ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1614B

MAJOR PERMIT AMENDMENT APPLICATION

VOLUME 7 OF 7

Prepared for

Pine Hill Farms Landfill TX, LP

May 2024

STATE OF TEXAS
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05/20/2024

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Project No. 0120-076-11-106

This document is intended for permitting purposes only.

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MAJOR PERMIT AMENDMENT APPLICATION

PART III – SITE DEVELOPMENT PLAN

APPENDIX IIIH
GROUNDWATER SAMPLING AND ANALYSIS PLAN

Prepared for

Pine Hill Farms Landfill TX, LP

May 2024

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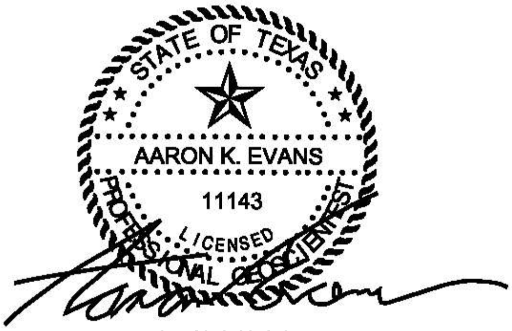

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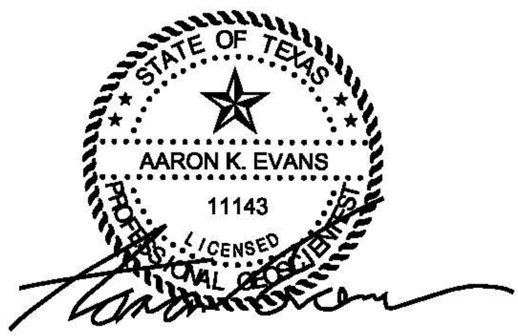

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1 INTRODUCTION

Appendix IIIH addresses §330.63(f)

This groundwater sampling and analysis plan (GWSAP) has been prepared for the Royal Oaks Landfill (Texas Commission on Environmental Quality [TCEQ] Municipal Solid Waste [MSW] Permit No. MSW-1614B). This plan incorporates the GWSAP procedures and methodology from the previous permit (MSW-1614A). The following plan contains the groundwater monitoring system design, the procedures for collecting representative samples from groundwater monitor wells, and the laboratory requirements for obtaining representative data. The plan also includes monitor well placement, design and construction, and well development procedures. This GWSAP has been prepared, and will be followed, in accordance with Title 30 TAC §330.401 through §330.415, §330.419 and §330.421. Groundwater monitoring will be conducted through the active life of the Site and post-closure care period, pursuant to Title 30 TAC §330.401(f). Once approved, a copy of this GWSAP will be placed in the Site Operating Record.

2 GROUNDWATER MONITORING SYSTEM

2.1 Groundwater Monitoring System

The facility's currently installed groundwater monitoring system network is shown on Figure IIIH-A-1 (Existing Groundwater Monitoring System Network) in Appendix IIIH-A. The existing system was permitted with approval of the 2008 Subchapter J Permit Modification by the Carel Corporation under Permit MSW-1614A. The existing groundwater monitoring system design includes nine point of compliance (POC) monitor wells, three upgradient (background) monitor wells, and one observation well, which are screened within sediments of site-specific Aquifer A and Aquifer B. The facility's existing groundwater monitoring network is discussed in Section 2.1.2.

Pursuant to the proposed lateral landfill expansion for Permit MSW-1614B, the facility advanced 14 boreholes and installed 12 groundwater piezometers in 2023 to assess hydrogeological and geotechnical conditions for the proposed lateral expansion area. Regional and site-specific hydrogeology are detailed in Appendix IIIG (Geology Report) of the SDP. The facility's existing and previously advanced borehole, piezometer, and monitor well locations are shown on Figure IIIG-B-1 in Appendix IIIG. The facility's existing nine monitor wells and 12 2023-installed groundwater piezometers were surveyed for vertical and horizontal control by WCG in August 2023 and their as-built survey data (signed and sealed by a Texas RPLS) are provided in Appendix IIIH-A (drawings ABS-1 and ABS-2).

Pursuant to the permit amendment for Permit MSW-1614B, updates to the groundwater monitoring network design are proposed to accommodate the facility's waste footprint expansion. The proposed groundwater monitoring network is discussed in Section 2.1.3 and illustrated on Figures IIIH-A-2 and IIIH-A-3 in Appendix IIIH-A.

2.1.1 Uppermost Aquifer

The uppermost monitorable groundwater zone within the landfill permit boundary is encountered within Aquifer A which transmits perched groundwater around the currently developed landfill footprint.

The first continuous groundwater zone and permitted Uppermost Aquifer (under Permit MSW-1614B) beneath the existing developed landfill unit is contained within Aquifer B. The facility's existing groundwater monitoring system is designed to monitor groundwater within both Aquifer A and Aquifer B.

The second continuous groundwater zone encountered beneath the developed landfill unit occurs within Aquifer C which transmits perched groundwater from the northwest corner of the permit boundary toward the southeast. Aquifer C does not extend below the entirety of the proposed eastern expansion area or easternmost permit boundary.

The first continuous groundwater zone encountered beneath the entire permit boundary is within Aquifer D sediments which transmit groundwater from west and toward the east-northeast. Aquifer D is the Uppermost Aquifer beneath the lateral expansion area.

Monthly static groundwater elevation gauging of the expansion piezometers and the facility's existing monitor wells began in August 2023. Groundwater potentiometric surface contour maps prepared from monthly sitewide groundwater gauging data collected by WCG between August 2023 and March 2024 are provided in Appendix IIIG-D in Appendix IIIG of the SDP. The groundwater elevation data were collected from the facility's nine existing groundwater monitor wells and 12 subsurface investigation piezometers. These recent sitewide potentiometric surface contours indicate an uppermost aquifer groundwater flow regime consistent with those depicted historically for Aquifer A and Aquifer B and demonstrate a consistent groundwater flow regime for Aquifer C and Aquifer D. The facility's site-specific Aquifers and hydrogeology are discussed further in Appendix IIIG (Geology Report).

2.1.2 Existing Groundwater Monitoring Network

The facility's existing permitted groundwater monitoring networks are shown on Figure IIIH-A-1 (Existing Groundwater Monitoring System Network) in Appendix IIIH-A. As illustrated on Figure IIIH-A-1, the existing groundwater monitoring networks are designed with POC detection monitor wells spaced less than 600-feet apart along the point of compliance; with the exception of Aquifer B monitor wells MW-20 and MW-21 which are spaced 739-feet apart. The greater distance between these wells was accepted by TCEQ with approval of the 2008 Subchapter J Permit Modification that permitted the existing groundwater monitoring system design which demonstrated that the locations of MW-20 and MW-21 were chosen based on the occurrence of saturated Aquifer B sediments along the eastern Aquifer B point of compliance.

2.1.3 Proposed Groundwater Monitoring Network Design

The proposed groundwater monitoring network designs are indicated in Table 2-1 and illustrated on Figure IIIH-A-2 (Proposed Aquifer A and B Groundwater Monitoring System Network), Figure IIIH-A-3 (Proposed Aquifer C and D Groundwater Monitoring System Network), and Figure IIIH-A-4 (Groundwater Monitor Well Details) in Appendix IIIH-A.

2.1.3.1 Aquifer A

The existing Aquifer A monitoring system design utilizes one background monitor well (MW-8) and three POC monitor wells (MW-10, MW-22, and MW-25). No changes are proposed to the existing Aquifer A system design. However, revision to the Aquifer A monitor well names are proposed to distinguish these wells from those screened within deeper site-specific aquifers. The proposed naming revisions are indicated in Table 2-1 and on Figure IIIH-A-2 in Appendix IIIH-A and include the addition of an “A” prior to the existing monitor well number.

2.1.3.2 Aquifer B

The existing Aquifer B monitoring system design utilizes two background monitor wells (MW-9 and MW-17), six POC monitor wells (MW-12, MW-15, MW-20, MW-21, MW-23, and MW-24), and one observation well (MW-11). Proposed revision to the aquifer B system includes the conversion of existing observation well MW-11 to a POC monitor well and the removal of existing POC monitor wells MW-20 and MW-21.

Monitor wells MW-20 and MW-21 will be removed prior to the development of the expansion area (Cells 10, 11, or 12). Aquifer B sediments outcrop the immediate east of MW-20 and MW-21 and will be removed during expansion area development. Therefore, no additional or replacement Aquifer B monitor wells are proposed.

Revision to the Aquifer B monitor well names are also proposed to distinguish these wells from those screened within deeper site-specific aquifers. The proposed system revisions are indicated in Table 2-1 and on Figure IIIH-A-2 in Appendix IIIH-A and include the addition of an “B” prior to the existing monitor well number.

2.1.3.3 Aquifer C

The proposed Aquifer C monitoring system design includes one background monitor well (MW-C1), three POC monitor wells (MW-C3, MW-C4, and MW-C5), and one observation well (OW-C2).

Monitor wells MW-C1 and MW-C3 will be converted from existing piezometers PWCG-9B and PWCG-7B; respectively. Piezometer to monitor well conversion will occur and prior to development of the expansion area (cells 10, 11, or 12) and quarterly background data collection monitoring will begin (in accordance with Section 5.3) prior to waste placement in expansion area cells 10, 11, or 12.

Observation well OW-C2 will be converted from existing piezometer PWCG-1B. OW-C2 will be gauged (static water level measured) during routine semiannual groundwater monitoring events to provide groundwater elevation data for Aquifer C in the north facility area. Piezometer to observation well conversion will occur prior to development of the expansion area (cells 10, 11, or 12).

New monitor wells MW-C4 and MW-C5 will be installed prior to development of the expansion area (cells 10, 11, or 12) and quarterly background data collection monitoring will begin (in accordance with Section 5.3) prior to waste placement in expansion area cells 10, 11, or 12.

2.1.3.4 Aquifer D

The proposed Aquifer D monitoring system design includes one background monitor well (MW-D1), three POC monitor wells (MW-D3, MW-D4, MW-D5, and MW-D6), and five observation wells (OW-D2, OW-D7, OW-D8, OW-D9, and OW-D10).

Monitor wells MW-D1, MW-D3, and MW-D6 will be converted from existing piezometers PWCG-9A, PWCG-2, and PWCG-4; respectively. Piezometer to monitor well conversion will occur prior to development of the expansion area (cells 10, 11, or 12) and quarterly background data collection monitoring will begin (in accordance with Section 5.3) prior to waste placement in expansion area cells 10, 11, or 12.

Observation wells OW-D2, OW-D7, OW-D8, OW-D9, and OW-D10 will be converted from existing piezometers PWCG-1A, PWCG-5, PWCG-6, PWCG-7A, and PWCG-8; respectively. These observation wells will be gauged (static water level measured) during routine semiannual groundwater monitoring events to provide groundwater elevation data for Aquifer D at their location. Piezometer to observation well conversion will occur prior to development of the expansion area (cells 10, 11, or 12).

New monitor wells MW-D4 and MW-D5 will be installed prior to development of the expansion area (cells 10, 11, or 12) and quarterly background data collection monitoring will begin (in accordance with Section 5.3) prior to waste placement in expansion area cells 10, 11, or 12.

As indicated on Figure IIIH-A-3, existing Aquifer D expansion area piezometer PWCG-3 is scheduled to removed and will not be converted to a monitor well. PWCG-3 was the first expansion area piezometer installed in Aquifer D sediments during the 2023 subsurface investigation. The static groundwater levels measured in PWCG-3 are observed to be within a few feet of the piezometer screen bottom. PWCG-3 has allowed for the collection of representative Aquifer D static water level measurements to date. However, based on review of historical water levels in former monitor well MW-7 (located in the northeast corner of the permit boundary in the vicinity of MW-D4 and screened within Aquifer D sediments), the groundwater elevation in PWCG-3 may fall below the screen bottom in this piezometer during future gauging events. POC monitor well MW-D5 is therefore proposed to be installed near PWCG-3 and screened deeper within Aquifer D to ensure continuity of long-term groundwater sampling at its location. The shallower installation of PWCG-3 within Aquifer D is due to an extended capillary fringe interval above the water table observed at time of drilling within silty sand sediments.

Table 2-1
Groundwater Monitoring Network

Well Name	Gradient Position	Current Condition	System Status
Aquifer A			
MW-A8	BG	Existing MW-8	Retained in system
MW-A10	POC	Existing MW-10	Retained in system
MW-A22	POC	Existing MW-22	Retained in system
MW-A25	POC	Existing MW-25	Retained in system
Aquifer B			
MW-B9	BG	Existing MW-9	Retained in system
MW-B11	POC	Existing MW-11	Retained in system
MW-B12	POC	Existing MW-12	Retained in system
MW-B15	POC	Existing MW-15	Retained in system
MW-B23	POC	Existing MW-23	Retained in system
MW-B24	POC	Existing MW-24	Retained in system
OW-B17	BG	Existing MW-17	Converted to OW
Aquifer C			
MW-C1	BG	Existing Piezometer PWCG-9B	To be converted to MW
MW-C3	POC	Existing Piezometer PWCG-7B	To be converted to MW
MW-C4	POC	Future MW	To be installed
MW-C5	POC	Future MW	To be installed
OW-C2	BG	Existing Piezometer PWCG-1B	To be converted to OW
Aquifer D			
MW-D1	BG	Existing Piezometer PWCG-9A	To be converted to MW
MW-D3	POC	Existing Piezometer PWCG-2	To be converted to MW
MW-D4	POC	Future MW	To be installed
MW-D5	POC	Future MW	To be installed
MW-D6	POC	Existing Piezometer PWCG-4	To be converted to MW
OW-D2	BG	Existing Piezometer PWCG-1A	To be converted to OW
OW-D7	BG	Existing Piezometer PWCG-5	To be converted to OW
OW-D8	BG	Existing Piezometer PWCG-6	To be converted to OW
OW-D9	BG	Existing Piezometer PWCG-7A	To be converted to OW
OW-D10	BG	Existing Piezometer PWCG-8	To be converted to OW

NOTES: MW = Monitor Well.
POC = Point of compliance well located hydraulically downgradient from landfill unit.
BG = Background well located hydraulically upgradient from the landfill unit.
OW = Observation Well.

2.2 Monitor Well Design and Maintenance

Monitor wells construction details are summarized in Figure IIIH-A-4 (Groundwater Monitor Well Details) in Appendix IIIH-A. Existing monitor well construction details were obtained from lithologic borehole logs, monitor well data sheets, and asbuilt survey reports (provided in Appendix IIIH-A). Construction details for the facility's proposed new monitor well installations are estimated from the existing subsurface and topographic data. Typical groundwater monitor well specifications are depicted in Figure IIIH-A-5 in Appendix IIIH-A.

Review of installation records indicate that the facility's existing monitor wells are constructed in accordance with the requirements of Title 30 TAC §330.421. Future groundwater monitor wells will be installed in accordance with the requirements of Title 30 TAC §330.421.

Well location coordinates, nearest ground elevations, top of casing elevations, and well construction details for the facility's existing wells and future piezometer to well conversions were obtained from an August 2023 WCG Asbuilt Survey Report and the individual Monitor Well Data Sheets (provided in Appendix IIIH-A). Construction details for the facility's new monitor wells installations (MW-C4, MW-C5, MW-D4, and MW-D5) are estimated from the existing subsurface and topographic data. These data are summarized in Figure IIIH-A-4 (Groundwater Monitoring System Well Details). Typical groundwater monitor well specifications are depicted in Figure IIIH-A-5. Review of monitor well installation records indicate that the facility's existing monitor wells, and the existing piezometers scheduled for future conversion to monitor wells, are constructed in accordance with the requirements of Title 30 TAC §330.421.

All parts of the groundwater system will be operated and maintained so that they perform to design specifications throughout the life of the monitoring program. Any well that is damaged to the extent that it is no longer suitable for sampling will be reported to the TCEQ who may make a determination about whether to repair or replace the well. Well plugging and abandonment will be performed by a Texas-licensed well driller in accordance with TCEQ and any other applicable regulatory requirements. No well will be plugged and abandoned without prior written authorization from TCEQ. Any new or replacement monitor well installation will be performed in accordance with Title 30 TAC §330.421 by a Texas-licensed monitor well driller. Monitor well construction will provide for the maintenance of the integrity of the borehole, collection of representative groundwater samples from the Uppermost Aquifer, and prevention of migration of groundwater and surface water within the borehole in accordance with Title 30 TAC §330.421(a).

Future monitor wells will be installed with a borehole diameter that is at least four inches larger than the diameter of the well casing. A smaller borehole/well annulus may be approved by TCEQ. A log of the borehole will be made by or under the supervision of a licensed professional geoscientist or engineer who is familiar with the geology of the area, and will be sealed, signed, and dated by the licensed professional.

The screened section of monitor wells will be compatible with the casing (both will generally be of the same material). The screen will not involve the use of any glues or solvents for construction. A wire-wound screen is recommended to provide maximum inflow. Field-cut slots are not permitted for well screens. Filter cloth will not be used. A blank-pipe sediment trap, typically up to two-feet in length, will be installed below the screen. A bottom cap is typically placed on the bottom of the sediment trap. The sediment trap will not extend through the lower confining layer of the water-bearing zone being sampled. Screen sterilization methods will be the same as those for casing. Selection of the size of the screen opening will be done by a person experienced with such work and will include consideration of the distribution of particle sizes both in the water-bearing zone and in the filter pack surrounding the screen. The screen opening will not be larger than the smallest fraction of the filter pack.

Where monitor wells are installed in unusual conditions, all aspects of the installation will be approved in writing in advance by TCEQ. Such aspects include, for example, the use of cellar-type enclosures for the top-well equipment or multiple completions in a single hole.

Monitor well installation and construction details will be submitted on forms available from the TCEQ and will be completed and submitted within 60 days of well completion. A copy of the detailed geologic log of the borehole (i.e., lithologic log), a description of development procedures, any particle size or other sample data from the well, and a site map drawn to scale showing the location of all monitor wells and the point of compliance will be submitted to the executive director at the same time. The licensed driller will be familiar with the forms required by other agencies; a copy of those forms must also be submitted to TCEQ.

2.3 Groundwater Monitoring Program

Facility detection monitor wells will be sampled semi-annually for the detection monitoring parameters listed in 40 Code of Federal Regulations (CFR), Part 258, Appendix I, which are also listed in Table 5-1 in Section 5.1. Details regarding groundwater sampling, analyses, and statistical comparison procedures are discussed in the following sections of Appendix IIIH.

In accordance with Title 30 TAC §403(e)(3), Republic Waste Services of Texas, Ltd. will promptly notify the executive director, and any local pollution agency with jurisdiction that has requested to be notified, in writing of changes in facility construction or operation or changes in adjacent property that affect or are likely to affect the direction and rate of groundwater flow and the potential for detecting groundwater contamination and that may require the installation of additional wells or sampling points. Such additional wells or sampling points may require a modification of the Site Development Plan which will be requested in accordance with Title 30 TAC §305.70(j). Details regarding groundwater sampling, analyses, and statistical comparison procedures are discussed in the following sections of Appendix IIIH.

According to the facility's 2023 First Semiannual Detection and Assessment Groundwater Monitoring Report (Hydrex, August 2023), the facility's existing groundwater detection monitor wells are exclusively in detection monitoring status; except for MW-20 and MW-21 which is in assessment monitoring status for ongoing detections of acetone, total barium, and total copper.

3 GROUNDWATER SAMPLING PROCEDURES

3.1 Health and Safety Plan

A health and safety plan is required for all groundwater sampling events at the landfill. Prior to monitor well purging and sampling, the sampling contractor's Ground Water Sampling Health and Safety Plan must be in place. Designing the Site Ground Water Sampling Health and Safety Plan will be the responsibility of the party performing the actual work. In addition, each laboratory facility is responsible for their own standard laboratory health and safety plan as required by current Occupational and Safety and Health Administration (OSHA) regulations.

A health and safety plan is recommended for all groundwater sampling events at the landfill. Designing a Ground Water Sampling Health and Safety Plan is the responsibility of the party performing the actual field sampling work.

3.2 Sample Event Preparation and QA/QC

3.2.1 General Event Preparation

The laboratory performing the groundwater analysis will supply all necessary transportation coolers, pre-cleaned sample containers, quality assurance and quality control (QA/QC) trip blanks, chemical preservatives, sample container labels, custody seals, and chain-of-custody forms. All field data will be entered on a field data sheet (see example provided in Appendix IIIH-C) or an equivalent form. A specific contact person should be established at both the facility and contract laboratory for communication between the two parties.

3.2.2 Sample Container Selection

Each sample container will be constructed of materials compatible and non-reactive with the sample it is designed to contain. Consult Appendix IIIH-D (Containerization and Preservation of Samples) to determine the number, type, and volume of appropriate containers. As noted in Section 3.2.1, the contract laboratory performing the analysis will supply all the required containers. Sample containers will be purchased as a pre-cleaned product or cleaned in the laboratory in a manner consistent with EPA protocols.

3.2.3 Equipment Preparation Prior to Site Arrival

Equipment preparation includes, at a minimum, decontamination procedures for water level indicators and field parameter (temperature, pH, specific conductivity, and turbidity) measurement devices. Operation and calibration of field instruments will be performed per the manufacturers' instructions.

- Water Level Indicators – Water level indicators will be decontaminated prior to initial Site arrival by hand-washing the sensor probe and entire length of tape in a laboratory grade non-phosphate detergent followed by a triple rinse with organic free deionized or distilled water.
- Field Parameter Measuring Devices – Field parameter measuring devices will be decontaminated by hand washing the sample cells in a laboratory grade non-phosphate detergent followed by a triple rinse with organic free deionized or distilled water. Meters will then be checked for proper calibration and operation as per the manufacturers' instructions. Any malfunctioning meters will be replaced prior to packing.

In the case of equipment failure, it is recommended that back-up instruments be in the sample crew's possession. If a back-up instrument is not available, then sampling will not proceed until the necessary properly functioning and calibrated replacement equipment is made available.

3.2.4 Field QA/QC Samples

Field QA/QC samples are used to identify sample contamination from the field, and/or shipping procedures, and document the precision of analytical processing by the laboratory. These blanks consist of one trip blank per sampling event, one field blank for each day of sampling, and one field duplicate per sampling event. A basic description of these field QA/QC samples follows:

- Trip Blank – samples will be prepared in the laboratory by filling the appropriate clean sample containers with organic-free water and adding the applicable chemical preservative, as indicated in Appendix IIIH-D. Trip blank samples will be shipped in the transportation cooler to the field and shipped back to the laboratory with the collected groundwater samples. The trip blank will be tested to detect any contamination that may occur as a result of the containers, sample coolers, cleaning procedures, or chemical preservatives used. Trip blank samples will be analyzed for the VOC constituents indicated in Table 5-1 of Section 5.1 at a minimum frequency of one per sampling event.
- Field Blank – sample containers will be collected in the field at a routine sample collection point by filling the appropriate sample containers with laboratory-grade distilled or deionized water. The field blank samples will be tested to detect contamination that may occur as a result of Site ambient air

conditions and serve as an additional check for contamination in sample containers or transport coolers. Field blanks samples will be collected and analyzed for the VOC constituents indicated in Table 5-1 of Section 5.1 at a frequency of one per day of sampling.

- Field Duplicate – a duplicate set of groundwater samples collected from a detection monitor well and labeled with a non-existent well number so that the laboratory is unaware that the samples are duplicates. These samples are obtained by consecutively filling two sets of separate sample containers with groundwater obtained from the same detection monitor well and analyzing each set of samples independently. Field duplicate samples are useful in documenting the precision of sampling and analytical processes. Field duplicate samples will be collected in proper alternating order for each parameter (e.g. VOCs for the sample point container, VOCs for the field duplicate container, metals for the sample point container, metals for the field duplicate container, etc.). Field duplicate samples will be collected and analyzed for the total metal and VOC constituents indicated in Table 5-1 of Section 5.1 at a minimum frequency of one per sampling event.

Appropriate field QA/QC documentation will be recorded on the field data sheet; an example of which is included in Appendix IIIH-C.

3.3 Monitor Well Inspection

During each monitoring event, every gauged well and its surface completion will be visually examined for anything unusual. This includes examination of the well casing, well head, protective cover, locking device, concrete pad, labels, etc. All observations will be recorded on the field data sheet. If any problems are discovered, they will be reported to the facility manager as soon as practical.

3.4 Monitor Well Purging

3.4.1 General Well Purge Information

Purging a monitor well is just as important as the subsequent sampling of the well. Over a certain period of time stagnant well water may become unrepresentative of formation water due to chemical and biochemical changes which alter water quality.

3.4.2 Water Level Measurement

Prior to purging each monitor well, a water level measurement is required. The water level in each well will be gauged and recorded on the field data sheet. Water level indicator equipment will be constructed of chemically inert materials and will be decontaminated with a non-phosphate detergent, followed with a deionized or distilled water rinse, before use in each well. Water levels will be measured with a precision of +/- 0.01 foot. Groundwater elevations must be measured within a period of time short enough to avoid temporal variations in groundwater flow which could preclude an accurate determination of groundwater flow rate and direction. Water level measurements will be taken from the permanent datum point that will be clearly marked on the top of the well casing.

3.4.3 Purge Equipment and Procedures

Groundwater wells will be purged with disposable bailers or well-dedicated pumps to minimize cross contamination potential. Purge and decontamination/rinsate water will be collected in containers and disposed of in accordance with Section 3.4.6. Disposable, powderless gloves will be changed between wells and between purging and sampling to reduce the potential for cross-contamination and exposure to potentially contaminated groundwater.

3.4.3.1 Hand Bailing

Bailer purging will be conducted until field parameters are stable, three casing volumes of water have been removed, or the well is purged to dryness. Bailer purge field parameters include temperature, specific conductivity, pH, and turbidity.

A new bailer will be used to purge each monitor well. If the well is not sampled immediately following purging, then a second new bailer will be used to collect the sample upon return to the well. All used bailers will be disposed of immediately following use. A bailer is considered contaminated and must be discarded for a new bailer if it comes in contact with any surface other than the groundwater being purged/sampled, bailing twine, well casing, sampler's nitrile gloves, or filling spout apparatus. Bailers must be constructed of Teflon, polypropylene, or polyethylene.

3.4.3.2 Dedicated Pumps

Samplers may employ either standard-flow purging/sampling techniques or low-flow purging/sampling techniques as deemed appropriate based on the well's recharge capacity/characteristics and the capability of the installed pump. Pump purging must be conducted until a minimum of two pump and tubing volumes of water have been removed. Non-low flow purging will be conducted until field parameters are stable, three casing volumes have been removed, or the well is purged to dryness. Low-flow purging will be conducted at a rate of approximately 50-250 milliliters per minute until field parameter stabilization is achieved. Pump purge field parameters include temperature, specific conductivity, pH, and turbidity.

Well-dedicated pumps will remain dedicated to each respective well throughout monitoring unless replacement is necessary due to damage or wear, in which case repairs will be completed or a new dedicated pump will be installed. Bladder pumps are recommended for well-dedicated pump installations.

3.4.3.3 Field Parameter Stabilization

Field parameter stabilization is defined by three consecutive measurements, taken at 3-minute to 5-minute intervals, which exhibit values within the following ranges:

- pH = ±0.2 standard units;
- Specific Conductivity = ±3%;
- Temperature = ±3%;
- Turbidity = ±10% or 3 consecutive readings <10 NTUs.

3.4.4 Purge Order

Based on water-level measurements taken prior to well purging, sampling will generally proceed from the well with the highest groundwater elevation to those with successively lower elevations unless contamination is known to be present. If contamination is present, monitor wells not likely to be contaminated must be sampled before those that are known to be contaminated. The sampling sequence may be modified to accommodate unusual weather conditions or slow recovery wells.

3.4.5 Purge Volume Measurement

Purged water must be measured in a graduated container to accurately determine purge volume. The volume of water in the well casing can be calculated by subtracting the gauged depth to the water surface from the recorded total depth of the well casing. The volume of water contained in one foot of 2-inch diameter schedule 40 PVC well casing is 0.163 gallons. The total amount of water present in the well casing (one casing volume) can be calculated by multiplying the depth of water by the appropriate conversion value for the well's casing diameter (0.163 gallons/foot in this example). A well casing volume calculation example follows:

Total depth of well casing (feet)	41.50
Depth to groundwater (feet)	-12.36
Depth of water column (feet)	29.14
Gallons/feet of 2-inch casing	x 0.163
One casing volume of water (gallons)	4.75

3.4.6 Purge Water Management

All purge water and excess sample water will initially be collected in appropriate sealed containers. Contaminated purge water and excess sample water is considered contaminated if the concentration of any detected constituent statistically exceeds the constituent's background concentration. Contaminated purge water will be handled in the same manner as leachate. If needed, TCEQ will be consulted to assist in assessing proper disposal protocol. Uncontaminated groundwater may be discharged to the ground surface away from the well.

3.5 Monitor Well Sample Collection

3.5.1 General Sample Collection Information

Sampling will take place within 24 hours of completion of purging. If field parameter stabilization is achieved, the well may be sampled immediately following stabilization. If after 24 hours, a slowly recharging well has not recovered sufficiently for a complete set of samples, a partial set of samples will be collected in the order specified in Section 3.5.2 until no more samples for the set can be collected.

3.5.2 Sample Collection Order

Samples will be collected and containerized according to the volatility of the required analyses. A specific collection order is as follows:

- Volatile Organic Compounds
- Semi-Volatiles (if collected)
- Total Metals
- Field Parameters
- Inorganics (if collected)

3.5.3 Sampling Equipment and Procedures

Groundwater samples will be collected with a new disposable bailer or well-dedicated purging/sampling pump (if installed). If a pump is used to sample, the pump controller will be adjusted to reduce the flow rate to between 100 and 250 ml/min for the duration of sampling. If a bailer is used to sample, sample containers will be filled by draining the bailer-collected groundwater from the bottom of the bailer. Special care will be taken to minimize sample agitation. All groundwater samples will be collected by filling directly into each of the required sample containers.

3.5.4 Sample Preservation

All samples will be containerized and preserved according to Appendix IIIH-D (Sample Containerization and Preservation). Preservation acids may be added to the applicable sample container in the field or pre-preserved by the laboratory prior to sample collection. Methods of preservation are intended to retard biological action, retard hydrolysis of chemical compounds and complexes, and reduce the volatility of constituents.

Samples requiring refrigeration to four degrees Centigrade, according to Appendix IIIH-D will be accomplished by placing the sample containers immediately into coolers containing wet ice and delivering to the analytical laboratory as soon as practical. Groundwater samples for detection or assessment monitoring constituent analyses will not be filtered in the field or the laboratory.

3.5.5 Field Measurements

Required field measurements include water levels, temperature, pH, specific conductance, and turbidity. Water level measurement procedures are described in Section 3.4.2. Field parameters will be measured using either handheld instruments placed directly into discharged water or an in-line flow through cell. All instruments will be properly calibrated and checked with standards according to the manufacturer's instructions. Any improperly operating instruments must be replaced prior to continuing sample collection operations. Field parameter readings will be taken in a separate container not used for sample collection.

3.6 Record Keeping

3.6.1 Field Data Sheets

All field information will be completely and accurately documented and entered on a standard field data sheet, an example of which is provided in Appendix IIIH-C. Information recorded on the field data sheets will be provided in the sampling event's groundwater monitoring report, a copy of which will be included in the facility's Site Operating Record. All field data sheet entries will be made legible in indelible ink.

3.6.2 Chain-of-Custody/Sample Container Labels

Proper chain of custody records are required to insure the integrity of the samples and the conditions of the samples upon receipt at the laboratory, including the temperature of the samples at the time of login. The sample collector will fill in all applicable sections of the chain of custody and transmit the original, with the respective samples, to the laboratory performing the analysis. Upon receipt of the samples at the laboratory, the sample coordinator will complete the applicable receiving information on the chain of custody, make a copy for their files, and make the original documents part of the final analytical report (see Appendix IIIH-E for an example chain-of-custody form). Chain of custody form copies will be included in the sampling event's groundwater monitoring report, a copy of which will be included in the facility's Site Operating Record.

All sample containers will be labeled legibly to prevent misidentification. The following information will be indicated on each sample container label with waterproof pen:

- Collector's name, date, and time of sampling
- Sample source
- Sample Identification number
- Sample preservatives (if any)
- Analytical tests to be performed on the sample

3.7 Sample Transport

Samples will be transmitted from the field to the analytical laboratory either by hand delivery or via an overnight courier service. Samples are to be shipped with wet ice in insulated shipping containers capable of maintaining all samples at approximately four degrees centigrade. Before a shipping container is turned over to a common courier (or any other person who does not complete the chain-of-custody documentation), it will be sealed using a method that will reveal whether the container's security has been compromised. Overnight courier shipping containers must be of a sturdy waterproof design (ice chests are commonly used) equipped with adequate cushioning material to prevent sample container breakage during shipment.

4 LABORATORY PROCEDURES/PERFORMANCE STANDARDS

All groundwater analyses will be performed by a TCEQ-accredited environmental testing laboratory in accordance with acceptable accreditation standards (e.g. NELAC). All groundwater analytical data will be provided to TCEQ in the sampling event's groundwater monitoring report, a copy of which will be included in the facility's Site Operating Record.

The owner or operator will 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 commission for review. This data review will include examination of the quality control results and other supporting information.

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 program, it does not necessarily mean that the data is unusable. The owner or operator may still report the analytical data but will include a discussion of any issues identified by the laboratory.

A Laboratory Case Narrative (LCN) report for all problems and anomalies observed must be submitted by the owner and/or operator. A sample laboratory QC checklist is provided in Appendix IIIH-G. 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 will 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. Exceedance of holding times and identification of matrix interferences will be identified. Dilutions will 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 will 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.
3. An analytical report that documents the results and methods for each sample and analyte to be included for every analytical testing event. The test reports will document the reporting limit/method detection limit the laboratory used.
4. A release statement will be submitted from the laboratory. The 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 or Laboratory Case Narrative, 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 performed.
6. A laboratory checklist. The Laboratory Data Package Cover Page, and Laboratory Review Checklist or the laboratory quality assurance and quality

control data and laboratory analytical data (which may be submitted in hard-copy or electronic format), will be included with the TCEQ-0312 forms for each groundwater monitoring event. 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 or by adding additional explanations to the checklist. The permittee will require the laboratory to do an equivalent of an EPA Level 3 review regarding quality control analysis. The facility will explain any problems encountered in the laboratory analysis, either by adding additional explanations to the laboratory checklist or by extending the laboratory case narrative. Any information required in the laboratory case narrative that cannot be completed by the laboratory will be completed by the permittee.

7. If requested by TCEQ, laboratory analytical reports may be submitted either electronically or in hard copy.
8. The facility may explain any problems encountered in the laboratory analysis, either by adding additional explanations to the checklist or by extending the laboratory case narrative.
9. Any information required in the laboratory case narrative that cannot be completed by the laboratory will be completed by the permittee.

5 CONSTITUENTS, PQLS, AND DETECTION MONITORING

5.1 Analyzed Constituents

The detection monitoring constituents at the facility will be as referenced in Title 30 TAC §330.419 and specified in 40 CFR 258 Appendix I and Table 5-1. The laboratory will report the analytical results for each constituent to its respective practical quantitation limit (PQL) concentration. Groundwater samples will be collected and analyzed for the constituents listed in Table 5-1.

Table 5-1
Detection Monitoring Constituents

15 Total Metal Constituents[1]
Total Antimony
Total Arsenic
Total Barium
Total Beryllium
Total Cadmium
Total Chromium
Total Cobalt
Total Copper
Total Lead
Total Nickel
Total Selenium
Total Silver
Total Thallium
Total Vanadium
Total Zinc

[1] Analyses will be performed using the TCEQ – recommended EPA test methods or alternative methods with equivalent or better performance.

Table 5-1 (Continued)
Detection Monitoring Constituents

47 VOC Constituents[1]
Acetone
Acrylonitrile
Benzene
Bromochloromethane
Bromodichloromethane
Bromoform (Tribromomethane)
Carbon Disulfide
Carbon Tetrachloride
Chlorobenzene
Chloroethane (Ethyl Chloride)
Chloroform (Trichloromethane)
Dibromochloromethane (Chlorodibromomethane)
1,2-Dibromo-3-chloropropane (DBCP)
1,2-Dibromoethane (Ethylene Dibromide or EDB)
o-Dichlorobenzene (1,2-Dichlorobenzene)
p-Dichlorobenzene (1,4-Dichlorobenzene)
trans-1,4-Dichloro-2-butene
1,1-Dichloroethane (Ethylidene Chloride)
1,2-Dichloroethane (Ethylene Dichloride)
1,1- Dichloroethylene (Vinylidene Chloride)
Cis-1,2- Dichloroethylene (Cis-1,2- Dichloroethylene)
trans-1,2-Dichloroethylene (trans-1,2-Dichloroethene)
1,2-Dichloropropane (Propylene Dichloride)
cis-1,3-Dichloropropene
trans-1,3-Dichloropropene
Ethyl Benzene
2-Hexanone (Methyl Butyl Ketone or MBK)
Methyl Bromide (Bromomethane)
Methyl Chloride (Chloromethane)
Methylene Bromide (Dibromomethane)

1 Analyses will be performed using the TCEQ – recommended EPA test methods or alternative methods with equivalent or better performance.

Table 5-1 (Continued)
Detection Monitoring Constituents

47 VOC Constituents (Continued)[1]
Methylene Chloride (Dichloromethane)
Methyl Ethyl Ketone (2-Butanone or MEK)
Methyl Iodide (Iodomethane)
4-Methyl-2-Pentanone (Methyl Isobutyl Ketone or MIBK)
Styrene
1,1,1,2-Tetrachloroethane
1,1,2,2-Tetrachloroethane
Tetrachloroethylene (Tetracholorethane)
Toluene
1,1,1 Trichloroethane (Methylchloroform)
1,1,2-Trichloroethane
Trichloroethylene (Trichloroethene, TCE)
Trichloroflourmethane (CFC-11)
1,2,3-Trichloropropane
Vinyl Acetate
Vinyl Chloride
Xylenes

[1] Analyses will be performed using the TCEQ – recommended EPA test methods or alternative methods with equivalent or better performance.

5.2 Practical Quantitation Limit

The laboratory reporting limits will meet the requirements of Title 30 TAC §330.405(f)(5). Analytical results will be reported to the lowest concentration levels that can be reliably quantified (practical quantitation limits [PQL]). The following describes the PQL required:

- The PQL will be at or below the Ground Water Protection Standard (GWPS) concentration established for each analyte in accordance with Title 30 TAC §330.409(h), unless approved otherwise by the executive director.
- The PQL will be determined as the concentration that corresponds to the following precision and accuracy criteria:

Constituents/Chemicals of Concern	Precision (percent RSD)	Accuracy (percent recovery)
Metals	10	70-130
Volatiles	20	50-150
Semi-Volatiles	30	50-150

- The precision and accuracy of the PQL initially will be determined from the PQLs reported over the course of a minimum of eight groundwater monitoring events. The results obtained from these events will be used to demonstrate that the PQLs meet the specified precision and accuracy limits. The PQL may be updated as more data becomes available.
- The PQL will be supported by analysis of a PQL check sample, consisting of a laboratory reagent grade sample matrix spiked with constituents/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.
- Analytical results for data below the limit of detection ("non-detect" results) will be reported as less than the established PQL limit that meets those precision and accuracy requirements.
- If a PQL cannot be established according to the specified precision and accuracy limits, the owner or operator will ensure that the laboratory provides sufficient documentation to justify the alternate precision and accuracy limits. This information will be reported to the executive director by the owner or operator and will be evaluated on a case-by-case basis.

All samples will be analyzed within the required holding times for the particular analyses to be tested. A list of appropriate sample containers, sample preservation, and recommended holding times is presented in Appendix IIIH-D.

The sample containers will be filled in the following order.

1. VOCs
2. Semi-volatiles (if collected)
3. Total metals
4. Inorganics (if collected)

5.3 Background Data Collection

As stated in Title 30 TAC §330.405(b)(3)(A), the number of samples to be collected to establish background groundwater quality data for total metals will be consistent with the appropriate statistical procedures pursuant to Title 30 TAC §330.405(f). Following installation of a new monitor well or conversion of an existing piezometer into a monitor well, the facility will begin background data collection monitoring for the constituents listed in Table 5-1. Background data collection monitoring events will be conducted on a quarterly basis until a minimum of eight background data collection monitoring events have been completed.

Following the completion of background data collection for a given monitor well, the total metals analytical data will be evaluated to ensure that the data are representative of background groundwater constituent concentrations unaffected by waste management activities or other sources of contamination in accordance with Title 30 TAC §330.405(d) and §330.407(a). At a minimum the statistical evaluation will include a screening for potential outliers and analyses to identify significant trends. The evaluation will be documented in a report and submitted to TCEQ prior to the facility's next scheduled semiannual groundwater detection monitoring event.

5.4 Updating Background Data

The collection of groundwater samples to establish background water quality data for metals constituents will be performed in accordance with Title 30 TAC §330.405(d) and §330.407(a).

For interwell total metals statistical comparisons, ongoing analytical data obtained from each monitoring event will be incorporated into the background data pool. Data will be evaluated for potential outliers prior to incorporation into the well's background data pool.

For intra-well statistical comparisons, new data may be incorporated into background as frequently as once every two years. The facility will evaluate the data to ensure that the data are representative of background groundwater constituent concentrations unaffected by waste management activities or other sources of contamination. At a minimum the statistical evaluation will include a screening for potential outliers and analyses to identify significant trends and, if appropriate, the data will be incorporated into the well's background data pool. The evaluation will be documented in a report and submitted to the TCEQ prior to the facility's next scheduled semiannual groundwater detection monitoring event.

5.5 Detection Monitoring Events

Routine sampling and analysis for all facility background and point of compliance detection monitor wells will be conducted on a semi-annual basis (every six months) for the constituents listed in Table 5-1.

5.6 Groundwater Reporting and Submittals

No later than 60 days following completion of each groundwater monitoring event, statistical analyses will be performed in accordance with Section 6 of Appendix IIIH. Groundwater reporting frequency and procedures will be conducted in accordance with Title 30 TAC §330 Subchapter J, and TCEQ Guidelines for Groundwater Monitoring Report Submittals guidance (December 22, 2014).

5.6.1 Semiannual Detection Monitoring Reporting

In accordance with TCEQ reporting guidance, within 90 days after completion of each semiannual groundwater monitoring event, a semiannual groundwater detection monitoring report will be submitted that includes the following information, determined since the previously submitted semiannual report:

1. The landfill's groundwater sample and field quality control sample analytical data collected during the reporting year in hard-copy format on TCEQ Form-0312 (Groundwater Sampling Report) and in any other format requested by the TCEQ (e.g., electronic format);
2. The laboratory case narrative as described in Section 4 and either:
    a) A completed laboratory checklist equivalent to the example checklist presented in Appendix IIIH-G, or
    b) The laboratory quality assurance and quality control data and laboratory analytical data (which may be submitted in hard-copy or electronic format);
3. An explanation of any problems encountered in the laboratory analysis, either by adding additional explanations to the laboratory checklist or by extending the laboratory case narrative. Any information required in the laboratory case narrative that cannot be completed by the laboratory will be completed by the landfill;
4. A statement regarding identification of any statistical exceedances;
5. The results of all groundwater monitoring, testing, and analytical work, including a summary of background groundwater quality values, groundwater monitoring analyses, statistical calculations, graphs, and drawings;
6. The groundwater flow rate and direction in the uppermost aquifer, using the preceding semiannual sampling event's data. The report will include all documentation used to determine the groundwater flow rate and direction;
7. A contour map of piezometric water levels in the uppermost aquifer based on concurrent measurements in all gauged facility wells. The report will include all data or documentation used to establish the contour map;
8. Recommendation for any changes; and
9. Any other items requested by the Executive Director.

In accordance with Title 30 TAC 330.408(d), if it is determined that the detection monitoring system no longer satisfies the requirements of Title 30 TAC §330.407, the facility will submit an application for a permit amendment or modification to make appropriate changes within 90 days of this determination.

5.6.2 Semiannual Assessment Monitoring Reporting

If there are one or more facility wells in assessment monitoring status, then the facility will submit a semiannual assessment monitoring report within 60 days after completion of each semiannual groundwater assessment monitoring event. The semiannual groundwater assessment monitoring report will include the same data and information required in the facility's semiannual detection monitoring report (as defined in Section 5.6.1) but will be specific to the facility's assessment monitor wells, constituents, and statistics. The assessment monitoring statistical results will be compared to Groundwater Protection Standard concentrations to determine if the results are statistically significant.

The required semiannual groundwater assessment monitoring information may be provided either within the facility's semiannual detection monitoring report or submitted in an assessment-specific semiannual groundwater report. If the required detection and assessment monitoring information are combined into a single semiannual report submittal, then the combined report will be submitted to TCEQ within 60 days after completion of the semiannual groundwater monitoring event.

6 STATISTICAL METHODOLOGY – GROUNDWATER DATA ANALYSES

6.1 Statistical Methodology

Statistical analyses of groundwater analytical data will be performed in accordance with Title 30 TAC §330.405, §330.407, and §330.409, and EPA Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance (March, 2009). Statistical comparisons will be performed using Sanitas™, a commercial software program developed by Sanitas Technologies, Inc. or other equivalent statistical program. Flow charts depicting statistical analyses protocols for control charts, prediction limits, and 95 percent confidence intervals are included in Appendix IIIH-F. It is not possible to predict all future potential circumstances. Therefore, alternate statistical methods may be used as deemed appropriate for the data distribution of the constituents being evaluated, providing that they conform to the requirements and guidelines set forth in Title 30 TAC §330.407 and §330.409, and EPA Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance (March, 2009).

6.2 Exceedances, Resampling, ASDs, and Assessment Monitoring

Detection monitoring for the constituents listed in Table 5-1 of Section 5.1 and referenced in Title 30 TAC §330.419(a) will be conducted in accordance with Sections 5.3 and 5.5. An Initial Statistical Exceedance (ISE) of any constituent will be based on a detected concentration that exceeds the constituent's statistical limit. If an ISE of any constituent is indicated at any detection monitor well, a notice will be made to the TCEQ (and any other pollution control agency with jurisdiction that has requested to be notified) within 14 days.

6.2.1 Verification Resampling

Verification re-sampling is an integral part of the statistical methodology that is required to verify if an actual SSI has occurred. In the event that an ISE is indicated for any constituent listed in Table 5-1 (Section 5.1), verification resampling will be completed to either confirm or disconfirm the ISE. The verification resampling results will be submitted to TCEQ within the appropriate regulatory timeframe. If the ISE is verified through resampling then the verified exceedance constitutes a Statistically Significant Increase (SSI) and the facility will either:

(1) Notify the TCEQ (and any local pollution agency with jurisdiction that has requested to be notified) in writing of the verified SSI within 14 days and begin assessment monitoring within 90 days of the written notice (Title 30 TAC §330.407(b)(1)), or

(2) Within 14 days of the verified SSI determination date, notify the TCEQ (and any local pollution agency with jurisdiction that has requested to be notified) in writing of the facility's intent to submit an alternative source demonstration (ASD) report; and

(3) Within 90 days of the verified SSI determination, submit an ASD report to the TCEQ (and any local pollution agency with jurisdiction that has requested to be notified) that demonstrates that a source other than the facility caused the contamination or that the SSI resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality (Title 30 TAC §330.407(b)(3)(B)). The report must be prepared and certified by a qualified groundwater scientist. If the report does not sufficiently demonstrate an alternative contamination source to the TCEQ, then the facility must begin assessment monitoring with 90 days of the written ASD intent notification.

If the ASD is accepted by TCEQ then the monitor well may remain in detection monitoring status. If the owner/operator does not make a demonstration satisfactory to the executive director within 90 days of the date of the SSI notice, as made evident by a letter of denial from TCEQ, then the owner/operator will initiate an assessment monitoring program meeting the requirements of Title 30 TAC §330.409.

6.3 Assessment Monitoring

Assessment monitoring will be conducted at least semiannually in accordance with Title 30 TAC §330.409. The landfill will sample and analyze the groundwater monitoring system for the full list of constituents in 40 CFR, Part 258, Appendix II. Analyses for these constituents will also be conducted for the each well located on either side of the well exhibiting the verified SSI, unless an alternative subset of wells is designated by the TCEQ.

For any new constituent detected in the point of compliance wells as a result of the completed Appendix II analysis, a minimum of four statistically independent samples from each background well will be collected and analyzed to establish background levels for the additional constituent, unless an alternative subset of Appendix II background constituent analyses is designated by the TCEQ. After sampling the assessment monitor wells for Appendix II constituents, the TCEQ may specify an appropriate subset of wells to be sampled and analyzed for the Appendix II constituents during assessment monitoring and may delete any of the Appendix II constituents if the landfill demonstrates that the constituents are not reasonably expected to be in or derived from the waste contained in the unit.

If the concentrations of all 40 CFR Part 258, Appendix II constituents are shown to be at or below background values, using the statistical procedures in §330.405(f), for two consecutive sampling events, the owner or operator will notify the Executive Director in writing and return to detection monitoring if approved.

If the concentrations of any 40 CFR Part 258, Appendix II constituents are above background values, but all concentrations are below the groundwater protection standard established under subsection (h) or (i) of §330.409, using the statistical procedures in §330.405(f) of this title, the owner or operator shall continue assessment monitoring in accordance with §330.409.

Not later than 60 days after each sampling event, the facility will determine whether any 40 CFR Part 258, Appendix II constituents were detected at statistically significant levels above the groundwater protection standard established under subsection (h) or (i) of §330.409 in any sampling event. If the groundwater protection standard has been exceeded, the facility will notify the executive director and appropriate local government officials in writing within seven days of this determination.

The facility will also:

- characterize the nature and extent of the release by installing additional monitor wells as necessary;
- install at least one additional monitor well between the monitor well with the statistically significant level and the next adjacent wells along the point of compliance before the next sampling event and sample these wells in accordance with subsection (d)(1) of §330.409;
- notify in writing all persons that own or occupy the land that directly overlies any part of the plume of contamination if contaminants have migrated off-site as indicated by sampling of wells in accordance with §330.409(d)(1); and
- initiate an assessment of corrective measures as required by §330.411 within 90 days of the notice to TCEQ.

The facility may demonstrate that a source other than the landfill caused the contamination or that the statistically significant level resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. In making a demonstration under §330.409(g)(2), the facility will:

- notify the executive director in writing within 14 days of determining a statistically significant level above the groundwater protection standard at the point of compliance that the facility intends to make a demonstration under this paragraph;
- within 90 days of determining a statistically significant level above the groundwater protection standard, submit a report to TCEQ that demonstrates

that a source other than the landfill caused the contamination or that the statistically significant level resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The report will be prepared and certified by a qualified groundwater scientist;

- not filter the groundwater samples for constituents addressed by the demonstration prior to laboratory analysis. TCEQ may also require the facility to provide analysis of landfill leachate to support the demonstration; and
- continue to monitor in accordance with the assessment monitoring program established under §330.409.

If a successful demonstration is made, the facility will continue monitoring in accordance with the assessment monitoring program required by §330.409 and may return to detection monitoring if the 40 CFR Part 258, Appendix II constituents are at or below background as specified in subsection (e) of §330.409. Until a successful demonstration is made, the facility will comply with paragraph §330.409(g)(1), including initiating an assessment of corrective measures.

If the facility determines that the assessment monitoring program no longer satisfies the requirements of §330.409, the facility must, within 90 days, submit an application for a permit amendment or modification to make any appropriate changes to the monitoring program.

The facility will establish a groundwater protection standard for each 40 CFR Part 258, Appendix II constituent detected in the point of compliance monitor wells. The groundwater protection standard will be:

- for constituents for which a maximum contaminant level (MCL) has been promulgated under 40 CFR Part 141, Safe Drinking Water Act (codified), §1412, the MCL for that constituent;
- for constituents for which MCLs have not been promulgated, the background concentration for the constituent established from wells in accordance with §330.405(d); or
- for constituents for which the background level is higher than the MCL identified under paragraph (1) of §330.409 or health-based levels identified under §330.409(i), the background concentration.

TCEQ may establish an alternative groundwater protection standard for 40 CFR Part 258, Appendix II constituents for which MCLs have not been established. These groundwater protection standards will be appropriate health-based levels that satisfy either the criteria of §330.409(i)(1) - (4), inclusive or comply with §330.409(i)(5).

The facility will submit an annual assessment monitoring report within 60 days after the facility's second semiannual groundwater sampling event that includes the following information determined since the previously submitted report:

- a statement whether a statistically significant level above a groundwater protection standard established in subsection (h) or (i) of §330.409 has occurred in any well during the previous calendar year period and the status of any statistically significant level events.

6.4 Corrective Action Monitoring

Detection of assessment monitoring constituents at statistically significant levels, as defined in Title 30 TAC §330.409, could result in corrective action monitoring. Groundwater monitoring for the purpose of corrective action assessment and remediation will be conducted in accordance with Title 30 TAC §330.411 through §330.415, and in consultation with TCEQ. At a minimum, the assessment will address the following:

- a characterization of the contaminated groundwater, including concentrations of assessment constituents as defined in 30 TAC §330.409;
- the concentration limit for each constituent found in the groundwater;
- detailed plans and an engineering report describing the corrective action to be taken;
- a description of how the groundwater monitoring program will demonstrate the adequacy of the corrective action; and
- a schedule for submittal of the above information provided the owner or operator obtains written authorization from the executive director prior to submittal of the complete permit application.

7 GROUNDWATER ANALYTICAL RESULTS AND POTENTIAL RESPONSE ACTIONS

7.1 Groundwater Quality

Title 30 TAC §330.63(f)(5-7) require a comparison of the facility's groundwater analytical data to the specific constituents referenced in Title 30 TAC §330.419(a) and listed in 40 CFR, Part 258, Appendix I. The facility's historical groundwater analytical data for all existing Subtitle D monitor wells is presented in Table IIIH-B-1 (total metals constituents) and Table IIIH-B-2 (VOC constituents). The historical groundwater analytical data for the former Subtitle D groundwater monitor wells is presented in Table IIIH-B-3 (total metals constituents) and Table IIIH-B-4 (VOC constituents). Hydrex conducts groundwater monitoring and statistical analyses for the facility. According to Hydrex, all detection monitor wells were exclusively in detection status as of August 2023; except for monitor wells MW-20 and MW-21 which are in assessment monitoring status for acetone, total barium, and total copper.

7.2 Potential Contaminant Migration

In the unlikely occurrence of a release of leachate from the landfill unit, the most probable pathway for the migration of pollutants will occur vertically through the vadose zone and laterally into the uppermost saturated Aquifer strata at the point of release. Once within the Uppermost Aquifer, pollutants would be transported within the Aquifer strata, above the Lower Confining Unit, and down gradient in the direction of groundwater flow toward the permitted Point of Compliance and network of groundwater detection monitor wells.

8 REFERENCES

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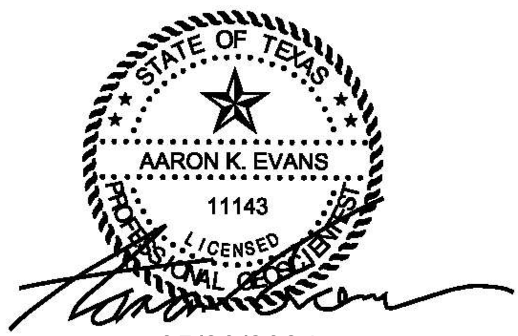
APPENDIX IIIH-A

GROUNDWATER MONITORING SYSTEM



05/20/2024

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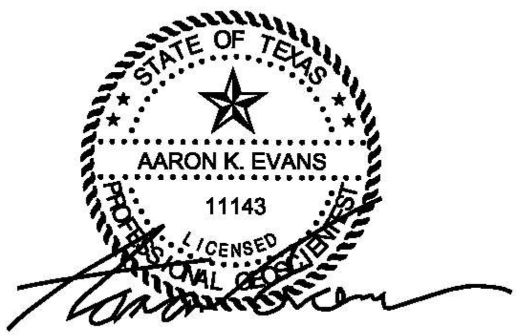
FIGURE IIIH-A-1 – Existing Groundwater Monitoring Network
FIGURE IIIH-A-2 – Proposed Aquifer A and B Groundwater Monitoring System Network
FIGURE IIIH-A-3 – Proposed Aquifer C and D Groundwater Monitoring System Network
FIGURE IIIH-A-4 – Groundwater Monitor Well Details
FIGURE IIIH-A-5 – Typical Groundwater Monitor Well Details

Groundwater Monitoring System Certification	IIIH-A-6
WCG Groundwater Monitor Well and Piezometer Asbuilt Survey Report	IIIH-A-7
Hydrex Groundwater Potentiometric Surface Maps	IIIH-A-10
Existing Monitor Well Lithologic Logs and Monitor Well Data Sheets	IIIH-A-55
Former Monitor Well Driller Plugging Report	IIIH-A-89



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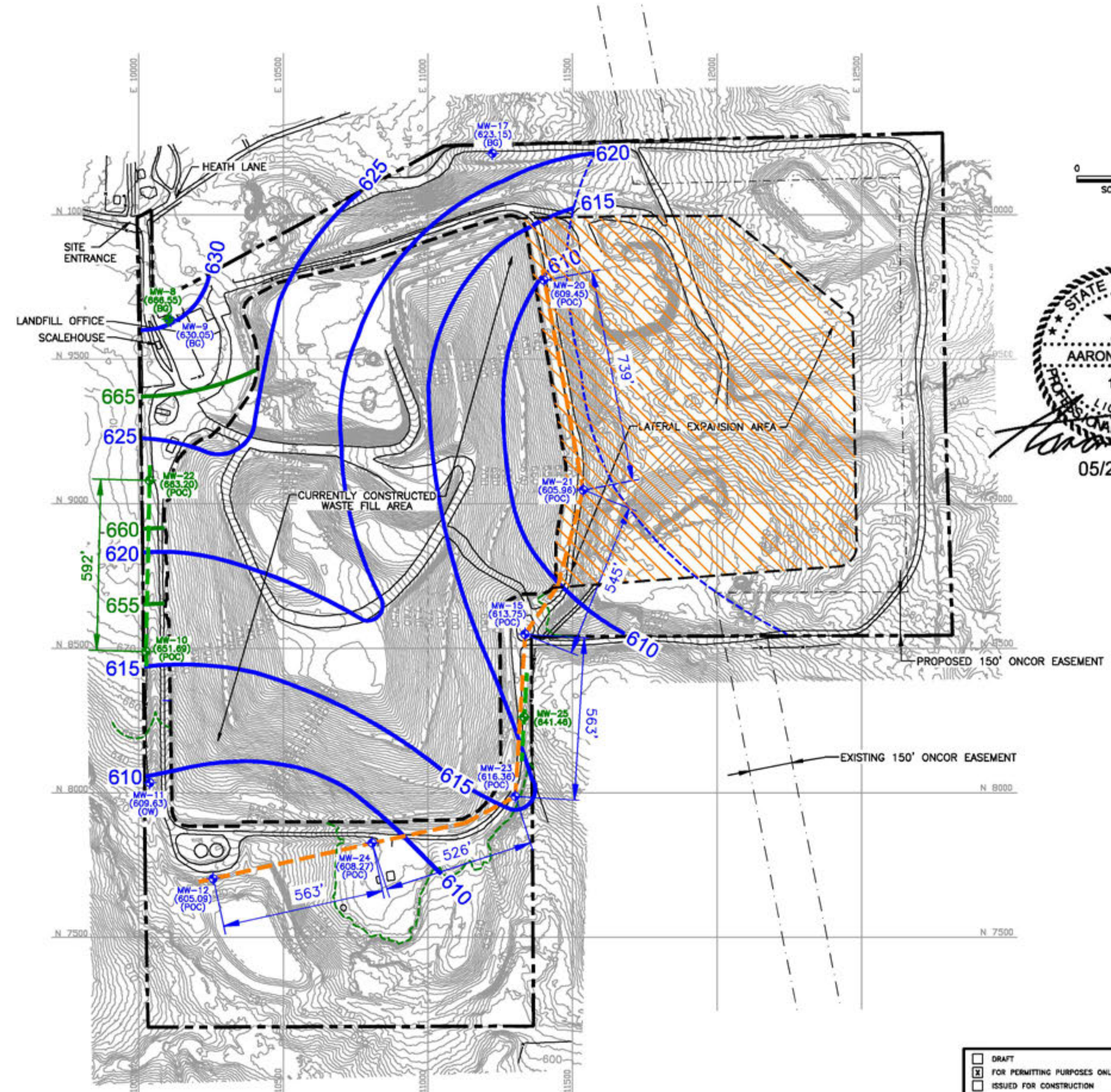

LEGEND

PERMIT BOUNDARY

PERMITTED LIMITS OF WASTE

PROPOSED LIMITS OF WASTE

EXISTING EASEMENT

PROPOSED EASEMENT

630 EXISTING CONTOUR

N 9500 SITE GRID COORDINATE

PROPOSED LATERAL EXPANSION AREA

MW-8 (666.55) (BG) EXISTING AQUIFER A GROUNDWATER MONITOR WELL WITH GROUNDWATER ELEVATION AND PERMITTED GRADIENT DESIGNATION POSTED IN PARENTHESIS

MW-24 (608.27) (POC) EXISTING AQUIFER B GROUNDWATER MONITOR WELL WITH GROUNDWATER ELEVATION AND PERMITTED GRADIENT DESIGNATION POSTED IN PARENTHESIS

660 AQUIFER A GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR IN FT-MSL

620 AQUIFER B GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR IN FT-MSL

AQUIFER A APPROXIMATE OUTCROP BOUNDARY

AQUIFER B APPROXIMATE OUTCROP BOUNDARY

AQUIFER A EXISTING POINT OF COMPLIANCE

AQUIFER B EXISTING POINT OF COMPLIANCE

592' AQUIFER A INTERWELL SPACING ALONG EXISTING POINT OF COMPLIANCE IN LINEAR FEET

563' AQUIFER B INTERWELL SPACING ALONG EXISTING POINT OF COMPLIANCE IN LINEAR FEET

STATE OF TEXAS
AARON K. EVANS
11143
LICENSED
PROFESSIONAL GEOSCIENTIST

05/20/2024

NOTES:

1. EXISTING CONTOURS DEVELOPED BY FIRMATEK FROM AERIAL PHOTOGRAPHY FLOWN NOVEMBER 10, 2022. THE GRID SYSTEM IS BASED ON A SITE GRID SYSTEM. ELEVATIONS ARE BASED ON NAVD 88.
2. EXISTING GROUNDWATER MONITOR WELL LOCATION COORDINATES OBTAINED FROM AUGUST 2023 AS-BUILT SURVEY BY WEAVER CONSULTANTS GROUP.
3. AQUIFER OUTCROP BOUNDARIES APPROXIMATED FROM SUBSURFACE INVESTIGATION LITHOLOGIC LOGS AND WELL SCREENING DATA.
4. GROUNDWATER POTENTIOMETRIC SURFACE ELEVATIONS MEASURED BY WEAVER CONSULTANTS GROUP IN SEPTEMBER 2023 AND POSTED AT EACH MEASUREMENT LOCATION IN FT-MSL.
5. GROUNDWATER POTENTIOMETRIC SURFACE CONTOURS ARE INTERPOLATED BETWEEN MEASUREMENT LOCATIONS; ACTUAL CONDITIONS MAY VARY.
6. MONITOR WELL MW-20 AND MW-21 LOCATIONS AND INTERWELL SPACING ACCEPTED BY TCEQ WITH APPROVAL OF THE 2008 SUBCHAPTER J PERMIT MODIFICATION BY THE CAREL CORPORATION.
7. PERMITTED GRADIENT DESIGNATIONS OBTAINED FROM 2008 SUBCHAPTER J PERMIT MODIFICATION BY THE CAREL CORPORATION AND GROUNDWATER MONITORING REPORTS BY HYDREX ENVIRONMENTAL FOR PERMIT MSW-1614A. PERMITTED UPGRADIENT BACKGROUND MONITOR WELLS ARE ANNOTATED WITH "(BG)", DOWNGRADIENT POINT OF COMPLIANCE WELLS ARE ANNOTATED WITH "(POC)", AND OBSERVATIONS WELLS ARE ANNOTATED WITH "(OW)".

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DESIGN BY: DCS
REVIEWED BY: AKE

Weaver Consultants Group
TBPE REGISTRATION NO. F-3727

PREPARED FOR
PINE HILL FARMS LANDFILL TX, LP

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
EXISTING GROUNDWATER MONITORING SYSTEM NETWORK

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS

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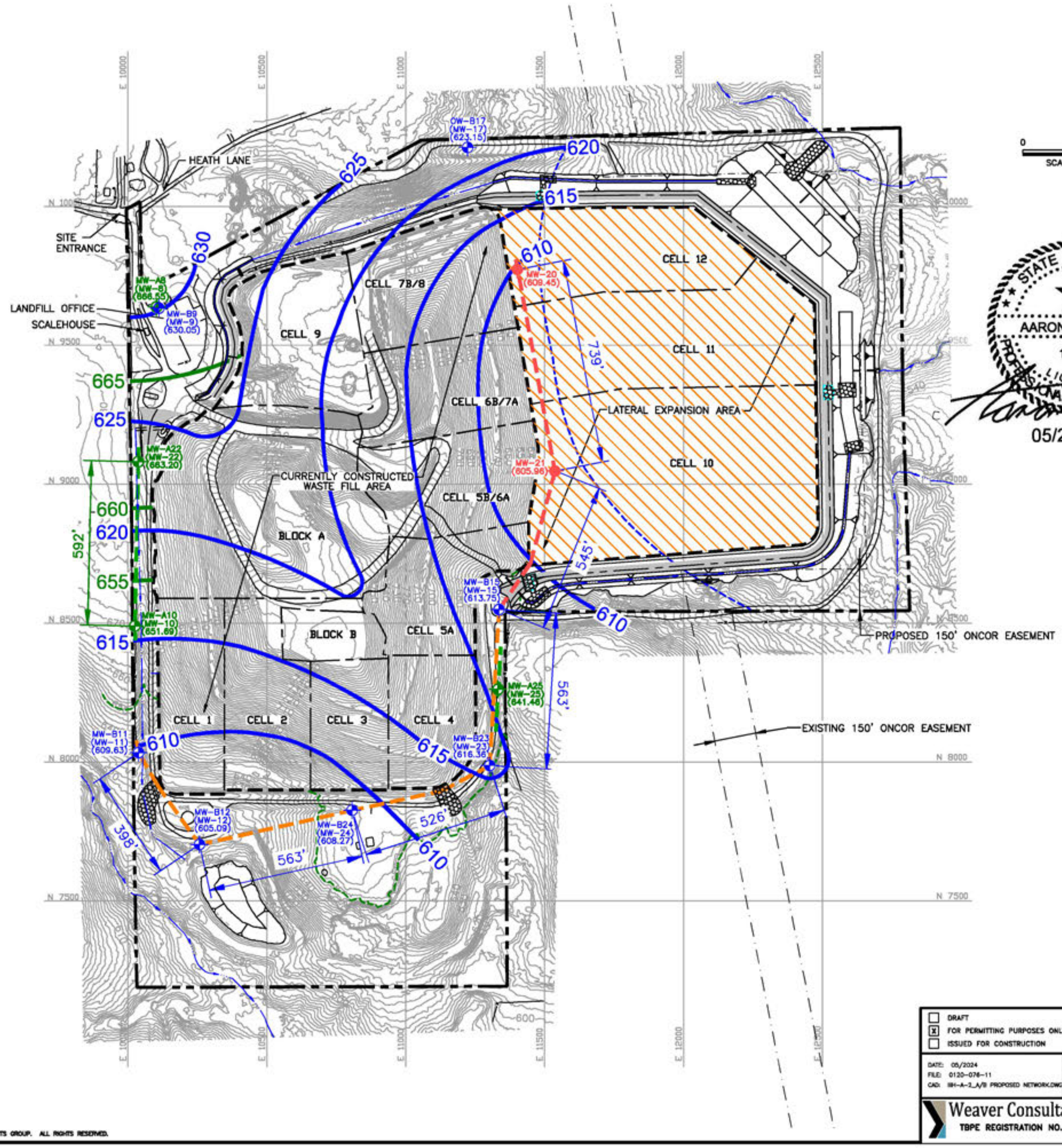
FIGURE IIIH-A-1

O:\0120\76\EXPANSION 2023\PART III\IIIH\IIIH-A-1 - EXISTING GW NETWORK.dwg, byoung, 1:2



LEGEND

- PERMIT BOUNDARY
- PERMITTED LIMITS OF WASTE
- PROPOSED LIMITS OF WASTE
- EXISTING EASEMENT
- PROPOSED EASEMENT
- 630 EXISTING CONTOUR
- N 9500 SITE GRID COORDINATE
- CELL BOUNDARY
- CHANNEL CENTERLINE
- PROPOSED LATERAL EXPANSION AREA
- MW-A8 (MW-8) (666.55) EXISTING AQUIFER A GROUNDWATER MONITOR WELL PROPOSED NEW DESIGNATION WITH FORMER MONITOR WELL NAME AND GROUNDWATER ELEVATION POSTED IN PARENTHESIS
- MW-B24 (MW-24) (608.27) EXISTING AQUIFER B GROUNDWATER MONITOR WELL PROPOSED NEW DESIGNATION WITH FORMER MONITOR WELL NAME AND GROUNDWATER ELEVATION POSTED IN PARENTHESIS
- MW-20 (609.45) EXISTING AQUIFER B GROUNDWATER MONITOR WELL TO BE REMOVED FROM SYSTEM WITH GROUNDWATER ELEVATION POSTED IN PARENTHESIS
- 660 AQUIFER A GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR IN FT-MSL
- 620 AQUIFER B GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR IN FT-MSL
- AQUIFER A APPROXIMATE OUTCROP BOUNDARY
- AQUIFER B APPROXIMATE OUTCROP BOUNDARY
- AQUIFER A FINAL POINT OF COMPLIANCE
- AQUIFER B INTERIM POINT OF COMPLIANCE
- AQUIFER B FINAL POINT OF COMPLIANCE
- 592' AQUIFER A INTERWELL SPACING ALONG EXISTING POINT OF COMPLIANCE IN LINEAR FEET
- 563' AQUIFER B INTERWELL SPACING ALONG EXISTING POINT OF COMPLIANCE IN LINEAR FEET

0 200 400
SCALE IN FEET

STATE OF TEXAS
AARON K. EVANS
11143
LICENSED
PROFESSIONAL GEOSCIENTIST
05/20/2024

NOTES:

1. EXISTING CONTOURS DEVELOPED BY FIRMATEK FROM AERIAL PHOTOGRAPHY FLOWN NOVEMBER 10, 2022. THE GRID SYSTEM IS BASED ON A SITE GRID SYSTEM. ELEVATIONS ARE BASED ON NAVD 88.
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4. GROUNDWATER POTENTIOMETRIC SURFACE ELEVATIONS MEASURED BY WEAVER CONSULTANTS GROUP IN SEPTEMBER 2023 AND POSTED AT EACH MEASUREMENT LOCATION IN FT-MSL.
5. GROUNDWATER POTENTIOMETRIC SURFACE CONTOURS ARE INTERPOLATED BETWEEN MEASUREMENT LOCATIONS; ACTUAL CONDITIONS MAY VARY.
6. MONITOR WELL MW-20 AND MW-21 LOCATIONS AND INTERWELL SPACING ACCEPTED BY TCEQ WITH APPROVAL OF THE 2008 SUBCHAPTER J PERMIT MODIFICATION BY THE CAREL CORPORATION.
7. INTERIM AQUIFER B POINT OF COMPLIANCE AND MONITOR WELLS MW-20 AND MW-21 TO BE REMOVED AS LANDFILL IS DEVELOPED IN ACCORDANCE WITH SECTION 2.0 AND FIGURE IIIH-A-4 OF THE FACILITY'S GWSAP.

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PINE HILL FARMS LANDFILL TX, LP

REVISIONS

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MAJOR PERMIT AMENDMENT
PROPOSED AQUIFER A AND B GROUNDWATER MONITORING SYSTEM NETWORK
ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS

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FIGURE IIIH-A-2

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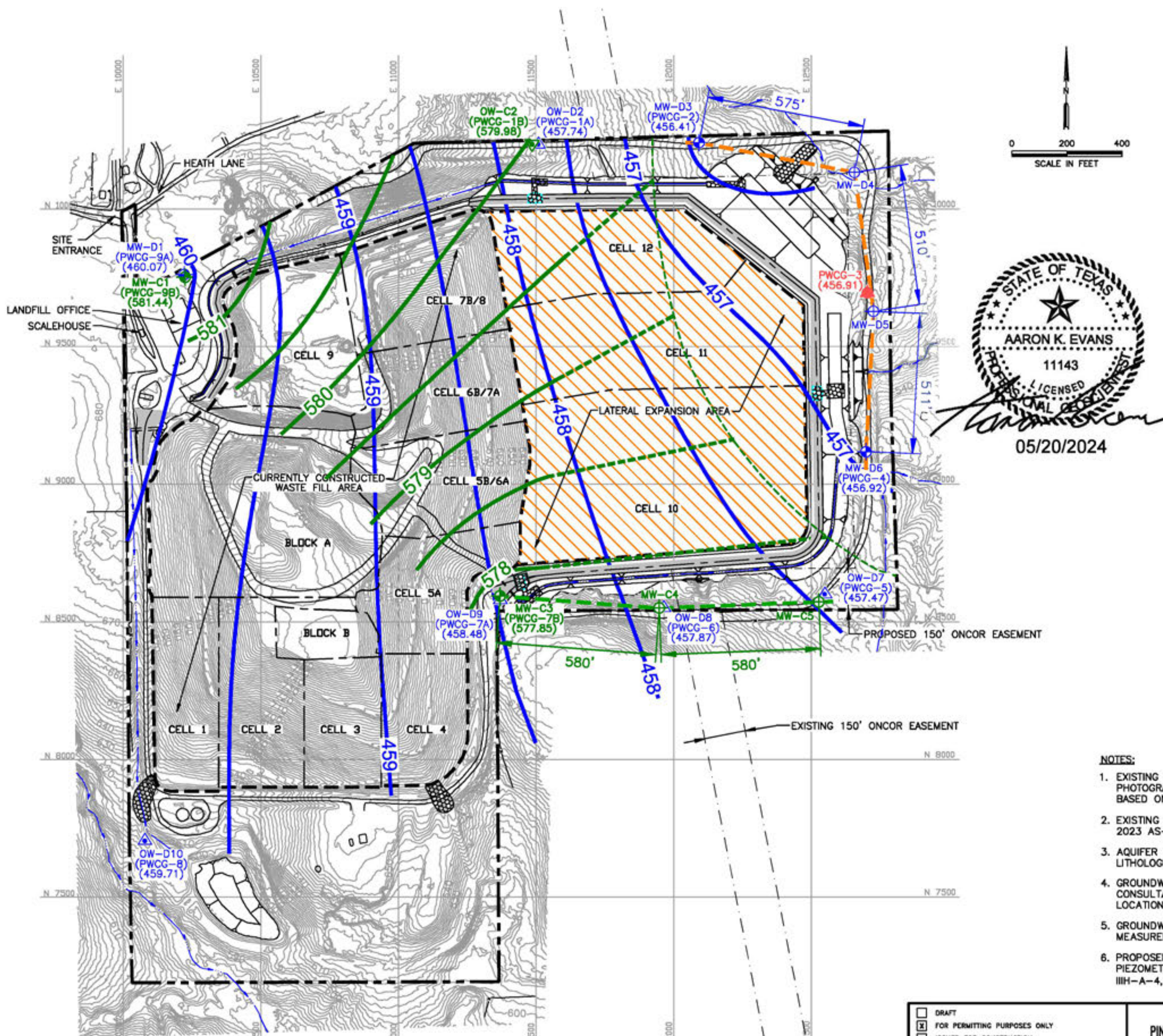

LEGEND

- PERMIT BOUNDARY
- PERMITTED LIMITS OF WASTE
- PROPOSED LIMITS OF WASTE
- EXISTING EASEMENT
- PROPOSED EASEMENT
- 630 EXISTING CONTOUR
- N 9500 SITE GRID COORDINATE
- CELL BOUNDARY
- CHANNEL CENTERLINE
- PROPOSED LATERAL EXPANSION AREA
- MW-C1 (PWCG-9B) (581.44) PROPOSED AQUIFER C GROUNDWATER MONITOR WELL (TO BE CONVERTED FROM EXISTING PIEZOMETER) WITH FORMER PIEZOMETER NAME AND GROUNDWATER ELEVATION POSTED IN PARENTHESIS
- OW-C2 (PWCG-1B) (579.98) PROPOSED AQUIFER C GROUNDWATER OBSERVATION WELL (TO BE CONVERTED FROM EXISTING PIEZOMETER) WITH FORMER PIEZOMETER NAME AND GROUNDWATER ELEVATION POSTED IN PARENTHESIS
- MW-C4 PROPOSED NEW AQUIFER C GROUNDWATER MONITOR WELL (TO BE INSTALLED)
- MW-D3 (PWCG-2) (456.41) PROPOSED AQUIFER D GROUNDWATER MONITOR WELL (TO BE CONVERTED FROM EXISTING PIEZOMETER) WITH FORMER PIEZOMETER NAME AND GROUNDWATER ELEVATION POSTED IN PARENTHESIS
- OW-D7 (PWCG-5) (457.47) PROPOSED AQUIFER D GROUNDWATER OBSERVATION WELL (TO BE CONVERTED FROM EXISTING PIEZOMETER) WITH FORMER PIEZOMETER NAME AND GROUNDWATER ELEVATION POSTED IN PARENTHESIS
- MW-D4 PROPOSED NEW AQUIFER D GROUNDWATER MONITOR WELL (TO BE INSTALLED)
- PWCG-3 (456.91) EXISTING AQUIFER D PIEZOMETER TO BE REMOVED WITH GROUNDWATER ELEVATION POSTED IN PARENTHESIS
- 581 AQUIFER C GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR IN FT-MSL
- 460 AQUIFER D GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR IN FT-MSL
- AQUIFER C APPROXIMATE OUTCROP BOUNDARY
- AQUIFER C PROPOSED POINT OF COMPLIANCE
- AQUIFER D PROPOSED POINT OF COMPLIANCE
- 592' AQUIFER C INTERWELL SPACING ALONG PROPOSED POINT OF COMPLIANCE IN LINEAR FEET
- 563' AQUIFER D INTERWELL SPACING ALONG PROPOSED POINT OF COMPLIANCE IN LINEAR FEET

NOTES:

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4. GROUNDWATER POTENTIOMETRIC SURFACE ELEVATIONS MEASURED BY WEAVER CONSULTANTS GROUP IN SEPTEMBER 2023 AND POSTED AT EACH MEASUREMENT LOCATION IN FT-MSL.
5. GROUNDWATER POTENTIOMETRIC SURFACE CONTOURS ARE INTERPOLATED BETWEEN MEASUREMENT LOCATIONS; ACTUAL CONDITIONS MAY VARY.
6. PROPOSED MONITOR WELLS WILL BE INSTALLED, OR CONVERTED FROM EXISTING PIEZOMETERS, AS LANDFILL IS DEVELOPED IN ACCORDANCE WITH SECTION 2.0, FIGURE IIIH-A-4, AND FIGURE IIIH-A-5 OF THE FACILITY'S GWSAP.

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FIGURE IIIH-A-3

O:\0120\76\EXPANSION 2023\PART III\IIIH\IIIH-A-3 - PROPOSED AQUIFER C & D GW NETWORK.dwg, byoung, 1:2

WELL NAME (FORMER NAME LISTED IN PARENTHESIS)	AQUIFER	BACKGROUND (BG) OR POINT OF COMPLIANCE (POC) WELL?	INSTALL DATE	SITE GRID COORDINATES		TOP OF CASING ELEVATION	GROUND ELEVATION	WELL CONSTRUCTION DEPTHS				WELL CONSTRUCTION ELEVATIONS				GROUNDWATER ELEVATION[4]
				NORTHING	EASTING			TOP OF FILTER PACK	TOP OF SCREEN	BOTTOM OF SCREEN	BOTTOM OF FILTER PACK	TOP OF FILTER PACK	TOP OF SCREEN	BOTTOM OF SCREEN	BOTTOM OF FILTER PACK	
EXISTING WELLS - TO REMAIN IN SYSTEM																
MW-A8 (MW-8)	A	BG	Oct-94	9638.41	10103.40	688.28	685.6	28.0	29.0	39.0	40.0	657.6	656.6	646.6	645.6	666.50
MW-A10 (MW-10)	A	POC	Oct-94	8489.50	10025.36	673.80	670.9	23.0	24.0	34.0	35.0	647.9	646.9	636.9	635.9	651.69
MW-A22 (MW-22)	A	POC	Sep-09	9081.10	10037.74	689.11	686.6	24.0	26.0	36.0	39.0	662.6	660.6	650.6	647.6	663.20
MW-A25 (MW-25)	A	POC	Sep-09	8261.66	11332.44	665.97	663.5	24.0	27.0	32.0	35.0	639.5	636.5	631.5	628.5	641.46
MW-B9 (MW-9)	B	BG	Oct-94	9633.67	1012.25	688.51	685.8	64.0	65.0	75.0	75.0	621.8	620.8	610.8	610.8	630.05
MW-B11 (MW-11)	B	POC	Oct-94	8033.94	10038.53	632.11	629.3	18.0	20.0	30.0	30.0	611.3	609.3	599.3	599.3	609.63
MW-B12 (MW-12)	B	POC	Oct-94	7703.13	10258.18	614.37	611.5	8.0	9.5	14.5	15.0	603.5	602.0	597.0	596.5	605.09
MW-B15 (MW-15)	B	POC	Nov-94	8548.93	11336.20	664.21	661.8	47.8	49.0	59.0	60.0	614.0	612.8	602.8	601.8	613.75
MW-B23 (MW-23)	B	POC	Sep-09	7987.36	11302.70	657.65	655.7	39.0	42.0	52.0	55.0	616.7	613.7	603.7	600.7	616.36
MW-B24 (MW-24)	B	POC	Sep-09	7826.06	10807.39	660.61	657.7	54.0	56.0	66.0	69.0	603.7	601.7	591.7	588.7	608.27
OW-B17 (MW-17)[5]	B	BG	Jul-03	10212.22	11223.16	645.65	643.5	26.0	28.0	38.0	40.0	617.5	615.5	605.5	603.5	623.15
PROPOSED WELLS - TO BE ADDED TO SYSTEM																
MW-C1 (PWCG-9B)	C	BG	Jul-23	9752.08	10225.50	685.22	682.3	105.0	112.0	122.0	124.0	577.3	570.3	560.3	558.3	581.44
MW-C3 (PWCG-7B)	C	POC	Jul-23	8593.43	11369.24	659.09	656.1	90.0	96.0	106.0	115.0	566.1	560.1	550.1	541.1	577.85
MW-C4	C	POC	TBD	8550.0	11948.0	637.0	634.0	65.0	67.0	77.0	78.0	569.0	567.0	557.0	556.0	577.80
MW-C5	C	POC	TBD	8572.0	12528.0	591.00	588.0	13.0	15.0	30.0	31.0	575.0	573.0	558.0	557.0	577.70
MW-D1 (PWCG-9A)	D	BG	Jul-23	9761.40	10221.82	685.05	681.7	205.0	215.0	235.0	242.0	476.7	466.7	446.7	439.7	460.07
MW-D3 (PWCG-2)	D	POC	Jun-23	10240.83	12092.70	567.92	564.8	110.0	116.0	136.0	141.5	454.8	448.8	428.8	423.3	456.41
MW-D4	D	POC	TBD	10133.0	12657.0	523.0	520.0	90.0	92.00	112.00	115.0	430.0	428.0	408.0	405.0	456.50
MW-D5	D	POC	TBD	9628.0	12726.0	549.0	546.0	95.0	97.0	117.0	120.0	451.0	449.0	429.0	426.0	456.90
MW-D6 (PWCG-4)	D	POC	May-23	9117.84	12699.05	557.30	554.9	105.0	110.0	130.0	136.5	449.9	444.9	424.9	418.4	456.92
OW-C2 (PWCG-1B)[5]	C	BG	Jun-23	10234.66	11485.41	623.23	620.2	40.0	42.0	47.0	48.0	580.2	578.2	573.2	572.2	579.98
OW-D2 (PWCG-1A)[5]	D	BG	Jun-23	10234.91	11507.95	621.15	618.3	160.0	170.0	190.0	200.0	458.3	448.3	428.3	418.3	457.74
OW-D7 (PWCG-5)[5]	D	BG	May-23	8600.43	12548.53	590.55	587.7	135.0	140.0	160.0	170.0	452.7	447.7	427.7	417.7	457.47
OW-D8 (PWCG-6)[5]	D	BG	Jul-23	8550.74	11964.53	635.70	632.9	185.0	190.0	210.0	215.0	447.9	442.9	422.9	417.9	457.87
OW-D9 (PWCG-7A)[5]	D	BG	Jul-23	8579.67	11370.10	659.96	656.9	210.0	222.0	242.0	244.0	446.9	434.9	414.9	412.9	458.48
OW-D10 (PWCG-8)[5]	D	BG	Jul-23	7704.53	10079.08	612.35	609.4	165.0	176.0	196.0	200.0	444.4	433.4	413.4	409.4	459.71
EXISTING WELLS - TO BE REMOVED FROM SYSTEM																
MW-20	B	POC	Jul-17	9773.45	11401.79	636.01	632.8	15.0	17.0	27.0	27.5	617.8	615.8	605.8	605.3	609.45
MW-21	B	POC	Sep-09	9047.40	11537.02	632.67	630.6	23.5	25.5	28.0	31.0	607.1	605.1	602.6	599.6	605.96

NOTES:

1. ELEVATIONS LISTED IN FEET ABOVE MEAN SEA LEVEL (FT-MSL); DEPTHS LISTED IN FEET BELOW GROUND SURFACE (FT-BGS).
2. EXISTING WELL COORDINATES, TOP OF CASING ELEVATIONS, AND GROUND ELEVATIONS OBTAINED FROM ASBUILT SURVEY CONDUCTED BY WEAVER CONSULTANTS GROUP IN AUGUST 2023.
3. WELL COMPLETION DETAILS FOR EXISTING WELLS AND PROPOSED PIEZOMETER TO WELL CONVERSIONS OBTAINED FROM MONITOR WELL DATA SHEETS AND/OR LITHOLOGIC LOGS AND REFLECT ASBUILT CONDITION.
4. GROUNDWATER ELEVATIONS GAUGED BY WEAVER CONSULTANTS GROUP IN SEPTEMBER 2023.
5. OBSERVATION WELLS TO BE RETAINED IN SYSTEM FOR GROUNDWATER GAUGING PURPOSES INDICATED BY "OW" DESIGNATION.
6. DETAILS FOR PROPOSED FUTURE WELLS ESTIMATED FROM EXISTING SUBSURFACE INVESTIGATION DATA; ACTUAL DETAILS TO BE DETERMINED AT TIME OF INSTALLATION BASED ON SUBSURFACE CONDITIONS ENCOUNTERED.
7. WELLS ARE TO BE CONVERTED, INSTALLED, OR REMOVED IN ACCORDANCE WITH SECTION 2.0 OF THE GWSAP.
8. TBD = TO BE DETERMINED.

STATE OF TEXAS
AARON K. EVANS
11143
LICENSED PROFESSIONAL GEOSCIENTIST

05/20/2024

☐ DRAFT
☒ FOR PERMITTING PURPOSES ONLY
☐ ISSUED FOR CONSTRUCTION

DATE: 05/2024
FILE: 0120-076-11
CAD: IIIH-A-4-WELL DETAILS.DWG

DRAWN BY: SRF
DESIGN BY: DCS
REVIEWED BY: AKE

Weaver Consultants Group
TBPE REGISTRATION NO. F-3727

PREPARED FOR
PINE HILL FARMS LANDFILL TX, LP

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMMENDMENT

GROUNDWATER MONITOR WELL DETAILS

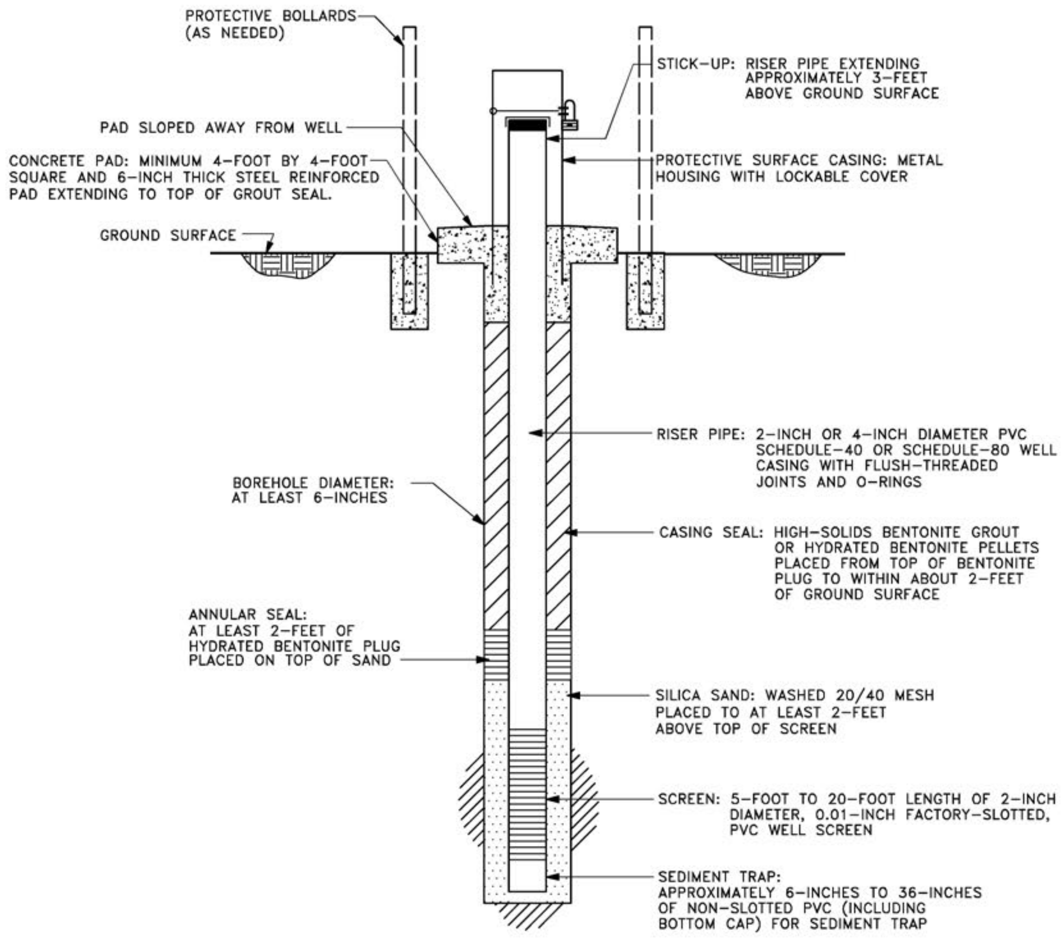
ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS

WWW.WCGRP.COM

FIGURE IIIH-A-4

O:\0120\76\EXPANSION 2023\PART III\IIIH\IIIH-A-4 - MONITOR WELL DETAILS.dwg, byoung, 1:2

TYPICAL GROUNDWATER MONITOR WELL DETAIL



NOT TO SCALE

05/20/2024

☐ DRAFT ☒ FOR PERMITTING PURPOSES ONLY ☐ ISSUED FOR CONSTRUCTION	PREPARED FOR PINE HILL FARMS LANDFILL TX, LP
DATE: 05/2024 FILE: 0120-076-11 CAD: IIIH-A-5-TYPICAL WELL DETAILS.DWG	DRAWN BY: SRF DESIGN BY: DCS REVIEWED BY: AKE

REVISIONS

NO.	DATE	DESCRIPTION

Weaver Consultants Group
TBPE REGISTRATION NO. F-3727

MAJOR PERMIT AMENDMENT
TYPICAL GROUNDWATER MONITOR WELL DETAILS
ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS

WWW.WCGRP.COM | FIGURE IIIH-A-5

GROUNDWATER MONITORING SYSTEM CERTIFICATION

General Site Information

Site: Royal Oaks Landfill

Site Location: Cherokee County

MSW Permit No.: 1614B

Qualified Groundwater Scientist Statement

I, Aaron K. Evans, am a registered professional geoscientist in the State of Texas and a qualified groundwater scientist as defined in Title 30 TAC §330.3(120). I have reviewed the groundwater monitoring system and supporting details contained herein. In my professional opinion, the groundwater monitoring system design and construction details are in compliance with the groundwater monitoring requirements specified in Title 30 TAC §§330.401, 330.403, 330.405, 330.407, 330.409, 330.419, and 330.421. This system has been designed for the Royal Oaks Landfill. 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: Weaver Consultants Group, LLC
6420 Southwest Boulevard, Suite 206
Fort Worth, Texas 76109

STATE OF TEXAS
AARON K. EVANS
11143
LICENSED
PROFESSIONAL GEOSCIENTIST

Signature: 05/20/2024
Aaron K. Evans, P.G., Texas License No. 11143

Date: 05/20/2024

WCG GROUNDWATER MONITOR WELL AND PIEZOMETER ASBUILT SURVEY REPORT

0 200 400
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- PERMITTED LIMITS OF WASTE
- PROPOSED LIMITS OF WASTE
- 630 EXISTING CONTOUR
- N 9500 SITE GRID COORDINATE
- PROPOSED LATERAL EXPANSION AREA
- MW-25 EXISTING GROUNDWATER MONITORING WELL LOCATION
- PWCG-2 GROUNDWATER PIEZOMETER LOCATION

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY FIRMATEK FROM AERIAL PHOTOGRAPHY FLOWN NOVEMBER 20, 2022.
2. COORDINATES SHOWN HEREON BASED ON A LOCAL SITE COORDINATE SYSTEM TIED TO LOCAL SITE CONTROL POINTS. (SEE CONTROL TABLE AT LOWER LEFT)
3. ELEVATIONS SHOWN HEREON ON FIGURES 1 & 2 ARE RELATIVE TO A LOCAL SITE VERTICAL DATUM TIED TO THE PERMITTED SITE BENCHMARK #100 LOCATED NEAR MW-9. (SEE CONTROL TABLE AT LOWER LEFT)
4. GEODETIC LATITUDE & LONGITUDE COORDINATES SHOWN HEREON ON FIGURE 2 ARE RELATIVE TO WGS84.
5. LOCATION FOR THE GROUND WATER MONITOR WELLS AND GROUNDWATER PIEZOMETERS ARE BASED ON A GROUND SURVEY PERFORMED BY WEAVER CONSULTANTS GROUP, LLC ON AUGUST 15, 2023.
6. REFER TO FIGURE 2 FOR LOCATIONS AND ELEVATIONS OF SAID WELLS AND PIEZOMETERS.

SURVEYOR CERTIFICATION

THAT I, ANDREW J. WIDOLFF, A REGISTERED PROFESSIONAL LAND SURVEYOR BY THE STATE OF TEXAS, AFFIRM THAT THIS DOCUMENT AND DATA DEPICTED HEREON IS BASED UPON A FIELD SURVEY ON AUGUST 15, 2023 UNDER MY DIRECT SUPERVISION.

STATE OF TEXAS REGISTERED ANDREW J. WIDOLFF 6771 PROFESSIONAL LAND SURVEYOR

Andrew Widolff
1-12-24

ANDREW J. WIDOLFF, RPLS #6771
WEAVER CONSULTANTS GROUP, LLC
6420 SOUTHWEST BLVD #206
FORT WORTH, TX 76103 817-735-9770
TBPELS SURV FIRM NO. 10095400

SITE CONTROL				
PT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
100	9635.777	10107.73	685.526	SITE BM

☐ DRAFT
☒ FOR INFORMATION PURPOSES ONLY
☐ ISSUED FOR CONSTRUCTION

DATE: 01/2024
FILE: 0120-076-11
CAD: FIG-1 PIEZO SURVEY REPORT.DWG

DRAWN BY: EA
DESIGN BY:
REVIEWED BY: AJW

Weaver Consultants Group
TBPE REGISTRATION NO. F-3727

PREPARED FOR
ROYAL OAKS LANDFILL TX, LP

REVISIONS		
NO.	DATE	DESCRIPTION

GROUNDWATER MONITOR WELL & GROUNDWATER PIEZOMETER AS-BUILT SURVEY REPORT

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS

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DRAWING ABS-1

WELL-ID	NORTHING	EASTING	LATITUDE	LONGITUDE	ELEVATION	DESCRIPTION
MW-8	9638.62	10103.39	32.00155941N	95.26776340W	688.62	LID
	9638.41	10103.40	32.00155886N	95.26776336W	688.28	PVC
	9640.58	10103.02	32.00156482N	95.26776456W	685.61	DISK
	9641.63	10105.45	32.00156765N	95.26775668W	685.60	NG
MW-9	9633.63	10112.10	32.00154554N	95.26773540W	688.75	LID
	9633.67	10112.25	32.00154565N	95.26773493W	688.51	PVC
	9635.43	10111.69	32.00155051N	95.26773669W	685.82	DISK
	9636.10	10114.01	32.00155231N	95.26772920W	685.78	NG
MW-10	8489.45	10025.57	31.99840243N	95.26803896W	674.20	LID
	8489.50	10025.36	31.99840257N	95.26803964W	673.8	PVC
	8490.64	10027.19	31.99840568N	95.26803371W	671.14	DISK
	8489.16	10027.94	31.99840160N	95.26803132W	670.89	NG
MW-11	8034.00	10038.46	31.99715043N	95.26800711W	632.21	LID
	8033.94	10038.53	31.99715026N	95.26800689W	632.11	PVC
	8035.45	10039.86	31.99715438N	95.26800255W	629.30	DISK
	8034.05	10041.13	31.99715052N	95.26799851W	629.25	NG
MW-12	7703.31	10258.21	31.99623754N	95.26730546W	614.64	LID
	7703.13	10258.18	31.99623705N	95.26730556W	614.37	PVC
	7704.42	10259.95	31.99624057N	95.26729984W	611.65	DISK
	7705.87	10258.64	31.99624459N	95.26730403W	611.51	NG
MW-15	8548.89	11335.99	31.99854185N	95.26381131W	664.57	LID
	8548.93	11336.20	31.99854197N	95.26381064W	664.21	PVC
	8550.42	11337.39	31.99854605N	95.26380678W	661.68	DISK
	8548.67	11332.95	31.99854130N	95.26382112W	661.79	NG
MW-17	10212.16	11223.21	32.00311530N	95.26413931W	645.99	LID
	10212.22	11223.16	32.00311548N	95.26413945W	645.65	PVC
	10212.31	11221.33	32.00311575N	95.26414537W	643.41	CONC
	10212.46	11220.51	32.00311617N	95.26414800W	643.46	NG
MW-20	9773.64	11401.68	32.00190679N	95.26357309W	636.44	LID
	9773.45	11401.79	32.00190628N	95.26357275W	636.01	PVC
	9774.78	11401.45	32.00190994N	95.26357382W	633.34	DISK
	9776.16	11401.33	32.00191371N	95.26357417W	632.75	NG
MW-21	9047.38	11537.22	31.99990823N	95.26315157W	633.02	LID
	9047.40	11537.02	31.99990830N	95.26315221W	632.67	PVC
	9047.63	11536.13	31.99990894N	95.26315508W	630.38	NAIL
	9047.41	11534.30	31.99990836N	95.26316100W	630.55	NG
MW-22	9081.14	10037.56	32.00002844N	95.26798762W	689.31	LID
	9081.10	10037.74	32.00002832N	95.26798704W	689.11	PVC
	9081.22	10038.90	32.00002863N	95.26798331W	686.54	NAIL
	9081.24	10040.32	32.00002866N	95.26797872W	686.59	NG
MW-23	7987.32	11302.45	31.99699905N	95.26393156W	658.02	LID
	7987.36	11302.70	31.99699914N	95.26393077W	657.65	PVC
	7987.78	11301.13	31.99700034N	95.26393580W	655.27	NAIL
	7988.77	11299.67	31.99700308N	95.26394050W	655.70	NG
MW-24	7826.04	10807.14	31.99656484N	95.26553247W	660.92	LID
	7826.06	10807.39	31.99656489N	95.26553165W	660.61	PVC
	7827.40	10807.36	31.99656858N	95.26553174W	657.71	NAIL
	7828.60	10807.46	31.99657185N	95.26553137W	657.65	NG
MW-25	8261.53	11332.54	31.99775214N	95.26382863W	666.36	LID
	8261.66	11332.44	31.99775249N	95.26382894W	665.97	PVC
	8261.60	11331.36	31.99775235N	95.26383242W	663.44	NAIL
	8261.53	11329.94	31.99775219N	95.26383700W	663.45	NG

PIEZO-ID	NORTHING	EASTING	LATITUDE	LONGITUDE	ELEVATION	DESCRIPTION
PWCG-1A	10234.99	11507.95	32.00317284N	95.26322042W	621.49	LID
	10234.91	11507.95	32.00317261N	95.26322043W	621.15	PVC
	10233.09	11508.07	32.00316761N	95.26322006W	618.69	CONC
	10232.39	11507.91	32.00316567N	95.26322060W	618.33	NG
PWCG-1B	10234.59	11485.38	32.00317215N	95.26329324W	623.58	LID
	10234.66	11485.41	32.00317234N	95.26329312W	623.23	PVC
	10232.76	11485.48	32.00316711N	95.26329294W	620.52	CONC
	10231.94	11485.56	32.00316486N	95.26329270W	620.15	NG
PWCG-2	10240.78	12092.69	32.00317800N	95.26133428W	568.11	LID
	10240.83	12092.70	32.00317813N	95.26133427W	567.92	PVC
	10239.54	12093.74	32.00317458N	95.26133094W	565.25	NAIL
	10237.89	12092.48	32.00317007N	95.26133504W	564.83	NG
PWCG-3	9694.41	12703.19	32.00166509N	95.25937704W	552.91	LID
	9694.54	12703.27	32.00166546N	95.25937678W	552.73	PVC
	9695.71	12704.33	32.00166866N	95.25937333W	550.16	NAIL
	9694.37	12705.86	32.00166494N	95.25936843W	549.85	NG
PWCG-4	9117.80	12699.04	32.00008042N	95.25940289W	558.02	LID
	9117.84	12699.05	32.00008052N	95.25940287W	557.30	PVC
	9118.48	12699.87	32.00008228N	95.25940019W	555.09	NAIL
	9117.93	12701.60	32.00008071N	95.25939463W	554.89	NG
PWCG-5	8600.46	12548.49	31.99866133N	95.25989963W	590.64	LID
	8600.43	12548.53	31.99866123N	95.25989953W	590.55	PVC
	8600.42	12546.85	31.99866122N	95.25990494W	587.95	NAIL
	8602.42	12546.42	31.99866674N	95.25990627W	587.69	NG
PWCG-6	8550.67	11964.53	31.99853521N	95.26178411W	635.85	LID
	8550.74	11964.53	31.99853540N	95.26178410W	635.70	PVC
	8549.31	11966.03	31.99853145N	95.26177931W	633.13	NAIL
	8547.93	11964.60	31.99852770N	95.26178394W	632.94	NG
PWCG-7A	8579.78	11370.17	31.99862614N	95.26370041W	660.13	LID
	8579.67	11370.10	31.99862582N	95.26370064W	659.96	PVC
	8579.66	11368.24	31.99862583N	95.26370664W	657.24	CONC
	8579.75	11367.73	31.99862609N	95.26370828W	656.91	NG
PWCG-7B	8593.55	11369.25	31.99866401N	95.26370307W	659.45	LID
	8593.43	11369.24	31.99866367N	95.26370312W	659.09	PVC
	8593.48	11367.37	31.99866384N	95.26370916W	656.31	CONC
	8593.46	11366.68	31.99866380N	95.26371136W	656.05	NG
PWCG-8	7704.45	10079.16	31.99624395N	95.26788290W	612.71	LID
	7704.53	10079.08	31.99624417N	95.26788315W	612.35	PVC
	7705.37	10080.86	31.99624543N	95.26787740W	609.74	CONC
	7705.83	10081.67	31.99624770N	95.26787476W	609.44	NG
PWCG-9A	9761.32	10221.83	32.00189451N	95.26737876W	685.19	LID
	9761.40	10221.82	32.00189473N	95.26737878W	685.05	PVC
	9762.08	10223.68	32.00189557N	95.26737279W	682.16	CONC
	9762.42	10224.18	32.00189747N	95.26737116W	681.72	NG
PWCG-9B	9751.98	10225.52	32.00186875N	95.26736707W	685.49	LID
	9752.08	10225.50	32.00186904N	95.26736711W	685.22	PVC
	9752.82	10227.33	32.00187103N	95.26736121W	682.79	CONC
	9753.04	10228.11	32.00187162N	95.26735867W	682.25	NG

SURVEYOR CERTIFICATION

THAT I, ANDREW J. WIDOLFF, A REGISTERED PROFESSIONAL LAND SURVEYOR BY THE STATE OF TEXAS, AFFIRM THAT THIS DOCUMENT AND DATA DEPICTED HEREON IS BASED UPON A FIELD SURVEY ON AUGUST 15, 2023 UNDER MY DIRECT SUPERVISION.

STATE OF TEXAS
REGISTERED
ANDREW J. WIDOLFF
6771
PROFESSIONAL
LAND SURVEYOR

1-12-24

ANDREW J. WIDOLFF, RPLS #6771
WEAVER CONSULTANTS GROUP, LLC
6420 SOUTHWEST BLVD #206
FORT WORTH, TX 76103 817-735-9770
TBPELS SURV FIRM NO. 10095400

NOTES:

1. REFER TO FIGURE 1 PLAN VIEW FOR LOCATIONS OF GROUNDWATER MONITORING WELLS AND PIEZOMETERS.

LEGEND

LID	TOP OF CLOSED PROTECTIVE COVER
CONC/DISK/NAIL	SURFACE PAD CONCRETE/PAD MONUMENT
NG	NEAREST GROUND
PVC	TOP OF PVC WELL CASING

☐ DRAFT
☒ FOR INFORMATION PURPOSES ONLY
☐ ISSUED FOR CONSTRUCTION

DATE: 01/2024 DRAWN BY: EA
FILE: 0120-076-11 DESIGN BY:
CAD: FIG-1 PIEZO SURVEY REPORT.DWG REVIEWED BY: AJW

Weaver Consultants Group
TBPE REGISTRATION NO. F-3727

PREPARED FOR
ROYAL OAKS LANDFILL TX, LP

REVISIONS

NO.	DATE	DESCRIPTION

GROUNDWATER MONITOR WELL & GROUNDWATER PIEZOMETER AS-BUILT SURVEY REPORT

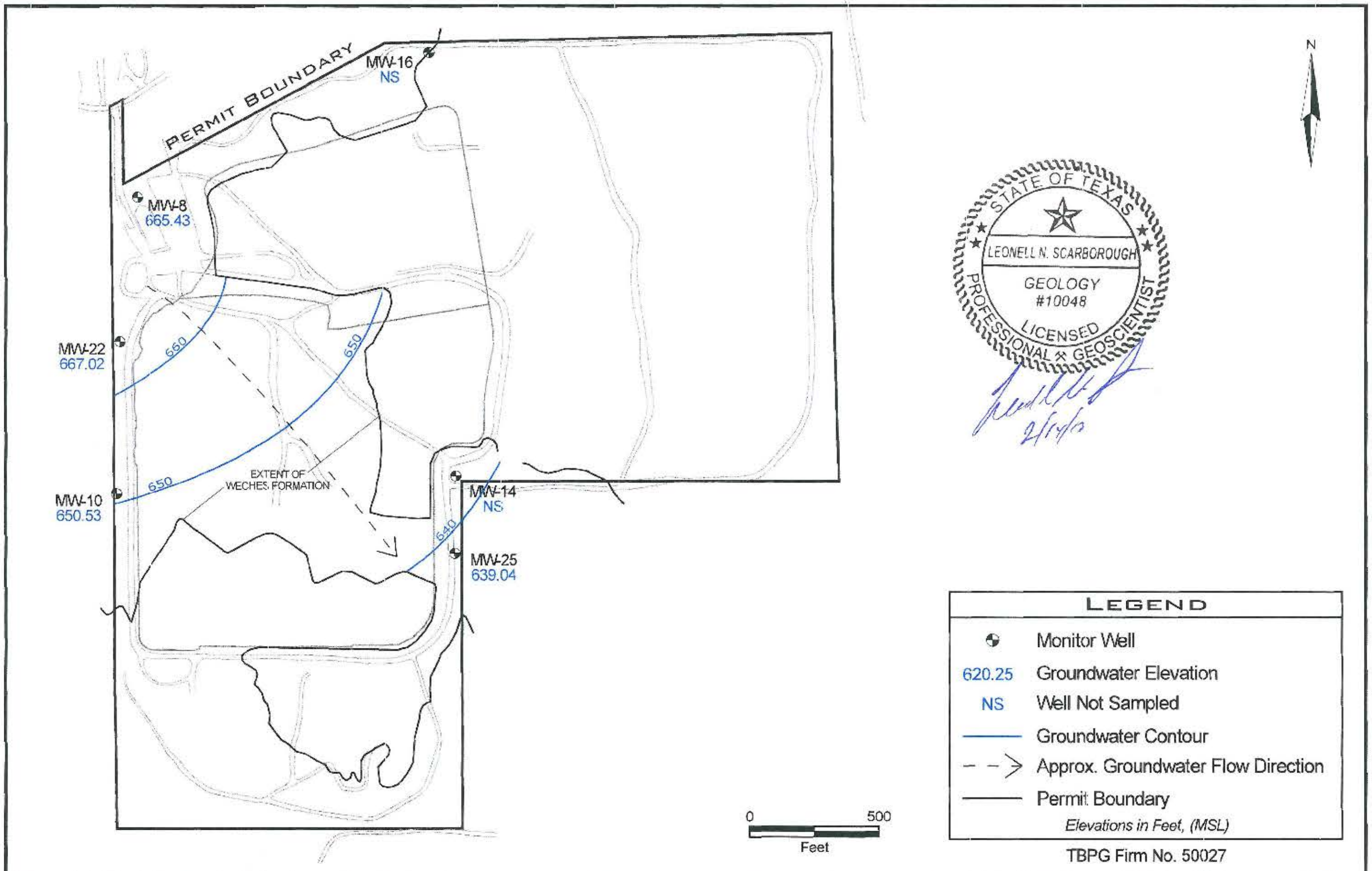
ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS

WWW.WCGRP.COM DRAWING ABS-2

P:\SBH Survey\Solid Waste\0120 (Allied)\076 (Royal Oaks Landfill)\2023\0120-076-11-106 (2023 Expansion)\01 Subsurface Investigation\2. Exhibit\FIG-1 PIEZO MW SURVEY REPORT.dwg

HYDREX

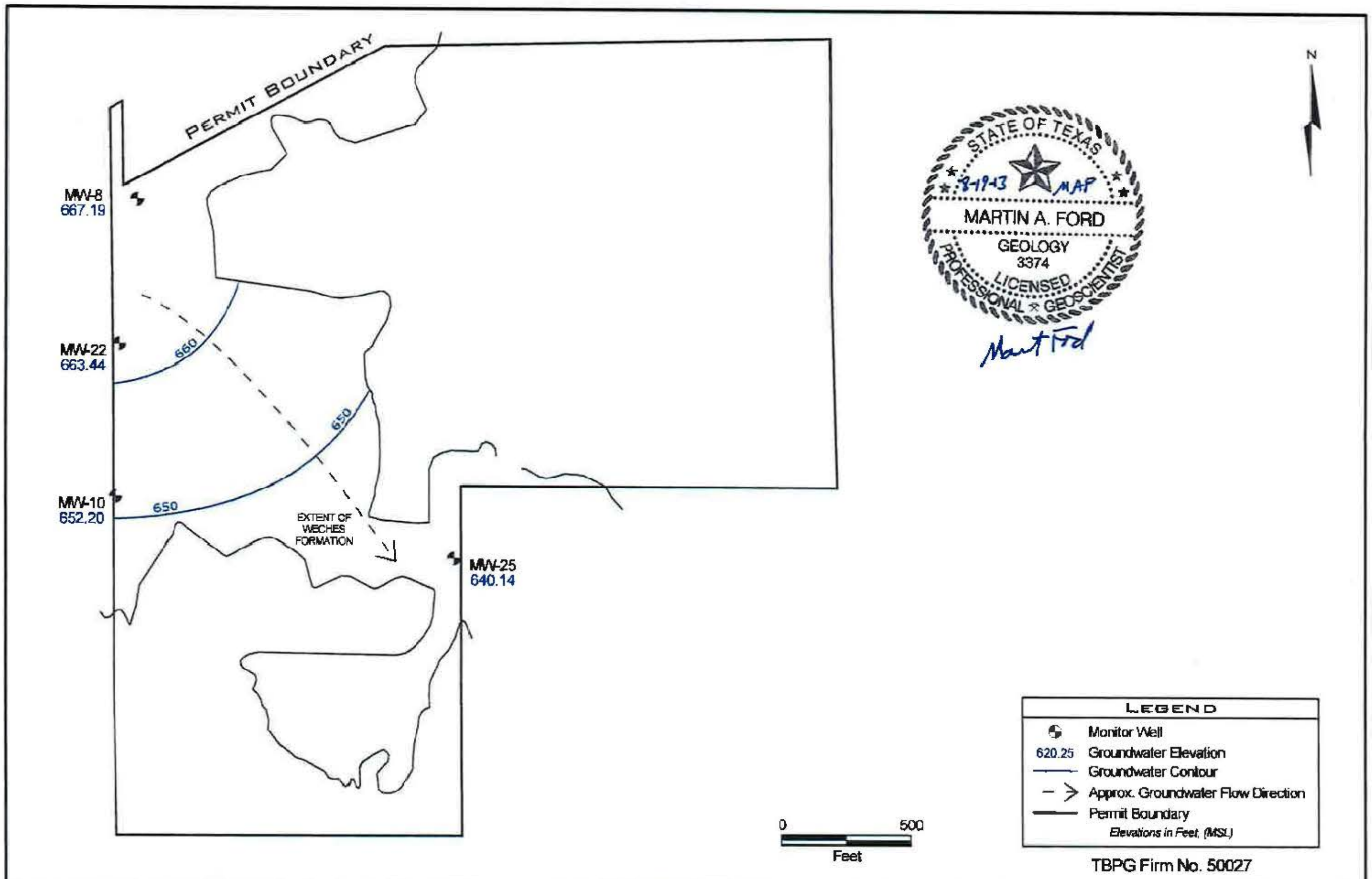
GROUNDWATER POTENTIOMETRIC SURFACE MAPS



Hydrex
ENVIRONMENTAL, INC.
1120 NW Stallings Drive
Nacogdoches, Texas 75964
(936) 568-9451 Fax: (936) 568-9527

Groundwater Elevation Map
(Weches Formation)
Water Levels Measured 12/3/2012

Figure 1	Job No. L-05-839
Royal Oaks Landfill MSW Permit No. 1614A Cherokee County, Texas	
2012	Graphics: MDR



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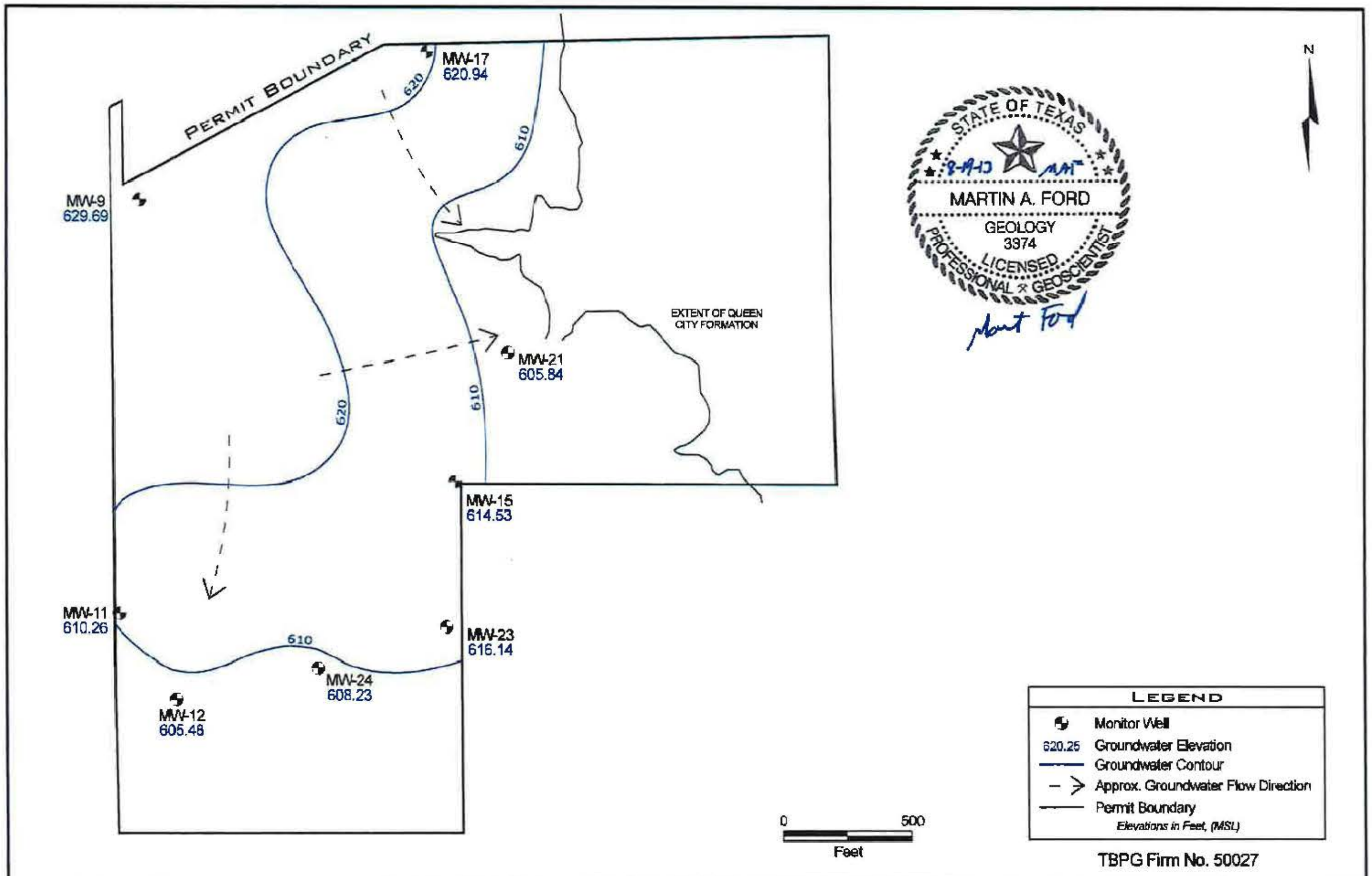
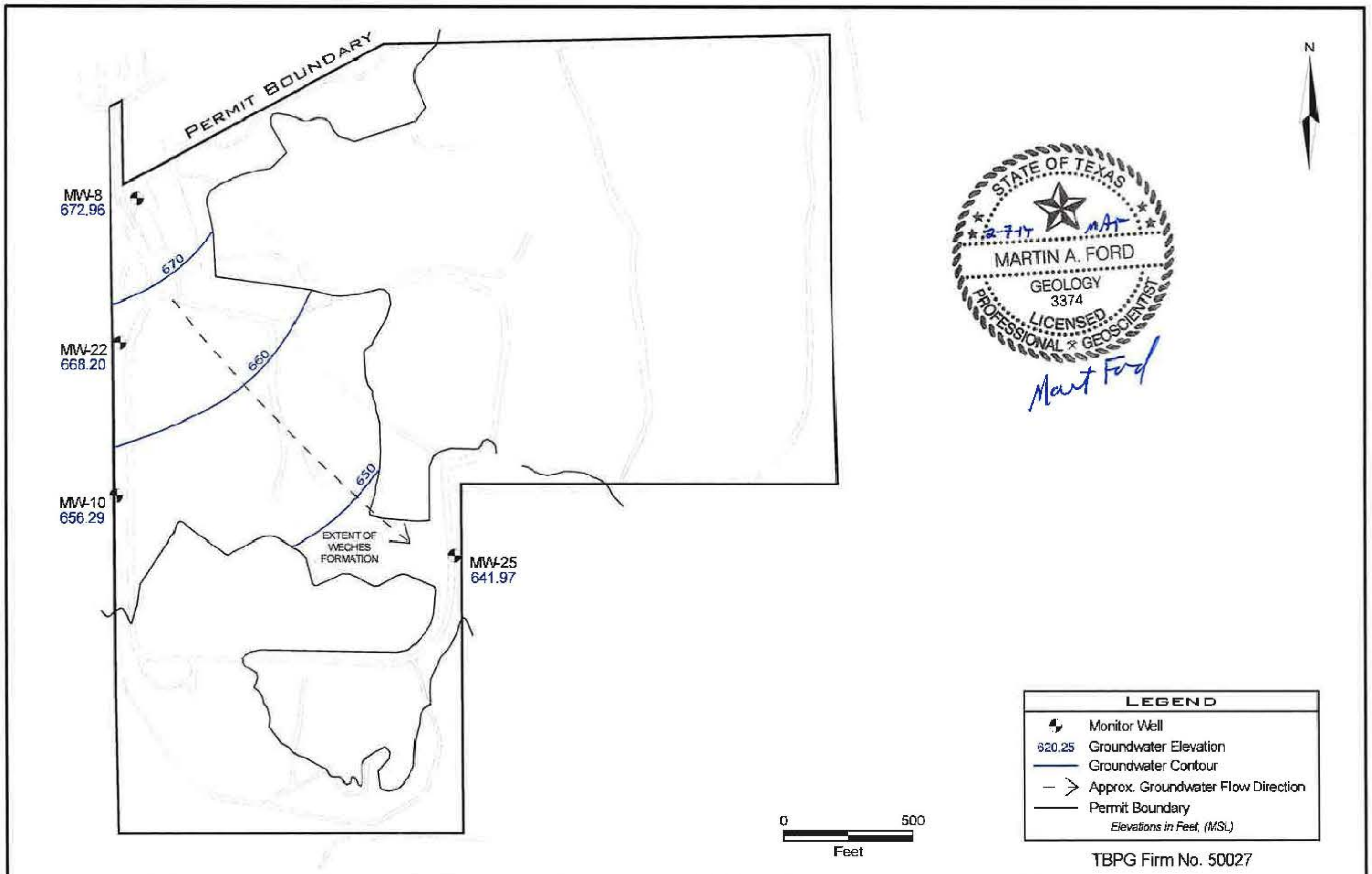
1120 NW Stallings Drive
Nacogdoches, Texas 75964
(936) 568-9451 Fax: (936) 568-9527

Groundwater Elevation Map
(Weches Formation)
Water Levels Measured 06/11/2013

Figure 1	Job No. L-05-839
Royal Oaks Landfill MSW Permit No. 1614A Cherokee County, Texas	
2013	Graphics: MDR



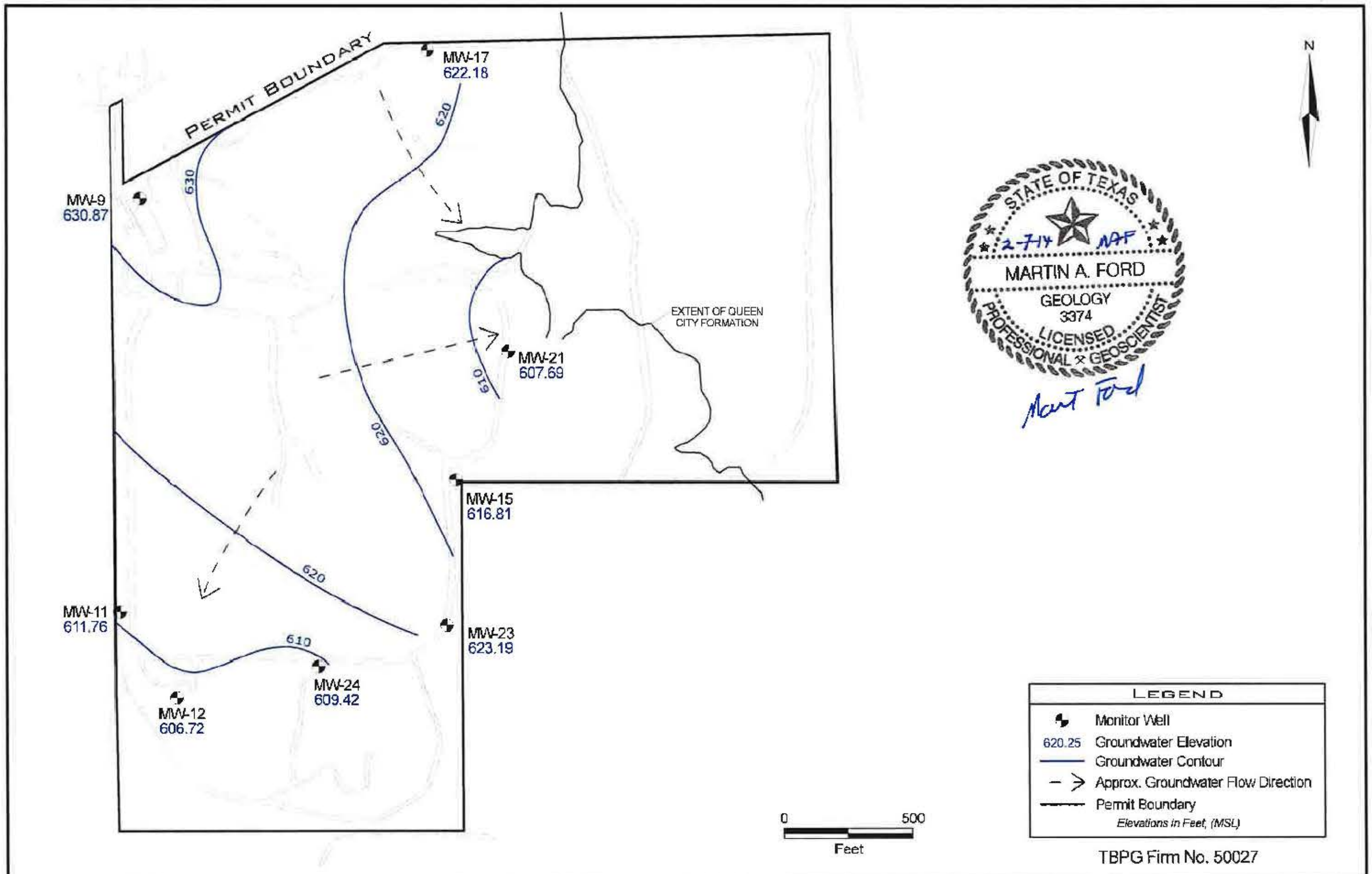
Hydrex ENVIRONMENTAL, INC. 1120 NW Stallings Drive Nacogdoches, Texas 75964 (936) 568-9451 Fax: (936) 568-9527	Groundwater Elevation Map (Queen City Formation) Water Levels Measured 06/11/2013	Figure 2	Job No. L-05-839
		Royal Oaks Landfill MSW Permit No. 1614A Cherokee County, Texas	
		2013	Graphics: MDR



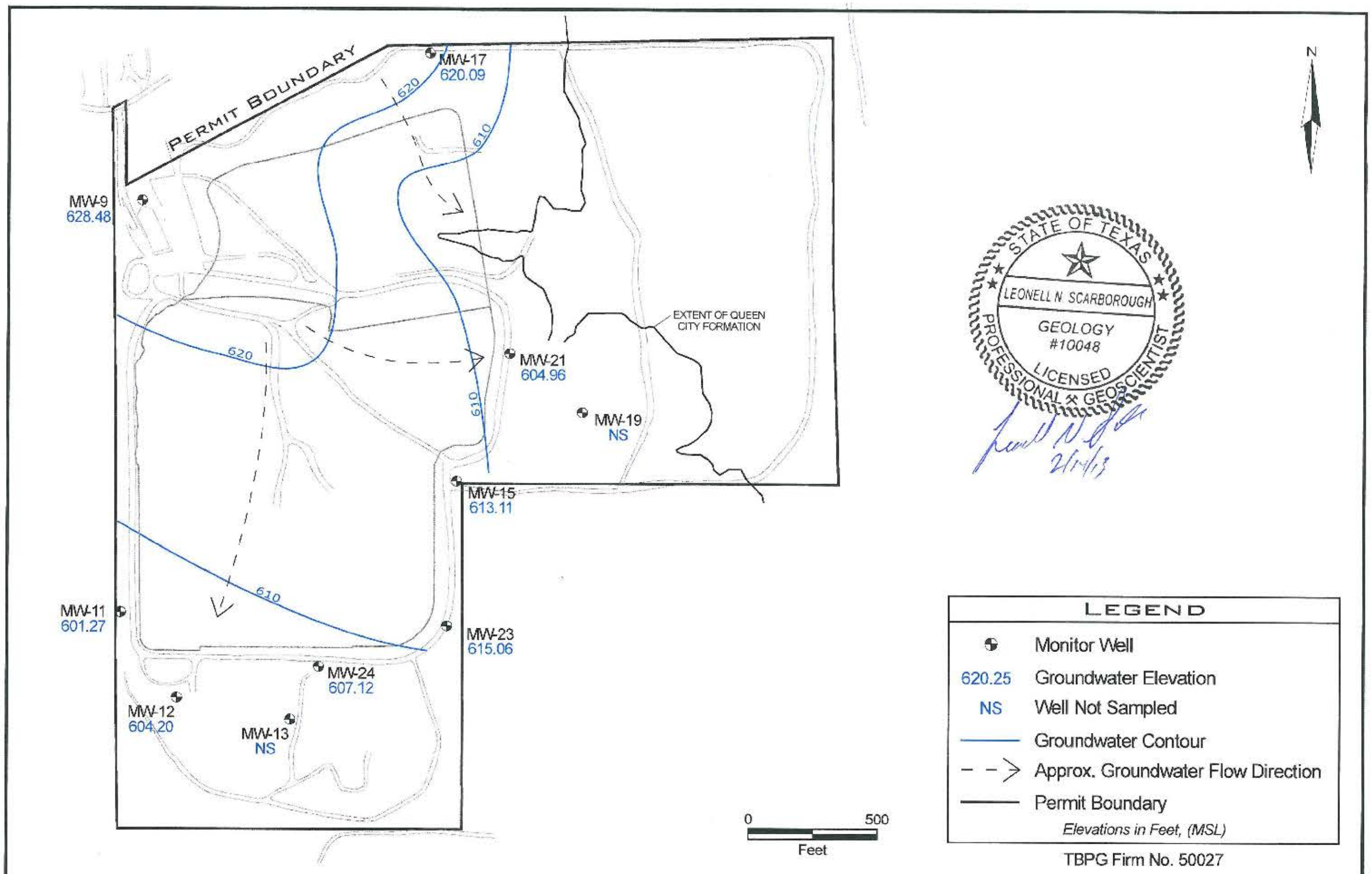
Hydrex
ENVIRONMENTAL, INC.
1120 NW Stallings Drive
Nacogdoches, Texas 75964
(936) 568-9451 Fax: (936) 568-9527

Groundwater Elevation Map
(Weches Formation)
Water Levels Measured 12/3-4/2013

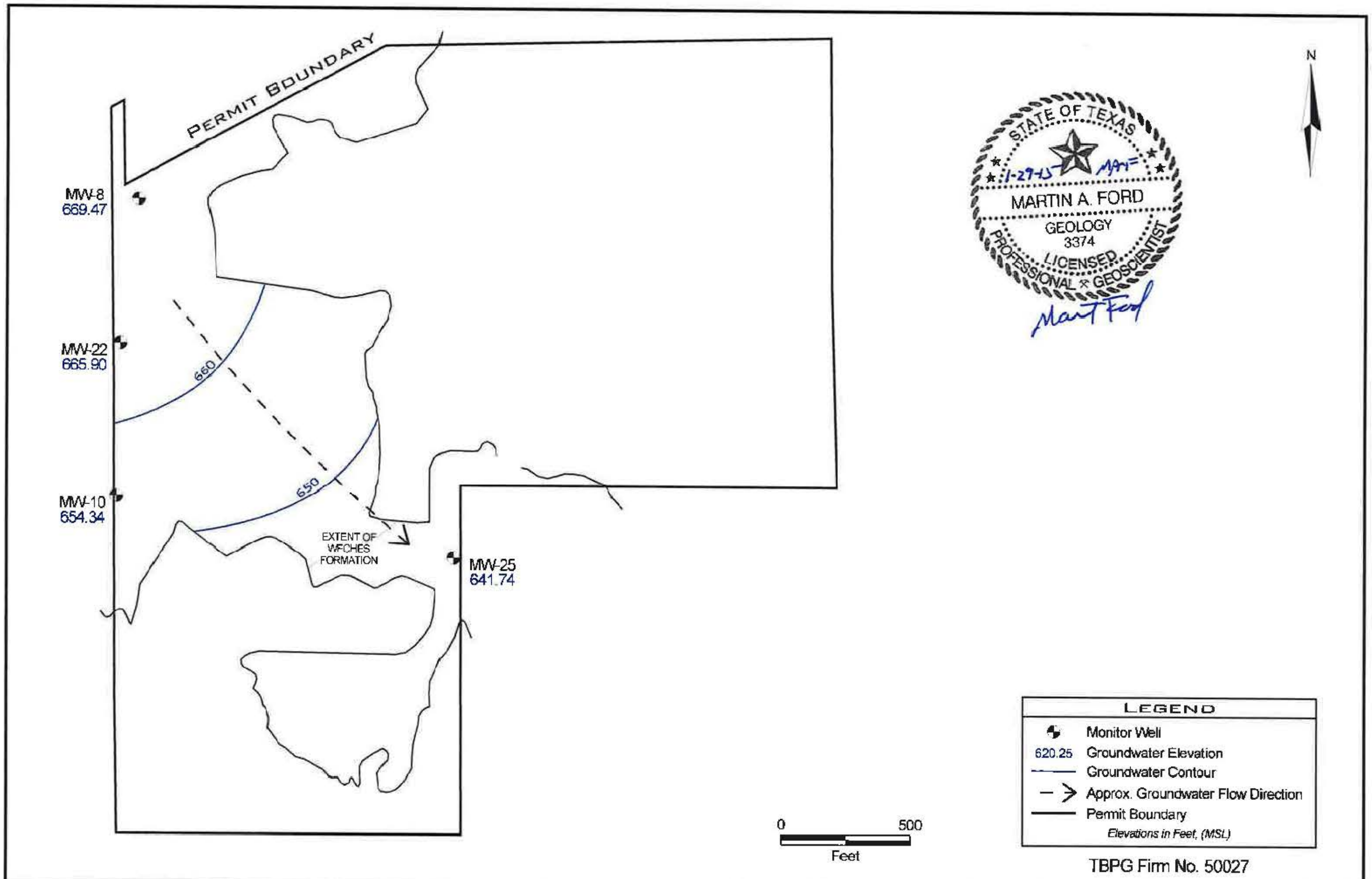
Figure 3	Job No. L-05-839
Royal Oaks Landfill MSW Permit No. 1614A Cherokee County, Texas	
2013	Graphics: MDR



Hydrex ENVIRONMENTAL, INC. 1120 NW Stallings Drive Nacogdoches, Texas 75964 (936) 568-9451 Fax: (936) 568-9527	**Groundwater Elevation Map (Queen City Formation)** Water Levels Measured 12/3-4/2013	Figure 4	Job No. L-05-839
		Royal Oaks Landfill MSW Permit No. 1614A Cherokee County, Texas	
		2013	Graphics: MDR



