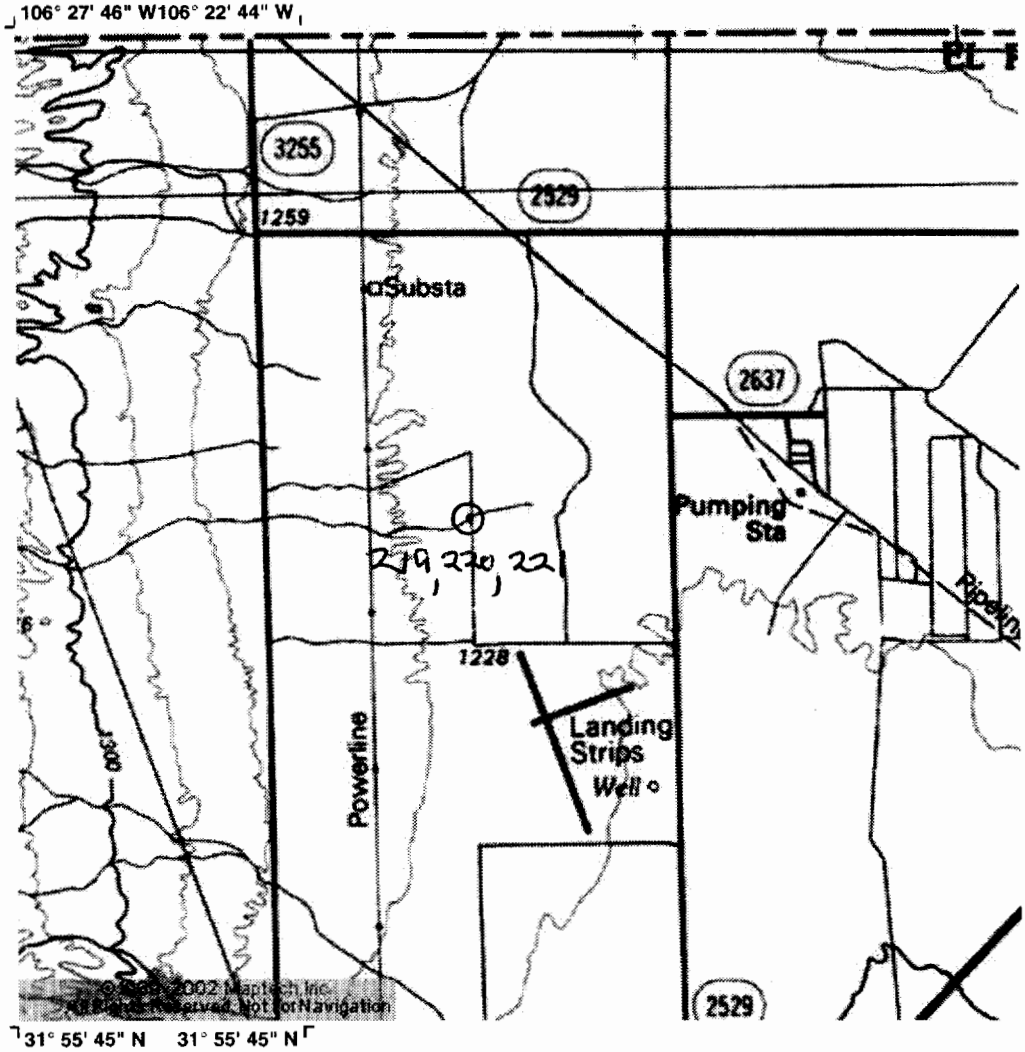

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Texas Water Development Board
Well Schedule

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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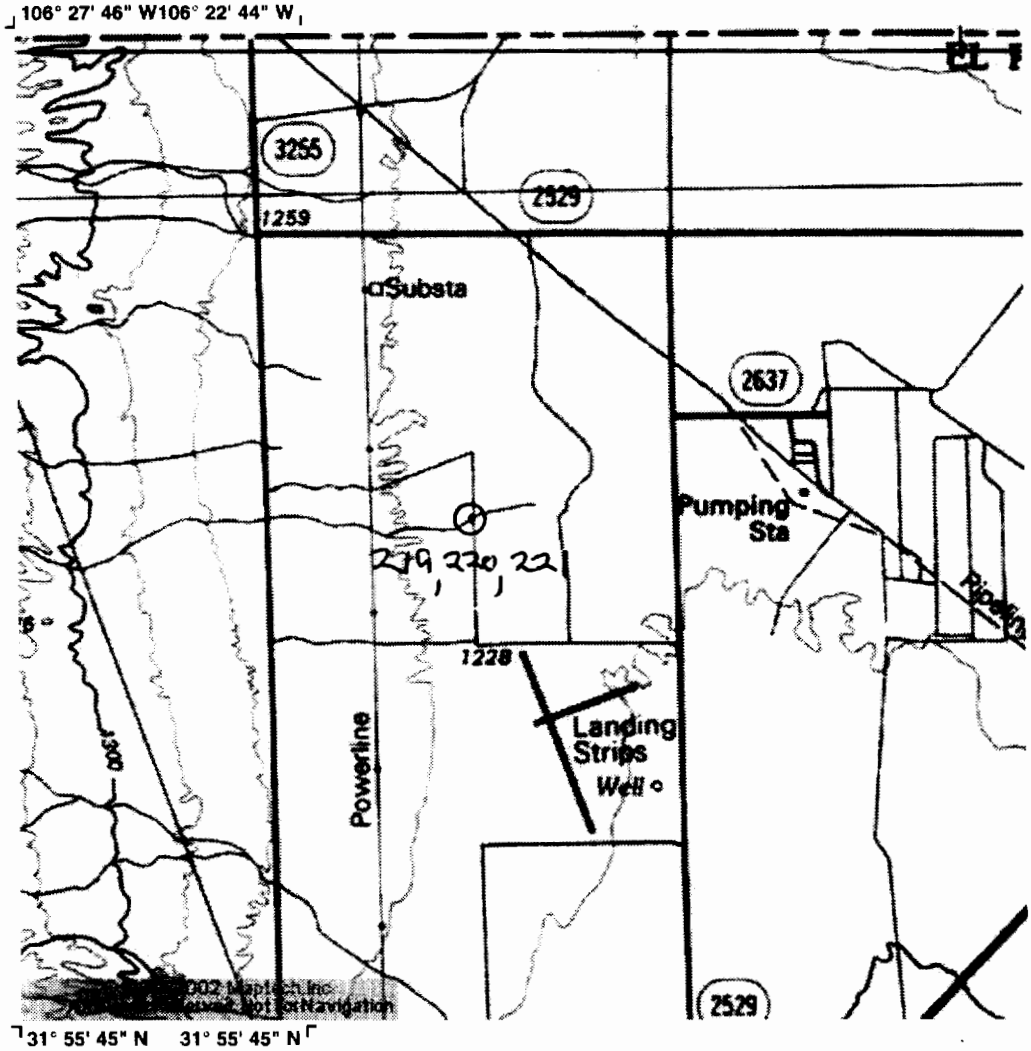
32° 0' 5" N 32° 0' 5" N
106° 27' 46" W106° 22' 44" W



31° 55' 45" N 31° 55' 45" N
106° 27' 46" W106° 22' 44" W

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49.05. 219
220
221

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			
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. + -
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.
3
4
5
6

Aquifer

49-05-221

Well Number

Form at: V:/HEMon/Shareforms/WellSchedule

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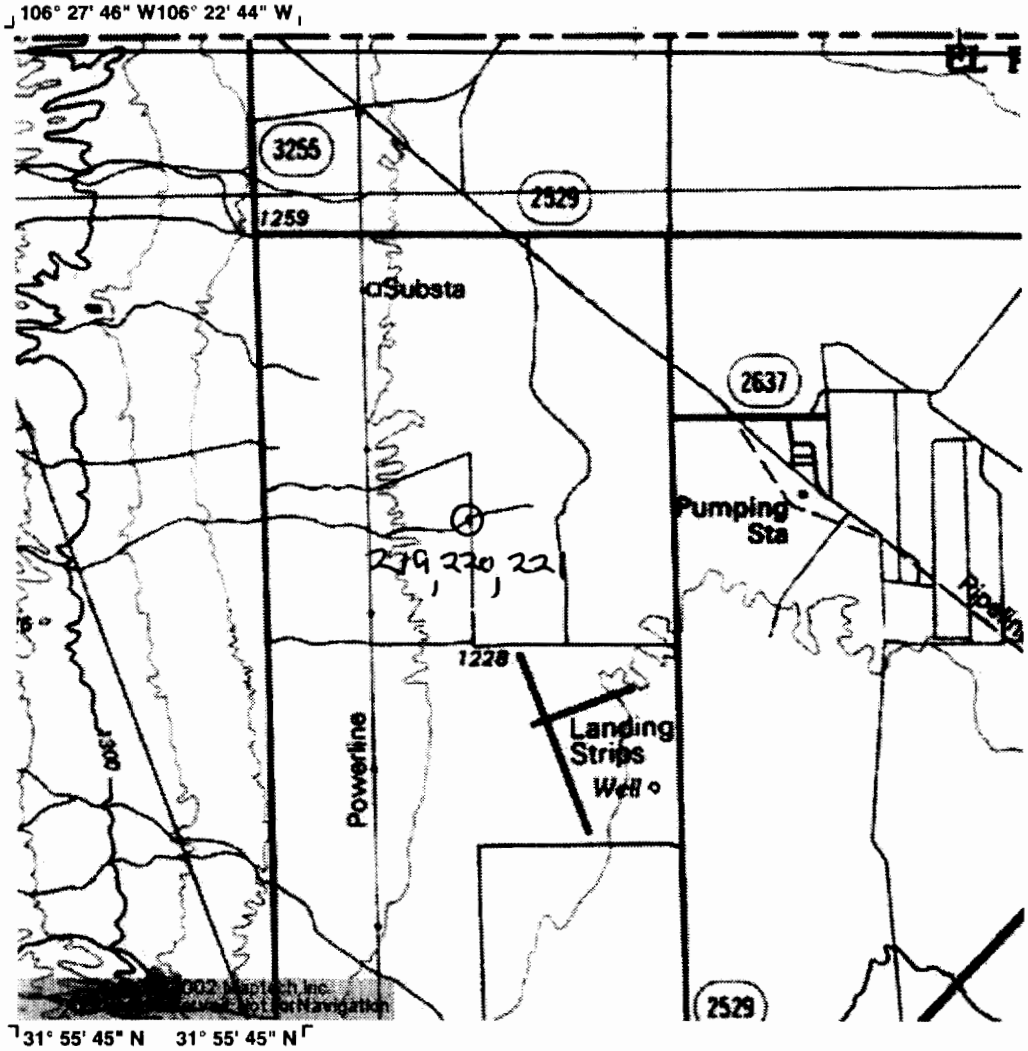

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49.05. 219
220
221

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			
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
4
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6

_____
Aquifer

49-05-222
Well Number

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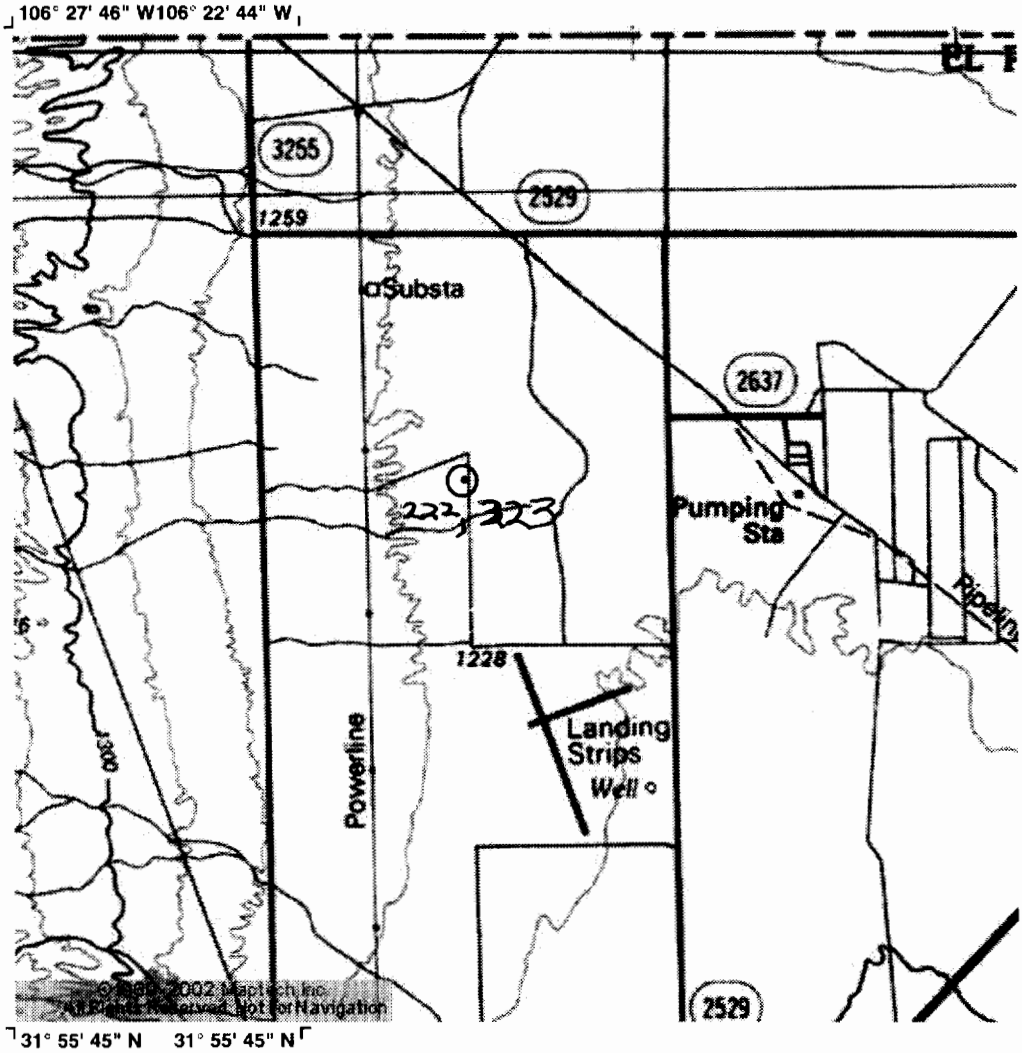

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49-05- 222
223

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			
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 102

Remarks
1 well is part of EPWU's recharge
2 study.
3
4
5
6

Aquifer

49-05-223

Well Number

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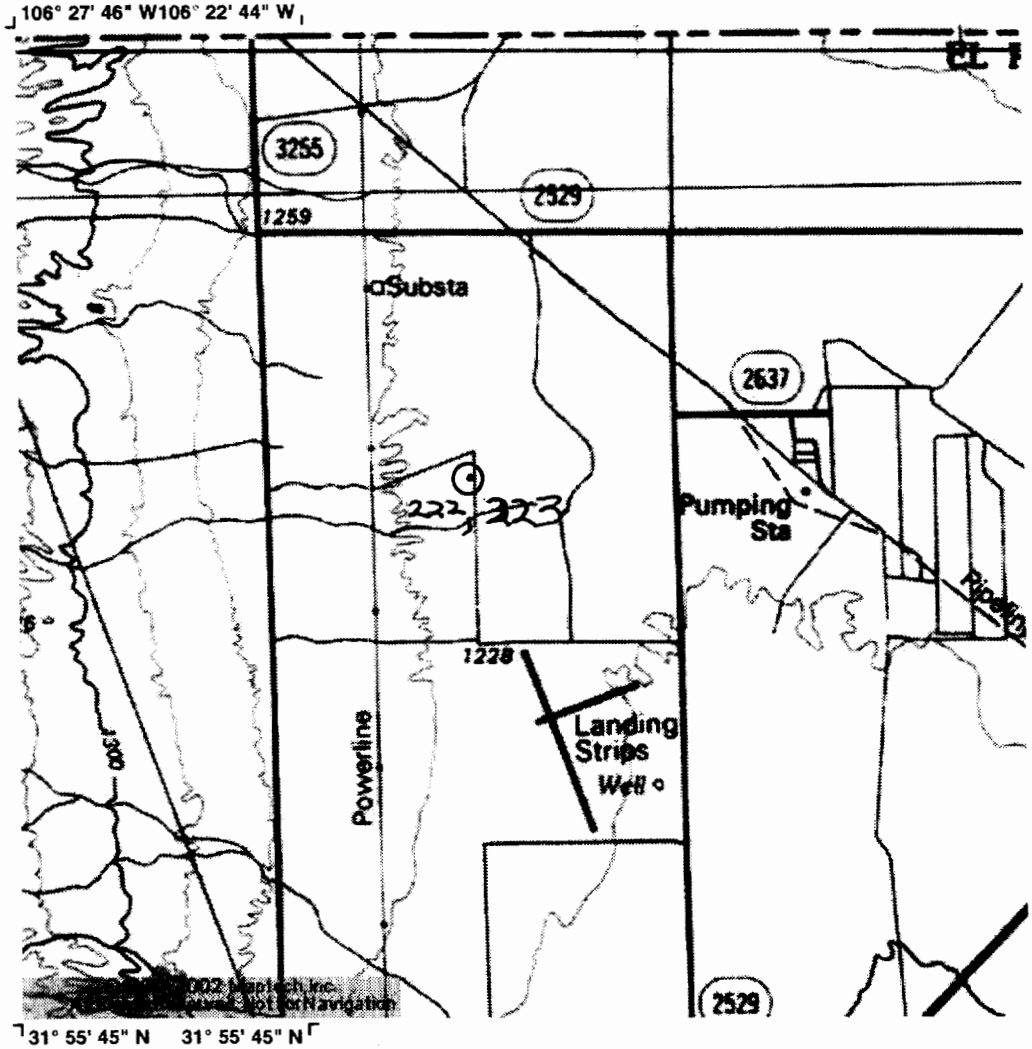

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49-05-222
223

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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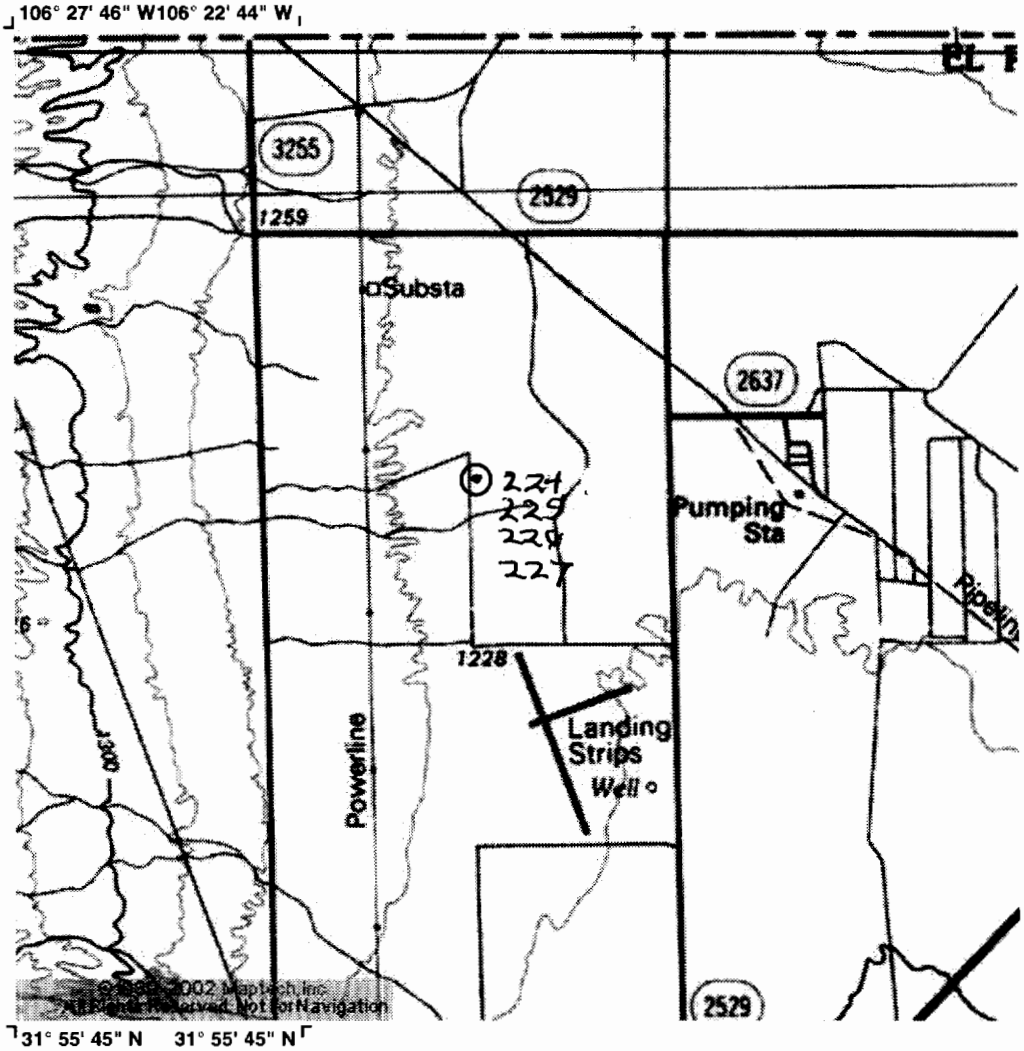
32° 0' 5" N 32° 0' 5" N

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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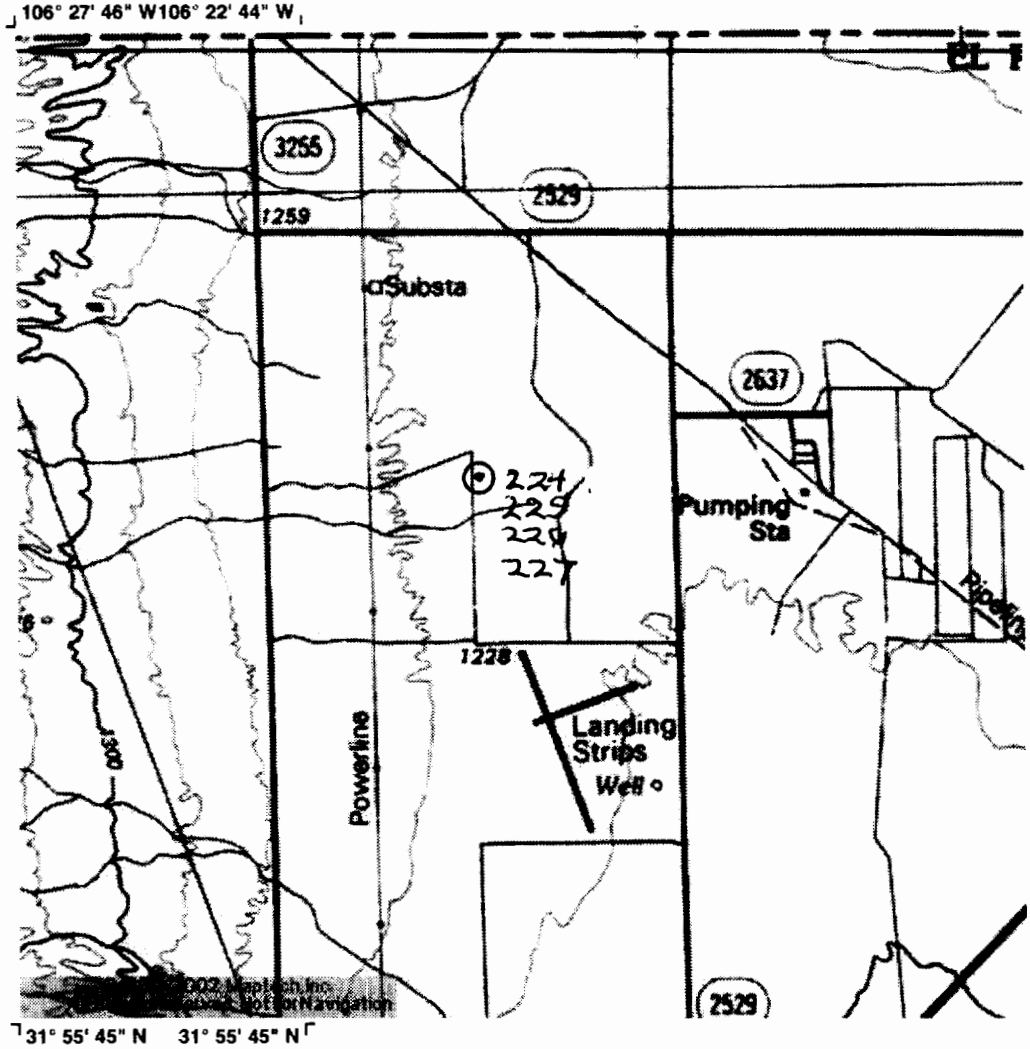

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49 05. 224
225
226
227

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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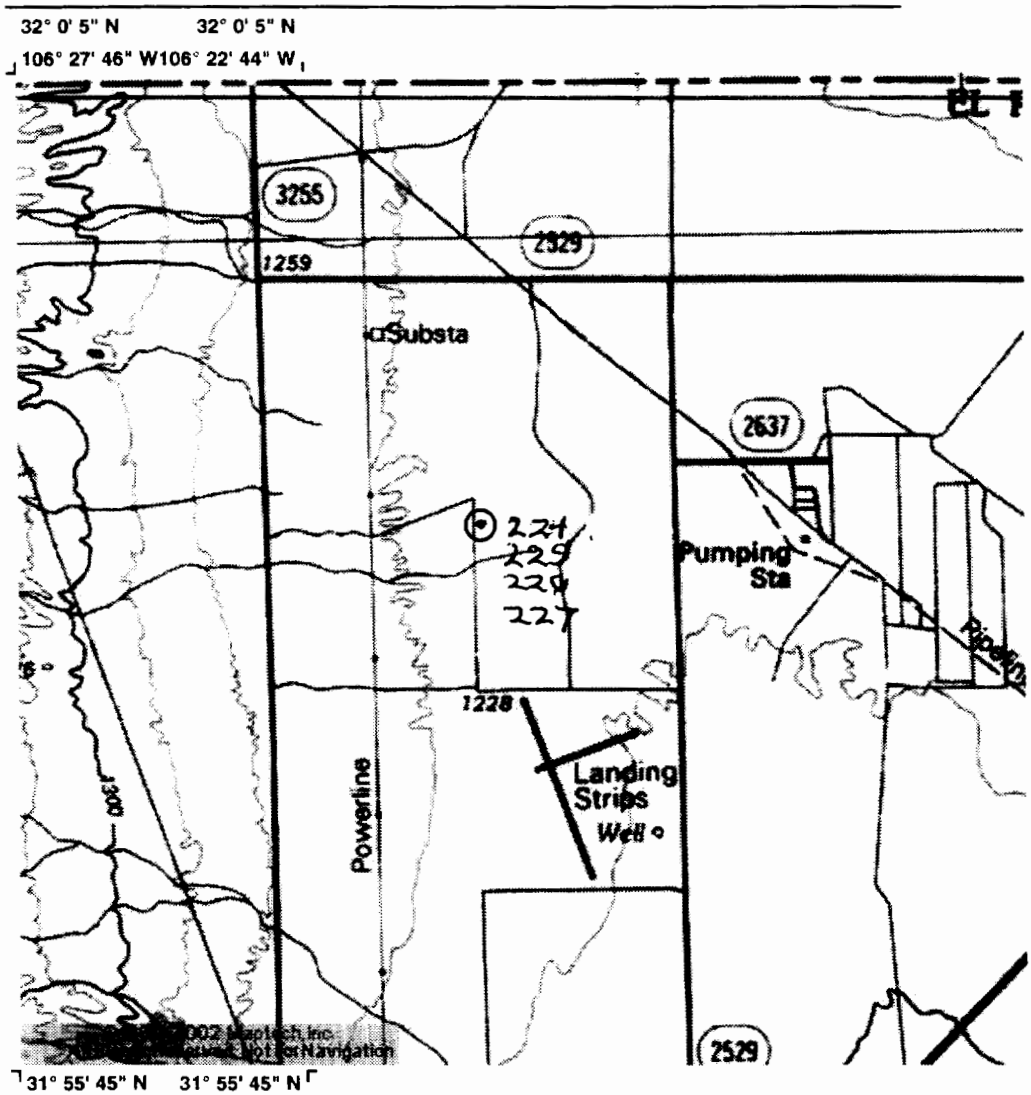

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49 05. 224
225
226
227

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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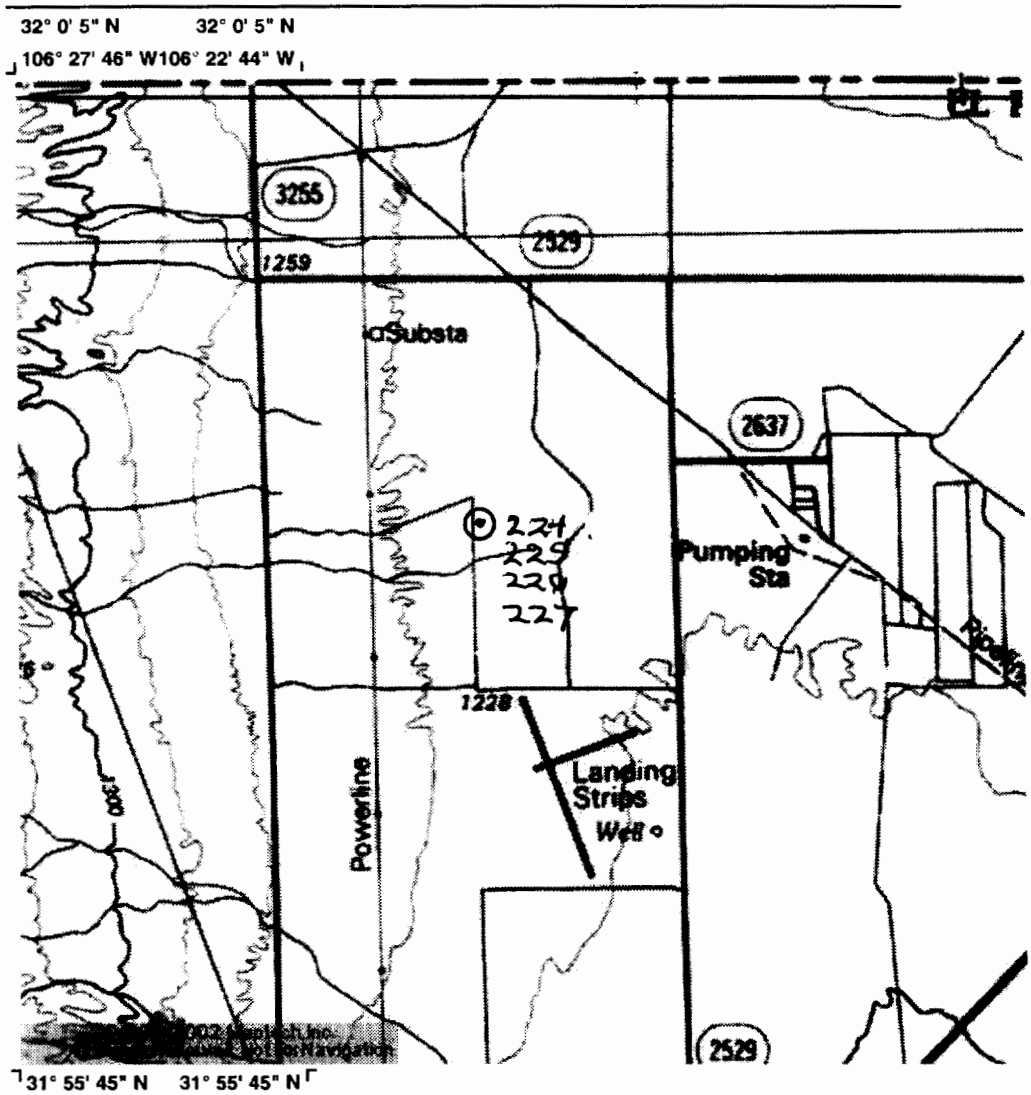

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49 05. 224
225
226
227

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

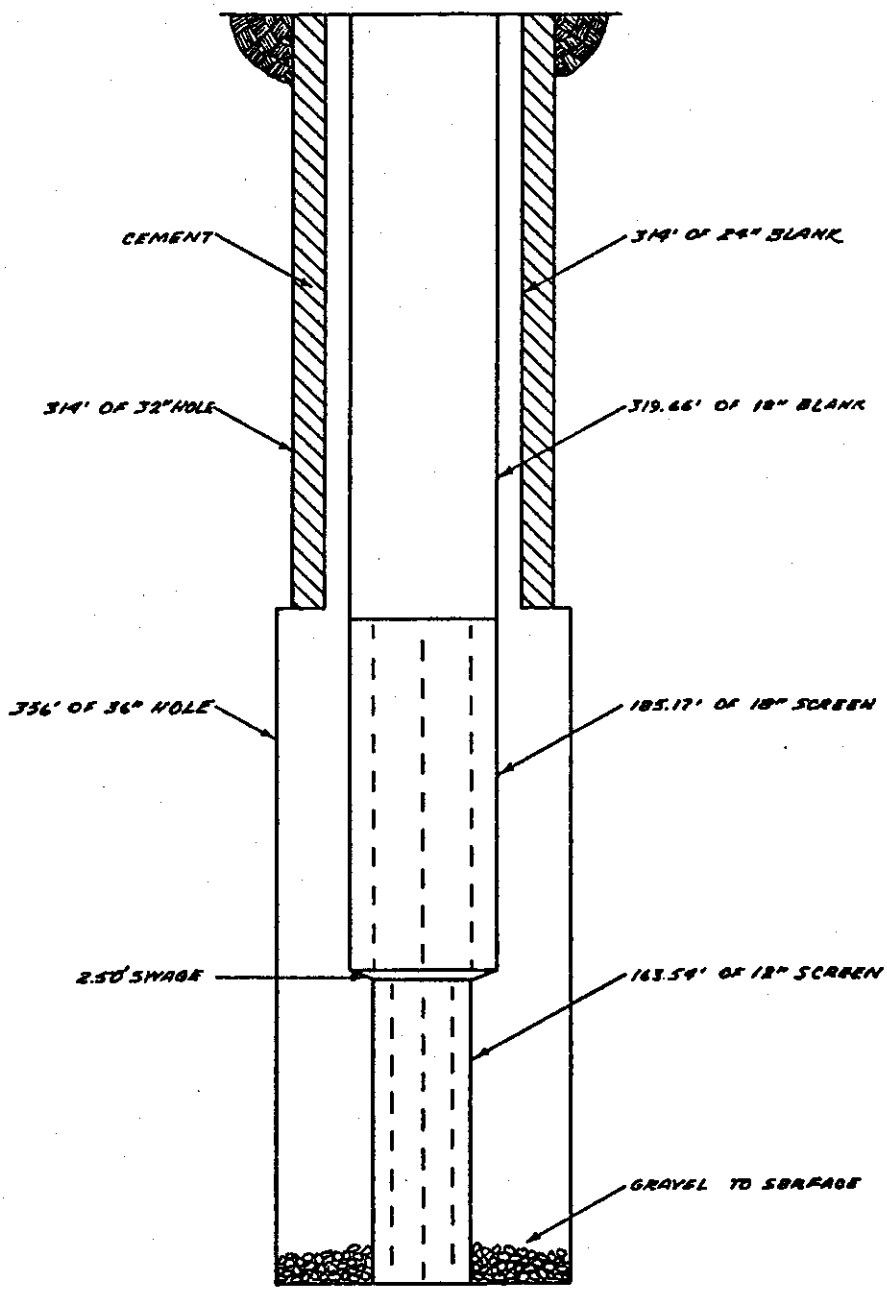
Date Installed

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

ΣANIONS - ΣCATIONS = ± (0.1065 + 0.0155 ΣANIONS)

+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

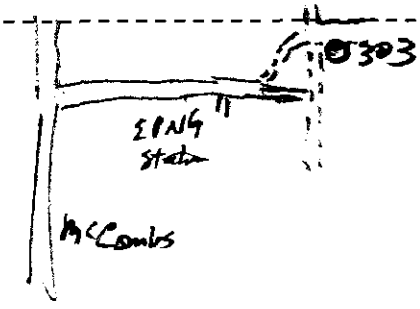
Source of Data USGS well sched (ERLeggat 3/4/57)

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 _____

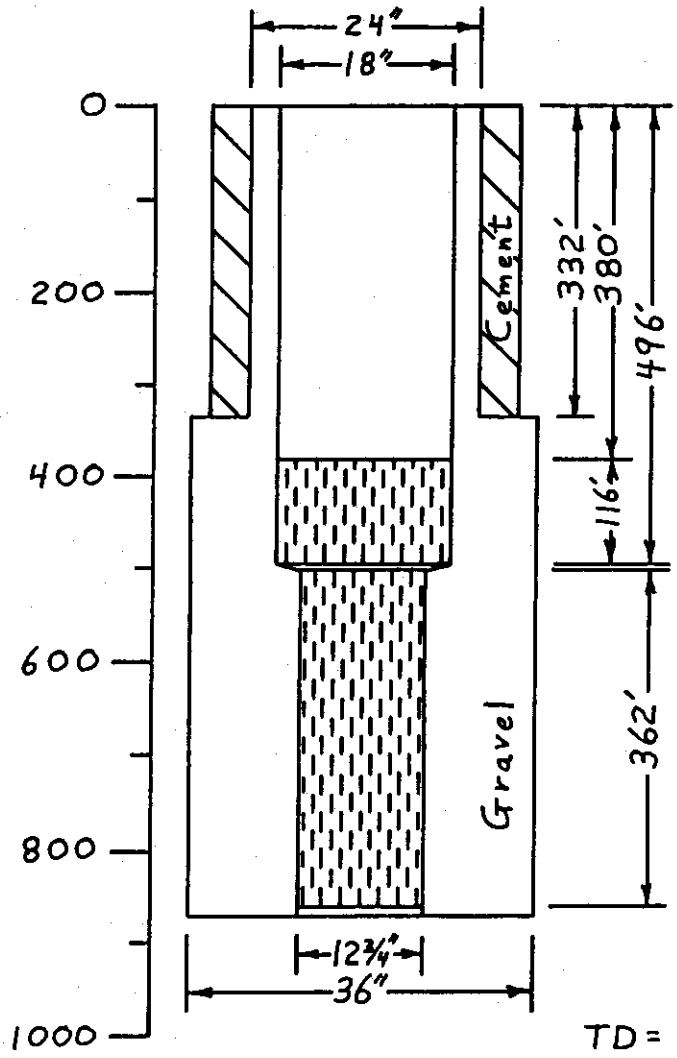
Date Installed _____

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.

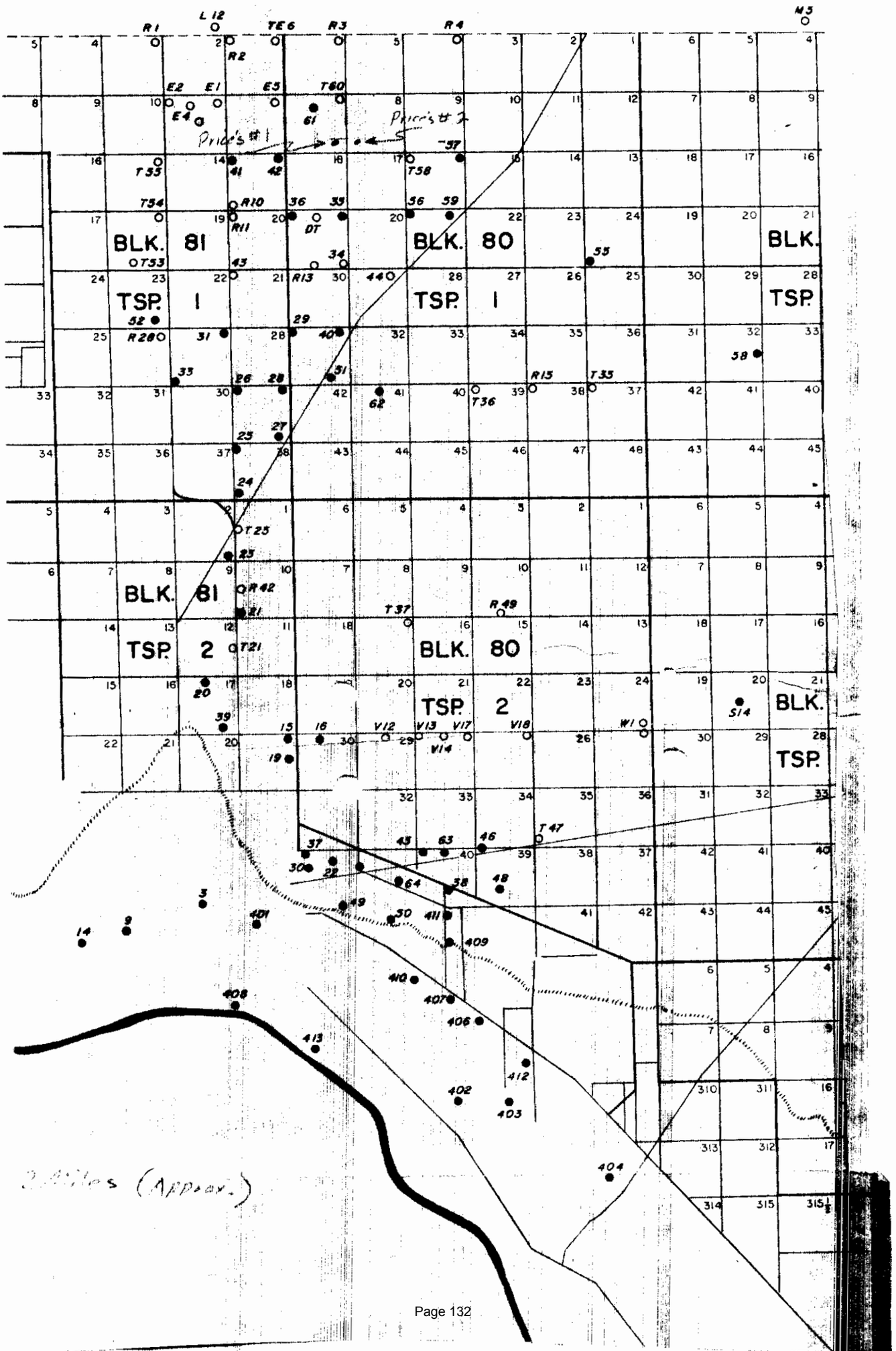
Respectfully submitted,

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
34
55
43
R13
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29
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T25
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R42
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T37
R49
20
39
S14
15
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 _____

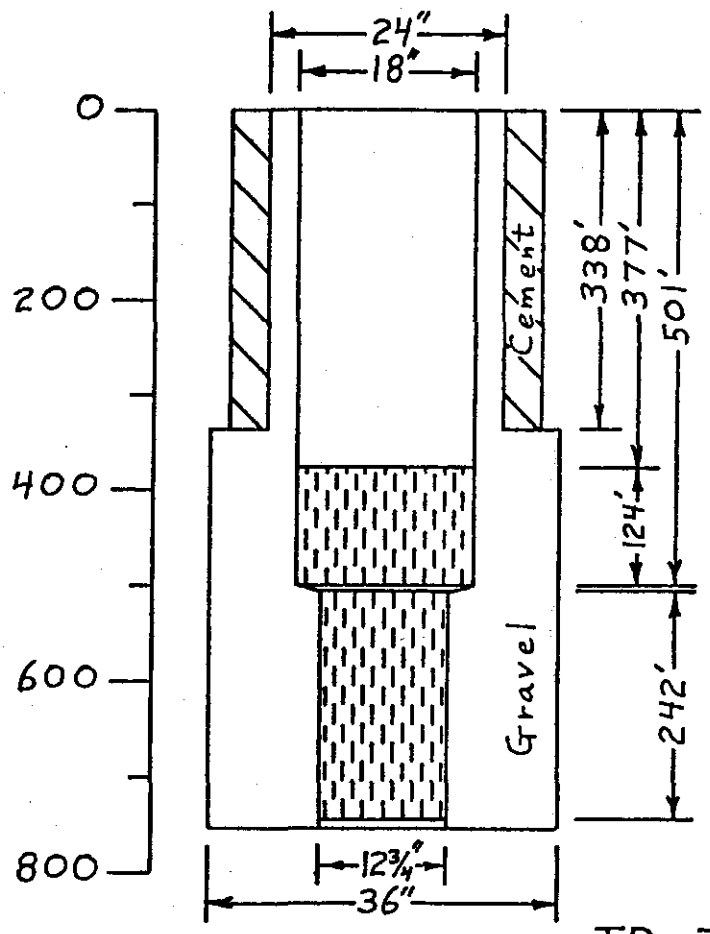
Date Installed _____

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

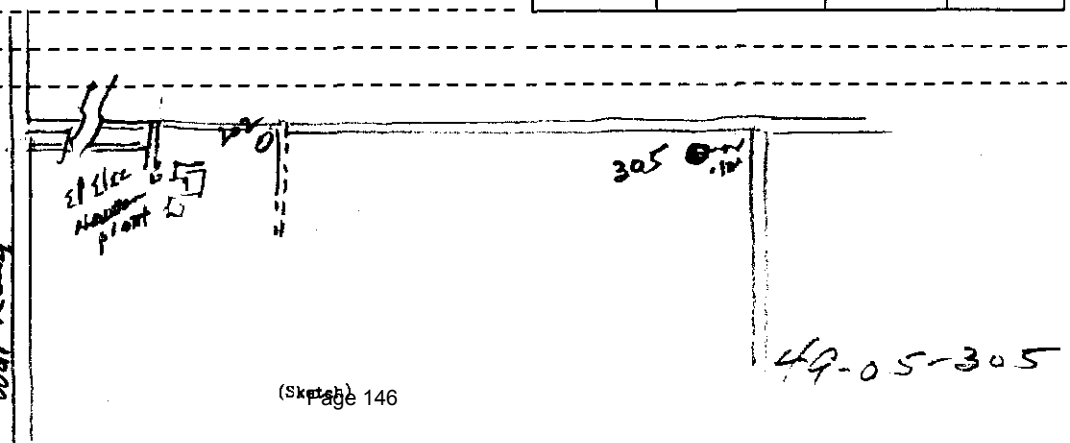
14. Other data available as circled: Driller's Log, Radioactivity Log, (Electric Log),

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 _____

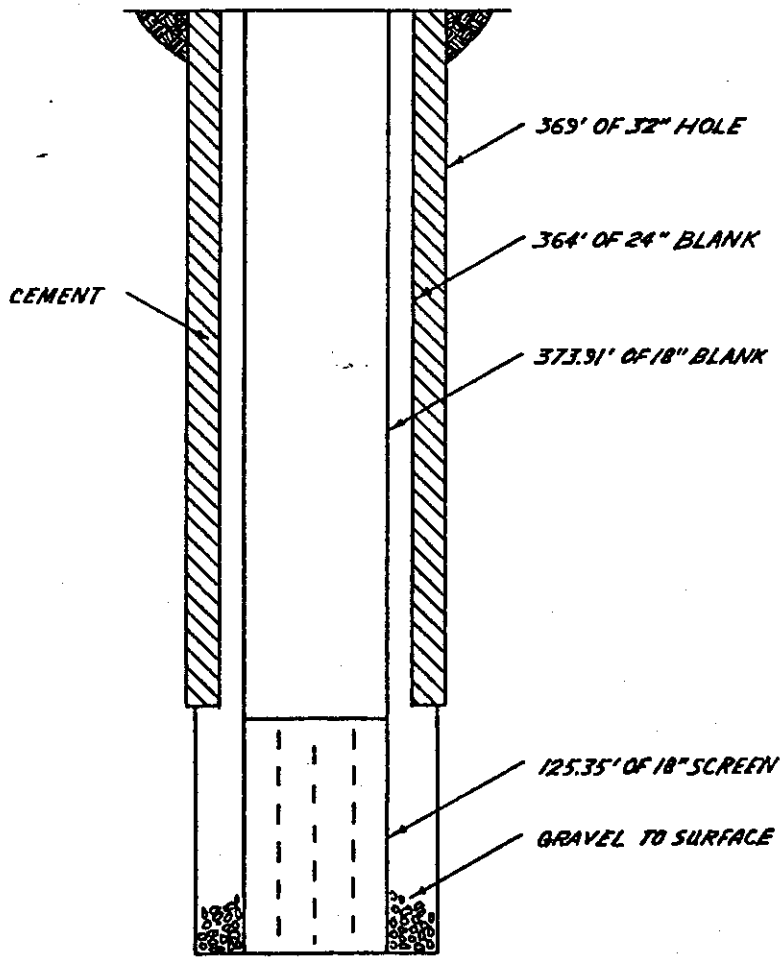
Date Installed _____

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

Water Resources Division
Austin, Texas

State: Texas 41 8 County: El Paso 1 2 3 4 Well No. Latitude 315909N 5 11 Longitude 1062435 12 18 Seq. No. 1 19 Date M D Y 08 01 66 20 25 Sampling Depth 26 29 Type C 30

Well No. R-101, city/E-5 Location 1 mi. S of Tex.-New Mex. state line on McCombs Rd. NE¼ sec. 12 BLK 91 TWP 1

Owner: City of El Paso Date drilled: 8/65 Depth: 834 WBP Bolson Deposits Prod. intervals 374-499 Water level 600 blw LSD stat 352.4

Yield after pumping indef. Yield 200 GPM meas Pt. of coll. faucet on pump Appearance clear Use ind. Collector M.E. Davis

10^6					
K	359	R sample	630		6.71 (31–35)
pH	7.2 (36–38)	Temperature °F	79 (39–41)		
Density at 20°C			ppm		epm
SiO_2	5 ml	A sample 1.202	31 (42–44)		
Al	ml	A 0.00250 mg	ppm	Sample	
	.00625 mg	.0125 mg	.025 mg		
	A 0.025 mg	25 ml 0.018 Sample	Total 0.01 ppm		
	25 ml 0.000 Sample	Diss. 0.00 ppm			
	Total 0.05 ppm				0.00
Sr	Dissolved 0.83 ppm				0.02
Ca	100 ml 6.05 27.4		310 (45–49)		1.50
	epm Ca + Mg		514 (50–53)		0.06
	epm Ca	epm Mg 5.57			
Na	~~80.2~~ 76.2		761 (54–58)		3.31
	Na + K Calc.				
			147 (59–61)		0.12
	4.27 x 1.10				
Percent error	10.2	Total cations			5.01

			ppm		epm
HCO_3	50 ml 6.66		1217 (62–65)		2.11
	Total Alk as CO_3 0.00				
CO_3	50 ml		10 (66–67)		0.00
SO_4	10 ml		411 (68–72)		0.85
	Blk				
	Std				
	Sample 2.06				
Cl	25.25 ml	350 x 1.10	812 (73–76)		2.29
	Source 79	Card No. 80 A			
F	10 ml		017 (26–28)		
	A 1.00 ppm	2.00 ppm	A sample 1.203		
NO_3	0.95 ml std.	10 ml	418 (29–32)		0.02
	A sample	A ml std			
	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				
0.39 / 10.30	Total anions				5.39

Equivalents per million

Na+K — Cl
Ca — HCO_3+CO_3
Mg — SO_4

B	A 0.001 mg 0.206	5 ml	018 (36–38)		
	0.005 mg 0.506				
	mg				
	Temp. mg 0.892	0.012			
Al	(39–41)	Fe 015 (42–45)	Mn 005 (46–49)		
Cu	(50–52)	Pb (53–54)	Zn (55–57)		
Dissolved solids:	Determined (58–63)	Calculated 340 (64–69)			
Hardness	ml	Ca+Mg 99 (70–73)			
	epm Ca + Mg 1.08				
	epm Alk 0.00	NCH 0 (74–77)			
	epm NCH				
Color	10 (78–79)	Card No. 8 80			
Br	(26–28)	I (29–31)			
Alk. as $CaCO_3$	(32–35)	Free CO_2 (36–38)			
Percent Na	61	SAR 3.2 (39–41)	RSC 1.3 (42–44)		
MEAS	(45–47)	NO_2 (67–68)	Card No. 5 80		

Analyst HELEN CONNELL Checked by C.H.K.

Date begun AUG 16 1966 Completed AUG 24 1966

Transmittals	Date
Records processing	
Collector	SEP 23 1966
Owner	

1.52

R-101

Recorded by: Punched by: Date:

Page 148

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

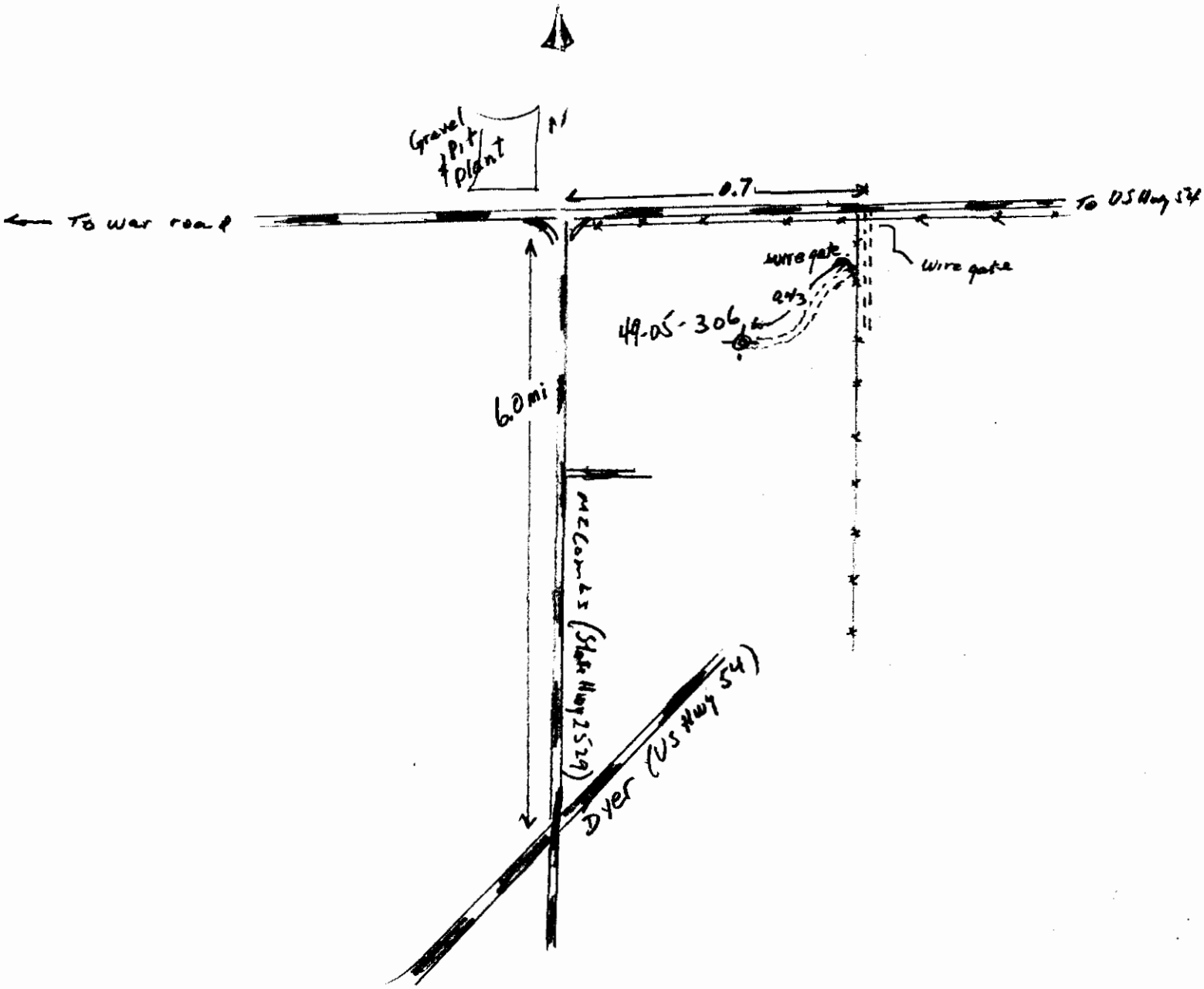
WELL SCREEN

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 _____

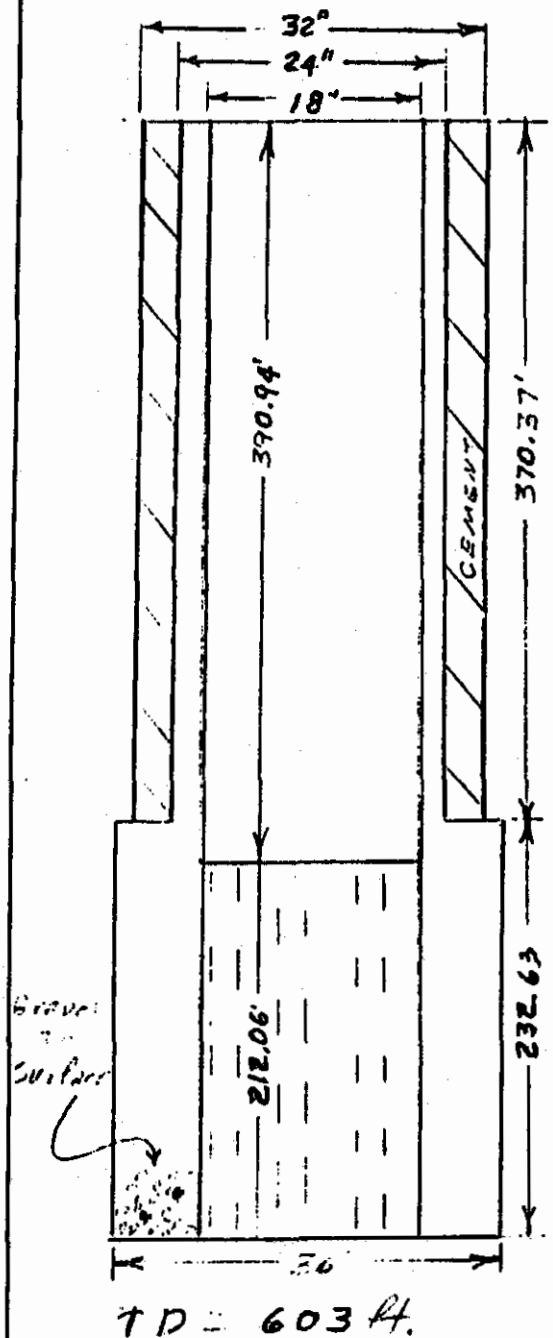
Date Installed _____

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-49-05-317
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 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

49-05-307

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	
				1858	1417	

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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.

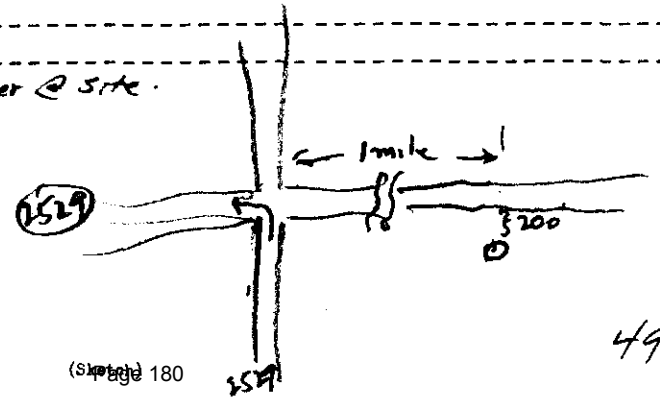
Diam. (in.)	Type	Setting, ft. from	to
	none		

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)

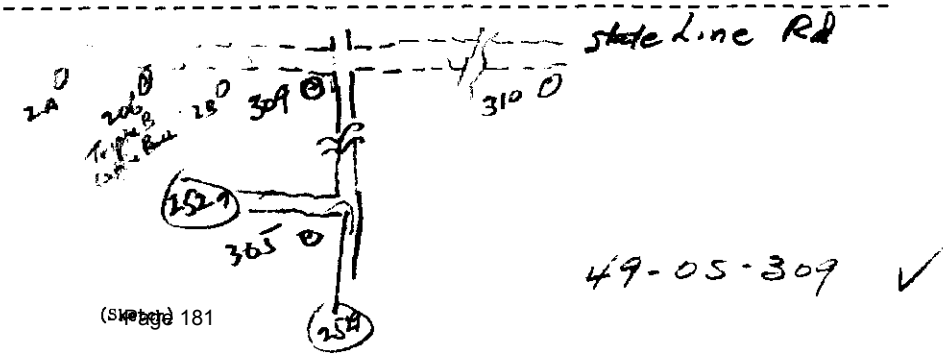
16. Remarks:

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

(PER SHARPIED CHANGES)
ADDED PERFORATIONS IN JULY 1988 — JL-49-05-309 — 7/18/89

330-360' 30 — NOW CALLED LANDFILL 2ND WELL LF-4

OVER / 370-400' 30

$ 420-450' 30 — Σ 90'

EL PASO WATER UTILITIES
WATER ANALYSIS REPORT

OLD TE-6 — ORIG SCRN 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

Remarks ______________
LOD = LIMIT OF DETECTION

TAG#-

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

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

KEY PUNCHED

ANALYST J. McGill

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					

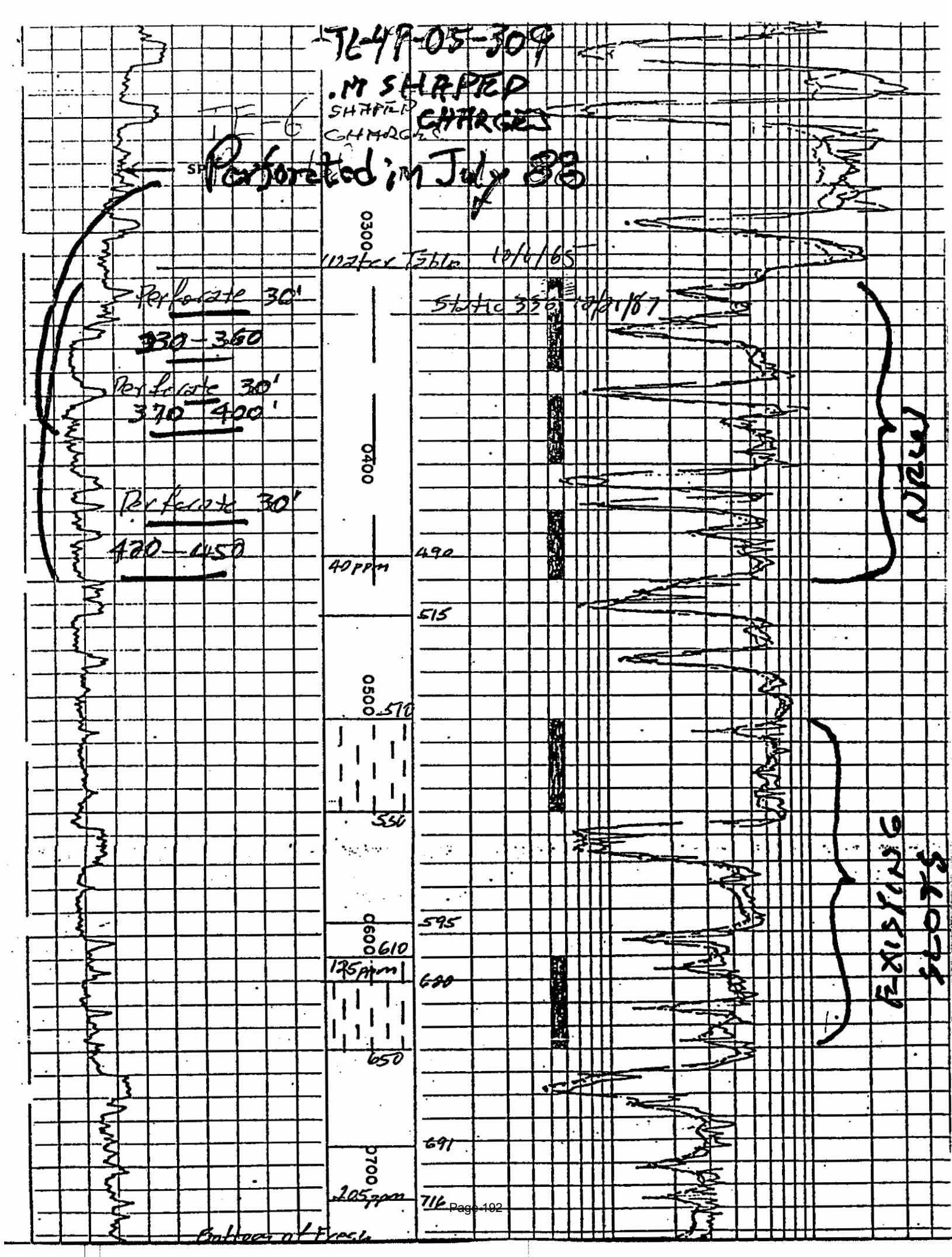
Checking Correctness of Analysis:						
Measured Diluted E. C.	430					
Calculated Diluted E. C.	435					
% Error	+1.2%					

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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(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 10-05-65

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	
		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	
				1858	1417	

Gartrell
ysi

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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.

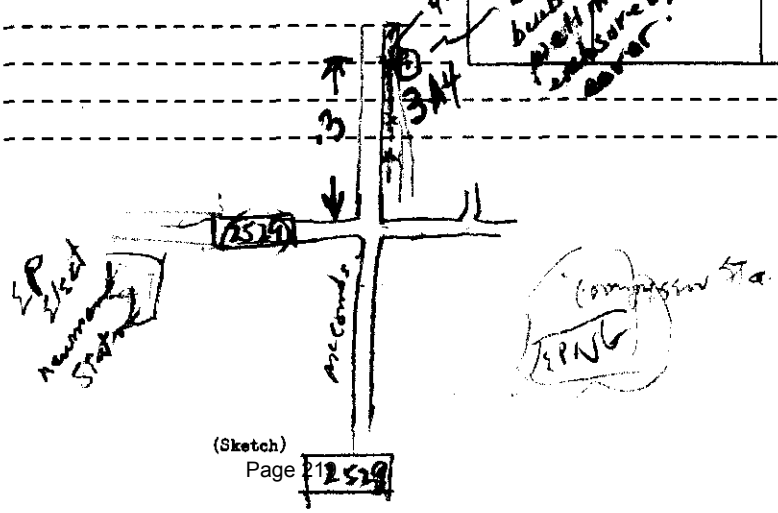
WELL SCREEN

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

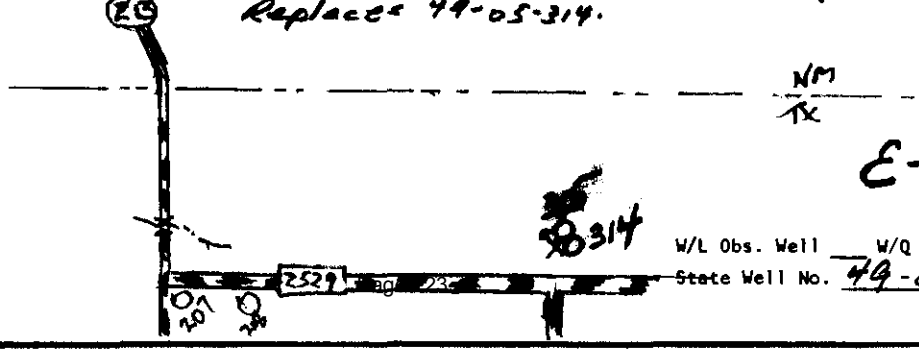
_____ ft. rept. meas. _____ 19___ above/below _____ which is ___ ft. above/below Land Surface

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

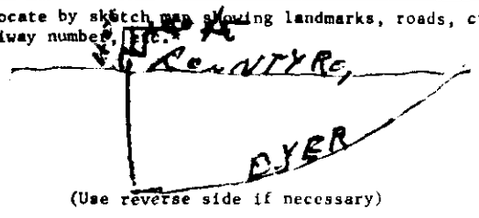
For TWDB use only
Well No. 49-05-38
Located on map
Received: 3-9-79

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.

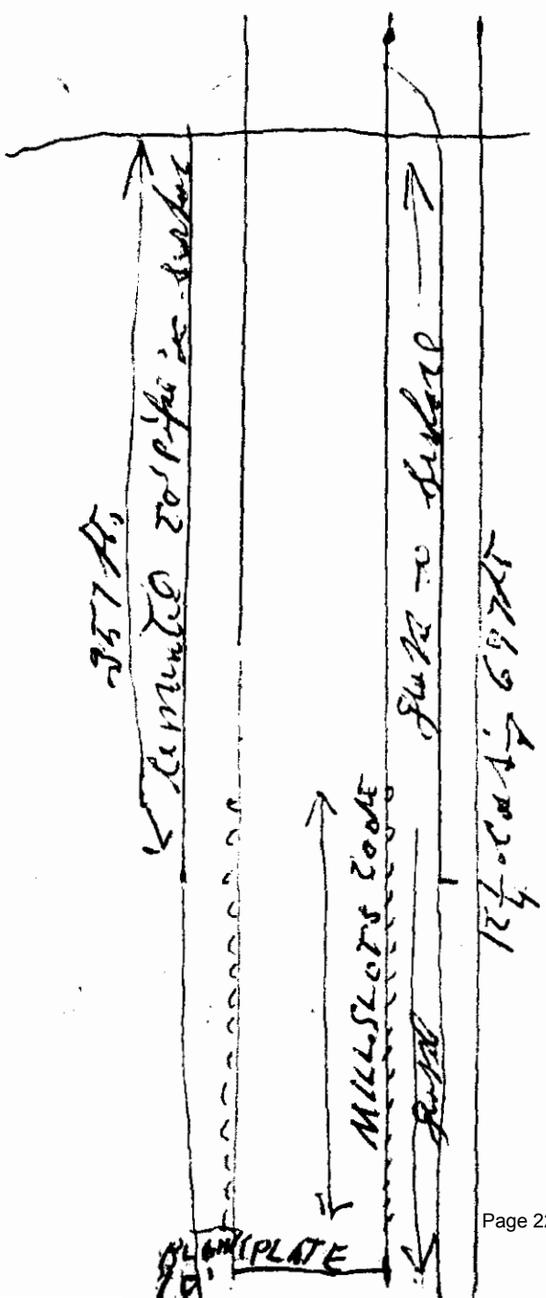
Reference points from which distances are measured and directions given should be some permanent landmark such as intersections, center of towns, river and creek bridges, railroad crossings, etc. The distance and direction from the nearest town should always be indicated.

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; ck

1) OWNER:
Person having well drilled: EL PASO NAT. GAS Co (Name) Address: EL PASO Texas (Street or RFD) (City) (State)

Landowner: [illegible] (Name) Address: [illegible] (Street or RFD) (City) (State)

2) LOCATION OF WELL:
County: El PASO, ______ miles in ______ (N.E., S.W., etc.) direction from ______ (Town)

Locate by sketch map showing landmarks, roads, creeks, hiway number, etc.*: See attached map (North ↑)

(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. ______
(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

(Use 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 (Type or Print) Water Well Drillers Registration No. 027

ADDRESS: P.O. Box 2469 (Street or RFD) Houston (City) Texas (State)

(Signed) Wallace H Claypool (Water Well Driller) Layne Texas Co (Company Name)

Please attach electric log, chemical analysis, and other pertinent information, if available.

*Additional instructions on reverse side.