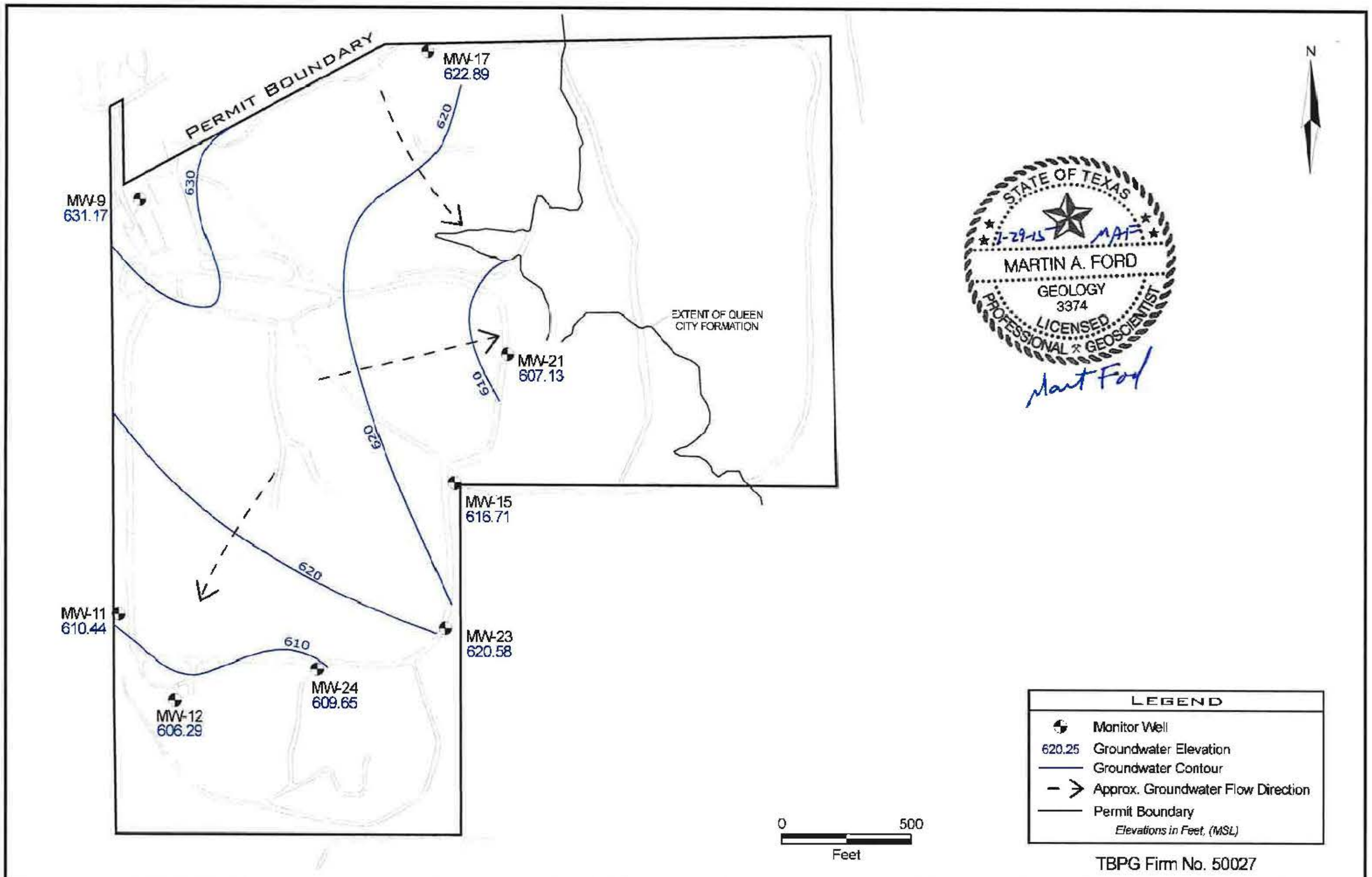
Hydrex ENVIRONMENTAL, INC. 1120 NW Stallings Drive Nacogdoches, Texas 75964 (936) 568-9451 Fax: (936) 568-9527	Groundwater Elevation Map (Queen City Formation) Water Levels Measured 12/3/2012	Figure 2	Job No. L-05-839
		Royal Oaks Landfill MSW Permit No. 1614A Cherokee County, Texas	
		2012	Graphics: MDR



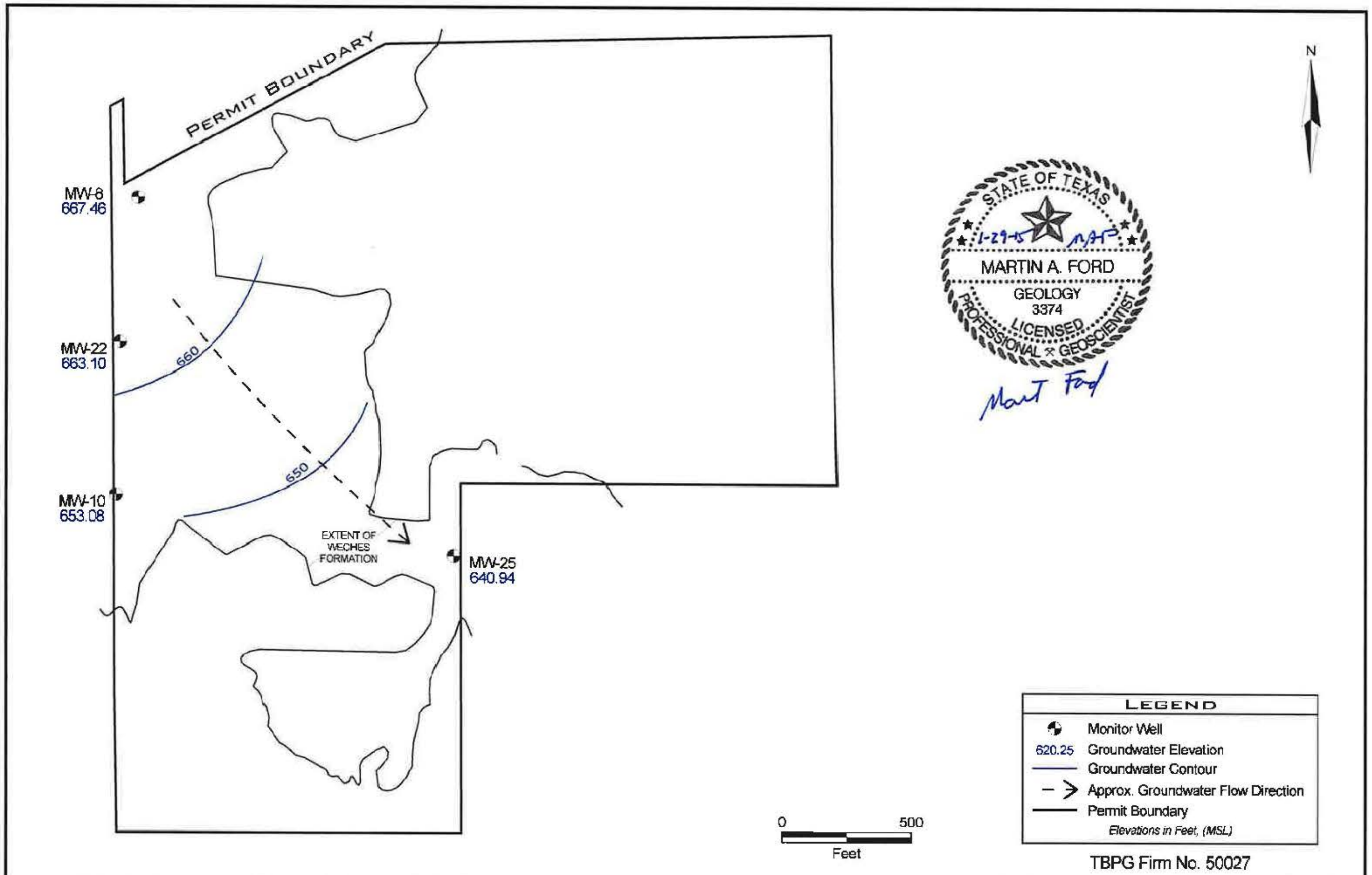
Hydrex
ENVIRONMENTAL, INC.
1120 NW Stallings Drive
Nacogdoches, Texas 75964
(936) 568-9451 Fax: (936) 568-9527

Groundwater Elevation Map
(Weches Formation)
Water Levels Measured 6/2/2014

Figure 1	Job No. L-05-839
Royal Oaks Landfill MSW Permit No. 1614A Cherokee County, Texas	
2014	Graphics: MKT



Hydrex ENVIRONMENTAL, INC. 1120 NW Stallings Drive Nacogdoches, Texas 75964 (936) 568-9451 Fax: (936) 568-9527	Groundwater Elevation Map (Queen City Formation) Water Levels Measured 6/2/2014	Figure 2	Job No. L-05-839
		Royal Oaks Landfill MSW Permit No. 1614A Cherokee County, Texas	
		2014	Graphics: MKT

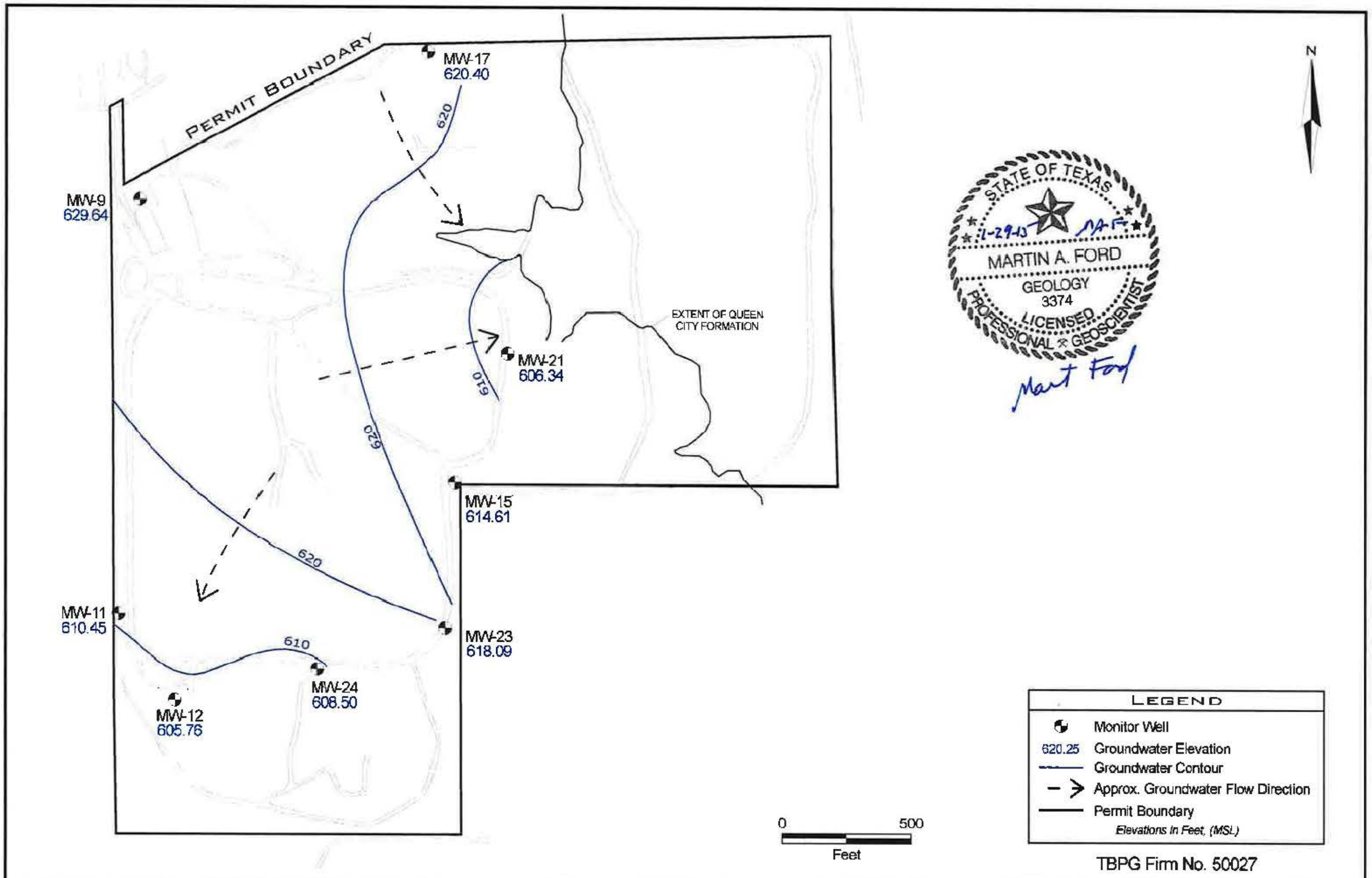


Hydrex ENVIRONMENTAL, INC.
1120 NW Stallings Drive
Nacogdoches, Texas 75964
(936) 568-9451 Fax: (936) 568-9527

Groundwater Elevation Map (Weches Formation)

Water Levels Measured 12/1/2014

Figure 3	Job No. L-05-839
Royal Oaks Landfill MSW Permit No. 1614A Cherokee County, Texas	
2014	Graphics: MKT

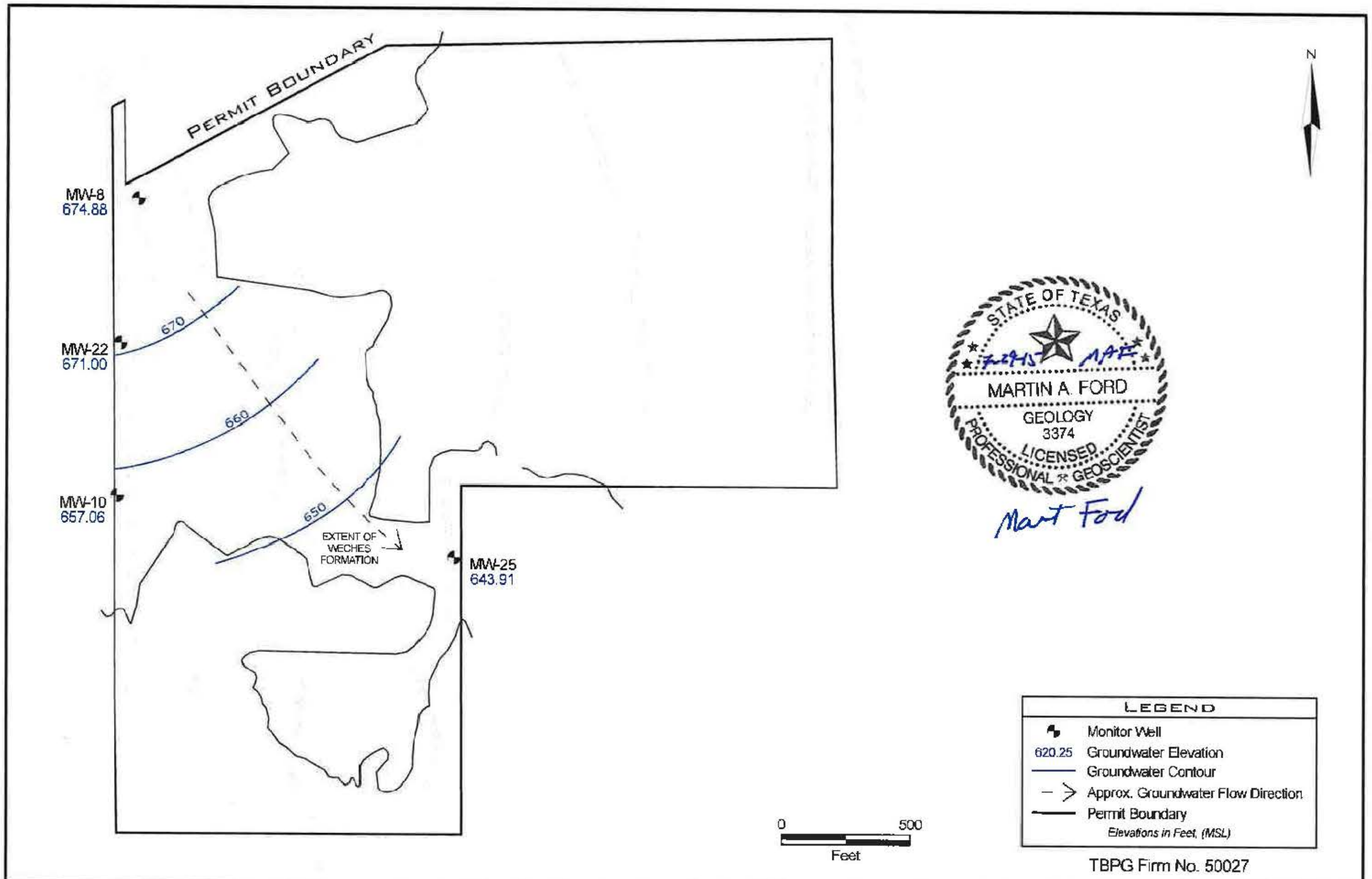


Hydrex ENVIRONMENTAL, INC.
1120 NW Stallings Drive
Nacogdoches, Texas 75964
(936) 568-9451 Fax: (936) 568-9527

Groundwater Elevation Map (Queen City Formation)

Water Levels Measured 12/1/2014

Figure 4	Job No. L-05-839
Royal Oaks Landfill MSW Permit No. 1614A Cherokee County, Texas	
2014	Graphics: MKT

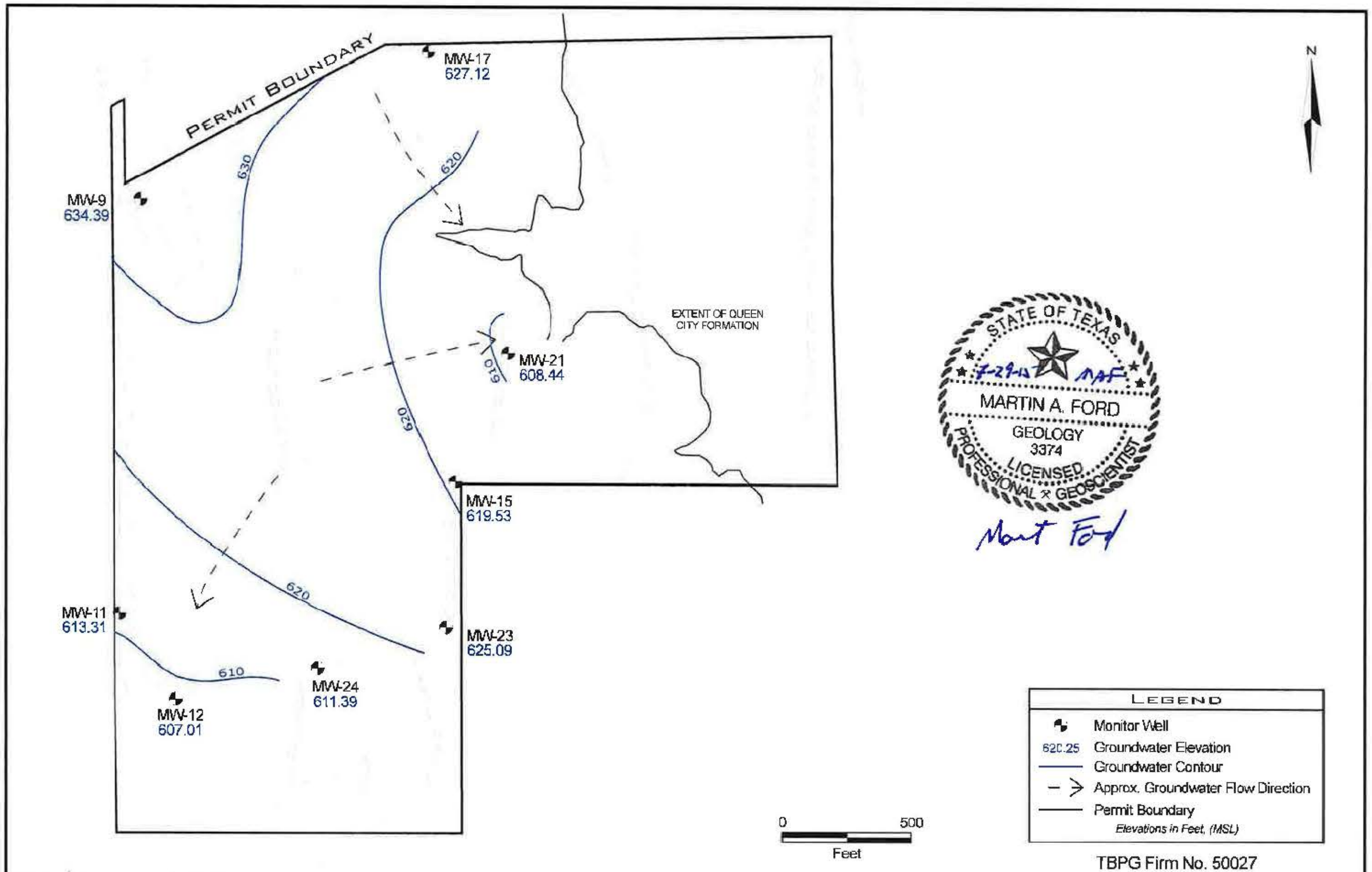


ENVIRONMENTAL, INC.
1120 NW Stallings Drive
Nacogdoches, Texas 75964
(936) 568-9451 Fax: (936) 568-9527

Groundwater Elevation Map (Weches Formation)

Water Levels Measured 6/2-3/2015

Figure 1	Job No. L-05-839
Royal Oaks Landfill MSW Permit No. 1614A Cherokee County, Texas	
2015	Graphics: MDR

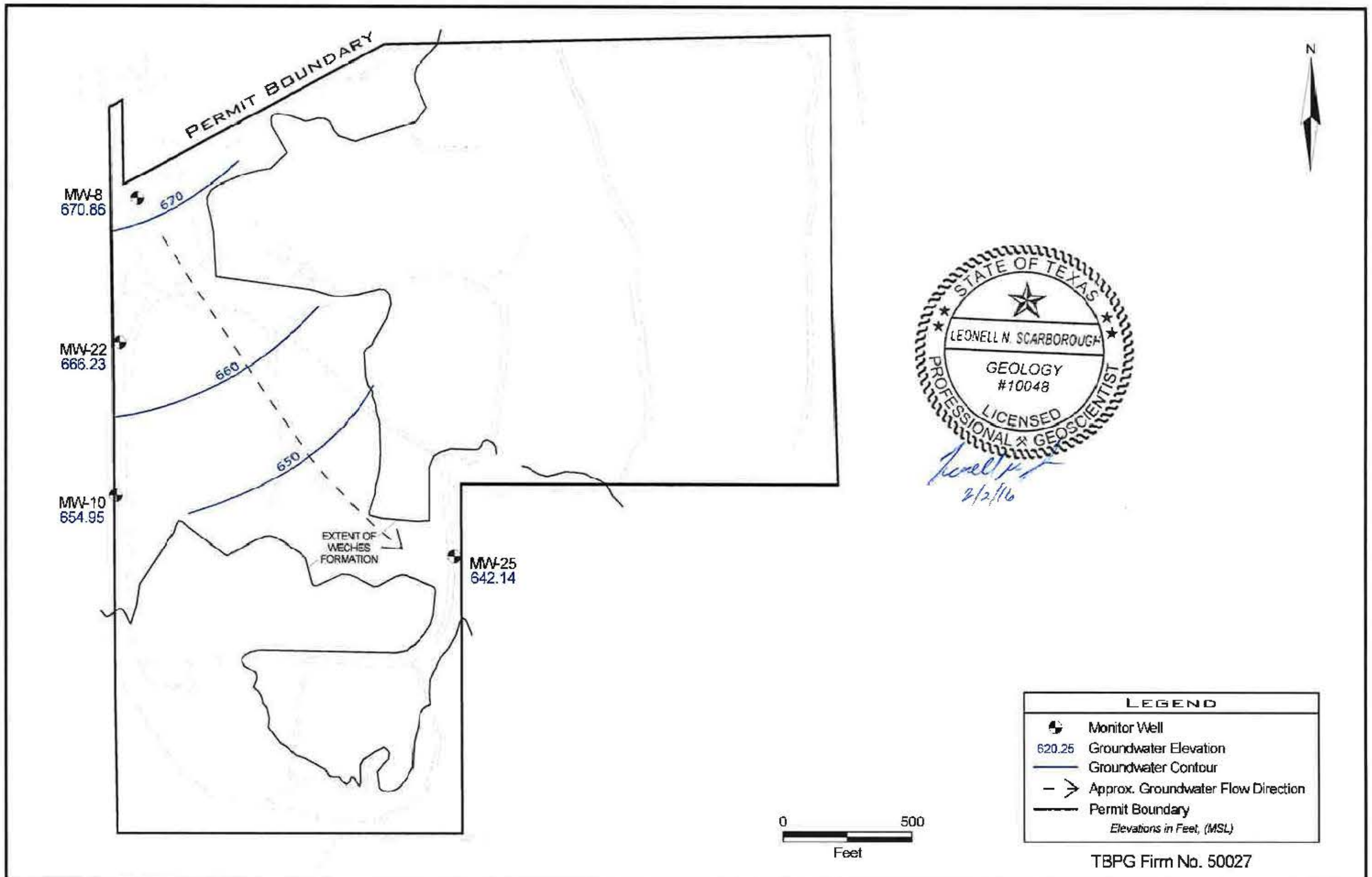


TBPG Firm No. 50027

Hydrex ENVIRONMENTAL, INC.
1120 NW Stallings Drive
Nacogdoches, Texas 75964
(936) 568-9451 Fax: (936) 568-9527

Groundwater Elevation Map
(Queen City Formation)
Water Levels Measured 6/2-3/2015

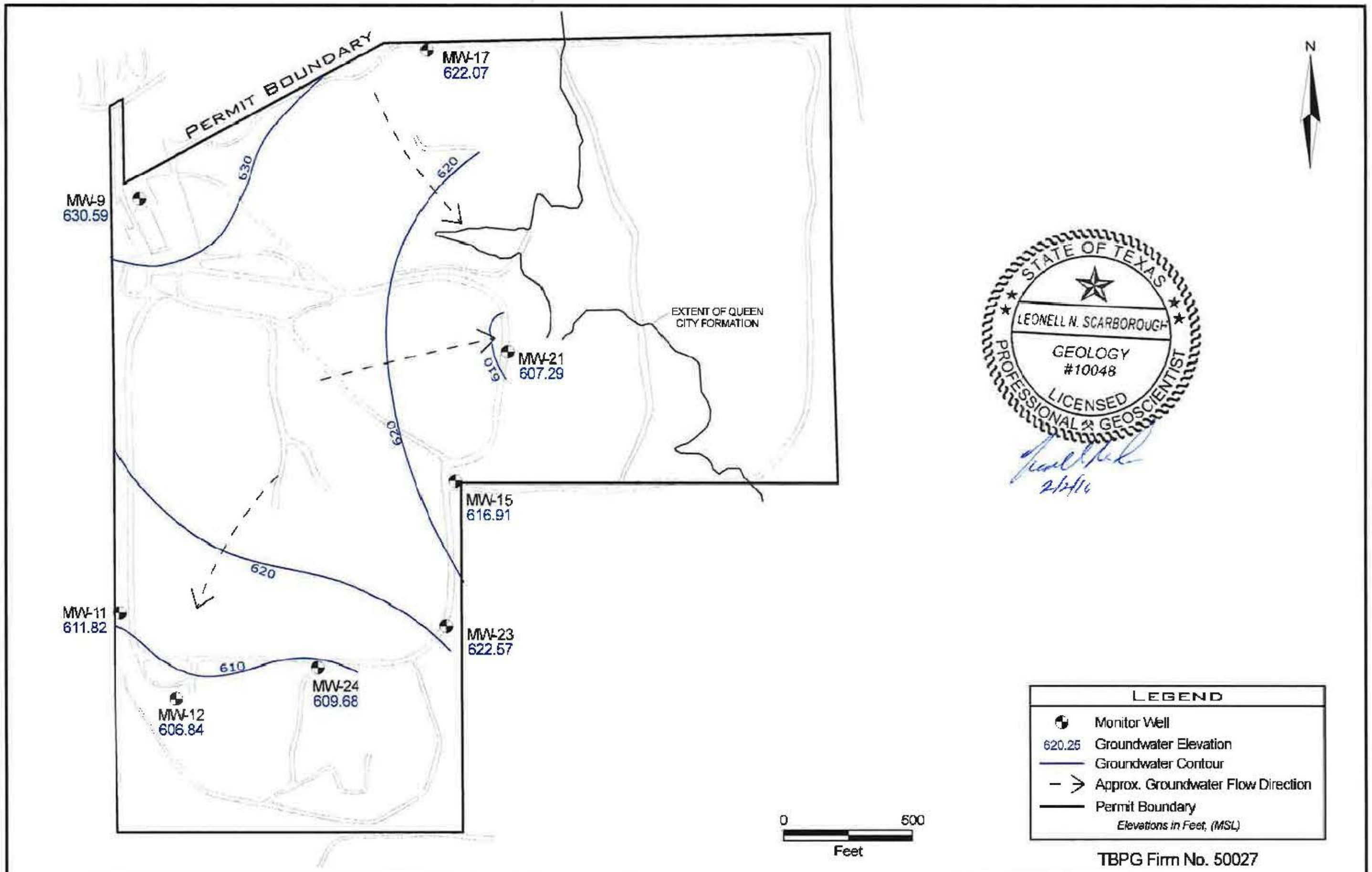
Figure 2	Job No. L-05-839
Royal Oaks Landfill MSW Permit No. 1614A Cherokee County, Texas	
2015	Graphics: MDR



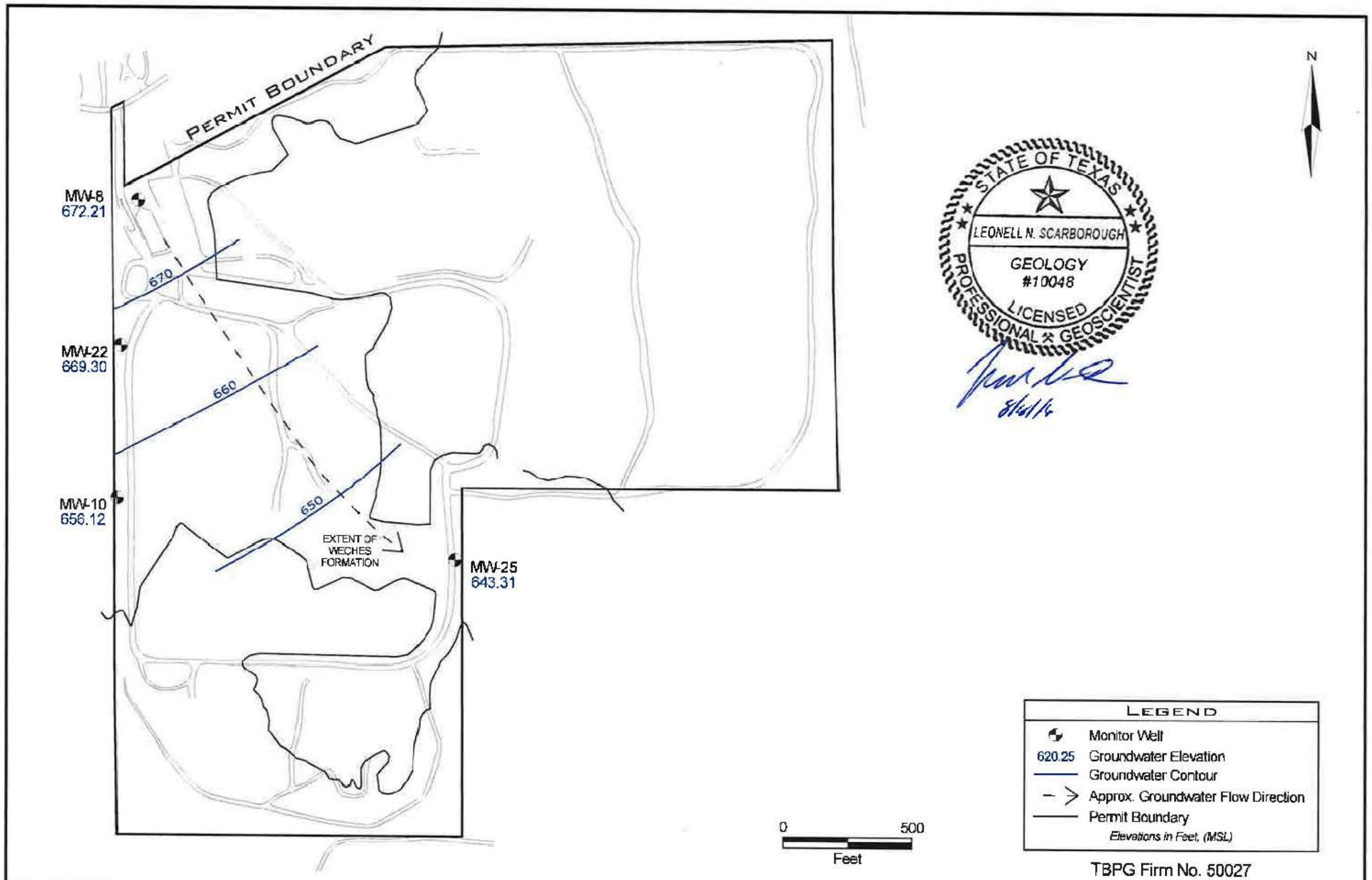
Hydrex
ENVIRONMENTAL, INC.
1120 NW Stallings Drive
Nacogdoches, Texas 75964
(936) 568-9451 Fax: (936) 568-9527

Groundwater Elevation Map
(Weches Formation)
Water Levels Measured 12/7/2015

Figure 3	Job No. L-05-839
Royal Oaks Landfill MSW Permit No. 1614A Cherokee County, Texas	
2015	Graphics: MDR



Hydrex ENVIRONMENTAL, INC. 1120 NW Stallings Drive Nacogdoches, Texas 75964 (936) 568-9451 Fax: (936) 568-9527	Groundwater Elevation Map (Queen City Formation) Water Levels Measured 12/7/2015	Figure 4	Job No. L-05-839
		Royal Oaks Landfill MSW Permit No. 1614A Cherokee County, Texas	
		2015	Graphics: MDR

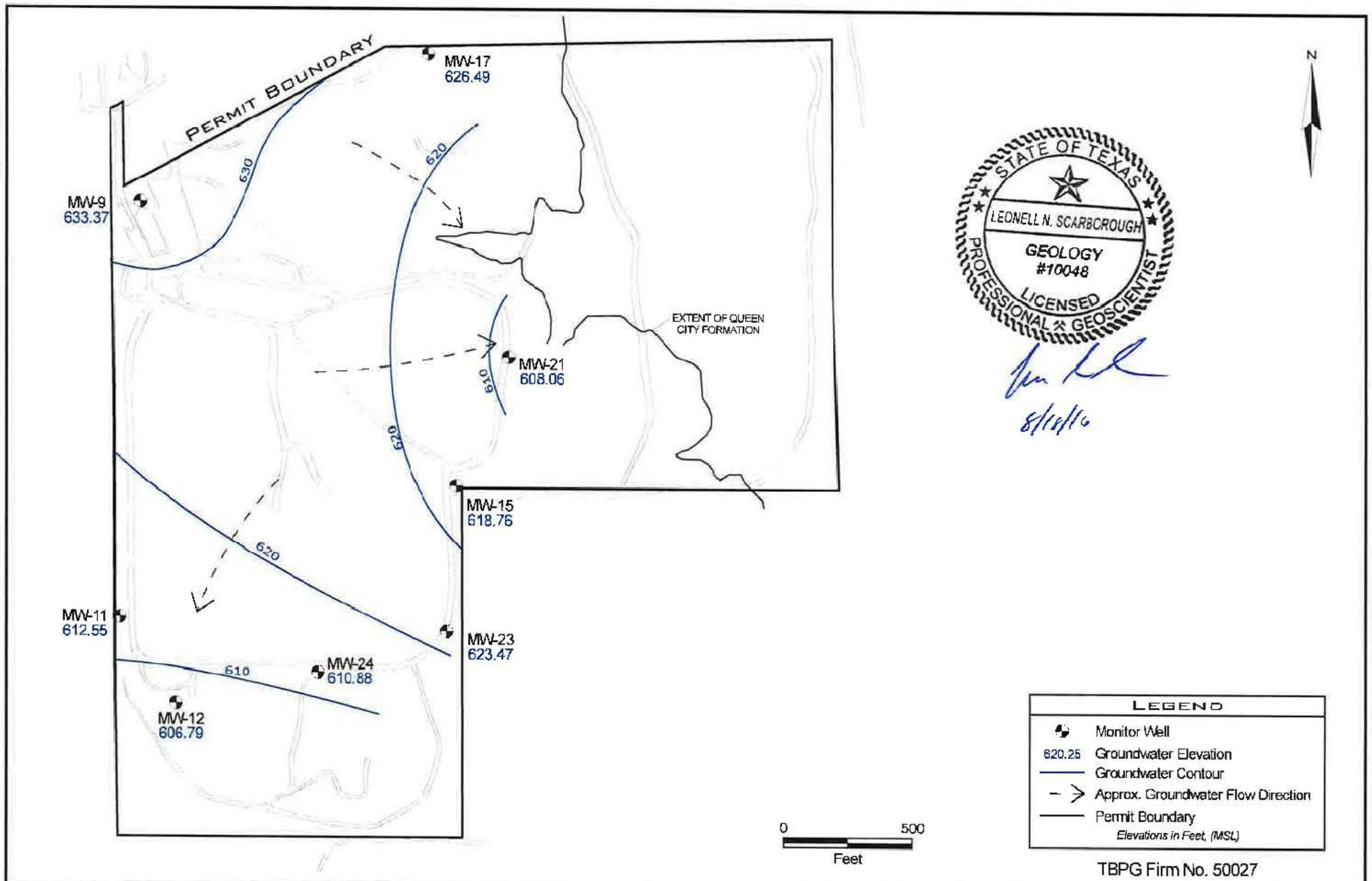


Hydrex
ENVIRONMENTAL, INC.
1120 NW Stallings Drive
Nacogdoches, Texas 75964
(936) 568-9451 Fax: (936) 568-9527

Groundwater Elevation Map (Weches Formation)

Water Levels Measured 6/20-21/2016

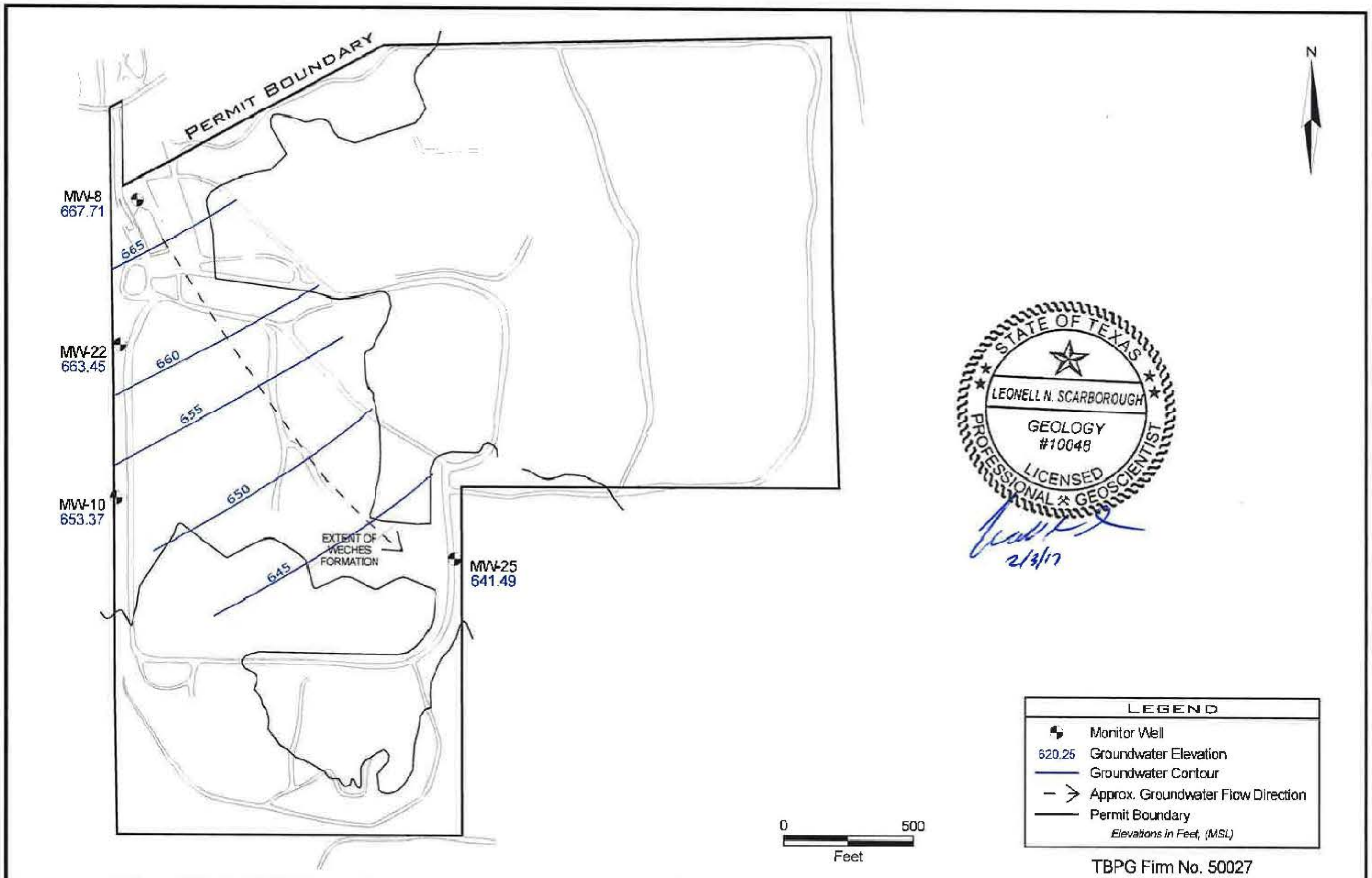
Figure 1	Job No. L-05-839
Royal Oaks Landfill MSW Permit No. 1614A Cherokee County, Texas	
2016	Graphics: MKT



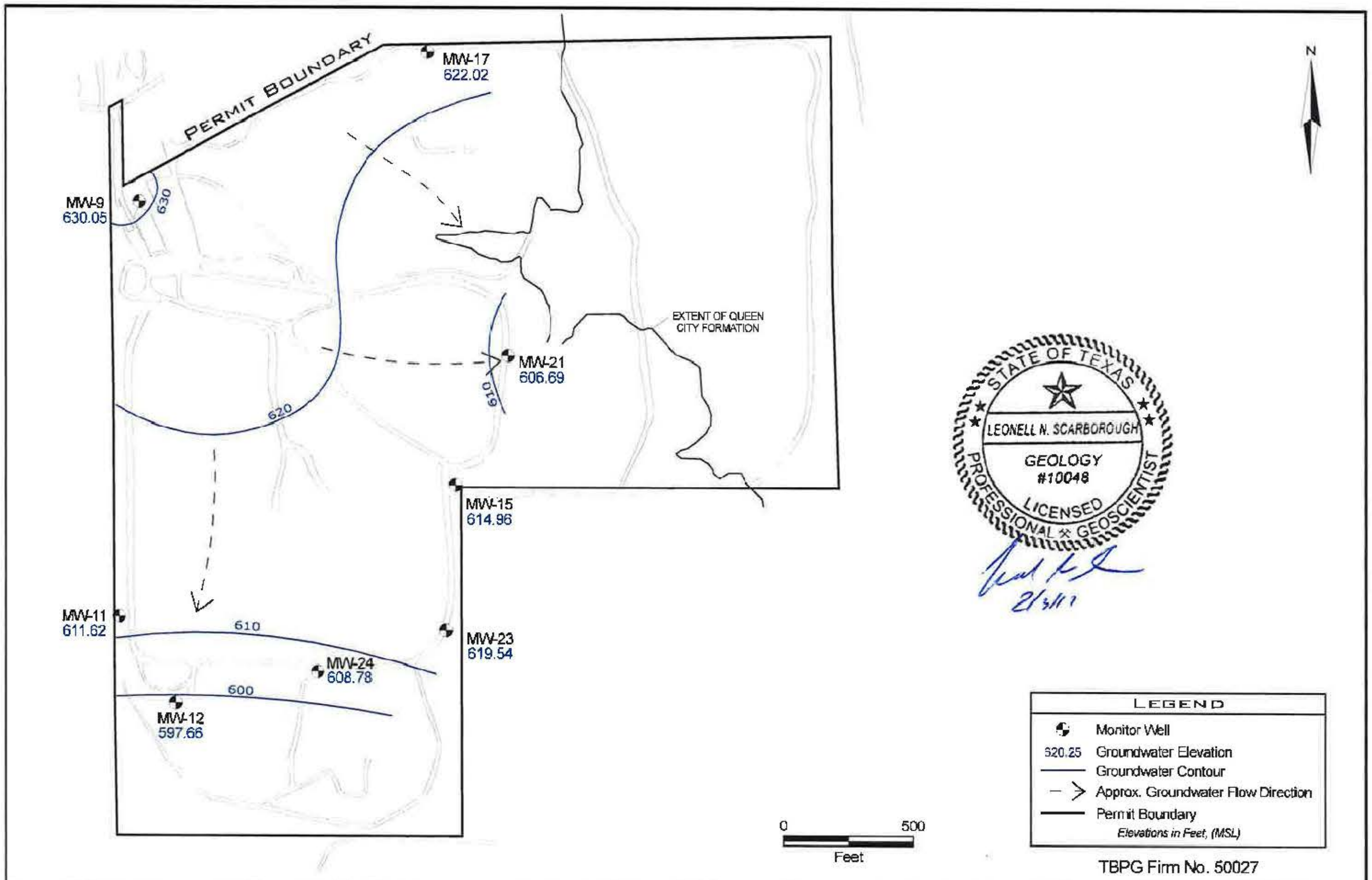
Hydrex
ENVIRONMENTAL, INC.
1120 NW Stallings Drive
Nacogdoches, Texas 75964
(936) 568-9451 Fax: (936) 568-9527

Groundwater Elevation Map
(Queen City Formation)
Water Levels Measured 6/20-21/2016

Figure 2	Job No. L-05-839
Royal Oaks Landfill MSW Permit No. 1614A Cherokee County, Texas	
2016	Graphics: MKT



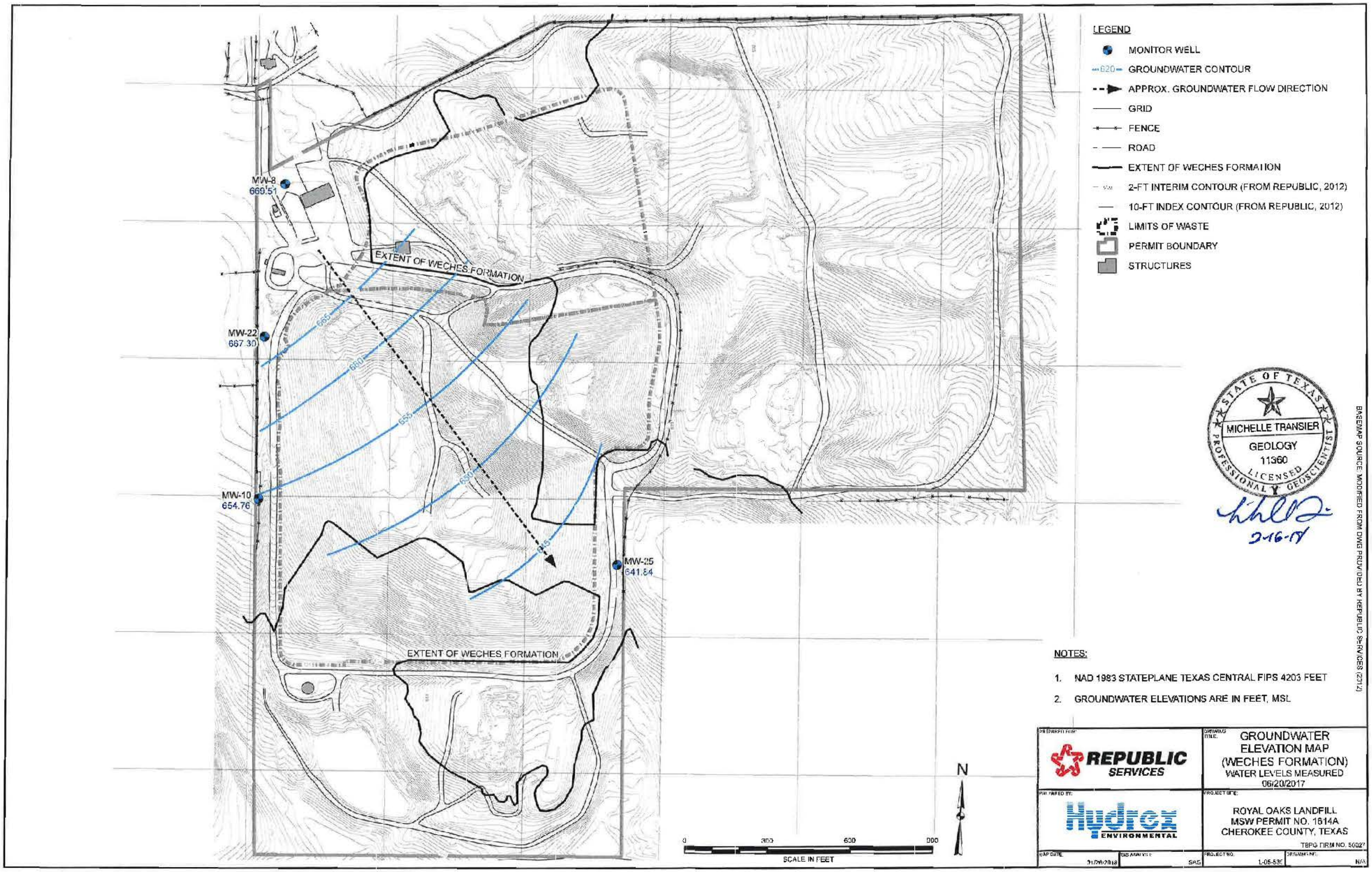
Hydrex ENVIRONMENTAL 1120 NW Stallings Drive Nacogdoches, Texas 75964 (936) 568-9451 Fax: (936) 568-9527	Groundwater Elevation Map (Weches Formation) Water Levels Measured 12/6/2016	Figure 3 Royal Oaks Landfill MSW Permit No. 1614A Cherokee County, Texas 2016	Job No. L-05-839 Graphics: MKT

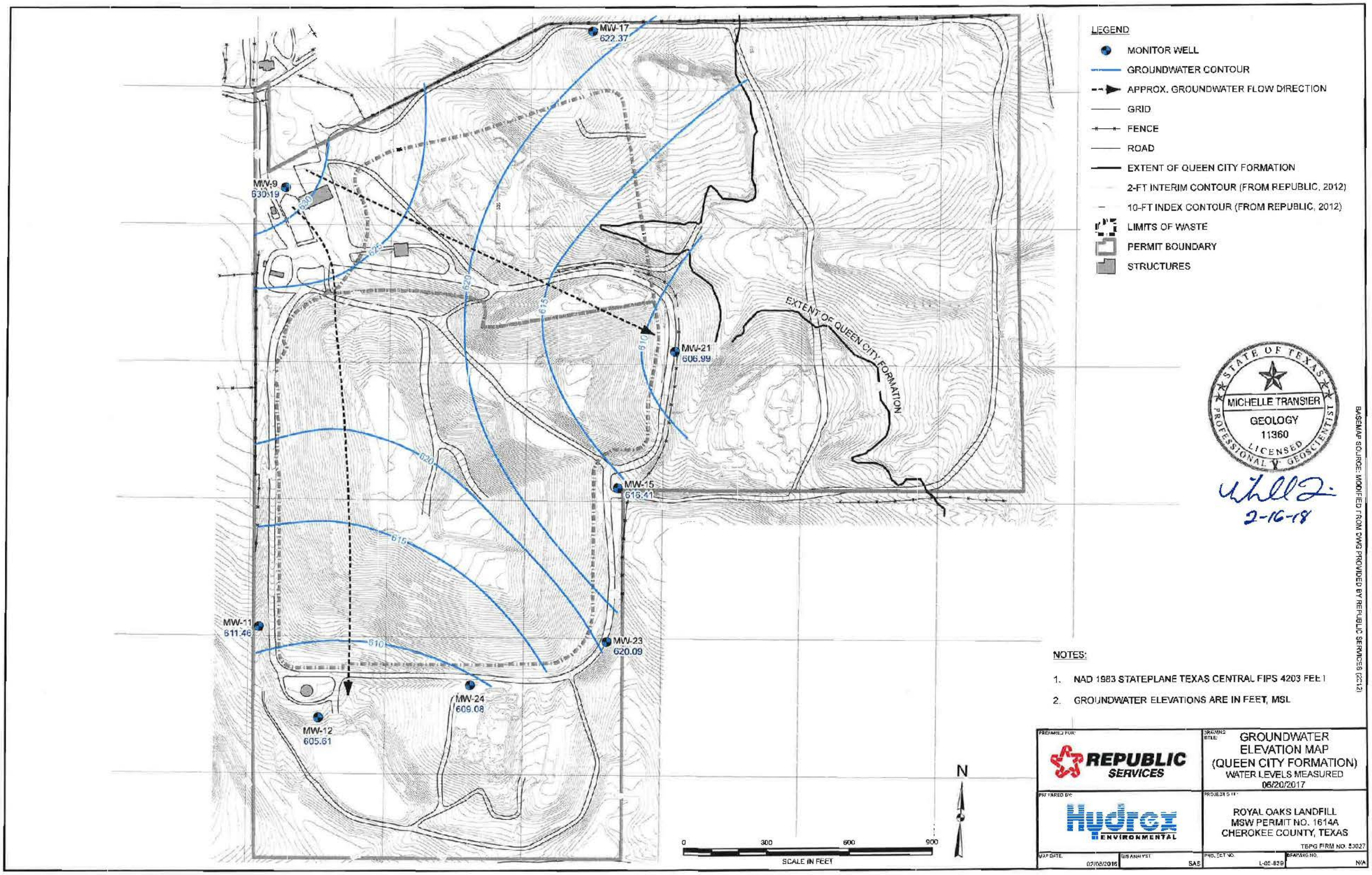


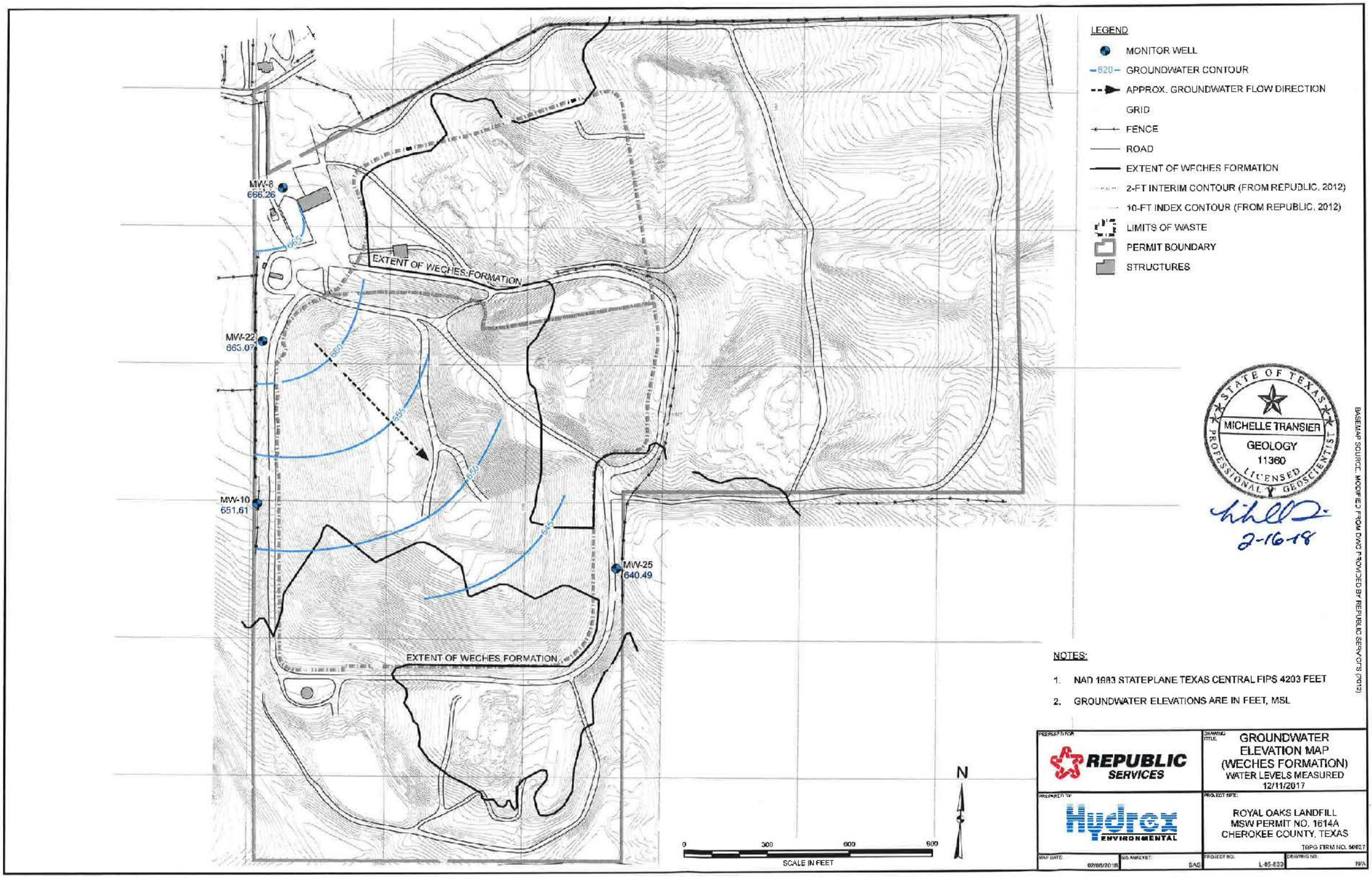
Hydrex ENVIRONMENTAL
1120 NW Stallings Drive
Nacogdoches, Texas 75964
(936) 568-9451 Fax: (936) 568-9527

Groundwater Elevation Map
(Queen City Formation)
Water Levels Measured 12/6/2016

Figure 4	Job No. L-05-839
Royal Oaks Landfill MSW Permit No. 1614A Cherokee County, Texas	
2016	Graphics: MKT


LEGEND
MONITOR WELL
620 GROUNDWATER CONTOUR
APPROX. GROUNDWATER FLOW DIRECTION
GRID
FENCE
ROAD
EXTENT OF WECHES FORMATION
2-FT INTERIM CONTOUR (FROM REPUBLIC, 2012)
10-FT INDEX CONTOUR (FROM REPUBLIC, 2012)
LIMITS OF WASTE
PERMIT BOUNDARY
STRUCTURES
MW-8
669.51
MW-22
667.30
MW-10
654.76
MW-25
641.84
665
660
655
650
645
EXTENT OF WECHES FORMATION
EXTENT OF WECHES FORMATION
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST
2-16-18
NOTES:
1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL
BASEMAP SOURCE: MODIFIED FROM DWG PROVIDED BY REPUBLIC SERVICES (2012)
N
0
300
600
900
SCALE IN FEET
REPUBLIC SERVICES
Hydrex ENVIRONMENTAL
GROUNDWATER
ELEVATION MAP
(WECHES FORMATION)
WATER LEVELS MEASURED
06/20/2017
ROYAL OAKS LANDFILL
MSW PERMIT NO. 1614A
CHEROKEE COUNTY, TEXAS
TBPG FIRM NO. 50027
SAS
1-05-530
N/A


LEGEND
MONITOR WELL
GROUNDWATER CONTOUR
APPROX. GROUNDWATER FLOW DIRECTION
GRID
FENCE
ROAD
EXTENT OF QUEEN CITY FORMATION
2-FT INTERIM CONTOUR (FROM REPUBLIC, 2012)
10-FT INDEX CONTOUR (FROM REPUBLIC, 2012)
LIMITS OF WASTE
PERMIT BOUNDARY
STRUCTURES
MW-17
622.37
MW-9
630.19
MW-21
606.99
MW-15
618.41
MW-11
611.46
MW-23
620.09
MW-24
609.08
MW-12
605.61
630
625
620
615
610
EXTENT OF QUEEN CITY FORMATION
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST
2-16-18
BASEMAP SOURCE: MODIFIED FROM DWG PROVIDED BY REPUBLIC SERVICES (2012)
NOTES:
1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL
N
0
300
600
900
SCALE IN FEET
PREPARED FOR:
REPUBLIC SERVICES
PREPARED BY:
Hydrex ENVIRONMENTAL
DRAWING TITLE:
GROUNDWATER ELEVATION MAP (QUEEN CITY FORMATION)
WATER LEVELS MEASURED 06/20/2017
ROYAL OAKS LANDFILL
MSW PERMIT NO. 1614A
CHEROKEE COUNTY, TEXAS
TBPG FIRM NO. 50027
MAP DATE: 02/08/2016
GIS ANALYST: SAS
PROJECT NO. L-05-839
DRAWING NO. N/A

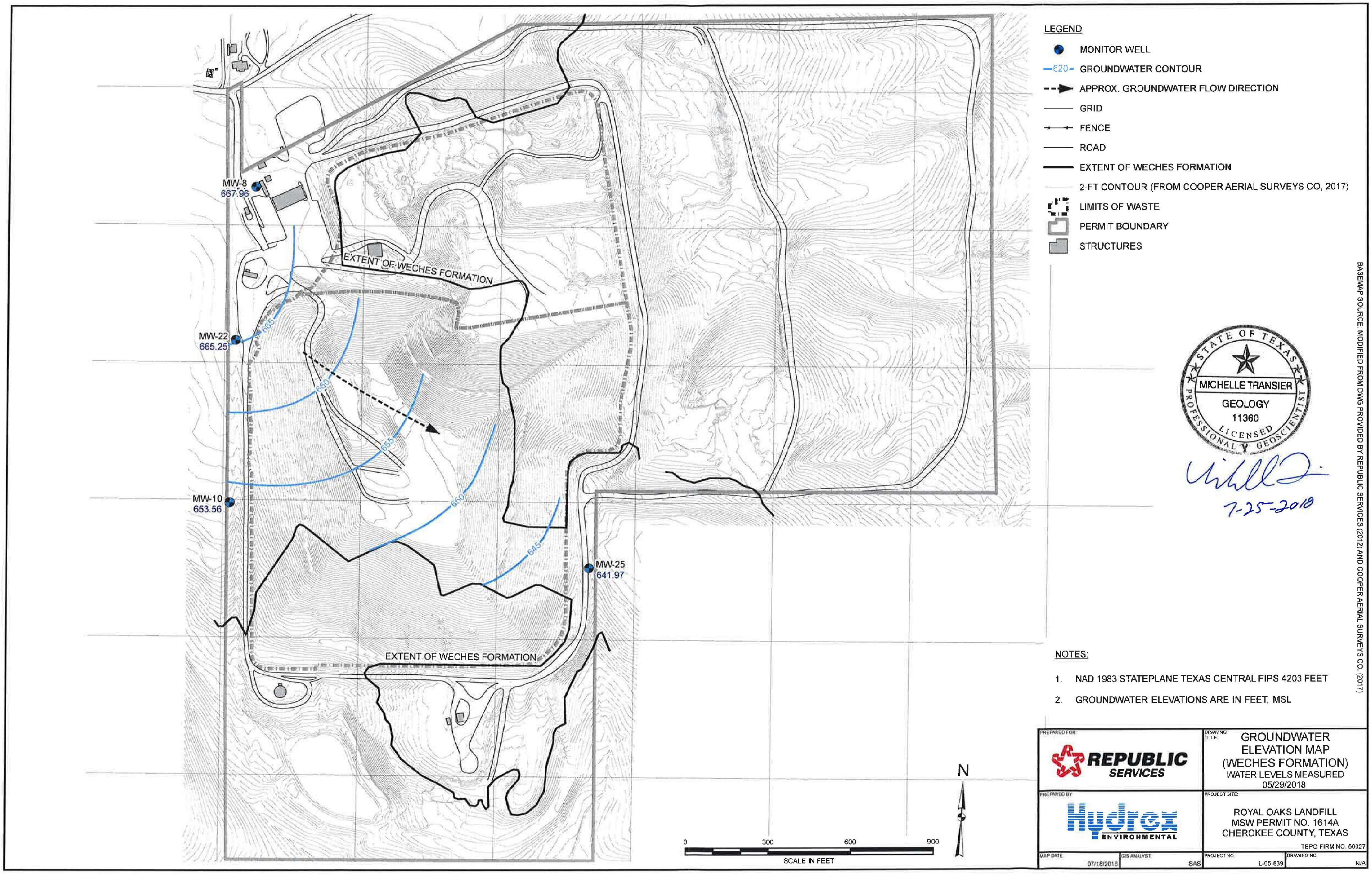


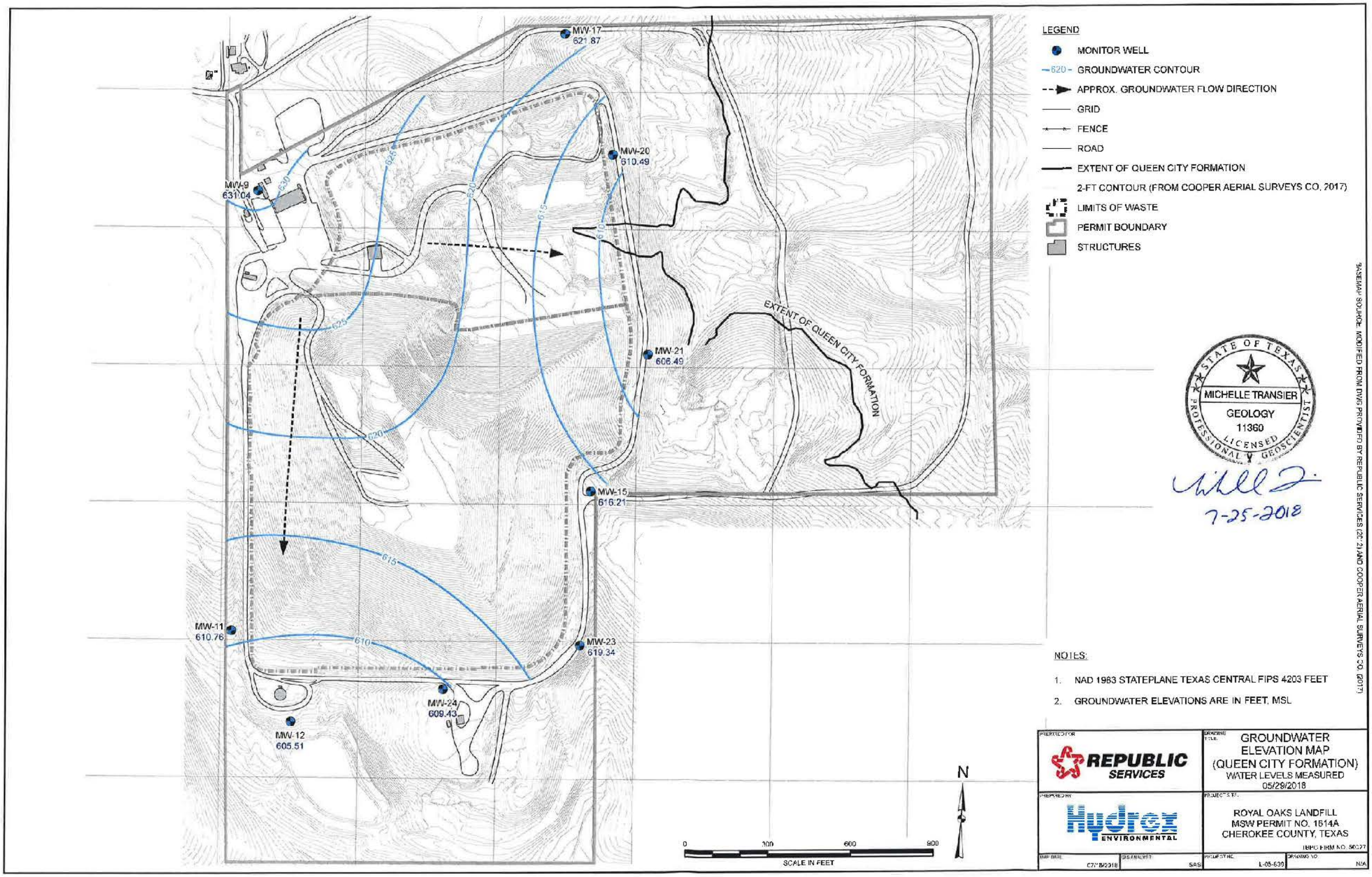
NOTES:

1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL

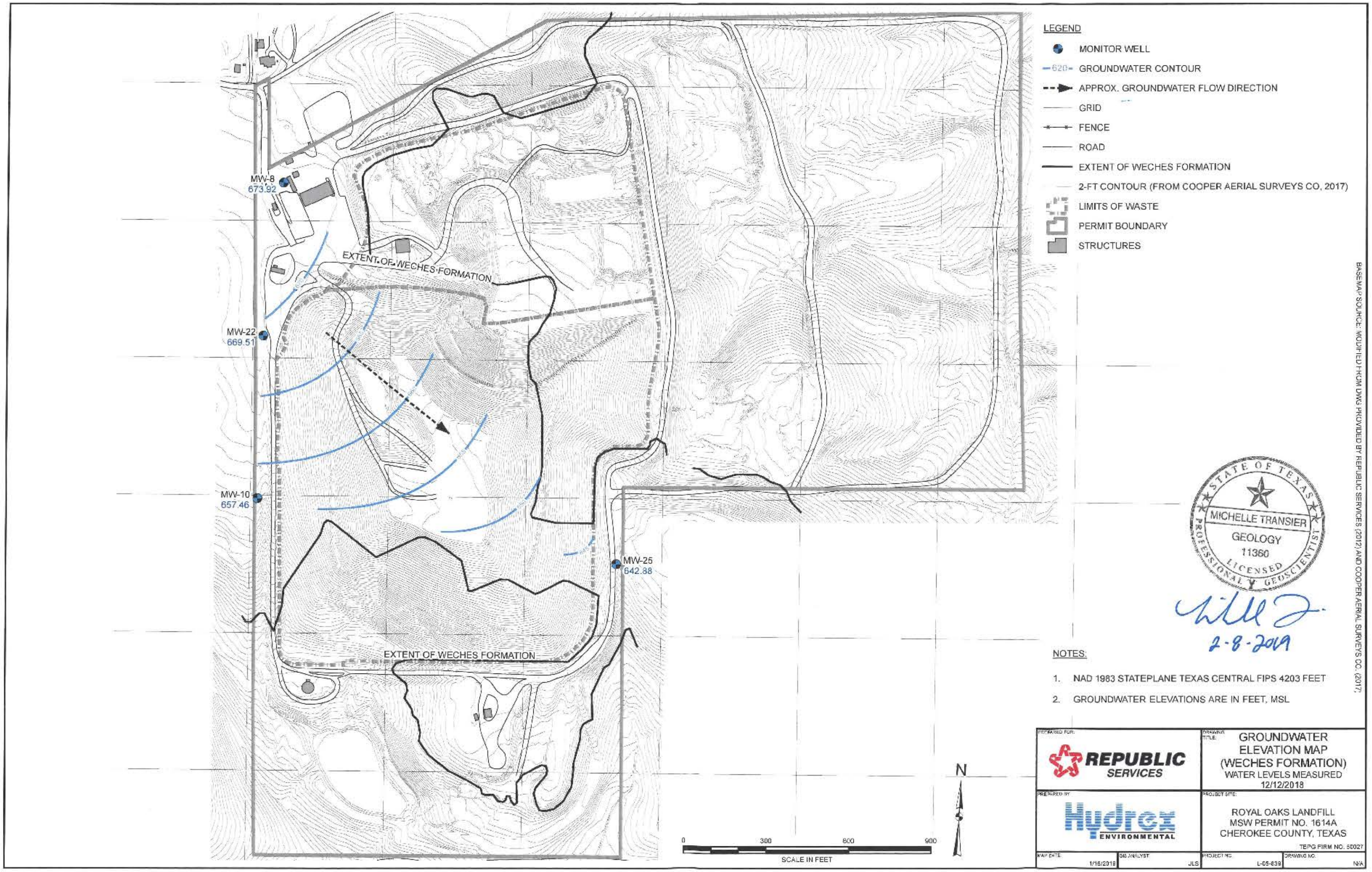
PREPARED FOR: REPUBLIC SERVICES	DRAWING TITLE: GROUNDWATER ELEVATION MAP (WECHES FORMATION) WATER LEVELS MEASURED 12/11/2017
PREPARED BY: Hydrex ENVIRONMENTAL	PROJECT SITE: ROYAL OAKS LANDFILL MSW PERMIT NO. 1614A CHEROKEE COUNTY, TEXAS TBPG FIRM NO. 50027
MAP DATE: 02/05/2018 / GIS ANALYST: SAS	PROJECT NO.: L-05-033 / DRAWING NO.: N/A

LEGEND
MONITOR WELL
620 GROUNDWATER CONTOUR
APPROX. GROUNDWATER FLOW DIRECTION
GRID
FENCE
ROAD
EXTENT OF QUEEN CITY FORMATION
2-FT INTERIM CONTOUR (FROM REPUBLIC, 2012)
10-FT INDEX CONTOUR (FROM REPUBLIC, 2012)
LIMITS OF WASTE
PERMIT BOUNDARY
STRUCTURES
MW-17
620.32
MW-9
629.41
MW-20
608.81
MW-21
605.76
MW-15
613.81
MW-11
609.56
MW-23
615.81
MW-24
607.98
MW-12
605.01
625
620
615
610
EXTENT OF QUEEN CITY FORMATION
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST
2-16-18
BASEMAP SOURCE: MODIFIED FROM DWG PROVIDED BY REPUBLIC SERVICES (2012)
NOTES:
1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL
N
0
300
600
900
SCALE IN FEET
PREPARED FOR
REPUBLIC SERVICES
DRAWING TITLE
GROUNDWATER ELEVATION MAP (QUEEN CITY FORMATION)
WATER LEVELS MEASURED 12/11/2017
PREPARED BY
Hydrex ENVIRONMENTAL
PROJECT SITE
ROYAL OAKS LANDFILL
MSW PERMIT NO. 1614A
CHEROKEE COUNTY, TEXAS
TBPG FIRM NO. 50027
02/06/2018
SAS
PROJECT NO.
L-03-639
DRAWING NO.
N/A

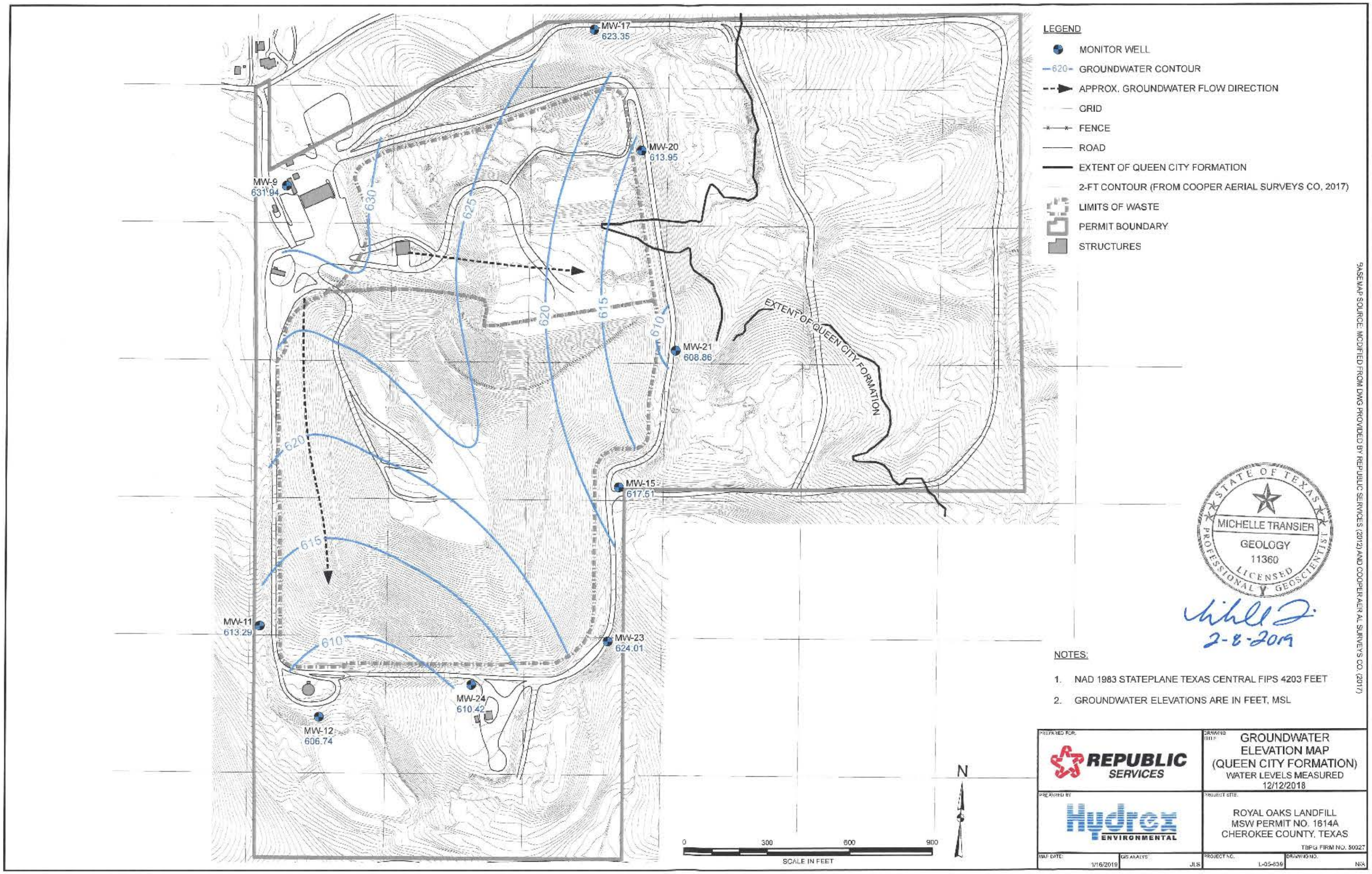

MW-8
667.96
MW-22
665.25
MW-10
653.56
MW-25
641.97
665
660
655
650
645
EXTENT OF WECHES FORMATION
EXTENT OF WECHES FORMATION
LEGEND
MONITOR WELL
620 GROUNDWATER CONTOUR
APPROX. GROUNDWATER FLOW DIRECTION
GRID
FENCE
ROAD
EXTENT OF WECHES FORMATION
2-FT CONTOUR (FROM COOPER AERIAL SURVEYS CO, 2017)
LIMITS OF WASTE
PERMIT BOUNDARY
STRUCTURES
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST
7-25-2018
BASEMAP SOURCE: MODIFIED FROM DWG PROVIDED BY REPUBLIC SERVICES (2012) AND COOPER AERIAL SURVEYS CO. (2017)
NOTES:
1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL
N
0
300
600
900
SCALE IN FEET
PREPARED FOR:
REPUBLIC SERVICES
PREPARED BY:
Hydrex ENVIRONMENTAL
DRAWING TITLE:
GROUNDWATER ELEVATION MAP (WECHES FORMATION) WATER LEVELS MEASURED 05/29/2018
PROJECT SITE:
ROYAL OAKS LANDFILL
MSW PERMIT NO. 1614A
CHEROKEE COUNTY, TEXAS
TBPG FIRM NO. 50027
MAP DATE: 07/18/2018
GIS ANALYST: SAS
PROJECT NO: L-05-839
DRAWING NO: N/A

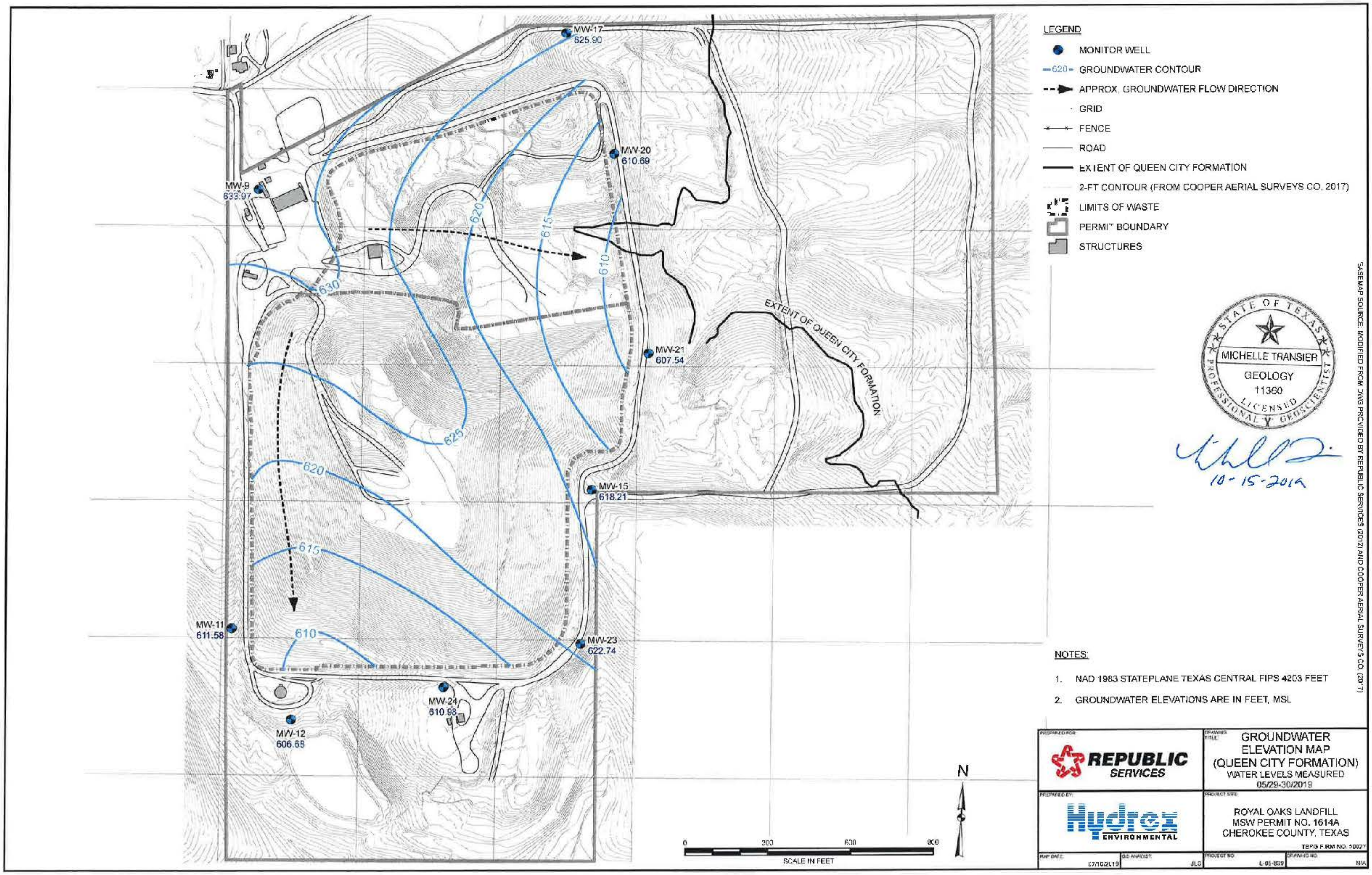


LEGEND
MONITOR WELL
620 GROUNDWATER CONTOUR
APPROX. GROUNDWATER FLOW DIRECTION
GRID
FENCE
ROAD
EXTENT OF QUEEN CITY FORMATION
2-FT CONTOUR (FROM COOPER AERIAL SURVEYS CO, 2017)
LIMITS OF WASTE
PERMIT BOUNDARY
STRUCTURES
MW-17
621.87
MW-20
610.49
MW-9
631.04
MW-21
606.49
MW-15
616.21
MW-11
610.76
MW-23
619.34
MW-24
609.43
MW-12
605.51
630
625
620
615
610
EXTENT OF QUEEN CITY FORMATION
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST
7-25-2018
BASEMAP SOURCE: MODIFIED FROM DWG PROVIDED BY REPUBLIC SERVICES (2021) AND COOPER AERIAL SURVEYS CO. (2017)
NOTES:
1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL
N
0
300
600
900
SCALE IN FEET
PREPARED FOR
REPUBLIC SERVICES
PREPARED BY
Hydrex ENVIRONMENTAL
DRAWING TITLE:
GROUNDWATER
ELEVATION MAP
(QUEEN CITY FORMATION)
WATER LEVELS MEASURED
05/29/2018
PROJECT:
ROYAL OAKS LANDFILL
MSW PERMIT NO. 1514A
CHEROKEE COUNTY, TEXAS
TBPG FIRM NO. 50227
MAP DATE
07/18/2018
GIS ANALYST
SAS
PROJECT NO.
L-05-630
DRAWING NO.
N/A

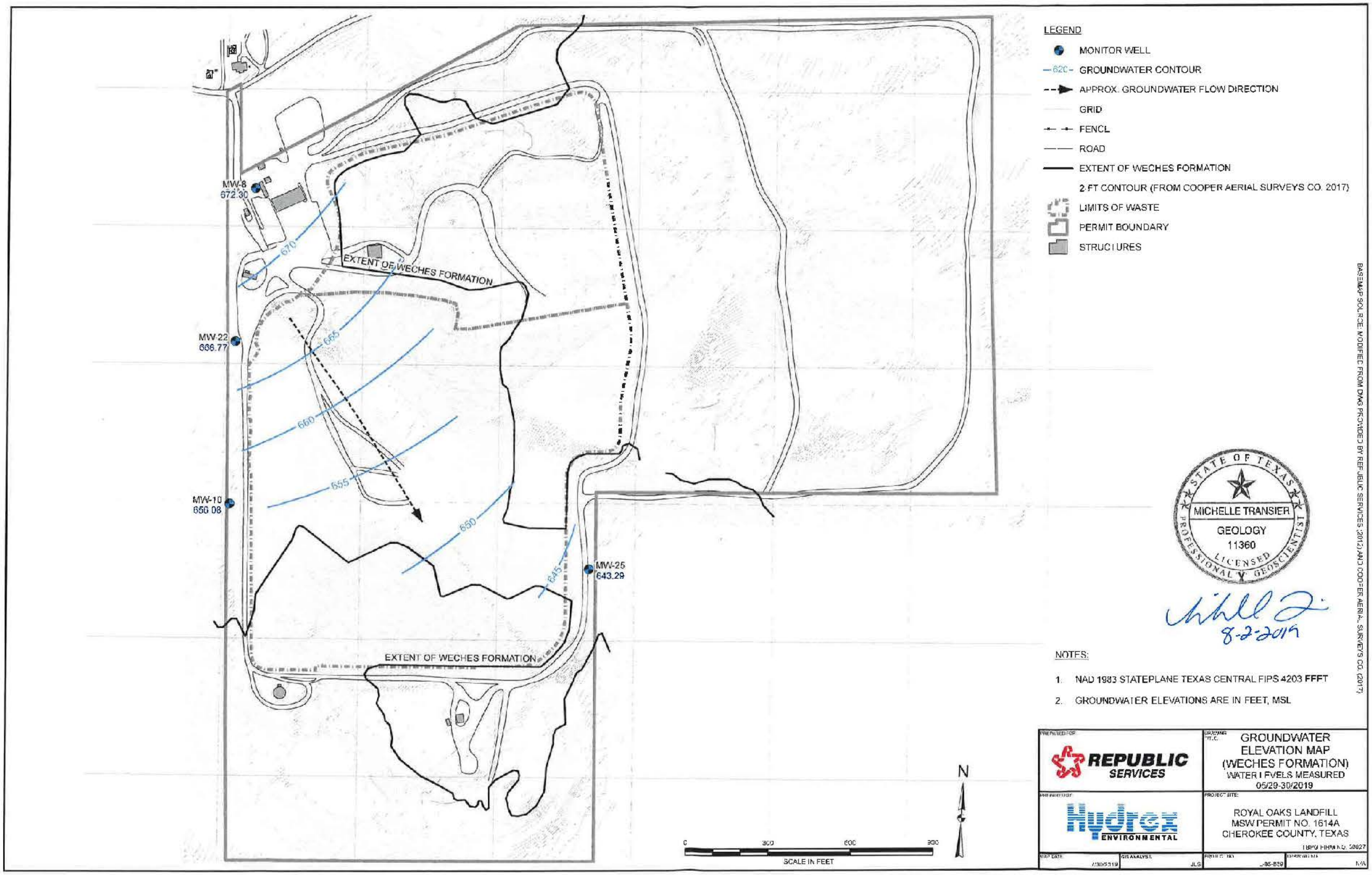


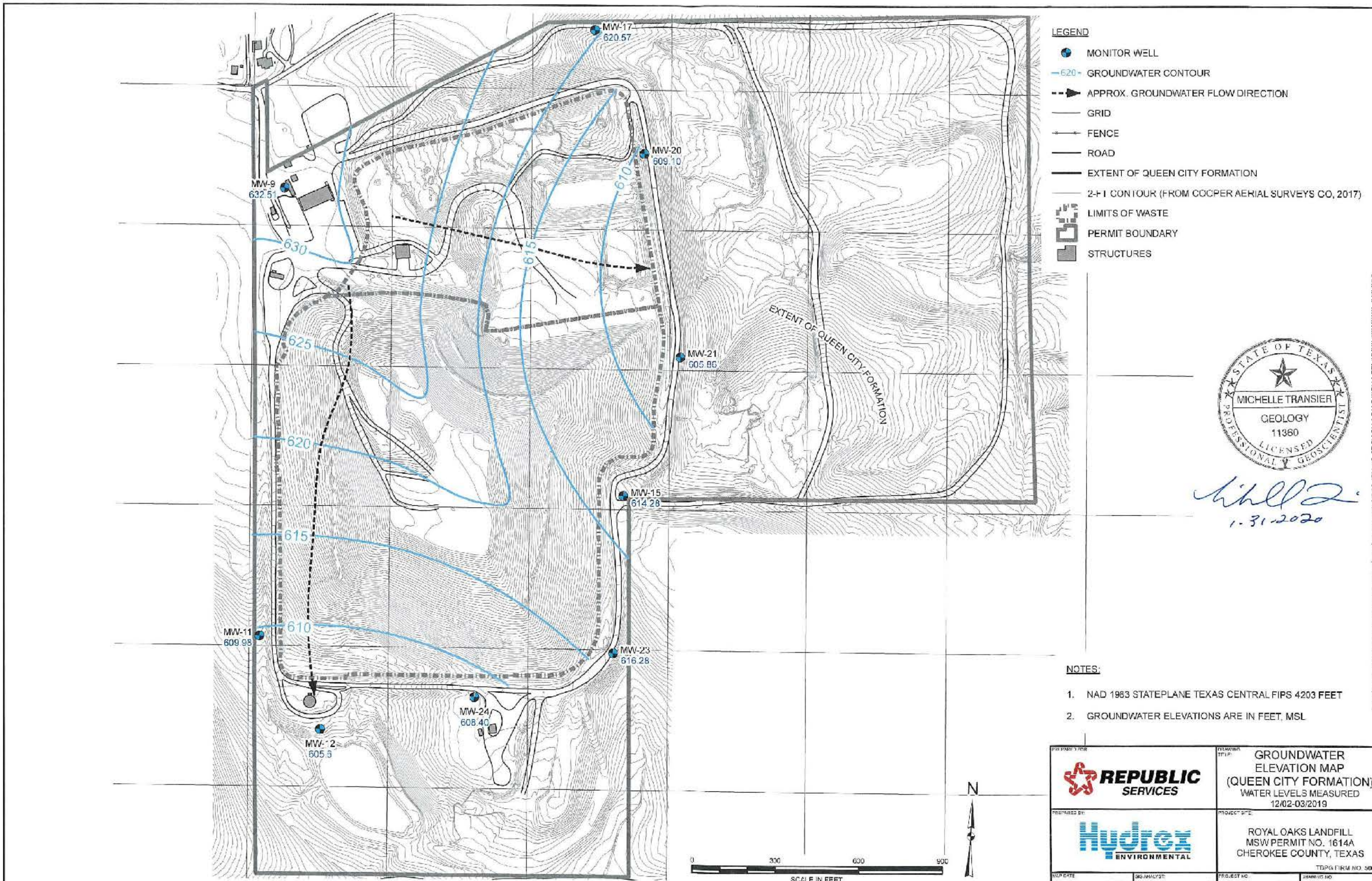
LEGEND
MONITOR WELL
620 GROUNDWATER CONTOUR
APPROX. GROUNDWATER FLOW DIRECTION
GRID
FENCE
ROAD
EXTENT OF WECHES FORMATION
2-FT CONTOUR (FROM COOPER AERIAL SURVEYS CO, 2017)
LIMITS OF WASTE
PERMIT BOUNDARY
STRUCTURES
MW-8
673.92
MW-22
669.51
MW-10
657.46
MW-25
642.88
EXTENT OF WECHES FORMATION
EXTENT OF WECHES FORMATION
N
0
300
600
900
SCALE IN FEET
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST
2-8-2019
NOTES:
1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL
BASEMAP SOURCE: MODIFIED HCM DWG PROVIDED BY REPUBLIC SERVICES (2012) AND COOPER AERIAL SURVEYS CO. (2017)
PREPARED FOR:
REPUBLIC SERVICES
DRAWING TITLE:
GROUNDWATER ELEVATION MAP
(WECHES FORMATION)
WATER LEVELS MEASURED
12/12/2018
PREPARED BY:
Hydrex ENVIRONMENTAL
PROJECT SITE:
ROYAL OAKS LANDFILL
MSW PERMIT NO. 1614A
CHEROKEE COUNTY, TEXAS
TBPG FIRM NO. 50027
MAP DATE
1/16/2019
GIS ANALYST
JLS
PROJECT NO.
L-05-639
DRAWING NO.
N/A

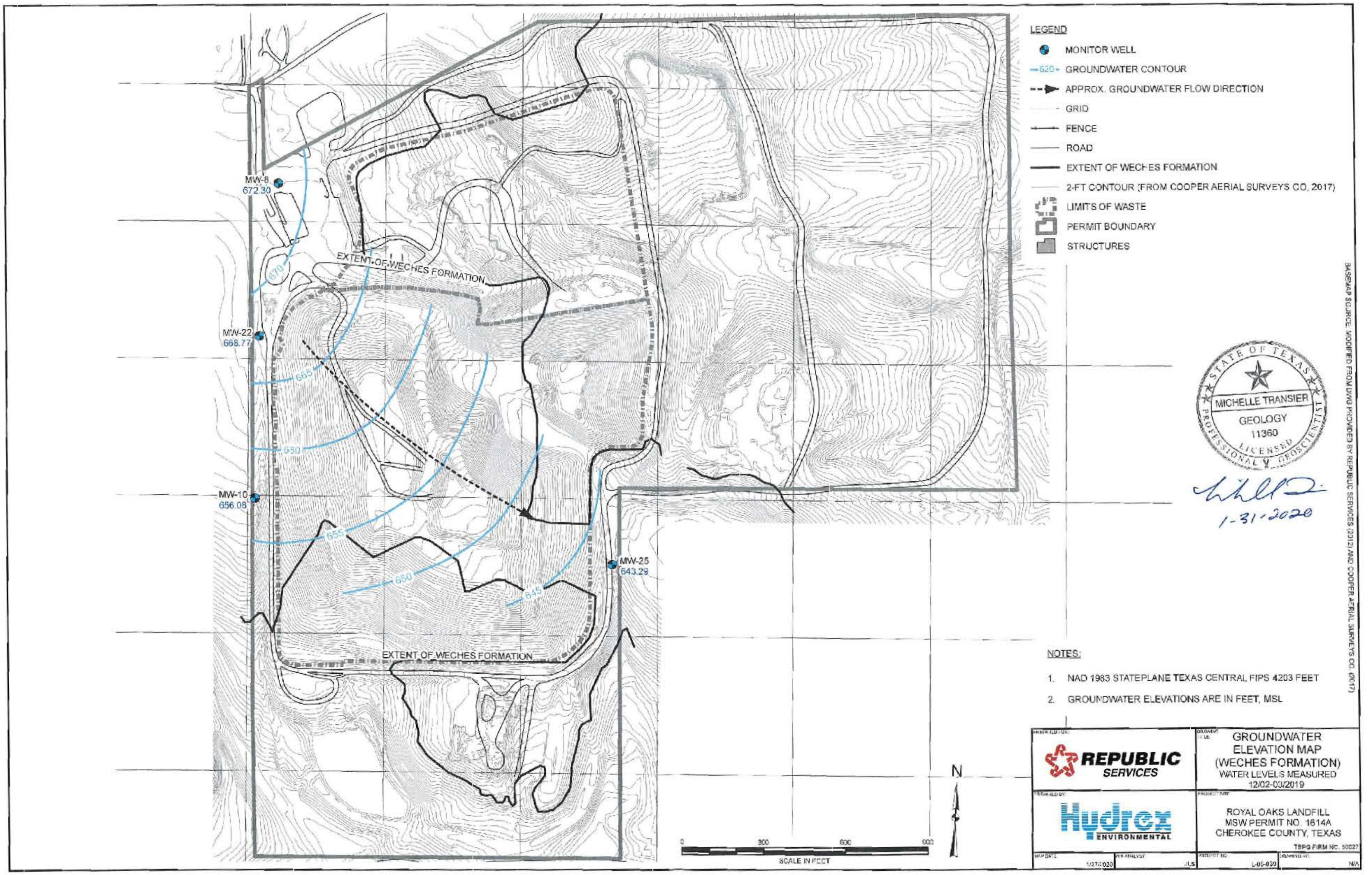

LEGEND
MONITOR WELL
620 GROUNDWATER CONTOUR
APPROX. GROUNDWATER FLOW DIRECTION
GRID
FENCE
ROAD
EXTENT OF QUEEN CITY FORMATION
2-FT CONTOUR (FROM COOPER AERIAL SURVEYS CO, 2017)
LIMITS OF WASTE
PERMIT BOUNDARY
STRUCTURES
MW-17 623.35
MW-20 613.95
MW-9 631.94
MW-21 608.86
MW-15 617.51
MW-11 613.29
MW-23 624.01
MW-24 610.42
MW-12 606.74
630
625
620
615
610
EXTENT OF QUEEN CITY FORMATION
BASEMAP SOURCE: MODIFIED FROM DWG PROVIDED BY REPUBLIC SERVICES (2012) AND COOPER AERIAL SURVEYS CO. (2017)
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST
2-8-2019
NOTES:
1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL
N
0
300
600
900
SCALE IN FEET
PREPARED FOR:
REPUBLIC SERVICES
DRAWING TITLE:
GROUNDWATER ELEVATION MAP (QUEEN CITY FORMATION)
WATER LEVELS MEASURED 12/12/2018
PREPARED BY:
Hydrex ENVIRONMENTAL
PROJECT SITE:
ROYAL OAKS LANDFILL
MSW PERMIT NO. 1614A
CHEROKEE COUNTY, TEXAS
TBPG FIRM NO. 50027
MAP DATE: 1/16/2019
GIS ANALYST: JLS
PROJECT NO. L-05-036
DRAWING NO. N/A



LEGEND
MONITOR WELL
620 GROUNDWATER CONTOUR
APPROX. GROUNDWATER FLOW DIRECTION
GRID
FENCE
ROAD
EXTENT OF QUEEN CITY FORMATION
2-FT CONTOUR (FROM COOPER AERIAL SURVEYS CO. 2017)
LIMITS OF WASTE
PERMIT BOUNDARY
STRUCTURES
MW-17 625.90
MW-20 610.69
MW-9 633.97
MW-21 607.54
MW-15 618.21
MW-11 611.58
MW-23 622.74
MW-24 610.98
MW-12 606.68
630
625
620
615
610
EXTENT OF QUEEN CITY FORMATION
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST
10-15-2019
BASEMAP SOURCE: MODIFIED FROM DWG PROVIDED BY REPUBLIC SERVICES (2012) AND COOPER AERIAL SURVEYS CO. (2017)
NOTES:
1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL
N
0
300
600
900
SCALE IN FEET
PREPARED FOR:
REPUBLIC SERVICES
DRAWING TITLE:
GROUNDWATER ELEVATION MAP (QUEEN CITY FORMATION)
WATER LEVELS MEASURED 05/29-30/2019
PREPARED BY:
Hydrex ENVIRONMENTAL
PROJECT SITE:
ROYAL OAKS LANDFILL
MSW PERMIT NO. 1614A
CHEROKEE COUNTY, TEXAS
TBPG FIRM NO. 50027
MAP DATE: 07/10/2019
GIS ANALYST: JLG
PROJECT NO: L-05-039
DRAWING NO: N/A


LEGEND
MONITOR WELL
GROUNDWATER CONTOUR
APPROX. GROUNDWATER FLOW DIRECTION
GRID
FENCE
ROAD
EXTENT OF WECHES FORMATION
2-FT CONTOUR (FROM COOPER AERIAL SURVEYS CO. 2017)
LIMITS OF WASTE
PERMIT BOUNDARY
STRUCTURES
MW-8
672.30
MW-22
666.77
MW-10
650.08
MW-25
643.29
670
665
660
655
650
645
EXTENT OF WECHES FORMATION
EXTENT OF WECHES FORMATION
BASEMAP SOURCE: MODIFIED FROM DWG PROVIDED BY REPUBLIC SERVICES (2012) AND COOPER AERIAL SURVEYS CO. (2017)
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST
8-2-2019
NOTES:
1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL
N
0
300
600
900
SCALE IN FEET
REPUBLIC SERVICES
Hydrex ENVIRONMENTAL
GROUNDWATER ELEVATION MAP (WECHES FORMATION)
WATER LEVELS MEASURED 05/29-30/2019
ROYAL OAKS LANDFILL
MSW PERMIT NO. 1614A
CHEROKEE COUNTY, TEXAS
TBPG FIRM NO. 50627


LEGEND
MONITOR WELL
620 GROUNDWATER CONTOUR
APPROX. GROUNDWATER FLOW DIRECTION
GRID
FENCE
ROAD
EXTENT OF QUEEN CITY FORMATION
2-FT CONTOUR (FROM COOPER AERIAL SURVEYS CO, 2017)
LIMITS OF WASTE
PERMIT BOUNDARY
STRUCTURES
MW-17
620.57
MW-20
609.10
MW-9
632.51
MW-21
605.86
MW-15
614.28
MW-11
609.98
MW-23
616.28
MW-24
608.40
MW-12
605.5
630
625
620
615
610
EXTENT OF QUEEN CITY FORMATION
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST
1-31-2020
BASEMAP SOURCE MODIFIED FROM DWG PROVIDED BY REPUBLIC SERVICES (2012) AND COOPER AERIAL SURVEYS CO. (2017)
NOTES:
1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL
N
0
300
600
900
SCALE IN FEET
REPUBLIC SERVICES
Hydrex ENVIRONMENTAL
GROUNDWATER ELEVATION MAP (QUEEN CITY FORMATION)
WATER LEVELS MEASURED 12/02-03/2019
ROYAL OAKS LANDFILL
MSW PERMIT NO. 1614A
CHEROKEE COUNTY, TEXAS
TBPG FIRM NO. 50027
1/27/2020
JLS
L-05-839
N/A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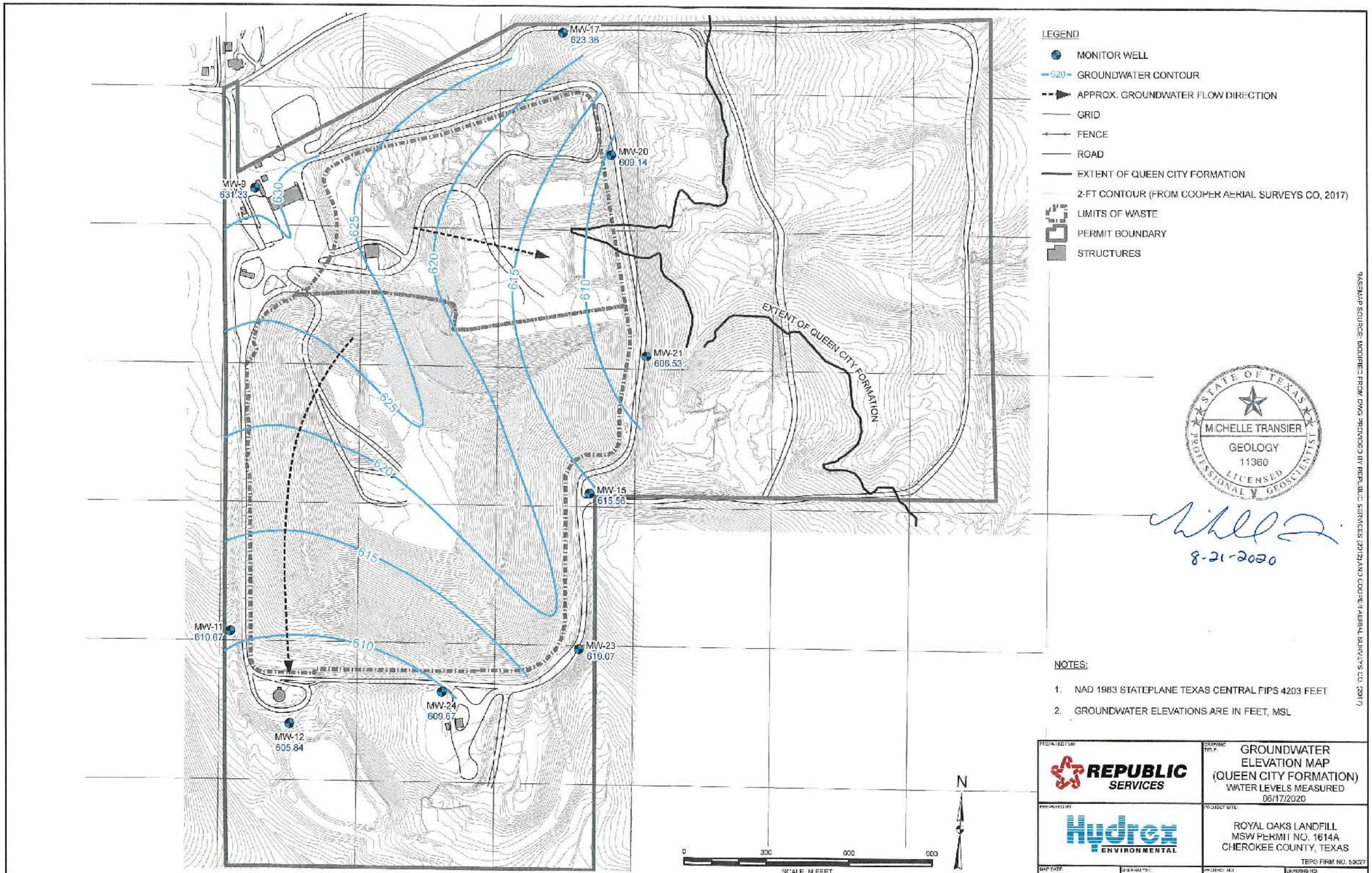
MONITOR WELL
620 GROUNDWATER CONTOUR
APPROX. GROUNDWATER FLOW DIRECTION
GRID
FENCE
ROAD
EXTENT OF WECHES FORMATION
2-FT CONTOUR (FROM COOPER AERIAL SURVEYS CO, 2017)
LIMITS OF WASTE
PERMIT BOUNDARY
STRUCTURES
MW-8
672.30
MW-22
668.77
MW-10
656.05
MW-25
643.29
670
665
660
655
650
645
EXTENT OF WECHES FORMATION
EXTENT OF WECHES FORMATION
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST
1-31-2020
BASEMAP SOURCE: MODIFIED FROM DWG PROVIDED BY REPUBLIC SERVICES (2012) AND COOPER AERIAL SURVEYS CO. (2017)
NOTES:
1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL
N
0
300
600
900
SCALE IN FEET
REPUBLIC SERVICES
Hydrex ENVIRONMENTAL
GROUNDWATER ELEVATION MAP (WECHES FORMATION)
WATER LEVELS MEASURED 12/02-03/2019
ROYAL OAKS LANDFILL
MSW PERMIT NO. 1614A
CHEROKEE COUNTY, TEXAS
TBPG FIRM NO. 50037
1/27/2020
JLS
L-05-020
N/A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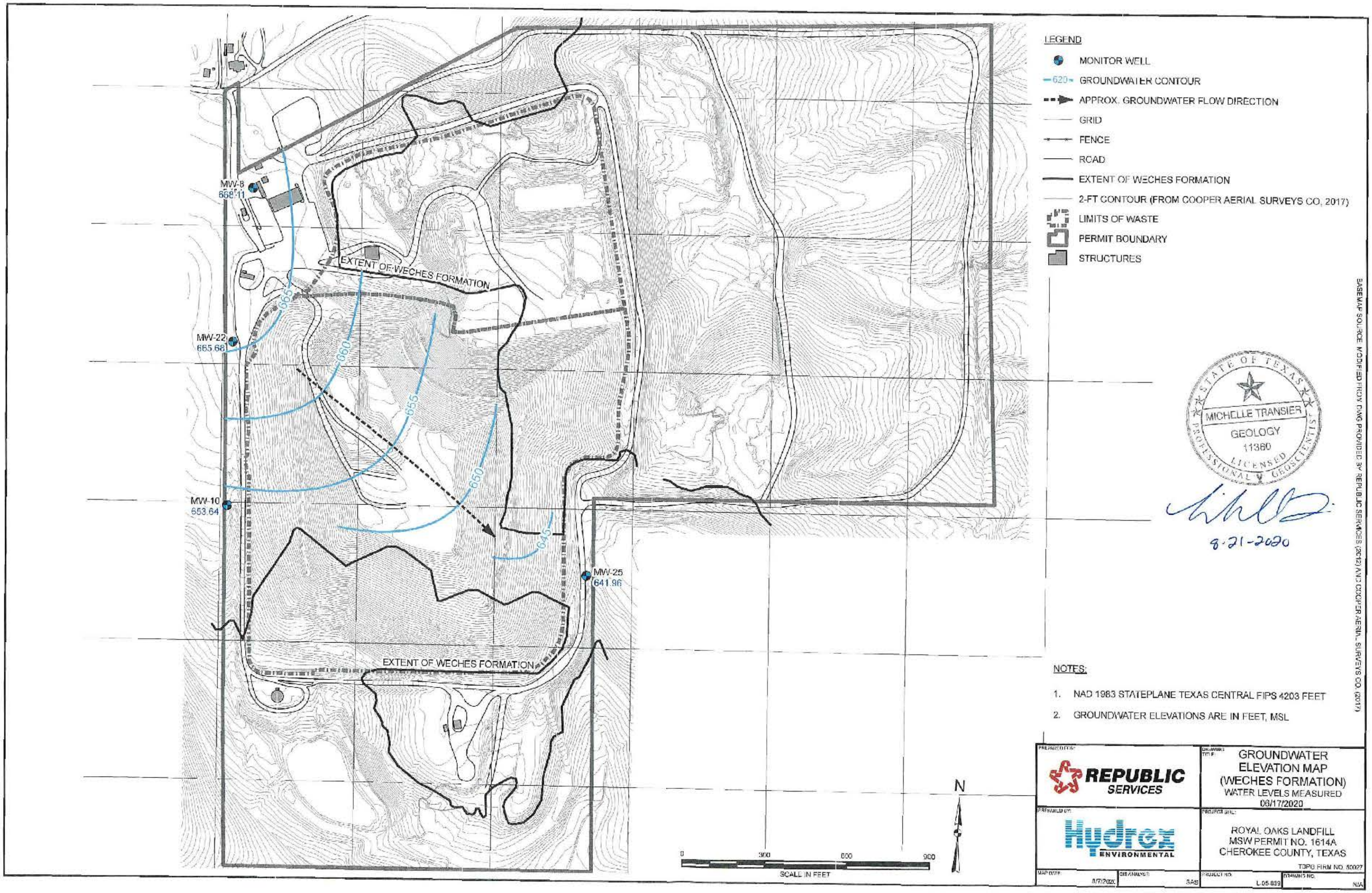
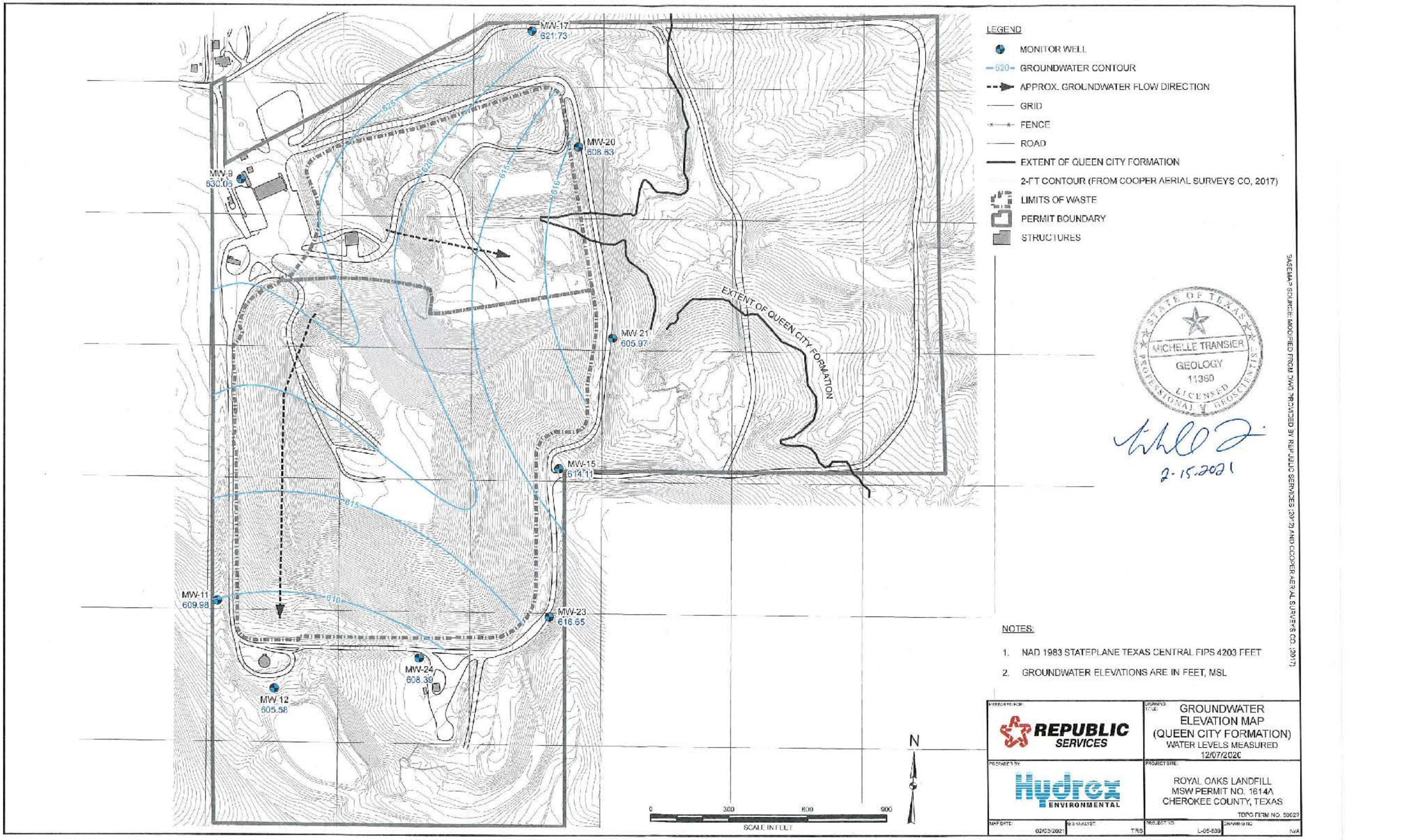
MONITOR WELL
620 GROUNDWATER CONTOUR
APPROX. GROUNDWATER FLOW DIRECTION
GRID
FENCE
ROAD
EXTENT OF QUEEN CITY FORMATION
2-FT CONTOUR (FROM COOPER AERIAL SURVEYS CO, 2017)
LIMITS OF WASTE
PERMIT BOUNDARY
STRUCTURES
MW-17
623.36
MW-20
609.14
MW-9
631.33
MW-21
606.53
MW-15
615.56
MW-11
610.67
MW-23
619.07
MW-24
609.67
MW-12
605.84
630
625
620
615
610
EXTENT OF QUEEN CITY FORMATION
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST
8-21-2020
NOTES:
1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL
REPUBLIC SERVICES
Hydrex ENVIRONMENTAL
GROUNDWATER ELEVATION MAP (QUEEN CITY FORMATION)
WATER LEVELS MEASURED 06/17/2020
ROYAL OAKS LANDFILL
MSW PERMIT NO. 1614A
CHEROKEE COUNTY, TEXAS
TBPG FIRM NO. 50027
8/7/2020
SAS
L-06-839
N/A
N
0
300
600
900
SCALE IN FEET
BASEMAP SOURCE: MODIFIED FROM DWG PROVIDED BY REPUBLIC SERVICES (2012) AND COOPER AERIAL SURVEYS CO. 2017)


LEGEND
MONITOR WELL
620 GROUNDWATER CONTOUR
APPROX. GROUNDWATER FLOW DIRECTION
GRID
FENCE
ROAD
EXTENT OF WECHES FORMATION
2-FT CONTOUR (FROM COOPER AERIAL SURVEYS CO, 2017)
LIMITS OF WASTE
PERMIT BOUNDARY
STRUCTURES
MW-8
668.11
MW-22
665.68
MW-10
653.64
MW-25
641.96
665
660
655
650
645
EXTENT OF WECHES FORMATION
EXTENT OF WECHES FORMATION
BASEMAP SOURCE: MODIFIED FROM DWG PROVIDED BY REPUBLIC SERVICES (2012) AND COOPER AERIAL SURVEYS CO (2017)
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST
8-21-2020
NOTES:
1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL
N
0
300
600
900
SCALE IN FEET
PREPARED FOR:
REPUBLIC SERVICES
DRAWING TITLE:
GROUNDWATER ELEVATION MAP (WECHES FORMATION)
WATER LEVELS MEASURED 06/17/2020
PREPARED BY:
Hydrex ENVIRONMENTAL
PROJECT SITE:
ROYAL OAKS LANDFILL
MSW PERMIT NO. 1614A
CHEROKEE COUNTY, TEXAS
TBPG FIRM NO. 50027
MAP DATE: 8/7/2020
GIS ANALYST: SAS
PROJECT NO. L-05-839
DRAWING NO. N/A



MW-17
621.73
MW-20
608.63
MW-9
630.06
MW-21
605.97
MW-15
614.11
MW-11
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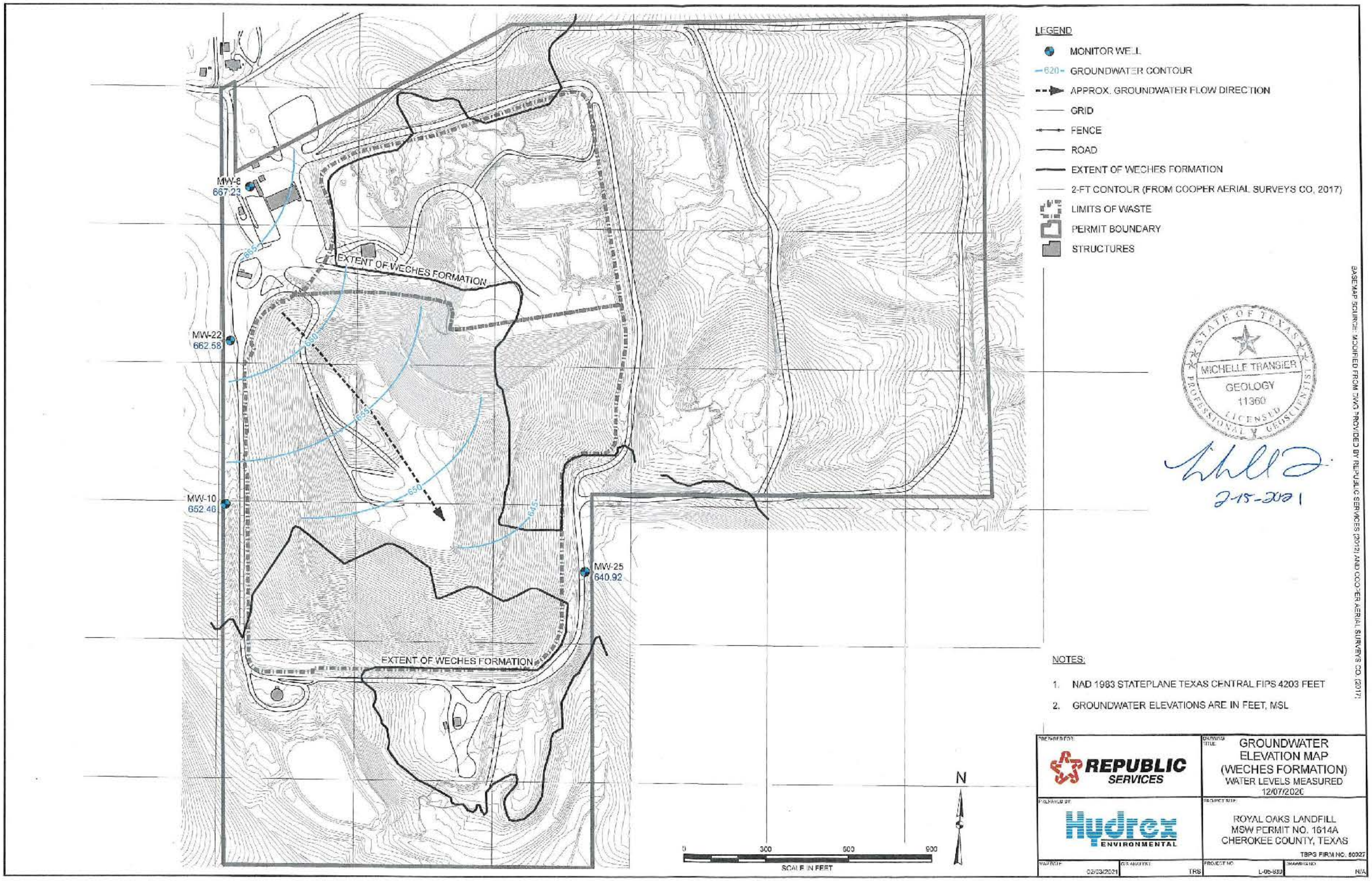
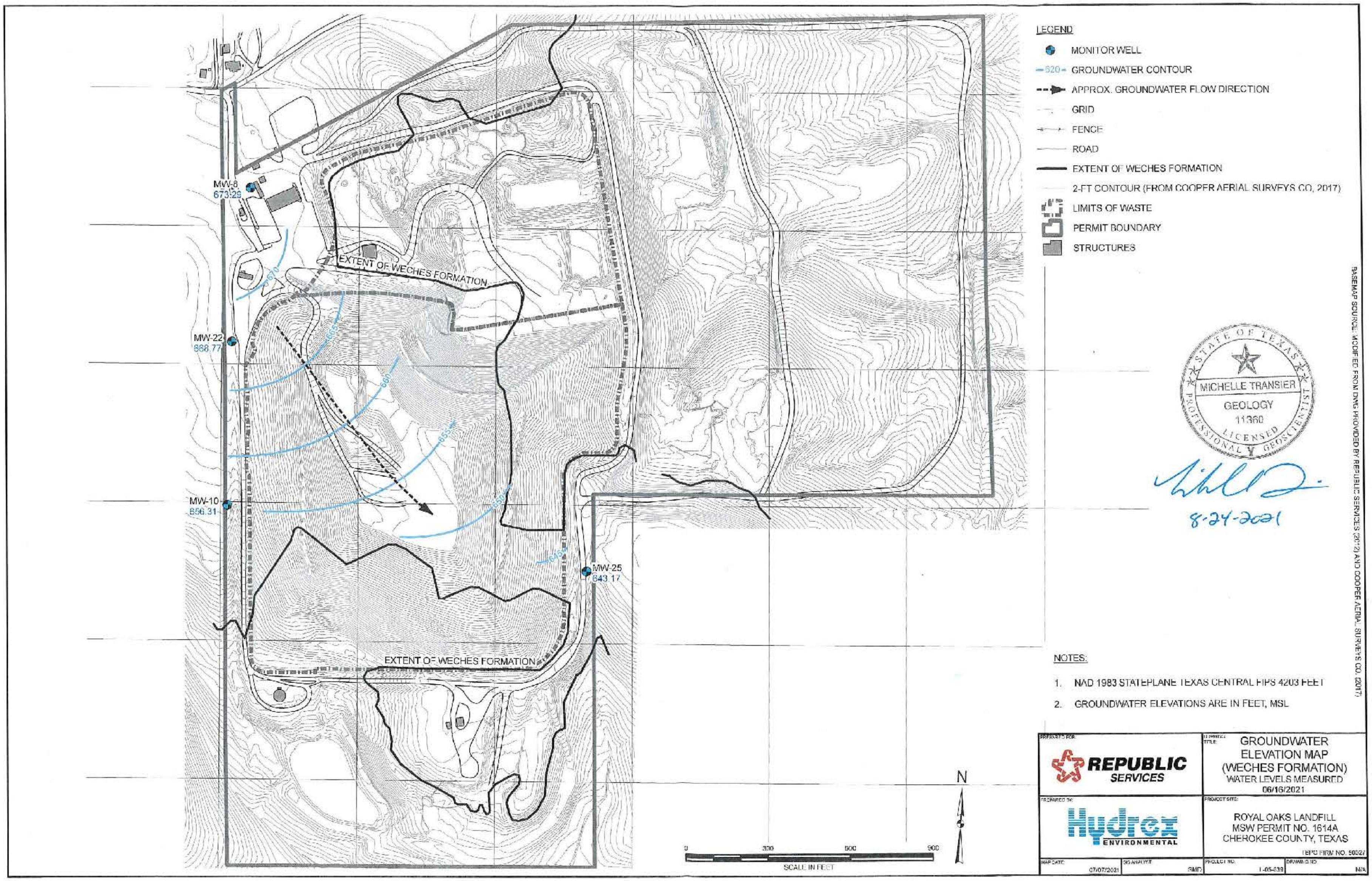
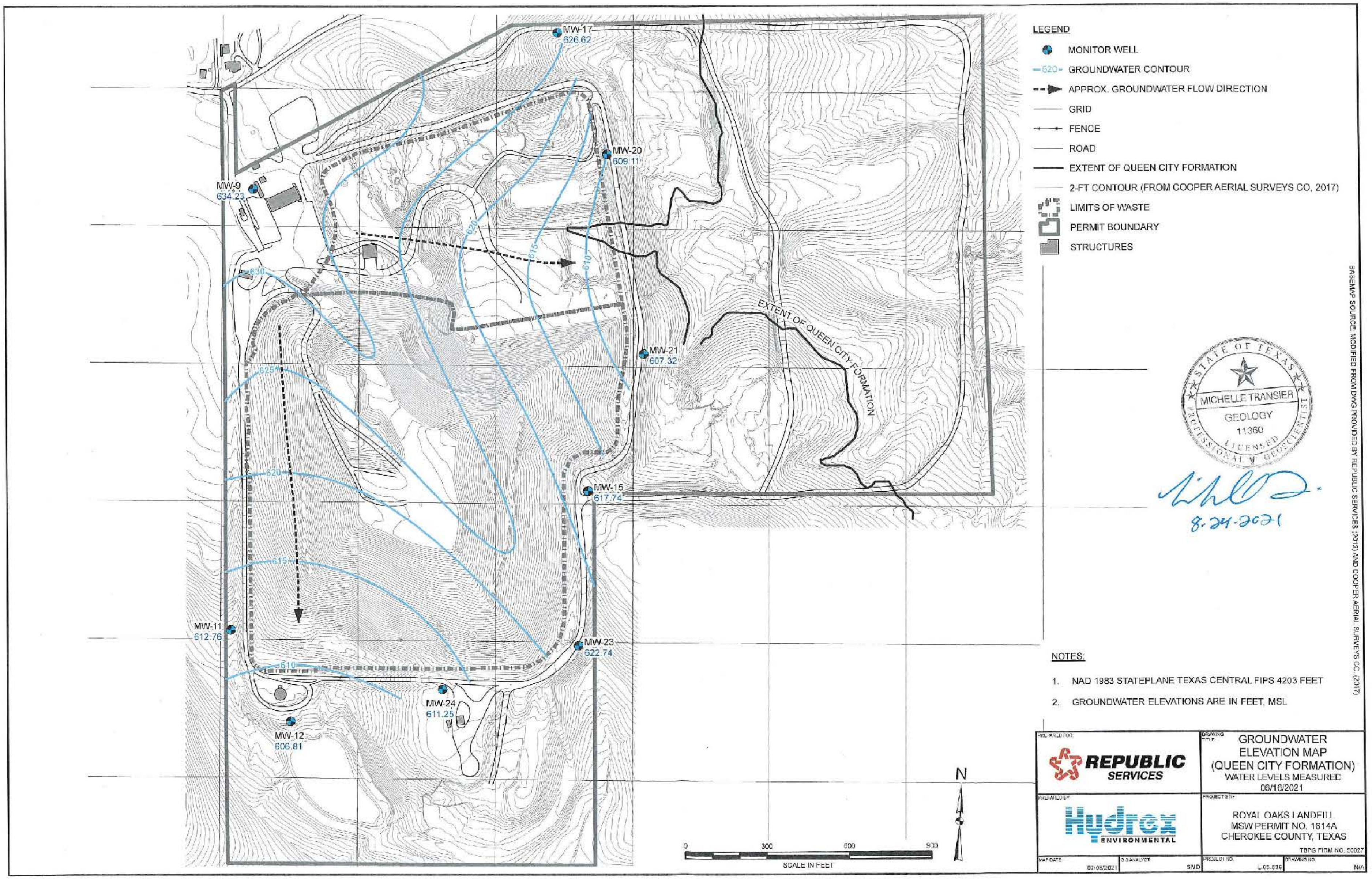
MW-23
616.65
MW-24
608.39
MW-12
605.58
625
620
615
610
EXTENT OF QUEEN CITY FORMATION
LEGEND
MONITOR WELL
620 GROUNDWATER CONTOUR
APPROX. GROUNDWATER FLOW DIRECTION
GRID
FENCE
ROAD
EXTENT OF QUEEN CITY FORMATION
2-FT CONTOUR (FROM COOPER AERIAL SURVEYS CO, 2017)
LIMITS OF WASTE
PERMIT BOUNDARY
STRUCTURES
BASEMAP SOURCE: MODIFIED FROM DWG PROVIDED BY REPUBLIC SERVICES (2012) AND COOPER AERIAL SURVEYS CO. (2017)
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST
2-15-2021
NOTES:
1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL
N
0
300
600
900
SCALE IN FEET
PREPARED FOR:
REPUBLIC SERVICES
DRAWING TITLE:
GROUNDWATER ELEVATION MAP (QUEEN CITY FORMATION)
WATER LEVELS MEASURED 12/07/2020
PREPARED BY:
Hydrex ENVIRONMENTAL
PROJECT SITE:
ROYAL OAKS LANDFILL
MSW PERMIT NO. 1614A
CHEROKEE COUNTY, TEXAS
TBPG FIRM NO. 50027
MAP DATE: 02/03/2021
GIS ANALYST: TRS
PROJECT NO. L-05-639
DRAWING NO. N/A


LEGEND
MONITOR WELL
620 GROUNDWATER CONTOUR
APPROX. GROUNDWATER FLOW DIRECTION
GRID
FENCE
ROAD
EXTENT OF WECHES FORMATION
2-FT CONTOUR (FROM COOPER AERIAL SURVEYS CO, 2017)
LIMITS OF WASTE
PERMIT BOUNDARY
STRUCTURES
MW-8
667.23
MW-22
662.58
MW-10
662.46
MW-25
640.92
665
660
655
650
645
EXTENT OF WECHES FORMATION
EXTENT OF WECHES FORMATION
BASEMAP SOURCE: MODIFIED FROM DWG PROVIDED BY REPUBLIC SERVICES (2012) AND COOPER AERIAL SURVEYS CO. (2017)
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST
2-15-2021
NOTES:
1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL
N
0
300
600
900
SCALE IN FEET
PREPARED FOR:
REPUBLIC SERVICES
PREPARED BY:
Hydrex ENVIRONMENTAL
DRAWING TITLE:
GROUNDWATER ELEVATION MAP (WECHES FORMATION)
WATER LEVELS MEASURED 12/07/2020
PROJECT SITE:
ROYAL OAKS LANDFILL
MSW PERMIT NO. 1614A
CHEROKEE COUNTY, TEXAS
TBPG FIRM NO. 50027
MAP DATE 02/03/2021
GIS ANALYST TRS
PROJECT NO. L-05-839
DRAWING NO. N/A