TWDB-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

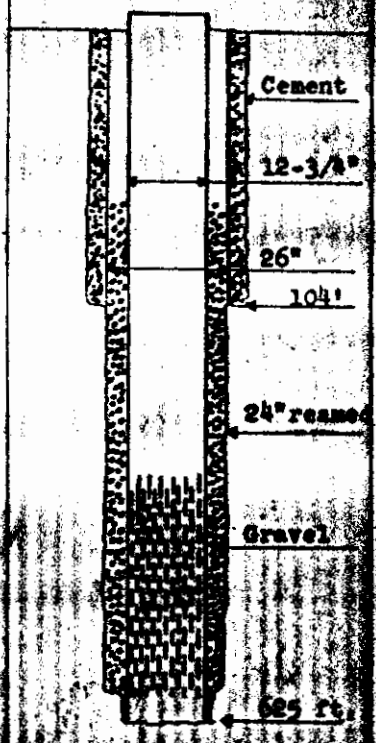
DRILLER V. Matus RIG NO. 6

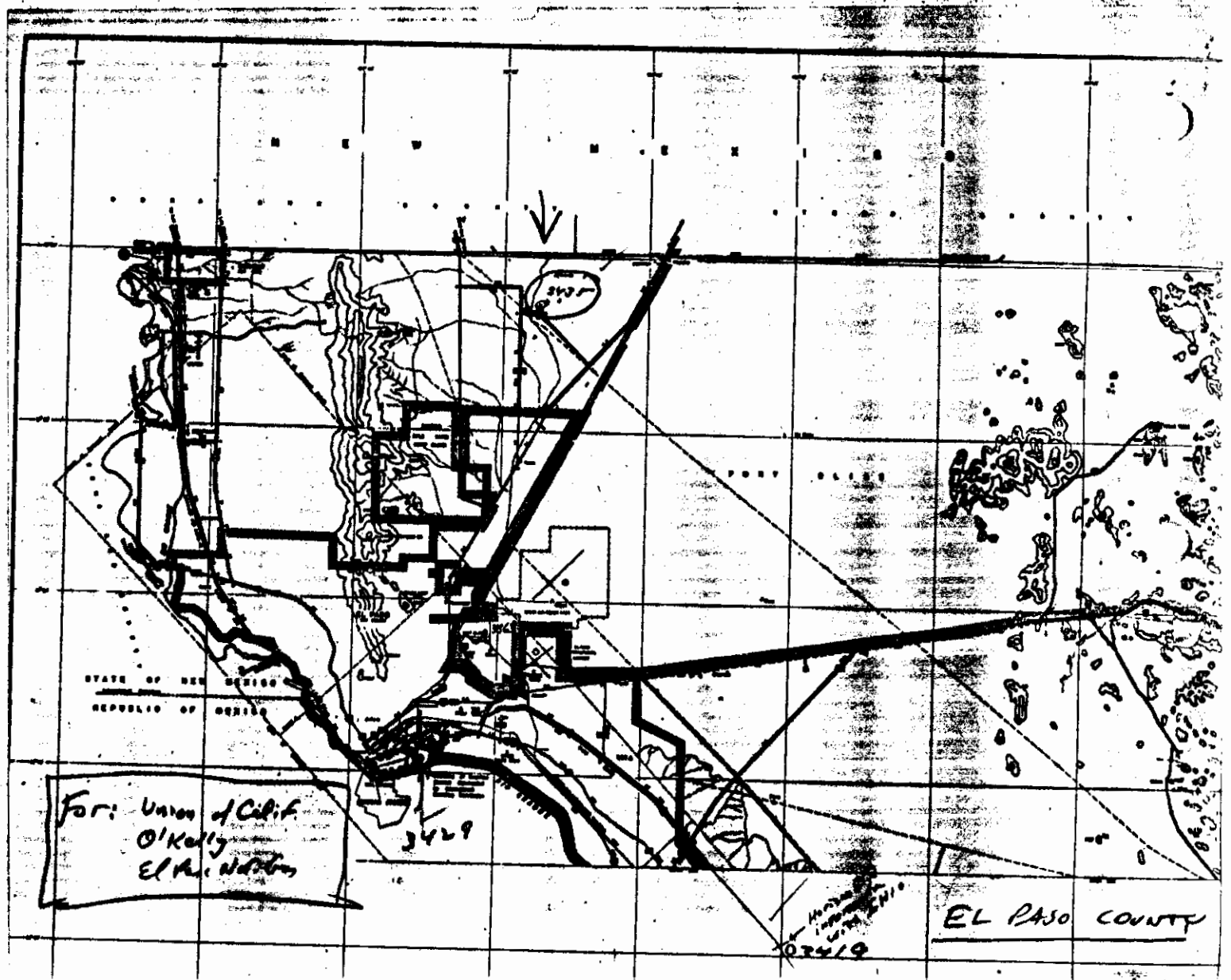
OTHER H. Thompson.

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

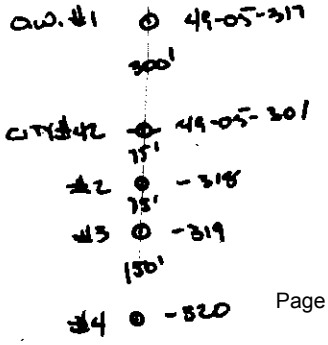
14. Use: Dom., Stock, Public Supply, Ind., Irr., Observation Other (Test Hole, Oil Test, etc.) _____

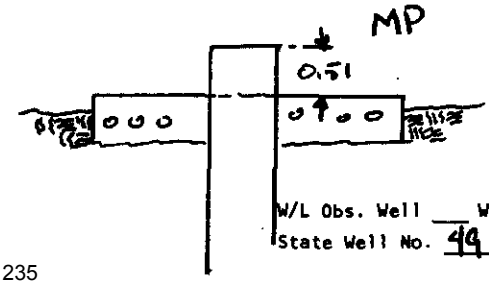
15. Recorded by: R. ZUBIA Source of data: USGS well sched. (DE. WHITE) Date: 12/28/81

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

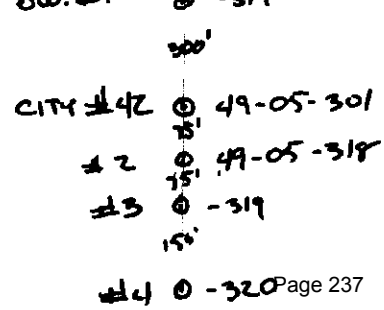
14. Use: Dom., Stock, Public Supply, Ind., Irr. (Observation) Other (Test Hole, Oil Test, etc.) _____

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 1154 HAWKINS BLVD, 79925 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

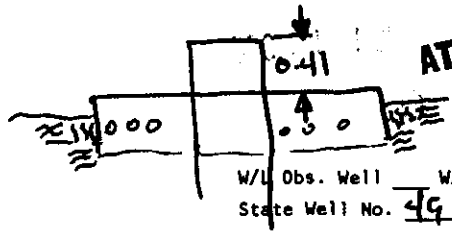
See sketch with 49-05-317

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

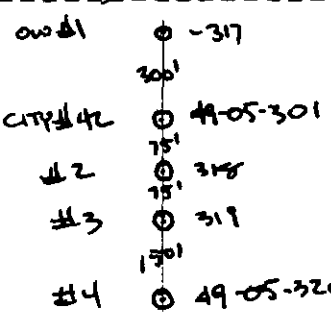
14. Use: Dom., Stock, Public Supply, Ind., Irr. (Observation) Other (Test Hole, Oil Test, etc.) _____

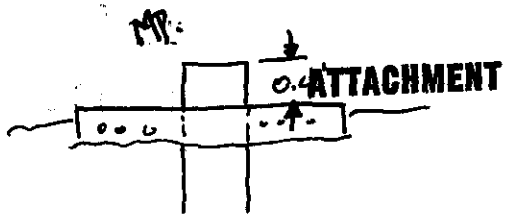
15. Recorded by: P. ZUBIA Source of data: USGS Well Schedule (E. White) Date: 12/28/81

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)

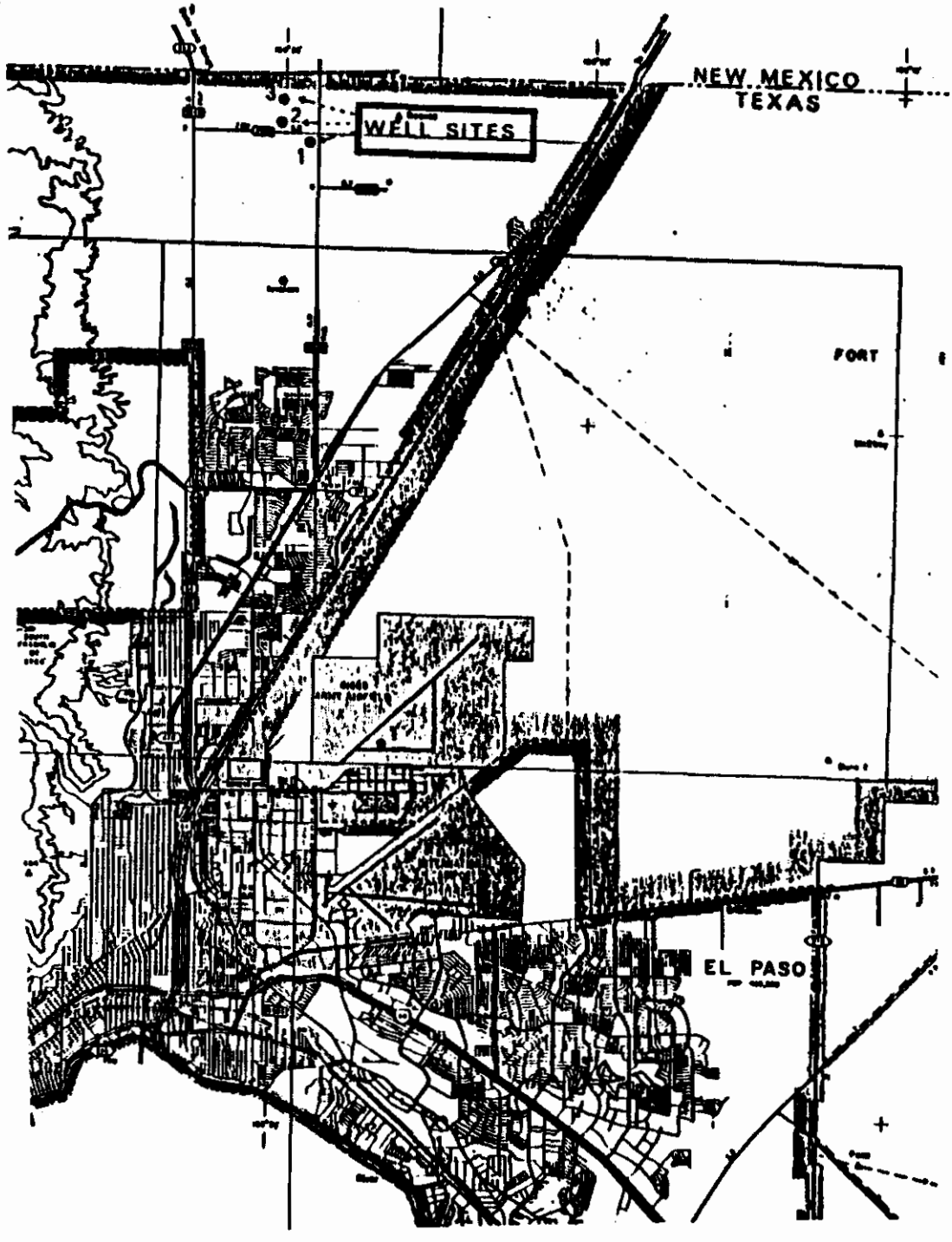
(Signed) James M Cole (Water Well Driller) Cole Drilling Company (Company Name)

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'

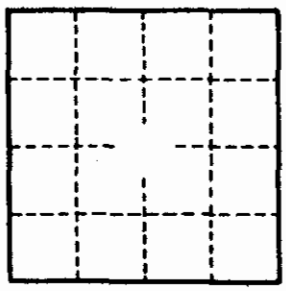
Depth to consolidated rock: _____ ft (60–63) Source of data: _____ (64)

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)

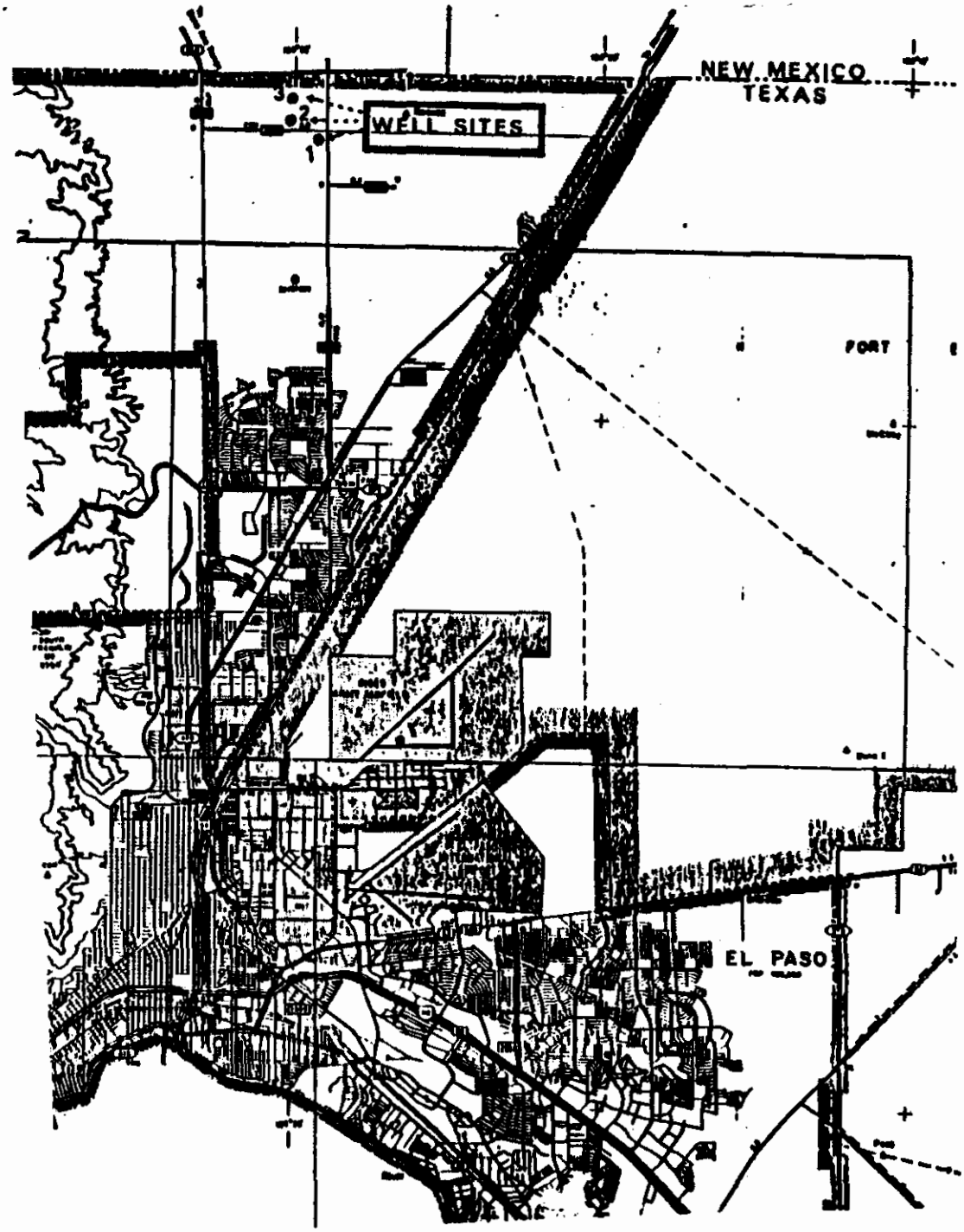
(Signed) James M. Cole (Water Well Driller) Cole Drilling Company (Company Name)

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)

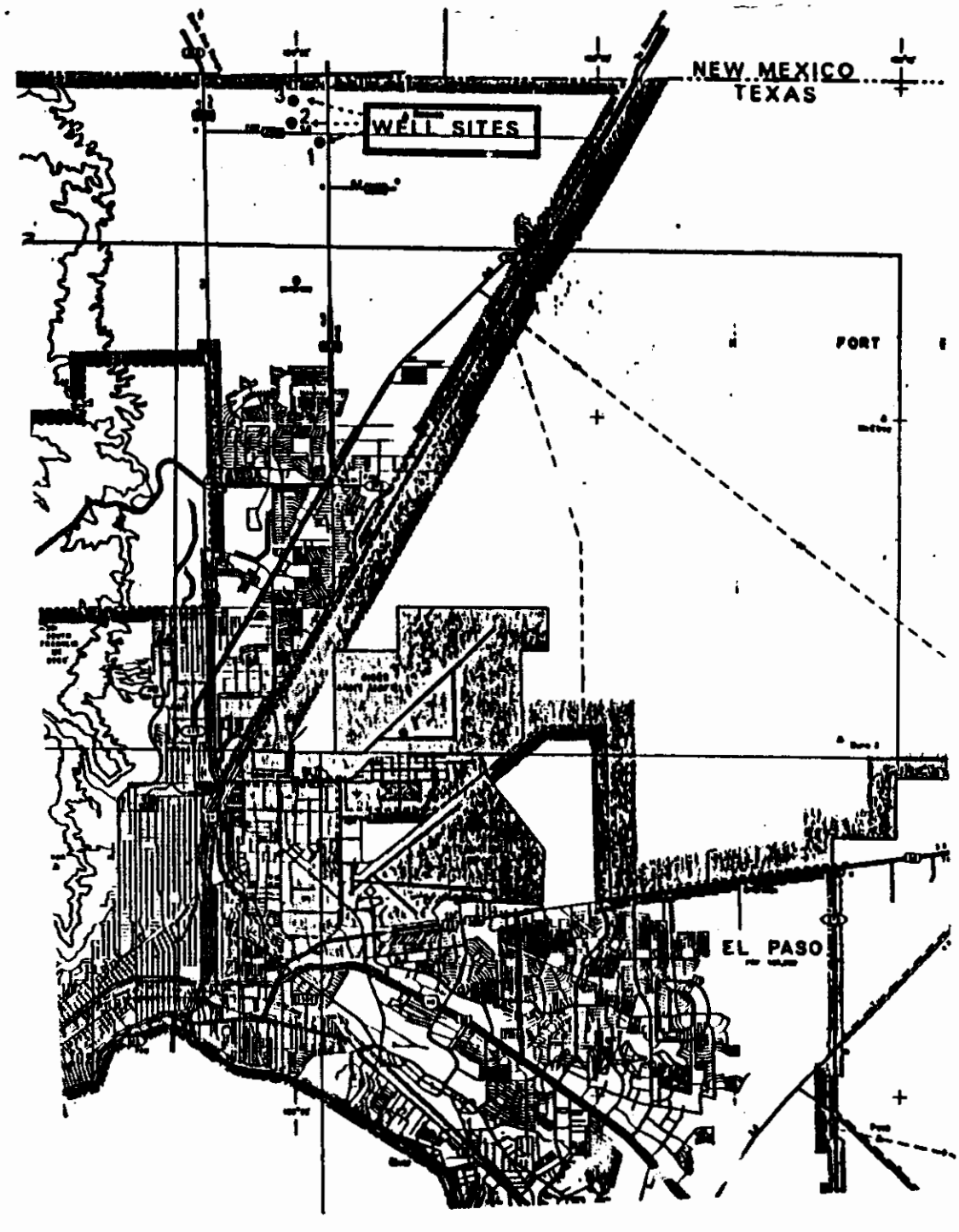
Please attach electric log, chemical analysis, and other pertinent information, if available.

*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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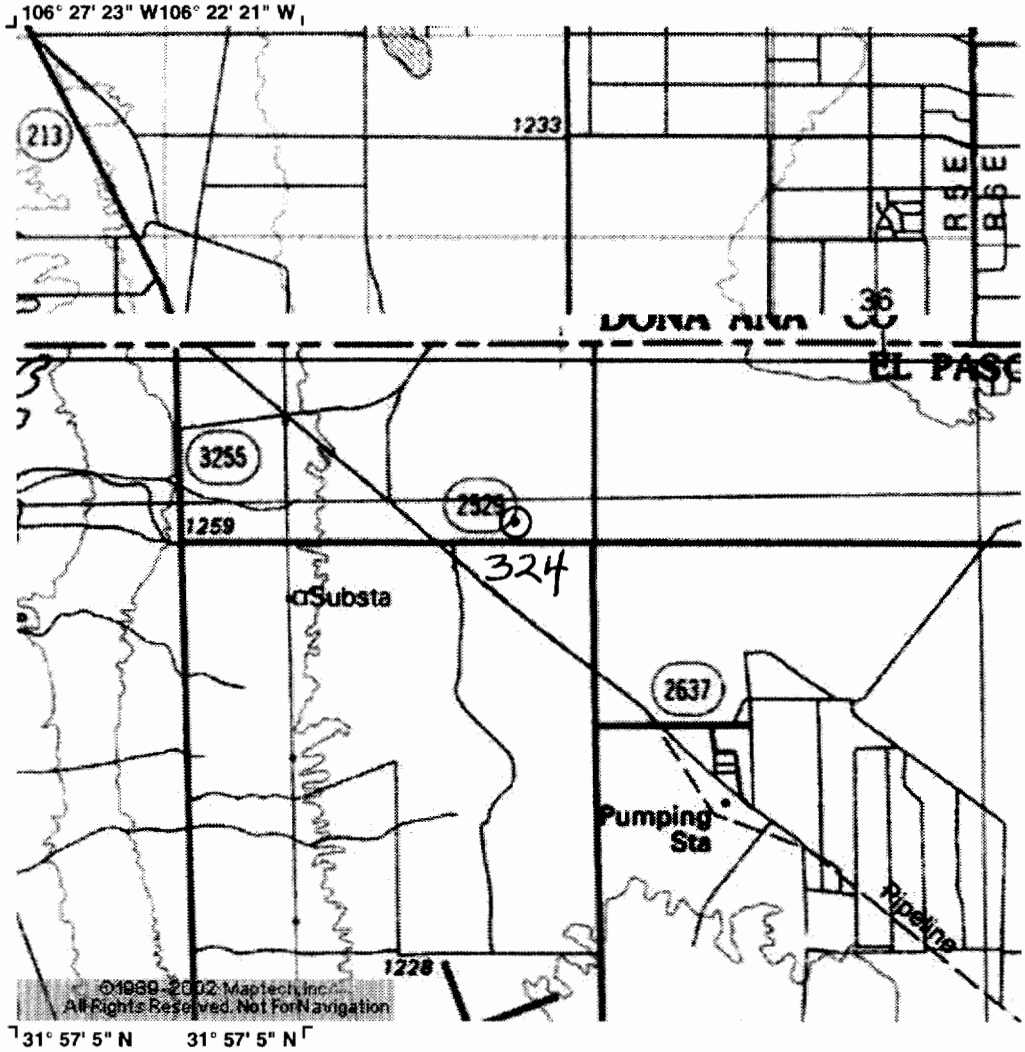

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49-05-324

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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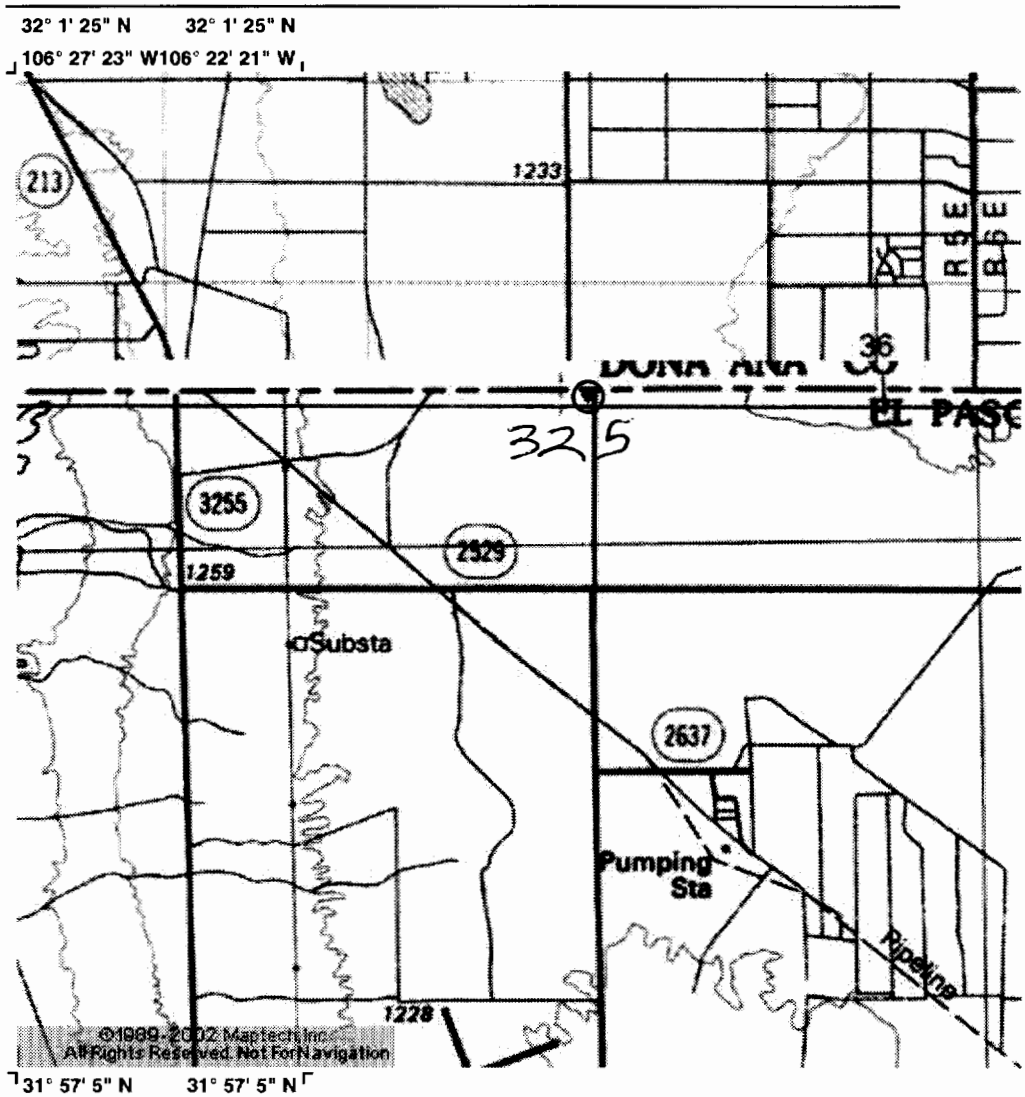

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49-05325

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'

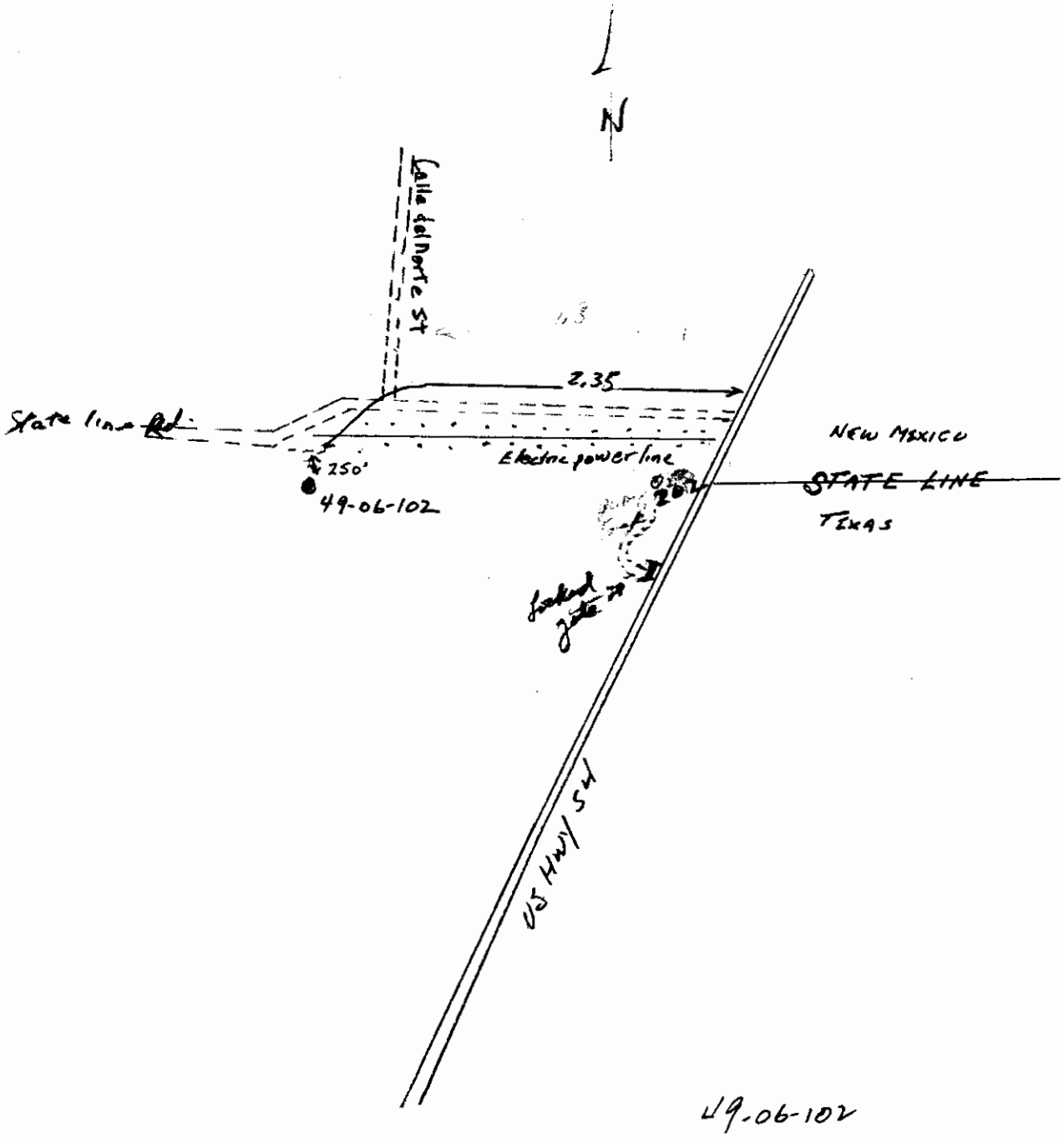
Obs Well

✓

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

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

Remarks: .....

.....

.....

Oscar Estrada 49-06-104

Analyst

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

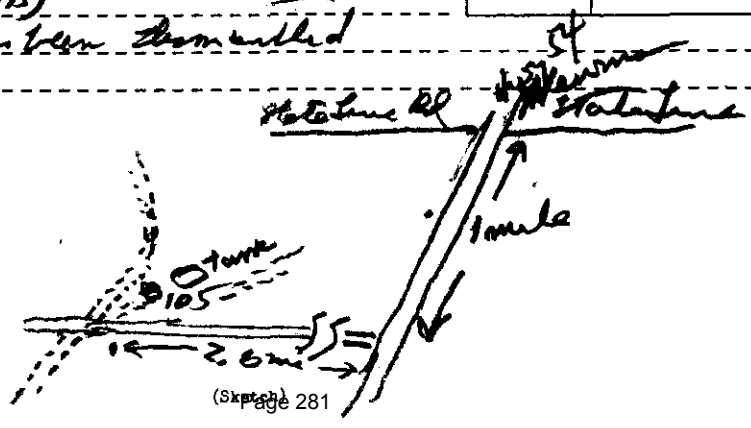
Aquifer Hueco Bolson Field No. M-247 R-5 State Well No. 49-06-105

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

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.

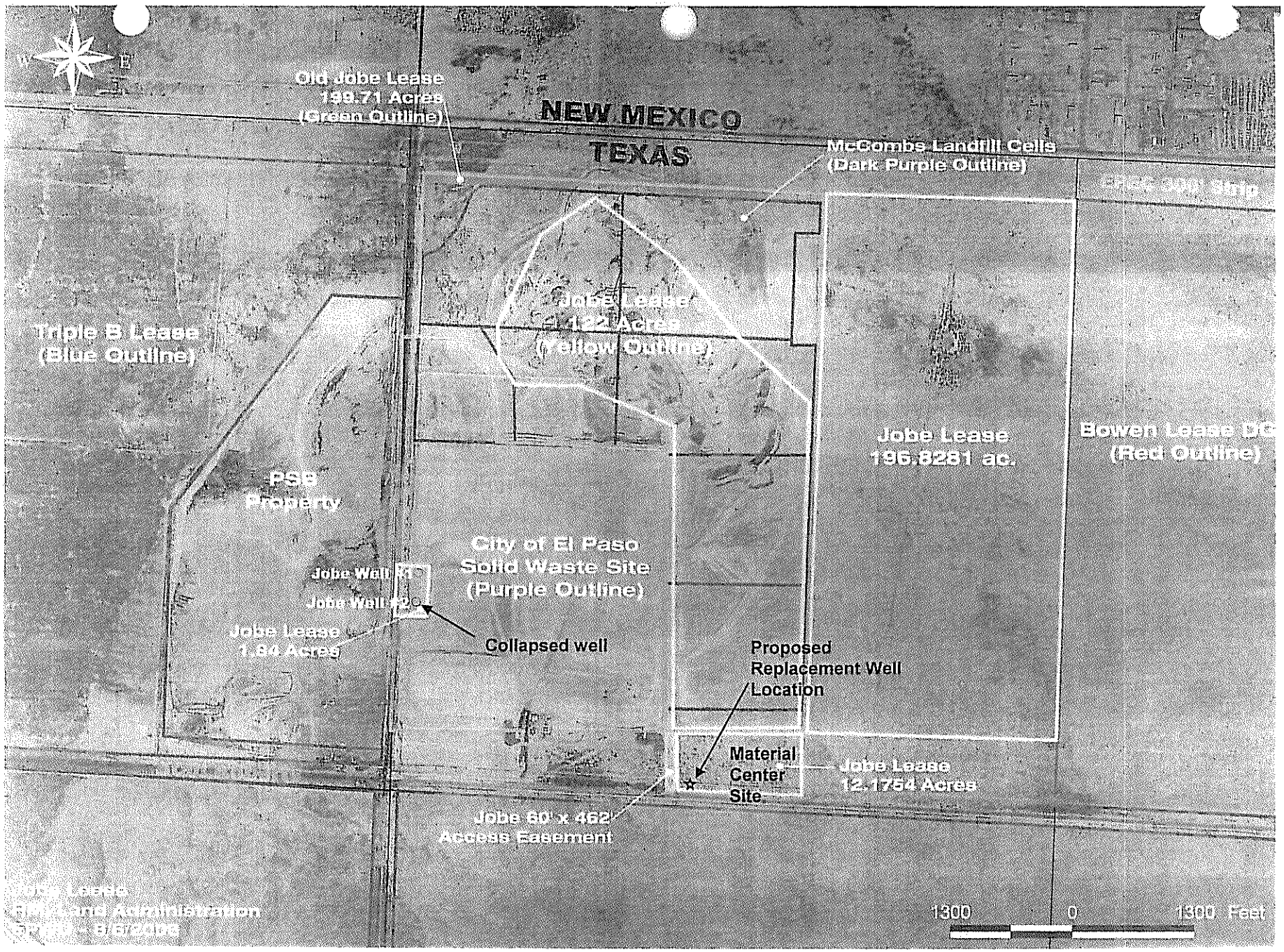
If you have any questions or need additional information, please do not hesitate to call me at (915) 564-1653.

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

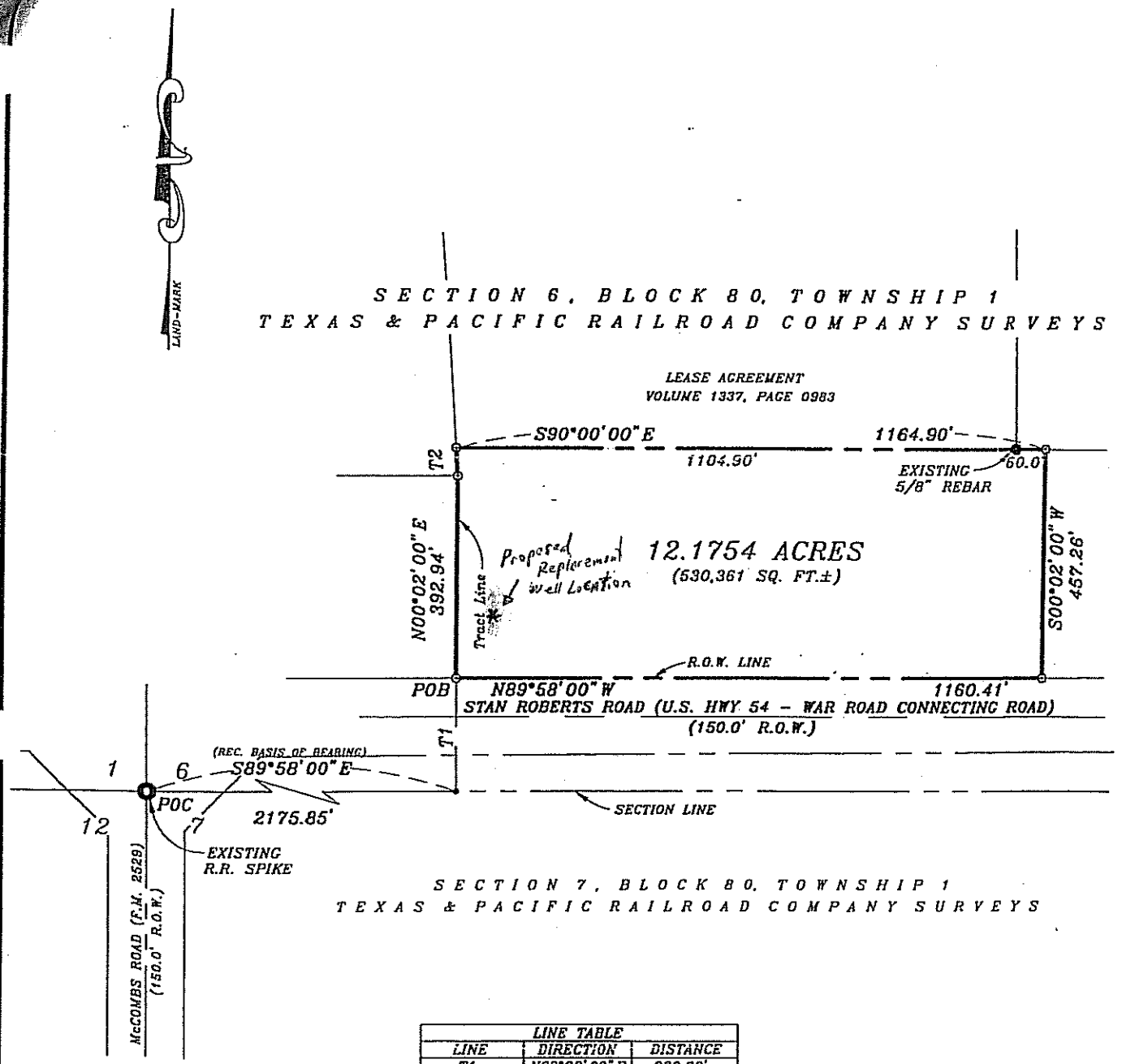

Old Jobe Lease
139.71 Acres
(Green Outline)
NEW MEXICO
TEXAS
McCombs Landfill Cells
(Dark Purple Outline)
Jobe Lease
2.122 Acres
(Yellow Outline)
Triple B Lease
(Blue Outline)
Jobe Lease
196.8281 ac.
Bowen Lease
(Red Outline)
PSB
Property
City of El Paso
Solid Waste Site
(Purple Outline)
Jobe Well #1
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'

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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 Dense	Sand with gravel. Low Plasticity Index. Tan.
30			X	S	48				SP		
35			X	S	56				SP	Damp 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 Dense	Sand with gravel. Low Plasticity Index. Tan to Grey.
30				S	41				SP		
35				S	40				SP		
40				S	58				SP	Dry Very Dense	
45				S	61				SP		
50				S	37				CH	Slightly Damp 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 Medium Dense	Sand with gravel. Low Plasticity Index. Tan to Grey.
30				S	46				SP	Dry Dense	
35				S	56				SP	Dry Very Dense	
40				S	68				SP		
45				S	51				SP		
				S	33						
50									CH	Slightly Damp 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 Dense	Sand with gravel. Low Plasticity Index. Tan to Grey.
30			X	S	56				SP	Dry Very Dense	
35			X	S	68				SP		
40			X	S	72				SP	Slightly Damp Very Dense	Sand with gravel with thin layer of clay. Low Plastic Index. Tan to Grey.
45			X	S	74				SP	Slighty Damp 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 Dense	Sand with gravel. Low Plasticity Index. Tan to Grey.
30			X	S	46				SP		
35			X	S	58				SP	Dry 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 Dense	Sand with gravel. Low Plasticity Index. Tan to Grey.
30			X	S	48				SP		
35			X	S	54				SP	Dry 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

Boring Plan	Sheet A1
Logs of the Borings	Sheets A2 - A9
Particle Size Analyses	Sheets A10 - A46
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%.

T 8

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 1×10^{-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'

GEOTECHNICAL ENGINEERS
2525 EAST YANDELL DR.
EL PASO, TEXAS 79903
(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
2525 EAST YANDELL DR
EL PASO, TEXAS 79903
(915) 532-7566

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

GEOTECHNICAL ENGINEERS
2525 EAST YANDELL DR
EL PASO, TEXAS 79903
(915) 532-7566

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

GEOTECHNICAL ENGINEERS
3525 EAST YANDELL DR
EL PASO, TEXAS 79903
(915) 532-7566

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
2525 EAST YANDELL DR
EL PASO, TEXAS 79903
(915) 532-7566

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

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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

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Sheet A6

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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

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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

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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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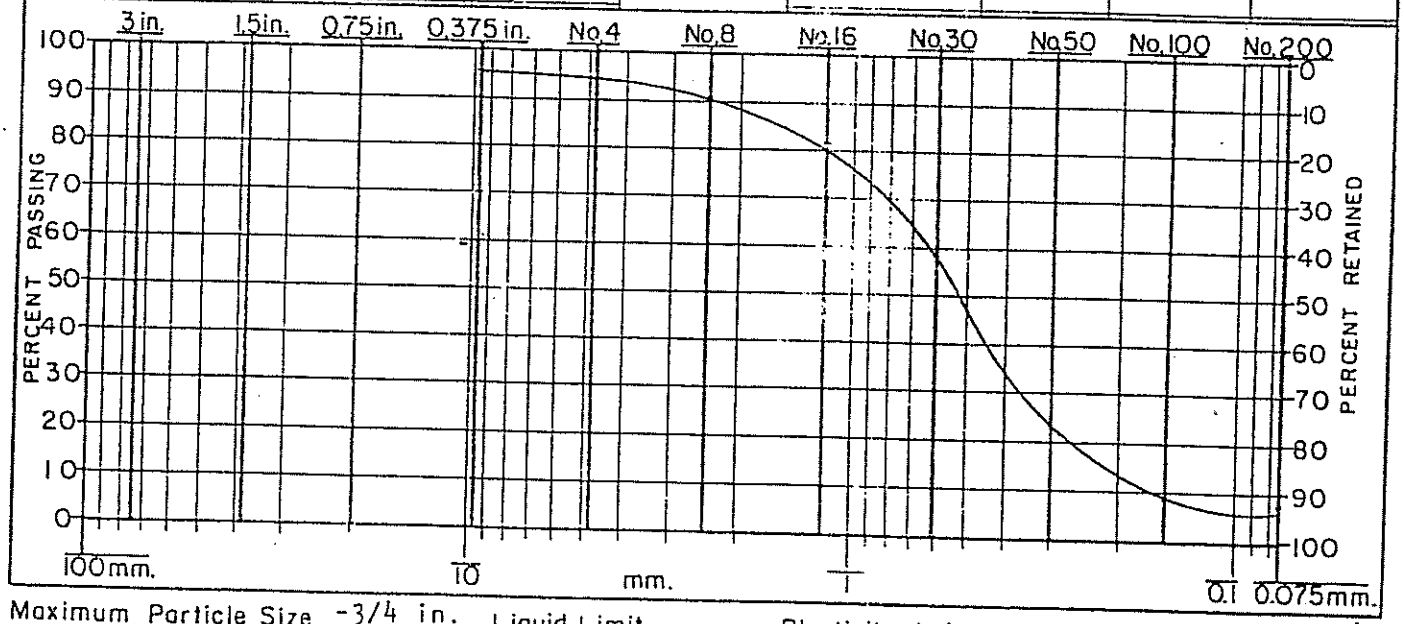
PROJECT Northeast Landfill

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

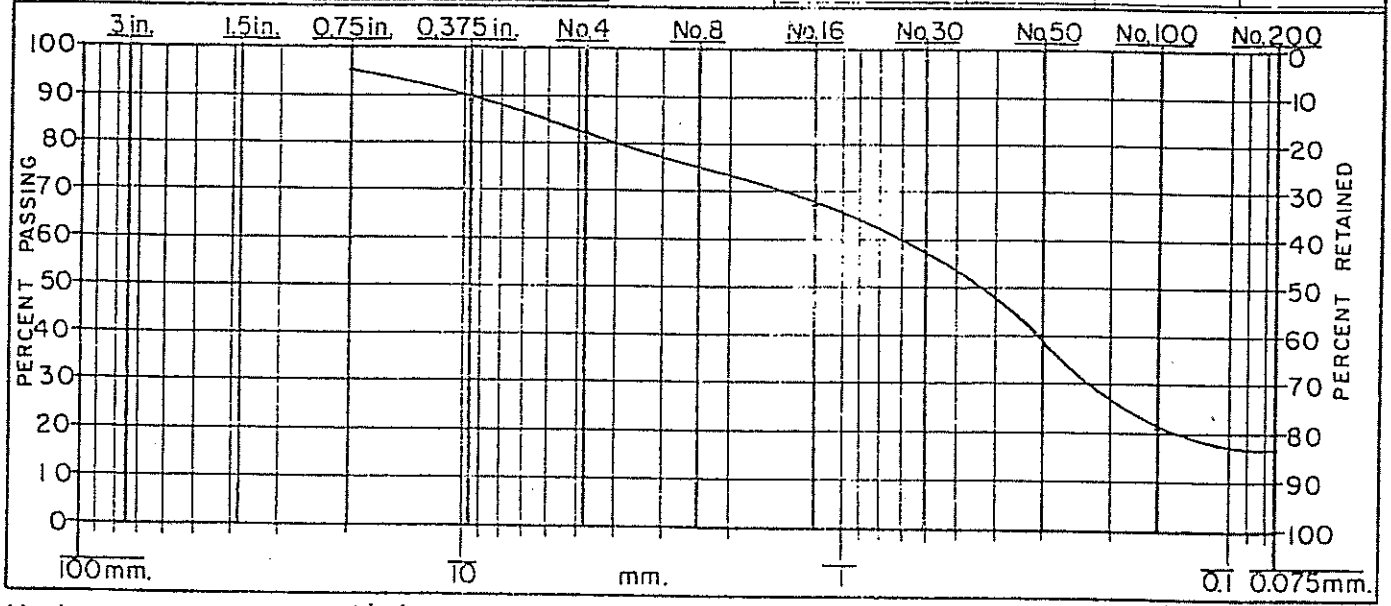
REPORT OF TEST ON SAND, silty

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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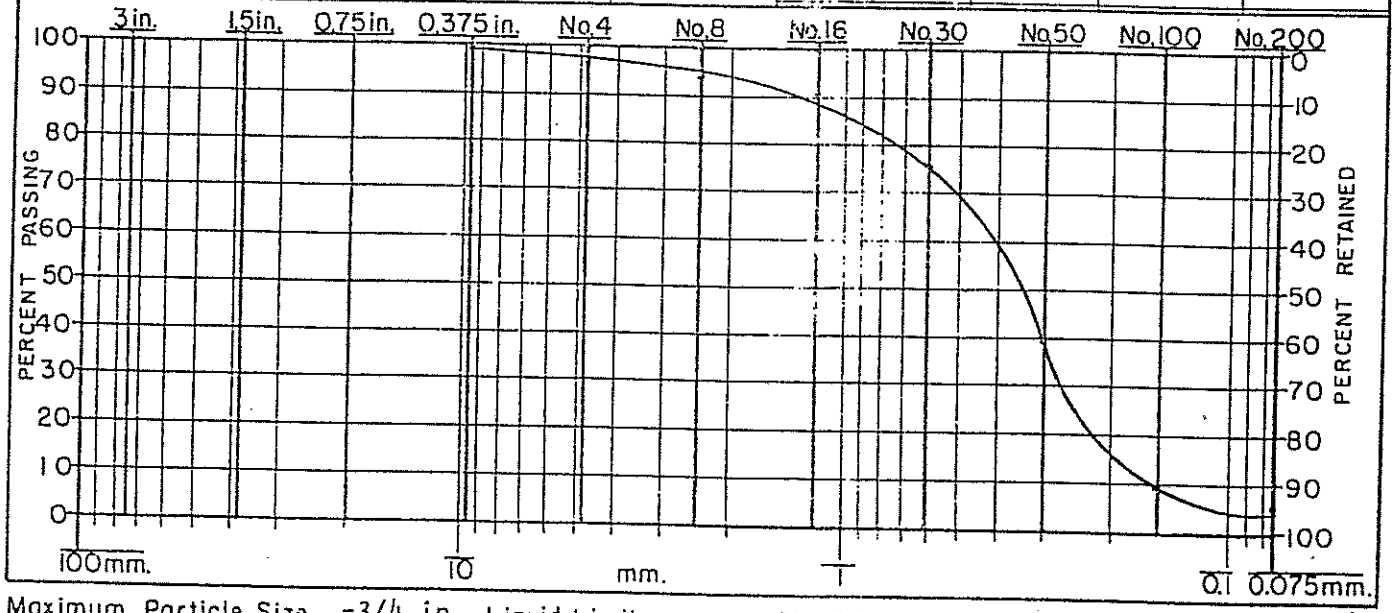
REPORT OF TEST ON SAND, poorly graded, SAND, silty

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

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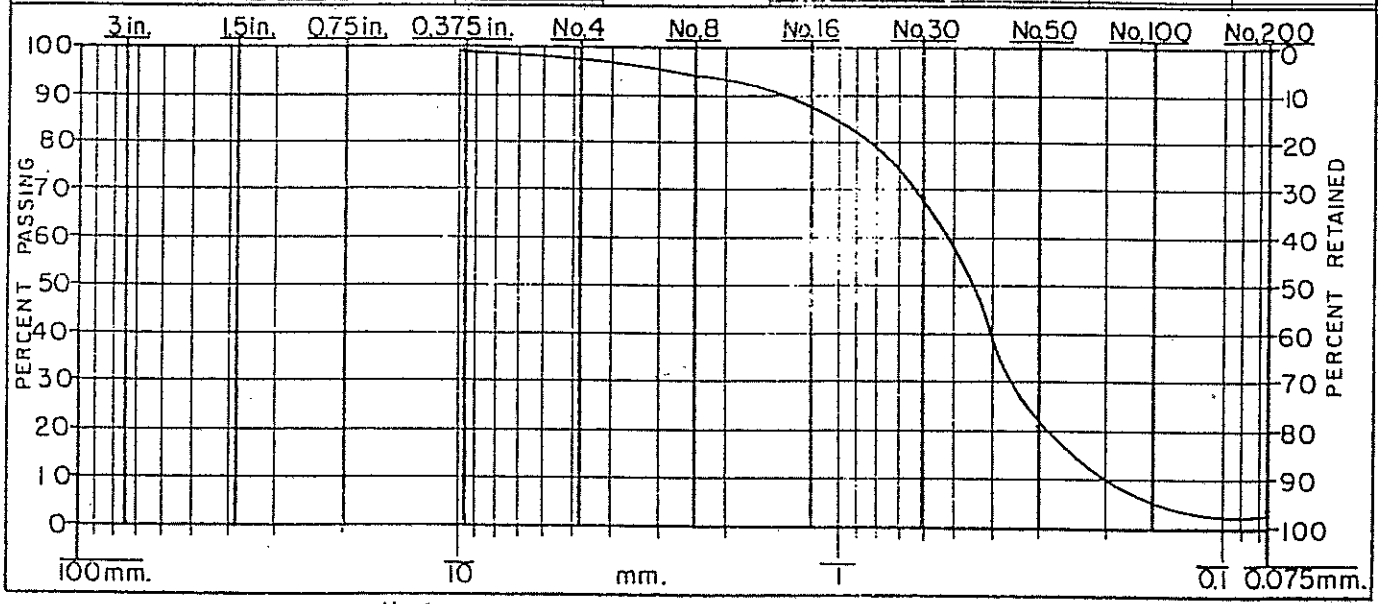
PROJECT Northeast Landfill

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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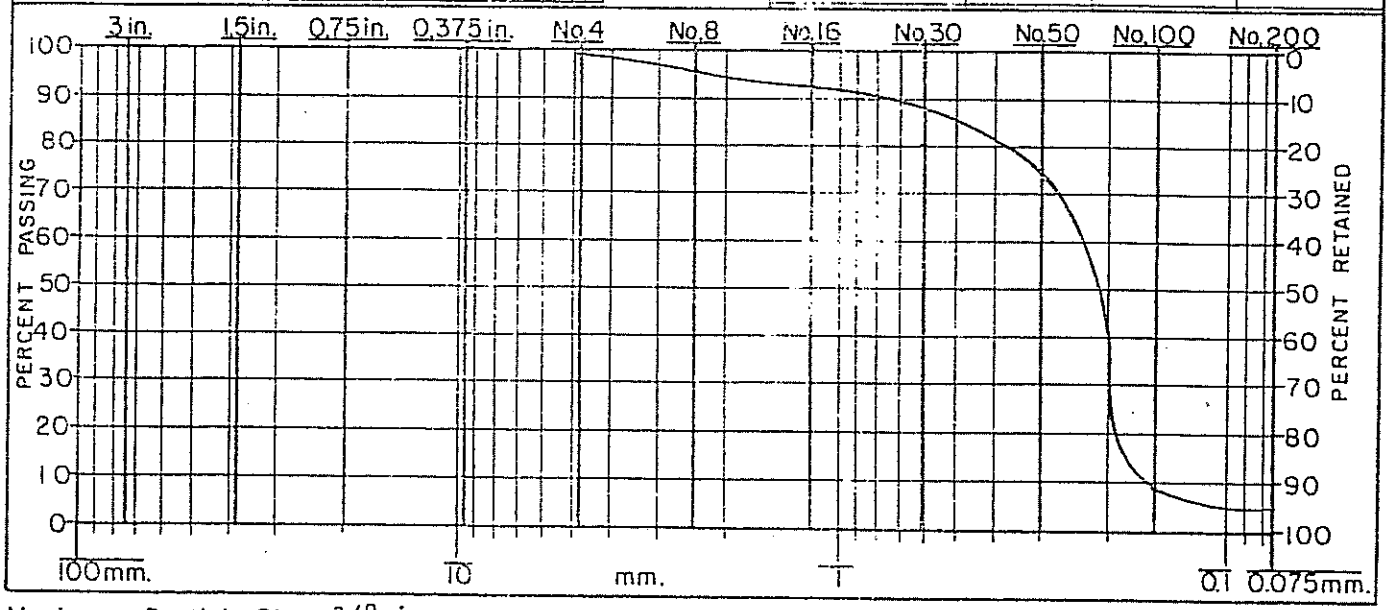
PROJECT Northeast Landfill

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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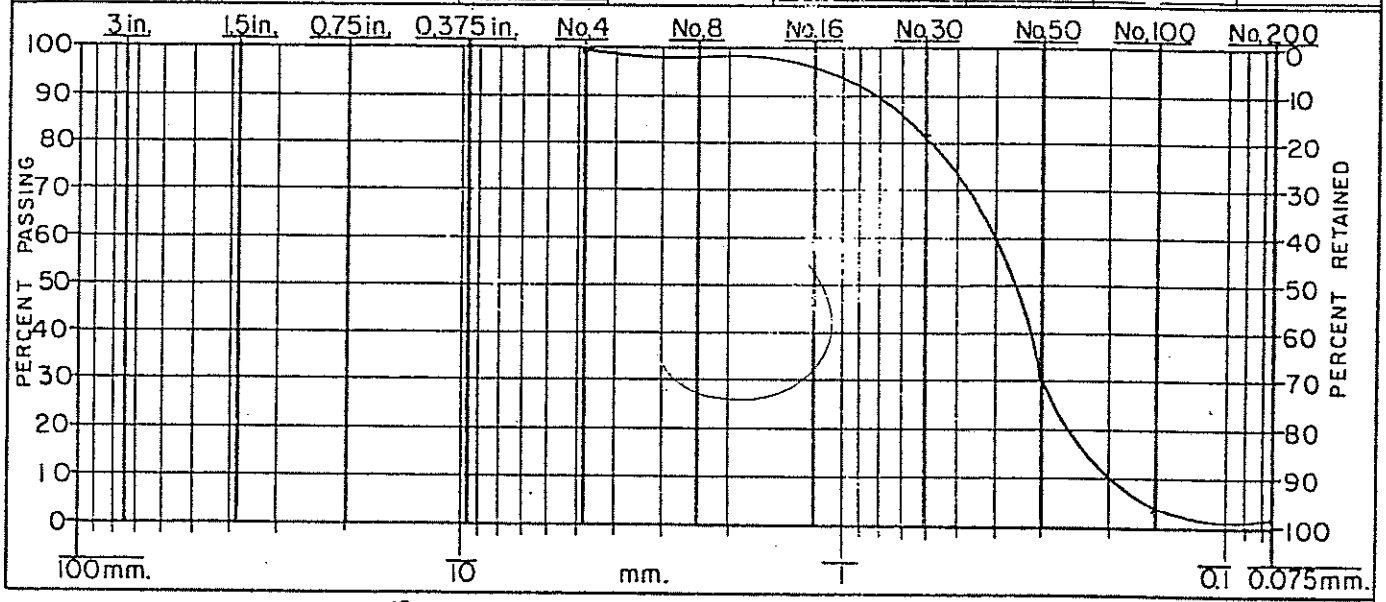
PROJECT Northeast Landfill

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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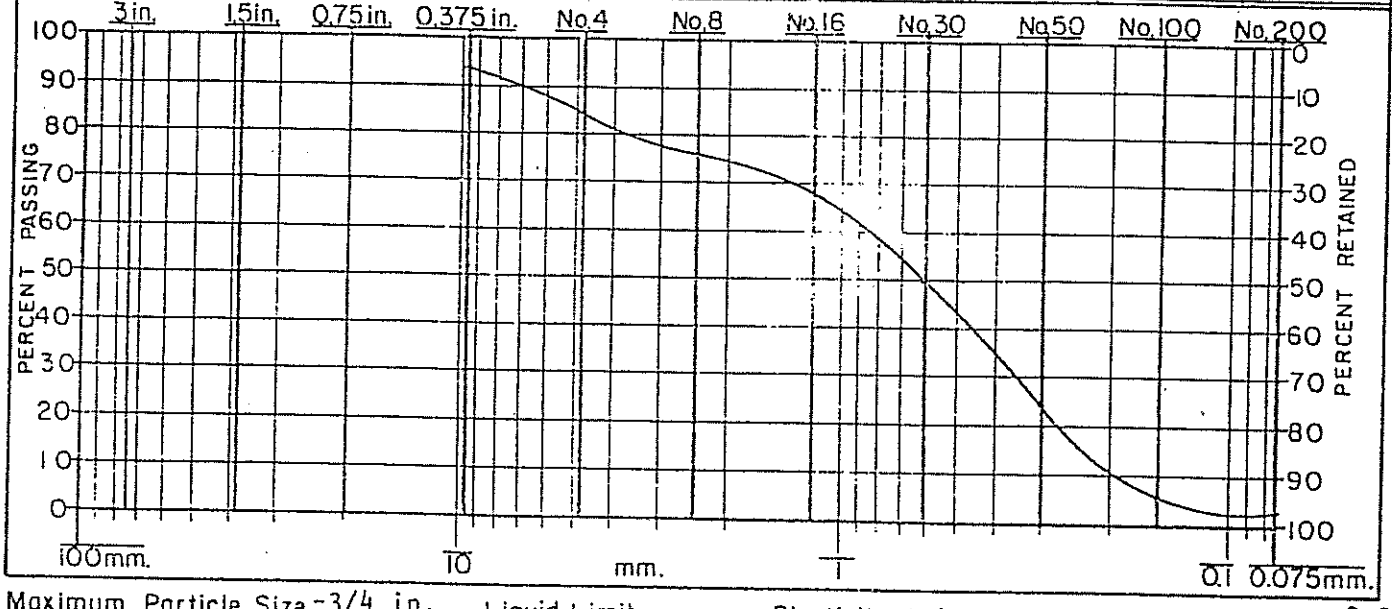
PROJECT Northeast Landfill

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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PROJECT Northeast Landfill

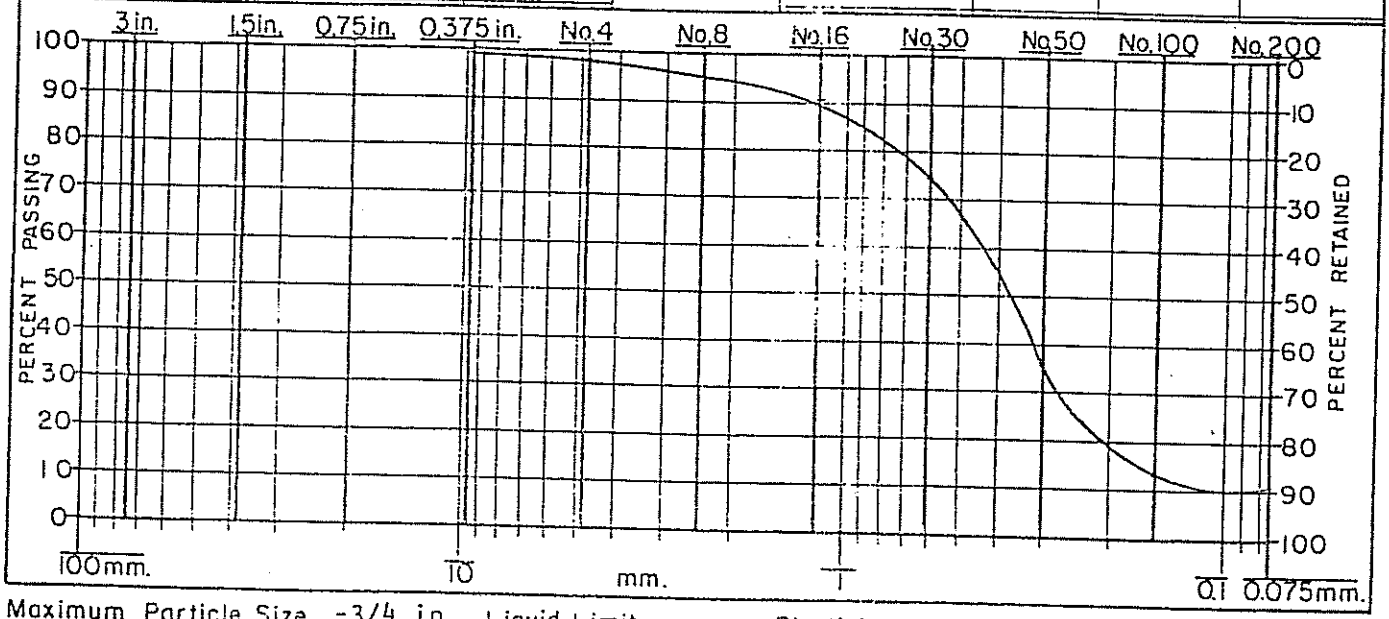
REPORT OF TEST ON SAND, poorly graded, SAND, silty

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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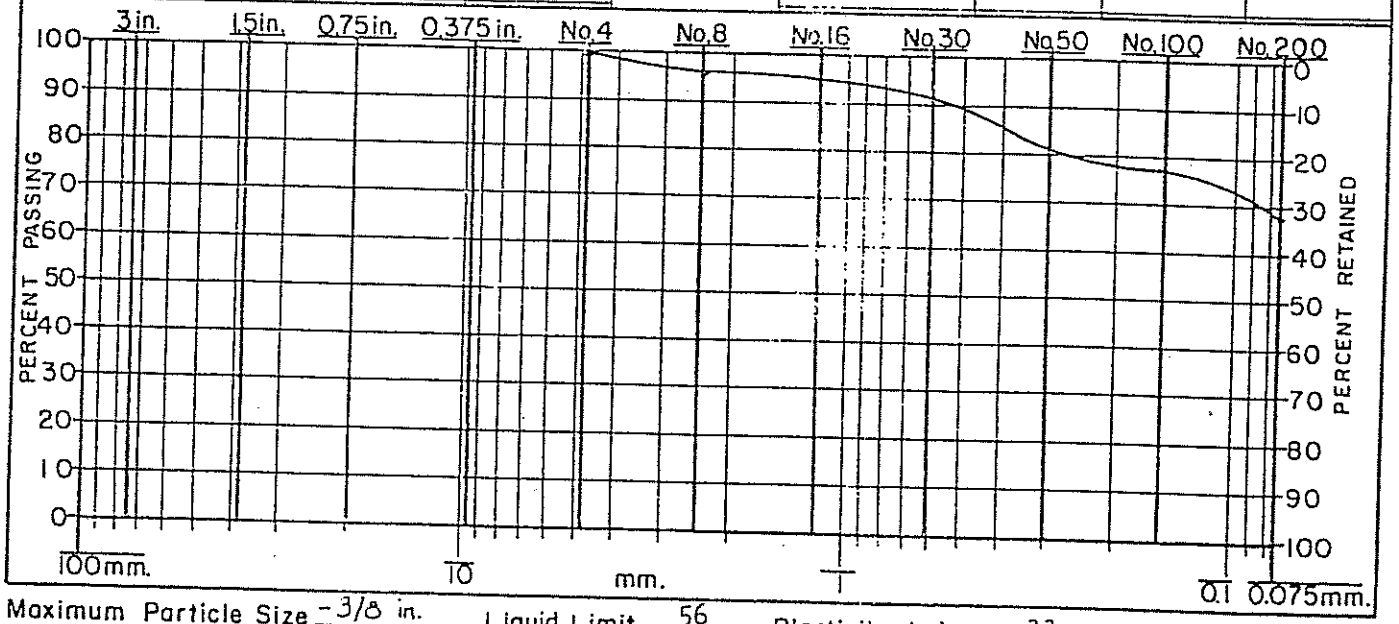
PROJECT Northeast Landfill

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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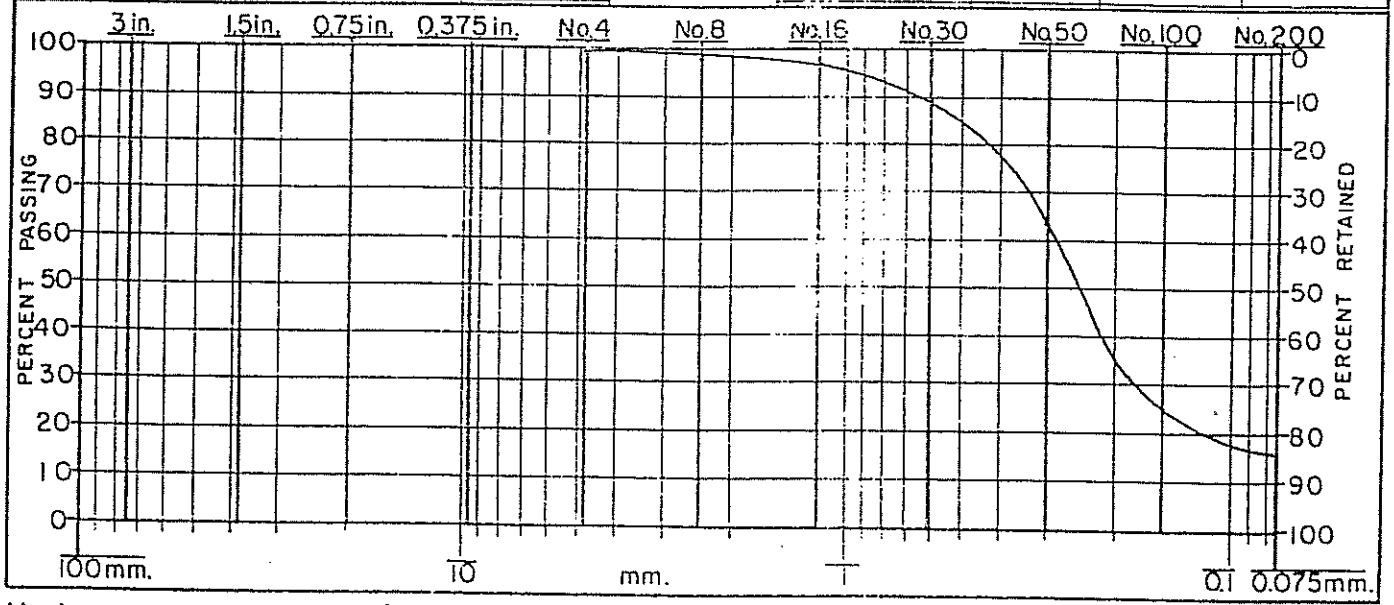
PROJECT Northeast Landfill

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

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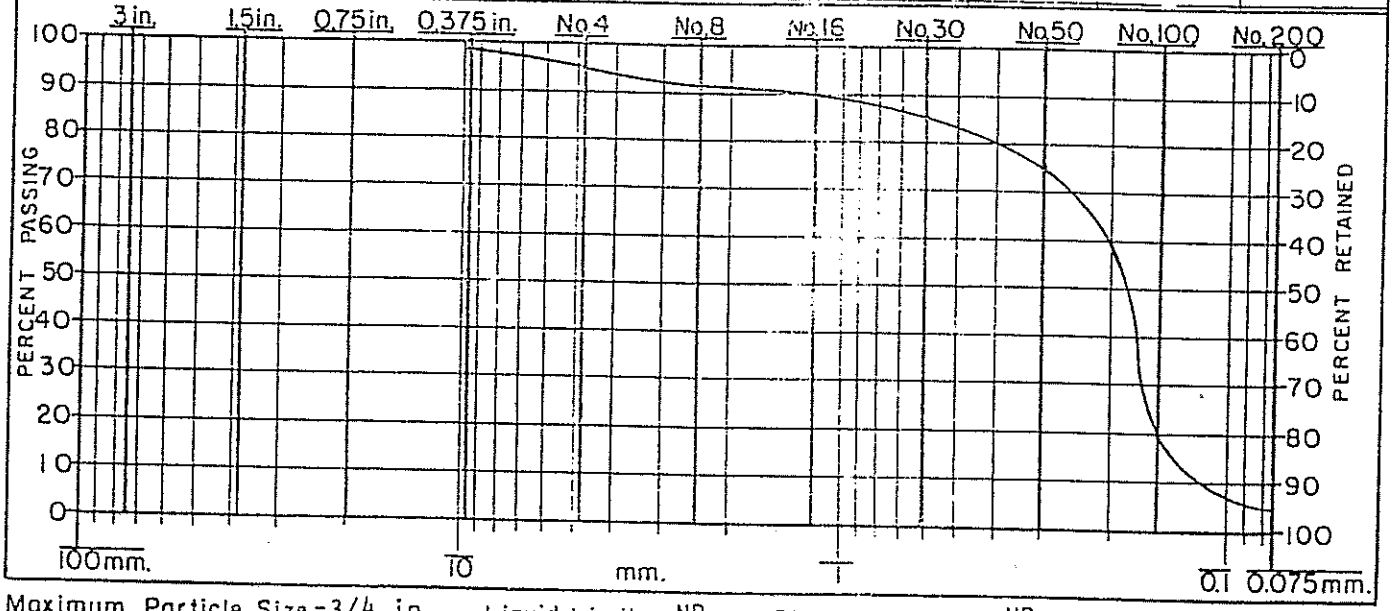
PROJECT Northeast Landfill

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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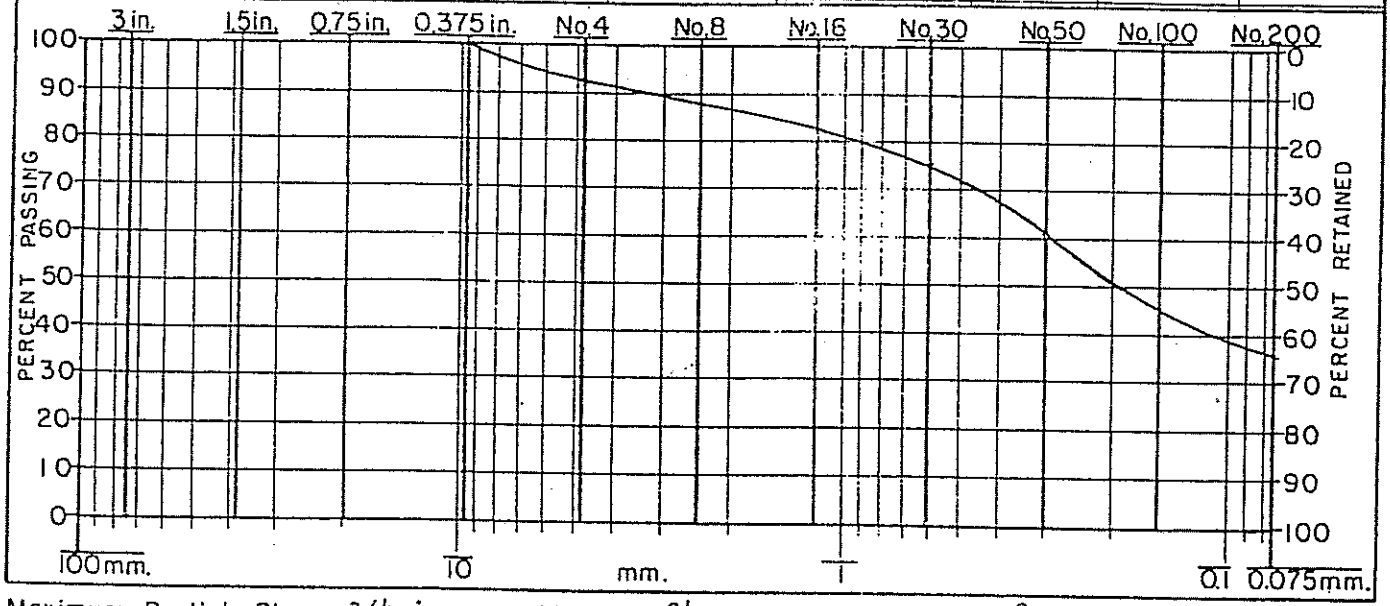
REPORT OF TEST ON SAND, clayey

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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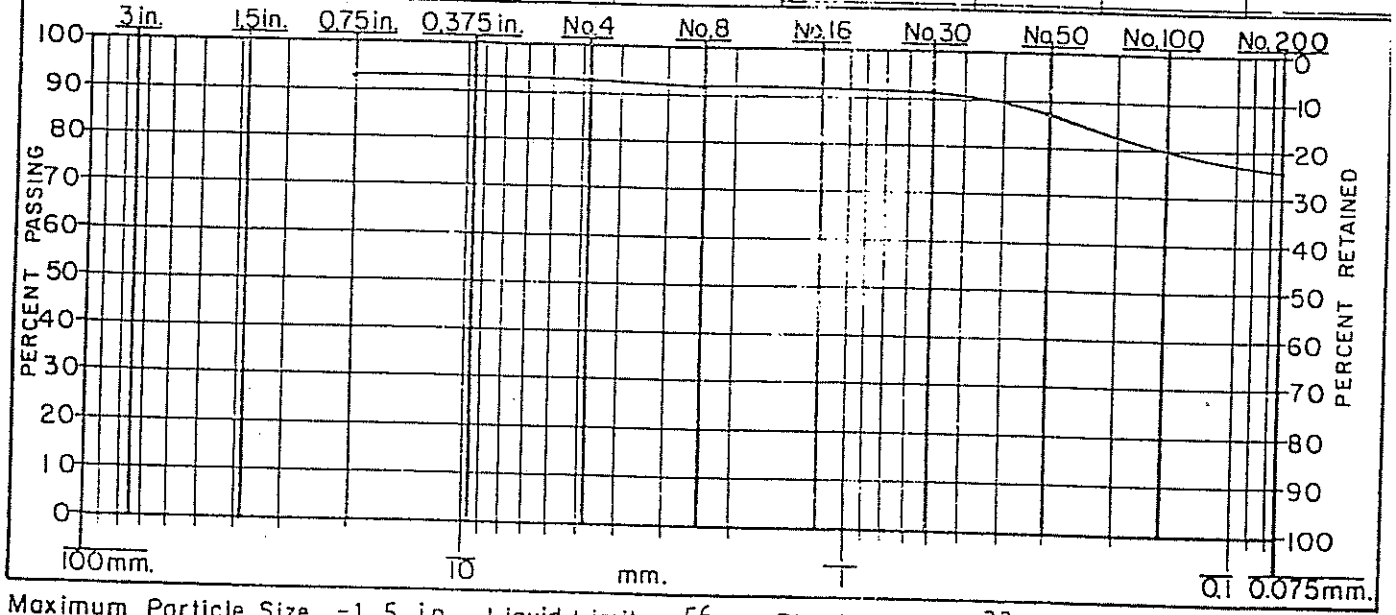
REPORT OF TEST ON CLAY of high plasticity

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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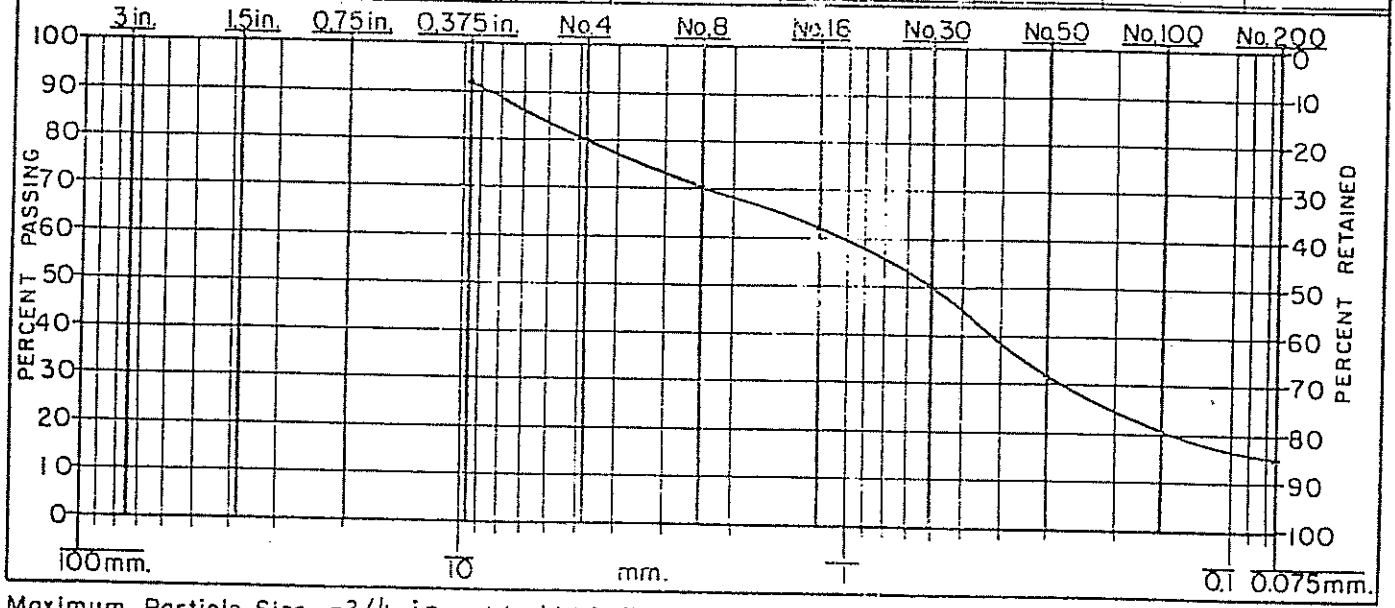
REPORT OF TEST ON SAND, silty

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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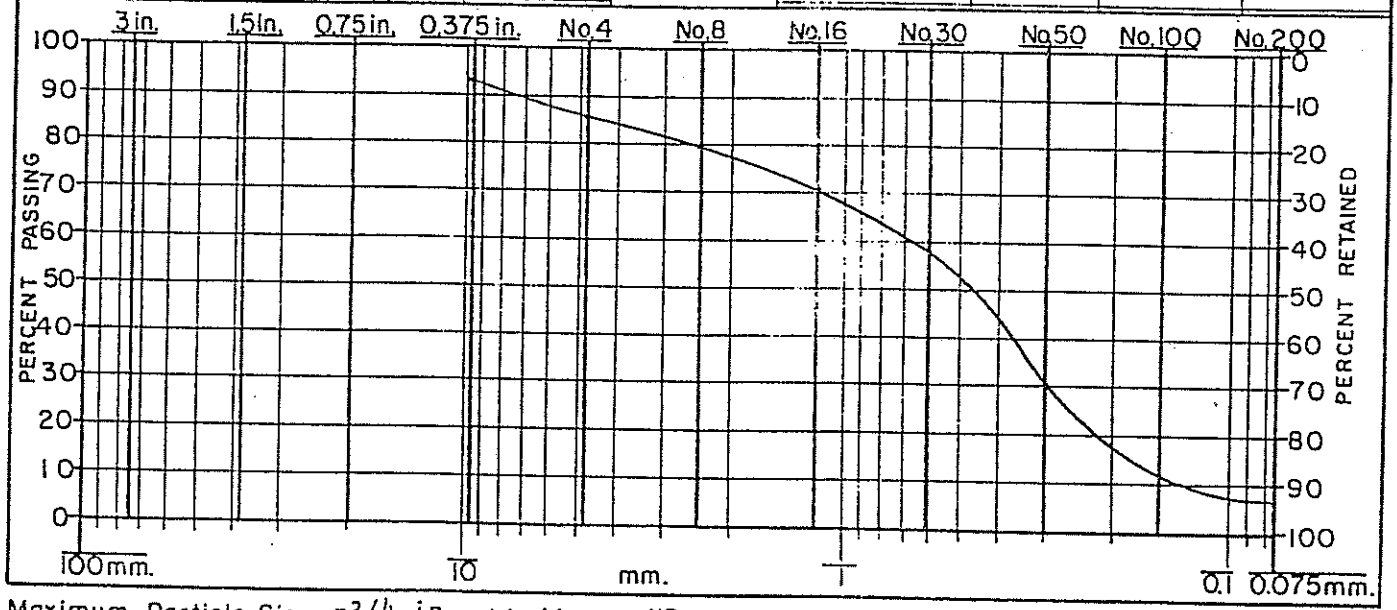
REPORT OF TEST ON SAND, poorly graded, SAND, silty

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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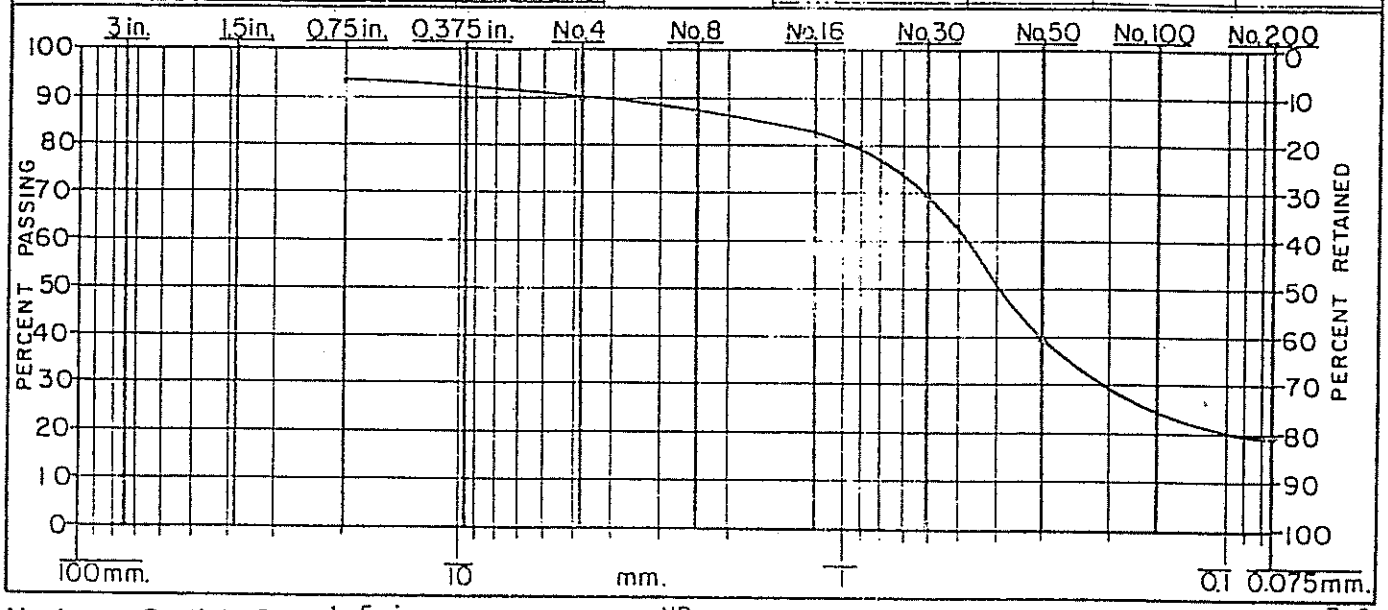
REPORT OF TEST ON SAND, silty

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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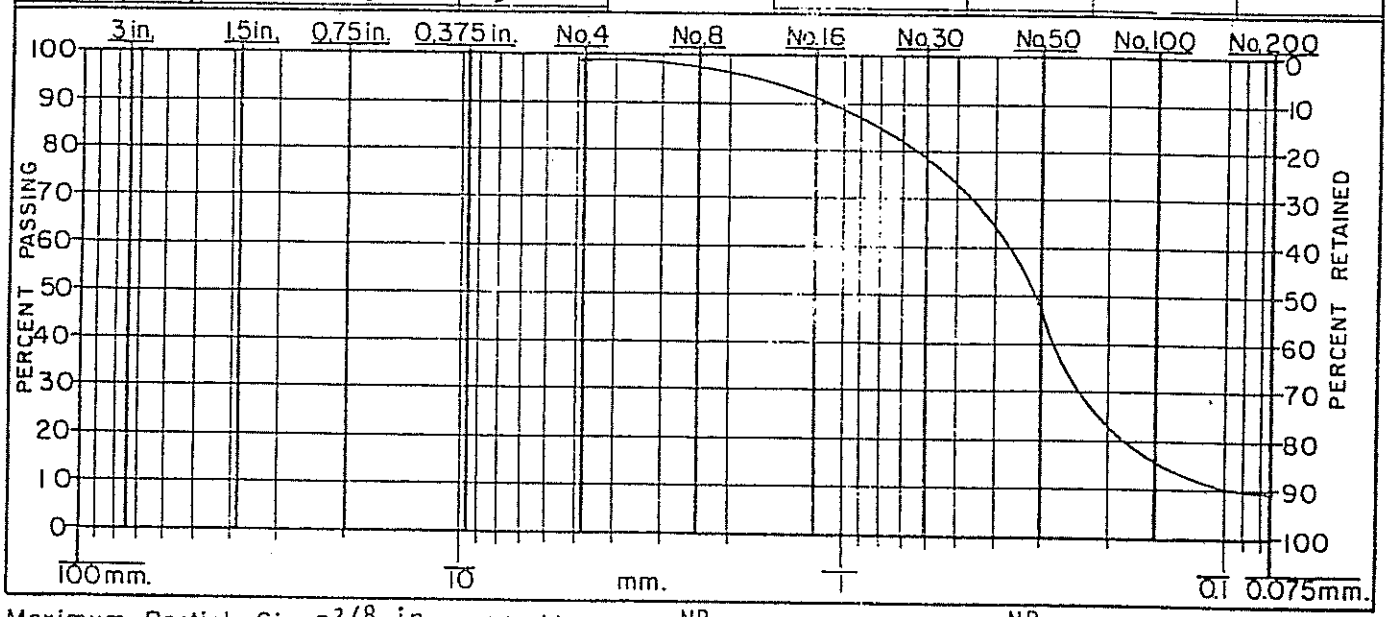
REPORT OF TEST ON SAND, poorly graded, SAND, silty

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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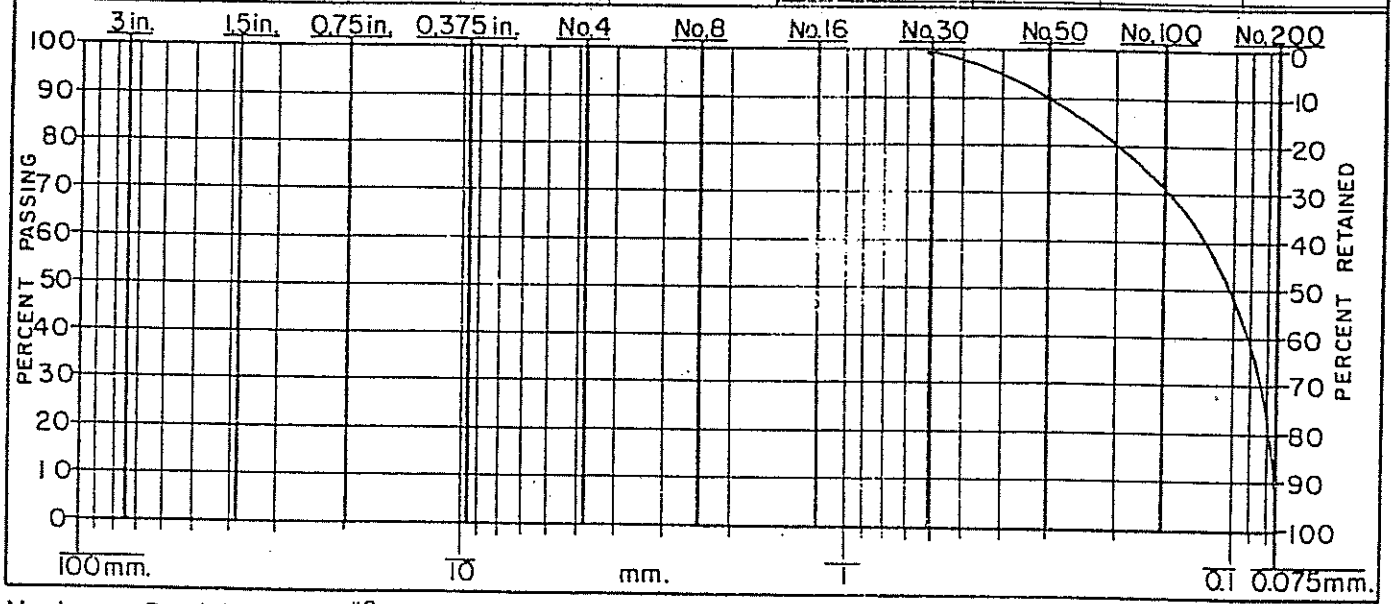
REPORT OF TEST ON SAND, poorly graded, SAND, silty

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

This report covers laboratory procedures in accordance with ASTM D 2487, D 2217, D422, D423, D424 & D2216.

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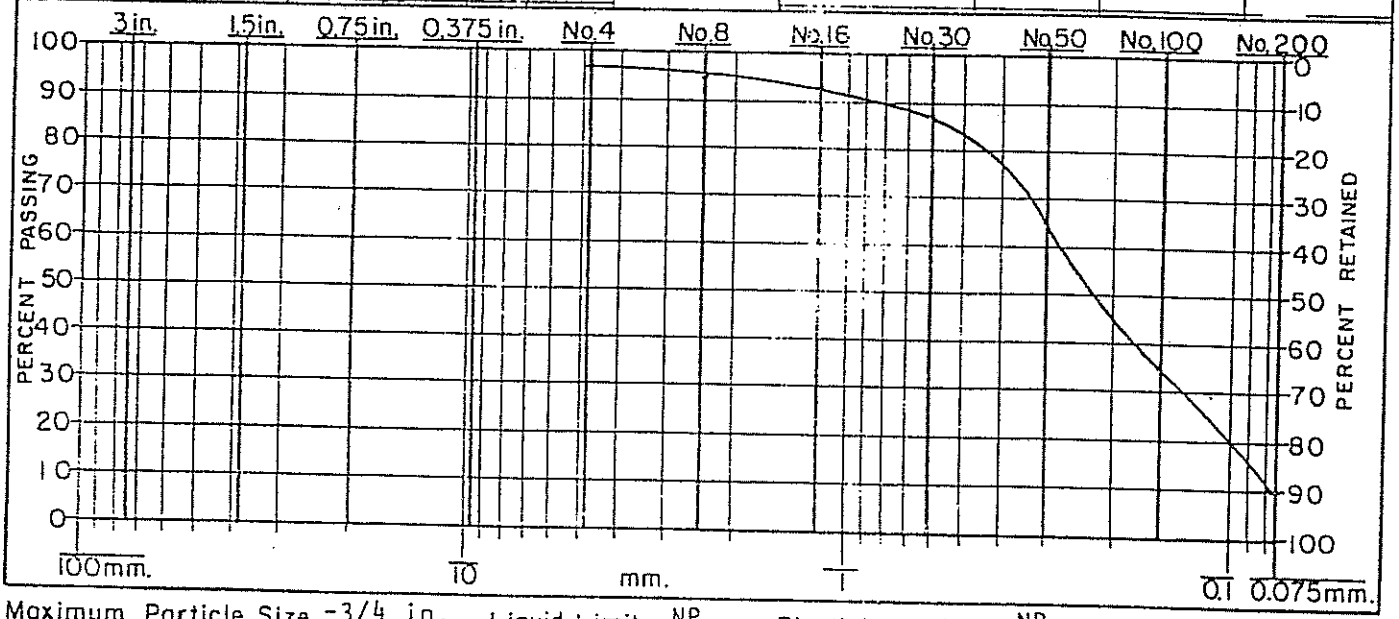
REPORT OF TEST ON SAND, poorly graded, SAND, silty

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

This report covers laboratory procedures in accordance with ASTM D 2487, D 2217, D422, D423, D424 & D2216.

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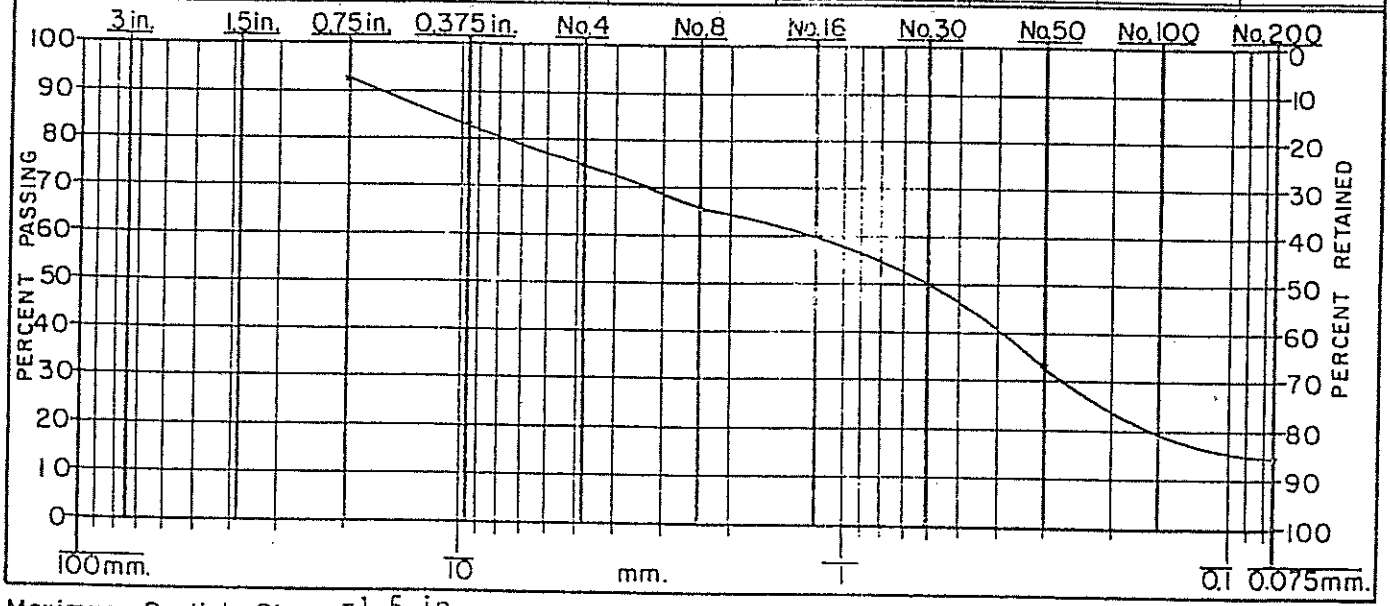
REPORT OF TEST ON SAND, silty

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

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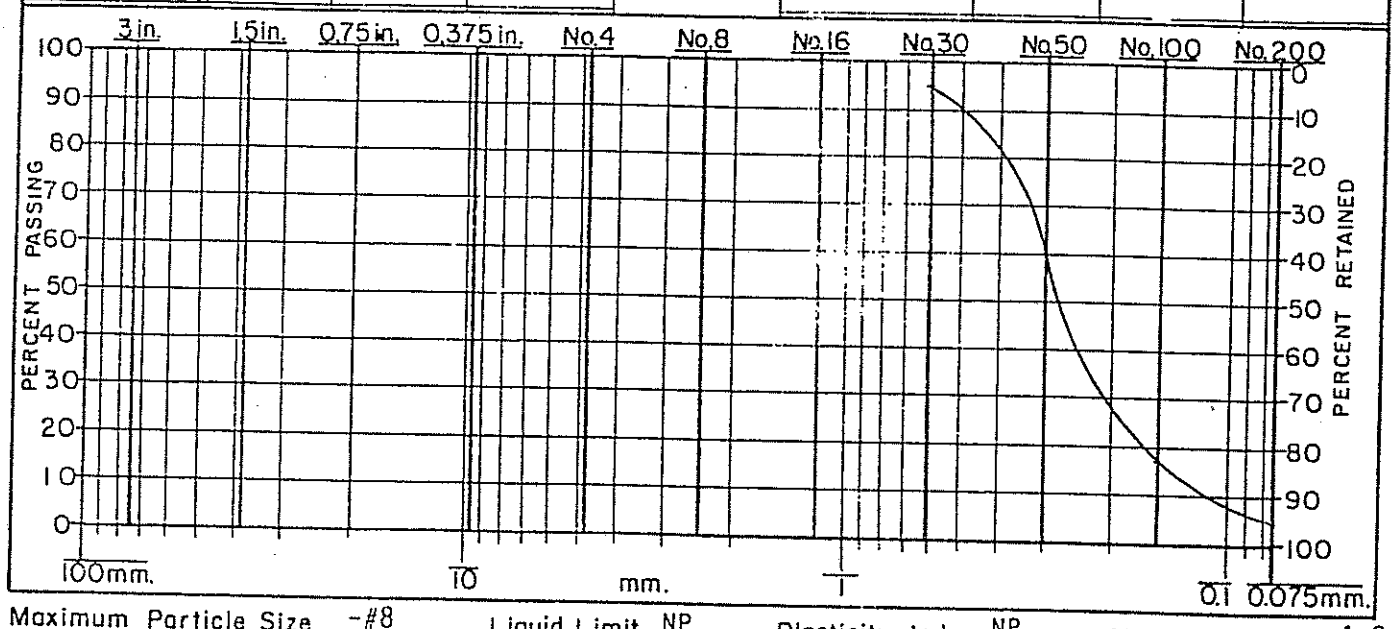
REPORT OF TEST ON SAND, poorly graded

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

This report covers laboratory procedures in accordance with ASTM D 2487, D 2217, D422, D423, D424 & D2216.

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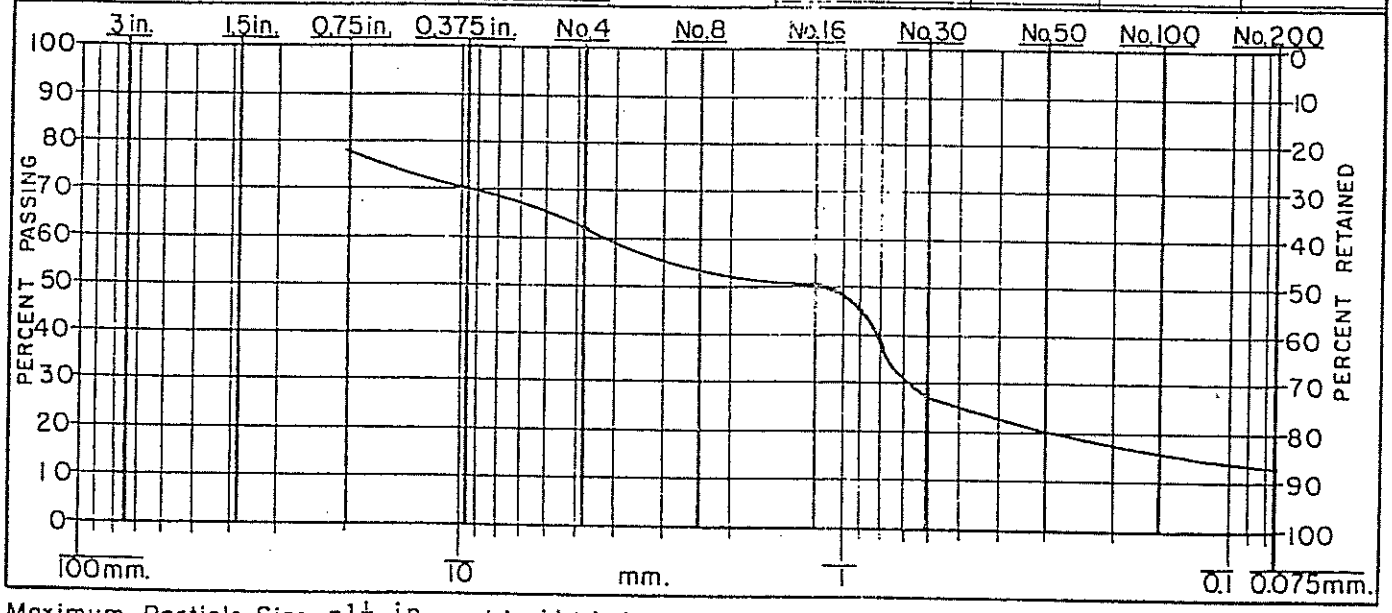
REPORT OF TEST ON SAND, silty

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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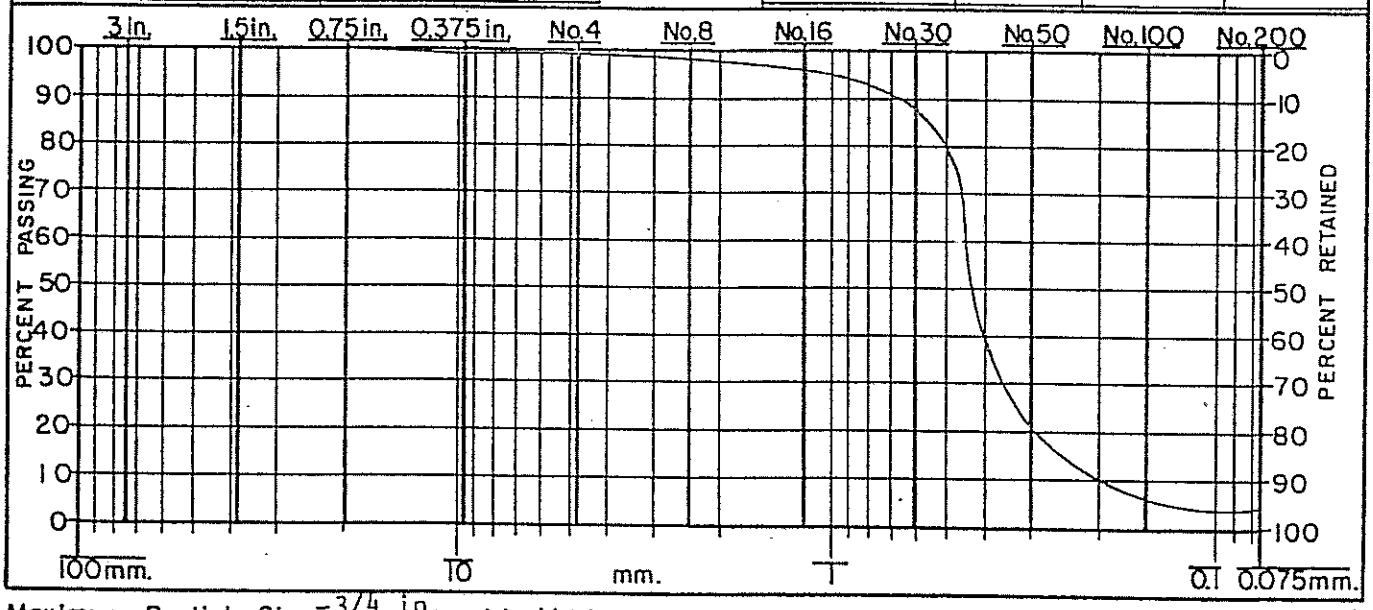
REPORT OF TEST ON SAND, poorly graded

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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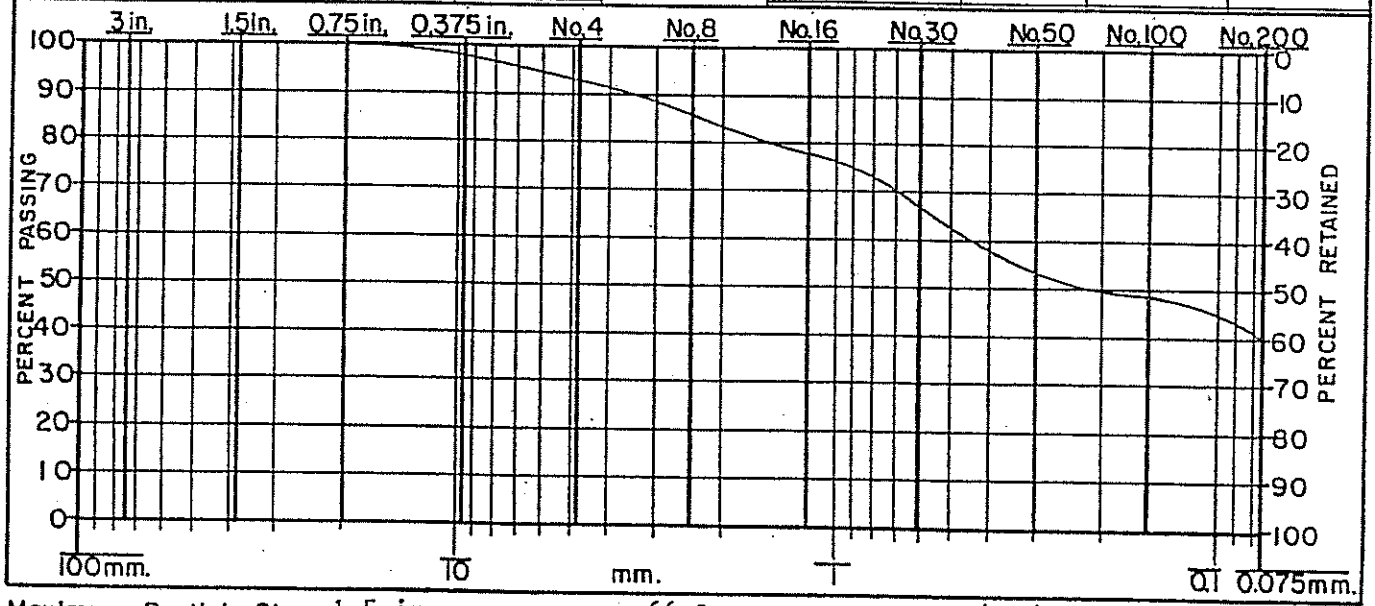
REPORT OF TEST ON SAND, clayey

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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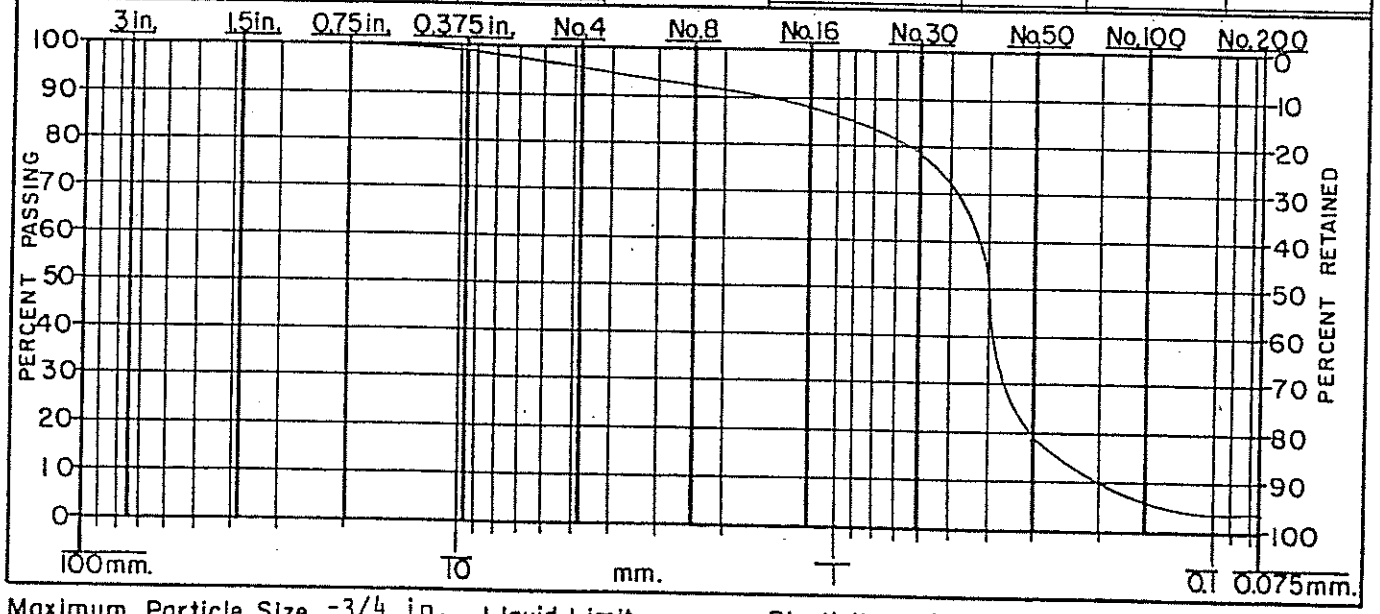
REPORT OF PARTICLE SIZE ANALYSIS

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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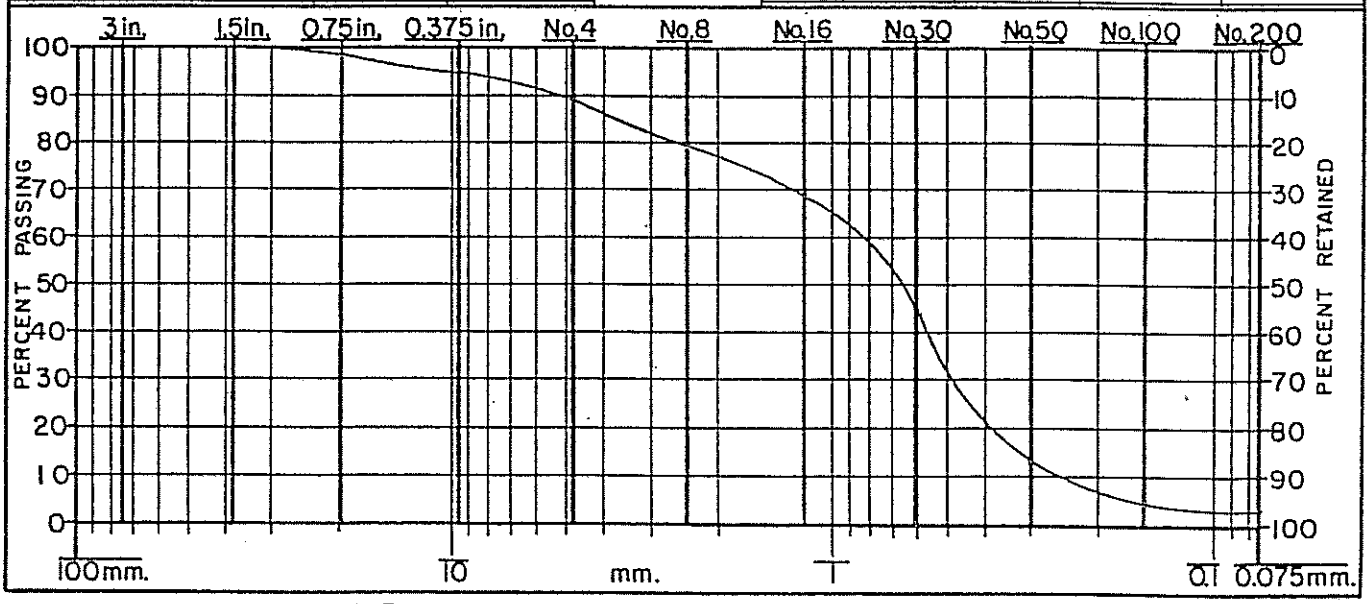
REPORT OF TEST ON SAND, poorly graded

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

This report covers laboratory procedures in accordance with ASTM D 2487, D 2217, D 422, D 423, D 424 & D 2216.

REMARKS:

COPIES TO

LABORATORY NO

FILE NO 82182

Danny R Anderson, Consultants

GEOTECHNICAL ENGINEERS
2525 EAST YANDELL DR
EL PASO, TEXAS 79903
(915) 532-7566

DATE

PROJECT Northeast Landfill

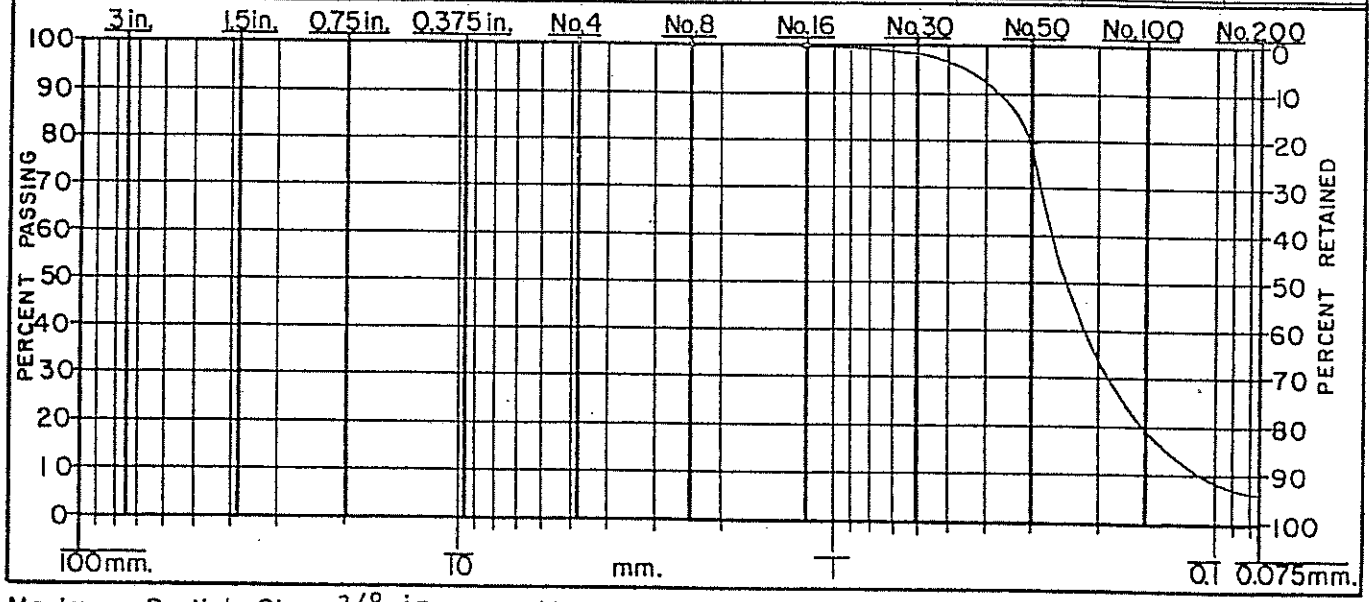
REPORT OF TEST ON SAND, poorly graded, SAND, silty

RECEIVED FROM Boring Number 7 at 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.

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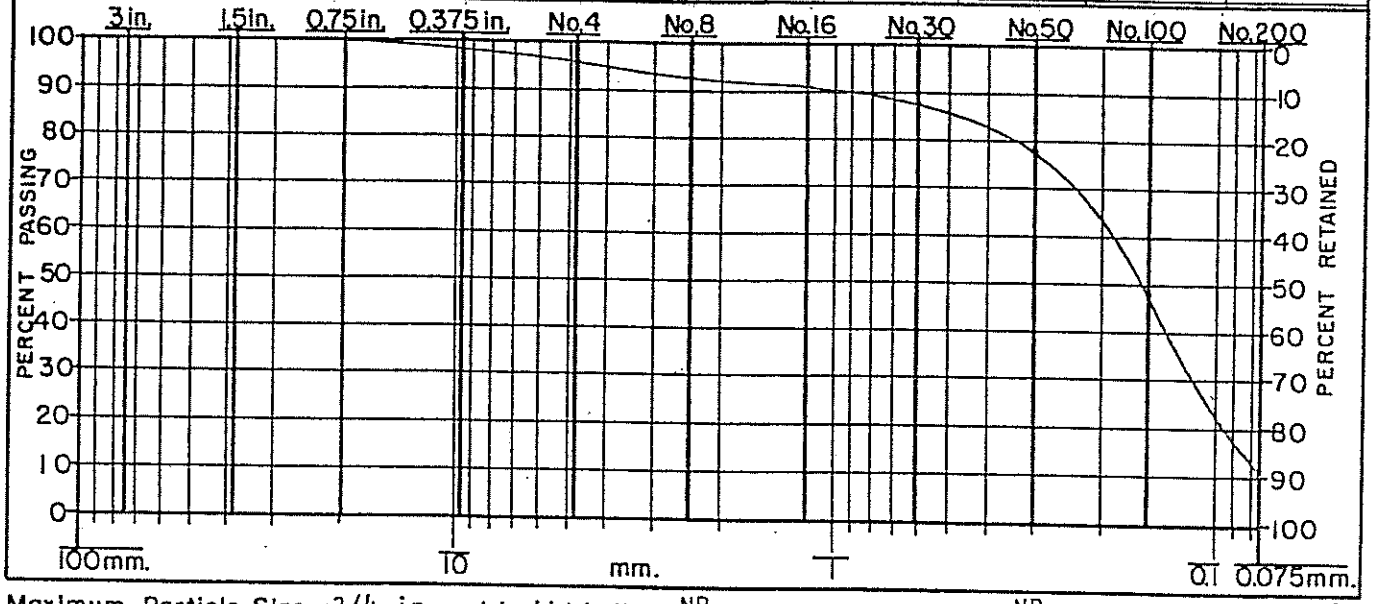
PROJECT Northeast Landfill

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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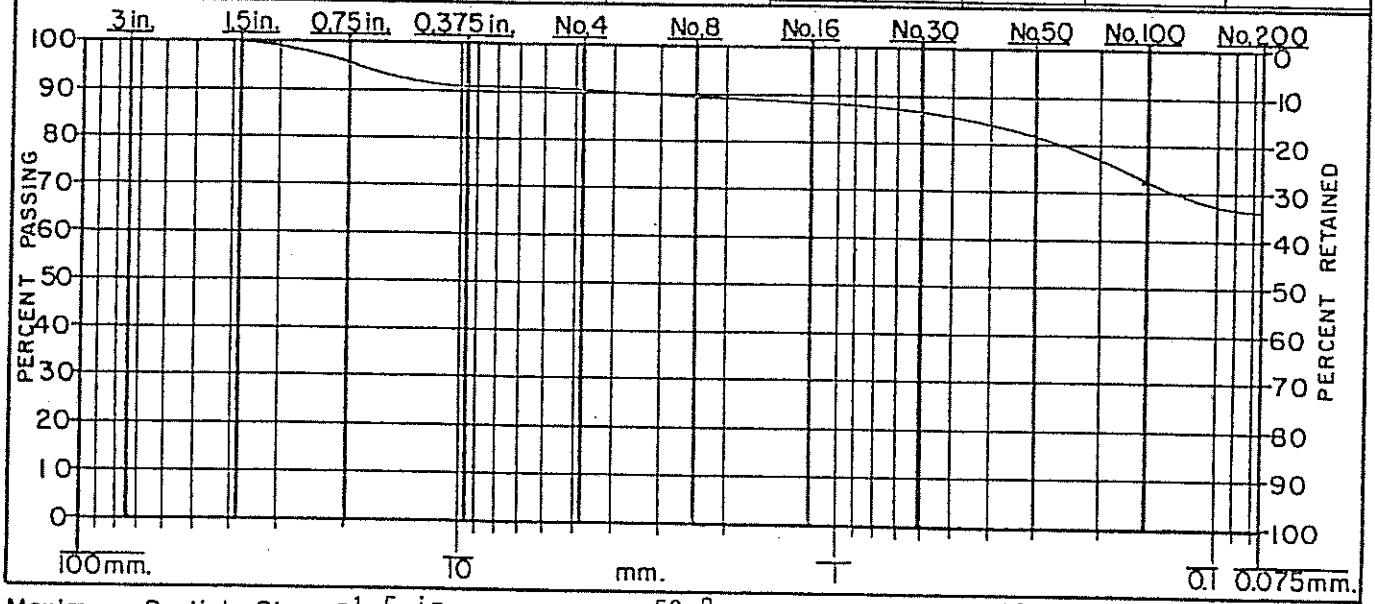
PROJECT Northeast Landfill

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

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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Sheet A41

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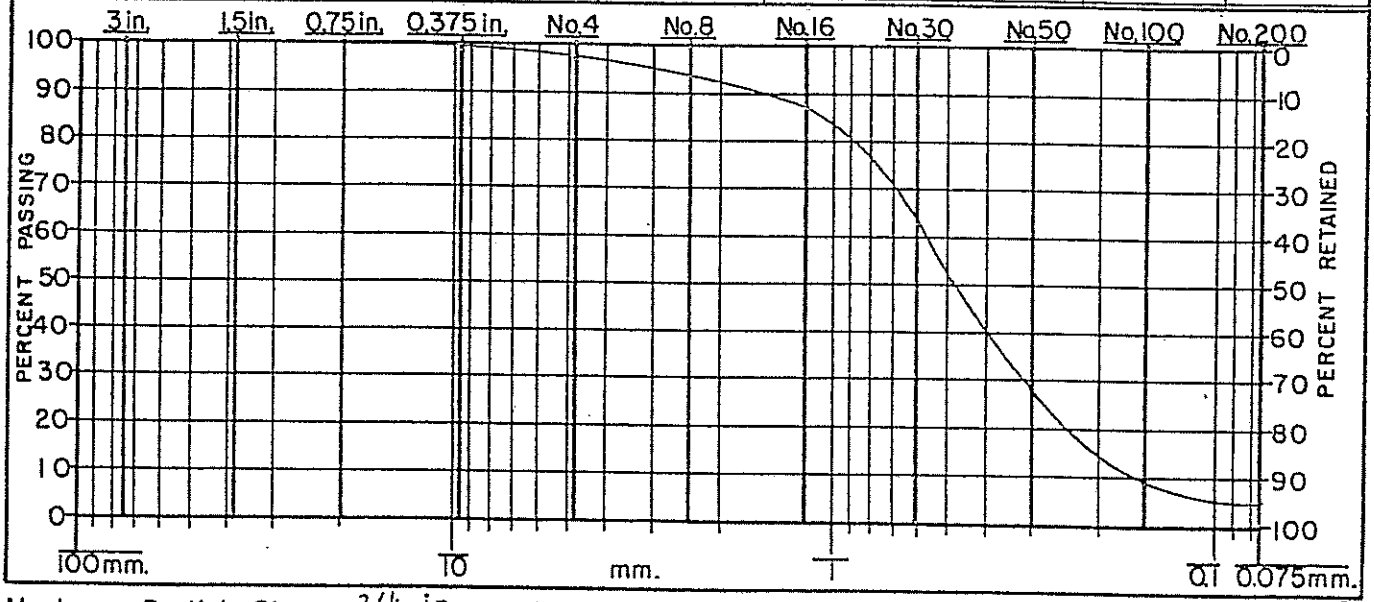
PROJECT Northeast Landfill

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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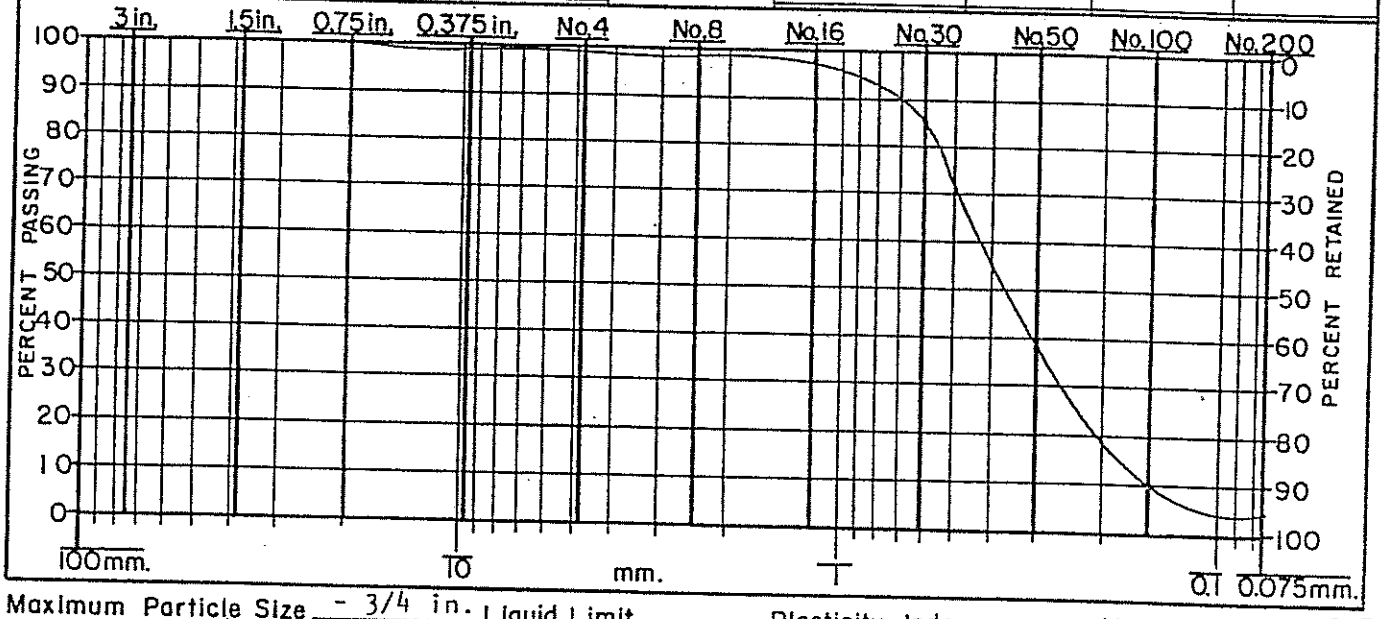
PROJECT Northeast Landfill

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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PROJECT Northeast Landfill

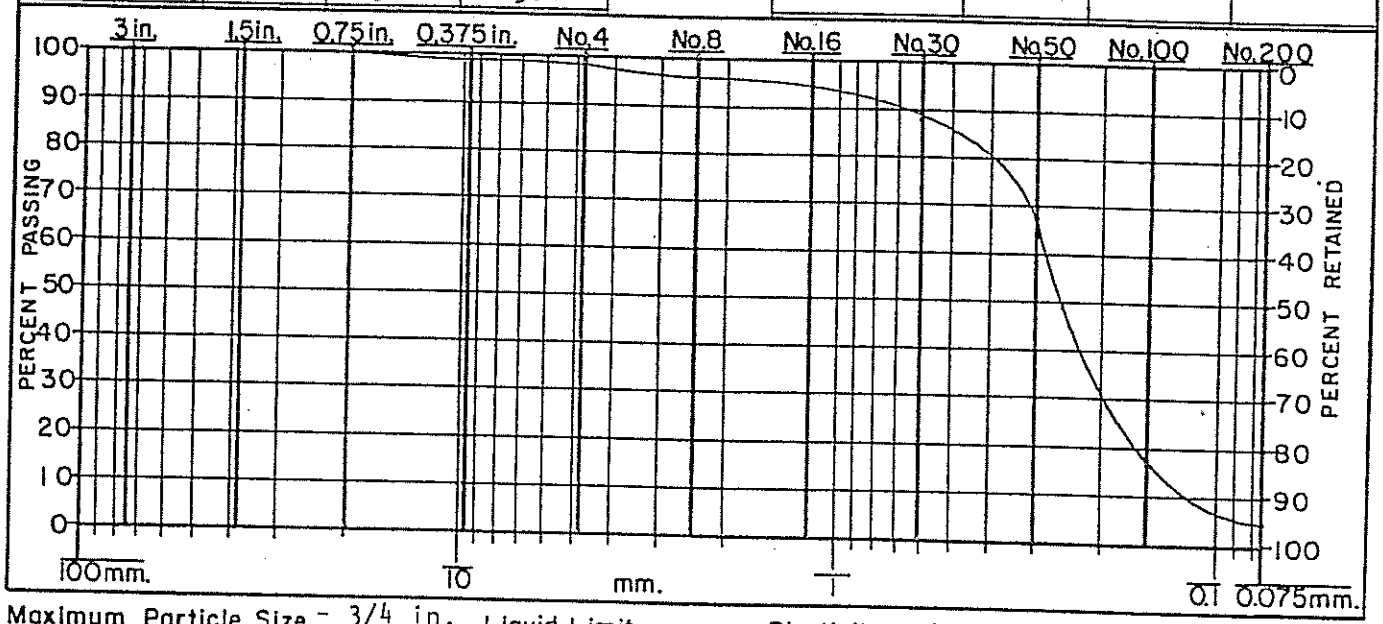
REPORT OF TEST ON SAND, poorly graded

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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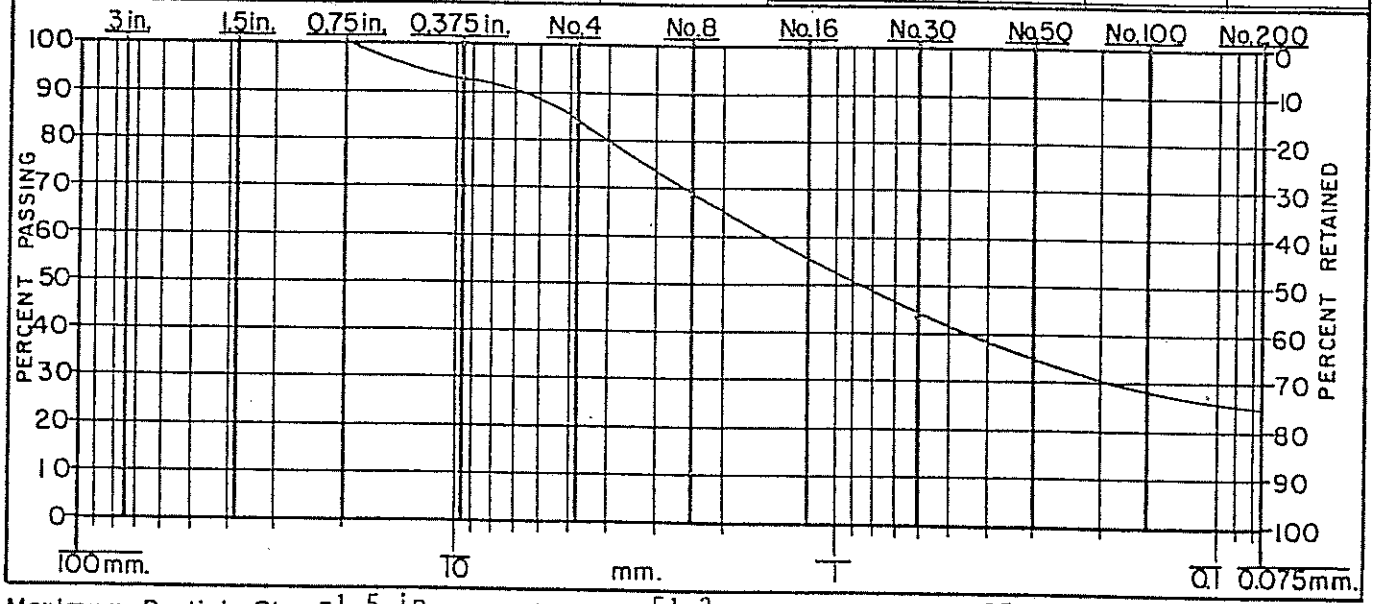
PROJECT Northeast Landfill

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

This report covers laboratory procedures in accordance with ASTM D 2487, D 2217, D422, D423, D424 & D2216.

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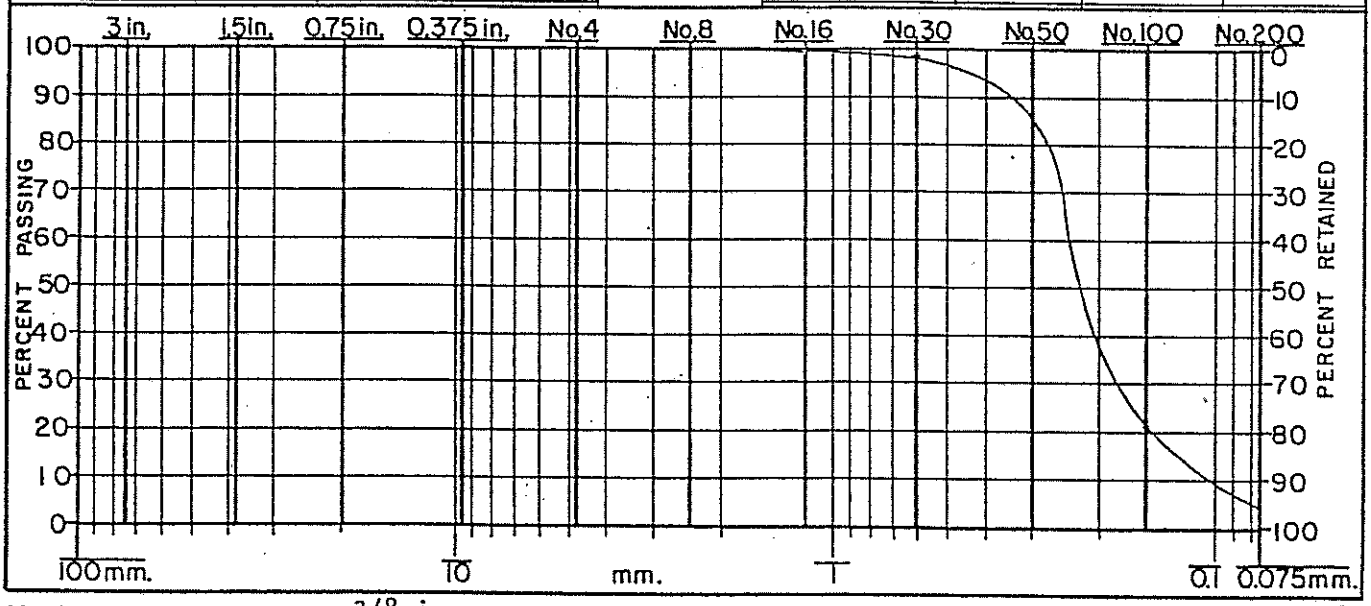
PROJECT Northeast Landfill

REPORT OF TEST ON SAND, poorly graded

RECEIVED FROM Boring Number 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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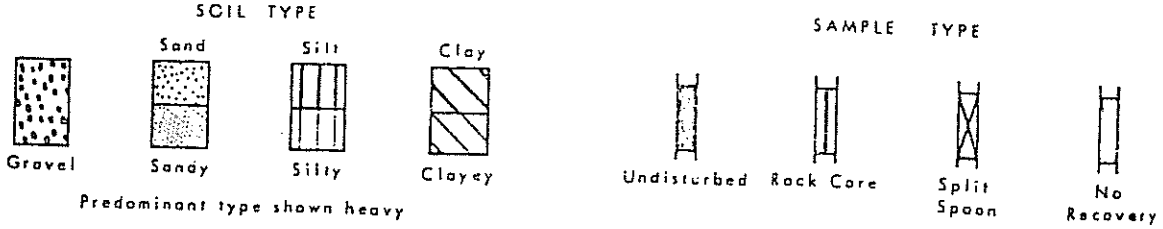
KEY TO SOIL CLASSIFICATIONS AND SYMBOLS



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

SAIC

To: TCEQ

From: Randall J. Sippel, P.G., SAIC RJS

Subject: Appendix 3K, Attachment 4 – Location Restrictions

Date: November 2, 2012

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

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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

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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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.

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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

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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.usgu.gov/research/hazmap/

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."

- 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.

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).

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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.

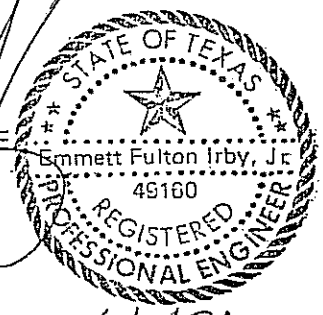
The results of our evaluation suggest the McCombs Municipal Landfill is not subject to restrictsions due to the presence of floodplains, wetlands, seismic zones or unstable areas. The site is not subject to restrictions due to the presence of nearby airports.

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."

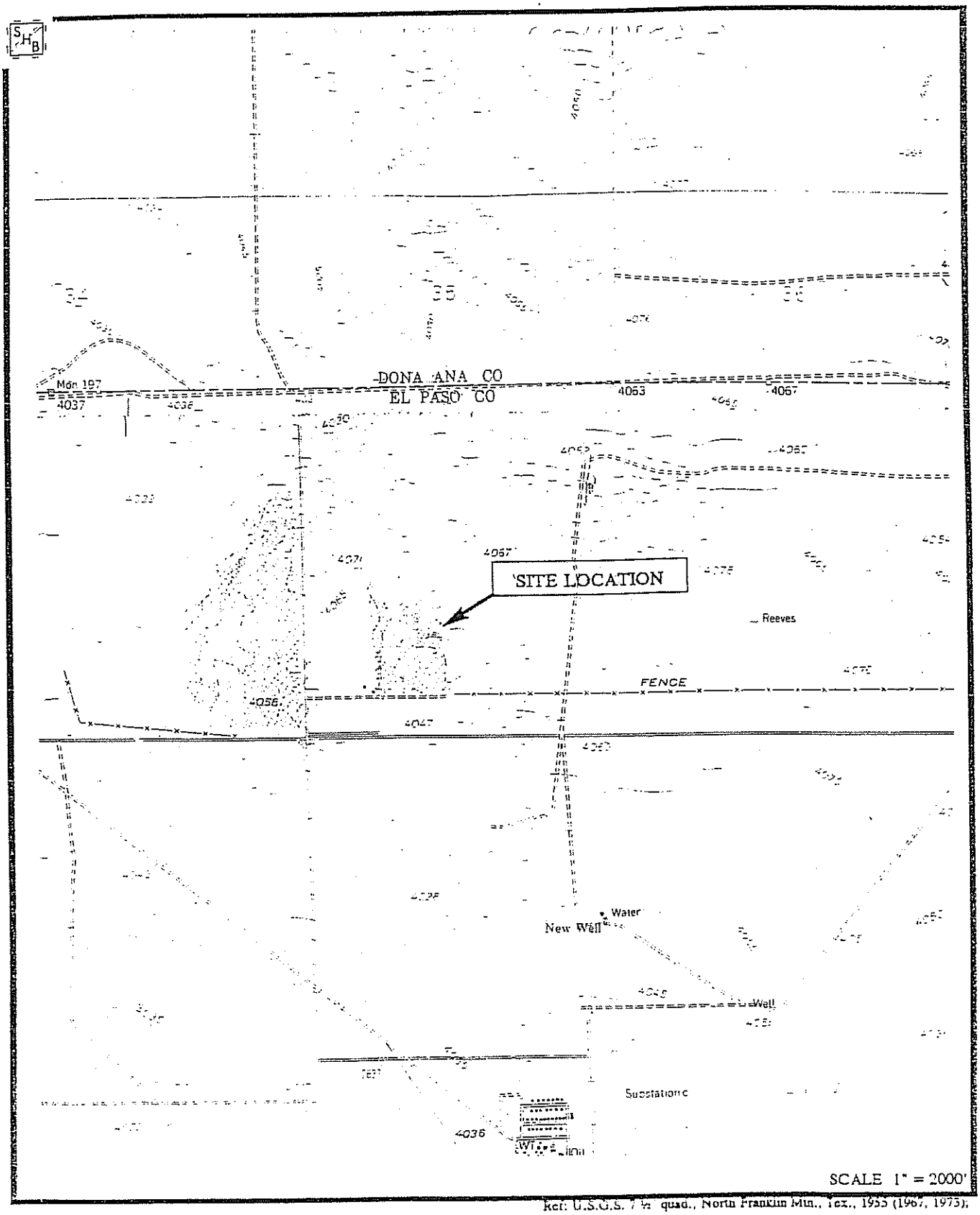
In summary these location restrictions state that existing MSWLF's within 10,000 feet of the end of any runway used by turbojet aircraft or within 5000 feet of runways used only by piston-type aircraft must demonstrate that the MSWLF does not pose a bird hazard to aircraft. Existing MSWLF's may not restrict 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

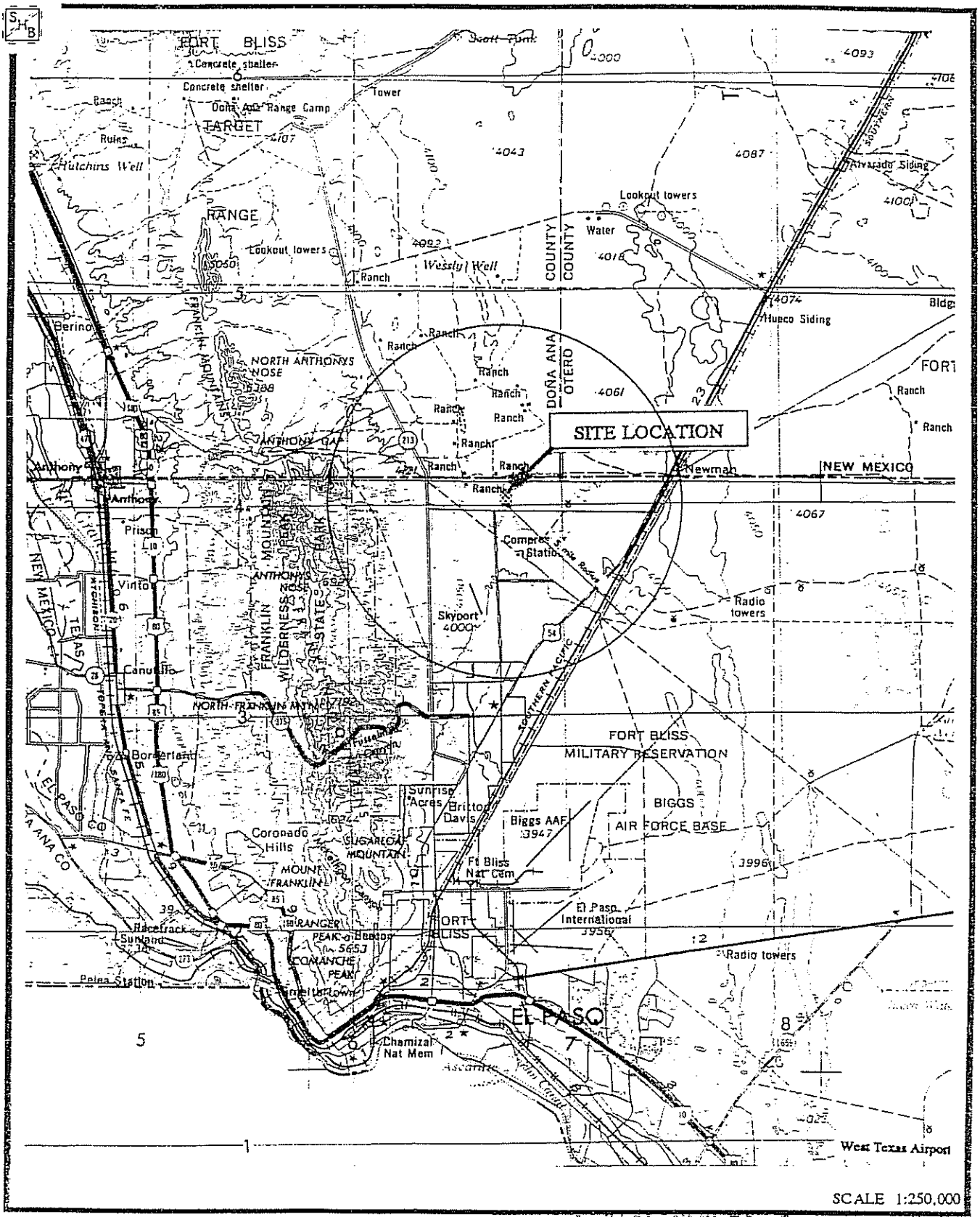
The initial permit application for the McCombs Landfill was completed by DRA on behalf of the City. The permit application addressed site characteristics, and included discussions of the types of wastes to be accepted, and presents pertinent operational and maintenance criteria. Subsurface investigations 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.