EXTENT OF WECHES FORMATION
EXTENT OF WECHES FORMATION
MW-8
673.29
MW-22
666.77
MW-10
656.31
MW-25
643.17
N
0
300
600
900
SCALE IN FEET
LEGEND
MONITOR WELL
620 GROUNDWATER CONTOUR
APPROX. GROUNDWATER FLOW DIRECTION
GRID
FENCE
ROAD
EXTENT OF WECHES FORMATION
2-FT CONTOUR (FROM COOPER AERIAL SURVEYS CO, 2017)
LIMITS OF WASTE
PERMIT BOUNDARY
STRUCTURES
BASEMAP SOURCE: MODIFIED FROM DWG PROVIDED BY REPUBLIC SERVICES 2012 AND COOPER AERIAL SURVEYS CO. (2017)
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST
8-24-2021
NOTES:
1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL
PREPARED FOR:
REPUBLIC SERVICES
DRAWING TITLE:
GROUNDWATER ELEVATION MAP (WECHES FORMATION) WATER LEVELS MEASURED 06/16/2021
PREPARED BY:
Hydrex ENVIRONMENTAL
PROJECT SITE:
ROYAL OAKS LANDFILL
MSW PERMIT NO. 1614A
CHEROKEE COUNTY, TEXAS
TBPG FIRM NO. 50027
MAP DATE: 07/07/2021
GIS ANALYST: GMD
PROJECT NO. 1-05-039
DRAWING NO. N/A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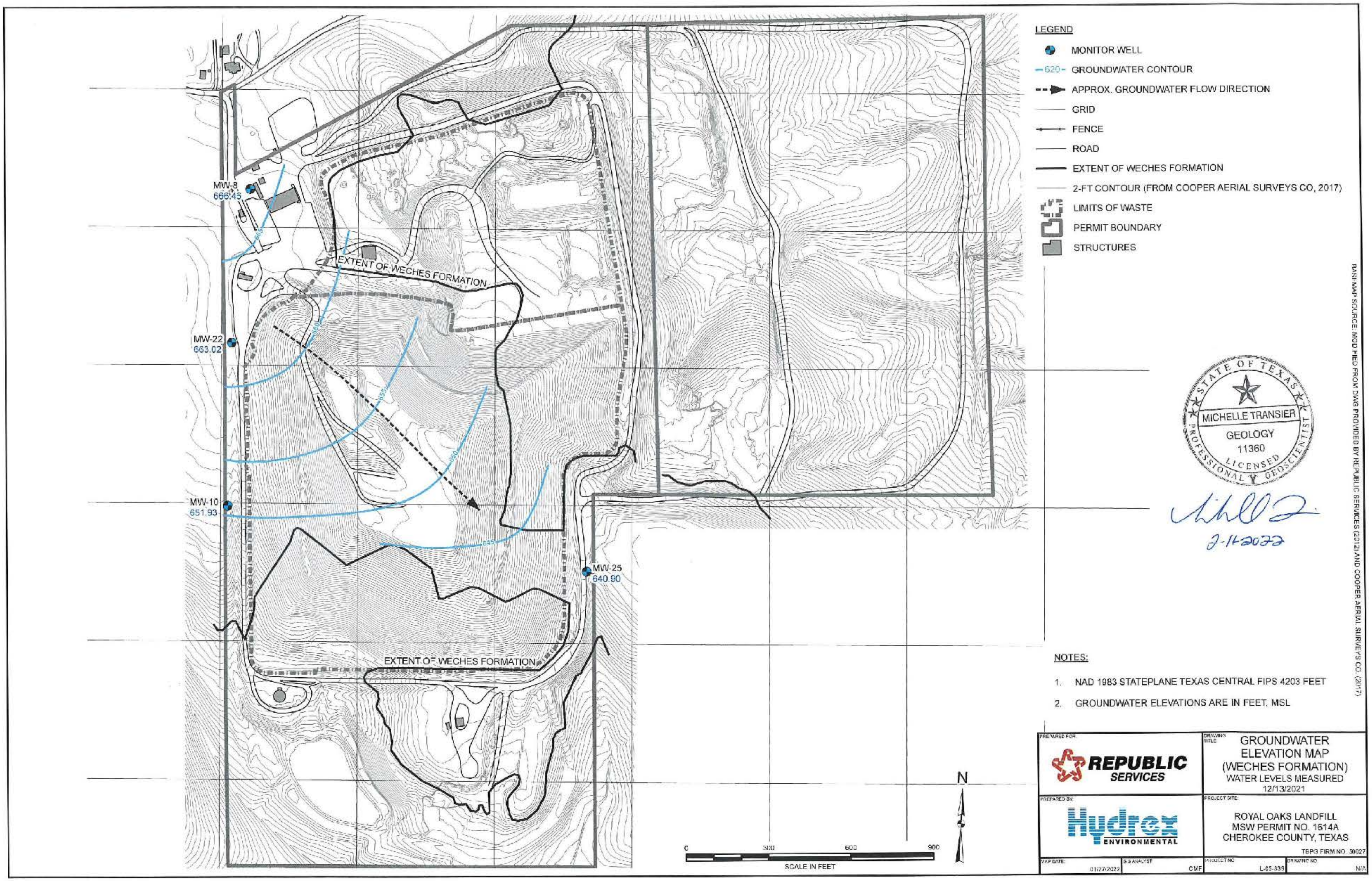
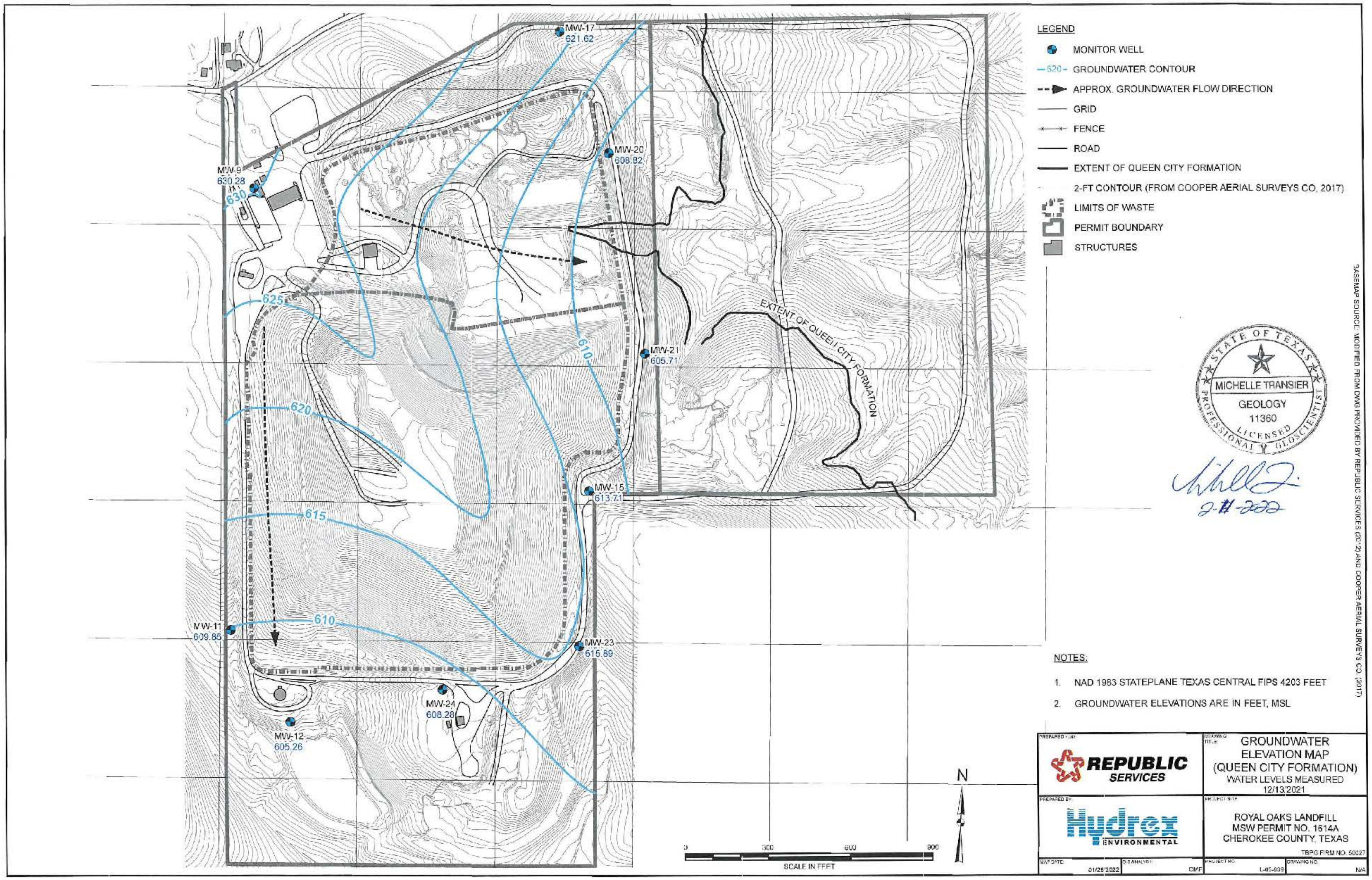
MW-20
609.11
MW-9
634.23
MW-21
607.32
MW-15
617.74
MW-11
612.76
MW-23
622.74
MW-24
611.25
MW-12
606.81
630
625
620
615
610
EXTENT OF QUEEN CITY FORMATION
N
0
300
600
900
SCALE IN FEET
LEGEND
MONITOR WELL
620 GROUNDWATER CONTOUR
APPROX. GROUNDWATER FLOW DIRECTION
GRID
FENCE
ROAD
EXTENT OF QUEEN CITY FORMATION
2-FT CONTOUR (FROM COOPER AERIAL SURVEYS CO, 2017)
LIMITS OF WASTE
PERMIT BOUNDARY
STRUCTURES
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST
8-24-2021
BASEMAP SOURCE: MODIFIED FROM DWG PROVIDED BY REPUBLIC SERVICES (2015) AND COOPER AERIAL SURVEYS CO. (2017)
NOTES:
1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL
REPUBLIC SERVICES
DRAWING TITLE:
GROUNDWATER
ELEVATION MAP
(QUEEN CITY FORMATION)
WATER LEVELS MEASURED
06/16/2021
Hydrex ENVIRONMENTAL
PROJECT SITE:
ROYAL OAKS LANDFILL
MSW PERMIT NO. 1614A
CHEROKEE COUNTY, TEXAS
TBPG FIRM NO. 50027
MAP DATE:
07/06/2021
SMD
PROJECT NO.
L-05-635
DRAWING NO.
N/A


LEGEND
MONITOR WELL
620 GROUNDWATER CONTOUR
APPROX. GROUNDWATER FLOW DIRECTION
GRID
FENCE
ROAD
EXTENT OF WECHES FORMATION
2-FT CONTOUR (FROM COOPER AERIAL SURVEYS CO, 2017)
LIMITS OF WASTE
PERMIT BOUNDARY
STRUCTURES
MW-8
666.45
MW-22
663.02
MW-10
651.93
MW-25
640.90
EXTENT OF WECHES FORMATION
EXTENT OF WECHES FORMATION
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST
2-11-2022
BASE MAP SOURCE: MODIFIED FROM DWG PROVIDED BY REPUBLIC SERVICES (2012) AND COOPER AERIAL SURVEYS CO. (2017)
NOTES:
1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL
N
0
300
600
900
SCALE IN FEET
PREPARED FOR:
REPUBLIC SERVICES
PREPARED BY:
Hydrex ENVIRONMENTAL
DRAWING TITLE:
GROUNDWATER ELEVATION MAP (WECHES FORMATION)
WATER LEVELS MEASURED 12/13/2021
PROJECT SITE:
ROYAL OAKS LANDFILL
MSW PERMIT NO. 1614A
CHEROKEE COUNTY, TEXAS
TBPG FIRM NO. 50027
MAP DATE: 01/27/2022
GIS ANALYST: CMF
PROJECT NO: L-05-535
DRAWING NO: N/A



MW-17
621.62
MW-9
630.28
630
MW-20
608.82
625
610
MW-21
605.71
620
MW-15
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615
MW-11
609.85
610
MW-23
615.89
MW-24
608.28
MW-12
605.26
EXTENT OF QUEEN CITY FORMATION
LEGEND
MONITOR WELL
620 GROUNDWATER CONTOUR
APPROX. GROUNDWATER FLOW DIRECTION
GRID
FENCE
ROAD
EXTENT OF QUEEN CITY FORMATION
2-FT CONTOUR (FROM COOPER AERIAL SURVEYS CO, 2017)
LIMITS OF WASTE
PERMIT BOUNDARY
STRUCTURES
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST
2-11-2022
NOTES:
1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL
N
0
300
600
900
SCALE IN FEET
REPUBLIC SERVICES
Hydrex ENVIRONMENTAL
GROUNDWATER ELEVATION MAP (QUEEN CITY FORMATION)
WATER LEVELS MEASURED 12/13/2021
ROYAL OAKS LANDFILL
MSW PERMIT NO. 1614A
CHEROKEE COUNTY, TEXAS
TBPG FIRM NO. 50027
01/26/2022
CMF
N/A
BASEMAP SOURCE: MODIFIED FROM DWG PROVIDED BY REPUBLIC SERVICES (2022) AND COOPER AERIAL SURVEYS CO. (2017)

LEGEND

- MONITOR WELL
- 620 GROUNDWATER CONTOUR
- APPROX. GROUNDWATER FLOW DIRECTION
- GRID
- FENCE
- ROAD
- EXTENT OF WECHES FORMATION
- 2-FT CONTOUR (FROM COOPER AERIAL SURVEYS CO. 2017)
- LIMITS OF WASTE
- PERMIT BOUNDARY
- STRUCTURES

BASEMAP SOURCE: MODIFIED FROM DWG PROVIDED BY REPUBLIC SERVICES (2012) AND COOPER AERIAL SURVEYS CO. (2017)

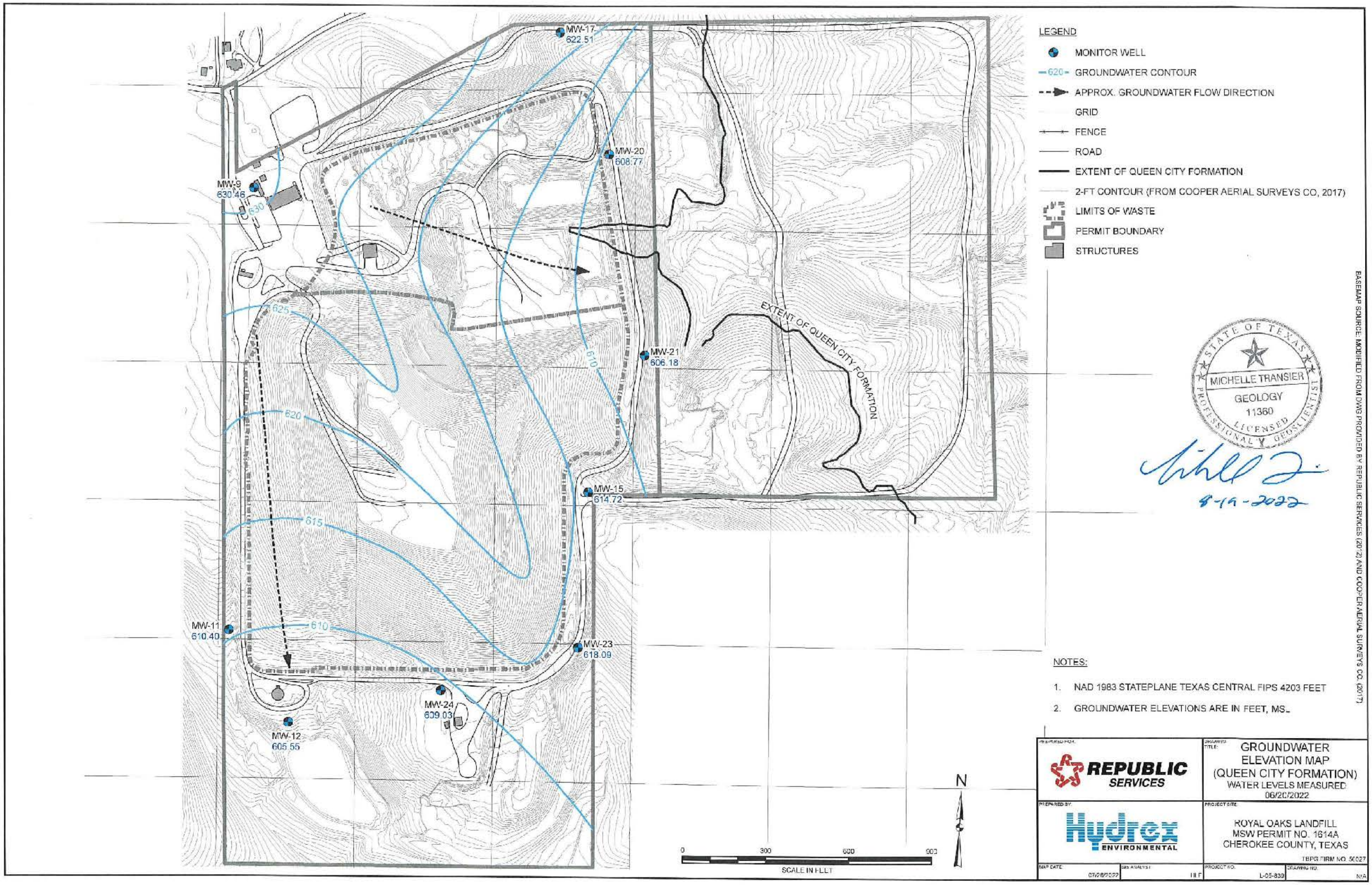
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST

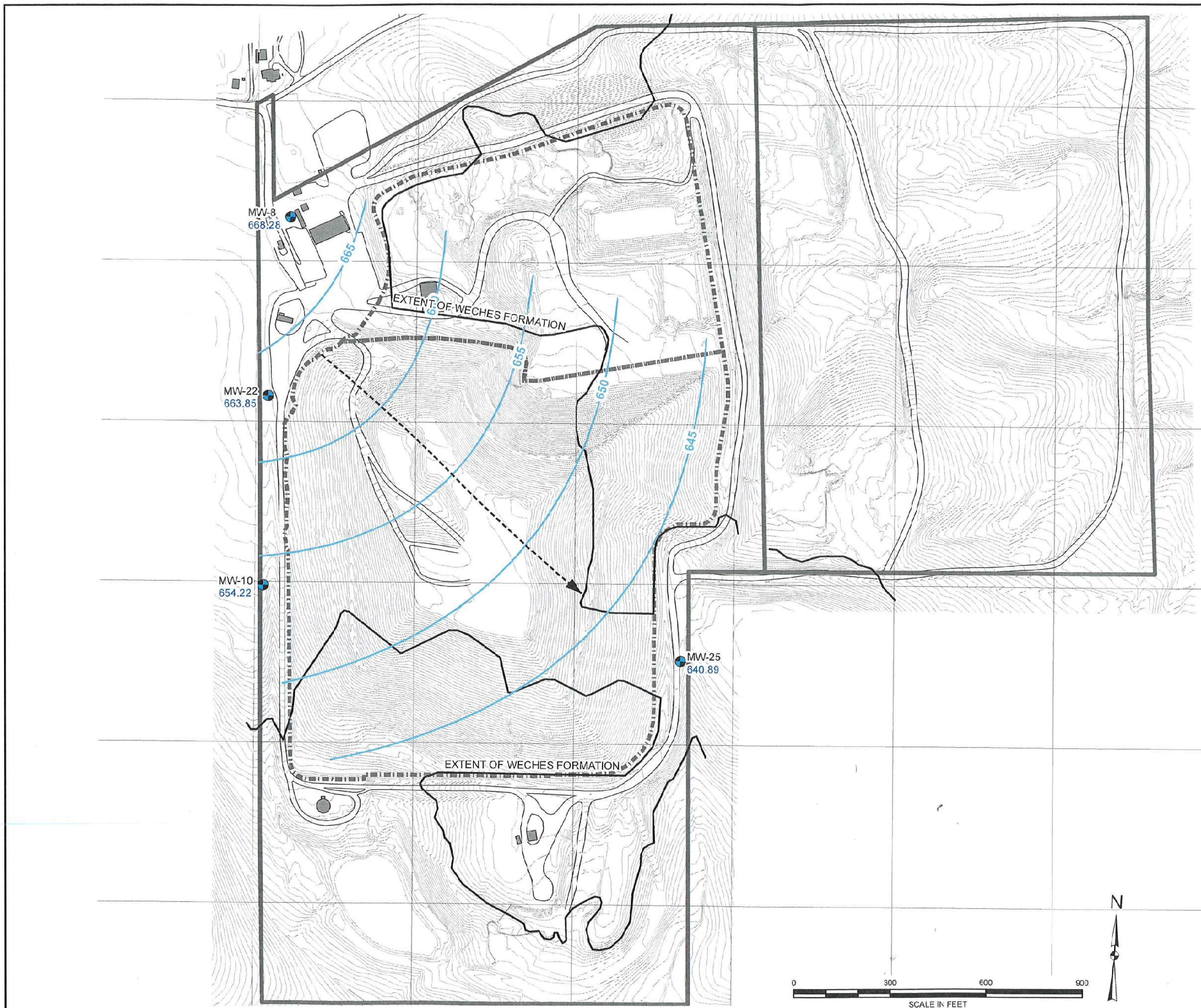
8-19-2022

NOTES:

1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL

PREPARED FOR: REPUBLIC SERVICES	DRAWING TITLE: GROUNDWATER ELEVATION MAP (WECHES FORMATION) WATER LEVELS MEASURED 6/20/2022
PREPARED BY: Hydrex ENVIRONMENTAL	PROJECT SITE: ROYAL OAKS LANDFILL MSW PERMIT NO. 1614A CHEROKEE COUNTY, TEXAS
	TBPG FIRM NO. 50027
MAP DATE: 07/20/2022 GIS ANALYST: HLF	PROJECT NO.: L-05-839 DRAWING NO.: N/A


LEGEND
MONITOR WELL
620 GROUNDWATER CONTOUR
APPROX. GROUNDWATER FLOW DIRECTION
GRID
FENCE
ROAD
EXTENT OF QUEEN CITY FORMATION
2-FT CONTOUR (FROM COOPER AERIAL SURVEYS CO, 2017)
LIMITS OF WASTE
PERMIT BOUNDARY
STRUCTURES
MW-17 622.51
MW-20 608.77
MW-9 630.46
MW-21 606.18
MW-15 614.72
MW-11 610.40
MW-23 618.09
MW-24 609.03
MW-12 605.55
630
625
620
615
610
EXTENT OF QUEEN CITY FORMATION
BASEMAP SOURCE: MODIFIED FROM DWG PROVIDED BY REPUBLIC SERVICES (2022) AND COOPER AERIAL SURVEYS CO. (2017)
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST
8-19-2022
NOTES:
1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL
N
0
300
600
900
SCALE IN FEET
PREPARED FOR:
REPUBLIC SERVICES
DRAWING TITLE:
GROUNDWATER ELEVATION MAP (QUEEN CITY FORMATION)
WATER LEVELS MEASURED 06/20/2022
PREPARED BY:
Hydrex ENVIRONMENTAL
PROJECT SITE:
ROYAL OAKS LANDFILL
MSW PERMIT NO. 1614A
CHEROKEE COUNTY, TEXAS
TBPG FIRM NO. 50027
MAP DATE: 07/28/2022
GIS ANALYST:
PROJECT NO. L-05-839
DRAWING NO. N/A



LEGEND

- MONITOR WELL
- 620 GROUNDWATER CONTOUR
- APPROX. GROUNDWATER FLOW DIRECTION
- GRID
- FENCE
- ROAD
- EXTENT OF WECHES FORMATION
- 2-FT CONTOUR (FROM COOPER AERIAL SURVEYS CO, 2017)
- LIMITS OF WASTE
- PERMIT BOUNDARY
- STRUCTURES

BASEMAP SOURCE: MODIFIED FROM DWG PROVIDED BY REPUBLIC SERVICES (2012) AND COOPER AERIAL SURVEYS CO. (2017)

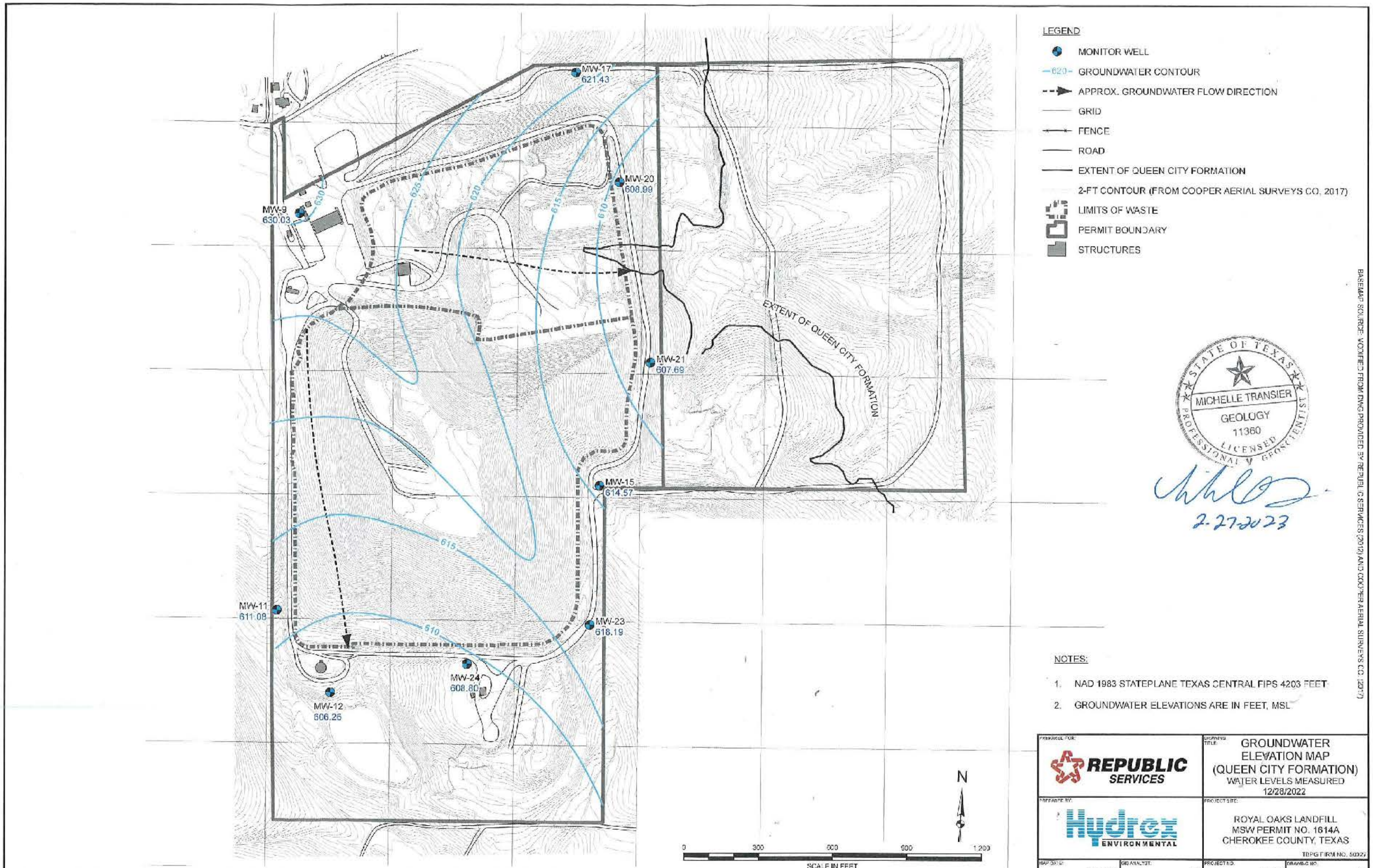
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST

2-27-2023

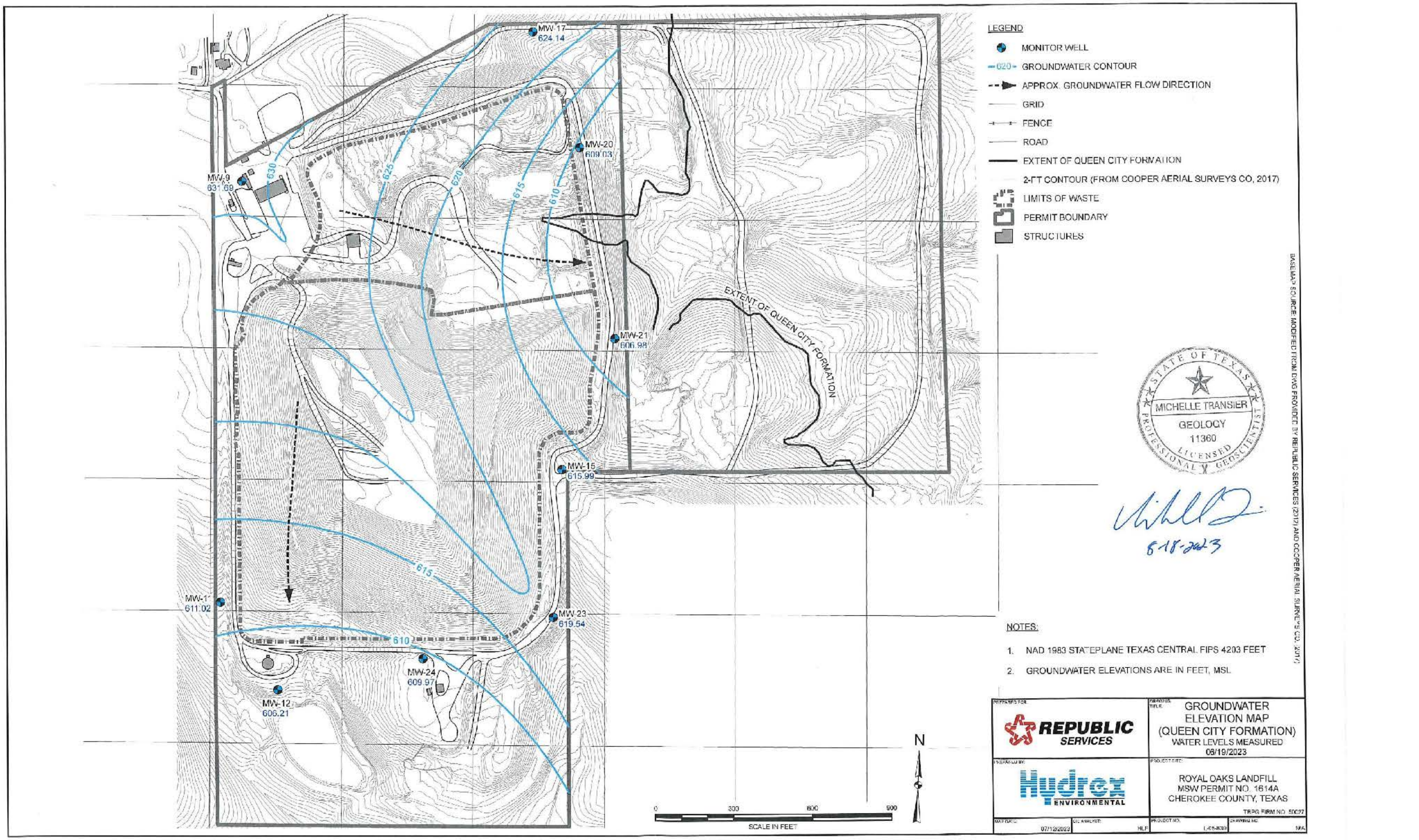
NOTES:

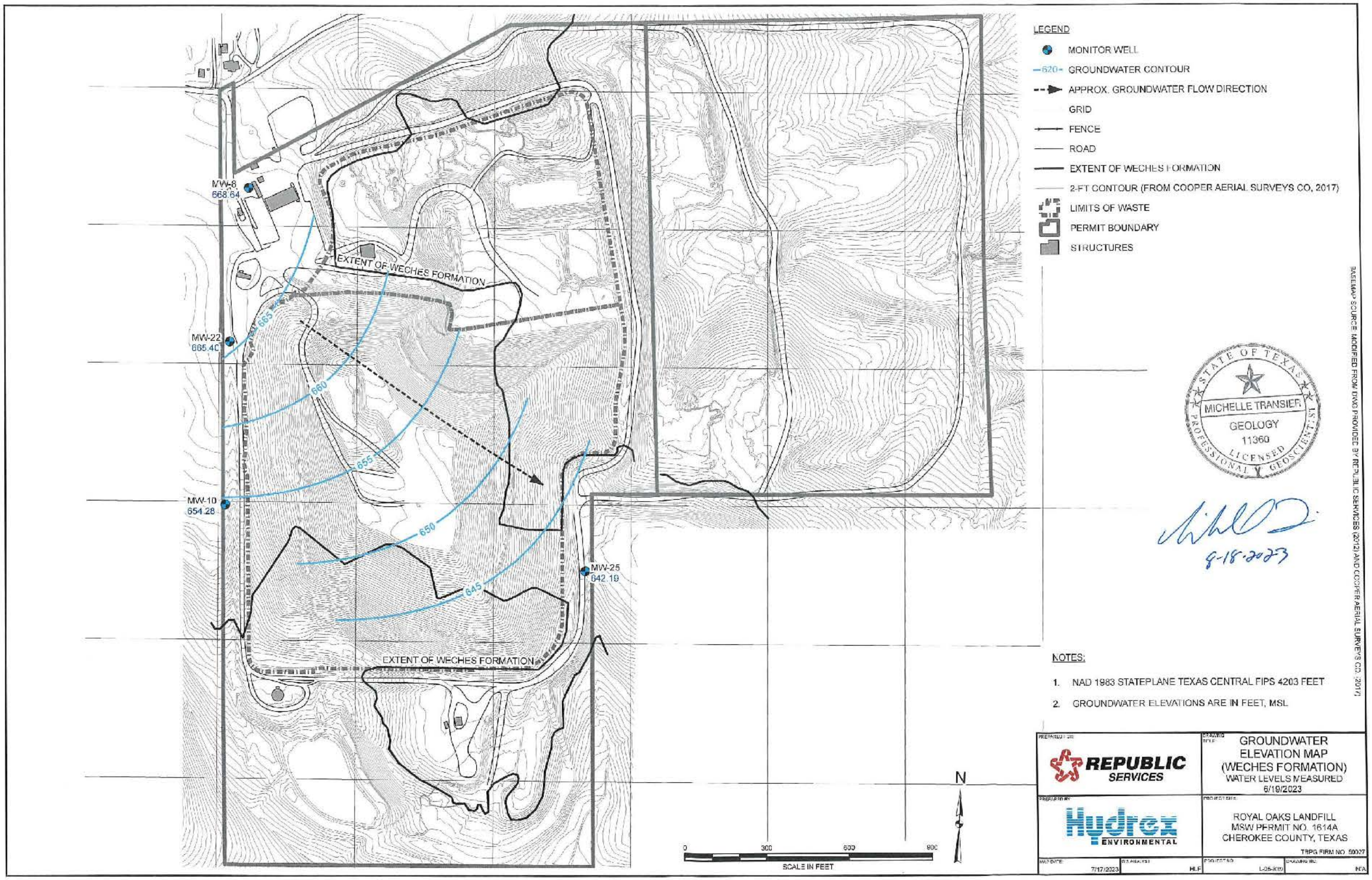
1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL

PREPARED FOR: REPUBLIC SERVICES	DRAWING TITLE: GROUNDWATER ELEVATION MAP (WECHES FORMATION) WATER LEVELS MEASURED 12/28/2022
PREPARED BY: Hydrex ENVIRONMENTAL	PROJECT SITE: ROYAL OAKS LANDFILL MSW PERMIT NO. 1614A CHEROKEE COUNTY, TEXAS TBPG FIRM NO. 50027
MAP DATE: 01/17/2023 GIS ANALYST: HLF	PROJECT NO. L-05-839 DRAWING NO. N/A



LEGEND
MONITOR WELL
620 GROUNDWATER CONTOUR
APPROX. GROUNDWATER FLOW DIRECTION
GRID
FENCE
ROAD
EXTENT OF QUEEN CITY FORMATION
2-FT CONTOUR (FROM COOPER AERIAL SURVEYS CO. 2017)
LIMITS OF WASTE
PERMIT BOUNDARY
STRUCTURES
MW-17 621.43
MW-20 608.99
MW-9 630.03
MW-21 607.69
MW-15 614.57
MW-11 611.08
MW-23 618.19
MW-24 608.80
MW-12 606.26
630
625
620
615
610
615
610
EXTENT OF QUEEN CITY FORMATION
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST
2-27-2023
BASEMAP SOURCE: MODIFIED FROM DWG PROVIDED BY REPUBLIC SERVICES (2012) AND COOPER AERIAL SURVEYS CO. (2017)
NOTES:
1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL
N
0 300 600 900 1,200
SCALE IN FEET
PREPARED FOR:
REPUBLIC SERVICES
DRAWING TITLE:
GROUNDWATER ELEVATION MAP (QUEEN CITY FORMATION)
WATER LEVELS MEASURED 12/28/2022
PREPARED BY:
Hydrex ENVIRONMENTAL
PROJECT SITE:
ROYAL OAKS LANDFILL
MSW PERMIT NO. 1614A
CHEROKEE COUNTY, TEXAS
TBPG FIRM NO. 50027
MAP DATE: 01/17/2023
GIS ANALYST: HLF
PROJECT NO. L-05-639
DRAWING NO. N/A


LEGEND
MONITOR WELL
620 GROUNDWATER CONTOUR
APPROX. GROUNDWATER FLOW DIRECTION
GRID
FENCE
ROAD
EXTENT OF QUEEN CITY FORMATION
2-FT CONTOUR (FROM COOPER AERIAL SURVEYS CO, 2017)
LIMITS OF WASTE
PERMIT BOUNDARY
STRUCTURES
MW-17 624.14
MW-20 609.03
MW-9 631.69
MW-21 606.98
MW-15 615.99
MW-1 611.02
MW-23 619.54
MW-24 609.97
MW-12 606.21
630
625
620
615
610
EXTENT OF QUEEN CITY FORMATION
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST
8-18-2023
NOTES:
1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL
N
0 300 600 900
SCALE IN FEET
REPUBLIC SERVICES
Hydrex ENVIRONMENTAL
GROUNDWATER ELEVATION MAP (QUEEN CITY FORMATION) WATER LEVELS MEASURED 06/19/2023
ROYAL OAKS LANDFILL
MSW PERMIT NO. 1614A
CHEROKEE COUNTY, TEXAS
TBPG FIRM NO. 50527
07/12/2023
BASEMAP SOURCE: MODIFIED FROM DWG PROVIDED BY REPUBLIC SERVICES (2017) AND COOPER AERIAL SURVEYS CO, 2017)


MW-8
668.64
MW-22
665.40
MW-10
654.28
MW-25
642.19
EXTENT OF WECHES FORMATION
EXTENT OF WECHES FORMATION
665
660
655
650
645
LEGEND
MONITOR WELL
620 GROUNDWATER CONTOUR
APPROX. GROUNDWATER FLOW DIRECTION
GRID
FENCE
ROAD
EXTENT OF WECHES FORMATION
2-FT CONTOUR (FROM COOPER AERIAL SURVEYS CO, 2017)
LIMITS OF WASTE
PERMIT BOUNDARY
STRUCTURES
BASEMAP SOURCE: MODIFIED FROM DWG PROVIDED BY REPUBLIC SERVICES (2012) AND COOPER AERIAL SURVEYS CO. 2017)
STATE OF TEXAS
MICHELLE TRANSIER
GEOLOGY
11360
LICENSED
PROFESSIONAL GEOSCIENTIST
9-18-2023
NOTES:
1. NAD 1983 STATEPLANE TEXAS CENTRAL FIPS 4203 FEET
2. GROUNDWATER ELEVATIONS ARE IN FEET, MSL
N
0
300
600
900
SCALE IN FEET
PREPARED FOR:
REPUBLIC SERVICES
DRAWING TITLE:
GROUNDWATER ELEVATION MAP (WECHES FORMATION)
WATER LEVELS MEASURED 6/19/2023
PREPARED BY:
Hydrex ENVIRONMENTAL
PROJECT SITE:
ROYAL OAKS LANDFILL
MSW PERMIT NO. 1614A
CHEROKEE COUNTY, TEXAS
TBPG FIRM NO. 50027
MAP DATE: 7/17/2023
GIS ANALYST: HLF
PROJECT NO: L-05-839
DRAWING NO: N/A

EXISTING MONITOR WELL
LITHOLOGIC LOGS AND
MONITOR WELL DATA SHEETS

LAIDLAW WASTE SYSTEMS, INC.

Subsurface Boring Log

Well Name/Location: MW-8/Royal Oaks

Project: *Groundwater Monitoring Plan for Subtitle D* **Project No.:** *042480069*
Client: *Royal Oaks Landfill, Cherokee County, Texas*

Start Date: *10/05/94*
Finish Date: *10/11/94*

DRILLING DATA

Inspector:	*Eric Matzner*
Contractor:	*Groundwater Technology, Inc.*
Equipment:	*Mobil B-61*
Method:	*6-5/8" ID Hollow-Stem Auger*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*CME*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*Sch. 40 PVC*	*Sch. 40 PVC*
Diameter (ID):	*4-inch*	*4-inch, 0.010" slot*
Coupling:	*Flush-Threaded*	*Flush-Threaded*

WELL DEVELOPMENT

Method:	*Surge/Purge*
Duration:	*6 hours*
Gals. Purged:	*240 gallons*
Slug Test: (cm/sec)	*NA*

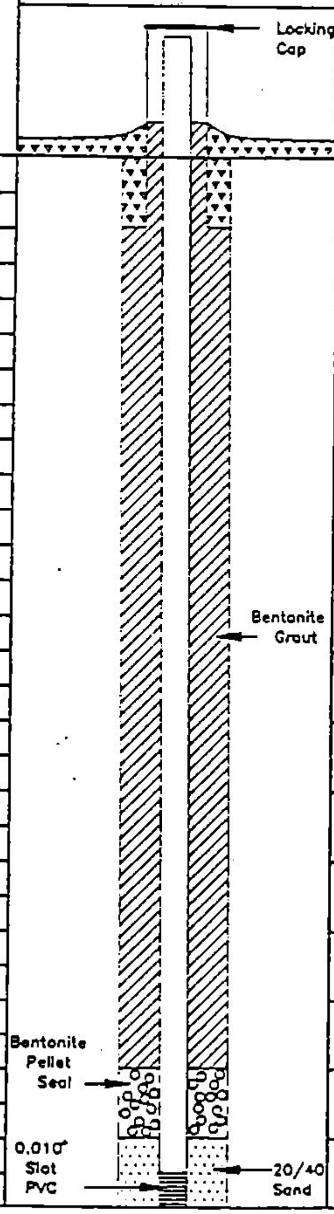
SURVEY DATA DATUM

Grade:	*685.53*
TWC:	*688.41*
TPC:	*688.77*
North:	*9638.43*
East:	*10103.40*

Geophysical Log: ☐ yes ☑ no

Comments:

WELL CONSTRUCTION



SAMPLE DATA

Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0	1		2.0	SM		Silty Sand; SM; tan to strong brown, soft, friable, dry, very fine-grained, moderately sorted, quartz sand	Sparta Fm
	2		2.0				
5	3		2.0				
	4		2.0	SC		Clayey Sand; SC; brown, yellow and red banding, very stiff, low plasticity, dry to slightly moist, occasional hard streaks	
10	5		1.75				
	6		1.0	SM		Silty Sand; SM; brown, yellowish-red and gray banding, stiff, slightly moist, fine-grained quartz, occasional very thin beds of ironstone	
	7		1.5				
15	D.O.		D.O.			Ironstone layers, hard, indurated sand, iron cemented	Drilled out
	8		2.0	CL		Top of Weches Formation Silty Clay; CL; yellowish-brown, strong brown bandings, hard, low plasticity, slightly moist, abundant ironstone fragments	Weches Fm
20	9		2.0				
	10		2.0				
	11		2.0	CH		Clay; CH; dk gray-green, med. stiff, high plasticity, moist, glauconitic	Wet
25	12		1.5	SC		Clayey Sand; SC; dk gray-green, fine-grained quartz and glauconite, wet	
	13		2.0	SMML		Silt and Sand; SMML; dark gray-green, hard, friable, dry to slightly moist	Hard streak Dry to moist
30	14		2.0	SC		Clayey Sand; SC; very dark grayish green, stiff, wet, glauconitic	Wet

LAIDLAW
LAIDLAW WASTE SYSTEMS, INC.

Subsurface Boring Log

Well Name/Location: MW-8/Royal Oaks

Project: *Groundwater Monitoring Plan for Subtitle D*

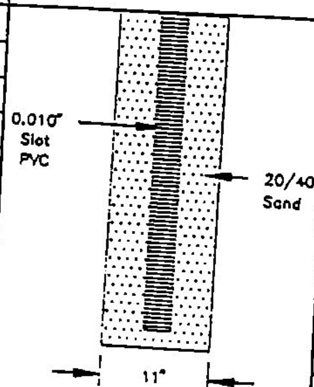
Client: *Royal Oaks Landfill, Cherokee County, Texas*

Project No.: *042480069*

Start Date: *10/05/94*

Finish Date: *10/11/94*

WELL CONSTRUCTION



SAMPLE DATA (CONTINUATION)

Depth (feet)	Samp. No. (soil) / Run No. (rock)	Blows/6 in. (soil) / Hydraul. Cond. cm/sec (rock)	Rec. (ft.)	USCS (soil) / RQD (rock)	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
30							
	15		2.0				Wet
35	16		2.0				
	17		2.0				
	18		2.0			Silty layer @ 37' - 39'	
40	19		2.0			Clayey Silt; CL; very dark grayish-green, medium stiff, dry	Dry
						End of boring at 40 feet	
45							

A. Monitor Well Data Sheet

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
MSWD-SE67

Permittee or Site Name: Royal Oaks Landfill

County: Cherokee County

Date of Monitor Well Installation: 10/06/94

Monitor Well: Latitude: 32°00'05.0" Longitude: 95°16'03.1"

Monitor Well Groundwater

Gradient: Upgradient X Downgradient ____

MSW PERMIT NO: 1614

Monitor Well I.D. No.: MW-8

Date of Monitor Well Development: 10/17/94

Monitor Well Driller Name: Benny Hinojosa

License No.: 3127M

NOTE:

(A) The information shown in the sketch below should be considered the minimum required for an installed ground-water monitor well.
(B) Report All Depths from Surface Elevation and all Elevations relative to Mean Sea Level.
(C) The minimun distance between the inside wall of the Bore Hole and the outside of the Well Casing shall be 3".
(D) Use Flush Screw Joint Casing only, 2" diameter or larger. Recommend 4" diameter minimum & Teflon Taping Casing Joints.
(E) Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist or Engineer Supervising Well Installation: Eric C. Matzner

Static Water Level Elevation (with respect to MSL) after Well Developement: 673.25

Name of Geologic Formation(s) in which Well is completed: Weches

Type of Locking Device: pad lock

Type of Casing Protection: 6"x5' round, anodized aluminum

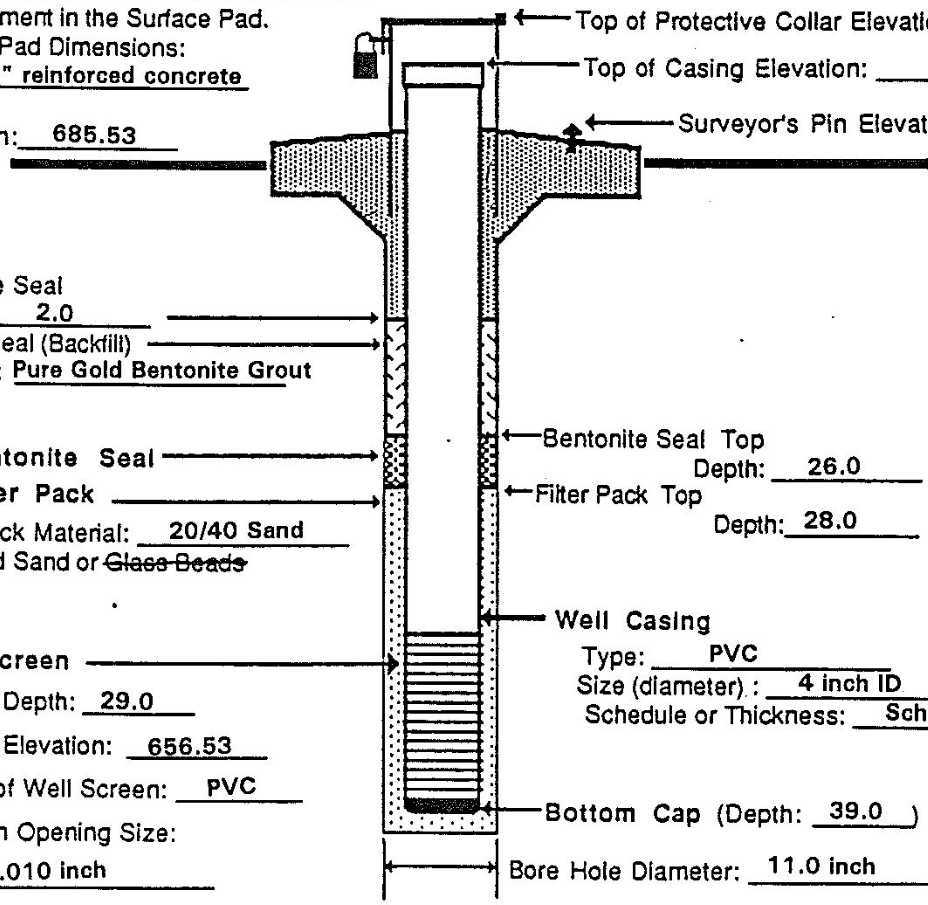
Concrete Surface Pad - Recommend steel reinforcement in the Surface Pad.
Surface Pad Dimensions: 4'x4'x6" reinforced concrete

Surface Elevation: 685.53

Top of Protective Collar Elevation: 688.87

Top of Casing Elevation: 688.41

Surveyor's Pin Elevation: 685.83



Concrete Seal Depth: 2.0

Casing Seal (Backfill) Material: Pure Gold Bentonite Grout

Bentonite Seal

Filter Pack

Filter Pack Material: 20/40 Sand
Sterilized Sand or ~~Glass Beads~~

Bentonite Seal Top Depth: 26.0 Elevation: 659.53

Filter Pack Top Depth: 28.0 Elevation: 657.53

Well Casing
Type: PVC
Size (diameter): 4 inch ID
Schedule or Thickness: Sch 40

Well Screen
Top Depth: 29.0
Top Elevation: 656.53
Type of Well Screen: PVC
Screen Opening Size: 0.010 inch

Bottom Cap (Depth: 39.0)

Bore Hole Diameter: 11.0 inch

LAIDLAW WASTE SYSTEMS, INC.

Subsurface Boring Log

Well Name/Location: MW-9/Royal Oaks

Project: *Groundwater Monitoring Plan for Subtitle D* Project No.: *042480069*
Client: *Royal Oaks Landfill, Cherokee County, Texas*

Start Date: *10/07/94*
Finish Date: *10/11/94*

DRILLING DATA

Inspector: *Eric Matzner*
Contractor: *Groundwater Technology, Inc.*
Equipment: *Mobil B-61*
Method: *6-5/8" ID Hollow-Stem Auger*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	CME	NA	NA
Diameter:	2"	NA	NA
Other:	NA	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	Sch. 40 PVC	Sch. 40 PVC
Diameter (ID):	4-inch	4-inch, 0.010" slot
Coupling:	Flush-Threaded	Flush-Threaded

WELL DEVELOPMENT

Method: *Surge/Purge*
Duration: *6 hours*
Gals. Purged: *390 gallons*
Slug Test: (cm/sec) *NA*

SURVEY DATA DATUM

Grade: *685.63*
TWC: *688.59*
TPC: *688.87*
North: *9633.49*
East: *10112.17*

Geophysical Log: ☐ yes ☑ no
Comments:

Well construction: Locking Cap; Bentonite Grout

Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0–6	1		2.0			Silty Sand; SM; tan to strong brown, soft, friable, dry, very fine-grained, moderately sorted, quartz sand	Sparta Fm
	2		2.0				
	3		2.0				
6–10	4		2.0			Clayey Sand; SC; brown, yellow and red banding, very stiff, low plasticity, dry to slightly moist, occasional hard streaks	
	5		1.75				
10–14	6		1.0			Silty Sand; SM; brown, yellowish-red and gray banding, stiff, slightly moist, fine-grained quartz, occasional very thin beds of ironstone	
	7		1.5				
14–16	D.O.		D.O.			Ironstone layers, hard, indurated sand, iron cemented	Drilled out
16–22	8		2.0			Top of Weches Formation Silty Clay; CL; yellowish-brown, strong brown bandings, hard, plasticity, slightly moist, abundant ironstone fragments	Weches Fm
	9		2.0				
	10		2.0				
22–24	11		2.0			Clay; CH; dk gray-green, med. stiff, high plasticity, moist, glauconitic	Wet
24–26	12		1.5			Clayey Sand; SC; dk gray-green, fine-grained quartz and glauconite, wet	
26–28	13		2.0			Silt and Sand; SMML; dark gray-green, hard, friable, dry to slightly moist	Hard streak Dry to moist
28–30	14		2.0			Clayey Sand; SC; very dark grayish green, stiff, wet, glauconitic	Wet

LAIDLAW
LAIDLAW WASTE SYSTEMS, INC.

Subsurface Boring Log

Well Name/Location: MW-9/Royal Oaks

Page 2 of

Project: *Groundwater Monitoring Plan for Subtitle D*
Client: *Royal Oaks Landfill, Cherokee County, Texas*
Project No.: *042480069*
Start Date: *10/07/94*
Finish Date: *10/11/94*

(CONTINUATION)

Depth (feet): 30 – 70

WELL CONSTRUCTION: Bentonite Grout; Bentonite Pellet Seal; 0.010" Slot PVC; 20/40 Sand

SAMPLE DATA

Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)
15		2.0		
16		2.0		
17		2.0		
18		2.0		
19		2.0		
1		2.0		
2		NR		
3		2.0		
4		2.0		
5		2.0		
6		2.0		
7		2.0		
8		2.0		
9		2.0		
10		2.0		
11		2.0		
12		2.0		
13		2.0		
14		2.0		
15		2.0		

VISUAL CLASSIFICATION	REMARKS
	Wet
Silty layer @ 37' - 39'	
Clayey Silt; CL; very dark grayish-green, medium stiff, friable, dry	
Sandy, Clayey Silt; ML; very dark grayish-green, stiff to very stiff, low plasticity, dry to slightly moist, glauconitic, occasional thin beds of silty sand and indurated siltstone. Sands are occasionally moist.	
Top of Queen City Formation Silty Clay; CL; very dark brown, hard, low plasticity, dry to slightly moist, occasional glauconitic filled burrows, 5-10% white mica	Queen City Fm
Silty Clayey Sand; SC; very dark brown, hard, slightly moist to moist, common carbonaceous material, 5-10% white mica	Slightly moist
Silty Sand; SM; soft to stiff, friable, moist to wet, very fine-grained quartz, 5-10% white mica, interbedded thin beds of sand and very thin beds of sandy silt	Wet

A. Monitor Well Data Sheet

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
MSWD-SE67

Permittee or Site Name: Royal Oaks Landfill

County: Cherokee County

Date of Monitor Well Installation: 10/08/94

Monitor Well: Latitude: 32°00'05.0" Longitude: 95°16'03.0"

Monitor Well Groundwater

Gradient: Upgradient X Downgradient ____

MSW PERMIT NO: 1614

Monitor Well I.D. No.: MW-9

Date of Monitor Well Development: 10/17/94

Monitor Well Driller Name: Benny Hinojosa

License No.: 3127M

NOTE:

(A)The information shown in the sketch below should be considered the minimum required for an installed ground-water monitor well.
(B) Report All Depths from Surface Elevation and all Elevations relative to Mean Sea Level.
(C) The minimun distance between the inside wall of the Bore Hole and the outside of the Well Casing shall be 3".
(D) Use Flush Screw Joint Casing only, 2" diameter or larger. Recommend 4" diameter minimum & Teflon Taping Casing Joints.
(E) Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist or Engineer Supervising Well Installation: Eric C. Matzner

Static Water Level Elevation (with respect to MSL) after Well Development: 632.16

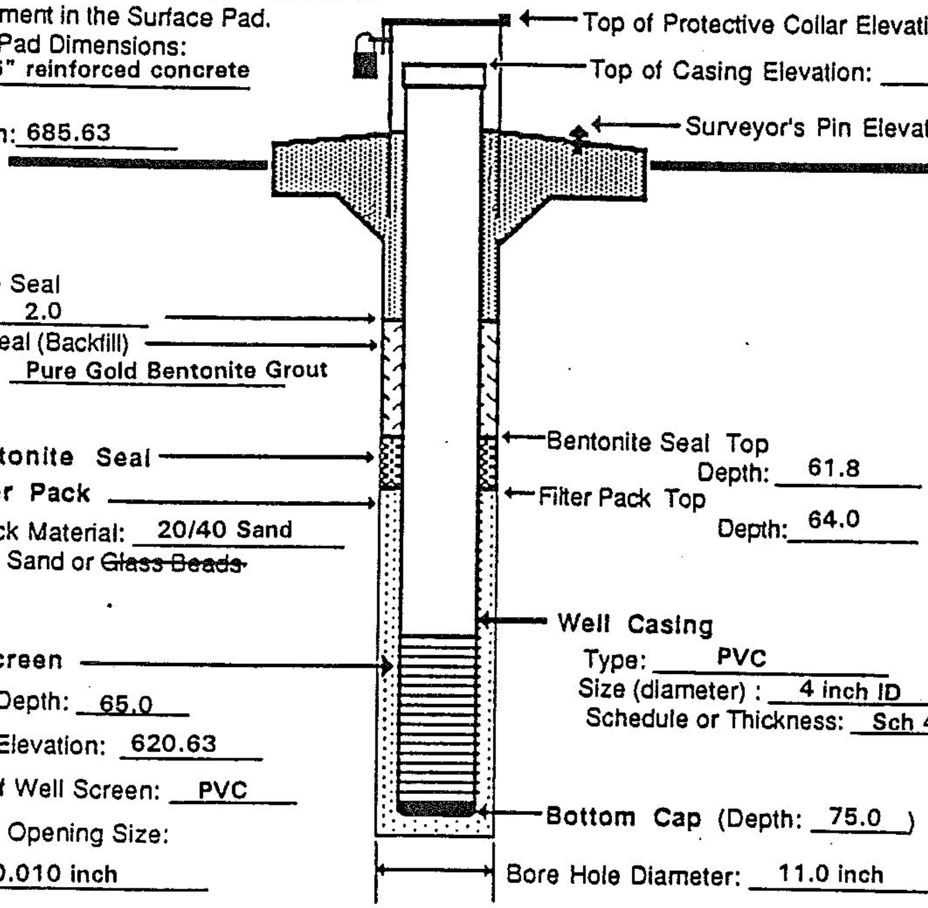
Name of Geologic Formation(s) in which Well is completed: Queen City

Type of Locking Device: pad lock

Type of Casing Protection: 6" x 5' round, anodized aluminum

Concrete Surface Pad - Recommend steel reinforcement in the Surface Pad.
Surface Pad Dimensions: 4'x4'x6" reinforced concrete

Surface Elevation: 685.63



Top of Protective Collar Elevation: 688.87

Top of Casing Elevation: 688.59

Surveyor's Pin Elevation: 685.97

Concrete Seal Depth: 2.0

Casing Seal (Backfill) Material: Pure Gold Bentonite Grout

Bentonite Seal

Filter Pack

Filter Pack Material: 20/40 Sand
Sterilized Sand or ~~Glass Beads~~

Bentonite Seal Top Depth: 61.8 Elevation: 623.83

Filter Pack Top Depth: 64.0 Elevation: 621.63

Well Casing
Type: PVC
Size (diameter): 4 inch ID
Schedule or Thickness: Sch 40

Well Screen
Top Depth: 65.0
Top Elevation: 620.63
Type of Well Screen: PVC
Screen Opening Size: 0.010 inch

Bottom Cap (Depth: 75.0)

Bore Hole Diameter: 11.0 inch

LAIDLAW
LAIDLAW WASTE SYSTEMS, INC.

Subsurface Boring Log

Well Name/Location: MW-9/Royal Oaks
Page 3 of 3

Project: *Groundwater Monitoring Plan for Subtitle D* Project No.: *042480069*
Client: *Royal Oaks Landfill, Cherokee County, Texas*
Start Date: *10/07/94*
Finish Date: *10/11/94*

(CONTINUATION)

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
70–72	0.010" Slot PVC; 20/40 Sand; 11"	16		2.0				Wet
72–74		17		2.0				
74–76		18		2.0			Clayey Sandy Silt; ML; very dark brown, stiff, low plasticity, moist to slightly moist, interbedded clays and silts	
76–78		19		NR				
78							End of boring at 78 feet	

LAIDLAW
LAIDLAW WASTE SYSTEMS, INC.

Subsurface Boring Log

Well Name/Location: MW-10/Royal Oaks

Project: Groundwater Monitoring Plan for Subtitle D — Project No.: 042480069
Client: Royal Oaks Landfill, Cherokee County, Texas
Start Date: 10/04/94
Finish Date: 10/11/94

DRILLING DATA

Inspector:	Eric Matzner
Contractor:	Groundwater Technology, Inc.
Equipment:	Mobil B-61
Method:	6-5/8" ID Hollow-Stem Auger

SAMPLING METHODS

	Sampler	Tube	Core
Type:	CME	NA	NA
Diameter:	2"	NA	NA
Other:	NA	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	Sch. 40 PVC	Sch. 40 PVC
Diameter (ID):	4-inch	4-inch, 0.010" slot
Coupling:	Flush-Threaded	Flush-Threaded

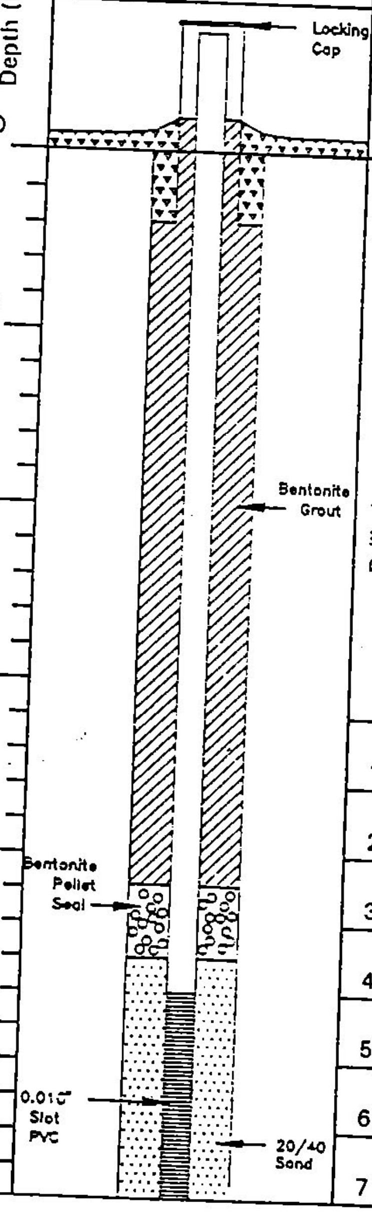
WELL DEVELOPMENT

Method:	Surge/Purge
Duration:	6 hours
Gals. Purged:	140 gallons
Slug Test: (cm/sec)	NA

SURVEY DATA DATUM

Grade:	670.91
TWC:	673.91
TPC:	674.32
North:	8489.50
East:	10025.58

Geophysical Log: ☐ yes ☑ no
Comments:



Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0–10.5	Drilled out 0.0' - 16.0'					Silty Sand; SM; tan, friable, dry, occasional hard ironstone layers	Sparta Fm
10.5–16						Top of Weches Formation Clayey Silt; CL; brown, dry, occasional ironstone layers	Weches Fm
16–18	1		2.0			Clay; CH; white with tan mottles, very hard, high plasticity, dry, occasional thin beds of clayey silt and ironstone	
18–20	2		2.0			Silty Clay; CL; brown, low plasticity, slightly moist, occasional ironstone fragments	
20–22	3		2.0			Silty Sand; SM; very dark grayish-green, glauconitic, very hard, friable, very fine-grained sand, poorly sorted, occasional hard streaks	Dry Slightly moist
22–24	4		2.0				
24–26	5		2.0				
26–28	6		2.0				Moist
28–30	7		2.0				

A. Monitor Well Data Sheet

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
MSWD-SE67

Permittee or Site Name: Royal Oaks Landfill

County: Cherokee County

Date of Monitor Well Installation: 10/05/94

Monitor Well: Latitude: 31°59'53.7" Longitude: 95°16'04.1"

Monitor Well Groundwater

Gradient: Upgradient ___ Downgradient X

MSW PERMIT NO: 1614

Monitor Well I.D. No.: MW-10

Date of Monitor Well Development: 10/18/94

Monitor Well Driller Name: Benny Hinojosa

License No.: 3127M

NOTE:

(A)The information shown in the sketch below should be considered the minimum required for an installed ground-water monitor well.
(B) Report All Depths from Surface Elevation and all Elevations relative to Mean Sea Level.
(C) The minimun distance between the inside wall of the Bore Hole and the outside of the Well Casing shall be 3".
(D) Use Flush Screw Joint Casing only, 2" diameter or larger. Recommend 4" diameter minimum & Teflon Taping Casing Joints.
(E) Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist or Engineer Supervising Well Installation: Eric C. Matzner

Static Water Level Elevation (with respect to MSL) after Well Developement : 654.33

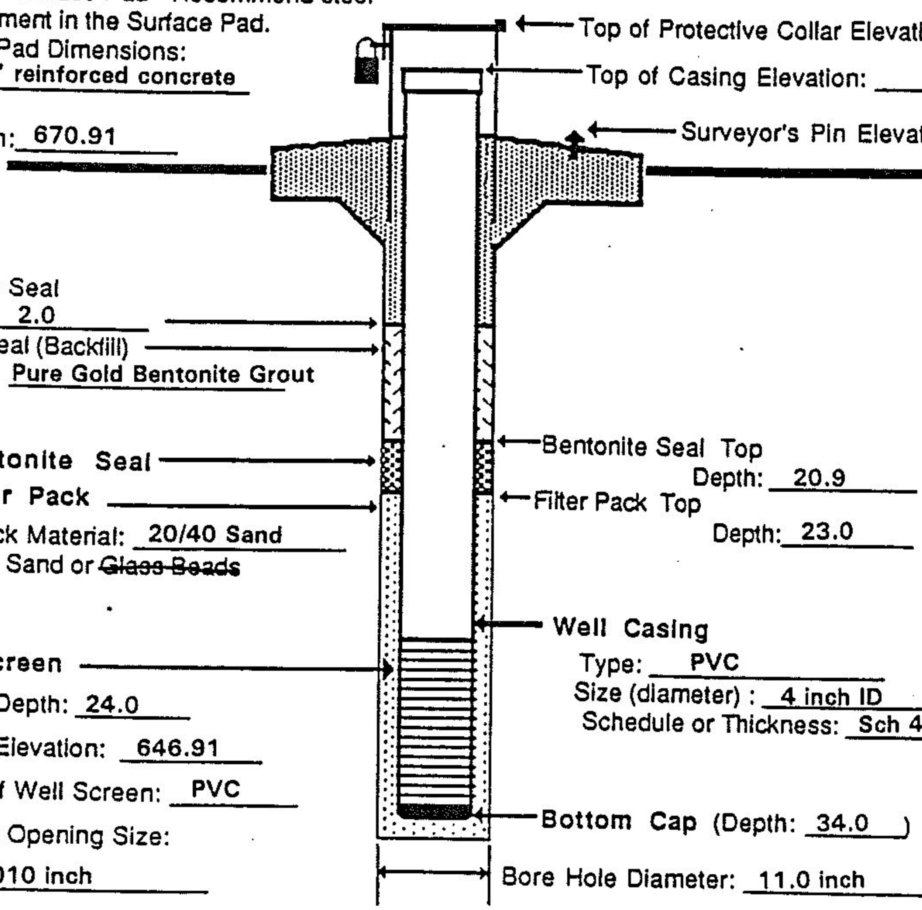
Name of Geologic Formation(s) in which Well is completed: Weches

Type of Locking Device: pad lock

Type of Casing Protection: 6"x5' round, anodized aluminum

Concrete Surface Pad - Recommend steel reinforcement in the Surface Pad.
Surface Pad Dimensions: 4'x4'x6" reinforced concrete

Surface Elevation: 670.91



Top of Protective Collar Elevation: 674.32

Top of Casing Elevation: 673.91

Surveyor's Pin Elevation: 671.27

Concrete Seal Depth: 2.0

Casing Seal (Backfill) Material: Pure Gold Bentonite Grout

Bentonite Seal

Filter Pack

Filter Pack Material: 20/40 Sand
Sterilized Sand or ~~Glass Beads~~

Bentonite Seal Top Depth: 20.9 Elevation: 650.01

Filter Pack Top Depth: 23.0 Elevation: 647.91

Well Casing
Type: PVC
Size (diameter) : 4 inch ID
Schedule or Thickness: Sch 40

Well Screen
Top Depth: 24.0
Top Elevation: 646.91
Type of Well Screen: PVC
Screen Opening Size: 0.010 inch

Bottom Cap (Depth: 34.0)

Bore Hole Diameter: 11.0 inch

LAIDLAW WASTE SYSTEMS, INC.

Subsurface Boring Log

Well Name/Location: MW-10/Royal Oaks

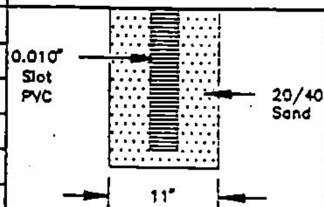
Project: *Groundwater Monitoring Plan for Subtitle D* Project No.: *042480069*

Client: *Royal Oaks Landfill, Cherokee County, Texas*

Start Date: *10/04/94*

Finish Date: *10/11/94*

WELL CONSTRUCTION



(CONTINUATION)

Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
30							
	8		2.0				
	9		2.0				
35	10		1.0			Silty Clay; CL; very dark grayish-green, glauconitic, very hard, low plasticity, slightly moist	
						End of boring at 35 feet	
40							
45							
50							
55							
60							
65							
70							

LAIDLAW WASTE SYSTEMS, INC.

Subsurface Boring Log

Well Name/Location: MW-11/Royal Oaks

Project: *Groundwater Monitoring Plan for Subtitle D*
Project No.: *042480069*
Client: *Royal Oaks Landfill, Cherokee County, Texas*
Start Date: *10/06/94*
Finish Date: *10/11/94*

DRILLING DATA

Inspector:	*Eric Matzner*
Contractor:	*Groundwater Technology, Inc.*
Equipment:	*Mobil B-61*
Method:	*6-5/8" ID Hollow-Stem Auger*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*CME*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*Sch. 40 PVC*	*Sch. 40 PVC*
Diameter (ID):	*4-inch*	*4-inch, 0.010" slot*
Coupling:	*Flush-Threaded*	*Flush-Threaded*

WELL DEVELOPMENT

Method:	*Surge/Purge*
Duration:	*6 hours*
Gals. Purged:	*138 gallons*
Slug Test: (cm/sec)	*NA*

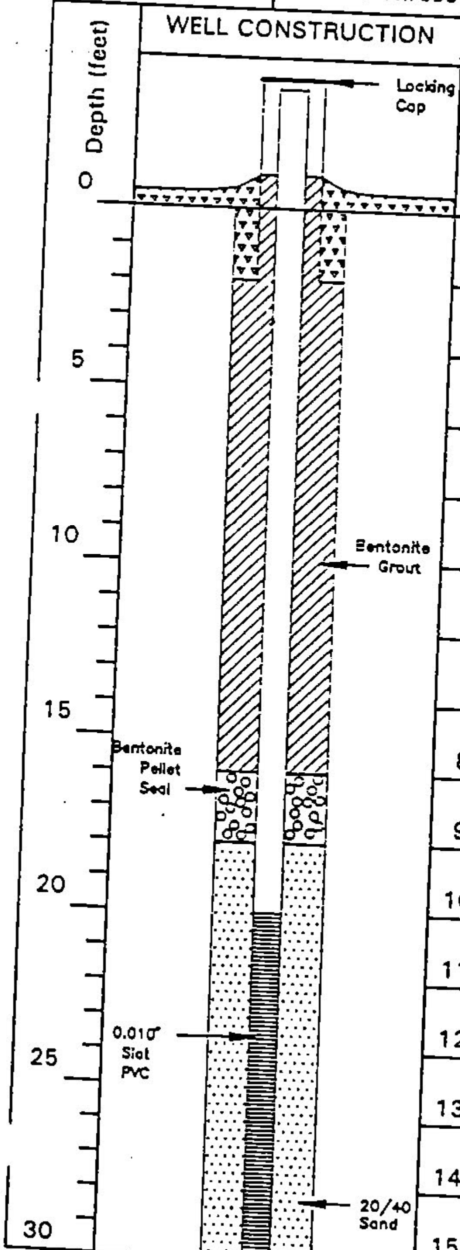
SURVEY DATA DATUM

Grade:	*629.40*
TWC:	*631.96*
TPC:	*632.38*
North:	*8034.16*
East:	*10038.34*

Geophysical Log: ☐ yes ☑ no

Comments:

WELL CONSTRUCTION



SAMPLE DATA

Samp. No. (soil) / Run No. (rock)	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)
1		2.0		
2		2.0		
3		2.0		
4		2.0		
5		2.0		
6		2.0		
7		2.0		
8		2.0		
9		2.0		
10		2.0		
11		2.0		
12		2.0		
13		2.0		
14		2.0		
15		2.0		

VISUAL CLASSIFICATION / REMARKS

VISUAL CLASSIFICATION	REMARKS
Sandy Silty Clay; CL; red to brown with depth, soft near surface, becoming hard around 4', friable to low plasticity, dry to slightly moist, high plasticity around 8' to 10', common ironstone fragments –glauconitic sandy silt at 11.7'	
Sandy Clayey Silt; CL/ML; very dark bluish-green, becoming brown with depth, soft to hard, low plasticity, slightly moist, interbedded silts and clays	
Top of Queen City Formation Silty Sand; SM; very dark brown, very stiff, friable to low plasticity, moist to wet, very fine-grained quartz, 5-10% white mica, interbedded very thin beds of silts and sands, occasional carbonaceous material	Queen City Fm Moist Wet
Sand; SP; very dark brown, medium stiff, friable, wet, 5% dark minerals, very fine-grained quartz	
Silty Sand; SM; very dark brown, medium stiff, friable, wet, interbedded silt and sand	
Sand; SP; very dark brown, wet, common carbonaceous material, 10% white mica	
Sandy Silt; ML; dark brown, hard, dry, interbedded silt and clay	Dry

LAIDLAW

LAIDLAW WASTE SYSTEMS, INC.

Subsurface Boring Log

Well Name/Location: MW-11/Royal Oaks

Project: *Groundwater Monitoring Plan for Subtitle D* Project No.: *042480069*

Client: *Royal Oaks Landfill, Cherokee County, Texas*

Start Date: *10/06/94*

Finish Date: *10/11/94*

(CONTINUATION)

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
30	20/40 Sand; 11"						End of boring at 30 feet	
35								
40								
45								

A. Monitor Well Data Sheet

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
MSWD-SE67

Permittee or Site Name: Royal Oaks Landfill

County: Cherokee County

Date of Monitor Well Installation: 10/06/94

Monitor Well: Latitude: 31°59'49.2" Longitude: 95°16'04.0"

Monitor Well Groundwater

Gradient: Upgradient ___ Downgradient X

MSW PERMIT NO: 1614

Monitor Well I.D. No.: MW-11

Date of Monitor Well Development: 10/18/94

Monitor Well Driller Name: Benny Hinojosa

License No.: 3127M

NOTE:

(A)The information shown in the sketch below should be considered the minimum required for an installed ground-water monitor well.
(B) Report All Depths from Surface Elevation and all Elevations relative to Mean Sea Level.
(C) The minimun distance between the inside wall of the Bore Hole and the outside of the Well Casing shall be 3".
(D) Use Flush Screw Joint Casing only, 2" diameter or larger. Recommend 4" diameter minimum & Teflon Taping Casing Joints.
(E) Well development should continue until water is clear, and pH and conductivity are stable.

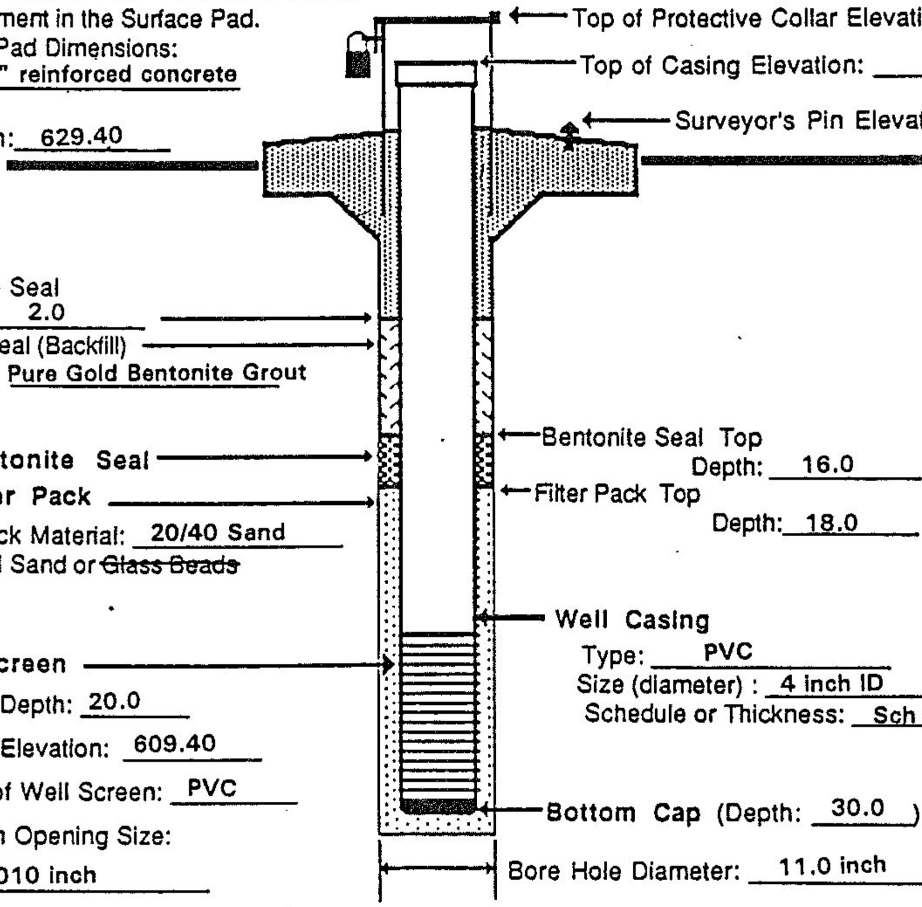
Geologist, Hydrologist or Engineer Supervising Well Installation: Eric C. Matzner

Static Water Level Elevation (with respect to MSL) after Well Developement: 611.6

Name of Geologic Formation(s) in which Well is completed: Queen City

Type of Locking Device: pad lock

Type of Casing Protection: 6"x5' round, anodized aluminum



Concrete Surface Pad - Recommend steel reinforcement in the Surface Pad.
Surface Pad Dimensions: 4'x4'x6" reinforced concrete

Surface Elevation: 629.40

Top of Protective Collar Elevation: 632.38

Top of Casing Elevation: 631.96

Surveyor's Pin Elevation: 629.44

Concrete Seal Depth: 2.0

Casing Seal (Backfill) Material: Pure Gold Bentonite Grout

Bentonite Seal

Filter Pack

Bentonite Seal Top Depth: 16.0 Elevation: 613.40

Filter Pack Top Depth: 18.0 Elevation: 611.40

Filter Pack Material: 20/40 Sand
Sterilized Sand or ~~Glass Beads~~

Well Casing
Type: PVC
Size (diameter): 4 inch ID
Schedule or Thickness: Sch 40

Well Screen
Top Depth: 20.0
Top Elevation: 609.40
Type of Well Screen: PVC
Screen Opening Size: 0.010 inch

Bottom Cap (Depth: 30.0)

Bore Hole Diameter: 11.0 inch

LAIDLAW WASTE SYSTEMS, INC.

Subsurface Boring Log

Well Name/Location: MW-12/Royal Oaks

Page 1 of

Project: *Groundwater Monitoring Plan for Subtitle D* Project No.: *042480069*

Client: *Royal Oaks Landfill, Cherokee County, Texas*

Start Date: *10/04/94*

Finish Date: *10/11/94*

DRILLING DATA

Inspector: *Eric Matzner*

Contractor: *Groundwater Technology, Inc.*

Equipment: *Mobil B-61*

Method: *6-5/8" ID Hollow-Stem Auger*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	CME	NA	NA
Diameter:	2"	NA	NA
Other:	NA	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	Sch. 40 PVC	Sch. 40 PVC
Diameter (ID):	4-inch	4-inch, 0.010" slot
Coupling:	Flush-Threaded	Flush-Threaded

WELL DEVELOPMENT

Method: *Surge/Purge*

Duration: *6 hours*

Gals. Purged: *111 gallons*

Slug Test: (cm/sec) *NA*

SURVEY DATA DATUM

Grade: *611.49*

TWC: *614.39*

TPC: *614.77*

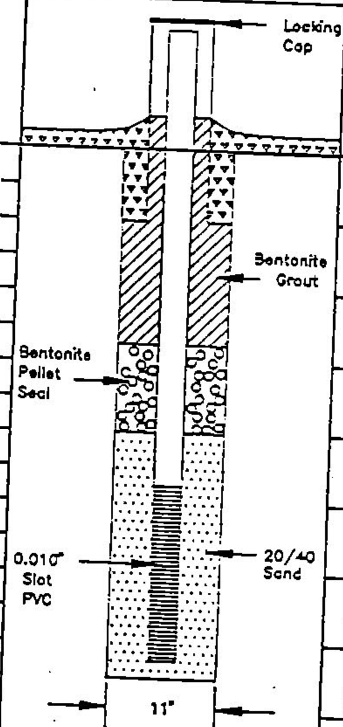
North: *7703.47*

East: *10258.17*

Geophysical Log: ☐ yes ☑ no

Comments:

WELL CONSTRUCTION



SAMPLE DATA

Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0–2	1		2.0			Silty Clay; CL; red; dry occasional ironstone pebbles	Queen City Fm
2–4	2		2.0			Clayey Silt; ML; yellow, red banding; slightly moist; friable	
4–6	3		2.0			Silty Sand to Sandy Silt; SM; iron stained; very fine grained sand; very moist	
6–8	4		2.0				Very moist
8–10	5		2.0				
10–12	6		2.0			Sand; SP; dark brown; very fine- to fine-grained; well sorted friable becomes clayey with depth; occasional carbonaceous material	Wet
12–14	7		2.0				
14–16	8		2.0			Silty Clayey Sand; SM; brown, with very thin beds of sandy silt; slightly moist	
16–18	9		2.0				
						End of boring at 18 feet	

Depth scale: 0, 5, 10, 15, 20, 25, 30

A. Monitor Well Data Sheet

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
MSWD-SE67

Permittee or Site Name: Royal Oaks Landfill

County: Cherokee County

Date of Monitor Well Installation: 10/04/94

Monitor Well: Latitude: 31°59'45.9" Longitude: 95°16'01.5"

Monitor Well Groundwater

Gradient: Upgradient ___ Downgradient X

MSW PERMIT NO: 1614

Monitor Well I.D. No.: MW-12

Date of Monitor Well Development: 02/02/95

Monitor Well Driller Name: Benny Hinojosa

License No.: 3127M

NOTE:

(A) The information shown in the sketch below should be considered the minimum required for an installed ground-water monitor well.
(B) Report All Depths from Surface Elevation and all Elevations relative to Mean Sea Level.
(C) The minimun distance between the inside wall of the Bore Hole and the outside of the Well Casing shall be 3".
(D) Use Flush Screw Joint Casing only, 2" diameter or larger. Recommend 4" diameter minimum & Teflon Taping Casing Joints.
(E) Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist or Engineer Supervising Well Installation: Eric C. Matzner

Static Water Level Elevation (with respect to MSL) after Well Developement : 607.31

Name of Geologic Formation(s) in which Well is completed: Queen City

Type of Locking Device: pad lock

Type of Casing Protection: 6"x5' round, anodized aluminum

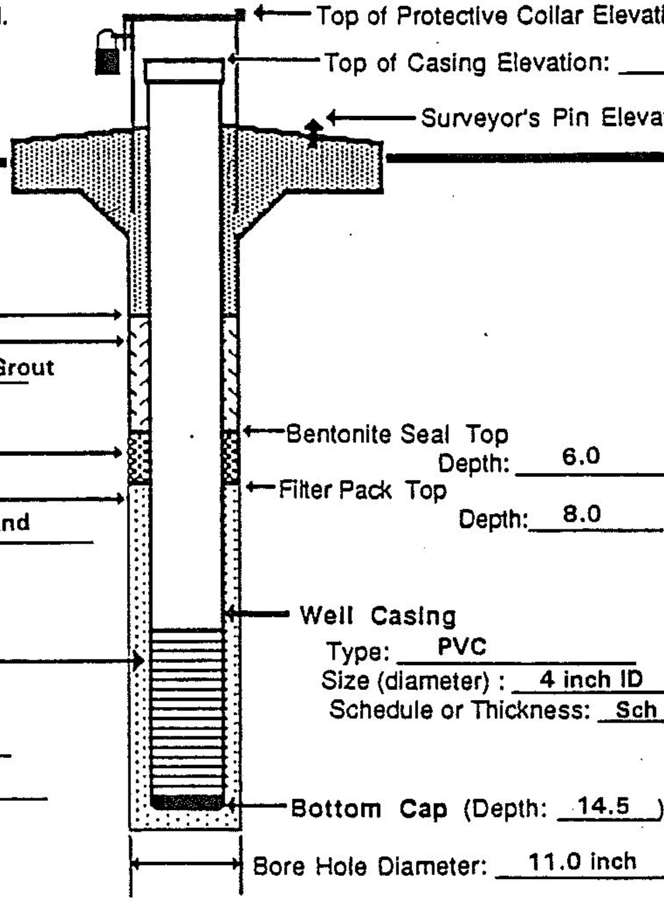
Concrete Surface Pad - Recommend steel reinforcement in the Surface Pad.
Surface Pad Dimensions: 4'x4'x6" reinforced concrete

Surface Elevation: 611.49

Top of Protective Collar Elevation: 614.77

Top of Casing Elevation: 614.39

Surveyor's Pin Elevation: 611.77



Concrete Seal Depth: 2.0

Casing Seal (Backfill) Material: Pure Gold Bentonite Grout

Bentonite Seal

Filter Pack

Filter Pack Material: 20/40 Sand
Sterilized Sand or ~~Glass Beads~~

Bentonite Seal Top Depth: 6.0 Elevation: 605.49

Filter Pack Top Depth: 8.0 Elevation: 603.49

Well Casing
Type: PVC
Size (diameter) : 4 inch ID
Schedule or Thickness: Sch 40

Well Screen
Top Depth: 9.5
Top Elevation: 601.99
Type of Well Screen: PVC
Screen Opening Size: 0.010 inch

Bottom Cap (Depth: 14.5)

Bore Hole Diameter: 11.0 inch

LAIDLAW LAIDLAW WASTE SYSTEMS, INC.

Subsurface Boring Log

Well Name/Location: **MW-15/Royal Oaks**

Page 1 of

Project: *Groundwater Monitoring Plan for Subtitle D*
Project No.: *042480069*
Client: *Royal Oaks Landfill, Cherokee County, Texas*
Start Date: *11/10/94*
Finish Date: *11/18/94*

DRILLING DATA

Inspector:	*Eric Matzner*
Contractor:	*Groundwater Technology, Inc.*
Equipment:	*Mobil B-61*
Method:	*6-5/8" ID Hollow-Stem Auger*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	CME	NA	NA
Diameter:	2"	NA	NA
Other:	NA	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	Sch. 40 PVC	Sch. 40 PVC
Diameter (ID):	4-inch	4-inch, 0.010" slot
Coupling:	Flush-Threaded	Flush-Threaded

WELL DEVELOPMENT

Method:	Surge/Purge
Duration:	6.0 hours
Gals. Purged:	122 gallons
Slug Test: (cm/sec)	NA

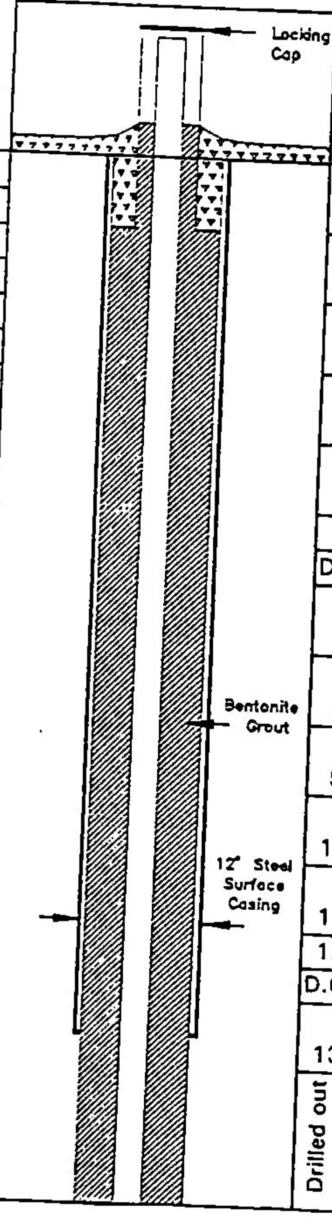
SURVEY DATA DATUM

Grade:	661.38
TWC:	664.21
TPC:	664.58
North:	8548.9
East:	11336.1

Geophysical Log: ☐ yes ☑ no

Comments:

WELL CONSTRUCTION



SAMPLE DATA

Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0–2	1		2.0			Clayey Silt; CL; brown to reddish brown, with yellow mottles and red and white banding, stiff, low plasticity, dry to slightly moist, ocasional ironstone fragments and very thin beds	Weches Fm
2–4	2		2.0				
4–6	3		2.0				Dry to slightly moist
6–8	4		2.0				
8–10	5		2.0				Moist
10–11	6		1.0				
11–12	D.O.		D.O.				Hard streak drilled out
12–14	7		2.0			Sandy Silt; ML; dark grayish-green, soft, friable, moist	
14–16	8		2.0			Silty Sand; SM; dark grayish-green, medium stiff, friable, moist, occasional hard streaks, sediments become clayier with depth	Moist
16–18	9		2.0				
18–20	10		2.0				
20–22	11		2.0			Clayey Silt; CL; dark grayish-green, glauconitic, hard, low plasticity, slightly moist	
22–23	12		1.0				
23–24	D.O.		D.O.				Hard streaks
24–26	13		2.0				12-inch steel surface casing 0-25'
26–30	Drilled out						

LAIDLAW
LAIDLAW WASTE SYSTEMS, INC.

Subsurface Boring Log

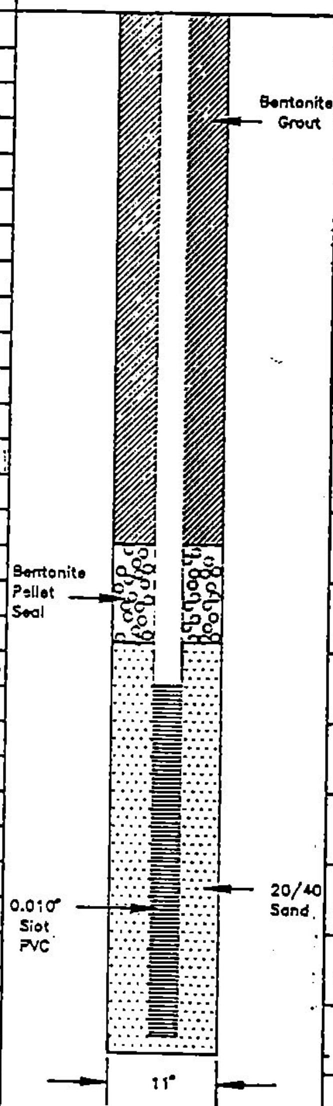
Well Name/Location: MW-15/Royal Oaks

Project: *Groundwater Monitoring Plan for Subtitle D* Project No.: *042480069*
Client: *Royal Oaks Landfill, Cherokee County, Texas*

Start Date: *11/10/94*
Finish Date: *11/18/94*

(CONTINUATION)

WELL CONSTRUCTION



SAMPLE DATA

Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)
30–36	Drilled out 26'-36'				
	1		2.0		
	2		2.0		
	3		2.0		
	4		2.0		
	5		2.0		
	6		2.0		
	7		1.0		
	8		2.0		
	9		2.0		
	10		2.0		
	11		2.0		
	12		2.0		

VISUAL CLASSIFICATION / REMARKS

VISUAL CLASSIFICATION	REMARKS
Clayey Silt; CL/ML; dark grayish-green, medium soft to stiff, friable, dry to slightly moist, glauconitic, occasional siltstone rock fragments	Dry
Top of Queen City Formation Clayey Sandy Silt; ML; very dark brown, stiff, friable, dry to moist with depth, occasional glauconitic silt-filled burrows, 1-5% white mica	Queen City Fm Moist
Silt and Sand; SM/ML; dark brown, soft, friable, moist to very moist to wet at 58.0', very fine-grained quartz, 5-10% white mica, occasional nodules of indurated sand, occasional thin beds of clayey silt and sandy silt	Moist Very moist Wet
Silty Clay; CL; dark brown, very hard, low plasticity, dry, interbedded very thin beds of silty clay and laminae of sandy silt	
End of boring at 60 feet	

Depth scale: 30, 35, 40, 45, 50, 55, 60, 65, 70 (feet)

A. Monitor Well Data Sheet

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
MSWD-SE67

Permittee or Site Name: Royal Oaks Landfill

County: Cherokee County

Date of Monitor Well Installation: 11/18/94

Monitor Well: Latitude: 31°59′54.7″ Longitude: 95°16′03.7″

Monitor Well Groundwater Gradient: Upgradient ___ Downgradient X

MSW PERMIT NO: 1614

Monitor Well I.D. No.: MW-15

Date of Monitor Well Development: 11/18/94

Monitor Well Driller Name: Benny Hinojosa

License No.: 3127M

NOTE:

(A) The information shown in the sketch below should be considered the minimum required for an installed ground-water monitor well.
(B) Report All Depths from Surface Elevation and all Elevations relative to Mean Sea Level.
(C) The minimun distance between the inside wall of the Bore Hole and the outside of the Well Casing shall be 3".
(D) Use Flush Screw Joint Casing only, 2" diameter or larger. Recommend 4" diameter minimum & Teflon Taping Casing Joints.
(E) Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist or Engineer Supervising Well Installation: Eric C. Matzner

Static Water Level Elevation (with respect to MSL) after Well Developement: 618.44

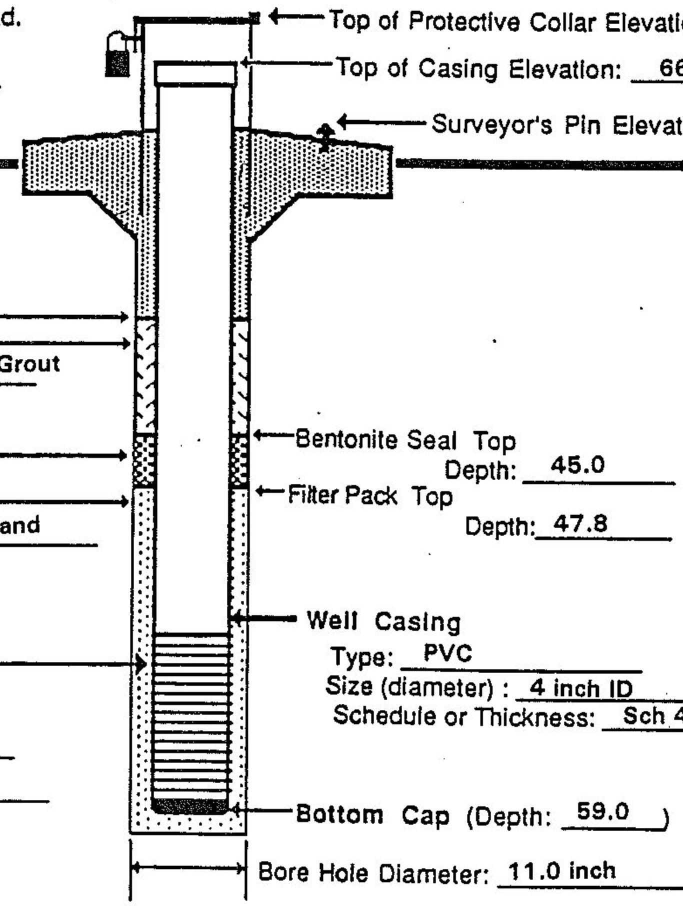
Name of Geologic Formation(s) in which Well is completed: Queen City

Type of Locking Device: pad lock

Type of Casing Protection: 6"x5′ round, anodized aluminum

Concrete Surface Pad - Recommend steel reinforcement in the Surface Pad.
Surface Pad Dimensions: 4′x4′x6" reinforced concrete

Surface Elevation: 661.38



Top of Protective Collar Elevation: 664.58

Top of Casing Elevation: 664.21

Surveyor's Pin Elevation: 661.72

Concrete Seal Depth: 2.0

Casing Seal (Backfill) Material: Pure Gold Bentonite Grout

Bentonite Seal

Filter Pack

Filter Pack Material: 20/40 Sand
Sterilized Sand or ~~Glass Beads~~

Bentonite Seal Top Depth: 45.0 Elevation: 616.38

Filter Pack Top Depth: 47.8 Elevation: 613.58

Well Screen
Top Depth: 49.0
Top Elevation: 612.38
Type of Well Screen: PVC
Screen Opening Size: 0.010 inch

Well Casing
Type: PVC
Size (diameter): 4 inch ID
Schedule or Thickness: Sch 40

Bottom Cap (Depth: 59.0)

Bore Hole Diameter: 11.0 inch

WEAVER BOOS CONSULTANTS
GEO ENVIRONMENTAL ENGINEERS AND SCIENTISTS

LOG OF BORING NO. MW-17

Project Title: Royal Oaks Landfill
Project No: 0120-76-13

Geologist: J Yahr
Driller: TSS

Boring Start Date: 7/31/2003 | Northing: 10212.05 ft.
Boring End Date: 7/31/2003 | Easting: 11222.93 ft.
TOC Elevation: 645.07 | Ground Elevation: 642.82 ft.

Remarks: Water at 30 feet at time of drilling, 23.73 feet BTOC after 24 hours. Additional above ground casing and new protective cover installed 6 days after original completion. Orginal above ground casing was approximately 26 inches AGL.

Depth (ft)	Samples	Description	USCS	Hand Penetrometer Test (tsf)	Penetration Blows/Ft	Percent Passing No. 200	Percent Moisture Content	Dry Density (pcf)	Liquid Limit	Plastic Limit	Plasticity Index	Permeability (cm/s)	Well Detail
	C	Sand, silty, clay, dry, ironstone fragments, red brown (10R3/4). 640.8											
		Clay, silty slightly sandy, moderately moist, moderately plastic, red brown (10R 4/6) with ironstone fragments. 637.8		0.5									
5	C	Silt, clayey, sandy, moderately moist, with red brown layers and ironstone fragments.											
		- increased clay content.		3.0									
10	C	- increased silt, sand, abundant ironstone fragments. 629.8		4.0									
		Sand, clayey, silty, very moist, medium to fine grained, unconsolidated, banded tan and dark brown (10YR 6/2 to 10YR 4/2).											
15	C												
20	C	- hard. - color change to yellow, becomes loose.											
													618.8
25	C	- wet.											616.8
													614.8
30	C	612.8 Sand/Clay, moist, alternating layers of olive grey sand, (5Y 4/1) and dark brown plastic clay (10YR 2/2). Sand is medium to fine grained, slightly silty, clayey. Clay is firm, plastic, sandy.											
35	C	604.8											604.8

Monitor Well Data Sheet

Permittee or Site Name: Royal Oaks Landfill
County: Cherokee
Date of Monitor Well Installation: 7/31/03
Monitor Well Northing: 10212.05 Easting: 11222.93
Monitor Well Groundwater Gradient Position:
Upgradient X Downgradient

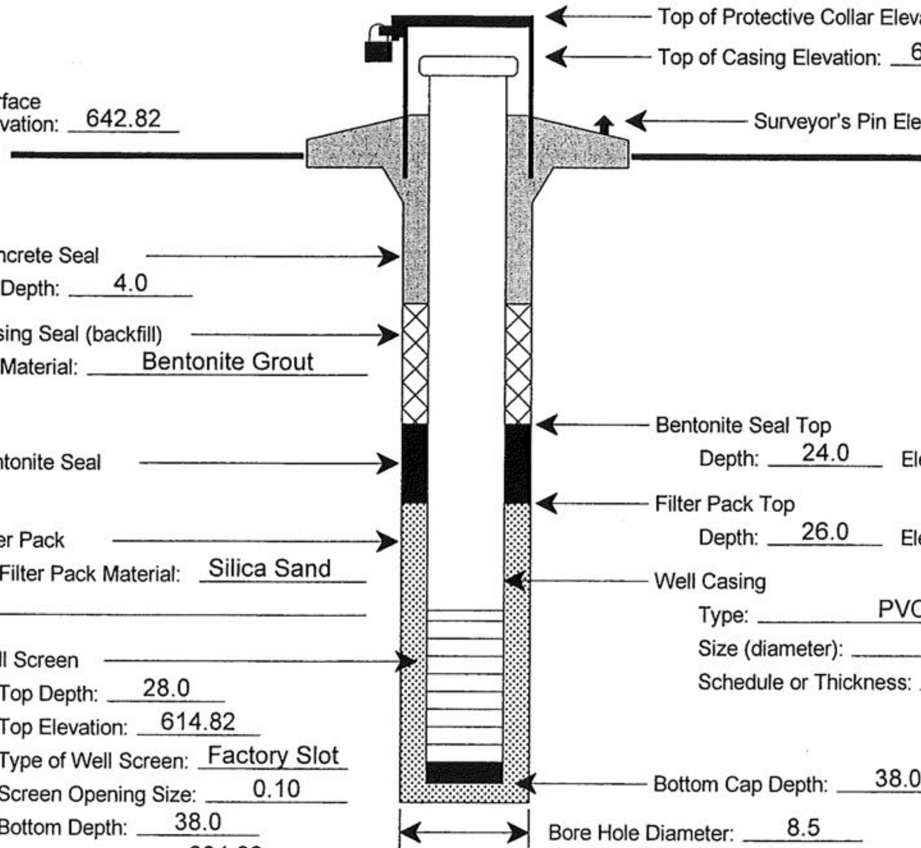
MSW Permit No.: 1614A
Monitor Well I.D. No.: MW-17
Date of Monitor Well Development: 8/1/03
Monitor Well Driller Name: Brian Kern
License No.: 54611

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: J. Yahr
Static Water Level Elevation (with respect to MSL) after Well Development: 617.34
Name of Geologic Formation(s) in which Well is completed: Queen City

Type of Locking Device: Padlock Type of Casing Protection: Steel Stickup
Concrete Surface Pad (with steel reinforcement) Dimensions: 4' X 4' X 6"



Top of Protective Collar Elevation: 645.44
Top of Casing Elevation: 645.07
Surface Elevation: 642.82
Surveyor's Pin Elevation: 642.94

Concrete Seal
Depth: 4.0

Casing Seal (backfill)
Material: Bentonite Grout

Bentonite Seal

Bentonite Seal Top
Depth: 24.0 Elevation: 618.82

Filter Pack Top
Depth: 26.0 Elevation: 616.82

Filter Pack
Filter Pack Material: Silica Sand

Well Casing
Type: PVC
Size (diameter): 4"
Schedule or Thickness: Schd 40

Well Screen
Top Depth: 28.0
Top Elevation: 614.82
Type of Well Screen: Factory Slot
Screen Opening Size: 0.10
Bottom Depth: 38.0
Bottom Elevation: 604.82

Bottom Cap Depth: 38.0

Bore Hole Diameter: 8.5

TCEQ-10308

Hydrex ENVIRONMENTAL

Monitor Well

Monitor Well No.: **MW-20**

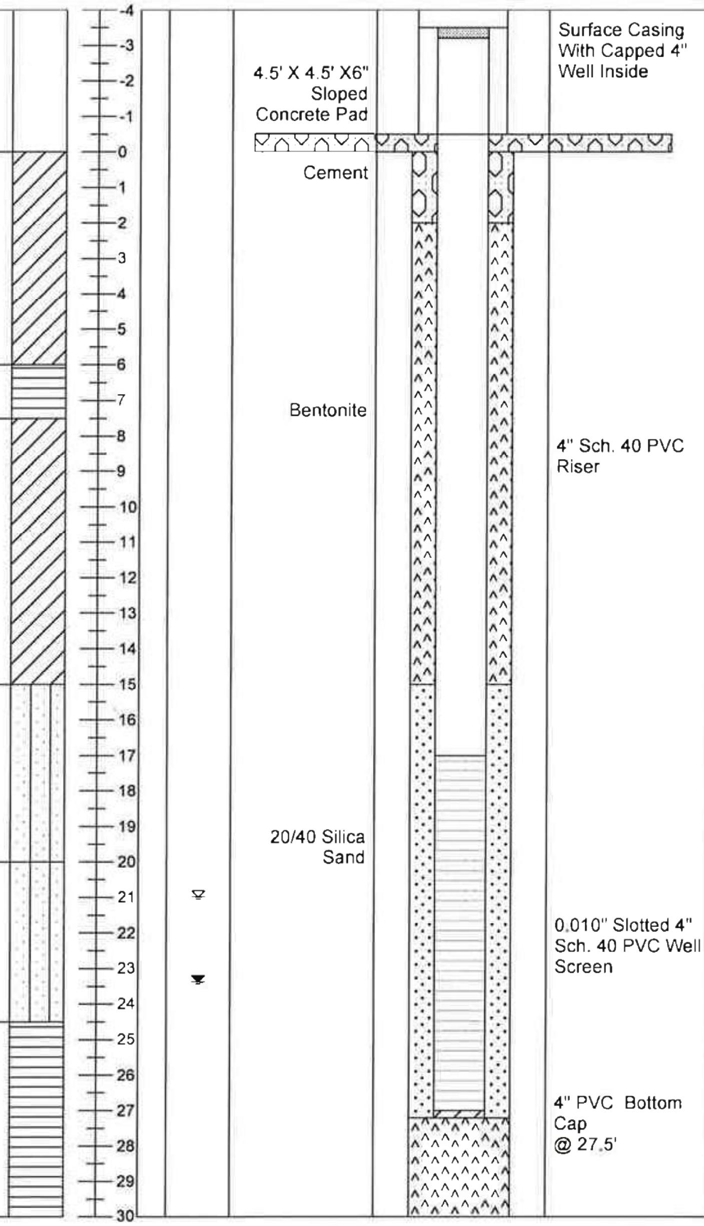
STATE OF TEXAS
LEONELL N. SCARBOROUGH
GEOLOGY
#10048
LICENSED
PROFESSIONAL GEOSCIENTIST
9/8/17

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Royal Oaks Landfill**	DRILLER:	**Thomas Daniel Cook**
PROJECT NO.:	**L-04-1144**	DRILLER'S LICENSE NO.:	**2853**
LOGGED BY:	**Stephen Rowland, Dillon Bybee**	RIG TYPE:	**D-50**
SUPERVISING PG:	**Leonell N. Scarborough**	METHOD OF DRILLING:	**Hollow Stem Auger**
COMPLETION:	**7/18/17**	SAMPLING METHODS:	**Split Barrel Sampler**
DEVELOPMENT:	**7/21/17**	TOP OF CASING ELEV.	**635.61'**
SITE LOCATION:	**Jacksonville, Texas**	HOLE DIAMETER:	**8.25"**
WELL OWNER:	**Royal Oaks Landfill**	LATITUDE: **32.001907**	LONGITUDE: **-95.263573**

■ Sample ▼ Water level after completion ▽ Water level while drilling

TBPG Firm No. 50027

DESCRIPTION	USCS	DEPTH
SILTY CLAY - Road base and fill, reddish-brown silty clay, dry -@ 2'-4', some iron oxide concretions and fine-grained brown quartz sand -@ 4'-6', color change to dark greenish-black	CL	0–6
CLAY - Dark green clay, very dense, shell fragments throughout, dry	CH	6–7.5
SILTY CLAY - Dark greenish-brown silty clay with some fine-grained quartz sand and iron oxide concretions, dry -@ 12', zone of increased iron oxide concretions -@ 13.8', white silty clay lens	CL	7.5–15
SILTY SAND - Very fine reddish-yellow sand with some silt, iron oxide streaks and white silty sand lenses throughout	SM	15–20
SILTY SAND - Alternating bands of greyish-yellow and white medium-grained quartz sand with lenses of brownish-red silty clay, wet at 21'	SM	20–24.5
CLAY - Dark brownish-black clay, very dense, with white silt laminations throughout, increasing silt with depth, dry	CH	24.5–30



NOTES: Log should not be used separately from original report. USCS Description based on field classification.

Monitor Well Data Sheet

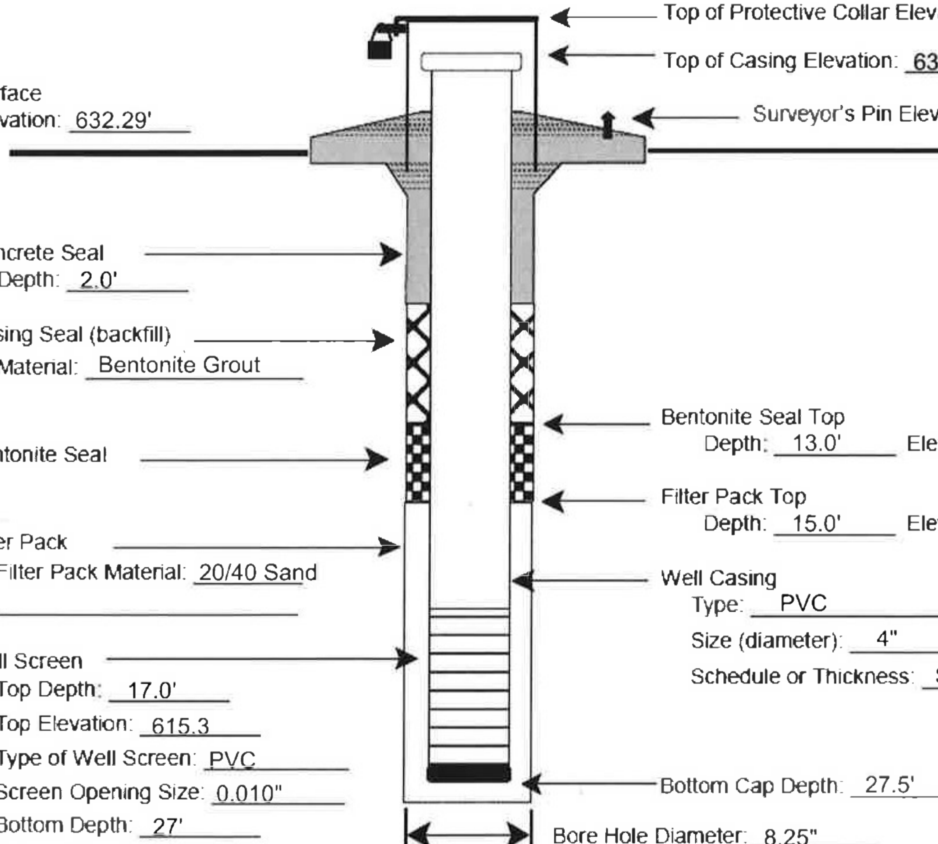
Texas Commission on Environmental Quality
Waste Permits Division

Permittee or Site Name: Royal Oaks Landfill
MSW Permit No.: 1614A
County: Cherokee County
Monitor Well I.D. No.: MW-20
Date of Monitor Well Installation: 7/18/2017
Date of Well Development: 7/21/2017
Monitor Well Latitude: 32.001907 Longitude: 95.263573
Monitor Well Driller
Name: Thomas Cook
License No.: 2853
Monitor Well Hydraulic Position:
Upgradient ______ Downgradient X

Geologist, Hydrologist, or Engineer Supervising Well Installation: Leonell N. Scarborough
Static Water Level Elevation (with respect to MSL) after Well Development: 608.91' (9/6/2017)
Name of Geologic Formation(s) in which Well is completed: Queen City
Type of Locking Device: Pad Lock Type of Casing Protection: Steel
Concrete Surface Pad (with steel reinforcement) Dimensions: 4.5'x4.5'x6"

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.



Top of Protective Collar Elevation: 636.03'
Top of Casing Elevation: 635.61'
Surface Elevation: 632.29'
Surveyor's Pin Elevation: 632.98'
Concrete Seal Depth: 2.0'
Casing Seal (backfill) Material: Bentonite Grout
Bentonite Seal
Bentonite Seal Top Depth: 13.0' Elevation: 619.3
Filter Pack
Filter Pack Material: 20/40 Sand
Filter Pack Top Depth: 15.0' Elevation: 617.3
Well Casing Type: PVC
Size (diameter): 4"
Schedule or Thickness: Sch. 40
Well Screen
Top Depth: 17.0'
Top Elevation: 615.3
Type of Well Screen: PVC
Screen Opening Size: 0.010"
Bottom Depth: 27'
Bottom Elevation: 605.29
Bottom Cap Depth: 27.5'
Bore Hole Diameter: 8.25"

TCEQ-10308 (Rev. 11/18/11)

LOG OF MONITOR WELL NO. MW-21

Project Description: 2009 Monitor Well Installations

CAREL CORPORATION

Location: Royal Oaks Landfill

Surface El.: 629.9 feet
Completion Depth: 31 feet
Date Boring Started: 9/24/2009
Date Boring Completed: 9/29/2009

Depth, feet	MATERIAL DESCRIPTION	Monitor Well Description
0–2	Silty CLAY, dark brown, dry	Concrete from 0 to 2' bgs
	SILT, red to brown	
	GRAVEL with some silt, reddish rusty brown, gravel is subangular and poorly sorted with iron nodules, dry	
5	CLAY, reddish brown	
	Silty CLAY with some mixed gravel, subangular and poorly sorted gravel	
	Silty CLAY, reddish orange, slightly moist	
10	Silty CLAY, reddish orange, friable, dry	Bentonite grout from 2' to 20.5' bgs
15	SILT, reddish orange, friable with some dry clay particles, dry, clay particles have white silt stringers	
	slightly moist at 18 feet below ground surface	
20	moist at 20 feet below ground surface	Bentonite seal from 20.5' to 23.5' bgs
	Silty SAND, light gray, sand is very fine grained, subrounded, and well sorted, wet	20/40 Silica sand from 23.5' to 31' bgs
25	Silty SAND, medium gray, sand is very fine grained and subrounded, wet	0.010" Slotted screen from 25.5' to 28' bgs
	SILT, medium to dark gray, moist	
30	CLAY, dark gray to brown, hard	3' sump

STATE OF TEXAS
MICHAEL J. HULL
GEOLOGY
#4152
LICENSED
PROFESSIONAL GEOSCIENTIST

Michael J. Hull
10/28/09

Drilling Contractor: Sunbelt Services
Drilling Method: HSA
Sampling Method: Split Spoon
Geologist/Engineer: Michael Hull
Project No.: 09-07-17

Groundwater Observations

Date	Depth
9/25/09	23.00
9/29/09	21.96

Remarks: 10 inch borehole diameter

MW WITH WELL DETAILS AND LOGO ROYAL_OAKS.GPJ CAREL.GDT 10/16/09

LOG OF MONITOR WELL NO. MW-21
PAGE 1 of 1

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.

MONITORING WELL DATA SHEET

Permitee or Site Name: Royal Oaks Landfill
County: Cherokee County
Date of Monitor Well Installation: 9/25/2009
Well Location: Latitude: 31°59'59.7"
Monitor Well Groundwater Gradient
Gradient: Upgradient: ______ Downgradient: X

MSW Permit No.: 1614-A
Monitor Well I.D. No.: MW-21
Date of Monitor Well Development: 9/29/2009
Longitude: 95°15'47.3"
Monitor Well Driller
Name: Mario Robles
License No.: 52694

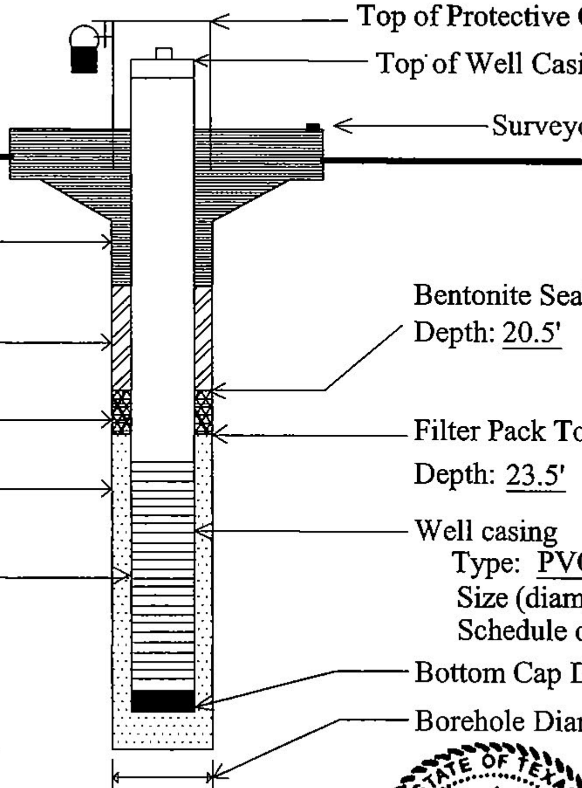
Notes:

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to the 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" diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommended).
- Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist, or Engineer Supervising Well Installation: Michael Hull
Static Water Level Elevation (with respect to MSL) after Well Development: 607.94'
Name of Geologic Formation(s) in which Well is completed: Queen City

Type of locking device: Padlock
Type of Well Casing Protection: 6"x6"x5' Steel Casing

Concrete surface pad dimensions: 4'x4'x6"



Top of Protective Collar Elevation: 632.92' MSL
Top of Well Casing Elevation: 632.59' MSL
Surface elevation: 629.90' MSL
Surveyors Pin Elevation: 630.25' MSL

Concrete Seal Depth: 2.0'
Casing seal material: Bentonite Grout
Bentonite Seal
Filter pack Material: 20/40 Sand

Bentonite Seal Top Depth: 20.5' Elevation: 609.40' MSL
Filter Pack Top Depth: 23.5' Elevation: 606.40' MSL

Well casing
Type: PVC
Size (diameter): 4"
Schedule or Thickness: Sch. 40

Bottom Cap Depth: 31'
Borehole Diameter: 10"

Well screen
Screen top depth: 25.5'
Top Elevation: 604.40' MSL
Type of well Screen: PVC
Screen Opening Size: 0.010"
Screen Bottom depth: 28'
Bottom Elevation: 601.90' MSL

TCEQ-10308

STATE OF TEXAS
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Michael J. Hull
10/28/09

LOG OF MONITOR WELL NO. MW-22

Project Description: 2009 Monitor Well Installations

CAREL CORPORATION

Location: Royal Oaks Landfill

Surface El.: 686.5 feet
Completion Depth: 39 feet
Date Boring Started: 9/21/2009
Date Boring Completed: 9/28/2009

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
0			Silty CLAY, red to brown		Concrete from 0 to 2' bgs
			SAND, very fine to fine grained, tan, moderately well sorted		
5			SAND, red to brown, black iron stone staining		
			Silty SAND, red to brown (rusty) silt to very fine grained sand, well sorted		
10			Tight and hard at 10 feet below ground surface		
			Silty SAND, red to brown (rusty), silt to very fine grained sand, well sorted, soft friable sand, moist		Bentonite grout from 2' to 21' bgs
15			Silty SAND, yellow, red to brown hard drilling at 16 feet below ground surface		
			SAND, brown to light brown, silt to very fine grained sand, well sorted, wet to moist		
20			SILTSTONE, iron-some limonite		
			CLAY, gray to green, some glauconite		Bentonite seal from 21' to 24' bgs
25			GRAVEL with some sand, iron, yellow brown, limonite, gravel is rusty brown and poorly sorted, wet		20/40 Silica sand from 24' to 39' bgs
			CLAY, dry, gray to green, gray to black glauconite		
30			Silty CLAY with sand, silty to fine grained sand, clay is grayish green with some glauconite, dry to damp		0.010" Slotted screen from 26' to 36' bgs
35			Sandy GRAVEL, black to brown, poorly sorted, wet		
			Silty SAND with clay, reddish orange to brown, silty sand		
			GRAVEL and sand, orange brown		3' sump
			CLAY, gray to green, glauconite, very plastic, wet		
40					
45					

STATE OF TEXAS
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Michael J. Hull
10/28/09

Drilling Contractor: Sunbelt Services
Drilling Method: HSA
Sampling Method: Split Spoon
Geologist/Engineer: Michael Hull
Project No.: 09-07-17

Groundwater Observations	
Date	Depth
9/21/09	24.00
9/28/09	22.85

Remarks: 10 inch borehole diameter

MW WITH WELL DETAILS AND LOGO ROYAL_OAKS.GPJ CAREL.GDT 10/28/09

LOG OF MONITOR WELL NO. MW-22
PAGE 1 of 1

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.

MONITORING WELL DATA SHEET

Permitee or Site Name: Royal Oaks Landfill

County: Cherokee County

Date of Monitor Well Installation: 9/22/2009

Well Location: Latitue: 32°00'00.1"

Monitor Well Groundwater Gradient

Gradient: Upgradient: ____ Downgradient: X

MSW Permit No.: 1614-A

Monitor Well I.D. No.: MW-22

Date of Monitor Well Development: 9/28/2009

Longitude: 95°16'04.8"

Monitor Well Driller

Name: Mario Robles

License No.: 52694

Notes:

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to the 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" diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommended).
- Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist, or Engineer Supervising Well Installation: Michael Hull

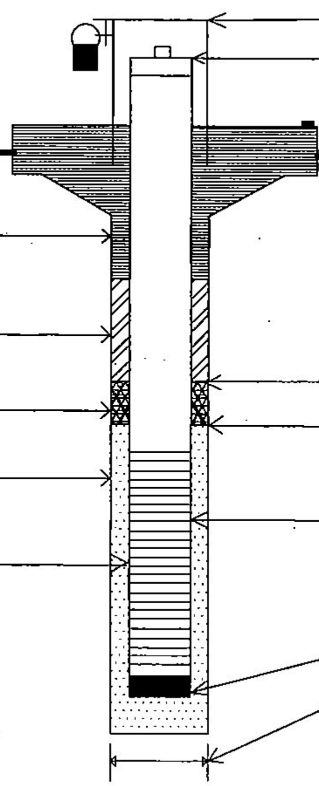
Static Water Level Elevation (with respect to MSL) after Well Development: 663.65'

Name of Geologic Formation(s) in which Well is completed: Weches

Type of locking device: Padlock

Type of Well Casing Protection: 6"x6"x5' Steel Casing

Concrete surface pad dimensions: 4'x4'x6"



Top of Protective Collar Elevation: 689.50' MSL

Top of Well Casing Elevation: 689.20' MSL

Surface elevation: 686.50' MSL

Surveyors Pin Elevation: 686.69' MSL

Concrete Seal Depth: 2.0'

Casing seal material: Bentonite Grout

Bentonite Seal

Bentonite Seal Top Depth: 21' Elevation: 665.50' MSL

Filter pack Material: 20/40 Sand

Filter Pack Top Depth: 24' Elevation: 662.50' MSL

Well screen
- Screen top depth: 26'
- Top Elevation: 660.50' MSL
- Type of well Screen: PVC
- Screen Opening Size: 0.010"
- Screen Bottom depth: 36'
- Bottom Elevation: 650.50' MSL

Well casing
- Type: PVC
- Size (diameter): 4"
- Schedule or Thickness: Sch. 40

Bottom Cap Depth: 39'

Borehole Diameter: 10"

TCEQ-10308

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Michael J. Hull
10/28/09

LOG OF MONITOR WELL NO. MW-23

Project Description: 2009 Monitor Well Installations

CAREL

Location: Royal Oaks Landfill

Surface El.: 655 feet
Completion Depth: 55 feet
Date Boring Started: 9/24/2009
Date Boring Completed: 9/29/2009

Depth, feet	MATERIAL DESCRIPTION	Monitor Well Description
0	Silty CLAY, dark brown, dry	Concrete from 0 to 2' bgs
5	dark gray, greenish black with some glauconite	
10	dark brown	
	dark gray to green	
15	Silty SAND, reddish brown, with gravel at base, silty to gravel, dry	Bentonite grout from 2' to 35' bgs
	Silty CLAY, dark gray to green with glauconite	
20	Silty SAND, dark gray to green, sand is silty to very fine grained and subrounded, moderately sorted with some glauconite, dry	
25	with clay, gray to brown, moist	
30	red to rusty brown, with some limonite	
	SILT, light gray to white, moist	
35	Silty SAND, light gray to white, sand is silty to very fine grained and subrounded, moderately well sorted, wet	Bentonite seal from 35' to 39' bgs
	light brown	
40	yellow to orange-brown	20/40 Silica sand from 39' to 55' bgs
	brown, moist	0.010" Slotted screen from 42' to 52' bgs
50	gray brown	
	Silty CLAY, gray brown and brown mixed layer, dry, hard	3' sump
55		
60		
65		

Michael J. Hull 10/28/

STATE OF TEXAS
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Drilling Contractor: Sunbelt Services
Drilling Method: HSA
Sampling Method: Split Spoon
Geologist/Engineer: Michael Hull
Project No.: 09-07-17

Groundwater Observations	
Date	Depth
9/24/09	35.00
9/29/09	38.02

Remarks: 10 inch borehole diameter

LOG OF MONITOR WELL NO. MW-23
PAGE 1 of 1

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.

MW WITH WELL DETAILS AND LOGO ROYAL_OAKS.GPJ CAREL.GDT 10/28/09

MONITORING WELL DATA SHEET

Permitee or Site Name: Royal Oaks Landfill
MSW Permit No.: 1614-A

County: Cherokee County
Monitor Well I.D. No.: MW-23

Date of Monitor Well Installation: 9/24/2009
Date of Monitor Well Development: 9/29/2009

Well Location: Latitude: 31°59'49.2"
Longitude: 95°15'50.2"

Monitor Well Groundwater Gradient
Gradient: Upgradient: ______ Downgradient: X

Monitor Well Driller
Name: Mario Robles
License No.: 52694

Notes:

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to the 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" diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommended).
- Well development should continue until water is clear, and pH and conductivity are stable.

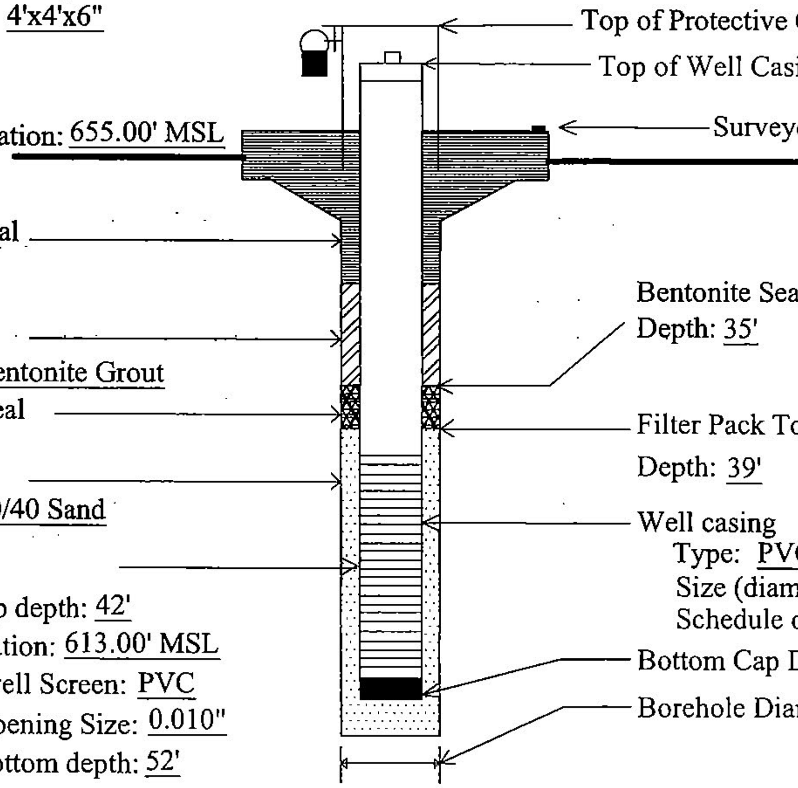
Geologist, Hydrologist, or Engineer Supervising Well Installation: Michael Hull
Static Water Level Elevation (with respect to MSL) after Well Development: 616.98'
Name of Geologic Formation(s) in which Well is completed: Queen City

Type of locking device: Padlock
Type of Well Casing Protection: 6"x6"x5' Steel Casing

Concrete surface pad dimensions: 4'x4'x6"

Top of Protective Collar Elevation: 657.94' MSL
Top of Well Casing Elevation: 657.59' MSL

Surface elevation: 655.00' MSL
Surveyors Pin Elevation: 655.23' MSL



Concrete Seal Depth: 2.0'

Casing seal material: Bentonite Grout

Bentonite Seal Top
Depth: 35' Elevation: 620.00' MSL

Bentonite Seal

Filter Pack Top
Depth: 39' Elevation: 616.00' MSL

Filter pack Material: 20/40 Sand

Well casing
Type: PVC
Size (diameter): 4"
Schedule or Thickness: Sch. 40

Well screen
Screen top depth: 42'
Top Elevation: 613.00' MSL
Type of well Screen: PVC
Screen Opening Size: 0.010"
Screen Bottom depth: 52'
Bottom Elevation: 603.00' MSL

Bottom Cap Depth: 55'

Borehole Diameter: 10"

STATE OF TEXAS
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Michael J. Hull
10/28/09

TCEQ-10308

LOG OF MONITOR WELL NO. MW-24

Project Description: 2009 Monitor Well Installations

CAREL CORPORATION

Location: Royal Oaks Landfill

Surface El.: 657.5 feet
Completion Depth: 69 feet
Date Boring Started: 9/22/2009
Date Boring Completed: 9/28/2009

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
			Silty CLAY, red to brown		Concrete from 0 to 2' bgs
			GRAVEL, sand, dark brown to black, gravel is poorly sorted with iron and limonite		
5			CLAY, yellow to brown, silty, limonite stain		
			SILT, dark gray to green, gray black with glauconite		
			Silty CLAY, yellow to brown with limonite staining carbonaceous		
10			Silt and CLAY, dark gray to brown with glauconite inclusions, friable		
15			Silty CLAY, silt dark gray to green with glauconite, friable, slightly moist		
20					
			SILT, light gray to green with clay, hard, dry		
25			Silty CLAY, dark gray to green, soft, friable with glauconite		Bentonite grout from 2' to 49' bgs
30					
			SILTSTONE, light gray to green, hard, dry		
35			Silty CLAY, dark gray to green, soft, friable, with glauconite, carbonaceous		
40					

STATE OF TEXAS
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PROFESSIONAL GEOSCIENTIST

Michael Hull
10/28/09

Drilling Contractor: Sunbelt Services
Drilling Method: HSA
Sampling Method: Split Spoon
Geologist/Engineer: Michael Hull
Project No.: 09-07-17

Groundwater Observations	
Date	Depth
9/22/09	53.00
9/28/09	49.82

Remarks: 10 inch borehole diameter

MW WITH WELL DETAILS AND LOGO ROYAL_OAKS.GPJ CAREL.GDT 10/28/09

LOG OF MONITOR WELL NO. MW-24
PAGE 1 of 2

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 MONITOR WELL NO. MW-24

Project Description: 2009 Monitor Well Installations

CAREL CORPORATION

Location: Royal Oaks Landfill

Surface El.: 657.5 feet
Completion Depth: 69 feet
Date Boring Started: 9/22/2009
Date Boring Completed: 9/28/2009

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
			CLAY, dark brown, silty, slightly moist to moist with light gray silt stringer, soft, friable towards base, moist		
45			Silty SAND, brown, sand is silty to very fined grained, moderately sorted, soft, friable, moist		
50			light gray, moist to wet		Bentonite seal from 49' to 54' bgs
55			Sandy SILT, brown to gray, sand is very fine grained and subrounded, moderately well sorted, wet		20/40 Silica sand from 54' to 69' bgs
			Silty CLAY, brown to gray, moist		
60			CLAY, dark brown, dry		0.010" Slotted screen from 56' to 66' bgs
			SILT, dark gray to brown, moist		
65			Silt/Silty SAND, dark brown, subrounded to rounded, well sorted, moist		3' sump
70					
75					
80					

STATE OF TEXAS
MICHAEL J. HULL
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#4152
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Michael J. Hull
10/28/09

Drilling Contractor: Sunbelt Services
Drilling Method: HSA
Sampling Method: Split Spoon
Geologist/Engineer: Michael Hull
Project No.: 09-07-17

Groundwater Observations	
Date	Depth
9/22/09	53.00
9/28/09	49.82

Remarks: 10 inch borehole diameter

MW WITH WELL DETAILS AND LOGO ROYAL_OAKS.GPJ CAREL.GDT 10/28/09

LOG OF MONITOR WELL NO. MW-24
PAGE 2 of 2

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.

MONITORING WELL DATA SHEET

Permitee or Site Name: Royal Oaks Landfill
County: Cherokee County
Date of Monitor Well Installation: 9/22/2009
Well Location: Latitude: 31°59'47.6"
Monitor Well Groundwater Gradient
Gradient: Upgradient: ____ Downgradient: X

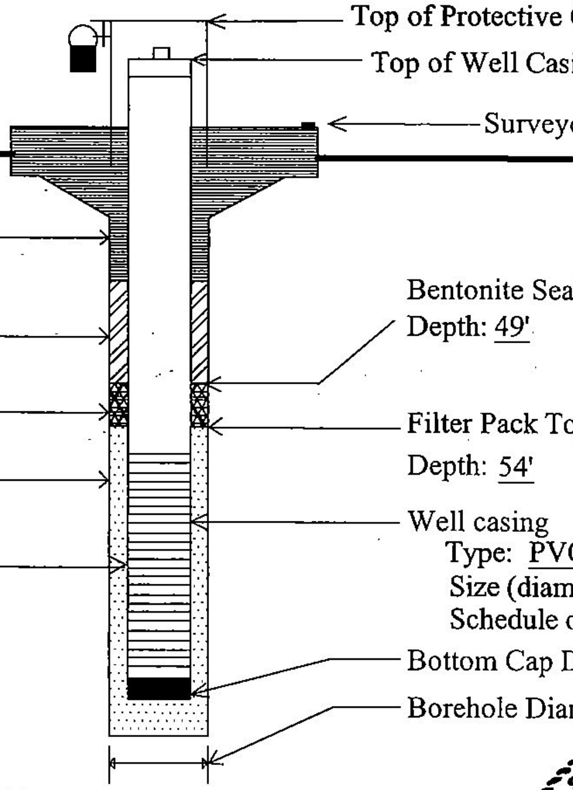
MSW Permit No.: 1614-A
Monitor Well I.D. No.: MW-24
Date of Monitor Well Development: 9/28/2009
Longitude: 95°15'55.9"
Monitor Well Driller
Name: Mario Robles
License No.: 52694

Notes:

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to the 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" diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommended).
- Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist, or Engineer Supervising Well Installation: Michael Hull
Static Water Level Elevation (with respect to MSL) after Well Development: 607.68'
Name of Geologic Formation(s) in which Well is completed: Queen City

Type of locking device: Padlock
Type of Well Casing Protection: 6"x6"x5' Steel Casing
Concrete surface pad dimensions: 4'x4'x6"



Top of Protective Collar Elevation: 660.89' MSL
Top of Well Casing Elevation: 660.58' MSL
Surface elevation: 657.50' MSL
Surveyors Pin Elevation: 657.70' MSL

Concrete Seal Depth: 2.0'

Bentonite Seal Top Depth: 49' Elevation: 608.50' MSL

Casing seal material: Bentonite Grout

Bentonite Seal

Filter Pack Top Depth: 54' Elevation: 603.50' MSL

Filter pack Material: 20/40 Sand

Well casing
Type: PVC
Size (diameter): 4"
Schedule or Thickness: Sch. 40

Well screen
Screen top depth: 56'
Top Elevation: 601.50' MSL
Type of well Screen: PVC
Screen Opening Size: 0.010"
Screen Bottom depth: 66'
Bottom Elevation: 591.50' MSL

Bottom Cap Depth: 69'
Borehole Diameter: 10"

STATE OF TEXAS
MICHAEL J. HULL
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Michael J Hull
10/28/09

TCEQ-10308

LOG OF MONITOR WELL NO. MW-25

Project Description: 2009 Monitor Well Installations

CAREL CORPORATION

Location: Royal Oaks Landfill

Surface El.: 663.2 feet
Completion Depth: 35 feet
Date Boring Started: 9/23/2009
Date Boring Completed: 9/29/2009

Depth, feet	MATERIAL DESCRIPTION	Monitor Well Description
0–2	Sandy SILT, dark gray to green, black, silt, subrounded, well sorted, hard, dry	Concrete from 0 to 2' bgs
2–3	CLAY, white, plastic, moist	
3–8	SANDY Silt, red to rusty brown, sand is very fine grained and subrounded, moderately sorted with iron nodules, dry to slightly moist	
8–15	Sandy SILT, red (rusty) brown and gray to green, silt to very fine grained, subrounded, moderately well sorted, inter bedded with glauconite, dry	Bentonite grout from 2' to 21' bgs
	dark gray to green, fissile and soft with glauconite and slightly wet at 12' bgs	
15–19	Silty SAND, dark gray to green, sand is silt to very fine grained and is subrounded, moderately sorted, fissile and soft with glauconite, moist	
19–21	CLAY, gray to green, glauconite, plastic, slightly moist	
21–30	Silt SAND, dark gray to green, sand is silt to very fine grained and subrounded, moderately sorted with glauconitic and fissile, moist	Bentonite seal from 21' to 24' bgs
	slightly wet to wet at 24' bgs	20/40 Silica sand from 24' to 35' bgs
	moist at 28' bgs	
30–34	SILTSTONE, silicified, light gray to white, hard streak, moist	0.010" Slotted screen from 27' to 32' bgs
34–35	CLAY, dark gray to green	3' sump

STATE OF TEXAS
MICHAEL J. HULL
GEOLOGY
4152
LICENSED
PROFESSIONAL GEOSCIENTIST

Michael J. Hull 10/28/09

Drilling Contractor: Sunbelt Services
Drilling Method: HSA
Sampling Method: Split Spoon
Geologist/Engineer: Michael Hull
Project No.: 09-07-17

Groundwater Observations	
Date	Depth
9/23/09	24.00
9/29/09	21.62

Remarks: 10 inch borehole diameter

MW WITH WELL DETAILS AND LOGO ROYAL_OAKS.GPJ CAREL.GDT 10/28/09

LOG OF MONITOR WELL NO. MW-25
PAGE 1 of 1

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.