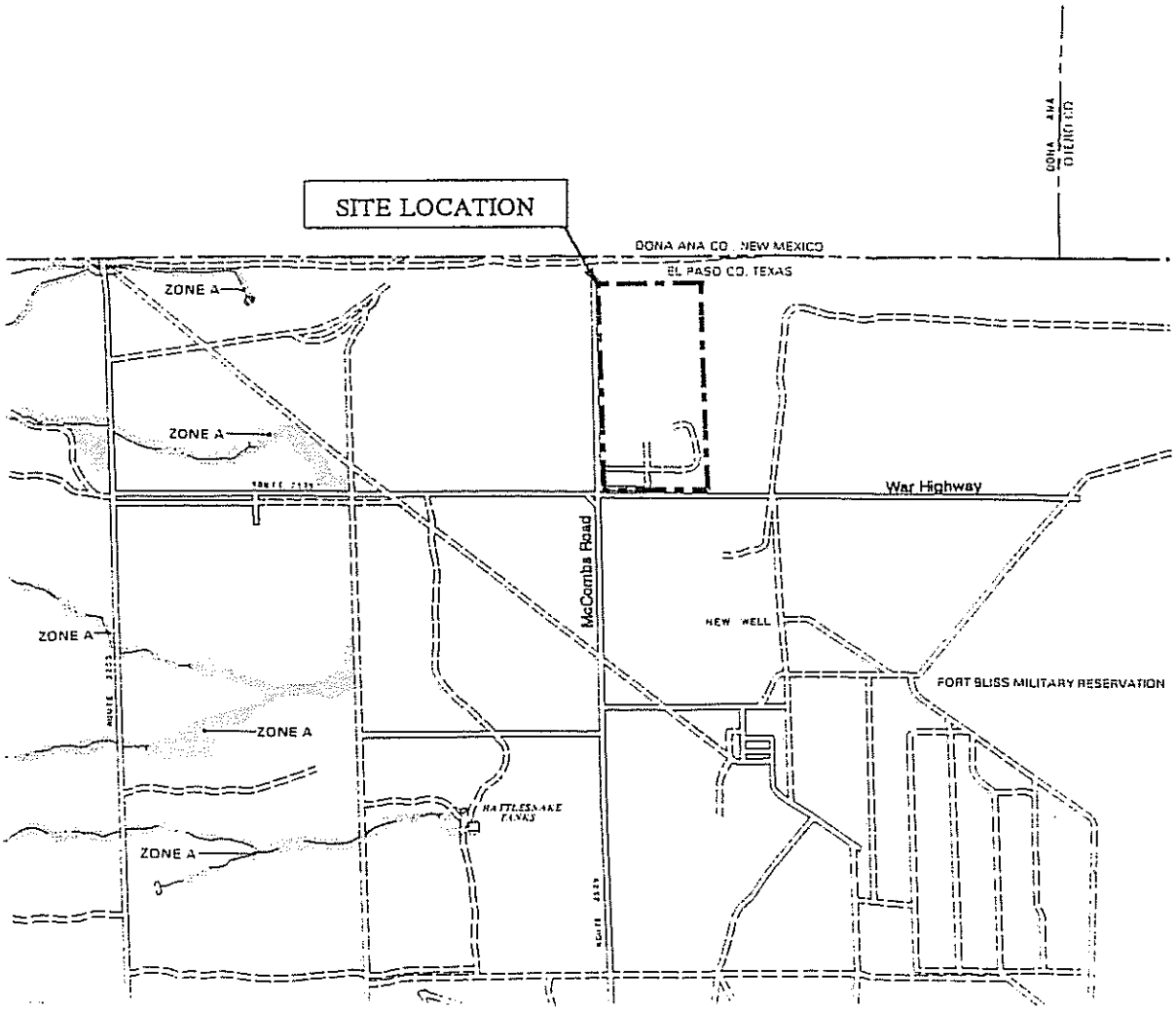
The FIRM map shown on Figure 3 indicates that the site does not lie within a designated 100-year floodplain.

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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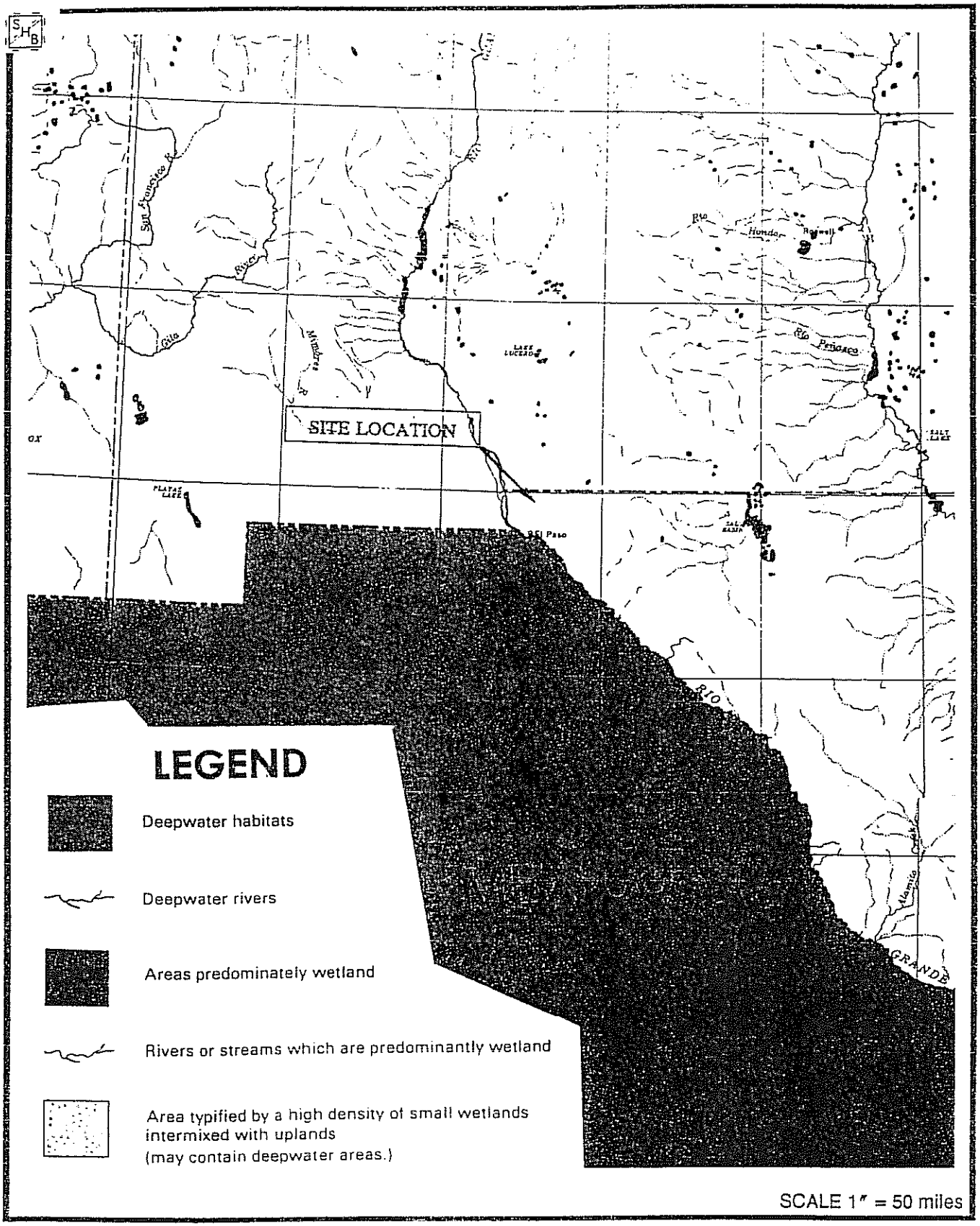

Location Restrictions Evaluation
McCombs Landfill
El Paso, Texas
Job No. E94-4082

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.
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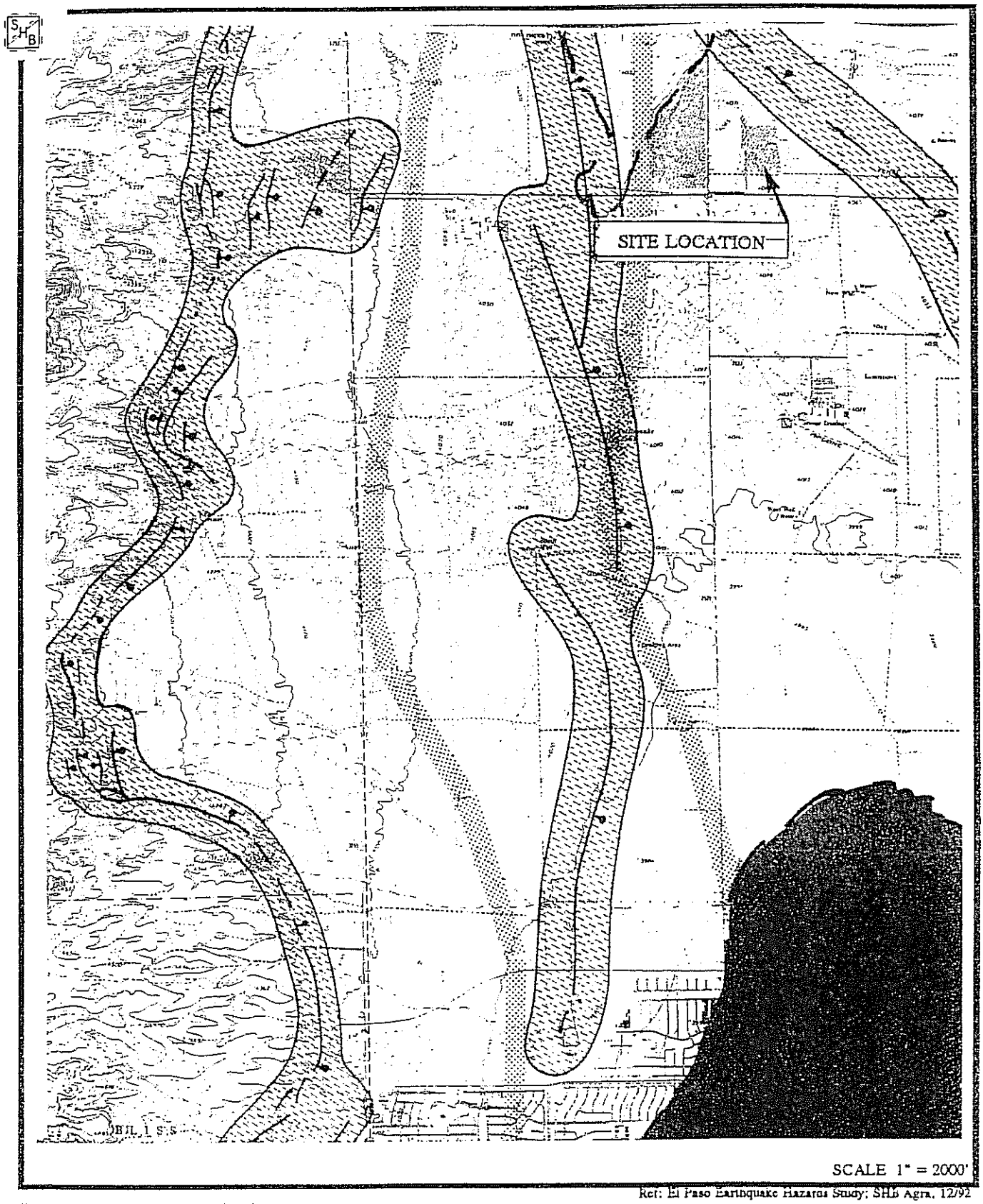
Numerous fault scarps of Quaternary age are present in the Hueco Bolson near the landfill. One inferred scarp apparently traverses the northeastern quadrant of the landfill permit area (SHB, 1993). This fault was not identified on the geologic map prepared by Harbour (1972). Insufficient information 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.

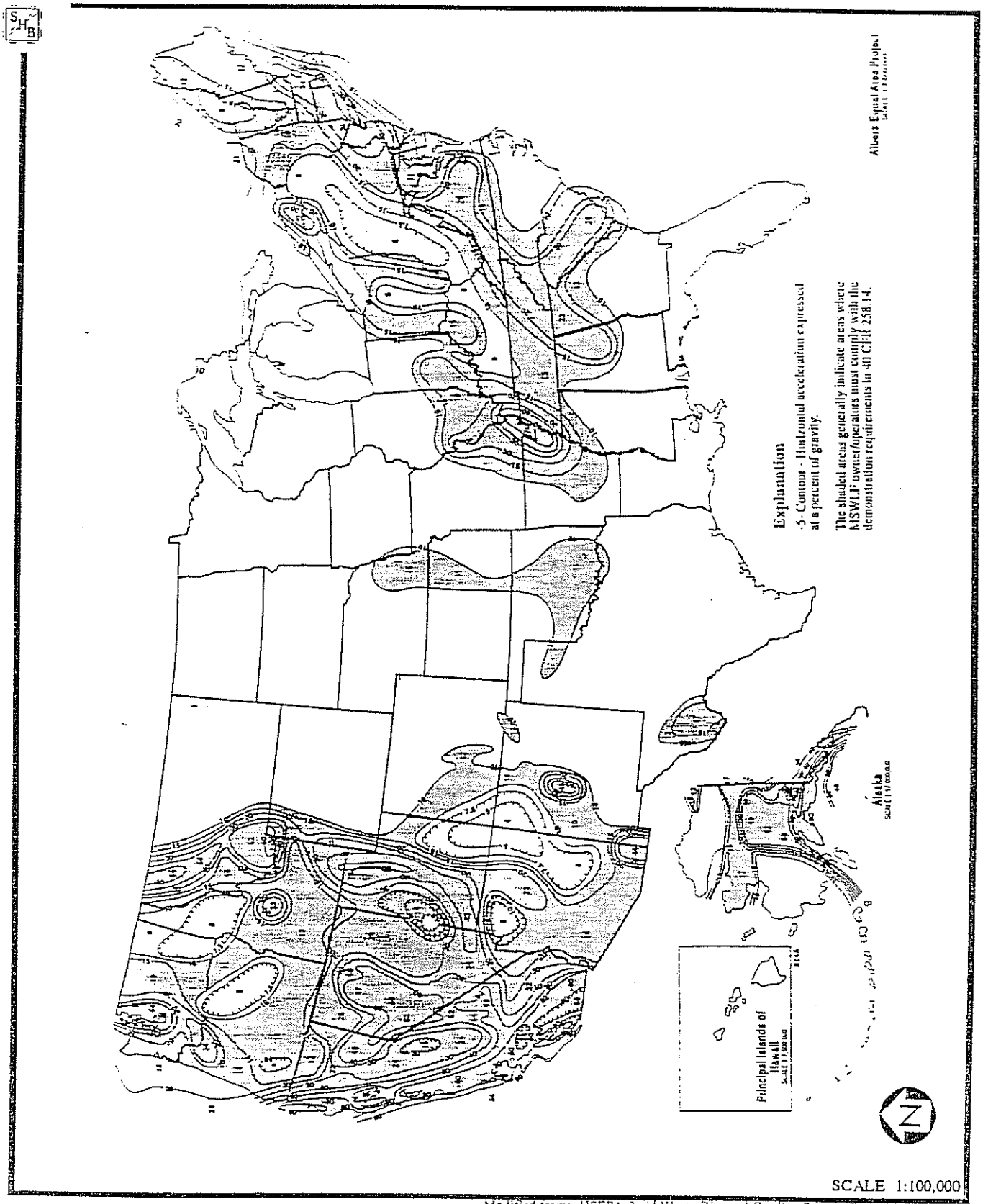
El Paso County (and the Landfill) fall outside of any designated seismic impact zones (See Figure 6).

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.

Bureau of Economic Geology, 1983, Geologic Atlas of Texas, Van Horn-El Paso Sheet, the University of Texas at Austin, Austin, Texas.

Collins, E.W., and Raney, J.A., 1991, Tertiary and Quaternary Structure and Paleotectonics of the Hueco Basin, Trans-Pecos Texas and Chihuahua, Mexico; Texas Bureau of Economic Geology, Geologic Circular 91-2, 44p.

Danny R. Anderson Consultants, 1982, Southeast El Paso Sanitary Landfill, Report prepared for the City of El Paso.

El Paso Water Utilities, 1993, Water Table Contour Map, unpublished map.

Land, L.F., and Armstrong, C.A., 1985, A Preliminary Assessment of Land-Surface Subsidence in the El Paso, Texas Area, USGS Water Resources Investigations Report 85-4155, Austin, Texas, 96p.

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.

Serrano, Alfonso; 1993, City Engineering, personal communication.

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

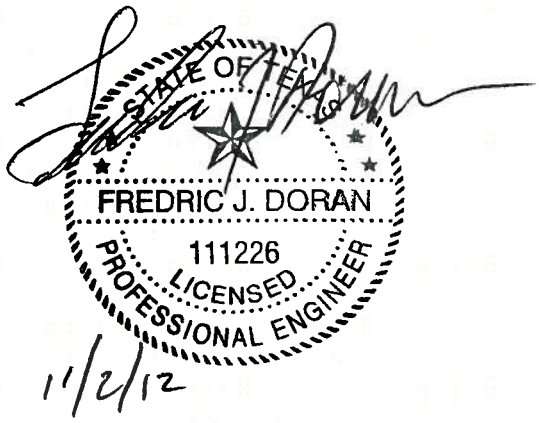
From: Fred J. Doran, SAIC

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

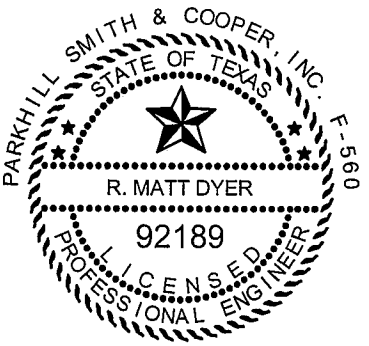
Monitor Well Installation Report

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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1.0 INTRODUCTION....1
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

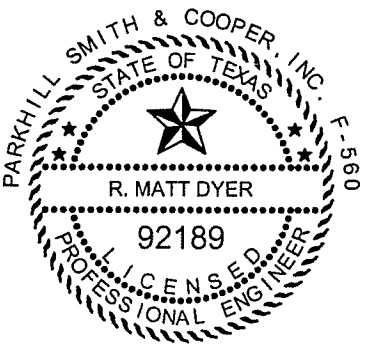
5.0 CERTIFICATION OF GROUNDWATER MONITORING SYSTEM

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** **El Paso , TX 79907**	Grid #:	**49-05-3**
Well Location:	**13600 McCombs St.** **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: _____

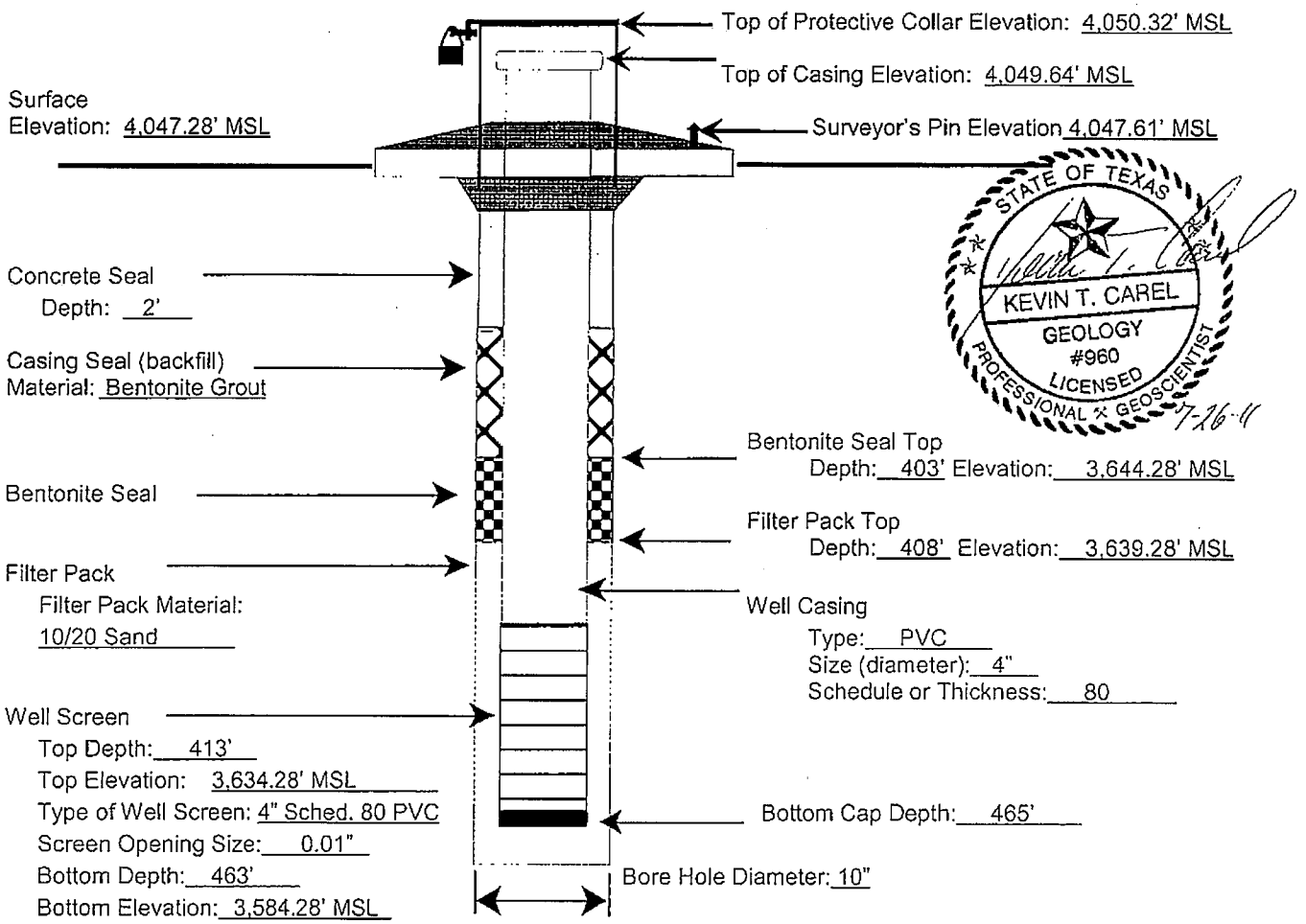
MSW Permit No.: 729A
Monitor Well I.D. No.: PZ-4
Date of Monitor Well Development: June 8, 2011
Monitor Well Driller
Name: William B. Bludworth
License No. 4885

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
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GEOLOGY
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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

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
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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 El Paso , TX 79907**	Grid #:	**49-05-3**
Well Location:	**13600 McCombs St. 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: _____

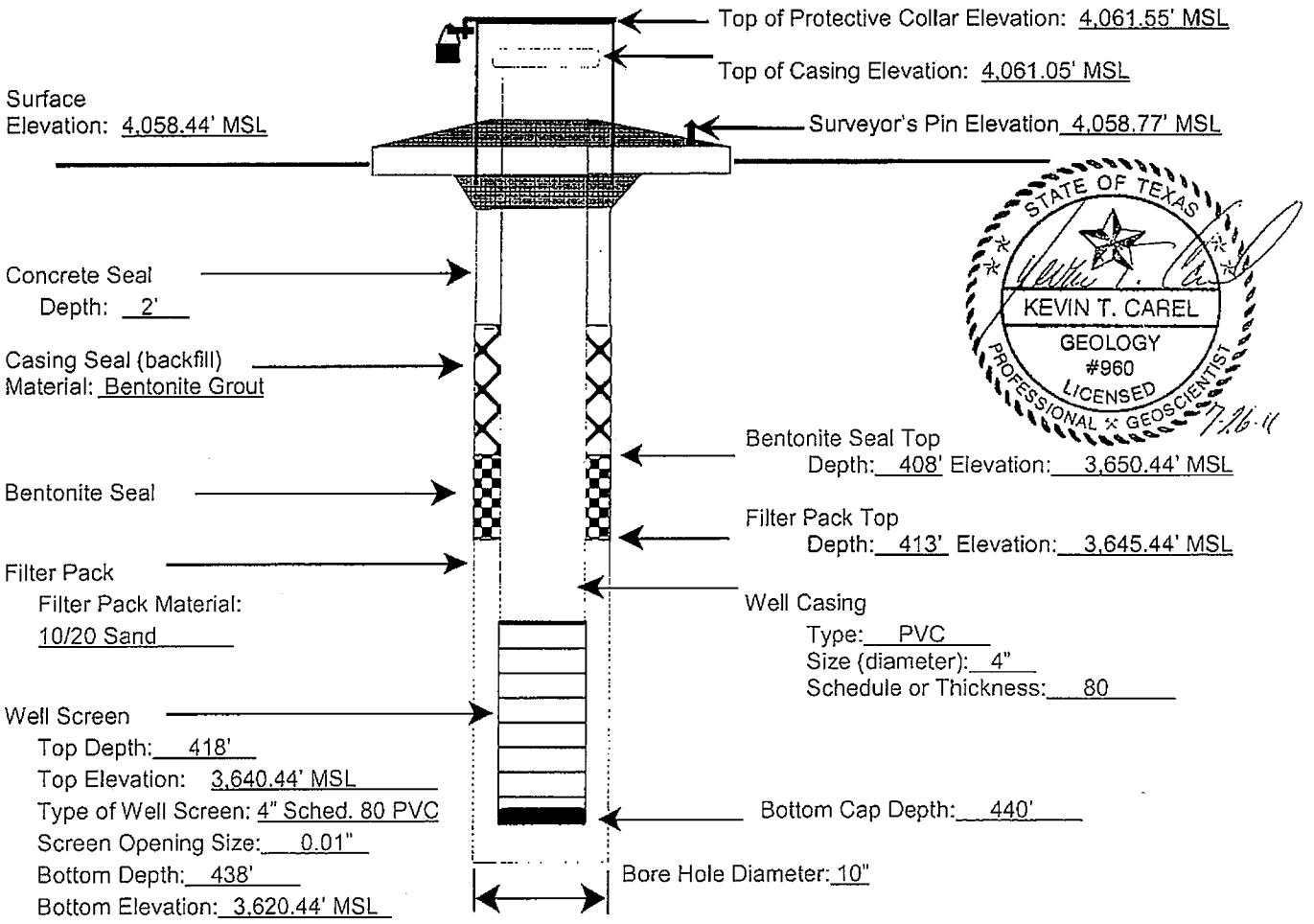
MSW Permit No.: 729A
Monitor Well I.D. No.: PZ-5
Date of Monitor Well Development: June 7, 2011
Monitor Well Driller
Name: William B. Bludworth
License No. 4885

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
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7-19-11

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Sampling Method: Cuttings
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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

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▽ Water level at time of drilling.
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LOG OF PIEZOMETER NO. PZ-5

Project Description: 2011 McCombs Landfill Piezometer Installations

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Surface El.: 4058.44 feet MSL
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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					

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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 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
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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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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*

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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.

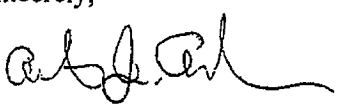
We therefore are modifying the request in our letter dated October 8, 2009, and ask that you begin monitoring in accordance with the facility GWSAP in existing monitor wells MW-1, 2, and 3, and in piezometer PZ-5 at the first event following the installation of PZ-5.

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) 10 mg/m³ / (% silica + 2) (respirable) 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. Any fume respirator or high efficiency particulate filter respirator. Any supplied-air respirator. Any self-contained breathing apparatus.
50 x PEL or less	A high efficiency particulate filter respirator with a full facepiece. Any supplied-air respirator with a full facepiece, helmet, or hood. 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. 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)). 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). 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 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 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	1.5×10^{-9} cm/sec (in fresh water)
Appearance	Beige to tan chips

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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). 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 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 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.

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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

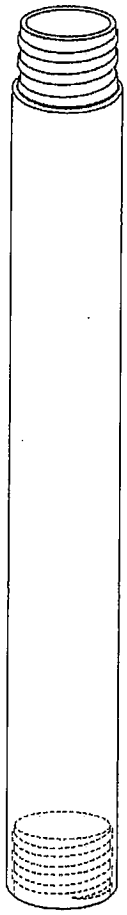
Customer Service	(800) 735-6075 Toll Free	(281) 871-4612
Technical Service	(877) 379-7412 Toll Free	(281) 871-4613

FLUSH THREAD PVC SCREEN AND CASING

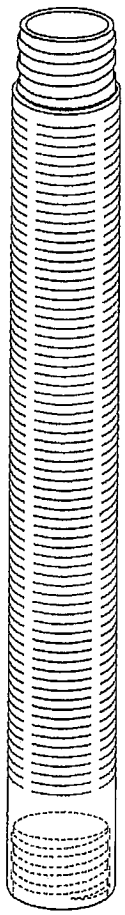
- ✓ Monoflex CNC computer lathed flush threads follow ASTM F-480 recommendations for reliable, consistent results on the job site.
- ✓ Our close tolerances provide a strong connection while retaining ease of assembly.
- ✓ Manufactured from quality PVC pipe, Monoflex flush thread screens and casings are 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.

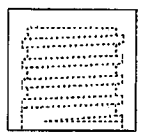
Please specify part number when ordering.



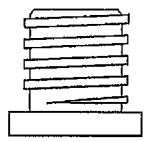
Flush Thread Casing



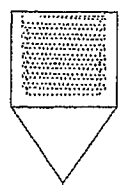
Flush Thread Screen



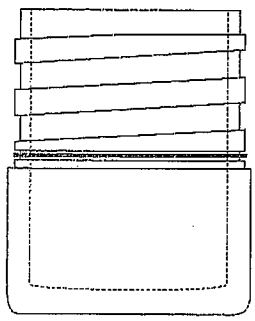
Female Cap (solid)



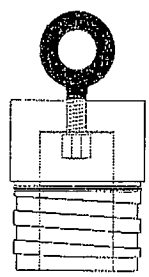
Male Plug (solid)



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.

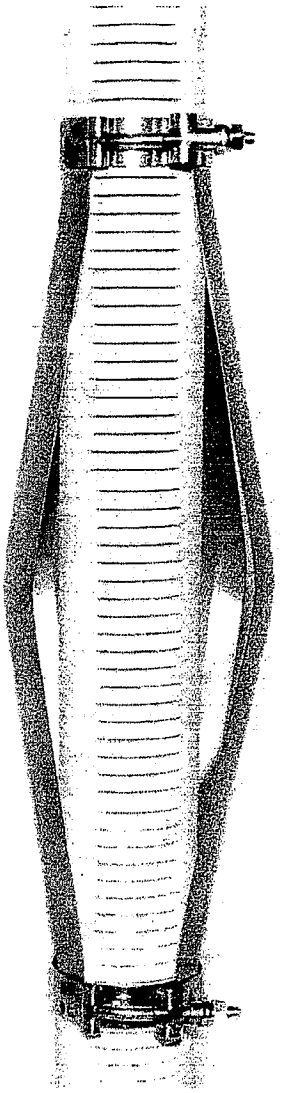
Stainless Steel Centralizers

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

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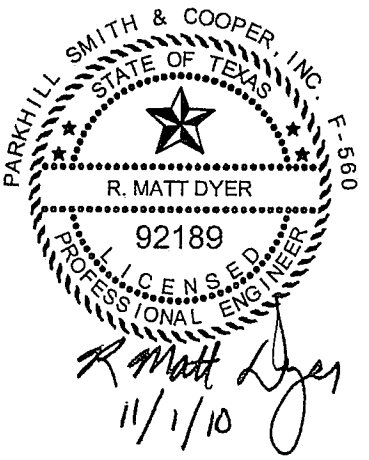


November 2010

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.

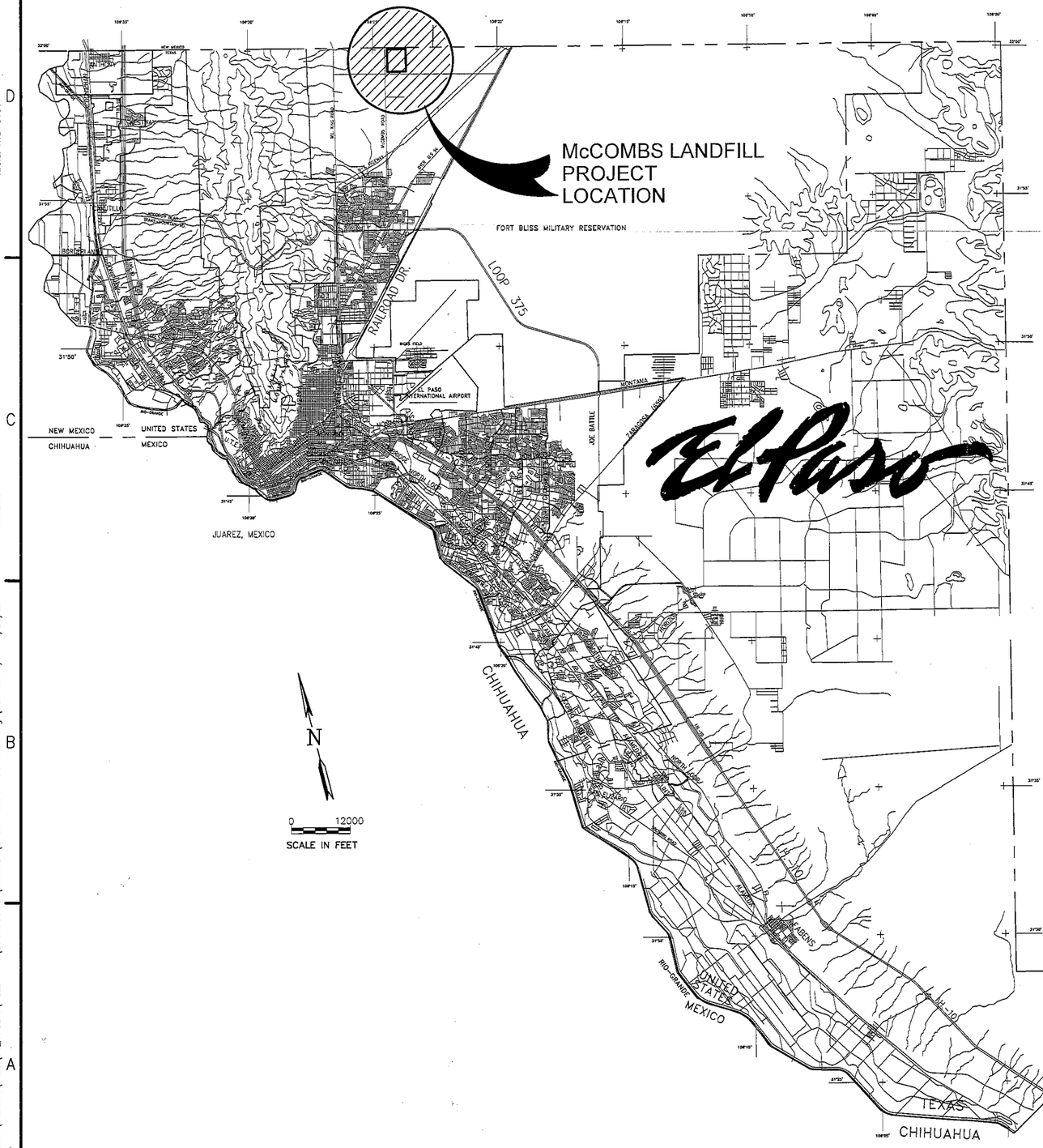
3.7 DEFECTIVE CONCRETE

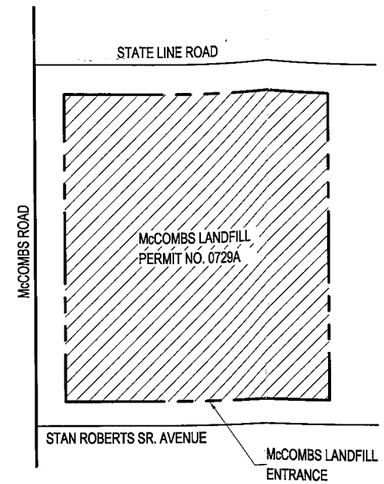
A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
B. Repair or replacement of defective concrete will be determined by the Engineer.
C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction 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

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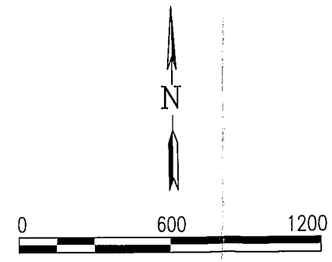

LEGEND

- 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

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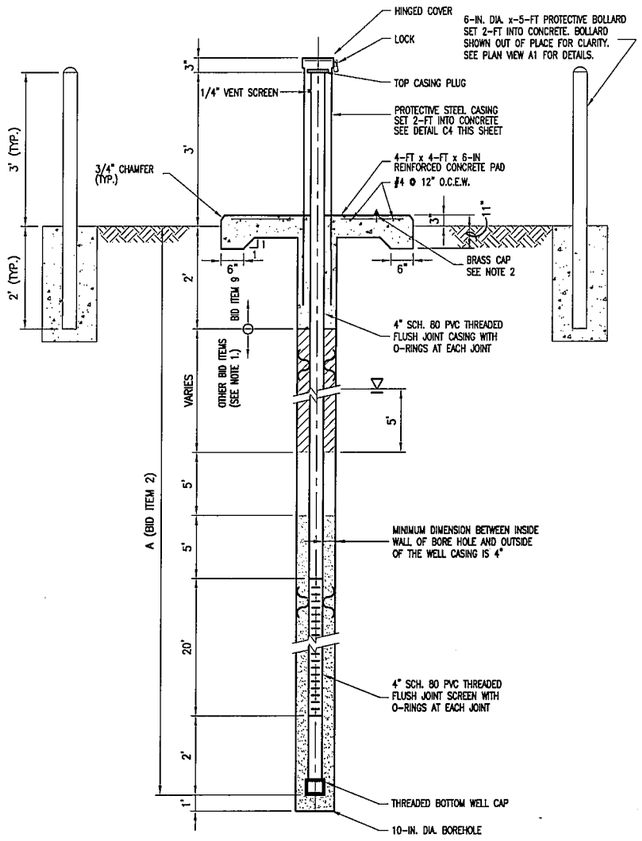
Xrefs: XSV-5151-McCOMBS, XTB-5151

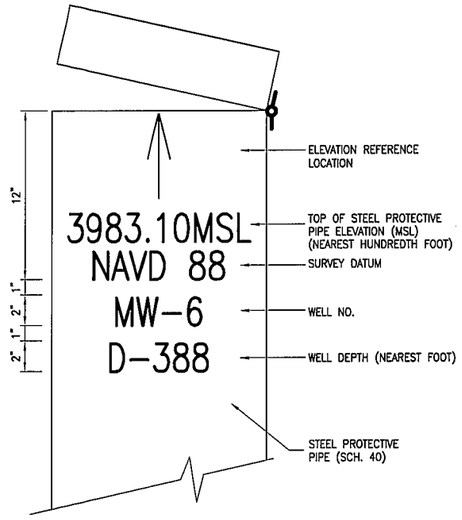
VARYING WELL DEPTHS	
WELL NO.	A±(FT.)
PZ-4	440
PZ-5	459

MATERIAL LEGEND

- CONCRETE CAP AND SEAL
- CASING SEAL
- ANNULAR SEAL
- GRAVEL



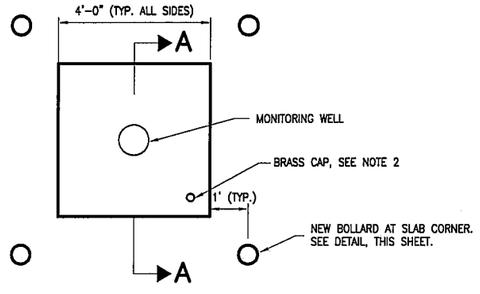
B2 MONITOR WELL CROSS SECTION A-A
NO SCALE



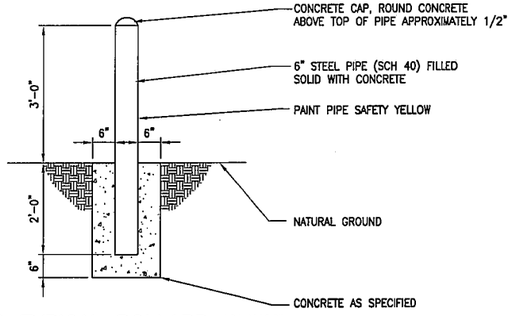
C4 WELL IDENTIFICATION
NO SCALE

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"

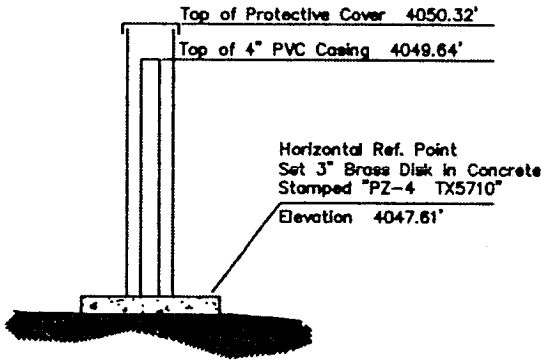
June 16, 2011

Parkhill, Smith & Cooper, Inc.
115 W. Griggs
Las Cruces, New Mexico 88001
Attn: Matt Dyer, P.E.

Subject: McCombs Landfill new Monitor Well Locations.

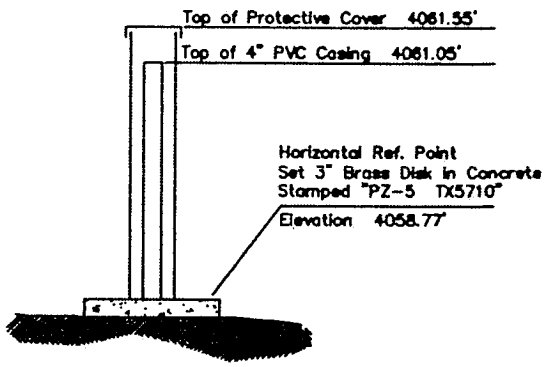
Dear Matt:

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

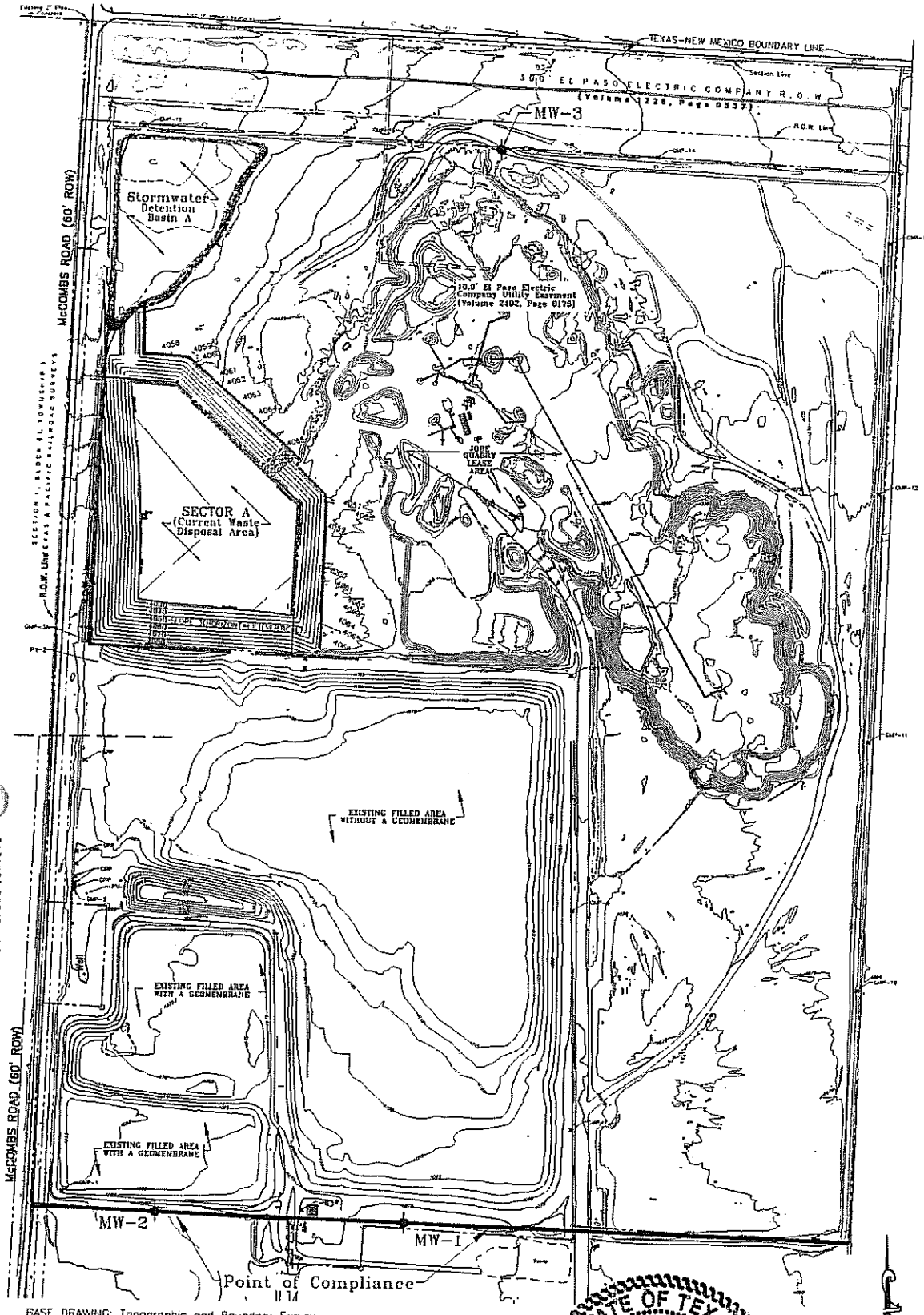
STATE OF TEXAS
VALERIE A. JOOSTEN
89118
12/22/03
LICENSED
PROFESSIONAL ENGINEER

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

VJ\H:\Data\Env\ASF02\045\monitwells\gw.installation121803.doc



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

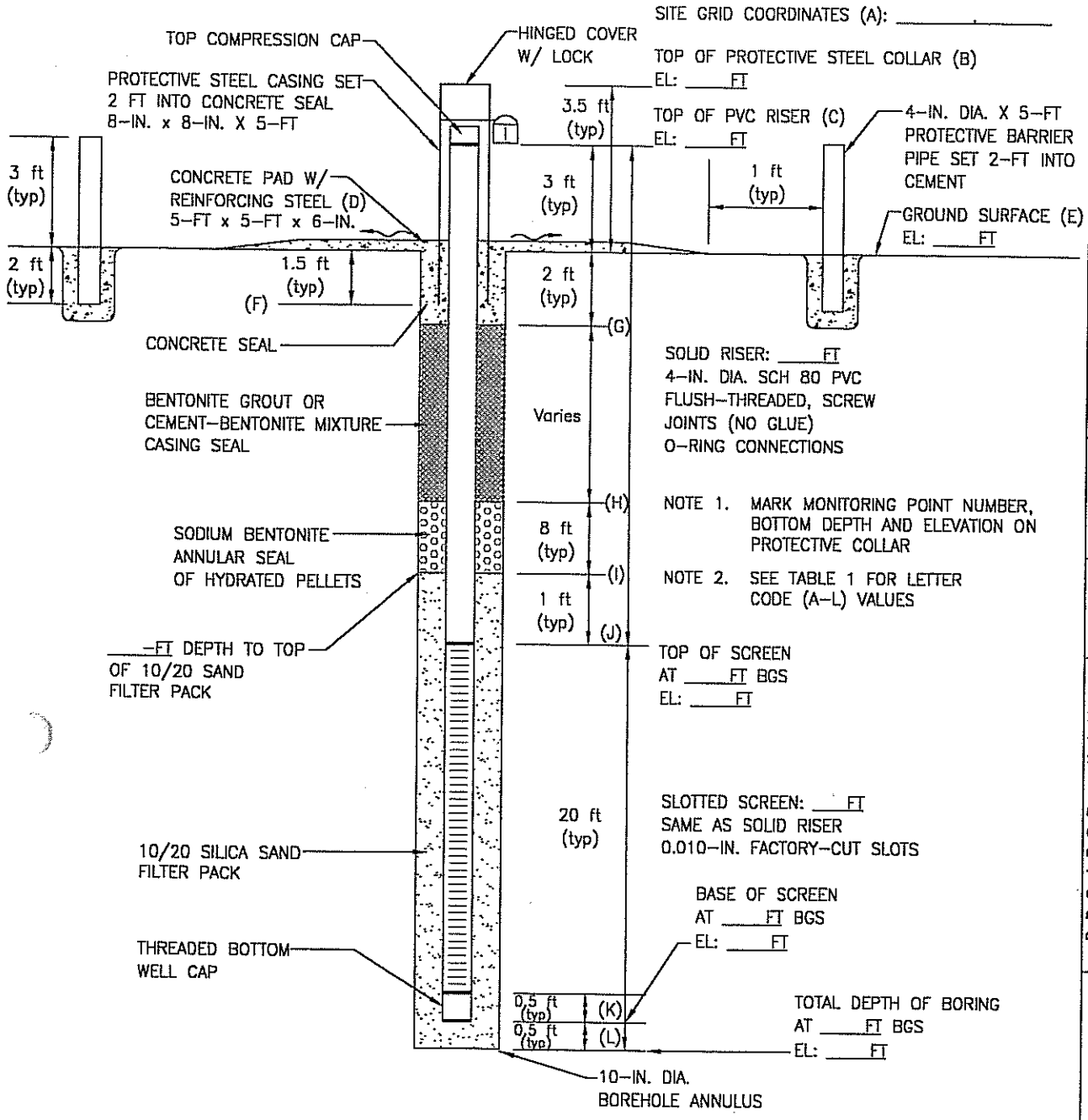
PROJECT NAME
McCOMBS LANDFILL
PHASE III - SECTOR A
MSW PERMIT No. 729A
EL PASO, TEXAS

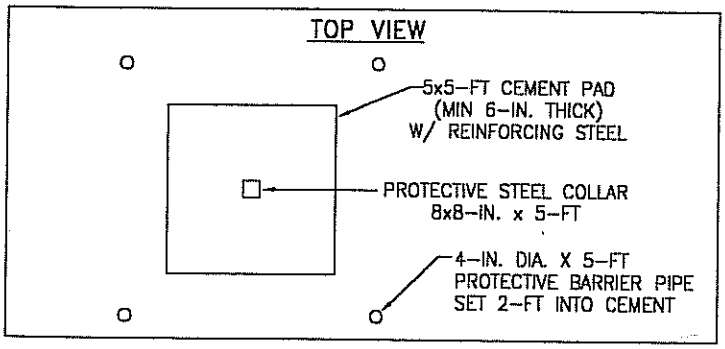
CITY OF El Paso
#2 CIVIC CENTER PLAZA PH. (915) 541-4200

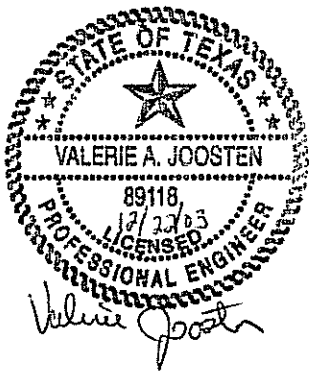
SHEET TITLE
GROUNDWATER MONITOR WELL LOCATION MAP

SHEET 1 OF 1

FIGURE 1







NO.	DATE	REVISION REMARKS	BY

Raba Kistner

PROJECT: A5F02-048-00

SCALE Horiz. N.T.S. Vert. N.T.S.
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

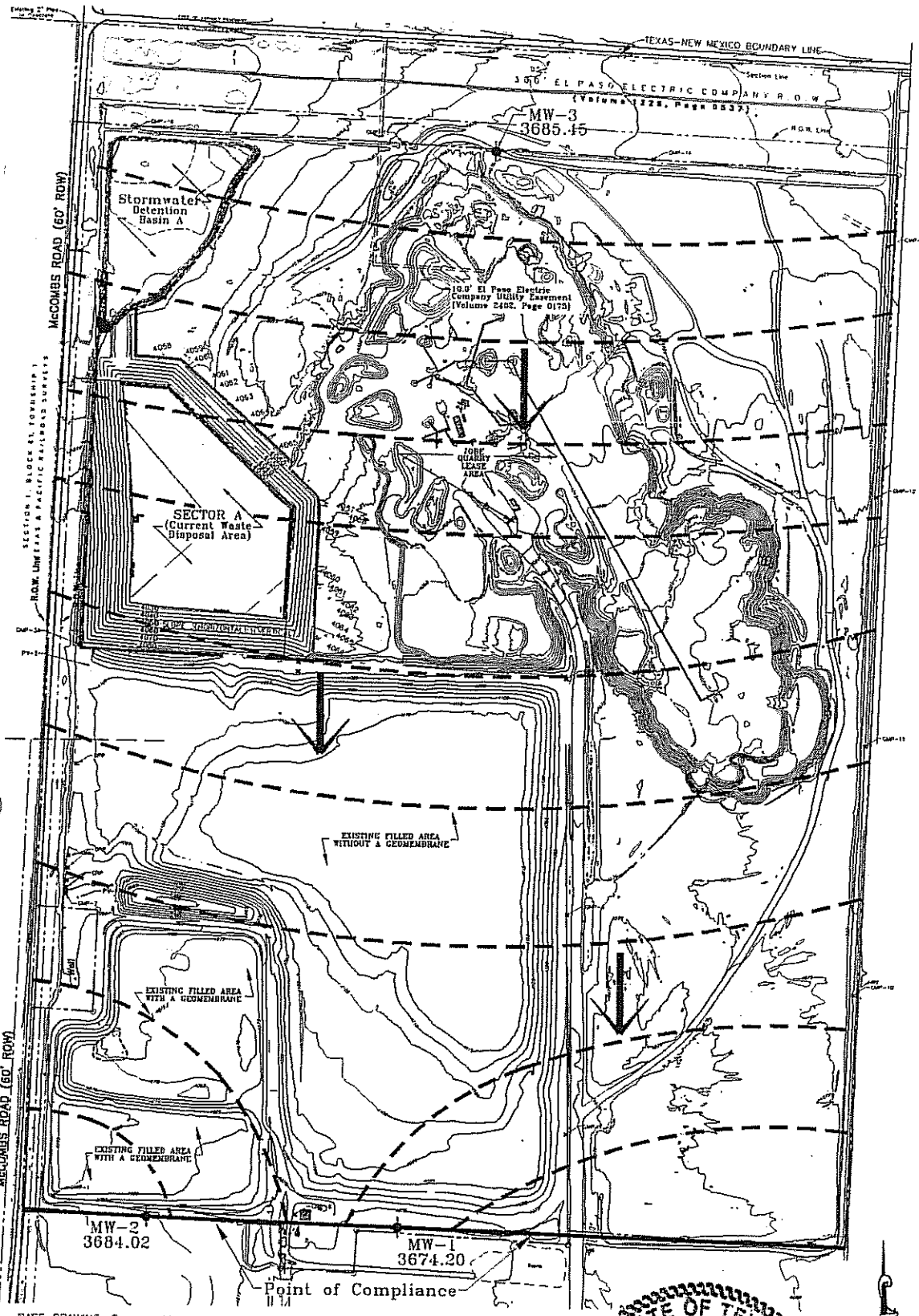
PROJECT NAME
McCOMBS LANDFILL
MSW PERMIT No. 729A
EL PASO, TEXAS

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.

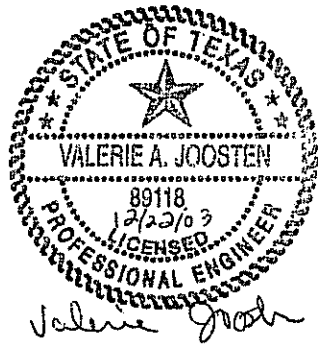
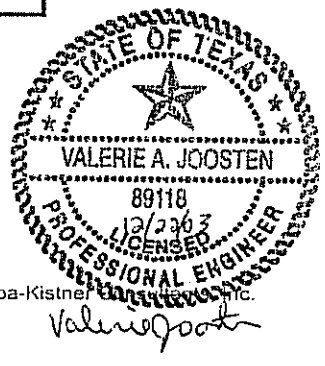


TABLE 2 -- MONITOR WELL CONSTRUCTION DATA
City of El Paso McCombs Landfill -- Permit No. MSW-729A
El Paso County, Texas
R-K Project No. ASF02-045-00

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 Cl, F, NO3, SO4, pH, Cond, T-P Alk, HCO3, CO3, TDS Iced, 14 Day Hold Time	1 QT PLASTIC	150.1, 300.0 SM 2501B, SM 2520B
1A [ ] NITRATE/NITRITE Iced, 48 Hour Hold Time	100 mL PLASTIC	353.2, 300.0
1C [ ] NITRATE Iced, 14 Day Hold Time	100 mL PLASTIC	300.0
2 [ ] ALL METALS No Field Preservation, 14 Day Hold Time	1 QT PLASTIC	200.8, 200.7, 245.1
2A [ ] METALS 14 GROUP (ICP) Al, Be, Ba, Cr, Cu, Fe, Pb, Mn, Ni, Na, Ag, Zn, Ca, Mg No Field Preservation, 14 Day Hold Time	1 QT PLASTIC	200.8, 200.7
[ ] SINGLE METAL Al, Sb, As, Ba, Be, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Ni, Ag, Tl, Zn Se, Na, (Hardness Ca, Mg) No Field Preservation, 14 Day Hold Time	1 QT PLASTIC	200.8, 200.7, 245.1
[ ] _____ ONLY		
16 [ ] RADIOCHEMICAL No Field Preservation, 5 Day Hold Time	1 GAL PLASTIC	900.0, 804.0 903.1 SM 7500-UC
17 [ ] ASBESTOS Iced, 48 Hour Hold Time	1QT PLASTIC	

18 [X] VOC Ascorbic Acid, HCl, Iced, 14 Day Hold Time	2-40 mL GLASS	524.2
14 [ ] TRIHALOMETHANES Sodium Thiosulfate, Iced, 14 Day Hold Time	2-40 mL GLASS	502.2 or 524.2
[ ] MTHM – Potential No Field Preservation, 7 Day Hold Time	3-40 mL GLASS	502.2 or 524.2
18 [ ] HALOACETIC ACIDS (HAA) Ammonium Chloride, Iced, 14 Day Hold Time	2-60 mL GLASS	552.2
4 [ ] INSECTICIDES (SOC1) Sodium Thiosulfate, Iced, 7 Day Hold Time	1 QT GLASS	505
6 [ ] HERBICIDES (SOC3) Sodium Thiosulfate, Iced, 14 Day Hold Time	500 mL GLASS	515.1
8 [ ] SEMIVOLATILES (SOC5) 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 Cl, F, NO3, SO4, pH, Cond, T-P Alk, HCO3, CO3, TDS Iced, 14 Day Hold Time	1 QT PLASTIC	150.1, 300.0 SM 2501B, SM 2520B
1A	[ ] NITRATE/NITRITE Iced, 48 Hour Hold Time	100 mL PLASTIC	353.2, 300.0
1C	[ ] NITRATE Iced, 14 Day Hold Time	100 mL PLASTIC	300.0
2	[ ] ALL METALS No Field Preservation, 14 Day Hold Time	1 QT PLASTIC	200.8, 200.7, 245.1
2A	[ ] METALS 14 GROUP (ICP) Al, Be, Ba, Cr, Cu, Fe, Pb, Mn, Ni, Na, Ag, Zn, Ca, Mg No Field Preservation, 14 Day Hold Time	1 QT PLASTIC	200.8, 200.7
	[ ] SINGLE METAL Al, Sb, As, Ba, Be, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Ni, Ag, Tl, Zn Se, Na, (Hardness Ca, Mg) No Field Preservation, 14 Day Hold Time	1 QT PLASTIC	200.8, 200.7, 245.1
	[ ] _____ ONLY		
16	[ ] RADIOCHEMICAL No Field Preservation, 5 Day Hold Time	1 GAL PLASTIC	900.0, 804.0 903.1 SM 7500-UC
17	[ ] ASBESTOS Iced, 48 Hour Hold Time	1QT PLASTIC	

13	[ ] VOC Ascorbic Acid, HCl, Iced, 14 Day Hold Time	2-40 mL GLASS	524.2
14	[ ] TRIHALOMETHANES Sodium Thiosulfate, Iced, 14 Day Hold Time	2-40 mL GLASS	502.2 or 524.2
	[ ] MTHM – Potential No Field Preservation, 7 Day Hold Time	3-40 mL GLASS	502.2 or 524.2
18	[ ] HALOACETIC ACIDS (HAA) Ammonium Chloride, Iced, 14 Day Hold Time	2-60 mL GLASS	552.2
4	[ ] INSECTICIDES (SOC1) Sodium Thiosulfate, Iced, 7 Day Hold Time	1 QT GLASS	505
6	[ ] HERBICIDES (SOC3) Sodium Thiosulfate, Iced, 14 Day Hold Time	500 mL GLASS	515.1
8	[X] SEMIVOLATILES (SOC5) 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

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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 SURFACE ELEVATION: 4067.35'	FORMATION	WELL	METHANE	HYDROGEN SULFIDE	OXYGEN %	PID ppm
0				CLAY, Sandy Brown - 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

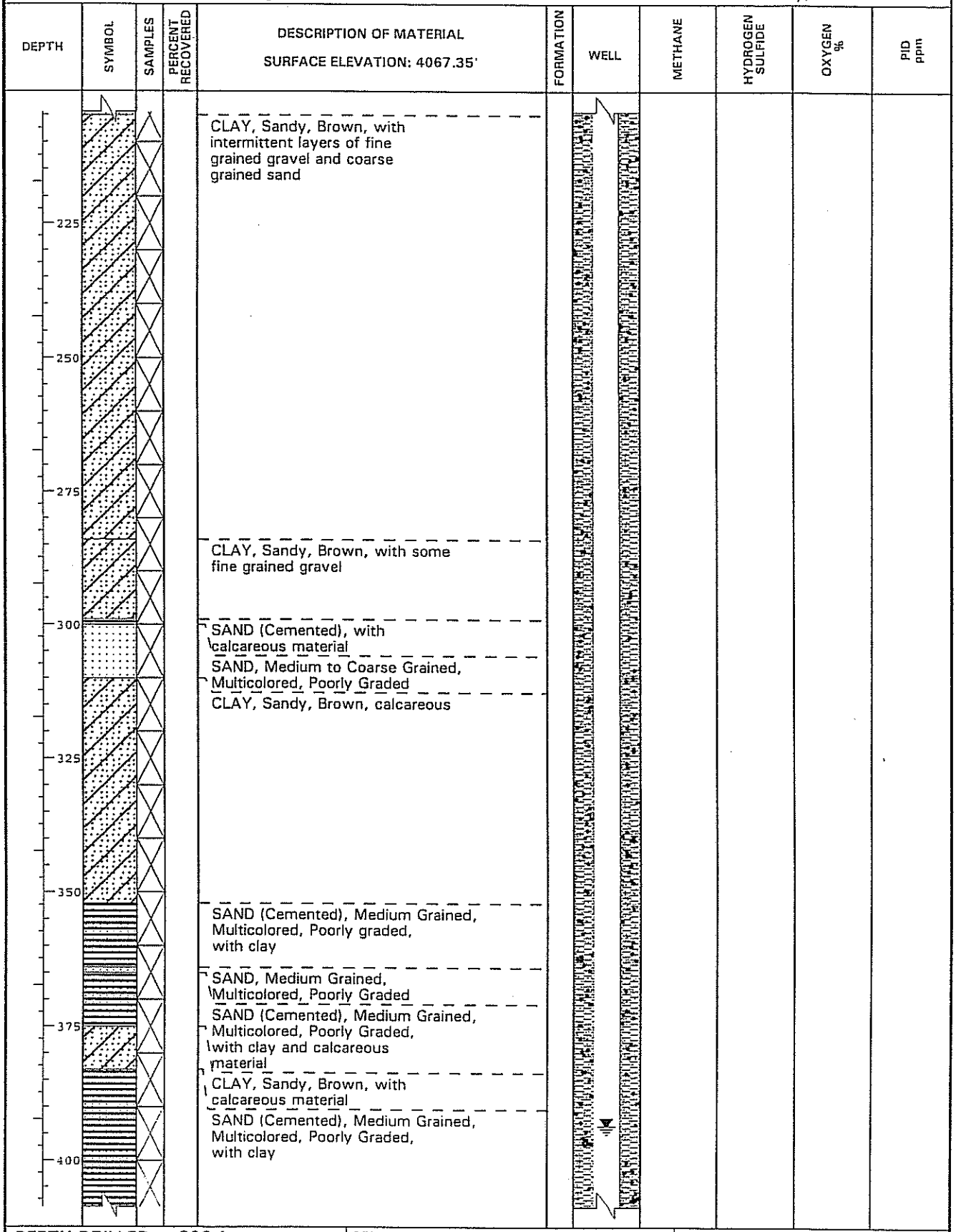
LOG OF BORING NO. MW-1

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

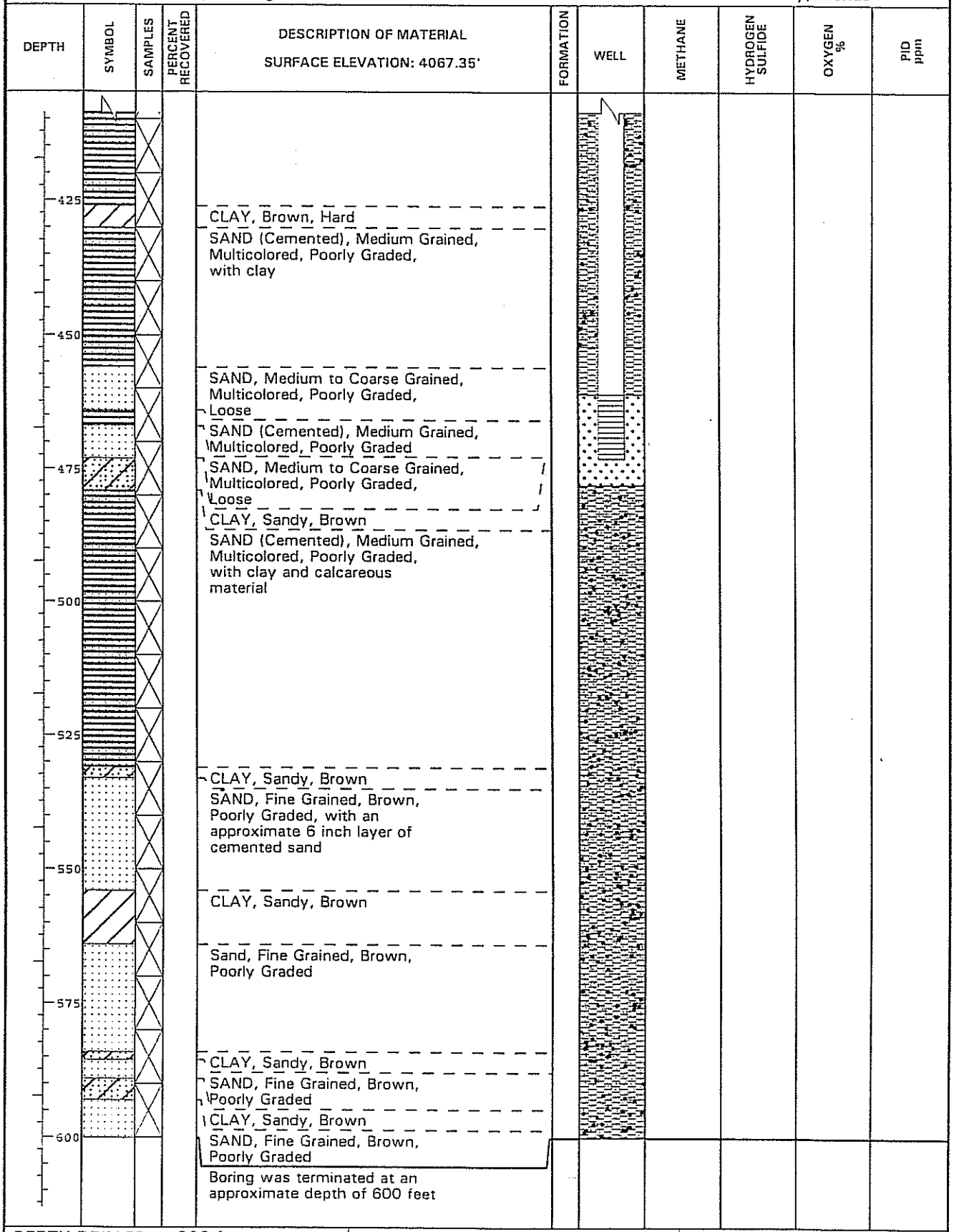
LOG OF BORING NO. MW-1

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 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

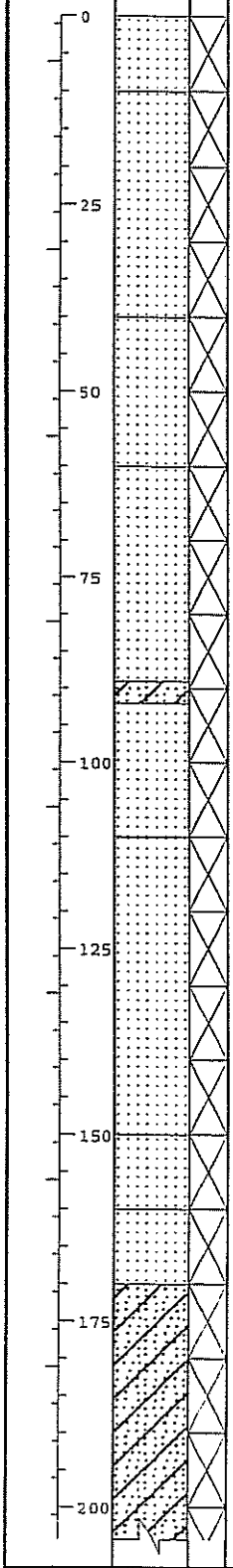
LOG OF BORING NO. MW-2

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 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 - with clay layer at 16 feet - 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 - 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

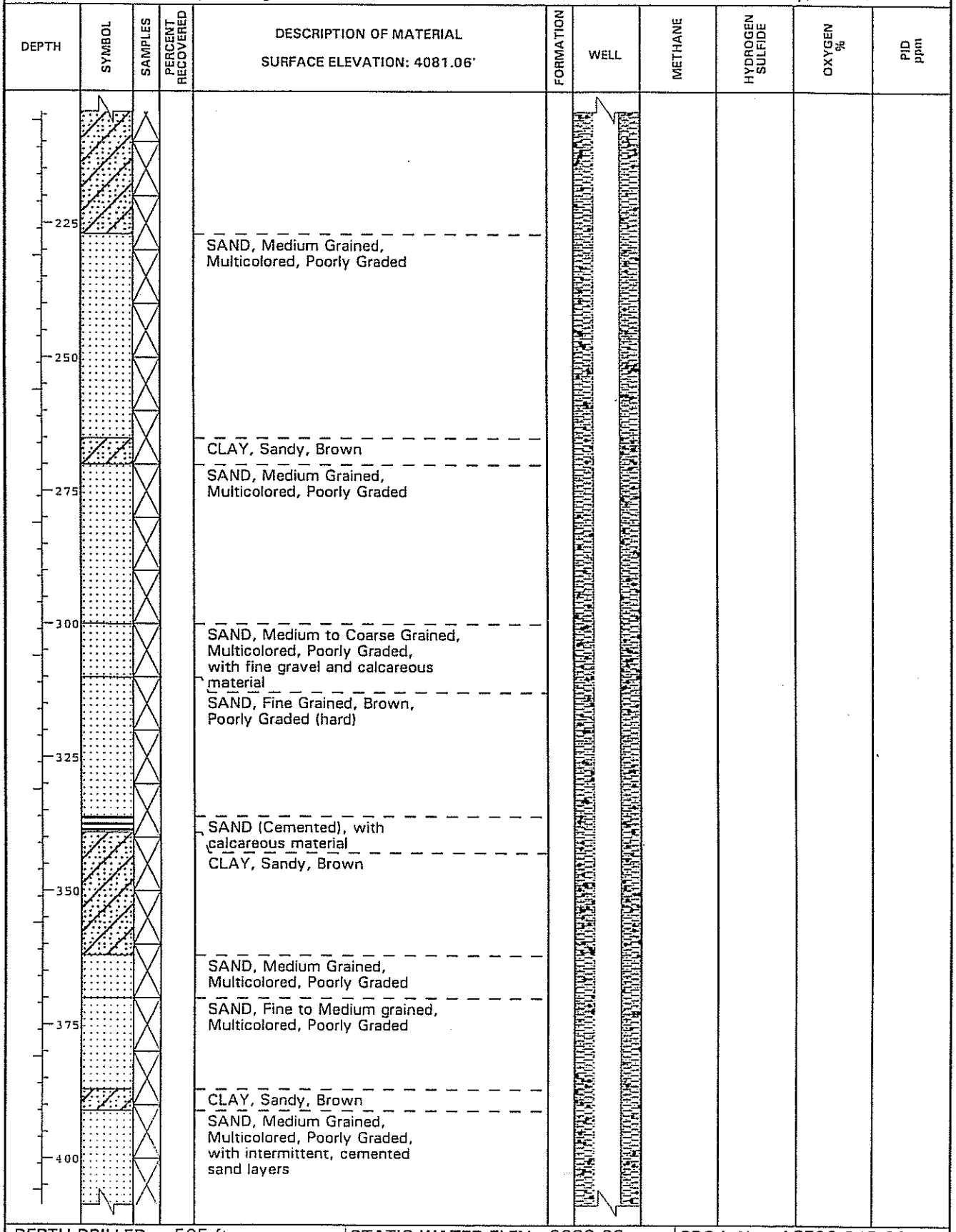
LOG OF BORING NO. MW-2

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

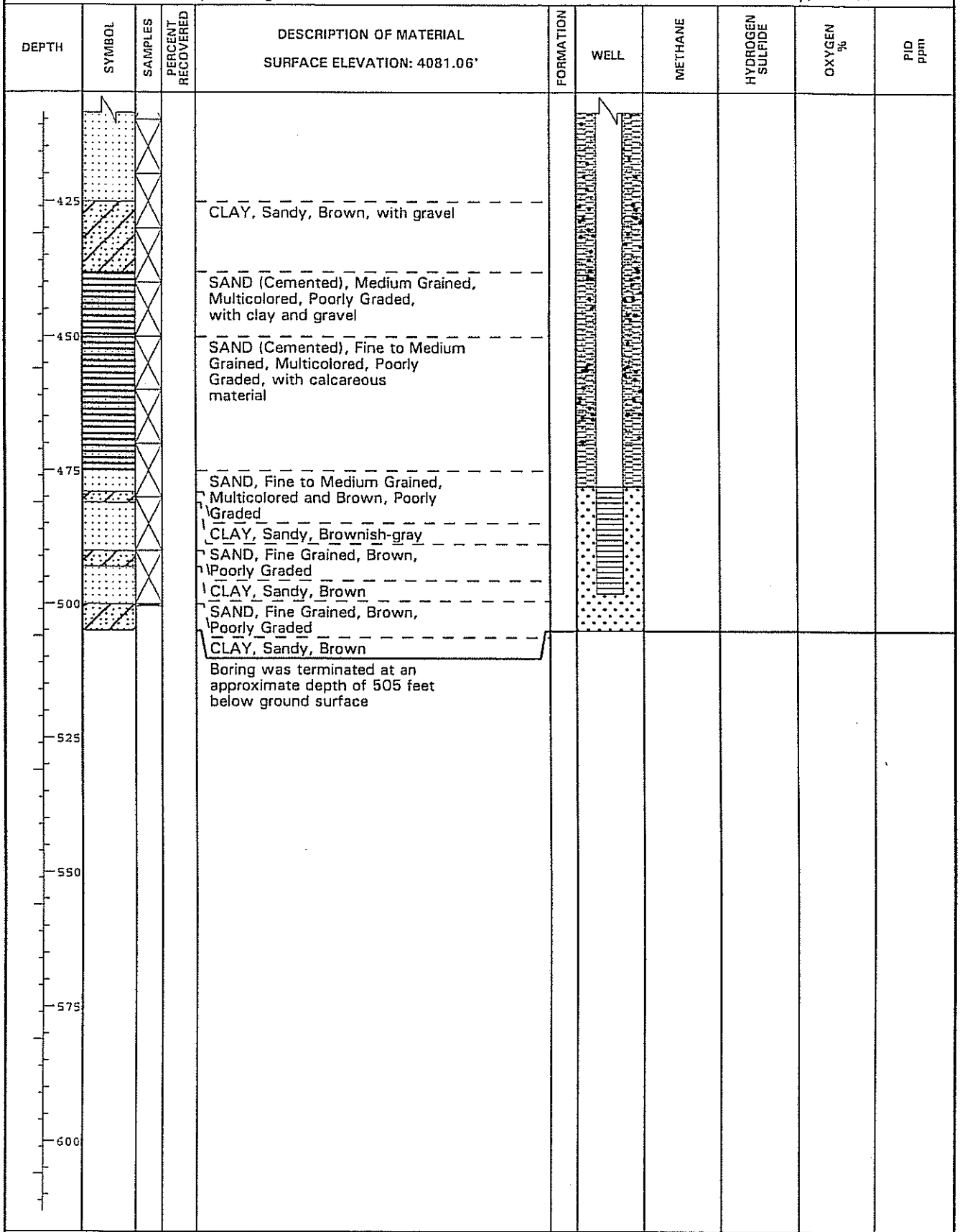
LOG OF BORING NO. MW-2

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

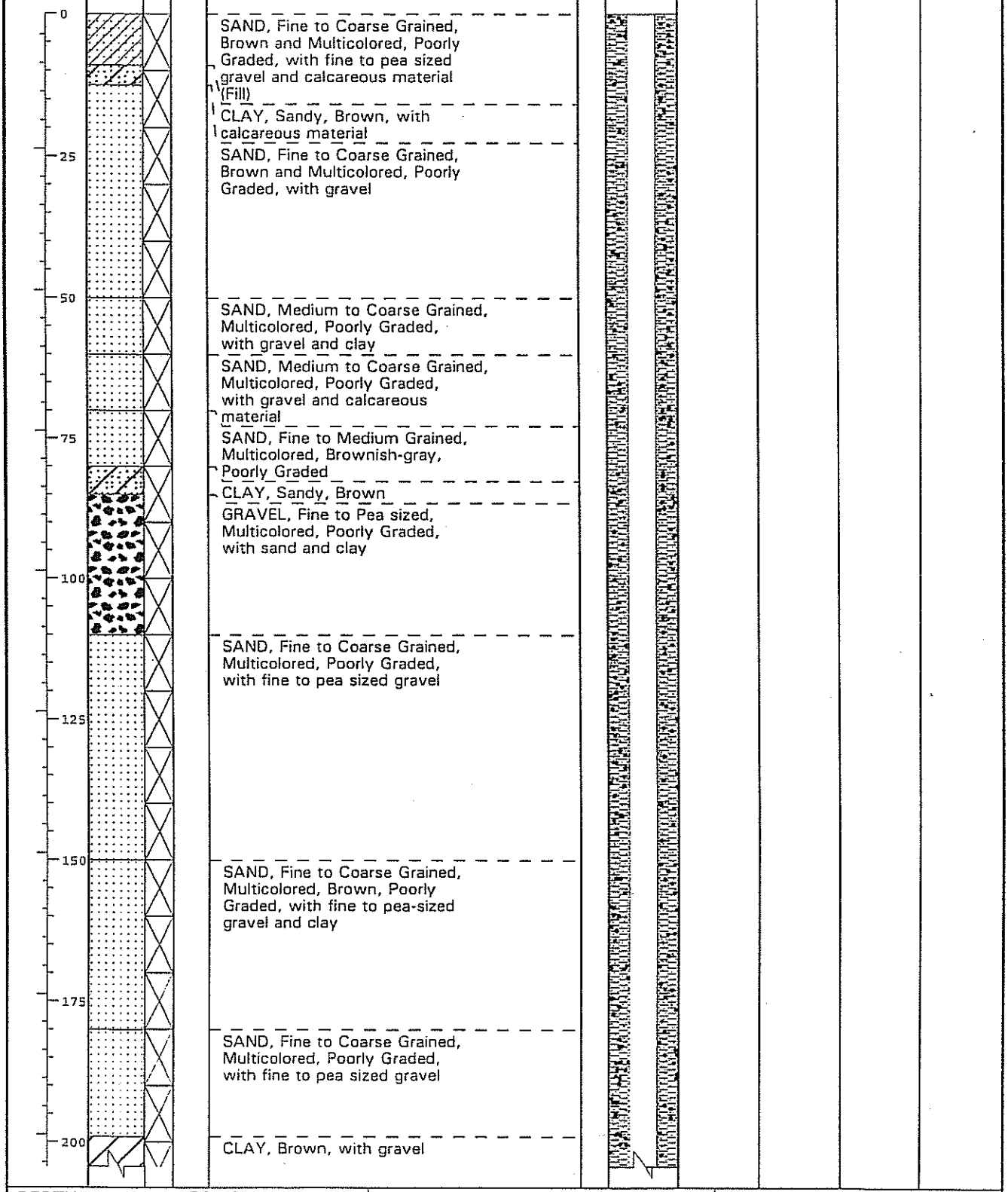
LOG OF BORING NO. MW-3

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

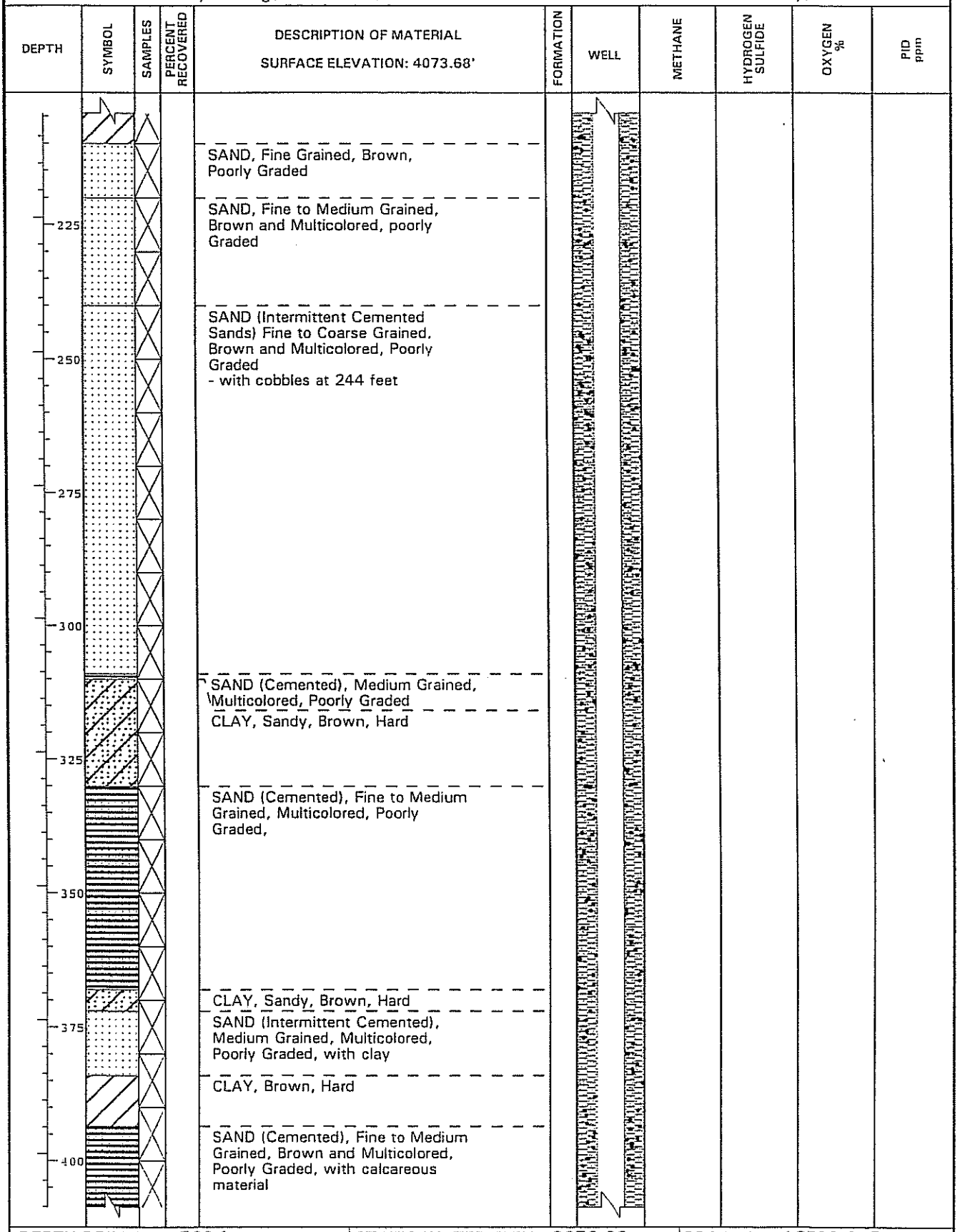
LOG OF BORING NO. MW-3

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

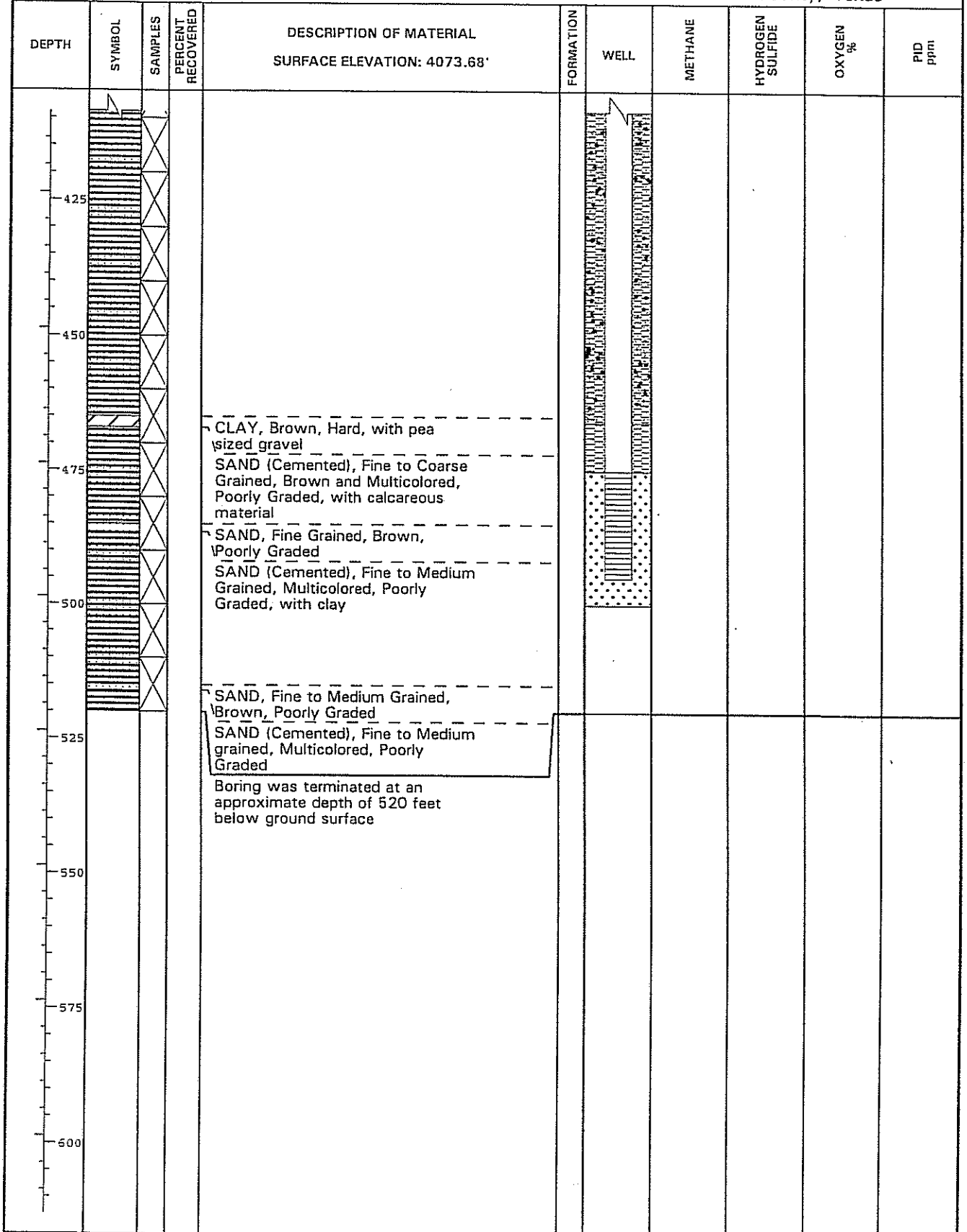
LOG OF BORING NO. MW-3

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

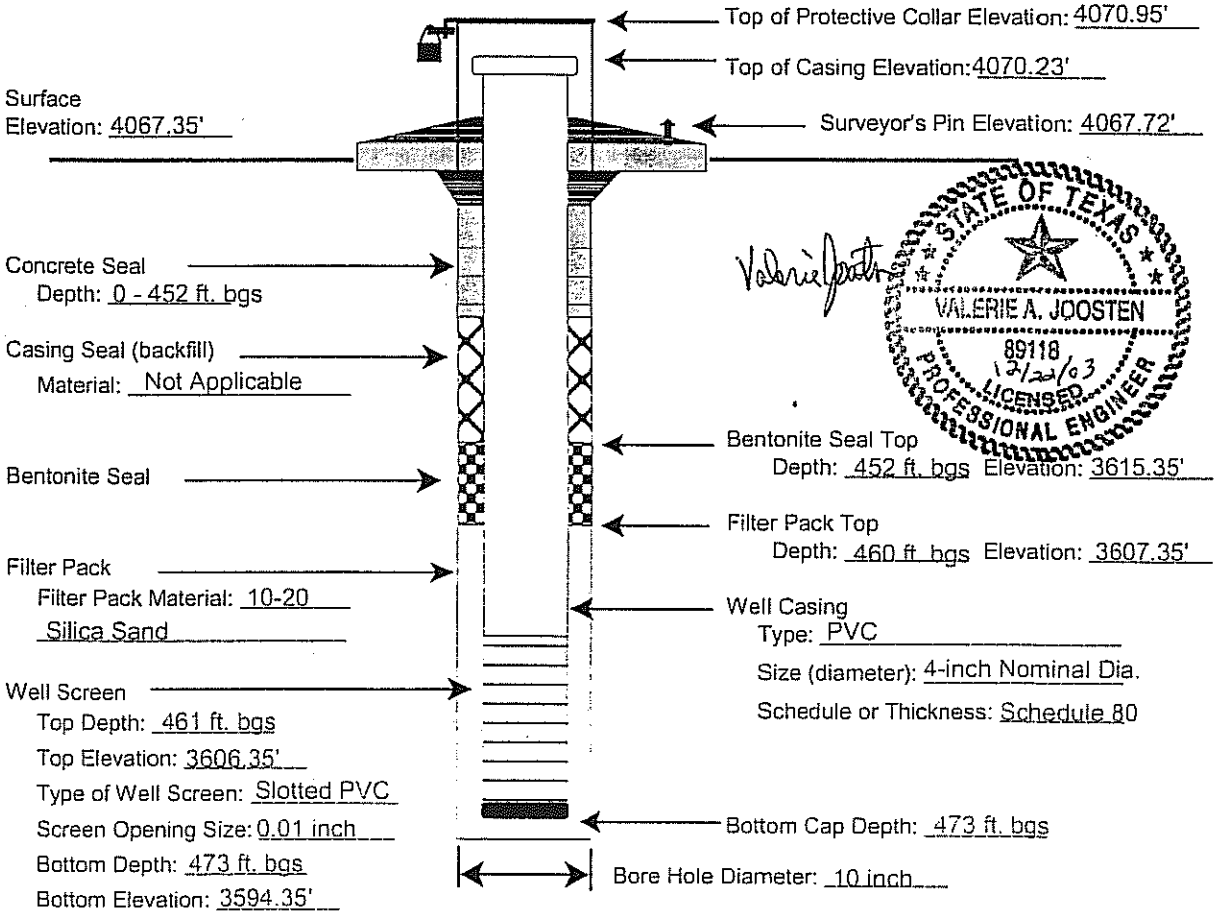
MSW Permit No.: 729A
Monitor Well I.D. No.: MW-1
Date of Monitor Well
Development: 8/12/3003 - 8/13/2003
Monitor Well Driller
Name: R.C. Corona
License No.: 4709M

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

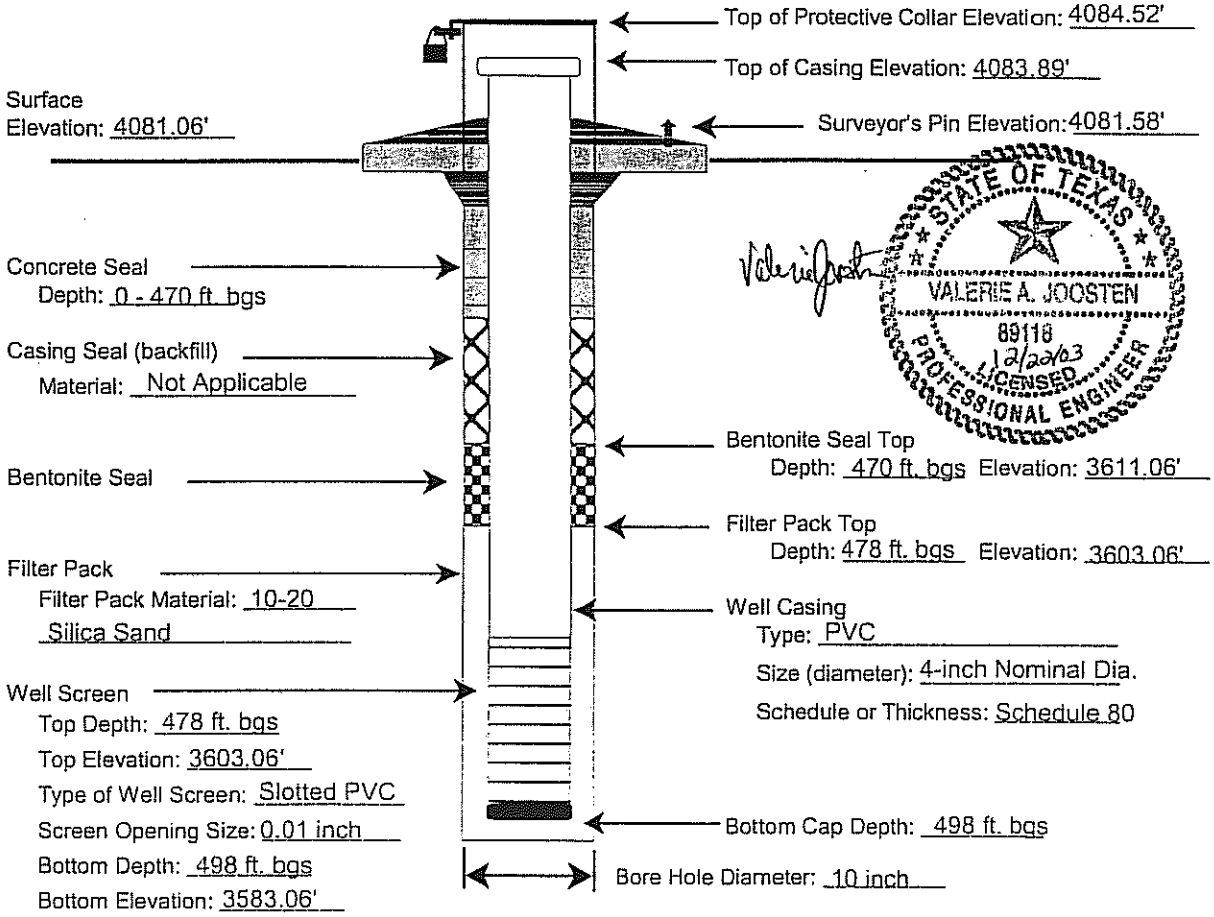
MSW Permit No.: 729A
Monitor Well I.D. No.: MW-2
Date of Monitor Well Development: 8/21/2003
Monitor Well Driller
Name: R.C. Corona
License No.: 4709M

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

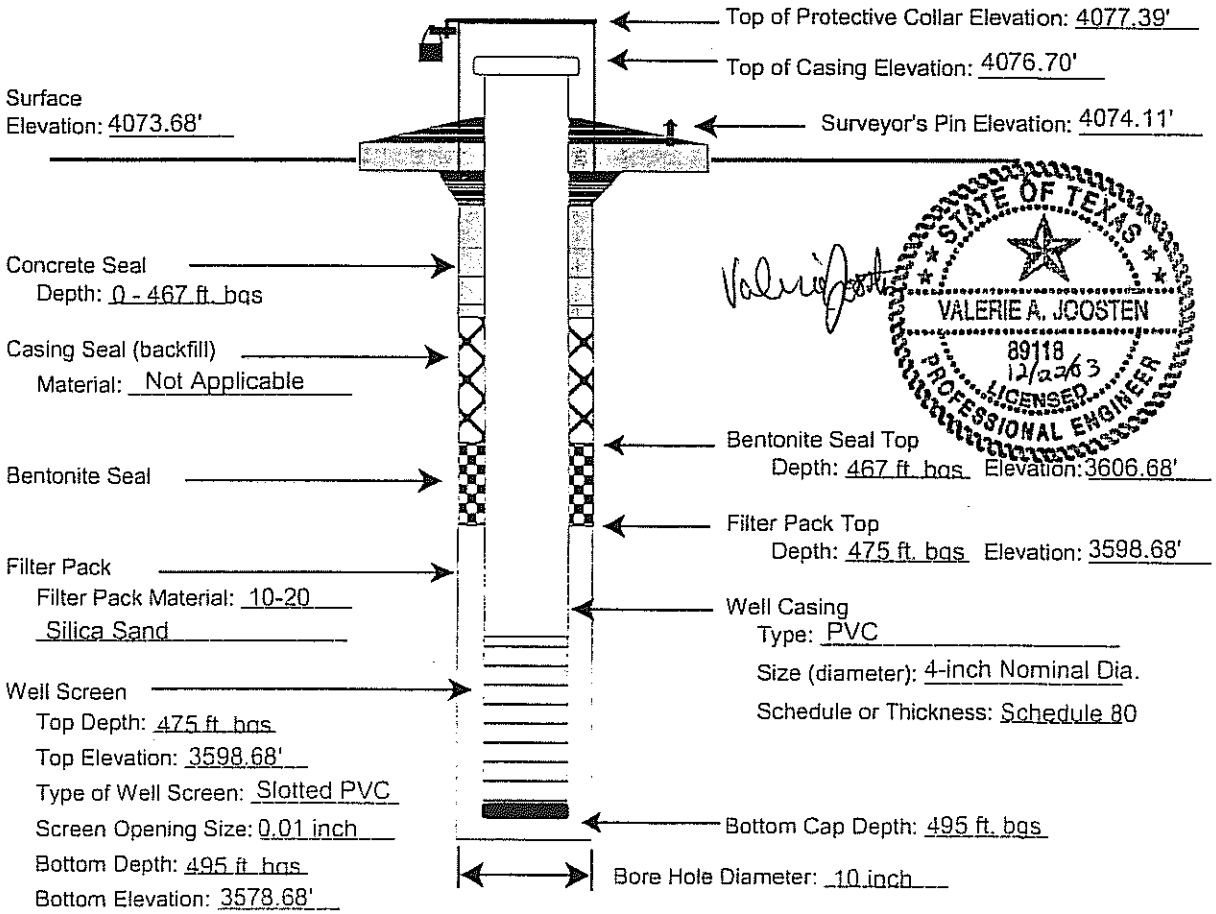
MSW Permit No.: 729A
Monitor Well I.D. No.: MW-3
Date of Monitor Well Development: 9/2/2003 - 9/3/2003
Monitor Well Driller
Name: R.C. Corona
License No.: 4709M

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

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]

11) WATER LEVEL:
Static level 397.96 ft. below land surface Date 9/05/03
Artesian flow ____ gpm. Date

12) PACKERS: Type Depth

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other Bailer
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 Lirata Drlg. Co (Type or print) WELL DRILLER'S LICENSE NO. 4709 M

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"

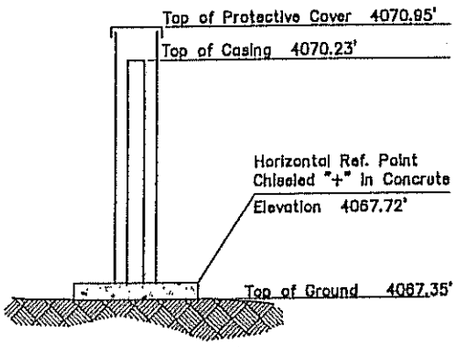
September 8, 2003

Raba Kistner
7002 Commerce
El Paso, Texas 79915
Attn: Valerie A. Joosten, P.E.

Subject: McCombs Landfill new Monitor Well Locations.

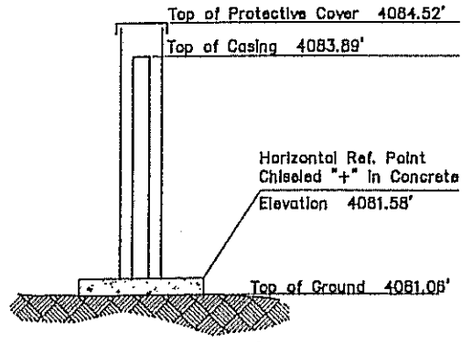
Dear Valerie:

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.



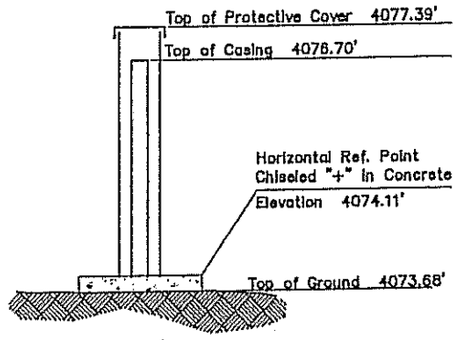
Well MW–1

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	

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

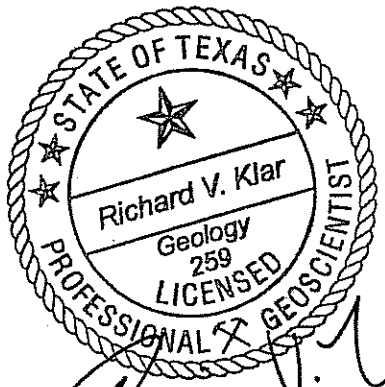
§330.230(c)(2) **Qualified Groundwater Scientist Certification**

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

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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.

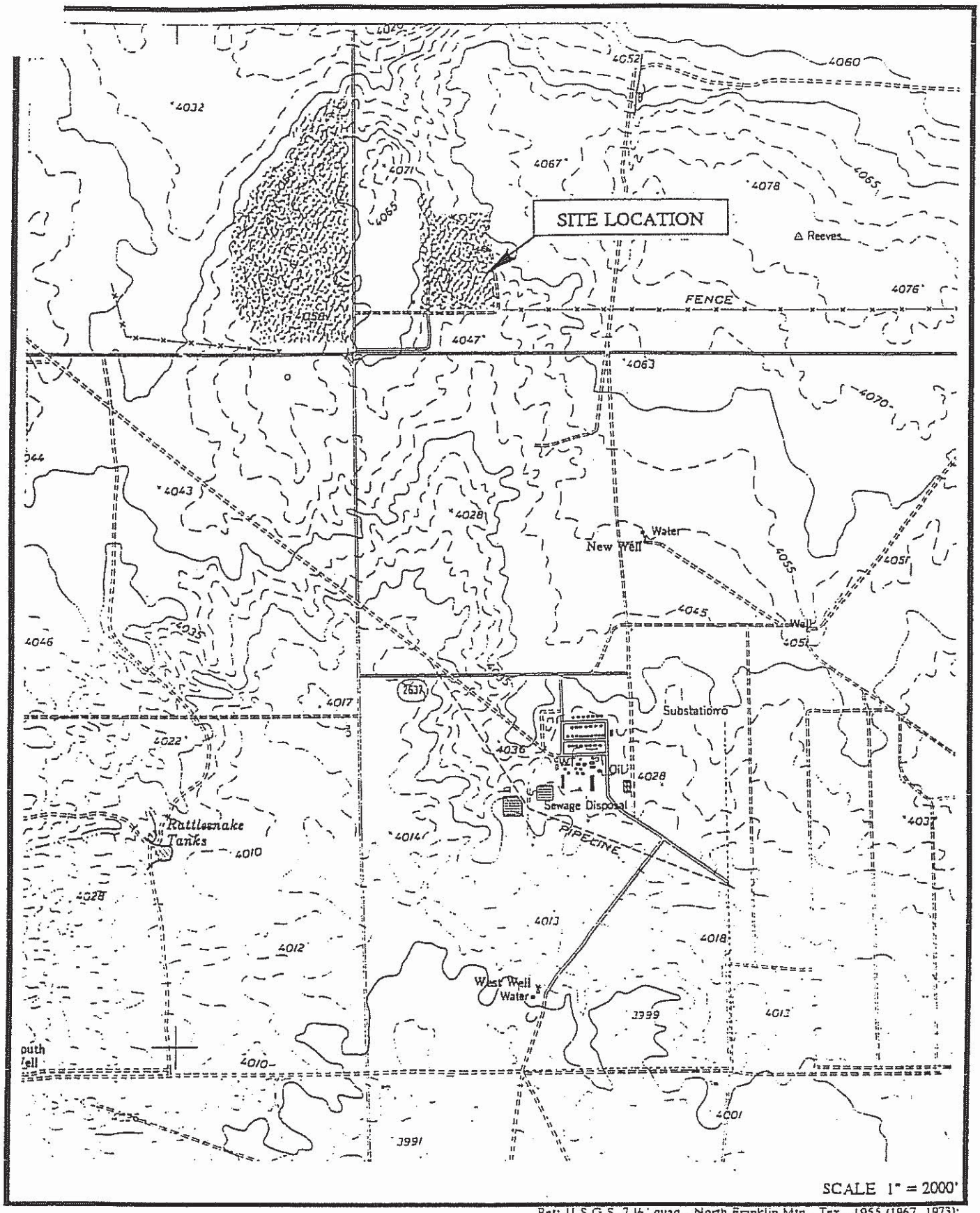
3. SITE BACKGROUND

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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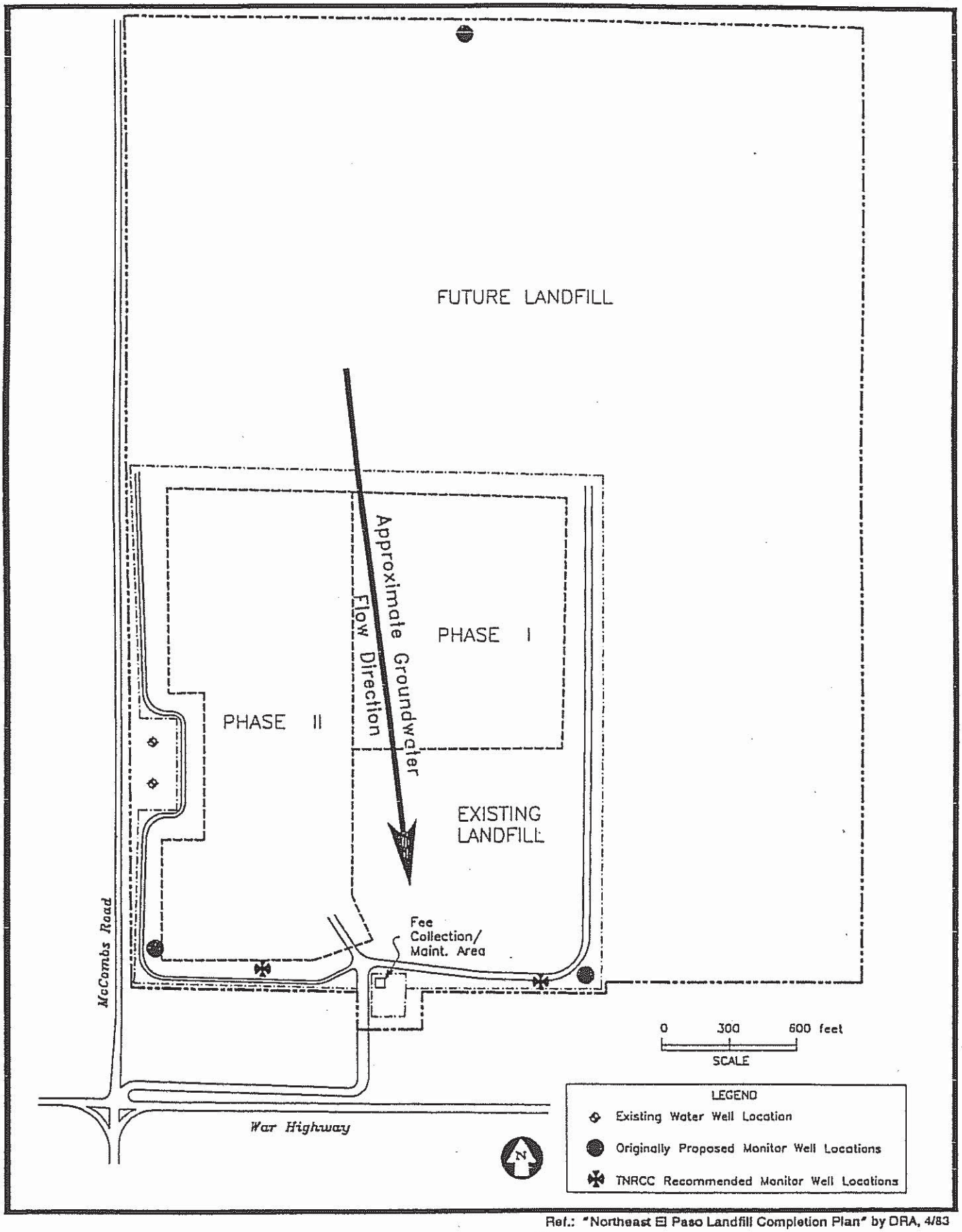

Ref.: "Northeast El Paso Landfill Completion Plan" by DRA, 4/83

Groundwater Sampling and Analysis Plan
McCombs Landfill
El Paso, Texas
AEE Job E93-4034

Figure 2
Site Plan with Proposed
Monitor Well Locations

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Appendix 3L – Attachment 2
Groundwater Sampling and Analysis Plan

SAIC®

Part III
Site Development Plan
Attachment 11
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

ATTACHMENT 11

GROUNDWATER SAMPLING AND ANALYSIS PLAN

McCOMBS LANDFILL

MSW PERMIT NO. 729AB

CITY OF EL PASO

EL PASO COUNTY, TEXAS

SEPTEMBER 4, 2002

REVISED SEPTEMBER 2009

THE CITY OF EL PASO — TEXAS

STATE OF TEXAS — ROBERT HOLLY HOLDER — 59052 — LICENSED PROFESSIONAL ENGINEER

09/10/09

Revised By

STATE OF TEXAS — KEVIN T. CAREL — GEOLOGY #960 — LICENSED PROFESSIONAL GEOSCIENTIST

9-10-09

F-560

PSC **Parkhill, Smith & Cooper, Inc.**
Engineers ▫ Architects ▫ Planners

The CAREL CORPORATION

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STATE OF TEXAS ROBERT HOLLY HOLDER 59052 LICENSED PROFESSIONAL ENGINEER 09/10/09

STATE OF TEXAS KEVIN T. CAREL GEOLOGY #960 LICENSED PROFESSIONAL GEOSCIENTIST 9.10.09

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Att11-1 Laboratory Checklist

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. 729XB 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
Permit No. MSW 729AB
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] Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

[redacted]

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

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 ____

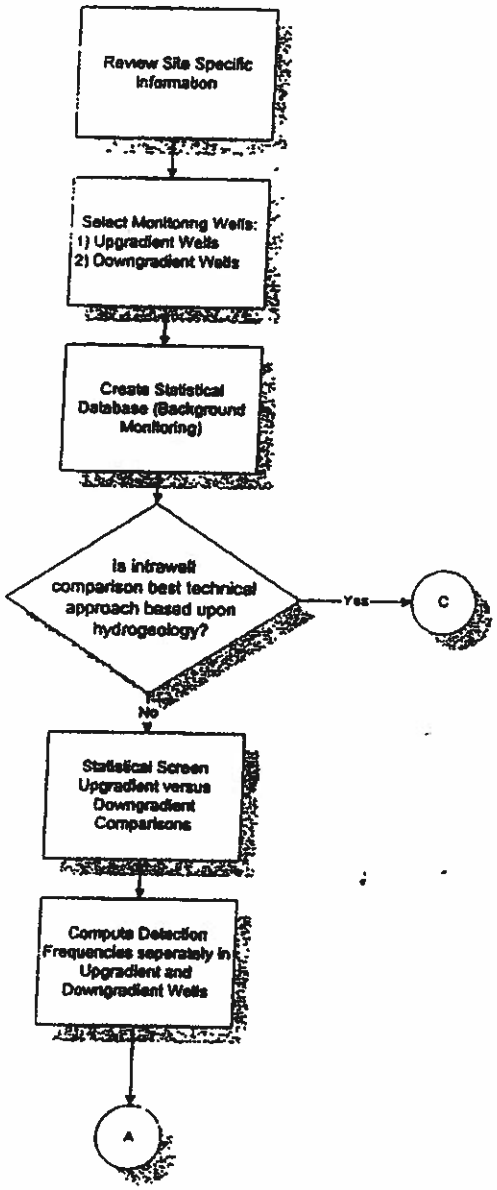
QC Level
☐ I. ☐ II. ☐ III.

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
MSW Permit No. 729AB



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
MSW Permit No. 729AB

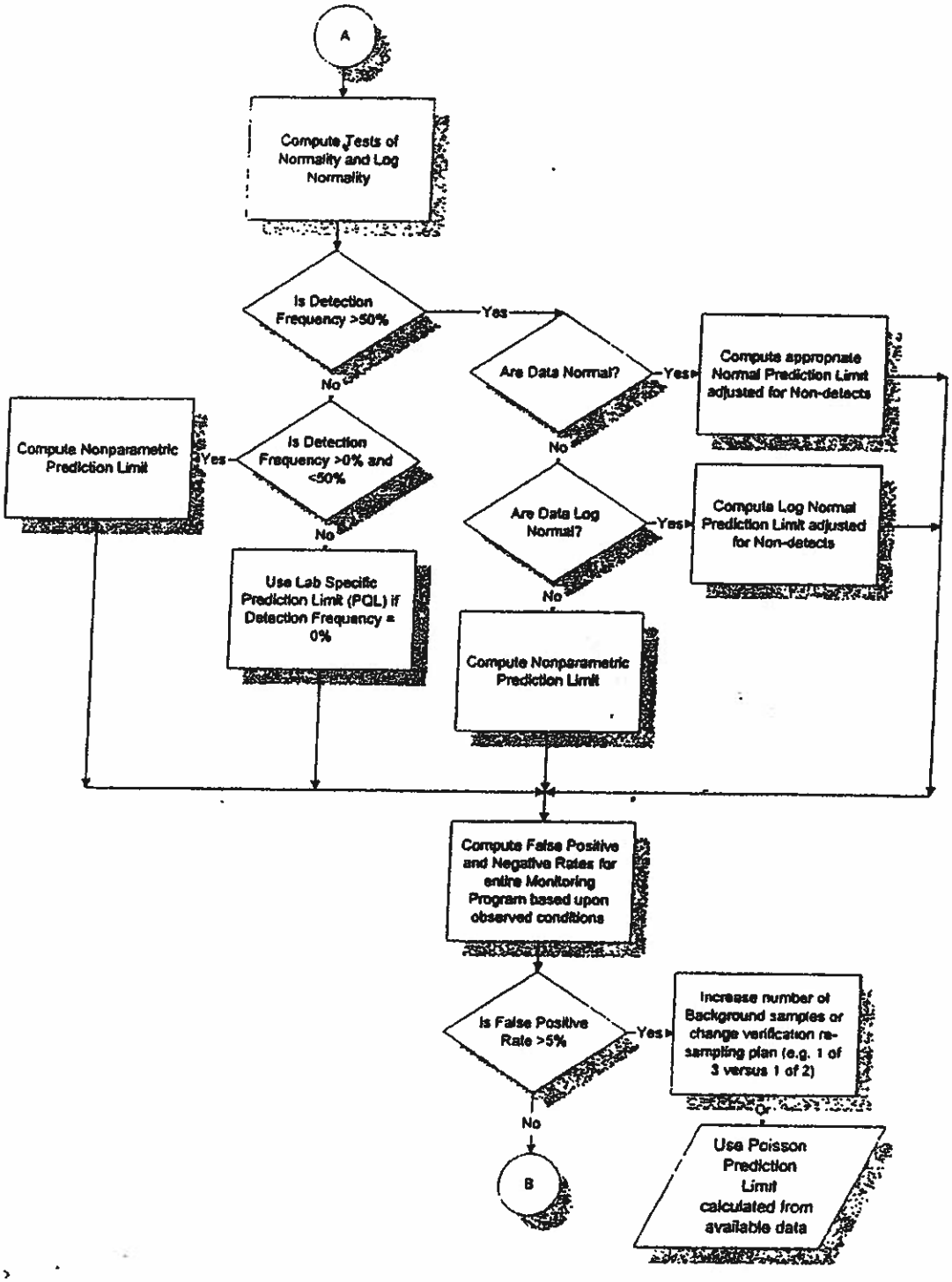


Figure Att11-3 (Continued)
Development of a Statistical Detection Monitoring Plan
McCombs Landfill
MSW Permit No. 729AXB

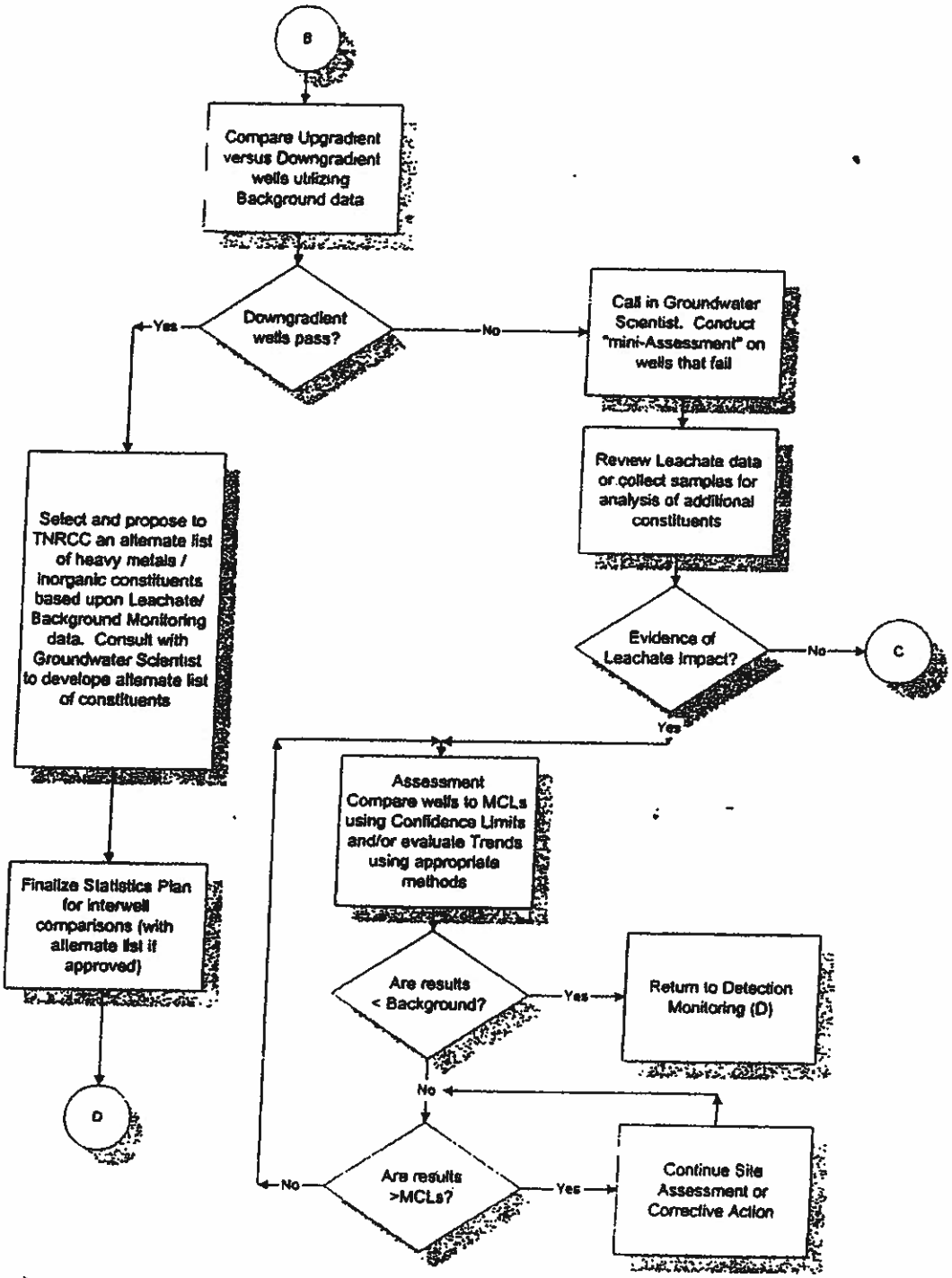


Figure Att11-3 (Continued)
Development of a Statistical Detection Monitoring Plan
McCombs Landfill
MSW Permit No. 729AB

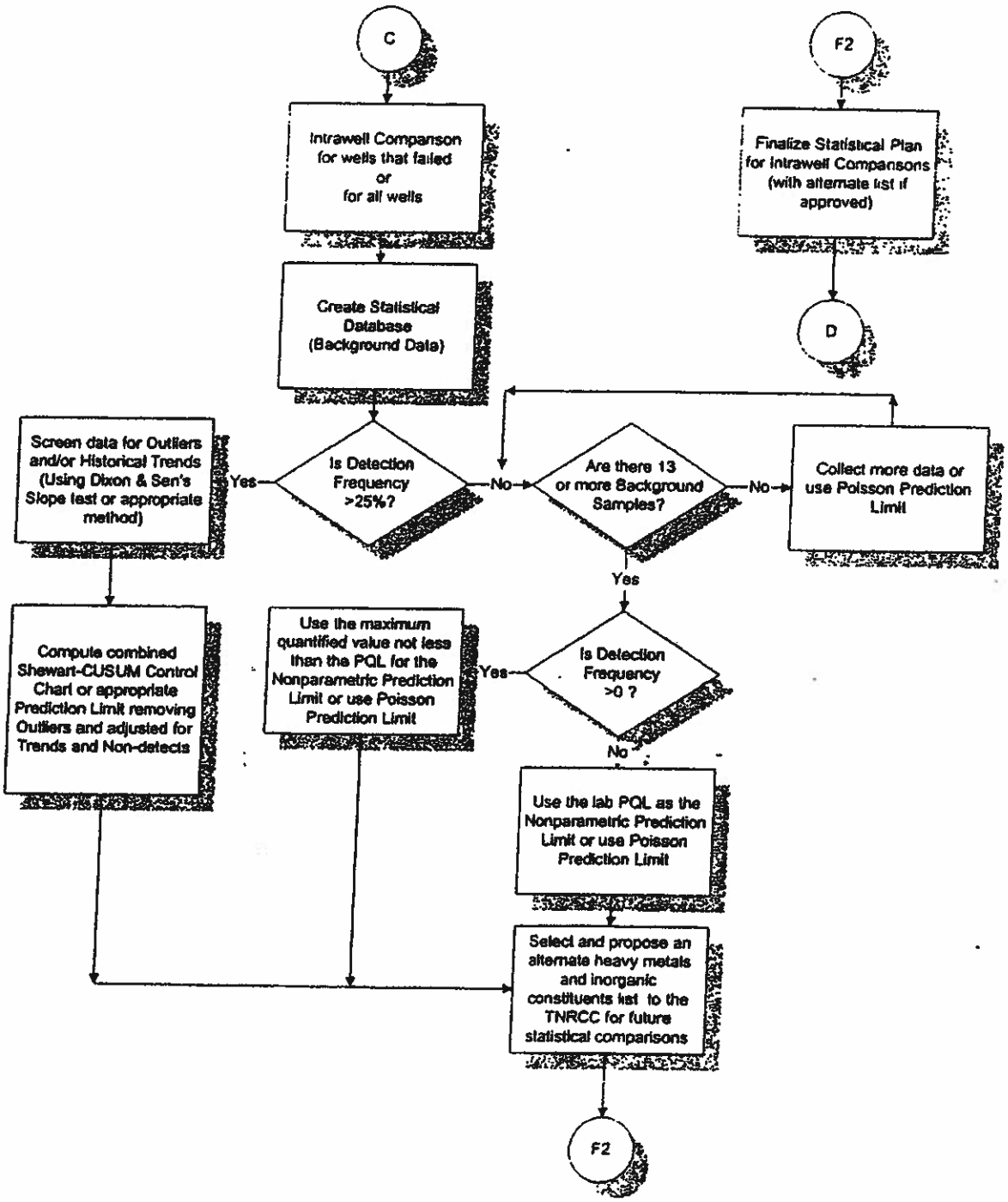
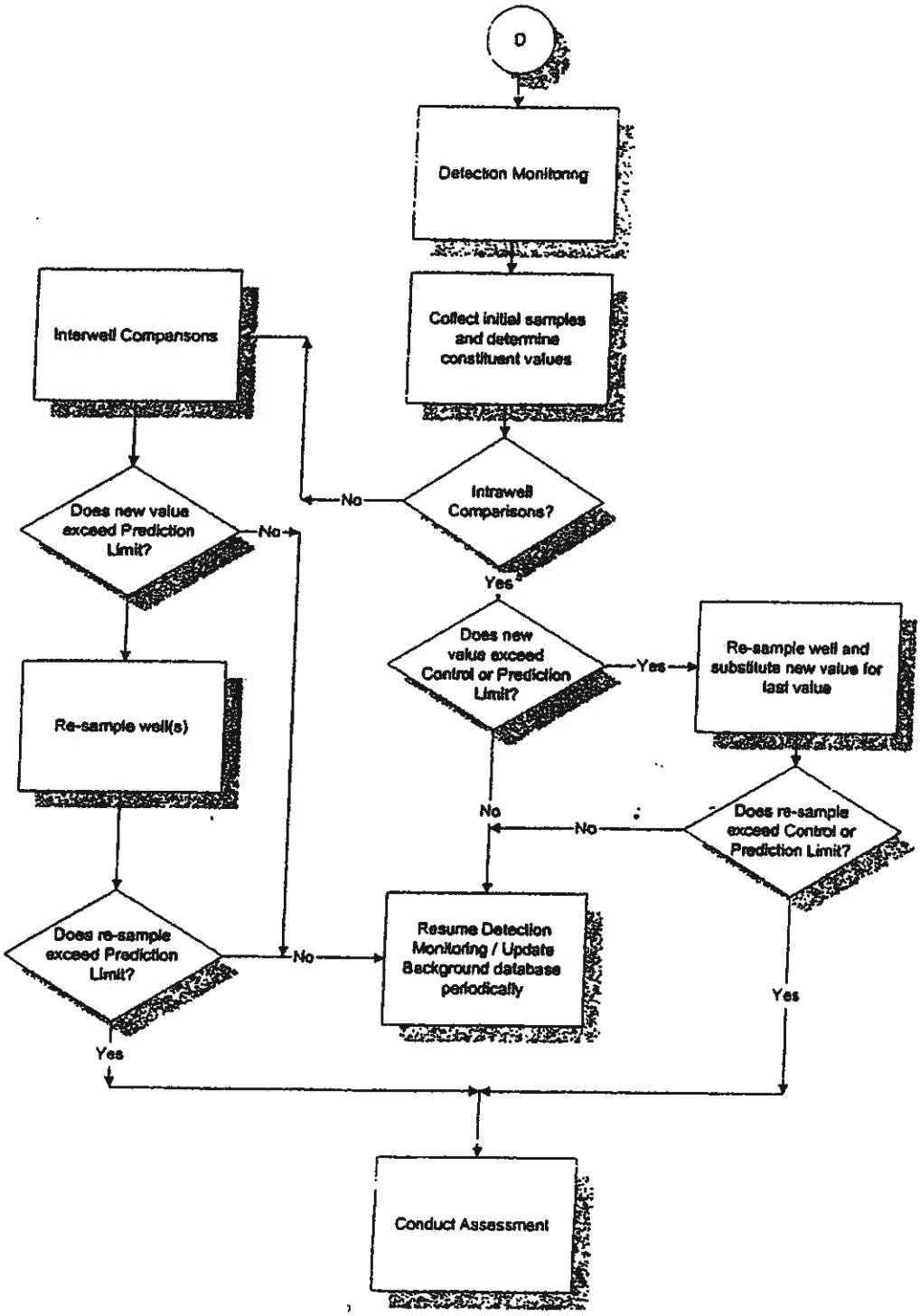


Figure Att11-3 (Continued)
Development of a Statistical Detection Monitoring Plan
McCombs Landfill
MSW Permit No. 729AB



TABLES

Table Att11-1
Sampling, Preservation, and Storage Procedures for Ground Water Monitoring
McCombs Landfill
MSW Permit No. 729AB

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]
		Chain-of-custody (C-O-C)					
R1	OI	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. O = 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

SAIC®

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

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

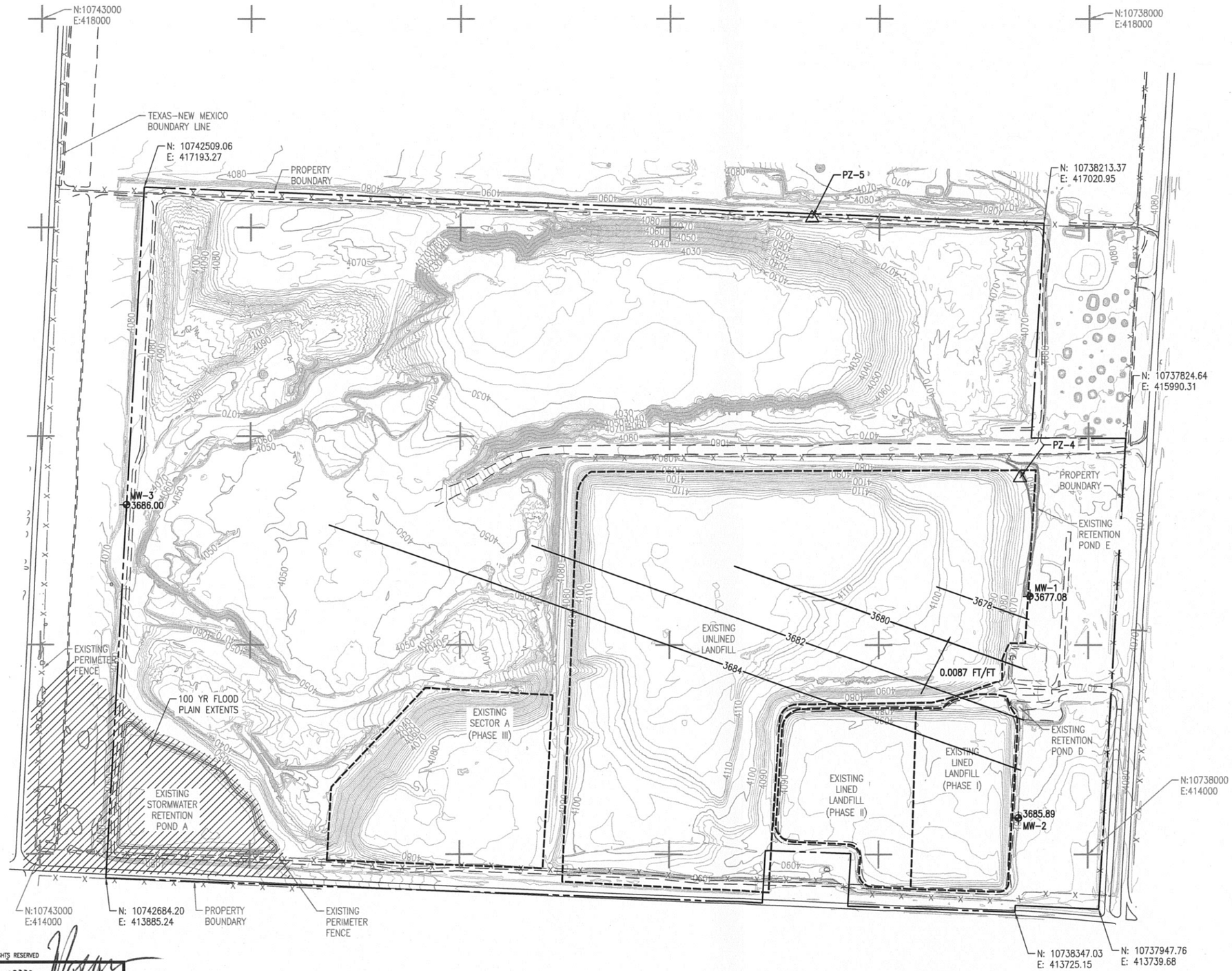
MONITORING WELL LOCATIONS

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



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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

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

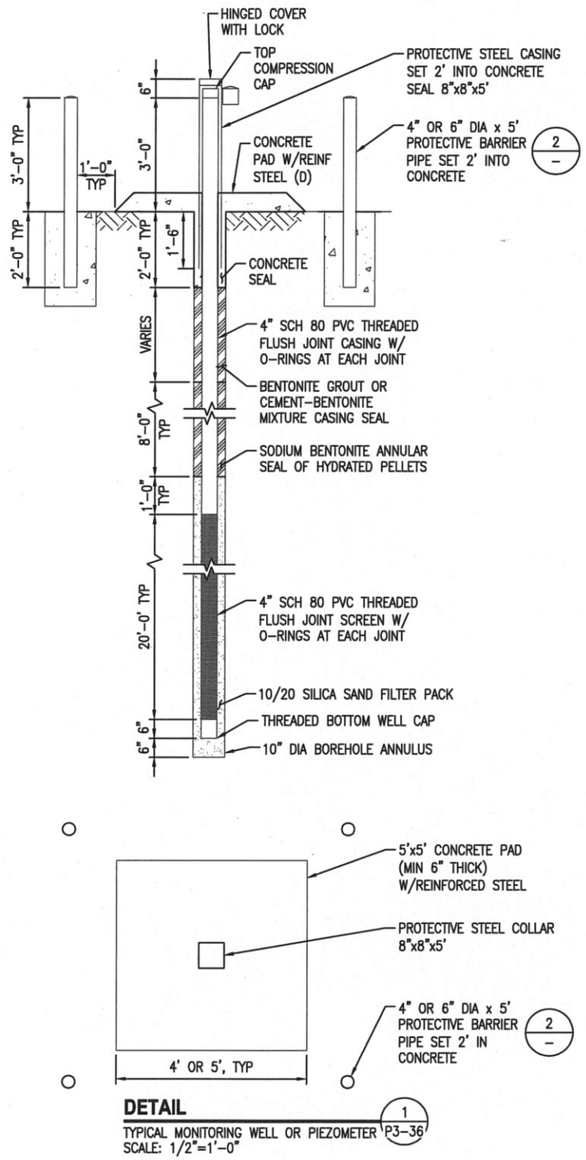
GROUND WATER CONTOUR MAP

PROJECT NUMBER: 9631500115
SHT. 70 OF: 78
DRAWING NUMBER: P3–37

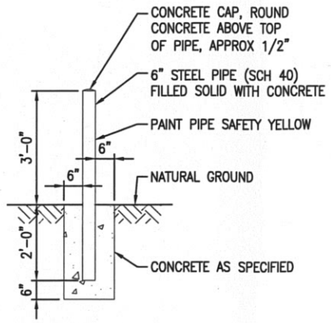
Keller, Tonya L. 10/29/2012 12:51:54 PM – P:\00218000 el paso tx\9631500115\data analytical\CADD\P3–37 GROUND WATER CONTOUR MAP.dwg

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

THE CITY OF EL PASO TEXAS

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SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve
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St. Paul, MN 55121
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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)						
(future well)						
(future well)						
(future well)						
(future well)						
(future well)						
(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

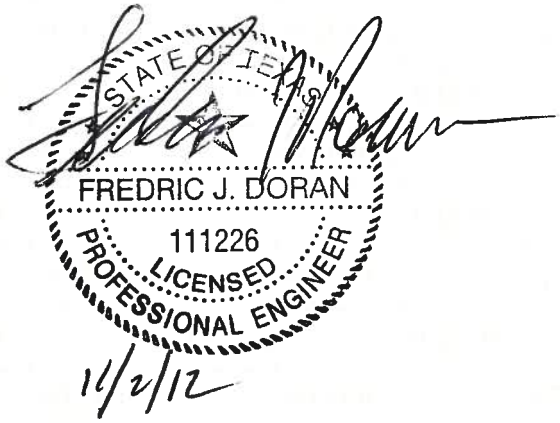
From: Fred J. Doran, SAIC

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



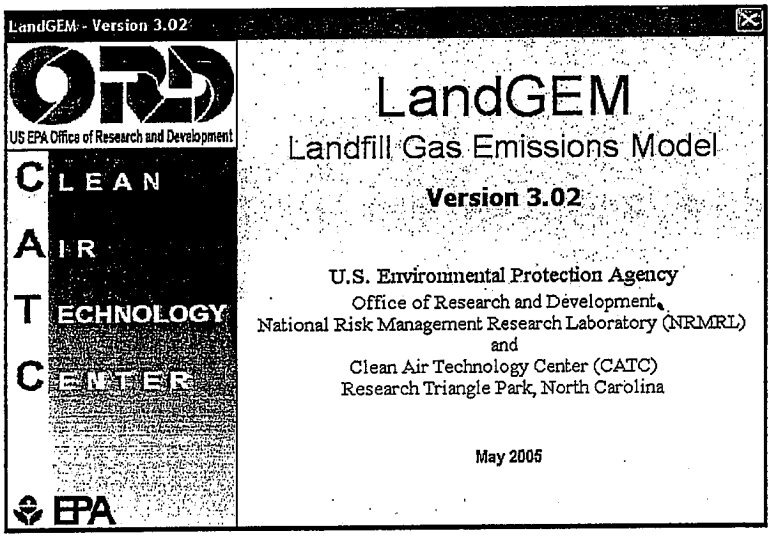
SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve, Suite 305 | St. Paul, MN 55121 | tel: 651.994.8415 | fax: 651.994.8396 | saic.com/EEandI

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 ith year (Mg)
t_{ij} = age of the jth section of waste mass M_i accepted in the ith 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

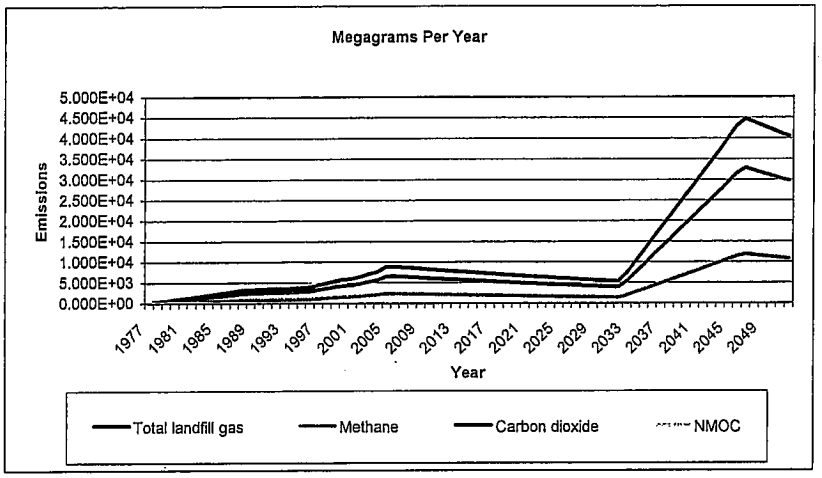
Pollutant Parameters

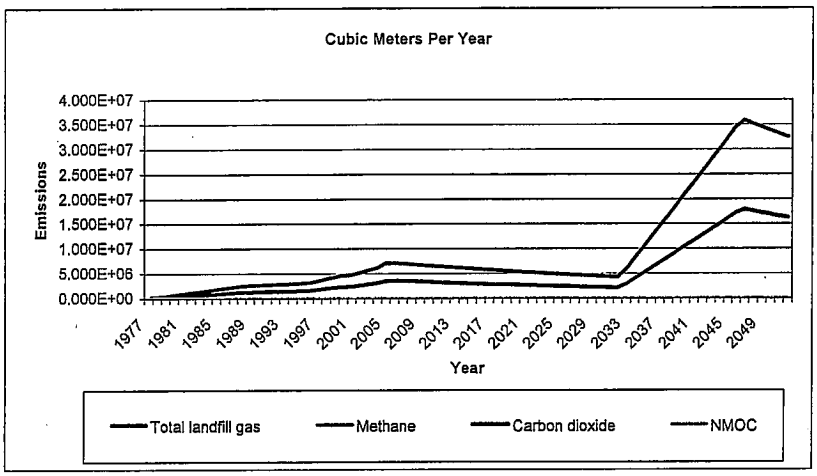
		Gas / Pollutant Default Parameters:		*User-specified Pollutant Parameters:*	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl 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		

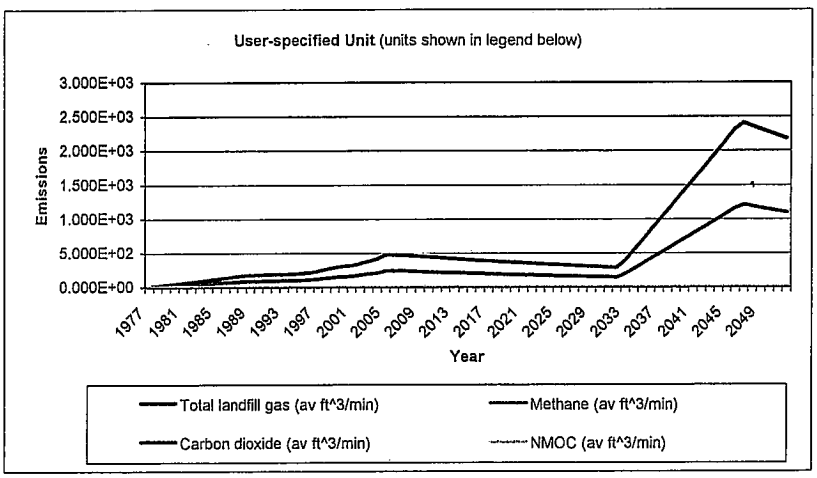
Pollutant Parameters (Continued)

		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		

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

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

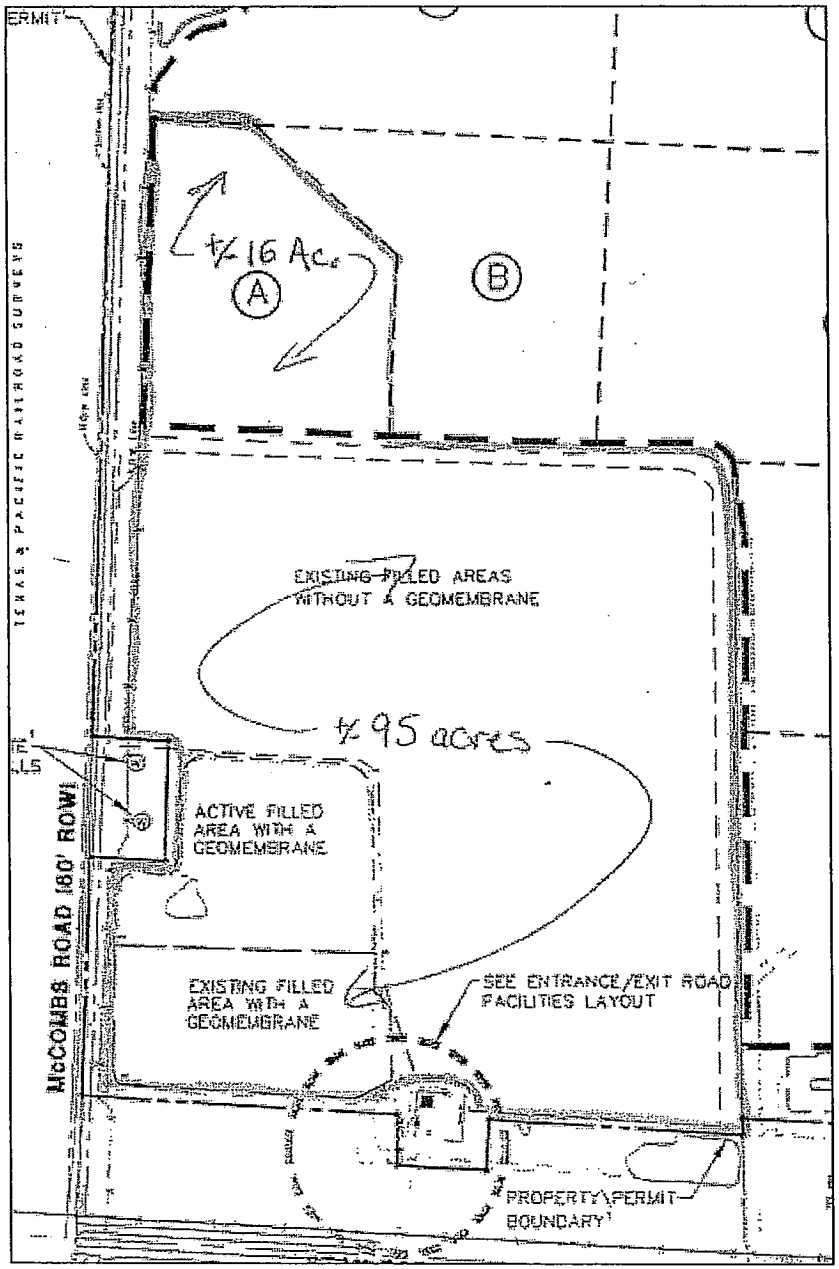
Landfill gas was submitted to Air Technologies for testing. As required by Method 25-C, NMOC concentrations were corrected for nitrogen and moisture content. Using the corrected results, a NMOC concentration of hexane was measured. Results of analytical testing are attached to this report.