MONITORING WELL DATA SHEET

Permitee or Site Name: Royal Oaks Landfill
County: Cherokee County
Date of Monitor Well Installation: 9/23/2009
Well Location: Latitude: 31°59'51.9"
Monitor Well Groundwater Gradient
Gradient: Upgradient: ____ Downgradient: X

MSW Permit No.: 1614-A
Monitor Well I.D. No.: MW-25
Date of Monitor Well Development: 9/29/2009
Longitude: 95°15'49.8"
Monitor Well Driller
Name: Mario Robles
License No.: 52694

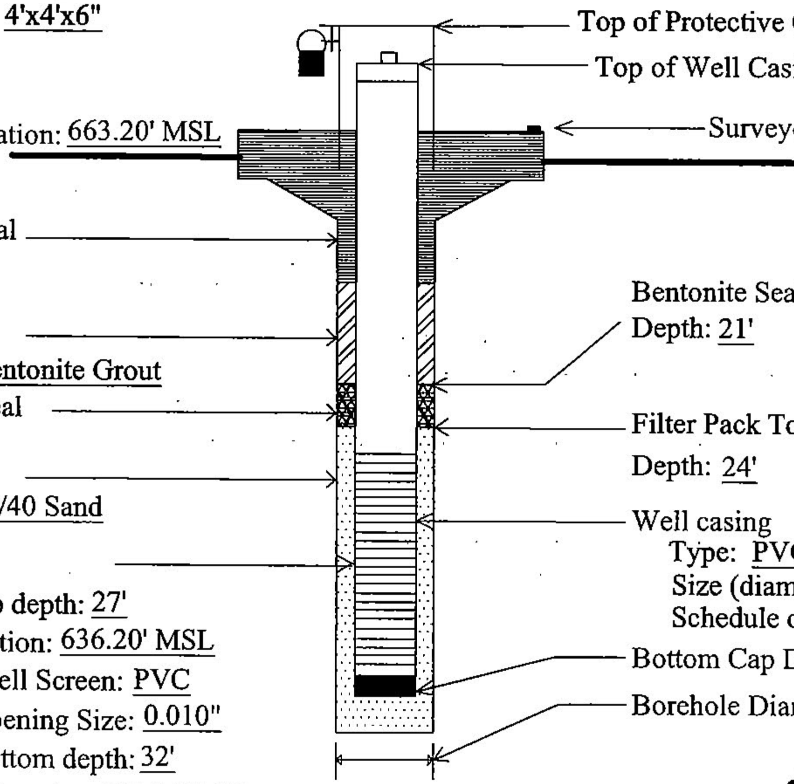
Notes:

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to the 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" diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommended).
- Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist, or Engineer Supervising Well Installation: Michael Hull
Static Water Level Elevation (with respect to MSL) after Well Development: 641.58'
Name of Geologic Formation(s) in which Well is completed: Weches

Type of locking device: Padlock
Type of Well Casing Protection: 6"x6"x5' Steel Casing

Concrete surface pad dimensions: 4'x4'x6"



Top of Protective Collar Elevation: 666.19' MSL
Top of Well Casing Elevation: 665.84' MSL
Surface elevation: 663.20' MSL
Surveyors Pin Elevation: 663.29' MSL

Concrete Seal
Depth: 2.0'

Casing seal
material: Bentonite Grout

Bentonite Seal

Filter pack
Material: 20/40 Sand

Well screen
Screen top depth: 27'
Top Elevation: 636.20' MSL
Type of well Screen: PVC
Screen Opening Size: 0.010"
Screen Bottom depth: 32'
Bottom Elevation: 631.20' MSL

Bentonite Seal Top
Depth: 21' Elevation: 642.20' MSL

Filter Pack Top
Depth: 24' Elevation: 639.20' MSL

Well casing
Type: PVC
Size (diameter): 4"
Schedule or Thickness: Sch. 40

Bottom Cap Depth: 35'
Borehole Diameter: 10"

TCEQ-10308

STATE OF TEXAS
MICHAEL J. HULL
GEOLOGY
#4152
LICENSED
PROFESSIONAL GEOSCIENTIST

Michael J. Hull
10/28/09

FORMER MONITOR WELL
DRILLER PLUGGING REPORTS

STATE OF TEXAS PLUGGING REPORT for Tracking #89044

Owner:	**Royal Oaks Landfill**	Owner Well #:	**MW-13**
Address:	**608 CR 4102** **Jacksonville , TX 75766**	Grid #:	**38-06-3**
Well Location:	**608 CR 4102** **Jacksonville , TX 75766**	Latitude:	**31° 59' 46" N**
Well County:	**Cherokee**	Longitude:	**095° 15' 57" W**
		GPS Brand Used:	**Garmin**
Well Type:	**Monitor**		

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller:	**No Data**
Driller's License Number of Original Well Driller:	**No Data**
Date Well Drilled:	**No Data**
Well Report Tracking Number:	**No Data**
Diameter of Borehole:	**No Data**
Total Depth of Borehole:	**No Data**
Date Well Plugged:	**7/25/2013**
Person Actually Performing Plugging Operation:	**Wilburn Ragon**
License Number of Plugging Operator:	**54683**
Plugging Method:	**Tremmie pipe cement from bottom to top.**
Plugging Variance #:	**No Data**
Casing Left Data:	1st Interval: **4 inches diameter, From 40 ft to 20 ft** 2nd Interval: **No Data** 3rd Interval: **No Data**
Cement/Bentonite Plugs Placed in Well:	1st Interval: **From 40 ft to 2 ft; Sack(s)/type of cement used: 8** 2nd Interval: **From 2 ft to 0 ft; Sack(s)/type of cement used: .5 bentonite** 3rd Interval: **No Data** 4th Interval: **No Data** 5th Interval: **No Data**
Certification Data:	The plug installer certified that the plug installer plugged this well (or the well was plugged under the plug installer's direct supervision) and that each and all of the statements herein are true and correct. The plug installer understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**ETTL Engineers & Consultants** **1717 E Erwin Street** **Tyler , TX 75702**
Plug Installer License Number:	**54683**

Licensed Plug Installer Signature:	**Wilburn Ragon**
Registered Plug Installer Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Plugging Method Comments:	**No Data**

Please include the plugging report's tracking number (Tracking **#89044**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

STATE OF TEXAS PLUGGING REPORT for Tracking #89045

Owner:	**Royal Oaks Landfill**	Owner Well #:	**MW-14**
Address:	**608 CR 4102 Jacksonville , TX 75766**	Grid #:	**38-06-3**
Well Location:	**608 CR 4102 Jacksonville , TX 75766**	Latitude:	**31° 59' 55" N**
Well County:	**Cherokee**	Longitude:	**095° 15' 50" W**
		GPS Brand Used:	**Garmin**
Well Type:	**Monitor**		

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller:	**No Data**
Driller's License Number of Original Well Driller:	**No Data**
Date Well Drilled:	**No Data**
Well Report Tracking Number:	**No Data**
Diameter of Borehole:	**No Data**
Total Depth of Borehole:	**No Data**
Date Well Plugged:	**7/25/2013**
Person Actually Performing Plugging Operation:	**Wilburn Ragon**
License Number of Plugging Operator:	**54683**
Plugging Method:	**Tremmie pipe cement from bottom to top.**
Plugging Variance #:	**No Data**
Casing Left Data:	1st Interval: **4 inches diameter, From 23.5 ft to 15 ft** 2nd Interval: **No Data** 3rd Interval: **No Data**
Cement/Bentonite Plugs Placed in Well:	1st Interval: **From 23.5 ft to 2 ft; Sack(s)/type of cement used: 3** 2nd Interval: **From 2 ft to 0 ft; Sack(s)/type of cement used: .5 bentonite** 3rd Interval: **No Data** 4th Interval: **No Data** 5th Interval: **No Data**
Certification Data:	The plug installer certified that the plug installer plugged this well (or the well was plugged under the plug installer's direct supervision) and that each and all of the statements herein are true and correct. The plug installer understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**ETTL Engineers & Consultants 1717 E Erwin Street Tyler , TX 75702**
Plug Installer License Number:	**54683**

Licensed Plug Installer Signature:	**Wilburn Ragon**
Registered Plug Installer Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Plugging Method Comments:	**No Data**

Please include the plugging report's tracking number (Tracking **#89045**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

STATE OF TEXAS PLUGGING REPORT for Tracking #89043

Owner:	**Royal Oaks Landfill**	Owner Well #:	**MW-16**
Address:	**608 CR 4102** **Jacksonville , TX 75766**	Grid #:	**38-06-1**
Well Location:	**608 CR 4102** **Jacksonville , TX 75766**	Latitude:	**31° 59' 13" N**
Well County:	**Cherokee**	Longitude:	**095° 21' 24" W**
		GPS Brand Used:	**Garmin**
Well Type:	**Monitor**		

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller:	**No Data**
Driller's License Number of Original Well Driller:	**No Data**
Date Well Drilled:	**No Data**
Well Report Tracking Number:	**No Data**
Diameter of Borehole:	**No Data**
Total Depth of Borehole:	**No Data**
Date Well Plugged:	**7/25/2013**
Person Actually Performing Plugging Operation:	**Wilburn Ragon**
License Number of Plugging Operator:	**54683**
Plugging Method:	**Tremmie pipe cement from bottom to top.**
Plugging Variance #:	**No Data**
Casing Left Data:	1st Interval: **4 inches diameter, From 16 ft to 5.5 ft** 2nd Interval: **No Data** 3rd Interval: **No Data**
Cement/Bentonite Plugs Placed in Well:	1st Interval: **From 16 ft to 2 ft; Sack(s)/type of cement used: 3** 2nd Interval: **From 2 ft to 0 ft; Sack(s)/type of cement used: .5 bentonite** 3rd Interval: **No Data** 4th Interval: **No Data** 5th Interval: **No Data**
Certification Data:	The plug installer certified that the plug installer plugged this well (or the well was plugged under the plug installer's direct supervision) and that each and all of the statements herein are true and correct. The plug installer understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**ETTL Engineers & Consultants** **1717 E Erwin Street** **Tyler , TX 75702**
Plug Installer License Number:	**54683**

Licensed Plug Installer Signature:	**Wilburn Ragon**
Registered Plug Installer Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Plugging Method Comments:	**No Data**

Please include the plugging report's tracking number (Tracking **#89043**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

STATE OF TEXAS PLUGGING REPORT for Tracking #89046

Owner:	Royal Oaks Landfill	Owner Well #:	MW-19
Address:	608 CR 4102 Jacksonville , TX 75766	Grid #:	38-06-3
Well Location:	608 CR 4102 Jacksonville , TX 75766	Latitude:	31° 59' 57" N
Well County:	Cherokee	Longitude:	095° 15' 44" W
		GPS Brand Used:	Garmin
Well Type:	Monitor		

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller:	No Data
Driller's License Number of Original Well Driller:	No Data
Date Well Drilled:	No Data
Well Report Tracking Number:	No Data
Diameter of Borehole:	No Data
Total Depth of Borehole:	No Data
Date Well Plugged:	7/25/2013
Person Actually Performing Plugging Operation:	Wilburn Ragon
License Number of Plugging Operator:	54683
Plugging Method:	Tremmie pipe cement from bottom to top.
Plugging Variance #:	No Data
Casing Left Data:	1st Interval: 4 inches diameter, From 69 ft to 0 ft 2nd Interval: No Data 3rd Interval: No Data
Cement/Bentonite Plugs Placed in Well:	1st Interval: From 69 ft to 2 ft; Sack(s)/type of cement used: 15 2nd Interval: From 2 ft to 0 ft; Sack(s)/type of cement used: .5 bentonite 3rd Interval: No Data 4th Interval: No Data 5th Interval: No Data
Certification Data:	The plug installer certified that the plug installer plugged this well (or the well was plugged under the plug installer's direct supervision) and that each and all of the statements herein are true and correct. The plug installer understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	ETTL Engineers & Consultants 1717 E Erwin Street Tyler , TX 75702
Plug Installer License Number:	54683

Licensed Plug Installer Signature:	**Wilburn Ragon**
Registered Plug Installer Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Plugging Method Comments:	**No Data**

Please include the plugging report's tracking number (Tracking **#89046**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

APPENDIX IIIH-B

GROUNDWATER MONITORING DATA

STATE OF TEXAS
AARON K. EVANS
11143
LICENSED
PROFESSIONAL GEOSCIENTIST

05/20/2024

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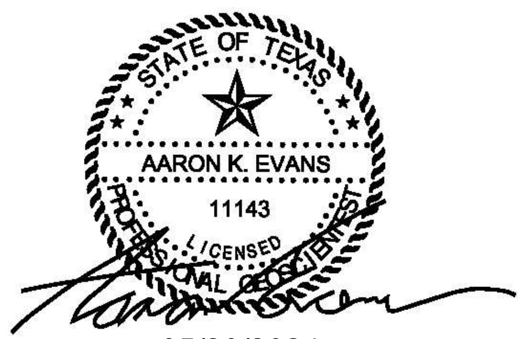
Table IIIH-B-1 Total Metals Analytical Data from Existing Subtitle D Groundwater Monitor Wells IIIH-B-1

Table IIIH-B-2 VOC Analytical Data from Existing Subtitle D Groundwater Monitor Wells IIIH-B-13

Table IIIH-B-3 Total Metals Analytical Data from Former Subtitle D Groundwater Monitor Wells IIIH-B-23

Table IIIH-B-4 VOC Analytical Data from Former Subtitle D Groundwater Monitor Wells IIIH-B-24



05/20/2024

Table IIIH-B-1

Total Metals Analytical Data from Existing Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Total Antimony	Total Arsenic	Total Barium	Total Beryllium	Total Cadmium	Total Chromium	Total Cobalt	Total Copper	Total Lead	Total Nickel	Total Selenium	Total Silver	Total Thallium	Total Vanadium	Total Zinc
MW-8	03/12/07	<5	<10	41	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
	06/21/07	<5	<10	32	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
	09/17/07	<5	<10	40	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
	06/02/09	<1	<10	30	<1	<2	<8	<6	<12	<10	<9	<15	<3	<0.5	<6	<30
	09/29/09	<1	<10	34	<1	<2	<8	<6	<12	<10	<9	<15	<3	<0.5	<6	<30
	12/08/09	<1	<10	37	<1	<2	<8	6.6	<12	<10	<9	<15	<3	<0.5	<6	<30
	03/09/10	<1	<10	31	<1	<2	<8	<6	<12	<10	<9	<15	<3	<0.5	<6	<30
	06/08/10	<5	<5	31	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	08/30/10	<5	<5	30	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/15/10	<5	<5	35	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	03/24/11	<5	<5	38	<4	<2	<20	9	<10	<15	<20	<50	<10	<1	<10	<100
	06/17/11	<5	<5	24	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/08/11	<5	<5	33	<4	<2	<20	6	<10	<15	<20	<50	<10	<1	<10	<100
	06/18/12	<5	<5	24	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/03/12	<5	<5	34	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/11/13	<5	<5	23	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/03/13	<5	<5	31	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/02/14	<5	<5	24	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/01/14	<5	<5	29.2	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/03/15	<5	<5	24.6	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/07/15	<5	<5	34.3	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/16	<5	<5	26.4	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/06/16	<5	<5	31.9	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/17	<5	<5	22.2	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/11/17	<5	<5	31.8	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	05/29/18	<5	<5	21.3	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/12/18	<5	<5	39.8	<4	<2	<20	7.5	<10	<15	<20	<50	<10	<1	<10	<100
	05/29/19	<5	<5	25.7	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/02/19	<5	<5	30.5	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/16/20	<5	<5	20.5	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/07/20	<5	<5	34.7	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/16/21	<5	<5	24.9	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/13/21	<5	<5	29.7	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/22	<5	<5	21.9	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/28/22	<5	<5	27.8	<4	<2	<20	5.6	<10	<15	<20	<50	<10	<1	<10	<100
	06/19/23	<5	<5	19.8	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100

Table IIIH-B-1

Total Metals Analytical Data from Existing Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Total Antimony	Total Arsenic	Total Barium	Total Beryllium	Total Cadmium	Total Chromium	Total Cobalt	Total Copper	Total Lead	Total Nickel	Total Selenium	Total Silver	Total Thallium	Total Vanadium	Total Zinc
MW-9	03/12/07	<5	17	110	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
	06/21/07	<5	31	150	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
	09/17/07	<5	13	79	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
	06/02/09	<1	15	59	1.1	<2	<8	<6	<12	<10	<9	<15	<3	<0.5	<6	<30
	09/29/09	<1	20	89	no data	<2	<8	<6	<12	<10	<9	<15	<3	<0.5	<6	<30
	12/08/09	<1	27	110	no data	<2	<8	<6	<12	<10	<9	<15	<3	<0.5	<6	<30
	03/09/10	<1	21	100	no data	<2	<8	<6	<12	<10	<9	<15	<3	<0.5	<6	<30
	06/08/10	<5	17	65	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	08/30/10	<5	15	56	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/15/10	<5	12	48	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	03/24/11	<5	no data	37	<4	<2	<20	no data	<10	<15	<20	<50	<10	<1	<10	<100
	06/22/11	<5	16	49	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/08/11	<5	8.9	48	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/19/12	<5	5.9	45	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/03/12	<5	11	62	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/11/13	<5	11	59	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/03/13	<5	13	53	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/02/14	<5	12	51	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/01/14	<5	13	49.6	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/02/15	<5	12.2	50.9	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/07/15	<5	18.7	80.9	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/16	<5	13.6	54.6	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/06/16	<5	21.7	96.9	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/17	<5	22.4	93.6	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/11/17	<5	15.1	62.9	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	05/29/18	<5	<5	21.8	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/12/18	<5	11.9	55	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	05/30/19	<5	11	55	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/02/19	<5	13	62.2	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/16/20	<5	13	61.2	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/07/20	<5	12.5	53	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/16/21	<5	10.9	56.4	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/14/21	<5	13	51.4	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/22	<5	12.6	48.3	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/28/22	<5	13.1	46.8	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/19/23	<5	27.8	118	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100

Table IIIH-B-1

Total Metals Analytical Data from Existing Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Total Antimony	Total Arsenic	Total Barium	Total Beryllium	Total Cadmium	Total Chromium	Total Cobalt	Total Copper	Total Lead	Total Nickel	Total Selenium	Total Silver	Total Thallium	Total Vanadium	Total Zinc
MW-10	03/13/07	<5	<10	28	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
	06/21/07	<5	<10	34	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
	09/17/07	<5	<10	38	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
	06/02/09	<1	<10	29	<1	<2	<8	<6	<12	<10	<9	<15	<3	<0.5	<6	<30
	09/28/09	<1	<10	39	<1	<2	<8	no data	<12	<10	<9	<15	<3	<0.5	<6	<30
	12/07/09	<1	<10	41	<1	<2	<8	no data	<12	<10	<9	<15	<3	<0.5	<6	<30
	03/09/10	<1	<10	30	<1	<2	<8	no data	<12	<10	<9	<15	<3	<0.5	<6	<30
	06/08/10	<5	<5	33	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	08/31/10	<5	<5	35	<4	<2	<20	<5	<10	no data	<20	<50	<10	<1	<10	<100
	12/15/10	<5	<5	44	<4	<2	<20	6.1	<10	<15	<20	<50	<10	<1	<10	<100
	03/24/11	<5	<5	41	<4	<2	<20	5.3	<10	<15	<20	<50	<10	<1	<10	<100
	06/17/11	<5	<5	28	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/07/11	<5	<5	30	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/12	<5	<5	34	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/03/12	<5	<5	48	<4	<2	<20	8.3(O)	<10	<15	<20	<50	<10	<1	<10	<100
	06/11/13	<5	<5	31	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/04/13	<5	<5	47	<4	<2	<20	8.1	<10	<15	<20	<50	<10	<1	<10	<100
	06/02/14	<5	<5	37	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
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	06/03/15	<5	<5	35.1	<4	<2	<20	<5	25.8(O)	<15	<20	<50	<10	<1	<10	<100
	12/07/15	<5	<5	51.4	<4	<2	<20	6.8	<10	<15	<20	<50	<10	<1	<10	<100
	06/21/16	<5	<5	36.3	<4	<2	<20	<5	<10	<15	<20	<5	<10	<1	<10	<100
	12/06/16	<5	<5	45.9	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/17	<5	<5	35.1	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
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	12/12/18	<5	<5	50.6	<4	<2	<20	7.4	<10	<15	<20	<50	<10	<1	<10	<100
	05/30/19	<5	<5	37.6	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/02/19	<5	<5	48.6	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/16/20	<5	<5	37.2	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/07/20	<5	<5	48.1	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/16/21	<5	<5	40	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/13/21	<5	<5	48.3	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/22	<5	<5	38.1	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/28/22	<5	<5	48.4	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/19/23	<5	<5	40	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100

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Total Metals Analytical Data from Existing Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Total Antimony	Total Arsenic	Total Barium	Total Beryllium	Total Cadmium	Total Chromium	Total Cobalt	Total Copper	Total Lead	Total Nickel	Total Selenium	Total Silver	Total Thallium	Total Vanadium	Total Zinc
MW-11	03/13/07	<5	100	510	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
	06/21/07	<5	34	120	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
	09/17/07	<5	25	80	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
MW-12	03/13/07	<5	21	100	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
	06/21/07	<5	<10	81	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
	09/18/07	<5	17	76	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
	09/28/09	<1	21	75	no data	<2	<8	<6	<12	<10	<9	<15	<3	<0.5	<6	<30
	12/07/09	<1	no data	77	<1	<2	<8	<6	<12	<10	<9	<15	<3	<0.5	<6	<30
	03/09/10	<1	12	68	<1	<2	<8	<6	<12	<10	<9	<15	<3	<0.5	<6	<30
	06/09/10	<5	7.4	70	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	08/31/10	<5	18	74	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/16/10	<5	14	80	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	03/25/11	<5	42	96	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/16/11	<5	21	78	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/07/11	<5	7	76	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/12	<5	no data	no data	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/04/12	<5	<5	82	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/11/13	<5	24	91	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/04/13	<5	40	120	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/02/14	<5	43	130	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/02/14	<5	242(O)	467(O)	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	02/12/15	no data	146(O)	265(O)	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	06/03/15	<5	8.2	70	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/07/15	<5	11.5	89.8	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/21/16	<5	19.6	96.1	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
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	02/13/17	no data	no data	131	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	06/20/17	<5	19	106	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/11/17	<5	8.2	96.5	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	05/29/18	<5	31.8	129	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
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	05/30/19	<5	74.5	262(O)	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	08/13/19	no data	no data	154	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	12/03/19	<5	13.6	101	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/17/20	<5	263	543	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	08/20/20	no data	107	304	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	12/08/20	<5	235	678	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	03/16/21	no data	462	988(O)	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data

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Total Metals Analytical Data from Existing Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Total Antimony	Total Arsenic	Total Barium	Total Beryllium	Total Cadmium	Total Chromium	Total Cobalt	Total Copper	Total Lead	Total Nickel	Total Selenium	Total Silver	Total Thallium	Total Vanadium	Total Zinc
MW-12	04/08/21	no data	15.9	89.9	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	06/17/21	<5	18.5	100	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/14/21	<5	8.9	80.7	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/21/22	<5	34.5	124	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/29/22	<5	21.4	85.7	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/23	<5	500	827	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	09/06/23	no data	33.7	114	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
MW-15	03/12/07	<5	<10	26	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
	06/21/07	<5	<10	26	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
	09/17/07	<5	<10	24	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
	06/02/09	<1	<10	30	<1	<2	<8	<6	<12	<10	<9	<15	<3	<0.5	<6	<30
	09/28/09	<1	<10	28	<1	<2	<8	<6	<12	<10	<9	<15	<3	<0.5	<6	<30
	12/07/09	<1	<10	25	<1	<2	<8	<6	<12	<10	<9	<15	<3	<0.5	<6	<30
	03/09/10	<1	<10	29	<1	<2	<8	<6	<12	<10	<9	<15	<3	<0.5	<6	<30
	06/09/10	<5	<5	30	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	08/31/10	<5	<5	28	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/15/10	<5	<5	28	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	03/24/11	<5	<5	26	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/16/11	<5	<5	25	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/08/11	<5	<5	30	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/19/12	<5	<5	23	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/04/12	<5	<5	26	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
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	06/02/14	<5	<5	27	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/02/14	<5	<5	23.6	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
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	06/20/16	<5	<5	24.2	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/06/16	<5	<5	23.5	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/17	<5	<5	24.5	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/11/17	<5	<5	23.9	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
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	05/30/19	<5	<5	22.9	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/03/19	<5	<5	22.8	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/17/20	<5	<5	22.2	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/07/20	<5	<5	21.6	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100

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Total Metals Analytical Data from Existing Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Total Antimony	Total Arsenic	Total Barium	Total Beryllium	Total Cadmium	Total Chromium	Total Cobalt	Total Copper	Total Lead	Total Nickel	Total Selenium	Total Silver	Total Thallium	Total Vanadium	Total Zinc
MW-15	06/17/21	<5	<5	22.4	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/14/21	<5	<5	22.9	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/21/22	<5	<5	22.5	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/29/22	<5	<5	22.6	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/19/23	<5	<5	28.1	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
MW-17	03/13/07	<5	39	77	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
	06/21/07	<5	27	63	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
	09/17/07	<5	48	110	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
	06/03/09	<1	no data	no data	<1	<2	<8	<6	<12	<10	<9	<15	<3	<0.5	<6	<30
	09/28/09	<1	26	60	<1	<2	<8	<6	<12	<10	<9	<15	<3	<0.5	<6	<30
	12/07/09	<1	no data	53	<1	<2	<8	<6	<12	<10	<9	<15	<3	<0.5	<6	<30
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	12/15/10	<5	30	65	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	03/24/11	<5	34	66	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/16/11	<5	26	55	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/07/11	<5	26	68	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
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	12/03/12	<5	28	66	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
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	12/04/13	<5	27	65	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/02/14	<5	43	80	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/01/14	<5	44.7	73	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
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	12/07/15	<5	72.4(O)	134	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/16	<5	39.3	71.6	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/06/16	<5	<5	34.7	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/17	<5	46.1	90.4	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/11/17	<5	34.3	64.9	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	05/29/18	<5	106(O)	206	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	07/25/18	no data	41.7	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	12/12/18	<5	48.5	75.4	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	05/30/19	<5	86.9(O)	120	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/02/19	<5	61.1	109	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/16/20	<5	62.9	83.2	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/07/20	<5	73	97.4	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/17/21	<5	58.3	84.2	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100

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Total Metals Analytical Data from Existing Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Total Antimony	Total Arsenic	Total Barium	Total Beryllium	Total Cadmium	Total Chromium	Total Cobalt	Total Copper	Total Lead	Total Nickel	Total Selenium	Total Silver	Total Thallium	Total Vanadium	Total Zinc
MW-17	12/14/21	<5	32.5	58.3	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/21/22	<5	26.6	53.7	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/28/22	<5	33.2	58.7	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/23	<5	120	187	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	09/06/23	no data	40.3	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
MW-20	09/06/17	<5	<5	92.8	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/11/17	<5	<5	68.9	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	03/07/18	<5	<5	148	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	05/29/18	<5	<5	121	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	09/12/18	<5	<5	96.1	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/12/18	<5	<5	158	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	03/07/19	<5	<5	194	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	05/30/19	<5	<5	150	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/03/19	<5	<5	97	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/17/20	<5	<5	132	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/08/20	<5	<5	138	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/17/21	<5	<5	156	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/14/21	<5	<5	130	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/21/22	<5	<5	136	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/29/22	<5	<5	119	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/23	<5	<5	157	<4	<2	<20	<5	12.7	<15	<20	<50	<10	<1	<10	<100
MW-21	09/30/09	<1	no data	no data	<1	<2	<8	no data	<12	<10	<9	<15	<3	<0.5	no data	<30
	12/08/09	<1	17	39	<1	<2	<8	<6	<12	<10	<9	<15	<3	<0.5	<6	<30
	03/09/10	<1	16	39	<1	<2	<8	<6	<12	<10	<9	<15	<3	<0.5	<6	<30
	06/08/10	<5	14	39	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	08/31/10	<5	<5	23	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/15/10	<5	<5	29	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	03/24/11	<5	<5	17	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/17/11	<5	<5	36	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/08/11	<5	<5	84(O)	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	03/21/12	no data	no data	59	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	06/19/12	<5	<5	84(O)	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	09/11/12	no data	no data	57	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	12/04/12	<5	8.4	28	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/11/13	<5	<5	68	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/04/13	<5	<5	85	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/02/14	<5	<5	80	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/02/14	<5	<5	128	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100

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Total Metals Analytical Data from Existing Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Total Antimony	Total Arsenic	Total Barium	Total Beryllium	Total Cadmium	Total Chromium	Total Cobalt	Total Copper	Total Lead	Total Nickel	Total Selenium	Total Silver	Total Thallium	Total Vanadium	Total Zinc
MW-21	06/02/15	<5	<5	136	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/07/15	<5	<5	188(O)	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	02/24/16	no data	no data	198	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	06/20/16	<5	<5	248(O)	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	09/07/16	no data	no data	129	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	12/06/16	<5	<5	291	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/17	<5	<5	349	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/11/17	<5	<5	325	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	05/29/18	<5	<5	211	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/12/18	<5	<5	302	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	05/30/19	<5	<5	335	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/03/19	<5	<5	412	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	02/17/20	no data	no data	426(O)	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	06/17/20	<5	<5	380	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/08/20	<5	<5	448	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	03/16/21	no data	no data	472(O)	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	04/08/21	no data	no data	491	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	06/17/21	<5	<5	394	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/14/21	<5	<5	478	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/21/22	<5	<5	449	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	09/01/22	no data	no data	511	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	12/29/22	<5	<5	455	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/23	<5	<5	432	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100

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Total Metals Analytical Data from Existing Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Total Antimony	Total Arsenic	Total Barium	Total Beryllium	Total Cadmium	Total Chromium	Total Cobalt	Total Copper	Total Lead	Total Nickel	Total Selenium	Total Silver	Total Thallium	Total Vanadium	Total Zinc
MW-22	09/28/09	<1	no data	no data	<1	<2	<8	no data	<12	<10	no data	<15	<3	<0.5	<6	no data
	12/08/09	<1	no data	130	<1	<2	<8	97	<12	<10	32	<15	<3	<0.5	<6	no data
	03/09/10	<1	no data	120	<1	<2	<8	120	<12	<10	39	<15	<3	<0.5	<6	no data
	06/08/10	<5	<5	120	<4	<2	<20	140	<10	<15	44	<50	<10	<1	<10	120
	08/31/10	<5	5.1	110	<4	<2	<20	130	<10	<15	40	<50	<10	<1	<10	<100
	12/15/10	<5	5.9	86	<4	<2	<20	91	<10	<15	27	<50	<10	<1	<10	<100
	03/24/11	<5	7.2	98	<4	<2	<20	110	<10	<15	32	<50	<10	<1	<10	<100
	06/16/11	<5	5	94	<4	<2	<20	100	<10	<15	32	<50	<10	<1	<10	<100
	12/07/11	<5	<5	100	<4	<2	<20	95	<10	<15	30	<50	<10	<1	<10	<100
	06/18/12	<5	7	95	<4	<2	<20	190	<10	<15	45	<50	<10	<1	<10	120
	12/03/12	<5	<5	83	<4	<2	<20	130	<10	<15	32	<50	<10	<1	<10	<100
	06/11/13	<5	<5	88	<4	<2	<20	160	<10	<15	39	<50	<10	<1	<10	<100
	12/04/13	<5	5.1	74	<4	<2	<20	130	<10	<15	35	<50	<10	<1	<10	<100
	06/02/14	<5	26(O)	79	<4	<2	<20	200	<10	<15	42	<50	<10	<1	<10	120
	08/26/14	no data	5.5	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	12/01/14	<5	<5	66.5	<4	<2	<20	138	<10	<15	33.3	<50	<10	<1	<10	<100
	06/03/15	<5	18(O)	66.5	<4	<2	<20	184	<10	<15	38.1	<50	<10	<1	<10	104
	08/27/15	no data	12.3	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	12/07/15	<5	44.6(O)	74	<4	<2	<20	165	<10	<15	36	<50	<10	<1	<10	104
	02/24/16	no data	<5	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	06/21/16	<5	<5	68.9	<4	<2	<20	162	<10	<15	34.7	<50	<10	<1	<10	<100
	12/06/16	<5	9.8	67.9	<4	<2	<20	144	<10	<15	32.1	<50	<10	<1	<10	<100
	06/20/17	<5	<5	68.5	<4	<2	<20	216	<10	<15	44.1	<50	<10	<1	<10	125(O)
	09/06/17	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	126
	12/11/17	<5	6.5	74.2	<4	<2	<20	174	<10	<15	37.5	<50	<10	<1	<10	103
	05/29/18	<5	39.7(O)	69.6	<4	<2	<20	221	<10	<15	42.8	<50	<10	<1	<10	128(O)
	07/25/18	no data	<5	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	111
	12/12/18	<5	6.4	53.8	<4	<2	<20	178	<10	<15	33.9	<50	<10	<1	<10	104
	05/29/19	<5	<5	69.7	<4	<2	<20	207	<10	<15	42.2	<50	<10	<1	<10	130(O)
	08/13/19	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	124
	12/02/19	<5	<5	70.8	<4	<2	<20	159	<10	<15	35.2	<50	<10	<1	<10	101
	06/16/20	<5	6.4	72.1	<4	<2	<20	219	<10	<15	43.1	<50	<10	<1	<10	130
	12/07/20	<5	6.6	72	<4	<2	<20	205	<10	<15	39	<50	<10	<1	<10	124
	06/16/21	<5	<5	72.4	<4	<2	<20	231	<10	<15	42.6	<50	<10	<1	<10	131
	12/13/21	<5	<5	74.7	<4	<2	<20	171	<10	<15	36.3	<50	<10	<1	<10	<100
	06/20/22	<5	<5	71	<4	<2	<20	201	<10	<15	39.8	<50	<10	<1	<10	123
	12/28/22	<5	<5	68.8	<4	<2	<20	124	<10	<15	31.0	<50	<10	<1	<10	<100
	06/19/23	<5	<5	12.7	80.6	<2	<20	248	<10	<15	45.1	<50	<10	<1	<10	146

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Total Metals Analytical Data from Existing Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Total Antimony	Total Arsenic	Total Barium	Total Beryllium	Total Cadmium	Total Chromium	Total Cobalt	Total Copper	Total Lead	Total Nickel	Total Selenium	Total Silver	Total Thallium	Total Vanadium	Total Zinc
MW-22	09/06/23	no data	16	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	120
MW-23	09/29/09	<1	21	100	<1	<2	<8	no data	<12	<10	no data	<15	<3	<0.5	no data	no data
	12/08/09	<1	33	71	no data	<2	<8	29	<12	<10	20	<15	<3	<0.5	<6	<30
	03/09/10	<1	28	60	<1	<2	<8	23	<12	<10	no data	<15	<3	<0.5	<6	<30
	06/09/10	<5	29	83	<4	<2	<20	24	<10	<15	<20	<50	<10	<1	<10	<100
	08/31/10	<5	31	90	<4	<2	<20	29	<10	<15	20	<50	<10	<1	<10	<100
	12/15/10	<5	27	90	<4	<2	<20	19	<10	<15	<20	<50	<10	<1	<10	<100
	03/24/11	<5	no data	69	<4	<2	<20	16	<10	<15	<20	<50	<10	<1	<10	<100
	06/16/11	<5	24	80	<4	<2	<20	17	<10	<15	<20	<50	<10	<1	<10	<100
	12/08/11	<5	13	86	<4	<2	<20	16	<10	<15	<20	<50	<10	<1	<10	<100
	06/19/12	<5	11	51	<4	<2	<20	10	<10	<15	<20	<50	<10	<1	<10	<100
	12/03/12	<5	17	86	<4	<2	<20	23	<10	<15	<20	<50	<10	<1	<10	<100
	06/11/13	<5	16	67	<4	<2	<20	15	<10	<15	<20	<50	<10	<1	<10	<100
	12/04/13	<5	18	69	<4	<2	<20	26	<10	<15	<20	<50	<10	<1	<10	<100
	06/02/14	<5	21	63	<4	<2	<20	21	<10	<15	<20	<50	<10	<1	<10	<100
	12/02/14	<5	21.9	71.6	<4	<2	<20	22.8	<10	<15	<20	<50	<10	<1	12.7	<100
	02/12/15	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	<10	no data
	06/02/15	<5	27	39.4	<4	<2	<20	10.3	<10	<15	<20	<50	<10	<1	<10	<100
	12/07/15	<5	28.4	50.9	<4	<2	<20	16.1	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/16	<5	20.7	30.7	<4	<2	<20	7.8	<10	<15	<20	<50	<10	<1	<10	<100
	12/06/16	<5	20.9	76	<4	<2	<20	21.2	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/17	<5	21.6	53.6	<4	<2	<20	16.7	<10	<15	<20	<50	<10	<1	<10	<100
	12/11/17	<5	23.7	66.1	<4	<2	<20	15.5	<10	<15	<20	<50	<10	<1	<10	<100
	05/29/18	<5	30.6	63	<4	<2	<20	19.2	<10	<15	<20	<50	<10	<1	<10	<100
	12/12/18	<5	30.6	56.3	<4	<2	<20	19.7	<10	<15	<20	<50	<10	<1	<10	<100
	05/30/19	<5	23	51.7	<4	<2	<20	14.6	<10	<15	<20	<50	<10	<1	<10	<100
	12/03/19	<5	18.5	60.3	<4	<2	<20	13.4	<10	<15	<20	<50	<10	<1	<10	<100
	06/17/20	<5	23	58.4	<4	<2	<20	16.4	<10	<15	<20	<50	<10	<1	<10	<100
	12/07/20	<5	25.4	66.6	<4	<2	<20	17	<10	<15	<20	<50	<10	<1	<10	<100
	06/17/21	<5	28.9	66.2	<4	<2	<20	15.6	<10	<15	<20	<50	<10	<1	<10	<100
	12/14/21	<5	20.3	65.5	<4	<2	<20	13.5	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/22	<5	23.3	63.4	<4	<2	<20	15.2	<10	<15	<20	<50	<10	<1	<10	<100
	12/29/22	<5	25.6	61.5	<4	<2	<20	11.7	<10	<15	<20	<50	<10	<1	<10	<100
	06/19/23	<5	37.7	66	<4	<2	<20	14.6	<10	<15	<20	<50	<10	<1	<10	<100

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Total Metals Analytical Data from Existing Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Total Antimony	Total Arsenic	Total Barium	Total Beryllium	Total Cadmium	Total Chromium	Total Cobalt	Total Copper	Total Lead	Total Nickel	Total Selenium	Total Silver	Total Thallium	Total Vanadium	Total Zinc
MW-24	09/30/09	<1	no data	no data	<1	<2	<8	no data	<12	<10	no data	<15	<3	<0.5	<6	<30
	12/08/09	<1	14	31	no data	<2	<8	<6	<12	<10	<9	<15	<3	<0.5	<6	<30
	03/09/10	<1	17	52	<1	<2	<8	<6	<12	<10	<9	<15	<3	<0.5	<6	<30
	06/09/10	<5	21	65	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	08/31/10	<5	18	50	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/15/10	<5	21	58	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	03/24/11	<5	20	79	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/16/11	<5	19	55	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/07/11	<5	19	65	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/12	<5	23	140	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	09/11/12	no data	no data	220(O)	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	12/04/12	<5	13	56	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/11/13	<5	14	62	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/04/13	<5	20	81	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/02/14	<5	19	96	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/02/14	<5	17.2	61.4	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/02/15	<5	17.3	64.6	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/07/15	<5	19	84.4	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/16	<5	17.1	53.2	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/06/16	<5	18	69.7	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/17	<5	16.9	71.6	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/11/17	<5	19.6	74.9	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	05/29/18	<5	16.6	67	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/12/18	<5	26.2	156	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	05/30/19	<5	21.4	114	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/03/19	<5	19	60.8	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/17/20	<5	18	84.5	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/08/20	<5	22.3	119	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/17/21	<5	19.4	72.9	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/14/21	<5	15.3	54.7	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/21/22	<5	18.4	67.6	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	12/29/22	<5	17.8	71	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	06/19/23	<5	47.1	318	<4	<2	<20	<5	<10	<15	<20	<50	<10	<1	<10	<100
	09/06/23	no data	16.6	63.6	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data

Table IIIH-B-1

Total Metals Analytical Data from Existing Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Total Antimony	Total Arsenic	Total Barium	Total Beryllium	Total Cadmium	Total Chromium	Total Cobalt	Total Copper	Total Lead	Total Nickel	Total Selenium	Total Silver	Total Thallium	Total Vanadium	Total Zinc
MW-25	09/30/09	<1	no data	no data	<1	<2	<8	18	<12	<10	no data	<15	<3	<0.5	<6	<30
	12/08/09	<1	no data	29	no data	<2	<8	24	<12	<10	<9	<15	<3	<0.5	<6	<30
	03/09/10	<1	12	28	<1	<2	<8	24	<12	<10	<9	<15	<3	<0.5	<6	<30
	06/09/10	<5	14	28	<4	<2	<20	21	<10	<15	<20	<50	<10	<1	<10	<100
	08/31/10	<5	17	27	<4	<2	<20	18	<10	<15	<20	<50	<10	<1	<10	<100
	12/15/10	<5	16	29	<4	<2	<20	18	<10	<15	<20	<50	<10	<1	<10	<100
	03/24/11	<5	11	24	<4	<2	<20	15	<10	<15	<20	<50	<10	<1	<10	<100
	06/16/11	<5	17	27	<4	<2	<20	13	<10	<15	<20	<50	<10	<1	<10	<100
	12/08/11	<5	17	34	<4	<2	<20	17	<10	<15	<20	<50	<10	<1	<10	<100
	06/19/12	<5	9.5	30	<4	<2	<20	12	<10	<15	<20	<50	<10	<1	<10	<100
	12/03/12	<5	12	37(O)	<4	<2	<20	12	<10	<15	<20	<50	<10	<1	<10	<100
	03/18/13	no data	no data	43	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	06/11/13	<5	14	38(O)	<4	<2	<20	11	<10	<15	<20	<50	<10	<1	<10	<100
	09/26/13	no data	no data	37	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	12/03/13	<5	16	47(O)	<4	<2	<20	12	<10	<15	<20	<50	<10	<1	<10	<100
	02/24/14	no data	no data	47	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	06/02/14	<5	16	42	<4	<2	<20	8.7	<10	<15	<20	<50	<10	<1	<10	<100
	12/01/14	<5	18.7	41.6	<4	<2	<20	8.7	<10	<15	<20	<50	<10	<1	<10	<100
	06/03/15	<5	19.8	54.5	<4	<2	<20	10.9	<10	<15	<20	<50	<10	<1	<10	<100
	12/07/15	<5	23	62.5	<4	<2	<20	11.4	<10	<15	<20	<50	<10	<1	<10	<100
	06/21/16	<5	17.4	49.4	<4	<2	<20	9	<10	<15	<20	<5	<10	<1	<10	<100
	12/06/16	<5	19.1	65.3	<4	<2	<20	10.6	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/17	<5	17.3	66.6	<4	<2	<20	9.5	<10	<15	<20	<50	<10	<1	<10	<100
	12/11/17	<5	18.4	62.4	<4	<2	<20	8.7	<10	<15	<20	<50	<10	<1	<10	<100
	05/29/18	<5	17.6	70.6	<4	<2	<20	9.7	<10	<15	<20	<50	<10	<1	<10	<100
	12/12/18	<5	17.2	83.4	<4	<2	<20	10.3	<10	<15	<20	<50	<10	<1	<10	<100
	05/30/19	<5	16.6	90.3	<4	<2	<20	10.8	<10	<15	<20	<50	<10	<1	<10	<100
	12/02/19	<5	16.9	85.5	<4	<2	<20	9.4	<10	<15	<20	<50	<10	<1	<10	<100
	06/16/20	<5	15.9	92.6	<4	<2	<20	11	<10	<15	<20	<50	<10	<1	<10	<100
	12/07/20	<5	17	92.1	<4	<2	<20	10.5	<10	<15	<20	<50	<10	<1	<10	<100
	06/16/21	<5	17.3	115	<4	<2	<20	12.1	<10	<15	<20	<50	<10	<1	<10	<100
	12/13/21	<5	16.2	84	<4	<2	<20	8.2	<10	<15	<20	<50	<10	<1	<10	<100
	06/20/22	<5	15.8	104	<4	<2	<20	10.2	<10	<15	<20	<50	<10	<1	<10	<100
	12/28/22	<5	18.1	103	<4	<2	<20	9.7	<10	<15	<20	<50	<10	<1	<10	<100
	06/19/23	<5	18.9	116	<4	<2	<20	10.9	<10	<15	<20	<50	<10	<1	<10	<100

Table IIIH-B-2
VOC Analytical Data from Existing Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Acetone	Acrylo-nitrile	Benzene	Bromochloro-methane	Bromodichloro-methane	Bromoform	Carbon Disulfide	Carbon Tetrachloride	Chloro-benzene	Chloro-ethane	Chloroform	Dibromo-chloromethane	1-2-Dibromo-3-chloropropane	1-2-Dibromo-ethane	1,2-Dichloro-benzene	1,4-Dichloro-benzene	trans-1,4-Dichloro-2-butene	1,1-Dichloro-ethane	1,2-Dichloro-ethane	1,1-Dichloro-ethene	cis-1,2-Dichloro-ethene	trans-1,2-Dichloro-ethene	1,2-Dichloro-propane	cis-1,3-Dichloro-propene	trans-1,3-Dichloro-propene	Ethyl-benzene	2-Hexa-none	Bromo-methane	Chloro-methane	Dibromo-methane	Methylene chloride	Methyl Ethyl Ketone	Iodo-methane	4-Methyl-2-Pentanone	Styrene	1,1,1,2-Tetrachloro-ethane	1,1,2,2-Tetrachloro-ethane	Tetrachloro-ethylene	Toluene	1,1,1-Trichloro-ethane	1,1,2-Trichloro-ethane	Trichloro-ethylene	Trichloro-fluoro-methane	1,2,3-Trichloro-propane	Vinyl Acetate	Vinyl Chloride	Total Xylenes
MW-8	03/29/95	<5	<7	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<1	<1	<5	<1	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1
	06/29/95	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<5
	10/12/95	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<5
	12/11/95	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<5
	03/28/96	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<5
	06/26/96	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
	09/25/96	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
	12/11/96	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
	05/23/97	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
	12/10/97	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
	05/29/98	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
	12/15/98	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
	06/03/99	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
	12/16/99	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
	06/02/00	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<5	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
	12/11/00	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
	06/19/01	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<5	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
	12/11/01	<10	<25	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<10	<2	<10
	06/18/02	<10	<25	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	12/12/02	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	06/30/03	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	12/10/03	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	06/21/04	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	12/07/04	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
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Table IIIH-B-2
VOC Analytical Data from Existing Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Acetone	Acrylo-nitrile	Benzene	Bromochloro-methane	Bromodichloro-methane	Bromoform	Carbon Disulfide	Carbon Tetrachloride	Chloro-benzene	Chloro-ethane	Chloroform	Dibromo-chloromethane	1-2-Dibromo-3-chloropropane	1-2-Dibromo-ethane	1,2-Dichloro-benzene	1,4-Dichloro-benzene	trans-1,4-Dichloro-2-butene	1,1-Dichloro-ethane	1,2-Dichloro-ethane	1,1-Dichloro-ethene	cis-1,2-Dichloro-ethene	trans-1,2-Dichloro-ethene	1,2-Dichloro-propane	cis-1,3-Dichloro-propene	trans-1,3-Dichloro-propene	Ethyl-benzene	2-Hexa-none	Bromo-methane	Chloro-methane	Dibromo-methane	Methylene chloride	Methyl Ethyl Ketone	Iodo-methane	4-Methyl-2-Pentanone	Styrene	1,1,1,2-Tetrachloro-ethane	1,1,2,2-Tetrachloro-ethane	Tetrachloro-ethylene	Toluene	1,1,1-Trichloro-ethane	1,1,2-Trichloro-ethane	Trichloro-ethylene	Trichloro-fluoro-methane	1,2,3-Trichloro-propane	Vinyl Acetate	Vinyl Chloride	Total Xylenes
MW-9	03/29/95	<5	<7	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<1	<1	<5	<1	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1
	06/29/95	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<5
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Table IIIH-B-2
VOC Analytical Data from Existing Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Acetone	Acrylo-nitrile	Benzene	Bromochloro-methane	Bromodichloro-methane	Bromoform	Carbon Disulfide	Carbon Tetrachloride	Chloro-benzene	Chloro-ethane	Chloroform	Dibromo-chloromethane	1-2-Dibromo-3-chloropropane	1-2-Dibromo-ethane	1,2-Dichloro-benzene	1,4-Dichloro-benzene	trans-1,4-Dichloro-2-butene	1,1-Dichloro-ethane	1,2-Dichloro-ethane	1,1-Dichloro-ethene	cis-1,2-Dichloro-ethene	trans-1,2-Dichloro-ethene	1,2-Dichloro-propane	cis-1,3-Dichloro-propene	trans-1,3-Dichloro-propene	Ethyl-benzene	2-Hexa-none	Bromo-methane	Chloro-methane	Dibromo-methane	Methylene chloride	Methyl Ethyl Ketone	Iodo-methane	4-Methyl-2-Pentanone	Styrene	1,1,1,2-Tetrachloro-ethane	1,1,2,2-Tetrachloro-ethane	Tetrachloro-ethylene	Toluene	1,1,1-Trichloro-ethane	1,1,2-Trichloro-ethane	Trichloro-ethylene	Trichloro-fluoro-methane	1,2,3-Trichloro-propane	Vinyl Acetate	Vinyl Chloride	Total Xylenes
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	06/16/20	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	12/07/20	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
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	06/20/22	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	12/28/22	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	06/19/23	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10

Table IIIH-B-2
VOC Analytical Data from Existing Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Acetone	Acrylo-nitrile	Benzene	Bromochloro-methane	Bromodichloro-methane	Bromoform	Carbon Disulfide	Carbon Tetrachloride	Chloro-benzene	Chloro-ethane	Chloroform	Dibromo-chloromethane	1-2-Dibromo-3-chloropropane	1-2-Dibromo-ethane	1,2-Dichloro-benzene	1,4-Dichloro-benzene	trans-1,4-Dichloro-2-butene	1,1-Dichloro-ethane	1,2-Dichloro-ethane	1,1-Dichloro-ethene	cis-1,2-Dichloro-ethene	trans-1,2-Dichloro-ethene	1,2-Dichloro-propane	cis-1,3-Dichloro-propene	trans-1,3-Dichloro-propene	Ethyl-benzene	2-Hexa-none	Bromo-methane	Chloro-methane	Dibromo-methane	Methylene chloride	Methyl Ethyl Ketone	Iodo-methane	4-Methyl-2-Pentanone	Styrene	1,1,1,2-Tetrachloro-ethane	1,1,2,2-Tetrachloro-ethane	Tetrachloro-ethylene	Toluene	1,1,1-Trichloro-ethane	1,1,2-Trichloro-ethane	Trichloro-ethylene	Trichloro-fluoro-methane	1,2,3-Trichloro-propane	Vinyl Acetate	Vinyl Chloride	Total Xylenes
MW-11	03/29/95	<5	<7	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<1	<1	<5	<1	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1
	06/29/95	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<5
	10/13/95	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<5
	12/12/95	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<5
	03/28/96	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<5
	06/27/96	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
	09/26/96	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
	12/12/96	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
	05/23/97	<10	<50	<5	<5	<5	<5	6	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
	07/10/97	no data	no data	no data	no data	no data	no data	<5	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	12/10/97	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
	05/29/98	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
	12/15/98	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
	06/03/99	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
	12/16/99	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
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	06/19/01	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<5	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
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	12/18/02	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	06/30/03	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	12/10/03	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	06/21/04	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	12/07/04	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	06/17/05	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
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	06/21/07	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<7.5	no data	no data	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	12/06/07	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	06/12/08	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	12/11/08	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	06/02/09	<25	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<1	<2	<2	<1	<1	<20	<1	<1	<2	<1	<2	<1	<1	<5	<5	<10	<5	<2	<1	<5	<10	<2	<10	<5	<1	<2	<1	<1	<5	<1	<1	<5	<5	<1	<1	<10

Table IIIH-B-2
VOC Analytical Data from Existing Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Acetone	Acrylo-nitrile	Benzene	Bromochloro-methane	Bromodichloro-methane	Bromoform	Carbon Disulfide	Carbon Tetrachloride	Chloro-benzene	Chloro-ethane	Chloroform	Dibromo-chloromethane	1-2-Dibromo-3-chloropropane	1-2-Dibromo-ethane	1,2-Dichloro-benzene	1,4-Dichloro-benzene	trans-1,4-Dichloro-2-butene	1,1-Dichloro-ethane	1,2-Dichloro-ethane	1,1-Dichloro-ethene	cis-1,2-Dichloro-ethene	trans-1,2-Dichloro-ethene	1,2-Dichloro-propane	cis-1,3-Dichloro-propene	trans-1,3-Dichloro-propene	Ethyl-benzene	2-Hexa-none	Bromo-methane	Chloro-methane	Dibromo-methane	Methylene chloride	Methyl Ethyl Ketone	Iodo-methane	4-Methyl-2-Pentanone	Styrene	1,1,1,2-Tetrachloro-ethane	1,1,2,2-Tetrachloro-ethane	Tetrachloro-ethylene	Toluene	1,1,1-Trichloro-ethane	1,1,2-Trichloro-ethane	Trichloro-ethylene	Trichloro-fluoro-methane	1,2,3-Trichloro-propane	Vinyl Acetate	Vinyl Chloride	Total Xylenes
MW-12	03/29/95	<5	<7	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<1	<1	<5	<1	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1
	06/30/95	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<5
	10/13/95	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<5
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Table IIIH-B-2
VOC Analytical Data from Existing Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Acetone	Acrylo-nitrile	Benzene	Bromochloro-methane	Bromodichloro-methane	Bromoform	Carbon Disulfide	Carbon Tetrachloride	Chloro-benzene	Chloro-ethane	Chloroform	Dibromo-chloromethane	1-2-Dibromo-3-chloropropane	1-2-Dibromo-ethane	1,2-Dichloro-benzene	1,4-Dichloro-benzene	trans-1,4-Dichloro-2-butene	1,1-Dichloro-ethane	1,2-Dichloro-ethane	1,1-Dichloro-ethene	cis-1,2-Dichloro-ethene	trans-1,2-Dichloro-ethene	1,2-Dichloro-propane	cis-1,3-Dichloro-propene	trans-1,3-Dichloro-propene	Ethyl-benzene	2-Hexa-none	Bromo-methane	Chloro-methane	Dibromo-methane	Methylene chloride	Methyl Ethyl Ketone	Iodo-methane	4-Methyl-2-Pentanone	Styrene	1,1,1,2-Tetrachloro-ethane	1,1,2,2-Tetrachloro-ethane	Tetrachloro-ethylene	Toluene	1,1,1-Trichloro-ethane	1,1,2-Trichloro-ethane	Trichloro-ethylene	Trichloro-fluoro-methane	1,2,3-Trichloro-propane	Vinyl Acetate	Vinyl Chloride	Total Xylenes
MW-12	09/06/23	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
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Table IIIH-B-2
VOC Analytical Data from Existing Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Acetone	Acrylo-nitrile	Benzene	Bromochloro-methane	Bromodichloro-methane	Bromoform	Carbon Disulfide	Carbon Tetrachloride	Chloro-benzene	Chloro-ethane	Chloroform	Dibromo-chloromethane	1-2-Dibromo-3-chloropropane	1-2-Dibromo-ethane	1,2-Dichloro-benzene	1,4-Dichloro-benzene	trans-1,4-Dichloro-2-butene	1,1-Dichloro-ethane	1,2-Dichloro-ethane	1,1-Dichloro-ethene	cis-1,2-Dichloro-ethene	trans-1,2-Dichloro-ethene	1,2-Dichloro-propane	cis-1,3-Dichloro-propene	trans-1,3-Dichloro-propene	Ethyl-benzene	2-Hexa-none	Bromo-methane	Chloro-methane	Dibromo-methane	Methylene chloride	Methyl Ethyl Ketone	Iodo-methane	4-Methyl-2-Pentanone	Styrene	1,1,1,2-Tetrachloro-ethane	1,1,2,2-Tetrachloro-ethane	Tetrachloro-ethylene	Toluene	1,1,1-Trichloro-ethane	1,1,2-Trichloro-ethane	Trichloro-ethylene	Trichloro-fluoro-methane	1,2,3-Trichloro-propane	Vinyl Acetate	Vinyl Chloride	Total Xylenes
MW-15	06/19/23	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
MW-17	12/10/03	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
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	06/21/04	no data	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
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	12/11/17	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
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	06/16/20	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
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	06/21/22	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
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	06/01/23	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
MW-20	12/11/17	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	05/29/18	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	12/12/18	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
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	12/14/21	29.5	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	03/02/22	74.9(O)	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	03/16/22	39.3	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	06/21/22	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	12/29/22	77.0	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	06/20/23	21.8	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10

Table IIIH-B-2
VOC Analytical Data from Existing Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Acetone	Acrylo-nitrile	Benzene	Bromochloro-methane	Bromodichloro-methane	Bromoform	Carbon Disulfide	Carbon Tetrachloride	Chloro-benzene	Chloro-ethane	Chloroform	Dibromo-chloromethane	1-2-Dibromo-3-chloropropane	1-2-Dibromo-ethane	1,2-Dichloro-benzene	1,4-Dichloro-benzene	trans-1,4-Dichloro-2-butene	1,1-Dichloro-ethane	1,2-Dichloro-ethane	1,1-Dichloro-ethene	cis-1,2-Dichloro-ethene	trans-1,2-Dichloro-ethene	1,2-Dichloro-propane	cis-1,3-Dichloro-propene	trans-1,3-Dichloro-propene	Ethyl-benzene	2-Hexa-none	Bromo-methane	Chloro-methane	Dibromo-methane	Methylene chloride	Methyl Ethyl Ketone	Iodo-methane	4-Methyl-2-Pentanone	Styrene	1,1,1,2-Tetrachloro-ethane	1,1,2,2-Tetrachloro-ethane	Tetrachloro-ethylene	Toluene	1,1,1-Trichloro-ethane	1,1,2-Trichloro-ethane	Trichloro-ethylene	Trichloro-fluoro-methane	1,2,3-Trichloro-propane	Vinyl Acetate	Vinyl Chloride	Total Xylenes
MW-21	12/08/09	<25	<50	<1	<1	<1	<5	<5	<5	<1	<5	4	<1	<2	<2	<1	<1	<20	<1	<1	<2	<1	<2	<1	<1	<5	<5	<10	<5	<2	<1	<5	<10	<2	<10	<5	<1	<2	<1	<1	<5	<1	<1	<5	<5	<1	<1	<10
	06/08/10	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	<10	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
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	12/04/12	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	06/11/13	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
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	12/02/14	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
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	06/17/20	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
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	06/17/21	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	12/14/21	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	06/21/22	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	12/29/22	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
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MW-22	12/08/09	<25	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<1	<2	<2	<1	<1	<20	<1	<1	<2	2	<2	<1	<1	<5	<5	<10	<5	<2	<1	<5	<10	<2	<10	<5	<1	<2	<1	<1	<5	<1	<1	<5	<5	<1	<1	<10
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	12/15/10	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	<10	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	06/16/11	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	1.1	<1	<1	<2	<5	<2	<5	<10	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	09/19/11	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	<1	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	12/07/11	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	<10	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	06/18/12	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	<10	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	12/03/12	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
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	09/26/13	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	<1	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
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	08/26/14	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	1.1	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	10/02/14	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	1.1	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	12/01/14	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	06/03/15	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	12/07/15	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	06/21/16	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	12/06/16	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	06/20/17	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	12/11/17	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	05/29/18	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	12/12/18	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	05/29/19	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	12/02/19	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	06/16/20	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	12/07/20	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	06/16/21	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	12/13/21	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
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	12/28/22	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	06/19/23	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	09/06/23	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data

Table IIIH-B-2
VOC Analytical Data from Existing Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Acetone	Acrylo-nitrile	Benzene	Bromochloro-methane	Bromodichloro-methane	Bromoform	Carbon Disulfide	Carbon Tetrachloride	Chloro-benzene	Chloro-ethane	Chloroform	Dibromo-chloromethane	1-2-Dibromo-3-chloropropane	1-2-Dibromo-ethane	1,2-Dichloro-benzene	1,4-Dichloro-benzene	trans-1,4-Dichloro-2-butene	1,1-Dichloro-ethane	1,2-Dichloro-ethane	1,1-Dichloro-ethene	cis-1,2-Dichloro-ethene	trans-1,2-Dichloro-ethene	1,2-Dichloro-propane	cis-1,3-Dichloro-propene	trans-1,3-Dichloro-propene	Ethyl-benzene	2-Hexa-none	Bromo-methane	Chloro-methane	Dibromo-methane	Methylene chloride	Methyl Ethyl Ketone	Iodo-methane	4-Methyl-2-Pentanone	Styrene	1,1,1,2-Tetrachloro-ethane	1,1,2,2-Tetrachloro-ethane	Tetrachloro-ethylene	Toluene	1,1,1-Trichloro-ethane	1,1,2-Trichloro-ethane	Trichloro-ethylene	Trichloro-fluoro-methane	1,2,3-Trichloro-propane	Vinyl Acetate	Vinyl Chloride	Total Xylenes
MW-23	12/08/09	<25	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<1	<2	<2	<1	<1	<20	<1	<1	<2	<1	<2	<1	<1	<5	<5	<10	<5	<2	<1	<5	<10	<2	<10	<5	<1	<2	<1	<1	<5	<1	<1	<5	<5	<1	1.4	<10
	06/09/10	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	<10	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	12/15/10	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	<10	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	06/16/11	<20	<50	1.2	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	<10	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	12/08/11	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	<10	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	06/19/12	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	<10	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	12/03/12	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	06/11/13	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	12/04/13	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
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	12/02/14	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
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Table IIIH-B-2
VOC Analytical Data from Existing Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Acetone	Acrylo-nitrile	Benzene	Bromochloro-methane	Bromodichloro-methane	Bromoform	Carbon Disulfide	Carbon Tetrachloride	Chloro-benzene	Chloro-ethane	Chloroform	Dibromo-chloromethane	1-2-Dibromo-3-chloropropane	1-2-Dibromo-ethane	1,2-Dichloro-benzene	1,4-Dichloro-benzene	trans-1,4-Dichloro-2-butene	1,1-Dichloro-ethane	1,2-Dichloro-ethane	1,1-Dichloro-ethene	cis-1,2-Dichloro-ethene	trans-1,2-Dichloro-ethene	1,2-Dichloro-propane	cis-1,3-Dichloro-propene	trans-1,3-Dichloro-propene	Ethyl-benzene	2-Hexa-none	Bromo-methane	Chloro-methane	Dibromo-methane	Methylene chloride	Methyl Ethyl Ketone	Iodo-methane	4-Methyl-2-Pentanone	Styrene	1,1,1,2-Tetrachloro-ethane	1,1,2,2-Tetrachloro-ethane	Tetrachloro-ethylene	Toluene	1,1,1-Trichloro-ethane	1,1,2-Trichloro-ethane	Trichloro-ethylene	Trichloro-fluoro-methane	1,2,3-Trichloro-propane	Vinyl Acetate	Vinyl Chloride	Total Xylenes
MW-25	12/08/09	<25	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<1	<2	<2	<1	<1	<20	<1	<1	<2	<1	<2	<1	<1	<5	<5	<10	<5	<2	<1	<5	<10	<2	<10	<5	<1	<2	<1	<1	<5	<1	<1	<5	<5	<1	<1	<10
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	12/15/10	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	<10	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
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	06/11/13	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	12/03/13	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
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	12/01/14	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
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	12/12/18	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
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	12/13/21	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	06/20/22	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	12/28/22	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10
	06/19/23	<20	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<2	<5	<1	<2	<2	<100	<1	<1	<1	<1	<1	<1	<2	<5	<2	<5	no data	<5	<1	<5	<5	<5	<5	<2	<2	<1	<5	<1	<1	<1	<5	<10	<1	<100	<2	<10

Table IIIH-B-3

Total Metals Analytical Data from Former Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Total Antimony	Total Arsenic	Total Barium	Total Beryllium	Total Cadmium	Total Chromium	Total Cobalt	Total Copper	Total Lead	Total Nickel	Total Selenium	Total Silver	Total Thallium	Total Vanadium	Total Zinc
MW-13	03/13/07	<5	<10	96	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
	06/21/07	<5	13	100	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
	09/18/07	<5	10	93	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
MW-14	03/12/07	<5	10	33	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
	06/21/07	<5	<10	30	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
	09/17/07	<5	<10	35	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	<100
MW-19	03/13/07	<5	190	750	<2	<3	<50	<50	<50	<10	<50	<20	<50	<2	<50	180
	06/21/07	<5	90	300	<2	<3	<50	<50	<50	<10	52	<20	<50	<2	<50	150
	09/17/07	<5	180	530	<2	<3	<50	<50	<50	10	<50	<20	<50	<2	<50	120

Table IIIH-B-4
VOC Analytical Data from Former Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Acetone	Acrylo-nitrile	Benzene	Bromochloro-methane	Bromodichloro-methane	Bromoform	Carbon Disulfide	Carbon Tetrachloride	Chloro-benzene	Chloro-ethane	Chloroform	Dibromo-chloromethane	1-2-Dibromo-3-chloropropane	1-2-Dibromo-ethane	1,2-Dichloro-benzene	1,4-Dichloro-benzene	trans-1,4-Dichloro-2-butene	1,1-Dichloro-ethane	1,2-Dichloro-ethane	1,1-Dichloro-ethene	cis-1,2-Dichloro-ethene	trans-1,2-Dichloro-ethene	1,2-Dichloro-propane	cis-1,3-Dichloro-propene	trans-1,3-Dichloro-propene	Ethyl-benzene	2-Hexa-none	Bromo-methane	Chloro-methane	Dibromo-methane	Methylene chloride	Methyl Ethyl Ketone	Iodo-methane	4-Methyl-2-Pentanone	Styrene	1,1,1,2-Tetrachloro-ethane	1,1,2,2-Tetrachloro-ethane	Tetrachloro-ethylene	Toluene	1,1,1-Trichloro-ethane	1,1,2-Trichloro-ethane	Trichloro-ethylene	Trichloro-fluoro-methane	1,2,3-Trichloro-propane	Vinyl Acetate	Vinyl Chloride	Total Xylenes
MW-13	03/29/95	<5	<7	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<1	<1	<5	<1	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1
	06/29/95	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<5
	10/12/95	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<5
	12/11/95	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<5
	03/28/96	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<5
	06/27/96	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
	09/25/96	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
	12/11/96	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
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	12/10/97	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
	05/29/98	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5
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Table IIIH-B-4
VOC Analytical Data from Former Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Acetone	Acrylo-nitrile	Benzene	Bromochloro-methane	Bromodichloro-methane	Bromoform	Carbon Disulfide	Carbon Tetrachloride	Chloro-benzene	Chloro-ethane	Chloroform	Dibromo-chloromethane	1-2-Dibromo-3-chloropropane	1-2-Dibromo-ethane	1,2-Dichloro-benzene	1,4-Dichloro-benzene	trans-1,4-Dichloro-2-butene	1,1-Dichloro-ethane	1,2-Dichloro-ethane	1,1-Dichloro-ethene	cis-1,2-Dichloro-ethene	trans-1,2-Dichloro-ethene	1,2-Dichloro-propane	cis-1,3-Dichloro-propene	trans-1,3-Dichloro-propene	Ethyl-benzene	2-Hexa-none	Bromo-methane	Chloro-methane	Dibromo-methane	Methylene chloride	Methyl Ethyl Ketone	Iodo-methane	4-Methyl-2-Pentanone	Styrene	1,1,1,2-Tetrachloro-ethane	1,1,2,2-Tetrachloro-ethane	Tetrachloro-ethylene	Toluene	1,1,1-Trichloro-ethane	1,1,2-Trichloro-ethane	Trichloro-ethylene	Trichloro-fluoro-methane	1,2,3-Trichloro-propane	Vinyl Acetate	Vinyl Chloride	Total Xylenes
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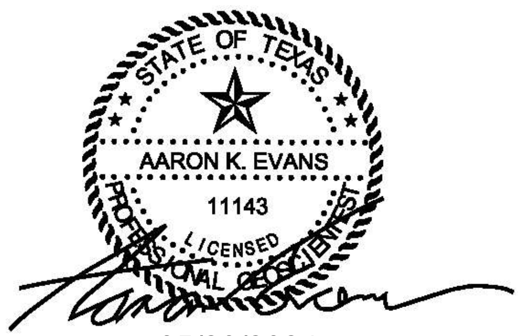
	12/12/02	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	03/11/03	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	06/30/03	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	12/10/03	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5

Table IIIH-B-4
VOC Analytical Data from Former Subtitle D Groundwater Monitor Wells

Well No.	Event Date	Acetone	Acrylo-nitrile	Benzene	Bromochloro-methane	Bromodichloro-methane	Bromoform	Carbon Disulfide	Carbon Tetrachloride	Chloro-benzene	Chloro-ethane	Chloroform	Dibromo-chloromethane	1-2-Dibromo-3-chloropropane	1-2-Dibromo-ethane	1,2-Dichloro-benzene	1,4-Dichloro-benzene	trans-1,4-Dichloro-2-butene	1,1-Dichloro-ethane	1,2-Dichloro-ethane	1,1-Dichloro-ethene	cis-1,2-Dichloro-ethene	trans-1,2-Dichloro-ethene	1,2-Dichloro-propane	cis-1,3-Dichloro-propene	trans-1,3-Dichloro-propene	Ethyl-benzene	2-Hexa-none	Bromo-methane	Chloro-methane	Dibromo-methane	Methylene chloride	Methyl Ethyl Ketone	Iodo-methane	4-Methyl-2-Pentanone	Styrene	1,1,1,2-Tetrachloro-ethane	1,1,2,2-Tetrachloro-ethane	Tetrachloro-ethylene	Toluene	1,1,1-Trichloro-ethane	1,1,2-Trichloro-ethane	Trichloro-ethylene	Trichloro-fluoro-methane	1,2,3-Trichloro-propane	Vinyl Acetate	Vinyl Chloride	Total Xylenes
MW-16	03/22/05	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
MW-19	12/10/03	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	03/10/04	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	06/21/04	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	09/29/04	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	12/07/04	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	03/22/05	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	06/17/05	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	09/07/05	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	12/20/05	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	06/13/06	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	12/05/06	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	06/21/07	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<7.5	no data	no data	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	12/06/07	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	06/12/08	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	12/11/08	<10	<50	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<5	<5	<10	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<2	<5
	06/03/09	<25	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<1	<2	<2	<1	<1	<20	<1	<1	<2	<1	<2	<1	<1	<5	<5	<10	<5	<2	<1	<5	<10	<2	<10	<5	<1	<2	<1	<1	<5	<1	<1	<5	<5	<1	<1	<10
	12/08/09	<25	<50	<1	<1	<1	<5	<5	<5	<1	<5	<1	<1	<2	<2	<1	<1	<20	<1	<1	<2	<1	<2	<1	<1	<5	<5	<10	<5	<2	<1	<5	<10	<2	<10	<5	<1	<2	<1	<1	<5	<1	<1	<5	<5	<1	<1	<10

APPENDIX IIIH-C

SAMPLE FIELD DATA SHEET



05/20/2024

SAMPLE
Groundwater Sampling Field Data Sheet

Date: ___________

Site: ___________ **Location:** _________ **Permit No.:** ________
File: (Project #)
Name of Person(s) Sampling: ___________ **Title:** (Tech. Title)

Monitor Well No.: _______ **Upgradient:** (Yes or No) **Downgradient:** (Yes or No)

Top of Procover: (Number) FT-MSL **Top of PVC:** (Number) FT-MSL **Ground Surface:** (Number) FT-MSL

Ground Water Depth (from top of PVC): (Number) FT-BGS. (Number) FT-MSL
Well Depth (from top of PVC) (Number) FT-BGS. (Number) FT-MSL

Water Volume in Casing: (Number) gal. **Time Purge Started:** (Number) **Time Purge Ended:** (Number)
2" well contains 0.163 gallons/foot

Well Diameter: (Number) in. **Total Volume Purged:** (Number) gal. (Min. 3 to 5 vols.)
Well Pumped/Bailed Dry? (Yes or No)

Bailer/Pump: (Description) **Dedicated?** (Yes or No) **Disposable?** (Yes or No)
Field Meters (pH, Eh, SC): (Description) **Dedicated?** (Yes or No) **Disposable?** (Yes or No)
Field Equipment: (Description) **Dedicated?** (Yes or No) **Disposable?** (Yes or No)

Method of Decontamination: (insert brief description)

Sample Condition: **Color:** (Description) **Odor:** (Description)

Field Measurements:

pH:	(Number)	(Number)	(Number)	(Number) std. units
Specific Conductivity:	(Number)	(Number)	(Number)	(Number) umhos/cm
Temperature:	(Number)	(Number)	(Number)	(Number) °C
Dis. Oxygen:	(Number)	(Number)	(Number)	(Number)
Eh:	(Number)	(Number)	(Number)	(Number) MV
Time:	(Number)	(Number)	(Number)	(Number)

Well Recharge: Very Poor Poor Fair Moderate Good Very Good

Weather Conditions: Temperature: (Number) **Skies:** Clear Partly Cloudy Cloudy

Precipitation: (Description) Light Moderate Heavy

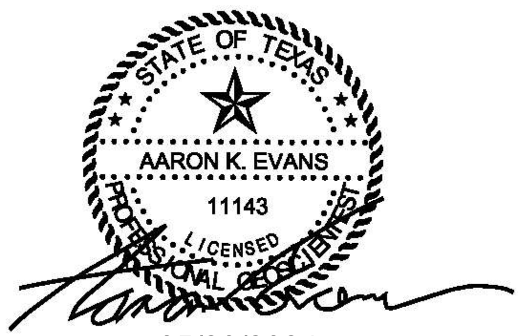
Wind Speed/Direction: (Number) N NE E SE S SW W NW

Notes/Observations: (Text inserted here)

Sampler(s) Signature: ____

APPENDIX IIIH-D

CONTAINERIZATION AND PRESERVATION OF SAMPLES



05/20/2024

RECOMMENDED CONTAINERIZATION AND PRESERVATION OF SAMPLES

Measurement[a]	Volume (mL)	Container[b]	Preservative	Holding Times	Reference
Physical Properties					
Specific Cond. (Field)	100	P,G	Cool, 4 °C	Det. on Site	1
Specific Cond. (Lab)	100	P,G	Cool, 4 °C	28 Days	1
pH (Field)	50	P,G	None	Det. on Site	1,2
pH (Lab)	50	P,G	None	24 Hrs	1,2
Temperature	1000	P,G	None	Det. On Site	1
Turbidity	100	P,G	Cool, 4 °C	Det. On Site	1

Measurement[a]	Volume (mL)	Container[b]	Preservative	Holding Times	Reference
Inorganics, Non-Metallics					
Ammonia as Nitrogen	1000	P,G	Cool, 4 °C H_2SO_4 to pH <2	28 days	2,3
Carbonate/Bicarbonate	200	P,G	Cool, 4 °C	14 days	1
Chemical Oxygen Demand (COD)	50	P,G	H_2SO_4 to pH <2	28 days	1
Chloride	200	P,G	None	28 Days	1,2
Nitrate plus Nitrite	200	P,G	Cool, 4 °C H_2SO_4 to pH <2	28 days	1,2
Sulfate	100	P,G	Cool, 4 °C	28 days	1,2
Total Alkalinity	200	P, G	Cool, 4 °C	14 days	1
Total Dissolved Solids (TDS)	500	P,G	Cool, 4 °C	7 days	2,3
Total Organic Carbon (TOC)	250	P,G	Cool, 4 °C HCL or H_2SO_4 to pH <2	28 days	2,3

RECOMMENDED CONTAINERIZATION AND PRESERVATION OF SAMPLES

Measurement$_a$	Volume (mL)	Container$_b$	Preservative	Holding Times	Reference
Metals (except mercury)					
Total	500	P,G	HNO_3 to pH <2	6 Mos	1,2
Dissolved	500	P,G	Filt. + HNO_3 to pH <2	6 Mos	1,2
Mercury – Total	500	P,G	HNO_3 to pH <2	28 days	1,2
Mercury – Dissolved	300	P,G	Filt. + HNO_3 to pH <2	28 days	1,2

Measurement$_a$	Volume (mL)	Container$_b$	Preservative	Holding Times	Reference
Organics					
Volatile Organics by GC/MS	100 (2 vials @ 40ml)	G, Teflon septum cap	Cool, 4 °C HCL to pH <2	14 days	2,3
Herbicides	1000	Glass Only	Cool, 4 °C	7 days [c] 40 days [d]	2,3
Pesticides and PCB's	1000	Glass Only	Cool, 4 °C	7 days [c] 40 days [d]	2,3
Semi-Volatiles Acid and Base/Neutral Compounds	2000	Glass Only	Cool, 4 °C	7 days [c] 40 days [d]	2,3

NOTES:

a Additional measurements not required per the GWSAP are included in the event assessment monitoring is initiated or if the need to sample for additional parameters arises due to unforeseen circumstances.

b Plastic (P) or Glass (G). For metals, polyethylene with an all polypropylene cap is preferred.

c Maximum holding time from sampling to extraction.

d Maximum holding time from extraction to analysis.

REFERENCES:

1 Methods for Chemical Analysis of Water and Wastes, March, 1983, USEPA, 600/4-79-020 and additions thereto.

2 Test Methods for Evaluating Solid Waste, Physical/Chemical Method, November, 1986, Third Edition, USEPA, SW-846 and additions thereto.

3 "Guidelines Establishing Test Procedures for the Analysis of Pollutant Under the Clean Water Act", Environmental Protection Agency, Code of Federal Regulations (CFR), Title 40, Part 136.

APPENDIX IIIH-E

SAMPLE CHAIN-OF-CUSTODY FORM

STATE OF TEXAS
AARON K. EVANS
11143
LICENSED
PROFESSIONAL GEOSCIENTIST

05/20/2024

CHAIN OF CUSTODY RECORD

Page ☐ of ☐

Client:	Phone #:	Fax #:
Project Name:	Project Task Code:	PO/WO #:
Samplers: (print first & last name)	Samplers: (signature)	

Lab Code	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Analysis Requested														Sample Comments: (Equipment Type, Filtration, AIS, Preservation)

_______ (Initials) In the event that samples are received by the lab at a temperature greater than 6 ° C, I hereby authorize RMB Environmental Laboratories to process the samples as received.

_______ (Initials) In the event that samples are received by the lab at a temperature greater than 6 ° C, please contact client at phone # ____________________ before processing samples.

Relinquished by: (signature)	Date	Time	Received by Lab: (signature)	Date	Time

☐ Electronic Data Deliverable (EDD): Lab_MN format

Report to:

Bill to:

Shipping Method
- ☐ Speedee
- ☐ UPS
- ☐ USPS
- ☐ FedEx
- ☐ Hand Delivery
- ☐ Other:______

☐ DOES meet proper sample storage and transportation guidelines

☐ Does NOT meet proper sample storage and transportation guidelines

Explain:____

☐ Rcvd on ice ☐ Rcvd at room temp Rcvd Temp:__________° C

☐ Samples received same day as collection

Comments:____

BILLING

Shipping:______________

Mileage:______________

Field Staff:______________

Equipment:______________

Other:______________

APPENDIX IIIH-F

STATISTICAL ANALYSIS FLOW CHARTS

STATE OF TEXAS
AARON K. EVANS
11143
LICENSED
PROFESSIONAL GEOSCIENTIST

05/20/2024

FIGURE 1

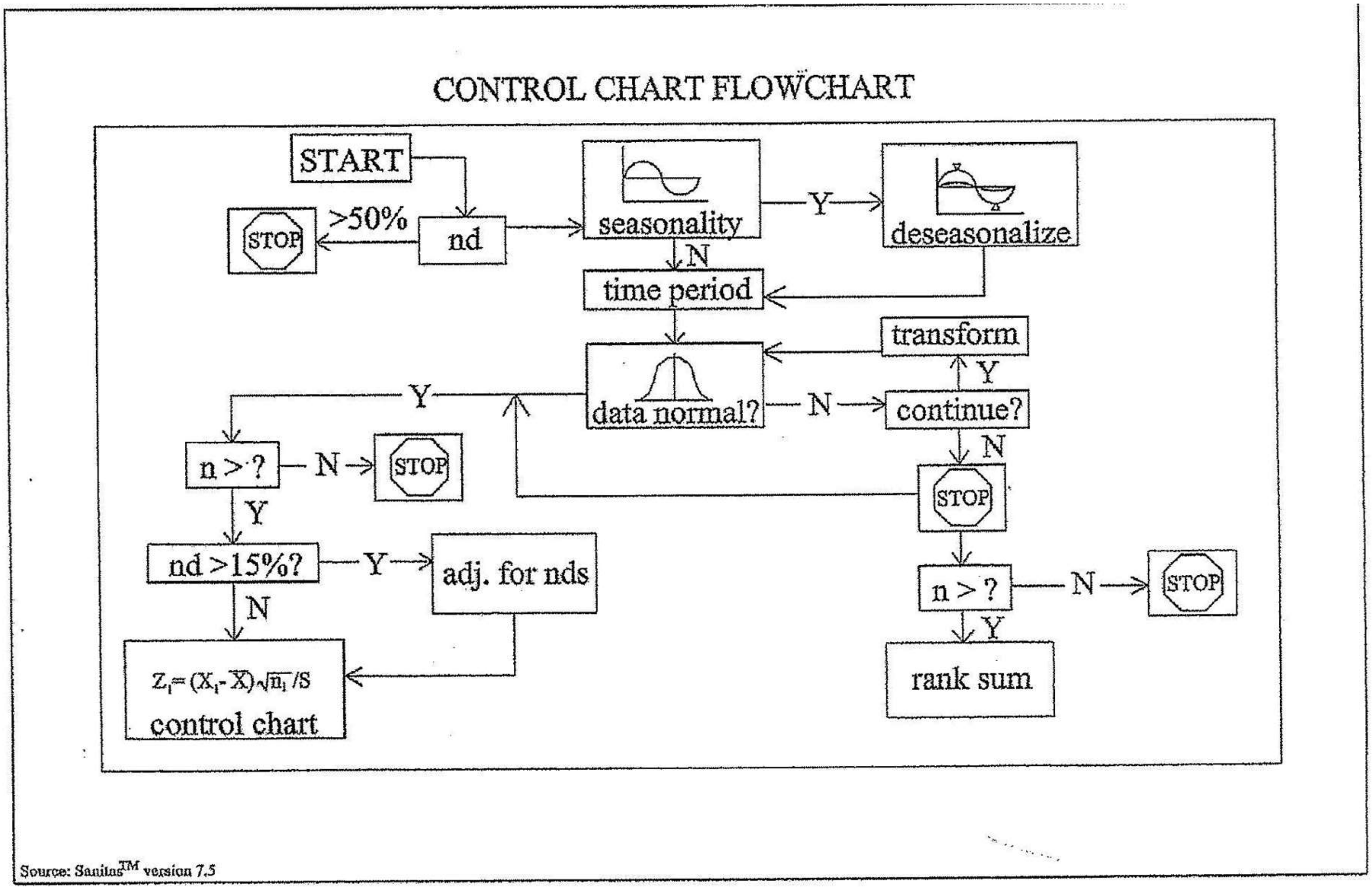

CONTROL CHART FLOWCHART
START
STOP
>50%
nd
seasonality
Y
N
deseasonalize
time period
transform
data normal?
continue?
n > ?
nd >15%?
adj. for nds
$Z_i = (X_i - \bar{X})\sqrt{n_i}/S$
control chart
rank sum
Source: Sanitas™ version 7.5

FIGURE 2

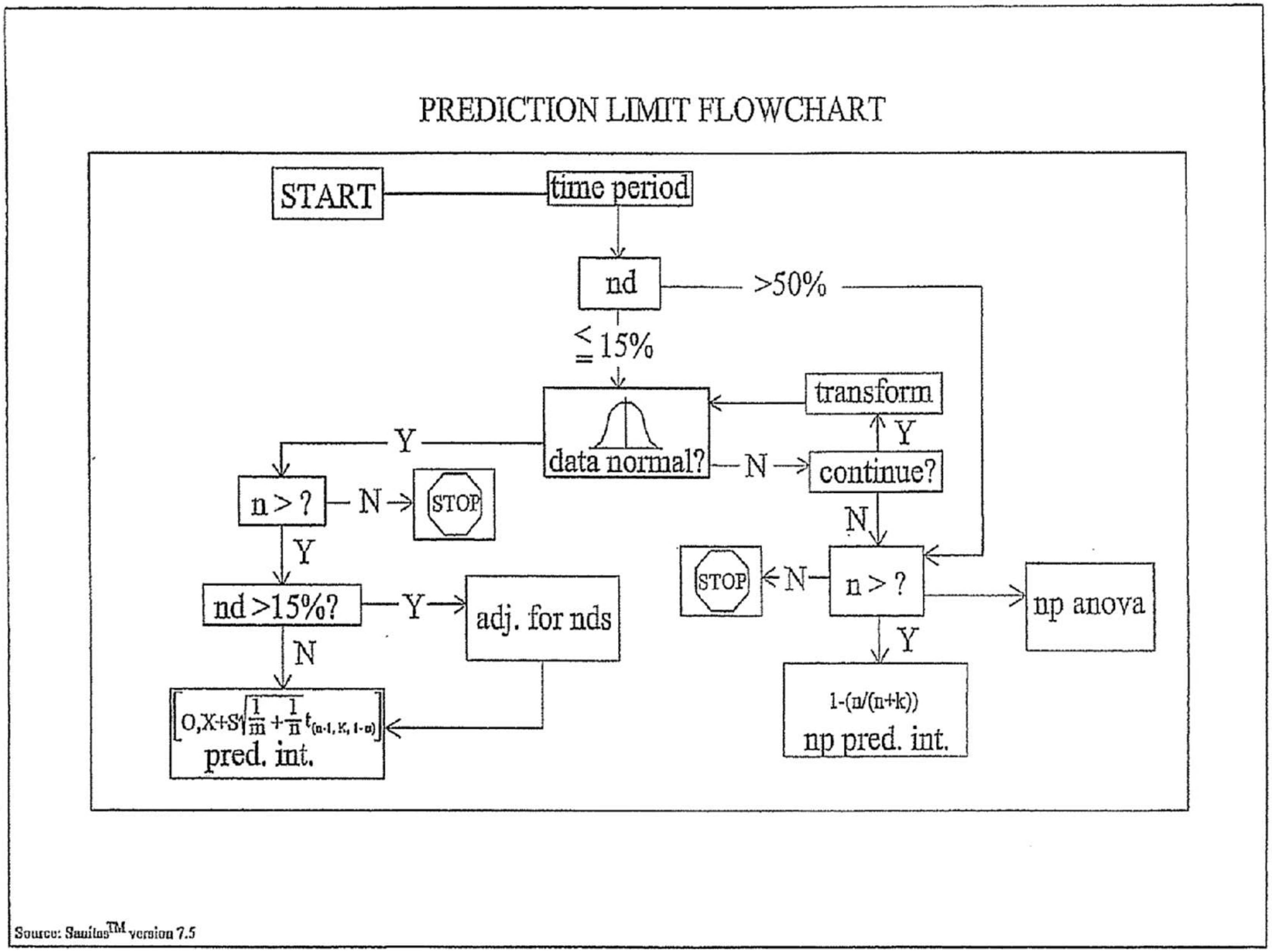
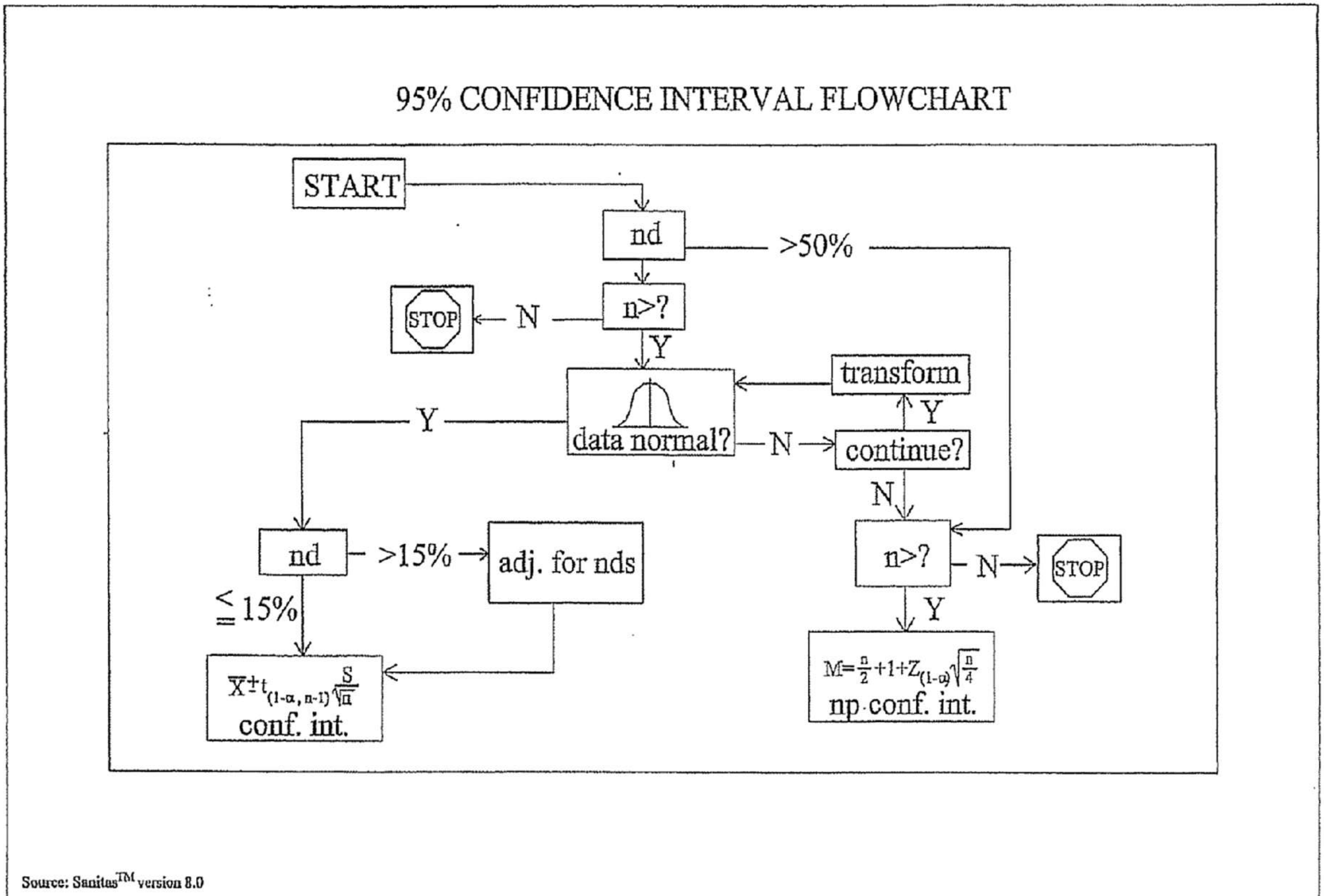
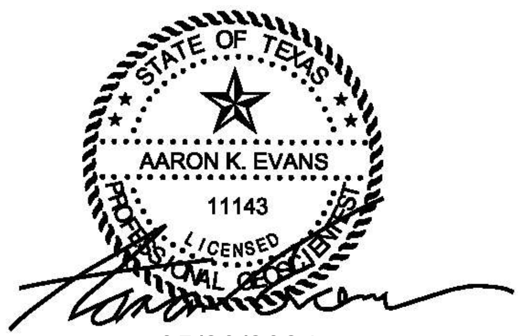

PREDICTION LIMIT FLOWCHART
START
time period
nd
>50%
≤ 15%
transform
Y
data normal?
N
continue?
n > ?
STOP
nd >15%?
adj. for nds
np anova
1-(n/(n+k))
np pred. int.
pred. int.
Source: Sanitas™ version 7.5

FIGURE 3


95% CONFIDENCE INTERVAL FLOWCHART
START
nd
>50%
n>?
N
STOP
Y
transform
Y
data normal?
N
continue?
N
nd
>15%
adj. for nds
n>?
N
STOP
≤15%
Y
$\overline{X} \pm t_{(1-\alpha, n-1)} \frac{S}{\sqrt{n}}$
conf. int.
$M = \frac{n}{2} + 1 + Z_{(1-\alpha)} \sqrt{\frac{n}{4}}$
np conf. int.
Source: Sanitas™ version 8.0

APPENDIX IIIH-G

SAMPLE LABORATORY QC CHECKLIST



05/20/2024

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 specified in NELAC Chapter 5 for reporting results, e.g., Section 5.5.10 in 2003 NELAC Standard
  - 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 method quantitation limits (MQLs) 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 as 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[4]	ER#[5]
		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 < MQL, 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 < MQL?					
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	**Method quantitation limits (MQLs):**					
		Are the MQLs for each method analyte included in the laboratory data package?					
		Do the MQLs correspond to the concentration of the lowest non-zero calibration standard?					
		Are unadjusted MQLs 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?					

Laboratory Review Checklist: Supporting 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?					
S2	OI	**Initial and continuing calibration verification (ICCV and CCV) and continuing calibration blank[6] :**					
		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?					
S3	O	**Mass spectral tuning:**					
		Was the appropriate compound for the method used for tuning?					
		Were ion abundance data within the method-required QC limits?					
S4	O	**Internal standards (IS):**					
		Were IS area counts and retention times within the method-required QC limits?					
	OI	**Raw data (NELAC section 1 appendix A glossary, and section 5.)**					
		Were the raw data (for example, chromatograms, spectral data) reviewed by an analyst?					
		Were data associated with manual integrations flagged on the raw data?					
S6	O	**Dual column confirmation**					
		Did dual column confirmation results meet the method-required QC?					
S7	O	**Tentatively identified compounds (TICs):**					
		If TICs were requested, were the mass spectra and TIC data subject to appropriate checks?					
S8	I	**Interference Check Sample (ICS) results:**					
		Were percent recoveries within method QC limits?					
S9	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?					
S10	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?					
S11	OI	**Proficiency test reports:**					
		Was the laboratory's performance acceptable on the applicable proficiency tests or evaluation studies?					
S12	OI	**Standards documentation**					
		Are all standards used in the analyses NIST-traceable or obtained from other appropriate sources?					
S13	OI	**Compound/analyte identification procedures**					
		Are the procedures for compound/analyte identification documented?					
S14	OI	**Demonstration of analyst competency (DOC)**					
		Was DOC conducted consistent with NELAC Chapter 5C?					
		Is documentation of the analyst's competency up-to-date and on file?					
S15	OI	**Verification/validation documentation for methods** (NELAC Chap 5n 5)					
		Are all the methods used to generate the data documented, verified, and validated, where applicable?					
S16	OI	**Laboratory standard operating procedures (SOPs):**					
		Are laboratory SOPs current and on file for each method performed?					

Laboratory Review Checklist: Exception Reports	
Laboratory Name:	LRC Date:
Project Name:	Laboratory Job Number:
Reviewer Name:	Prep Batch Number(s):

ER#[5]	DESCRIPTION

1. Items identified by the letter "R" must be available as a hard copy or as a .pdf file. 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).

6. CCB = Continuing Calibration Blank

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1614B

MAJOR PERMIT AMENDMENT APPLICATION

PART III – SITE DEVELOPMENT PLAN
APPENDIX III I
LANDFILL GAS MANAGEMENT PLAN

Prepared for

Pine Hill Farms Landfill TX, LP

May 2024

STATE OF TEXAS
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This document is intended for permitting purposes only.

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1 INTRODUCTION

1.1 Scope

This Landfill Gas Management Plan (LGMP) has been developed for the Royal Oaks Landfill consistent with the requirements set forth in the Texas Commission on Environmental Quality (TCEQ) Municipal Solid Waste (MSW) regulations Title 30 Texas Administrative Code (TAC) §330.371, §330.159, and RCRA Subtitle D regulations in 40 CFR §258.23. The existing landfill is owned by the City of Jacksonville and operated by Pine Hill Farms Landfill TX, LP.

This LGMP describes the existing and proposed upgrades to the landfill gas (LFG) monitoring network. It also discusses the operation and monitoring of this network, notification procedures, and possible remediation activities, if required. In addition, this LGMP includes a description of the Landfill Gas Collection and Control System (GCCS) and future installation.

1.2 Purpose

Title 30 TAC §330.159 requires landfills to develop a LGMP in accordance with Title 30 TAC §330.371. Compliance with Title 30 TAC §330.371 requires landfills to implement a routine monitoring program for methane to verify that (1) the concentration of methane gas generated by the facility does not exceed 1.25% by volume in facility structures (excluding LFG control or recovery system components) within the permit boundary, and (2) the concentration of methane gas does not exceed 5% by volume in monitoring points, probes, subsurface soils, or other matrices at the facility boundary as defined by the legal description in the permit or permit by rule.

The purpose of the LGMP is to provide guidelines for management of LFG at the site during the operational life of the landfill and after its closure. These guidelines cover the evaluation of LFG migration at the permit boundary and in structures within the permit boundary. The presence of LFG will be verified by monitoring LFG concentrations in monitoring probes near the facility's permit boundary and within on-site occupied structures. LFG migration may be controlled by various options which are discussed in Section 5.

The LFG monitoring (postclosure care period) program will continue for a period of 30 years after final closure of the facility or until the owner or operator receives written authorization from TCEQ to revise or discontinue the program. The request to revise or discontinue the LFG monitoring program will be based on a demonstration along with collected data by the owner or operator that there is no potential for gas migration along the property boundary or into on-site structures.

2 SITE CHARACTERISTICS

2.1 Introduction

The Royal Oaks Landfill is an existing Type I municipal solid waste (MSW) disposal facility located approximately 2.5 miles north of Jacksonville, Texas and is 0.5 miles east of the intersection of Health Lane and U.S. Highway 69. The address of the landfill is:

Royal Oaks Landfill
608 CR 4102
Jacksonville, TX 75766

A site plan for the Royal Oaks Landfill is included as Figure III I-A-1 in Appendix III I-A. The current TCEQ approved LFG monitoring probe network includes twenty (20) existing LFG monitoring probes and a utility trench vent located along the existing permit boundary as shown on Figure III I-A-1. Information regarding the existing LFG monitoring probes is included in Appendix III I-C.

This LGMP addresses the existing monitoring probes/trench vents as well as the monitoring probe upgrade required by the proposed expansion of the Royal Oaks Landfill. As a result of the proposed landfill expansion, 9 existing LFG monitoring probes will be abandoned, 8 new probes will be installed, and 11 existing probes will remain in-place. In addition, the existing trench vent will remain in-place as well. The 9 existing probes will be abandoned to allow for future filling and site operations. The existing 11 LFG monitoring probes along the western boundary will remain in-place as no changes are proposed to the permitted landfill area. At landfill completion, the monitoring network will consist of 19 LFG monitoring probes and a trench vent as shown on Figure III I-A-1 in Appendix III I-A. Table III I-1 summarizes the probes that will remain in-place, probes that will be abandoned, and the probes that will be added as part of this plan. Refer to Section 3 for a detailed discussion on the perimeter monitoring network.

Table III I-1
List of Existing and Proposed LFG Monitoring Probes

Existing Probes To Remain In-Place	Existing Probes To Be Abandoned	New Probes To Be Added
GP-1	GP-9	GP-9A
GP-2	GP-10	GP-10A
GP-3	GP-11	GP-11A
GP-4	GP-12	GP-12A
GP-5	GP-13	GP-13A
GP-6	GP-14	GP-14A
GP-7	GP-20	GP-18
GP-8A	GP-21	GP-19
GMP-15	GP-22	
GMP-16		
GMP-17		

The design of the LFG monitoring system for this site is based on the following factors: geologic conditions, hydrogeologic conditions, hydraulic conditions, location of facility structures and off-site structures, underground utilities, land use, nature and age of waste, climate, and depth of waste. These factors are described in detail in the following subsections.

2.2 Geologic Conditions

According to the Bureau of Economic Geology (Geologic Atlas of Texas: Palestine Sheet [1975] and Tyler Sheet [1993]), the Royal Oaks Landfill is located upon Eocene-age Sparta Sand, Weches, and Queen City formation sediments as shown on Figure IIIG-A.1 – Regional Geologic Map. The Queen City Formation is classified by the Texas Water Development Board as a minor Texas aquifer (Queen City Aquifer) and overlies the Reklaw Formation. The Reklaw Formation sediments are described as predominantly low permeability clays and silts which function regionally as a lower confining unit to the overlying Queen City Aquifer. The site stratigraphy is presented in the text, borings, and geologic cross sections in Part III, Appendix IIIG.

These site-specific geologic units include (in descending order): Surficial sediments (Sparta and Weches Formation), Stratum A (Weches Formation), Stratum B (Uppermost Queen City Formation), Stratum C (Mid Queen City Formation), and Stratum D (Lower Queen City Formation). Site-specific strata A through D are comprised of an uppermost component of course-grained saturated sediments

(Aquifers A through D) and an underlying component of fine-grained unsaturated sediments (Aquitards A through D). Refer to Part III, Appendix IIIG – Geology Report for additional information on geologic conditions at the site. Based on the site geology, both the single probe and multi-casing or nested probe design will be used for the proposed new probes.

2.3 Hydrogeologic Conditions

Groundwater at the site is observed within four distinct hydraulically separated site-specific aquifers (Aquifer A, Aquifer B, Aquifer C, and Aquifer D). The groundwater data was evaluated for the design of the gas probe depth. Refer to Part III, Appendix IIIG – Geology Report for additional information on hydrogeologic conditions at the site. The groundwater data was evaluated for the design of the gas probe depth.

2.4 Hydraulic Conditions

The site is located adjacent to the Barber Branch of Mud Creek within the Neches River watershed in Cherokee County, Texas. The site generally drains south to a tributary of Ragsdale Creek and east to the Barber Branch. The hydraulic conditions were considered in the layout of the LFG monitoring probes. Each probe location was evaluated and no interference with surface drainage where observed (e.g., probes located within channels, letdowns, ponds, etc.).

2.5 Facility Structures Within the Permit Boundary

Currently, facility structures are located within the existing permit boundary. All on-site structures are and will be equipped with continuous LFG monitoring systems. Existing and future onsite structures (per any future permit amendments or modifications), including but not limited to buildings, subsurface vaults, utilities, or any other areas where potential gas buildup would be of concern located within the permit boundary will be monitored as described in Section 3.2 of this appendix. For future development at the site, the LFG monitoring system will be reviewed and revised as needed to protect human health and the environment.

2.6 Underground Utilities

In developing the design of the LFG monitoring system, the location of underground utilities was reviewed as possible pathways for LFG migration. Passive vent pipe has been installed near underground utilities where they cross the permit boundary to monitor for the potential presence of LFG. Currently, the underground utilities which cross the permit boundary consist of a water line along the northwest permit boundary. The utility trench vent (TV-1) has been installed nearby this utility crossing to monitor for the potential presence of LFG, as shown on Figure III I-A-1 in Appendix III I-A.

In addition, all future underground utilities which cross the permit boundary will be vented and monitored as well. A construction detail for the passive trench vent pipes is provided on Figure III I-A-2 in Appendix III I-A. The vents will be equipped with monitoring ports to facilitate routine methane monitoring.

2.7 Land Use and Offsite Structures

Land use within one mile of the site consists of predominantly agriculture and residential land (approximately 72 percent of area within a mile of the permit boundary). The remaining area within a 1-mile radius of the permit boundary consists primarily of industrial, commercial, and manufacturing land. The nearest residence is approximately 40 feet from the northern portion of the permit boundary (approximately 480 feet from the limits of waste). Please refer to Parts I/II, Section 7 – Land Use for additional information.

A site map showing the off-site structures located within 1,000 feet of the permit boundary is presented in Appendix III I-B. The inter-probe spacing is based on the surrounding land use and off-site. The inter-probe spacing between the probes will be less than 1,000 feet except for in areas where there are nearby off-site structures, in which case the spacing will be less than 600 feet. For future development at the site, the LFG monitoring system will be reviewed and revised as needed to protect human health and the environment.

2.8 Nature and Age of Waste

The Royal Oaks Landfill is currently operated as a Type I municipal solid waste disposal facility. The facility accepts waste for disposal from both public and private entities within the Cherokee County and surrounding communities.

The major classifications of solid waste to be accepted at the Royal Oaks Landfill include municipal solid waste, household waste, yard waste, commercial waste, industrial waste (nonhazardous), construction-demolition waste, and some special wastes. Consistent with Title 30 TAC §330.15, the facility will not accept for disposal liquid waste, regulated hazardous waste, prohibited PCBs, infectious medical waste, and other wastes prohibited by TCEQ regulations.

The currently permitted 54.5 acres Type I MSW disposal area began accepting waste in 1984. Refer to Parts I/II, Sections 2 and 3 for additional information. The nature and age of waste was used in LFG generation modeling to estimate current and future LFG generation for the site.

2.9 Climate

The climate of the region is characterized as very warm and humid. According to the U.S. Climate Data for the region, the average annual precipitation is approximately 46.3 inches. The temperature ranges between an average low of 36°F in January and an average high of 95°F in August. The climate was considered in the surface completion design of the probes. Based on the existing probe information, a bentonite/concrete surface seal was used in the gas probe to reduce the potential of surface water infiltration.

2.10 Depth of Waste and Liner Description

The filled areas of the existing landfill were constructed consistent with the permit requirements in effect at that time. The existing site consists of approximately 13.4 acres of pre-Subtitle D area and 41.1 acres of Subtitle D lined area.

The pre-Subtitle D area was developed by excavating to the permitted grade and installing a 3-foot compacted clay liner, consistent with the permit requirements of Permit No. MSW-1614. Cells 1 through 9 were constructed to Subtitle D standards, under Permit No. MSW-1614A. Cells 1 through 9 were constructed with a liner system consisting of a geosynthetic clay liner, 60-mil HDPE geomembrane liner, drainage geocomposite, and a protective cover layer.

The minimum elevation of the landfill liner system excavation is 506.0 feet above mean sea level (ft-msl) and the maximum elevation of the landfill final cover will be 776.5 ft-msl. Refer to Appendix IIIA for detailed information on liner system and waste depth.

Waste depth and liner configurations were considered in the probe design. The proposed probe is designed to monitor subsurface soil layers and extend down to the lowest bottom of waste elevation near the probe location.

2.11 Summary

The probe design and monitoring system layout were based on the geologic conditions, hydrogeologic conditions, hydraulic conditions, location of the facility structures, underground utilities, land use, climate, and depth of waste discussed in the above sections. The LFG monitoring system, along with quarterly monitoring, will continue to meet the performance standards of Title 30 TAC §330.371(a) based on above mentioned parameters and the probe design.

3 MONITORING

3.1 Perimeter Monitoring

3.1.1 Existing Perimeter Monitoring Network

The site currently has twenty (20) permanent existing LFG monitoring probes and a utility trench vent to monitor the concentration of methane gas in accordance with Title 30 TAC §330.371(a)(2). The locations of the existing perimeter monitoring probes/vent are shown on Figure III I-A-1 in Appendix III I-A. The boring logs for the existing LFG monitoring probes are included in Appendix III I-C.

As a result of the proposed landfill expansion as listed in Table III I-1, 9 of the existing LFG monitoring probes will be abandoned, 8 new probes will be installed, and 11 of the existing LFG monitoring probes will remain. At landfill completion, the monitoring network will consist of 19 LFG monitoring probes as shown on Figure III I-A-1 in Appendix III I-A. The existing 11 LFG monitoring probes along the western boundary will remain in-place as no changes are proposed to the permitted landfill area. The other existing probes will be abandoned to allow for future filling and site operations. The abandonment will include removing the surface completion material, attempting to pull the probe casing materials, and grouting the borehole with bentonite grout from the total depth to surface. The probes will be abandoned and plugged in accordance with applicable rules in Title 16 TAC Chapter 76.

3.1.2 Proposed Landfill Gas Monitoring Network

As part of the proposed landfill expansion, 8 new probes will be installed prior to abandoning the existing probes or prior to placing waste within 1,000 feet from the proposed probe location. The new probes will be installed in accordance with applicable rules in Title 16 TAC Chapter 76.

The location of the proposed new probes, the existing probes that will be abandoned, and the existing probes that will remain in-place are shown on Figure III I-A-1 in Appendix III I-A. The proposed probe is designed to be both the single casing and multi-casing or nested probe and will be installed similar to the detail shown on Figure III I-A-2 in Appendix III I-A. 3 of the 8 new probes (GP-11A, GP-12A, and 18) will be installed as single casing probe and remaining 5 new probes (GP-9A, GP-10A, GP-13A, GP-14A, and GP-19) will be installed as multi-casing or nested probe to monitor the different site-specific subsurface geology as discussed in Section 2.2. The depth of the new probe will be dependent on the field conditions at the time of installation, however at a minimum, the depth of the probe will extend down to the lowest bottom of waste placement elevation within 1,000 feet of the proposed probe location. Data regarding the new probes is summarized in Table III I-2 below.

Table III I-2
Proposed LFG Monitoring Probe Data[1]

Probe ID[2]		Probe Ground Surface Elevation[3] (ft msl)	Lowest Bottom of Waste within 1,000 ft[4] (ft msl)	Proposed Probe Bottom Elevation (ft msl)	Proposed Boring Depth[5] (ft bgs)
GP-9A	B	660	513	605	55
	C			545	115
	D			513	147
GP-10A	C	602	506	562	40
	D			506	96
GP-11A	D	540	506	506	34
GP-12A	D	562	506	506	56
GP-13A	A	672	518	640	32
	B			615	57
	C			565	107
	D			518	154
GP-14A	A	650	550	640	10
	B			615	35
	C			565	85
	D			550	100
GP-18	D	534	506	506	28
GP-19	C	610	509	570	40
	D			509	101

1 The data given is approximate. Actual probe ground elevation, bottom elevation, and depth will be determined prior to and/or at the time of installation.
2 Refers to Aquifer A through D.
3 Probe ground surface elevation based on aerial topographic survey flown on November 10, 2022.
4 Lowest bottom of waste elevation within 1,000 feet of the proposed probe based on Drawing A.1 – Top of Liner Plan included in Part III, Appendix IIIA-A.
5 Approximate probe depth in feet below grade.

3.1.3 Proposed Passive Trench Vents

LFG trench vent has been installed near the existing underground utility trenches where they cross the permit boundary, as discussed in Section 2.6 and shown on Figure III I-A-1. Future passive trench vents will also be installed in or near any future underground utilities which crosses the permit boundary. A typical detail of the vent pipe construction is shown on Figure III I-A-2 in Appendix III I-A. The underground utility locations will be identified and located by representatives of the utility easement owners.

3.1.4 Monitoring Procedures

All monitoring probes/trench vents will be sampled for methane during the quarterly monitoring period. In addition, sampling for specified trace gases may be conducted as requested by the Executive Director of the TCEQ.

Methane concentrations will be measured using a portable gas detection device pre-calibrated against reference methane standard. In accordance with manufacturer recommendations, the portable gas detector will be field calibrated prior to each monitoring event. As such, the portable gas detector will be field calibrated at least once a quarter prior to taking the quarterly probe measurements. The portable gas detection device will be equipped with a suction sampling line. The sampling line will be connected to the top of each probe and on each passive trench vent to enable gas samples to be drawn directly into the monitoring instrument without diluting the sample. The instrument is designed to give a direct reading of the methane concentration in either percent of the lower explosive limit (LEL) or percent methane by volume. A landfill representative or consultant will conduct the monitoring and the percent methane by volume reading from the device will be recorded. The monitoring equipment will be maintained and calibrated in accordance with the manufacturer's recommended procedures prior to use.

Monitoring data will be recorded on the Landfill Gas Monitoring Report (LGMR) form shown in Appendix III I-D, or a similar form, and the data maintained in the facility's Site Operating Record. Probe and passive trench vent monitoring procedures will be as recommended by the gas detection device instrument manufacturer. The manufacturers' information on perimeter monitoring equipment currently used at the site is provided in Appendix III I-E. However, the site may use equipment, similar or equivalent to the existing equipment to measure methane concentrations in the future.

If LFG monitoring determines that methane has been detected in concentrations exceeding the regulatory limit, notification procedures, as described in Section 4, and remediation procedures, as described in Section 5, will be implemented.

3.1.5 Maintenance Procedures

As part of the overall maintenance program, routine inspection of the probes/trench vents will be conducted at least once a quarter. In addition, each time LFG monitoring is conducted, the sampler will inspect the integrity of the monitoring probes/trench vent. The sampler will record pertinent information on the LGMR form (Appendix III I-D) or similar form. Each probe/trench vent will be routinely inspected once a quarter for the following:

- Verify that the monitoring probes/trench vents are clearly numbered.
- Verify that the protective cover or piping is intact and is not bent or excessively corroded.
- Verify that the concrete pad is intact.
- Verify that the padlock is functional on the probe casing.
- Verify that the visible portion of the PVC riser is intact.

If damage or excessive wear to the monitoring probe/trench vent is observed, it will be reported to the Operational Manager and the monitoring probe/trench vent will be repaired if the damage is affecting the accuracy of the probe. If it is not possible to repair the monitoring probe/trench vent and the damage can potentially affect the accuracy of future monitoring results, the monitoring probe/trench vent will be abandoned and replaced with a new monitoring probe/trench vent in accordance with Sections 3.1.2, 3.1.3, and 3.4 of this plan.

3.2 Monitoring of Facility Structures

3.2.1 Monitoring Procedures

All on-site structures will be sampled for methane during the quarterly monitoring period. In addition, sampling for specified trace gases may be conducted as requested by the Executive Director of the TCEQ.

All on-site occupied enclosed structures, including, but not limited to buildings, subsurface vaults, utilities, or any other areas where potential gas build-up would be of concern, as applicable will be equipped with a continuous monitor/alarm that provides an audible alarm if methane concentrations exceed 1.25% by volume (which is 25 percent of LEL for methane). If a methane level above the regulatory limit is detected, it will be documented in percent methane by volume and reported as outlined in Section 3.3.

The continuous monitors' performance will be tested using a known methane calibration gas at least once a quarter prior to taking the quarterly measurements and will be documented on the LGMR form shown in Appendix III I-D or using a similar form. If the monitoring equipment alarm does not test properly during quarterly testing, they will be repaired or replaced. The manufacturer's information regarding the monitors/alarms currently used at the site is provided in Appendix III I-E. However, the site may use equipment, similar or equivalent to the existing equipment to measure methane concentrations in the future.

If methane concentrations exceeding the regulatory limits are detected within an enclosed building, the building will be immediately evacuated and ventilated by opening doors and windows. Notification procedures described in Section 4 will then be implemented. If existing enclosed structures are removed from the site to allow for the continued development of the landfill, the monitors/alarms installed in the structures will be decommissioned.

3.2.2 Maintenance Procedures

The continuous LFG monitors/alarms will be maintained and tested in accordance with the manufacturer's recommendations and specifications. According to the manufacturer's information in Attachment III I-D, the alarm does not require regular maintenance and it uses a self-purging semi-conductor sensor that has a 7-10 year life expectancy. As such, the sensor will be replaced every 7-10 years. In addition, on a quarterly basis the monitors/alarms will be inspected to ensure they are properly installed and connected to power.

3.3 Recordkeeping/Reporting

The recordkeeping and reporting requirements will be consistent with those outlined in Title 30 TAC §330.159, §330.371, and §330.125. Records will be maintained for the methane monitoring. The records will be kept on site and maintained as part of the Site Operating Record. Field data will be recorded on the LGMR form (or similar form) shown in Appendix III I-D.

The LFG monitoring probes/trench vents and any on-site occupied structures will be monitored quarterly and the results will be placed in the Site Operating Record and made available to the TCEQ upon request. In the event continuous LFG monitors/alarms require replacement, then it will be documented in the Site Operating Record.

For those quarterly LFG monitoring events when the measured methane levels are either: (1) above 5% methane by volume in monitoring points, probes, subsurface soils, or other matrices at the facility boundary defined by the legal description in the permit; or (2) above 1.25% methane by volume in air in facility structures (excluding gas control or recovery system components), LFG monitoring reports will be submitted to the TCEQ.

3.4 Contingency Plan

In accordance with Title 30 TAC §330.371(g)(3), the following contingency plan will be used if the main monitoring system breaks down or becomes ineffective.

LFG Monitoring Probes/Trench Vents

1. Within 60 days, when it is noted that an LFG monitoring probe/trench vent has become inoperative, a notification will be submitted to the TCEQ. The

notification will describe the proposed repair and the schedule for implementation. The damaged or inoperative LFG monitoring probe/trench vent will be replaced with a new probe/trench vent similar to the details of the existing probe/trench vent.

2. Should a monitoring event occur prior to replacement of a damaged probe/trench vent, a bar-hole will be placed next to the damaged probe/trench vent, and a portable gas detection device suitable for methane detection will be used until the probe/trench vent is replaced. The portable gas detection device will be calibrated prior to use per the manufacturer's guidance.
3. Upon completion of the replacement probe/trench vent, an installation report including any boring logs and construction details will be submitted to the TCEQ.

Continuous LFG Monitors/Alarms

1. Damaged or inoperative continuous monitors/alarms will be repaired or replaced within 30 days of the monitoring event during which the damage was noted.
2. A portable gas detection device calibrated for 1.25% volume will be used to monitor weekly until the stationary unit(s) is replaced.

4 EXCEEDANCE ACTION PLAN

4.1 Exceedance Response Measures

This action plan has been prepared for the protection of human health and the environment in the event concentrations of methane exceed allowable limits either within any enclosed structures that may be constructed within the permit boundary or in the LFG monitoring probes. The appropriate emergency response is different for each situation; therefore, the following plan will address the situations for enclosed structures and probes separately.

This action plan will be implemented upon the initial exceedance of a perimeter monitoring probe/trench vent or enclosed structure monitor.

4.1.1 Initial Action

The initial action in the event methane is detected at levels above regulation limits is to immediately take all necessary steps to ensure protection of human health and notify the TCEQ Executive Director, local and county officials, emergency officials, and the public as outlined in Section 4.2. The specific response depends on the circumstances of the situation.

Building/Structures. If a continuous monitoring device installed within an occupied enclosed structure located within the permit boundary is triggered or if LFG monitoring equipment indicates that 1.25 percent methane by volume has been exceeded, the building or structure is to be immediately evacuated of all personnel and the Operational Manager will be notified. Personnel (except for qualified monitoring personnel) will not be allowed to re-enter the affected building or structure until additional measures are taken. Notification procedures will be implemented as described in Section 4.2.

Perimeter Monitoring Probes/Trench Vents. If an exceedance of allowable limits of methane is detected at the permit boundary in one of the monitoring probes/trench vents, the Operational Manager will be notified immediately. The immediate emergency response measure will be for the Operational Manager to determine if any nearby buildings or structures (including off site) are at risk and if evacuation of the buildings should be requested. Notification procedures will be implemented as described in Section 4.2.

4.2 Notification Procedures

When methane levels above the regulatory limit have been detected, sampling personnel will immediately notify the Operational Manager by telephone, SMS text message, or e-mail. The Operational Manager or his representative will then notify the Executive Director of the TCEQ, and the following local/county officials, and emergency officials by writing (telephone, letter, fax, or e-mail) within 7-days after initial detection:

Executive Director
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, TX 78711-3087
Telephone: 512-239-3900
Fax: 512-239-3939
E-mail: [redacted]

TCEQ Region 5 Office
Waste Section Manager
2916 Teague Dr
Tyler, TX 75701-3734
Telephone: 903-535-5100

Cherokee County Health Department
803 College Avenue
Jacksonville, TX 75766
Telephone: 903-586-6191

Jacksonville Fire Department
911 S Bolton St.
Jacksonville, TX 75766
Telephone: 903-586-7131

The public (property owners located within 1,000 feet of the affected probe/vent) will also be notified by writing, telephone, SMS text message, or e-mail after the confirmed exceedance.

The site will then take action as described in Section 5. Subsequent notifications during remediation activities will be followed as described in the remediation plan, if deemed necessary.

The TCEQ will be notified again in writing for any additional monitored points that were not part of the original notification which now exhibit methane exceedances above the regulatory limit. If the new monitored points affect property owners which were not originally notified, they will be notified as described above.

4.3 Placement into Operating Record

Records of LFG monitoring, including the data and methane gas levels, whether for routine monitoring, or remediation purposes, will be maintained and placed in the Site Operating Record. In the event that levels of methane above the regulatory limit have been detected either in facility structures and monitoring points or in monitoring probes/trench vents, a description of steps taken to protect human health must also be placed in the Site Operating Record. Notifications made verbally or in writing will also be recorded and placed into the Site Operating Record. These placements into the Site Operating Record will occur within 7 days after detection of methane above the regulatory limit.

5 REMEDIATION PLAN

Once methane levels above regulatory limits have been accurately detected in the facility buildings/structures or in one or more of the LFG monitoring probes/utility trench vents at the permit boundary, the remediation plan as listed below will be developed and implemented within 60 days of detection. An incident specific remediation plan may also be prepared and/or implemented. The Executive Director may establish an alternative schedule for demonstrating compliance with routine monitoring and required actions if methane gas exceeds the limits noted in Title 30 TAC §330.371(a).

The first remediation action will be an investigation of the cause of the methane levels. The investigation may include some or all of the following elements, depending on the circumstances:

- Bar-hole probe or hydropunch testing in the vicinity of the impacted monitoring probe/trench vent
- Sampling and laboratory analysis of LFG samples collected from the monitoring probe/trench vent to determine the concentration of methane and trace compounds
- A gas analysis to try to determine the source
- Additional LFG monitoring

Using accumulated data, an assessment will be made to determine an appropriate course of action to mitigate the LFG migration. Such actions may vary with the specific incident, but may include (and are not limited to) installation of the following:

- Passive vents
- Cut-off trenches
- Active GCCS

The incident specific remediation actions will be performed within 60 days of the detection per Title 30 TAC §330.371(c)(3). The TCEQ will be notified that this or an incident-specific remediation plan has been implemented within 60 days of detection.

6 LFG COLLECTION AND CONTROL SYSTEMS

6.1 Existing LFG System

Currently, the Royal Oaks Landfill has an existing landfill gas (LFG) system as shown on Figure III I-F-2 in Appendix III I-F. The existing LFG system consists of vertical LFG wells, LFG collection piping, and solar flares. The existing LFG system will be expanded as described below as needed to control LFG and in accordance with New Source Performance Standards for Municipal Solid Waste Landfill (NSPS) as discussed below.

6.2 Future GCCS Installation

As the site develops, additional vertical LFG extraction wells and related landfill gas collection and control system (GCCS) components may be installed in phases as needed to reduce the buildup of internal gas pressures caused by the increased generation of LFG. The future GCCS may include LFG extraction wells, a LFG collection piping network, condensate management system, and associated LFG system components as shown on Figure III I-F-1. The typical details of the future GCCS components are included in Appendix III I-F.

In addition, interim horizontal LFG collectors may also be installed in areas of the landfill that are not yet at final grade and will be replaced by future LFG extraction wells once the landfill achieves its final elevation. The horizontal LFG collectors will be installed similar to the detail shown on Figure III I-F-6 of Appendix III I-F. Each LFG extraction well will be installed in vertical borings drilled within the waste and completed similar to the details shown on Figure III I-F-3 of Appendix III I-F. The extraction wells will not be drilled closer to the liner system than the distance specified on Figure III I-F-3 of Appendix III I-F. Excavated waste from the borings will be temporarily accumulated next to the borehole and then transported to an onsite active disposal area and/or to a nearby permitted landfill.

Based on industry standards for internal extraction wells, a spacing of approximately 200 to 300 feet was used to develop the future extraction well layout. Future wells may be installed in closer spacing as needed to facilitate the operations of the existing LFG facility or future energy facility installed at the site. However, at a minimum, future LFG extraction wells will be installed as shown on Figure III I-F-1 of Appendix III I-F. The LFG extraction wells spacing may vary during interim phases of the landfill. Existing LFG extraction wells in areas receiving additional waste will be extended and/or replaced with a new well as necessary based on the additional waste fill.

Each extraction well and horizontal collector will be equipped with a control valve and monitoring port similar to the detail shown on Figure III I-F-4 of Appendix III I-F. These control valves and monitoring ports, used in conjunction with controls on the blower, will allow the site to regulate vacuum and LFG levels at each individual extraction well/horizontal collector. This will allow the site to make adjustments in order to effectively reduce the potential for subsurface migration and odors, as well as to protect the integrity of the final cover system.

It is expected that the GCCS will be installed prior to final cover placement and the LFG extraction wells will be connected to the geomembrane with a boot when the final cover system is installed. If installation of a LFG extraction well is required after the final cover installation, the geomembrane cover will be cut and removed in the work area prior to LFG extraction well installation and then the geomembrane boot will be installed.

The as-built information for each phase of the GCCS installation will be maintained in the site operating record. The as-built information will document the location of the extraction wells, piping, and related GCCS components. The GCCS will be installed as described in this section; as such, no additional authorization (i.e. permit modification) will be required to install each phase of the GCCS unless there is a significant change in the number of extraction wells or the layout of GCCS.

Following each GCCS installation, an as-built GCCS drawing will be submitted to the TCEQ to incorporate each GCCS installation into the existing permit in the form of revision to Appendix III I-F. The new drawing will be placed behind the existing Figure III I-F-2. In addition, the existing site layout will also be submitted in the form of revision to Figure III I-F-2 of Appendix III I-F to update the existing GCCS conditions.

6.3 GCCS Operation and Maintenance

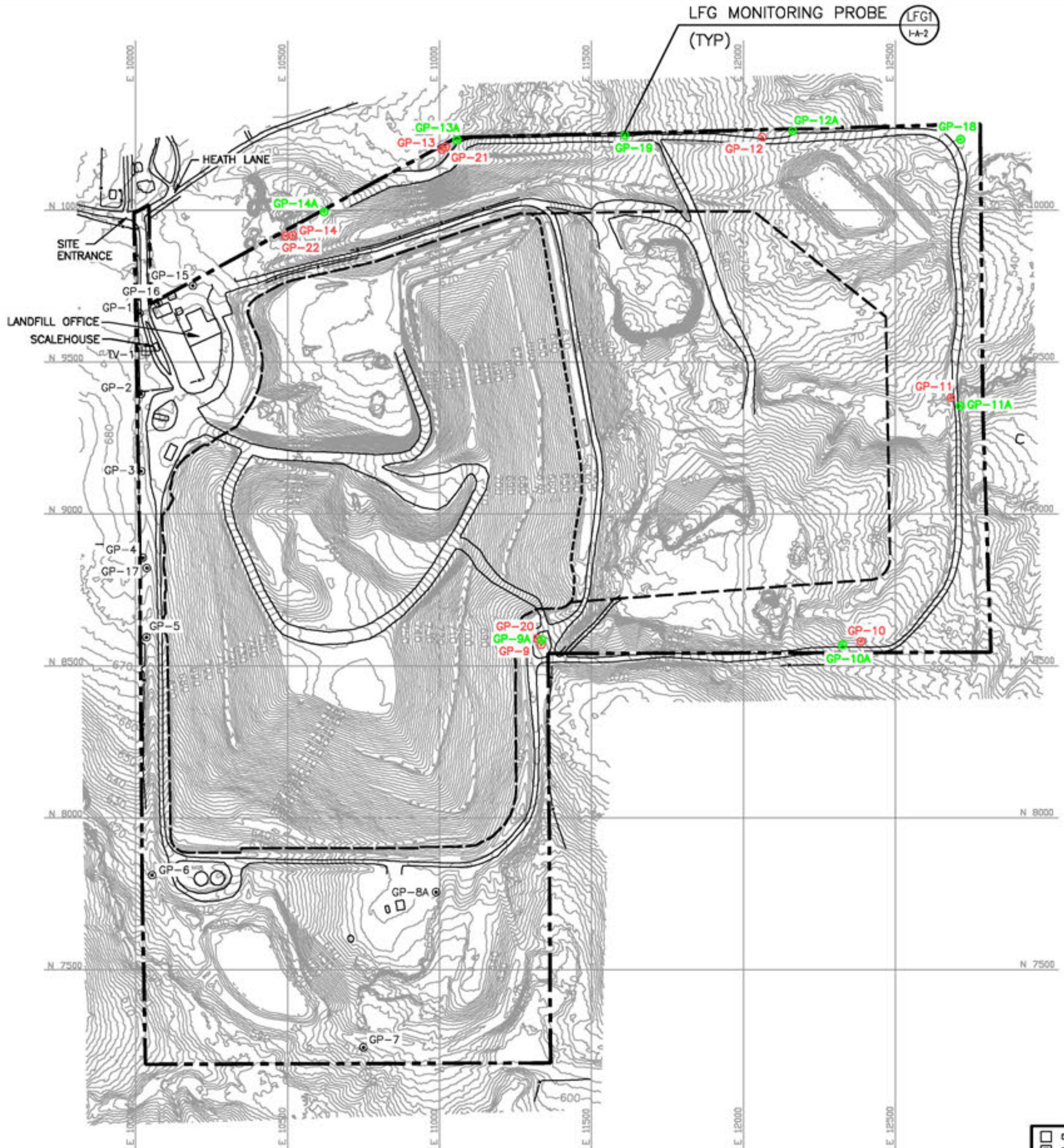
The operation and maintenance of the proposed GCCS will be performed consistent with industry guidelines and practices. Wellhead and system monitoring will be performed on a routine basis to monitor overall system performance. As needed, system adjustments will be made to optimize the extraction of LFG from the landfill to control LFG migration, odors, and greenhouse gases.

APPENDIX III I-A

PERIMETER LANDFILL GAS MONITORING SYSTEM
LANDFILL GAS PROBE/VENT DETAILS

STATE OF TEXAS
COLIN G. McINNES
115872
LICENSED
PROFESSIONAL ENGINEER
5/29/2024

Includes Figures III I-A-1 and III I-A-2



N

0 200 400
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- PERMITTED LIMIT OF WASTE
- PROPOSED LIMIT OF WASTE
- E 10500 — SITE GRID
- 610 — EXISTING CONTOUR (SEE NOTE 1)
- GP-1 — EXISTING GAS PROBE
- TV-1 — EXISTING TRENCH VENT
- GP-18 — PROPOSED GAS PROBE
- GP-10 — EXISTING GAS PROBE (TO BE ABANDONED)

NOTES:

1. EXISTING CONTOURS DEVELOPED BY FIRMATEK FROM AERIAL PHOTOGRAPHY FLOWN NOVEMBER 10, 2022.
2. LOCATION OF THE PROPOSED GAS PROBES ARE APPROXIMATE. ACTUAL LOCATION WILL BE DETERMINED BASED ON FIELD CONDITIONS AT THE TIME OF INSTALLATION.

STATE OF TEXAS
COLIN G. McINNES
115872
LICENSED
PROFESSIONAL ENGINEER
5/24/2024

☐ DRAFT
☒ FOR PERMITTING PURPOSES ONLY
☐ ISSUED FOR CONSTRUCTION

DATE: 05/2024
FILE: 0120-076-11
CAD: III I-A-1 LFG MONITORING SYSTEM.DWG

DRAWN BY: VRS
DESIGN BY: LKS
REVIEWED BY: CAM

Weaver Consultants Group
TBPE REGISTRATION NO. F-3727

PREPARED FOR
PINE HILL FARMS LANDFILL TX, LP

REVISIONS

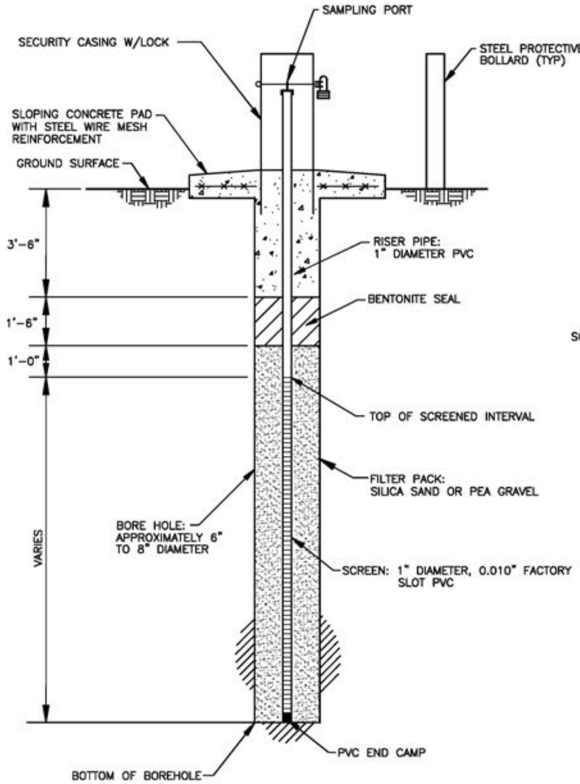
NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT PERIMETER LANDFILL GAS MONITORING SYSTEM

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS

WWW.WCGRP.COM

FIGURE III I-A-1

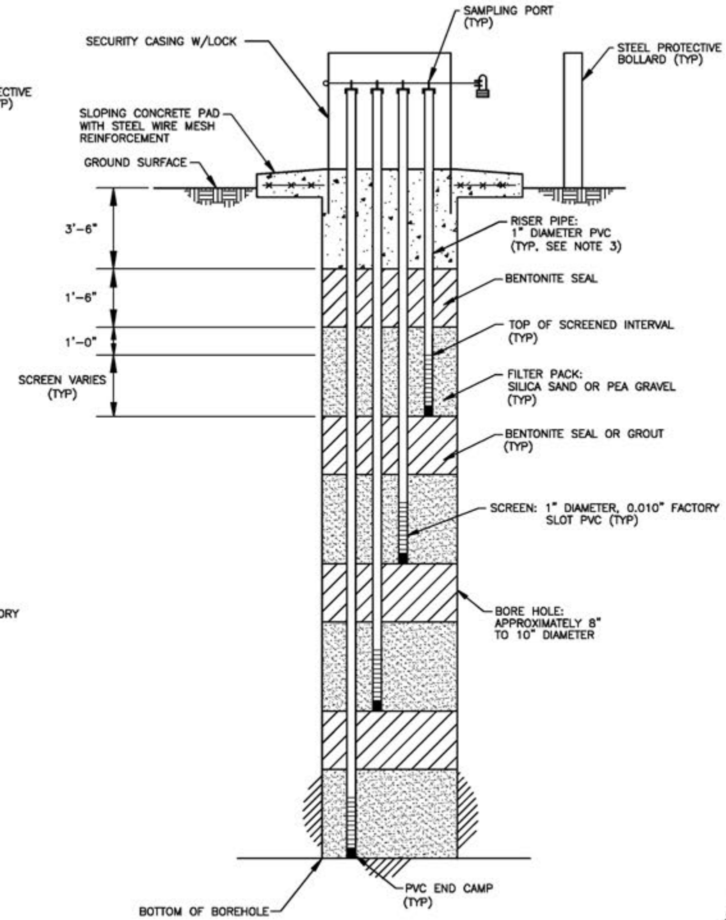


LFG MONITORING PROBE (SINGLE) LFG1 I-A-2

NTS

NOTES:

1. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.
2. ACTUAL DIMENSION OF THE GAS MONITORING PROBE WILL BE DETERMINED BASED ON FIELD CONDITIONS AT THE TIME OF CONSTRUCTION.