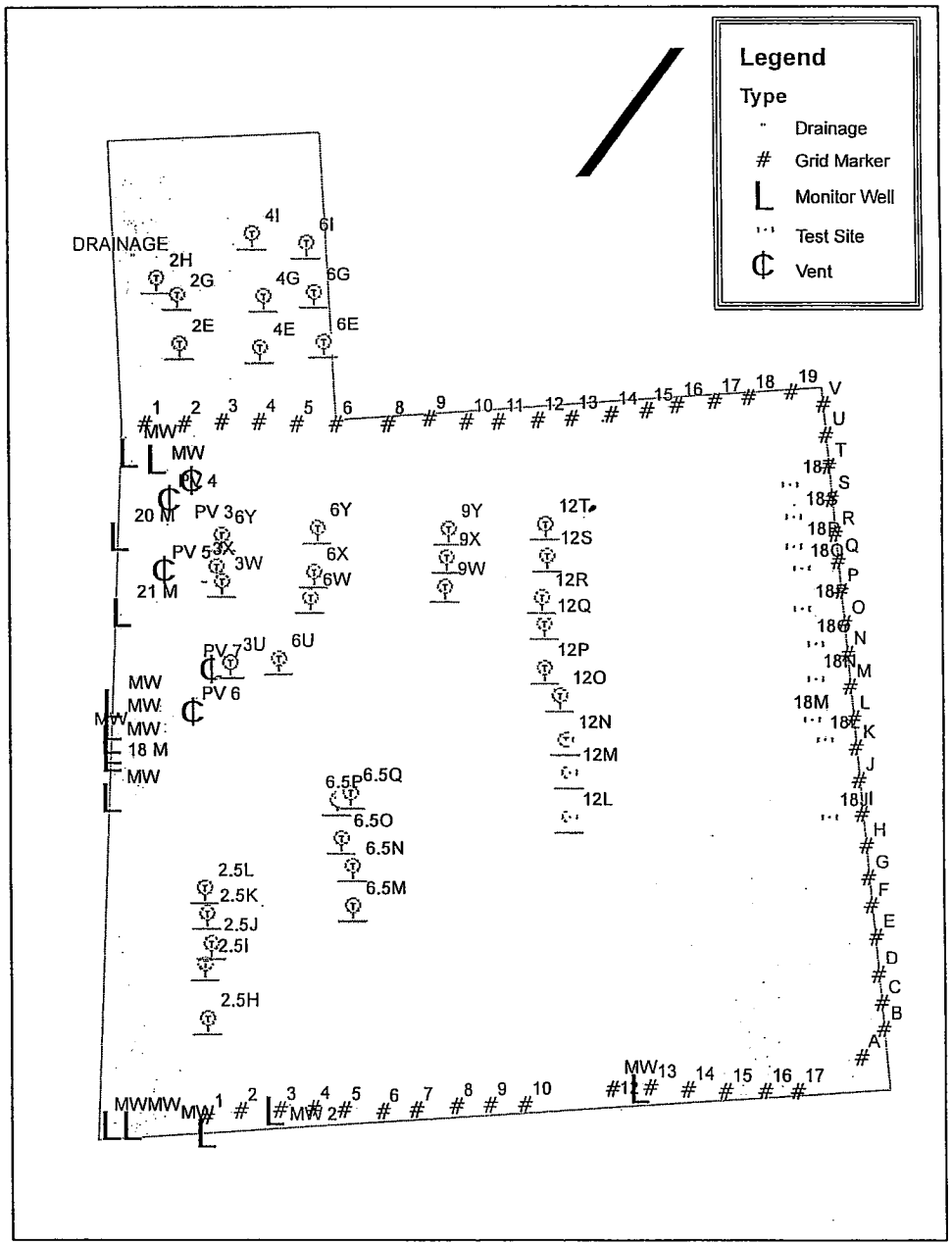
March 21, 2007
Proposal No. 021407021
Tier 2 McCombs Landfill

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
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Bill To: ESN-South
Attn: Rolf Woods
Co: ESN-South
Address 14993 SPID # A388
City Corpus Christi State TX Zip 78418

Special Instructions/Comments:

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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.
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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

SAIC®

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

STORMWATER RETENTION POND C

N: 10737824.64
E: 415990.31

SECTOR E

SECTOR D

SECTOR F

SECTOR G

PZ-4

MW-3

PROPERTY BOUNDARY

EXISTING RETENTION POND E

SECTOR H

SECTOR J

PROPOSED FUTURE FLARE/ENGINE SKID AREA

MW-1

SECTOR C

SECTOR B

EXISTING MAINTENANCE BUILDINGS, GATEHOUSE, AND STORAGE AREA

EXISTING UNLINED LANDFILL

EXISTING SECTOR A (PHASE III)

SECTOR A

SECTOR I

SECTOR K

EXISTING LINED LANDFILL (PHASE II)

EXISTING LINED LANDFILL (PHASE I)

EXISTING STORMWATER RETENTION POND A

FLARE STATION

PV-2A
PV-3
PV-4
PV-6
PV-7
PV-1
PV-1A
GMCS
PV-2
PV-5

MW-2

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

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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
- CHAIN LINK OR OTHER FENCE
- GMCS — GAS MONITORING CONTROL SYSTEM

GRAPHIC SCALE

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

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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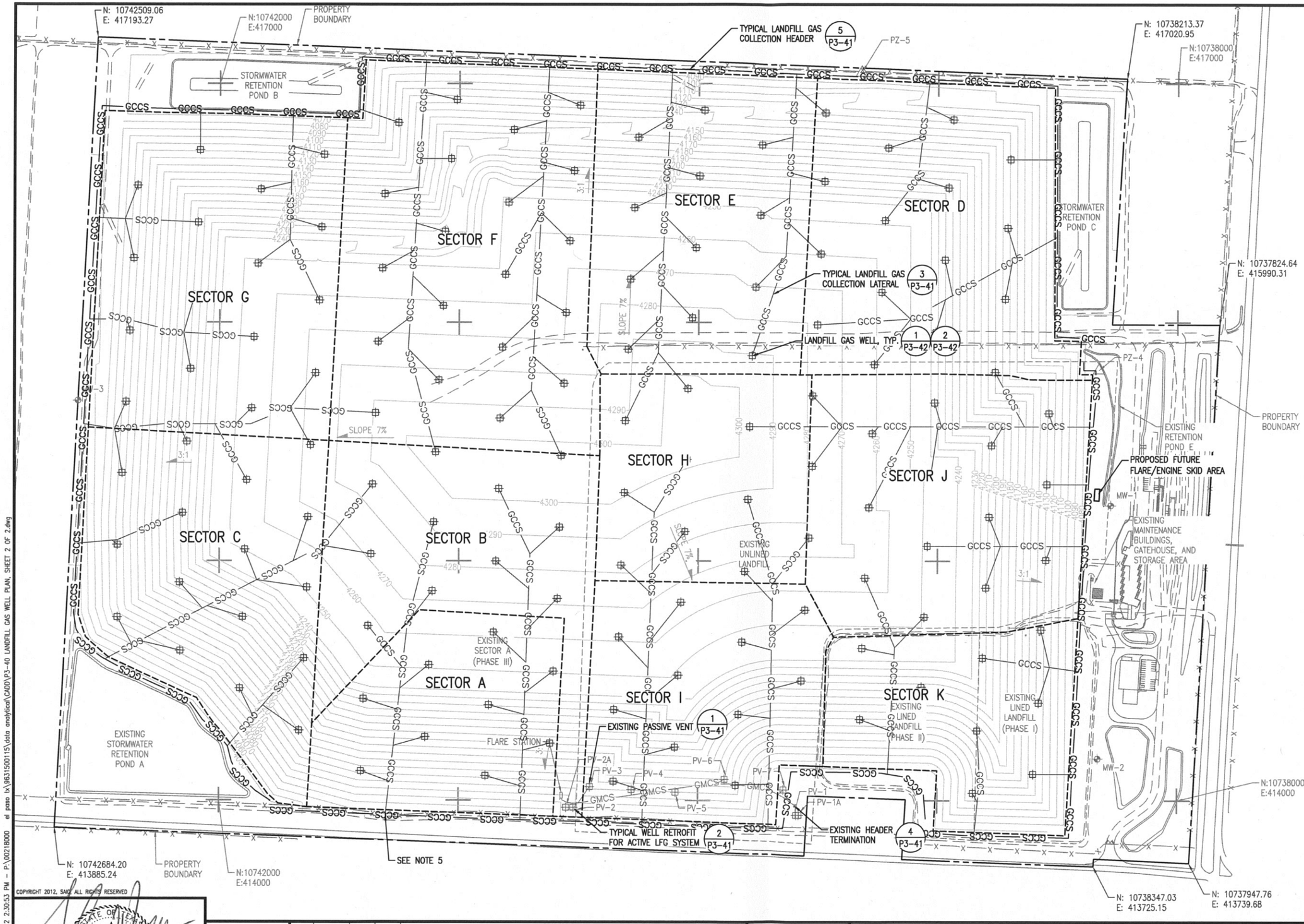
MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

LANDFILL GAS WELL PLAN, SHEET 1 OF 2

PROJECT NUMBER: 9631500115
SHT. 72 OF: 78
DRAWING NUMBER: P3-39

Keller, Tonya L. 10/29/2012 2:21:05 PM – P:\0021B000 el paso txt\9631500115\data analysis\CAD\CAD\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
- CHAIN LINK OR OTHER FENCE
- GMCS — GAS MONITORING CONTROL SYSTEM
- GCCS — GAS COLLECTION CONTROL SYSTEM

GRAPHIC SCALE
1"=200'-0"
200 0 200 400
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

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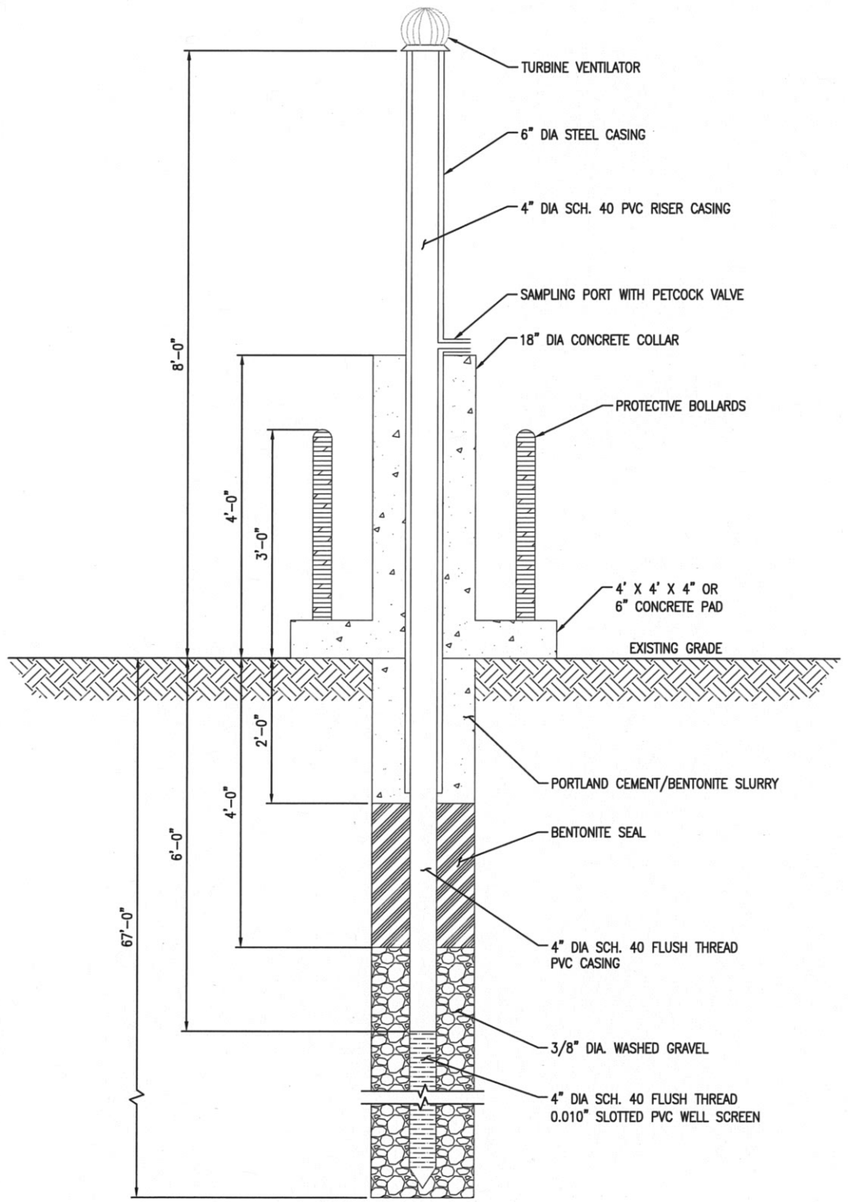
LANDFILL GAS WELL PLAN, SHEET 2 OF 2

PROJECT NUMBER: 9631500115
SHT. 73 OF: 78
DRAWING NUMBER: P3-40

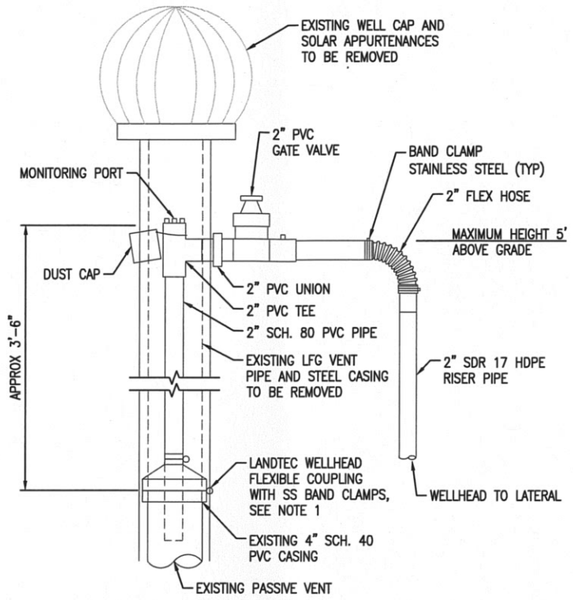
Keller, Tonya L. 10/29/2012 2:30:53 PM – P:\00218000 el paso tx\9631500115\data analytical\CADD\P3-40 LANDFILL GAS WELL PLAN, SHEET 2 OF 2.dwg

NOTES

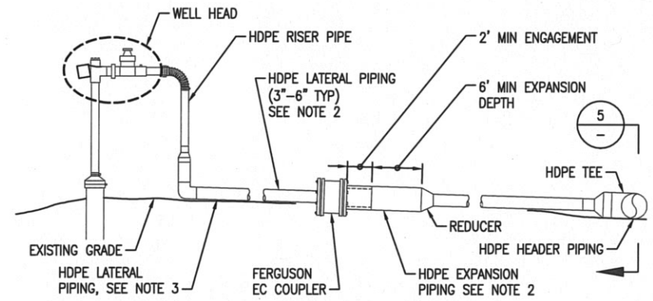
1. WELLHEAD ILLUSTRATED IS 2" LANDTEC ACCU-FLO WELLHEAD OR EQUIVALENT.
2. ALL PIPE SIZES AND DIMENSIONS ARE APPROXIMATE. EXACT SIZING AND DIMENSIONS SHALL BE DETERMINED DURING DESIGN.
3. HEADER AND LATERAL PIPING ABOVE GROUND.



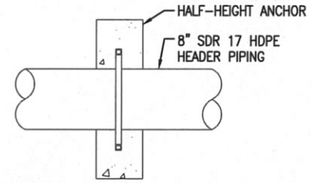
DETAIL 1 / P3-40
EXISTING PASSIVE VENT
SCALE: 1"=1'-0"



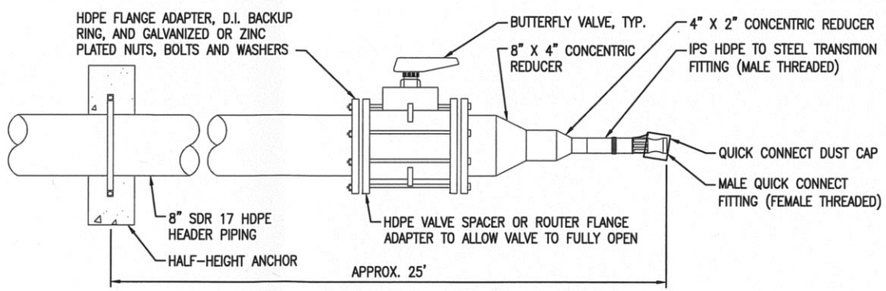
DETAIL 2 / P3-40
TYPICAL WELL RETROFIT FOR ACTIVE LFG SYSTEM
SCALE: 1"=1'-0"



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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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
1	11/2/12	TLK	FJD	SECOND TECHNICAL NOD
0	11/22/11	FJD	SEK	MAJOR PERMIT AMENDMENT

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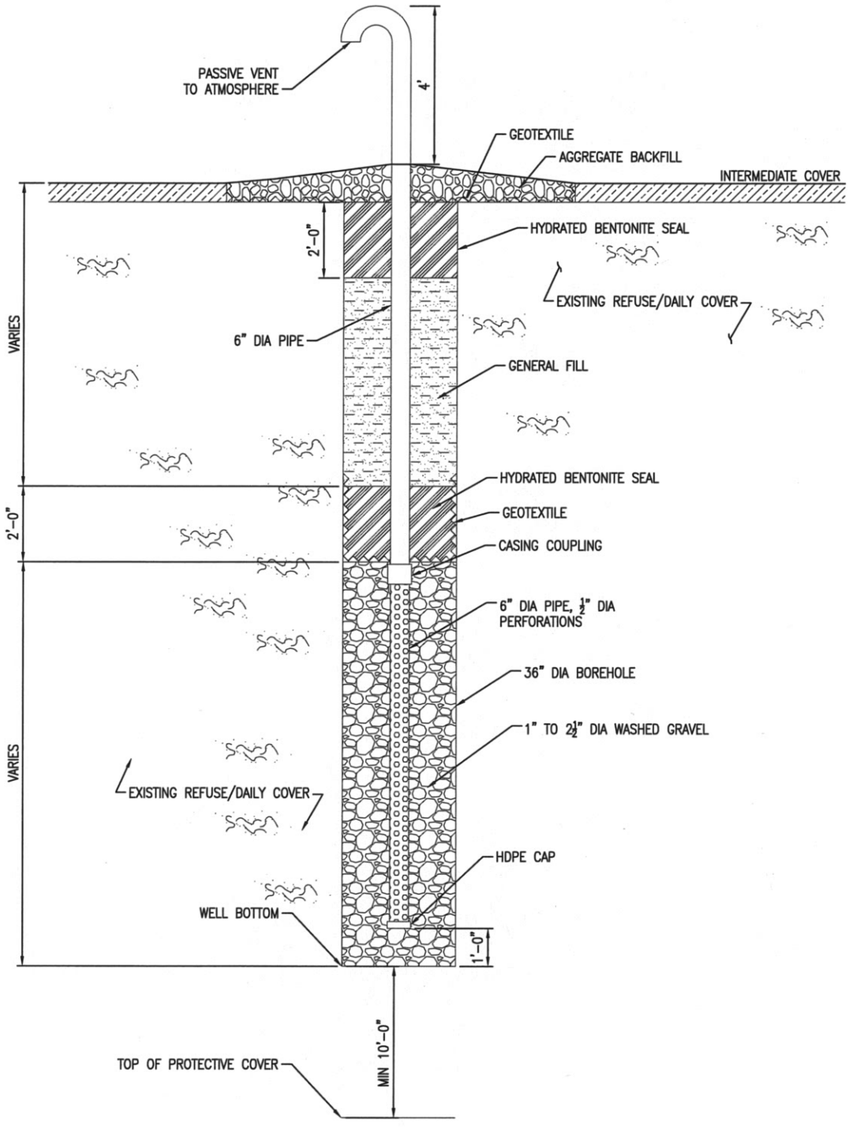
MAJOR PERMIT AMENDMENT

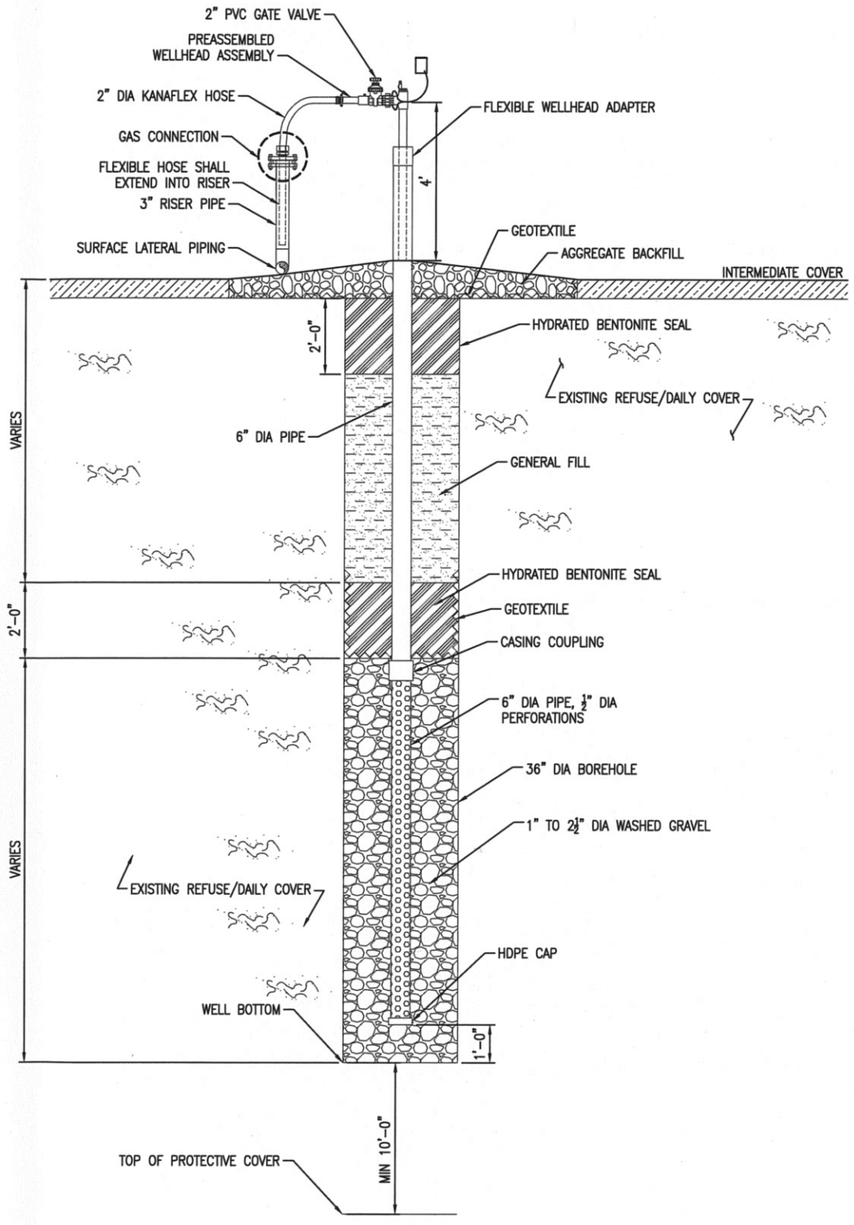
TYPICAL GAS WELL AND VENT DETAILS, SHEET 1 OF 2

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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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

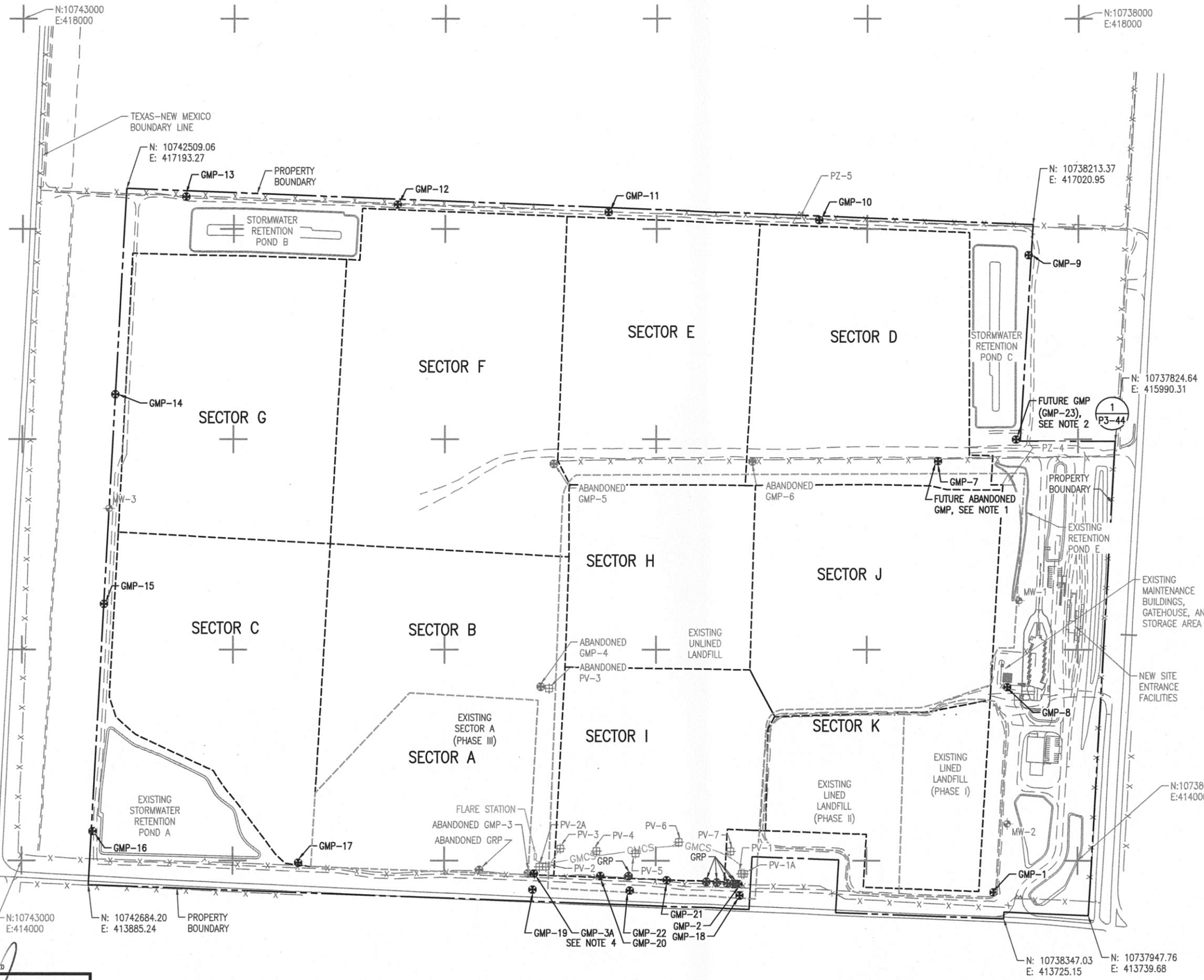
SAIC Energy, Environment & Infrastructure, LLC
1380 Corporate Center Curve
Suite 305
St. Paul, MN 55121
(651) 994-8415

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

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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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

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

MCCOMBS LANDFILL
MAJOR PERMIT AMENDMENT

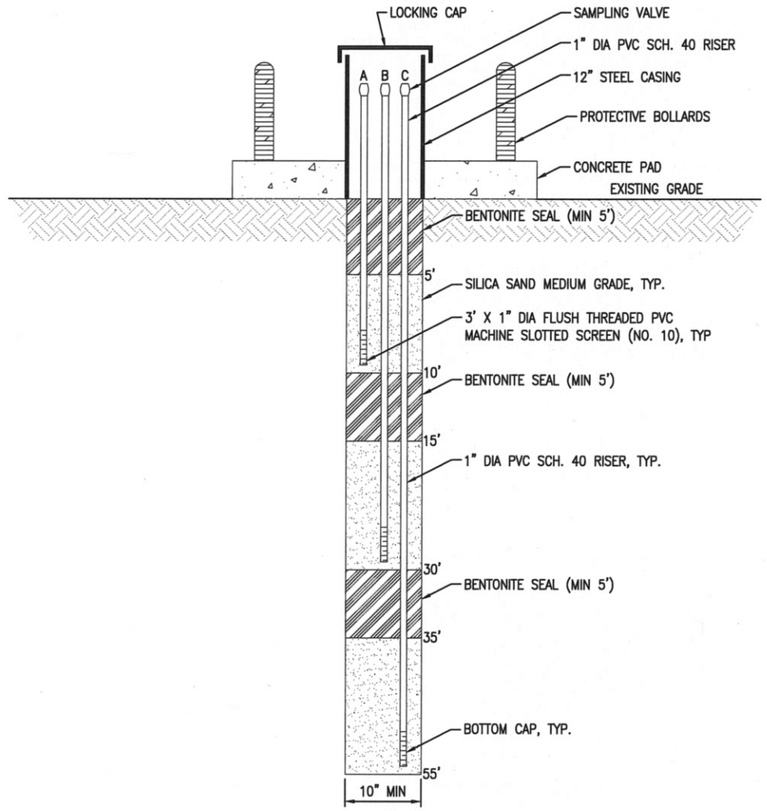
LANDFILL GAS MONITORING PROBE PLAN

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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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

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 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

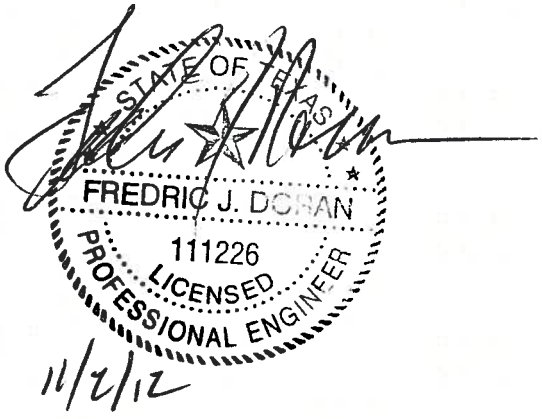
From: Fred J. Doran, SAIC FJD

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

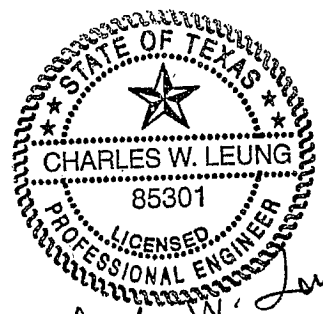
(CONTINUED)

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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6 WASTE STREAM

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12 ENCLOSED STRUCTURE MONITORING

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16 MONITORING PROCEDURES

17 CONTINGENCY PLAN

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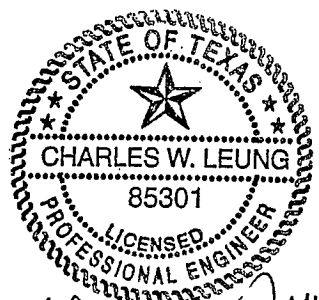
REFERENCES



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

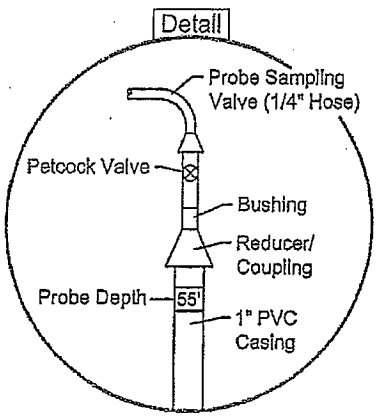
GAS MONITOR WELL SCHEMATIC GMP-18

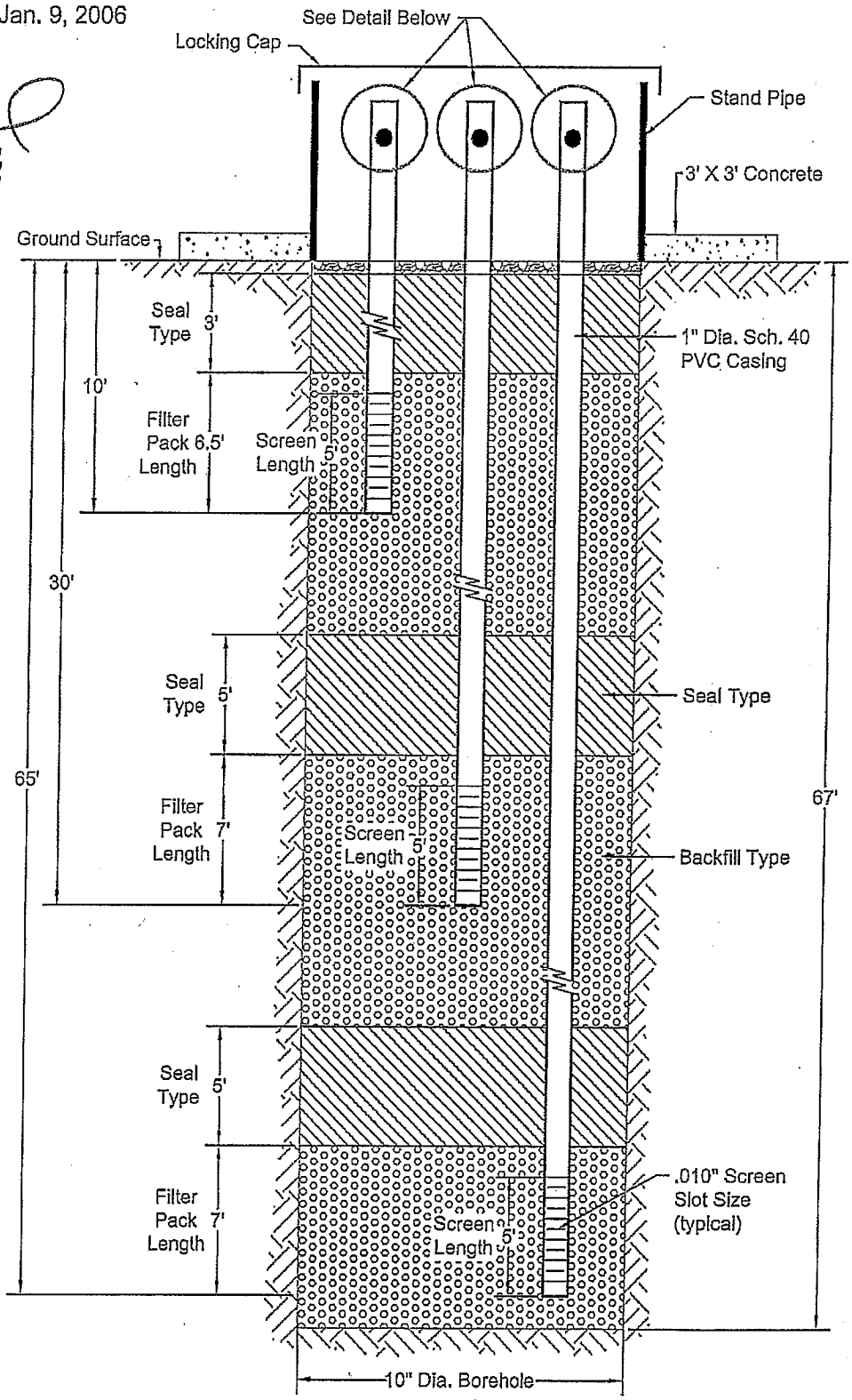
PROJECT Landfill Gas Study - McCombs Landfill
JOB NO. 4-717-000291 DATE 12/15/2004
RIG TYPE CME 75 LOGGED W. Smith
BORING TYPE 10" O.D. Hollow Stem Auger DWG BY C. Holguin
File No: P:\Drafting2\2004\0291\VMW-2 Well.dwg CHECKED BY E. Osorio
DRILLED BY- Tierra

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										

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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

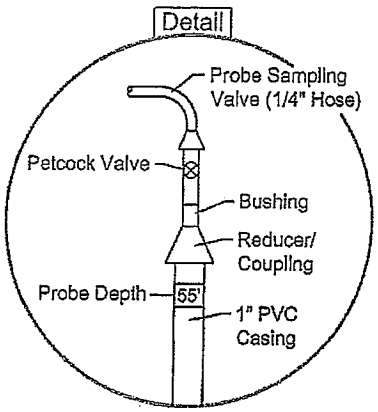
GAS MONITOR WELL SCHEMATIC GMP-19

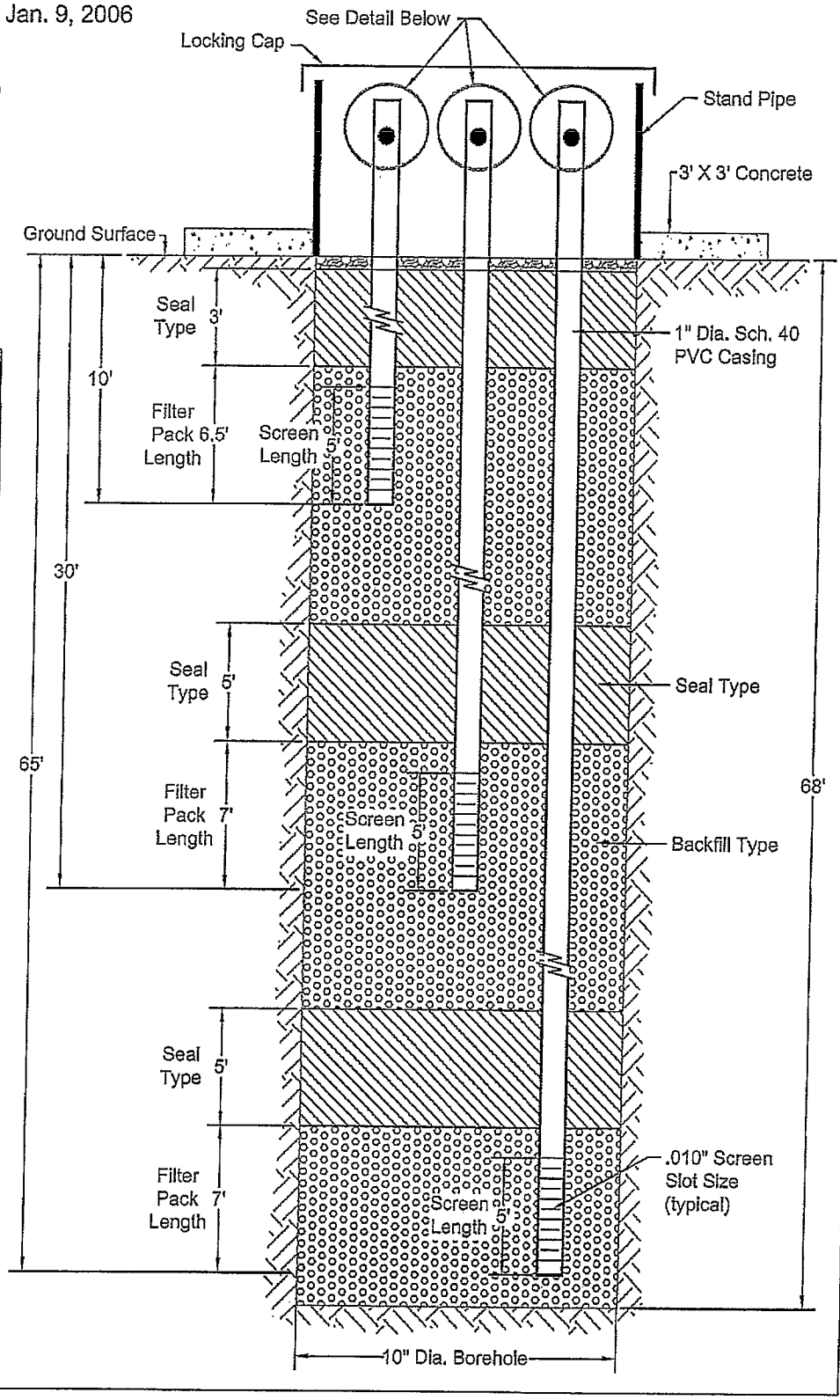
PROJECT Landfill Gas Study - McCombs Landfill
JOB NO. 4-717-000291 DATE 12/15/2004
RIG TYPE CME 75 LOGGED W. Smith
BORING TYPE 10" O.D. Hollow Stem Auger DWG BY C. Holguin
File No: P:\Drafting2\2004\0291\VMW-3 Well.dwg CHECKED BY E. Osorio
DRILLED BY Tierra

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.	

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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 65.0 Boring Terminated at 65'. Bottom of hole at 65.0 feet.	0.0
70					
75					

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David L. Hartsfield P.G.
6-28-07

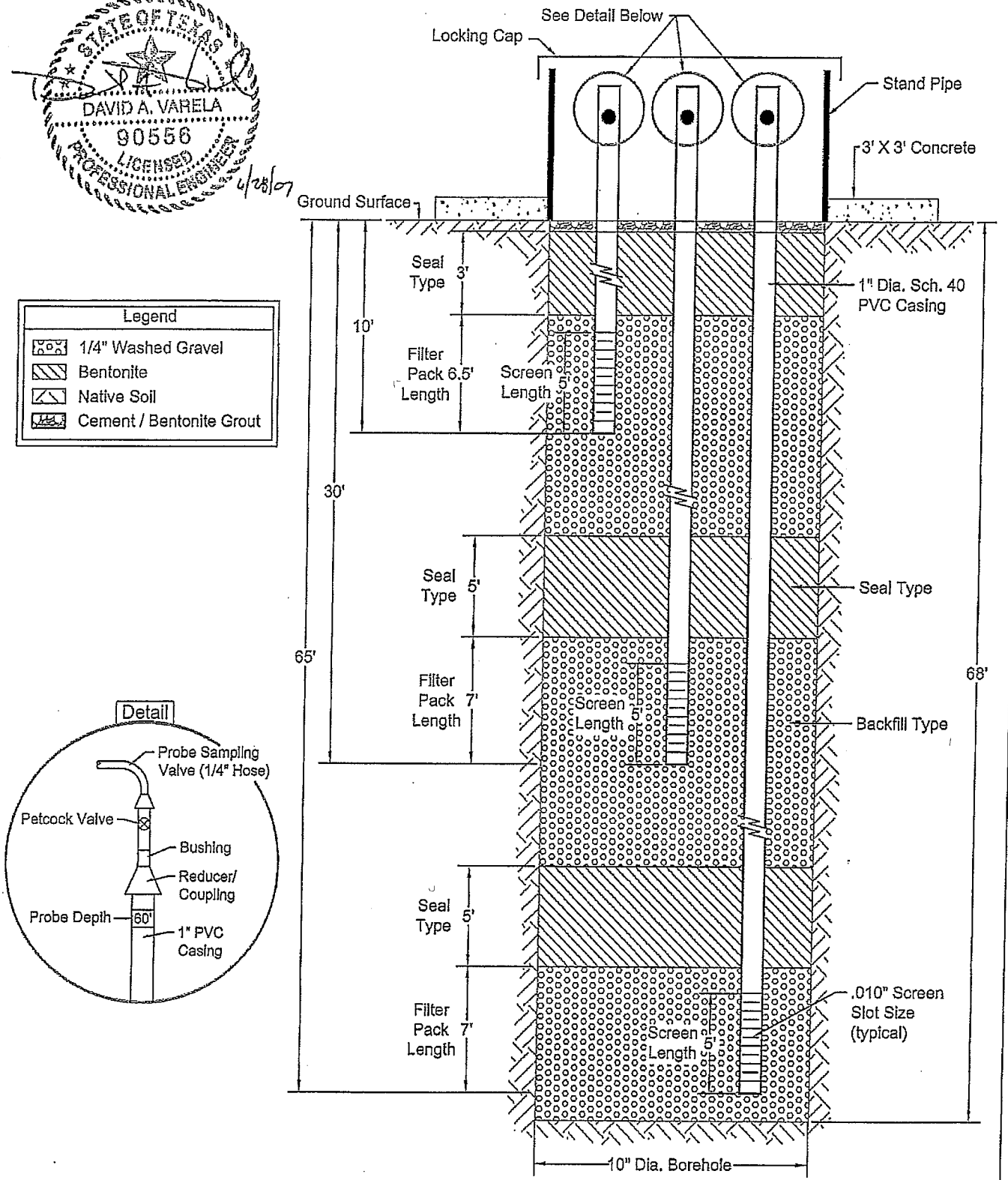
AMEC WELL LOG AND DIAGRAM BORE LOGS GMP-20 TO 22.GPJ GINT US LAB.GDT 06/27/07

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.	

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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					

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6-28-07

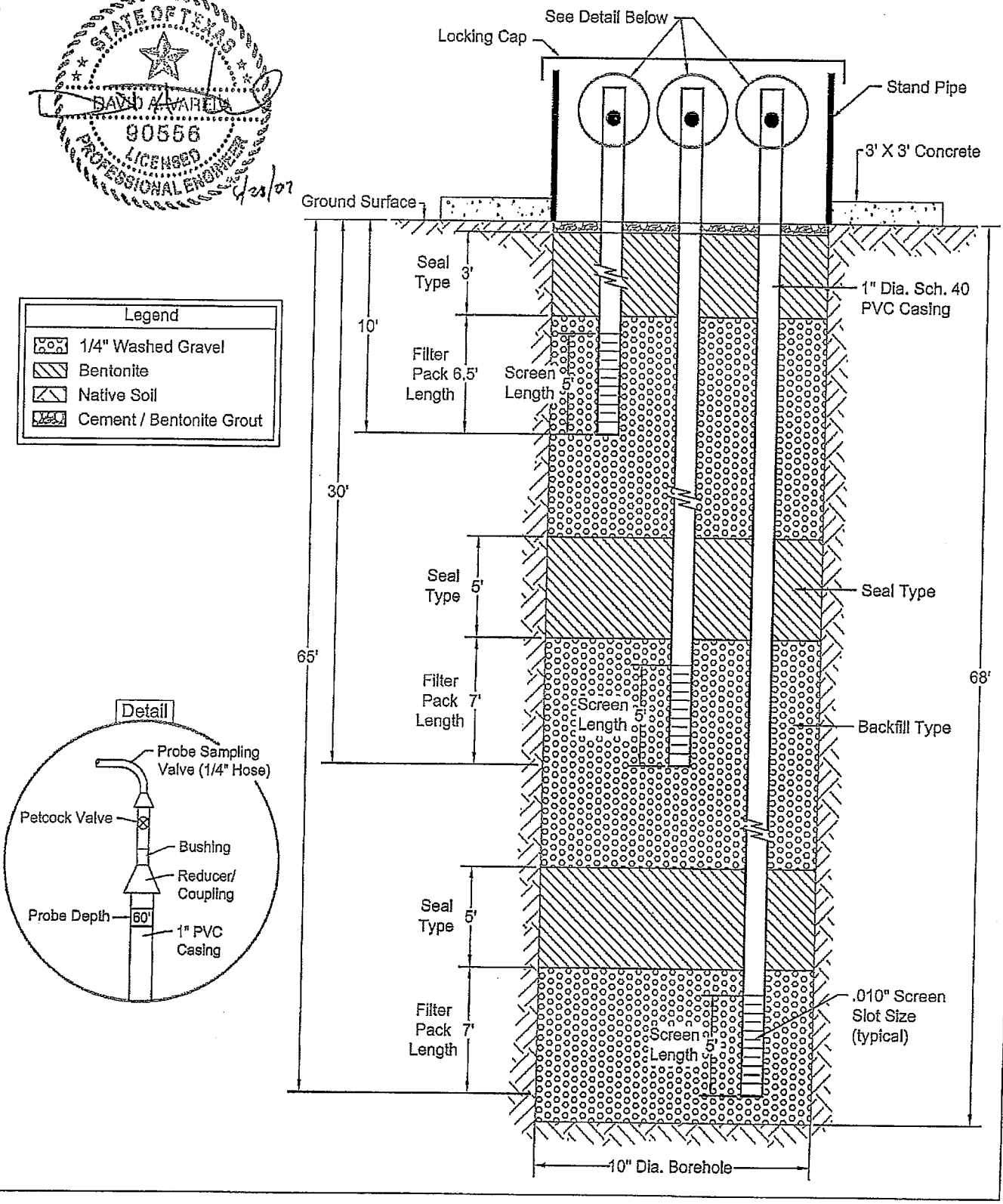
AMEC WELL LOG AND DIAGRAM BORE LOGS GMP-20 TO 22.GPJ GINT US LAB.GDT 06/27/07

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
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2707
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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

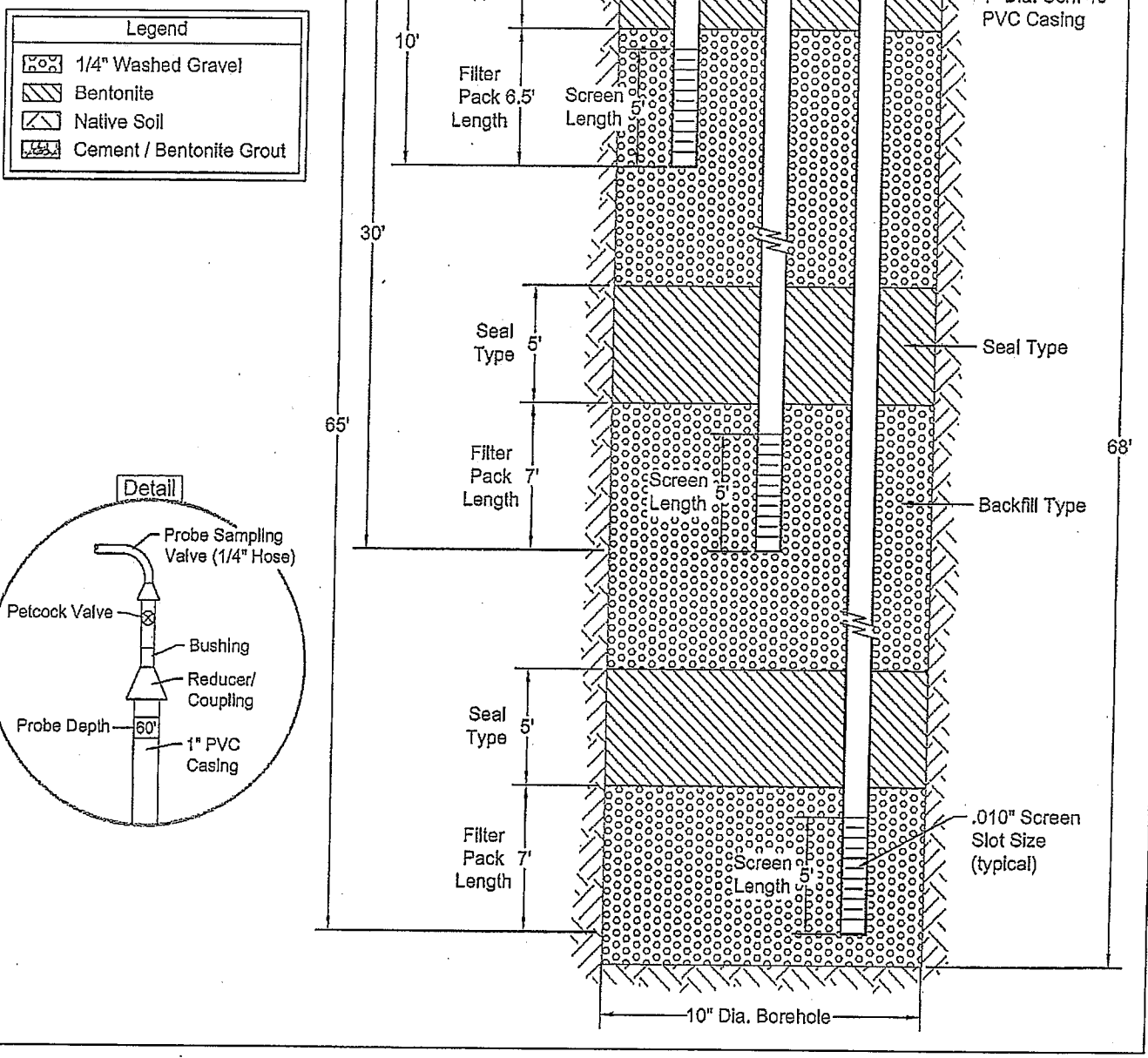
AMEC WELL LOG AND DIAGRAM BORE LOGS GMP-20 TO 22.GPJ GINT US LAB.GDT 05/27/07

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

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			

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

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

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 El Paso , TX	Grid #:	49-05-3
Well Location:	Same 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 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

	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: 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 El Paso , TX	Grid #:	49-05-3
Well Location:	Same 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 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

	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: 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 #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 El Paso , TX	Grid #:	49-05-3
Well Location:	Same 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

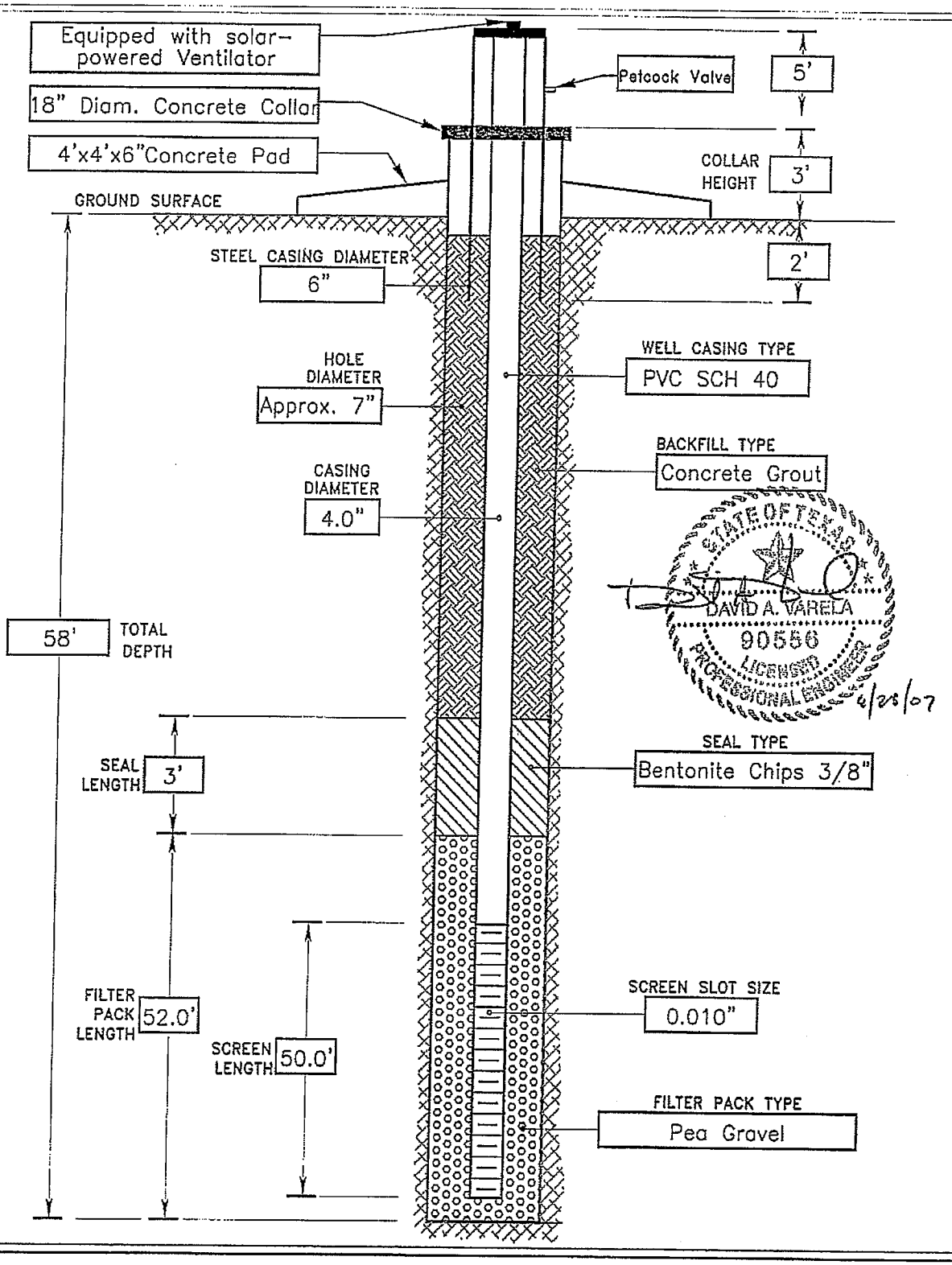
JOB NO. 6-717-500029 DATE INSTALLED 11/13/2006

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
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-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												

STATE OF TEXAS
David L. Hartsfield
Geology
2707
LICENSED PROFESSIONAL GEOSCIENTIST

6-28-07

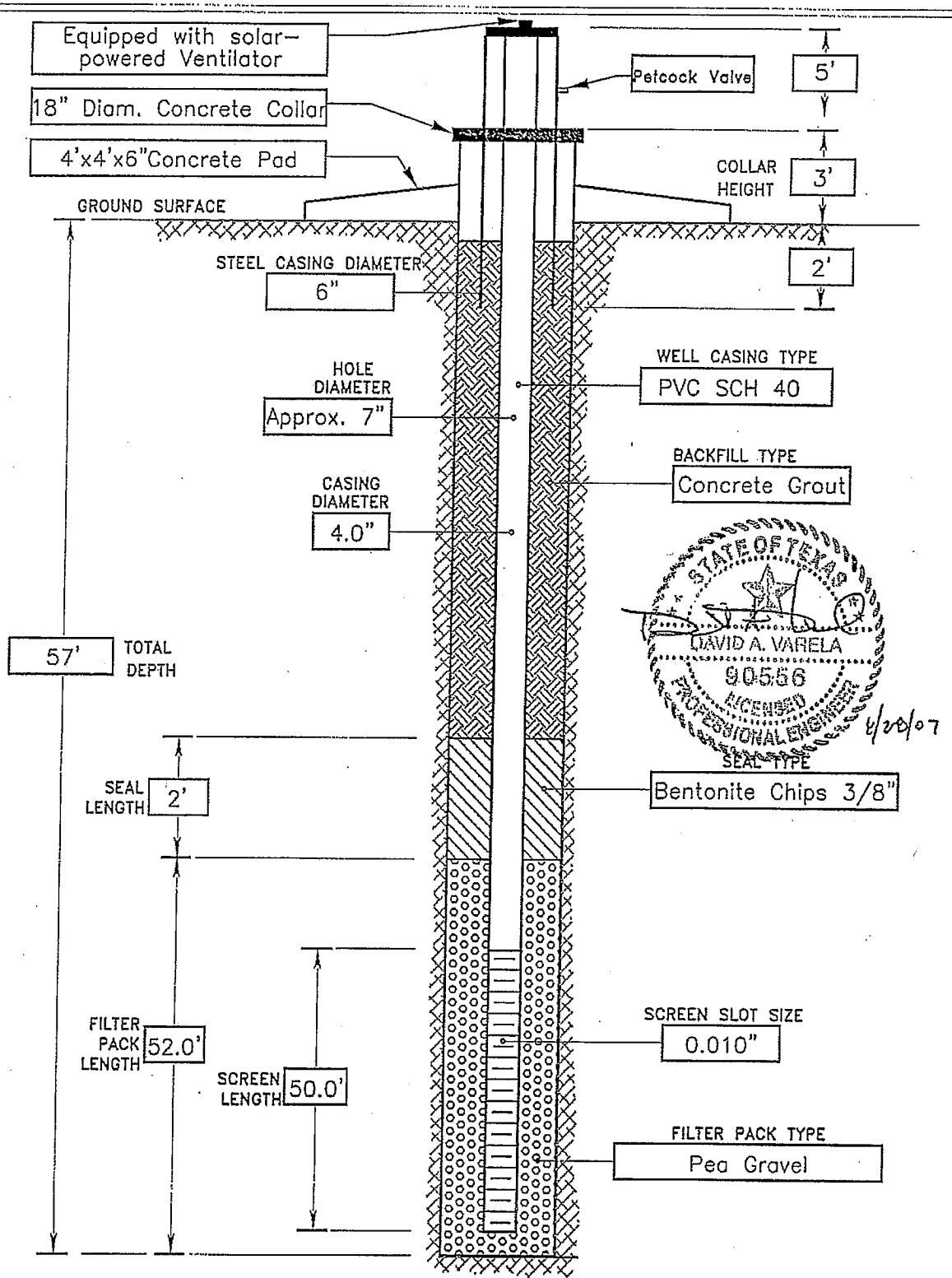
GROUND WATER		
DEPTH	HOUR	DATE

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
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-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
David L. Hartsfield
Geology
2707
LICENSED PROFESSIONAL GEOSCIENTIST

P.G.
6-28-07

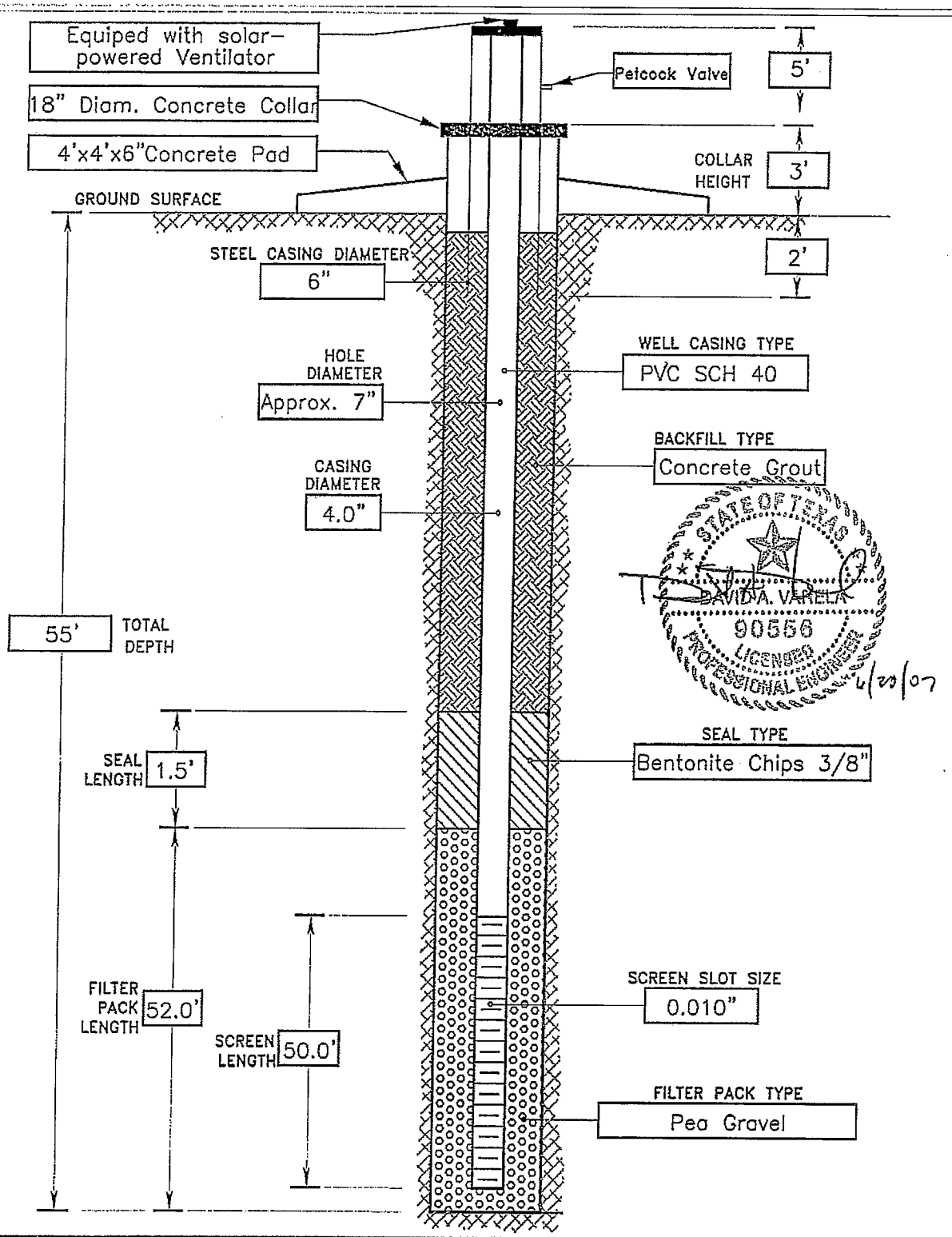
GROUND WATER		
DEPTH	HOUR	DATE

SAMPLE TYPE
A - Auger cuttings B - Block sample
S - 2" O.D. 1.33" 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
David L. Hartsfield
Geology
2707
LICENSED
PROFESSIONAL GEOSCIENTIST

P.G.
6-28-07

GROUND WATER		
DEPTH	HOUR	DATE

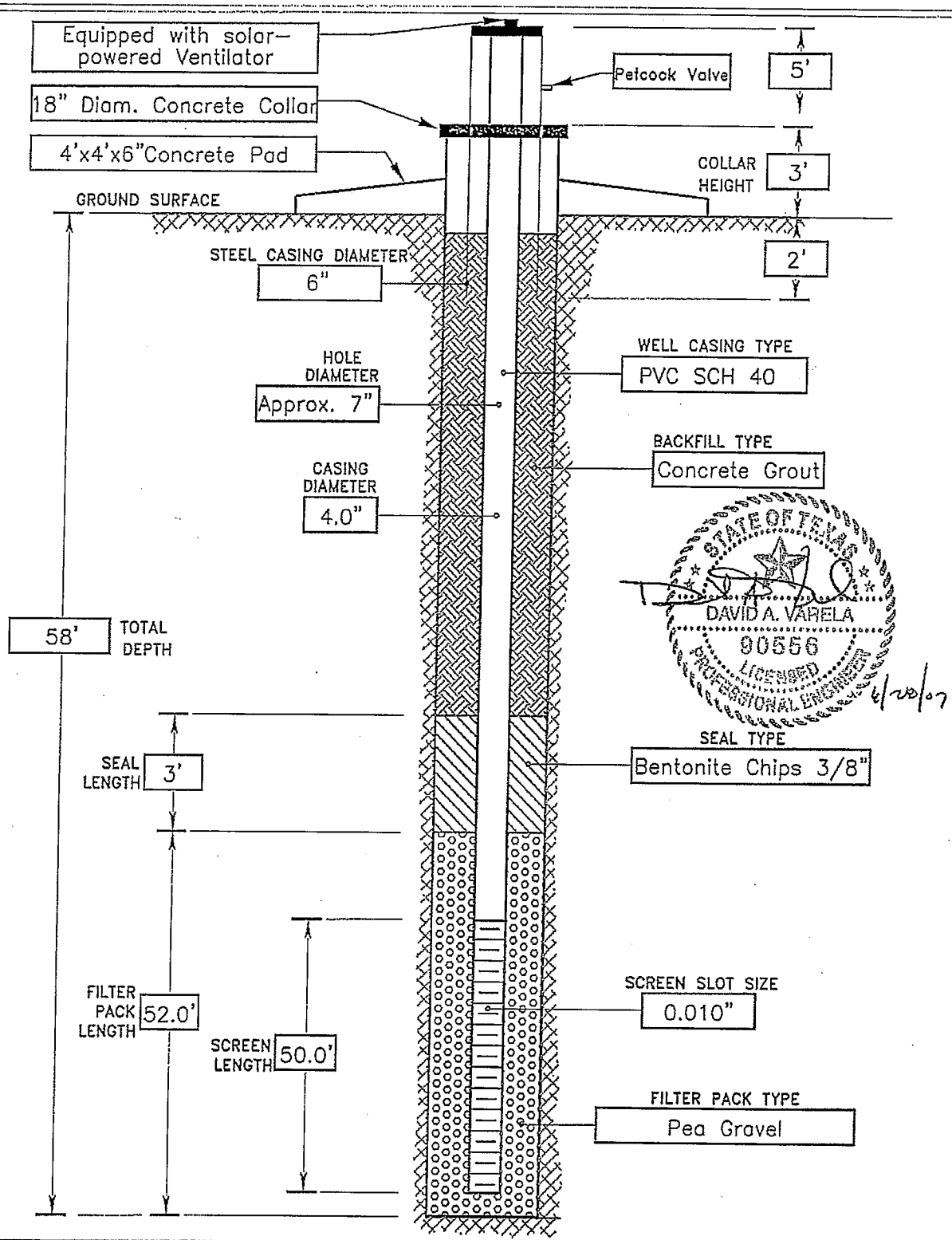
SAMPLE TYPE
A - Auger cuttings B - Block sample
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 3" O.D. thin-walled Shelby tube

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
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-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

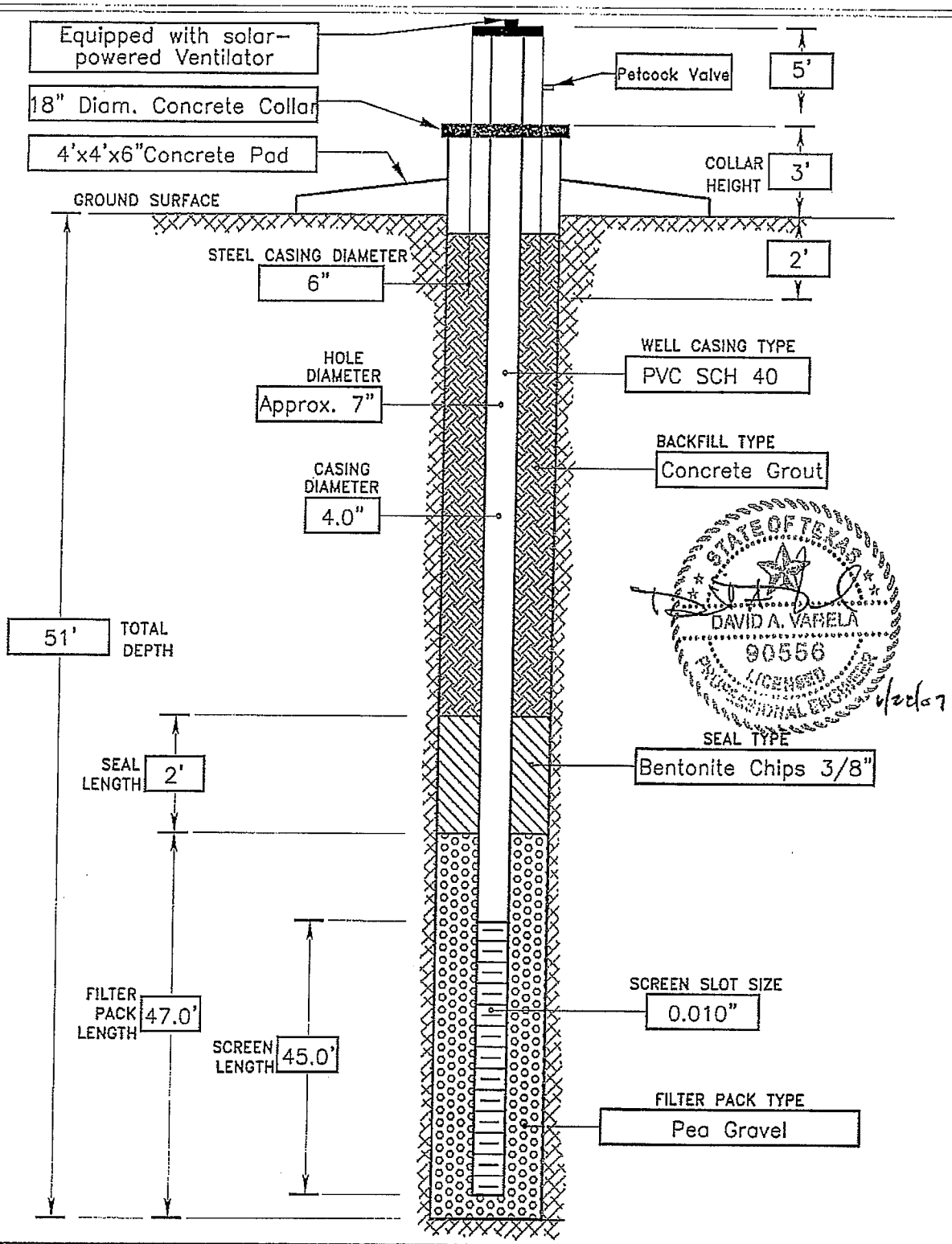
SAMPLE TYPE
A - Auger cuttings B - Block sample
S - 2" O.D. 1.35" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 3" O.D. thin-walled Shelby tube

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.