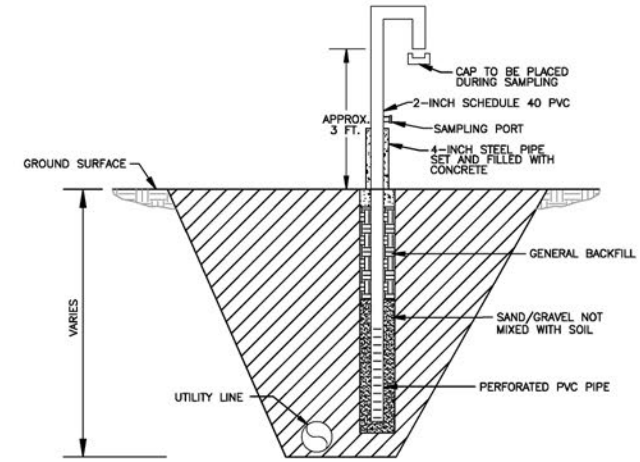


LFG MONITORING PROBE (MULTIPLE) LFG1A I-A-2

NTS

NOTES:

1. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.
2. ACTUAL DIMENSION OF THE GAS MONITORING PROBE WILL BE DETERMINED BASED ON FIELD CONDITIONS AT THE TIME OF CONSTRUCTION.
3. THE NUMBER OF RISER PIPES IN THE BORE HOLE VARIES. PLEASE REFER TO TABLE III 1-2 FOR NUMBER OF RISER PIPES AT EACH PROBE LOCATION.



LFG TRENCH VENT LFG2 I-A-2

NTS

NOTES:

1. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.
2. ACTUAL DIMENSION OF THE LFG TRENCH VENT WILL BE DETERMINED BASED ON FIELD CONDITIONS AT THE TIME OF CONSTRUCTION.

STATE OF TEXAS
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LICENSED PROFESSIONAL ENGINEER
5/24/2024

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DATE: 05/2024
FILE: 0120-076-11
CAD: III I-A-2 PROBE/VENT DETAILS.DWG

DRAWN BY: VRS
DESIGN BY: LKS
REVIEWED BY: CAM

Weaver Consultants Group
TBPE REGISTRATION NO. F-3727

PREPARED FOR
PINE HILL FARMS LANDFILL TX, LP

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
LANDFILL GAS PROBE/
VENT DETAILS

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS

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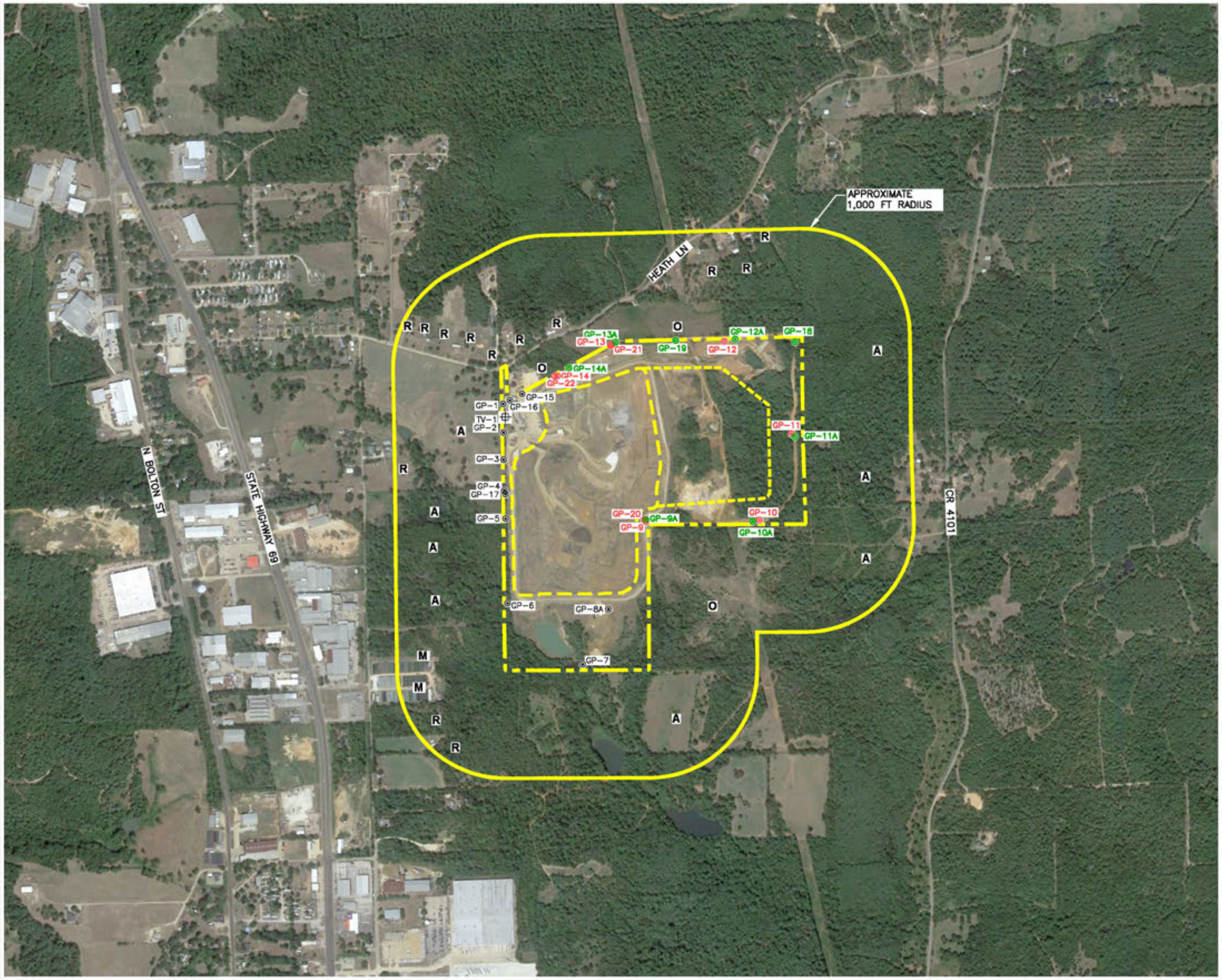
FIGURE III I-A-2

APPENDIX III I-B

SURROUNDING DEVELOPMENT MAP

Includes Figure III I-B-1



N

0 500 1000
SCALE IN FEET

LEGEND

PERMIT BOUNDARY
PERMITTED LIMITS OF WASTE
PROPOSED LIMITS OF WASTE
GP-1 EXISTING GAS PROBE
TV-1 EXISTING TRENCH VENT
GP-18 PROPOSED GAS PROBE
GP-12 EXISTING GAS PROBE (TO BE ABANDONED)
R RESIDENCE
A AGRICULTURAL
M HEAVY MANUFACTURING
O GOVERNMENT OWNED

NOTE:

1. AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH DATED 09-09-2021.

STATE OF TEXAS
COLIN G. McINNES
115872
LICENSED
PROFESSIONAL ENGINEER
5/24/2024

☐ DRAFT
☒ FOR PERMITTING PURPOSES ONLY
☐ ISSUED FOR CONSTRUCTION

DATE: 05/2024
FILE: 0120-076-11
CAD: III I-B-1 SURROUNDING DEVELOPMENT.DWG

DRAWN BY: VRS
DESIGN BY: LKS
REVIEWED BY: CAM

Weaver Consultants Group
TBPE REGISTRATION NO. F-3727

PREPARED FOR
PINE HILL FARMS LANDFILL TX, LP

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
SURROUNDING DEVELOPMENT MAP

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS

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FIGURE III I-B-1

O:\0120\76\EXPANSION 2023\PART III\III I-B-1_SURROUNDING DEVELOPMENT.dwg, byoung, 1:2

APPENDIX III I-C

EXISTING LANDFILL GAS MONITORING PROBE INFORMATION

STATE OF TEXAS
COLIN G. McINNES
115872
LICENSED
PROFESSIONAL ENGINEER
5/29/2024

Includes pages III I-C-1 through III I-C-25

PROJECT: Gas Probes
PROJECT LOCATION: Jacksonville
PROJECT NUMBER: 933-4171.23

RECORD OF BOREHOLE GP-1

BORING DATE: 9/27/93
BORING LOCATION: See Figure 1

SHEET: 1 OF 1
DATUM: Mean Sea Level

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	REMARKS	PIEZOMETER OR STANDPIPE INSTALLATION
0	4.25"-ID Augers				685.80 / 0.00							
		Orange-tan Silty SAND.	SM									Cement
												Bentonite
						1	3" ST	PUSH		18/24		
5												
						2	3" ST	PUSH		18/24		
10		- ferrous gravel, 11 ft to 12 ft.			673.80 / 12.00							
		Orange-tan CLAY with ferrous gravel and sand pockets.	CH			3	3" ST	PUSH		24/24		
15					670.80 / 15.00							
		Boring terminated at 15-ft-penetration.									No water level detected, 1230, 9/29/93.	
20												
25												
30												
35												
40												

DRILL RIG: Mobile B-61
DRILLING CONTRACTOR: CCI, Dallas, TX
DRILLER: J. Barr

Golder Associates

LOGGED: CDC
CHECKED: RCP
DATE: 9/27/93

PROJECT: Gas Probes
PROJECT LOCATION: Jacksonville
PROJECT NUMBER: 933-4171.23

RECORD OF BOREHOLE GP-2

BORING DATE: 9/27/93
BORING LOCATION: See Figure 1

SHEET: 1 OF 1
DATUM: Mean Sea Level

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	REMARKS	PIEZOMETER OR STANDPIPE INSTALLATION
0	4.25"-ID Augers				685.60 / 0.00							
		Light brown Silty SAND.	SM								No water level detected, 1230, 9/29/93.	Cement; Bentonite
						1	3" ST	PUSH		18/24		
5												
		- ferrous sand pockets at 9 ft.				2	3" ST	PUSH		18/24		
10												
						3	3" ST	PUSH		0/24	No recovery with Shelby tube.	
					670.60 / 15.00	4	2" SS	50/ 1/4"		0/ 1/4	No recovery with split-spoon.	
15		Boring terminated at 15-ft-penetration.										
20												
25												
30												
35												
40												

DRILL RIG: Mobile B-61
DRILLING CONTRACTOR: CCI, Dallas, TX
DRILLER: J. Barr

Golder Associates

LOGGED: CDC
CHECKED: RCP
DATE: 9/27/93

PROJECT: Gas Probes
PROJECT LOCATION: Jacksonville
PROJECT NUMBER: 933-4171.23

RECORD OF BOREHOLE GP-3

BORING DATE: 9/29/93
BORING LOCATION: See Figure 1

SHEET: 1 OF 1
DATUM: Mean Sea Level

DEPTH SCALE FEET	BORING METHOD	DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	REMARKS	PIEZOMETER OR STANDPIPE INSTALLATION
0	4.25"-ID Augers				685.40 0.00							
		Red and tan Silty SAND. - with ferrous stains below 3 ft. - with ferrous gravel at 4 ft.	SM								No water level detected, 1230, 9/29/93.	Cement Bentonite
4						1	3" ST	PUSH		18/24		
9						2	3" ST	PUSH		18/24		
14						3	3" ST	PUSH		24/24		
15		Boring terminated at 15-ft-penetration.			670.40 15.00							

DRILL RIG: Mobile B-61
DRILLING CONTRACTOR: CCI, Dallas, TX
DRILLER: J. Barr

Golder Associates

LOGGED: CDC
CHECKED: RCP
DATE: 9/27/93

PROJECT: Gas Probes
PROJECT LOCATION: Jacksonville
PROJECT NUMBER: 933-4171.23

RECORD OF BOREHOLE GP-4

BORING DATE: 9/28/93
BORING LOCATION: See Figure 1

SHEET: 1 OF 1
DATUM: Mean Sea Level

DEPTH SCALE FEET	BORING METHOD	DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	REMARKS	PIEZOMETER OR STANDPIPE INSTALLATION
0	4.25"-ID Augers	Light tan to red Silty SAND.	SM		682.00 / 0.00							Cement
		- with ferrous stains at 4 ft.				1	3" ST	PUSH		18/24		Bentonite
5												
10		- clayey sand with trace of ferrous gravel at 9 ft.				2	3" ST	PUSH		18/24		
15		- with ferrous gravel at 14 ft.				3	3" ST	PUSH		24/24	Hard to drill at 13 ft.	
		Yellow-brown CLAY with ferrous gravel seams.	CH		664.00 / 18.00	4	3" ST	PUSH		18/24		
20												1230 9/29/93
		Green glauconitic Silty SAND with red ferrous gravel.	SM		659.00 / 23.00	5	3" ST	PUSH		24/24		
25		Boring terminated at 25-ft-penetration.			657.00 / 25.00							
30												
35												
40												

DRILL RIG: Mobile B-61
DRILLING CONTRACTOR: CCI, Dallas, TX
DRILLER: J. Barr

Golder Associates

LOGGED: CDC
CHECKED: RCP
DATE: 9/28/93

PROJECT: Gas Probes
PROJECT LOCATION: Jacksonville
PROJECT NUMBER: 933-4171.23

RECORD OF BOREHOLE GP-5

BORING DATE: 9/28/93
BORING LOCATION: See Figure 1

SHEET: 1 OF 1
DATUM: Mean Sea Level

DEPTH SCALE FEET	BORING METHOD	DESCRIPTION	USCS	ELEV / DEPTH	NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	REMARKS	PIEZOMETER OR STANDPIPE INSTALLATION
0	4.25"-ID Augers			674.20 / 0.00							
		Red and tan Clayey SAND to Silty SAND with ferrous stains.	SM								Cement
											Bentonite
5					1	3" ST	PUSH		18/24		
		- light grey at 9 ft.			2	3" ST	PUSH		18/24		
10		- ferrous gravel layer, 11 ft to 12 ft.									
		Tan and light grey CLAY with ferrous gravel pockets and seams.	CH	662.20 / 12.00							
15					3	3" ST	PUSH		24/24		
20					4	3" ST	PUSH		24/24		1230 9/29/93
		Green glauconitic Silty SAND.	SM	651.20 / 23.00	5	3" ST	PUSH		24/24		
25		Boring terminated at 25-ft-penetration.		649.20 / 25.00							
30											
35											
40											

DRILL RIG: Mobile B-61
DRILLING CONTRACTOR: CCI, DAllas, TX
DRILLER: J. Barr

Golder Associates

LOGGED: CDC
CHECKED: RCP
DATE: 9/28/93

PROJECT: Gas Probes
PROJECT LOCATION: Jacksonville
PROJECT NUMBER: 933-4171.23

RECORD OF BOREHOLE GP-6

BORING DATE: 9/29/93
BORING LOCATION: See Figure 1

SHEET: 1 OF 1
DATUM: Mean Sea Level

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	REMARKS	PIEZOMETER OR STANDPIPE INSTALLATION
0	4.25"-ID Augers				613.70 / 0.00							
		Orange-red Clayey SAND with ferrous stains.	SC									Cement
												Bentonite
		- with ferrous gravel at 4 ft.				1	3" ST	PUSH		24/24		
5												
						2	3" ST	PUSH		24/24		
10					603.70 / 10.00							1230 9/29/93
		Boring terminated at 10-ft-penetration.										
15												
20												
25												
30												
35												
40												

DRILL RIG: Mobile B-61
DRILLING CONTRACTOR: CCI, Dallas, TX
DRILLER: J. Barr

Golder Associates

LOGGED: CDC
CHECKED: RCP
DATE: 9/29/93

PROJECT: Gas Probes
PROJECT LOCATION: Jacksonville
PROJECT NUMBER: 933-4171.23

RECORD OF BOREHOLE GP-7

BORING DATE: 9/29/93
BORING LOCATION: See Figure 1

SHEET: 1 OF 1
DATUM: Mean Sea Level

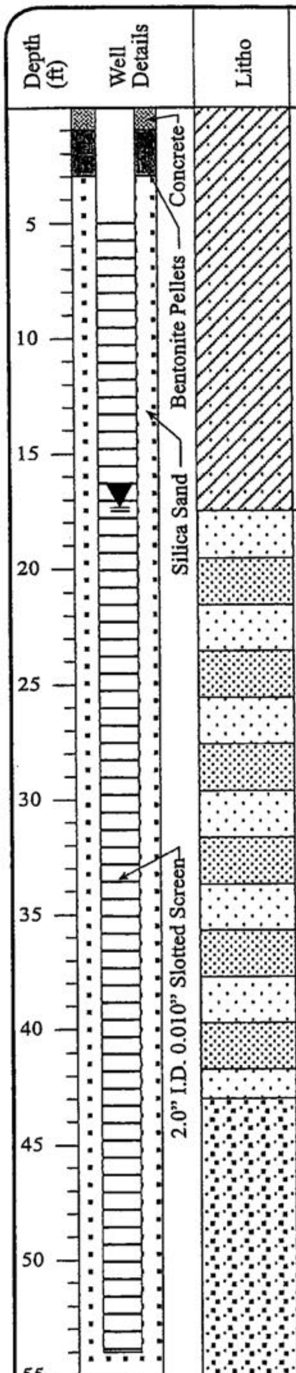
DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	REMARKS	PIEZOMETER OR STANDPIPE INSTALLATION
0	4.25"-ID Augers				612.10 / 0.00							
		Red-orange Silty SAND to Clayey SAND.	SM								No water level detected, 1230, 9/29/93.	Cement
												Bentonite
5						1	3" ST	PUSH		18/24		
		-clayey sand with ferrous gravel at 9 ft.	SC									
10					602.10 / 10.00	2	3" ST	PUSH		24/24		
		Boring terminated at 10-ft-penetration.										
15												
20												
25												
30												
35												
40												

DRILL RIG: Mobile B-61
DRILLING CONTRACTOR: CCI, Dallas, Tx
DRILLER: J. Barr

Golder Associates

LOGGED: CDC
CHECKED: RCP
DATE: 9/29/93

BORING LOG FOR GAS PROBE GP-8A



USCS	Description
CL	Silty Clay, yellow brown, soft, dry, firm, becomes slightly moist and plastic with occasional sand (< 10%) at 10'. Numerous black ferrugenous stringers, especially at 8-10'. Sand is very well rounded, medium grained feldspar. Becomes very moist due to probable water table at 17.5'.
641.1' / 17.5'	
ML	Alternating Glauconitic Siltstone and Clayey Sandy Silt, dark green, 1 - 2' thick, with about a 50/50 ratio. Siltstone is hard, dry to moist, and occassional ferrugenous stringers and traces of muscovite. Clayey Sandy Silt is unconsolidated, soft, sticky, wet, usually flows, and has no return in split spoon. Occassional slickensides and bivalve fossils seen in siltstone. Sand content in siltstone decreases with depth. Rocks are probably Eocene-age Weches Formation.
615.6' / 43'	
SM	Silty Sandstone, greenish brown, alternating with units having higher clay content. Sandstone is very fine grained, loose, wet to moist, well sorted and rounded quartz grains. Units with higher clay content recovered in split spoon. Low clay content units flow.
603.6' / 55'	

Note: Probe installed at N 7755.0, E 10988.6 at surface elevation 658.6 feet m.s.l.

Weaver Boos & Gordon 6420 Southwest Blvd., Fort Worth, Texas (817) 735-9770	Installed: 01/21/02	**Boring Log for Gas Probe GP-8A** Pine Hill Farms Landfill TX, LP Royal Oaks Landfill Jacksonville, Cherokee County, Texas

PROJECT: Gas Probes
PROJECT LOCATION: Jacksonville
PROJECT NUMBER: 933-4171.23

RECORD OF BOREHOLE GP-9

BORING DATE: 9/27/93
BORING LOCATION: See Figure 1

SHEET: 1 OF 1
DATUM: Mean Sea Level

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	REMARKS	PIEZOMETER OR STANDPIPE INSTALLATION
0	4.25"-ID Augers				660.60 / 0.00							
		Yellow-brown CLAY with fine ferrous gravel.	CH								No water level detected, 1230, 9/29/93.	Cement
												Bentonite
5		-with ferrous silt partings at 4 ft.				1	3" ST	PUSH		24/24		
10					650.60 / 10.00	2	3" ST	PUSH		24/24		
		Boring terminated at 10-ft-penetration.										
15												
20												
25												
30												
35												
40												

DRILL RIG: Mobile B-61
DRILLING CONTRACTOR: CCI, Dallas, TX
DRILLER: J. Barr

Golder Associates

LOGGED: CDC
CHECKED: RCP
DATE: 9/27/93

PROJECT: Gas Probes
PROJECT LOCATION: Jacksonville
PROJECT NUMBER: 933-4171.23

RECORD OF BOREHOLE GP-10

BORING DATE: 9/28/93
BORING LOCATION: See Figure 1

SHEET: 1 OF 1
DATUM: Mean Sea Level

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	REMARKS	PIEZOMETER OR STANDPIPE INSTALLATION
0	4.25"-ID Augers				597.20 / 0.00							
		Red CLAY.	CH								No water level detected, 1230, 9/29/93.	Cement; Bentonite
		-with silt and sand pockets at 4 ft.				1	3" ST	PUSH		24/24		
5												
		- with sand seams at 9 ft.				2	3" ST	PUSH		24/24		
10		Boring terminated at 10-ft-penetration.			587.20 / 10.00							
15												
20												
25												
30												
35												
40												

DRILL RIG: Mobile B-61
DRILLING CONTRACTOR: CCI, Dallas, TX
DRILLER: J. Barr

Golder Associates

LOGGED: CDC
CHECKED: RCP
DATE: 9/28/93

PROJECT: Gas Probes
PROJECT LOCATION: Jacksonville
PROJECT NUMBER: 933-4171.23

RECORD OF BOREHOLE GP-11

BORING DATE: 9/28/93
BORING LOCATION: See Figure 1

SHEET: 1 OF 1
DATUM: Mean Sea Level

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	REMARKS	PIEZOMETER OR STANDPIPE INSTALLATION
0	4.25"-ID Augers				538.60 / 0.00							
		Organic silt with fine sand, wood and root fragments. (Topsoil)	ML									Cement; Bentonite
5						1	3" ST	PUSH		24/24		
10						2	3" ST	PUSH		24/24		1230 9/29/93
		Boring terminated at 10-ft-penetration.			528.60 / 10.00							
15												
20												
25												
30												
35												
40												

DRILL RIG: Mobile B-61
DRILLING CONTRACTOR: CCI, Dallas, TX
DRILLER: J. Barr

Golder Associates

LOGGED: CDC
CHECKED: RCP
DATE: 9/28/93

PROJECT: Gas Probes
PROJECT LOCATION: Jacksonville
PROJECT NUMBER: 933-4171.23

RECORD OF BOREHOLE GP-12

BORING DATE: 9/28/93
BORING LOCATION: See Figure 1

SHEET: 1 OF 1
DATUM: Mean Sea Level

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	REMARKS	PIEZOMETER OR STANDPIPE INSTALLATION
0	4.25"-ID Augers				568.10 / 0.00							
		Red and gray CLAY with ferrous stains.	CH								No water level detected, 1230, 9/29/93.	Cement; Bentonite
5						1	3" ST	PUSH		24/24		
		- with silt pockets and ferrous gravel at 9 ft.				2	3" ST	PUSH		18/24		
10					558.10 / 10.00							
		Boring terminated at 10-ft-penetration.										
15												
20												
25												
30												
35												
40												

DRILL RIG: Mobile B-61
DRILLING CONTRACTOR: CCI, Dallas, TX
DRILLER: J. Barr

Golder Associates

LOGGED: CDC
CHECKED: RCP
DATE: 9/28/93

PROJECT: Gas Probes
PROJECT LOCATION: Jacksonville
PROJECT NUMBER: 933-4171.23

RECORD OF BOREHOLE GP-13

BORING DATE: 9/28/93
BORING LOCATION: See Figure 1

SHEET: 1 OF 1
DATUM: Mean Sea Level

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	REMARKS	PIEZOMETER OR STANDPIPE INSTALLATION
0	4.25"-ID Augers				676.40 / 0.00							
		Yellow-brown Gravelly CLAY to Red fine to medium Clayey GRAVEL.	CL								No water level detected. 1230, 9/29/93.	Cement
												Bentonite
						1	3" ST	PUSH		18/24		
5												
			GC									
						2	3" ST	PUSH		18/24		
10					666.40 / 10.00							
		Boring terminated at 10-ft-penetration.										
15												
20												
25												
30												
35												
40												

DRILL RIG: Mobile B-61
DRILLING CONTRACTOR: CCI, Dallas, TX
DRILLER: J. Barr

Golder Associates

LOGGED: CDC
CHECKED: RCP
DATE: 9/28/93

PROJECT: Gas Probes
PROJECT LOCATION: Jacksonville
PROJECT NUMBER: 933-4171.23

RECORD OF BOREHOLE GP-14

BORING DATE: 9/28/93
BORING LOCATION: See Figure 1

SHEET: 1 OF 1
DATUM: Mean Sea Level

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	REMARKS	PIEZOMETER OR STANDPIPE INSTALLATION
0	4.25"-ID Augers				664.00 / 0.00							
		Yellow-brown CLAY.	CH								No water level detected, 1230, 9/29/93.	Cement
												Bentonite
5		- hard ferrous seams at 4 ft.				1	3" ST	PUSH		24/24		
		- brown and with ine ferrous gravel at 9 ft.				2	3" ST	PUSH		24/24		
10					654.00 / 10.00							
		Boring terminated at 10-ft-penetration.										
15												
20												
25												
30												
35												
40												

DRILL RIG: Mobile B-61
DRILLING CONTRACTOR: CCI, Dallas, TX
DRILLER: J. Barr

Golder Associates

LOGGED: CDC
CHECKED: RCP
DATE: 9/28/93

PROJECT: Gas Probes
PROJECT LOCATION: Jacksonville
PROJECT NUMBER: 933-4171.23

RECORD OF BOREHOLE GP-15

BORING DATE: 9/27/93
BORING LOCATION: See Figure 1

SHEET: 1 OF 1
DATUM: Mean Sea Level

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	REMARKS	PIEZOMETER OR STANDPIPE INSTALLATION
0	4.25"-ID Augers				683.10 / 0.00							
		Light orange Silty SAND to orange and tan Clayey SAND.	SM								No water level detected, 1230, 9/29/93.	Cement
												Bentonite
						1	3" ST	PUSH		18/24		
5												
			SC									
		- with ferrous gravel and stains at 9 ft.				2	3" ST	PUSH		18/24		
10					673.10 / 10.00							
		Boring terminated at 10-ft-penetration.										
15												
20												
25												
30												
35												
40												

DRILL RIG: Mobile B-61
DRILLING CONTRACTOR: CCI, Dallas, TX
DRILLER: J. Barr

Golder Associates

LOGGED: CDC
CHECKED: RCP
DATE: 9/27/93

WEAVER BOOS CONSULTANTS

LOG OF BORING NO. GP-16

Project Title: Royal Oaks Landfill

Project No: 0120-76-13

Geologist: J Yahr

Driller: TSS

Boring Start Date: 8/1/2003 Northing: 9692.56 ft.

Boring End Date: 8/1/2003 Easting: 10074.54 ft.

TOC Elevation: 687.94 Ground Elevation: 684.92 ft.

Remarks: Water at 45 feet at time of drilling, 56.57 BTOC at 24 hours.

Depth (ft)	Samples	Graphic Log	Description	USCS	Field Tests: Hand Penetrometer Test (tsf)	Field Tests: Penetration Blows/Ft	Laboratory Tests: Percent Passing No. 200	Percent Moisture Content	Dry Density (pcf)	Liquid Limit	Plastic Limit	Plasticity Index	Permeability (cm/s)	Well Detail
	C		Sand, clayey, silty, fine grained, red, orange, dry. 681.9		0.5									
5	C		Sand, fine to very fine grained, loose, slightly moist, yellow-orange (10YR 6/2).		3.5									
			674.9											
10	C		Ironstone, hard, hematitic. 673.9											
			Sand, clayey, silty, w/ ironstone fragments, dry, unconsolidated, light brown (5YR 6/6).		2.5									
15	C		668.9											
			Clay, silty, slightly sandy, non-plastic, medium brown (5YR 4/4).		4.0									
20	C													
			660.4											
25	C		Sand, clayey, silty, glauconitic, fine grained, moist, medium grey green (5BG 4/2).											
			- color change to brown-dark brown (5YR 4/3 - 5YR 2/2), very moist. 654.9											
30	A		Clay, silty, plastic, firm, dark brown (5YR 2/2). 650.9											
35	A		Sand, silty, glauconitic, fine to very fine grained, WET, grey-green (10G 4/2). 644.9											

WEAVER BOOS CONSULTANTS	LOG OF BORING NO. GP-16	Geologist: J Yahr Driller: TSS	Page 2 of 2
	Project Title: Royal Oaks Landfill Project No: 0120-76-13		

Boring Start Date: 8/1/2003 Northing: 9692.56 ft.
Boring End Date: 8/1/2003 Easting: 10074.54 ft.
TOC Elevation: 687.94 Ground Elevation: 684.92 ft.

Remarks: Water at 45 feet at time of drilling, 56.57 BTOC at 24 hours.

Depth (ft)	Samples	Graphic Log	Description	USCS	Hand Penetrometer Test (tsf)	Penetration Blows/Ft	Percent Passing No. 200	Percent Moisture Content	Dry Density (pcf)	Liquid Limit	Plastic Limit	Plasticity Index	Permeability (cm/s)	Well Detail
	A		Silt, sandy, slightly clayey, wet yellow grey-green (10GY 5/2).											
45	A		636.9											
			Sand, glauconitic, clayey, silty, very fine grained, blue green (5BG 4/2).											
50	A													631.9
			630.9											
			Clay, sandy, glauconitic, plastic, firm, moderately moist.											
55	C		628.9											628.9
			Sand, with alternating clay bands, sand is fine - very fine grained, very friable. Clay is brown, hard, slightly plastic, moist.											627.9
60	C													
65	C													617.9
70			614.9											614.9
75														

Field Tests: Hand Penetrometer Test (tsf), Penetration Blows/Ft. Laboratory Tests: Percent Passing No. 200 through Permeability (cm/s).

WELL VERSION 3.0_RO ROYALOAKS.GPJ WEAVER BOOS FW.GDT 8/27/03

WEAVER BOOS CONSULTANTS

LOG OF BORING NO. GP-17

Project Title: Royal Oaks Landfill
Project No: 0120-76-13

Geologist: J Yahr
Driller: TSS

Boring Start Date: 7/29/2003 Northing: 8822.17 ft.
Boring End Date: 7/29/2003 Easting: 10037.12 ft.
TOC Elevation: 684.29 Ground Elevation: 680.72 ft.

Remarks: Water at 40 feet at time of drilling, 57.28 BTOC at 24 hours.

Field Tests: Hand Penetrometer Test (tsf); Penetration Blows/Ft. Laboratory Tests: Percent Passing No. 200; Percent Moisture Content; Dry Density (pcf); Liquid Limit; Plastic Limit; Plasticity Index; Permeability (cm/s). Well Detail.

Depth (ft)	Samples	Description	Elev.	USCS	Hand Penetrometer Test (tsf)	Penetration Blows/Ft	Percent Passing No. 200	Percent Moisture Content	Dry Density (pcf)	Liquid Limit	Plastic Limit	Plasticity Index	Permeability (cm/s)
0–6	C, C	Sand, loose, slightly moist, medium to fine grained, yellow-brown, (10YR 6/2). Possible fill.	674.7		5.0								
6–9		Sand, slightly silty, friable, medium grained, angular, reddish brown, (10R 4/6).	671.7		3.5								
9–17	C, C	Sand, loose, moist, w/ grey banded layers.	663.7		0.5, 0.5								
17–18		Clay, very plastic, firm, moist, light grey, bentonitic.	662.7										
18–20	C	Sand, friable, medium to fine grained, angular, w/ ironstone fragments.	660.7										
20–24		Clay, very silty, sandy, moist, interbedded clay (55%) and sandy silt (45%), dark grey-green (5G 2/1).	656.7										
24–32	C, C	Sand, silty, clayey, very fine to fine grained, dark grey to grey green (5G 2/1 - 10G 6/2) some interbedded clays. 24-25 very hard, wet @ 26'. - more clay, plastic, silty, moist - more silty sand, very wet, green grey (10G 6/2)	648.7										
32–34		Clay, silty, plastic, wet, grey-green (10G 6/2).	646.7										
34–	C, C	Interbedded layers of silt sand and clay. Layers are approx 1 foot thick, silty sandy clay, sandy clayey silt, and clayey silty sand. dark grey-green (5G 3/2).											

WELL VERSION 3.0_RO_ROYALOAKS.GPJ WEAVER BOOS FW.GDT 8/27/03

LOG OF BORING NO. GP-17

WEAVER BOOS CONSULTANTS

Project Title:	Royal Oaks Landfill
Project No:	0120-76-13
Geologist:	J Yahr
Driller:	TSS

Boring Start Date:	7/29/2003	Northing:	8822.17 ft.
Boring End Date:	7/29/2003	Easting:	10037.12 ft.
TOC Elevation:	684.29	Ground Elevation:	680.72 ft.

Remarks: Water at 40 feet at time of drilling, 57.28 BTOC at 24 hours.

Field Tests: Hand Penetrometer Test (tsf), Penetration Blows/Ft
Laboratory Tests: Percent Passing No. 200, Percent Moisture Content, Dry Density (pcf), Liquid Limit, Plastic Limit, Plasticity Index, Permeability (cm/s)

Depth (ft)	Samples	Description	Elevation	USCS	Well Detail
40–53.5	C (45), C (50)	Interbedded layers of silt sand and clay. Layers are approx 1' thick, silty sandy clay, sandy clayey silt, and clayey silty sand. dark grey-green (5G 3/2).	626.7		627.7
53.5–59.5	C (55), C (60)	Clay, sandy, silty, glauconitic, moderately plastic, firm, moist, dark green - grey (5G 3/2)	620.7		625.7, 624.7
59.5–65.5	C (65)	Sand, fine to very fine grained, with interbedded clays, friable,slightly moist, brown sands (5YR 4/1)) - dark brown (clays (10YR 2/2)).	614.7		614.7

Depth scale: 45, 50, 55, 60, 65, 70, 75

WELL VERSION 3.0_RO ROYALOAKS.GPJ WEAVER BOOS FW.GDT 8/27/03

WEAVER BOOS CONSULTANTS

LOG OF BORING NO. GP-20

Project Title: Royal Oaks Landfill
Project No: 0120-76-13

Geologist: J Yahr
Driller: TSS

Boring Start Date:	7/30/2003	Northing:	8589.77 ft.
Boring End Date:	7/30/2003	Easting:	11321.29 ft.
TOC Elevation:	664.82	Ground Elevation:	661.12 ft.

Remarks: Water at 35 feet at time of drilling, 43.31 feet BTOC at 24 hours.

Depth (ft)	Samples	Description	Elevation	USCS	Hand Penetrometer Test (tsf) (Field Tests)	Penetration Blows/Ft (Field Tests)	Percent Passing No. 200 (Laboratory Tests)	Percent Moisture Content (Laboratory Tests)	Dry Density (pcf) (Laboratory Tests)	Liquid Limit (Laboratory Tests)	Plastic Limit (Laboratory Tests)	Plasticity Index (Laboratory Tests)	Permeability (cm/s) (Laboratory Tests)	Well Detail
0	C	Clay, very plastic, slightly moist, bentonitic, w/ iron staining, light grey (5Y 8/1).	660.1											
		Sand, clayey, silty, very fine grained, slightly moist, iron staining.	656.1		4.0									
5	C	Clay, plastic, bentonitic, dry, light iron staining, light grey (5Y 8/1).	654.1											
10, 15	C, C	Sand, silty, clayey, very fine grained, w/ hard ironstone layers, brown (10YR 5/4).	645.1		4.5; 3.0									
20	C	Silt, clayey, sandy, dark grey, (5G 2/1).	639.1											
		Clay, very silty, sandy, moist, firm, very plastic, dark grey (5G 2/1).	637.1											
25	C	Silt, clayey, with thin sand laminations, moderately moist, dark grey green (5G 3/2), shaley.	631.1											
30	C	Clay, very silty, firm, moist, moderately plastic.	629.1											
35	C	Silt, with interbedded clay and sand layers, glauconitic, dark grey green (5G 3/2).	622.6											624.1; 622.1
		Sand, with sandstone and silt, fine to very fine grained, medium green (10G4/2).												621.1

WELL VERSION 2.0_RO ROYALOAKS.GPJ WEAVER BOOS FW.GDT 8/27/03

WEAVER BOOS CONSULTANTS

LOG OF BORING NO. GP-20

Project Title: Royal Oaks Landfill
Project No: 0120-76-13

Geologist: J Yahr
Driller: TSS

Boring Start Date: 7/30/2003
Boring End Date: 7/30/2003
TOC Elevation: 664.82
Northing: 8589.77 ft.
Easting: 11321.29 ft.
Ground Elevation: 661.12 ft.

Remarks: Water at 35 feet at time of drilling, 43.31 feet BTOC at 24 hours.

Depth (ft)	Samples	Graphic Log	Description	USCS	Hand Penetrometer Test (tsf)	Penetration Blows/Ft	Percent Passing No. 200	Percent Moisture Content	Dry Density (pcf)	Liquid Limit	Plastic Limit	Plasticity Index	Permeability (cm/s)	Well Detail
	C		619.1											
45	C		Sand, interbedded clean brown (5YR 4/1) and silty dark green (5G 3/2) sands, friable, slightly moist. 611.1										611.1	
50														
55														
60														
65														
70														
75														

WELL VERSION 3.0_RO ROYALOAKS.GPJ WEAVER BOOS FW.GDT 9/27/03

WEAVER BOOS CONSULTANTS

LOG OF BORING NO. GP-21

Project Title: Royal Oaks Landfill
Project No: 0120-76-13

Geologist: J Yahr
Driller: TSS

Boring Start Date: 7/28/2003 Northing: 10207.33 ft.
Boring End Date: 7/28/2003 Easting: 11020.53 ft.
TOC Elevation: 678.1 Ground Elevation: 674.72 ft.

Remarks: Water at 35 feet at time of drilling, 35.19 feet BTOC after 24 hours.

Depth (ft)	Samples	Graphic Log	Description	USCS	Field Tests: Hand Penetrometer Test (tsf)	Field Tests: Penetration Blows/Ft	Laboratory Tests: Percent Passing No. 200	Laboratory Tests: Percent Moisture Content	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Liquid Limit	Laboratory Tests: Plastic Limit	Laboratory Tests: Plasticity Index	Laboratory Tests: Permeability (cm/s)	Well Detail
0	C		Clay, slightly silty, low plasticity, dry, mottled light brown (5YR 5/6) and yellow orange (10YR 6/6).											
					4.0									
5	C													
					4.0									
10	C													
					4.0									
15	C		657.7											
			Sand, silty, slightly clayey, fine grained, glauconitic, greyish green (5G 5/2).											
20	C													
25	C		644.7											
30	C		Clay, silty, plastic, firm, WET, dark grey (5G 2/1). 639.7											
35	C		Clay, silty, plastic, slightly sandy, slightly glauconitic, dark grey green (10G 2/2). 635.7											
			Silt, clayey, slightly moist, dark grey green (10G 2/2).											

WELL VERSION 3.0_RO ROYALOAKS.GPJ WEAVER BOOS FW.GDT 8/27/03

WEAVER BOOS CONSULTANTS	LOG OF BORING NO. GP-21 Project Title: Royal Oaks Landfill Project No: 0120-76-13	Geologist: J Yahr Driller: TSS	Page 2 of 2

Boring Start Date: 7/28/2003 Northing: 10207.33 ft.
Boring End Date: 7/28/2003 Easting: 11020.53 ft.
TOC Elevation: 678.1 Ground Elevation: 674.72 ft.

Remarks: Water at 35 feet at time of drilling, 35.19 feet BTOC after 24 hours.

Depth (ft)	Samples	Graphic Log	Description	USCS	Hand Penetrometer Test (tsf)	Penetration Blows/Ft	Percent Passing No. 200	Percent Moisture Content	Dry Density (pcf)	Liquid Limit	Plastic Limit	Plasticity Index	Permeability (cm/s)	Well Detail
	C		Silt, clayey, slightly moist, dark grey green (10G 2/2).											
45	C												628.7	
			626.7										626.7	
			Sand, slightly clayey, with rare clay lenses, very fine grained, moist, olive grey - olive black (5Y 4/1 - 5Y 2/1).										625.7	
50	C													
55	C													
			615.4										615.4	
60														
65														
70														
75														

WELL VERSION 3.0 RO ROYALOAKS.GPJ WEAVER BOOS FW.GDT 8/27/03

WEAVER BOOS CONSULTANTS

LOG OF BORING NO. GP-22

Project Title: Royal Oaks Landfill
Project No: 0120-76-13

Geologist: J Yahr
Driller: TSS

Boring Start Date: 7/28/2003 Northing: 9915.42 ft.
Boring End Date: 7/28/2003 Easting: 10494.19 ft.
TOC Elevation: 669.23 Ground Elevation: 665.64 ft.

Remarks: Water at 40 at time of drilling, 34.40 feet BTOC after 24 hours.

Depth (ft)	Samples	Description	Elevation	USCS	Hand Penetrometer Test (tsf)	Penetration Blows/Ft	Percent Passing No. 200	Percent Moisture Content	Dry Density (pcf)	Liquid Limit	Plastic Limit	Plasticity Index	Permeability (cm/s)
0–11.5	C, C, C	Clay, silty, moist, w/ thin bands of reddish ironstone, dark yellow orange (10YR 6/6).	654.1		4.0, 4.0, 0.5								
11.5–12		Clay, hard, plastic, silty, dark green (5G 3/2).	653.6										
12–16	C	Clay, silty, micaceous, dark grey green (5G 3/2).	649.6		0.5								
16–25	C, C	Sand, silty, clayey, very fine - fine grained, glauconitic.	640.6										
25–31	C	Clay, silty, moderately plastic, dark grey green (5G 3/1).	634.6										
31–33		Sand, silty, hard, very fine grained, pale green (10G 6/2).	632.6										
33–	C, C	Clay, plastic, greenish black (5GY 2/1).											

WELL VERSION 3.0_RO ROYALOAKS.GPJ WEAVER BOOS FW.GDT 8/27/03

WEAVER BOOS CONSULTANTS

LOG OF BORING NO. GP-22

Project Title: Royal Oaks Landfill

Project No: 0120-76-13

Geologist: J Yalir

Driller: TSS

Boring Start Date: 7/28/2003 Northing: 9915.42 ft.

Boring End Date: 7/28/2003 Easting: 10494.19 ft.

TOC Elevation: 669.23 Ground Elevation: 665.64 ft.

Remarks: Water at 40 at time of drilling; 34.40 feet BTOC after 24 hours.

Depth (ft)	Samples	Graphic Log	Description	USCS	Hand Penetrometer Test (tsf)	Penetration Blows/Ft	Percent Passing No. 200	Percent Moisture Content	Dry Density (pcf)	Liquid Limit	Plastic Limit	Plasticity Index	Permeability (cm/s)	Well Detail
			Clay, plastic, greenish black (5GY 2/1). 622.6										623.6	
	C		Sand, clayey, micaceous, very fine to fine grained, slightly moist, olive grey (5Y 5/2).										621.6	
45													620.6	
	C													
50														
	C													
55			610.6										610.6	
60														
65														
70														
75														

WELL VERSION 3.0 RO ROYALOAKS.GPJ WEAVER BOOS FW.GDT 8/27/03

APPENDIX III I-D

LANDFILL GAS
MONITORING REPORT FORM

Includes pages III I-D-1 and III I-D-2

ROYAL OAKS LANDFILL
LANDFILL GAS MONITORING REPORT FORM

Sampled by:______________________________ Date:________________________________

Time:________(Start) __________ (Finish) Temperature:_________________________

Weather:_____________________ Barometric Pressure (optional): ________________

Monitoring Equipment:_________________ Date of Calibration: ___________________

CALIBRATION:

Standard Concentration: ______ % by Vol. Instrument Reading: _____________%

Probe/Vent No.	% METHANE (By Volume)[3] 0-100	%[1] LEL 0-100	STATIC PRESSURE "w.c."[2] (Optional)	O_2% (Optional)	PROBE INTEGRITY VERIFIED Yes/No
GP-1					
GP-2					
GP-3					
GP-4					
GP-5					
GP-6					
GP-7					
GP-8A					
GP-9A					
GP-10A					
GP-11A					
GP-12A					
GP-13A					
GP-14A					
GP-15					
GP-16					
GP-17					
GP-18					
GP-19					
TV-1					

ROYAL OAKS LANDFILL
LANDFILL GAS MONITORING REPORT FORM (CONTINUED)

ONSITE STRUCTURES	Verify if Continuous LFG Alarm is Operational (Circle One)		Was Continuous LFG Alarm Tested (Circle One)		Continuous LFG Alarm Activated (>1.25% CH_4 by volume / LEL>25%)[3] During Previous Quarter (Circle One)	
Scale House	YES	NO	YES	NO	YES	NO
Maintenance Building	YES	NO	YES	NO	YES	NO

[1] % LEL = (20) x (observed % methane) – Note: Record >100% in LEL column if percent methane is over 5%. The reference to LEL is for methane by volume % conversion purpose only.
[2] "w.c." – Inches Water Column
[3] Monitoring results shall be recorded as percent methane by volume. The reference to LEL is for methane by volume % conversion purpose only.

APPENDIX III I-E

TYPICAL MONITORING EQUIPMENT MANUFACTURER'S INFORMATION

Includes pages III I-E-1 through III I-E-17

PERIMETER MONITORING EQUIPMENT

GEM™ 2000
PORTABLE GAS ANALYZER
Instrumentation

The GEM ™ 2000 combines the GEM ™ 500 and the GA-90 into one faster, more accurate, intrinsically safe instrument

The **GEM™2000** was designed by **CES-LANDTEC** specifically for use on landfills to monitor landfill gas (LFG) extraction systems, flares, and migration control systems.

The **GEM™2000** samples and analyzes the Methane, Carbon Dioxide and Oxygen content of landfill gas. The easy-to-read LCD screen shows the results as percentages of CH_4, CO_2, O_2 and "balance" gas. The **GEM™2000** calculates and displays gas flow rate. It also measures and displays Btu content, temperature (w/optional probe), relative and atmospheric pressures and CH_4 LEL (Lower Explosive Limit).

GEM™ 2000
"The Future of Landfill Gas Monitoring"

Performance
New technological advances in hardware and software dramatically improve speed and accuracy

Safe
Certified Intrinsically Safe for landfill use

Efficient
Two operating modes, each with two screens for streamlined functionality

Flexible
DataField software offers integration with various PC applications

Experience
Built on the success of hundreds of field-tested instruments

"The best just got better!"

DataField COMPATIBLE

GEM™2000 Multi-Functional Analyzer

Diverse Field Applications... monitors migration control systems, gas extraction systems, flares, migration probes, and more.

Gas Extraction Monitor Mode... provides automatic sampling and analysis of gas composition % by volume CH_4, CO_2, O_2 and balance gas, % LEL CH_4, temperature (with optional probe), static pressure, differential pressure, and barometric pressure. Calculates gas flow rates (SCFM) as well as Btu content.

Landfill Gas Analyzer Mode... provides automatic sampling and analysis of gas composition % by volume CH_4, CO_2, O_2 and % balance gas, % LEL CH_4, temperature (with optional probe), barometric pressure and relative pressure. Can be used for data logging, with user programmed intervals.

Easy to Read Display... extra large backlit LCD shows up to five gases, atmospheric and gas vacuum pressure, temperature, ID code – all at the same time.

Intrinsically Safe... essential for protecting personnel who work with hazardous and explosive landfill gases.

On Site Calibration... rapid field calibration checking or adjustment can be carried out on site.

Automatic Purge... automatically purges analyzer when a new ID is selected. (This feature can be turned off).

Light-Weight Compact Size... easy to carry. Weighs less than five pounds.

Quick Analysis... completes sampling and displays gas analysis and flow results in less than one minute.

Infrared Gas Analyzer... provides accurate measurements of methane (CH_4), and carbon dioxide (CO_2).

Gas Temperature... read when using optional temperature probe or can be entered manually.

Durable Oxygen Sensor... provided by the galvanic cell principle, not influenced by other gases (i.e. CH_4, CO_2, CO, SO_2 or H_2S).

User Friendly On-Screen Menu... in each mode the user performs most operations in just two screens.

PC Data Downloading... provided by RS232 interface with **DataField CS** software (Release 3.0 or later).

Data Storage/Retrieval... stores prior measurements taken for each monitoring point, 900 monitoring points total.

Date/Time Stamp... recorded for all stored data.

Prior Data Recall... allows user to view prior data for each monitoring point.

Methane Analysis... displayed as either % CH_4 by volume or LEL CH_4 (Landfill Gas Analyzer Mode only).

Durable Construction... built of strong, durable plastic material suitable for harsh landfill environments.

All Weather Use... designed to operate in extremes from 32°F to 104°F. Sealed, weather-tight case.

Built-in Adjustable Alarms... allows user to set alarm limits for CH_4 and O_2.

Rechargeable Batteries... internal, rechargeable nickel metal hydride batteries are standard.

Operating Time... approximately 8 hours with normal pump usage (approximately 10 hours without pump running).

Fast Recharge Time... approximately 3 hours from complete discharge.

Battery Check... battery life is continuously displayed.

Monitoring Point ID Codes... provides alphanumeric identification of monitoring points for data storage and recall.

ID Comments... allows user to answer up to 3 questions with a list of 9 potential answers each.

Imperial vs. SI Units... can display measurements in Imperial (USA) or SI (metric) units.

Interfaces to DataField Management Software... which provides statistical analysis and reporting of LFG data.

Multiple Flow Meter Analysis... calculates gas flow with Accu-Flo Wellheads, Orifice plates and Pitot tubes.

Gold Warranty Service Program... ensures that your analyzer is properly maintained for optimum performance. (Optional).

Additional Information

The **CES-LANDTEC** team is committed to introducing new and more efficient technologies into an industry which recognizes innovation.

The **GEM™2000** is part of **CES-LANDTEC's** family of products developed specifically for the landfill industry. Other **CES-LANDTEC** products and services include:

- GEM™500
- SEM-500
- Accu-Flo Wellheads
- DataField Online Service
- DataField SES Environmental Management System
- MANAGEbyNet Project Management Software
- QuickSWPPP Software

— Providing Technology and Software for a better Environment —

GEM™2000 Typical Accuracy

CONCENTRATION	% CH_4 by VOLUME	% CO_2 by VOLUME	% O_2 by VOLUME
5% (LEL CH_4)	±0.3%	±0.3%	±1.0%
FULL SCALE	±3.0% (70%)	±3.0% (40%)	±1.0% (25%)

GEM™2000 Specifications

	SENSOR RANGE	RESOLUTION
Methane - CH_4	0-70%	0.1%
Carbon Dioxide - CO_2	0-40%	0.1%
Oxygen - O_2	0-25%	0.1%
Pressures (diff)	0-10" W.C.	0.001" W.C.
(static)	0-100" W.C.	0.1" W.C.

Pump Flow Rate – 500 cc/min at nominal flow, 250 cc/min at 80" W.C.
Vacuum – Up to 80" W.C.
UL Certified to Class 1, Zone 1, AEx Ib d IIa T4

SWANA MEMBER

An involved and contributing member of the Solid Waste Association of North America.

CES LANDTEC
An ISO 9001 Certified Company
850 South Via Lata, Suite 112 Colton, CA 92324

Western Sales Office
(800) 821-0496 • Fax (909) 825-0591
Eastern Sales Office
(800) 390-7745 • Fax (301) 391-6546

REV 0303

ensure the best possible accuracy.

2.13 Update Site Data

Allows the user to answer questions (pre-defined in LSGAM software) relating to the site (e.g. name of operator, weather conditions, etc.). Site Questions are different than ID Questions. Once answered, site answers to site questions will be associated with all subsequent readings until the instrument is turned off or the question answers are updated.

This is covered in detail in section 3.2 of this manual.

2.14 Data Logging (GA mode only)

Enables the user to leave the Instrument unattended to take samples at pre-determined intervals. The reading interval and pump run time may be edited prior to commencing the logging cycle. The ID code may ONLY be set in LSGAM communication software.

Once the logging function is activated, the instrument will carry out a 30 second 'Warm-up' countdown (displayed bottom right) and begin the first sample. After each sample, the unit will automatically sleep to conserve power if the time between the pump ending and the next sample is greater than 30 seconds.

The instrument is reactivated (awakened) during a logging cycle, the LANDTEC logo will be displayed for a few seconds and the Gas Reading screen will be displayed. This will initiate a 30 second countdown to the next sample being taken unless the operator stops the logging function. The data will be logged against the ID setup through LSGAM for the Data Logging function

2.15 Operating Language

The operating language of the instrument can be set to English, German, Spanish, French, Italian or Brazilian Portuguese through this option.

2.16 View Data

The view data allows the user to see the readings that are in the GEM2xxx memory. Often the amount of data stored is more than can be displayed adequately on one screen so pressing the ⑤ key will allow the user to see additional screens with stored data. The 2 '∧', 4 '<', 6 '>' and 8 '∨' cursor keys will move forward or backwards through the instruments memory. Pressing the ① key will exit to the Gas Reading screen.

2.17 Adjust Contrast

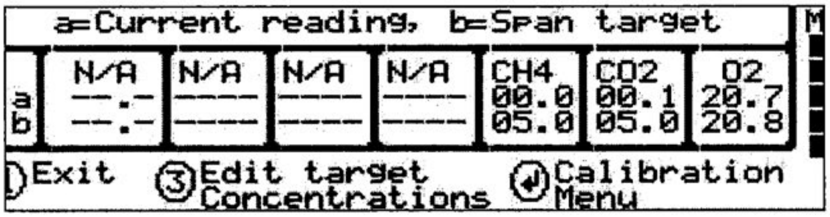
The GEM2xxx automatically adjusts the screen contrast according to the ambient temperature to maintain normal viewing.

The contrast can be manually adjusted by using the 4 '<' and 6 '>' cursor keys. The manual contrast setting is stored when the '↵' key is pressed.

2.18 Field Calibration

Whenever carrying out a user calibration function it is important to ensure the correct values are entered. Additionally, in the case of a zeroing function, ensure only certified gas or ambient air is used and no connection is made to a probe or wellhead fitting. Additionally, ensure the instrument is purged of any residual gas that may be inside the instrument prior to zeroing. Calibration cylinders are sold by LANDTEC. The regulator, sold by LANDTEC, is set to 0.5 liters per minute and 15 psig maximum. A normal field calibration usually requires the gas to be running for about two minutes.

Upon selecting this option, the Field Calibration screen is displayed. A brief description of the user span calibration procedure and the current reading (row '**a**') and user span calibration gas values (row '**b**') are displayed.



The span gas values may be changed via the '③ **Edit Target Concentrations**' option. Once this option has been selected, **all** the gas values will require entry. Each entry is to be confirmed by pressing the '↵' key. It is important to confirm the concentration of the calibration gas(es) used and enter the value(s) properly.

The calibration menu has the following menu options:

2.18.1 Zero Channels

Selected from the **'Field Calibration'** - **'↵-Calibration Menu'** allows the relevant reading to be zeroed. When selected, a list of the available options will be displayed, this usually includes CH_4, and O_2, also the Gas Pod (if fitted).

Supply a zero gas mixture to the instrument for the gas to be zeroed. Ensure the reading for the selected gas has settled to its lowest value before selecting the zero function. When the required option is selected, the user zero function will be carried out automatically. The operation will be carried out when the '↵' key is pressed.

2.18.2 Span Channels

Spanning Channels should be carried out prior to use or when the ambient operating temperature changes greater than +/- 20 degrees Fahrenheit. Selected from the **'Field Calibration'** - **'↵-Calibration Menu'**, allows the relevant reading to be span calibrated (in accordance with the calibration value entered). When selected, a list of the available options will be displayed, which includes CH_4, CO_2, O_2, (CO & H_2S internally for the Plus) and if an external Gas Pod is fitted (H2S, CO, SO2, H2, NO2, Cl2, or HCN).

When the required option is selected from the list, the span calibration function will be carried out automatically. When carrying out this procedure, ensure the span calibration procedure (as outlined below) is followed:

1. Apply the relevant known certified gas concentration through the inlet port of the Instrument.
2. Wait until the current gas reading has stabilized.
3. Select the required calibration option via the '**↵-Calibration Menu**'.

2.18.3 Factory Settings

This will clear any user zero and span calibration data. It will also restore the pre-programmed factory settings for **ALL** channels – CH_4, CO_2, O_2 (CO & H_2S for the Plus) or Gas Pod (if fitted) and pressure transducers.

2.18.4 Last Field Cal

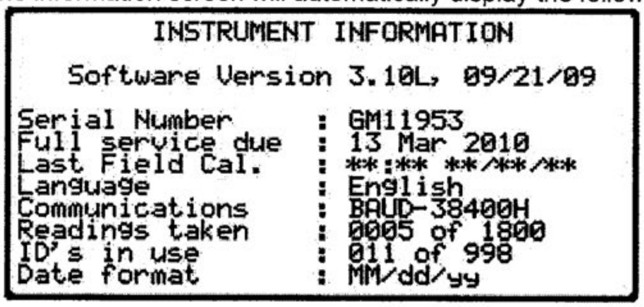
Displays the date the last field calibration was carried out (zero or span).

2.19 Mode of Operation

Allows changing instrument between GA mode and GEM mode of operation.

2.20 Information Screen

The information screen will automatically display the following information:



Navigation

Note: This menu item is specific to GEM2NAV instrument models.

This feature has two options Navigation Screen ON and Navigation Screen OFF. If the Navigation is turned ON, a navigation screen will appear after selecting a well ID. If the Navigation screen is OFF you will skip entering through the navigation screen. If all well locations are known, the user may choose to turn this feature off. Even if this feature is turned off, the GPS will record the related information with readings.

2.21 Exit Menu

The Exit Menu simply exits the main menu screen and returns to the gas reading screen.

7 Service & Maintenance

7.1 Factory Service

LANDTEC Facilities are the ONLY authorized service centers for the GEM™ Family of instruments. LANDTEC offers a several service plans to facilitate your bi-annual Factory Servicing of the instrument. Please contact your LANDTEC representative for more information on the service plan that best fits your specific needs. Factory Service includes but is not limited to the following;

General operations
The main functions of the gas analyzers operation are checked to ensure that they are within specification.

Barometric pressure reading
The barometric pressure reading is checked to ensure it is within specification. This is carried out by way of comparing the atmospheric reading against a known standard. If necessary, reprogramming is quoted.

Static and differential pressure readings
The static and differential pressure transducers are checked to ensure they are within specifications. This is carried out by comparing instrument readings to a known standard, applying a known pressure and noting both readings. If necessary, reprogramming will be quoted.

Pump functionality (flow and vacuum)
All flow and vacuum functions of the internal pump are checked to ensure the operation is within specification.

Water ingress/blockage
The internal filters are checked for cleanliness and moisture ingress to ensure they are not contaminated.

Flow fail setting
The flow fail function is checked to ensure proper operation within the specified limits.

Gas pod and Temperature probe connectivity reading
The connectivity of the gas analyzer is checked to ensure correct operation and reading performance with accessories.

Computer controlled gas check
Inward and outward gas checks are carried out by way of connecting the gas analyzer to a custom built computer controlled calibration chamber and proprietary software. At the inward stage, two sets of readings are taken - one using the customer's calibration settings and a second set using factory calibration settings. During this process a range of gases are used that span the reading range of the gas analyzer.

Structural and aesthetics check
The instrument is checked for cracks, scratches and broken or missing pieces.

7.2 *Factory Service Facilities*

LANDTEC North America
850 S. Via Lata, Suite 112
Colton, CA 92324
USA
Sales Tel: +1 (800) 821-0496 or +1 (909) 783-3636
Service Tel: 1 (909) 783-3636 x6141
Web: www.LANDTECNA.com

LANDTEC Europe
Formerly Geotechnical Instruments
Sovereign House Queensway
Leamington Spa, Warwickshire CV31 3JR,
England
Tel: +44(0)1926 338111
Web: www.geotech.co.uk

LANDTEC South America
LANDTEC Produtos e Servicos Ambientais Ltda.
Rua Pedroso de Carmargo, 237 - Chácara
Santo Antonio - SP/SP CEP 0417-010
Brazil
Phone: +55(11) 5181-6591
Web: www.landtecbrazil.com.br

7.3 *User Maintenance*

This instrument is designed to be low maintenance and rugged. However, field calibrations are recommended prior to use or when the ambient operating temperature of the instrument changes more than +/- 20 degrees Fahrenheit. See section 2.18 for further information on field calibrations. Additionally, it may be necessary to change the user accessible filters and o-rings from time to time.

There are two user accessible filters, the particulate filter is located in the back of the instrument, see section 1.1 for location, and the water trap filter which is part of the included hose kit. There are four user changeable o-rings, one on the particulate filter cover, one on the outside of the water trap filter housing, one on the inside of the water trap filter housing, and one on the ends of each male quick connect fitting included on the hose kits.

Note: The o-rings on the male quick connect fittings should be routinely checked as dust and dirt from the various wells they connect to can be abrasive. A damaged or leaky o-ring may allow air intrusion into your gas sample. This intrusion of air may not be noticed when calibrating the instrument because the calibration does not occur under vacuum.

BUILDING MONITORING EQUIPMENT

Macurco GAS DETECTION

Macurco™ Combustible Gas Detector

GD-6

Detector, Controller and Transducer

c ETL us LISTED Intertek

Methane, Propane or Hydrogen Gas Detection

The GD-6 is a versatile, easy-to-use device that allows you to select between methane, propane or hydrogen gas detection. Combustible gas detectors will respond to a wide range of hydrocarbons, including aerosol sprays, cleaning solvents, paint thinner and other common volatile organic compounds. This low voltage detector provides automatic feedback and fan or valve control that can help reduce combustible gas concentrations in parking garages, battery rooms, maintenance facilities, and other locations that require combustible gas detection.

Selectable options include:

- Target Gas: Methane (NG), Propane (LP) or Hydrogen (H2)
- Output: Fan relay, Alarm relay and 4-20mA current loop
- Controls: Digital display (0-50% LEL), buzzer, fan delay, fan minimum runtime

Installation

- Mounts on a standard 4" x 4" electrical box
- 5 A SPDT fan relay controls valves, louvers or exhaust fans
- 0.5 A N.O. or N.C alarm relay connects to warning devices or control panels
- 4-20mA current loop - compatible with the Macurco DVP-120 Control Panel
- Factory calibrated

AERIONICS

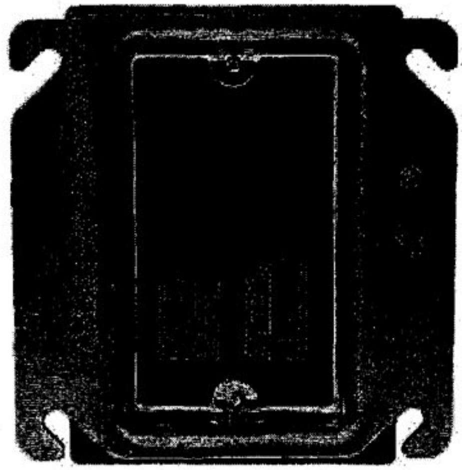
Other Features

- Supervised system design: detector problem will cause the fan & alarm relay to activate
- Optional calibration kit allows the GD-6 to be field tested and calibrated
- ETL Listed to UL 61010-1, CAN/CSA C22.2 No 61010-1

Manufactured by Aerionics, Inc. Sioux Falls, SD – Phone: 1-877-367-7891 – Email [redacted] – www.macurco.com

GD-6 Specifications

- Power: 3 W (max) from 12 to 24 VAC or 12 to 48 VDC
- Current @ 24 VDC: 75 mA in alarm, 50 mA fan relay on and 23 mA stand by
- Shipping Weight: 1 pound (0.45 kg)
- Size: 4 1/2 x 4 x 2 1/8 in. (11.4 X 10.2 X 5.4 cm)
- Color: Dark gray
- Connections: plugs/terminals
- Mounting box: (not included) 4x4 electric
- Fan relay: 5 A, 240 VAC, pilot duty, SPDT, latching or non-latching
- Fan relay actuation: selectable at OFF, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 (default), 11, 12, 13, 14, 15, 16, 17, 18, 19, 20% LEL
- Fan Delay Settings of 0, 1, 3 (default), 5 and 10 minutes
- Fan Minimum Runtime settings are OFF (default), 3, 5, 10 or 15 minutes
- Alarm relay: 0.5A 120 V, 60 VA
- Alarm relay actuation: selectable N.O. default or N.C.
- Alarm relay settings: OFF, 5, 10, 15, 20 (default), 25% LEL
- Current Loop, 4-20 mA for 0-50% LEL
- Operating Environ: 0°F to 125° F (-18°C or above 52°C).10 to 90% RH



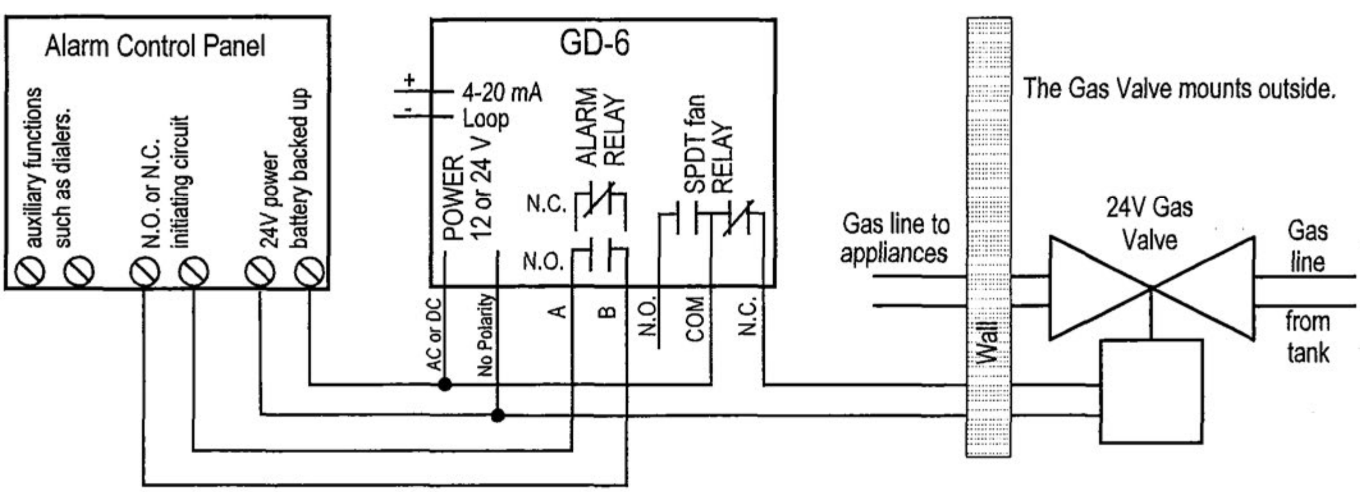
GD-6 Rear View

Location

A GD-6 is usually located in areas where there is potential for gas leaks; where there are gas appliances, areas through which gas pipes pass, where batteries are being stored or charged, etc. DO NOT mount the GD-6 in a corner. DO NOT mount the GD-6 where the normal ambient temperature is below below 0°F or exceeds 125°F (-18°C or above 52°C). If the target gas is lighter than air; natural gas (Methane) or Hydrogen (H2), mount the GD-6 high on a wall or column about one foot down from the ceiling. If the target gas is heavier than air; propane (LP), mount the GD-6 low on a wall or column one foot above the floor. Use the same spacing as for smoke detectors, 30 foot centers, 900 square feet per detector.

TYPICAL CONNECTION OF GD-6

TYPICAL COVERAGE 900 SQUARE FEET



Made in the USA

Made in the U.S.A. with US and imported materials

MACURCO
Gas Detection Experts

Onboard Diagnostics

The GD-6 monitors all critical functions of the unit through software diagnostics that continuously test and verify unit operations. If a problem is found, the unit will switch to a fail-safe/error mode or trouble condition. In this error mode, the Fan and Alarm relays will be activated, the 4-20 mA current loop will go to 24 mA, the unit will display the error code and the buzzer will chirp intermittently. This is a safety precaution. To clear this mode, simply turn off power to the unit for a few seconds, or push the TEST switch (inside the unit). This will cause the unit to restart the 1 minute self-test cycle.

The 4-20 mA signal can be used for troubleshooting:

- 0 mA is most likely a connection problem
- 4-20 mA is normal gas reading range (0-50% LEL)
- 24 mA indicates a Trouble condition

Error Codes

t01	Sensor is missing
t04	Bad EEPROM checksum
t08	Sensor is shorted
t10	Bad EEPROM
t20	Bad calibration
t40	Factory calibration was not done
t80	ADC reading failed
t100	Under range sensor
t200	Sensor expired

NOTE: For trouble codes over 080 the display will alternate between t_1 and t00 for t100 and between t_2 and t00 for t200.

If the error mode repeats frequently, check for continuous power and proper voltage. If power is not the problem and a unit has repeating error conditions, it may need to be returned to Macurco for service, per these User Instructions.

If the error mode indicates "Sensor expired" see the Sensor Life Reset section of these User Instructions.

Sensor Poisons

The gas sensor in the detector is designed with extreme sensitivity to the environment. As a result, the sensing function may be deteriorated if it is exposed to a direct spray from aerosols such as paints, silicone vapors, etc., or to a high density of corrosive gases (such as hydrogen sulfide, sulfur dioxide) for an extended period of time.

MAINTENANCE

The GD-6 does not require regular maintenance other than cleaning. The unit uses a long life pellistor sensor that has a 5+ year life expectancy. All maintenance and repair of products manufactured by Macurco are to be performed at the appropriate Macurco manufacturing facility. Macurco does not sanction any third-party repair facilities.

General

All GD-6 units are factory calibrated and 100% tested for proper operation. The unit also performs a regular automatic self-test during normal operation. If the unit detects an improper voltage or inoperable component, it will default into Error mode. In this error mode, the Fan and Alarm relays will be activated, the 4-20 mA output will go to 24 mA, the unit will display the error code and the buzzer will chirp intermittently.

Operation Test

Normally this will be the only test required for the GD-6 and is the recommended way to test the unit or units after installation. Check that the green GD-6 operating LED light is illuminated continuously. If not, do not proceed with the tests. If the unit is in error mode contact your local representative or Macurco technical service representative for information on resolving the problem.

1. Remove the single screw in the middle of the front cover of the GD-6.
2. Remove the front cover.
3. Observe the LED light on the front of the GD-6.
4. If the light is solid green proceed to step 6.
5. If the light is off or flashing Green, refer to the General section above.
6. Locate the switch labeled ENTER/TEST on the left side of the printed circuit board. Press the Test switch once.
7. The GD-6 will step through a cycle test:
   a. The display progresses through the BUZ (Buzzer Test) Art (alarm relay test), Frt (fan relay test) then 42t (4-20 mA output test). Make sure that the settings are "on" or not disabled "diS".
   b. During the first 10 seconds of the test cycle, the display will show BUZ and set off the audible buzzer
   c. The alarm relay will be closed, so any devices connected to that relay will be tested.
   d. The Fan relay will be activated for the next 1 minute of the test, so if the fan circuits are wired in the normal manner, the fan should run.
   e. The 4-20mA output will then ramp up from 4 to 16 mA over the next 130 seconds of the test, so if the circuit is wired in the normal manner, the control panel or building automation system should respond.
   f. At the end of the test cycle, the light will turn green and be on steady (Normal Operation), the fan & alarm relay will be in standby mode and the 4-20 mA output will return to 4 mA (in clean air).
8. When testing is completed reassemble the unit or units.

Manual Operation Test

This option gives the user the opportunity to manually initiate an individual test for each relay, the analog output and the sensor response to gas. From normal operation mode press the Next button 3 times to get to the Test Mode (tSt). Press the Enter button once to get into the Test Menu. Press the Next button to scroll through the four test options and press Enter to initiate the selected test. Note that if the relay or 4–20 mA output has been disabled, the test selection will not be displayed in the test menu.

Art - Alarm Relay Test, 10 seconds

Frt - Fan Relay Test, 60 seconds

42t - 420 loop test, 25 seconds

gtS - Gas Test, 3 minutes (no output to the panel during the gas test)

Macurco™ Combustible Gas Detector, Field Calibration Kit GD6-FCK

General
The GD-6 can be bump-tested or calibrated with the GD6-FCK with Methane, Propane or Hydrogen gas, regulator and test hood, available through your local representative or from Macurco.

Contents of the FCK
- GDM-FCK: Two Gas Cylinders, 10% LEL Methane gas in air, 20% LEL Methane in air, Gas regulator with two feet of plastic tubing, Humidifier and Gas test hood
- GDP-FCK: Two Gas Cylinders, 10% LEL Propane gas in air, 20% LEL Propane in air, Gas regulator with two feet of plastic tubing, Humidifier and Gas test hood
- GDH-FCK: Two Gas Cylinders, 10% LEL Hydrogen gas in air, 20% LEL Hydrogen in air, Gas regulator with two feet of plastic tubing, Humidifier and Gas test hood

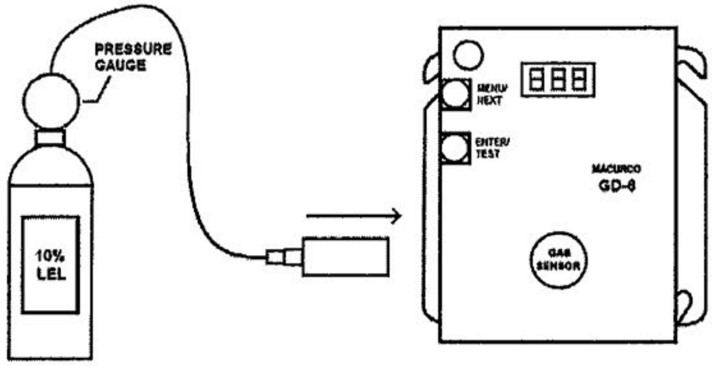
FCK Information
Several detectors can be calibrated with one FCK. The only limitation is the amount of gas in the cylinder. The 17 liter cylinder with 0.2 LPM (Liters Per Minute) regulator has approximately 85 minutes of continuous calibration run time. Replacement cylinders are available. The gas cylinder should be replaced when the pressure gauge on the regulator shows 25-psi or less.

Note: For optimum test results it is suggested that the unit be in clean air (green light on) and be in a low ambient air flow

Gas Testing

Testing the Fan Relay

Note: The gas concentration to activate the fan relay depends on the setting.
1. Remove the Philips screw on the front of the GD-6. Remove the front cover.
2. Connect the 10% LEL cylinder of Combustible Gas to the regulator. Ensure that the gas used for calibration matches the gas selected in the GD-6 configuration.
3. Assemble regulator, hose and test hood and place the test hood over the gas sensor.
4. Check the pressure gauge on the regulator. If you have 25-psi or less you will need to replace the gas canister.
   Note: The time to activate the fan relay depends on the delay setting.



5. Turn on the regulator to start the gas flow and wait with the gas applied continuously.
6. With the display function turned "On", the GD-6 will show the current concentration of gas or "0" (zero) in clean air. When the gas concentration reaches the fan relay setting (5% LEL, for example) the display will flash back and forth between "FAn" and "5". With the display function turned "Off", the display does not show the gas concentration, but will show "FAn" as long as the fan relay is activated.

   Note: If the Fan relay does not close within 2 minutes, consider these possibilities:
   a. Gas cylinder is empty, check the pressure gauge. Replace the gas cylinder if 25-psi or less.
   b. Unit needs to be re-calibrated (go through recalibration and re-test).
   c. Detector is in need of servicing (return unit to factory for servicing).
   d. Detector has fan relay set to disable (OFF) or 20% LEL. Set fan relay to 5% LEL and repeat the test.
7. Remove the gas from the sensor. Proceed to test the alarm relay or replace the top cover.

Testing the Alarm Relay

Note: The gas concentration to activate the Alarm relay depends on the setting.
Connect the 20% LEL cylinder of Combustible Gas to the regulator. Ensure that the gas used for calibration matches the gas selected in the GD-6 configuration.
1. Check the pressure gauge. If there is 25-psi or less the cylinder should be replaced.
2. Place the test hood over the gas sensor. Turn on the regulator to start the gas flow.
3. The Fan relay should activate according to the settings.
4. With the display function turned "On" and the gas concentration reaching the Alarm Relay setting, (20% LEL, for example) the display will flash back and forth between "ALr" and "20". The buzzer will sound indicating "Alarm" if the buzzer is turned "On". With the display function turned off the display does not show the gas concentration, but will show "ALr" when the Alarm relay is activated.
5. **Note: If the Alarm relay fails to operate within 2 minutes, consider these possibilities:**
   a. Gas cylinder is empty, check the pressure gauge. Replace the gas cylinder if 25-psi or less.
   b. Unit needs to be re-calibrated (go through recalibration and re-test).
   c. Detector is in need of servicing (return unit to factory for servicing).
   d. Detector has Alarm relay set to disable (OFF). Set Alarm relay to 20% LEL and repeat the test.
6. Remove the gas from the sensor after test. Proceed to test the 4-20 mA output or replace the top cover.

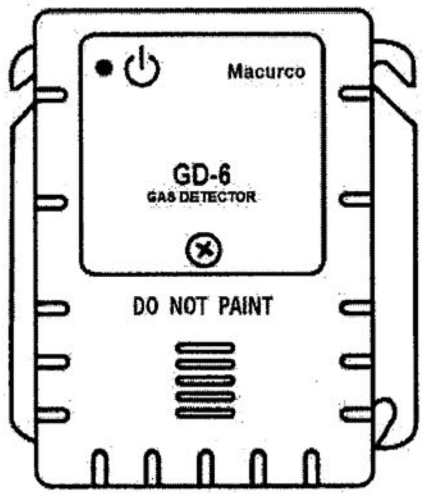
Testing the 4-20 mA current loop

Connect the 20% LEL cylinder of Combustible Gas to the regulator. Ensure that the gas used for calibration matches the gas selected in the GD-6 configuration.
1. Check the pressure gauge. If there is 25-psi or less the cylinder should be replaced.
2. Place the test hood from the regulator over the gas sensor. Turn on the regulator to start the gas flow.
3. The fan relay should activate according to the settings.
4. The alarm relay should activate according to the settings.
5. The 4-20 mA output should ramp up from 4mA in clean air to 20 mA at 50% LEL. See 4-20 mA diagram in these *User Instructions*.
   Note: If the 4-20mA output does not ramp up within 2 minutes, consider these possibilities:
   a. Gas cylinder is empty, check the pressure gauge. Replace the gas cylinder if 25-psi or less.
   b. Unit needs to be re-calibrated (go through recalibration and re-test).
   c. Detector is in need of servicing (return unit to factory for servicing).
   d. Detector has 4-20 mA option set to "OFF". Set 4-20 mA option to "On" and repeat the test.
6. Remove the gas from the sensor. Re-assemble the GD-6 (make sure the LED is aligned with the hole on the front of the case).

Quick Gas Test

A cigarette lighter can be used to perform a functionality test of the GD-6. This test allows installers to do a quick functionality test of the gas sensor.

1. Units to be tested must be powered continuously for a minimum of 3 minutes before proceeding.
2. For optimum test results, the unit should be in clean air and be in a low ambient air flow.
3. Check that the GD-6 status indicator light is illuminated, green continuously. If not, do not proceed with tests. See GD-6 *Trouble Indicator* section in these *User Instructions*.
4. The display option should be set to "On" and reading 0% LEL in clean air.
5. Aim the lighter into the sensor grate area (under "DO NOT PAINT") on the front cover and release the gas without igniting the flame for 2 to 3 seconds.



6. Wait for a few seconds. The digital display should climb indicating the increased gas concentration at the sensor confirming a pass of the quick test.

   Note: If the Display does not change within 10 seconds, consider these possibilities:

   a. Lighter is empty.
   b. Unit needs to be re-calibrated (go through the *Field Calibration Procedure* in these *User Instructions* and re-test).
   c. Detector is in need of servicing (return unit to factory for servicing).
7. Wait for the display to return to 0% LEL and configure options to desired settings.

FIELD CALIBRATION PROCEDURE
Note: For optimum calibration results the unit should be in clean air and be in a low ambient air flow.

Zero the Sensor
1. Remove the Philips screw on the front of the GD-6. Pull the front cover of the unit off.
2. To select Calibration Zero Mode (**000**), from normal mode, press the ***Next*** button four times to get to **CAL or Cal**ibration Mode.
3. Then press the ***Enter*** button to get to "**000**" **-** Calibration Zero Mode.
4. Press the ***Enter*** button and the display will read **0** alternating with **000** (blinking) indicating zero calibration in progress (max 165 sec).
5. If the process is successful, the display will read __**0** alternating with **PAS** (blinking) Zero Calibration complete.
6. If the process was not successful the display will read __**1** alternating with **Fail** (blinking) Zero Failed. If this occurs, repeat steps 2 through 4. If the sensor fails to zero twice contact Technical Assistance: 1-877-367-7891.
7. To return to Normal Mode press ***Enter*** and then press ***Next*** until "End" is displayed. Press ***Enter*** to return to Normal Mode.

Calibration

1. Remove the Philips screw on the front of the GD-6. Pull the front cover of the unit off.
2. Assemble the 10% LEL gas cylinder and regulator together. Ensure that the gas used for calibration matches the gas that the GD-6 is configured to (**mE, Pro or Hy**).
3. Check the pressure gauge on the regulator. If you have 25-psi or less you will need to replace the gas canister.
4. Place the test Hood from the regulator over the gas sensor.
5. To select Calibration Span Mode (**SPn**), from normal mode, press the ***Next*** button four times to get to **CAL** or Calibration Mode.
6. Then press the ***Enter*** button to get to **"000"** Calibration Zero Mode, then press the ***Next*** button to get to **"SPn" –** Calibration Span Mode.
7. Press the ***Enter*** button and the display will read **10** alternating with the gas, **mE, Pro or Hy** (blinking), indicating the sensor is looking for gas.
8. Start applying gas to the gas sensor.
   Note: The sensor will look for the gas for 45 seconds. If no gas is applied or detected in that time, the display will return to CAL.
9. When the sensor detects the gas, the display will flash back and forth between the **gas concentration** and **SPn** and the calibration will progress. The display will show this for a maximum of 165 seconds.
10. When the calibration is successful, the display will flash back and forth between **10** and **PAS.**
11. Remove the gas. The display will return to "**SPn**", then normal mode. The calibration is done.
12. If the calibration fails, the display will flash back and forth between the gas concentration and **FAL** (fail). If this occurs, check the pressure gauge on the regulator. If the pressure is less than 25-psi the flow of gas may not be adequate to properly calibrate the unit. If there is proper pressure in the cylinder repeat steps 4 through 11. If the unit fails to calibrate twice contact Macurco Technical Assistance at 1-877-367-7891.
13. Disassemble the cylinder and regulator.
14. Re-assemble the GD-6 (make sure the LED is aligned with the hole in the front case).

MACURCO FIXED GAS DETECTION PRODUCTS LIMITED WARRANTY

Macurco, warrants the field test kits will be free from defective materials and workmanship for a period of one (1) years from date of manufacture (indicated on the gas bottle label), provided it is maintained and used in accordance with Macurco instructions and/or recommendations. If any component becomes defective during the warranty period, it will be replaced or repaired free of charge, if the unit is returned in accordance with the instructions below. This warranty does not apply to units that have been altered or had repair attempted, or that have been subjected to abuse, accidental or otherwise. The above warranty is in lieu of all other express warranties, obligations or liabilities. THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE ARE LIMITED TO A PERIOD OF ONE (1) YEARS FROM THE PURCHASE DATE. Macurco shall not be liable for any incidental or consequential damages for breach of this or any other warranty, express or implied, arising out of or related to the use of said gas detector. Manufacturer or its agent's liability shall be limited to replacement or repair as set forth above. Buyer's sole and exclusive remedies are return of the goods and repayment of the price, or repair and replacement of non-conforming goods or parts.

Manufactured by Aerionics, Inc.
Round Rock, Texas
[redacted]
Phone: 1-877-367-7891
Rev 4.10.2012

MACURCO
Gas Detection Experts

APPENDIX III I-F

LANDFILL GAS COLLECTION AND CONTROL SYSTEM PLAN

STATE OF TEXAS
COLIN G. McINNES
115872
LICENSED
PROFESSIONAL ENGINEER
5/29/2024

Includes Figures III I-F-1 through III I-F-6

LEGEND

- PERMIT BOUNDARY
- PROPOSED LIMIT OF WASTE
- E 10500 — SITE GRID
- 610 — EXISTING CONTOUR (SEE NOTE 1)
- GP-1 — EXISTING GAS PROBE
- TV-1 — EXISTING TRENCH VENT
- GP-18 — PROPOSED GAS PROBE
- EW-10 — EXISTING LFG EXTRACTION WELL
- PROPOSED LFG EXTRACTION WELL
- PROPOSED LFG COLLECTION PIPING
- PROPOSED CONDENSATE SUMP
- PROPOSED ISOLATION VALVE
- PROPOSED AIR SUPPLY LINE
- PROPOSED CONDENSATE FORCEMAIN
- PROPOSED AIR/FORCEMAIN VALVE

NOTES:

1. EXISTING CONTOURS DEVELOPED BY FIRMATEK FROM AERIAL PHOTOGRAPHY FLOWN NOVEMBER 10, 2022.
2. LOCATIONS SHOWN FOR THE PROPOSED LFG EXTRACTION WELLS, COLLECTION PIPING, SUMPS, VALVES, AND ASSOCIATED LFG SYSTEM COMPONENTS ARE APPROXIMATE. ACTUAL NUMBERS, LOCATIONS, AND PIPING CONFIGURATION TO BE DETERMINED BASED ON THE FIELD CONDITIONS AT THE TIME OF INSTALLATION.
3. LOCATION OF THE PROPOSED FLARE FACILITY IS APPROXIMATE. ADDITIONAL LFG CONTROL EQUIPMENT MAY BE INSTALLED IN THE FUTURE WHEN APPROPRIATE TO HANDLE ADDITIONAL LFG EXTRACTED BY THE GCCS. INTERIM FLARE(S) MAY BE INSTALLED AT VARIOUS SITE LOCATIONS AS NEEDED.
4. PROPOSED LFG SYSTEM COMPONENTS WILL BE INSTALLED IN PHASES AS NEEDED.

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5/29/2024

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DATE: 05/2024
FILE: 0120-076-11
CAD: III I-F-1 GCCS COMPLETION PLAN.DWG

DRAWN BY: VRS
DESIGN BY: LKS
REVIEWED BY: CAM

PREPARED FOR
PINE HILL FARMS LANDFILL TX, LP

REVISIONS		
NO.	DATE	DESCRIPTION

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MAJOR PERMIT AMENDMENT GCCS COMPLETION PLAN

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS

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FIGURE III I-F-1

O:\0120\76\EXPANSION 2023\PART III\III\III I-F-1_GCCS COMPLETION PLAN.dwg, byoung, 1:2

N

0 200 400
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- PERMITTED LIMIT OF WASTE
- PROPOSED LIMIT OF WASTE
- E 10500 — SITE GRID
- 610 — EXISTING CONTOUR (SEE NOTE 1)
- MW-10 EXISTING GROUNDWATER MONITORING WELL
- GP-1 EXISTING GAS PROBE
- TV-1 EXISTING TRENCH VENT
- EW-1 EXISTING LFG EXTRACTION WELL
- SF-1 EXISTING SOLAR FLARE
- EXISTING LFG COLLECTION PIPING

NOTE:

1. EXISTING CONTOURS DEVELOPED BY FIRMATEK FROM AERIAL PHOTOGRAPHY FLOWN NOVEMBER 10, 2022.

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DATE: 05/2024
FILE: 0120-076-11
CAD: III I-F-2 EXISTING GCCS LAYOUT.DWG

DRAWN BY: VRS
DESIGN BY: LKS
REVIEWED BY: CAM

Weaver Consultants Group
TBPE REGISTRATION NO. F-3727

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PINE HILL FARMS LANDFILL TX, LP

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
EXISTING GCCS LAYOUT

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS

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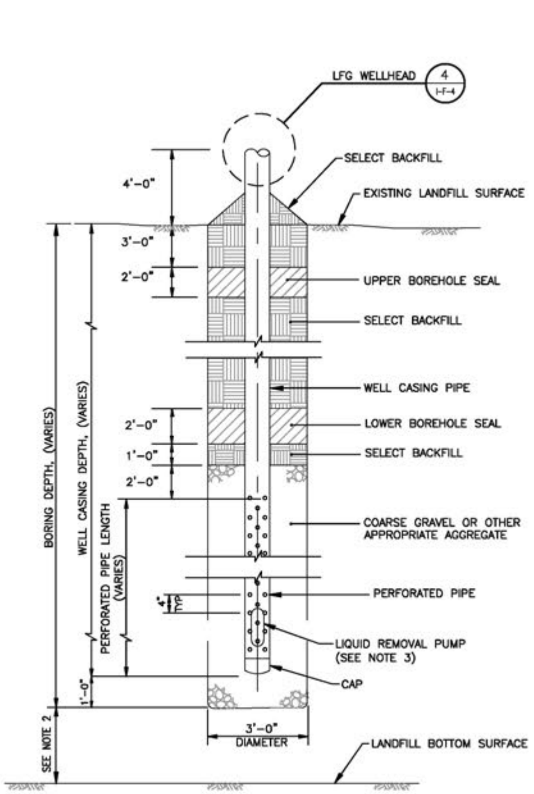
FIGURE III I-F-2

O:\0120\76\EXPANSION 2023\PART III\III I-F-2_EXISTING GCCS LAYOUT.dwg, byoung, 1:2

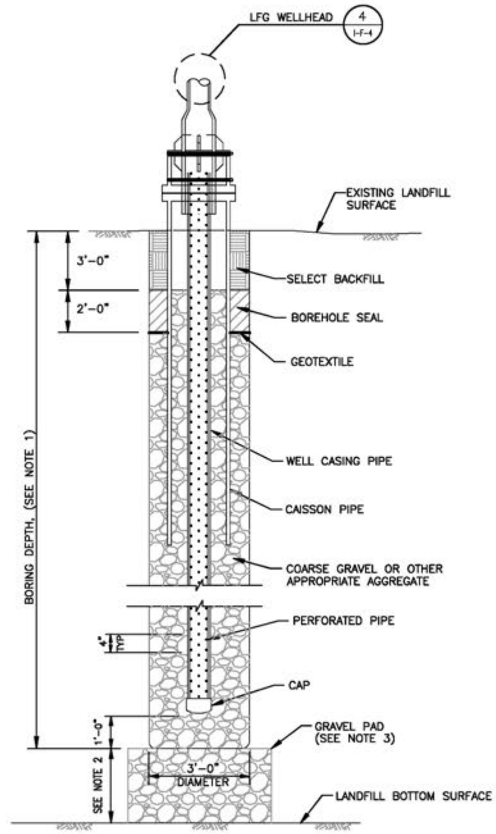


LFG EXTRACTION WELL (1, I-F-3)

(INTERIM COVER)
NTS

NOTES:

1. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.
2. BOTTOM OF BORE HOLE TO BE A MINIMUM OF 10 FT FROM LANDFILL REPORTED BOTTOM SURFACE. ALL DEPTHS WILL BE CONFIRMED PRIOR TO DRILLING.
3. PUMPS MAY BE INSTALLED AS NEEDED.

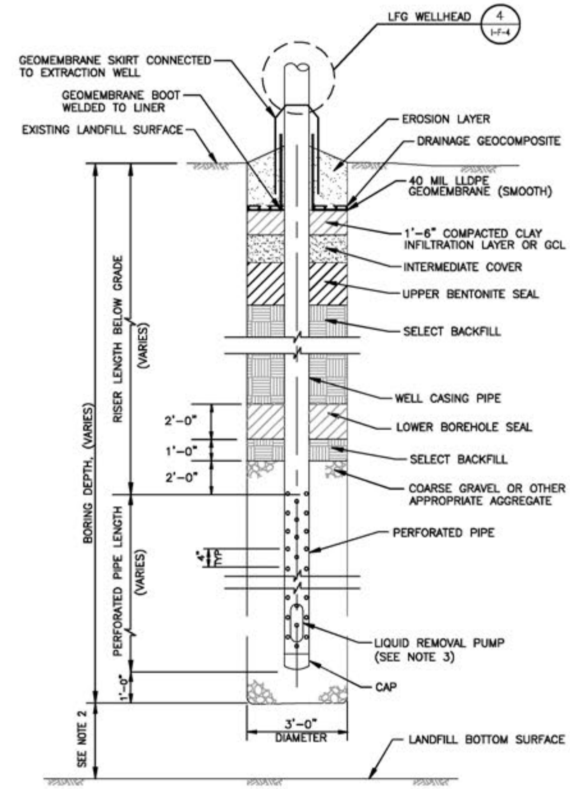


LFG CAISSON WELL (2, I-F-3)

NTS

NOTES:

1. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.
2. BOTTOM OF BORE HOLE TO BE A MINIMUM OF 10 FT FROM LANDFILL REPORTED BOTTOM SURFACE. ALL DEPTHS WILL BE CONFIRMED PRIOR TO DRILLING.
3. FOR BOTTOM-UP CAISSON WELLS INSTALLED TO THE BOTTOM LINER SYSTEM A GRAVEL PAD WILL BE PLACED AS SHOWN ABOVE.
4. LFG CAISSON WELL MAY BE INSTALLED IN LANDFILL AREA RECEIVING ADDITIONAL WASTE.



LFG EXTRACTION WELL (3, I-F-3)

(IN FINAL COVER)
NTS

NOTES:

1. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.
2. BOTTOM OF BORE HOLE TO BE A MINIMUM OF 10 FT FROM LANDFILL REPORTED BOTTOM SURFACE. ALL DEPTHS WILL BE CONFIRMED PRIOR TO DRILLING.
3. PUMPS MAY BE INSTALLED AS NEEDED.
4. GEOMEMBRANE BOOT AND SKIRT ONLY APPLICABLE IN LANDFILL AREAS WITH GEOMEMBRANE FINAL CAP.

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DATE: 05/2024
FILE: 0120-076-11
CAD: III I-F-3 WELL DETAILS.DWG
DRAWN BY: VRS
DESIGN BY: LKS
REVIEWED BY: CAM

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EXTRACTION WELL DETAILS

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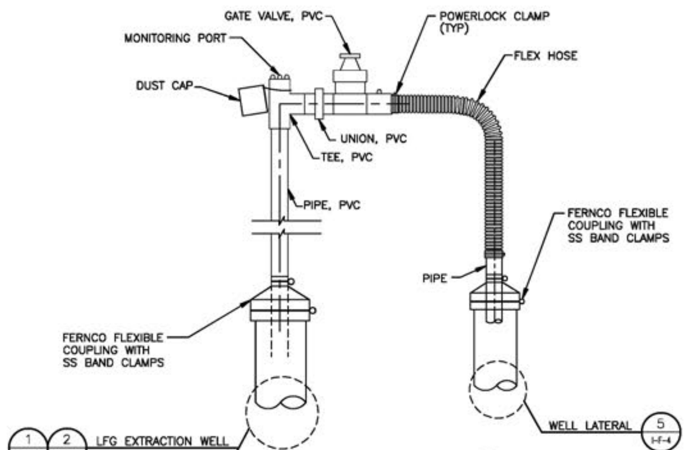
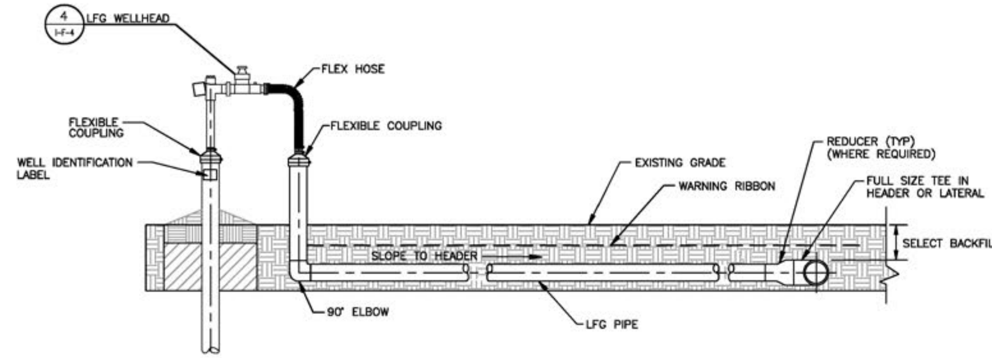
FIGURE III I-F-3

0:\0120\76\EXPANSION 2023\PART III\III\III I-F-3 EXTRACTION WELL DETAILS.dwg, byoung, 1:2



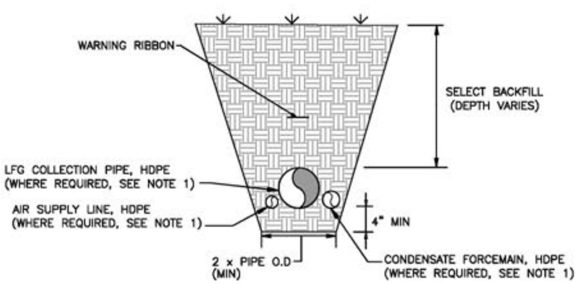
LFG WELLHEAD 4 I-F-4
NTS

NOTES:
1. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.
2. EXACT WELLHEAD CONFIGURATION DEPENDS ON MANUFACTURER.



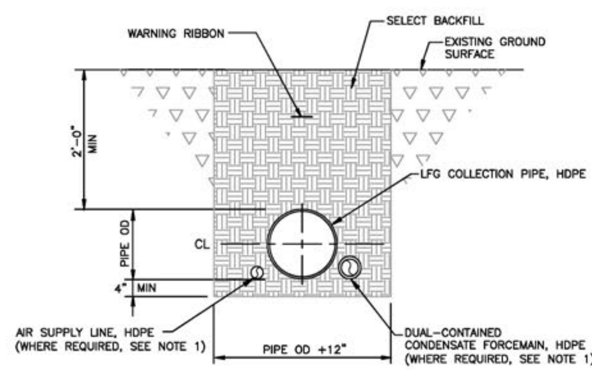
WELL LATERAL 5 I-F-4
NTS

NOTES:
1. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.
2. THIS DETAIL REPRESENTS TYPICAL WELL LATERAL INSTALLED WITHOUT OR ABOVE FINAL COVER. SHOULD THE WELL LATERAL BE INSTALLED BELOW THE FINAL COVER WITH GEOMEMBRANE; A GEOMEMBRANE SKIRT COMPONENT WILL BE ADDED.



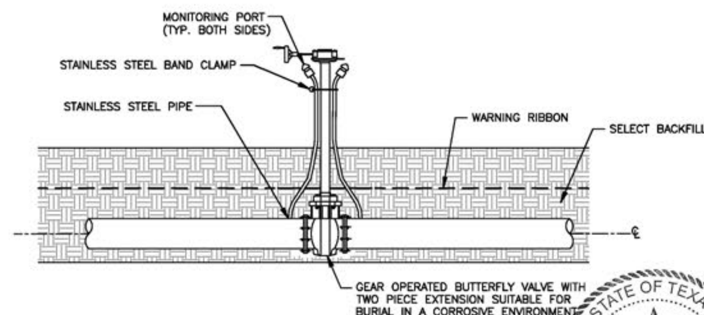
PIPE TRENCH 6 I-F-4
(INSIDE LIMITS OF WASTE)
NTS

NOTES:
1. THE NUMBER OF PIPES IN THE PIPE TRENCH VARIES.
2. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.



PIPE TRENCH 7 I-F-4
(OUTSIDE LIMITS OF WASTE)
NTS

NOTES:
1. THE NUMBER OF PIPES IN THE PIPE TRENCH VARIES.
2. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.



LFG ISOLATION VALVE 8 I-F-4
NTS

NOTES:
1. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.
2. THIS DETAIL REPRESENTS TYPICAL LFG ISOLATION VALVE INSTALLED WITHOUT OR ABOVE FINAL COVER. SHOULD THE LFG ISOLATION VALVE BE INSTALLED BELOW THE FINAL COVER WITH GEOMEMBRANE; A GEOMEMBRANE SKIRT COMPONENT WILL BE ADDED.

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PIPING DETAILS

DATE: 05/2024
FILE: 0120-076-11
CAD: III I-F-4 DETAILS.DWG

DRAWN BY: VRS
DESIGN BY: LKS
REVIEWED BY: CAM

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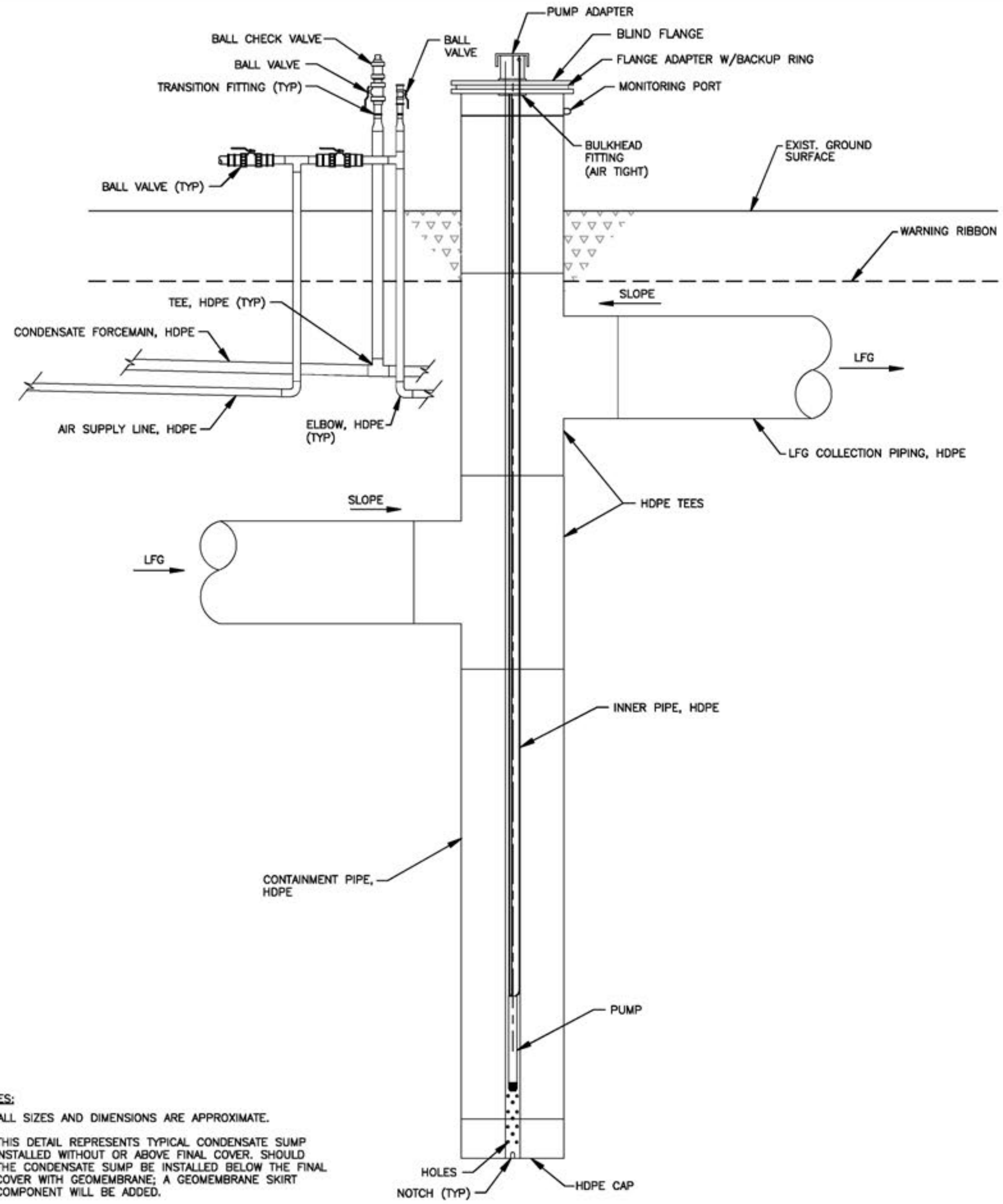
FIGURE III I-F-4

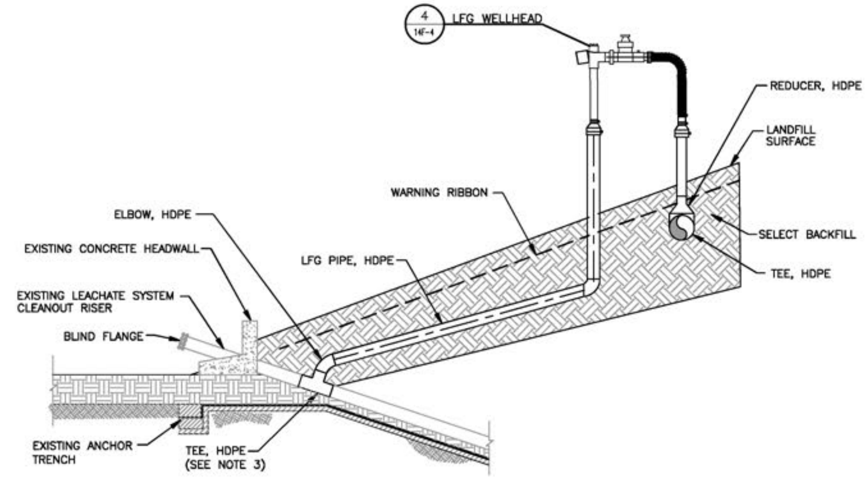
0:\0120\76\EXPANSION 2023\PART III\III\III I-F-4 PIPING DETAILS.dwg, byoung, 1:2



CONDENSATE SUMP 9 I-F-5
NTS

NOTES:

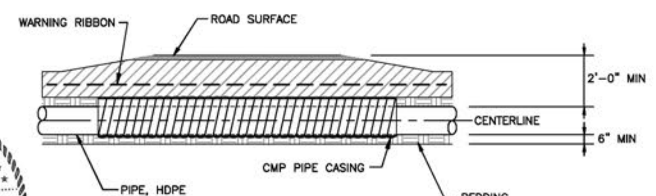
1. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.
2. THIS DETAIL REPRESENTS TYPICAL CONDENSATE SUMP INSTALLED WITHOUT OR ABOVE FINAL COVER. SHOULD THE CONDENSATE SUMP BE INSTALLED BELOW THE FINAL COVER WITH GEOMEMBRANE; A GEOMEMBRANE SKIRT COMPONENT WILL BE ADDED.



LFG PIPING TO LCR CONNECTION 10 I-F-5
NTS

NOTES:

1. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.
2. THIS DETAIL REPRESENTS TYPICAL LFG PIPING TO LCR CONNECTION INSTALLED WITHOUT OR ABOVE FINAL COVER. SHOULD THE LFG PIPING TO LCR CONNECTION BE INSTALLED BELOW THE FINAL COVER WITH GEOMEMBRANE; A GEOMEMBRANE SKIRT COMPONENT WILL BE ADDED.
3. THE ELEVATION OF THE EXISTING LINER SYSTEM WILL BE VERIFIED PRIOR TO CONSTRUCTION. THE VERIFICATION PROCESS WILL INCLUDE THE REVIEW OF EXISTING AS-BUILT LINER CERTIFICATION INFORMATION.



ROAD CROSSING 11 I-F-5
NTS

NOTE:

1. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.

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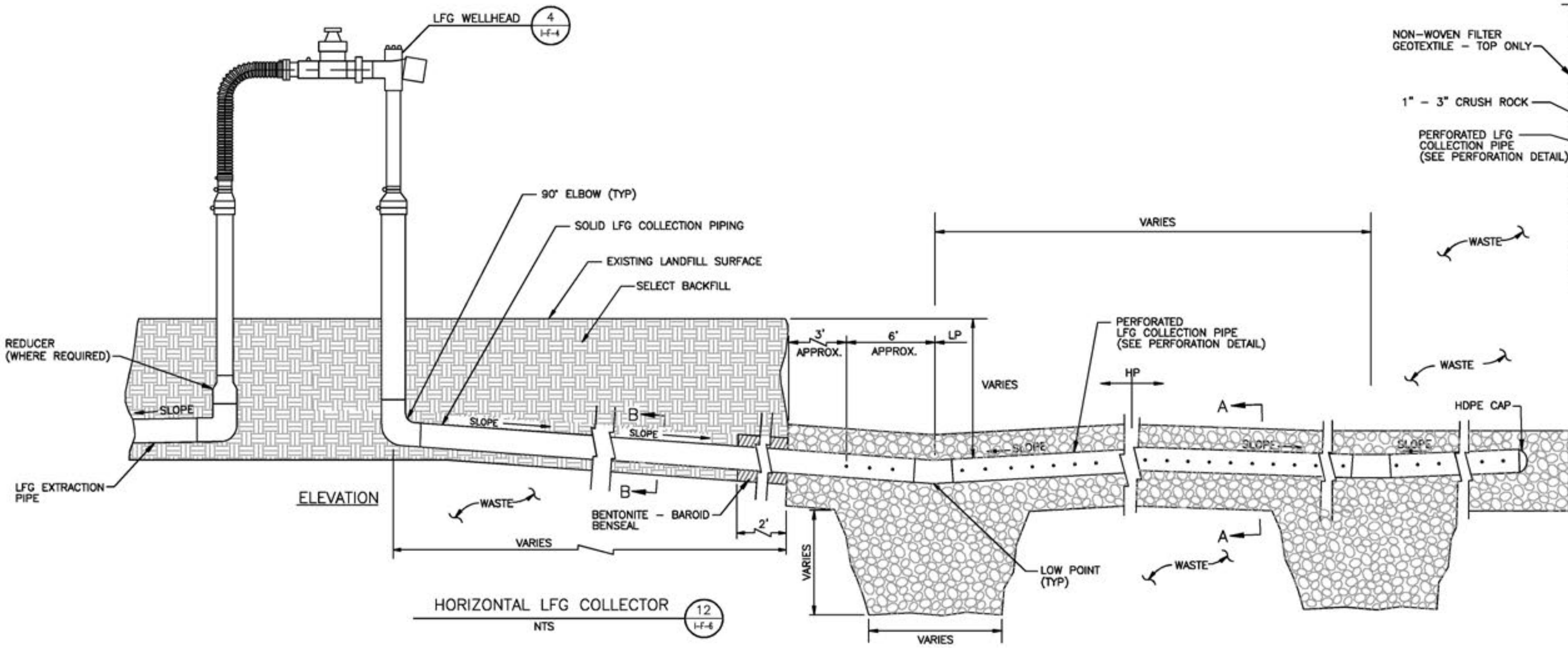
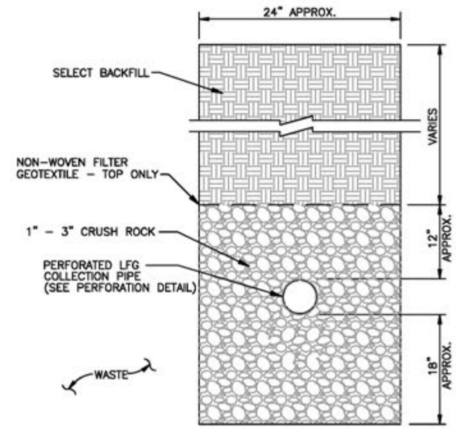
DATE: 05/2024 FILE: 0120-076-11 CAD: III I-F-5 DETAILS.DWG DRAWN BY: VRS DESIGN BY: LKS REVIEWED BY: CAM	REVISIONS NO. | DATE | DESCRIPTION	ROYAL OAKS LANDFILL CHEROKEE COUNTY, TEXAS
Weaver Consultants Group TBPE REGISTRATION NO. F-3727		WWW.WCGRP.COM | FIGURE III I-F-5



HORIZONTAL LFG COLLECTOR

NTS

12 I-F-6



SECTION A–A

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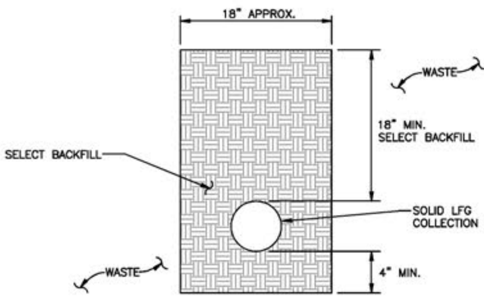

SECTION B–B

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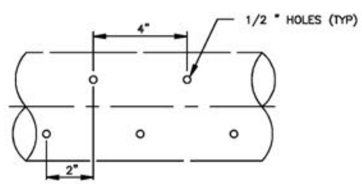

LFG COLLECTION PIPE PERFORATION DETAIL

NTS

NOTES:

1. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.
2. HORIZONTAL LFG COLLECTORS MAY BE USED FOR INTERIM GAS CONTROL.

STATE OF TEXAS
COLIN G. McINNES
115872
LICENSED PROFESSIONAL ENGINEER
5/29/2024

☐ DRAFT ☒ FOR PERMITTING PURPOSES ONLY ☐ ISSUED FOR CONSTRUCTION	PREPARED FOR PINE HILL FARMS LANDFILL TX, LP	MAJOR PERMIT AMENDMENT HORIZONTAL LFG COLLECTOR DETAILS
DATE: 05/2024 DRAWN BY: VRS FILE: 0120-076-11 DESIGN BY: LKS CAD: III I-F-6 DETAILS.DWG REVIEWED BY: CAM	REVISIONS NO. DATE DESCRIPTION	ROYAL OAKS LANDFILL CHEROKEE COUNTY, TEXAS
Weaver Consultants Group TBPE REGISTRATION NO. F-3727		WWW.WCGRP.COM FIGURE III I-F-6

APPENDIX III I-G

LFG GENERATION MODEL

Includes pages III I-G-1 through III I-G-3

LANDFILL GAS GENERATION MODEL

Table 14-G-1 presents the results of an LFG generation rate estimate prepared for the Royal Oaks Landfill. The estimate was generated using the U.S. Environmental Protection Agency (EPA) Landfill Gas Emission Model (LandGEM), Version 3.02. The modeling results reflect the estimated waste quantities accepted over the operating life of the site, including the proposed landfill expansion.

The gas generation established by the EPA in AP-42, Compilation of Air Pollutant Emission Factors, recommends a methane generation potential (L_o) of 100 cubic meters per megagram of solid waste, and a methane generation constant (k) of 0.04 year^{-1}. For converting methane to LFG, a methane content of 50 percent was assumed.

The results suggest the LFG generation rate will continue to increase with time as more waste is placed in the landfill. Based on LandGEM model results and using the site life calculations, the peak LFG generation is expected to be achieved in year 2041 with a maximum generation rate of approximately 1,665 standard cubic feet per minute.

Table III I-G-1
Estimated Landfill Gas Generation Rate
Royal Oaks Landfill

Year	Waste Acceptance (Mg/yr)	Waste In Place (Mg)	Landfill Gas Generation (scfm)
1984	6,645	0	0
1985	6,645	6,645	4
1986	6,645	13,290	7
1987	6,645	19,934	10
1988	6,645	26,579	13
1989	31,150	33,224	16
1990	40,113	64,374	32
1991	41,186	104,487	52
1992	46,258	145,673	72
1993	66,412	191,931	93
1994	49,795	258,343	125
1995	67,842	308,138	146
1996	85,889	375,980	176
1997	83,357	461,869	215
1998	66,350	545,226	250
1999	86,664	611,576	275
2000	86,480	698,240	310
2001	56,082	784,720	344
2002	55,007	840,802	360
2003	72,017	895,809	375
2004	79,263	967,826	398
2005	85,192	1,047,089	424
2006	84,636	1,132,281	453
2007	84,847	1,216,917	480
2008	77,851	1,301,764	506
2009	72,490	1,379,615	527
2010	65,790	1,452,105	545
2011	57,801	1,517,895	558
2012	56,479	1,575,696	567
2013	69,060	1,632,175	574
2014	79,491	1,701,235	588
2015	95,281	1,780,726	607
2016	92,409	1,876,007	634
2017	97,200	1,968,416	658
2018	114,098	2,065,616	683
2019	118,838	2,179,714	717
2020	123,380	2,298,552	751
2021	158,053	2,421,932	787
2022	163,684	2,579,985	839
2023	163,610	2,743,669	893
2024	165,107	2,907,279	944
2025	166,618	3,072,385	994
2026	168,142	3,239,003	1,043
2027	169,681	3,407,145	1,091
2028	171,233	3,576,825	1,138

Table III I-G-1
Estimated Landfill Gas Generation Rate
Royal Oaks Landfill

Year	Waste Acceptance (Mg/yr)	Waste In Place (Mg)	Landfill Gas Generation (scfm)
2029	172,800	3,748,059	1,184
2030	174,381	3,920,859	1,229
2031	175,808	4,095,240	1,273
2032	177,247	4,271,048	1,315
2033	178,697	4,448,295	1,357
2034	180,160	4,626,992	1,399
2035	181,634	4,807,151	1,439
2036	183,120	4,988,785	1,478
2037	184,619	5,171,905	1,517
2038	186,129	5,356,524	1,555
2039	187,652	5,542,653	1,592
2040	189,188	5,730,306	1,629
2041	58,754	5,919,494	**1,665**
2042	0	5,978,248	1,631
2043	0	5,978,248	1,567
2044	0	5,978,248	1,505
2045	0	5,978,248	1,446
2046	0	5,978,248	1,390
2047	0	5,978,248	1,335
2048	0	5,978,248	1,283
2049	0	5,978,248	1,232
2050	0	5,978,248	1,184
2051	0	5,978,248	1,138

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1614B

MAJOR PERMIT AMENDMENT APPLICATION

PART III – SITE DEVELOPMENT PLAN
APPENDIX IIIJ
CLOSURE PLAN

Prepared for

Pine Hill Farms Landfill TX, LP

May 2024

STATE OF TEXAS
DAVID E. POE
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05/20/2024

Prepared by

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6420 Southwest Blvd., Suite 206
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WCG Project No. 0120-076-11-106

This document is intended for permitting purposes only.

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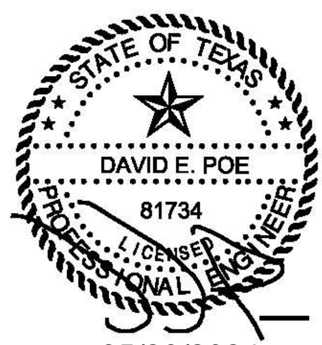


05/20/2024

APPENDIX IIIJ-A
Final Cover System Quality Control Plan

APPENDIX IIIJ-B
GCL Alternative Final Cover Demonstration

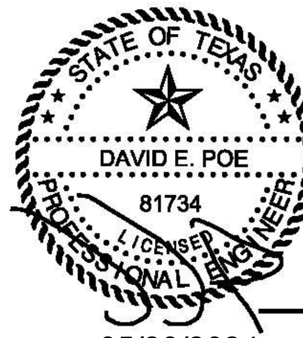
APPENDIX IIIJ-C
Closure Plan for Municipal Solid Waste Type I Landfill Units and
Final Facility Closure (Form 20720)

FIGURES

Figures

Figure IIIJ-1 – Landfill Completion Plan

Figure IIIJ-2 – Final Closure Schedule

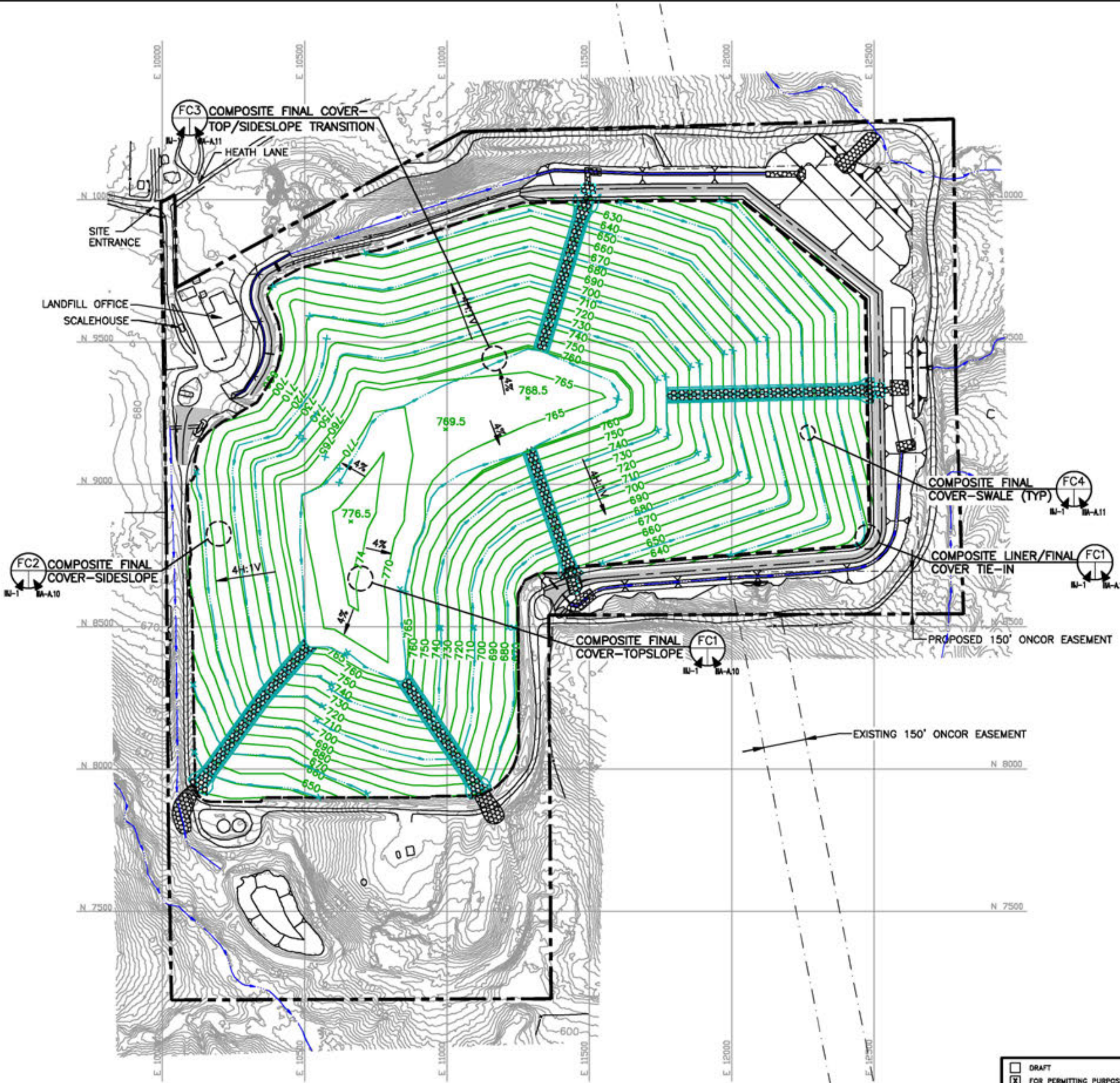


05/20/2024

1 INTRODUCTION

This appendix addresses §330.63(h) and §330.451 through §330.461.

This Final Closure Plan has been prepared for the Royal Oaks Landfill consistent with Title 30 Texas Administrative Code (TAC) Section 330, Subchapter K, §330.451 through §330.461, as well as §330.63(h). In accordance with Title 30 TAC §330.457(f)(1), a copy of the approved closure plan will be placed in the site operating record prior to the initial receipt of waste. The landfill completion plan for this site consists of final contours and drainage features for the completed landfill. The landfill completion plan is provided on Figure IIIJ-1.



N

0 200 400
SCALE IN FEET

LEGEND

	PERMIT BOUNDARY
	LIMIT OF WASTE
E 10500	SITE GRID
610	EXISTING CONTOUR (SEE NOTE 1)
624	PROPOSED FINAL COVER CONTOUR
	DRAINAGE SWALE
	DRAINAGE LETDOWN
	CHANNEL CENTERLINE

NOTES:

1. EXISTING CONTOURS DEVELOPED BY FIRMATEK FROM AERIAL PHOTOGRAPHY FLOWN NOVEMBER 10, 2022. THE GRID SYSTEM IS BASED ON A SITE GRID SYSTEM. ELEVATIONS ARE BASED ON NAD 88.
2. PERMIT BOUNDARY WAS REPRODUCED FROM LEGAL DESCRIPTION PROVIDED BY STANGER SURVEYING COMPANY, DATED APRIL 1995.
3. REFER TO APPENDIX IIF–SURFACE WATER DRAINAGE PLAN FOR DRAINAGE DESIGN INFORMATION.
4. MAXIMUM FINAL COVER ELEVATION IS 776.5 FT–MSL. MAXIMUM TOP OF WASTE ELEVATION IS 773.0 FT–MSL.
5. TYPICAL SIDESLOPES ARE 4H:1V (25%). TYPICAL TOPSLOPE IS 4%.

STATE OF TEXAS
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05/20/2024

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☒ FOR PERMITTING PURPOSES ONLY
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PREPARED FOR
PINE HILL FARMS LANDFILL TX, LP

MAJOR PERMIT AMENDMENT
COMPLETION PLAN

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS

DATE: 05/2024	DRAWN BY: JDW
FILE: 0120-76-11	DESIGN BY: SAB
CAD: IIIJ-1 COMPLETION PLAN.DWG	REVIEWED BY: DEP

REVISIONS

NO.	DATE	DESCRIPTION

Weaver Consultants Group
TBPE REGISTRATION NO. F-3727

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DRAWING IIIJ-1

SHEET IIIJ-2

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2 FINAL COVER SYSTEM

2.1 Introduction

The final cover system for the Royal Oaks Landfill has been developed to incorporate the requirements of Title 30 TAC §330.457(f)(4). The rules state that the owner or operator of an MSW landfill unit shall complete closure activities for the unit in accordance with the approved closure plan within 180 days following the initiation of closure activities (closure activities for MSW landfill units shall begin no later than 30 days after the date on which the unit receives the known final receipt of wastes, or, if the unit has remaining capacity and there is a reasonable likelihood that the unit will receive additional wastes, no later than one year after the most recent receipt of wastes). Closure will include installation of a final cover system and storm water runoff controls. The storm water runoff controls are addressed in Appendix IIIF – Surface Water Drainage Plan. The final cover system design is discussed below and is also detailed in Appendix IIIA-A. Cross-sections are provided in Appendix IIIA-B.

2.2 Final Cover System Design

The final cover system will consist of a composite final cover system for both the pre-Subtitle D and Subtitle D areas. The final cover system will provide a low maintenance cover, protect against erosion, reduce rainfall percolation through the cover system and subsequently minimize leachate generation within the landfill. As depicted on Figure IIIJ-1 (and Drawing A.2 – Landfill Completion Plan in Appendix IIIA-A), a maximum slope of 4 percent is provided for the top slopes. Typical sideslopes of 4H:1V are provided to control erosion and facilitate drainage of the landfill.

Composite Final Cover System

- A 12-inch-thick earthen material erosion layer capable of sustaining vegetative growth. The vegetation will consist of native or introduced grasses, as well as a mixture of Bermuda, vetch, rye, wheat grass, wild flowers, and other flowering plants capable of providing 95 percent coverage over the final cover.

- A drainage geocomposite drainage layer (250-mil-thick geonet with 6 oz/sy geotextile(s) heat-bonded to the top side for top slopes and heat-bonded to both sides for side slopes).
- A 40-mil, smooth or textured (topslope) and textured (sideslope), linear low-density polyethylene (LLDPE) geomembrane.
- An 18-inch-thick compacted clay infiltration layer with a coefficient of permeability of less than or equal to 1×10^{-5} cm/s. A geosynthetic clay liner (GCL) may be installed as an alternative to the compacted clay infiltration layer.

The low permeability components of the final cover (geomembrane, 18-inch-thick clay infiltration layer, or GCL) are designed to minimize infiltration of surface water into the underlying waste material. Details of the final cover systems are shown in Appendix IIIA-A. Material specifications, construction, and testing procedures are provided in Appendix IIIJ-A – Final Cover System Quality Control Plan (FCSQCP).

Vegetation will be established over the installed final cover system to minimize the erosion potential of the cover slopes. The erosion layer was evaluated using the Universal Soil Loss Equation (USLE) developed by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). The evaluation is presented in Appendix IIIF.

Landfill gas generated in the landfill will be managed as discussed in Appendix III I – Landfill Gas Management Plan. The landfill gas system, if installed, will collect the gas generated by deposited waste and control gas emissions from the site.

Permanent final cover erosion control structures including swales and chutes will be constructed on the final cover. The design of the final cover system erosion control structures is provided in Appendix IIIF-B. A soil loss and sheet flow velocity demonstration for the erosion layer is included in Appendix IIIF-D.

2.3 Installation Methods and Procedures

The final cover system will be constructed in accordance with the requirements listed on the permit drawings in Appendix IIIA-A and the Final Cover System Quality Control Plan (FCSQCP) presented in Appendix IIIJ-A. Testing and evaluation of the final cover system during construction will be in accordance with Appendix IIIJ-A – FCSQCP.

3 CLOSURE PROCEDURES

3.1 Sequence of Final Cover Placement

The Royal Oaks Landfill may place final cover over the landfill unit throughout the active life of the landfill. As detailed on Drawing I/IIA.7, final cover will be placed as the site is being developed. The final cover placement procedures listed below will be followed until the entire waste footprint is closed:

- Survey controls will be implemented to control the filling of solid waste to the top of the daily/intermediate cover layer elevation.
- The final cover system layers will be constructed over areas that have reached the bottom of final cover grades. Testing of the various components of the final cover system will be performed in accordance with this closure plan (see Section 2.3).
- A final cover certification report, complete with an as-built survey, will be prepared by an independent licensed professional engineer and submitted to the TCEQ for approval.
- The TCEQ-approved final cover certification report will be maintained in the Site Operating Record, and the final cover log (see Part IV – Section 4.18.5) will be updated to reflect the area where final cover has been placed. The TCEQ Regional Office will also be notified that final cover placement has occurred at the site.

Note that the placement of final cover does not represent closure of a portion of the site. Closure for the landfill unit is discussed in Section 3.2 and closure of the other MSW units at the site is discussed in Section 3.3. Requirements for final closure of the site are discussed in Section 4. Post-closure care activities will commence once the entire site has been closed as discussed in Section 4.

3.2 Landfill Unit Closure During Active Life

Should closure of the landfill become necessary at any time during the active life of the landfill, the following steps will be taken:

- Engineering plans will be developed to address site closure at the time of discontinued waste filling.
- A revised final closure plan will be developed and submitted to the TCEQ for approval.
- The final waste received will be placed and properly compacted.
- Excavations will be filled with suitable material, and the site will be graded to promote runoff and prevent ponding.
- The top of the landfill will be regraded and reshaped as needed to provide the proper slope for positive drainage.
- The final cover system will be constructed according to specifications.
- Following application of final cover, the site will be vegetated with appropriate grasses to minimize erosion. The established grasses will provide a minimum of 95 percent coverage of the final cover system.
- A surface water management system will be constructed to minimize erosion.
- A closure certification will be prepared by an independent licensed professional engineer and submitted to TCEQ for approval.
- All proper notices and documentation will be filed with the appropriate agencies.

3.2.1 Estimate of Largest Active Disposal Area

Consistent with Title 30 TAC §330.503(a), the largest area that could be open within the next year is shown on Figure IIIL.1 and is listed in Appendix IIIL – Closure and Post Closure Care Cost Estimate. Consistent with this rule and TCEQ guidelines for financial assurance to complete closure and postclosure activities, financial assurance will be posted for the current active area as discussed in Appendix IIIL – Closure and Postclosure Care Cost Estimate. The entire site will also need to be administratively closed.

Supporting calculations are presented in Appendix IIIL – Closure and Postclosure Care Cost Estimate.

3.2.2 Estimate of Maximum Inventory of Waste Ever On Site

The estimate of maximum inventory of waste (defined as waste and daily cover) ever on site over the active life of the facility is approximately 10.538 million cubic yards. The site life calculations (Appendix IIIM – Site Life Calculations) show that approximately 6,585,900 cubic yards of airspace remain (using the November 10, 2022 topographic map). Supporting calculations are included in Appendix IIIM – Site Life Calculations.

3.3 Leachate Storage Tanks and Piping

The leachate storage tanks and piping will continue to operate throughout the active life of the site and the postclosure period. Once the postclosure period has ended, the following steps will be taken to decommission the leachate storage tanks and piping.

- The remaining leachate will be transferred to a properly permitted offsite treatment or disposal facility.
- General cleanup of the site, including areas around the leachate storage tank (i.e., washdown of the concrete truck loading pad, etc.) will be performed.

The tanks will be demolished and the debris will be disposed of at a permitted disposal facility.

3.4 Liquid Waste Bulking Facility Closure

It is anticipated that the Liquid Waste Bulking Facility will continue to operate throughout the active life of the Royal Oaks Landfill. During closure of the site, the following steps will be taken to decommission the Liquid Waste Bulking Facility.

- The final waste received or stored at the facility will be solidified and transferred to the landfill for disposal.
- General cleanup of the site, including all areas around the Liquid Waste Bulking Facility (i.e., removal of bulking agents, washdown of floor, etc.) will be performed.
- The facility equipment will be dismantled and removed from the site.
- The concrete mixing basins will be demolished and the concrete debris will be disposed of. Any soil below the basins that is visually stained will be excavated and disposed of in the landfill.

A description of the Liquid Waste Bulking Facility closure procedures will be included in the closure certification report.

3.5 Citizens Convenience Center Closure

The Citizens Convenience Center will likely operate throughout the active life of the facility. During closure of the site, the Citizens Convenience Center will be decommissioned. Closure activity will include a general cleanup of the area. All roll-offs will be emptied at the landfill working face and removed from the site.

4 SCHEDULE OF UNIT CLOSURE AND FACILITY FINAL CLOSURE

4.1 Final Closure Requirements

The site will be closed in an orderly fashion, consistent with Title 30 TAC §330.457 and §330.461, implementing the following steps:

- No later than 45 days prior to initiation of final closure activities for the municipal solid waste landfill (MSWLF) unit, the Executive Director of TCEQ will be notified of the intent to close the unit and that a notice of the intent to close the unit has been placed in the operating record.
- No later than 90 days prior to initiation of final facility closure, a public notice of facility closure which contains the name, address, and physical location of the facility, the permit number, and the last date of intended receipt of waste, will be provided in the newspaper of the largest circulation in the vicinity of the facility. Pine Hill Farms Landfill TX, LP will also make available a copy of the approved final closure and postclosure plan at the landfill office for public access and review.
- Consistent with Title 30 TAC §330.461(b) and following notification of the Executive Director of TCEQ, a minimum of one sign will be posted at the main entrance and all other frequently used points of access for the facility notifying all persons utilizing the facility of the closure date or date after which further receipt of waste is prohibited. In addition, access control is provided by perimeter fencing and a locked gate following the closure date to prevent unauthorized disposal or dumping of solid waste at the facility.
- Final closure activities will commence for the MSWLF unit no later than 30 days after the date the MSWLF unit receives the known final receipt of wastes. If the MSWLF unit has remaining capacity and there is a reasonable likelihood that the MSWLF unit will receive additional wastes, final closure activities will commence no later than 1 year after the most recent receipt of wastes.

  Final closure activities of the MSWLF unit will be completed in accordance with the Closure Plan (this appendix) within 180 days following the initiation of closure activities as defined in Title 30 TAC §330.457(f)(3). If necessary, as noted in Title 30 TAC §330.457(f)(4), a request for an extension of the completion of final closure activities may be submitted and granted by the

Executive Director. The request will include all applicable documentation necessary to demonstrate that final closure will take longer than 180 days and all steps have been taken and will continue to be taken to prevent threats to human health and the environment from the unclosed site.

- Following completion of final closure activities of the MSWLF unit, the facility will comply with the post-closure care requirements specified in Title 30 TAC §330.463(b). Within ten days after completion of final closure activities, a documented certification, signed by an independent licensed professional engineer, will be submitted to the Executive Director of the TCEQ for review and approval. This certification will verify that final closure has been completed in accordance with the approved final closure plan and will include all applicable documentation necessary for certification of final closure. Once approved, this certification will be placed in the Site Operating Record.
- Within 10 days after completion of final closure activities of the facility, a certified copy of an Affidavit to the Public (most current format provided by the TCEQ will be used) will be submitted to the Executive Director of the TCEQ by registered mail and placed in the facility's site operating record. In addition, a certified notation will be recorded on the deed to the facility that will in perpetuity notify any potential purchaser of the property that the land has been used as a landfill facility and the use of the land is restricted according to the provisions specified in Title 30 TAC §330.465. Within 10 days after completion of final closure activities of the facility, a certified copy of the modified deed will be submitted to the Executive Director and placed in the operating record.
- Following receipt of the required final closure documents and an inspection report from the TCEQ Regional Office verifying proper closure of the MSWLF facility according to this Closure Plan (this appendix), the Executive Director may acknowledge the termination of operation and closure of the facility and deem it properly closed. The steps in the closure process are depicted on Figure IIIJ-3 – Final Closure Schedule. Consistent with Title 30 TAC §330.461(c)(2), a professional engineer certification will be submitted to TCEQ within 10 days of completion of closure. In accordance with Title 30 TAC §330.463(b), the postclosure care period begins immediately upon the date of final closure.

4.2 Provisions for Extending Closure Period

If the Royal Oaks Landfill has remaining capacity at the time of its closure, final closure activities will begin no later than one year after the most recent receipt of wastes. A request for an extension beyond the one-year deadline for the initiation of final closure may be submitted to the Executive Director for review and approval and will include all applicable documentation to demonstrate that the unit or site has the capacity to receive additional waste, and that the Royal Oaks Landfill has taken all steps necessary to prevent threats to human health and the environment.

Royal Oaks Landfill
Figure IIIJ-2 – Final Closure Schedule

	DAY 30	DAY 60	DAY 90	DAY 120	DAY 150	DAY 180	DAY 210	DAY 240	DAY 270	DAY 300
Written notification of closure to TCEQ		—	—							
Public notice of facility closure published in newspaper	—	—	—							
Posting of sign		●								
Initiation of final closure activities			●							
Time interval for completion of final closure activities				—	—	—	—	—	—	
Submit engineering certification of final closure to TCEQ										●
Submit certified copies of Affidavit to the Public and modified deed to TCEQ										●

Note: Schedule is based on anticipated date of beginning final closure activities. Heavy vertical line signifies final receipt of waste. Schedule is shown for reference purposes only. Implementation of closure activities shall follow the TCEQ-approved closure plan and applicable rules.

5 CLOSURE COST ESTIMATE

A detailed written cost estimate, in current dollars, showing the cost of hiring a third party to close the largest area of the landfill ever requiring a final cover at any time during the active life of the unit is provided in Part III, Appendix IIIL – Closure and Postclosure Care Cost Estimate. The closure cost estimate is provided on Table IIIL-1 of Appendix IIIL.

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1614B

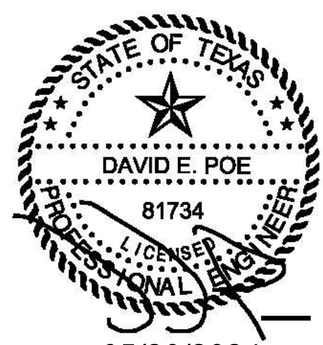
MAJOR PERMIT AMENDMENT APPLICATION

PART III – SITE DEVELOPMENT PLAN
APPENDIX IIIJ-A
FINAL COVER SYSTEM QUALITY CONTROL PLAN

Prepared for

Pine Hill Farms Landfill TX, LP

May 2024



05/20/2024

Prepared by

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WCG Project No. 0120-076-11-106

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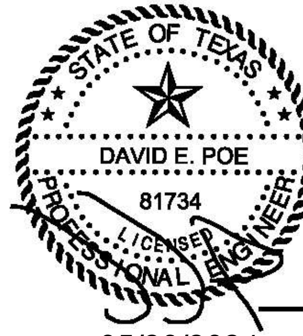

05/20/2024

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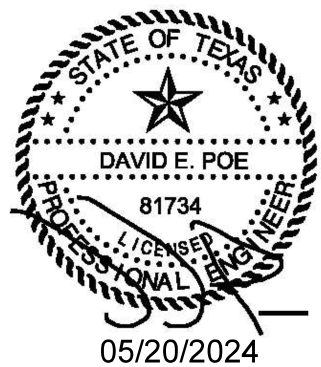

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Final Cover Drainage Layer Design

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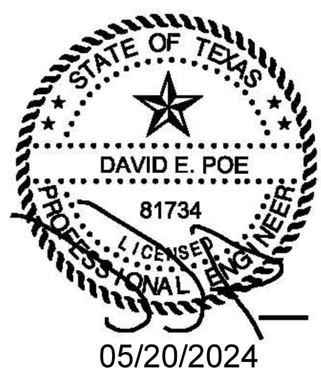

1 INTRODUCTION

1.1 Purpose

This Final Cover System Quality Control Plan (FCSQCP) has been prepared to provide the Owner, Operator, Design Engineer, Construction Quality Assurance Professional of Record, and the Contractor the means to govern the construction quality and to satisfy the environmental protection requirements under current Texas Commission on Environmental Quality (TCEQ) Municipal Solid Waste Regulations (MSWR). More specifically, the FCSQCP addresses the soil and geosynthetic components of the final cover system.

This FCSQCP is divided into the following parts:

- Section 1 – Introduction
- Section 2 – Construction Quality Assurance for Soil Infiltration Layer
- Section 3 – Construction Quality Assurance for Geosynthetic Clay Liner
- Section 4 – Construction Quality Assurance for Geosynthetics
- Section 5 – Construction Quality Assurance for Erosion Layer
- Section 6 – Geotechnical Strength Testing Requirements
- Section 7 – Documentation

1.2 Definitions

Whenever the terms listed below are used, the intent and meaning will be interpreted as indicated.

ASTM

American Society for Testing and Materials.

Atterberg Limits

A series of six "limits of consistency" of fine-grained soils defined by Swedish soil scientist Albert Atterberg, two of which are frequently used today to establish a soil's physical boundaries dealing with its plasticity characteristics. These soil boundaries or limits used most frequently in geotechnical engineering are based upon the numerical difference of the Liquid Limit and the Plastic Limit as defined below:

- Liquid Limit (LL) – The percentage of moisture in a soil, subjected to a prescribed test, that defines the upper point at which the soil's consistency changes from the plastic to the liquid state.
- Plastic Limit (PL) – The percentage of moisture in a soil, subjected to a prescribed test, that defines the lower point at which the soil's consistency changes from the plastic to the semi-solid state.
- Plasticity Index (PI) – The numerical difference between the LL and the PL of a fine-grained soil that denotes the soils plastic range. The larger the PI the greater a soil's plasticity range and the greater it's plasticity characteristics.

Compactive Effort

The amount of compaction energy held constant, and usually transferred into a soil sample with a compaction hammer device, used on soil samples in various laboratory test procedures to establish a soil's density at various moisture contents.

Construction Quality Assurance (CQA)

A planned system of activities that provides the Operator and permitting agency assurance that the facility was constructed as specified in the design (EPA, 1986). Construction quality assurance includes observations and evaluations of materials, and workmanship necessary to determine and document the quality of the constructed facility. Construction quality assurance (CQA) refers to measures taken by the CQA organization to assess if the installer or contractor is in compliance with the plans and specifications for a project.

Construction Quality Assurance (CQA) Monitors

These are representatives of the POR who work under direct supervision of the POR. The CQA monitor is responsible for quality assurance monitoring and performing on-site tests and observations. The CQA monitor performing QA/QC observation and testing will be a qualified professional meeting one of the following qualifications: NICET-certified in geotechnical engineering technology at level II or higher for soils testing; a minimum of four years of directly related experience; a minimum of six months of directly related experience and has completed the Geosynthetic Institutes (GSI) Construction Quality Assurance Inspectors Certification Program (CQA-ICP); or a graduate engineer or geologist. Field observations, testing, or other activities associated with CQA may be performed by the CQA monitor(s) on behalf of the POR.

Additional CQA monitors may be used if they work under the direct supervision of a qualified CQA monitor who is on-site.

Construction Quality Assurance Professional of Record (POR)

The POR is an authorized representative of the Operator and has overall responsibility for construction quality assurance and confirming that the facility was constructed in general accordance with plans and specifications approved by the permitting agency. The POR must be licensed as a Professional Engineer in Texas and experienced in geotechnical testing and its interpretations. Experience and education should include geotechnical engineering, engineering geology, soil mechanics, geotechnical laboratory testing, construction quality assurance, and quality control testing, and hydrogeology. The POR must show competency and experience in certifying like installations, and be approved by the permitting agency, and be presently employed by or practicing as a geotechnical engineer in a recognized geotechnical/environmental engineering organization. The credentials of the POR must meet or exceed the minimum requirements of the permitting agency. Any references to monitoring, testing, or observations to be performed by the POR should be interpreted to mean the POR or CQA monitors working under the POR's direction. The POR or his designated representative will be on-site during all final cover system construction.

The POR may also be known in applicable regulations and guidelines as the CQA Engineer, Resident Project Representative, or the Geotechnical Professional (GP).

Contract Documents

These are the official set of documents issued by the Operator. The documents include bidding requirements, contract forms, contract conditions, specifications, contract drawings, addenda, and contract modifications.

Contract Specifications

These are the qualitative requirements for products, materials, and workmanship upon which the contract is based.

Contractor

This is the person or persons, firm, partnership, corporation, or any combination, private or public, who, as an independent contractor, has entered into a contract with the Operator and who is referred to throughout the contract documents by singular number and masculine gender.

Design Engineer

These individuals or firms are responsible for the design and preparation of the project construction drawings and specifications. Also referred to as "designer" or "engineer".

Earthwork

This is a construction activity involving the use of soil materials as defined in the construction drawings and specifications and Section 2 of this plan.

Film Tear Bond (FTB)

A failure in the geomembrane sheet material on either side of the seam and not within the seam itself.

Final Cover System Evaluation Report (FCSER)

Upon completion of closure activities, the FCSER which will be signed by the POR and include all the documentation necessary for certification of closure.

Fish Mouth

A semi-conical opening of the seam that is formed by an edge wrinkle in one sheet of the geomembrane.

Geomembrane Liner (GM)

This is a synthetic lining material, also referred to as geomembrane, membrane liner, or sheet. The term Flexible Membrane Liner (FML) is also used for GM.

Geosynthetics Contractor

This individual is also referred to as the "contractor" or "installer", and is the person or firm responsible for geosynthetic construction. This definition applies to any person installing FML or other geosynthetic materials, even if not his primary function.

Independent Testing Laboratory

A laboratory that is independent of ownership or control by the permittee or any party to the construction of the final cover or the manufacturer of the final cover products used.

Manufacturing Quality Assurance (MQA)

A planned system of activities that provides assurance that the raw materials were constructed (manufactured) as specified.

Manufacturing Quality Control (MQC)

A planned system of inspection that is used to directly monitor and control the manufacture of a material.

Nonconformance

This is a deficiency in characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate. Examples of nonconformances include, but are not limited to, physical defects, test failures, and inadequate documentation.

Operator

The organization that will operate the disposal unit.

Operator's Representative

This is the person that is an official representative of the operator responsible for planning, organizing, and controlling the design and construction activities.

Panel

This is a unit area of the GM or FML, which will be seamed in the field.

Permeant Fluid

Fluid used in a laboratory coefficient of permeability test and limited to tap water or 0.005 Normal solution of $CaSO_4$. Distilled water will not be used in these test procedures.

Quality Assurance

This is a planned and systematic pattern of procedures and documentation to ensure that items of work or services meet the requirements of the contract documents. Quality assurance includes quality control. Quality assurance will be performed by the POR and CQA monitor.

Quality Control

These actions provide a means to measure and regulate the characteristics of an item or service to comply with the requirements of the contract documents. Quality control will be performed by the contractor.

Representative Sample

A representative sample of FML material consists of 1 or more specimens (commonly referred to as coupons) from the same rectangular portion of FML material, oriented along a seam, that is removed for field or laboratory testing purposes.

Soil Borrow Source

Soils in which the Liquid Limit (LL) and Plasticity Index (PI) do not vary by 10 points. A soil that varies by 10 or more points from the originally established LL or PI is considered as a separate soil source for the purpose of this FCSQCP and requires a separate soils test series.

Soil Test Series

Tests performed to determine a soil's physical characteristics and to document its ability to satisfy the MSWR soil infiltration layer requirements. These tests include sieve analysis (gradation), Atterberg Limits, moisture/density, and coefficient of permeability.

Specimen

(With respect to FML destructive testing) – A specimen is the individual test strip (sometimes called coupon) from a sample location. A sample location usually consists of many specimens.

2 CONSTRUCTION QUALITY ASSURANCE FOR SOIL INFILTRATION LAYER

2.1 Introduction

This section of the FCSQCP addresses the construction of the soil infiltration layer component of the final cover system and outlines the FCSQCP program to be implemented with regard to materials selection and evaluation, laboratory test requirements, field test requirements and treatment of problems.

The scope of soil infiltration layer related construction quality assurance includes the following elements:

- Subgrade preparation
- Soil infiltration layer stockpile
- Soil infiltration layer placement
- General fill

2.2 Composite Final Cover

The landfill is designed to include a composite final cover system over the waste fill footprint (with exception to pre-Subtitle D areas) as discussed in Section 2.2 of the Closure Plan (Appendix IIIJ). The cover system includes an 18-inch-thick compacted clay infiltration layer, 40-mil LLDPE geomembrane, drainage geocomposite, and 12-inch-thick erosion layer capable of sustaining vegetative growth. As an option to the 18-inch-thick soil infiltration layer, a geosynthetic clay liner (GCL) may be used. The final cover system is designed to minimize the amount of precipitation that infiltrates the deposited waste, thus minimizing the amount of leachate generated. The final cover system is designed to convey stormwater to detention ponds via final cover erosion control structures and perimeter channels.

2.3 Soil Infiltration Layer Construction

Sections 2.3.1 and 2.3.2 describe general construction procedures to be used for the soil infiltration layer and the preparation of the intermediate cover layer.

Construction must be conducted in accordance with the project construction drawings, which will be developed in accordance with this FCSQCP and the Closure Plan (Appendix IIIJ) at the time of each final cover construction.

2.3.1 Intermediate Cover

Before soil infiltration layer construction, the vegetation on the intermediate cover will be removed. The surface of the intermediate cover will be graded and compacted to prepare the working surface for the first lift of infiltration layer soil. Intermediate cover soil will be added or removed to be consistent with the lines and grades specified in the details. The CQA monitor will visually inspect and approve the prepared intermediate cover prior to the placement of the soil infiltration layer or general fill. Surveying will be performed to verify that the finished intermediate cover is completed consistent with the lines and grades specified in the design.

2.3.2 Soil Infiltration Layer

The soil infiltration layer will consist of a minimum 18-inch-thick compacted soil barrier (measured perpendicular to the subgrade surface) that will extend along the sideslopes and topslopes of the landfill. All soils used in soil infiltration layers will have the following minimum values verified by testing in a third-party soil laboratory:

- Plasticity Index equal to or greater than 15.
- Liquid Limit equal to or greater than 30.
- Percent passing the No. 200 mesh sieve equal to or greater than 30 percent.
- Percent passing the 1-inch screen equal to 100 percent.
- Coefficient of permeability of less than or equal to $1x10^{-5}$ cm/s for the composite Subtitle D cover infiltration layer.

The soil infiltration layer material will consist of relatively homogeneous clay, and clayey soils. The soil will be free of debris, rock greater than 1 inch in diameter, vegetative matter, frozen materials, foreign objects, and organics. Testing will be performed in accordance with Section 2.4 (refer to Table 2-1 for test methods) for each borrow source. A permeability test will be conducted on samples from each borrow source. The permeability test specimens will be prepared by laboratory compaction to a dry density of approximately 95 percent of the Standard Proctor (ASTM D 698) maximum dry density at a moisture content at or above the optimum moisture content. One Proctor moisture-density relationship and remolded permeability test will be required for each different material as determined by a change in the liquid limit or plasticity index of more than 10 percentage points.

The CQA monitor, earthwork contractor, and/or Operator will identify the clay material during excavation, and the clay material will be stockpiled separately, if stockpiling is required. Because of possible variability of the available clay materials, additional stockpile testing will be performed if different physical properties of the borrow soil (color, texture, etc.) are observed by the CQA monitor, and the materials vary by more than ten points in either liquid limit or plasticity index from previously evaluated materials.

The clay materials to be used for infiltration layer will require processing to achieve the required moisture content for compaction. The physical characteristics of the clay materials will be evaluated through visual observation before and during construction. To add moisture to the material properly, the clod sizes will first be crushed or reduced into manageable sizes of 1 inch in diameter or less. Rocks or clods within the infiltration layer should be less than 1 inch in diameter and will not total more than 10 percent by weight. The prepared infiltration layer will be observed such that rock content will not be a detriment to the integrity of the overlying geomembrane.

Clod-size reduction, if necessary, may be achieved using processing equipment. In order to efficiently break down the clods, multiple passes of the processing equipment in two directions are recommended. Water will be applied as necessary to the material and worked into the material with the processing or compacting equipment. If necessary to achieve even moisture distribution or break down clod, the material will be watered and processed in the stockpile prior to placing in the infiltration layer to allow the soil adequate time to hydrate. Water used for the soil infiltration layer must be clean and not contaminated by waste or any objectionable material. Collected on-site stormwater may be utilized if it has not come into contact with the waste.

The soil infiltration layer must be compacted with a pad/tamping-foot or prong-foot (sheepsfoot) roller. The lift thickness will be controlled so that there is total penetration through the loose lift under compaction into the top of the previously compacted lift; therefore, the lift thickness must not be greater than the pad or prong length. The top of intermediate cover will be scarified a minimum of two inches prior to placement of the first lift of soil infiltration layer. Use of pad/tamping foot or prong-foot rollers will provide sufficient roughening of soil infiltration layer lift's surface for bonding between lifts. These procedures are necessary to achieve adequate bonding between lifts and reduce seepage pathways. Adequate cleaning devices must be in place and maintained on the compaction roller so that the prongs or pad feet do not become clogged with clay soils to the point that they cannot achieve full penetration during initial compaction. The footed roller is necessary to achieve this bonding and to reduce the individual clods and achieve a blending of the soil matrix through its kneading action.

In addition to the kneading action, weight of the compaction equipment is important. The minimum weight of the compactor should be 40,000 pounds, and a minimum of four passes are recommended for the compaction process. A pass is defined as one direction of the compactor, not just an axle, over a given area. The recommended minimum of four passes is for a vehicle with front and rear drums. The Caterpillar 815B and 825C are examples of equipment typically used to achieve satisfactory results. The soil infiltration layer will not be compacted with a bulldozer or any track-mobilized equipment unless it is used to pull a pad-footed roller.

CQA testing of the soil infiltration layer will be performed as the infiltration layer is being constructed and in accordance with this FCSQCP. Testing procedures, frequency, and passing criteria will be in accordance with Section 2.4. Soil infiltration layer construction and testing will be conducted in a systematic and timely fashion on each lift. In general, delays will be avoided in infiltration layer construction (typically no more than 60 days). Reasons for any delays in infiltration layer construction (greater than 60 days) should be fully explained in the FCSER submittal. Construction methods and test procedures documented in the FCSER will be consistent with the FCSQCP.

The soil infiltration layer material will be compacted to a minimum of 95 percent of the maximum dry density determined by Standard Proctor (ASTM D 698) at a moisture content above the Standard Proctor optimum. Sections of the soil infiltration layer which do not pass both the density and moisture requirements will be reworked with additional passes of the compactor and moisture conditioned until the section in question passes. All field density test results will be incorporated into the FCSER.

Hydraulic conductivity samples will be obtained by pushing a sampler through the constructed infiltration layer. The sample from each test location will be sealed and transported to the laboratory. Two samples may be collected at each sample location and labeled the “A” and “B” sample. The sampling holes (e.g., samples for hydraulic conductivity) will be backfilled with bentonite or a bentonite/infiltration layer soil material mixture consisting of at least 20 percent bentonite.

If the integrity of the “A” sample appears to have been compromised during the transportation of the sample prior to testing, the “B” sample may be tested. In addition, if an “A” sample hydraulic conductivity test does not comply with the minimum allowable value, the “B” sample collected at the same location may be tested to determine compliance with the hydraulic conductivity requirements if during testing of the “A” sample, the ASTM D 5084 or EM 1110-2-1906 procedure was not followed or the permeameter malfunctioned. The POR will provide a detailed justification of the use of the “B” sample, if applicable, in the FCSER.

If the “B” sample passes, the area will be considered in compliance. If the “B” sample fails (or sample “A” fails in such a way that there is not an option to use the “B” sample), the test interval will be considered unsatisfactory for the area bounded by passing test locations (but not extending past a satisfactory test location). Additional tests may be taken to further define the unsatisfactory area. The area defined unsatisfactory will be reworked and retested in accordance with this section. Furthermore, if it is determined that the "B" sample may not be used to replace the "A" sample result, then the test interval will be considered unsatisfactory for the area bounded by passing test locations (but not extending past a satisfactory test location).

Once the exact area is determined, the constructed soil infiltration layer lifts will be removed to the bottom of the lift that did not pass the hydraulic conductivity test, and reconstructed until all the samples obtained from the failed area meet the hydraulic conductivity requirements. At a minimum, one hydraulic conductivity test will be performed for each repair area, given that the reconstructed soil infiltration layer area is not larger than one acre. The reconstructed soil infiltration layer area will be tied into the currently constructed soil infiltration layer with a 5H:1V transition slope. The reconstructed soil infiltration layer area is also subject to field density and moisture content testing per Table 2-1 (at least one field density and one moisture content test is required for each lift regardless of the size of the area that is reconstructed). The testing frequency for reconstructed areas will be in accordance with Table 2-1. Reconstruction activities, including additional testing and surveying, will be incorporated into the FCSER.

The finished top surface of the soil infiltration layer must be rolled with a smooth, steel-wheeled roller to obtain a hard, uniform, and smooth surface. The surface of the soil infiltration layer will then be carefully inspected by the CQA monitor for any gravel, rock pieces, and deleterious materials, which might impact the integrity of the geomembrane to be placed upon it. All voids created by removing gravel, rock pieces, or other deleterious materials will be backfilled with infiltration layer material to the density specifications outlined for soil infiltration construction and tested at the discretion of the CQA monitor. The soil infiltration layer will be prevented from losing moisture prior to placement of geomembrane. Preserving the moisture content of the installed soil infiltration layer will be dependent on the earthwork contractor's means and methods and is subject to POR approval.

Surveying will be performed to document that the finished soil infiltration layer has been constructed to a minimum thickness of 18 inches. The infiltration layer will be surveyed as indicated in Table 2-1 to verify that a minimum 18-inch-thick soil layer is present at each location.

The location of the settlement plates will be established by a registered surveyor or professional engineer. The shaft extending upward from the base will be marked to indicate the minimum required thickness of the infiltration layer. The infiltration layer will be constructed to the minimum thickness marked on the shaft of the settlement plate. The POR and CQA monitor will verify that the infiltration layer is placed uniformly between each settlement plate. Once the survey is complete, the settlement plate shaft will be removed and the resulting hole will be backfilled with bentonite or a bentonite/infiltration layer soil mixture consisting of at least 20 percent bentonite. An infiltration layer thickness drawing with each of the survey measurement grid points will be provided. Coordinates defining the perimeter of the final cover system will be called out on the final drawings. The infiltration layer thickness drawing will be sealed by a Texas registered surveyor. After the construction of the infiltration layer is complete, the Texas registered surveyor will survey the final elevation of the infiltration layer. The infiltration layer certification drawing will be included in the FCSER. In addition, the elevations obtained for the top of the infiltration layer will be used to verify that the as-built slopes are consistent with the approved landfill completion plan. A statement that confirms that the as-built slopes are consistent with the approved landfill completion plan will be included in the FCSER.

2.3.3 General Fill

General fill material placed below the final cover will be placed in uniform lifts which do not exceed 12 inches in loose thickness and are compacted to at least 90 percent of Standard Proctor (ASTM D 698) maximum dry density at a moisture content ranging from 2 percentage points below optimum to 3 percentage points above optimum (-2 to +3). General fill will be uncontaminated earthen material.

2.3.4 Surface Water Removal

The prepared intermediate cover or infiltration layer which is under construction may encounter water from storm events. Prior to placement of the soil infiltration layer, intermediate cover will be graded to provide positive drainage for the base grades of the soil infiltration layer. The soil infiltration layer will not be placed in standing water and water will not be allowed to accumulate over constructed infiltration layer. The construction area will be graded to provide for positive drainage. Temporary diversion berms will be constructed as needed to divert surface flow away from the construction area.

2.3.5 Infiltration Layer Tie-In Construction

Newly constructed infiltration layer will be tied-in with any adjoining existing infiltration layers. Additionally, terminations will be constructed for future tie-ins along edges where the infiltration layer will be extended in the future. During the construction of continuous infiltration layers, the new infiltration layer segment will not be constructed by “butting” the entire thickness of the new infiltration layer directly against the edge of the old infiltration layer. The tie-in will be constructed either by a sloped transition (typically 5 horizontal to 1 vertical) or a stair-stepped transition (typically 1 lift thickness per step). The length of the tie-in should be at least 5 feet per foot of infiltration layer thickness. The tie-ins with existing clay infiltration layer will be constructed utilizing a sloped or stair-stepped transition. In general, terminations for future tie-ins will be constructed by extending the infiltration layer approximately 7.5 feet past the limits for the final cover area under construction.

2.4 Construction Testing

2.4.1 Standard Operating Procedures

CQA monitors will perform field and laboratory tests in accordance with applicable standards specified in this FCSQCP. Sampling will be performed by using standard ASTM practices for recovering samples (e.g., ASTM D 1587). The sampling holes will be backfilled with bentonite or bentonite/infiltration layer soil material mixture consisting of at least 20 percent bentonite.

2.4.2 Test Frequencies

The test frequencies for the infiltration layer are listed in Table 2-1. Additional testing must be conducted whenever work or materials are suspect, marginal, or of poor quality. Further testing may also be performed to provide additional data for engineering evaluation. The minimum number of tests is interpreted to mean minimum number of passing tests, and any tests that do not meet the requirements will not contribute to the total number of tests performed to satisfy the minimum test frequency.

2.5 Reporting

The POR on behalf of the Operator will submit to the TCEQ a FCSER for approval of each final cover area. Section 7 describes the documentation requirements.

Table 2-1
Standard Tests on Infiltration Layer Soils

Soil Test Category	Type of Test	Standard Test Method	Frequency of Testing
Quality Control Testing of Source Borrow Materials	Unified Soil Classification	ASTM D 2487	Once per soil type
	Moisture/Density Relationship	ASTM D 698	
	Grain Size	ASTM D 422 or D 1140	
	Atterberg Limits	ASTM D 4318	
	Coefficient of Permeability	ASTM D 5084 or CoE EM1110-2-1906	1/Moisture/Density Relationship
Constructed Soil Infiltration Layer	Field Density	ASTM D 6938 and D2216[A]	1/8,000 ft^2 per 6-inch lift[B]
	Grain Size	ASTM D 422 or D 1140	1/100,000 ft^2 per 6-inch lift[B]
	Atterberg Limits	ASTM D 4318	
	Coefficient of Permeability	ASTM D 5084 or CoE EM1110-2-1906	1/surface acre (evenly distributed through all lifts)[B, D]
	Thickness[C]	Texas Licensed Surveyor	1/10,000 ft^2

[A] This method is not applicable if the field measuring device (i.e., nuclear gauge) also measures moisture.
[B] A minimum of 1 of each of the designated tests must be conducted for each lift, regardless of cover area.
[C] If the option to use settlement plates to verify the thickness of the final cover layers is utilized, the procedure outlined in Section 2.3.2 will be followed.
[D] One permeability test is required for each acre of final cover construction area. In addition, one permeability test is required for each lift of final cover construction area (or reconstructed area). Therefore, a 1-acre final cover construction area constructed in three lifts will require three permeability tests (one for each lift), while a 9-acre final cover construction area constructed in three lifts will require one permeability test per acre for a total of nine permeability tests with three tests on each lift.

3 CONSTRUCTION QUALITY ASSURANCE FOR GEOSYNTHETIC CLAY LINER

3.1 Introduction

Geosynthetic clay liner (GCL) may be placed within the composite final cover system as an alternative to the soil infiltration layer. An alternative final cover system analysis of the composite final cover system with a GCL is included in Appendix IIIJ-B – GCL Alternative Final Cover Design Demonstration. The GCL was incorporated into the geotechnical analysis included in Appendix IIIE.

3.2 Material Requirements

The GCL material requirements are summarized in Table 3-1. The POR will obtain manufacturer's information for the actual GCL material to be delivered prior to shipment. Upon approval of the POR, GCL material will be shipped to the site. A certificate of analysis for each GCL lot will be submitted to the POR as part of the quality control documentation. The manufacturer will provide recommended seaming procedures and supporting tests (flow box or other suitable device) to the POR as part of the quality control documentation. The manufacturer must provide documentation showing the GCL seams are no more permeable than the GCL itself at a confining pressure anticipated in the field. Only a reinforced GCL which consists of bentonite encapsulated between two geotextiles (one nonwoven and one woven, needlepunched together) will be used. The nonwoven side of the GCL will be installed downward in contact with the intermediate cover.

The GCL will be shipped in rolls which are wrapped individually in relatively impermeable and opaque protective covers. The rolls will be stored in accordance with ASTM D 5888. GCL testing shall be performed by the manufacturer and a third-party independent laboratory. The POR will review the manufacturer's quality control certificates and verify that the GCL meets the values given in the plan or specifications for those tests listed in Table 3-1. All required quality control documentation will be approved by the POR prior to deployment of any GCL. The POR shall perform verification testing as required by additional detailed construction specifications or as required in the judgment of the POR.

Table 3-1
Required Testing and Properties for GCL Materials[1]

Tester	Test[11]	Property	Required Values	Standard Test Method	Frequency of Testing[9]
Supplier or GCL Manufacturer	Bentonite[2]	Free Swell (ml/2g)	24	ASTM D 5890	Per 50 tons and every truck or railcar
		Fluid Loss (ml)	18	ASTM D 5891	
	Geotextile	Mass Unit/Unit Area (oz/sy)	5.9/3	ASTM D 5261	per 200,000 ft^2
		Tensile Strength at Break[3] (%)	65	ASTM D 6768	
GCL Manufacturer's	GCL Product	Clay Mass/Unit Area[4] (lb/sf)	0.75	ASTM D 5993	per 40,000 ft^2
		Bentonite Moisture Content[2] (%)	35	ASTM D 5993	
		Tensile Strength[6] (lb/in)	23	ASTM D 6768	per 200,000 ft^2
		Permeability[2,5] (cm/s)	5×10^{-9}	ASTM D 5887	Per week for each production line
		Lap Joint Permeability[2](cm/s)	5×10^{-9}	Flow box or other suitable device	Per GCL adjoining material and lap type[7]
Independent Laboratory (Conformance Testing)	GCL Product	Clay Mass/Unit Area (lb/sf)	0.75	ASTM D 5993	Per 100,000 ft^2
		Permeability[7]	5×10^{-9}	ASTM D 5887	
		Direct Shear[8]	Refer to Section 6 for required values		

1 Tests and required values are developed using GRI – GCL3 – Test Methods, Required Properties, and Testing Frequencies of Geosynthetic Clay Liners (GCLs) – see also Note 10.
2 Tests to be performed on bentonite before incorporation into GCL. These values are maximum; all others are minimum.
3 The geotextiles in their as-received condition are evaluated by incubation in a forced air oven set at 60° C for 50 days, per ASTM D 5721. If individual yarns are used in reinforcing GCLs, they must also meet this same endurance criterion.
4 Bentonite is measured after oven drying per the stated test method.
5 Report last 20 permeability values, ending on production date of supplied GCL.
6 May also be performed as conformance testing.
7 Test at confining/consolidating pressures simulating field conditions for ASTM D 5887.
8 Not applicable for slopes of 7H:1V or flatter. Testing must be on material in hydrated state unless GCL is to include geomembrane on both sides of GCL, and must use strain rates, confining pressures, and other parameters which simulate field conditions. Only reinforced GCL (bentonite encapsulated between two geotextiles, one nonwoven and one woven, which are needle punched together) will be used for final cover.
9 Testing frequency is based on GRI-GCL3.
10 Sampling of GCL products for laboratory testing will be in accordance with ASTM D 6072.

3.3 GCL Installation

All installation of GCL will have continuous on-site monitoring during construction by the POR or technician under his direct supervision. The POR will follow general procedures set forth in ASTM D 6102 for the installation of GCL. The installer will provide a panel layout plan, which will be reviewed by the POR prior to any material deployment. The POR must review field conditions and approve a revised panel layout if the field conditions vary from the original plan layout.

3.3.1 Surface Preparation

The subgrade surface (intermediate cover) for the GCL installation must be stable. It will be smooth and free of all foreign and organic material, sharp objects, exposed soil or aggregate particles greater than ¾ inch (or less if recommended by the manufacturer), or other deleterious materials. Standing water or excessive water on the subgrade will not be allowed. If standing water is encountered it will be removed and soils with excessive moisture will be excavated and replaced with suitable borrowed soils to provide a firm, smooth-surfaced base for GCL placement. The POR will verify that the subgrade does not contain excessive moisture, and that soft soil is removed from the area. A firm, smooth-surfaced base grade will be established before GCL placement. The POR may require additional compaction and grading that will result in a smooth surface as necessary. The survey results for the subgrade layer will be included in the FCSER. Prior to GCL installation, the POR will verify the following:

- The grades below the GCL have been verified and accepted by the GCL contractor.
- Required documentation for constructed layers, if any, and subgrade preparation below the GCL have been completed and are acceptable.
- The supporting surface has been rolled to provide a smooth surface and does not contain materials which could damage the GCL or adjacent layer.

3.3.2 Deployment

Equipment used to deploy GCL over soil must not cause excessive rutting of the intermediate cover. Deployed GCL panels should contain no folds or excessive slack. Generators, gasoline or solvent cans, tools, or supplies must not be stored directly on GCL. Installation personnel must not smoke or wear damaging shoes when working on GCL.

GCL on sideslopes must not be unrolled in a direction perpendicular to the direction of the slope. GCL should be anchored at the top of the slope temporarily and then unrolled working from top of the slope so as to keep the material free of wrinkles and folds, and anchored at the bottom of the slope.

Horizontal seams will not be allowed on slopes if there is less than 5-feet of overlap on lower GCL panel, which is anchored in intermediate cover with 6-inches of intermediate cover material and 1-foot of runout. If anchoring is not used, then horizontal seams on side slopes should be staggered.

The POR will observe the GCL as it is deployed for even bentonite distribution, thin spots, or other panel defects. The POR will record all defects and the disposition of the defects (panel rejected, patch installed, etc.). All repairs are to be made in accordance with the specifications at the discretion of the POR. The POR will verify that only panels that can be covered in one day are deployed and that the GCL panels are not placed during wet, rainy weather. In accordance with the construction specifications, the POR will also verify the following:

- Proper GCL deployment techniques
- Proper overlap during deployment
- Seams between GCL panels are constructed per manufacturer's recommendations.
- The bentonite does not exceed the specified amount of hydration prior to covering
- Defects are patched and overlapped properly
- On sideslopes, the GCL is anchored at the top and then unrolled
- Observe that no debris is trapped beneath or within the GCL.

The POR will observe the GCL for premature hydration visually and by walking over the GCL to locate soft spots. All GCL that has prematurely hydrated according to the specifications will be removed and replaced with new GCL. These observations will be documented in the FCSER.

3.3.3 Patching

Patches are to be constructed in accordance with ASTM D 6102. Patches will extend at least 12 inches beyond the extent of damage.

3.3.4 Anchor Trench Backfill

GCL anchored in the same trench with overlying geomembrane according to Section 4.3.4 of this plan. Anchorage will be provided at the top of each slope that will receive GCL. The front edges of the anchor trench will be rounded to prevent sharp corners.

3.4 GCL Protection

Construction equipment (other than low contact pressure rubber-tired vehicles such as ATVs or golf carts) on the GCL (or overlain geosynthetics) will not be allowed. The CQA monitor will verify that small equipment such as generators is placed on scrap FML material (rub sheets). The erosion layer will be placed as soon as possible after installation of GCL/FML and drainage geocomposite using low ground pressure equipment as discussed under Section 4.5. Soil cover material placed directly over GCL should be non-calcareous and contain no rocks greater than that recommended by the manufacturer. The POR may require soil cover material to be tested for calcareous content. The CQA monitor will verify that GCL (or overlying geosynthetics) are not displaced or damaged while overlying materials are being placed.

4 CONSTRUCTION QUALITY ASSURANCE FOR GEOSYNTHETICS

4.1 Introduction

This section describes CQA procedures for the installation of geosynthetic components.

The scope of geosynthetic-related construction quality assurance includes the following elements:

- Geomembrane Liner
  - 40-mil LLDPE – smooth or textured on both sides on the top slopes and textured on both sides for the side slopes. Minimum required material properties for the geomembrane are listed in Table 4-2.
- Geosynthetic Clay Liner (GCL)
  - GCL as alternative to 18-inch-thick compacted clay infiltration layer. Minimum required material properties for the GCL are listed in Table 3-1.
- Drainage Layer
  - Drainage geocomposite (single-sided or double-sided on the top slopes and double-sided on the side slopes). Minimum required material properties for the drainage layer are listed in Table 4-3.

The overall goal of the geosynthetics quality assurance program is to assure that proper construction techniques and procedures are used, the geosynthetic contractor implements his quality control plan in accordance with this FCSQCP, the construction and testing of all elements of the final cover are performed in accordance with this FCSQCP and the Closure Plan (Appendix IIIJ), and that the project is built in accordance with the project construction drawings and technical specifications. The quality assurance program is intended to identify and define problems that may occur during construction and to observe that these problems are avoided and/or corrected before construction is complete. The FCSER, prepared after project completion, will document that the constructed facility meets design intent and specifications and that all final cover construction and QA/QC testing are performed in accordance with this FCSQCP.

4.2 Geosynthetics Quality Assurance

4.2.1 General

A geomembrane and a drainage geocomposite (and GCL, if used, and as described in Section 3 of this FCSQCP) are the geosynthetic components of the composite final cover system. All testing requirements and minimum required properties are listed in Tables 4-1, 4-2, and 4-3. Construction quality control for the geosynthetic installation will be performed by the geosynthetic installation contractor. Construction quality assurance for the geosynthetic installation will be performed by the POR to assure the geosynthetic is constructed as specified in the design. Construction must be conducted in accordance with the project construction drawings, which will be developed in accordance with this FCSQCP and the Closure Plan (Appendix IIIJ) at the time of each final cover construction and in accordance with specifications outlined in this FCSQCP. To monitor compliance, a quality assurance program will include the following:

- A review of the manufacturer's quality control submittals
- Material conformance testing
- Field and construction testing
- Construction monitoring.

The manufacturer's quality control submittals will include resin and physical material testing. Conformance testing refers to verification tests conducted by an independent third party laboratory to confirm the material meets the required specification prior to acceptance of the geosynthetic from the manufacturer. Field and construction testing includes testing that occurs during geosynthetics installation.

Quality assurance testing will be conducted in accordance with this FCSQCP, the project construction drawings, and specifications. Field testing will be observed by the CQA monitor. Documentation must meet the requirements of this FCSQCP.

4.3 Geomembrane

4.3.1 General

This section describes material types, handling, installation, and testing of geomembrane. Smooth or textured geomembrane will be used on top slopes (slopes less than 6 percent) and textured geomembrane will be used on sideslopes (typically 25 percent or 4H:IV slopes).

References within this section to the infiltration layer as the foundation layer for geomembrane installation should also be considered applicable to installations incorporating GCL as a substitution layer.

4.3.2 Delivery

Upon delivery of the geomembrane, the CQA monitor will observe that:

- The geomembrane is delivered in rolls and is not folded. Folded geomembrane is not acceptable because the highly crystalline structure of the geomembrane will be damaged if it is folded. Any evidence of folding (other than from the manufacturing process) or other shipping damage is cause for rejection of the material.
- Equipment used to unload and store the rolls does not damage the geomembrane.
- The geomembrane is stored in an acceptable location in accordance with the specifications and stacked not more than five rolls high. The geomembrane is protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, or other damage.
- Manufacturing documentation required by the specifications has been received and reviewed for compliance with the specifications. This documentation will be included in the FCSER.
- The geosynthetics receipt log form has been completed for materials received.

Damaged geomembrane may be rejected and removed from the site or stored at a location separate from accepted geomembrane. Geomembrane that does not have proper manufacturer's documentation must be stored at a separate location until documentation has been received, reviewed, and accepted.

4.3.3 Conformance Testing

Tests. One geomembrane sample will be obtained for every resin lot of material supplied and for each 100,000 square feet of geomembrane installed. The material will be sampled at the site by the CQA monitor. The samples will be forwarded to the third-party laboratory for the following conformance tests:

- Specific gravity/Density (ASTM D 1505 or alternate ASTM D 792, Method A if approved by the POR)
- Carbon black content (ASTM D 1603)
- Carbon black dispersion (ASTM D 5596)

- Thickness (ASTM D 5199 for smooth geomembrane and ASTM D 5994 for textured geomembrane)
- Tensile properties (ASTM D 638/Type IV Specimen).

The density of the geomembrane must be less than 0.939 g/cc; the carbon black content must be between 2 percent and 3 percent; and recycled or reclaimed material must not be used in the manufacturing process.

The design engineer may require additional test procedures and will inform the third party laboratory in writing. The POR must review all test results and report any nonconformance to the design engineer prior to product installation. In addition to the conformance thickness tests shown above, field thickness measurements must be taken at maximum 5-foot intervals along the leading edge of each geomembrane panel. No single measurement may be less than 10 percent below the required nominal thickness for the panel to be accepted (i.e., for 40 mil geomembrane a minimum thickness of 36 mils is required), and the average must be at least 40 mils.

Sampling Procedure. Samples will be taken across the entire roll width. Unless otherwise specified, samples should be approximately 15 inches long by the roll width. The CQA monitor must mark the machine direction and the manufacturer's roll identification number on the sample. The CQA monitor must also assign a conformance test number to the sample and mark the sample with that number.

Table 4-1
Required Testing for Geomembranes

Responsible Party	Type of Test		Standard Test Method	Frequency of Testing
Resin Manufacturer	Resin	Density	ASTM D 1505/D792	Per 100,000 ft^2 and every resin lot
		Melt Flow Index	ASTM D 1238 (Condition E)	
	Resin/Compound Evaluation		Per manufacturer's quality control specifications	Per manufacturer's quality control specifications
Geomembrane Manufacturer	Manufacturer's Quality Control		Testing per GRI Standard, GRI Test Method GM17 for 40 mil LLDPE[1]	
Conformance Testing by Third Party Independent Laboratory	Thickness[2]		ASTM D 5199 (smooth LLDPE), or D 5994 (textured LLDPE)	Per 100,000 ft^2 and every resin lot
	Specific Gravity/Density		ASTM D 1505/D 792	
	Carbon Black Content		ASTM D 1603	
	Carbon Black Dispersion		ASTM D 5596	
	Tensile Properties		ASTM D 6693 (Type IV)	
Third Party CQA	Destructive Seam Field Testing[3]	Shear & Peel	ASTM D 6392	Various for field, lab, and archive
	Non-Destructive Seam Field Testing	Air Pressure	ASTM D 5820	All dual-track fusion weld seams
		Vacuum	ASTM D 5641	All non-air pressure tested seams when possible

1 UV Resistance testing not required for geomembrane, which is to be immediately covered.

2 Field thickness measurements for each panel must be conducted. Use ASTM D 5199/D 5994 and perform 1 series of measurements along the leading edge of each panel, with individual measurements no greater than 5 feet apart. No single measurement will be less than 10% below the required nominal thickness in order for the panel to be acceptable.

3 Passing criteria for seams are listed in Table 4-2.

Table 4-2
Minimum Required Properties of 40-mil-thick Smooth and Textured (Both Sides) LLDPE Geomembrane

Property	Test Method	Minimum Required Property[7]	
		Smooth	Textured
Thickness, mils Minimum average Lowest individual reading Lowest individual of 8 of 10 readings	ASTM D 5199 (smooth) ASTM D 5994 (textured)	 40 36 NA	 38 34 36
Density, g/cc (maximum)	ASTM D 1505/ D 792	0.939	0.939
Asperity Height, mils	GRI GM12	NA	16
Tensile Properties[1] Break Strength, lb/in Break Elongation, %	ASTM D 6693, Type IV	152 800	60 250
Tear Resistance, lb	ASTM D 1004	22	22
Puncture Resistance, lb	ASTM D 4833	56	44
Break Resistance Strain, % (min)	ASTM D 5617	30	30
Carbon Black Content[2], %	ASTM D 1603	2.0-3.0	2.0 – 3.0
Carbon Black Dispersion[3], Category	ASTM D 5596	1 or 2 and 3	1 or 2 and 3
Oxidative Induction Time (OIT), minimum average Standard OIT, minutes, or High Pressure OIT, minutes	ASTM D 3895 ASTM D 5885	100 400	100 400
Oven Aging at 85ºC, minimum average Standard OIT – % retained after 90 days or High Pressure OIT – % retained after 90 days	ASTM D 5721 ASTM D 3895 ASTM D 5885	 35 60	 35 60
UV Resistance[4], minimum average High Pressure OIT[5] – % retained after 1600 hrs	GRI GM 11 ASTM D 5885	35	35
Seam Properties[6] Shear Strength, lb/in Peel Strength, lb/in	ASTM D 6392	60 50 (44, Extrusion Weld)	60 50 (44, Extrusion Weld)

1 Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction. Break elongation is calculated using a gauge length of 2.0 inches.
2 Other methods such as ASTM D 4218 or microwave methods are acceptable if an appropriate correlation can be established.
3 Carbon black dispersion for 10 different views; 9 in Categories 1 or 2 and 1 in Category 3.
4 The condition of the test should be 20 hr UV cycle at 75˚C followed by 4 hr. condensation at 60˚C.
5 UV resistance is based on percent retained value regardless of the original HP-OIT value.
6 Values listed for shear strength and peel strength are for 5 out of 5 specimens.
7 Minimum required property values are based on GRI GM17, except for seam properties, which are based on GRI GM19.

4.3.4 Anchor Trench Backfill

General fill material placed in anchor trenches will be uncontaminated earthen material and will be placed in uniform lifts, which do not exceed 12 inches in loose thickness and are compacted to at least 90 percent of Standard Proctor (ASTM D 698) maximum dry density. In-place moisture/density tests may be taken at the discretion of the CQA monitor to evaluate the quality of the backfill. The test results will not be required as part of the FCSER. Slightly rounded corners will be provided in anchor trenches where the geomembrane enters the trench so as to avoid sharp bends in the geomembrane. No loose soil (e.g., excessive water content) will be allowed to underlie the anchored components of final cover system.

4.3.5 Geomembrane Installation

Surface Preparation. Prior to any geomembrane installation, the subgrade (i.e., soil infiltration layer) should be inspected by the CQA and geosynthetics contractor. The POR or CQA monitor must observe the following:

- Lines and grades for the infiltration layer have been verified by the contractor and surveying of top of soil infiltration grades has been completed in accordance with Section 2.
- Soil infiltration layer construction has been completed in areas with no ponded water.
- The infiltration layer has been placed in accordance with the specification.
- No signs of desiccation exist, and the moisture content of the infiltration layer surface was controlled. A smooth drum roller will be used, as necessary, to minimize desiccation.
- The infiltration layer is free of surface irregularities and protrusions.
- The infiltration layer surface does not contain stones or other objects that could damage the geomembrane and underlain infiltration layer. The surface will be smooth and free of foreign and organic material, sharp objects, stones greater than 3/4 inches, or other deleterious material.
- The anchor trench dimensions have been checked, and the trenches are free of sharp objects and stones.
- The geomembrane will not be placed during inclement weather such as rain or high winds.
- Construction stakes and hubs have been removed and the resultant holes have been properly backfilled. There are no rocks, debris, or any other objects on the infiltration layer surface.

- The geosynthetics contractor, POR or his representative, and the permittee or his representative have certified in writing that the surface on which the geomembrane will be installed is acceptable.

Panel Placement. Prior to the installation of the geomembrane, the contractor must submit drawings showing the panel layout, indicating panel identification number, both fabricated (if applicable) and field seams, as well as details not conforming to the drawings. The POR must review field conditions and approve revised panel layout plan if the field conditions vary from the original plan layout.

The CQA monitor must maintain an up-to-date panel layout drawing showing panel numbers that are keyed to roll numbers on the placement log. The panel layout drawing will also include seam numbers and destructive test locations.

During panel placement, the POR or CQA monitor must:

- Observe that the geomembrane is placed in direct and uniform contact with underlying soil infiltration layer.
- Record roll numbers, panel numbers, and dimensions on the panel or seam logs. Measure and record thickness of leading edge of each panel at 5-foot maximum intervals. No single thickness measurement can be less than 10 percent below the required nominal thickness.
- Observe the sheet surface as it is deployed and record panel defects and repair of the defects (panel rejected, patch installed, extrudate placed over the defect, etc.) on the repair sheet. Repairs must be made in accordance with the specifications and located on a repair drawing.
- Observe that support equipment is not allowed on the geomembrane during handling (see Section 4.5 also).
- Observe that the surface beneath the geomembrane has not deteriorated since previous acceptance.
- Observe that there are no stones, construction debris, or other items beneath the geomembrane that could cause damage to the geomembrane.
- Observe that the geomembrane is not dragged across a surface that could damage the material. If the geomembrane is dragged across an unprotected surface, the geomembrane must be inspected for scratches and repaired or rejected, as necessary.
- Record weather conditions including temperature, wind, and humidity. The geomembrane must not be deployed in the presence of excess moisture (e.g., fog, dew, mist, etc.). In addition, geomembrane seaming operation should not be performed when the air temperature is less than 41°F or greater than 104°F, or when standing water or frost is on the ground, unless these requirements are waived by the design engineer. Excessive wind is that which can lift and move the geomembrane panels.

- Observe that people working on the geomembrane do not smoke, wear shoes that could damage the liner, or engage in activities that could damage the liner.
- Observe that the method used to deploy the sheet minimizes wrinkles but does not cause bridging and that the sheets are anchored to prevent movement by the wind (the contractor is responsible for any damage to or from windblown geomembrane). Excessive wrinkles should be walked-out or removed at the discretion of the CQA monitor.
- Observe that no more panels are deployed than can be seamed on the same day.
- Observe that seams are oriented parallel to the slip direction, and the textured material extends a minimum of approximately 5 feet out past the side slope.

The CQA monitor must inform both the contractor and the POR of the above conditions.

Field Seaming. The contractor must provide the POR with a seam and panel layout drawing and update this drawing daily as the job proceeds. No panels should be seamed until the panel layout drawing has been accepted by the POR. A seam numbering system must provide a unique number for each seam and be agreed to by the POR and contractor prior to the start of seaming operations. One procedure is to identify the seam by adjacent panels. For example, the seam located between Panels 306 and 401 would be Seam No. 306/401.

Prior to geomembrane welding, each welder and welding apparatus (both wedge and extrusion welder) must be tested, at a minimum, at daily start-up and immediately after any break, and/or anytime the machine is turned off for more than 30 minutes in accordance with the specifications to determine if the equipment is functioning properly. The FCSER should include the names for each seamer and the time and the temperatures for each seaming apparatus used each day. One trial weld will be taken prior to the start of work and when the type of geomembrane seam (e.g., smooth to smooth, smooth to textured, etc.) is changed. In addition, a trial weld will also be obtained prior to seaming the tie-in. The trial weld sample must be 3 feet long and 12 inches wide, with the seam centered lengthwise. The minimum number of specimens per trial weld test must be two coupons for shear and two coupons for peel. Both the inner and outer welds of dual track fusion welds must be tested for each peel test coupon (or additional coupons will be required). Trial weld samples must comply with “Passing Criteria for Welds” included in Section 4.3.6 – Construction Testing. The CQA monitor must observe welding operations, quantitative testing of each trial weld for peel and shear, and recording of the results on the trial weld form. The trial weld will be completed under conditions similar to those under which the panels will be welded. Regarding the locus-of-break patterns of the different seaming methods in shear and peel, the following are unacceptable break codes per their description in ASTM D 6392:

Hot Wedge: AD and AD-Brk>25%

Extrusion Fillet: AD1, AD2, AD-WLD (unless strength is achieved)

Additionally, there should be no apparent weld separation (i.e., greater than 1/8 inch). The third party strength tests must meet the manufacturer's specifications for the sample sheets, or percentage of the manufacturer's parent sheet strength as determined by the manufacturer. For dual-track fusion welds, both sides (the inner and outer weld) must meet the minimum requirements for a satisfactory peel test. Reference to 25% peel or separation during testing means 25% of the width of a single weld (i.e., full width of an extrusion weld, or a single track of a dual track fusion weld). If, at any time, the CQA monitor believes that an operator or welding apparatus is not functioning properly, a weld test must be performed. If there are wide changes in temperature (±30° Fahrenheit), humidity, or wind speed, the test weld should be repeated. The test weld must be allowed to cool to ambient temperature before testing. If a weld test fails the shear or peel test, the length of the non-passing weld will be identified at a 10-foot interval, and the failed area will be patched. Patching will be performed by placing additional geomembrane material over the failed area or removing the failed geomembrane weld and patching it with additional geomembrane per POR's direction. The welding for patches must comply with the welding passing criteria requirements outlined in this section.

Construction quality assurance documentation of trial seam procedures will include, at a minimum, the following:

- Documentation that trial seams are performed by each welder and welding apparatus prior to commencement of welding and prior to commencement of the second half of the workday.
- The welder, the welding apparatus number, time, date, ambient air temperature, and welding machine temperatures.

During geomembrane welding operations, the CQA monitor must observe the following:

- The contractor has the number of welding apparatuses and spare parts necessary to perform the work.
- Equipment used for welding will not damage the geomembrane.
- The extrusion welder is purged prior to beginning a weld until the heat-degraded extrudate is removed (extrusion welding only).
- Seam grinding has been completed less than one hour before seam welding, and the upper sheet is beveled (extrusion welding only).

- The ambient temperature, measured 6 inches above the geomembrane surface, is between 41°F and 104°F, or manufacturer's recommended temperature limits if they are more stringent.
- The end of old welds, more than five minutes old, are ground to expose new material before restarting a weld (extrusion welding only).
- The contact surfaces of the sheets are clean, free of dust, grease, dirt, debris, and moisture prior to welding.
- The weld is free of dust, rocks, and other debris.
- The seams are overlapped a minimum of 3 inches for extrusion and hot-wedge welding, or in accordance with manufacturer's recommendations, whichever is more stringent. Panels should be overlapped (shingled) in the downgrade direction.
- No solvents or adhesives are present in the seam area.
- The procedure used to temporarily hold the panels together does not damage the panels and does not preclude CQA testing.
- The panels are being welded in accordance with the plans and specification. Seams should be oriented parallel to the line of maximum slope with no horizontal seams on side slopes or top slopes. In corners and odd-shaped geometric locations, the number of field seams should be minimized.
- There is no free moisture in the weld area.
- Measure surface sheet temperature every two hours.
- Observe that at the end of each day or installation segment, unseamed edges are anchored with sandbags or other approved device. Penetration anchors will not be used to secure the geomembrane.

4.3.6 Construction Testing

Nondestructive Seam Testing. The purpose of nondestructive testing is to detect discontinuities or holes in the seam. It also indicates whether a seam is continuous and non-leaking. Nondestructive tests for geomembrane include vacuum testing for extrusion welds and air pressure testing for dual-track fusion welds. Nondestructive testing must be performed over the entire length of the seam.

Nondestructive testing is performed entirely by the contractor. The CQA monitor's responsibility is to observe and document that testing performance is in compliance with the specifications and document any seam defects and their repairs.

Nondestructive testing procedures are described below.

- For welds tested by vacuum method, the weld is placed under suction utilizing a vacuum box made of rigid housing with a transparent viewing window, a soft neoprene rubber gasket attached to the open bottom perimeter, a vacuum gauge on the inside, and a valve assembly attached to the vacuum hose connection. The box is placed over a seam section that has been thoroughly saturated with a soapy water solution (1 oz. soap to 1 gallon water). The rubber gasket on the bottom perimeter of the box must fit snugly against the soaped seam section of the liner, to ensure a leak-tight seal. The vacuum pump is energized, and the vacuum box pressure is reduced to approximately 3 to 5 psi gauge. Any pinholes, porosity, or non-bonded areas are detected by the appearance of soap bubbles in the vicinity of the defect. Dwell time must not be less than ten seconds.

- Air pressure testing is used to test double seams with an enclosed air space. Both ends of the air channel should be sealed. The pressure feed device, usually a needle equipped with a pressure gauge, is inserted into the channel. Air is then pumped into the channel to a minimum pressure of 30 psi. The air chamber must sustain the pressure for five minutes without losing more than 4 psi. Following a passed pressure test, the opposite end of the tested seam must be punctured to release the air. The pressure gauge must return to zero; if not, a blockage is most likely present in the seam channel. Locate the blockage and test the seam on both sides of the blockage. The penetration holes must be sealed after testing.

During nondestructive testing, the CQA monitor must perform the following work:

- Review technical specifications regarding test procedures.
- Observe that equipment operators are fully trained and qualified to perform their work.
- Observe that test equipment meets project specifications.
- Observe that the entire length of each seam is tested in accordance with the specifications.
- Observe all continuity testing and record results on the appropriate log.
- Observe that testing is completed in accordance with the project specifications.
- Identify the failed areas by marking the area with a waterproof marker compatible with the geomembrane and inform the contractor of any required repairs, then record the repair area on the repair log.
- Observe that repairs are completed and tested in accordance with the project specifications.
- Record completed and tested repairs on the repair log and the repair drawing.

Destructive Seam Testing. Destructive seam tests for geomembrane seams will be performed at a frequency of at least one test for each 500 linear feet of seam length.

At a minimum, a destructive test will be completed for each welding machine used for seaming. A destructive test will also be completed for individual repairs (or additional seaming for the failed welds) at intervals of at least one test per 500 linear feet. Only individual repairs (or additional seaming for failed seams) requiring more than 10 feet of seaming shall count toward the testing interval. The CQA monitor must perform additional tests if he suspects a seam does not meet specification requirements. Reasons for performing additional tests may include, but are not limited to the following:

- Wrinkling in seam area
- Non-uniform weld
- Excess crystallinity
- Suspect seaming equipment or techniques
- Weld contamination
- Insufficient overlap
- Adverse weather conditions
- Possibility of moisture, dust, dirt, debris, and other foreign material in the seam
- Failing tests.

There are two types of destructive testing required for the geomembrane installation: peel adhesion (peel) and bonded seam strength (shear) in accordance with ASTM D 6392. The purpose of peel and shear tests is to evaluate seam strength and to evaluate long-term performance. Shear strength measures the continuity of tensile strength through the seam and into the parent material. Peel strength determines weld quality. Test welds must be allowed to cool naturally to ambient temperature prior to testing.

The CQA monitor selects locations where seam samples will be cut for laboratory testing. Select these locations as follows:

- A minimum of one random test within each 500 feet of seam length. This is an average frequency for the entire installation; individual samples may be taken at greater or lesser intervals.
- Sample locations should not be disclosed to the contractor prior to completion of the seam.
- A maximum frequency must be agreed to by the contractor, POR, and the Operator at the preconstruction meeting. However, if the number of failed samples exceeds 5 percent of the tested samples, this frequency may be increased at the discretion of the POR. Samples taken as the result of failed tests do not count toward the total number of required tests.

Sampling Procedures. The contractor will remove samples at locations identified by the CQA monitor. The CQA monitor must:

- Observe sample cutting.
- Mark each sample with an identifying number that contains the seam number and destructive test number.
- Record sample location on the panel layout drawing and destructive seam log.
- Record the sample location, weather conditions, and reason sample was taken (e.g., random sample, visual appearance, result of a previous failure, etc.).

For each destructive test obtain one sample approximately 45 inches long by 12 inches wide, with the weld centered along the length. Cut two 1-inch-wide coupons from each end of the sample (a total of 4 coupons). The contractor must test two of these coupons in shear and two in peel (one shear and one peel from each end) using a tensiometer capable of quantitatively measuring the seam strengths. For double wedge welding, both sides of the air channel will be tested in peel. The CQA monitor must observe the tests and record the results on the destructive seam test log. A geomembrane seam sample passes the field testing when the break is a film tear bond (FTB) and the seam strength meets the required strength values for peel and shear given previously in Table 4-2 and below in the subsection "Passing Criteria for Welds" for both field testing and third party laboratory testing. As previously discussed, both welds have to pass for dual-track welds. Also, it is recommended that additional samples be obtained as discussed in the following paragraph if there is apparent separation of the weld during peel testing.

If one or both of the 1-inch specimens fail in either peel or shear, the contractor can, at his discretion: (1) reconstruct the entire seam between passed test locations, or (2) take two additional test samples 10 feet or more in either direction from the point of the failed test and repeat this procedure. For tracking purposes the additional samples should be identified by assigning an identifying letter to the initial destructive test sample number (i.e., DS-6A and B). Only satisfactory tests count toward the required minimum number, and additional tests (i.e., A and B) count as one test, if passing. If the second set of tests pass, the contractor can reconstruct or cap-strip the seam between the two passed test locations. If subsequent tests fail, the sampling and testing procedure is repeated until the length of the poor quality seam is established. Repeated failures indicate that either the seaming equipment or operator is not performing properly, and appropriate corrective action must be taken immediately.

If the field test coupons are satisfactory, divide the remaining sample into three parts: one 12-inch by 12-inch section for the contractor, one 12-inch by 16-inch section for the third party laboratory for testing, and one 12-inch by 12-inch section for the Operator to archive. The laboratory sample will be shipped to the third party laboratory for subsequent testing.

If the laboratory test fails in either peel or shear, the contractor must either reconstruct the entire seam between passing test locations or recover additional samples at least 10 feet on either side of the failed sample for retesting. Sample size and disposition must be as described in the preceding paragraph. This process is repeated until passed tests bracket the failed seam section. Seams must be bounded by locations from which passing laboratory tests have been taken. Laboratory testing governs seam acceptance. In no case can field testing of repaired seams be used for final acceptance.

Third Party Laboratory Testing. Destructive samples must be shipped to the third party laboratory for seam testing. Testing for each sample will include five bonded seam shear strength tests and five peel adhesion tests (ten for dual-track welds). For dual-track welds each peel test specimen (coupon) will be tested on both sides of the air channel (i.e., the inner and outer welds). All five specimens tested in peel and shear will meet the minimum strength requirements. The minimum peel strength and the minimum shear strength values must meet the manufacturer's specifications. Additionally, all 5 of the peel test coupons must have no greater than 25 percent seam separation. For dual-track welds if either weld exhibits greater than 25 percent separation or does not meet the required strength, that coupon is considered out of compliance and causes the weld to fail. The third party laboratory must provide test results in timely manner, in writing or via telephone, to the POR. Certified test results are to be provided within five days. The CQA monitor must immediately notify the POR in the event of a calibration discrepancy or failed test results.

Passing Criteria for Welds. Passing criteria are established by GRI GM-19 for geomembrane seams. A passing extrusion or fusion welded seam will be achieved when the following values are tested. The following values listed for shear and peel strengths are for all 5 test specimens for 40-mil smooth and textured LLDPE. Elongation measurements should be omitted for field testing.

- Shear strength (lb/in) 60
- Shear elongation at break (%) 50
- Peel strength (lb/in) 50 (44, Extrusion weld)
- Peel separation (%) 25

4.3.7 Repairs

Any portion of the geomembrane with a detected flaw, or which fails a nondestructive or destructive test, or where destructive tests were cut, or where nondestructive tests left cuts or holes, must be repaired in accordance with the specifications developed for each phase of final cover construction and consistent with application parts (e.g., material requirements, installation, testing, etc.) of Section 4 of this FCSQCP. The CQA monitor must locate and record all repairs on the repair sheet and panel layout drawing. Repair techniques include the following:

- Patching – used to repair large holes, tears, large panel defects, undispersed raw materials, contamination by foreign matter, and destructive sample locations.
- Extrusion – used to repair small defects in the panels and seams. In general, this procedure should be used for defects less than 3/8-inch in the largest dimension.
- Capping – used to repair failed welds or to cover seams where welds or bonded sections cannot be nondestructively tested.
- Removal – used to replace areas with large defects where the preceding methods are not appropriate. Also used to remove excess material (wrinkles, fishmouths, intersections, etc.) from the installed geomembrane. Areas of removal will be patched or capped.

Repair techniques include the following procedures:

- Abrade geomembrane surfaces to be repaired (extrusion welds only) no more than one hour prior to the repair.
- Clean and dry surfaces at the time of repair.
- Extend patches or caps at least 6 inches beyond the edge of the defect, and round corners of material to be patched and the patches to a radius of at least 3 inches. Bevel the top edges of patches prior to extrusion welding.
- Perform testing on repair seams consistent with Section 4.3.6 – Construction Testing.

4.3.8 Wrinkles

Wrinkles must be walked out or removed as much as possible prior to field seaming. Any wrinkles which can fold over must be repaired either by cutting out excess material or, if possible, by allowing the liner to contract by temperature reduction. In no case can material be placed over the geomembrane which could result in the geomembrane folding. The CQA monitor must monitor geomembrane for wrinkles and notify the contractor if wrinkles are being covered by soil. The CQA monitor is then responsible for documenting corrective action to remove the wrinkles.

4.3.9 Folded Material

Folded geomembrane must be removed. Remnant folds evident after deployment of the roll that are due to manufacturing process are acceptable.

4.3.10 Geomembrane Anchor Trench

The geomembrane anchor trench will be left open until seaming is completed. Expansion and contraction of the geomembrane should be accounted for in the geomembrane placement. Prior to backfilling, the depth of penetration of the geomembrane into the anchor trench must be verified by the CQA monitor at a minimum of 100-foot spacing along the anchor trench. The anchor trench should be filled in the morning when temperatures are coolest to reduce bridging of the geomembrane.

4.3.11 Geomembrane Acceptance

The contractor retains all ownership and responsibility for the geomembrane until acceptance by the Operator. In the event the contractor is responsible for placing cover over the geomembrane, the contractor retains all ownership and responsibility for the geomembrane until all required documentation is complete, and the cover material is placed. After panels are placed, seamed, tested successfully, and any repairs are made, the completed installation will be walked by the Operator's and contractor's representatives. Any damage or defect found during this inspection will be repaired properly by the installer. The installation will not be accepted until it meets the requirements of both representatives. In addition, the geomembrane will be accepted by the POR only when the following has been completed:

- The installation is finished.
- Seams have been inspected and verified to be acceptable.
- Required laboratory and field tests have been completed and reviewed.
- Required contractor-supplied documentation has been received and reviewed.
- As-built record drawings have been completed and verified by the POR. The as-built drawings show the true panel dimensions, the location of seams, trenches, pipes, appurtenances, and repairs.
- Acceptance of the FCSER by TCEQ.

4.3.12 Bridging

Bridging of geomembrane must be removed.

4.4 Drainage Geocomposite – Geonet and Geotextile

4.4.1 General

The drainage layer consists of a drainage geocomposite overlying the geomembrane and infiltration layer on the topslopes and sideslopes. The CQA monitor will provide on-site observation of drainage layer installation. The POR will make sufficient site visits during the drainage layer installation to document the installation in the FCSER.

Double-sided drainage geocomposite (non-woven geotextile bonded to the top and bottom of HDPE drainage net) will be installed on the sideslopes and single-sided drainage geocomposite (non-woven geotextile bonded to the top of the HDPE drainage net) will be installed on the top slope. The drainage geocomposite will have the minimum properties listed in Table 4-3.

Manufacturer quality control testing procedures and frequencies for drainage geocomposite are discussed in Section 4.4.3 and Table 4-3.

The drainage layer for Subtitle D areas has been designed to include a network of drainage pipes that will convey flow from the drainage geocomposite to either the final cover drainage letdowns or the perimeter drainage system. The drainage layer component design and specifications (including the pipe design and specifications) are included in Appendix IIIJ-A-A.

4.4.2 Delivery

Upon delivery the CQA monitor must observe the following:

- The drainage geocomposite is wrapped in rolls with protective covering.
- The rolls are not damaged during unloading.
- Protect the drainage geocomposite from mud, soil, dirt, dust, debris, cutting, or impact forces.
- Each roll must be marked or tagged with proper identification.

Any damaged rolls will be rejected and removed from the site or stored at a location separate from accepted rolls, designated by the Operator. Rolls that do not have proper manufacturer's documentation will also be stored at a separate location until documentation has been received and approved. The references herein to drainage geocomposite also apply to geonet and geotextile as applicable.

4.4.3 Testing

The drainage geocomposite manufacturer (or supplier) will conduct quality control testing and certify that materials delivered to the site comply with project specifications for each phase of final cover construction. The minimum testing frequency will be one test sample per 100,000 square feet of drainage geocomposite (or geonet/geotextile). The material certifications will be reviewed by the POR to verify that the drainage geocomposite meets the values given in the FCSQCP or specifications. Third party laboratory testing will be required for drainage layer geocomposite transmissivity.

Geonet will be tested by the manufacturer for thickness, tensile strength, and carbon black content. Geotextile will be tested for mass per unit area, grab tensile strength, and Apparent Opening Size (AOS). The finished drainage geocomposite will be tested for peel adhesion and transmissivity. Table 4-3 summarizes testing requirements for drainage geocomposite and geotextile.

Where optional procedures are noted in the test method, the specification requirements will prevail. The CQA monitor will review test results and will report any nonconformance to the POR and to the contractor.

4.4.4 Installation

Surface Preparation. Prior to drainage geocomposite installation, the CQA monitor must observe the following:

- Lines and grades have been verified by the surveyor (where required).
- The subgrade has been prepared in accordance with the specifications and the geomembrane has been installed as outlined in Section 4.3.5.
- The geomembrane installation, including required documentation, has been completed.
- The supporting surface (i.e., top of geomembrane) does not contain stones or debris that could damage the drainage geocomposite or the geomembrane.

Drainage Geocomposite Placement. During placement, the CQA monitor must:

- Ensure that single-sided geocomposite is placed on slopes less than 7H:1V and double-sided geocomposite is placed on slopes equal to or steeper than 7H:1V. Note that placement of double-sided geocomposite on slopes less than 7H:IV is an acceptable substitution.
- Observe the drainage geocomposite as it is deployed and record defects and disposition of the defects (i.e., panel rejected, patch installed, etc.). Repairs are to be made in accordance with the specifications.

- Verify that equipment used does not damage the drainage geocomposite or underlying geomembrane by handling, trafficking, leakage of hydrocarbons, or by other means.
- Verify that people working on the drainage geocomposite do not smoke, wear shoes that could damage the geocomposite, or engage in activities that could damage the geocomposite or underlying geomembrane.
- Verify that the drainage geocomposite is anchored to prevent movement by the wind (the contractor is responsible for any damage resulting to or from windblown geocomposite).
- Verify that the drainage geocomposite remains free of contaminants such as soil, grease, fuel, etc.

Table 4-3
Geotextile and Drainage Geocomposite
Required Testing and Properties[1]

Material	Test	Standard	Required Property[5]	Test Frequency
Geotextile (Before Lamination)	Unit Weight Apparent Opening Size Grab Strength Tear Strength Puncture Strength Permeability	ASTM D 5261 ASTM D 4751 ASTM D 4632 ASTM D 4533 ASTM D 6241 ASTM D 4491	6 oz/sy 0.25 mm 157 lbs 55 lbs 310 lbs 0.2 sec^{-1}	See Note 1
HDPE Geonet (Before Lamination)	Specific Gravity Thickness Carbon Black Tensile Strength	ASTM D 1505 ASTM D 5199 ASTM D 1603 ASTM D 7179	0.95 g/cm^3 0.25 inch 2% 45 lb/in	Per 50,000 lb. Per 50,000 lb. Per 100,000 lb. Per 50,000 lb.
Drainage Geocomposite	Transmissivity[2, 4]	ASTM D 4716	$2.13x10^{-3}$ m^2/s (Topslope/ single-sided) $5.80x10^{-4}$ m^2/s (Sideslope/ double-sided)	Per 200,000 lb.
	Strength[3]	ASTM D 5321	Refer to Section 6 for geotechnical strength requirements.	Per 100,000 lb.
	Peel Adhesion	ASTM D 7005	1.0 lb/in	Per 100,000 lb.

1 Minimum Average Roll Valve (MARV) except Apparent Opening Site (AOS) is Maximum Average Roll Valve (MaxARV).
2 Minimum required property values for the geotextile and HDPE geonet are based on calculations provided in Appendix IIIJ-A-A. The geonet properties are based on values specified in GRI standard GM-13. In addition, each material will be tested prior to construction to verify that it meets the minimum required properties. Actual geonet thickness, if greater than the minimum, will be determined by manufacturer quality control testing and recommendations.
3 The adhesion and interface friction angle of the geocomposite components will be determined to verify they meet the values used in the slope stability analysis of Appendix IIIE-A. This test may be performed using stack testing (i.e., performing a single test combining all components of the final cover system). The slope stability analysis may be repeated to demonstrate that the actual materials used for construction will result in an acceptable factor of safety.
4 Different testing gradients for the geocomposite may be specified in the project specifications if the specified gradients are not applicable or no longer conservative in view of existing or expected slope conditions.
5 Minimum required property values for the geotextile and drainage geocomposite transmissivity are based on calculations provided in Appendix IIIJ-A-A. In addition, each material will be tested prior to construction to verify that it meets the minimum required properties.
6 Reference to "geocomposite thickness" within the LQCP and in supporting calculations (Appendix IIIJ-A-A) refers to the thickness of the geonet, not the overall thickness of the geocomposite. The transmissivity values used for the calculations supporting this LQCP may or may not be representative of actual transmissivity values for every geocomposite manufacturer and may require a prospective material supplier to provide a geocomposite that varies in thickness from the geocomposite presented in this LQCP in order to meet the minimum transmissivity criteria set forth in this LQCP.
7 Higher mass/unit area geotextile may be used; however, it will be required to pass all strength requirements and geocomposite transmissivity requirements under varying loading conditions.

- Observe that the drainage geocomposite is laid smooth and free of tension, stress, folds, wrinkles, or creases.
- Observe that on slopes the drainage geocomposite is secured with sand bag anchoring at the top of the slope and then rolled down the slope.
- Observe that adjacent rolls of drainage geocomposite are overlapped, tied, and seamed in accordance with the specifications and manufacturer's recommendations.
- Observe that tying is with plastic fasteners (i.e., zip ties) in accordance with the manufacturer's recommendations. In the absence of other specifications the geonet panels will be tied approximately every 5 feet along the roll length (edges) and every 1 foot along the roll width (ends).
- Observe that geotextile component is overlapped and either heat bonded or sewn together.
- Observe that the drainage collection pipe is secured to the drainage geocomposite by using zip ties at a minimum frequency of 50 feet.

4.4.5 Repairs

Repair procedures include:

- Holes or tears in the drainage geocomposite will be repaired by placing a patch extending 2 feet beyond the edges of the hole or tear.
- Secure patch to the originally installed drainage geocomposite by tying every 6 inches.
- Where the hole or tear width across the roll is more than 50 percent of the roll width, the damaged area will be cut out across the entire roll, and the two portions of the drainage geocomposite will be jointed.
- Patches will be installed in accordance with "Drainage Geocomposite Placement" under Section 4.4.4.

4.5 Equipment on Geosynthetic Materials

Construction equipment on the composite will be minimized to reduce the potential for geosynthetic material damage or puncture. The CQA monitor will verify that small equipment such as generators are placed on scrap geomembrane material (rub sheets) above geosynthetic materials in the final cover system. The erosion layer will be placed using low ground pressure equipment. The CQA monitor will verify that the geosynthetics are not displaced while the soil layers (i.e., erosion layer) are being placed.

Unless otherwise specified by the POR, lifts of soil material placed over geosynthetics will conform to the following guidelines:

Equipment Ground Pressure (psi)	Minimum Lift Thickness (in.)
< 5.0	12 and under
5.1 - 8.0	18
8.1 - 16.0	24
>16.0	36

No equipment will be left running and unattended over the constructed geosynthetics.

4.6 Reporting

The POR on behalf of the Operator will submit to the TCEQ a FCSER for approval of the constructed final cover system. Section 7 describes the documentation requirements.

5 CONSTRUCTION QUALITY ASSURANCE FOR EROSION LAYER

The erosion layer will consist of a minimum of 12 inches of earthen material and will be capable of sustaining native and introduced vegetative growth and must be seeded immediately after completion of the final cover. Temporary or permanent erosion control materials may be used to minimize erosion and aid establishment of vegetation. The physical characteristics of the erosion layer will be evaluated through visual observation (and laboratory testing if deemed necessary by the POR) before construction and visual observation during construction. Additional testing during construction will be at the discretion of the POR.

The erosion layer may be placed using any appropriate equipment capable of completing the work and should only receive the minimal compaction effort required for stability. Under no circumstances will the construction equipment come in direct contact with the installed geosynthetics. Equipment used to install the erosion layer must meet the requirements of Section 4.5.

The thickness of the erosion layer will be verified with surveying procedures at a minimum of one survey point per 10,000 square feet of constructed area by a qualified surveyor with a minimum of one reference point. The survey results for the erosion layer will be included in the FCSER.

During construction the CQA monitor will:

- Verify that grade control is performed prior to work.
- Verify that underlying geosynthetic installations are not damaged during placement operations or by survey grade controls. Mark damaged geosynthetics and verify that damage is repaired.
- Monitor haul-road thickness over installed geosynthetics and verify that equipment hauling and material placement meet equipment specifications. (See Section 4.5).
- The POR will coordinate with the project surveyor to perform a thickness verification survey of the erosion layer materials upon completion of placement operations. Verify corrective action measures as determined by the verification survey. Thickness surveying to determine minimum erosion layer thickness will be performed similar to the infiltration layer thickness verification discussed in Section 2 and shown in Table 2-1.

6 GEOTECHNICAL STRENGTH TESTING REQUIREMENTS

This section of the FCSQCP addresses the geotechnical strength requirements for the Subtitle D final cover system. Each component of the final cover system is subject to the material testing requirements outlined in Sections 2 through 5 of this FCSQCP, as applicable. Additionally, prior to each final cover construction event, geotechnical testing (interface and material internal shear strength testing) will be performed of the materials and material interfaces used in the design. Testing will be performed using actual materials to verify that the final cover meets the material strength requirements (see Table 6-2). A geotechnical analysis (infinite slope stability analysis) using the example strength parameters listed in Table 6-1 is presented in Appendix IIIE-A-4.

Note that the interface strength values for the various final cover components provided in Table 6-1 are examples only, and do not represent the minimum required interface strength parameters required for the final cover system design. The Minimum Required Interface Friction Strength Values for Conformance Testing shown in the table on page IIIE-A-4-11 (Appendix IIIE-A-4) are also presented in Table 6-2 and represent the minimum required interface test results to demonstrate conformance of the final cover system components, including results for stack testing, testing of individual material interfaces, and internal shear strength testing. Note that the values presented in Tables 6-1 and 6-2 are representative of the 4H:1V final cover system slopes and are considered the worst-case condition when compared to the relatively flat (4 percent slope) top slope of the landfill.

The testing outlined in Tables 6-1 and 6-2 will be performed under the supervision of the POR by a third party independent geotechnical laboratory. The POR will ensure that (1) the strength values presented in Table 6-2 are met, or (2) provide an updated geotechnical analysis (i.e., infinite slope stability analysis) in the FCSER that will be submitted to TCEQ after each final cover construction event. If laboratory stack testing is selected for confirmation strength testing as outlined in Table 6-2, the results of the stack testing must meet or exceed the shear strength values set forth in Table 6-2. In the event the testing results do not meet the minimum values set forth in Table 6-2, an updated geotechnical analysis (infinite slope stability analysis as presented in Appendix IIIE-A-4) will be required incorporating the strength parameters obtained from stack testing (as representative of the worst case scenario for the final cover configuration). If the geotechnical analysis is updated, the resulting factor of safety values must meet the recommended minimum factor of safety values established in Appendix IIIE-A-4 for both peak and residual strength (i.e., 1.5 and 1.0, respectively).

Table 6-1
Example Strength Values for Various Final Cover Components[1, 2, 3]

Final Cover System Component Interface	Peak Strength		Residual Strength	
	Adhesion (psf)	Friction Angle (degree)	Adhesion (psf)	Friction Angle (degree)
Erosion Layer/Geocomposite Interface	200	20	270	15
Double-sided Geocomposite/ Textured LLDPE Geomembrane Interface	200	19	120	10
Textured LLDPE Geomembrane/Clay Infiltration Layer Interface	210	18	50	14
Textured LLDPE Geomembrane/GCL	850	25	400	10
GCL Internal (Reinforced Only)	800	18	380	11
GCL/Intermediate Cover Soils	100	--	18	--

Table 6-2
Minimum Required Interface Friction Strength Values for Conformance Testing of Final Cover Components[1,2,3]

Final Cover System Component Interface	Peak Strength[4]		Residual Strength[4]	
	Adhesion (psf)	Friction Angle (degree)	Adhesion (psf)	Friction Angle (degree)
All Material Interfaces and Internal Shear Strength	65	6	35	5

Notes (Tables 6-1 and 6-2)

1 The adhesion and interface friction angle of final cover components will be determined using ASTM D5321 by a third party verified geotechnical laboratory to verify they meet the values used in the slope stability analysis included in IIIE-A.

2 The required testing may be performed using stack testing (i.e., performing a single test combining all components of the final cover) or by testing the individual interfaces listed in Table 6-1.

3 The slope stability analysis may be repeated to demonstrate that the actual materials used for construction will result in an acceptable factor of safety. Refer to Appendix IIIE-A for detailed strength information and procedures for calculating factors of safety.

4 The minimum shear strength values shown in Table 6-2 result in factors of safety of 2.06 for peak strength and 1.17 for residual strength conditions.

7 DOCUMENTATION

The quality assurance plan depends on thorough monitoring and documentation of construction activities. Therefore, the POR and CQA monitor will document that quality assurance requirements have been addressed and satisfied. Documentation will consist of daily recordkeeping, testing and installation reports, nonconformance reports, progress reports, photographic records, and design and specification revisions. The appropriate documentation will be included in the FCSER. Standard report forms will be provided by the POR prior to construction.

7.1 Preparation of FCSER

The POR, on behalf of the Operator, will submit to the TCEQ a FCSER for approval of each portion of final cover system constructed.

Testing, evaluation, and submission of the FCSER for the final cover system during construction will be in accordance with this FCSQCP. The construction methods and test procedures documented in the FCSER will be consistent with this FCSQCP.

At a minimum, the FCSER will contain:

- A summary of all construction activities.
- All laboratory and field test results.
- Third party conformance test results for geocomposite transmissivity and strength parameters.
- Manufacturer's certifications for all geosynthetics.
- Documentation of thickness of the infiltration and erosion layers by a Texas registered Surveyor.
- Sampling and testing location drawings.
- A description of significant construction problems and the resolution of these problems.
- As-built record drawings, including all previous FCSER submittals and dates of TCEQ approval.
- A statement of compliance with the permit FCSQCP and construction plans.

- The reports will be signed and sealed by a professional engineer(s) licensed in the State of Texas.

The as-built record drawings will accurately site the constructed location of work items, including the anchor trenches. The POR will review and verify that as-built drawings are correct. As-built drawings will be included in the FCSER.

7.2 Reporting Requirements

The FCSER will be signed and sealed by the POR, signed by the site operator, and submitted to the MSW Permits Section of the Waste Permits Division of the TCEQ for approval.

APPENDIX IIIJ-A-A

FINAL COVER DRAINAGE LAYER DESIGN

Includes pages IIIJ-A-A-1 through IIIJ-A-A-52

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Required: The purpose of this appendix is to design the drainage layer that is located between the geomembrane and erosion layer. As shown on Drawing A.11 in Appendix IIIA-A (Details FC1 and FC2), the drainage layer will consist of a single-sided drainage geocomposite on the topslope and a double-sided geocomposite on the sideslope at this site. In addition, a network of drainage pipes will convey flow from the drainage geocomposite to either a drainage letdown structure (refer to Sheet IIIJ-A-A-14) or to the perimeter drainage system (as shown on Drawing A.13, Detail FC5). A detail of the drainage pipe in the final cover is provided on Drawing A.12, Detail FC4. The following design criteria are used to design the geocomposite drainage layers.

1. Sideslope. The sideslope drainage layer is designed to prevent uplift forces from occurring on the erosion layer. This will ensure the stability of the erosion layer.

2. Topslope. The topslope drainage layer is designed so that the erosion layer located on the topslope does not become completely saturated and is designed to withstand potential estimated hydrostatic uplift forces.

3. Topslope/Sideslope Transition. This drainage layer is designed to prevent uplift forces from occurring on the erosion layer along the grade break. This will ensure the stability of the erosion layer.

Method: **Sideslope**

1. Determine the transmissivity of the specified drainage geocomposite. The laboratory transmissivity is reduced to simulate the actual transmissivity after strength and environmental factors are taken into consideration.

2. Determine the capacity of the drainage geocomposite using the HELP model to compare the maximum head on the liner to the thickness of the geocomposite.

3. Determine the pipe capacity, spacing, and size to ensure that no uplift forces on the erosion layer will occur (i.e., demonstrate that the flow depth within the drainage geocomposite is less than the drainage geocomposite thickness).

Topslope

1. Determine the transmissivity of the specified drainage geocomposite. The laboratory transmissivity is reduced to simulate the actual transmissivity after strength and environmental factors are taken into consideration.

2. Use HELP to demonstrate that the proposed pipe spacing and single-sided drainage geocomposite are adequate to keep the erosion layer from becoming completely saturated. Also, verify that potential uplift forces will not cause a stability issue with the erosion layer.

Topslope/Sideslope Transition

1. Estimate the percolation into the drainage geocomposite from the erosion layer. To provide for a conservative anaysis, it is assumed that the permeability of the cover soils is equal to the percolation rate into the drainage geocomposite.

2. Determine the capacity of the drainage geocomposite based on the estimated sideslope transmissivity and compare to the estimated flow rate that occurs due to infiltration.

3. Determine the pipe capacity, spacing, and size to ensure that no uplift forces on the erosion layer will occur (i.e., demonstrate that the flow depth within the drainage geocomposite is less than the drainage geocomposite thickness).

References:

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2. Maidment, David R., *Handbook of Hydrology* . McGraw-Hill, Inc. 1993.
3. *The Hydrologic Evaluation of Landfill Performance (HELP) Model, User's Guide for Version 3.* EPA/600/R-94/168a, September 1994.
4. Giroud, J.P., Zornberg, J.G., Zhao, A., *Hydraulic Design of Geosynthetic and Granular Liquid Collection Layer* , 2000.
5. Gray, Donald H., Koerner, Robert M., Qian, Xuede, Geotechnical Aspects of Landfill Design and Construction, 2002.
6. Geosynthetic Institute, GRI Standard GC-8, 2001.
7. GSE Drainage Design Manual, Second Edition, June 2007.

Solution:

1. **Sideslope**

1.1 Determine the transmissivity of the specified drainage geocomposite.

Final Cover Drainage Layer Thickness:

Specified Design:
Drainage layer consists of a double-sided geocomposite - 250 mil geonet with 6 oz/sy geotextiles.

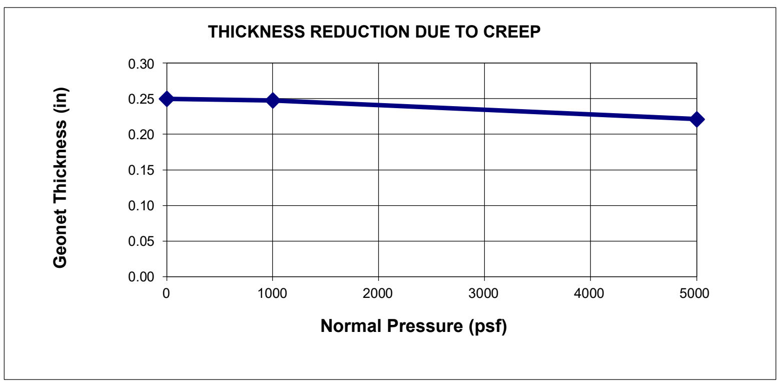
Assume the final cover drainage layer will undergo compression due to the weight of soil (erosion layer).

Unloaded Geocomposite Drainage Layer Thickness =	0.250	in
Unit Weight of Erosion Layer Soil =	120	pcf
Thickness of Erosion Layer =	1	ft

Table 1.1 - Final Cover Drainage Layer Thickness

Fill Condition	Slope %	d_S[1] (ft)	P[2] (psf)	t[3] (in)	t[3] (m)
Closed (sideslope)	25	1.03	124	0.250	0.006

[1] d_S is the vertical thickness of soil above the final cover drainage layer.
[2] P is the pressure on the final cover drainage layer due to the weight of the erosion layer soil.
[3] t is the thickness of the final cover drainage layer after being subjected to compression based on the chart below adapted from Reference 7.



Reduction Factors for Strength and Environmental Conditions:

Table 1.2 - Reduction Factors

Reduction Factors		Closed Condition
RF_{IN}	Delayed Intrusion	1.1
RF_{CC}	Chemical Clogging	1.15
RF_{BC}	Biological Clogging	2.0
Total Reduction Factor[2]		2.53

Overall Factor of Safety to Account For Uncertainties	2.0
Overall Reduction Factor (ORF)[3]	5.06

[1] Values are obtained from References 1, 5, and 6.

[2] The Total Reduction Factor is the product of all the reduction factors.

[3] The Overall Reduction Factor is the product of the Total Reduction Factor and Overall Factor of Safety to account for uncertainties.

Required Transmissivity Data:

The required minimum transmissivity for the 250-mil-thick double-sided geocomposite is shown on Sheet IIIJ-A-A-12.

Calculate the Design Transmissivity (T_{DES}) of the final cover geocomposite drainage layer:

Table 1.3 - Transmissivity of the Specified Geocomposite Material

Fill Condition	P[1] (psf)	t[2] (in)	T[3] (m^2/s)	ORF[4]	T_{DES}[5] (m^2/s)	T_{DES}[5] (sf/s)	k[6] (cm/s)
Closed (sideslope)	124	0.250	5.80E-04	5.06	1.15E-04	1.23E-03	19.43

[1] P is the pressure on the final cover drainage layer due to the weight of erosion layer from Table 1.1.

[2] t is the drainage layer thickness from Table 1.1.

[3] T is obtained from the specified transmissivity values for a representative geocomposite drainage layer (250-mil-thick geonet with 6 oz/sy geotextiles) as shown on Sheet IIIJ-A-A-12.

[4] ORF is the Overall Reduction Factor obtained from Table 1.2.

[5] T_{DES} is the design transmissivity value calculated using the following equation:

$$T_{DES} = T / ORF$$

[6] T_{DES} is the design transmissivity value calculated using the following equation:

$$k = T_{DES}/t$$

1.2 Determine the capacity of the drainage geocomposite using the HELP model to compare the maximum head on the liner to the thickness of the geocomposite.

$t_{geocomposite}$		>	h_{max}	
(Thickness of the drainage geocomposite)			(Maximum Head Estimated by HELP Model. Refer to page IIIJ-A-A-17)	
0.250	in	>	0.030	in

Since the thickness of the drainage geocomposite is greater than the maximum head on the liner, the actual flow depth is contained within the geocomposite and the design is acceptable. Therefore, the maximum spacing of 160 feet between the drain pipes located on the 4H:1V sideslopes is acceptable. As shown on Sheet IIIJ-A-A-14, the distance between the pipes on the sideslope is equal to no more than 160 feet.

1.3 Determine pipe size required to convey the design flow for the specified pipe length and pipe outlet spacing.

Maximum flow to a collection pipe has been estimated by using the HELP model.
From the HELP model, the lateral drainage collected per unit length of drainage geocomposite is:

Lateral Drainage Collected $d_{collected}$=	0.171	ft/day, (drainage collected expressed as depth from HELP)
L (4H:1V)=	160	ft (sideslope length between the pipe and the grade break)
q_p =	$d_{collected}$ * 1 * L	cfs
q_p =	0.00032	cfs (Flow per Unit Length of Pipe, q_p)

Maximum Flow to Collection Pipe for Various Pipe Lengths:

$Q_{max} = L_{p\text{-}max} \times q_p$

Pipe Length, $L_{p\text{-}max}$ (ft)	Flow per Unit Length of Pipe, q_p (cfs/ft)	Maximum Pipe Flow, Q_{max}[1] (cfs)
< 500	0.00032	0.158
500-1,430	0.00032	0.453

[1] Maximum pipe flow is calculated using the maximum pipe length in each range.

Capacity of collection pipe:

Use Manning's Equation to determine the pipe capacity.

Pipe Capacity (Q_{pc}):

$$Q_{pc} = \frac{1.49AR^{2/3}S^{1/2}}{n}$$ (from Chapter 10 of Ref 2)

where:
- Q_{pc}: Full flow pipe capacity (cfs)
- d: Diameter (inches), HDPE ADS collection pipe
- A: Flow area (sf), Cross section of pipe
- P: Perimeter (ft)
- R: Hydraulic radius (ft) = Cross section (A) / Perimeter (P)
- S: Pipe slope (ft/ft)
- n: Manning's roughness coefficient

Pipe Capacity for Different Pipe Sizes						
d (inches)	A (sf)	P (ft)	R (ft)	S (ft/ft)	n	Q_{pc} (cfs)
4	0.09	1.05	0.08	0.005	0.010	0.171
6	0.19	1.57	0.12	0.005	0.010	0.474

Fullness Ratio of Pipe (f):

$f = Q_{max}/Q_{pc}$ (Ratio of maximum calculated flow (Q_{max}) to total flow capacity (Q_{pc}) for pipe)

Fullness Ratio of Pipe (f)					
Fill Condition	Pipe Length (ft)	d (inches)	Q_{max} (cfs)	Q_{pc} (cfs)	f
Closed (sideslope)	< 500	4	0.158	0.171	0.93
	500-1,430	6	0.453	0.474	0.96

Conclusion: A pipe size of 4 inches is acceptable for the sideslope area for pipes lengths of 500 feet and shorter. A pipe size of 6 inches is acceptable for pipe lengths between 500 and 1,430 feet.

A minimum open area of 1 square inch per foot of drainage pipe is recommended by the U.S. Soil Conservation Service and the U.S. Bureau of Reclamation. Therefore, the number of 0.5 in diameter holes per foot will be 6 and total slot area provided by the manufacturer will provide documentation that minimum of 1 square inch of total slot area is provided per linear foot of pipe.

2. Topslope

2.1 Determine the transmissivity of the specified drainage geocomposite.

Final Cover Drainage Layer Thickness:

Specified Design:
Drainage layer consists of single-sided geocomposite drainage layer - 250 mil geonet with 6 oz/sy geotextile.

Assume the final cover drainage layer will undergo compression due to the weight of soil (erosion layer).

Unloaded Geocomposite Drainage Layer Thickness =	0.25	in
Unit Weight of Erosion Layer Soil =	120	pcf
Thickness of Erosion Layer =	1	ft

Table 2.1 - Final Cover Drainage Layer Thickness

Fill Condition	Slope %	d_S[1] (ft)	P[2] (psf)	t[3] (in)	t[3] (m)
Closed (topslope)	4	1.001	120	0.250	0.006

[1] d_S is the vertical thickness of soil above the final cover drainage layer.
[2] P is the pressure on the final cover drainage layer due to the weight of the erosion layer soil.
[3] t is the thickness of the final cover drainage layer after being subjected to compression based on the chart shown above in Step 1.2 adapted from Reference 7.

Reduction Factors for Strength and Environmental Conditions:

Table 2.2 - Factors of Safety

Reduction Factors		Closed Condition
RF_{IN}	Delayed Intrusion	1.1
RF_{CC}	Chemical Clogging	1.15
RF_{BC}	Biological Clogging	2.0
Total Reduction Factor[2]		2.53

Overall Factor of Safety to Account For Uncertainties	2.0
Overall Reduction Factor (ORF)[3]	5.06

[1] Values are obtained from References 1, 5, and 6.
[2] The Total Reduction Factor is the product of all the reduction factors.
[3] The Overall Reduction Factor is the product of the Total Reduction Factor and Overall Factor of Safety to account for uncertainties.

Required Transmissivity Data:

The required minimum transmissivity for the 250-mil-thick single-sided geocomposite is shown on Sheet IIIJ-A-A-13.

Calculate the Design Transmissivity (T_{DES}) and permeability of the final cover geocomposite drainage layer:

Table 2.3 - Required Transmissivity

Fill Condition	P[1] (psf)	t[2] (in)	T[3] (m^2/s)	ORF[4]	T_{DES}[5] (m^2/s)	k[6] (cm/s)
Closed (topslope)	120	0.250	2.13E-03	5.06	4.21E-04	6.63

[1] P is the pressure on the final cover drainage layer due to the weight of erosion layer from Table 2.1.

[2] t is the drainage layer thickness from Table 2.1.

[3] T is obtained from the specified transmissivity values for a representative geocomposite drainage layer (250-mil-thick geonet with 6 oz/sy polypropylene geotextile) as shown on Sheet IIIJ-A-A-13.

[4] ORF is the Overall Reduction Factor obtained from Table 2.2.

[5] T_{DES} is the design transmissivity value calculated using the following equation:

T_{DES} = T / (FS Factor)

[6] k is the hydraulic conductivity and calculated using the following equation:

k = T_{DES} / t

2.2 Use HELP to demonstrate that the drainage geocomposite is adequate to keep the erosion layer from becoming completely saturated and verify that the erosion layer will not be impacted by uplift.

Compare the maximum head on the liner to the thickness of the gecomposite:

$t_{erosion}$		>	h_{max}	
(Thickness of the erosion layer)			(Maximum Head Estimated by HELP Model. Refer to page IIIJ-A-A-17)	
12.0	in	>	7.622	in

Since the maximum head on the final cover geomembrane is less than the thickness of the erosion layer, the erosion will not become completely saturated. Therefore, the maximum spacing of 180 feet between the drain pipes located on the topslope is acceptable. As shown on Sheet IIIJ-A-A-14, the distance between the pipes on the topslope is equal to no more than 180 feet.

Verify that the erosion layer will not be impacted by uplift.

Uplift may occur if the depth of water in the geocomposite exceeds the thickness of the geocomposite. As noted above, the maximum water depth on the geomembrane is 6.191 inches. If this occurs, the potential for uplift exists. Therefore to prevent uplift, the weight of erosion layer must be higher than the uplift exerted by the maximum head in drainage geocomposite.

Maximum Head Estimated by HELP Model, h_{max}=	7.622	inches (refer to page IIIJ-A-A-17)
Unit Weight of Erosion Layer, γ_{EL}=	120	pcf
Unit Weight of Water, γ_W=	62.4	pcf
Thickness of Erosion Layer, h_{EL}=	12	inches
Uplift Force, UF=	h_{max} x γ_W	psf
Weight of Erosion Layer, W_{EL}=	h_{EL} x γ_{EL}	psf
UF=	(6.191/12)*62.4	(psf)
W_{EL}=	1 ft x 120 pcf	(psf)
UF=	39.6	psf
W_{EL}=	120	psf
Factor of Safety, FS=	W_{EL} / UF	
FS=	120 / 33.6	
FS=	3.0	

Conclusion:
A factor of safety of more than one indicates that the erosion layer will not be impacted by uplift force caused by the maximum head in the geocomposite estimated by the HELP Model. Therefore, the erosion layer is stable as designed. As shown on page IIIJ-A-A-17, under normal conditions the head in the geocomposite is 0.021 inches which is less than the thickness of the geocomposite. Therefore, the thickness of the water on the geomembrane will not exceed the thickness of the geocomposite under normal conditions.

2.3 Determine pipe size required to convey the design flow for the specified pipe length and pipe outlet spacing.

Maximum flow to a collection pipe has been estimated by using the HELP model.
From the HELP model, the lateral drainage collected per unit length of drainage geocomposite is:

Lateral Drainage Collected $d_{collected}$=	0.174	ft/day, (drainage collected expressed as depth from HELP)
L (5%)=	180	ft (topslope length between the pipe and the grade break)
q_p =	$d_{collected}$ * 1 * L	cfs
q_p =	0.00036	cfs (Flow per Unit Length of Pipe, q_p)

Maximum Flow to Collection Pipe for Various Pipe Lengths:

$Q_{max} = L_{p\text{-}max} \times q_p$

Pipe Length, $L_{p\text{-}max}$ (ft)	Flow per Unit Length of Pipe, q_p (cfs/ft)	Maximum Pipe Flow, Q_{max}[1] (cfs)
< 450	0.00036	0.163
450-900	0.00036	0.326

[1] Maximum pipe flow is calculated using the maximum pipe length in each range.

Collection Pipe Size:

Use Manning's Equation to determine the pipe size.

Pipe Capacity (Q_{pc}):

$$Q_{pc} = \frac{1.49AR^{2/3}S^{1/2}}{n}$$

(from Chapter 10 of Ref 2)

where:

Q_{pc}: Full Flow Pipe Capacity (cfs)
d: Diameter (inches), HDPE ADS Collection Pipe Diameter
A: Flow area (sf), Cross Section Pipe
P: Perimeter (ft)
R: Hydraulic radius (ft) = Cross Section (A) / Perimeter (P)
S: Pipe slope (ft/ft)
n: Manning's Roughness Coefficient

Pipe Capacity for Different Pipe Sizes

d (inches)	A (sf)	P (ft)	R (ft)	S (ft/ft)	n	Q_{pc} (cfs)
4	0.09	1.05	0.08	0.005	0.010	0.171
6	0.19	1.57	0.12	0.005	0.010	0.474

Fullness Ratio of Pipe (f):

$f = Q_{max}/Q_{pc}$ (Ratio of maximum calculated flow (Q_{max}) to total flow capacity (Q_{pc}) for pipe)

Fullness ratio of pipe (f)					
Fill Condition	Pipe Length (ft)	d (inches)	Q_{max} (cfs)	Q_{pc} (cfs)	f
Closed (topslope)	< 450	4	0.163	0.171	0.95
	450-900	6	0.326	0.474	0.69

Conclusion: A pipe size of 4 inches is acceptable for the topslope area for pipes lengths of 450 feet and shorter. A pipe size of 6 inches is acceptable for pipe lengths between 450 and 900 feet.

A minimum open area of 1 square inch per foot of drainage pipe is recommended by the U.S. Soil Conservation Service and the U.S. Bureau of Reclamation. Therefore, the number of 0.5 in diameter holes per foot will be 6 and total slot area provided by the manufacturer will provide documentation that minimum of 1 square inch of total slot area is provided per linear foot of pipe.

3. Topslope/Sideslope Transition

3.1 Estimate the percolation into the drainage geocomposite from the erosion layer.

Calculate the flow entering the geocomposite from unit area of erosion layer (q_f):

k_{cover} = 1.2E-04 cm/s

$q_f = k_{cover} * i$ (i is the gradient of water percolating within the drainage layer, and it is equal to 1 for vertical percolation.)

q_f = 1.2E-4 cm/s * 1 / (30.48 cm/ 1 ft)

q_f = 3.94E-06 cfs/sf

Calculate the maximum flow in drainage geocomposite on 4H:1V sideslope.
Consider the flow coming from the topdeck:

L (4H:1V)= 85 ft (estimated)

L (5%)= 110 ft, topdeck length between the topdeck pipe and the grade break (estimated)

L (total)= 195 ft

$q_p = q_f * L\ (total)$

q_p = 0.00077 sf/s (per unit width)

3.2 Determine the capacity of the sideslope drainage geocomposite based on the estimated transmissivity and compare to the estimated flow rate that occurs due to infiltration.

T_{DES} > q_p

(flow capacity of the drainage geocomposite per unit width. Refer to Section 1.1)

(estimated flow in the drainage geocomposite per unit width)

0.00123 sf/s (cf/s·ft) > 0.00077 sf/s (cf/s·ft)

Since the capacity of the drainage geocomposite is greater than the estimated flow in the geocomposite, the actual flow depth is contained within the geocomposite and the design is acceptable.

3.3 Determine pipe size required to convey the design flow for the specified pipe length and pipe outlet spacing.

Maximum flow to a collection pipe has been estimated by using the HELP model.
From the HELP model, the lateral drainage collected per unit length of drainage geocomposite is:

Sideslope:

Lateral Drainage Collected $d_{collected}$=	0.164	ft/day, (drainage collected expressed as depth from HELP)
L (4H:1V)=	85	ft (sideslope length between the pipe and the grade break)
$q_{p\ (Sideslope)}$ =	$d_{collected}$ * 1 * L	cfs
$q_{p\ (Sideslope)}$ =	0.00016	cfs (Flow per Unit Length of Pipe, q_p)

Topslope:

Lateral Drainage Collected $d_{collected}$=	0.207	ft/day, (drainage collected expressed as depth from HELP)
L (5%)=	110	ft (topslope length between the pipe and the grade break)
$q_{p\ (topslope)}$ =	$d_{collected}$ * 1 * L	cfs
$q_{p\ (topslope)}$ =	0.00026	cfs (Flow per Unit Length of Pipe, q_p)

Total: $q_{p\ (Total)}$ = 0.00042 cfs

Maximum Flow to Collection Pipe for Various Pipe Lengths:

$Q_{max} = L_{p\text{-}max} \times q_p$

Pipe Length, $L_{p\text{-}max}$ (ft)	Flow per Unit Length of Pipe, q_p (cfs/ft)	Maximum Pipe Flow, Q_{max} [1] (cfs)
< 350	0.00042	0.149
350-900	0.00042	0.382

[1] Maximum pipe flow is calculated using the maximum pipe length in each range.

Capacity of the collection pipe:

Use Manning's Equation to determine the pipe capacity.

Pipe Capacity (Q_{pc}):

$$Q_{pc} = \frac{1.49AR^{2/3}S^{1/2}}{n}$$

(from Chapter 10 of Ref 2)

where:

Q_{pc}: Full Flow Pipe Capacity (cfs)
d: Diameter (inches), HDPE ADS collection pipe
A: Flow area (sf), Cross section of pipe
P: Perimeter (ft)
R: Hydraulic radius (ft) = Cross section (A) / Perimeter (P)
S: Pipe slope (ft/ft)
n: Manning's roughness coefficient

Pipe Capacity						
d (inches)	A (sf)	P (ft)	R (ft)	S (ft/ft)	n	Q_{pc} (cfs)
4	0.09	1.05	0.08	0.005	0.010	0.171
6	0.19	1.57	0.12	0.005	0.010	0.474

Fullness Ratio of Pipe (f):

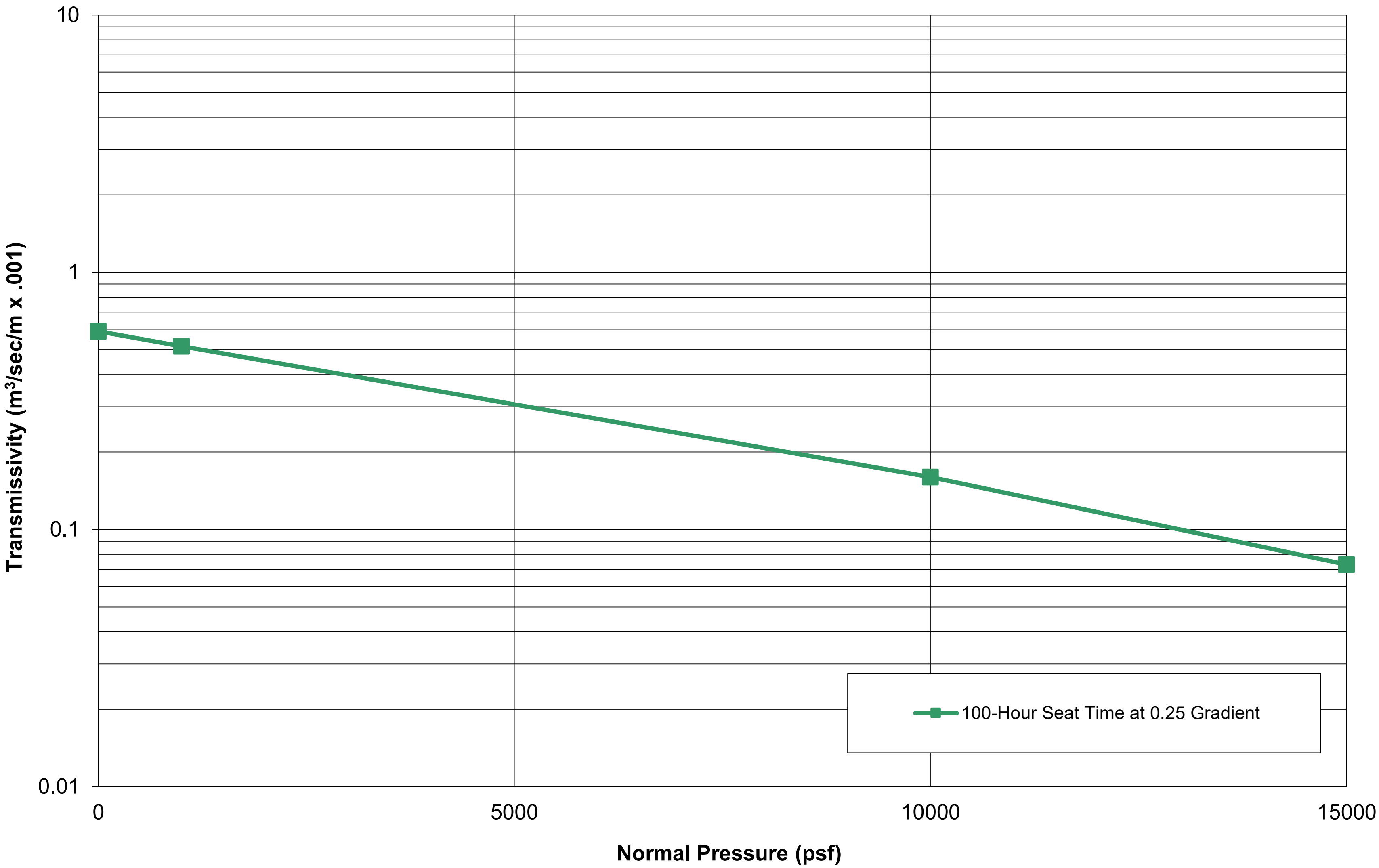
$f = Q_{max}/Q_{pc}$ **(Ratio of maximum calculated flow (Q_{max}) to total flow capacity (Q_{pc}) for pipe)**

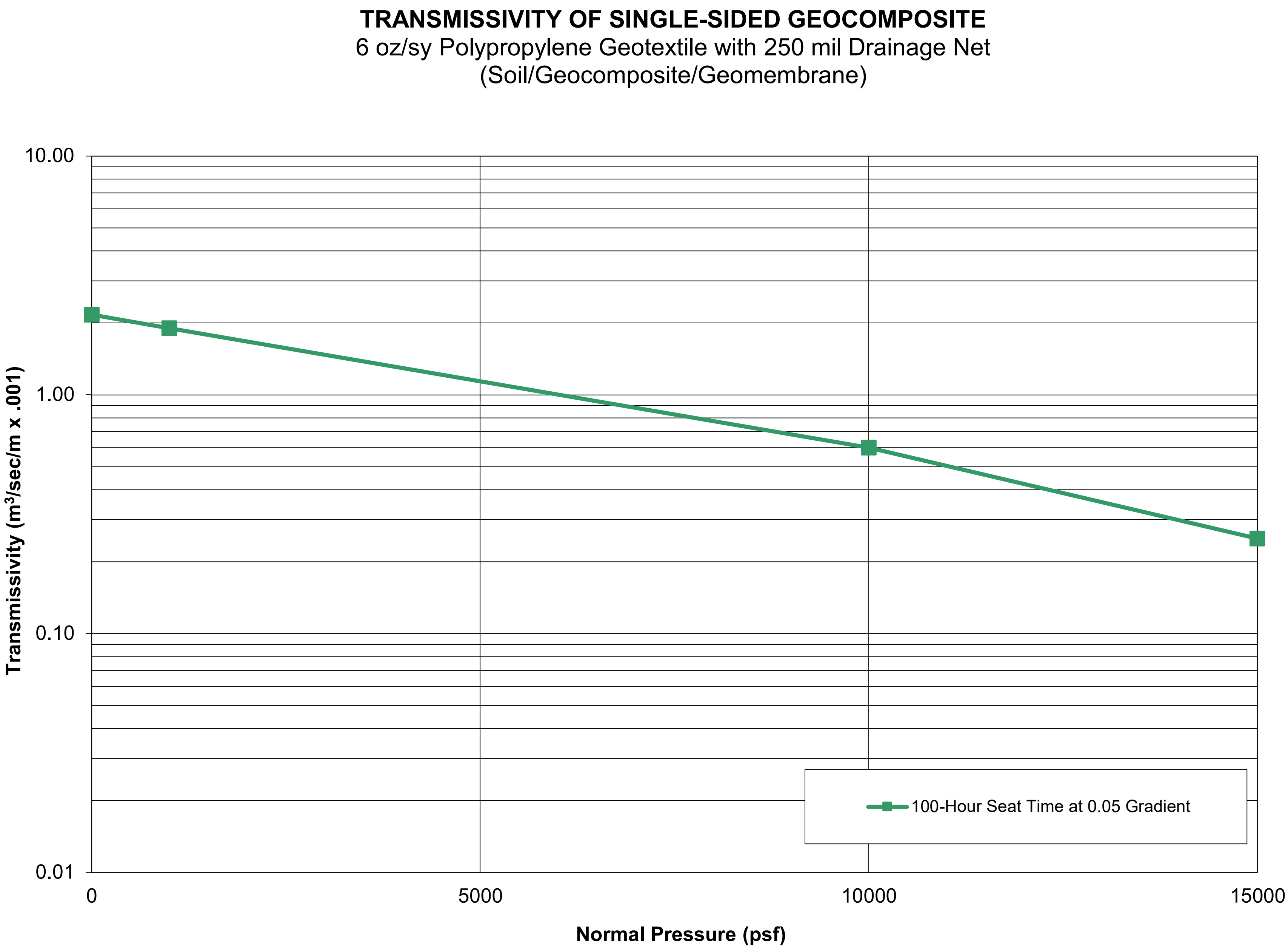
Fullness Ratio of Pipe (f)					
Fill Condition	Pipe Length (ft)	d (inches)	Q_{max} (cfs)	Q_{pc} (cfs)	f
Closed	< 350	4	0.149	0.171	0.87
(transition)	350-900	6	0.382	0.474	0.81

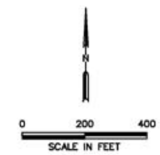
Conclusion: A pipe size of 4 inches is acceptable for the topslope area for pipes lengths of 350 feet and shorter. A pipe size of 6 inches is acceptable for pipe lengths between 350 and 900 feet.

A minimum open area of 1 square inch per foot of drainage pipe is recommended by the U.S. Soil Conservation Service and the U.S. Bureau of Reclamation. Therefore, the number of 0.5 in diameter holes per foot will be 6 and total slot area provided by the manufacturer will provide documentation that minimum of 1 square inch of total slot area is provided per linear foot of pipe.

TRANSMISSIVITY OF DOUBLE-SIDED GEOCOMPOSITE
6 oz/sy Polypropylene Geotextiles with 250 mil Drainage Net
(Soil/Geocomposite/Geomembrane)




TRANSMISSIVITY OF SINGLE-SIDED GEOCOMPOSITE
6 oz/sy Polypropylene Geotextile with 250 mil Drainage Net
(Soil/Geocomposite/Geomembrane)
10.00
1.00
0.10
0.01
Transmissivity (m³/sec/m x .001)
0
5000
10000
15000
Normal Pressure (psf)
100-Hour Seat Time at 0.05 Gradient

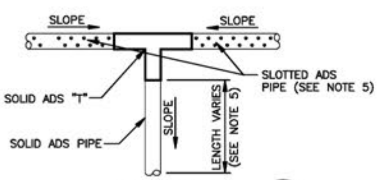


LEGEND

- PERMIT BOUNDARY
- LIMIT OF WASTE
- E 10500 SITE GRID
- 610 EXISTING CONTOUR (SEE NOTE 1)
- 624 PROPOSED FINAL COVER CONTOUR
- DRAINAGE SWALE
- DRAINAGE LETDOWN
- CHANNEL CENTERLINE
- PERFORATED DRAINAGE PIPE

NOTES:

1. EXISTING CONTOURS DEVELOPED BY FIRMATEK FROM AERIAL PHOTOGRAPHY FLOWN NOVEMBER 10, 2022. THE GRID SYSTEM IS BASED ON A SITE GRID SYSTEM. ELEVATIONS ARE BASED ON NAD 88.
2. TYPICAL SIDESLOPES ARE 4H:1V (25%). TYPICAL TOPSLOPE IS (4%).
3. MAXIMUM FINAL COVER ELEVATION IS 776.5 FT-MSL. MAXIMUM TOP OF WASTE ELEVATION IS 773.0 FT-MSL.
4. DRAINAGE PIPE WILL BE PLACED WITH A 0.5% FLOW LINE SLOPE PARALLEL TO THE SWALES ON THE TOPSLOPES AND SIDESLOPES OF THE FILL. THE PIPE WILL BE PLACED WITH A 0.5% FLOW SLOPE AT THE TOE OF THE FINAL COVER (NO MORE THAN 500 FEET ON THE FLAT AREAS) AND DAYLIGHTED IN DRAINAGE LETDOWNS AND AS NECESSARY AT THE TOE OF FINAL COVER TO THE PERIMETER DRAINAGE STRUCTURES WITH A SOLID PIPE TEE CONNECTION. PIPE SHALL BE ADVANCED DRAINAGE SYSTEM (ADS) OR SIMILAR.



DRAINAGE PIPE
DAYLIGHT (TYP)
TEE
IIIJ-A-A-14 IIIJ-A-A-14

☐ DRAFT	
☒ FOR PERMITTING PURPOSES ONLY	
☐ ISSUED FOR CONSTRUCTION	
DATE: 05/2024	DRAWN BY: RAA
FILE: 0120-76-11	DESIGN BY: SSM
CAD: IIIJ-A-A-14-DRAINAGE PIPE.DWG	REVIEWED BY: DEP

Weaver Consultants Group
TBPE REGISTRATION NO. F-3727

PREPARED FOR
PINE HILL FARMS LANDFILL TX, LP

REVISIONS		
NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
FINAL COVER DRAINAGE PIPE LAYOUT

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS

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HELP MODEL FOR
FINAL COVER

INTRODUCTION

The Hydrologic Evaluation of Landfill Performance (HELP) Model, Version 3.07 was used to estimate the head on final cover geomembrane. This HELP analysis was used to demonstrate that the proposed pipe spacing and single-sided drainage geocomposite are adequate to keep potential uplift forces from adversely impacting the erosion layer.

The closed landfill conditions were modeled for a 30-year period. The evaporative zone depth was selected to be 12 inches and the leaf area index was selected to be 4.5. These parameters are consistent with the parameters shown in Appendix IIIC-A. The curve numbers were calculated by HELP based on soil data and expected ground cover, surface slope, and slope length.

The final cover consists of a 12-inch erosion layer with the top 6 inches capable of sustaining growth of vegetation, a geocomposite drainage layer, a 40-mil LLDPE geomembrane liner, and an 18-inch infiltration layer. The geomembrane liner was modeled for good installation quality. The infiltration layer consists of compacted soil with a hydraulic conductivity of $1x10^{-5}$ cm/s. Default values for the porosity, field capacity, and wilting point for each layer were selected. Initial moisture content values were set at field capacity. However, HELP automatically sets the moisture content for a barrier layer (i.e., the infiltration layer) equal to porosity.

Refer to page IIIJ-A-A-17 for a summary of the HELP analysis. The HELP model output is included on pages IIIJ-A-A-18 through IIIJ-A-A-46.

		CLOSED SIDESLOPE (25%)	CLOSED TOPSLOPE (4%)	CLOSED SIDESLOPE TRANSITION	CLOSED TOPSLOPE TRANSITION
GENERAL	Case No.	1	2	3	4
INFORMATION	Output Page	IIIJ-A-A-19	IIIJ-A-A-26	IIIJ-A-A-33	IIIJ-A-A-40
	No. of Years	30	30	30	30
	Ground Cover	GOOD	GOOD	GOOD	GOOD
	SCS Runoff Curve No.	82.4	81.3	82.8	81.7
	Model Area (acre)	1.0	1.0	1.0	1.0
	Runoff Area (%)	100	100	100	100
	Maximum Leaf Area Index	4.5	4.5	4.5	4.5
	Evaporative Zone Depth (inch)	12	12	12	12
EROSION	Thickness (in)	12	12	12	12
LAYER	Porosity (vol/vol)	0.3980	0.3980	0.3980	0.3980
(Texture = 10)	Field Capacity (vol/vol)	0.2440	0.2440	0.2440	0.2440
	Wilting Point (vol/vol)	0.1360	0.1360	0.1360	0.1360
	Init. Moisture Content (vol/vol)	0.2440	0.2440	0.2440	0.2440
	Hyd. Conductivity (cm/s)	1.2E-04	1.2E-04	1.2E-04	1.2E-04
DRAINAGE	Thickness (in)	0.250	0.250	0.250	0.250
LAYER	Porosity (vol/vol)	0.8500	0.8500	0.8500	0.8500
(Texture = 0)	Field Capacity (vol/vol)	0.0100	0.0100	0.0100	0.0100
	Wilting Point (vol/vol)	0.0050	0.0050	0.0050	0.0050
	Init. Moisture Content (vol/vol)	0.0100	0.0100	0.0100	0.0100
	Hyd. Conductivity (cm/s)	19.43	6.63	19.43	6.63
	Slope (%)	25	4	25	4
	Slope Length (ft)	160	180	85	110
FLEXIBLE	Thickness (in)	0.04	0.04	0.04	0.04
MEMBRANE	Hyd. Conductivity (cm/s)	4.0E-13	4.0E-13	4.0E-13	4.0E-13
LINER	Pinhole Density (holes/acre)	0	0	0	0
(Texture = 36)	Install. Defects (holes/acre)	0	0	0	0
	Placement Quality	GOOD	GOOD	GOOD	GOOD
INFILTRATION	Thickness (in)	18	18	18	18
LAYER	Porosity (vol/vol)	0.4270	0.4270	0.4270	0.4270
(Texture = 0)	Field Capacity (vol/vol)	0.4180	0.4180	0.4180	0.4180
	Wilting Point (vol/vol)	0.3670	0.3670	0.3670	0.3670
	Init. Moisture Content (vol/vol)	0.4270	0.4270	0.4270	0.4270
	Hyd. Conductivity (cm/s)	1.0E-05	1.0E-05	1.0E-05	1.0E-05
PRECIPITATION	Average Annual (in)	45.72	45.72	45.72	45.72
RUNOFF	Average Annual (in)	2.638	1.944	2.840	2.227
EVAPOTRANSPIRATION	Average Annual (in)	28.75	28.57	28.74	28.70
LATERAL	Average Annual (cf/year)	52,038	55,198	51,327	53,733
DRAINAGE COLLECTED[1]	Peak Daily (cf/day)	7,431	7,563	7,126	8,996
LATERAL DRAINAGE	Peak Daily (in)	2.047	2.083	1.963	2.478
DEPTH	Peak Daily (ft)	0.171	0.174	0.164	0.207
HEAD ON FINAL	Average Annual (in)	0.000	0.021	0.000	0.005
COVER GEOMEMBRANE	Peak Daily (in)	0.030	7.622	0.034	1.295

[1] This is the lateral drainage collected in the drainage geocomposite in the final cover system.

HELP MODEL OUTPUT

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              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:\RO\J\A\SS\DATA4.D4
TEMPERATURE DATA FILE:      C:\RO\J\A\SS\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\RO\J\A\SS\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\RO\J\A\SS\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\RO\J\A\SS\DATA10.D10
OUTPUT DATA FILE:           C:\RO\J\A\SS\OUTPUT1.OUT


TIME:  10:35     DATE:   1/ 9/2024


******************************************************************************

     TITLE:  ROYAL OAKS LANDFILL - FC DESIGN - SS

******************************************************************************


     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  10
          THICKNESS                   =     12.00   INCHES
```

```
  POROSITY                    =      0.3980 VOL/VOL
  FIELD CAPACITY              =      0.2440 VOL/VOL
  WILTING POINT               =      0.1360 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.2440 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =  0.119999997000E-03 CM/SEC
NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  5.00
         FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                          LAYER  2
                          --------

              TYPE 2 - LATERAL DRAINAGE LAYER
                MATERIAL TEXTURE NUMBER   0
  THICKNESS                   =      0.25   INCHES
  POROSITY                    =      0.8500 VOL/VOL
  FIELD CAPACITY              =      0.0100 VOL/VOL
  WILTING POINT               =      0.0050 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.0100 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =   19.4300003000     CM/SEC
  SLOPE                       =     25.00   PERCENT
  DRAINAGE LENGTH             =    160.0    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         =      0.00   HOLES/ACRE
  FML INSTALLATION DEFECTS    =      0.00   HOLES/ACRE
  FML PLACEMENT QUALITY       =  3 - GOOD


                          LAYER  4
                          --------

                TYPE 3 - BARRIER SOIL LINER
```

MATERIAL TEXTURE NUMBER 0

THICKNESS	=	18.00 INCHES
POROSITY	=	0.4270 VOL/VOL
FIELD CAPACITY	=	0.4180 VOL/VOL
WILTING POINT	=	0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999975000E-05 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #10 WITH A GOOD STAND OF GRASS, A SURFACE SLOPE OF 25.% AND A SLOPE LENGTH OF 160. FEET.

SCS RUNOFF CURVE NUMBER	=	82.20	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.928	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	4.776	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.632	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	10.616	INCHES
TOTAL INITIAL WATER	=	10.616	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM SHREVEPORT LOUISIANA

STATION LATITUDE	=	32.28 DEGREES
MAXIMUM LEAF AREA INDEX	=	4.50
START OF GROWING SEASON (JULIAN DATE)	=	58
END OF GROWING SEASON (JULIAN DATE)	=	331
EVAPORATIVE ZONE DEPTH	=	12.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	8.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	70.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	72.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	72.00 %

AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 72.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SHREVEPORT LOUISIANA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.54	4.24	3.80	3.38	4.26	4.04
3.40	3.07	3.55	4.75	4.24	4.23

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SHREVEPORT LOUISIANA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
46.00	49.80	56.70	64.10	72.20	79.10
82.80	82.40	76.60	66.40	55.80	48.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SHREVEPORT LOUISIANA
AND STATION LATITUDE = 32.28 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.06	3.66	3.91	3.61	4.07	4.22
	3.38	2.64	3.32	4.70	4.22	3.92
STD. DEVIATIONS	2.78	1.82	1.66	1.52	1.88	2.72

	1.70	2.24	1.86	2.59	1.43	2.47

RUNOFF

TOTALS	0.235	0.199	0.093	0.047	0.168	0.365
	0.139	0.098	0.160	0.662	0.161	0.312
STD. DEVIATIONS	0.530	0.370	0.180	0.097	0.333	0.525
	0.262	0.211	0.299	0.987	0.127	0.593

EVAPOTRANSPIRATION

TOTALS	1.729	2.135	2.978	3.273	3.433	3.104
	2.990	2.193	2.491	1.801	1.225	1.398
STD. DEVIATIONS	0.185	0.403	0.730	0.937	1.150	1.595
	1.346	1.441	1.168	0.872	0.224	0.203

LATERAL DRAINAGE COLLECTED FROM LAYER 2

TOTALS	2.3647	1.6039	1.0213	0.4571	0.6054	0.7931
	0.3440	0.3242	0.4386	1.7414	2.4060	2.2359
STD. DEVIATIONS	2.2230	1.3506	1.1152	0.5386	0.8113	0.9587
	0.5193	0.6644	0.7215	1.3429	1.2960	1.8814

PERCOLATION/LEAKAGE THROUGH 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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.0007	0.0005	0.0003	0.0001	0.0002	0.0002
	0.0001	0.0001	0.0001	0.0005	0.0007	0.0006
STD. DEVIATIONS	0.0007	0.0004	0.0003	0.0001	0.0003	0.0003
	0.0001	0.0002	0.0002	0.0004	0.0004	0.0006

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.72 (8.166)	165946.7	100.00
RUNOFF	2.638 (1.8096)	9577.38	5.771
EVAPOTRANSPIRATION	28.750 (3.6477)	104361.41	62.889
LATERAL DRAINAGE COLLECTED FROM LAYER 2	14.33564 (4.86089)	52038.387	31.35850
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00000 (0.00000)	0.003	0.00000
AVERAGE HEAD ON TOP OF LAYER 3	0.000 (0.000)		
CHANGE IN WATER STORAGE	-0.008 (0.5583)	-30.52	-0.018

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	6.92	25119.600
RUNOFF	3.797	13781.3223
DRAINAGE COLLECTED FROM LAYER 2	2.04716	7431.17773
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000000	0.00005
AVERAGE HEAD ON TOP OF LAYER 3	0.021	
MAXIMUM HEAD ON TOP OF LAYER 3	0.030	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	0.0 FEET	

SNOW WATER	3.18	11547.1094

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3586

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1360

*** 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	2.6758	0.2230
2	0.0025	0.0100
3	0.0000	0.0000
4	7.6860	0.4270
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:\RO\J\A\TOP\DATA4.D4
TEMPERATURE DATA FILE:      C:\RO\J\A\TOP\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\RO\J\A\TOP\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\RO\J\A\TOP\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\RO\J\A\TOP\DATA10.D10
OUTPUT DATA FILE:           C:\RO\J\A\TOP\OUTPUT1.OUT


TIME:  10:34     DATE:   1/ 9/2024


******************************************************************************

     TITLE:  ROYAL OAKS LANDFILL - FC DESIGN - TOP

******************************************************************************


     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  10
           THICKNESS                    =     12.00   INCHES
```

```
  POROSITY                    =      0.3980 VOL/VOL
  FIELD CAPACITY              =      0.2440 VOL/VOL
  WILTING POINT               =      0.1360 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.2440 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =  0.119999997000E-03 CM/SEC
NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  5.00
         FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                          LAYER  2
                          --------

              TYPE 2 - LATERAL DRAINAGE LAYER
                MATERIAL TEXTURE NUMBER   0
  THICKNESS                   =      0.25   INCHES
  POROSITY                    =      0.8500 VOL/VOL
  FIELD CAPACITY              =      0.0100 VOL/VOL
  WILTING POINT               =      0.0050 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.0100 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =   6.63000011000     CM/SEC
  SLOPE                       =      4.00   PERCENT
  DRAINAGE LENGTH             =    180.0    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         =      0.00   HOLES/ACRE
  FML INSTALLATION DEFECTS    =      0.00   HOLES/ACRE
  FML PLACEMENT QUALITY       =  3 - GOOD


                          LAYER  4
                          --------

                TYPE 3 - BARRIER SOIL LINER
```

MATERIAL TEXTURE NUMBER 0

THICKNESS	=	18.00 INCHES
POROSITY	=	0.4270 VOL/VOL
FIELD CAPACITY	=	0.4180 VOL/VOL
WILTING POINT	=	0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999975000E-05 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #10 WITH A GOOD STAND OF GRASS, A SURFACE SLOPE OF 4.% AND A SLOPE LENGTH OF 180. FEET.

SCS RUNOFF CURVE NUMBER	=	81.20	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.928	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	4.776	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.632	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	10.616	INCHES
TOTAL INITIAL WATER	=	10.616	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
SHREVEPORT LOUISIANA

STATION LATITUDE	=	32.28 DEGREES
MAXIMUM LEAF AREA INDEX	=	4.50
START OF GROWING SEASON (JULIAN DATE)	=	58
END OF GROWING SEASON (JULIAN DATE)	=	331
EVAPORATIVE ZONE DEPTH	=	12.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	8.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	70.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	72.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	72.00 %

AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 72.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SHREVEPORT LOUISIANA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.54	4.24	3.80	3.38	4.26	4.04
3.40	3.07	3.55	4.75	4.24	4.23

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SHREVEPORT LOUISIANA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
46.00	49.80	56.70	64.10	72.20	79.10
82.80	82.40	76.60	66.40	55.80	48.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SHREVEPORT LOUISIANA
AND STATION LATITUDE = 32.28 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.06	3.66	3.91	3.61	4.07	4.22
	3.38	2.64	3.32	4.70	4.22	3.92
STD. DEVIATIONS	2.78	1.82	1.66	1.52	1.88	2.72

	1.70	2.24	1.86	2.59	1.43	2.47

RUNOFF

TOTALS	0.162	0.146	0.063	0.034	0.117	0.276
	0.114	0.072	0.109	0.513	0.109	0.229
STD. DEVIATIONS	0.428	0.276	0.128	0.083	0.233	0.406
	0.237	0.174	0.228	0.834	0.092	0.475

EVAPOTRANSPIRATION

TOTALS	1.730	2.131	2.965	3.242	3.401	3.075
	2.935	2.179	2.474	1.802	1.234	1.405
STD. DEVIATIONS	0.187	0.403	0.729	0.928	1.133	1.574
	1.320	1.423	1.147	0.872	0.227	0.202

LATERAL DRAINAGE COLLECTED FROM LAYER 2

TOTALS	2.4225	1.6306	1.0841	0.4796	0.6819	0.9278
	0.4074	0.3714	0.5030	1.9184	2.4631	2.3164
STD. DEVIATIONS	2.3567	1.3821	1.1688	0.5421	0.9120	1.1332
	0.5315	0.7150	0.7855	1.4826	1.2828	2.0318

PERCOLATION/LEAKAGE THROUGH 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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.0319	0.0292	0.0119	0.0037	0.0116	0.0182
	0.0066	0.0064	0.0082	0.0556	0.0290	0.0399
STD. DEVIATIONS	0.0461	0.0402	0.0168	0.0052	0.0275	0.0295
	0.0141	0.0162	0.0176	0.0730	0.0163	0.0568

****

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.72 (8.166)	165946.7	100.00
RUNOFF	1.944 (1.4257)	7057.87	4.253
EVAPOTRANSPIRATION	28.574 (3.6119)	103722.30	62.503
LATERAL DRAINAGE COLLECTED FROM LAYER 2	15.20617 (5.19671)	55198.402	33.26273
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00000 (0.00000)	0.015	0.00001
AVERAGE HEAD ON TOP OF LAYER 3	0.021 (0.011)		
CHANGE IN WATER STORAGE	-0.009 (0.4887)	-31.93	-0.019

****

****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	6.92	25119.600
RUNOFF	3.628	13168.5488
DRAINAGE COLLECTED FROM LAYER 2	2.08349	7563.07715
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000002	0.00569
AVERAGE HEAD ON TOP OF LAYER 3	4.598	
MAXIMUM HEAD ON TOP OF LAYER 3	7.622	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	30.5 FEET	

```
SNOW WATER                                        3.18         11547.1094


MAXIMUM VEG. SOIL WATER (VOL/VOL)                          0.3849

MINIMUM VEG. SOIL WATER (VOL/VOL)                          0.1360

 ***  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            2.6641         0.2220

                       2            0.0025         0.0100

                       3            0.0000         0.0000

                       4            7.6860         0.4270

                   SNOW WATER       0.000

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\RO\J\A\TSS\DATA4.D4
TEMPERATURE DATA FILE:      C:\RO\J\A\TSS\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\RO\J\A\TSS\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\RO\J\A\TSS\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\RO\J\A\TSS\DATA10.D10
OUTPUT DATA FILE:           C:\RO\J\A\TSS\OUTPUT1.OUT


TIME:  10:42     DATE:   1/ 9/2024


******************************************************************************

     TITLE:  ROYAL OAKS LANDFILL - FC DESIGN - SS TRANSITION

******************************************************************************


     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  10
           THICKNESS                   =    12.00   INCHES
```

```
  POROSITY                     =      0.3980 VOL/VOL
  FIELD CAPACITY               =      0.2440 VOL/VOL
  WILTING POINT                =      0.1360 VOL/VOL
  INITIAL SOIL WATER CONTENT   =      0.2440 VOL/VOL
  EFFECTIVE SAT. HYD. COND.    =  0.119999997000E-03 CM/SEC
NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  5.00
         FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                          LAYER  2
                          --------

              TYPE 2 - LATERAL DRAINAGE LAYER
                MATERIAL TEXTURE NUMBER   0
  THICKNESS                    =      0.25   INCHES
  POROSITY                     =      0.8500 VOL/VOL
  FIELD CAPACITY               =      0.0100 VOL/VOL
  WILTING POINT                =      0.0050 VOL/VOL
  INITIAL SOIL WATER CONTENT   =      0.0100 VOL/VOL
  EFFECTIVE SAT. HYD. COND.    =   19.4300003000     CM/SEC
  SLOPE                        =     25.00   PERCENT
  DRAINAGE LENGTH              =     85.0    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          =      0.00   HOLES/ACRE
  FML INSTALLATION DEFECTS     =      0.00   HOLES/ACRE
  FML PLACEMENT QUALITY        =  3 - GOOD


                          LAYER  4
                          --------

                TYPE 3 - BARRIER SOIL LINER
```

MATERIAL TEXTURE NUMBER 0

THICKNESS	=	18.00 INCHES
POROSITY	=	0.4270 VOL/VOL
FIELD CAPACITY	=	0.4180 VOL/VOL
WILTING POINT	=	0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999975000E-05 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #10 WITH A GOOD STAND OF GRASS, A SURFACE SLOPE OF 25.% AND A SLOPE LENGTH OF 85. FEET.