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:
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
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:
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
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:
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.

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

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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
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Email address: water.well@license.state.tx.us Web address: www.license.state.tx.us

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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		

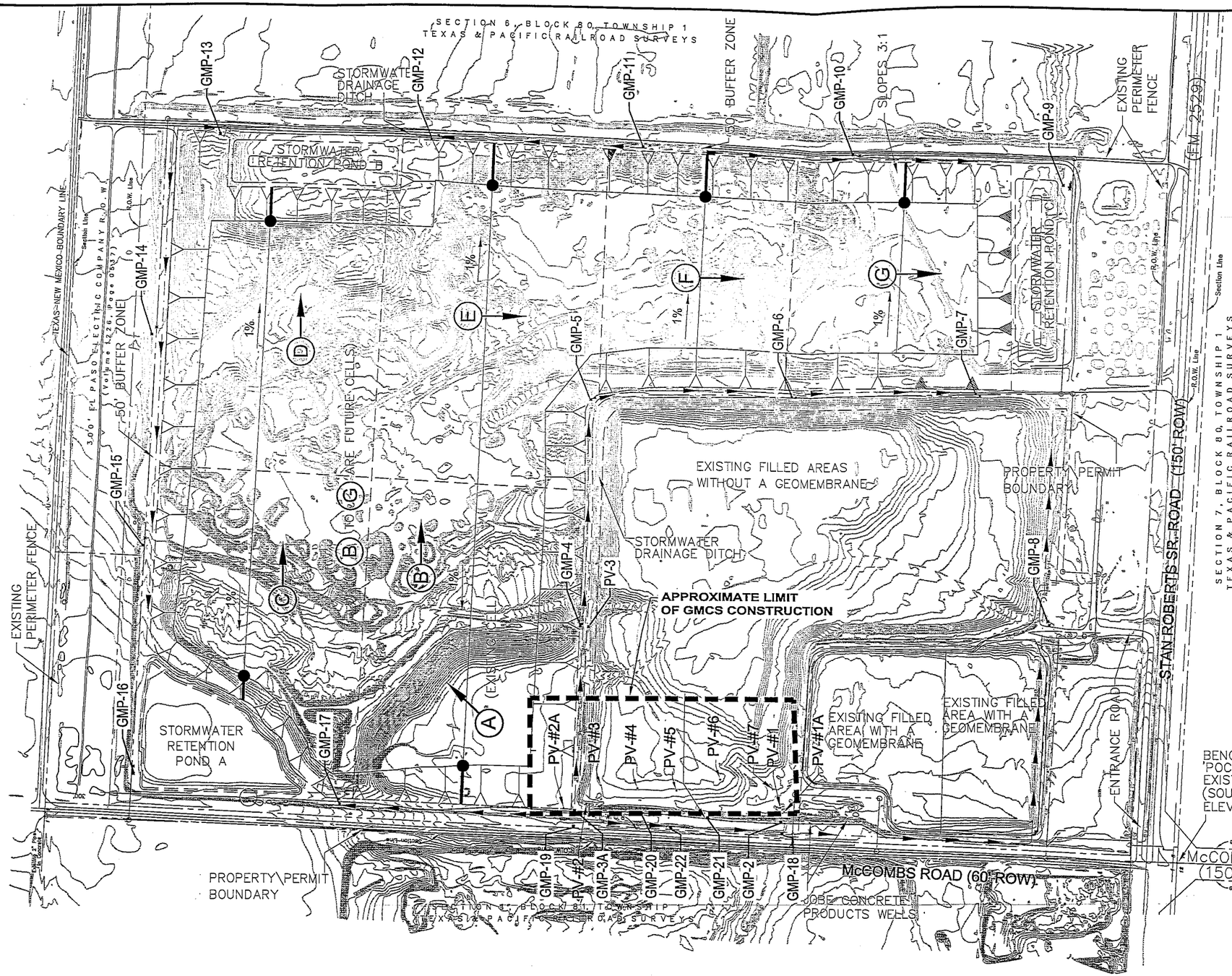
TDLR FORM 001WWD / 2-06 *TDLR (Original)* *Landowner (copy)* *Driller/Pump Installer (copy)*

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	-

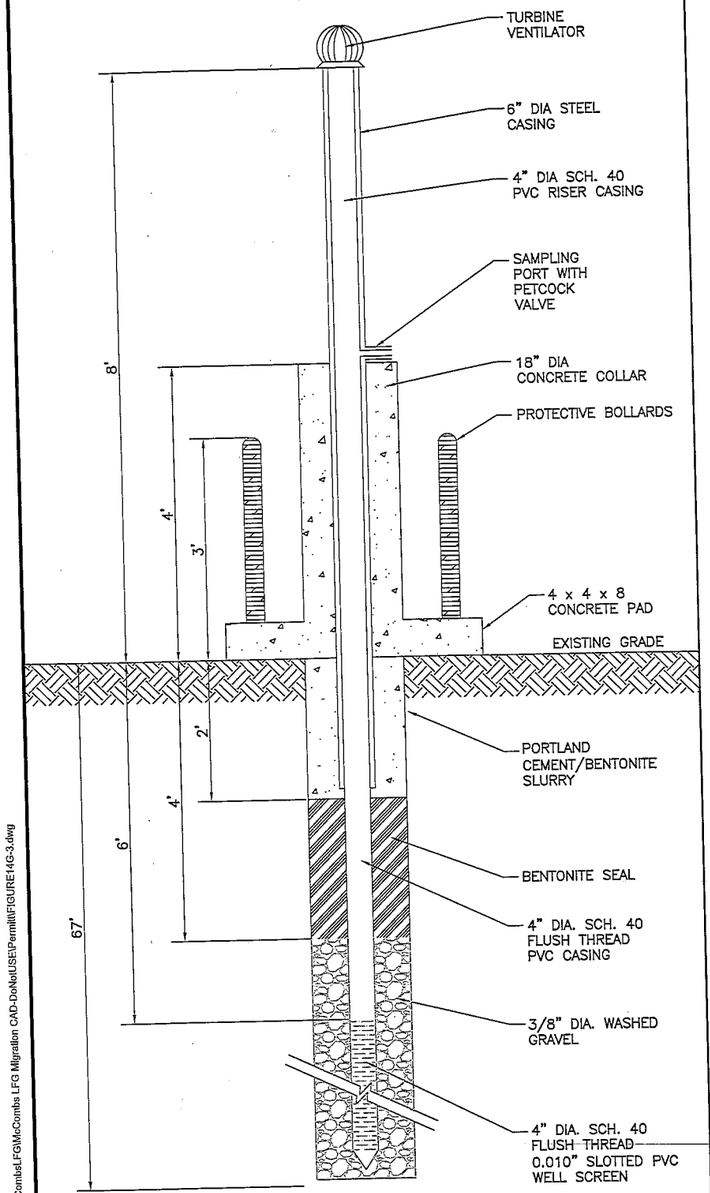
THE CITY OF EL PASO TEXAS

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)

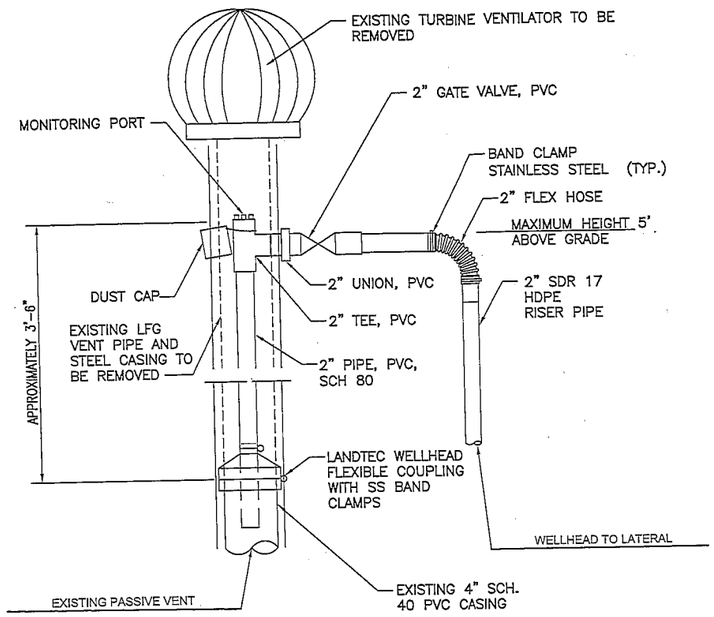
PROJECT NUMBER:	15-002180-01000
SHT.	OF: -
DRAWING NUMBER:	Figure 14G-2



EXISTING PASSIVE VENT DETAIL

NOTES:

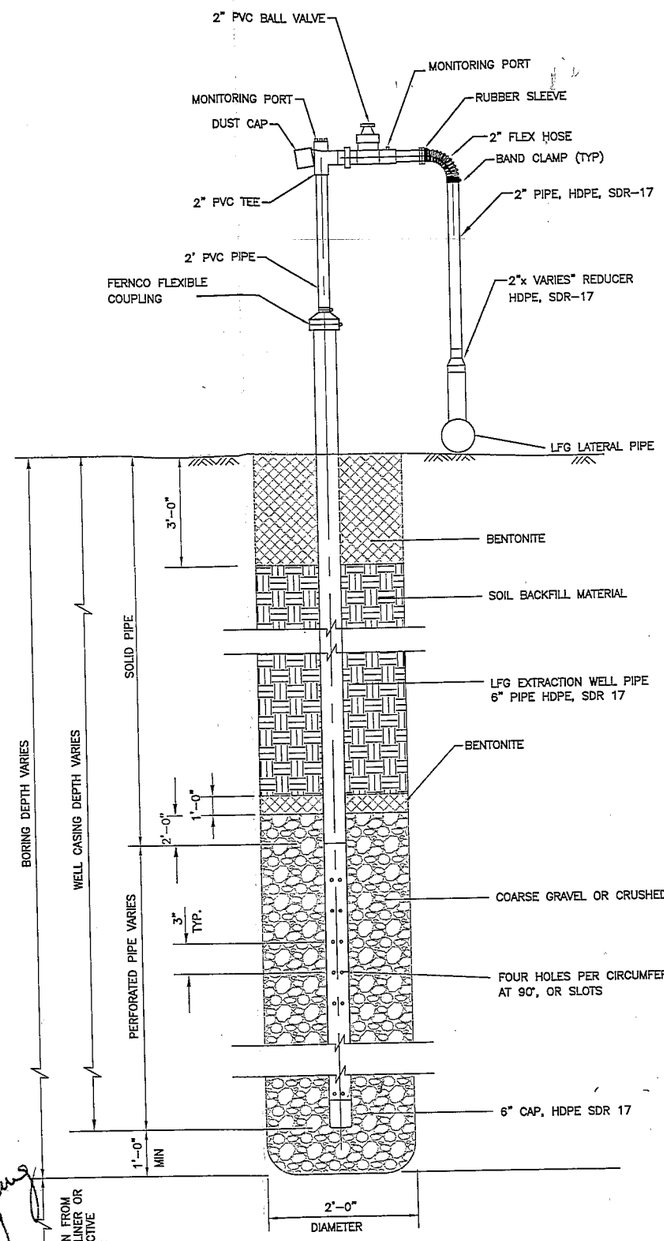
1. EXISTING DETAIL REPRODUCED WITHOUT MODIFICATION FROM CITY OF EL PASO DOCUMENTATION.



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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APPENDIX E: .....LANDFILL QUARTERLY METHANE INSPECTION FORM

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

AGRA Earth and Environmental Group, 1994, Gas Management Plan. Report Prepared for the City of El Paso.

Borrego, A., 1994 and 2001. City of El Paso Engineering Department. Personal communication.

Department of Solid Waste Management, 1999. Site Operating Plan. Department of Solid Waste Management.

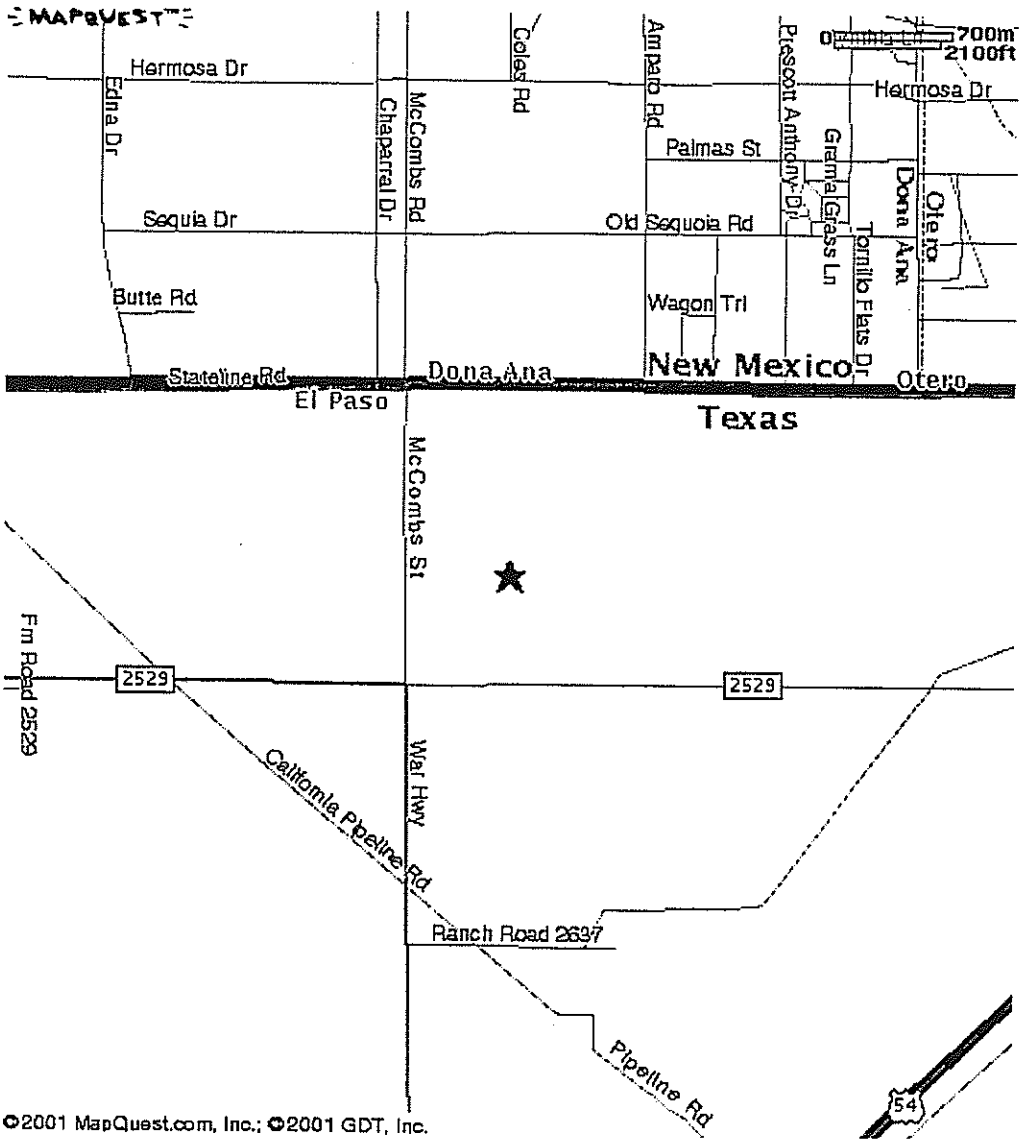
Dominguez, R., 2001, City of El Paso, Department of Solid Waste Management. Personal communication.

El Paso Water Utilities, 1993. Water Table Contour Map. Unpublished Map.

Leggat, E. R., 1962, Development of Groundwater in El Paso District, Texas, 1955-60, *Texas Water Commission Bulletin 6204.*

National Weather Service El Paso Area, Extremes for El Paso Texas 1879 thru 1998, accessed November 2001 <http://www.srh.noaa.gov/elp/climat/recelp.html>

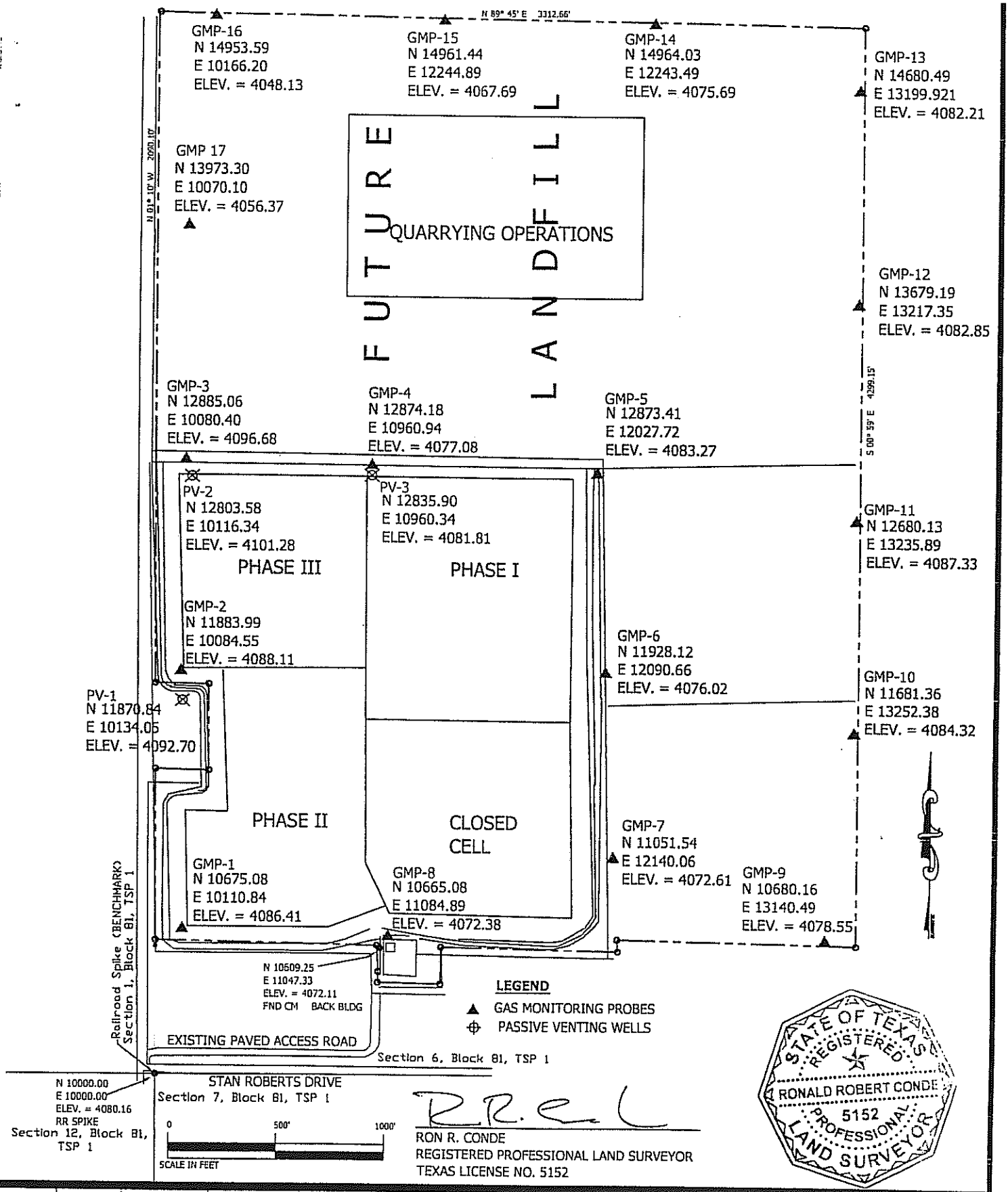
White, D.E., and Sladek, G.J., 1990, Summary of Data From the 1981-83 Pilot Study and 1985-89 Operations of the Hueco Bolson Recharge Project, Northeast El Paso, Texas, U.S. Geological Survey, Open-File Report 90-175.



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

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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

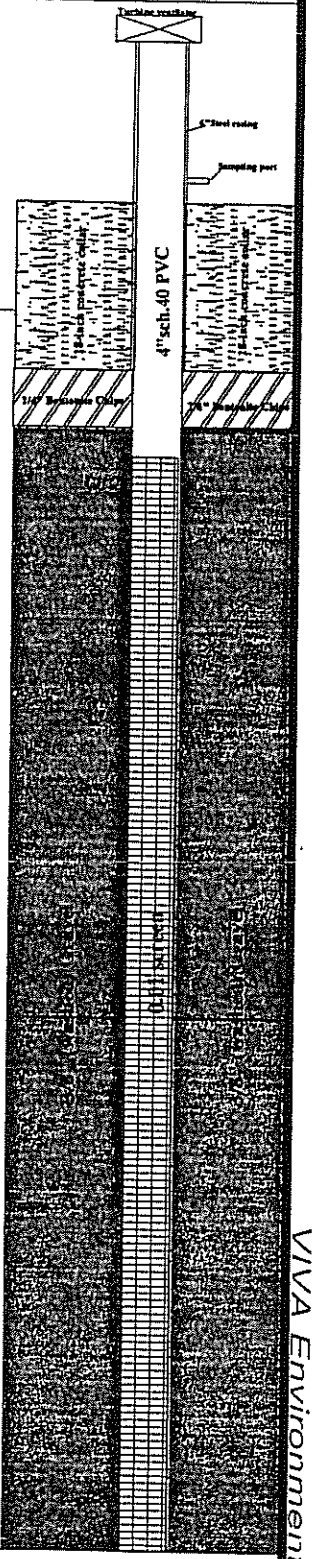
BORING EQUIPMENT & METHOD: Truck-mounted Mobile B-61 Drill Rig & 6 5\8" I.D. 10" O.D. Hollowstem Auger

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

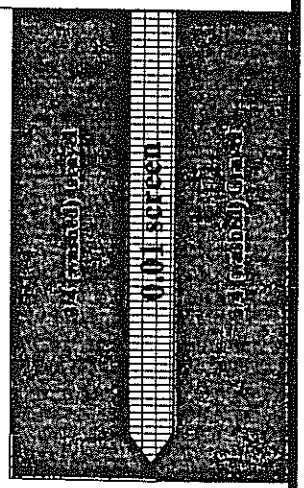
SURFACE ELEVATION:

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

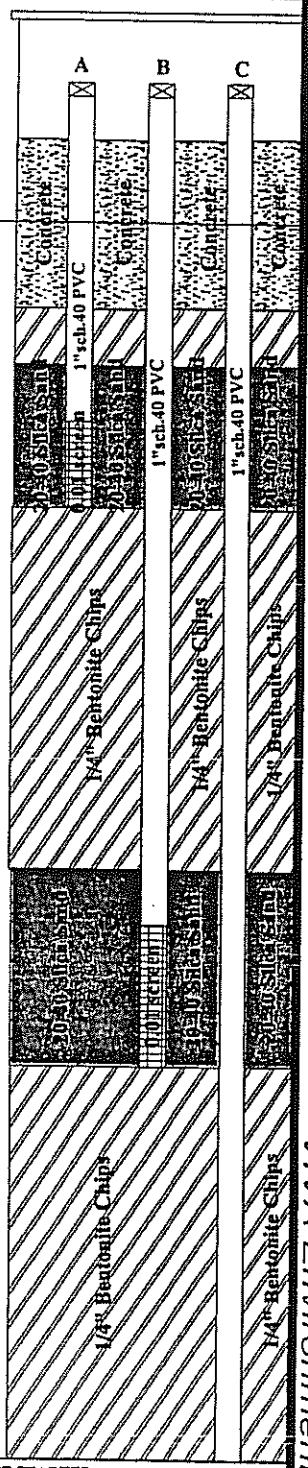
SURFACE ELEVATION:

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

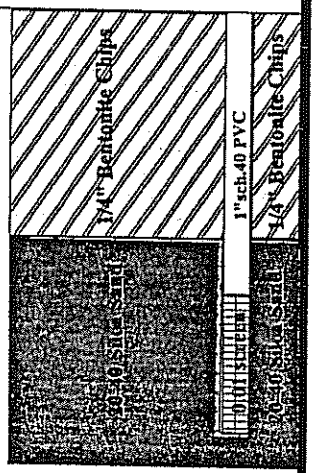
PROJECT LOCATION: McCombs Landfill
13600 McCombs
El Paso, Texas 79934

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

VIVA Environmental Inc.

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BORING LOG

WELL NO. GMP-10

PROJECT NAME: Methane Gas Monitoring Probe

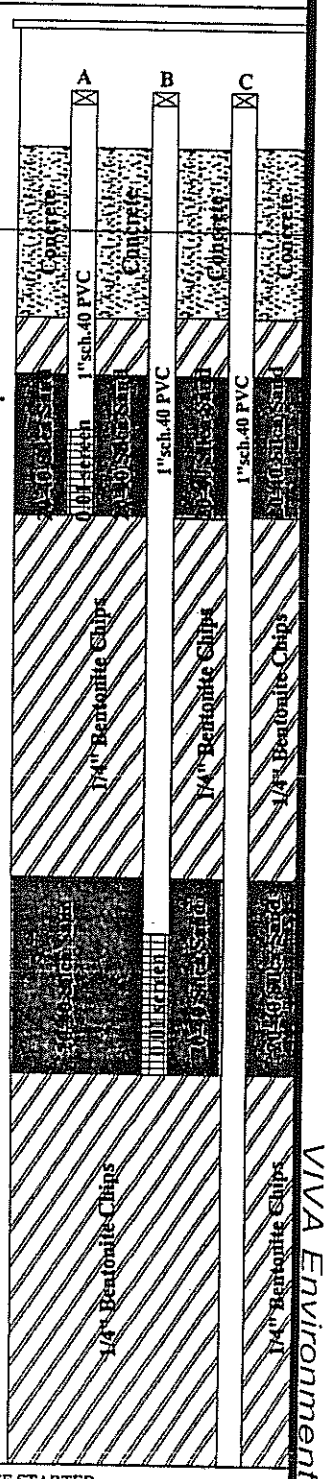
PROJECT LOCATION: McCombs Landfill, 13600 McCombs, El Paso, Texas 79934

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
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.

VIVA Environmental, Inc.
The Future is Clear!

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:

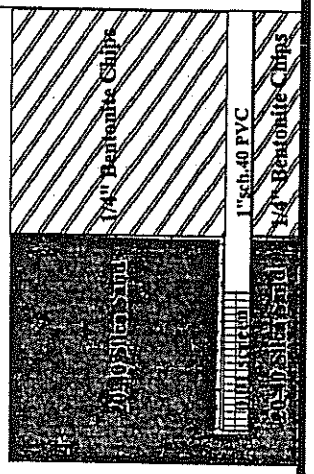
DESCRIPTION

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

VIVA Environmental Inc.

VIVA Environmental, Inc.
The Future Is Clear!

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:

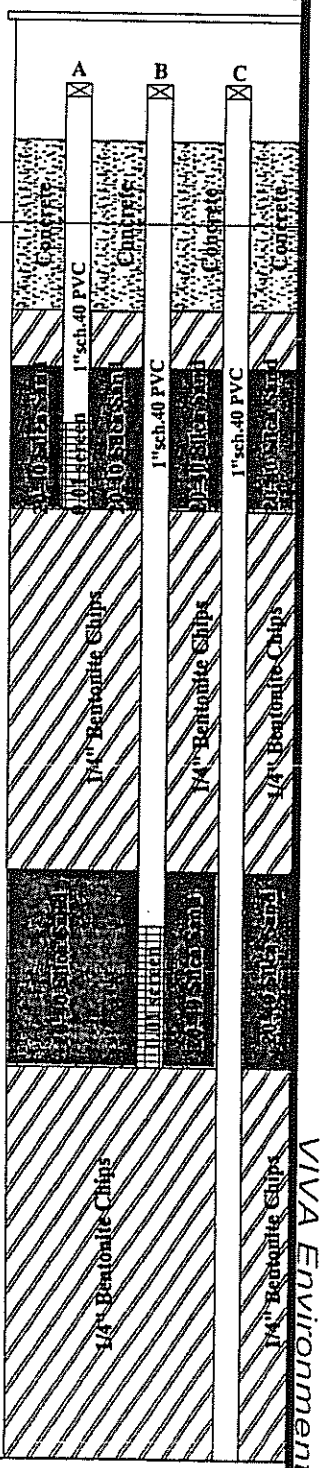
Truck-mounted Mobile B-61 Drill Rig & 6 5\8" I.D. 10" O.D. Hollowstem Auger

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.
The Future Is Clear!

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:

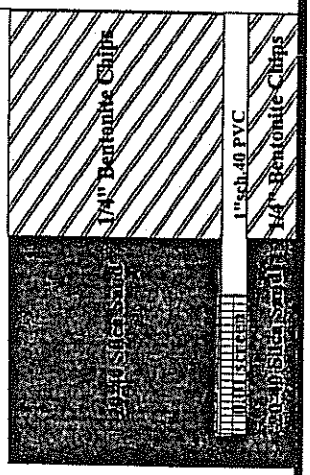
BENCHMARK:

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.

VIVA Environmental, Inc.
The Future Is Clear!

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

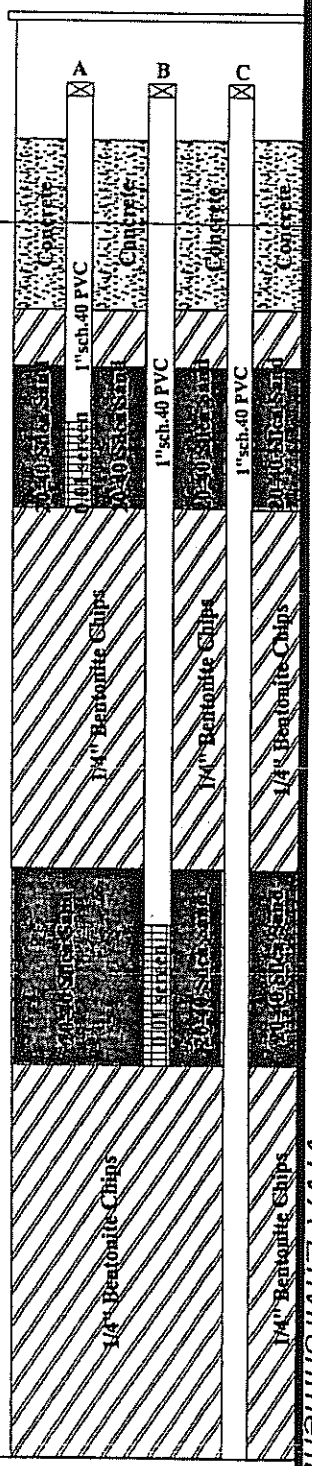
SURFACE ELEVATION:

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.
The Future Is Clear!

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:

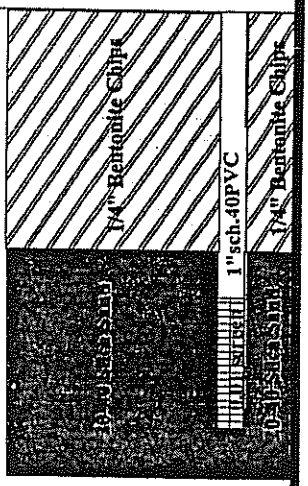
BENCHMARK:

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

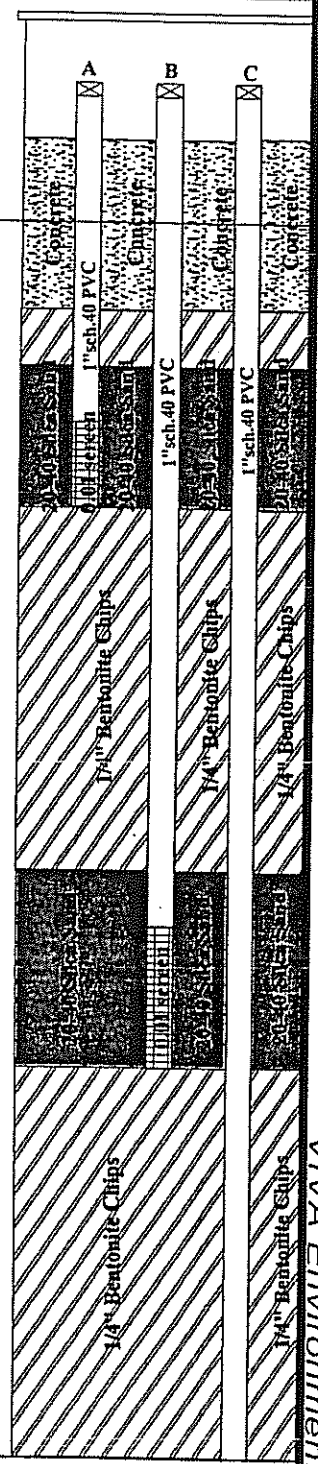
SURFACE ELEVATION:

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:

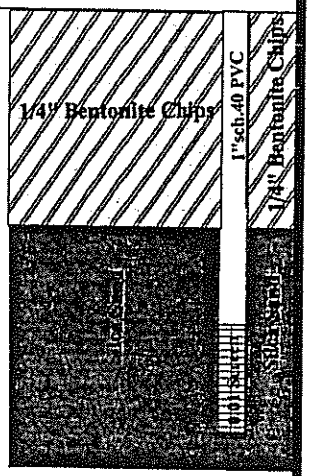
BENCHMARK:

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

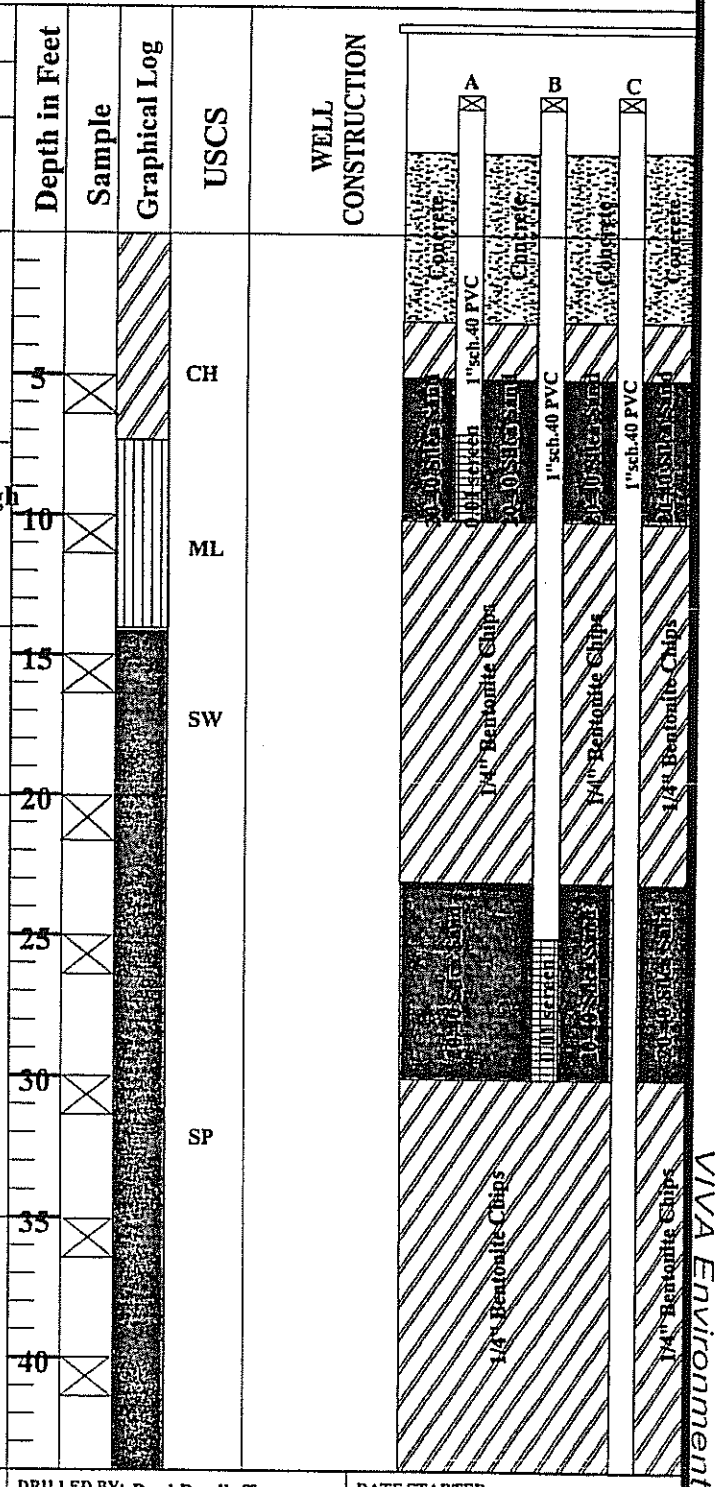
Clay, silty, some sand, fine grain, high plasitcity, dry, 5/6-7.5YR.

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.

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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

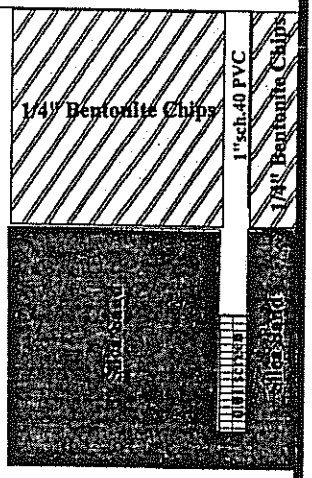
Depth in Feet	Sample	Graphical Log	USCS	WELL CONSTRUCTION
			SP	
45				
			SW	
50				
			SP	
55			CH	
60				
65				
70				
75				
80				

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.
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

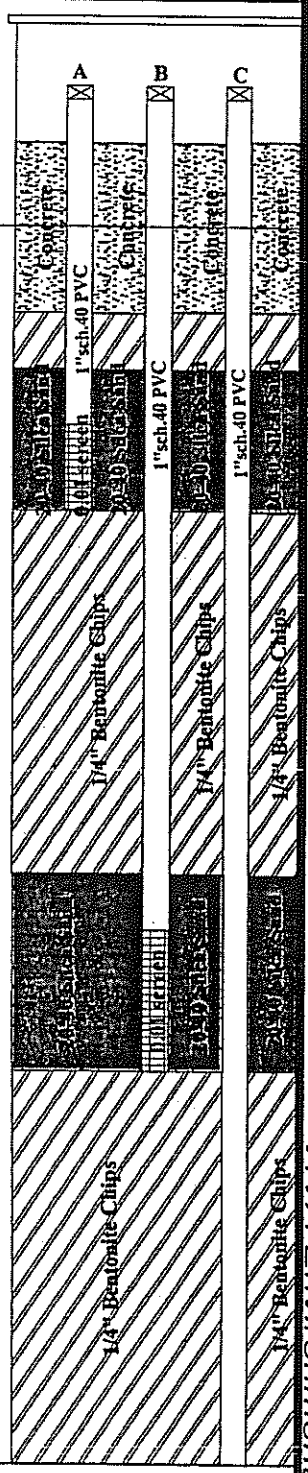
BORING EQUIPMENT & METHOD: Truck-mounted Mobile B-61 Drill Rig & 6 5\8" I.D. 10" O.D. Hollowstem Auger

SURFACE ELEVATION:

BENCHMARK:

DESCRIPTION	Depth in Feet	Sample	Graphical Log	USCS
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.
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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	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.

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The Future Is Clear!

BORING LOG

WELL NO. GMP-16

PROJECT NAME: Methane Gas Monitoring Probe

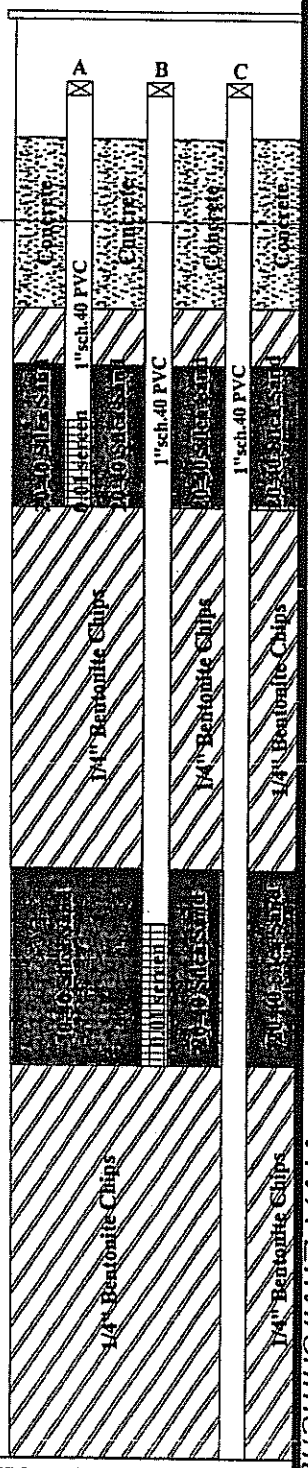
PROJECT LOCATION: McCombs Landfill
13600 McCombs
El Paso, Texas 79934

BORING EQUIPMENT & METHOD:
Truck-mounted Mobile B-61 Drill Rig & 6 5\8" I.D. 10" O.D. Hollowstem Auger

SURFACE ELEVATION:

BENCHMARK:

DESCRIPTION	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.
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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

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.

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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.

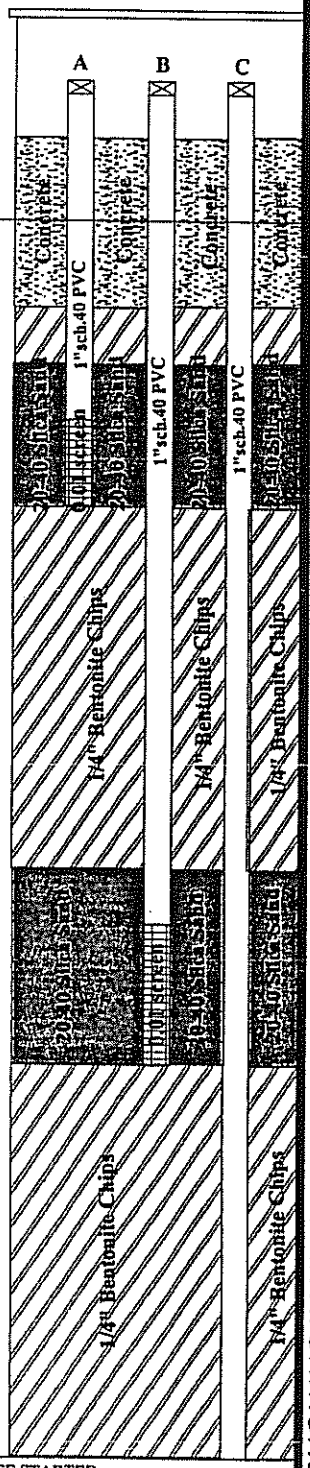
SM

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.

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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
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	

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Toll free (800)803-9202
Email address: water.well@license.state.tx.us

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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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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-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			

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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

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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		/ /

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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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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	

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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.

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-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.

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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.

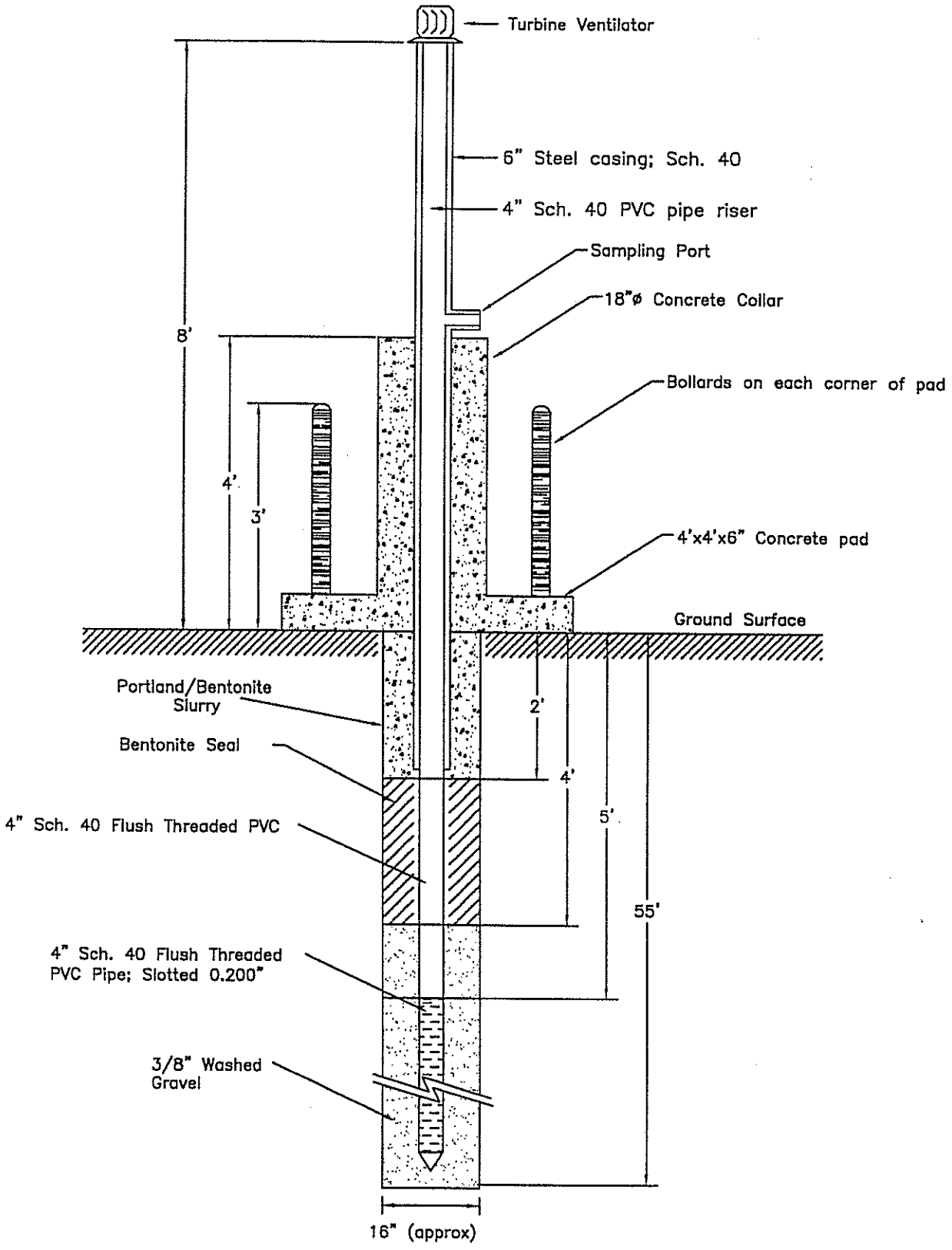
15) Water Test: Typetest ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated N/A
Yield: ___ gpm with ___ ft. drawdown after ___ hrs.

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



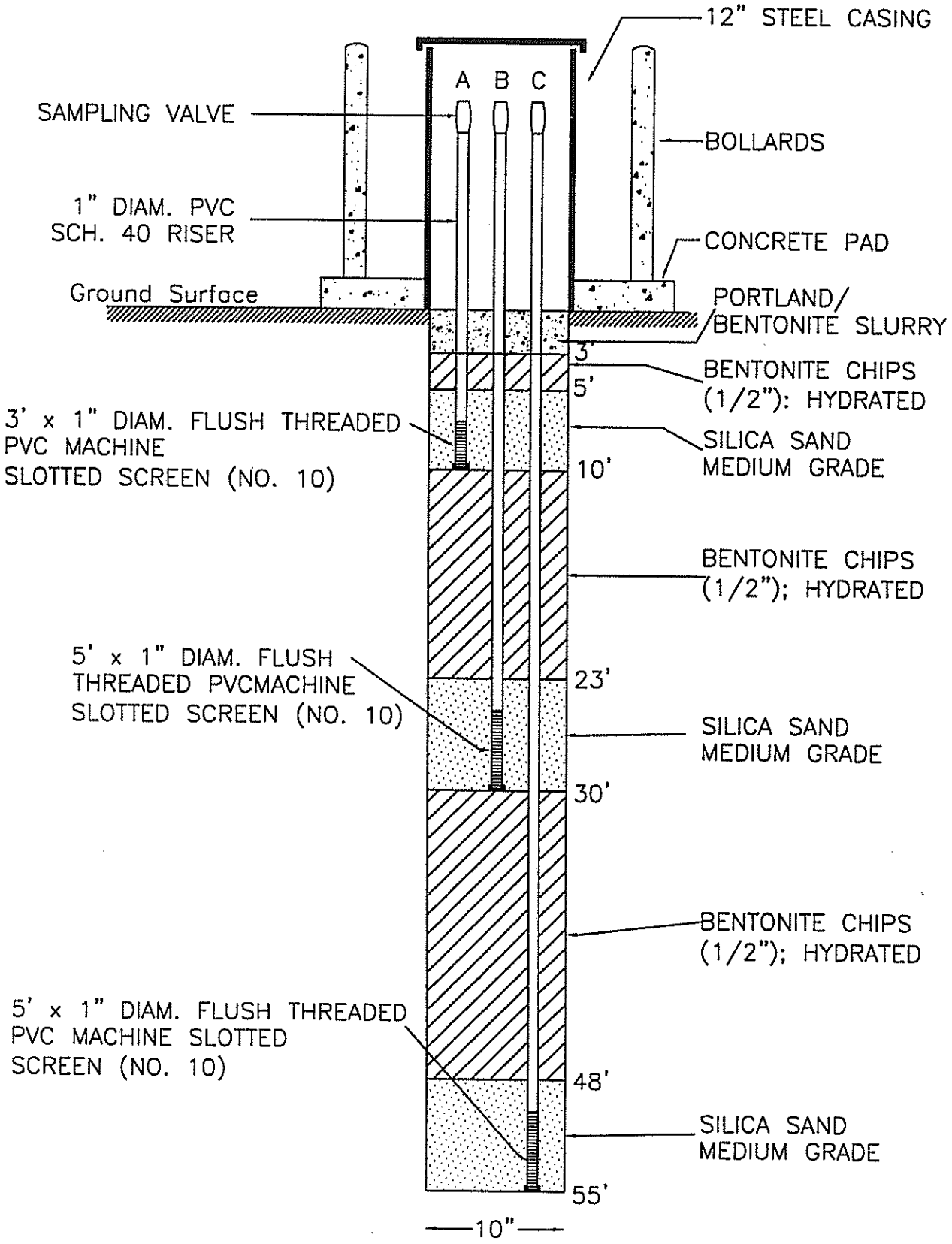
DRAWN BY:	REVIEWED BY:	ENGINEER:	JOB NO.	TITLE:	DATE:
AS	JM	PATRICK GOBB	CITY.03.33.34	McCOMBS LANDFILL	09/21/01

VIVA ENVIRONMENTAL, INC.
The Future is Clean
7201 STILES EL PASO, TEXAS 79915

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

VIVA ENVIRONMENTAL, INC.
The Future is Clear
7201 STILES EL PASO, TEXAS 79915

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

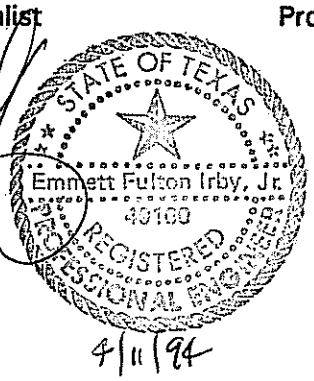
SHB AGRA JOB NO. E94-4037

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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1. Proposed GMP Placement

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

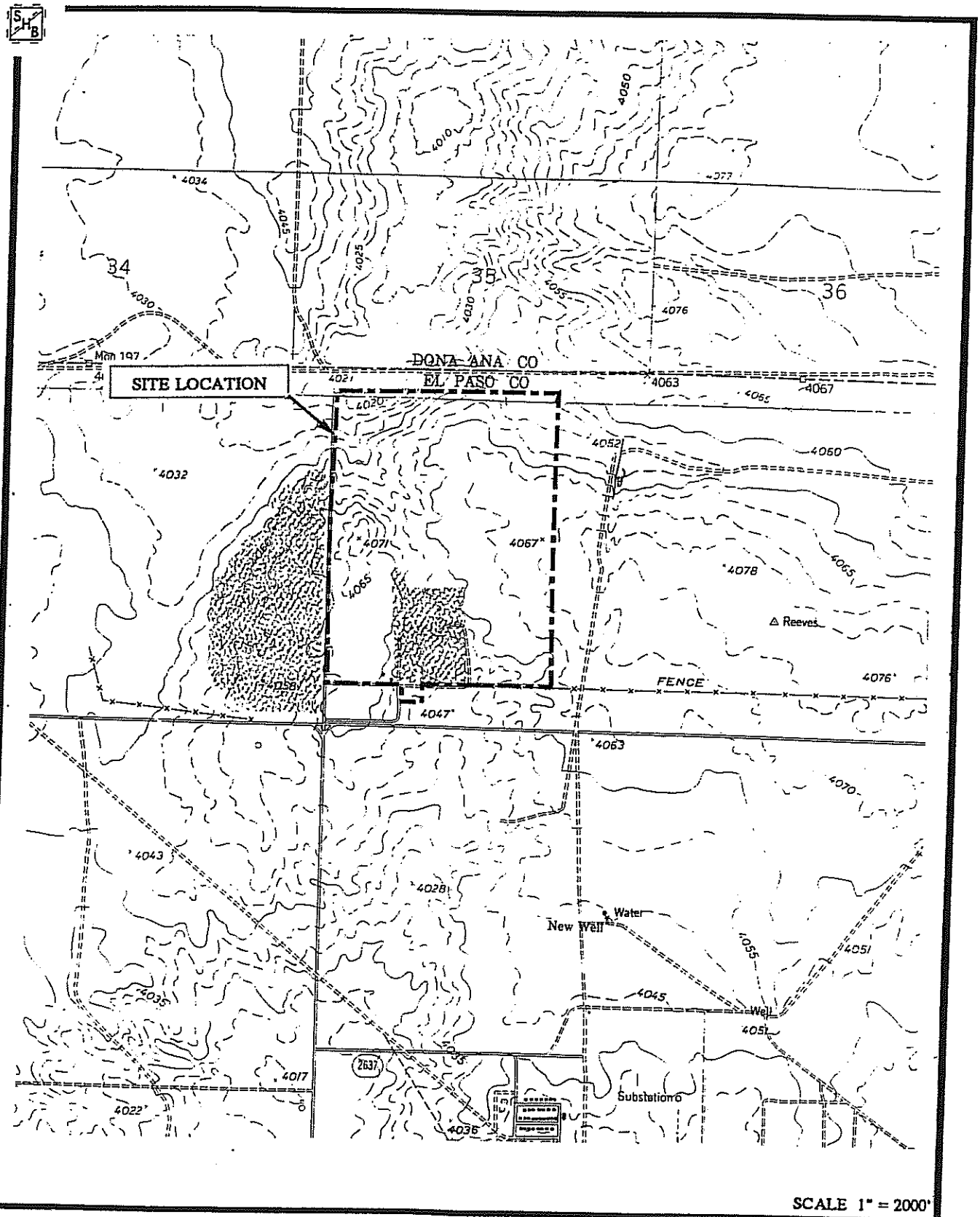
2.1 LANDFILL OPERATIONS

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
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Figure 1
Site Location Map

AGRA
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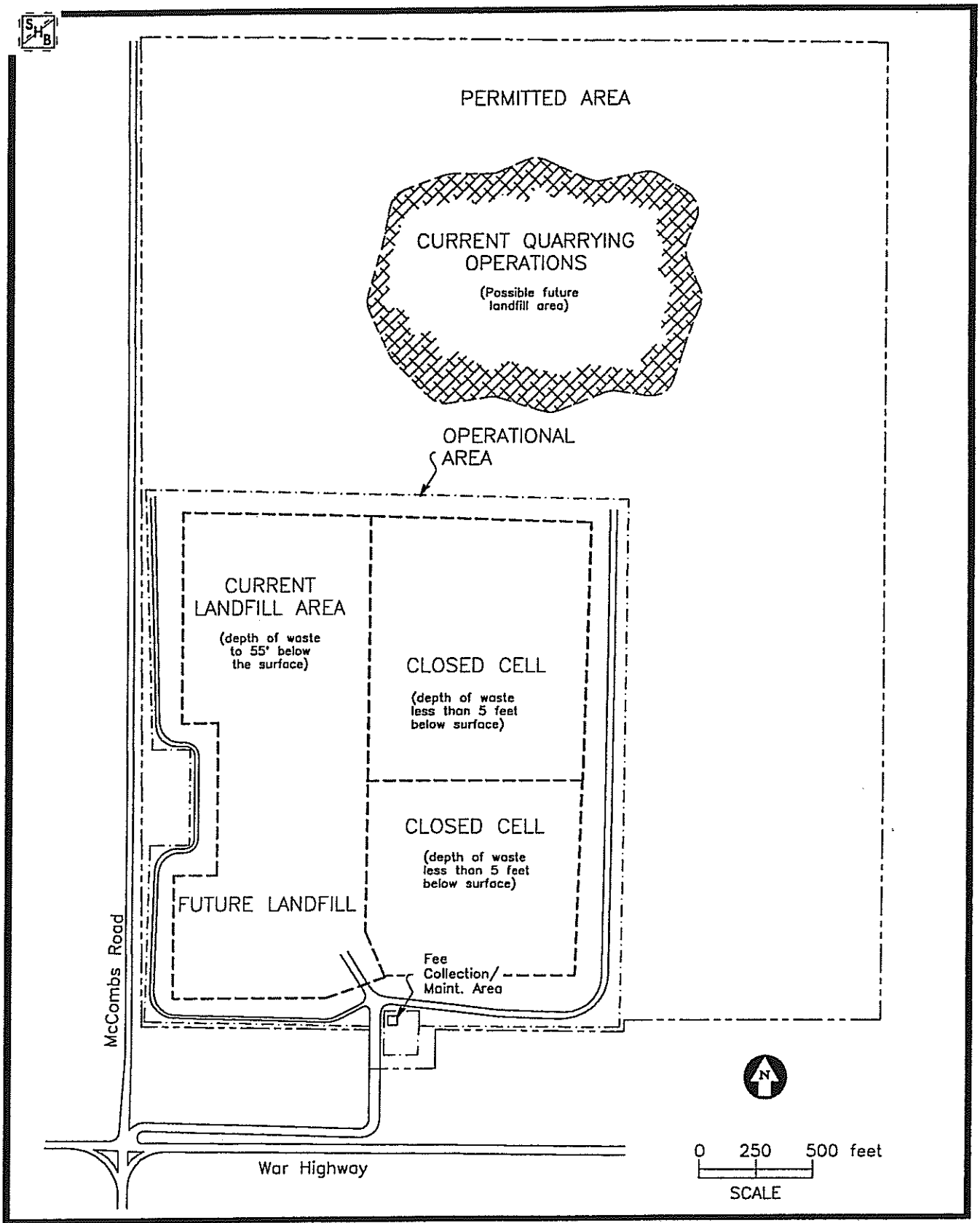

Landfill Gas Management Plan
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Ref.: "Northeast El Paso Landfill Completion Plan" by DRA, 4/83

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.

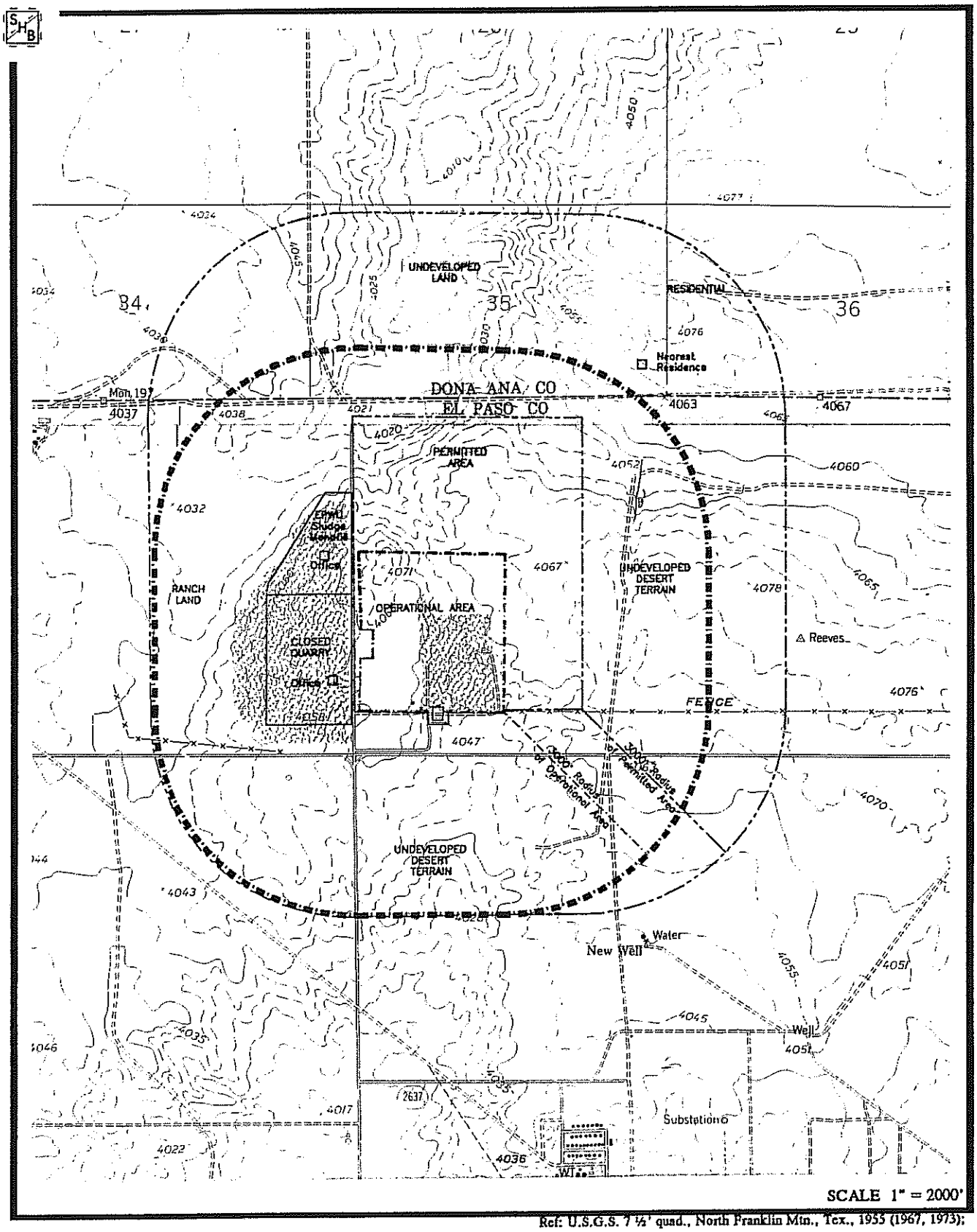
- Maintenance Building - a 40' by 40' metal building set on a concrete slab.

- 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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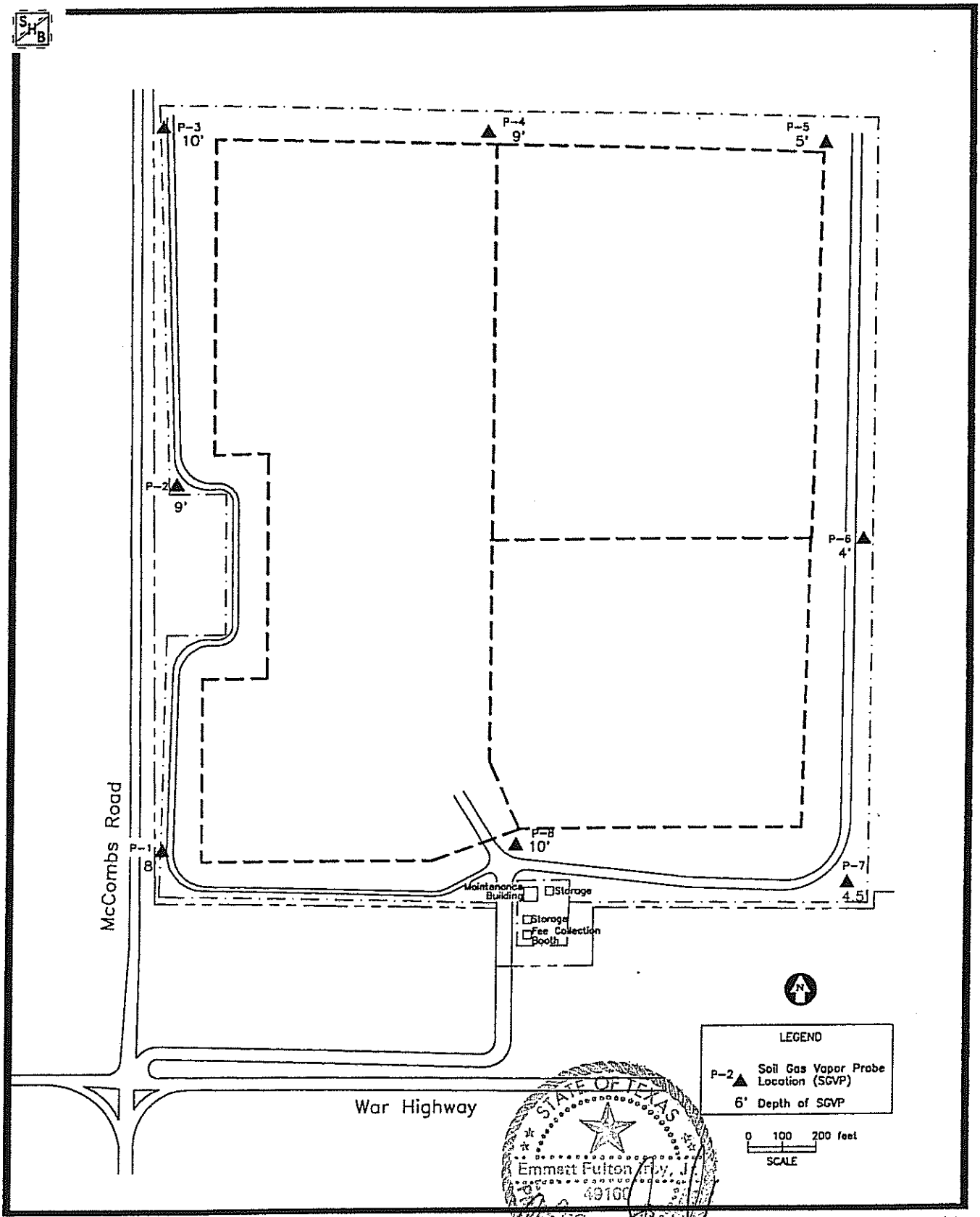

Ref: "Northeast El Paso Landfill Completion Plan" by DRA, 4/83

Landfill Gas Management Plan
McCombs Landfill
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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.

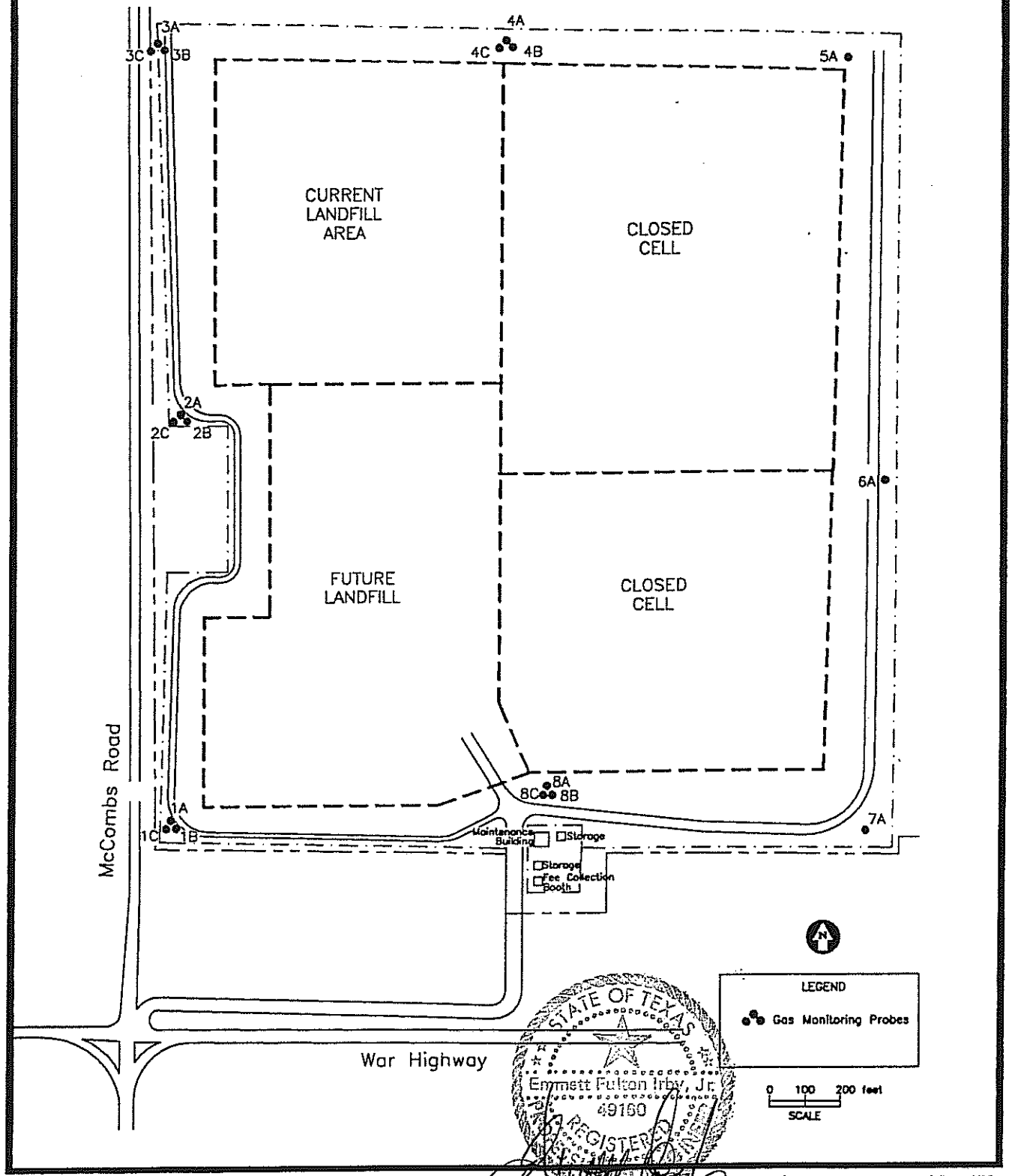
Permanent enclosed structure monitoring was performed on April 4, 1994. The interior of each of the structures on-site was monitored using a Bacharach Sniffer 301 Combustible Gas Indicator calibrated to methane. Special attention was given to cracks in the slabs and/or flooring. In addition, the exterior 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
McCombs Landfill
El Paso, Texas
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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.

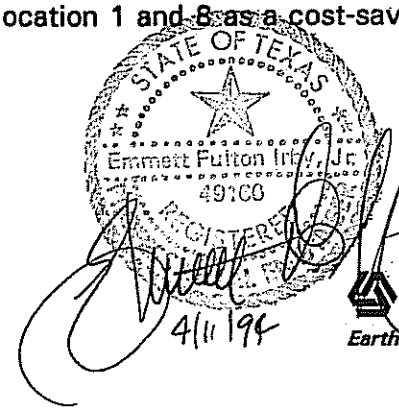
- Northwest Quadrant - The western half of the operational area was developed as a quarry, with excavations extending down to depths of approximately 50 to 55 feet below the surrounding land surface. During the last decade, municipal solid waste has been placed within the quarried areas of the northwest 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.

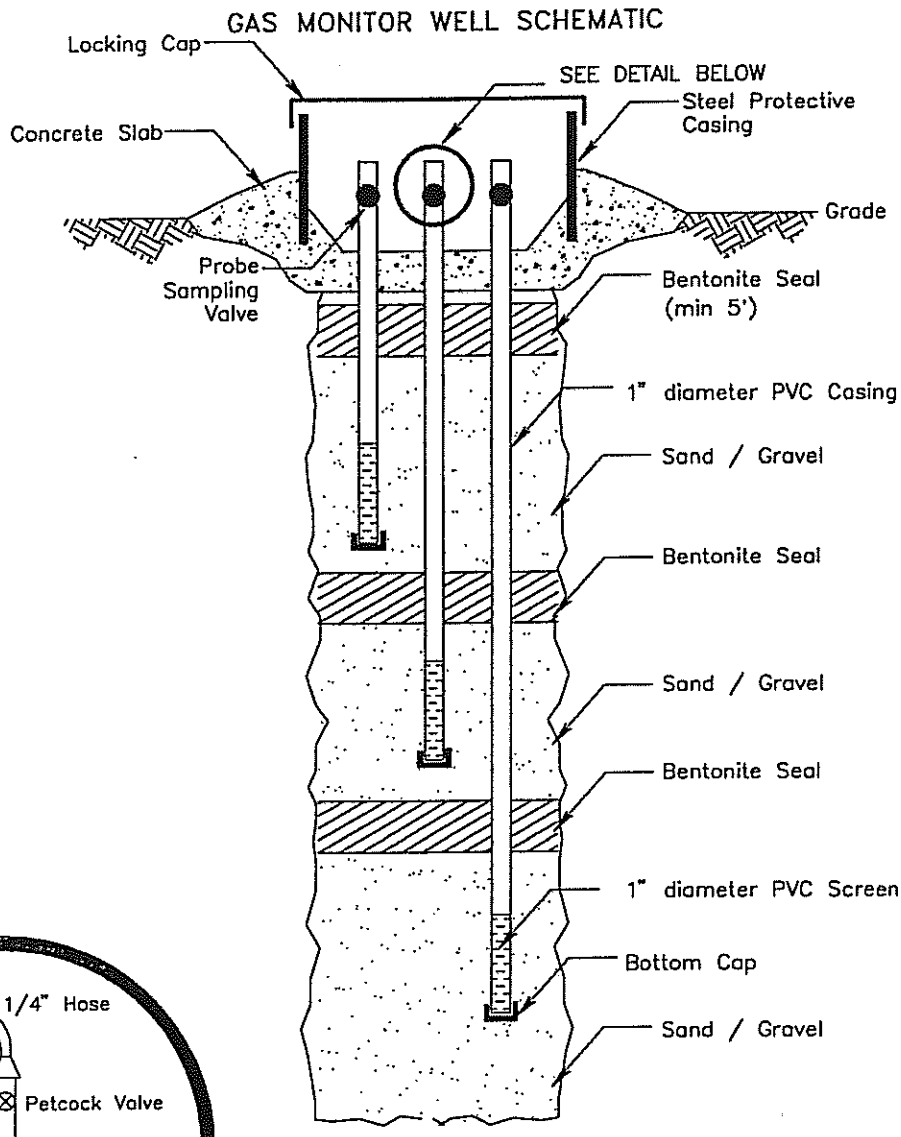
- The GMPs will be installed by a licensed monitor well driller in accordance with applicable Texas Water Well Drillers Board requirements.

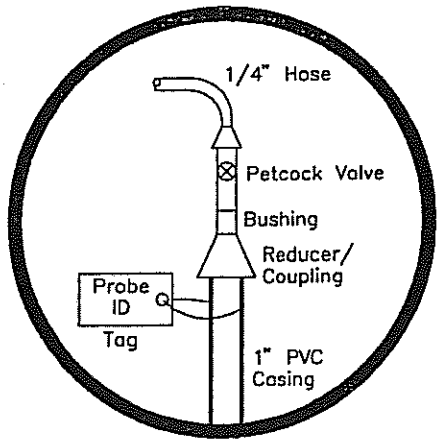
- All drilling and probe placement operations will be performed under the direction of an experienced geologist or engineer.

- 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

AGRA
Earth & Environmental Group

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. ______________

.ESS ______________ (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.

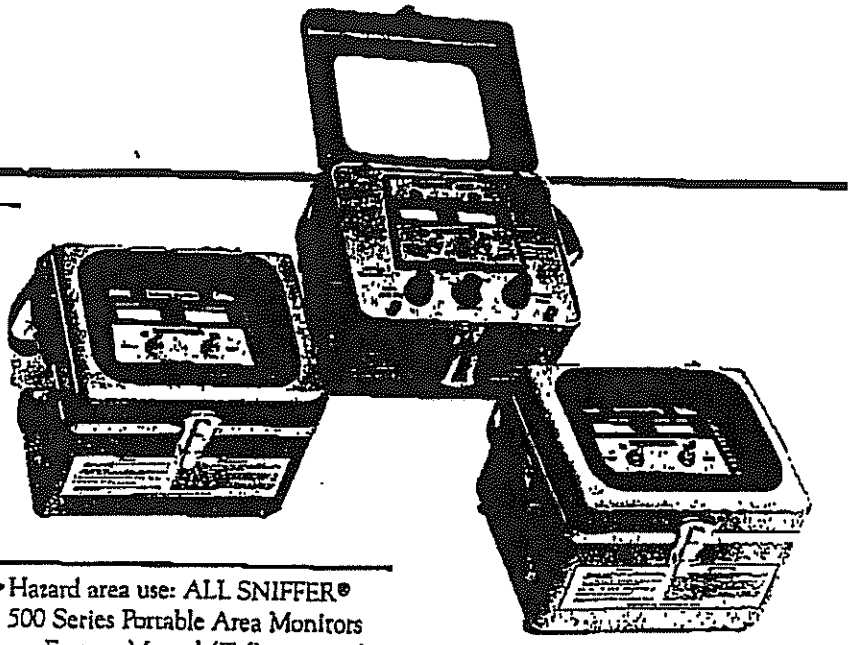
WARNING!

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

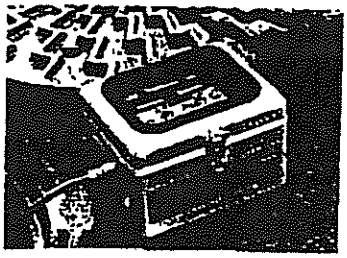
Portable Area Monitors

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

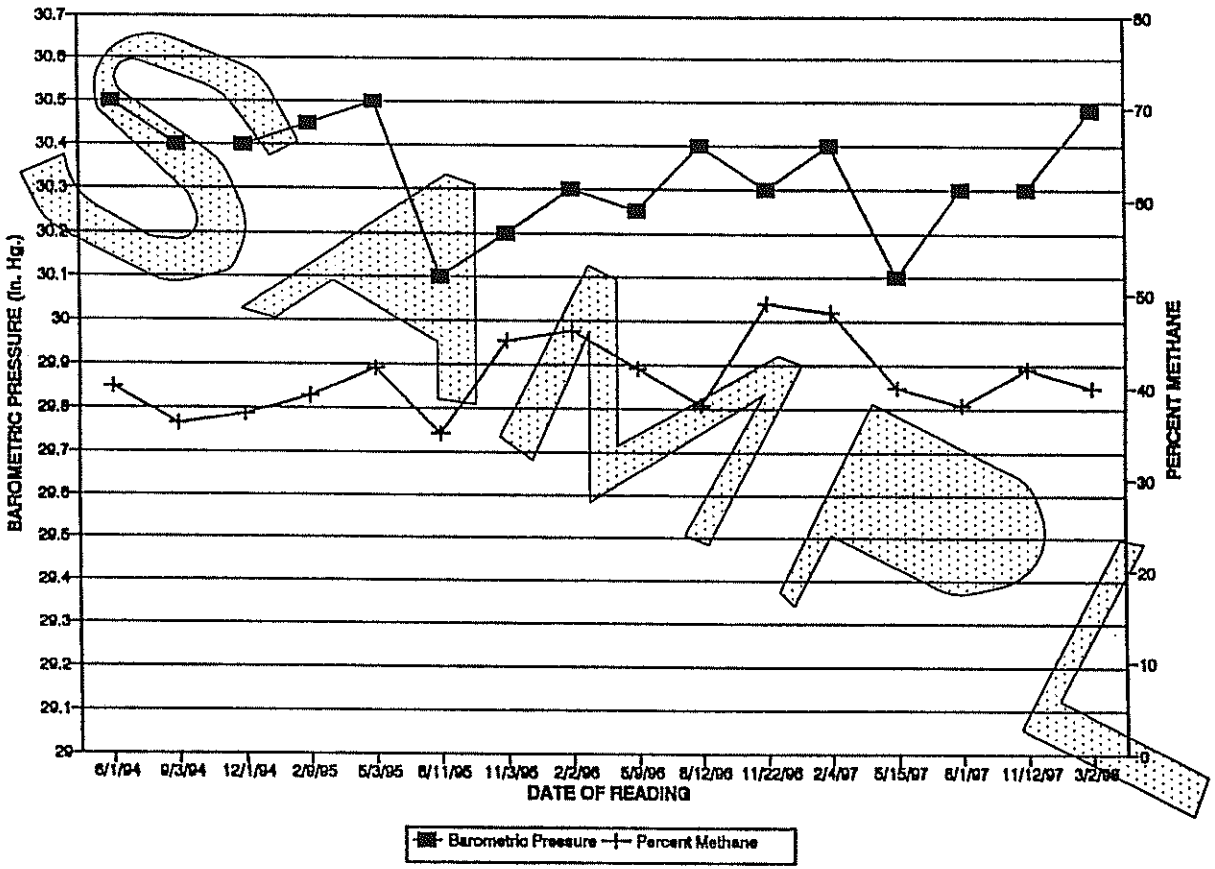
- Continuous monitoring for the hazard of confined space entry in:
  - Storage tanks
  - Ship compartments
  - Process or reaction vessels
  - Underground cable vaults
  - Meter and valve pits
  - Wells
  - Degreasers
  - Boilers
  - Tunnels
  - Sewers
  - Manholes
  - Silos
  - Bins
  - Pipelines
  - 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

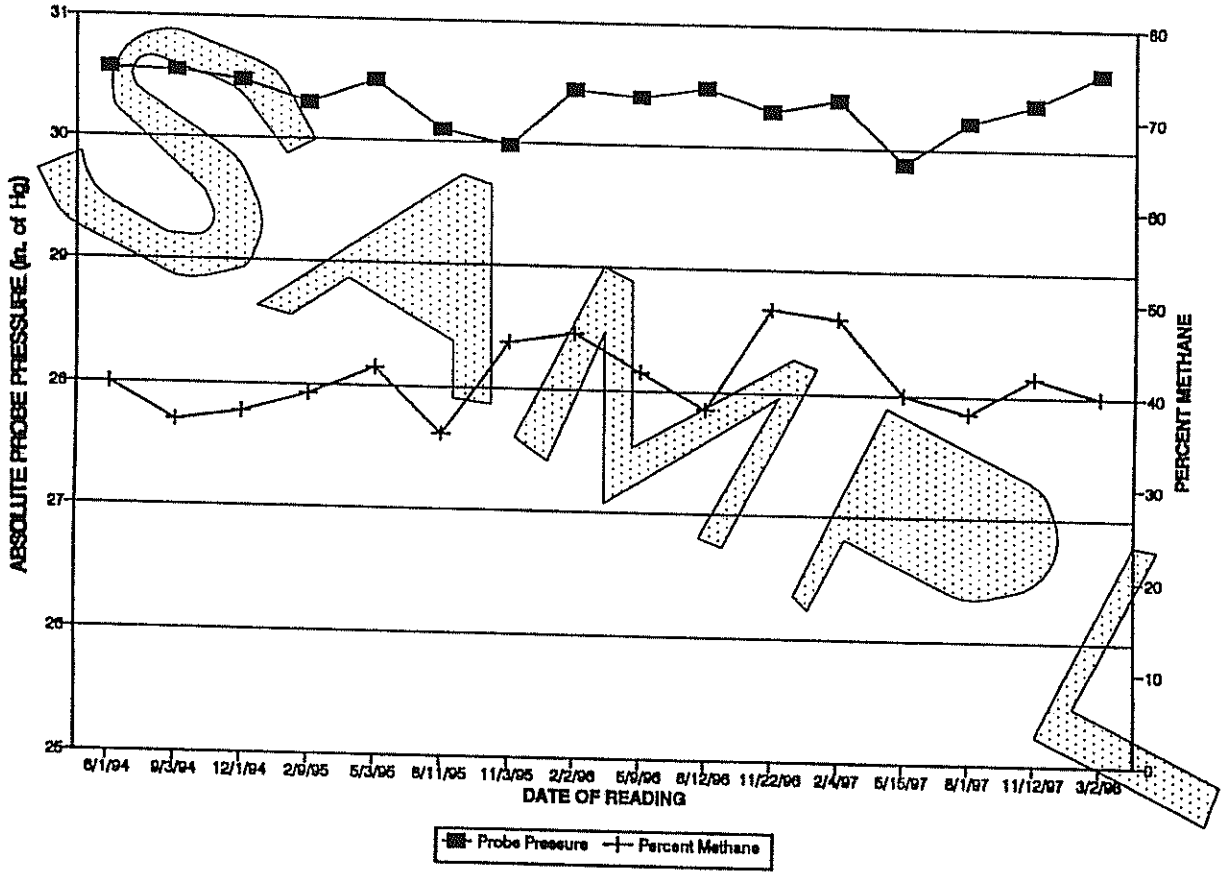
APPENDIX C

PRESENTATION OF DATA

METHANE MONITORING DATA
McCOMBS MUNICIPAL LANDFILL

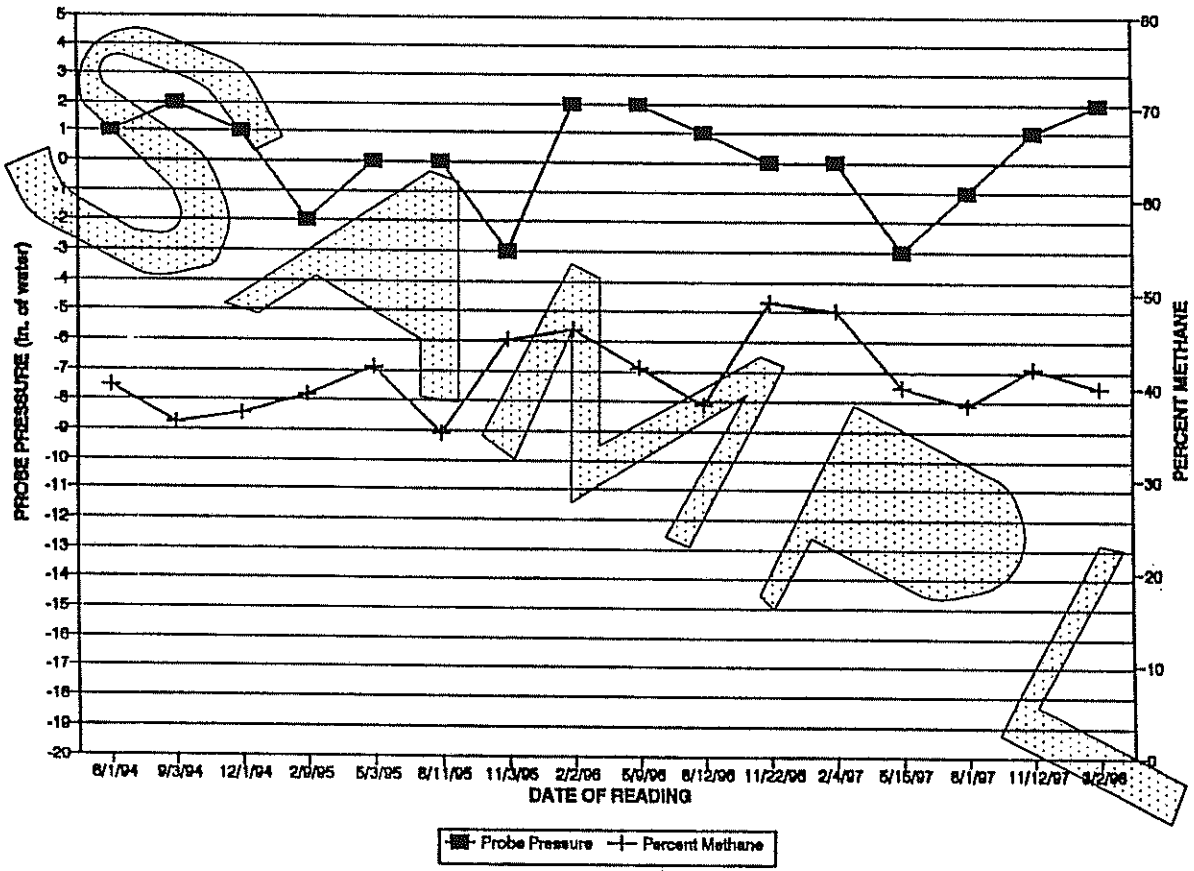


METHANE MONITORING DATA
McCOMBS MUNICIPAL LANDFILL



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
PHOENIX • TUCSON
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®

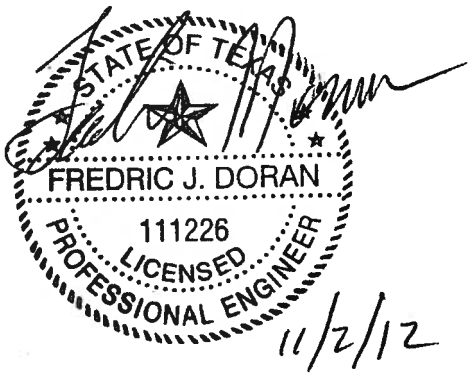
McCombs Municipal Landfill
El Paso County, Texas
TCEQ MSW Permit No. 729B

Part III
Appendix 3N
Use of Alternative CAP

Prepared for

City of El Paso

Updated November 2012, Revision 2



Prepared by

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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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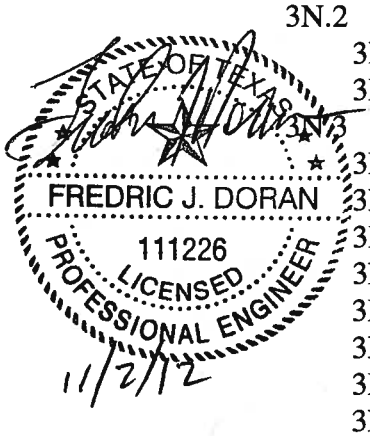

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This report has been prepared for the use of the client for the specific purposes identified in the report. The conclusions, observations and recommendations contained herein attributed to SAIC constitute the opinions of SAIC. To the extent that statements, information and opinions provided by the client or others have been used in the preparation of this report, SAIC has relied upon the same to be accurate, and for which no assurances are intended and no representations or warranties are made. SAIC makes no certification and gives no assurances except as explicitly set forth in this report.

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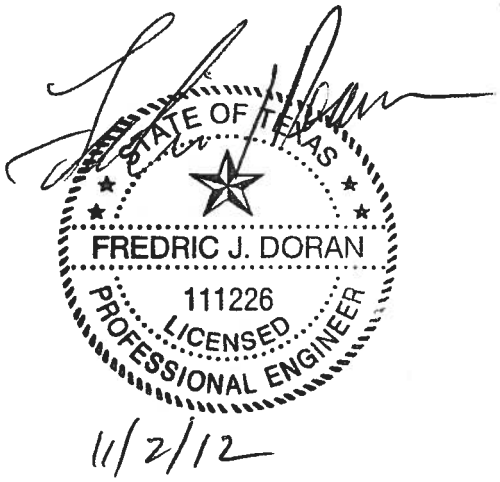

Appendix 3N
USE OF ALTERNATIVE CAP

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

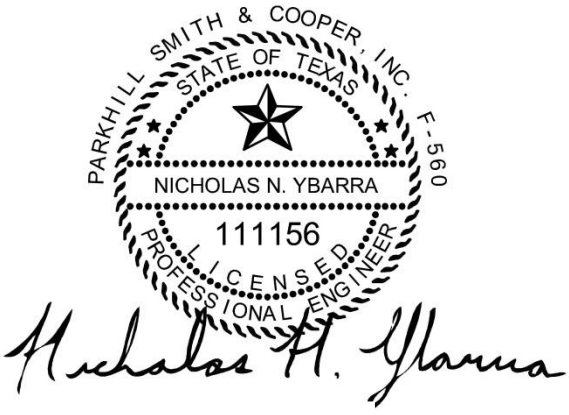
City of El Paso, Texas

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

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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       =  3.2711E+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

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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)         = 1.09545E+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

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 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

------------------------------------------------------------------------------
                            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

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 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

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 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

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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       =  2.8360E+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

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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       =  3.0868E+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

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 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.

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

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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)         = 1.30490E+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

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 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

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 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

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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       =  3.1289E+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

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 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

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 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

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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       =  3.2497E+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

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 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.

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

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 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

-------------------------------------------------------------------------------
                            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.

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

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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)         = 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

-------------------------------------------------------------------------------
                            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

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 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

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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       =  3.0941E+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

-------------------------------------------------------------------------------


 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

-------------------------------------------------------------------------------
                            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.

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

-------------------------------------------------------------------------------
                            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

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 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 54.4 %;  TMEAN = 276.8 K;  HDRY =  8.3514E+05 cm;  DAYUBC =   145

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 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

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 McCombs Landfill-ET Cap design-Two Layer-No Plants
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 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
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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%

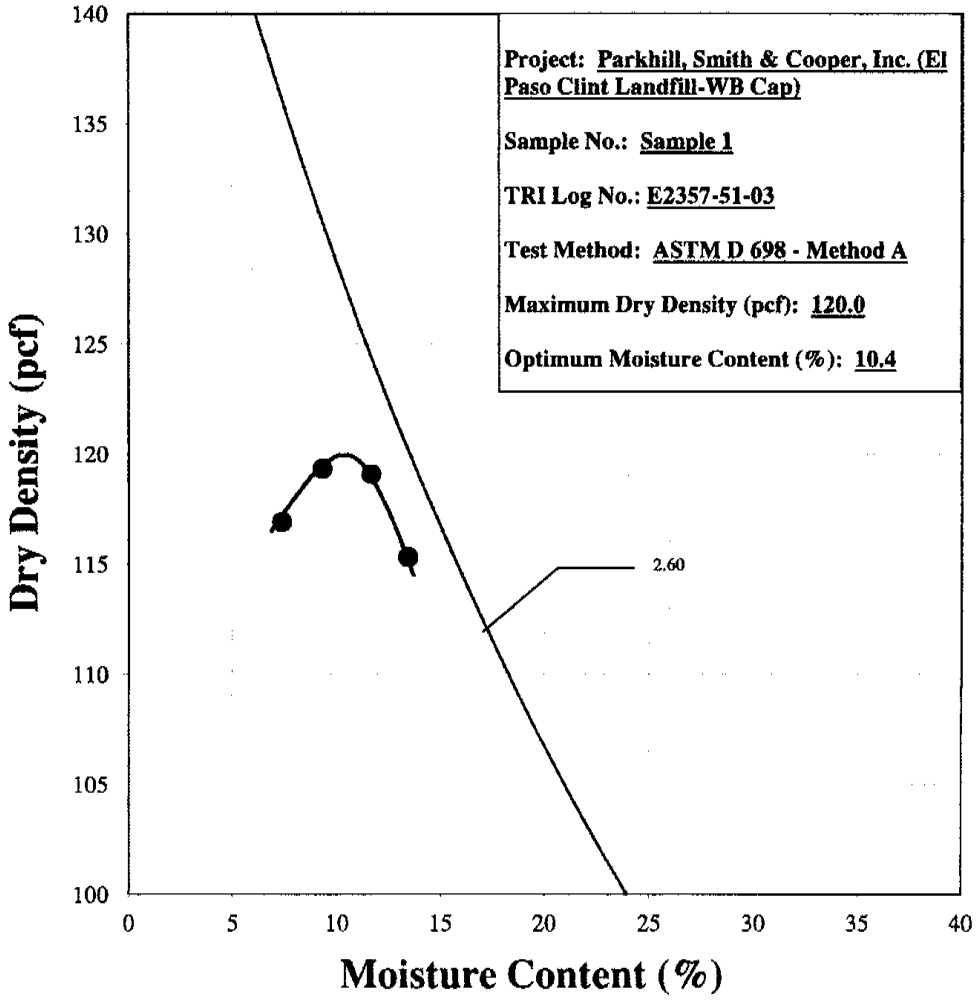
Summary of Saturated Hydraulic Conductivity Tests

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.

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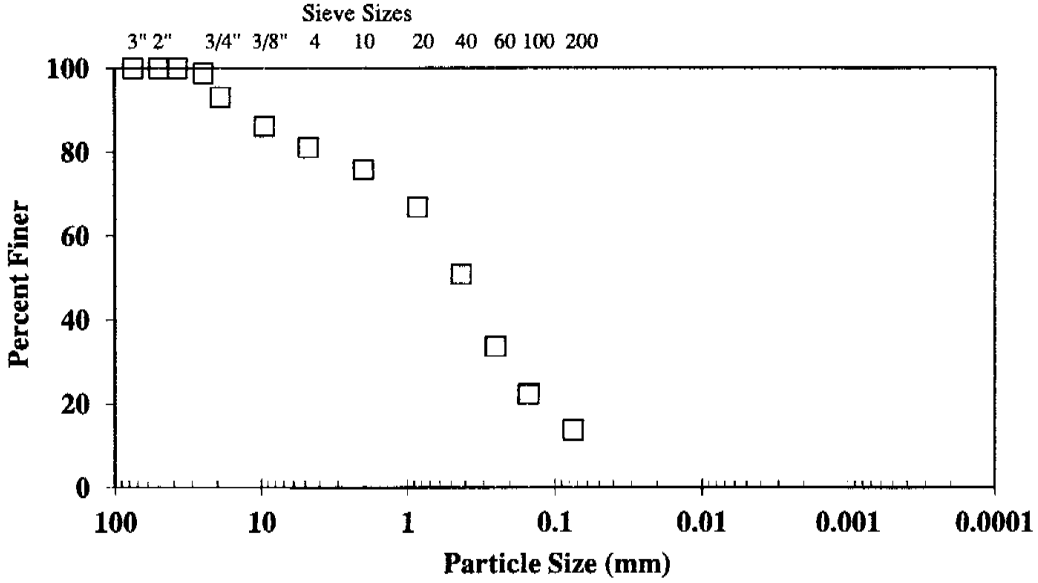
Particle Size Analysis for Soils

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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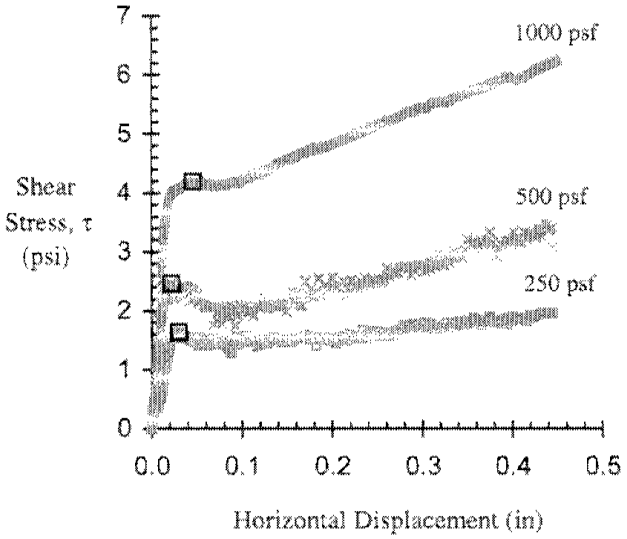
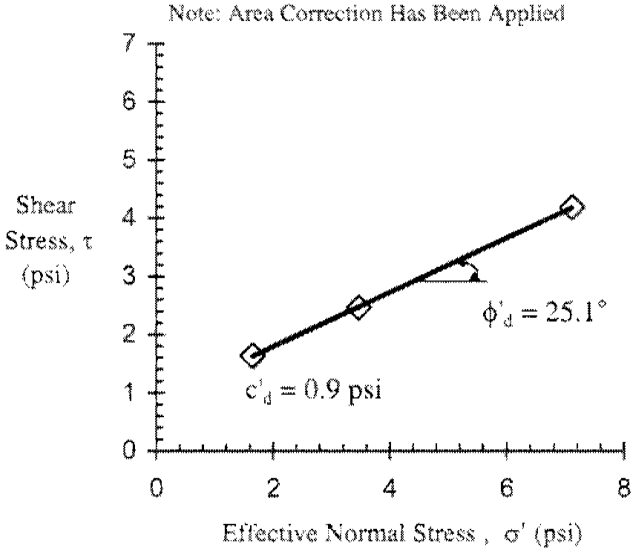
Direct Shear of Soil Under Consolidated-Drained Conditions

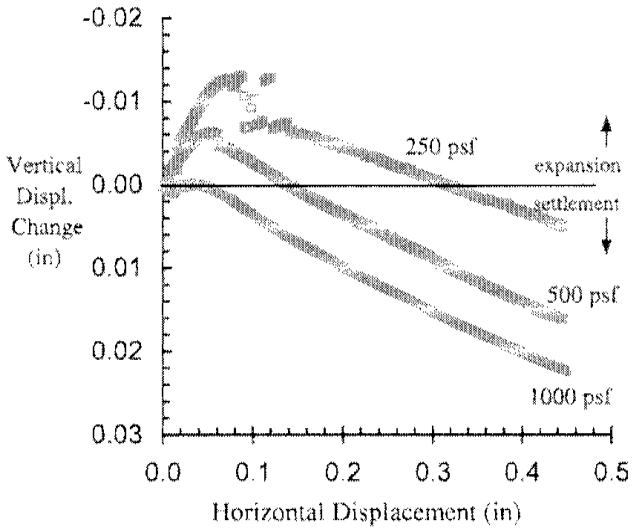
Client: Parkhill, Smith, Cooper Inc.
Project: El Paso Clint Landfill
Specimen: Sample #1

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	ϕ'_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

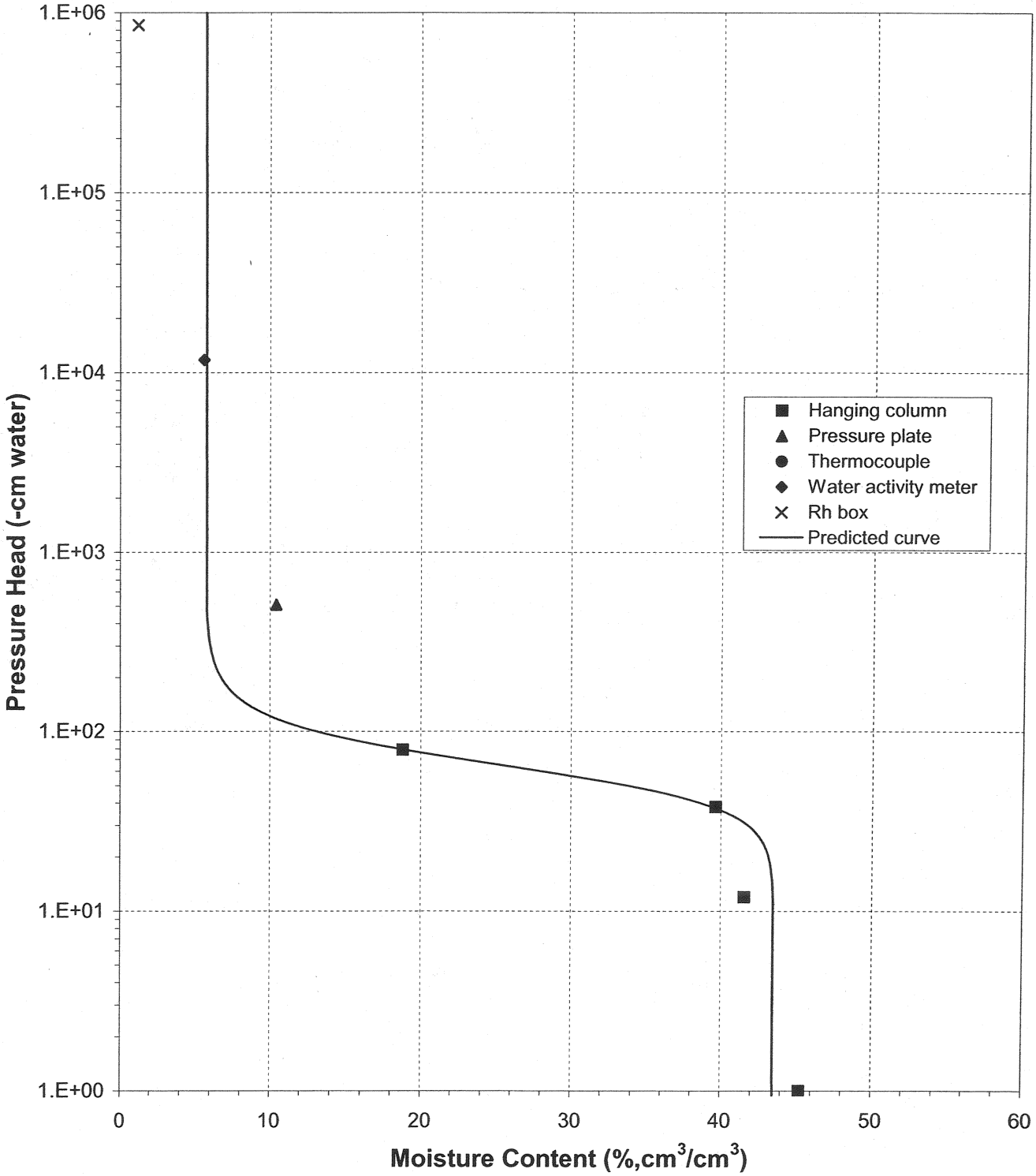
TRI Log No.: E2357-51-03
Test Method: ASTM D 3080
Test Date: 09/20/11
Displacement rate (in/min): 0.001

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

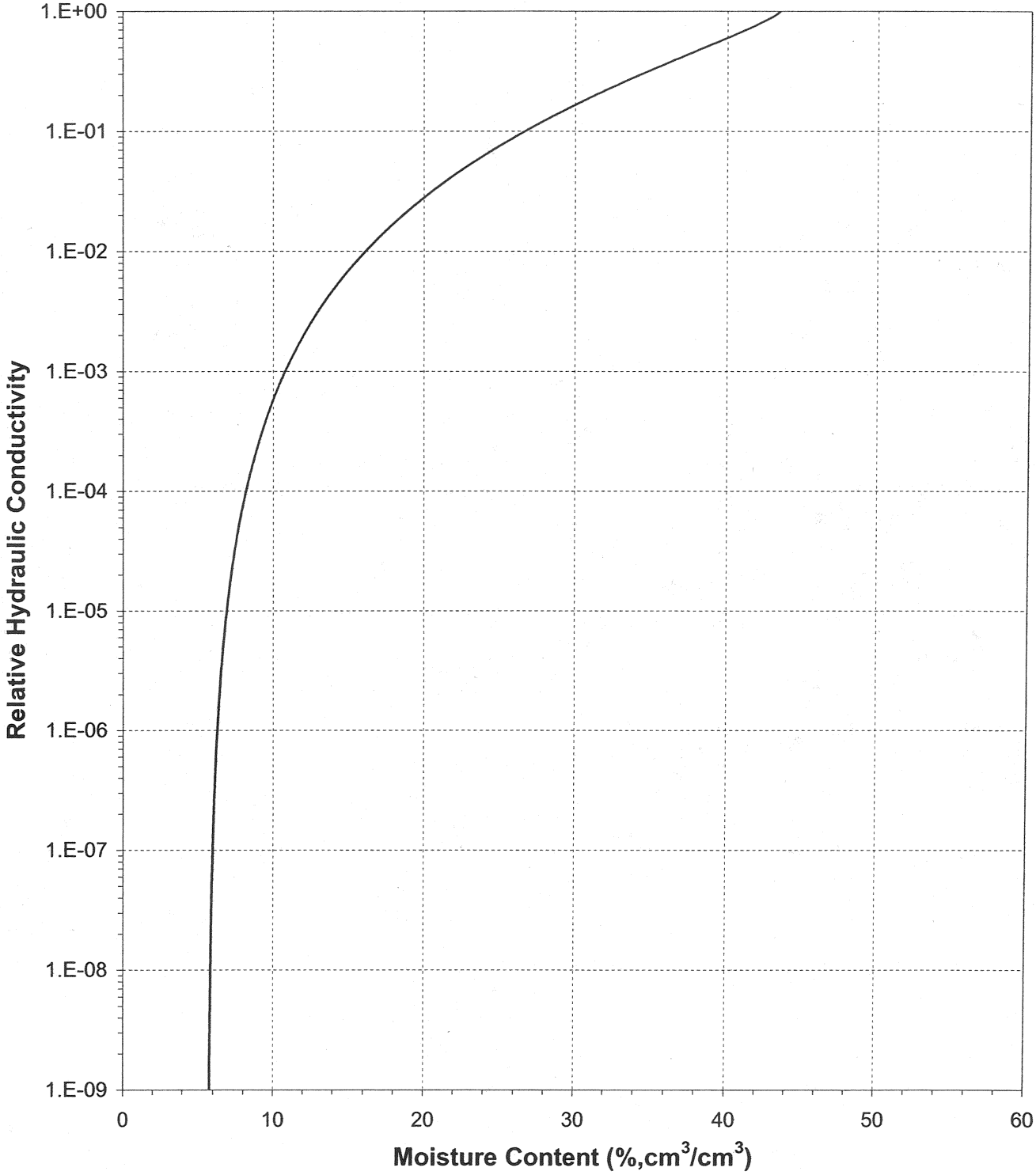
Predicted Water Retention Curve and Data Points

Sample Number: El Paso 80%



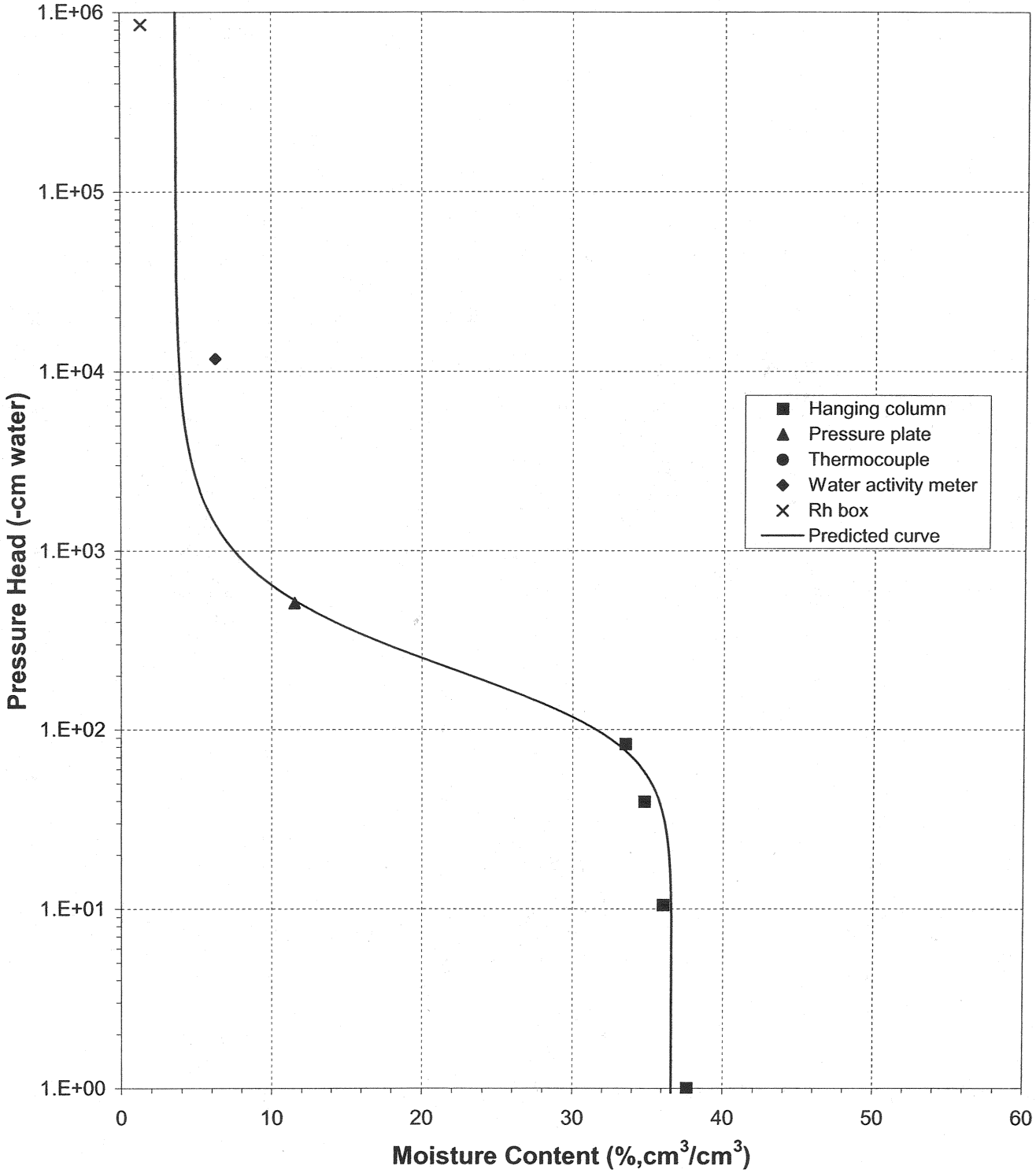
Plot of Relative Hydraulic Conductivity vs Moisture Content

Sample Number: El Paso 80%



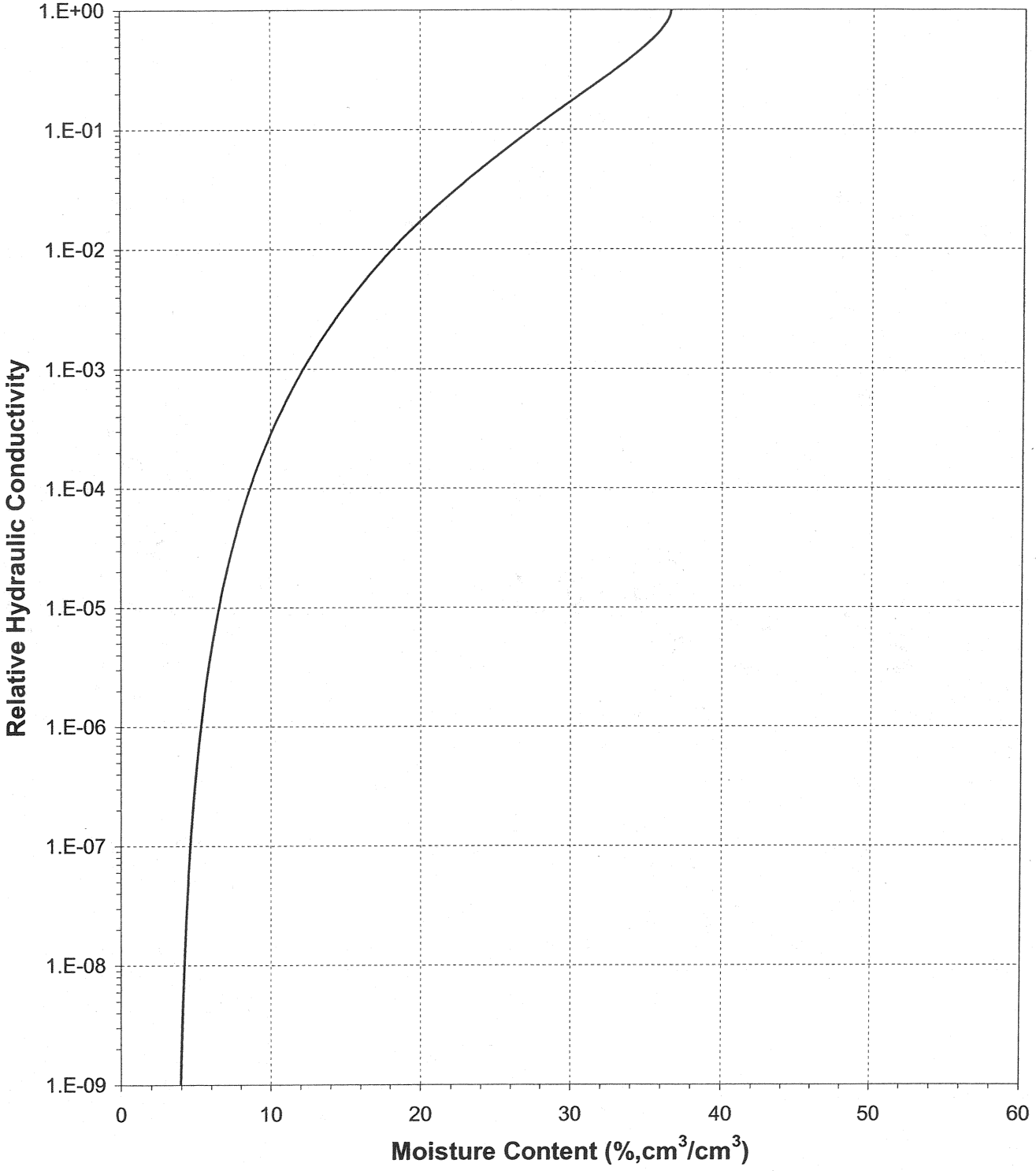
Predicted Water Retention Curve and Data Points

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

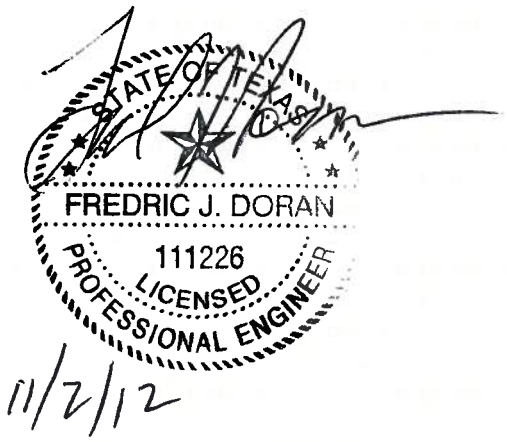
From: Fred J. Doran, SAIC

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®

N: 10742509.06
E: 417193.27

N:10742000
E:417000

PROPERTY BOUNDARY

STORMWATER RETENTION POND B

SECTOR F

SECTOR G

SECTOR E

SECTOR D

PREVIOUSLY CLOSED LANDFILL AREA

STORMWATER RETENTION POND C

N: 10738213.37
E: 417020.95

N:10738000
E:417000

N: 10737824.64
E: 415990.31

PROPERTY BOUNDARY

EXISTING RETENTION POND E

SECTOR H

EXISTING UNLINED LANDFILL CLOSURE AREA (70.8 ACRES)

SECTOR J

SECTOR G BASE/ SECTOR F FINAL CLOSURE AREA (131.6 ACRES)

SECTOR C

SECTOR B

EXISTING UNLINED LANDFILL

EXISTING MAINTENANCE BUILDINGS, GATEHOUSE, AND STORAGE AREA

SECTOR A

SECTOR I

SECTOR K

EXISTING LINED LANDFILL (PHASE II)

EXISTING LINED LANDFILL (PHASE I)

EXISTING LINED LANDFILL CLOSURE AREA – PHASE I AND II (20.5 ACRES)

NEW SITE ENTRANCE FACILITIES

N:10738000
E:414000

EXISTING STORMWATER RETENTION POND A

PREVIOUSLY CLOSED LANDFILL AREA

N: 10742684.20
E: 413885.24

PROPERTY BOUNDARY

N:10742000
E:414000

N: 10738347.03
E: 413725.15

N: 10737947.76
E: 413739.68

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).
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
- AREA REQUIRING FINAL COVER WITHOUT A GEOMEMBRANE LINER
- BUILDING/STRUCTURE
- RIPRAP
- 4050 — ELEVATION CONTOURS
- FACILITY/PROPERTY BOUNDARY
- 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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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®
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

Keller, Tonya L. 10/30/2012 11:57:39 AM – P:\0021800 el paso tx\9631500115\data analytical\CAD\P3–45 LARGEST AREA REQUIRING FINAL CLOSURE.dwg

Appendix 3O
Post-Closure Details

SAIC®

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®

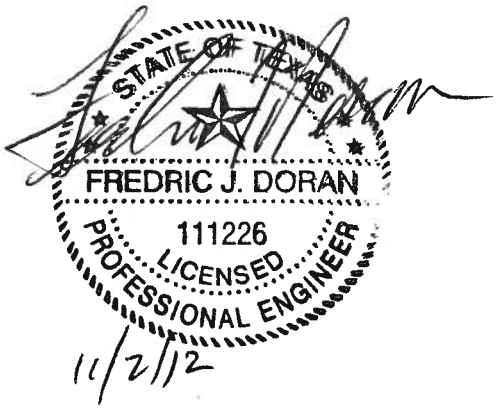
McCombs Municipal Landfill
El Paso County, Texas
TCEQ MSW Permit No. 729B

Part III
Appendix 3P
Final Cover Quality Control Plan

Prepared for

City of El Paso

Updated November 2012, Revision 1



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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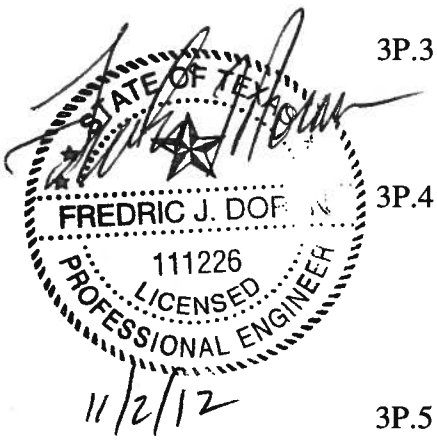

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This report has been prepared for the use of the client for the specific purposes identified in the report. The conclusions, observations and recommendations contained herein attributed to SAIC constitute the opinions of SAIC. To the extent that statements, information and opinions provided by the client or others have been used in the preparation of this report, SAIC has relied upon the same to be accurate, and for which no assurances are intended and no representations or warranties are made. SAIC makes no certification and gives no assurances except as explicitly set forth in this report.

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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 ASTM D 1140	1 Test/Source	100% Passing 1” 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 NSF Modified	1/100,000 SF or 1/lot	LLDPE: 60 lb/in
		Elongation at Break	ASTM D 638 NSF Modified	1/100,000 SF or 1/lot	LLDPE: ≥250%
		Carbon Black Content	ASTM D 3015/1603 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 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 x10^{-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 x10^{-3} cm/sec for erosion layer ≤1.3 x10^{-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 1 Test/10,000 CY	≤6.6 x10^{-3} cm/sec for erosion layer ≤1.3 x10^{-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 6.6×10^{-3} cm/sec;
- Apply 18 inches of erosion layer soil at 90% compaction (coefficient of permeability less than 1.3×10^{-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 6.6×10^{-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 1.3×10^{-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 November 2012, Revision 3

SAIC

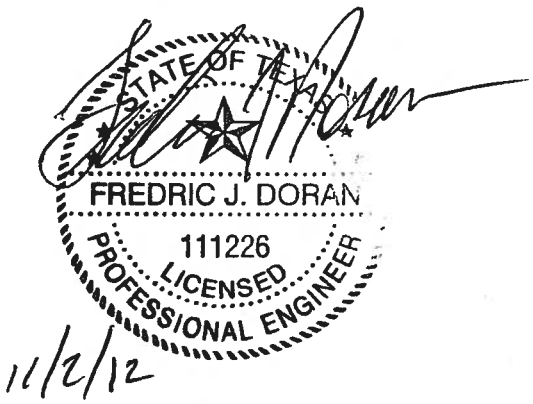
McCombs Municipal Landfill
El Paso County, Texas
TCEQ MSW Permit No. 729B

Major Permit Amendment Application
Part IV

Prepared for

City of El Paso

Updated November 2012, Revision 3



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Texas Board of Professional Engineers
Firm Registration No. 3823

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

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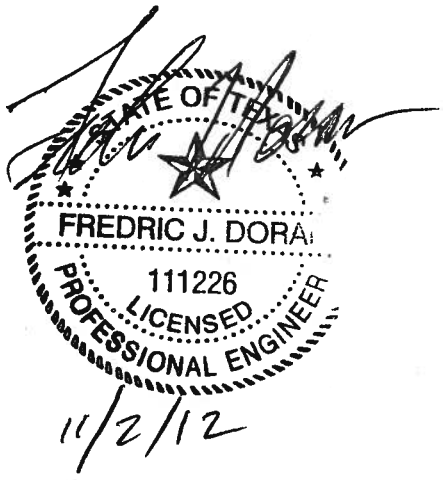

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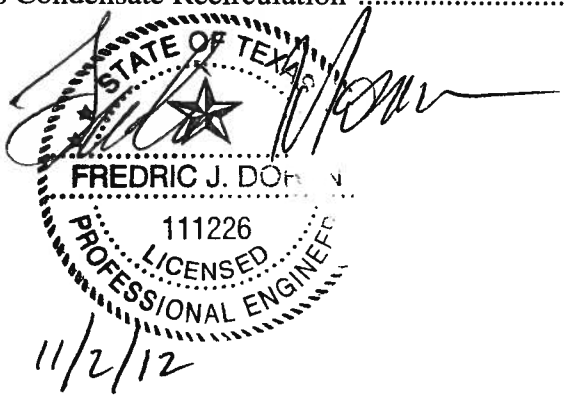

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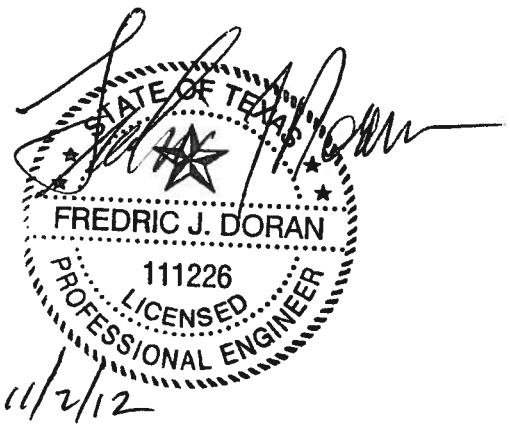

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Section 4.1
SITE OPERATING PLAN INTRODUCTION
30 TAC §330.65

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.

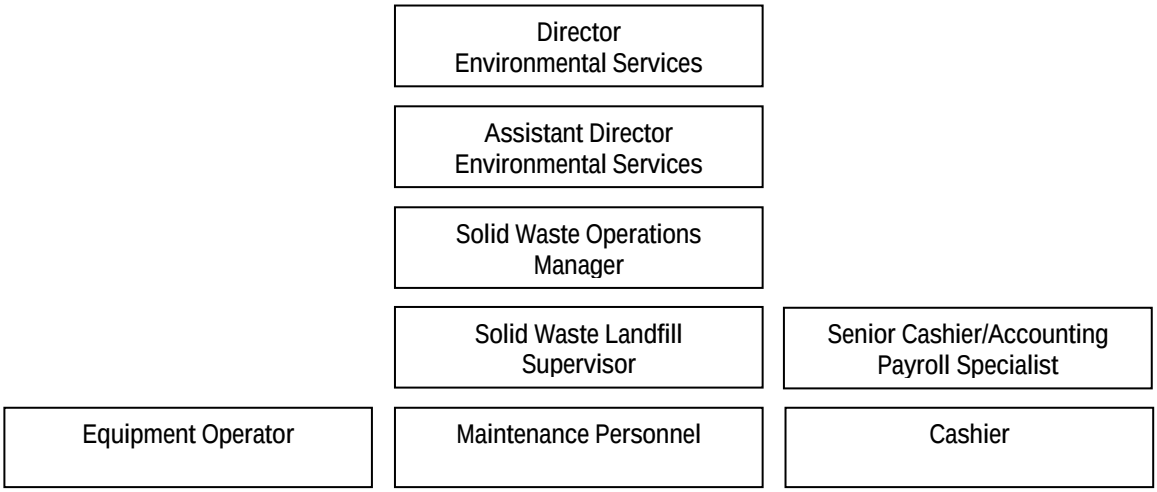
Table 4.4-1
Personnel Types and Descriptions

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. Minimum 1 year landfill operation experience. 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) 5 (1501 tpd – 2500 tpd) 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) 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) 2 (1501 tpd–3500 tpd)	240 HP or greater	Waste and soil spreading and compaction
Scraper	1 or more (0 tpd–1500 tpd) 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) 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. 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. 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 25th 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					
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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

T. Dan Friedkin
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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?

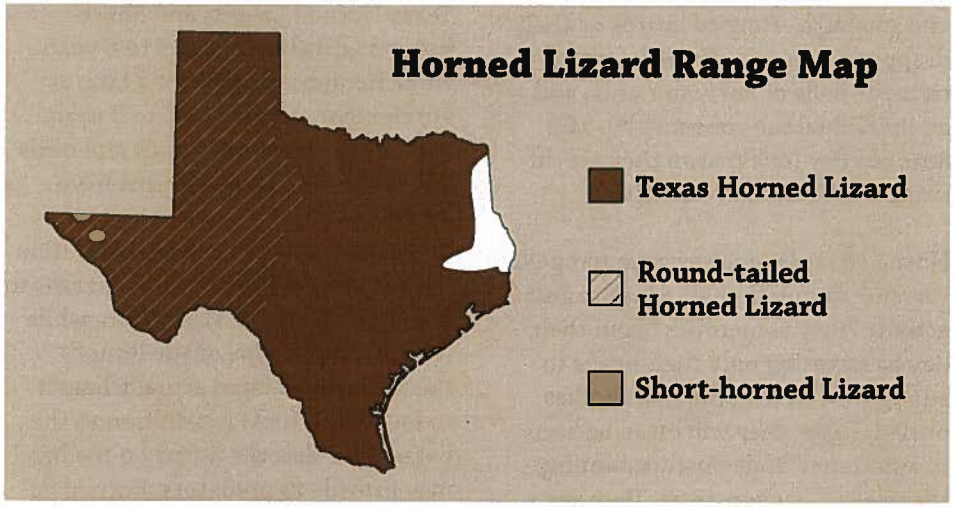
Harvester ants belong to the genera *Pogonomyrmex* or *Ephebomyrmex*. Twelve species of harvester ants are found in Texas, and the Red Harvester Ant (*Pogonomyrmex barbatus*) is the most widespread. Red harvester ants are easily identified by their large size (up to a half inch) and generally conspicuous 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.

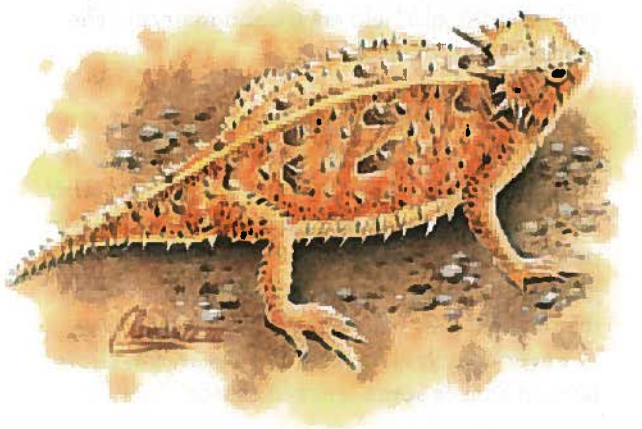
3. **Use prescribed fires to remove ground litter** – Horned lizards usually avoid areas with substantial dead vegetation on the ground (also called litter) because the litter can impede their movement. Burning is a useful tool to decrease ground litter and create open ground. Burning in small patches 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

[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:

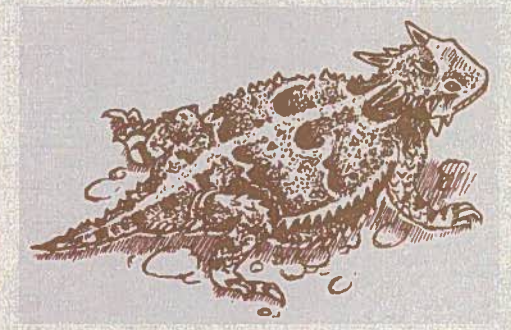
Please submit all forms by October 31

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.

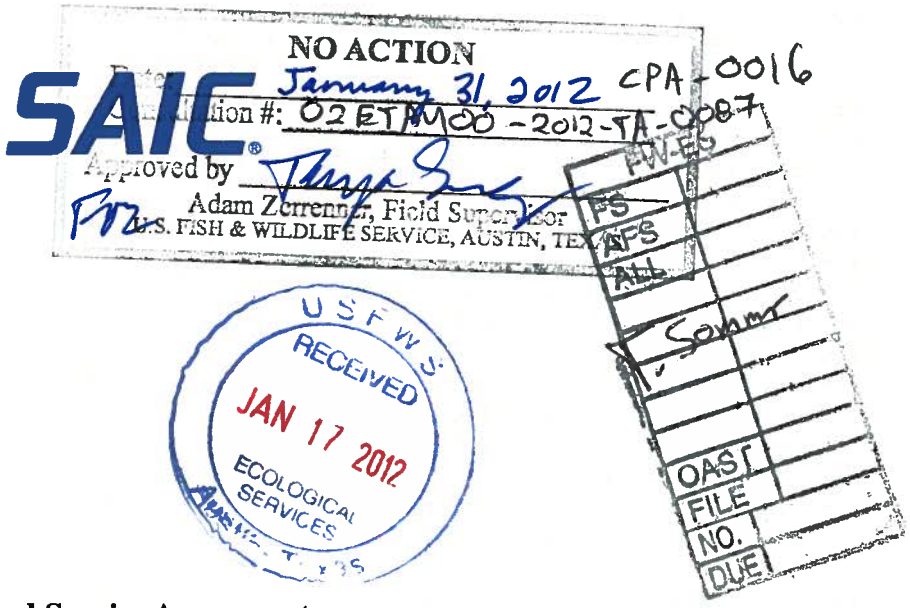
Sincerely,

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

3. Wait until the bird abandons the site on its own will; and
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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.

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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A Requirements for Acceptance of Petroleum Contaminated Soils

B Material Information Sheets – Woven Coated Polyethylene Tarps

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. P.O. Box 4040, 240 DuPont Road North Bay, Ontario P1B 9B4
Attention:	Mr. Todd Travis
Submitted By:	Fire & Flammability.
Report No.	99-J52-87-3-320(A) 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

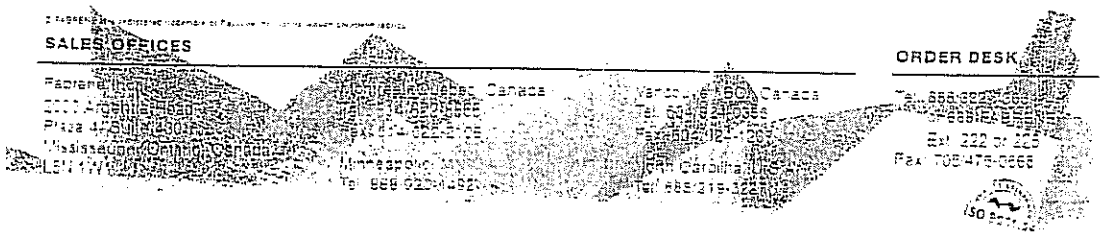
PROPERTY	UNIT		VALUES	TEST METHOD
Construction	Tapes/in	Warp	23.9	ASTM D3775
		Weft	16	
Unit Weight	oz/yd2		9.4	ASTM D3775
Tensile Grab Strength	lbf	Warp	495	ASTM D1682-64
		Weft	342	
Tear Strength * (tongue)	lbf	Warp	137	ASTM D2261-71
Tear Strength * (tongue)	lbf	Weft	124	ASTM D2261-71
Coating Thickness	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. P O Box 4040 240 DuPont Road North Bay, Ontario P1B 9B4
Attention:	Todd Travis
Submitted by:	Fire & Flammability
Report No	99-J52-87-3-320(C) 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

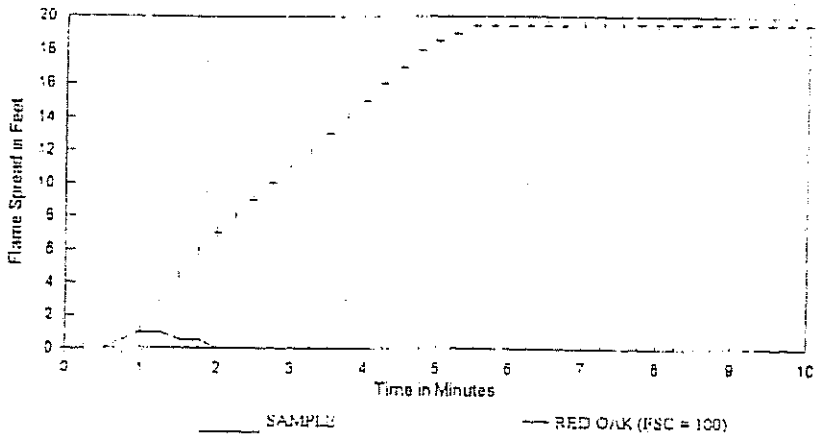
Bodycote Ortech Inc.

Surface Burning Characteristics of Fabrene® L257 Fabric — Page 3 of 3

For Fabrene Inc — Report No 99-J52-87-3-320(C)

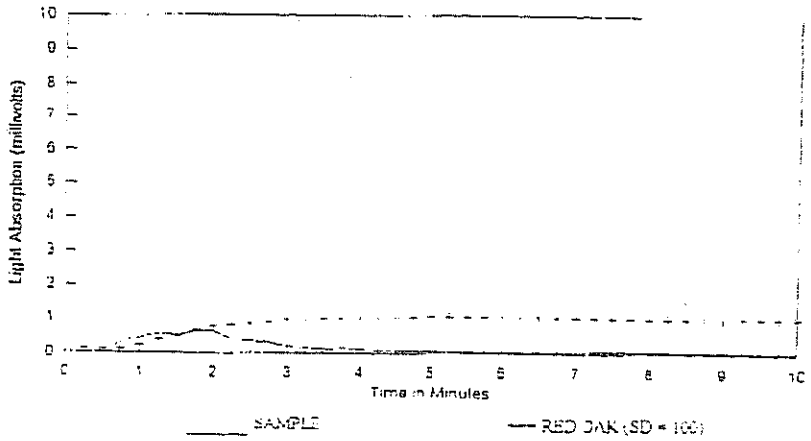
FLAME SPREAD INDEX

Fabrene® L257 split-tape polyethylene fabric



SMOKE DEVELOPED

Fabrene® L257 split-tape polyethylene fabric



FSI	SD
5	20

Appendix 4D
Special Waste Acceptance Plan

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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

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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) If **YES** go to question number 2 below. 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? IF **YES** comply with GOP Index 517-19-001. 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? *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: PMG-LF-P-001 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: PMG-LF-P-001 PMG-LF-P-004