SCS RUNOFF CURVE NUMBER	=	82.80	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.928	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	4.776	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.632	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	10.616	INCHES
TOTAL INITIAL WATER	=	10.616	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM SHREVEPORT LOUISIANA

STATION LATITUDE	=	32.28 DEGREES
MAXIMUM LEAF AREA INDEX	=	4.50
START OF GROWING SEASON (JULIAN DATE)	=	58
END OF GROWING SEASON (JULIAN DATE)	=	331
EVAPORATIVE ZONE DEPTH	=	12.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	8.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	70.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	72.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	72.00 %

AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 72.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SHREVEPORT LOUISIANA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.54	4.24	3.80	3.38	4.26	4.04
3.40	3.07	3.55	4.75	4.24	4.23

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SHREVEPORT LOUISIANA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
46.00	49.80	56.70	64.10	72.20	79.10
82.80	82.40	76.60	66.40	55.80	48.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SHREVEPORT LOUISIANA
AND STATION LATITUDE = 32.28 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.06	3.66	3.91	3.61	4.07	4.22
	3.38	2.64	3.32	4.70	4.22	3.92
STD. DEVIATIONS	2.78	1.82	1.66	1.52	1.88	2.72

	1.70	2.24	1.86	2.59	1.43	2.47

RUNOFF

TOTALS	0.254	0.213	0.103	0.054	0.183	0.390
	0.153	0.108	0.173	0.698	0.180	0.331
STD. DEVIATIONS	0.559	0.385	0.191	0.107	0.351	0.552
	0.276	0.228	0.316	1.017	0.138	0.622

EVAPOTRANSPIRATION

TOTALS	1.729	2.135	2.978	3.272	3.433	3.102
	2.986	2.194	2.493	1.799	1.225	1.398
STD. DEVIATIONS	0.185	0.402	0.730	0.936	1.150	1.593
	1.343	1.440	1.163	0.870	0.223	0.203

LATERAL DRAINAGE COLLECTED FROM LAYER 2

TOTALS	2.3451	1.5894	1.0104	0.4517	0.5899	0.7700
	0.3328	0.3155	0.4261	1.7030	2.3876	2.2179
STD. DEVIATIONS	2.1984	1.3365	1.1046	0.5354	0.7910	0.9333
	0.5064	0.6483	0.7026	1.3126	1.2886	1.8555

PERCOLATION/LEAKAGE THROUGH 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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.0006	0.0005	0.0003	0.0001	0.0002	0.0002
	0.0001	0.0001	0.0001	0.0005	0.0007	0.0006
STD. DEVIATIONS	0.0007	0.0004	0.0003	0.0001	0.0003	0.0003
	0.0001	0.0002	0.0002	0.0004	0.0004	0.0006

****

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.72 (8.166)	165946.7	100.00
RUNOFF	2.840 (1.8915)	10310.90	6.213
EVAPOTRANSPIRATION	28.744 (3.6454)	104339.50	62.875
LATERAL DRAINAGE COLLECTED FROM LAYER 2	14.13960 (4.78562)	51326.742	30.92966
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00000 (0.00000)	0.002	0.00000
AVERAGE HEAD ON TOP OF LAYER 3	0.000 (0.000)		
CHANGE IN WATER STORAGE	-0.008 (0.5557)	-30.49	-0.018

****

****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	6.92	25119.600
RUNOFF	3.887	14109.0332
DRAINAGE COLLECTED FROM LAYER 2	1.96322	7126.47314
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000000	0.00004
AVERAGE HEAD ON TOP OF LAYER 3	0.021	
MAXIMUM HEAD ON TOP OF LAYER 3	0.034	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	0.0 FEET	

```
SNOW WATER                                   3.18        11547.1094


MAXIMUM VEG. SOIL WATER (VOL/VOL)                 0.3582

MINIMUM VEG. SOIL WATER (VOL/VOL)                 0.1360


 ***  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.


******************************************************************************




******************************************************************************

                FINAL WATER STORAGE AT END OF YEAR   30
       ----------------------------------------------------------------------
                 LAYER        (INCHES)       (VOL/VOL)
                 -----        --------       ---------
                   1            2.6760         0.2230

                   2            0.0025         0.0100

                   3            0.0000         0.0000

                   4            7.6860         0.4270

               SNOW WATER       0.000

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******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\RO\J\A\TTOP\DATA4.D4
TEMPERATURE DATA FILE:      C:\RO\J\A\TTOP\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\RO\J\A\TTOP\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\RO\J\A\TTOP\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\RO\J\A\TTOP\DATA10.D10
OUTPUT DATA FILE:           C:\RO\J\A\TTOP\OUTPUT1.OUT


TIME:  10:48     DATE:   1/ 9/2024


******************************************************************************

     TITLE:  ROYAL OAKS LANDFILL - FC DESIGN - TOP TRANSITION

******************************************************************************


     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  10
           THICKNESS                  =     12.00   INCHES
```

```
  POROSITY                     =      0.3980 VOL/VOL
  FIELD CAPACITY               =      0.2440 VOL/VOL
  WILTING POINT                =      0.1360 VOL/VOL
  INITIAL SOIL WATER CONTENT   =      0.2440 VOL/VOL
  EFFECTIVE SAT. HYD. COND.    =  0.119999997000E-03 CM/SEC
NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  5.00
         FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                          LAYER  2
                          --------

              TYPE 2 - LATERAL DRAINAGE LAYER
                MATERIAL TEXTURE NUMBER   0
  THICKNESS                    =      0.25   INCHES
  POROSITY                     =      0.8500 VOL/VOL
  FIELD CAPACITY               =      0.0100 VOL/VOL
  WILTING POINT                =      0.0050 VOL/VOL
  INITIAL SOIL WATER CONTENT   =      0.0100 VOL/VOL
  EFFECTIVE SAT. HYD. COND.    =   6.63000011000     CM/SEC
  SLOPE                        =      4.00   PERCENT
  DRAINAGE LENGTH              =    110.0    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          =      0.00   HOLES/ACRE
  FML INSTALLATION DEFECTS     =      0.00   HOLES/ACRE
  FML PLACEMENT QUALITY        =  3 - GOOD


                          LAYER  4
                          --------

                TYPE 3 - BARRIER SOIL LINER
```

MATERIAL TEXTURE NUMBER 0

THICKNESS	=	18.00 INCHES
POROSITY	=	0.4270 VOL/VOL
FIELD CAPACITY	=	0.4180 VOL/VOL
WILTING POINT	=	0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999975000E-05 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE #10 WITH A
GOOD STAND OF GRASS, A SURFACE SLOPE OF 4.%
AND A SLOPE LENGTH OF 110. FEET.

SCS RUNOFF CURVE NUMBER	=	81.70	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.928	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	4.776	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.632	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	10.616	INCHES
TOTAL INITIAL WATER	=	10.616	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
SHREVEPORT LOUISIANA

STATION LATITUDE	=	32.28	DEGREES
MAXIMUM LEAF AREA INDEX	=	4.50	
START OF GROWING SEASON (JULIAN DATE)	=	58	
END OF GROWING SEASON (JULIAN DATE)	=	331	
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	8.60	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	70.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	72.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	72.00	%

AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 72.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SHREVEPORT LOUISIANA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.54	4.24	3.80	3.38	4.26	4.04
3.40	3.07	3.55	4.75	4.24	4.23

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SHREVEPORT LOUISIANA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
46.00	49.80	56.70	64.10	72.20	79.10
82.80	82.40	76.60	66.40	55.80	48.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SHREVEPORT LOUISIANA
AND STATION LATITUDE = 32.28 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.06	3.66	3.91	3.61	4.07	4.22
	3.38	2.64	3.32	4.70	4.22	3.92
STD. DEVIATIONS	2.78	1.82	1.66	1.52	1.88	2.72

	1.70	2.24	1.86	2.59	1.43	2.47

RUNOFF

TOTALS	0.198	0.173	0.079	0.039	0.139	0.312
	0.124	0.083	0.128	0.567	0.130	0.254
STD. DEVIATIONS	0.472	0.332	0.160	0.090	0.277	0.446
	0.241	0.190	0.253	0.888	0.109	0.510

EVAPOTRANSPIRATION

TOTALS	1.730	2.135	2.973	3.264	3.417	3.095
	2.969	2.191	2.491	1.799	1.230	1.401
STD. DEVIATIONS	0.186	0.402	0.732	0.936	1.148	1.588
	1.339	1.439	1.160	0.869	0.227	0.204

LATERAL DRAINAGE COLLECTED FROM LAYER 2

TOTALS	2.4037	1.6202	1.0405	0.4686	0.6467	0.8581
	0.3757	0.3533	0.4665	1.8406	2.4436	2.2850
STD. DEVIATIONS	2.2808	1.3657	1.1318	0.5470	0.8663	1.0591
	0.5450	0.6915	0.7526	1.4295	1.3058	1.9646

PERCOLATION/LEAKAGE THROUGH 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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.0083	0.0069	0.0038	0.0012	0.0026	0.0032
	0.0015	0.0013	0.0021	0.0094	0.0089	0.0076
STD. DEVIATIONS	0.0098	0.0074	0.0045	0.0014	0.0042	0.0043
	0.0029	0.0030	0.0045	0.0090	0.0053	0.0090

****

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES		CU. FEET	PERCENT
PRECIPITATION	45.72	(8.166)	165946.7	100.00
RUNOFF	2.227	(1.5710)	8083.34	4.871
EVAPOTRANSPIRATION	28.695	(3.6458)	104161.30	62.768
LATERAL DRAINAGE COLLECTED FROM LAYER 2	14.80246	(5.06492)	53732.914	32.37963
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00000	(0.00000)	0.008	0.00000
AVERAGE HEAD ON TOP OF LAYER 3	0.005	(0.002)		
CHANGE IN WATER STORAGE	-0.009	(0.5361)	-30.90	-0.019

****

****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	6.92	25119.600
RUNOFF	3.690	13395.6973
DRAINAGE COLLECTED FROM LAYER 2	2.47832	8996.30859
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000000	0.00120
AVERAGE HEAD ON TOP OF LAYER 3	0.960	
MAXIMUM HEAD ON TOP OF LAYER 3	1.295	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	7.8 FEET	

```
     SNOW WATER                                        3.18        11547.1094


     MAXIMUM VEG. SOIL WATER (VOL/VOL)                      0.3277

     MINIMUM VEG. SOIL WATER (VOL/VOL)                      0.1360


      ***  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            2.6727         0.2227

                    2            0.0025         0.0100

                    3            0.0000         0.0000

                    4            7.6860         0.4270

                 SNOW WATER      0.000

******************************************************************************
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```

GEOTEXTILE DESIGN

REQUIRED: Determine the required properties for the geotextile used as the top component of the drainage geocomposite.

METHOD: Design geotextiles and determine material property requirements.

REFERENCES:

1. MIRAFI, *Geotextile Filter Design, Application, and Product Selection Guide* , 1991, http://www.tcmirafi.com/pdf/brochures/ef_guidelines.pdf.
2. Koerner, R.M., *Designing With Geosynthetics* , Fifth Edition, 2005.
3. AASHTO Designation: M288-17.
4. GRI White Paper #4, *Reduction Factors (RFs) Used in Geosynthetic Design,* Feb. 3, 2005, revised Mar. 1, 2007.

SOLUTION:

Geotextile Used as Top Component of Drainage Geocomposite

The design calculations assume the erosion layer soil will consist of soils with a hydraulic conductivity less than 1.2×10^{-4} cm/s and percent fines (passing #200 sieve) greater than 20 percent.

If the erosion layer material contains less than 20 percent fines, these geotextile calculations will be revised and included in the GLER for a specific cell to demonstrate adequacy of the material used.

Retention:

Based on Chart 1 - "Soil Retention Criteria," given on page IIIJ-A-A-29, the apparent opening size (O_{95}) may be determined.

O_{95} < 0.21 mm

Permeability:

The required permeability is determined by comparing the permeability of the erosion layer (1.2×10^{-4} cm/s) with the permeability of the geotextile after the appropriate reduction factors are applied to the laboratory permeability of the geotextile.

Minimum Laboratory Permeability Specified (k_{ult}) = 0.2 cm/s

To determine the allowable permeability (k_{allow}) of the geotextile, the following reduction factors are used:

Table 2 - Reduction Factors[1]

RF_{SCB} =	Reduction factor for soil clogging and blinding	2.0
RF_{CR} =	Reduction factor for creep reduction of void space	2.0
RF_{IN} =	Reduction factor for adjacent materials intruding into void spaces	1.2
RF_{CC} =	Reduction factor for chemical clogging	1.0
RF_{BC} =	Reduction factor for biological clogging	2.0
	Overall Reduction Factor (ORF) =	9.6

[1] Reduction factors obtained from Ref. 4.

k_{allow} = k_{ult} / ORF = (0.2 cm/s) / 9.6

$\boxed{k_{allow} = 2.1\text{E-}02 \text{ cm/s}}$

$k_{allow} >> k_{erosion\ layer}$ (1.2×10^{-4} cm/s).

Specification: Geotextile component of geocomposite permeability shall be equal to or greater than 0.2 cm/s as determined by ASTM D 4491.

Survivability:

Geotextile properties should be selected considering Class 2 survivability (refer to Sheet IIIJ-A-A-30).

Durability:

Chemical compatibility with leachate will be considered during the selection process for the specific geotextile.

Summary of required properties for geotextile component of drainage geocomposite:

Apparent opening size	<	0.21	mm
Grab tensile strength	>	157	lb
Elongation	>=	50	%
Puncture strength	>	309	lb
Trapezoid tear	>	56	lb
Permeability	>=	0.2	cm/s

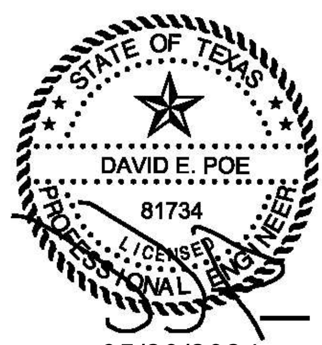
ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1614A

PART III – SITE DEVELOPMENT PLAN
APPENDIX IIIJ-B
GCL ALTERNATIVE FINAL COVER DEMONSTRATION

Prepared for

Pine Hill Farms Landfill Company, LP

May 2024



05/20/2024

Prepared by

Weaver Consultants Group, LLC
TBPE Registration No. F-3727
6420 Southwest Boulevard, Suite 206
Fort Worth, Texas 76109
817-735-9770

WCG Project No. 0120-076-11-106

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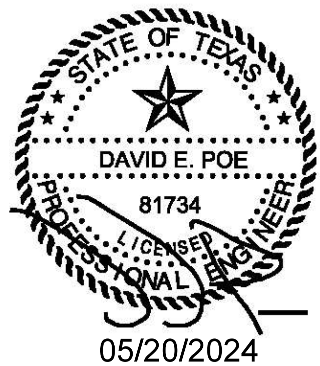
2.4 Landfill Profile Information IIIJ-B-4
2.5 HELP Summary and Output IIIJ-B-4

3 RESULTS **IIIJ-B-5**

APPENDIX IIIJ-B-1
Help Model Analysis



1 INTRODUCTION

1.1 Purpose and Scope

This Alternative Final Cover Design Demonstration provides demonstration of equivalency for an alternative geosynthetic clay liner (GCL) final cover system to be installed at the Royal Oaks Landfill. The demonstration was conducted using the Hydrologic Evaluation of Landfill Performance (HELP) Model. A stability analysis of the alternative GCL final cover system has been included in Appendix IIIE-A.

The purpose of this appendix is to demonstrate that the alternative GCL final cover system will meet the alternative final cover requirements specified in Title 30 Texas Administrative Code (TAC) §330.457(d). This alternative final cover design has been developed by replacing the 18-inch-thick clay infiltration layer in the composite final cover design with a GCL layer. The remaining components of the alternative final cover system are the same as the composite final cover system. The equivalency of the GCL alternative final cover is achieved by demonstrating that the predicted percolation rates through the GCL infiltration layer are less than the percolation rates through the 18-inch-thick compacted clay infiltration layer for both the top slope and side slope.

1.2 Alternative Final Cover

The alternative final cover system will consist of a GCL with a specified hydraulic conductivity of $3x10^{-9}$ cm/s or less overlain by a 40-mil-thick LLDPE geomembrane, drainage geocomposite, and erosion layer. The erosion layer will consist of a 12-inch-thick soil layer capable of sustaining vegetation growth. The intermediate cover placed below the GCL will consist of a 12-inch-thick layer of soil that will be compacted to provide a working surface for the GCL placement.

1.3 Equivalency Demonstration

This appendix includes HELP model simulations developed using the final cover components included in Appendix IIIC. For the purpose of comparing percolation through the final cover system, all layers below the infiltration layer were ignored. The top slope and side slope GCL alternative final cover HELP models were modeled by replacing the clay infiltration layer from the composite final cover models with GCL. As shown on Figure IIIJ-B.1, the predicted percolation rates through the GCL alternative final cover system are less than the percolation rates through the composite final cover system with a clay infiltration layer.

2 HELP MODEL ANALYSIS

2.1 HELP Model

The Hydrologic Evaluation of Landfill Performance (HELP) Model, Version 3.07 was used to estimate the rate of percolation through both the permitted and alternative final cover systems during the closed landfill condition. The HELP Model is a quasi-two-dimensional hydrologic model of water movement across, into, through, and out of a landfill. The model uses climate, soil, and landfill design data to perform a solution technique that accounts for the effects of surface storage, runoff, infiltration, percolation, soil moisture storage, evapotranspiration, and lateral drainage.

2.2 Model Setup

The site was modeled as a 1-acre unit area for the following.

- Regulatory Composite Final Cover
  - Case 1, Top Slope, Closed
  - Case 2, Side Slope, Closed
- GCL Alternative Final Cover
  - Case 3, Top Slope, Closed
  - Case 4, Side Slope, Closed

The closed landfill conditions were modeled for a 30-year period with initial moisture contents set to field capacity. The evaporative zone depth and leaf area index were suggested by the HELP model for Shreveport, Louisiana. The runoff potential for all of the conditions was 100 percent. The Soil Conservation Service (SCS) runoff curve numbers were input based on soil data and expected ground cover, surface slopes, and slope lengths.

2.3 Climate Data Input

Precipitation data was synthetically generated by the HELP model using normal mean monthly precipitation data from NOAA for the Jacksonville, Texas weather station for the years 1991 through 2020. The average annual precipitation over the modeled 30-year period was 45.72 inches. Temperature and solar radiation data was also synthetically generated by the HELP model using program defaults for Shreveport, Louisiana.

2.4 Landfill Profile Information

The various landfill final cover layers that are included in this demonstration are discussed below.

2.4.1 Regulatory Composite Final Cover System

The permitted final cover system was modeled with (1) a 12-inch-thick erosion layer, (2) a 250-mil geocomposite drainage layer, (3) a 40-mil LLDPE geomembrane, and (4) an 18-inch-thick infiltration layer with a hydraulic conductivity of $1x10^{-5}$ cm/s. The erosion and infiltration layers were modeled using default soil characteristics from the HELP model.

2.4.2 GCL Alternative Final Cover System

The GCL alternative final cover system was modeled with (1) a 12-inch-thick erosion layer, (2) a 250-mil geocomposite drainage layer, (3) a 40-mil LLDPE geomembrane, and (4) a GCL infiltration layer with a hydraulic conductivity of $3x10^{-9}$ cm/s. The erosion and GCL infiltration layers were modeled using default soil characteristics from the HELP model.

2.5 HELP Summary and Output

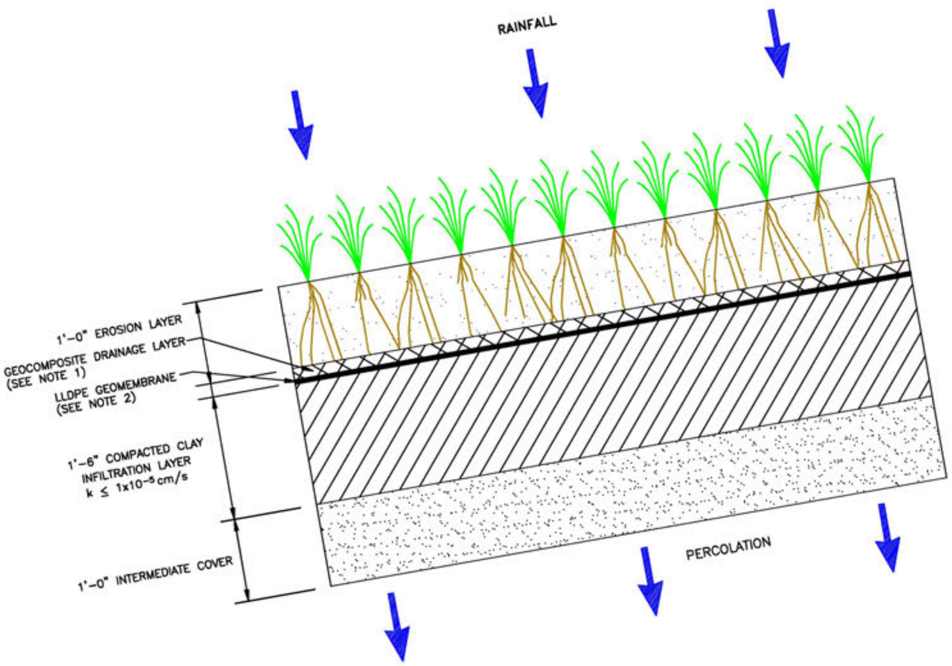
The HELP summary table and output files for the permitted final cover systems and proposed alternative final cover systems are presented on pages IIIJ-B-1-1 through IIIJ-B-1-30.

3 RESULTS

The HELP model was used to evaluate the design of the alternative final cover system by estimating the rate of percolation through the regulatory composite final cover system and GCL alternative final cover system. Model parameters and results are summarized on Figure IIIJ-B.1.

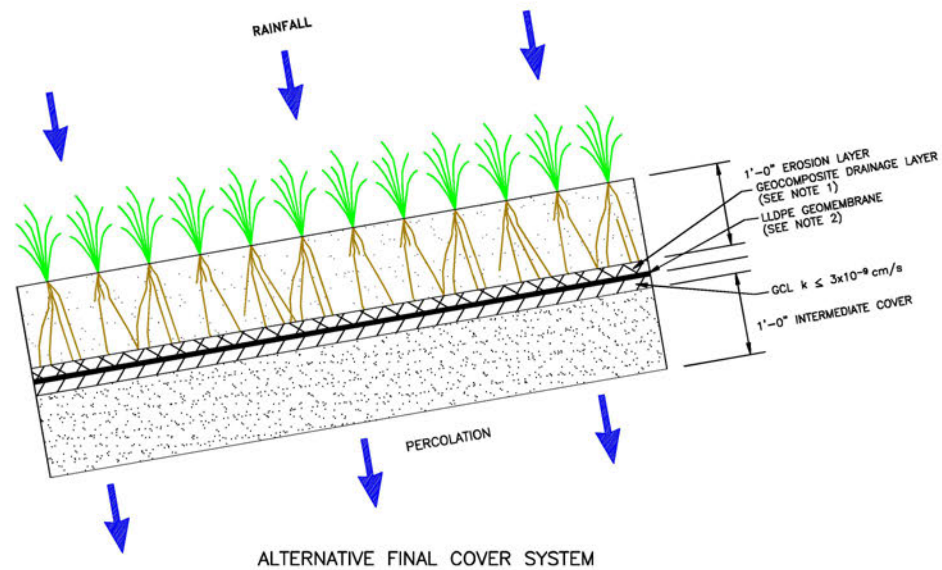
The results demonstrate that the GCL alternative final cover system meets TCEQ requirement listed under Title 30 TAC §330.457(d)(1) in which an alternative final cover must achieve an equivalent reduction in infiltration as the clay-rich soil cover. The GCL alternative final cover system achieved a lower percolation rate than the regulatory composite final cover system, as shown on Figure IIIJ-B.1.

AVERAGE ANNUAL RAINFALL = 45.72 IN/YEAR



COMPOSITE FINAL COVER SYSTEM

	TOP SLOPE	SIDE SLOPE
AVERAGE ANNUAL PERCOLATION (IN/YEAR)=	0.00062	0.00004
PEAK DAILY PERCOLATION (IN/DAY)=	0.00032	0.000004



ALTERNATIVE FINAL COVER SYSTEM

	TOP SLOPE	SIDE SLOPE
AVERAGE ANNUAL PERCOLATION (IN/YEAR)=	0.00001	0.00000
PEAK DAILY PERCOLATION (IN/DAY)=	0.000004	0.00000

NOTES:

1. THE FINAL COVER GEOCOMPOSITE DRAINAGE LAYER DESIGN IS INCLUDED IN APPENDIX IIIJ-A-A AND DESIGN CONSISTS OF SINGLE-SIDED GEOCOMPOSITE FOR THE TOP SLOPES AND DOUBLE-SIDED GEOCOMPOSITE FOR THE SIDE SLOPES.
2. THE OVERLYING LLDPE GEOMEMBRANE LINER DESIGN CONSISTS OF SMOOTH OR TEXTURED 40-MIL LLDPE FOR THE TOP SLOPES AND TEXTURED 40-MIL LLDPE FOR THE SIDE SLOPES.
3. THIS GRAPHIC IS DEVELOPED TO COMPARE THE COMPOSITE FINAL COVER SYSTEM AND ALTERNATIVE FINAL COVER SYSTEM PERCOLATION RATES THROUGH THE BOTTOM OF THE INFILTRATION AND GCL LAYERS, RESPECTIVELY.

☐ DRAFT
☒ FOR PERMITTING PURPOSES ONLY
☐ ISSUED FOR CONSTRUCTION

DATE: 05/2024	DRAWN BY: RAA
FILE: 0120-076-11	DESIGN BY: SSM
CAD: FIG IIIJ-B.1-DEMO. COMPARISON.DWG	REVIEWED BY: CRM

Weaver Consultants Group
TBPE REGISTRATION NO. F-3727

PREPARED FOR
PINE HILL FARMS LANDFILL TX, LP

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
ALTERNATIVE FINAL COVER
DEMONSTRATION COMPARISON

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS

WWW.WCGRP.COM

FIGURE IIIJ-B.1

APPENDIX IIIJ-B-1

HELP MODEL ANALYSIS

Includes pages IIIJ-B-1-1 through IIIJ-B-1-31

STATE OF TEXAS
DAVID E. POE
81734
LICENSED
PROFESSIONAL ENGINEER

05/20/2024

ROYAL OAKS LANDFILL
0120-076-11-106
HELP VERSION 3.07 SUMMARY SHEET
AFC DEMONSTRATION

		COMPOSITE FINAL COVER		GCL ALTERNATIVE FINAL COVER	
		TOP SLOPE	SIDE SLOPE	TOP SLOPE	SIDE SLOPE
GENERAL	Case No.	1	2	3	4
INFORMATION	Output Page	IIIJ-B-1-3	IIIJ-B-1-10	IIIJ-B-1-17	IIIJ-B-1-24
	No. of Years	30	30	30	30
	Ground Cover	GOOD	GOOD	GOOD	GOOD
	SCS Runoff Curve No.	81.2	82.2	81.2	82.2
	Model Area (acre)	1	1	1	1
	Runoff Area (%)	100	100	100	100
	Maximum Leaf Area Index	4.5	4.5	4.5	4.5
	Evaporative Zone Depth (inch)	12	12	12	12
EROSION	Thickness (in)	12	12	12	12
LAYER	Porosity (vol/vol)	0.3980	0.3980	0.3980	0.3980
(Texture = 10)	Field Capacity (vol/vol)	0.2440	0.2440	0.2440	0.2440
	Wilting Point (vol/vol)	0.1360	0.1360	0.1360	0.1360
	Init. Moisture Content (vol/vol)	0.2440	0.2440	0.2440	0.2440
	Hyd. Conductivity (cm/s)	1.2E-04	1.2E-04	1.2E-04	1.2E-04
DRAINAGE	Thickness (in)	0.25	0.25	0.25	0.25
LAYER	Porosity (vol/vol)	0.8500	0.8500	0.8500	0.8500
(Texture = 0)	Field Capacity (vol/vol)	0.0100	0.0100	0.0100	0.0100
	Wilting Point (vol/vol)	0.0050	0.0050	0.0050	0.0050
	Init. Moisture Content (vol/vol)	0.0100	0.0100	0.0100	0.0100
	Hyd. Conductivity (cm/s)	6.63	6.63	6.63	6.63
	Slope (%)	4	25	4	25
	Slope Length (ft)	180	160	180	160
FLEXIBLE MEMBRANE	Thickness (in)	0.04	0.04	0.04	0.04
LINER	Hyd. Conductivity (cm/s)	4.0E-13	4.0E-13	4.0E-13	4.0E-13
(Texture = 36)	Pinhole Density (holes/acre)	1	1	1	1
	Installation Defects (holes/acre)	4	4	4	4
	Placement Quality	GOOD	GOOD	GOOD	GOOD
INFILTRATION	Thickness (in)	18	18		
LAYER	Porosity (vol/vol)	0.4270	0.4270		
(Texture = 0)	Field Capacity (vol/vol)	0.4180	0.4180		
	Wilting Point (vol/vol)	0.3670	0.3670		
	Init. Moisture Content (vol/vol)	0.4270	0.4270		
	Hyd. Conductivity (cm/s)	1.0E-05	1.0E-05		
GEOSYNTHETIC CLAY	Thickness (in)			0.25	0.25
LINER	Porosity (vol/vol)			0.7500	0.7500
(Texture = 17)	Field Capacity (vol/vol)			0.7470	0.7470
	Wilting Point (vol/vol)			0.4000	0.4000
	Init. Moisture Content (vol/vol)			0.7500	0.7500
	Hyd. Conductivity (cm/s)			3.0E-09	3.0E-09
PRECIPITATION	Average Annual (in)	45.72	45.72	45.72	45.72
RUNOFF	Average Annual (in)	1.94	2.63	1.94	2.63
EVAPOTRANSPIRATION	Average Annual (in)	28.58	28.75	28.58	28.75
INFILTRATION RATE	Average Annual (in/year)	0.00062	0.00004	0.00001	0.00000
THROUGH FINAL COVER	Peak Daily (in/day)	0.00032	0.000004	0.000004	0.000000

HELP MODEL OUTPUT

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              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:\RO\J\B\COMPTS\DATA4.D4
TEMPERATURE DATA FILE:      C:\RO\J\B\COMPTS\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\RO\J\B\COMPTS\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\RO\J\B\COMPTS\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\RO\J\B\COMPTS\DATA10.D10
OUTPUT DATA FILE:           C:\RO\J\B\COMPTS\OUTPUT1.OUT


TIME:  13:23     DATE:   1/ 9/2024


******************************************************************************

     TITLE:  ROYAL OAKS LANDFILL - COMPOSITE FINAL COVER (TOPSLOPE)

******************************************************************************


     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  10
           THICKNESS                  =     12.00   INCHES
```

```
  POROSITY                    =      0.3980 VOL/VOL
  FIELD CAPACITY              =      0.2440 VOL/VOL
  WILTING POINT               =      0.1360 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.2440 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =  0.119999997000E-03 CM/SEC
NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  5.00
         FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.



                          LAYER  2
                          --------

                TYPE 2 - LATERAL DRAINAGE LAYER
                  MATERIAL TEXTURE NUMBER   0
  THICKNESS                   =      0.25   INCHES
  POROSITY                    =      0.8500 VOL/VOL
  FIELD CAPACITY              =      0.0100 VOL/VOL
  WILTING POINT               =      0.0050 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.0100 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =   6.63000011000     CM/SEC
  SLOPE                       =      4.00   PERCENT
  DRAINAGE LENGTH             =    180.0    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    =      4.00   HOLES/ACRE
  FML PLACEMENT QUALITY       =  3 - GOOD



                          LAYER  4
                          --------

                  TYPE 3 - BARRIER SOIL LINER
```

```
                 MATERIAL TEXTURE NUMBER   0
   THICKNESS                   =     18.00   INCHES
   POROSITY                    =      0.4270 VOL/VOL
   FIELD CAPACITY              =      0.4180 VOL/VOL
   WILTING POINT               =      0.3670 VOL/VOL
   INITIAL SOIL WATER CONTENT  =      0.4270 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-05 CM/SEC
```

```
           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE #10 WITH A
          GOOD STAND OF GRASS, A SURFACE SLOPE OF  4.%
          AND A SLOPE LENGTH OF  180. FEET.

SCS RUNOFF CURVE NUMBER              =     81.20
FRACTION OF AREA ALLOWING RUNOFF     =    100.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE   =      1.000  ACRES
EVAPORATIVE ZONE DEPTH               =     12.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE    =      2.928  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE   =      4.776  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE   =      1.632  INCHES
INITIAL SNOW WATER                   =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS     =     10.616  INCHES
TOTAL INITIAL WATER                  =     10.616  INCHES
TOTAL SUBSURFACE INFLOW              =      0.00   INCHES/YEAR
```

```
            EVAPOTRANSPIRATION AND WEATHER DATA
            -----------------------------------

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
          SHREVEPORT            LOUISIANA

     STATION LATITUDE                        =  32.28 DEGREES
     MAXIMUM LEAF AREA INDEX                 =   4.50
     START OF GROWING SEASON (JULIAN DATE)   =     58
     END OF GROWING SEASON (JULIAN DATE)     =    331
     EVAPORATIVE ZONE DEPTH                  =  12.0  INCHES
     AVERAGE ANNUAL WIND SPEED               =   8.60 MPH
     AVERAGE 1ST QUARTER RELATIVE HUMIDITY   =  70.00 %
     AVERAGE 2ND QUARTER RELATIVE HUMIDITY   =  72.00 %
     AVERAGE 3RD QUARTER RELATIVE HUMIDITY   =  72.00 %
```

AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 72.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SHREVEPORT LOUISIANA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.54	4.24	3.80	3.38	4.26	4.04
3.40	3.07	3.55	4.75	4.24	4.23

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SHREVEPORT LOUISIANA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
46.00	49.80	56.70	64.10	72.20	79.10
82.80	82.40	76.60	66.40	55.80	48.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SHREVEPORT LOUISIANA
AND STATION LATITUDE = 32.28 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.06	3.66	3.91	3.61	4.07	4.22
	3.38	2.64	3.32	4.70	4.22	3.92
STD. DEVIATIONS	2.78	1.82	1.66	1.52	1.88	2.72

```
                         1.70     2.24     1.86     2.59     1.43     2.47

RUNOFF
------
  TOTALS                 0.162    0.146    0.063    0.034    0.117    0.276
                         0.114    0.072    0.110    0.513    0.107    0.230

  STD. DEVIATIONS        0.428    0.276    0.127    0.083    0.233    0.406
                         0.237    0.174    0.228    0.834    0.088    0.475

EVAPOTRANSPIRATION
------------------
  TOTALS                 1.730    2.131    2.966    3.241    3.405    3.076
                         2.940    2.179    2.473    1.803    1.234    1.405

  STD. DEVIATIONS        0.187    0.403    0.728    0.927    1.132    1.575
                         1.317    1.424    1.146    0.873    0.226    0.202

LATERAL DRAINAGE COLLECTED FROM LAYER  2
----------------------------------------
  TOTALS                 2.4196   1.6307   1.0844   0.4815   0.6772   0.9315
                         0.3962   0.3728   0.5029   1.9176   2.4589   2.3237

  STD. DEVIATIONS        2.3570   1.3815   1.1689   0.5418   0.9091   1.1421
                         0.5167   0.7152   0.7830   1.4816   1.2878   2.0416

PERCOLATION/LEAKAGE THROUGH LAYER  4
------------------------------------
  TOTALS                 0.0001   0.0001   0.0000   0.0000   0.0000   0.0000
                         0.0000   0.0000   0.0000   0.0001   0.0001   0.0001

  STD. DEVIATIONS        0.0001   0.0001   0.0000   0.0000   0.0001   0.0001
                         0.0000   0.0000   0.0000   0.0002   0.0000   0.0001


-------------------------------------------------------------------------------
             AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


DAILY AVERAGE HEAD ON TOP OF LAYER  3
-------------------------------------
  AVERAGES               0.0316   0.0291   0.0121   0.0037   0.0114   0.0183
                         0.0064   0.0064   0.0083   0.0553   0.0287   0.0399

  STD. DEVIATIONS        0.0445   0.0401   0.0170   0.0052   0.0275   0.0294
                         0.0136   0.0161   0.0177   0.0729   0.0165   0.0569

*******************************************************************************
```

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.72 (8.166)	165946.7	100.00
RUNOFF	1.943 (1.4253)	7054.32	4.251
EVAPOTRANSPIRATION	28.583 (3.6101)	103757.41	62.525
LATERAL DRAINAGE COLLECTED FROM LAYER 2	15.19686 (5.20318)	55164.598	33.24236
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00062 (0.00030)	2.243	0.00135
AVERAGE HEAD ON TOP OF LAYER 3	0.021 (0.011)		
CHANGE IN WATER STORAGE	-0.009 (0.4878)	-31.90	-0.019

****

****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	6.92	25119.600
RUNOFF	3.628	13168.5488
DRAINAGE COLLECTED FROM LAYER 2	2.08349	7563.06934
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000316	1.14858
AVERAGE HEAD ON TOP OF LAYER 3	4.598	
MAXIMUM HEAD ON TOP OF LAYER 3	7.622	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	30.5 FEET	

```
    SNOW WATER                                  3.18         11547.1094


    MAXIMUM VEG. SOIL WATER (VOL/VOL)                  0.3849

    MINIMUM VEG. SOIL WATER (VOL/VOL)                  0.1360


     ***  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.


******************************************************************************




******************************************************************************

                  FINAL WATER STORAGE AT END OF YEAR   30
        ----------------------------------------------------------------------
                   LAYER        (INCHES)       (VOL/VOL)
                   -----        --------       ---------
                     1            2.6644         0.2220

                     2            0.0025         0.0100

                     3            0.0000         0.0000

                     4            7.6860         0.4270

                 SNOW WATER       0.000

******************************************************************************
******************************************************************************
```

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              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:\RO\J\B\COMPSS\DATA4.D4
TEMPERATURE DATA FILE:      C:\RO\J\B\COMPSS\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\RO\J\B\COMPSS\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\RO\J\B\COMPSS\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\RO\J\B\COMPSS\DATA10.D10
OUTPUT DATA FILE:           C:\RO\J\B\COMPSS\OUTPUT1.OUT


TIME:  13:25     DATE:   1/ 9/2024


******************************************************************************

     TITLE:  ROYAL OAKS LANDFILL - COMPOSITE FINAL COVER (SIDE SLOPE)

******************************************************************************


     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  10
           THICKNESS                  =     12.00   INCHES
```

```
  POROSITY                     =      0.3980 VOL/VOL
  FIELD CAPACITY               =      0.2440 VOL/VOL
  WILTING POINT                =      0.1360 VOL/VOL
  INITIAL SOIL WATER CONTENT   =      0.2440 VOL/VOL
  EFFECTIVE SAT. HYD. COND.    =  0.119999997000E-03 CM/SEC
NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  5.00
         FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.



                           LAYER  2
                           --------

              TYPE 2 - LATERAL DRAINAGE LAYER
                MATERIAL TEXTURE NUMBER   0
  THICKNESS                    =      0.25   INCHES
  POROSITY                     =      0.8500 VOL/VOL
  FIELD CAPACITY               =      0.0100 VOL/VOL
  WILTING POINT                =      0.0050 VOL/VOL
  INITIAL SOIL WATER CONTENT   =      0.0100 VOL/VOL
  EFFECTIVE SAT. HYD. COND.    =   6.63000011000     CM/SEC
  SLOPE                        =     25.00   PERCENT
  DRAINAGE LENGTH              =    160.0    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     =      4.00   HOLES/ACRE
  FML PLACEMENT QUALITY        =  3 - GOOD



                           LAYER  4
                           --------

                TYPE 3 - BARRIER SOIL LINER
```

```
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =     18.00   INCHES
POROSITY                     =      0.4270 VOL/VOL
FIELD CAPACITY               =      0.4180 VOL/VOL
WILTING POINT                =      0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC
```

```
          GENERAL DESIGN AND EVAPORATIVE ZONE DATA
          ----------------------------------------

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE #10 WITH A
          GOOD STAND OF GRASS, A SURFACE SLOPE OF 25.%
          AND A SLOPE LENGTH OF  160. FEET.

SCS RUNOFF CURVE NUMBER             =     82.20
FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
EVAPORATIVE ZONE DEPTH              =     12.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE   =      2.928  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE  =      4.776  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE  =      1.632  INCHES
INITIAL SNOW WATER                  =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS    =     10.616  INCHES
TOTAL INITIAL WATER                 =     10.616  INCHES
TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR
```

```
           EVAPOTRANSPIRATION AND WEATHER DATA
           -----------------------------------

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
          SHREVEPORT            LOUISIANA

     STATION LATITUDE                        =  32.28 DEGREES
     MAXIMUM LEAF AREA INDEX                 =   4.50
     START OF GROWING SEASON (JULIAN DATE)   =     58
     END OF GROWING SEASON (JULIAN DATE)     =    331
     EVAPORATIVE ZONE DEPTH                  =  12.0  INCHES
     AVERAGE ANNUAL WIND SPEED               =   8.60 MPH
     AVERAGE 1ST QUARTER RELATIVE HUMIDITY   =  70.00 %
     AVERAGE 2ND QUARTER RELATIVE HUMIDITY   =  72.00 %
     AVERAGE 3RD QUARTER RELATIVE HUMIDITY   =  72.00 %
```

AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 72.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SHREVEPORT LOUISIANA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.54	4.24	3.80	3.38	4.26	4.04
3.40	3.07	3.55	4.75	4.24	4.23

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SHREVEPORT LOUISIANA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
46.00	49.80	56.70	64.10	72.20	79.10
82.80	82.40	76.60	66.40	55.80	48.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SHREVEPORT LOUISIANA
AND STATION LATITUDE = 32.28 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.06	3.66	3.91	3.61	4.07	4.22
	3.38	2.64	3.32	4.70	4.22	3.92
STD. DEVIATIONS	2.78	1.82	1.66	1.52	1.88	2.72

```
                        1.70     2.24     1.86     2.59     1.43     2.47

RUNOFF
------
  TOTALS                0.233    0.198    0.092    0.047    0.167    0.363
                        0.139    0.098    0.160    0.659    0.161    0.311

  STD. DEVIATIONS       0.529    0.368    0.179    0.097    0.330    0.521
                        0.262    0.210    0.299    0.981    0.127    0.592

EVAPOTRANSPIRATION
------------------
  TOTALS                1.729    2.135    2.978    3.273    3.433    3.103
                        2.988    2.193    2.490    1.801    1.225    1.398

  STD. DEVIATIONS       0.185    0.403    0.730    0.938    1.150    1.594
                        1.345    1.440    1.169    0.871    0.223    0.203

LATERAL DRAINAGE COLLECTED FROM LAYER  2
----------------------------------------
  TOTALS                2.3653   1.6055   1.0222   0.4582   0.6055   0.7960
                        0.3451   0.3243   0.4392   1.7444   2.4068   2.2373

  STD. DEVIATIONS       2.2251   1.3528   1.1152   0.5406   0.8131   0.9644
                        0.5187   0.6654   0.7229   1.3466   1.2951   1.8829

PERCOLATION/LEAKAGE THROUGH 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


-------------------------------------------------------------------------------
             AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


DAILY AVERAGE HEAD ON TOP OF LAYER  3
-------------------------------------
  AVERAGES              0.0014   0.0010   0.0006   0.0003   0.0004   0.0005
                        0.0002   0.0002   0.0003   0.0010   0.0015   0.0013

  STD. DEVIATIONS       0.0013   0.0009   0.0007   0.0003   0.0005   0.0006
                        0.0003   0.0004   0.0004   0.0008   0.0008   0.0011

*******************************************************************************
```

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES		CU. FEET	PERCENT
PRECIPITATION	45.72	(8.166)	165946.7	100.00
RUNOFF	2.628	(1.8011)	9539.93	5.749
EVAPOTRANSPIRATION	28.746	(3.6457)	104347.59	62.880
LATERAL DRAINAGE COLLECTED FROM LAYER 2	14.34973	(4.86712)	52089.531	31.38932
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00004	(0.00001)	0.132	0.00008
AVERAGE HEAD ON TOP OF LAYER 3	0.001	(0.000)		
CHANGE IN WATER STORAGE	-0.008	(0.5575)	-30.52	-0.018

****

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	6.92	25119.600
RUNOFF	3.796	13779.7959
DRAINAGE COLLECTED FROM LAYER 2	2.01000	7296.30762
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000004	0.01415
AVERAGE HEAD ON TOP OF LAYER 3	0.036	
MAXIMUM HEAD ON TOP OF LAYER 3	0.081	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	0.0 FEET	

```
SNOW WATER                                3.18        11547.1094


MAXIMUM VEG. SOIL WATER (VOL/VOL)                  0.3578

MINIMUM VEG. SOIL WATER (VOL/VOL)                  0.1360

 ***  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.

******************************************************************************




******************************************************************************

               FINAL WATER STORAGE AT END OF YEAR   30
    ----------------------------------------------------------------------
                LAYER        (INCHES)        (VOL/VOL)
                -----        --------        ---------
                  1           2.6758           0.2230

                  2           0.0025           0.0100

                  3           0.0000           0.0000

                  4           7.6860           0.4270

               SNOW WATER     0.000

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\RO\J\B\ALTTS\DATA4.D4
TEMPERATURE DATA FILE:      C:\RO\J\B\ALTTS\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\RO\J\B\ALTTS\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\RO\J\B\ALTTS\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\RO\J\B\ALTTS\DATA10.D10
OUTPUT DATA FILE:           C:\RO\J\B\ALTTS\OUTPUT1.OUT


TIME:  13:29     DATE:   1/ 9/2024


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     TITLE:  ROYAL OAKS LANDFILL - ALTERNATIVE FINAL COVER (TOP SLOPE)

******************************************************************************


     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  10
           THICKNESS                   =     12.00   INCHES
```

```
  POROSITY                      =      0.3980 VOL/VOL
  FIELD CAPACITY                =      0.2440 VOL/VOL
  WILTING POINT                 =      0.1360 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.2440 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =  0.119999997000E-03 CM/SEC
NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  5.00
         FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                          LAYER  2
                          --------

               TYPE 2 - LATERAL DRAINAGE LAYER
                 MATERIAL TEXTURE NUMBER   0
  THICKNESS                     =      0.25   INCHES
  POROSITY                      =      0.8500 VOL/VOL
  FIELD CAPACITY                =      0.0100 VOL/VOL
  WILTING POINT                 =      0.0050 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.0100 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =   6.63000011000     CM/SEC
  SLOPE                         =      4.00   PERCENT
  DRAINAGE LENGTH               =    180.0    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      =      4.00   HOLES/ACRE
  FML PLACEMENT QUALITY         =  3 - GOOD


                          LAYER  4
                          --------

                 TYPE 3 - BARRIER SOIL LINER
```

MATERIAL TEXTURE NUMBER 17

THICKNESS	=	0.25 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

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #10 WITH A GOOD STAND OF GRASS, A SURFACE SLOPE OF 4.% AND A SLOPE LENGTH OF 180. FEET.

SCS RUNOFF CURVE NUMBER	=	81.20	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.928	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	4.776	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.632	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	3.118	INCHES
TOTAL INITIAL WATER	=	3.118	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM SHREVEPORT LOUISIANA

STATION LATITUDE	=	32.28 DEGREES
MAXIMUM LEAF AREA INDEX	=	4.50
START OF GROWING SEASON (JULIAN DATE)	=	58
END OF GROWING SEASON (JULIAN DATE)	=	331
EVAPORATIVE ZONE DEPTH	=	12.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	8.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	70.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	72.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	72.00 %

AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 72.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SHREVEPORT LOUISIANA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.54	4.24	3.80	3.38	4.26	4.04
3.40	3.07	3.55	4.75	4.24	4.23

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SHREVEPORT LOUISIANA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
46.00	49.80	56.70	64.10	72.20	79.10
82.80	82.40	76.60	66.40	55.80	48.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SHREVEPORT LOUISIANA
AND STATION LATITUDE = 32.28 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.06	3.66	3.91	3.61	4.07	4.22
	3.38	2.64	3.32	4.70	4.22	3.92
STD. DEVIATIONS	2.78	1.82	1.66	1.52	1.88	2.72

	1.70	2.24	1.86	2.59	1.43	2.47

RUNOFF

TOTALS	0.162	0.146	0.063	0.034	0.117	0.276
	0.114	0.072	0.109	0.513	0.109	0.229
STD. DEVIATIONS	0.428	0.276	0.128	0.083	0.233	0.406
	0.237	0.174	0.228	0.834	0.092	0.475

EVAPOTRANSPIRATION

TOTALS	1.730	2.130	2.967	3.244	3.404	3.075
	2.942	2.177	2.473	1.803	1.234	1.405
STD. DEVIATIONS	0.187	0.405	0.729	0.930	1.135	1.574
	1.320	1.422	1.146	0.872	0.227	0.202

LATERAL DRAINAGE COLLECTED FROM LAYER 2

TOTALS	2.4224	1.6314	1.0827	0.4791	0.6779	0.9307
	0.3968	0.3730	0.5037	1.9181	2.4629	2.3171
STD. DEVIATIONS	2.3566	1.3813	1.1693	0.5423	0.9113	1.1412
	0.5158	0.7143	0.7837	1.4823	1.2834	2.0319

PERCOLATION/LEAKAGE THROUGH 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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.0320	0.0293	0.0119	0.0037	0.0116	0.0183
	0.0064	0.0062	0.0082	0.0557	0.0289	0.0398
STD. DEVIATIONS	0.0462	0.0401	0.0165	0.0052	0.0275	0.0296
	0.0136	0.0159	0.0176	0.0730	0.0166	0.0573

****

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES		CU. FEET	PERCENT
PRECIPITATION	45.72	(8.166)	165946.7	100.00
RUNOFF	1.944	(1.4257)	7058.01	4.253
EVAPOTRANSPIRATION	28.584	(3.6147)	103760.07	62.526
LATERAL DRAINAGE COLLECTED FROM LAYER 2	15.19570	(5.19658)	55160.402	33.23984
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00001	(0.00000)	0.024	0.00001
AVERAGE HEAD ON TOP OF LAYER 3	0.021	(0.011)		
CHANGE IN WATER STORAGE	-0.009	(0.4889)	-31.83	-0.019

****

****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	6.92	25119.600
RUNOFF	3.628	13168.2627
DRAINAGE COLLECTED FROM LAYER 2	2.08349	7563.07178
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000004	0.01527
AVERAGE HEAD ON TOP OF LAYER 3	4.598	
MAXIMUM HEAD ON TOP OF LAYER 3	7.622	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	30.5 FEET	

```
SNOW WATER                                    3.18         11547.1094


MAXIMUM VEG. SOIL WATER (VOL/VOL)                         0.3849

MINIMUM VEG. SOIL WATER (VOL/VOL)                         0.1360


 ***  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            2.6649         0.2221

                2            0.0025         0.0100

                3            0.0000         0.0000

                4            0.1875         0.7500

             SNOW WATER      0.000

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\RO\J\B\ALTSS\DATA4.D4
TEMPERATURE DATA FILE:      C:\RO\J\B\ALTSS\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\RO\J\B\ALTSS\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\RO\J\B\ALTSS\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\RO\J\B\ALTSS\DATA10.D10
OUTPUT DATA FILE:           C:\RO\J\B\ALTSS\OUTPUT1.OUT


TIME:  13:50     DATE:   1/ 9/2024


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     TITLE:  ROYAL OAKS LANDFILL - FINAL COVER (SIDESLOPE)

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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  10
           THICKNESS                  =     12.00   INCHES
```

```
  POROSITY                     =      0.3980 VOL/VOL
  FIELD CAPACITY               =      0.2440 VOL/VOL
  WILTING POINT                =      0.1360 VOL/VOL
  INITIAL SOIL WATER CONTENT   =      0.2440 VOL/VOL
  EFFECTIVE SAT. HYD. COND.    =  0.119999997000E-03 CM/SEC
NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  5.00
         FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                          LAYER  2
                          --------

              TYPE 2 - LATERAL DRAINAGE LAYER
                MATERIAL TEXTURE NUMBER   0
  THICKNESS                    =      0.25   INCHES
  POROSITY                     =      0.8500 VOL/VOL
  FIELD CAPACITY               =      0.0100 VOL/VOL
  WILTING POINT                =      0.0050 VOL/VOL
  INITIAL SOIL WATER CONTENT   =      0.0100 VOL/VOL
  EFFECTIVE SAT. HYD. COND.    =   6.63000011000     CM/SEC
  SLOPE                        =     25.00   PERCENT
  DRAINAGE LENGTH              =    160.0    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     =      4.00   HOLES/ACRE
  FML PLACEMENT QUALITY        =  3 - GOOD


                          LAYER  4
                          --------

                TYPE 3 - BARRIER SOIL LINER
```

MATERIAL TEXTURE NUMBER 17

THICKNESS	=	0.25 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

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #10 WITH A GOOD STAND OF GRASS, A SURFACE SLOPE OF 25.% AND A SLOPE LENGTH OF 160. FEET.

SCS RUNOFF CURVE NUMBER	=	82.20	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.928	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	4.776	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.632	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	3.118	INCHES
TOTAL INITIAL WATER	=	3.118	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM SHREVEPORT LOUISIANA

STATION LATITUDE	=	32.28	DEGREES
MAXIMUM LEAF AREA INDEX	=	4.50	
START OF GROWING SEASON (JULIAN DATE)	=	58	
END OF GROWING SEASON (JULIAN DATE)	=	331	
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	8.60	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	70.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	72.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	72.00	%

AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 72.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SHREVEPORT LOUISIANA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.54	4.24	3.80	3.38	4.26	4.04
3.40	3.07	3.55	4.75	4.24	4.23

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SHREVEPORT LOUISIANA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
46.00	49.80	56.70	64.10	72.20	79.10
82.80	82.40	76.60	66.40	55.80	48.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SHREVEPORT LOUISIANA
AND STATION LATITUDE = 32.28 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.06	3.66	3.91	3.61	4.07	4.22
	3.38	2.64	3.32	4.70	4.22	3.92
STD. DEVIATIONS	2.78	1.82	1.66	1.52	1.88	2.72

	1.70	2.24	1.86	2.59	1.43	2.47

RUNOFF

TOTALS	0.233	0.198	0.092	0.047	0.167	0.363
	0.139	0.098	0.160	0.659	0.161	0.311
STD. DEVIATIONS	0.529	0.368	0.179	0.097	0.330	0.521
	0.262	0.210	0.299	0.981	0.127	0.592

EVAPOTRANSPIRATION

TOTALS	1.729	2.135	2.978	3.273	3.433	3.103
	2.988	2.193	2.490	1.801	1.225	1.398
STD. DEVIATIONS	0.185	0.403	0.730	0.938	1.150	1.594
	1.345	1.440	1.169	0.871	0.223	0.203

LATERAL DRAINAGE COLLECTED FROM LAYER 2

TOTALS	2.3653	1.6055	1.0222	0.4582	0.6055	0.7960
	0.3451	0.3243	0.4392	1.7444	2.4068	2.2373
STD. DEVIATIONS	2.2251	1.3528	1.1152	0.5406	0.8131	0.9644
	0.5187	0.6654	0.7229	1.3466	1.2951	1.8829

PERCOLATION/LEAKAGE THROUGH 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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.0014	0.0010	0.0006	0.0003	0.0004	0.0005
	0.0002	0.0002	0.0003	0.0010	0.0015	0.0013
STD. DEVIATIONS	0.0013	0.0009	0.0007	0.0003	0.0005	0.0006
	0.0003	0.0004	0.0004	0.0008	0.0008	0.0011

****

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES		CU. FEET	PERCENT
PRECIPITATION	45.72	(8.166)	165946.7	100.00
RUNOFF	2.628	(1.8011)	9539.93	5.749
EVAPOTRANSPIRATION	28.746	(3.6457)	104347.59	62.880
LATERAL DRAINAGE COLLECTED FROM LAYER 2	14.34977	(4.86714)	52089.656	31.38940
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00000	(0.00000)	0.006	0.00000
AVERAGE HEAD ON TOP OF LAYER 3	0.001	(0.000)		
CHANGE IN WATER STORAGE	-0.008	(0.5575)	-30.52	-0.018

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****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	6.92	25119.600
RUNOFF	3.796	13779.7959
DRAINAGE COLLECTED FROM LAYER 2	2.01001	7296.32178
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000000	0.00010
AVERAGE HEAD ON TOP OF LAYER 3	0.036	
MAXIMUM HEAD ON TOP OF LAYER 3	0.081	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	0.0 FEET	

```
SNOW WATER                                   3.18         11547.1094


MAXIMUM VEG. SOIL WATER (VOL/VOL)                      0.3578

MINIMUM VEG. SOIL WATER (VOL/VOL)                      0.1360

 ***  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           2.6758         0.2230

                 2           0.0025         0.0100

                 3           0.0000         0.0000

                 4           0.1875         0.7500

              SNOW WATER     0.000

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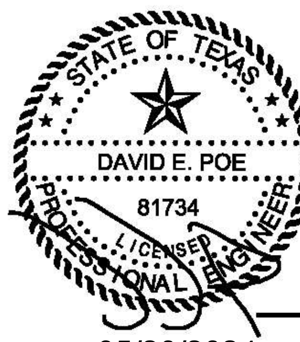
APPENDIX IIIJ-C

CLOSURE PLAN FOR MUNICIPAL SOLID WASTE TYPE I LANDFILL UNITS AND FINAL FACILITY CLOSURE (FORM 20720)



05/20/2024

Texas Commission on Environmental Quality

Closure Plan for Municipal Solid Waste Type I Landfill Units and Final Facility Closure

This form is for use by applicants or site operators of Municipal Solid Waste (MSW) Type I landfills to detail the plan for closure of a landfill unit, closure of associated storage or processing units, and final closure of the facility to meet the requirements in 30 TAC Chapter 330, §330.63(h) and 30 TAC Chapter 330 Subchapter K for a MSW Type I facility.

If you need assistance in completing this form, please contact the MSW Permits Section in the Waste Permits Division at (512) 239-2335.

I. General Information

Facility Name: **Royal Oaks Landfill**

MSW Permit No.: **1614B**

Site Operator/Permittee Name: **Pine Hill Farms Landfill TX, LP, 440 Heath Lane Jacksonville, TX 75766**

II. Landfill and Other Waste Management Units and Operations Requiring Closure at the Facility

A. Facility Units

Table 1. Description of Landfill Units.

Name or Descriptor of Unit	Operating Status of Unit	Type of Liner System Under Unit	Above Grade Class 1 Disposal Cells in this Unit	Below Grade Class 1 Disposal Cells in this Unit	Other Class 1 Disposal Cells in this Unit (describe)	Size of Unit's Waste Footprint (acres)	Maximum Inventory of Waste Ever in Unit (indicate cubic yards or tons)	Other Necessary Information that Pertains to the Unit
MSW Landfill	Active	Subtitle D and pre-Subtitle D	☐	☐	☐	83.1	10,538,370 CY	Waste = Waste plus Daily Cover
			☐	☐	☐			
			☐	☐	☐			
Totals						83.1	10,538,370	

Table 2. Description of Waste Storage or Processing Units or Operations Associated with this Permit.

Type of Storage or Processing Unit or Operation (individual units may be closed at any time prior to or during the final facility closure as described in this plan)	Operational Status of Unit	Size of the Area Used for the Storage or Processing Unit or Operation (Acres)	Maximum Inventory of Waste Ever in Storage or Processing Unit or Operation (indicate cubic yards or tons)	Other Information (enter other necessary information that pertains to the unit)
Citizens Convenience Center	Active	0.11	160 ☒cubic yards ☐tons	
Liquid Waste Bulking Facility	Future	0.55	480 ☒cubic yards ☐tons	
Totals		0.66	640 CY	

B. Waste Inventory Summary

Table 3. Maximum Inventory of Wastes Ever On Site.

Item	Quantity (indicate cubic yards or tons)
Maximum inventory of waste in landfill units (total from Table 1)	10,538,370 ☒cubic yards or ☐tons
Maximum inventory of waste in storage or processing units or operations (total from Table 2)	640 ☒cubic yards or ☐tons
Total Maximum Inventory of Wastes ever on site over the active life of the MSW facility (sum of totals from Tables 1 and 2)	10,534,010 ☒cubic yards or ☐tons

C. Drawings Showing Details of the Waste Management Units at Closure

Table 4. Location of the Drawings showing Details of the Waste Management Units at Closure (outlines, dimensions, maximum elevations of waste and final cover of landfill units, and waste storage or processing units or operations at closure of the facility).

Drawing Location in the SDP	Drawing Figure Number	Drawing Title	Waste Management Units Details Shown
Part III, App. IIIA-A	A.1	Top of Liner Plan	e.g., outlines, waste footprints, and dimensions of the landfill unit(s)
Part III, App. IIIA-A	A.2	Completion Plan	e.g., maximum elevations of waste and final cover of the landfill unit(s)

III. Description of the Final Cover System Design

A. Types and Descriptions of the Final Cover Systems

Table 5. Types and Descriptions of the Final Cover Systems Permitted or Proposed for Closure of the Landfill Units.

Landfill Unit Name or Descriptor	Type of Final Cover System	Final Cover System Components Description	Other Information (Enter other information as applicable)
MSW Landfill – Subtitle D Area	GCL Alternative	Comprised of GCL, geomembrane (LLDPE), geocomposite drainage layer, and a 12” vegetated erosion layer.	
MSW Landfill – Subtitle D Area	Regulatory Composite Final Cover	Comprised of an 18” low permeability ($1x10^{-5}$ cm/s) soil infiltration layer, geomembrane (LLDPE), geocomposite drainage layer, and a 12” vegetated erosion layer.	

B. Design Details

Table 6. Design Details of the Final Cover Top and Side Slopes for the Landfill Units.

Landfill Unit Name or Descriptor	Maximum Final Elevation of Waste (feet above mean sea level [ft-msl])	Maximum Elevation of Top of Final Cover (ft-msl)	Minimum Grade of the Final Cover Top Slope (%)	Maximum Grade of the Final Cover Side Slope (%)	Other Information (enter other information as applicable, e.g. above-grade Class 1 Cell Dikes)
MSW Landfill	773.0	776.5	4%	25%	

C. Final Cover Drainage Features

Storm water drainage and erosion and sediment control features incorporated on the final cover of the landfill units to protect the integrity and effectiveness of the final cover system include *(please list and describe the drainage features to be installed on the final cover at or prior to closure for each landfill unit, or list the drainage features and provide cross references on the location(s) of the descriptive and details (drawing) information in other parts of the SDP)*:

Storm water drainage features incorporated into the project include vegetative cover on the landfill side and topslopes, sideslope drainage swales, reinforced downchutes, perimeter ditches, and stormwater detention basins. Drainage feature design calculations are presented in Part III, Appendix IIIF – Surface Water Drainage Plan of the application.

D. Final Cover Vegetation or Other Ground Cover Material

The final cover will be seeded and/or sodded with native plants immediately following the application of the final cover in order to minimize erosion. Other materials, including **NA**, may be incorporated over the final cover soil surface to ensure sufficient coverage of the ground surface to minimize erosion. The estimated percent ground cover to minimize soil loss and maintain long-term erosional stability of the final cover top and side slopes is: 70%. The minimum material specifications for other ground cover materials are summarized in the table below.

For a landfill with water balance final cover design, the percentage vegetation cover (excluding other ground cover types) will not be less than that assumed in the water balance final cover model.

Table 7. Minimum Specification for Ground Cover Materials Other Than Vegetation, if Applicable.

Other Ground Cover Material	Maximum Particle Size (inches)	Minimum Particle Size (inches)	Material Placement Method	Thickness of Layer (inches)	Percentage Coverage (%)	Other (specify)
NA						

E. Final Contour Map

Figure **A.2 (Part III, App. IIIA-A)**, a facility final contour map is attached. The map shows the final contours of the landfill units and the entire facility at closure.

Figures **B.1 through B.9 (Part III, App. IIIA-B),** showing the cross–sections of the landfill units at closure are also provided.

The facility final contour and cross-section maps/drawings depict the following information:

(1) Final constructed contours of the landfill at closure.

(2) Top slopes and side slopes of the landfill units.

(3) Surface drainage features.

(4) 100-year floodplain, as applicable.

(5) Constructed features providing protection of/from the 100-year floodplain.

(6) Other (specify):

IV. Description of the Final Cover System Installation Procedure

A. Mode of Installation

Table 8. Mode of Final Cover Installation on the Landfill Units.

Landfill Unit Name or Descriptor	Largest Area of Unit Ever Requiring Final Cover (Acres)	Check this Column if Final Cover will be Placed in Installments as Permitted Elevation is Reached	Check this Column if Final Cover will be Placed when Entire Unit Area Reaches Permitted Elevation	Final Cover Installation Status
MSW Landfill	83.1 (see note in Table 9)	☐	☒	Yet to be installed
		☐	☐	
		☐	☐	
		☐	☐	

B. Installation Drawings for Final Cover and Drainage Features

The following attached plan and cross-section drawings show the final cover design details, the largest area requiring final cover, details of the sequence of installation of the final cover system, and all drainage features.

Table 9. List of Attached Installation Drawings for Final Cover and Drainage Features.

Drawing No.	Drawing Title	Description of Information Contained in Drawing
Drawings B.1 to B.9 (Part III, App. IIIA-B)	Varies	(e.g., final cover cross section details with references to base drawings)
Drawing IIIL.1 (Part III, App. IIIL – Closure and Postclosure Care Cost Estimates	Largest Area to Require Final Cover	(e.g., the largest area ever requiring final cover). Note that the largest area value will be reviewed periodically and adjusted as necessary along with the closure/postclosure care cost estimates and financial assurance demonstration.
Drawing I/IIA.4 to Drawing I/IIA.8 (Part I/II App I/IIA)	Varies	(e.g., details of the sequence final cover system installation)
Drawings IIIF.1 to IIIF.15 (Part III, App. IIIF – Surface Water Drainage Plan)	Varies	(e.g., details of all drainage features on the final cover)
NA		Other: describe as applicable

C. Final Cover Quality Control Plan

A final cover quality control plan (FCQCP), **Part III, Appendix IIIJ-A**, is attached. The FCQCP describes the final cover system design, construction, and evaluation protocol and processes, including the personnel, materials, methods, sampling and testing standards, procedures, and practices to be used in procuring, handling, installing, and evaluating all elements of the final cover system. It establishes the material requirements; personnel qualifications and roles; installation requirements; quality control and quality assurance monitoring, testing, documentation, and reporting programs to be used during construction of each component of the final cover system to assure and to verify that the final cover system is constructed as designed and in accordance with applicable rules and technical standards.

D. Documentation and Reporting of Final Cover System Construction and Testing

The professional of record will document all aspects and stages of the final cover installation, including materials used, equipment and construction methods, and the type and rate of sampling and quality control testing performed. Following completion of construction of the final cover, the site operator/permittee will submit to the TCEQ executive director, a Final Cover System Evaluation Report (FCSER) for each landfill unit.

V. Closure Activities and Completion Schedules for Each Landfill Unit and for the Final Facility Closure

A. Closure of a Landfill Unit

The following activities will be conducted to satisfy the closure criteria for a landfill unit:

(1) Closure Notification to the TCEQ Executive Director:

The site operator will inform the executive director of the TCEQ, in writing, of the intent to close the unit no later than 45 days prior to the initiation of closure activities and place this notice of intent in the operating record.

(2) Stoppage of Waste Acceptance and Commencement of Other Closure Activities for the Unit:

The site operator will stop accepting waste upon receiving the known final receipt of waste. The site operator will ensure that the permitted top elevations of the in-place waste, as depicted in/derived from the unit's final contour map approved by the TCEQ executive director, are not exceeded at any section or part of the landfill unit. The site operator will begin closure activities for the unit no later than:

- Thirty days after the date on which the unit receives the known final receipt of wastes; or

- One year after the most recent receipt of wastes if the unit has remaining capacity and there is a reasonable likelihood that the unit will receive additional wastes.

(3) Request for Extension Beyond the 1-Year Deadline for Commencing Closure Activities for a Unit:

The site operator may submit a written request to the executive director of the TCEQ for review and approval for an extension beyond the one-year deadline for the initiation of closure. The request will include the following:

(a) All applicable documentation necessary to demonstrate that the unit has the capacity to receive additional waste; and

(b) All documentation necessary to demonstrate that the site operator has taken and will continue to take all steps necessary to prevent threats to human health and the environment from the MSW landfill unit.

(4) Construction of Final Cover:

The site operator will construct the permitted final cover over the waste mass utilizing methods, procedures, and specifications described in the FCQCP. The final constructed contours, elevations, and slopes of the installed final cover will match the permitted final cover contours, elevations, and slopes shown in closure drawings contained in this closure plan.

(5) Construction of Drainage Features:

The site operator will construct the drainage structures shown in drawings referenced or contained in this closure plan or in the facility surface water drainage report.

(6) Completion of Outstanding or Replacement of Damaged Groundwater or Landfill Gas Monitoring Components:

The site operator will complete installation of any outstanding or replacement of any damaged groundwater or landfill gas monitoring system components and landfill gas control systems as needed to maintain current and effective groundwater or landfill gas monitoring and control systems.

(7) Submittal of Final Cover System Evaluation Report (FCSER) to the TCEQ Executive Director:

Following completion of construction of the final cover for the subject landfill unit, the site operator will submit to the TCEQ executive director for review and acceptance, a FCSER for the unit.

(8) Completion of Closure Activities for the Landfill Unit:

The site operator will complete closure activities for the unit within 180 days following the start of closure activities, unless the executive director of the TCEQ grants an extension as described in Item V.A.8(a) below.

(a) Request for Extension of the Completion of Closure Activities for the Landfill Unit:

The site operator may submit a written request for an extension for the completion of closure activities to the TCEQ for review and approval. The extension request will include:

- All applicable documentation necessary to demonstrate that closure will, of necessity, take longer than 180 days; and
- All applicable documentation necessary to document that all steps have been taken and will continue to be taken to prevent threats to human health and the environment from the unclosed MSW landfill unit.

(9) Submittal of Engineer's Certification of Closure to the TCEQ Executive Director and Request of Closure Inspection to TCEQ Regional Office:

Following completion of all closure activities for the landfill unit, the site operator will submit:

(a) Closure Inspection

A written request to the local TCEQ regional office for a closure inspection of the unit.

(b) Closure Certification

A certification, signed by an independent licensed professional engineer, to the executive director of the TCEQ for review and approval verifying that closure has been completed in accordance with this closure plan. The site operator will submit the certification via registered mail, and the submittal will contain all applicable documentation necessary for certification of closure of the unit, including:

- A final cover system evaluation report (FCSER) documenting the installation of the final cover. The FCSER may be submitted as a separate document for review and approval following the completion of the final cover installation. In that case, the certification of closure will be submitted subsequently;
- A final contour map as described under Section III.E that includes the relevant unit; and
- Copy of the letter to the TCEQ regional office requesting a closure inspection of the relevant unit.

(10) TCEQ's Acknowledgement of Termination of Operation and Closure of a Unit:

Upon receipt, the TCEQ executive director will review the closure documents for completeness and accuracy; and following receipt of the closure inspection report from the agency's regional office verifying proper closure of the MSW landfill unit according to this closure plan, the executive director will, in writing, acknowledge the termination of operation and closure of the unit and deem it properly closed. Thereafter, the site operator will comply with the post-closure care requirements described in the post-closure care plan for the unit.

(11) Deed Recordation for Disposed Regulated Asbestos Containing Materials (RACM):

Upon closure of the unit that accepted RACM, the site operator will place a specific notation that the unit accepted RACM in the deed records for the facility with a diagram identifying the RACM disposal areas. Concurrently, the site operator will submit to the TCEQ executive director, a notice of the deed recordation and a copy of the diagram identifying the asbestos disposal areas.

(12) Placement of all Closure Documentation in the Site Operating Record:

Once approved, the closure certification and all other documentation of closure will be placed in the site operating record.

(13) Closure Schedule for the Landfill Unit:

A closure schedule is provided on Figure III J-2 of Appendix III J. The schedule shows all the closure activities listed within Section V.A and the timelines for commencing and completing each activity. Also, the schedule shows that closure activities for the landfill unit will be completed within 180 days following the initiation of closure activities as required, unless an extension is granted by the TCEQ executive director.

(14) Other: (enter as applicable).

Not Applicable.

B. Closure of the Waste Storage or Processing Units or Operations

Closure of the waste storage or processing units or operations authorized under this permit will include removal of all waste, waste residues, and any recovered materials. The facility units and operations will either be dismantled and removed off-site or decontaminated. The site operator will dispose at the landfill or evacuate all materials (including feedstock, in process, and processed) to an authorized facility and disinfect all leachate handling units, tipping areas, processing areas, and post-processing areas. If there is evidence of a release from a unit or operation, the site operator will conduct an investigation, as approved by the TCEQ executive director, into the nature and extent of the release and an assessment of measures necessary to correct an impact to groundwater.

C. Final Closure of the Facility

In addition to the closure activities listed in Section V.A above for closing a landfill unit, the site operator will conduct the following activities for the closure of the entire facility:

(1) Publish Final Closure Notice and Place the closure Plan in a Public Place:

No later than 90 days prior to the initiation of the final facility closure, the site operator will:

(a) Publication of Notice:

The site operator will publish notice in the newspaper(s) of largest circulation in the vicinity of the facility to inform the public of the final closure of the facility. This notice will include:

- The name of the facility;
- The address, and physical location of the facility;
- The facility's permit number; and
- The last date of intended receipt of waste.

(b) Place Copies of the Closure Plan in a Public Place:

The site operator will also make available an adequate number of copies of the approved final closure and post-closure plans for public access and review at the **Jacksonville Public Library, 526 E Commerce Street, Jacksonville TX, 75766** (state public place within the area, including address, where the plan will be available for public access and review).

(2) Submit Written Notice of "Intent to Close the Facility" to the TCEQ Executive Director:

The site operator will provide written notification to the TCEQ executive director of the intent to close the facility. This notice will be provided to the executive director no later than 90 days prior to the initiation of the final facility closure, and thereafter be placed in the site operating record.

(3) Post Signs and Install Barriers:

Upon notifying the executive director of the intent to close the facility and no later than 90 days prior to the initiation of final facility closure, the site operator will:

(a) Post Final Closure Signs:

The site operator will post a minimum of one sign at the main entrance and all other frequently used points of access for the facility notifying all persons who may utilize the facility of the date of closing for the entire facility and the prohibition against further receipt of waste materials after the stated date.

(b) Install Barriers:

Also, the site/operator will install suitable barriers at all gates or access points to adequately prevent the unauthorized dumping of solid waste at the closed facility.

(4) Filling of “Affidavit to the Public” and Performance of the Final Deed Recording:

Upon closure of all the landfill units or upon final closure of the facility, the site operator will:

(a) File Affidavit

File with the county deed records an "Affidavit to the Public" in a form provided by the TCEQ executive director that includes an updated metes and bounds description of the extent of the disposal areas at the facility and the restrictions to future use of the land in accordance with applicable provisions under 30 TAC Chapter 330, Subchapter T.

(b) Record a Notation on the Deed

Record a certified notation on the deed to the facility property, or on some other instrument that is normally examined during title search, that will in perpetuity notify any potential purchaser of the property that the land has been used as a landfill facility and use of the land is restricted according to the provisions under 30 TAC Chapter 330, Subchapter T.

(c) Place Documents in the Operating Record

Place a copy of the “Affidavit to the Public” and a copy of the modified deed in the site operating record.

(5) Submittal of a Copy of the "Affidavit to the Public" and the "Modified Deed" to the TCEQ Executive Director:

Within ten days after completion of final closure activities of the facility, the site operator will submit the following to the TCEQ executive director by registered mail:

(a) A certified copy of the "Affidavit to the Public";

(b) A certified copy of the modified deed to the facility property; and

(c) A certification, signed by an independent licensed professional engineer, verifying that final facility closure has been completed in accordance with the approved closure plan. The submittal will contain all applicable documentation necessary for certification of final facility closure, including:

- Final Cover System Evaluation Report (FCSER) documenting the installation of the final cover. The FCSER may be submitted earlier as a separate document for review and approval following the completion of the final cover installation. In that case, the certification of closure will be submitted subsequently;
- A final contour map as described under Item III.G above;
- Copy of a letter to the TCEQ regional office requesting a final closure inspection of the facility; and
- Copies of documents verifying newspaper publication of the notice of the final facility closure.

(6) Other

Additional items relating to the schedule for final facility closure, and additional closure activities specific to the final closure of this facility include:
Not Applicable.

(7) TCEQ's Acceptance of Termination of Operation and Closure of a Landfill Facility:

Following the TCEQ executive director's receipt and completion of the review of the professional engineer's certification of the completion of facility closure and the final closure documents, and receipt of the inspection report from the agency's regional office verifying proper closure of the facility according to this closure plan, the executive director will, in writing, accept the termination of operation and closure of the facility and deem it properly closed. Thereafter, the site operator will comply with the post closure care requirements described in the post closure plan for the facility.

(8) Final Closure Schedule for the Facility:

The attached Figure **IIIJ-2 (Part III, Appendix IIIJ)**, Final Closure Schedule, provides the closure schedule for the final facility closure. It incorporates the schedule for closure of a unit as discussed in Section V.A and also shows the commencement and completion timelines for the final closure activities listed within this Section.

VI. Summary of Attachments

A. Drawings and Maps

The following Drawings and Maps are attached as part of this plan.

- Figure **A.2 (Completion Plan included in Part III, App. IIIA-A)**, Final Contour Map.
- Figures **B.1 through B.9 (included in Part III, App. IIA-B)**, Cross-Section Drawings of the Landfill Units at Closure.
- Figures **IIIF.1 through IIIF.15 (included in Part III, App. IIIF)**, Final Cover and Drainage Features Installation Drawings.
- Other Drawings/Maps: Figures **IIIL.1 (Part III, App. IIIL – Closure and Postclosure Care Cost Estimates)**

B. Documents

- Attachment **Part III, App. IIIJ-A**, Final Cover Quality Control Plan (FCQCP).
- Attachment **Part III, App. IIIJ-Closure Plan, Section 4)**, Final Closure Schedule Chart.
- Attachment, Landfill Unit Closure Schedule Chart, (Not Applicable)
- Other: Attachment Not Applicable

C. Additional Items Attached (enter as applicable)

Not Applicable.

VII. Professional Engineer’s Statement, Seal, and Signature

Name: **Jason Edwards, P.E.**

Title: **Senior Engineer**

Date: **05/2024**

Company Name: **Weaver Consultants Group, LLC**

Firm Registration Number: **F-3727**

Professional Engineer’s Seal

05/20/2024

Signature

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1614B

MAJOR PERMIT AMENDMENT APPLICATION

PART III – SITE DEVELOPMENT PLAN
APPENDIX IIIK
POSTCLOSURE CARE PLAN

Prepared for

Pine Hill Farms Landfill TX, LP

May 2024

STATE OF TEXAS
JASON E. EDWARDS
99336
LICENSED
PROFESSIONAL ENGINEER

Prepared by

05/20/2024

Weaver Consultants Group, LLC
TBPE Registration No. F-3727
6420 Southwest Blvd., Suite 206
Fort Worth, Texas 76109
817-735-9970

WCG Project No. 0120-076-11-106

This document is intended for permitting purposes only.

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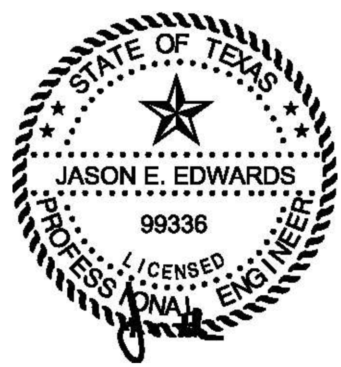
APPENDIX IIIK-A
Post-Closure Care Plan for Municipal Solid Waste Type I Landfill Units and Facilities (Form 20722)



05/20/2024

1 INTRODUCTION

This appendix addresses §330.463 and §330.465.

This Postclosure Care Plan has been prepared for the Royal Oaks Landfill consistent with Title 30 Texas Administrative Code (TAC) Section 330 Subchapter K. In accordance with Title 30 TAC §330.463(b)(3), a copy of the approved postclosure care plan will be placed in the site operating record prior to the initial receipt of waste. The landfill completion plan for this site consists of final contours and drainage features as depicted on Drawing A.2 – Landfill Completion Plan in Part III, Appendix IIIA-A.

2 POSTCLOSURE ACTIVITIES

2.1 Monitoring and Maintenance

In accordance with Title 30 TAC §330.463(b)(1), postclosure care will commence after professional engineer certification of the completion of closure requirements for a municipal solid waste management unit as accepted by the Executive Director. There are no on-site permanent enclosed structures located within the limits of waste; therefore, the requirements in Title 30 TAC §330.957(m)(1)(D-F) do not apply. Postclosure care monitoring and maintenance will continue for a period of 30 years unless the TCEQ approves a postclosure period of a different duration. Postclosure care monitoring and maintenance will consist, at a minimum, of the following requirements carried out by Pine Hill Farms Landfill TX, LP. The minimum frequencies for monitoring and maintenance activities will be consistent with Section 4.23 of Part IV – SOP, unless otherwise noted below.

- Retain the right of entry and maintain all rights-of-way to the closed landfill. Access controls will be inspected on a monthly basis.
- Conduct site inspections a minimum of semiannually after closure.
- Conduct maintenance and/or remediation activities, if needed, in order to maintain the integrity and effectiveness of the final cover, site vegetation, and drainage control systems. Vegetation shall be maintained on the final cover to provide a minimum of 95 percent coverage.
- Manage surface run-on and run-off, if needed, in order to minimize the erosion of the final cover system.
- Conduct inspections for seeps from final cover. Seepage will be controlled by placement of soil berms, diverted to a contaminated water collection area and treated in accordance with Section 4.2 of Appendix IIIC until the final cover can be repaired.
- The outlets of the final cover drainage pipes will be inspected. During wet weather conditions when flow is expected, the pipe outlets will be inspected to verify that flow is occurring. If there is no flow, the pipe will be checked for clogging and flushed or replaced if necessary. Inspections will occur semi-annually after closure.
- Correct the effects of settlement, subsidence, ponded water, erosion, or other events or failures, if needed, in-as-much as these situations are detrimental

to the integrity of the closed landfill. Any necessary corrections will be made to ensure the integrity of the final cover system.

- Maintain and operate the leachate collection system in accordance with Title 30 TAC §330.331 and §330.333 and the EPA's Design Criteria (i.e., less than 1 foot of leachate over the liner, or approved equivalent design). Leachate collection sump levels will be measured on a quarterly basis. Site personnel will verify that the leachate level is maintained within the sump as discussed in Appendix IIIC, Table 3-5. The leachate collection system will be operated consistent with Appendix IIIC – Leachate and Contaminated Water Management Plan, which includes procedures for the operation of the leachate collection sump, storage tanks, and the disposal of leachate. Pine Hill Farms Landfill TX, LP may submit a demonstration to the TCEQ that leachate does not pose a threat to human health and the environment. If the demonstration is approved by the TCEQ, Pine Hill Farms Landfill TX, LP will be allowed to discontinue the maintenance and operation of the leachate collection system. Refer to Section 3.4 of Appendix IIIJ for the procedures to decommission the leachate storage tank and piping.
- Maintain the groundwater monitoring system in accordance with Subchapter J of Title 30 TAC and monitor groundwater in accordance with an approved Groundwater Sampling and Analysis Plan (refer to Appendix IIIH for the minimum monitoring frequency requirements). However, Pine Hill Farms Landfill TX, LP may request TCEQ approval of (1) an alternative monitoring frequency, and/or (2) an alternative list of parameters to be monitored.
- Maintain and operate the perimeter landfill gas monitoring system in accordance with Subchapter I of Title 30 TAC. In accordance with Title 30 TAC §330.371(b)(2), the minimum monitoring frequency will be quarterly. However, Pine Hill Farms Landfill TX, LP may request TCEQ approval of an alternate monitoring frequency.
- Maintain and operate the landfill gas collection and/or control system in accordance with applicable regulations.

2.2 Decreasing Postclosure Period

The length of the postclosure care maintenance period may be decreased by the TCEQ if Pine Hill Farms Landfill TX, LP submits a documented certification signed by an independent licensed professional engineer and if the documented certification is approved by the TCEQ. The certification will include all applicable documentation demonstrating that the reduced period is sufficient to protect human health and the environment. Applicable documentation may include data from monitoring of groundwater, surface water, leachate levels, and landfill gas.

2.3 Increasing Postclosure Period

The length of the postclosure care maintenance period may be increased by the TCEQ if it is determined that the increased duration is necessary to protect human health and the environment.

2.4 Completion of Postclosure Period

Upon completion of the postclosure care maintenance period, Pine Hill Farms Landfill TX, LP will submit to the TCEQ documented certification, signed by an independent licensed professional engineer, verifying that postclosure care maintenance has been completed in accordance with the approved Postclosure Plan. The submittal will include all documentation necessary for certification of completion of postclosure care maintenance. The certification will be placed in the Site Operating Record upon approval. In addition, Pine Hill Farms Landfill TX, LP will submit to the Executive Director a request for voluntary revocation of the facility permit. Approval of voluntary revocation will be placed in the Site Operating Record.

3 PERSON RESPONSIBLE FOR CONDUCTING POSTCLOSURE ACTIVITIES

At the time of development of this document, the following position will be responsible for overseeing and/or conducting postclosure care activities at this landfill.

Environmental Manager
Republic Services
440 Health Lane
Jacksonville, TX 75766

The position responsible for conducting postclosure activities is subject to change. However, as part of the closure notification to TCEQ, as required by Title 30 TAC §330.463(b)(3)(B), Pine Hill Farms Landfill TX, LP will notify the TCEQ regarding the responsible position.

4 POSTCLOSURE LAND USE

4.1 Intended Use

There are no current planned uses for the Royal Oaks Landfill after closure. Should use of the closed landfill be considered, plans will be prepared and submitted to the TCEQ for review and approval.

4.2 Constraints on Postclosure Construction

There are no current plans to construct buildings or other structures on the closed Royal Oaks Landfill. Nevertheless, any future construction activities on the closed landfill will be subject to the provisions of Title 30 TAC §330.955(b), §330.957(b)(2)(A-D), §330.957(d-e), and §330.957(m)(l)(D-F), which require, among other things, prior approval of the TCEQ.

5 POSTCLOSURE COST ESTIMATE

A detailed written cost estimate, in current dollars, of the cost of hiring a third party to conduct postclosure care activities for the municipal solid waste unit, in accordance with the Postclosure Care Plan, is provided in Appendix IIIL – Cost Estimate for Closure and Postclosure Care. The estimated postclosure care cost estimate presented in Appendix IIIL will be updated if needed to ensure continued compliance with the financial assurance requirement.

APPENDIX IIIK-A

POST-CLOSURE CARE PLAN FOR MUNICIPAL SOLID WASTE TYPE I LANDFILL UNITS AND FACILITIES (FORM 20722)

STATE OF TEXAS
JASON E. EDWARDS
99336
LICENSED
PROFESSIONAL ENGINEER

05/20/2024

Texas Commission on Environmental Quality

Post-Closure Care Plan for Municipal Solid Waste Type I Landfill Units and Facilities

This form is for use by applicants or site operators of Municipal Solid Waste (MSW) Type I landfills to provide landfill unit or final facility post-closure care closure plans to meet the requirements in 30 TAC Chapter 330, §330.63(h) and as set out under 30 TAC Chapter 330 Subchapter K for a MSW Type I facility.

If you need assistance in completing this form, please contact the MSW Permits Section in the Waste Permits Division at (512) 239-2335.

I. General Information

Facility Name: Royal Oaks Landfill

MSW Permit No.: 1614B

Site Operator/Permittee Name: Pine Hill Farms Landfill TX, LP

II. Party Responsible for Overseeing and Conducting Post Closure Care Activities

Name (Person or Office Responsible): Austin Sparks

Position or Title: Environmental Manager

Mailing Address: 440 Heath Lane

City: Jacksonville

State: Texas

Zip Code: 75766

Telephone Number: (903) 539-7986

III. Post-Closure Care Status of Landfill Units at the Facility

Check the applicable box for the post-closure care status of the units at the facility and complete the applicable tables as indicated:

A. ☒ No landfill unit is in post-closure care in this facility at the time this application is submitted (skip Table 1 and complete Table 2 below if you check this item)

B. ☐ This facility includes landfill units currently in post-closure care and landfill units that are not yet in post-closure care (complete Tables 1 and 2 below if you check this item).

C. ☐ This facility contains only landfill units currently in post-closure care (complete Table 1 below if you check this item; do not complete Table 2).

Table 1: Landfill Units Currently in Post-Closure Care

Landfill Unit Name	Drawing Number Showing the Landfill Unit	Date TCEQ Acknowledged Closure of Unit	Date Post-Closure Care Commenced	Projected Date of End of Post-Closure Care

Table 2: Landfill Units Not yet in Post-Closure Care

Category of Landfill Unit (Regarding Status of Waste Receipt)	Landfill Unit Names or Descriptors	Site Development Plan Drawing Titles and Numbers Showing the Units
Stopped Receiving Waste Prior to October 9, 1993		
Received Waste on or after October 9, 1993	MSW Landfill (includes both current areas of filling and future expansion areas)	Part III, Appendix IIIA-A, Drawing A.1
Proposed to be Constructed	MSW Landfill (includes both current areas of filling and future expansion areas)	Part III, Appendix IIIA-A, Drawing A.1

Category of Landfill Unit (Regarding Status of Waste Receipt)	Landfill Unit Names or Descriptors	Site Development Plan Drawing Titles and Numbers Showing the Units
Other (enter as applicable)		

IV. Post-Closure Care Maintenance Requirements and Activities to be Conducted

A. Categories of Landfill Units and Applicable Post-Closure Care Maintenance Requirements and Activities

Check the appropriate boxes to indicate the categories of landfill units at the facility and complete the applicable section of the post-closure care maintenance requirements and activities below.

This facility includes landfill units that:

☐ Stopped receiving waste prior to October 9, 1993

If you check this item, complete the post-closure care maintenance requirements and activities specified in Subsection IV.B below. Skip Subsection IV.B if this item does not apply to your facility.

☒ Received waste on or after October 9, 1993

If you check this item, complete the post-closure care maintenance requirements and activities specified in Subsection IV.C below. Skip Subsection IV.C if this item does not apply to your facility.

☒ Are proposed to be constructed

If you check this item, complete the post-closure care maintenance requirements and activities specified in Subsection IV.C below. Skip Subsection IV.B, unless your facility also contains units that stopped receiving waste prior to October 9, 1993.

B. Post-Closure Care Maintenance Requirements and Activities for the Landfill Units that Stopped Receiving Waste Prior to October 9, 1993

The site operator will commence and conduct post-closure care maintenance of the units that stopped receiving waste prior to October 9, 1993 for a minimum of the first **five years** following commencement of post-closure care as specified below and in accordance with applicable rules under 30 TAC §330.463(a). Post-closure care maintenance will start on the date the professional engineer's certification of the completion of closure is accepted in writing by the TCEQ executive director and the site operator will carry out the following activities and operations during the period.

1. Maintenance of Right of Entry and Rights of Way

The site operator will retain the right of entry to and maintain all rights-of-way of the closed units in order to conduct periodic inspections of the units throughout the post-closure care period. TCEQ staff will have access to the site to conduct inspection or investigation that may be necessary during the period.

2. Inspection Activities and Correction of Problems

The site operator will conduct inspection of the closed landfill units at the frequencies indicated in Table 3 below, utilizing the inspection protocol maintained in the site operating record, and will correct all identified problems as needed.

Table 3: Inspection Activities Schedule

Post-Closure Care Inspection Item	Frequency of Inspection	Types of Deficiency Conditions to be looked for during Inspection
Final Cover Condition	N/A	
Vegetation	N/A	
Leachate Management Systems	N/A	
Landfill Gas Monitoring and Control Systems	N/A	

Post-Closure Care Inspection Item	Frequency of Inspection	Types of Deficiency Conditions to be looked for during Inspection
Groundwater Monitoring Systems	N/A	
Drainage Structures	N/A	
Ponding of Water	N/A	
Other:	N/A	

3. Continuation of Monitoring Programs during Post-Closure Care Period

The site operator will continue the monitoring programs listed in Table 4 during the post-closure care period. The monitoring programs will be conducted as specified in the applicable section of the facility's Site Development Plan and applicable rules.

Table 4: Monitoring and Reporting Schedule

Monitoring Program	Frequency of Monitoring	Frequency of Reporting of Results
Groundwater monitoring	N/A	
Landfill gas monitoring	N/A	
Other:	N/A	

4. Detection of a Release, Nature and Extent Investigation, and Corrective Action to Address Release from the MSW Unit

Upon detection of any evidence of a release from the landfill or other associated waste management units at the facility, the site operator will:

- Notify the executive director of the TCEQ of the condition detected;

- Investigate, if so directed by the executive director of the TCEQ, whether a release from the landfill or other associated waste management units at the facility has occurred;
- Investigate the nature and extent of the release, if a release is confirmed;
- Assess measures necessary to correct any impact to groundwater;
- Submit a corrective action plan via a permit modification for TCEQ executive director's review and approval; and
- Conduct corrective action as approved by the TCEQ executive director.

5. Extension of Post-Closure Care Period

If any of the problems listed in Table 3 occurs, or corrective action as indicated in Subsection IV.B.4 above continues, after the end of the five-year post-closure care period or persists for longer than the first five years of post-closure care, the site operator will be responsible for their correction and will continue to conduct post-closure care maintenance until the TCEQ executive director determines that all problems have been adequately resolved.

6. Reduction of Post-Closure Care Period

The site operator may request in writing for the TCEQ executive director to reduce the post-closure care period for the units if all wastes and waste residues have been removed during closure and any new or on-going corrective action to address confirmed releases from the landfill have been completed as acknowledged in writing by the executive director.

C. Post-Closure Care Requirements and Activities for Municipal Solid Waste Landfill Units that Receive Waste on or after October 9, 1993 and for New Units

The site operator will commence and conduct post-closure care maintenance of the units that receive waste on or after October 9, 1993 and new units constructed under this permit as follows and in accordance with applicable rules under 30 TAC §330.463.

1. Commencement of Post-Closure Care

Post-closure care maintenance will start on the date the professional engineer's certification of the completion of closure is accepted in writing by the TCEQ executive director and the site operator will carry out the following activities and operations during the period.

2. Period of Post-Closure Care

The site operator will conduct post-closure care for the landfill units for a period of **30 years**, unless this time period is increased or reduced by the executive director as discussed in Subsection IV.C.11.

3. Maintenance of Right of Entry and Rights of Way

The site operator will retain the right of entry to the closed units and the facility and will maintain all rights-of-way of the closed units in order to conduct periodic inspection and maintenance of the closed units until the end of the post-closure care period.

4. Inspection Activities

The site operator will conduct periodic inspection of the closed units to identify and document deficiency conditions and conduct maintenance and corrective action to maintain compliance. Sections IV.C. 8.(a)-(c) provide information on the inspection items and deficiency conditions that the site operator will look for during inspection of the major components of the landfill and the site during the post-closure care period. Other inspection and maintenance provisions that apply during the post-closure care period as specified in the facility's site operating plan, site development plan, or applicable rules will remain in effect.

5. Documentation of Inspection

The site operator will document and maintain records of the post-closure care inspections in the site operating record. The records will include:

- The date of inspection;
- Components and items inspected;
- Problems detected or observed; and
- The name of the personnel who conducted the inspection.

6. Corrective Actions

Based on the results of the inspection activities, the site operator will conduct needed restoration and remediation actions on the closed unit no later than the next scheduled inspection event. Also, the site operator will conduct maintenance action on regular periodic schedule in order to:

- Maintain the integrity and effectiveness of all final cover, facility vegetation, and drainage control systems;
- Correct any effects of settlement, subsidence, ponded water, erosion, or other events or failures detrimental to the integrity of the closed unit; and
- Prevent any surface run-on and run-off from eroding or otherwise damaging the final cover system during the post-closure care period.

7. Documentation of Corrective Actions

The site operator will document and maintain, in the facility's site operating record, records of the restoration, remediation, and maintenance activities performed, including the date of completion of the activities.

8. Inspection Activities Schedules

(a) Final Cover Inspection

Inspection Frequency: Semiannually

Other Inspection Occasions/Events:

Table 5: Final Cover Inspection Items

Inspection Item	Types of Deficiency Conditions to be looked for during Inspection
Vegetation and other Ground Cover Materials	Distressed vegetation, erosion areas, stressed or over-vegetated areas
Settlement	Areas of excessive settlement (overall settlement sufficient to pond water or disrupt drainage features requiring repair); identify repair methods
Subsidence	Areas of excessive subsidence (localized settlement sufficient to pond water or disrupt drainage features); identify repair methods.
Ponded Water	Identified by ponding on final cover. Determine limits and approximate depth of fill soil and regrading required to reduce or eliminate ponding.

Inspection Item	Types of Deficiency Conditions to be looked for during Inspection
Erosion	Identified by surface erosion damage or rilling of final cover and reviewing conditions that may be contributing to erosion (grading or blockage of sideslope swales; settlement causing surface flow concentration)
Other (enter other events or failures detrimental to the integrity and effectiveness of the final cover):	Animal burrows, surface cracks, slope reversals, seeps, vegetation die-out or over-vegetation
Other (enter other events or failures detrimental to the integrity and effectiveness of the final cover):	

(b) ***Drainage Control System Inspection***

Inspection Frequency: Semi Annually (concurrent with Final Cover Inspections)

Other Inspection Occasions/Events:

Table 6: Drainage Control System Inspection Items

Inspection Item	Types of Deficiency Conditions to be looked for during Inspection
Vegetation within Drainage Control Structures	Distressed vegetation, erosion areas, stressed or over-vegetated areas
Component Failures	Damage to sideslope swales or letdown structures, undercutting, piping, or overtopping, excessive sediment deposition
Wash Outs	Washouts in sideslope swales

Inspection Item	Types of Deficiency Conditions to be looked for during Inspection
Sediment Build Up	Sediment deposition sufficient to pond water or reverse or impeded drainage in sideslope swales or letdown structures
Other (enter other events or failures detrimental to the integrity and effectiveness of drainage structures):	Cracking, settlement, or distress of drainage control structures, culvert headwalls, or other hard-armor features

(c) *Access and Rights-of-Way*

Inspection Frequency: Semiannually (concurrent with Final Cover Inspections)

Other Inspection Occasions/Events:

Table 7: Access and Rights of Way Inspection Items

Inspection Item	Types of Deficiency Conditions to be looked for During Inspection
Gates, Gate Locks and Barriers	Broken or damaged locks, chains, gates, cattle guards (if installed)
Fence and other Access Control Barriers	Damaged or missing fencing, stretched or damaged barbed wire fencing
Vegetation Control in Areas of the Facility other than the Final Cover	General maintenance of facility vegetation, disease or pests that might affect final cover if unchecked
Other (enter other access control and rights-of-way inspection items):	General site security, site signage, perimeter road access

9. Continuation of Operation and Maintenance of the Leachate Collection and Removal Systems (LCRS)

The site operator will continue the operation and maintenance of the LCRS and disposal of leachate during the post-closure care period in accordance with the facility's leachate management plan found in Attachment/Appendix/Section (enter location of the leachate management plan) of the Site Development Plan and consistent with applicable provisions under 30 TAC Sections 330.331 and 330.333.

(a) Performance Monitoring and Inspection of the LCRS

During the post-closure care period, the site operator will monitor the performance of the LCRS on a (enter frequency) basis to assure continuous compliance with the design criteria and inspect the LCRS components on a (enter frequency) basis, at a minimum, to determine the need for repair or maintenance. Inspection and monitoring will follow the procedure described in the facility's leachate management plan found in Attachment/Appendix/Section (enter location of the leachate management plan) of the Site Development Plan or in the written inspection protocol maintained in the facility's site operating record. Results of the monitoring and inspection activities will be documented in the site operating record. The items and components of the leachate collection and removal system to be inspected will include but are not limited to the items in Table 8 below.

Table 8: Leachate Collection and Removal System Inspection

Inspection Item/Component	Types of Deficiency Conditions to be looked for during Inspection
Pumps, piping, and controls	Broken or inoperable pumps, distressed or damaged piping, flow gages, control panels
Ground condition in vicinity of leachate systems	Localized subsidence, erosion, animal burrowing
System leakage	Staining (on equipment or ground), wet areas, vegetation distress

(b) LCR Maintenance and Repairs

During the post-closure care period, the site operator will perform routine and needed maintenance or repairs of the LCRS items and components based on the monitoring and inspection results.

Maintenance and repair will be completed prior to the next scheduled monitoring event and documented within the site operating record.

(c) Discontinuation of Leachate Management

The site operator may submit data and information from the closed units to the TCEQ executive director to demonstrate that leachate does not pose a threat to human health and the environment. Upon the executive director's approval of the demonstration, the site operator will be allowed to stop managing leachate at the closed unit.

10. Continuation of Monitoring Systems Operation and Maintenance:

The site operator will continue to conduct monitoring systems operation and maintenance activities to ensure the integrity of the containment system and to promptly detect and control releases to the environment during the post-closure care period as follows.

(a) Groundwater Monitoring System

The site operator will continue groundwater monitoring activities (including sampling, analysis, reporting, etc.) in accordance with the approved site-specific Groundwater Sampling and Analysis Plan (GWSAP) found in (enter location of the GWSAP) of the Site Development Plan, the Groundwater Monitoring System Design found in (enter location of the Groundwater Monitoring System Design) of the Site Development Plan and consistent with the provisions under 30 TAC Chapter 330 Subchapter J. Groundwater monitoring will be conducted semiannually or as otherwise approved by the TCEQ executive director during the post-closure care period.

i. Inspection of the Groundwater Monitoring System

During each groundwater monitoring event, the site operator will perform inspection of all the groundwater monitoring wells that are part of the groundwater monitoring system and other items discussed in the GWSAP or the Groundwater Monitoring System Design. The items and components of the groundwater monitoring system to be inspected are included in Table 9:

Table 9: Groundwater Monitoring Systems Inspection

Inspection Item/Component	Types of Deficiency Conditions to be looked for during Inspection
Monitoring well	During each monitoring event, every gauged well and its surface completion will be visually examined for anything unusual. This includes examination of the well casing, well head, protective cover, locking device, concrete pad, labels, etc.

ii. Maintenance and Repair of the Groundwater Monitoring System

The site operator will perform needed maintenance and/or repairs of the groundwater monitoring system items and components based on the inspection results. Maintenance and/or repairs will be performed no later than the next scheduled monitoring event.

iii. Documentation of Inspection, Maintenance, and Repairs

The site operator will document and discuss the results of the groundwater monitoring system inspection, maintenance, and repair activities in the groundwater monitoring report submitted to the TCEQ executive director, and maintain the documents in the site operating record.

(b) Landfill Gas Management System

During the post-closure care, the site operator will continue landfill gas monitoring operations and activities, documentation, and reporting in accordance with the facility’s landfill gas management plan and consistent with the requirements under 30 TAC Chapter 330, Subchapter I.

i. LFG Monitoring and Monitoring System Inspection

All structures and perimeter gas monitoring probes will be sampled quarterly or more frequently as approved by the TCEQ executive director. The site operator will conduct routine inspections of the landfill gas management system components as provided in the landfill gas management plan during the post-closure care period. The items and components to be inspected are included in Table 10.

Table 10: Landfill Gas Management System Inspection

Inspection Item/Component	Types of Deficiency Conditions to be looked for during Inspection
Gas Monitoring Well	During each monitoring event, every gauged well and its surface completion will be visually examined for anything unusual. This includes examination of the well casing, well head, protective cover, locking device, concrete pad, labels, etc.

ii. LFG Management System Maintenance

The site operator will perform routine and needed maintenance of the landfill gas management system including calibration of the monitoring equipment. Needed maintenance and/or repair work will be performed based on the inspection and monitoring results no later than the next scheduled monitoring event.

(c) Continuation of Earth Electrical Resistivity Survey

The site operator will, if applicable, continue earth electrical resistivity surveys as applicable at the frequency stated in the approved site development plan or as otherwise approved by the TCEQ executive director.

11. Detection of a Release, Nature and Extent Investigation, and Corrective Action to Address Release from the MSW Unit

If there is evidence of a release from the landfill or other associated waste management units at the facility, the site operator will:

- Notify the executive director of the TCEQ of the condition detected;
- Investigate, if so directed by the executive director of the TCEQ, whether a release from the landfill or other associated waste management units at the facility has occurred;
- Investigate the nature and extent of the release, if a release is confirmed;
- Assess measures necessary to correct any impact to groundwater;
- Submit a corrective action plan via a permit modification for TCEQ executive director's review and approval; and
- Conduct corrective action as approved by the TCEQ executive director.

12. Revision of the Length of Post-Closure Care Period

(a) The Post-Closure Care Period May Be Decreased

The length of the post-closure care period may be decreased by the TCEQ executive director if the site operator submits a documented certification signed by a licensed professional engineer and including all applicable supporting documentation that demonstrates that the reduced period is sufficient to protect human health and the environment, and the executive director approves the decrease in writing after review.

(b) The Post-Closure Care Period May be Increased

The length of the post-closure care period may be increased by the TCEQ executive director if it is determined that the longer period is necessary to protect human health and the environment.

V. Recordkeeping

The site operator will place a copy of this post-closure plan in the facility's site operating record by the initial receipt of waste at the units proposed at the time of this application. Also, the site operator will document and maintain records of all inspection, monitoring, maintenance, repair, or remediation activities, and detail the results of any inspection and schedules of any other actions to be taken to maintain compliance, in the site operating record.

VI. Planned Use of the Land during and after the Post-Closure Care Period

Post-closure use of the property will not disturb the final cover, liners, or other containment or monitoring systems unless such disturbance is necessary for the proposed use or to protect human health and the environment and is authorized by the TCEQ executive director consistent with provisions under 30 TAC Chapter 330 Subchapter T.

Description of the Planned Use of the Land during or after the Post-Closure Care Period *(describe the planned use of the land during or after the post-closure care period; if not known at this time, enter "NOT KNOWN")*:

Not Known

VII. Post-Closure Care and Corrective Action Cost Estimates

A detailed written cost estimate in current dollars for conducting post closure care is provided in *(enter location of the post-closure care cost estimate in the application/permit document)*:

Part III, Appendix IIIL – Closure and Post closure cost estimates.

The cost estimate for corrective action will be provided as needed, via a permit modification, during the life and/or post-closure care period of the unit or facility.

VIII. Certification of Completion of Post-Closure Care

Upon completion of the post-closure care maintenance period for each municipal solid waste landfill unit, the site operator will submit to the TCEQ executive director for review and approval a certification, signed by an independent licensed professional engineer, verifying that post-closure care has been completed in accordance with the approved post-closure plan. The submittal to the executive director shall include all applicable documentation necessary for the certification of completion of post-closure care. These will include information relating to the condition and status of:

- The final cover integrity and stability, including the condition of the soil, vegetation, drainage structures, etc.
- Groundwater quality at the site, as determined from on-going groundwater detection or assessment monitoring or corrective measures data during the period.
- Landfill gas (methane) migration, as determined from on-going landfill gas monitoring and remediation data during the period.
- Leachate generation rate and quantity as determined from on-going leachate management data over the period.
- The surface water management system.
- Access control structures.

The engineer's certification of post-closure will show that, based on a summary of monitoring and inspection results, the final cover system continues to maintain its integrity, stability, and function; groundwater remains uncontaminated and monitoring is no longer required; landfill gas is not migrating beyond the facility boundary or accumulating in structures at action levels and monitoring is no longer required; leachate generation rate and quantity will not result in greater than 12 inches of head above the liner, no breakouts have occurred, and all slopes remain as approved and leachate management is no longer required; the surface water management system continues to function as designed; and the access control structures remain intact.

Documentation supporting the professional engineer's certification will be furnished to the TCEQ executive director upon request and will be maintained in the site operating record until the executive director acknowledges termination of post-closure in writing.

IX. Voluntary Revocation Request

Upon completion of the post-closure care period for the final unit at the facility, the site operator will submit to the executive director a request for voluntary revocation of the facility permit.

X. Attachments

The following figures and documents are attached as part of this post-closure care plan:

N/A

XI. Engineer's Seal and Signature

Name: Jason A. Edwards, P.E. Title: Senior Engineer

Date: 05/2024

Company Name: Weaver Consultants Group, LLC Firm Registration Number: F-3727

Professional Engineer's Seal

05/20/2024

Signature

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1614B

MAJOR PERMIT AMENDMENT APPLICATION

PART III – SITE DEVELOPMENT PLAN
APPENDIX IIIL
CLOSURE AND POSTCLOSURE CARE COST ESTIMATES

Prepared for

Pine Hill Farms Landfill TX, LP

May 2024

STATE OF TEXAS
JASON E. EDWARDS
99336
LICENSED
PROFESSIONAL ENGINEER

Prepared by

05/20/2024

Weaver Consultants Group, LLC
TBPE Registration No. F-3727
6420 Southwest Boulevard, Suite 206
Fort Worth, TX 76109
817-735-9770

WCG Project No. 0120-076-11-106

This document intended for permitting purposes only.

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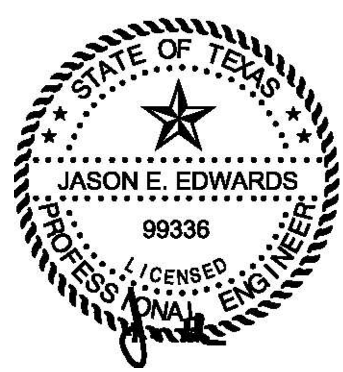
APPENDIX IIIL-A
Closure Cost Estimate Form for Municipal Solid Waste Type I Landfill (Form 20721)

APPENDIX IIIL-B
Post-Closure Cost Estimate Form for Municipal Solid Waste Type I Landfill (Form 20723)

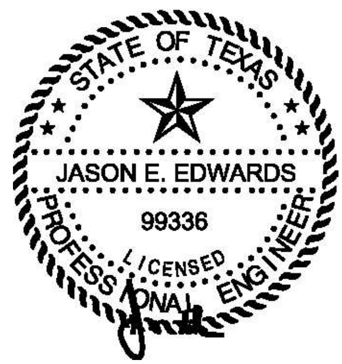
APPENDIX IIIL-C
Existing Facility Financial Assurance



05/20/2024

FIGURES

Figure IIIL.1 – Largest Area to Require Final Cover



05/20/2024

1 INTRODUCTION

This Cost Estimate for closure and postclosure care has been prepared consistent with Texas Administrative Code (TAC) Chapter 330.

This appendix addresses §330.63(j), §330.501, §330.503, §330.505 and §330.507.

2 CLOSURE COST ESTIMATE

This cost estimate shows the cost of hiring a third party to close the largest waste fill area that could potentially be open in the year to follow and those areas that have not received final cover. As shown on Figure IIIL.1, the closure area was determined to be 54.5 acres. The 54.5-acre area shown on Figure IIIL.1 includes the active area. The closure cost estimate includes: 1) engineering costs required to administratively close the facility; 2) construction costs involved with the construction of the final cover systems, the landfill gas system, and other activities required to close the facility; and 3) contingencies and other administrative costs that may be incurred during closure activities. A summary of closure cost estimate is presented on Table IIIL-1. The costs will be adjusted annually as indicated in Section 4.

An assessment will be completed each year to verify that the Closure Cost Estimate shown in Table IIIL-1 is consistent with the current permit conditions and the projected permit conditions for the upcoming 12-month period. The assessment will verify that the closure costs are based on the current active and inactive areas and that all other permit conditions are addressed by the Closure Cost Estimate (e.g., the number of groundwater monitor wells and landfill gas probes in the estimate match the wells and probes that are either in-place or need to be installed to match the number of wells and probes listed in the permit for the current phase of development).

The estimates will be updated, if needed, consistent with the procedures noted in Section 4. Continuous financial assurance coverage for closure of the facility will be provided until the facility reaches postclosure status and the requirements of the facility's final closure plan have been approved by the Executive Director. Approval documentation will be placed in the Site Operating Record. Additional information regarding the closure cost estimate is summarized below.

2.1 Engineering Costs

The cost estimates for hiring a third party is based on closing the largest area scheduled to receive final cover, which is 54.5 acres. An area of 54.5 acres is used for the closure estimates. This area is illustrated on Figure IIIL.1. A boundary survey will be required for the filing of the affidavit of closure, deed recording of any area of the site that has received waste, and publishing the public notice of closure activities. A topographic survey will be required to determine the existing height and top slope of the landfill so that permit compliance can be evaluated and the final closure systems, drainage system, and final grading can be engineered. An inspection of the site is included to identify any disposal areas requiring closure, drainage and erosion protection improvements, and identify any potential regulatory deficiencies. The site evaluation also includes the costs for a third party consultant to develop a preliminary engineering report that identifies the status of the site. The report will identify all areas of work necessary to close the landfill. The engineering costs include the cost to develop construction plans and closure schedules, closure testing and inspections, and TPDES permit document preparation. In addition, administration costs (i.e., for construction contracts and contract administration) have also been included.

2.2 Construction Costs

As shown on Figure IIIL.1, construction costs include construction of the final cover system, drainage improvements, and completion of the LFG system for the 54.5-acre area. The final cover system is detailed in Appendix IIIA-A. The construction costs include site grading and drainage including the final grading of the site, drainage improvements, and erosion and sedimentation controls for proper closure of the site.

2.3 Data Used to Develop Closure Cost Estimates

Consistent with Title 30 TAC §330.503 a detailed written cost estimate in current dollars is provided on Table IIIL-1. The cost data used to develop these estimates are based on current market conditions and were derived from similar projects completed by Pine Hill Farms TX, LP, its parent company Republic Services (Republic), and Weaver Consultants Group, LLC (WCG).

As shown in Table 16-1 in Parts I/II, Republic operates over 30 landfills in Texas and over 220 nationally. Over the last few years, Republic has completed several landfill closure projects and routinely constructs final cover systems as their landfill sites continue to develop.

WCG has been involved in many of the projects discussed above and similar projects in Texas. In addition, WCG has developed third-party closure cost estimates for over 25 sites in Texas (and numerous others nationally). Each of these estimates has been approved by TCEQ and similar state regulatory agencies.

Through the successful completion of these numerous closure related projects, Republic and WCG have gained a broad-based understanding of costs associated with landfill closures. The closure cost estimates listed in Table IIIL-1 are consistent with unit cost data used to develop closure cost estimates at other sites and are based on the extensive experience of Pine Hill Farms TX, LP, Republic, and WCG with each of the closure cost items.

In addition, consistent with Title 30 TAC §330.503 an assessment will be completed each year to verify that the closure cost estimates shown in Table IIIL-1 are consistent with the current permit conditions and the projected permit conditions for the upcoming 12-month period. The assessment will verify that the closure costs are based on the current active and inactive areas and that all other permit conditions are addressed by the Closure Cost Estimate (e.g., the number of groundwater monitor wells and landfill gas probes in the estimate match the wells and probes that are either in-place or need to be installed to match the number of wells and probes listed in the permit for the current phase of development). This assessment will also address the appropriateness of the unit cost data.

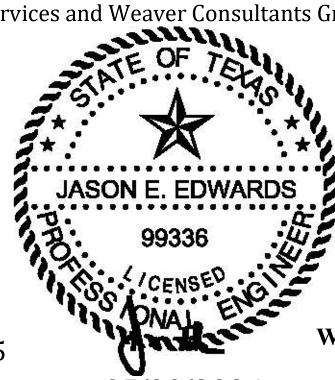
TABLE 1
ROYAL OAKS LANDFILL - CLOSURE COST

Area Requiring Final Cover	54.5	ac			
Composite Topslope Area	8.9	ac	Infilltration Layer Thickness	1.5	ft
Composite Sideslope Area	45.6	ac	Erosion Layer Thickness	1.0	ft
Pre Subtitle D Area	15.2	ac			
Permit Boundary Area	144.3	ac			

	Description		Quantity	Unit[1]	Unit Cost [2]	Proposed Total Cost (2024)
1.0 ENGINEERING						
1.1	Topographic Survey		1	LS	$ 5,180	**$ 5,180**
1.2	Boundary Survey for Affidavit		144.3	AC	$ 67	**$ 9,717**
1.3	Site Evaluation		144.3	AC	$ 730	**$ 105,394**
1.4	Development of Plans		54.5	AC	$ 616	**$ 33,595**
	Subtotal					**$ 153,886**
1.5a	Contract Administration			5%		**$ 7,694**
1.5b	Admin. Cost for Certification of Final Cover and Affidavit to the Public			5%		**$ 7,694**
1.6	Closure Inspection		54.5	AC	$ 1,886	**$ 102,761**
1.7	Permits		1	LS	$ 7,252	**$ 7,252**
1.8	Groundwater Consultant		N/A			
ENGINEERING TOTAL						**$ 272,035**
2.0 CONSTRUCTION						
2.1	Final Cover System					
	2.1.1	Infiltration Layer	131,890	CY	$ 6.01	**$ 792,659**
	2.1.2	Erosion Layer	87,927	CY	$ 3.89	**$ 342,035**
	2.1.3	Flexible Membrane Cover	2,374,020	SF	$ 0.48	**$ 1,139,530**
	2.1.4	Geocomposite	2,374,020	SF	$ 0.67	**$ 1,590,593**
	2.1.5	Installation of Gas Vents	55	VENT	$ 8,138	**$ 447,578**
2.2	Revegetation		54.5	AC	$ 1,031	**$ 56,180**
2.3	Site Grading and Drainage		54.5	AC	$ 1,715	**$ 93,445**
2.4	Citizens Convenience Center		1.0	LS	$ 5,180	**$ 5,180**
CONSTRUCTION TOTAL						**$ 4,467,199**
ENGINEERING AND CONSTRUCTION SUBTOTAL						**$ 4,739,234**
CONTINGENCY				10%		**$ 473,923**
CONTRACT PERFORMANCE BOND				2.0%		**$ 94,785**
THIRD PARTY ADMINISTRATION AND PROJECT MANAGEMENT COSTS				2.5%		**$ 118,481**
TOTAL CLOSURE COST						**$ 5,426,423**

[1] N/A = not applicable, LS = lump sum, AC = acres, CY = cubic yards, SF = square feet.

[2] Unit Costs are in 2024 dollars. Unit costs are based on current market conditions, typical engineering costs, and industry standards related to construction and reflect input from Republic Services and Weaver Consultants Group, LLC.



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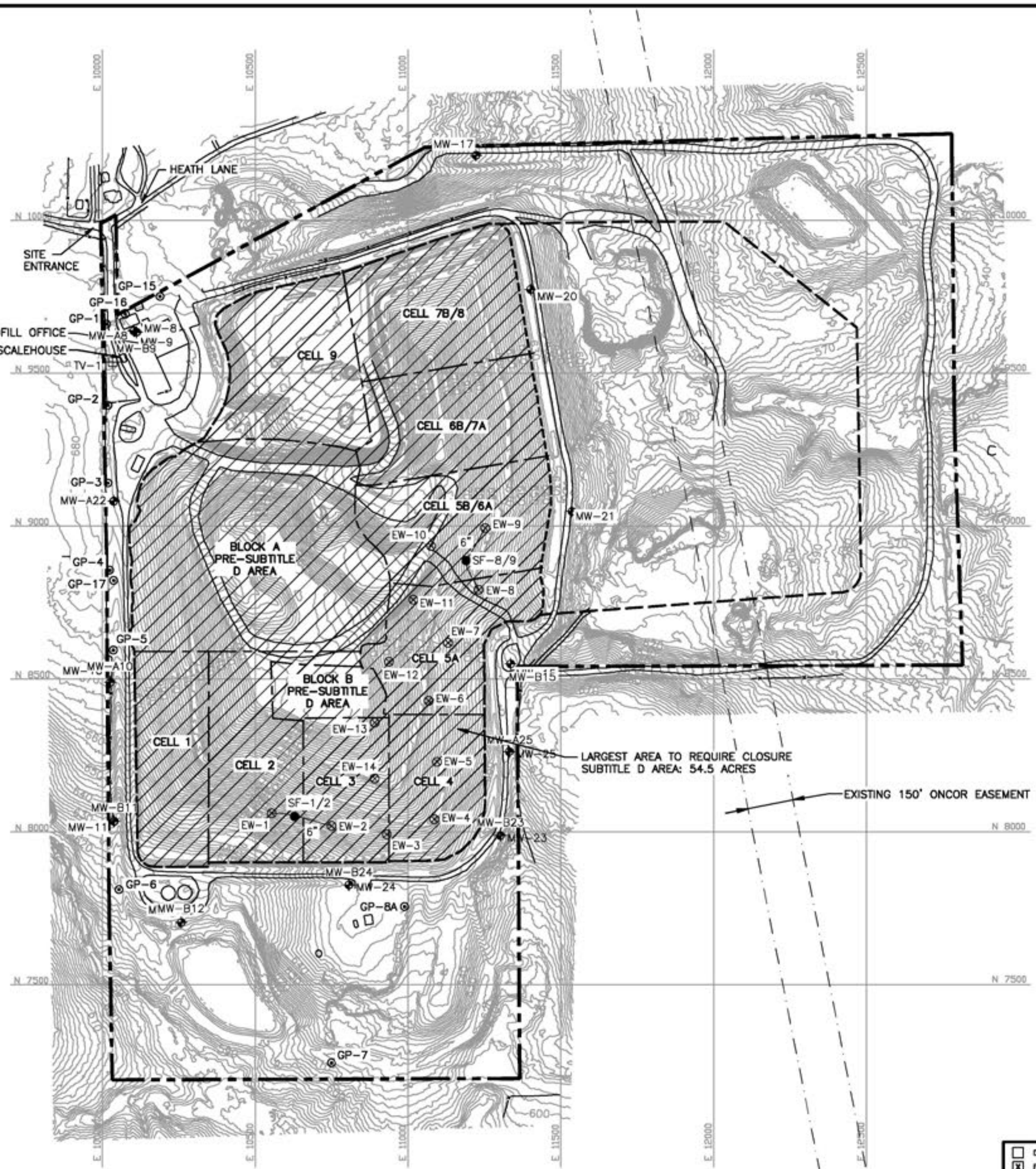


N

0 200 400
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- PERMITTED LIMIT OF WASTE
- PROPOSED LIMIT OF WASTE
- EXISTING EASEMENT
- E 10500 — SITE GRID
- 610 — EXISTING CONTOUR (SEE NOTE 1)
- MW-10 — EXISTING GROUNDWATER MONITORING WELL
- GP-1 — EXISTING GAS PROBE
- TV-1 — EXISTING TRENCH VENT
- EW-1 — EXISTING LFG EXTRACTION WELL
- SF-1 — EXISTING SOLAR FLARE
- EXISTING LFG COLLECTION PIPING
- ACTIVE AREA REQUIRING CLOSURE

NOTES:

1. EXISTING CONTOURS DEVELOPED BY FIRMATEK FROM AERIAL PHOTOGRAPHY FLOWN NOVEMBER 10, 2022.

STATE OF TEXAS
JASON E. EDWARDS
99336
LICENSED
PROFESSIONAL ENGINEER

05/20/2024

☐ DRAFT ☒ FOR PERMITTING PURPOSES ONLY ☐ ISSUED FOR CONSTRUCTION	PREPARED FOR PINE HILL FARMS LANDFILL TX, LP	MAJOR PERMIT AMENDMENT LARGEST AREA TO REQUIRE FINAL COVER ROYAL OAKS LANDFILL CHEROKEE COUNTY, TEXAS
DATE: 05/2024 FILE: 0120-076-11 CAD: IIIL-1.DWG DRAWN BY: VRS DESIGN BY: LKS REVIEWED BY: CAM	REVISIONS NO. / DATE / DESCRIPTION	
Weaver Consultants Group TBPE REGISTRATION NO. F-3727		WWW.WCGRP.COM FIGURE IIIL.1

3 POSTCLOSURE CARE COST ESTIMATE

The postclosure care period has been established by TCEQ regulations to be 30 years. This detailed cost estimate shows the cost of hiring a third party to conduct routine maintenance and monitoring during the postclosure period. During this period, continuous maintenance must be ongoing to assure the integrity and effectiveness of the final cover system, monitoring systems, leachate collection system, drainage system, and landfill gas system. A summary of postclosure cost estimate is presented on Table IIIL-5. The costs will be adjusted annually as indicated in Section 4. An assessment will be completed each year to verify that the Postclosure Cost Estimate shown in Table IIIL-5 is consistent with the current permit conditions and the projected permit conditions for the upcoming 12-month period. The assessment will verify that the postclosure costs are based on the current active area and that all other permit conditions are addressed by the Postclosure Cost Estimate (e.g., verify the LFG O&M cost estimate is updated to match the number of wells that will need to be maintained during the postclosure period). Continuous financial assurance coverage for the postclosure care period of the facility will be provided until the facility is released from the postclosure care period by the Executive Director, in accordance with the requirements of the facility's postclosure care plan. The estimates will be adjusted, as needed, consistent with the procedures noted in Section 4.

3.1 Engineering Costs

As shown on Table IIIL-5, engineering postclosure estimates include the cost of annual site inspections, corrective plans and specifications, and site compliance monitoring. The estimates are based on the largest area with waste in-place. Site inspections will be performed annually and will include identification of areas experiencing settlement or subsidence, identification of erosion or other drainage-related problems, and inspection of the leachate collection system, gas control and monitoring system, and the groundwater monitoring system. Correctional plans and specifications include the costs for an engineering consultant to prepare construction plans and specifications to correct problems identified during the site inspections. Gas monitoring and groundwater sampling and analysis will be performed as outlined in the Postclosure Care Plan (Appendix IIIK).

3.2 Construction Costs

Postclosure construction/maintenance estimates include the costs to correct problems determined by the engineering site inspections and as specified by the engineer's correctional plans and specifications. These costs will also include any ongoing site maintenance that is needed throughout the postclosure period. These costs include cover and drainage maintenance, as well as annual seeding and mowing costs. The leachate disposal costs include leachate removal from the area with a leachate collection system. Postclosure landfill gas control system O&M costs includes regular calibration and maintenance of regulatory equipment, such as valves and flow meters, associated system components of the active collection system and condensate disposal for the completely developed site.

A justification for the postclosure landfill gas (LFG) system operation and maintenance (O&M) cost estimate provided in Table IIIL-5 is discussed below. The following summary information can be found in Tables IIIL-2, IIIL-3, and IIIL-4.

- Table IIIL-2 – Estimated Routine O&M Costs. This table estimates the annual and 30-year cost for the routine O&M activities.
- Table IIIL-3 – Estimated Non-Routine O&M Costs. This table presents a summary of non-routine tasks and their associated costs. The estimates are based on the tasks required to replace or repair components on the flare/blower system.
- Table IIIL-4 – Summary of Estimated O&M Costs. This table provides a summary of the information listed in Tables IIIL-2 and IIIL-3.

Table IIIL-2
Estimated Routine Operation and Maintenance (O&M) Costs
Typical Landfill Gas Collection and Control System

Number of Extraction Wells	Annual Routine O&M Cost	30-year Routine O&M Cost
20	$25,500	$765,000
40	$32,000	$960,000
60	$38,500	$1,155,000
80	$45,000	$1,350,000
100	$51,500	$1,545,000
200	$64,500	$1,935,000
300	$77,500	$2,325,000
400	$96,500	$2,895,000
500	$109,500	$3,285,000
600	$122,500	$3,675,000
700	$135,500	$4,065,000
800	$148,500	$4,455,000

Annual routine maintenance includes the following items:

- Routine monitoring includes:
  - Balancing of the LFG extraction wells and monitoring of the blower/flare facility
  - Monitoring includes methane (% by volume), oxygen (% by volume), carbon dioxide (% by volume), pressures, and LFG temperature
  - Surface emissions and well field monitoring required under current NSPS regulations

- Maintenance of the GCCS will consist of:
  - Repair or replacement of sample ports
  - Repair or replacement of lateral valves
  - Adjusting and/or replacing flex joints
  - Adjusting and/or replacing flex tubing
  - Adjusting pipe supports to account for differential settlement

- Maintenance of a flare station includes:
  - Rotation of the blower operation
  - Maintaining vegetative growth inside the flare facility
  - Replacement of filters
  - Testing voltage output and operation of the blower(s)
  - Lubricating the blower bearings
  - Checking for blower belt wear and adjusting belt tension
  - Inspecting the flame arrestor and all safety shut-down features
  - Replacing recorder paper
  - Checking flare pilot system and pilot gas fuel tank levels
  - Checking flare controller set points and automatic louvers in accordance with the manufacturer's recommendations and schedules
  - Pump repairs to condensate sumps

Power costs are also included.

Table IIIL-3
Estimated Non-Routine O&M Costs
Typical Landfill Gas Collection and Control System

Number of Extraction Wells	Estimated Annual Non-Routine O&M Cost[1]	Estimated 30-Year Non-Routine O&M Cost
20	$10,000	$300,000
40	$10,000	$300,000
60	$10,000	$300,000
80	$10,000	$300,000
100	$10,000	$300,000
200	$10,000	$300,000
300	$10,000	$300,000
400[2]	$20,000	$600,000
500	$20,000	$600,000
600	$20,000	$600,000
700	$20,000	$600,000
800	$20,000	$600,000

1 This estimate assumes replacing and/or repairing the following flare components: LFG blower motor, air compressor and all sub-systems, enclosed flare stack thermal insulation, LFG flow rate and combustion temperature, monitoring devices, flame arrestor(s), knock-out-pot, all safety shut-down devices, telemetry system, and all electrical system controls.

2 It is assumed that a second enclosed flare will be required for a site of this size or larger. Therefore, flare maintenance costs are for 2 enclosed flare systems.

Table IIIL-4
Summary of Estimated O&M Costs
Typical Landfill Gas Collection and Control System

Number of Extraction Wells	Estimated 30-Year Routine Operation & Maintenance Costs	Estimated 30-Year Flare Operation & Maintenance Costs	Total Estimated 30-Year Operating Costs
20	$765,000	$300,000	$1,065,000
40	$960,000	$300,000	$1,260,000
60	$1,155,000	$300,000	$1,455,000
80	$1,350,000	$300,000	$1,650,000
100	$1,545,000	$300,000	$1,845,000
200	$1,935,000	$300,000	$2,235,000
300	$2,325,000	$300,000	$2,625,000
400	$2,895,000	$600,000	$3,495,000
500	$3,285,000	$600,000	$3,885,000
600	$3,675,000	$600,000	$4,275,000
700	$4,065,000	$600,000	$4,665,000
800	$4,455,000	$600,000	$5,055,000

3.3 Data Used to Develop Postclosure Cost Estimates

Consistent with Title 30 TAC §330.507, a detailed written postclosure cost estimate in current dollars is provided on Table IIIL-5. The cost data used to develop these estimates are based on current market conditions and were derived from similar projects completed by Pine Hill Farms TX, LP, its parent company Republic, and WCG.

As shown in Tables 16-1 and 16-2 in Parts I/II, Republic maintains over 10 landfills in Texas and over 50 landfills nationally that are in the postclosure care period.

WCG has been involved in many of the projects discussed above and similar projects in Texas. In addition, WCG has developed third-party postclosure cost estimates for over 25 sites in Texas (and numerous others nationally). Each of these estimates has been approved by TCEQ and similar state regulatory agencies.

Through the continued maintenance of the sites in the postclosure care period, Republic and WCG have gained a broad-based understanding of costs associated with postclosure maintenance activities. The postclosure cost estimates listed in Table IIIL-5 are consistent with unit cost data used to develop postclosure cost estimates at other sites. This unit cost data is based on the extensive experience of Pine Hill Farms TX, LP, Republic, and WCG with each of the postclosure cost items.

In addition, consistent with §330.507 an assessment will be completed each year to verify that the postclosure cost estimates shown in Table IIIL-5 are consistent with the current permit conditions and the projected permit conditions for the upcoming 12-month period. The assessment will verify that the postclosure costs are based on the current active and inactive areas and that all other permit conditions are addressed by the Postclosure Cost Estimate. This assessment will also address the appropriateness of the unit cost data.

Upon completion of closure activities and initiation of the postclosure care period, the facility may submit a request to the TCEQ Financial Assurance Unit to revise the postclosure cost estimate. The request shall update postclosure costs for inflation and to reflect the number of years remaining in the postclosure care period. Financial assurance will be maintained for a minimum 10-year postclosure care period regardless of the number of years remaining in the facility's 30-year postclosure care period. Correspondence with the TCEQ Financial Assurance Unit will be maintained in the Site Operating Record for the facility.

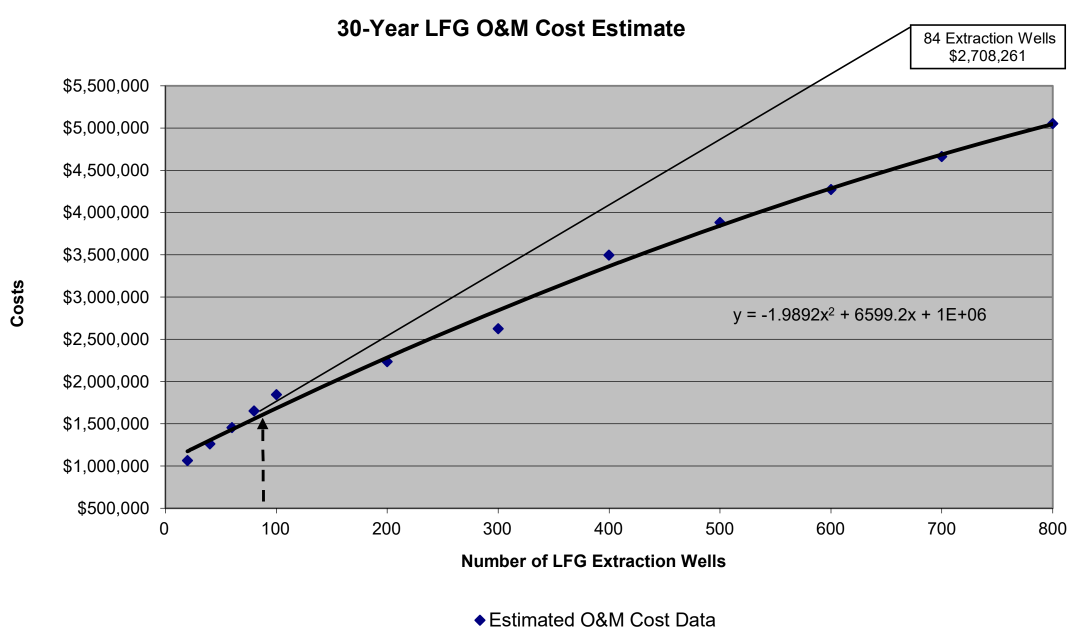
TABLE 2
ROYAL OAKS LANDFILL - POSTCLOSURE CARE COST

Permitted Waste Footprint	83.1	ac	Solid Waste Fill Area	83.1	ac
Area with leachate collection system	70.1	ac	Post Closure Care Period	30	yrs
Groundwater Monitoring Wells	27	wells	Gas Montoring Events	4	/yr
Gas Probes	19	probes	GW Monitoring Events	2	/yr
Area to be administratively closed	144.3	ac	Leachate Generation	3650	gal/ac

Description	Quantity	Unit[1]	Unit Cost [2]	Annual Cost	Proposed Total Cost
1.0 ENGINEERING					
1.1 Postclosure Care Plan	N/A				
1.2 Site Inspection and Recordkeeping (annual)	144.3	ACRE	$ 10.36	$ 1,495	**$ 44,848**
1.3 Correctional Plans and Specifications (annual)	83.1	ACRE	$ 14.14	$ 1,175	**$ 35,251**
1.4 Site Monitoring					
1.4.1 Groundwater Monitoring (semiannual)	27	WELLS	$ 1,373	$ 37,063	**$ 1,111,887**
1.4.2 Gas Monitoring (quarterly)	4	EVENTS	$ 1,200	$ 4,800	**$ 144,000**
ENGINEERING SUBTOTAL				$ 44,533	**$ 1,335,986**
2.0 CONSTRUCTION / MAINTENANCE	83.1	AC	$ 363	$ 30,132	**$ 903,962**
3.0 LEACHATE DISPOSAL/MAINTENANCE	255,865	GAL	$ 0.026	$ 6,652	**$ 199,575**
4.0 LFG SYSTEM MAINTENANCE	1	LS (see below)		$ 51,343	**$ 1,540,297**
SUBTOTAL				$ 132,661	**$ 3,979,820**
5.0 CONTINGENCY	1	10%		$ 13,300	**$ 398,000**
SUBTOTAL				$ 145,961	**$ 4,377,820**
6.0 THIRD PARTY ADMINISTRATION AND PROJECT MANAGEMENT	1	2.5%		$ 3,649	**$ 109,445**
TOTAL POSTCLOSURE CARE COST				$ 149,610	**$ 4,487,265**

[1] N/A = not applicable, AC = acres, GAL = gallons.

[2] Unit Costs are in 2024 dollars. Unit costs are based on current market conditions, typical engineering costs, and industry standards related to construction and reflect input from Republic Services and Weaver Consultants Group, LLC.



4 COST ESTIMATE ADJUSTMENTS

During the active life of the site, Pine Hill Farms TX, LP, will annually adjust the cost estimates for inflation no more than 60 days following establishment of the inflation factor. The adjustment may be made by recalculating the maximum costs of closure and postclosure in current dollars, or by using an inflation factor derived from the most recent Implicit Price Deflator for Gross National Product published by the United States Department of Commence in its Survey of Current Business. The inflation factor is the result of dividing the latest published annual deflator by the deflator for the previous year. The first adjustment is made by multiplying the closure and postclosure cost estimates by the inflation factor. The result is the adjusted closure and postclosure cost estimates. Subsequent adjustments are made by multiplying the latest adjusted closure and postclosure estimates by the latest inflation factor.

An increase in the closure or postclosure cost estimate and the amount of financial assurance will be made if changes to the final closure or postclosure care plan or the landfill conditions increase the maximum cost. If only the maximum area requiring closure changes (i.e., increases due to liner construction), a permit modification to change the closure and postclosure care cost estimates will be submitted to TCEQ.

A reduction in the closure or postclosure care cost estimate and the amount of financial assurance may be submitted if the cost estimate exceeds the maximum costs of closure at any time during the remaining life of the unit or postclosure care remaining over the postclosure care period. Pine Hill Farms TX, LP, will submit written notice to the Executive Director of the detailed justification for the reduction of the cost estimates and the amount of financial assurance. A reduction in the cost estimate and financial assurance will be considered a permit modification.

In the event that the facility were to enter into corrective action during the postclosure period, Pine Hill Farms TX, LP, will submit a corrective action cost estimate to the TCEQ in accordance with Title 30 TAC §330.509.

In accordance with Title 30 TAC §330.503(a) and §330.463(b)(3)(D), evidence of any additional financial assurance resulting from the annual revision of cost-estimates will be provided to the TCEQ within 30 days after the annual anniversary date.

APPENDIX IIIL-A

CLOSURE COST ESTIMATE FORM FOR MUNICIPAL SOLID WASTE TYPE I LANDFILL (FORM 20721)

05/20/2024

Texas Commission on Environmental Quality

Closure Cost Estimate Form for Municipal Solid Waste Type I Landfills

This form is for use by applicants or site operators to provide cost estimates for closure of MSW Type I landfills to meet the requirements in 30 Texas Administrative Code (TAC) Chapter 330, Section 330.63(j) and 30 TAC Chapter 330 Subchapter L. The costs to be provided herein are cost estimates for hiring a third party to close the largest waste fill area that could potentially be open in the year to follow and those areas that have not received final cover. If you need assistance in completing this form, please contact the MSW Permits Section in the Waste Permits Division at (512) 239-2335.

Facility Name: Royal Oaks Landfill

MSW Permit No.: 1614B

Site Operator/Permittee Name and Mailing Address: Pine Hill Farms TX, LP, 440 Heath Lane Jacksonville, TX 75766

Total Closure Cost Estimate (2023 Dollar Amount): $5,237,094

I. Professional Engineer’s Statement, Seal, and Signature

I am a licensed professional engineer in the State of Texas. To the best of my knowledge, this Closure Cost Estimate has been completed in substantial conformance with the facility Closure Plan and, in my professional opinion, is in compliance with Title 30 of the Texas Administrative Code, Chapter 330.

Name: Jason Edwards

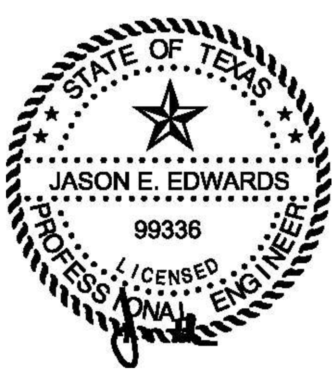
Title: Senior Engineer

Date: 05/2024

Company Name: Weaver Consultants Group, LLC

Firm Registration Number: F-3727

Professional Engineer’s Seal



05/20/2024

Professional Engineer’s Signature

II. Annual Review of Permit Conditions, Cost Estimates, Inflation Factor, and Financial Assurance

The permittee/site operator acknowledges that he/she will:

(1) Review the facility's permit conditions on an annual basis and verify that the current active and inactive waste fill areas of the landfill match the areas on which closure cost estimates are based.

(2) Request in writing via a permit modification application for an increase in the closure cost estimate and the amount of financial assurance provided if changes to the closure plan or the landfill conditions increase the maximum cost of closure at any time during the remaining active life of the landfill.

(3) Request in writing via a permit modification application for a reduction in the cost estimate and the amount of financial assurance provided if the cost estimate exceeds the maximum cost of closure at any time during the remaining active life of the landfill. The permit modification application will include a description of the situation and a detailed justification for the reduction of the closure cost estimate and the amount of financial assurance.

(4) Establish financial assurance for closure of the unit in an amount no less than the current closure cost estimate in accordance with 30 TAC Chapter 37, Subchapter R.

(5) Adjust the current cost estimate for inflation within 60 days prior to the anniversary date of the first establishment of the financial assurance mechanism.

(6) Provide annual inflation adjustments to the closure costs and financial assurance during the active life of the facility, until the facility is officially placed under the post closure care period and all requirements of the final closure plan have been approved in writing by the TCEQ executive director. The adjustment will be made using an inflation factor derived from the most recent annual Implicit Price Deflator for Gross National Product published by the United States Department of Commerce in its Survey of Current Business, as specified in paragraphs (1) and (2) of 30 TAC §37.131. The inflation factor is the result of dividing the latest published annual Deflator by the Deflator for the previous year.

(7) Provide continuous financial assurance coverage for closure until the facility is officially placed under the post-closure care period.

III. Description of the Closure Cost Estimates Worksheet

The following descriptions of the items on the closure cost estimates worksheet provide guidance for identifying the minimum work or cost elements and estimating the unit or lump sum cost of each item as applicable. Enter additional detail for each item in the field following the item as necessary and as site-specific condition warrants. The cost items are grouped under closure costs for engineering, construction, and storage and processing units. Include attachments to detail any additional work and associated costs necessary to close the site that is not already included as a line item on the worksheet. Reference the attachments and list the work or cost items in the fields under "Additional Engineering Cost Items Not Listed on the Worksheet," "Additional Construction Cost Items Not Listed on the Worksheet," or "Additional Storage and Processing Units Items Not Listed on the Worksheet" as applicable. Provide the total cost of the additional work or cost items in each cost category on the worksheet line that precedes the cost subtotal for each cost group.

1. Engineering Costs

The engineering tasks have been subdivided into seven items and are described below. Other related costs may be added as site-specific issues warrant.

1.1. Topographic Survey

A topographic survey will be required to verify the existing elevation and slopes of the landfill to ensure conformance with the final cover system, drainage system, and final grading designs.

Enter additional topographic survey work or cost element details as site-specific conditions warrant: $5,000

1.2. Boundary Survey

The metes and bounds description is required for filing of the affidavit of closure and deed recording of any area of the site which has received waste. Other activities to be included here are publication of the public notice of closing activities.

Enter additional boundary survey work or cost element details as site-specific conditions warrant: $9,380

1.3. Site Evaluation

The evaluation includes a site inspection to identify waste disposal areas, analyze drainage and erosion protection needs, and to determine other site operational features that are not in compliance with the permit. The site evaluation also includes verifying the need for new or relocation of existing groundwater monitoring wells and landfill gas monitoring probes, analysis of groundwater samples, and review of site operating record. The third party consultant who performed the site evaluation will prepare and submit an engineering report to the executive director to document the status of the site. The report will identify all areas of work and the associated implementation costs necessary to safely close the landfill operations with recommendations on how to fulfill these needs.

Enter additional site evaluation work or cost element details as site-specific conditions warrant: $101,732

1.4. Development of Plans

The final closure, plan the final cover system design and specifications, grading and drainage plans, specification for revegetation, design of any other improvements to bring the site into compliance with the permit, the closure schedule, and coordination with the TCEQ and provision of closure notice to the public.

Enter additional development of plans work or cost element details as site-specific conditions warrant: $32,428

1.5. Contract Administration (bidding and award)

The third-party consultant will advertise the project, receive the bids, evaluate the bids, award the closure construction contract and administer the contract during construction.

Enter additional contract administration work or cost element details as site-specific conditions warrant: $7,427

1.6. Closure Inspection and Testing

The professional of record will observe closure construction, perform cover thickness and permeability verification, and prepare an evaluation report upon completion of closure.

Enter additional closure inspection or testing work or cost element details as site-specific conditions warrant: $99,190

1.7. TPDES and other Permits

The third-party consultant will prepare plans, specifications, and other documents necessary for compliance with applicable federal and state laws and requirements, including the Clean Water Act, for the proper closure of the site.

Enter additional TPES or other permits work or cost element details as site-specific conditions warrant: $7,000

1.8. Additional Engineering Cost Items Not Listed on the Worksheet

List the Attachment(s) detailing any additional engineering cost items necessary to close the site that is not already included as a line item on the worksheet: Also, reference these Attachments in the “Units” column on this line of the worksheet. Provide the total cost of all additional engineering cost items in the “Cost” column.

Groundwater Monitoring Well Consultant: NA

The existing groundwater monitoring system is adequate. There should be no cost associated with this item.

1.9. Engineering Costs Subtotal: $262,582

1.9.1. Enter the sum of engineering costs in Items 1.1 through 1.8.

2. Construction Costs

Closure construction costs include those for construction of the final cover system, site grading, and drainage improvements. Other costs may be added as site-specific issues warrant.

2.1. Mobilization

2.1.1. Mobilization of Personnel and Equipment

The cost of mobilizing personnel and construction heavy equipment must be included as part of the construction costs.

Enter additional work or cost element details for mobilization of personnel and equipment as site-specific conditions warrant:

Included in overall cost of construction work.

2.2. Final Cover System

The owner or operator must install a final cover system that is designed to minimize infiltration and erosion. The final cover system is subdivided into the sideslope cover and cap cover with their associated components to facilitate cost calculations. If an alternative final cover is proposed, the closure cost estimate will still be based on a design that utilizes the conventional composite cover system.

Enter additional final cover system work or cost element details as site-specific conditions warrant: $3,784,077

2.2.1. Side Slope Cover

Enter information for Items 2.2.1a through 2.2.1h.

2.2.2. Top Slope Cover

Enter information for Items 2.2.2a through 2.2.2h.

2.2.3. Cells for Class 1 Nonhazardous Industrial Waste

2.3. Site Grading

Site grading includes the final grading of the site, including the landfill cap and sideslopes.

Enter additional site grading work or cost element details as site-specific conditions warrant: $90,198

2.4. Site Fencing and Security

Site fencing and security must be included for the area which has received waste and have no existing approved fencing.

Enter additional site fencing and security work or cost element details as site-specific conditions warrant: **The site has adequate existing fencing.**

2.5. Landfill Gas Monitoring and Control Systems

Enter information for Items 2.5.1 through 2.5.6.

Final installation of the landfill gas monitoring and control systems must include the installation costs of pipes and appurtenances. In the event of a forced closure, the systems may not have been completed, thus, the estimated costs to complete the landfill gas monitoring and control system must be provided.

Enter additional landfill gas monitoring and control systems work or cost element details as site-specific conditions warrant: $432,025

2.6. Groundwater Monitoring System

2.6.1. Monitor Well Installation

Upon closure of the site, it may be necessary to relocate the compliance boundary. This requires the installation of new monitor wells.

Enter additional groundwater monitoring system work or cost element details as site-specific conditions warrant:

The existing groundwater monitoring system is adequate.

2.6.2. Piezometer and Monitor Well Plugging and Abandonment

Piezometer or monitor well abandonment is the cost of abandoning (plugging) piezometers or monitor wells that are no longer needed. Determine the number of piezometers or monitor wells to be abandoned and include the total cost.

Enter additional plugging and abandonment work or cost element details as site-specific conditions warrant:

No plugging of piezometers or monitoring wells is required.

2.7. Leachate Management

2.7.1. Completion of Existing Leachate Collection System

In the event of a forced closure, there may be circumstances where the leachate collection system has not been completed. In this event, the leachate collection system must be closed with a permanent outfalls and permanent cleanouts installed.

Enter additional leachate management work or cost element details as site-specific conditions warrant: **The existing leachate management system is adequate.**

2.8. Stormwater Management

2.8.1. Stormwater Drainage Management System

To reduce the potential long-term impacts of the landfill on surface water quality, drainage features must be incorporated into the final cover design to direct runoff, minimize erosion, control sediments, and avoid ponding of stormwater. The drainage system construction costs must be included.

Enter additional stormwater drainage management work or cost element details as site-specific conditions warrant:

Included in overall cost of final cover system construction.

2.9. Additional Construction Cost Items Not Listed on Worksheet

List the Attachments detailing any additional construction cost items necessary to close the site that is not already included as a line item on the worksheet: Also, reference these Attachments in the "Units" column on this line of the worksheet. Provide the total cost of all additional construction cost items in the "Cost" column.

2.9.1. Cost to decommission citizens convenience center: $5,000

2.10. Construction Costs Subtotal: $4,304,190

2.10.1. Enter the sum of construction costs in Items 2.1 through 2.9.

3. Storage and Processing Unit Closure Costs

For landfills that incorporate storage and/or processing operations that are not separately authorized, all waste and processed and unprocessed materials associated with storage and/or processing units must be removed during the closure process.

3.1. Waste Disposal

The cost of disposal of waste at an authorized facility. *Enter additional waste disposal work or cost element information as necessary.*

Included in Item 2.9.1.

3.2. Material Removal and Disinfection

The cost of removal, including transportation, of any remaining processed and unprocessed materials to an authorized off-site location. *Enter additional material removal and disinfection work or cost element information as necessary.*

Included in Item 2.9.1.

3.3. Demolition and Disposal

The cost of dismantling and/or disinfection of storage and/or processing units and disposal, as applicable. *Enter additional demolition and disposal work or cost element information as necessary.*

Included in Item 2.9.1.

3.4. Additional Storage and Processing Unit Closure Cost Items Not Listed in Worksheet

List the Attachments detailing any additional storage and processing unit closure cost items necessary to close the site that is not already included as a line item on the worksheet. Also, reference these Attachments in the "Units" column on this line of the worksheet. Provide the total cost of all additional storage and processing unit closure cost items in the "Cost" column.

3.5. Storage and Processing Unit Closure Costs Subtotal: Not Applicable

4. Sum of Cost Subtotals: $4,566,525

4.1. Enter the sum of engineering, construction, and storage and processing unit closure cost subtotals from lines 1.9.1, 2.10.1, and 3.5.1.

5. Contingency: $456,653

5.1. Add an amount equal to at least 10 percent of the sum of cost subtotals to cover unanticipated events during implementation of closure activities.

6. Contract Performance Bond: $91,331

6.1. Add an amount equal to at least 2 percent of the sum of cost subtotals for purchase of a surety bond to guarantee satisfactory completion of the closure activities.

7. Third Party Administration and Project Management Costs: $114,163

7.1. Add an amount equal to at least 2.5 percent of the sum of cost subtotals to cover the cost for a third party hired by TCEQ to administer the closure activities.

8. Total Closure Cost: $5,237,094

8.1. Enter the sum of the amounts on lines 4.1, 5.1, 6.1, and 7.1.

IV. Closure Cost Estimates Worksheet

A. Landfill Data

Total Permitted Waste Disposal Area: 83.1 acres

Largest Area Requiring Final Cover in the year to follow: 54.5 acres

Total Filled Area with Constructed Final Cover: 0 acres

Total Area Certified Closed: 0 acres

Number of Monitor Wells to be Installed for Closure: 0

Number of Gas Probes to be Installed for Closure: 0

Total Acreage Needing LFG Collection and Control System: 70.1 acres

The unit or lump sum cost for each item is based on the work items and cost elements described in Section III of this Closure Cost Estimate document:

Yes ☒ No ☐ Partially ☐

(if "No" or "Partially" is checked, please include attachments describing the additional work items and detailing the unit, quantities, and costs for the additional items)

B. Facility Drawings and Financial Assurance Documentation

- Facility drawings
  - Attach facility drawings showing the closure areas to which the closure cost estimates apply.
- Financial assurance documentation
  - For an existing facility, attach a copy of the documentation required to demonstrate financial assurance as specified in 30 TAC Chapter 37, Subchapter R.
  - For a new facility, a copy of the required documentation shall be submitted 60 days prior to the initial receipt of waste.

C. Attachments

- Additional Engineering, Construction, and Storage and Processing Units Cost Items Details

D. Closure Cost Estimates Worksheet

If any item listed in this worksheet is not applicable to the subject facility, enter "NA" (Not Applicable) in the affected field.

Table 1. Closure Cost Estimates Worksheet.

Item No.	Item Description	Units[1]	Quantity	Unit Cost	Cost	Source of Unit Cost Estimate[2]
1. Engineering Costs						
1.1	Topographic Survey	Lump Sum	1	$5,000	$5,000	Third Party Estimate
1.2	Boundary Survey	Acres	144.3	$65	$9,380	Third Party Estimate
1.3	Site Evaluation	Acres	144.3	$705	$101,732	Third Party Estimate
1.4	Development of Plans	Acres	54.4	$595	$32,428	Third Party Estimate
1.5	Contract Administration (bidding and award)	5%	5%	NA	$7,427	Third Party Estimate
1.6	Closure Inspection and Testing	Acres	54.4	$1,820	$99,190	Third Party Estimate
1.7	TPDES and other Permits	Lump Sum	1	$7,000	$7,000	Third Party Estimate
1.8	Groundwater Monitoring Well Consultant	NA	NA	NA	NA	NA
1.9 Engineering Costs Subtotal						
1.9.1	Engineering Costs Subtotal	NA	NA	NA	$262,582	NA
2. Construction Costs						
2.1 Mobilization						
2.1.1	Mobilization of Personnel and Equipment	Lump Sum	NA	NA	NA	NA
2.2 Final Cover System Final Cover System is the same for topslope and sideslope area.						
2.2.1 Side Slope Cover						
2.2.1a	Infiltration Layer – Compacted Clay	Cubic Yards	131,648	$5.80	$764,962	Estimate from Recent Construction Experiences
2.2.1b	Infiltration Layer – Geosynthetic Clay Liner	Square Feet	NA	NA	NA	NA
2.2.1c	Flexible Membrane Cover – HDPE	Square Feet	NA	NA	NA	NA
2.2.1d	Flexible Membrane Cover – LLDPE	Square Feet	2,369,664	$0.46	$1,092,049	Estimate from Recent Construction Experiences
2.2.1e	Drainage Layer – Aggregate	Cubic Yards	NA	NA	NA	NA

Item No.	Item Description	Units[1]	Quantity	Unit Cost	Cost	Source of Unit Cost Estimate[2]
2.2.1f	Drainage Layer – Drainage Geocomposite Material	Square Feet	2,369,664	$0.65	$1,543,113	Estimate from Recent Construction Experiences
2.2.1g	Erosion Layer	Cubic Yards	87,765	$3.75	$329,725	Estimate from Recent Construction Experiences
2.2.1h	Vegetation	Acres	54.4	$995	$54,228	Estimate from Recent Construction Experiences
2.2.2 Top Slope Cover **Final Cover System is the same for topslope and sideslope area.**						
2.2.2a	Infiltration Layer – Compacted Clay	Cubic Yards	NA	NA	NA	NA
2.2.2b	Infiltration Layer – Geosynthetic Clay Liner	Square Feet	NA	NA	NA	NA
2.2.2c	Flexible Membrane Cover – HDPE	Square Feet	NA	NA	NA	NA
2.2.2d	Flexible Membrane Cover – LLDPE	Square Feet	NA	NA	NA	NA
2.2.2e	Drainage Layer – Aggregate	Cubic Yards	NA	NA	NA	NA
2.2.2f	Drainage Layer – Drainage Geocomposite Material	Square Feet	NA	NA	NA	NA
2.2.2g	Erosion Layer	Cubic Yards	NA	NA	NA	NA
2.2.2h	Vegetation	Acres	NA	NA	NA	NA
2.2.3 Cells for Class 1 Nonhazardous Industrial Waste						
2.2.3a	Dike Construction	specify	NA	NA	NA	NA
2.3 Site Grading						
2.3.1	Site Grading	Acres	54.4	$1,655	$90,198	Estimate from Recent Construction Experiences
2.4 Site Fencing and Security						
2.4.1	Site Fencing and Security	specify	NA	NA	NA	NA
2.5 Landfill Gas Monitoring and Control System						
2.5.1	Gas Control Wells	specify	NA	NA	NA	NA
2.5.2	Gas Header Piping	specify	NA	NA	NA	NA
2.5.3	Gas Lateral Piping	specify	NA	NA	NA	NA
2.5.4	Flare Station	Lump Sum	NA	NA	NA	NA
2.5.5	Condensate Sumps	specify	NA	NA	NA	NA

Closure Cost Estimate for MSW Type I Landfill

Facility Name: Royal Oaks Landfill — Revision No.: 0

Permit No: 1614B — Date: 05/2024

Item No.	Item Description	Units[1]	Quantity	Unit Cost	Cost	Source of Unit Cost Estimate[2]
2.5.6	Completion of LFG Monitoring System	Wells	55	$7,855	$432,025	Estimate from Recent Construction Experiences
2.6 Groundwater Monitoring System						
2.6.1	Groundwater Monitoring Well Installation	Each	NA	NA	NA	NA
2.6.2	Piezometer and Monitor Well Plugging and Abandonment	Each	NA	NA	NA	NA
2.7 Leachate Management						
2.7.1	Completion of Leachate Management System	specify	NA	NA	NA	NA
2.8 Stormwater Management						
2.8.1	Stormwater Drainage Management System	specify	NA	NA	NA	NA
2.9 Other Cost Items						
2.9.1	Additional Construction Cost Items (describe in attachments) Citizens Convenience Center	LS	1	$5,000	$5,000	Estimate from Recent Construction Experiences
2.10 Construction Costs Subtotal						
2.10.1	Construction Costs Subtotal	NA	NA	NA	$4,311,299	NA
3. Storage and Processing Unit Closure Costs						
3.1	Waste Disposal	☐ Tons ☐ Cubic Yards	NA	NA	NA	NA
3.2	Material Removal and Disinfection	specify	NA	NA	NA	NA
3.3	Demolition and Disposal Units Moved to Item 2.9.1	NA	NA	NA	NA	NA
3.4	Additional Storage and Processing Unit Closure Cost Items (describe in attachments)	identify attach-ments	NA	NA	NA	NA
3.5 Storage and Processing Unit Closure Costs Subtotal						
3.5.1	Storage and Processing Unit Closure Costs Subtotal	NA	NA	NA	$5,000	NA
4. Sum of Engineering, Construction, and Storage and Processing Unit Closure Costs						
4.1	Sum of Engineering, Construction, and Storage and Processing Unit Closure Cost Subtotals	NA	NA	NA	$4,573,882	NA

Closure Cost Estimate for MSW Type I Landfill

Facility Name: Royal Oaks Landfill — Revision No.: 0

Permit No: 1614B — Date: 05/2024

Item No.	Item Description	Units[1]	Quantity	Unit Cost	Cost	Source of Unit Cost Estimate[2]
5. Contingency						
5.1	Contingency (10% of Sum of Engineering, Construction, and Storage and Processing Unit Closure Cost Subtotals)	NA	NA	NA	$457,388	NA
6. Contract Performance Bond						
6.1	Contract Performance Bond (2% of Sum of Engineering, Construction, and Storage and Processing Unit Closure Cost Subtotals)	NA	NA	NA	$91,478	NA
7. Third Party Administration and Project Management Costs						
7.1	Third Party Administration and Project Management Costs (2.5% of Sum of Engineering, Construction, and Storage and Processing Unit Closure Cost Subtotals)	NA	NA	NA	$114,347	NA
8. Total Closure Costs						
8.1	Total Closure Costs (sum of amounts in Sections 4, 5, 6, and 7)	NA	NA	NA	$5,237,094	NA

[1] For items marked "specify," the responsible professional engineer will enter appropriate unit of measurement

[2] Sources of Unit Costs for Cost Estimates table may include:
(1) Published Cost Estimator Manuals (e.g., RS Means);
(2) Third Party Quotes (e.g., Environmental Field Services Contractors);
(3) Verifiable Data based on Actual Operations; or
(4) Other sources of cost acceptable to the executive director of the TCEQ.

APPENDIX IIIL-B

POST-CLOSURE COST ESTIMATE FORM FOR MUNICIPAL SOLID WASTE TYPE I LANDFILL (FORM 20723)

STATE OF TEXAS
JASON E. EDWARDS
99336
LICENSED
PROFESSIONAL ENGINEER

05/20/2024

Texas Commission on Environmental Quality

Post-Closure Care Cost Estimate Form for Municipal Solid Waste Type I Landfills

This form is for use by applicants or site operators to provide post-closure care cost estimates for post-closure care of MSW Type I landfills to meet the requirements in 30 Texas Administrative Code (TAC) Chapter 330, Section 330.63(j) and 30 TAC Chapter 330 Subchapter L. The costs to be provided herein are cost estimates for hiring a third party to conduct post-closure care of the largest waste fill area that has been certified closed in writing by the TCEQ executive director.

If you need assistance in completing this form, please contact the MSW Permits Section in the Waste Permits Division at (512) 239-2335.

I. General Information

Facility Name: **Royal Oaks Landfill**

MSW Permit No.: **1614B**

Date: **05/2024**

Revision Number: **0**

Site Operator/Permittee Name and Mailing Address: **Pine Hill Farms TX, LP, 440 Heath Lane Jacksonville, TX 75766**

Total Post-Closure Care Cost Estimate (2023 Dollar Amount): **$4,252,433**

II. Professional Engineer's Statement, Seal, and Signature

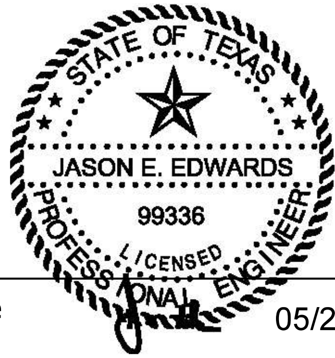
I am a licensed professional engineer in the State of Texas. To the best of my knowledge, this Post- Closure Care Cost Estimate has been completed in substantial conformance with the facility Post-Closure Care Plan and, in my professional opinion, is in compliance with Title 30 of the Texas Administrative Code, Chapter 330.

Name: Jason Edwards Title: Senior Engineer

Date: 05/2024

Company Name: Weaver Consultants Group, LLC Firm Registration Number: F-3727

Professional Engineer's Seal



Signature 05/20/2024

III. Annual Review of Permit Conditions, Cost Estimates, Adjustments for Inflation, and Financial Assurance

The site operator/permittee acknowledges that he/she will:

1. Revise and increase the post-closure care cost estimate and the amount of financial assurance provided whenever changes in the post-closure care plan or the landfill conditions increase the maximum cost of post-closure care at any time during the remaining active life of the landfill and until the facility is officially released from the post-closure care period in writing by the executive director.
2. Request a reduction in the post-closure care cost estimate and the amount of financial assurance as a permit modification whenever the post-closure care cost estimate exceeds the maximum cost of post-closure care remaining over the post-closure period. The permit modification will include a detailed justification for the reduction of the post-closure care cost estimate and the amount of financial assurance.
3. Establish financial assurance for post-closure care of the unit in an amount no less than the current post-closure care cost estimate in accordance with 30 TAC Chapter 37
4. Adjust the current post-closure care cost estimate for inflation within 60 days prior to the anniversary date of the first establishment of the financial assurance mechanism.
5. Provide annual inflation adjustments to the post-closure care costs and financial assurance during the active life of the facility and during the post closure care period. The adjustment will be made using an inflation factor derived from the most recent annual Implicit Price Deflator for Gross National Product published by the United States Department of Commerce in its Survey of Current Business, as specified in 30 TAC Chapter 37. The inflation factor is the result of dividing the latest published annual Deflator by the Deflator for the previous year.
6. Provide continuous financial assurance coverage for post-closure care until the facility is officially released in writing by the executive director from the post-closure care period in accordance with all requirements of the post-closure care plan.

IV. Description of Worksheet Items of the Post-Closure Care Cost Estimates

The following descriptions of the worksheet items provide guidance for identifying the minimum work or cost elements for estimating the unit or lump sum cost of each item as applicable. Enter additional detail for each item in the field following the item as necessary and as site-specific conditions warrant. The cost items are grouped under post-closure care costs for engineering, construction, and leachate management. Include attachments to detail any additional work and associated costs necessary for the post-closure care of the unit or facility that is not already included as a line item on the worksheet. Reference the attachments and list the work or cost items in the fields under "Additional Engineering Cost Items Not Listed on the Worksheet," "Additional Construction Cost Items Not Listed on the Worksheet," or Additional Leachate Management Costs Not Listed on the Worksheet" as applicable. Provide the total cost of additional work or cost items in each cost category on the worksheet line that precedes the cost subtotal for each cost group.

1. Engineering Costs

1.1. Site Inspection and Recordkeeping

Regularly scheduled and event-driven site inspection must be performed to identify areas experiencing settlement, subsidence, erosion, or other drainage related problems, and note the conditions of the environmental control and monitoring systems, including leachate collection, groundwater monitoring, and landfill gas monitoring systems. *Enter additional site inspection and recordkeeping work or cost element detail as site-specific conditions warrant.*

$1,443

Site inspections will identify any potential areas experiencing settlement and erosion over the entire area to be administratively closed. The inspection will also document the condition of the LCS, LFG, groundwater monitoring system, and other landfill systems.

1.2. Correctional Plans and Specifications

The cost for an engineering consultant to prepare corrective measure construction plans and specifications to correct problems identified during site inspections. *Enter additional work or cost element details for correctional plans and specifications as site-specific conditions warrant.*

$1,134

Includes preparation of plans and specifications to correct problems identified during inspections in area of waste in-place.

1.3. Site Monitoring

The cost of performing semiannual groundwater (including costs for sampling and analyzing parameters, and assessment and reporting) and quarterly landfill gas monitoring (including costs for sampling and reporting) and the monitoring of other site-specific systems at the landfill during the post-closure period. *Enter additional site monitoring work or cost element details as site-specific conditions warrant.*

$35,775

Includes cost for semi-annual groundwater monitoring and quarterly gas probe monitoring.

1.4. Additional Engineering Cost Items Not Listed on the Worksheet

List the Attachments detailing additional post-closure care engineering cost items not already included as a line item on the worksheet. (Also, reference these Attachments in the "Units" column of this line of the worksheet. Provide the total cost of all additional engineering cost items in the "Cost" column).

NA

2. Construction Costs

2.1. Cap and Sideslopes Repairs and Revegetation

The cost of repair of the cap and cap drainage control structures due to erosion or structural integrity failures and maintaining final cover vegetation to minimize erosion. *Enter additional cap and sideslopes repair and revegetation work or cost element details as site-specific conditions warrant.*

Included in Item 2.0 on Table IIIL-5.

2.2. Mowing and Vegetation Control

The cost of controlling vegetation growth on the final cover and other areas of the landfill. *Enter additional mowing and vegetation control work or cost element details as site-specific conditions warrant.*

Included in Item 2.0 on Table IIIL-5.

2.3. Groundwater Monitoring System Maintenance

The cost of repairs/replacement and routine maintenance. *Enter additional groundwater monitoring system maintenance work or cost element details as site-specific conditions warrant.*

Included in Item 2.0 on Table IIIL-5.

2.4. LFG Monitoring Probes Maintenance

The cost of repairs/replacement and routine maintenance. Enter additional LFG monitoring probes maintenance work or cost element details as site-specific conditions warrant.

$51,343

2.5. LFG Collection System Maintenance

The cost of repairs and routine maintenance. *Enter additional LFG collection system maintenance work or cost element details as site-specific conditions warrant.*

Included in Item 4.0 on Table IIIL-5.

2.6. Perimeter Fence and Gates Maintenance

The cost of maintaining perimeter fence and gates to restrict unauthorized access to the closed landfill. *Enter additional perimeter fence and gates maintenance work or cost element details as site-specific conditions warrant.*

Included in Item 2.0 on Table IIIL-5.

2.7. Access and Rights of Way Maintenance

The cost of maintaining the access roads and other rights of way to the closed landfill to conduct inspections, environmental sampling, routing maintenance and other post-closure activities. *Enter additional access and rights of way maintenance work or cost element details as site-specific conditions warrant.*

Included in Item 2.0 on Table IIIL-5.

2.8. Drainage System Cleanout and Repairs

The cost to include costs for maintaining and repairing ditches, conveyance structures, and ponds/basins. *Enter additional drainage system cleanout and repairs work or cost element details as site-specific conditions warrant.*

Included in Item 2.0 on Table IIIL-5.

2.9. Additional Construction and Maintenance Cost Items Not Listed on the Worksheet

List the Attachments detailing any additional construction and maintenance cost items necessary for post-closure care that are not already covered on the worksheet. (Also, reference these Attachments in the "Units" column on this line of the worksheet. Provide the total cost of all additional construction and maintenance cost items in the "Cost" column.)

Included in Item 2.0 on Table IIIL-5.

3. Leachate Management Costs

3.1. Leachate Collection and Removal System Operation and Maintenance

The cost of operation, routine maintenance and repairs. *Enter additional work or cost element details for leachate collection and removal system operation and maintenance as site-specific conditions warrant.*

The existing leachate management system is adequate.

3.2. Leachate Disposal

The cost of leachate disposal off-site. *Enter additional work or cost element details for leachate disposal as site-specific conditions warrant*.

$6,397

3.3. Additional leachate management cost items not listed on the worksheet.

List the Attachments detailing any additional leachate management cost items necessary for post-closure care that are not already covered on the worksheet. (Also, reference these Attachments in the "Units" column on this line of the worksheet. Provide the total cost of all additional leachate management cost items in the "Cost" column.)

NA

4. Sum of Cost Subtotals

Enter the sum of engineering, construction, and storage and leachate management post-closure care cost subtotals from lines 1.5.1, 2.10.1, and 3.5.1.

$125,717

5. Contingency

The cost added to cover unanticipated events during implementation of post-closure activities. (Enter additional work or cost element information as necessary)

$12,600

6. Third Party Administration and Project Management Costs

The cost for the third party hired by TCEQ to administer the post-closure activities. (Enter additional work or cost element information as necessary)

$3,458

V. Post-Closure Care Cost Estimates Worksheet

Post-Closure Care Period – 30 years

Total Permitted Acreage: 144.3 acres

Total Permitted Waste Footprint: 83.1 acres

Number of Groundwater Monitoring Wells: 27

Number of GW Monitoring Events: 2/year

Number of Gas Probes: 19

Number of LFG Monitoring Events: 4/year

The unit or lump sum cost for each item is based on the work items and cost elements described in Section III of this Post-Closure Cost Estimate document:

Yes ☒ No ☐ Partially ☐

If "No" or "Partially" is checked, please attach a written description of work items and cost elements which form the bases of unit or lump sum cost for the affected items.

(NOTE: If any item listed in this worksheet is not applicable to the subject facility, enter Not Applicable (N/A) in the affected fields)

Attachments

Additional Engineering, Construction, and Leachate Management Cost Items Details.

Table 1: Post-Closure Care Cost Estimates

Item No.	Item Description	Units	Annual Qty.	Unit Cost	Annual Cost	Source of Unit Cost Estimate[i]
1.0 Engineering Costs						
1.1	Site Inspection and Recordkeeping[ii]	Acre	144.3	$10.00	$1,443	WCG routinely provides this type of service.
1.2	Correctional Plans and Specifications	Acre	83.1	$13.65	$1,134	WCG routinely provides this type of service.
1.3 Site Monitoring						
1.3.1 Groundwater Monitoring System						
1.3.1(a)	Sampling and Analysis of GW Monitoring Wells (Quantity = 2 x Number of wells)	Wells	27	$1,325	$35,775	WCG routinely provides this type of service.
1.3.1(b)	Piezometers/Well Abandonment	Each	NA			
1.3.2 LFG Monitoring System						
1.3.2(a)	LFG Quarterly Monitoring (Quarterly)	Each	4	$135	$540	WCG routinely provides this type of service.
1.3.2(b)	LFG Probe Plugging and Abandonment	Each	NA			
1.4 Additional Engineering Cost Items (Detail in Attachments)						
1.4.1	Additional Engineering Cost Items (describe in attachments)	Identify attachments	NA	NA	NA	NA
1.5 Engineering Costs Subtotal						

Post-Closure Care Cost Estimate for MSW Type I Landfills

Facility Name: Royal Oaks Landfill — Revision No.: 0

Permit No: 1614B — Date: 05/2024

Item No.	Item Description	Units	Annual Qty.	Unit Cost	Annual Cost	Source of Unit Cost Estimate[i]
1.5.1	Engineering Costs Subtotal	NA	NA	NA	$38,892	NA
2.0 Construction and Maintenance Costs						
2.1	Cap and Sideslopes Repairs and Revegetation	Acres	83.1	$350	$29,085	Ongoing postclosure maintenance projects.
2.2	Mowing and Vegetation Management	Acres	Included in 2.1			
2.3	Groundwater Monitoring System Maintenance	specify	Included in monitoring.			
2.4	LFG Monitoring Probes Maintenance	specify	Included in monitoring.			
2.5	LFG Collection System Maintenance	specify	1	NA	$51,343	Ongoing postclosure maintenance projects.
2.6	Perimeter Fence and Gates Maintenance	specify	NA			
2.7	Access Roads Maintenance	specify	NA			
2.8	Drainage System Cleanout/Repairs	specify	NA			
2.9 Additional Construction and Maintenance Cost Items (Details in Attachments)						
2.9.1	Additional Construction and Maintenance Cost Items (details in attachments)	Identify attachments	NA	NA	NA	NA
2.10 Construction and Maintenance Costs Subtotal						
2.10.1	Construction and Maintenance Costs Subtotal	NA	NA	NA	$80,428	NA
3.0 Leachate Management						
3.1	Leachate Management System Operation and Maintenance	NA	NA	NA	NA	NA

Post-Closure Care Cost Estimate for MSW Type I Landfills

Facility Name: Royal Oaks Landfill — Revision No.: 0

Permit No: 1614B — Date: 05/2024

Item No.	Item Description	Units	Annual Qty.	Unit Cost	Annual Cost	Source of Unit Cost Estimate[i]
3.2	Leachate Disposal	Gals	151,110	$0.025	$6,397	NA
3.3 Additional Leachate Management Cost Items (Details in Attachments)						
3.4	Decommission Leachate Storage Tanks/Pipes	LS	NA	NA	NA	NA
3.5 Leachate Management Costs Subtotal						
3.5.1	Leachate Management Costs Subtotal	NA	NA	NA	$6,397	NA
4.0 Sum of Engineering, Construction, and Leachate Management Costs						
4.1	Sum of Engineering, Construction, and Leachate Management Cost Subtotals	NA	NA	NA	$125,717	NA
5.0 Contingency						
5.1	Contingency (10% of Sum of Engineering, Construction, and Leachate Management Cost Subtotals)	NA	NA	NA	$12,600	NA
6.0 Third Party Administration and Project Management Costs						
6.1	Third Party Administration and Project Management Costs (2.5% of Sum of Engineering, Construction, and Leachate Management Cost Subtotals)	NA	NA	NA	$3,458	NA
7. Total Post-Closure Cost						
7.1	Total Annual Post-Closure Cost (Sum of amounts in Sections 4, 5, and 6)	NA	NA	NA	$141,775	NA
7.2	30 Year Post-Closure Costs (Total Annual Post-Closure Cost x 30)	NA	NA	NA	$4,252,433	NA

[i] Sources of Unit Cost Estimates may include:
(1) Published Cost Estimator Manuals (e.g., RS Means);
(2) Third Party Quotes (e.g., Environmental Field Services Contractors); or
(3) Verifiable Data based on Actual Operations

[ii] Example Description for Item No. 1.1 – "Includes costs for site inspection performed at least annually for identification of areas experiencing settlement or subsidence, erosion or other drainage-related problems, inspection of the leachate collection system, gas monitoring system and LFG monitoring system."

APPENDIX IIIL-C

EXISTING FACILITY FINANCIAL ASSURANCE

STATE OF TEXAS
JASON E. EDWARDS
99336
LICENSED
PROFESSIONAL ENGINEER

05/20/2024

USI

USI Insurance Services
601 Union Street
Suite 1000
Seattle, WA 98101
www.usi.com
Tel: 206.441.6300

March 20, 2024

FedEx Priority Overnight

Austin Sparks
Republic Services
12920 FM 2767
Tyler, TX 75708
903-539-7986

RE: $ 8,369,798.00 Closure/Post Closure Bond
for Royal Oaks Landfill
for Pine Hill Farms Landfill TX, LP
Western Surety Company
Bond # 929520151

Please find enclosed increase Penalty Rider increasing the bond:
from $ 8,369,798.00 to $ 8,671,110.72 the effective date of change,
4/1/2024 has been used for the above captioned bond per your request.

You will need to send the enclosed original documents to the respective Obligee at your earliest convenience along with any other required paperwork.

Should you require further assistance or if you have any questions, please do not hesitate to contact us at 206-731-1200 or email us at [redacted]

Sincerely,

Amber

Amber Engel
Surety Department

INCREASE PENALTY RIDER

BOND AMOUNT $8,369,798.00 BOND NO. 929520151

To be attached and form a part of Bond No. 929520151, executed by Western Surety Company as surety, on behalf of Pine Hill Farms Landfill TX, LP as current principal of record, and in favor of Texas Commission on Environmental Quality, as Obligee for Closure Post Closure Royal Oaks LF, and in the amount of Eight Million Three Hundred Sixty Nine Thousand Seven Hundred Ninety Eight Dollars and 00/100 ($8,369,798.00).

In consideration of the agreed premium charged for this bond, it is understood and agreed that Western Surety Company hereby consents that effective from the 1st Day of April, 2024, said bond shall be amended as follows:

THE BOND PENALTY SHALL BE INCREASED:

FROM: Eight Million Three Hundred Sixty Nine Thousand Seven Hundred Ninety Eight Dollars and 00/100 ($8,369,798.00)

TO: Eight Million Six Hundred Seventy One Thousand One Hundred Ten Dollars and 72/100 ($8,671,110.72) Closure $6,067,364.04 / Post Closure $2,603,746.68

The INCREASE of said bond penalty shall be effective as of the 1st Day of April, 2024.

Signed, sealed and dated this 20th Day of March, 2024

Pine Hill Farms Landfill TX, LP
PRINCIPAL

BY ____________________
Calvin R. Boyd, TREASURER

Western Surety Company
SURETY

BY ____________________
Amber Engel, ATTORNEY-IN-FACT

Western Surety Company

POWER OF ATTORNEY APPOINTING INDIVIDUAL ATTORNEY-IN-FACT

Know All Men By These Presents, That WESTERN SURETY COMPANY, a South Dakota corporation, is a duly organized and existing corporation having its principal office in the City of Sioux Falls, and State of South Dakota, and that it does by virtue of the signature and seal herein affixed hereby make, constitute and appoint
Amber Engel , Individually
of Seattle, WA , its true and lawful Attorney(s)-in-Fact with full power and authority hereby conferred to sign, seal and execute for and on its behalf bonds, undertakings and other obligatory instruments of similar nature

- In Unlimited Amounts –

Surety Bond No: 929520151
Principal: Pine Hill Farms Landfill TX, LP
Obligee: Texas Commission on Environmental Quality

and to bind it thereby as fully and to the same extent as if such instruments were signed by a duly authorized officer of the corporation and all the acts of said Attorney, pursuant to the authority hereby given, are hereby ratified and confirmed.

This Power of Attorney is made and executed pursuant to and by authority of the Authorizing By-Laws and Resolutions printed at the bottom of this page, duly adopted, as indicated, by the shareholders of the corporation.

In Witness Whereof, WESTERN SURETY COMPANY has caused these presents to be signed by its Vice President and its corporate seal to be hereto affixed on this 10th day of January, 2024.

WESTERN SURETY COMPANY CORPORATE SEAL SOUTH DAKOTA

WESTERN SURETY COMPANY

Larry Kasten

Larry Kasten, Vice President

State of South Dakota } ss
County of Minnehaha

On this 10th day of January, 2024, before me personally came Larry Kasten, to me known, who, being by me duly sworn, did depose and say: that he resides in the City of Sioux Falls, State of South Dakota; that he is a Vice President of WESTERN SURETY COMPANY described in and which executed the above instrument; that he knows the seal of said corporation; that the seal affixed to the said instrument is such corporate seal; that it was so affixed pursuant to authority given by the Board of Directors of said corporation and that he signed his name thereto pursuant to like authority, and acknowledges same to be the act and deed of said corporation.

My commission expires

March 2, 2026

M. BENT
SEAL NOTARY PUBLIC SOUTH DAKOTA SEAL

M. Bent

M. Bent, Notary Public

CERTIFICATE

I, Paula Kolsrud, Assistant Secretary of WESTERN SURETY COMPANY do hereby certify that the Power of Attorney hereinabove set forth is still in force, and further certify that the By-Law and Resolutions of the corporation printed below this certificate are still in force. In testimony whereof I have hereunto subscribed my name and affixed the seal of the said corporation this 20th day of March , 2024.

WESTERN SURETY COMPANY CORPORATE SEAL SOUTH DAKOTA

WESTERN SURETY COMPANY

Paula Kolsrud

Paula Kolsrud, Assistant Secretary

Authorizing By-Laws and Resolutions

ADOPTED BY THE SHAREHOLDERS OF WESTERN SURETY COMPANY

This Power of Attorney is made and executed pursuant to and by authority of the following By-Law duly adopted by the shareholders of the Company.

Section 7. All bonds, policies, undertakings, Powers of Attorney, or other obligations of the corporation shall be executed in the corporate name of the Company by the President, Secretary, and Assistant Secretary, Treasurer, or any Vice President, or by such other officers as the Board of Directors may authorize. The President, any Vice President, Secretary, any Assistant Secretary, or the Treasurer may appoint Attorneys in Fact or agents who shall have authority to issue bonds, policies, or undertakings in the name of the Company. The corporate seal is not necessary for the validity of any bonds, policies, undertakings, Powers of Attorney or other obligations of the corporation. The signature of any such officer and the corporate seal may be printed by facsimile.

This Power of Attorney is signed by Larry Kasten, Vice President, who has been authorized pursuant to the above Bylaw to execute power of attorneys on behalf of Western Surety Company.

This Power of Attorney may be signed by digital signature and sealed by a digital or otherwise electronic-formatted corporate seal under and by the authority of the following Resolution adopted by the Board of Directors of the Company by unanimous written consent dated the 27th day of April, 2022:

"RESOLVED: That it is in the best interest of the Company to periodically ratify and confirm any corporate documents signed by digital signatures and to ratify and confirm the use of a digital or otherwise electronic-formatted corporate seal, each to be considered the act and deed of the Company."

Go to www.cnasurety.com > Owner / Obligee Services > Validate Bond Coverage, if you want to verify bond authenticity.

Form F4280-6-2023

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1614B

MAJOR PERMIT AMENDMENT

PART III – SITE DEVELOPMENT PLAN
APPENDIX IIIM
SITE LIFE CALCULATIONS

Prepared for

Pine Hill Farms Landfill TX, LP

May 2024

STATE OF TEXAS
JASON E. EDWARDS
99336
LICENSED
PROFESSIONAL ENGINEER
05/20/2024

Prepared by

Weaver Consultants Group, LLC
TPBE Registration No. F-3727
6420 Southwest Blvd., Suite 206
Fort Worth, TX 76109
817-735-9770

WCG Project No. 0120-076-11-106

This document is intended for permitting purposes only.

CONTENTS

1	**SITE LIFE**	**IIIM-1**
1.1	Solid Waste Generation	IIIM-1
1.2	Population Equivalent	IIIM-2
1.3	Landfill Capacity	IIIM-2
1.4	Site Life Calculations	IIIM-2

05/20/2024

1 SITE LIFE

1.1 Solid Waste Generation

The following estimate has been developed to provide an assessment of the solid waste generation rate for the Royal Oaks Landfill. It is important to note that the included estimate is based on numerous assumptions and may vary as market conditions change.

Over the last few years, the waste inflow rate at the Royal Oaks Landfill has varied from 384 tons per day to 515 tons per day as listed below.

Fiscal Year	Actual Waste Inflow[1]	Typical Daily Waste Inflow Rate Based on a 286-Day Operating Schedule
2019	109,883 tons per year	384 tons per day
2020	116,260 tons per year	407 tons per day
2021	128,527 tons per year	450 tons per day
2022	147,258 tons per year	515 tons per day

[1] Information obtained from the TCEQ MSW Annual Reports filed by the Royal Oaks Landfill.

The Royal Oaks Landfill estimates that the waste inflow will increase to 178,750 tons per year (625 tons per day based on a 286-day operating schedule) in 2022. The waste inflow rate is assumed to increase consistent with the projected growth rate for the facility's general service area which for this analysis is assumed to be Anderson, Cherokee, Van Zandt, Nacogdoches, Smith, and Henderson counties.

Using this methodology, the expected maximum annual waste acceptance rate is 210,782 tons per year (737 tons per day based on a 286-day operating schedule). The above projections are based on current market conditions and may vary as market conditions change. Over the life of the facility, the expected average daily volume of incoming waste is projected to be approximately 646 tons per day (184,756 tons per year based on a 286-day operating schedule).

Site life calculations based on the Royal Oaks Landfill projections are shown on pages IIIM-3 through IIIM-4.

1.2 Population Equivalent

Using the average waste inflow rate of 184,756 tons per year discussed in Section 1.1 (an average daily volume of 646 tons per day based on a 286-day operating schedule) and assuming 5 pounds of waste is generated per capita per day, the population equivalent is:

$$\frac{(184{,}756 \text{ tons/year}) \times (2{,}000 \text{ pounds/ton})}{(5 \text{ pounds/person/day}) \times (365 \text{ days/year})} = 202{,}472 \text{ persons}$$

1.3 Landfill Capacity

The estimated total capacity of waste (defined as waste and daily cover) ever on site over the active life of the facility is approximately 10.538 million cubic yards. The total volume available for solid waste and daily cover after November 10, 2022 (date of topographic information) is estimated to be 6,585,900 cubic yards. This airspace estimate includes the remaining available volume in the existing permitted area. The current volume of waste (defined as waste and daily cover) in-place as of November 10, 2022 is approximately 4.166 million cubic yards.

1.4 Site Life Calculations

The site life calculations are presented on pages IIIM-3 through IIIM-4. In summary, the site life is projected to be approximately 19.5 years, which would result in the site's closure during the year 2041.

Required: Determine approximate site life (years) for the site based on Royal Oaks Landfill's waste inflow projections. The site will typically operate 286 days per year.

Solution: Determine available landfill tonnage and initial annual waste inflow rate:

Remaining airspace (includes existing permitted site and expansion)=	6,585,900	cy	(as of November 10, 2022)
Percent daily cover =	14	%	
Projected density of waste/cover soils[1] =	1,431	lb/cy	

[1]Refer to page 3 for additional information regarding average in-place density of waste.

Estimate the total remaining airspace (tons).

-Estimate density of waste only

$(\gamma_{soil})(14\% \text{ of } 6{,}585{,}900 \text{ cy}) + (\gamma_{waste})(86\% \text{ of } 6{,}585{,}900 \text{ cy}) = (\gamma_{soil/waste})(6{,}585{,}900 \text{ cy})$

$(2{,}430 \text{ lb/cy})(922{,}026 \text{ cy}) + (\gamma_{waste})(5{,}663{,}874 \text{ cy}) = (1{,}431 \text{ lb/cy})(6{,}585{,}900 \text{ cy})$

$\gamma_{waste} =$ 1,268 lb/cy

Remaining available airspace = (86% of 5,763,634 cy)*(1268 lb/cy*1/2000 tons/lb)

Remaining available airspace = 3,591,950 tons

Total remaining capacity (includes existing permitted site and expansion) = 3,591,950 tons

Initial waste stream estimate =	625	tons/day
Days of operation per year =	286	days

Initial waste inflow rate = 178,750 tons/year

Assumed growth rates (based on population growth rates):

Growth rate (years 2021-2030)=	9.54%	or annualized growth rate of:	0.915%
Growth rate (years 2031-2040)=	8.49%	or annualized growth rate of:	0.818%
Growth rate (years 2041-2050)=	8.63%	or annualized growth rate of:	0.832%
Growth rate (years 2051-2060)=	10.50%	or annualized growth rate of:	1.004%
Growth rate (years 2061-2070)=	10.68%	or annualized growth rate of:	1.020%

The growth rate estimates were obtained from the Texas Water Development Board (County Population Projections for 2020-2070 from the 2022 Regional Water Plan). The initial waste stream estimate is based on site projections.

The following table calculates the waste stream growth (assuming the growth rates described above) and the projected cumulative airspace consumed.

	Year	Waste Inflow (tons/year)	Tonnage Consumed (tons)	
10-Nov	2022	178,750	24,976	51 days
	2023	180,386	205,362	
	2024	182,036	387,398	
	2025	183,702	571,100	
	2026	185,383	756,482	
	2027	187,079	943,561	
	2028	188,791	1,132,352	
	2029	190,518	1,322,870	
	2030	192,261	1,515,131	
	2031	193,835	1,708,966	
	2032	195,421	1,904,387	
	2033	197,020	2,101,407	
	2034	198,632	2,300,040	
	2035	200,258	2,500,297	
	2036	201,896	2,702,194	
	2037	203,549	2,905,742	
	2038	205,214	3,110,957	
	2039	206,894	3,317,850	
	2040	208,587	3,526,437	
	2041	65,513	3,591,950	114 days

Available tonnage is consumed during year	2041	
Site life is projected to be approximately	19.5	years

Initial inflow =	625	tons/day

Summary of waste tonnage information:

$$\text{Maximum inflow} = \frac{\text{Tonnage accepted during final year of operation (210,782 tons/year)}^{1}}{286 \text{ days of operation per year}}$$

[1] 210,782 tons/year represents the calculated total waste inflow rate for the final full year of 2041, the year in which the maximum waste inflow occurs.

Projected maximum waste inflow rate:

Maximum inflow =	737 tons/day

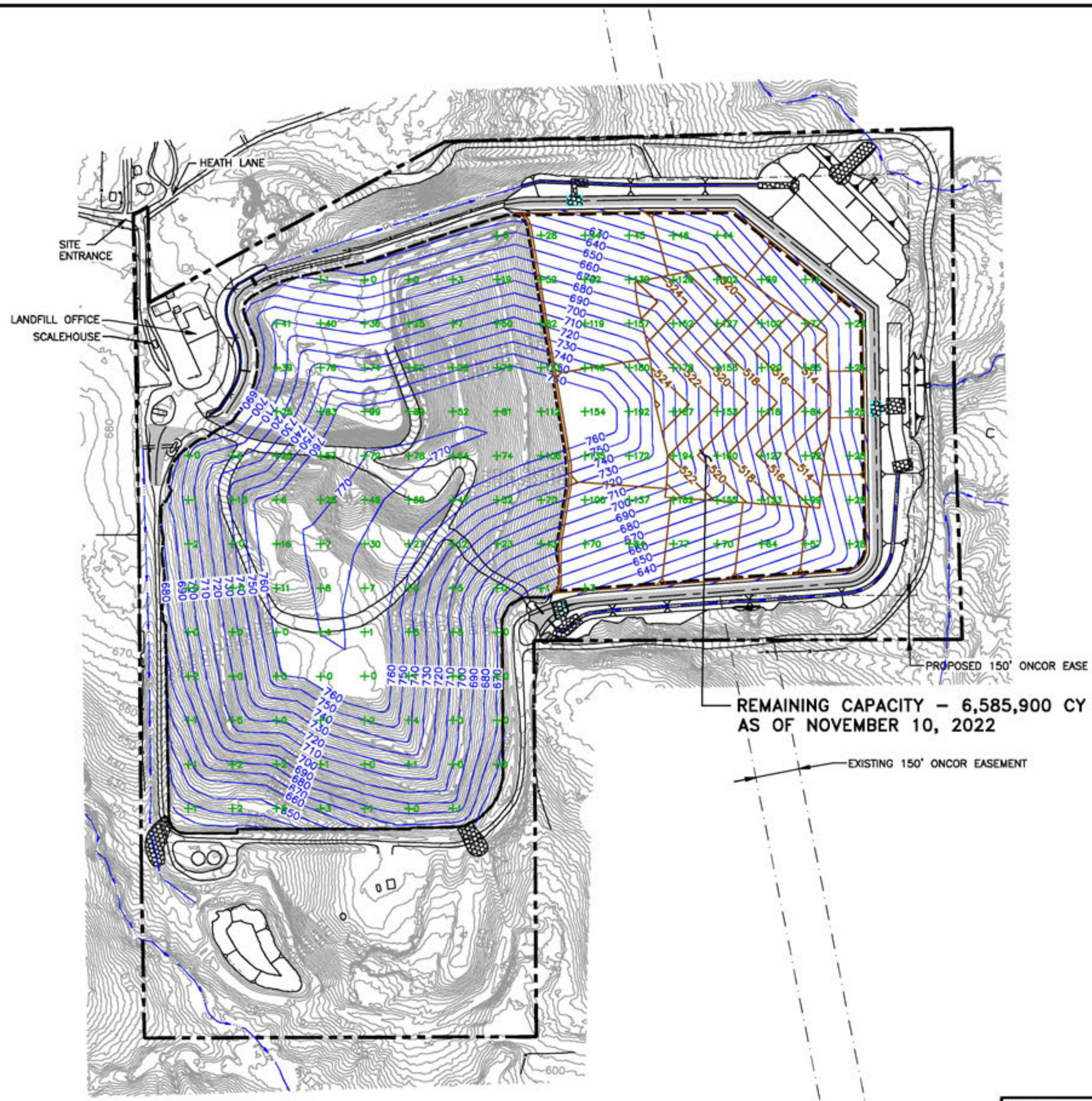
$$\text{Average inflow} = \frac{\text{Maximum waste accepted}}{\text{Site life}}$$

Projected average waste inflow rate:

$$\frac{3{,}591{,}950 \text{ tons}}{19.5 \text{ years} \quad * \quad 286 \text{ days/year}}$$

Average inflow =	646 tons/day

The above listed site life calculations are based on current market conditions and may vary based on waste stream, soil cover, actual tonnage received, or changing market conditions.



N

0 200 400
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- PERMITTED LIMIT OF WASTE
- PROPOSED LIMIT OF WASTE
- E 10500 SITE GRID
- 610 EXISTING CONTOUR (SEE NOTE 1)
- 440 FUTURE BOTTOM OF WASTE CONTOUR
- 650 TOP OF INTERMEDIATE COVER CONTOUR
- +97 DEPTH OF REMAINING FILL

NOTES:

1. EXISTING CONTOURS DEVELOPED BY FIRMATEK FROM AERIAL PHOTOGRAPHY FLOWN NOVEMBER 10, 2022.

STATE OF TEXAS
JASON E. EDWARDS
99336
LICENSED
PROFESSIONAL ENGINEER

05/20/2024

☐ DRAFT ☒ FOR PERMITTING PURPOSES ONLY ☐ ISSUED FOR CONSTRUCTION	PREPARED FOR PINE HILL FARMS LANDFILL TX, LP	MAJOR PERMIT AMNDMENT REMAINING CAPACITY
DATE: 05/2024 FILE: 0120-76-11 CAD: IIIM-REMAINING CAPACITY.DWG DRAWN BY: JDW DESIGN BY: BPY REVIEWED BY: JAE	REVISIONS NO. / DATE / DESCRIPTION	ROYAL OAKS LANDFILL CHEROKEE COUNTY, TEXAS
Weaver Consultants Group TBPE REGISTRATION NO. F-3727		WWW.WCGRP.COM / SHEET IIIM-5

O:\0120\76\EXPANSION 2023\PART III\IIIM\IIIM-5 REMAINING CAPACITY.dwg, byoung, 1:2

Required: Determine average density for the landfill between the bottom of waste and bottom of the final cover system.

Method:
1. Determine average thickness of waste throughout the landfill profile.
2. Determine the average density of the fill between the bottom of waste and the bottom of final cover.

References:
1. Acar, Yalcin B.& Daniel, David E., *Geoenvironment 2000 Characterization, Containment, Remediation, and Performance in Environmental Geotechnics,* Volume 2, American Society of Civil Engineers, 1995.

List of Symbols

$D_{avg.}$ = Average Density, lb/yd^3

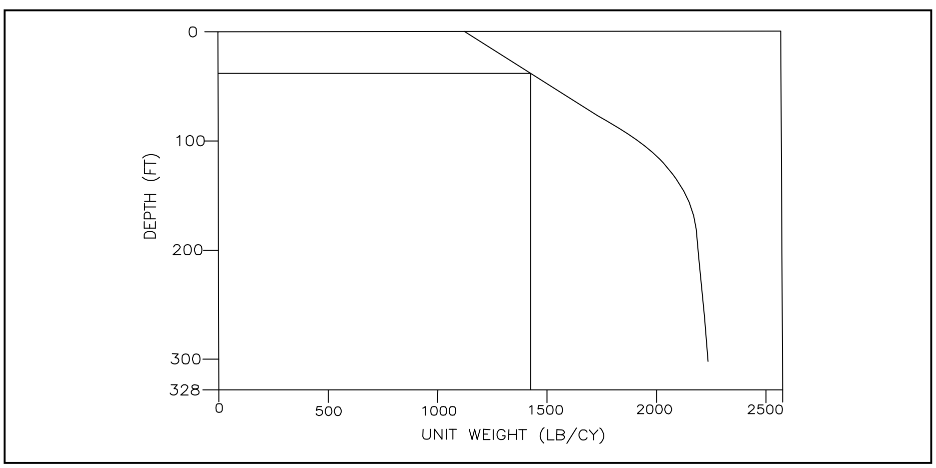
Procedure:
1. Determine average thickness of waste throughout the landfill profile.

   It was determined that the average thickness of waste over the entire site is 75 feet.

   The average density is calculated from the midpoint of the average depth (38 feet) to determine the average density.

2. Determine the average density of the fill using the Unit Weight Profile for MSW graph shown below. The density estimate is obtained using the midpoint of the average depth.

UNIT WEIGHT PROFILE FOR WASTE/DAILY COVER WITHIN A MSW LANDFILL [1]

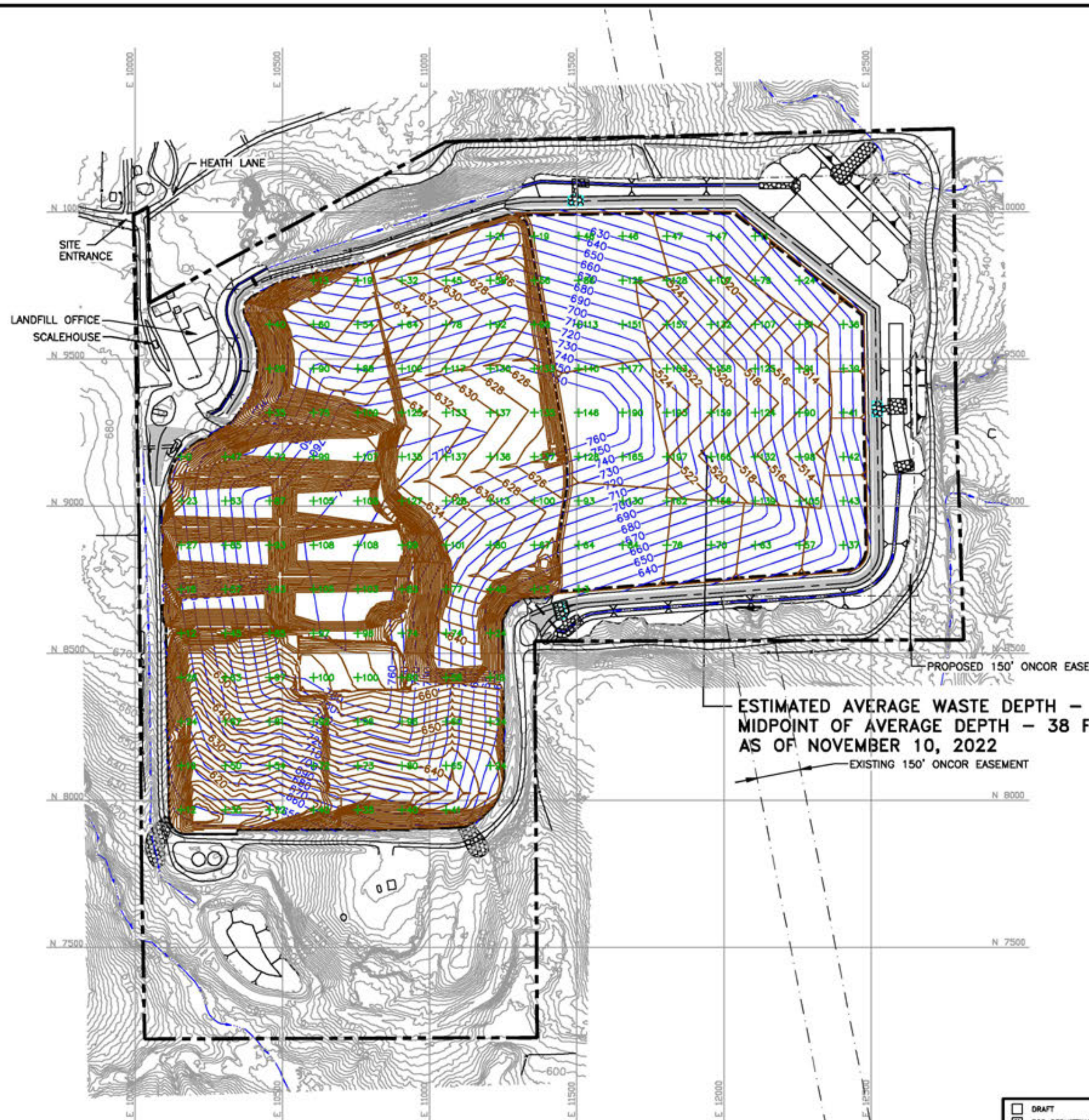


[1] Graph derived from Reference 1

Midpoint of Average Depth = 38 feet

The average density is calculated at the midpoint of the average depth (38 feet) to represent the average density of waste/cover soil within the landfill.

$\boxed{D_{avg.} = 1{,}431 \text{ lb/yd}^3}$



0 200 400
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- PERMITTED LIMIT OF WASTE
- PROPOSED LIMIT OF WASTE
- E 10500 — SITE GRID
- 610 — EXISTING CONTOUR (SEE NOTE 1)
- 440 — BOTTOM OF WASTE CONTOUR
- 650 — TOP OF INTERMEDIATE COVER CONTOUR
- +97 DEPTH OF REMAINING FILL

NOTES:

1. EXISTING CONTOURS DEVELOPED BY FIRMATEK FROM AERIAL PHOTOGRAPHY FLOWN NOVEMBER 10, 2022.
2. TOP OF PRE-SUBTITLE D LINER AREAS ARE APPROXIMATE AND WERE REPRODUCED FROM CROSS-SECTIONS INCLUDED IN THE 1983 PERMIT APPLICATION PREPARED BY STOKES & ASSOCIATES.

STATE OF TEXAS
JASON E. EDWARDS
99336
LICENSED
PROFESSIONAL ENGINEER

05/20/2024

☐ DRAFT ☒ FOR PERMITTING PURPOSES ONLY ☐ ISSUED FOR CONSTRUCTION	PREPARED FOR PINE HILL FARMS LANDFILL TX, LP		MAJOR PERMIT AMNDMENT AVERAGE WASTE DEPTH
DATE: 05/2024 FILE: 0120-76-11 CAD: IIIM-7 DEPTH OF FILL.DWG	DRAWN BY: JDW DESIGN BY: BPY REVIEWED BY: JAE	REVISIONS NO. | DATE | DESCRIPTION	ROYAL OAKS LANDFILL CHEROKEE COUNTY, TEXAS
Weaver Consultants Group TBPE REGISTRATION NO. F-3727			WWW.WCGRP.COM | SHEET IIIM-7

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ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1614B

MAJOR PERMIT AMENDMENT APPLICATION

PART IV – SITE OPERATING PLAN

Prepared for

Pine Hill Farms Landfill TX, LP

May 2024

Prepared by

05/20/2024

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This document is intended for permitting purposes only.

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LIST OF ACRONYMS

ADC – Alternative Daily Cover

ADCOP – Alternative Daily Cover Operating Plan

CFR – Code of Federal Regulations

DOT – Department of Transportation

EPA – U.S. Environmental Protection Agency

FWS – U.S. Fish and Wildlife Service

GCCS – Gas Collection and Control System

GLER – geomembrane liner evaluation report

LCS – leachate collection system

LFG – landfill gas

msl – mean sea level

MSW – Municipal Solid Waste

Non-RACM – nonregulated asbestos-containing material

OSHA – Occupational Health and Safety Administration

PCBs – polychlorinated biphenyls

RACM – regulated asbestos-containing material

RCRA – Resource Conservation Recovery Act

SDP – site development plan

SDS – Safety Data Sheets

LIST OF ACRONYMS (Continued)

SLER – soils and liner evaluation report

SPCC – Spill Prevention Control and Countermeasure

SOP – Site Operating Plan

SWP3 – Stormwater Pollution Prevention Plan

TAC – Texas Administrative Code

TCEQ – Texas Commission on Environmental Quality

TxDOT – Texas Department of Transportation

WWTP – wastewater treatment plant

1 INTRODUCTION

This Site Operating Plan (SOP) has been prepared for the Royal Oaks Landfill consistent with Title 30 TAC §330.65. The purpose of this SOP is to provide guidance to site management and operating personnel to meet the general and site-specific requirements of §330, Subchapters D and E. This document also provides a guide for site management to maintain the facility in compliance with the engineering design and applicable regulatory requirements of the TCEQ. The plan may also serve as a reference source and assist in personnel training. This SOP, the permit, and the current TCEQ regulations will be kept onsite throughout the facility's operating life.

Consistent with §330.127(3), the operating procedures and instructions outlined in this SOP will be followed and will be considered a part of the operating record of the facility. Landfill operations will be conducted in a professional manner by trained and qualified personnel who will be responsible for placement of waste in approved disposal cells utilizing equipment and procedures and standard industry practices to ensure protection of operating personnel, human health, and the environment.

Wherever the term “executive director” or “TCEQ” is used in this SOP, these terms shall refer to the executive director of the TCEQ or the designated representative of the TCEQ. References to information in the permit or permit application for this facility shall refer to the most current version of these documents, including any later approved amendments, modifications, or revisions.

If any questions arise regarding this SOP, Royal Oaks Landfill personnel should consult with:

1. Texas Commission on Environmental Quality
   Municipal Solid Waste Section
   Austin, Texas
   Telephone: (512) 239-2335

2. Texas Commission on Environmental Quality, Region 5
   Tyler, Texas
   Telephone: (903) 535-5100

3. Texas General Land Office
   Spill Reporting Telephone: 1-800-832-8224

2 PERSONNEL AND TRAINING

2.1 Personnel

This section lists the personnel involved with the operation of the Royal Oaks Landfill. The Pine Hill Farms Landfill TX, LP Management Team and Site Personnel are listed on the organizational chart shown on Figure 2.1. The following subsections describe the personnel involved with operating the Royal Oaks Landfill. In addition, a summary table noting the various site personnel and training requirements listed in the following section is provided in Table 2.1.

2.1.1 Royal Oaks Landfill Management Team

Pine Hill Farms Landfill TX, LP is the permittee and site operator of the Royal Oaks Landfill facility and is responsible for overall operation of the facility. Pine Hill Farms Landfill TX, LP is the contract operator of the landfill. Pine Hill Farms Landfill TX, LP is an indirect, wholly owned subsidiary of Republic Services (Republic).

Republic's South Area President has ultimate management and oversight responsibilities for all Republic Services, Inc. hauling and disposal operations within the South Area (which includes Texas). The Area President's responsibilities include staff management, financial planning, as well as other management responsibilities. The Area President reports to the Executive Vice President of Operations. The General Manager is responsible for operations oversight at several landfills in the area including the Royal Oaks Landfill. The General Manager reports to the Area Vice President. Other corporate resources that are available to the Royal Oaks Landfill management team are discussed in Section 2.1.9.

2.1.2 Operations Manager/Site Manager

The Operations Manager (also known as Site Manager) is responsible for daily operations, administers the facility's SDP, SOP, and will also serve as the Emergency Coordinator. This person is responsible for assuring that adequate personnel and equipment are available to provide facility operation in accordance with this SOP, the SDP, TCEQ regulations, and other applicable local, state or federal regulations. The Operations Manager will also be trained to implement the requirements listed in the site's SWP3 and SPCC plans. The Operations Manager will maintain an adequate level of competency, training and experience to fulfill these duties. The

Operations Manager reports directly to the General Manager. The Operations Manager will designate individual(s) to fulfill his duties during periods when the Operations Manager is unavailable. This individual will have the same qualifications and training as the Operations Manager (except that a Class A license is not required). Wherever this SOP provides that responsibility or authority is assigned to the Operations Manager, this responsibility or authority may be automatically transferred to the individual(s) so designated by the Operations Manager for this duty. The designated individual will have a minimum of 6 months of landfill operation experience or 6 months of on-the-job training by the Operations Manager or General Manager. All onsite employees, which may include Scale Operators, Equipment Operators, Mechanics, Spotters, and Laborers, are under the supervision of the Operations Manager or his designee. The Operations Manager is responsible for hiring and terminating personnel in these positions.

The Operations Manager must hold a Class A License and will meet the requirements of Title 30 TAC §30.210 related to Class A licensure experience. The Operations Manager must be familiar with the specific operating procedures set forth in this plan and will participate in training with other employees. The Operations Manager or his designee is also responsible for routine site inspections as described herein.

The Operations Manager’s responsibilities include the following:

1. Directing site personnel including Laborers, Spotters, Equipment Operators, Scale Operators, and Mechanics in the performance of tasks necessary for daily site operations.
2. Identifying any additional equipment or personnel necessary for normal operations in the event of equipment breakdowns, changes in waste volumes accepted, or other circumstances.
3. Performing inspections and completing inspection forms and checklists. The Operations Manager may delegate this responsibility to other staff.
4. Monitoring and evaluating the performance of employees with respect to assigned duties and compliance with regulatory requirements.
5. Anticipating changes to the operating practices necessary due to changes in the weather, disposal location, or other conditions affecting site operations.
6. Ensuring that inspections and monitoring (e.g., leachate collection system, GCCS, perimeter LFG monitoring, and groundwater monitoring) are completed on schedule and in accordance with all requirements.
7. Monitoring and abating any nuisance conditions, such as litter, odor, dust, and mud tracking.

2.1.3 Scale Operators

The primary job of the Scale Operators, stationed near the site entrance, is to maintain complete and accurate records of vehicles and solid waste entering the facility. The Scale Operator will be trained in site safety procedures, to visually check for unauthorized wastes, to weigh vehicles, collect waste disposal fees, and direct vehicles to the unloading areas. The Scale Operator reports to the Operations Manager or his designee. Specifically, Scale Operators are required to: (1) monitor the incoming vehicles for type of waste and exclude prohibited waste; (2) inspect waste loads to confirm that they are authorized for disposal; (3) review manifests and other shipping documents; (4) record incoming waste loads; (5) review and confirm special waste documents; and (6) accept tipping fees. Scale Operators should direct visitors to their destination within the facility.

Scale Operators receive training with respect to special waste evaluation and acceptance. Any questions regarding acceptance of special waste are to be addressed to the Operations Manager or his designee, the Special Waste Department, or the Special Waste Analyst.

The minimum qualifications for the scale operators are being able to fulfill the duties described in this section. Scale operators will also complete an on-the-job training program administered by the Operations Manager or other qualified personnel.

2.1.4 Equipment Operators

The Equipment Operators report to the Operations Manager or his designee. Equipment Operators are responsible for the safe operation of the equipment. Equipment Operators monitor and direct unloading vehicles and can also be responsible for maintenance, construction, litter abatement, and general site cleanup. Equipment Operators are also responsible for identifying prohibited wastes as discussed in Section 4.2. The Equipment Operators will intervene when necessary to prevent accidents. Equipment Operators will also report any operational problems to the Operations Manager or his designee. Equipment Operators that are hired based on previous heavy equipment experience may be assigned to operate specific types of equipment without additional training. Upon their employment, all Equipment Operators without experience in the equipment assigned will receive on-the-job training and oversight from an experienced operator until the new operator becomes proficient on the piece(s) of equipment to which he has been assigned, or until he is reassigned to a different piece of equipment for which his previous training or experience is adequate. Equipment Operators may also be required to assist in bird control activities under the supervision of the Operations Manager or his designee.

All Equipment Operators are required to wear safety equipment, as appropriate, for their work assignments.

The minimum qualifications for the equipment operators are being able to fulfill the duties described in this section. In addition, the equipment operators will have a minimum of 6 months of equipment operation experience or complete a 90-day on-the-job training program administered by a supervisor.

2.1.5 Spotters and Laborers

Spotters and Laborers will be assigned to collect litter, direct waste vehicles at the working face, and perform other tasks. Spotters and Laborers are also responsible for identifying prohibited wastes as discussed in Section 4.2. Spotters and Laborers will either be Royal Oaks Landfill employees or contract employees or a combination of both. Laborers may also be required to assist in bird control activities under the supervision of the Operations Manager or his designee.

Spotters and Laborers will be required to wear safety equipment, as appropriate for their work. Contract employee oversight will be by a Royal Oaks Landfill employee. Spotters and Laborers report to the Operations Manager or his designee.

The minimum qualifications for the spotters and laborers are being able to fulfill the duties described in this section. Spotters and laborers will also complete on-the-job training.

2.1.6 Mechanics

Mechanics perform necessary and routine maintenance on equipment. Mechanics may substitute as Equipment Operators, if needed, provided they have received the required training. Mechanics report to the Operations Manager or his designee. The minimum qualifications for the mechanics are being able to fulfill the duties described in this section (i.e., Section 2.1.6). Mechanics will also complete on-the-job training. The site may also use third party mechanics to perform maintenance on the equipment.

2.1.7 Other Site Personnel

Other Site Personnel or Laborers may be employed from time to time in categories such as maintenance, construction, litter abatement, and general site cleanup. Other Site Personnel and Laborers report to the Operations Manager or his designee. The Operations Manager or his designee will verify that "other site personnel" employed at the site receive training that is consistent with their job description. The Operations Manager or his designee will utilize Table 2.1 as a guide to assigning the training requirements for "other site personnel." Also, additional personnel will be utilized in the event of a temporary waste inflow increase due to a large special event project.

2.1.8 Special Waste Department and Special Waste Analyst

The Special Waste Department will provide review and approval for special waste requests received at the site. The Special Waste Analyst shall have experience performing the duties described above, as well as the completion of on-the-job training.

2.1.9 Other Corporate Resources

Pine Hill Farms Landfill TX, LP possesses additional solid waste management and operational resources, including consulting and management resources which are available to site personnel, if needed. The Operations Manager or General Manager can contact appropriate personnel to provide additional assistance at any time.

The Safety Manager and the Environmental Manager support the General Manager and Operations Manager. The Environmental Manager is responsible for environmental compliance, engineering, and construction issues as well as verifying that the site is developed consistent with the SDP.

2.2 Training

The Operations Manager and the Royal Oaks Landfill management team will train the Equipment Operators, Scale Operators, Mechanics, Laborers, and Spotters in the contents of this SOP, as applicable. Royal Oaks Landfill personnel will be trained pursuant to any applicable TCEQ regulations regarding training of MSW facility personnel. Site personnel will receive training in safety procedures, contingency plans, and the requirements of the permit for this facility, as applicable. Site training and safety meetings will be scheduled at least once per month. If a regular monthly scheduled meeting is canceled, it will be rescheduled or combined with the scheduled training in the following month. Site personnel shall be scheduled for attendance at training sessions to allow site operations to continue during training sessions. Although training topics for each month may vary, training shall be conducted at least annually for each of the following topics:

- Load inspection procedures
- Detection and control of hazardous wastes, PCB wastes, and other prohibited wastes
- Emergency response
- Procedures for using, inspecting, repairing, and replacing facility emergency and monitoring equipment, communications or alarm systems
- Health and safety

- Fire safety (e.g., fire extinguisher use, fire protection, fire prevention, and evacuation procedures)
- Litter control and windblown waste pick-up
- Properties of methane gas and safety procedures for methane gas
- Response to groundwater contamination incidents (i.e., compliance with SPCC Plan)
- Identification of protected, threatened, and endangered species (refer to Section 4.14)
- Shutdown of operations (i.e., end of day closure procedures)
- Communications or alarm systems

At a minimum, facility personnel will be trained in the procedures noted above (as applicable); also refer to Table 2.1 for required training topics within 6 months of the effective date of their initial employment or promotion to a new position.

In addition to the above, staff conducting random inspection procedures specified in this SOP will receive training on all aspects of the completion of random inspections and instruction on the identification of all special and prohibited wastes. Staff conducting random inspection procedures will maintain a thorough understanding of the SOP and will be trained in the following areas: (1) customer notification and load inspection procedures, (2) identification of regulated hazardous, PCB, and prohibited waste, (3) waste-handling procedures, (4) health and safety, and (5) recordkeeping. These personnel will have knowledge of barrel types, possible types of liquids, and company names on trucks that could be industrial or hazardous waste generators or generators of other unauthorized waste. In addition, key on-site personnel may attend the approved TCEQ waste screening course or other TCEQ approved course.

Records of training procedures, topics covered, and personnel attending will be placed in the Site Operating Record. Records will include a written description of the type and amount of both introductory and continuing training that is provided to each employee. Records will also note that an annual review of the training that is provided will be completed. Selected equipment operators, and other personnel may also receive training at TCEQ-sponsored or other appropriate training courses, as deemed appropriate by the Operations Manager or his designee or General Manager.

Site personnel will successfully complete training within 6 months after the date of their employment or assignment to the facility or to a new position at the facility. In addition, site personnel will not work in unsupervised positions until they have completed these training requirements.

Figure 2.1
Pine Hill Farms Landfill TX, LP
Organization Chart

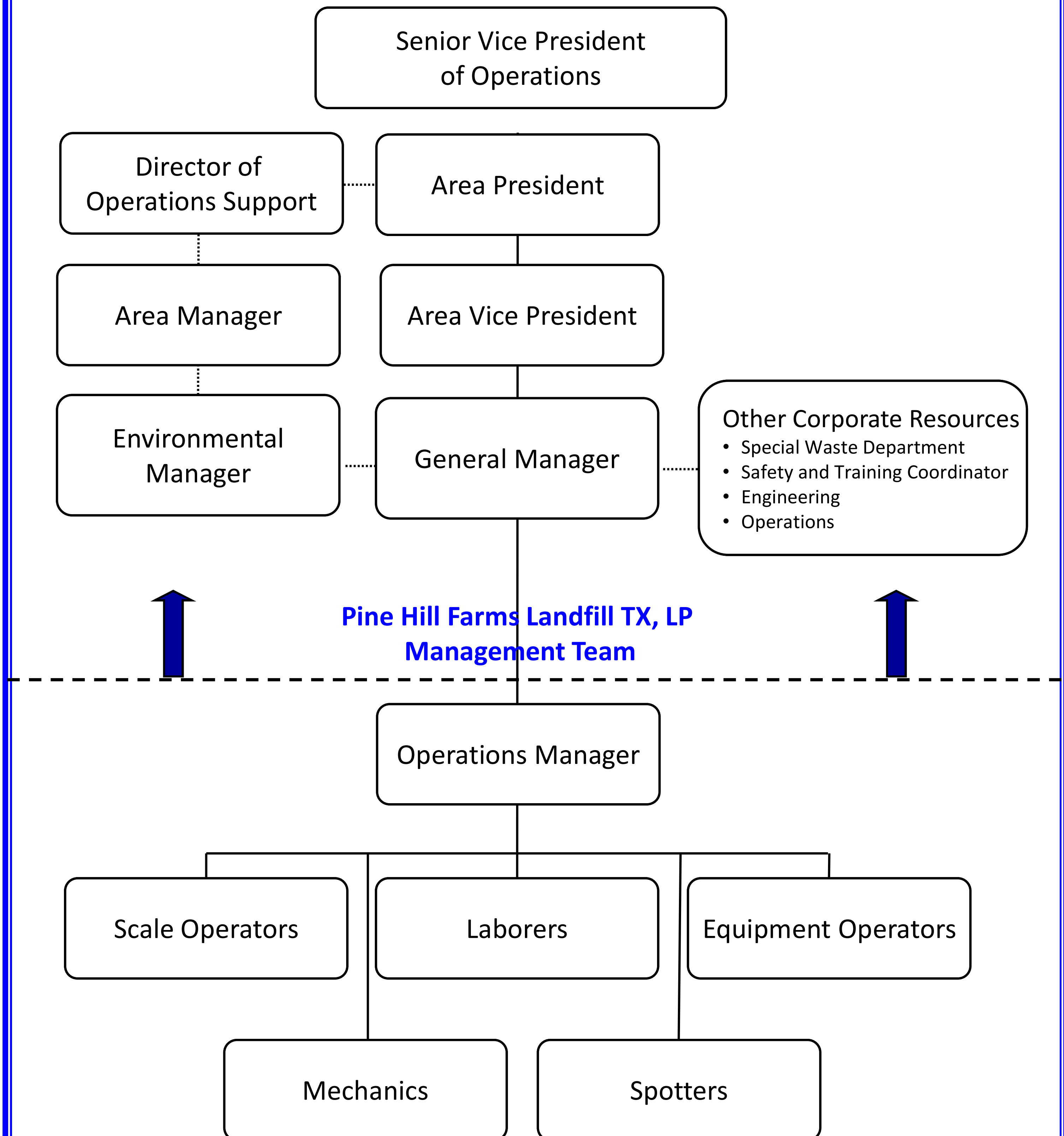

Table 2.1
Site Personnel and Training Summary

Position	Minimum Qualifications	Job Description	Required Training Topics												
			Site Orientation	Site Operations	Endangered Species	Prohibited Waste Identification	Safety	Fire Prevention	Load Inspection	SPCC	Emergency Response	Landfill License	Litter Control	Random Inspections	SWPPP
Operations Manager	Class A License	Refer to Section 2.1.2	X	X	X	X	X	X	X	X	X	A	X	X	X
Scale House Operators	The minimum qualifications for the Scale House Operators are being able to fulfill the duties described in Section 2.1.3, as well as a high school diploma or equivalent and the completion of a on-the-job training program (refer to Section 2.1.3 for more information).	Refer to Section 2.1.3	X			X	X	X	X		X			X	
Equipment Operators	The minimum qualifications for the Equipment Operators are being able to fulfill the duties described in Section 2.1.4, as well as a minimum of 6 months of experience or the completion of a 90-day on-the-job training program.	Refer to Section 2.1.4	X			X	X	X	X	X	X		X	X	X
Spotters and Laborers[1]	The minimum qualifications for the Spotters and Laborers are being able to fulfill the duties described in Section 2.1.5, as well as the completion of an on-the-job training program.	Refer to Section 2.1.5	X			X	X	X	X		X		X	X	X
Mechanics	The minimum qualifications for the Mechanics are being able to fulfill the duties described in Section 2.1.6, as well as the completion of an on-the-job training program.	Refer to Section 2.1.6	X				X	X		X					X
Special Waste Analyst[2]	The Special Waste Analyst shall have experience performing the duties described in Section 2.1.8. In addition, personnel filling these positions will complete an on-the-job training program.	Refer to Section 2.1.8	X			X			X					X	

[1]Laborers that are only hired to collect windblown waste will only be required to receive training for the following items: Site Orientation, Safety, and Litter Control.
[2]The special waste analyst may not be located at the site. This individual may be located in another facility or office.

3 EQUIPMENT

Sufficient quantity and quality of equipment will be provided onsite at the Royal Oaks Landfill to conduct site operations in accordance with the volume of waste accepted at the facility, design requirements and permit conditions.

The equipment listed in Table 3.1 will be available for use at the facility. Equipment requirements may vary in accordance with the method of landfill operations or the waste acceptance rate at any given time. Additional equipment will be provided by Royal Oaks Landfill as required for increasing volumes of incoming solid waste. Other similar types of equipment by other manufacturers may be substituted on an as-needed basis, at the discretion of the Operations Manager or General Manager. The equipment and scale house will be equipped with fire extinguishers. Backup equipment will be made available to Royal Oaks Landfill on an as needed basis from other area Republic landfills or other sources. The backup equipment will be equivalent to the equipment requirements listed in Table 3.1.

Table 3.1
Equipment Dedicated to the Royal Oaks Landfill

Equipment[9]	Minimum Number of Equipment Needed for Each Range of Waste Volume[1,6, 8, 10]					Typical Size[1]	Function
	0 | 40 Tons/ Day[4, 10]	40 | 1,500 Tons/Day[4]	1,500 | 3,000 Tons/Day[4]	3,000 | 6,000 Tons/Day[4]	6,000 | 10,000 Tons/Day[4]		
Compactor(s)	0	1	1	2	3	70,000 lbs	Trash compaction
Dozer(s)	1	1	1	1	2	140 hp or 35,000 lbs	Movement and placement of refuse and soil. May also be used to assist with waste compaction.
Articulated Dump Truck(s)[5]	0	1	1	2	3	Up to 40 tons	Excavation and Hauling of soil and fire fighting support
Excavator	0	1	1	1	1	10 foot reach	Excavation of soil, fire fighting support
Motorgrader	0	1	1	1	1	50 hp	Maintenance of interior roads
Pickup Truck(s)	0	1	1	1	1	¼ ton	Personnel use for litter control, maintenance
Water Truck(s)	0	1	1	2	3	2,000 gallons (minimum)	Dust control, compaction of earth fills, fire fighting support
Maintenance Truck(s)[2]	0	1	1	1	1	¼ ton	Equipment maintenance
Pumps with Hose	1	1	1	1	1	2” to 6” diameter pump	Pumping of stormwater
ADC Equipment	0	1	1	1	1	Varies	Application of ADC
Light Plant[3]	0	1	1	1	1	2 – 250 watt fixtures	Adequate lighting at active face
Wind Screens	0	6	8	10	15	8’x8’	Working face litter control

1 Number, types, and equipment manufacturers will vary based on operational needs.
2 As an alternative, the site may contract equipment maintenance with a third party. Under this scenario, maintenance equipment would only be on-site, when needed.
3 Only needed if site operates during low or no natural light conditions.
4 The waste volume will be determined by the sum of waste acceptance listed on the previous four TCEQ quarterly summary reports (as required by 30 TAC 330.125(h)).
5 As an alternate or in conjunction with the articulated dump truck and excavator, a scraper may also be used for excavation and hauling of soil. One scraper will be equivalent to one articulated dump truck and excavator.
6 If a second working face is in operation, the equipment requirements for the working face will match the waste volume that is disposed of at the other working face. However, other than the compactor or dozer, most of the equipment may be shared between working face (e.g., motor grader, pickup truck, water truck, maintenance truck, etc.)
7 The site may contract with a third party for street sweepers.
8 When the site accepts less than 40 tons/day, only a dozer will typically be needed to handle this low volume of waste. Other equipment needed to maintain the site will be utilized from other Republic Services landfills.
9 Limited equipment is needed for the Citizens Convenience Center. Roll-off containers will be emptied by using collection vehicles in the Citizens Convenience Center.
10 When in operation, typical equipment for the liquid waste bulking facility will include an excavator, wheel loader, and articulated dump truck.

Compactors will be used for spreading and compacting the refuse. An excavator and hauling trucks (or scraper) will be used for various purposes at the Royal Oaks Landfill, including excavating of the cover material used in the site operations and in fire fighting support (refer to Section 7 – Fire Protection Plan for additional information). The dozer is mainly used to spread waste at the active face, spread cover material, and assist with waste compaction. The motorgrader will be used for activities such as road maintenance, ditch construction, surface water control, and final grading of the completed fill areas. The water truck(s) will be used for dust control and moisture conditioning of soil materials, when necessary, and will be utilized, if necessary, in the event of a fire at the facility. The water trucks will be equipped with appropriate equipment to facilitate fire fighting. The windscreens and temporary litter fencing will be used to control windblown waste and litter as discussed in Section 4.5. The maintenance truck is used to provide service to the other site operating vehicles. In addition to the above, miscellaneous pick-ups, vans, and other light utility vehicles as well as instruments and safety and training equipment will be on-site to assist with site operations.

For information relating to methane monitoring at the Royal Oaks Landfill, see the Landfill Gas Management Plan (Appendix III I). For information relating to leachate monitoring, and the control of contaminated water, see the Leachate and Contaminated Water Management Plan (Appendix IIIC). Equipment needed for the application of ADC is discussed in Appendix IVB. Other miscellaneous equipment will be required for the maintenance of the machinery and other duties. This equipment will be kept onsite and will include an air compressor, power equipment, and tools.

4 OPERATIONAL PROCEDURES

4.1 Access Control

Public access to the waste fill area is controlled by the entrance facilities, which houses the Scale Operators, located in the northwestern portion of the facility. The site entrance facilities are staffed during hours of operation. The Scale Operators control access and monitor all vehicles entering and exiting the site.

4.1.1 Site Security

Site security measures are designed to prevent unauthorized persons from entering the site, to protect the facility and its equipment from possible damage caused by trespassers, and to prevent disruption of facility operations caused by unauthorized site entry.

Unauthorized access to the site is minimized by controlling access with perimeter fencing (minimum 4-foot-high, three-strand barbed wire fences), gated entrance, and natural barriers (e.g., existing trees and dense foliage). The access control plan is provided to prevent the entry of livestock, to protect the public from exposure to potential health and safety hazards, and to discourage unauthorized entry or uncontrolled disposal of solid waste or hazardous materials. Access control for the southern portion of the site will continue to be controlled by natural barriers, such as the existing vegetation and dense foliage. If the effectiveness of these natural barriers diminishes at any point during the life of the site (e.g., a storm affects the quality and quantity of existing trees and foliage), then the natural barriers will be replaced with additional fencing. Additionally, in areas of natural barriers, “no trespassing” signs will be added to discourage unauthorized entry or uncontrolled disposal of solid waste or hazardous materials. Access controls (fencing, gates, natural barriers) will be inspected weekly and documented in the Site Operating Record.

In the event of a breach of the access controls (e.g., a portion of a fence is impacted in a way that it no longer prevents access to the site), the TCEQ Regional Office and any local pollution agency with jurisdiction that has requested to be notified will be notified within 24 hours of detection of the breach. The breached area will be temporarily repaired within 24 hours of detection and will be permanently repaired by the time specified to the TCEQ Regional Office when it was reported in the initial breach report. In this case, the TCEQ Regional Office will also be notified when the permanent repair is completed. If a permanent repair can be made within 8 hours of detection, no notification to the TCEQ Regional Office is required. Temporary repairs may consist of a barbed wire fence, a 3-foot-high earthen berm, equipment, a security guard posted in the area of the breach or other barriers.

Entry to the active portion of the site will be restricted to designated personnel, approved waste haulers, and properly identified persons whose entry is authorized by Royal Oaks Landfill management. Visitors will be allowed on the active area only when accompanied by a site representative (note that third party contractors and vendors completing construction, maintenance, or monitoring activities will not be considered visitors for the purpose of access control).

4.1.2 Traffic Control

Access to the landfill site is provided by U.S. Highway 69 and Heath Lane. Scale Operators will restrict site access only to authorized vehicles and will direct these vehicles appropriately.

Solid waste transportation vehicles will be directed to appropriate unloading areas by signs located along the landfill access road. These vehicles will deposit their loads and depart the site. No private or commercial solid waste vehicles will be allowed access to any areas other than the active portion of the landfill. Site personnel will provide traffic directions when necessary to facilitate safe movement of vehicles.

Within the site, signs will be placed along the landfill access road, beginning at the gated entrance, at a frequency adequate for users to be able to understand where disposal areas are located and which roads are to be used for ingress and egress.

4.2 Unloading Wastes

4.2.1 Unloading Areas

The Royal Oaks Landfill accepts general municipal solid wastes as well as brush, rubbish, construction/demolition waste, and certain special wastes outlined in Section 4.20 of this SOP (refer to Parts I/II, Section 2.1.1 – Waste Acceptance Plan for a complete description of waste accepted for disposal at the facility). Wastes are disposed of or processed at the following four types of unloading areas at the Royal Oaks Landfill.

- Unloading Area or Working Face. The vast majority of all wastes accepted at this facility are disposed of at the working face. The working face includes areas where waste has been deposited for disposal but has not been covered with soil.

- RACM Unloading and Disposal Area. The RACM unloading area will be designated by the operations manager as noted in Section 4.20.5.
- Citizens Convenience Center. This unloading area is used by the general public (i.e., small-vehicle landfill customers) to dispose of their waste in an area separate from the MSW working face. This improves site safety by reducing traffic at the MSW working face. The Citizens Convenience Center is located over an impervious area. Citizens will be directed to the Convenience Center by site personnel at the entrance facility. Signs will be posted to assist citizens traveling to the Convenience Center. Waste material is offloaded from the small-vehicles to roll-off containers. The size of the roll-off containers will range between 20 and 40 cubic yards. The site then hauls the roll-off containers periodically to the MSW working face for disposal. The Citizens Convenience Center will not accept sharps. The maximum amount of waste stored at the Convenience Center is 200 cubic yards. The roll-off containers will be emptied at least at the end of each day the site is open or more frequently if needed. Storage for recycling may also occur in this area.
- Liquid Waste Bulking Facility. The liquid waste bulking facility area will accept liquid wastes as outlined in Appendix IVD.

4.2.2 Waste Excluded from Disposal at the Site

The following wastes are specifically excluded from disposal at the site:

- Liquid wastes that do not pass the paint filter test, except as allowed under Section 4.20.1 of this SOP
- Waste classified as hazardous by the TCEQ (refer to Section 6 for more information)
- Grease trap wastes, except as allowed under Section 4.20.1 of this SOP
- Waste prohibited by the TCEQ (see 30 TAC §330.15(e)) and unauthorized wastes (prohibited waste and unauthorized waste are used interchangeably)

4.2.3 Waste Unloading Procedures

Scale Operators, Equipment Operators, Laborers, and Spotters will monitor the incoming waste. Scale Operators control site access and monitor incoming vehicles for unauthorized or prohibited wastes by (1) receiving manifests and other shipping documents, (2) recording incoming waste loads, and (3) interviewing the driver, if necessary. Any nonconforming issues will be reported to the Operations Manager or his designee. If the non-conforming issues involve Special or Industrial wastes, the Operations Manager or his designee will review Sections 4.20 and 6.2 of the SOP to verify that all requirements for acceptance of Special and Industrial waste have been met before the material is accepted for disposal. The procedures for handling prohibited waste that is not discovered until after it is unloaded are discussed in Section 6.2.

Equipment Operators, Spotters, Laborers, or other field personnel will be present at all areas where waste is being unloaded to monitor unloading of waste. These personnel will be familiar with the rules and regulations governing the various types of waste that can or cannot be accepted into this facility and will be trained to identify prohibited wastes before being assigned to this task (refer to Section 2.2 for training procedures). The personnel will also be trained and have a basic understanding of both industrial and hazardous waste and their transportation and disposal requirements. The Spotters and Equipment Operators have the authority and responsibility to reject unauthorized loads, have unauthorized material removed by the transporter, and have the unauthorized material removed by on-site personnel or otherwise properly managed by the facility. In the event an unauthorized load is discovered at an unloading area, the Spotter, Laborer or Equipment Operator (i.e., working face staff) will notify the Operations Manager or the General Manager immediately. The Operations Manager or General Manager will verify that the appropriate action is taken. In addition, if the unauthorized load is discovered at the site entrance, the Scale Operator will notify the Operations Manager or the General Manager immediately to verify that the appropriate action is taken. A record of each unauthorized material removal event will be maintained in the Site Operating Record.

Solid waste unloading will be controlled to prevent disposal in locations other than those specified by site management. For example, random load inspections will be conducted as outlined in Section 6.2 of this SOP. Any allowable waste deposited in an unauthorized area will be immediately removed and disposed of properly at the current working face. The Spotters and Equipment Operators or other site personnel will actively investigate any approved waste haul vehicles that do not dispose of their waste in an authorized area. In the event that an authorized load of waste has been deposited in an unauthorized area, site personnel will notify the Operations Manager and the waste load will be promptly relocated to the authorized working face area.

4.2.4 Maximum Size of the Unloading Area

As discussed previously the following unloading areas exist at the Royal Oaks Landfill.

- Unloading Area or Working Face
- RACM Unloading and Disposal Area
- Citizens Convenience Center
- Liquid Waste Bulking Facility

The MSW unloading and working face area is discussed below. The RACM unloading and disposal area is discussed in Section 4.20.5 (maximum size 50 feet by 50 feet). The maximum size of the Citizens Convenience Center is 150 feet by 150 feet. The liquid waste bulking facility is discussed in Appendix IVA (maximum size 100 feet by 240 feet).

Control(s) will also be used to confine the working face to as small an area as practical consistent with the rate of incoming waste and safe and efficient working face operations. The maximum size of the working face will be limited to the area listed below for a range of waste accepted at the facility.

Maximum Working Face Size[1]

Incoming Waste[2] Accepted	Maximum Working Face Size[3, 4, 5, 6] (width by length)
0 – 40 Tons/Day	30 feet by 30 feet (or 900 sf)
40 – 1,500 Tons/Day	150 feet by 175 feet (or 26,250 sf)
1,500 – 3,000 Tons/Day	250 feet by 325 feet (or 81,250 sf)
3,000 – 6,000 Tons/Day	375 feet by 450 feet (or 168,750 sf)
6,000 – 10,000 Tons/Day	525 feet by 600 feet (or 315,000 sf)

1 Typically only 1-working face will be utilized. However, a second working face may be used in some cases (e.g., during a time when the active face is transitioned to a new cell). The typical maximum number of working faces to be used at the site is two. Additional working faces may be used if required to accommodate site operations. If more than two working faces will be used, the landfill will notify the region office prior to opening a third working face.

2 For the maximum working face size, the incoming waste tonnage accepted will be determined by the sum of waste acceptance listed on the previous four TCEQ quarterly summary reports. If daily waste inflow increases, the maximum working face size may be increased to accommodate existing waste inflow rates.

3 The working face maximum size listed above is based on the maximum area needed to spread and compact waste in uniform lifts. The working face does not include areas used to move waste from a tipper area to the working face.

4 During the placement of the first lift of MSW in a newly constructed cell, the maximum working face size listed above does not apply provided that odors, vectors, and windblown litter are controlled consistent with standard operating conditions.

5 The maximum working face size listed above does not apply to areas that have less than a six-foot thick waste column left before the final permitted grades are achieved provided that odors, vectors, and windblown waste are controlled consistent with standard operating conditions.

6 The width and length shown above is for guidance purposes only. The maximum working face size will be governed by the area listed above.

The working face includes areas where waste has been deposited for disposal but has not been covered with soil. The working face includes areas that are covered with daily cover and the area where waste is deposited on the working face. As discussed in Part III, Appendix IIIC (Leachate and Contaminated Water Management Plan) the working face area is surrounded by a contaminated water containment berm and stormwater diversion berm. The area within the containment and diversion berms includes the following:

- Working Face Area (as defined above)
- Contaminated Water Storage Area (as noted in Part III – Appendix IIIC this area is designed to contain stormwater that has contacted the working face)

4.2.5 Prohibited Waste

Prohibited or unauthorized waste that is not discovered until after it is unloaded shall be immediately returned to the vehicle that delivered the waste. That party shall be responsible for the proper disposal of this rejected waste at a permitted facility. In the event the prohibited waste is not discovered until after the vehicle that delivered it is gone, the waste shall be segregated and controlled to the extent possible. The prohibited waste will be covered with soil or ADC and no additional filling will occur over that area until the prohibited waste is removed and properly disposed of. Survey stakes or similar markings will be placed around the perimeter of the area that contains the prohibited waste so that it is clear where the prohibited waste is located. Alternatively, the prohibited waste may be segregated by placing the prohibited waste in a roll-off or similar container.

An effort shall 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, Royal Oaks Landfill will notify the TCEQ within 24 hours to seek guidance on how properly to dispose of the waste as soon as practical. A record of each unauthorized material removal event will be maintained in the Site Operating Record.

Signs with directional arrows and/or portable traffic barricades will help to restrict traffic to designated unloading areas. Signs will be placed along the access route to the current unloading areas. In addition, rules for waste disposal and prohibited waste will be prominently displayed on signs at the site entrance. Refer to Section 6 of this SOP for additional waste handling procedures.

Tires will only be accepted for disposal if they are split, quartered, or shredded.

4.3 Hours of Operation

The Royal Oaks Landfill will have the option to operate and accept waste 24 hours per day, seven days per week. However, hours of operation and waste acceptance may vary within a 24-hour period depending on incoming volumes of waste. A record of the actual operating and waste acceptance hours will be maintained in the Site Operating Record. The operating and waste acceptance hours will be posted on the site entrance sign. If the posted landfill hours are less than 24 hours a day, transportation of materials and heavy equipment operation can occur at any time (24 hours per day, seven days per week – this includes all construction-related activities).

The option to operate the site and accept waste at the site 24 hours per day, seven days per week will ensure that the site has the ability to provide solid waste disposal services for the surrounding area. The landfill serves a variety of areas that have long haul distances to the landfill and urban areas that have specific waste collection requirements (e.g., early morning collection so as to minimize area traffic impacts). An extended-hour operation will ensure that these areas have access to the landfill.

4.4 Site Signs

A sufficient number of signs that are readily visible will be utilized for proper management and operation of the Royal Oaks Landfill. A sign will be displayed at the entrance to the site. This sign will be readable from the site entrance, will measure at least 4 feet by 4 feet, and have lettering of at least 3 inches in height that state the name of the site, type of site, hours and days of waste acceptance, the TCEQ permit number, and local emergency fire department phone number. The sign displayed at the site entrance will also list an emergency 24-hour contact phone number(s) that reach an individual with the authority to obligate the facility at all times that the facility is closed (e.g., 911). The Operations Manager will be responsible for the accuracy of the information posted on the site sign. An additional sign will be posted containing a description of all excluded wastes. Signs prohibiting smoking, receipt of hazardous waste, receipt of Class 1 waste, and scavenging will be posted near the scale house.

Within the site, signs will be placed along the landfill access road, beginning at the gated entrance, at a frequency adequate for users to be able to understand where unloading areas are and which roads are to be used. Roads not being used for access to the unloading areas will be blocked or otherwise marked for no entry.

4.5 Control of Windblown Wastes and Litter

Windblown wastes will be controlled at the Royal Oaks Landfill by the methods used in Table 4.1. The Operations Manager or his designee is responsible for evaluating the effectiveness of the measures listed in Table 4.1. If windblown waste and litter control measures are found to be ineffective, the Operations Manager or his designee will utilize the measures listed in Table 4.1 (i.e., reducing working face size, repositioning portable fencing, adding temporary fencing, etc.) until the windblown waste and litter issues are resolved.

4.6 Easements and Buffer Zones

4.6.1 Easements

No solid waste unloading, storage, disposal, or processing operations will occur within any easement at the Royal Oaks Landfill. Also, no waste disposal is allowed within 25 feet of the centerline of a utility or pipeline easement. Easements will be marked as specified in Section 4.7 of this SOP.

4.6.2 Buffer Zones

No solid waste unloading, storage, disposal, or processing operations will occur within any buffer zone at the Royal Oaks Landfill. In accordance with Title 30 TAC 330.543(b)(2)(B) and (C), the buffer zones vary around the perimeter of the site, but generally they are not less than 50 feet between the permit boundary and existing waste (the limits of waste that was permitted as part of MSW Permit No. 1614A) and 125 feet from the newly permitted limits of waste (refer to Parts I/II, Appendix I/IIC – Location Restrictions Demonstration for more information).

Internal separation distances between processing and disposal units are shown in Appendix I/IIC, Drawing I/IIC-1. The buffer zones around the site will provide for the safe passage of fire fighting or other emergency vehicles. All buffer zones will be clearly marked as specified in Section 4.7 of this SOP.

Table 4.1
Windblown Waste and Litter Control Plan

Item	Plan
Containment of Waste Within Collection Vehicle	Waste transportation vehicles using this facility will be encouraged to use adequate covers or other means of containment. The adequacy of covers or containment of incoming wastes will be checked at the facility entrance. The Scale Operators will visually inspect each vehicle entering the site to verify that the load is secured. A sign will be posted at the entrance indicating that vehicles shall be covered (or secured) or an additional fee will be charged. Vehicles attempting to enter the site with unsecured loads will be documented and the list can be provided to law enforcement officials, if necessary. An additional surcharge fee will be demanded from unsecured vehicles.
Daily Cover	Daily cover (e.g., soil or ADC) will be applied at least once every 24 hours to assist with the control of windblown waste. The working face size may be reduced by the application of daily cover to assist with the control of windblown waste.
Portable Fencing	Portable fencing will be used for the confinement of windblown material in the areas adjacent to the working face area. Such fences shall be located along the downwind length of the working face area. The litter control fences will be constructed of screens attached to portable frames or other appropriate anchor methods. The litter control fence will be at least eight feet in height and will be located as close as practical to the working face area to control windblown waste and litter. Each day, the Operations Manager or his designee will review weather forecasts to verify that the litter control fences will be positioned downwind from the MSW working face.
Temporary Fencing	Temporary fencing may also be installed on the downwind side of the working face. The purpose of the temporary fencing is to catch windblown waste that escapes the portable fencing discussed above. The temporary fence will either consist of additional portable fencing described above or will be constructed using metal or wooden posts and fence material, or netting. The secondary fence shall have a minimum height of four feet and a minimum length of at least 175 feet (or match the maximum length of the working face as noted in the table in Section 4.2.). The Operations Manager or designee shall determine the appropriate fence location and actual length. Additional fences may be used if necessary for effective litter control based on the actual filling location, filling direction, wind direction, and wind speed. Any litter control fencing which is damaged by equipment or traffic shall promptly be repaired or replaced.
Perimeter Fencing	Tall perimeter fencing may also be used for the control of windblown waste and litter. Tall perimeter fencing may be installed between any waste filling area and the permit boundary. The tall perimeter fence will typically be at least ten feet in height. The actual length and height of the perimeter fencing used will be determined by the Operations Manager or his designee, based on the need for this additional litter control measure, filling location, average wind direction, average wind speed, height of fill above natural ground surface, and proximity of working face to the permit boundary.
Earthen Berms	The construction of earthen berms may be used for the control of windblown waste and litter. The berms can provide a wind break against prevailing winds. It is at the Site Operators discretion as to the locations and usage of the berms.
Windblown Waste and Litter Collection	As part of the overall site maintenance program, facility personnel will collect windblown waste materials that may have accumulated throughout the site, on fences and gates, and onsite access roads a minimum of once a day that the site is in operation. Such waste will be taken to and disposed of at the working face. The collection of windblown waste and litter will be an ongoing activity at the site each day the site is in operation. The inspection and clean-up of windblown waste and litter will be documented in the Site Operating Record daily.
RACM Area	As noted in Section 4.20.5, RACM wastes will be covered immediately after they are placed in the landfill unit. Therefore, windblown waste in this area is not an issue.
Liquid Waste Bulking Facility	The wastes in the liquid waste bulking facility are also not subject to wind given that the material is handled within basins.

4.7 Landfill Markers and Benchmark

Landfill markers will be installed to clearly mark significant features as described in §330.143(b). The markers will be steel, plastic, or wooden posts (or other TCEQ-approved material) and will extend at least 6 feet above the ground surface. The markers will not be obscured by vegetation and will be placed in sufficient numbers to clearly show the required boundaries. Markers will be installed with an offset where markers otherwise would not be visible. Markers that are removed or destroyed will be replaced within 15 days of their removal or destruction. Landfill markers will be inspected monthly to ensure they are installed and maintained in accordance with the requirements of this SOP and will be maintained and repaired if necessary. Refer to Section 4.23 of this SOP for site inspection and maintenance schedule. Inspection results and repairs will be documented in the Site Operating Record. Markers will be repainted if needed to retain visibility.

The landfill markers color scheme is listed below.

Landfill Markers

Marker	Color
Site Boundary	Black
Buffer Zone	Yellow
Easements and Right-of-Way	Green
Grid System	White
SLER/GLER	Red
Floodplain	Blue

The site boundary markers will be placed at each corner of the site and along each boundary line spaced no greater than 300 feet apart unless the area is inaccessible, in which case offset markers will be permissible. Fencing will be placed within these markers as required. The buffer zone markers will be placed along each buffer zone boundary at all corners and between corners at intervals of 300 feet unless the area is inaccessible, in which are offsets will be permissible.

The easement and right-of-way markers will be spaced no greater than 300 feet apart. The markers will be placed along the centerline of an easement and along the boundary of a right-of-way at each corner within the site and at the intersection of the permit boundary.

The landfill grid is based on the state plane coordinate system. The landfill grid system markers will be spaced no greater than 100 feet apart measured along perpendicular lines. Intermediate markers will be installed in the case where markers cannot be seen from opposite boundaries. The grid system markers will be maintained during the active life of the site. Placement of the landfill grid system markers may be made along a buffer zone boundary.

The SLER/GLER markers will be placed so that all areas for which a SLER/GLER has been submitted and approved by the TCEQ are readily determinable. Such markers are to provide site workers with immediate knowledge of the extent of approved disposal areas. These markers will be located so that they are not destroyed during operations unless operations extend into the next SLER/GLER. The location of these markers will be tied into the landfill grid system. SLER/GLER markers will not be placed inside the evaluated areas.

Flood protection markers will be installed for areas within the facility that are within the 100-year floodplain. The areas subject to flooding will be clearly marked by means of permanent posts not more than 300 feet apart or closer, if necessary, to retain visual continuity.

A permanent benchmark has been established at the site, as shown in Parts I/II, Appendix I/IIA, Drawing I/IIA.1 – General Site Plan. The benchmark elevation has been surveyed from a known United States Coast and Geodetic Survey benchmark or other reliable benchmark. The benchmark is a bronze survey marker set in concrete and stamped with an elevation and survey date.

4.8 Control of Waste Spilled on Route to the Site

The Operations Manager or his designee will take steps to encourage vehicles hauling waste to the working face arrive on-site with a tarpaulin, net, or other means to properly secure the load. The adequacy of covers or containment of incoming wastes will be checked at the facility entrance. The Scale House Attendant will visually inspect each vehicle entering the site to verify that the load is secured. A sign will be posted at the entrance indicating that vehicles shall be covered (or secured) or an additional fee will be charged. Vehicles attempting to enter the site with unsecured loads will be documented and the list can be provided to law enforcement officials, if necessary. An additional fee will be demanded from unsecured vehicles.

The Operations Manager or his designee will be responsible for the cleanup of waste materials (e.g., solid waste material that has left the vehicle) along and within the right-of-way of all public access roads serving the site for a distance of two miles in either direction from the entrance to the site. Cleanup for the spilled solid waste materials will be performed at least once per day that the site is open for waste acceptance. Laborers performing litter and spilled solid waste materials collection will be required to wear appropriate safety equipment. A log shall be maintained to document the date and time the roads are checked and whether litter was observed and when it was collected.

The Operations Manager or his designee will consult with TxDOT officials (or other applicable local agencies with maintenance authority over the roads) concerning cleanup of state highways and right-of-ways consistent with §330.145. The TxDOT

District Office or other applicable local agencies will be contacted to discuss the procedures for litter cleanup on, and within, right-of-ways along state highways in the vicinity of the site.

4.9 Disposal of Large Items

Large, heavy, or bulky items may be disposed of at the working face. Items that can be 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. If the scale operators or the Operations Manager or his designee do not believe a specific large, heavy, or bulky item can be incorporated into the working face without adversely disrupting site operations or that it might cause an issue with compaction or settlement, then the item will not be accepted for disposal. Refrigerators, freezers, air conditioning units, or other items containing chlorinated fluorocarbon (CFC) refrigerant shall be handled in accordance with 40 CFR §82.156(f), as amended. Items containing CFCs 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 and the generator or transporter provides written certification that the CFC has been evacuated from the unit. Items such as electrical equipment, which contains PCBs, will be excluded from waste fill. Procedures for detecting and excluding PCBs are provided in Section 6.

Large items will be reduced in size at the working face to the extent practical. Care will be taken during disposal of large items to ensure that: (1) large items are excluded from the initial 5 feet of waste placed over the liner system, (2) large items are placed so that they do not interfere with continued waste filling, and (3) that other, smaller municipal solid waste is placed and compacted around them. Large items that cannot be disposed of at the working face may either be recycled or disposed of in another permitted facility.

4.10 Air Quality and Odor Management Plan

The site will comply with all the applicable air quality rules and regulations. The site will be required to operate in accordance with the New Source Performance Standards (NSPS) for MSW landfills.

Steps will be taken to limit the impact of the facility's operation on air quality. Among the measures to be employed are the following:

- Accidental fires will be controlled as outlined in Section 7 of this SOP.
- Open burning of waste will not be permitted at this facility.

- Incoming waste will be promptly compacted into the working face area. Daily cover will be placed consistent with the procedures specified in Section 4.18.2.
- Ponded water at the site will be prevented as detailed in Section 4.19.
- The Gas Collection and Control System (GCCS) will be expanded and operated in accordance with all applicable requirements.
- As discussed in Section 4.12, the landfill haul roads and access roads will be maintained in a reasonable dust-free condition by periodic spraying from a water truck. During dry weather conditions, the Operations Manager or his designee will routinely inspect the site and establish a frequency, if necessary, to spray the access roads with water to prevent nuisance conditions from developing.

The site management team (e.g., Operations Manager or his designee, Environmental Manager, and General Manager) will verify that Royal Oaks Landfill does not violate any applicable air quality and/or LFG requirements (refer to Appendix III I – Landfill Gas Management Plan for more information). The Environmental Manager is responsible for verifying and documenting compliance with the site's operating permit and any other applicable regulations. Current permits will be maintained in the Site Operating Record.

The site management team will maintain the required probe monitoring data and GCCS records as described in the Landfill Gas Management Plan.

Odors shall be controlled at the site and will be reduced if they occur in accordance with this Odor Management Plan. Sources of landfill odor can vary considerably and may include the wastes being delivered to the landfill, the open working face, surface emissions from the covered portion of the landfill, the landfill GCCS system, the liquid waste bulking facility, the Citizens Convenience Center, or the leachate collection system. Many of the wastes received at a landfill are a source of odor upon receipt, such as sludge and dead animals. Other wastes have the potential for becoming a source of odor by their biodegradable characteristics, generating gases as they advance through the decomposition process. The generation of LFG within the landfill is one of the primary sources of odor. To address potential LFG odors, the Royal Oaks Landfill will install and operate a LFG collection and control system (GCCS). One of the primary objectives of this system is to remove the LFG from within the landfill before it can percolate to the landfill surface and enter the atmosphere. The LFG that is recovered from within the landfill will be conveyed to a landfill gas-to-energy facility for beneficial reuse or to a flare to be thermally destroyed. As landfill operations progress, the GCCS will be expanded when necessary. Leachate may also be a source of odor if not properly handled or disposed of in a timely manner. Among the measures that may be employed to reduce potential odors are the following.

- Minimize the size of the working face area.
- Increase the thickness of daily cover applied to the working face.
- Prevent ponded water, consistent with the procedures outlined in Section 4.19.
- Place daily and intermediate cover to the specified thickness over the fill area. The Operations Manager or his designee will visually inspect daily and intermediate cover areas to confirm that no trash is exposed and no significant erosion of cover material has occurred. Erosion rills located on daily cover, intermediate cover, or final cover areas will be promptly repaired (more information in Section 4.18).
- Assess the effectiveness of the LFG extraction system (once installed) and make all necessary repairs to the system or expand the system, if needed, to control odors.
- Identify any waste stream that requires special attention to control odor. If the Scale Operator notes a load with significant odors, they will notify the working face personnel. The load will be promptly covered with soil or solid waste when it arrives at the working face.
- Inspect the leachate collection and storage system to confirm that it is functioning as designed (e.g., inspect piping and storage tank system to verify no leaks have occurred). Vapor tight gaskets will be used on leachate risers if odor issues are identified at the risers.
- Inspect and evaluate leachate recirculation procedures. Leachate recirculation will be temporarily suspended if the odor issue is a result of recirculation activities. Leachate recirculation procedures will be evaluated to determine the cause of the odors and to mitigate the odor issue before the leachate recirculation activities are resumed.
- Inspect the Citizens Convenience Center to verify that odors are controlled. If odors become an issue, the stored material will be systematically removed until the odors are eliminated.
- Removal of leachate from the site should be performed under appropriate weather conditions.
- Liquid wastes will be promptly solidified and transported to the working face for disposal. If the liquid waste is left in the basin for any extended period of time during the day, it will be covered with wood chips, sawdust, or soil to control odors.
- Utilization of portable or semi-permanent (i.e., an installed odor control system may be relocated every few years depending on the location of landfill working face) odor control systems that use aqueous or non-aqueous odor control chemicals.

The Operations Manager or his designee will evaluate the perimeter of the site on days when the site is open for waste acceptance to assess the performance of site operations to control odors.

4.11 Disease Vector Control

Facility personnel will control on-site populations of vectors such as an insect, snake, rodent, birds, or animal capable of mechanically or biologically transferring a pathogen from one organism to another. The primary means of control will be to prevent, inhibit, or deter vectors from coming into contact with deposited waste through proper waste compaction and daily cover application. Waste deposited at a working face area will be promptly compacted in accordance with Section 4.17. Daily cover and/or ADC will be applied at the end of each operating day in accordance with Section 4.18.2. A schedule of inspections is provided in Section 4.23 (refer to daily cover item).

Documentation of these inspections will be maintained in the Site Operating Record. If site inspections identify the need for additional vector controls, the site will implement a control program by contracting with a licensed commercial pesticide applicator, or other qualified pest control specialist to perform the following services:

1. Develop a pest management program for the vectors identified.
2. Implement the additional vector management practices.
3. Assist in the development of vector specific awareness training materials for site personnel.
4. Assist the site in distributing these training materials and providing any necessary training activities on vector awareness and control for site personnel.

The site has a bird abatement program that incorporates the use of pyrotechnic devices (if permissible under the local conditions), or an alternative bird abatement program, to control birds at the active working face area. The most recent revision of the bird abatement plan will be maintained in the Site Operating Record.

4.12 Maintenance of Site Access

The facility has an existing paved entrance road at Heath Lane. In addition, the landfill access roads are constructed with a crushed-stone surface or similar material surface to provide for all weather access area from the unloading areas to public access roads (i.e., mud on vehicles will “spin off” on the access roads within the landfill before the vehicle returns to the public access road). During wet weather conditions, the Operations Manager or his designee will routinely inspect the site and implement measures to further minimize mud tracking onto public access roads, when necessary (e.g., temporary wheel washing procedures). Further, tracked mud and associated debris at the access to the facility on public roadways must be removed at least once per day on days when mud and associated debris are being tracked onto the public roadway.

The landfill haul and access roads will be maintained in a reasonable dust-free condition by periodic spraying from a water truck. During dry weather conditions, the Operations Manager or his designee will routinely inspect the site and establish a frequency, if necessary, to spray the landfill access roads with water to prevent nuisance conditions from developing. Litter and other debris along the landfill access roads will be removed, consistent with the schedule requirements listed in Section 4.23 of this SOP (i.e., litter or other debris will be picked up on a daily basis). Grading equipment will be used when necessary to control or remove mud accumulations on roads as well as minimize depressions, ruts, and potholes. In addition, all on-site and other access roadways will be maintained on a regular basis. Mud and assorted debris tracked onto public roadways will be removed at least once per day on days when mud and associated debris are being tracked onto public roadways to the extent that mud can be reasonably considered to be associated with landfill operations. Refer to Section 4.23 of this SOP for site inspection and maintenance list (this list also includes documentation requirements which are also explained in Section 9).

4.13 Salvaging and Scavenging

Salvaging is the controlled removal of waste materials for utilization, recycling, or sale. Salvaging must not be allowed to interfere with prompt sanitary disposal of solid waste or to create public health nuisances. Salvaged materials shall be removed from the facility often enough to prevent the items from becoming a nuisance, to preclude the discharge of any pollutants from the area, and to prevent an excessive accumulation of the material at the facility. Special waste received at the disposal facility not be salvaged.

Scavenging is the uncontrolled and unauthorized removal of materials at any point in the solid waste management system. Scavenging will be prohibited at all times.

4.14 Endangered Species

Information regarding endangered species is located in Parts I/II, Section 12, in accordance with §330.61(n) and §330.551. No suitable habitat exists on the site for any species listed for Cherokee County, nor has critical habitat been designated in the project area for any threatened or endangered species. Neither the facility nor its operation will result in the destruction or adverse modification of the critical habitat of endangered or threatened species or cause or contribute to the taking of endangered or threatened species. If endangered or threatened species are encountered during site operations, Texas Parks and Wildlife and U.S. Fish and Wildlife Department will be notified.

4.15 Control of Landfill Gas

The control and monitoring of landfill gas for the Royal Oaks Landfill will be in accordance with the Landfill Gas Management Plan (Part III, Appendix III I). The Landfill Gas Management Plan was developed in accordance with §330.371 and provides for required reports and other submittals to be included in the Site Operating Record and submitted to the Executive Director (refer to Section 4.10 for additional information).

As noted in the Landfill Gas (LFG) Management Plan, monitoring for the presence of methane gas at the site will be conducted on a quarterly basis. In particular, the LFG monitoring probes will be monitored for the possibility of subsurface perimeter methane concentrations exceeding the lower explosive limit (LEL). Additionally, on-site structures will be checked to ensure that methane concentrations do not exceed 25 percent of the LEL. The allowable limits and details of gas recovery are more fully described in the Landfill Gas Management Plan.

Monitoring for combustible gas concentrations will be performed quarterly within all site structures and at the LFG monitoring probes. Required reports and other submittals will be included in the Site Operating Record and submitted to the executive director. In the event that methane levels that exceed allowable limits are detected (25% of the LEL for methane in facility structures or 100% of the LEL at LFG monitoring probes), the TCEQ and other parties identified in the Landfill Gas Management Plan will be notified and steps will be implemented to protect human health, in accordance with the contingency plan presented in the Landfill Gas Management Plan. Documentation of the LFG measurements and of the protective measures implemented will be placed in the Site Operating Record within seven (7) days. A remediation plan for any methane gas exceedances as described in the Landfill Gas Management Plan will be implemented within 60 days of the methane detection. This remediation plan will be submitted to TCEQ to describe the proposed remediation activities.

4.16 Treatment of Oil, Gas, and Water Wells

There are no known water wells or oil wells (existing or abandoned) on the site. If a water well is proposed in the future, a permit modification will be submitted to the TCEQ to meet the requirements of §330.161. Any wells encountered will be plugged in accordance with all applicable rules and regulations of the TCEQ, the Railroad Commission of Texas, or other applicable State agencies.

Therefore, if an abandoned oil, gas, or water well is located, the Operations Manager will provide written notification to the TCEQ's Executive Director of their location within 30 days after discovery during the course of facility development. If any wells are encountered, they will be exposed, the casing cut to a minimum of 2 feet below the excavation, and the well capped and plugged in accordance with all applicable rules and regulations of the TCEQ, the Railroad Commission of Texas, or other applicable state agency.

The Operations Manager or his designee will provide written notification to the Executive Director of the location of any and all existing or abandoned water wells within the facility upon discovery during site development. Within 30 days of such a discovery, the Operations Manager or his designee will provide written notification and certification to the Executive Director of the TCEQ that all such wells have been capped, plugged, and closed in accordance with all applicable rules and regulations of the TCEQ or other applicable state agency. If a water well is proposed in the future, a permit modification will be submitted to the TCEQ to meet the requirements of §330.161. Water wells that will be used to supply the facility may remain in use provided they are not affected by landfill operations.

For crude oil or natural gas wells, or other wells associated with mineral recovery that are under the jurisdiction of the Railroad Commission of Texas, within 30 days after the plugging of any such well, the Operations Manager will provide the Executive Director of the TCEQ with written certification that all such wells have been properly capped, plugged, and closed in accordance with all applicable rules and regulations of the Railroad Commission of Texas.

A copy of the well plugging report to be submitted to the appropriate state agency will also be submitted to the executive director of the TCEQ within 30 days after the well has been plugged.

In the event that an abandoned well causes a change to the liner installation plan, a permit modification will be submitted to the Executive Director in accordance with §330.131(d).

4.17 Compaction of Solid Waste

Compaction of incoming waste facilitates efficient use of available space, minimizes settlement and consolidation, and promotes proper application of daily, intermediate, and final cover. Landfill compactor(s) or similar equipment will be used to compact waste at Royal Oaks Landfill. Unless otherwise documented in the Site Operating Record, the Operations Manager or his designee will instruct the Equipment Operators to spread waste in lifts that are approximately two feet thick. The compactor will typically make two to four passes to compact the waste. A pass is defined as one direction of travel. The Equipment Operators will be trained to determine whether the compaction equipment is functioning as designed to ensure that the waste lift is adequately compacted. The number of passes required may be increased depending upon the nature of the waste that is being compacted.

To prevent the formation of potentially unstable interim slope conditions, the sequence of fill will be developed in a manner that solid waste will be compacted in horizontal lifts starting from the top of the liner protective cover. After obtaining TCEQ approval for each newly constructed liner (i.e., approval of the GLER), the filling operation will start at the bottom of the landfill and continue vertically in horizontal lifts. Under no condition will the maximum allowable interim slopes or slope lengths be exceeded (refer to Part III, Appendix IIIE for allowable interim slope lengths) without prior TCEQ authorization.

4.18 Soil Management, Placement, and Compaction of Daily, Intermediate, and Final Cover

4.18.1 Soil Management

Earthen material for use as daily cover, intermediate cover, final cover, and other uses will be obtained from onsite and offsite borrow sources.

The earthen material will consist of soil that has not previously come in contact with waste and will be of sufficient volume to meet the fire protection requirements specified in Section 7.7. The stockpile will typically be located within the undeveloped, permitted portion of the waste disposal footprint or on the top deck of the landfill near the unloading areas. The stockpiles will not be located in a buffer zone or located in a manner that would block access of fire and emergency equipment. Also, the stockpile will be located in an area that does not affect drainage structures. As this earthen material is used, it will be replenished and/or located as soon as practical but shall at all times be maintained to meet the fire protection requirements specified in Section 7.7. Both the volume of earthen material required to be maintained within 1,000 feet of each working face and the volume of the earthen material to cover each working face with at least a 1 day application of 6 inches of daily cover will be documented on the Cover Application Log (refer to Section 4.18.5 and Section 7.7.4 for an example earthen material calculation).

4.18.2 Daily Cover

Daily cover of waste is used to control disease vectors, windblown waste, odors, fires, and scavenging and to promote runoff from the fill area. At least once every 24 hours, the exposed solid waste fill area(s) will be covered by (1) at least 6 inches of soil cover material that has not been previously mixed with garbage, rubbish, or other solid waste, or (2) an approved Alternate Daily Cover (ADC) material.

As discussed in Section 4.2, the working face includes where waste has been deposited for disposal but has not been covered with soil. The working face includes areas that are covered with alternate daily cover and the area where waste collection vehicles deposit waste onto the working face. As discussed in the Leachate and Contaminated Water Management Plan, the working face is surrounded by a contaminated water containment berm and stormwater diversion berm. The area within the containment and diversion berms includes:

- working face area (as defined above),
- waste collection vehicle area (area where waste collection vehicles access the working face),
- containment water storage area (this area is designated to contain stormwater that has contacted the working face).

ADC information is included in Appendix IVB of this SOP. The plan addresses the following items.

- Description and thickness of the alternative cover material
- Effect of ADC on vectors, fires, odors, and windblown litter
- Application and operational methods to be utilized at the site when using the ADC
- Chemical composition of the material and the MSDS(s) for the ADC

ADC is used to cover waste that will be filled again within a 24-hour period. ADC is only used in areas that are surrounded by the containment berm. This practice allows collection of runoff generated by an area covered with ADC to be contained and managed as contaminated water.

As mentioned above, ADC information is included in Appendix IVB. The remaining portion of this section details the procedures to be used if soil daily cover is utilized. To ensure that the soil daily cover soil will be adequate (i.e., minimize vectors, prevent contaminated stormwater runoff, prevent odors, etc.) the following procedures will be followed:

- The daily cover will be sloped to drain.
- The daily cover will be spread and compacted with a minimum of two passes with the dozer tracks to minimize infiltration of stormwater, graded to drain, and will not have any waste visibly protruding through it.
- The Operations Manager, or his designee, will document where daily cover has been placed and visually inspect during placement that a minimum of 6 inches (compacted thickness) of daily cover soil has been placed and that no waste is exposed through it. The Operations Manager or his designee shall document, on a daily basis, the daily cover placement area and indicate that

he (or his designee) has visually verified the thickness and condition in the Cover Application Log (discussed further in Section 4.18.5 of this SOP).

- The Operations Manager, or his designee, will inspect all daily cover areas for erosion, exposed waste or other damage each day the site is in operation. Repairs will be made as necessary. Erosion gullies or washed-out areas will be repaired after the area is accessible (i.e., after the cover soils and slopes dry out enough to allow access by earth-moving equipment without causing rutting of cover soils).
- The Operations Manager, or his designee, will inspect for seeps from daily cover. All seepage water from waste below the daily cover will be controlled by placement of soil berms and diverted to a contaminated water collection area. Contaminated water will be treated as outlined in the Leachate and Contaminated Water Management Plan.

Inactive areas with 6 inches of daily cover will be inspected each day the site is in operation for erosion, ponded water, seeps, protruding waste, or other detrimental conditions that may cause contaminated runoff from the daily cover. The Operations Manager, or his designee, will place additional cover, if needed, to repair erosion, prevent ponded water and seeps, and cover protruding waste. All areas that have received waste but will be inactive for longer than 180 days will receive an additional 6 inches of earthen material not previously mixed with garbage, rubbish or other solid waste placed over the daily cover for a total of not less than 12 inches of cover. This 12-inch-thick layer of cover soil will be classified as "intermediate cover" as described in Section 4.18.3 of this SOP. If the area becomes active again, the cover soil may be stripped off for use as daily cover in other areas.

4.18.3 Intermediate Cover

All areas that receive waste but will be inactive for longer than 180 days will be covered with an additional 6 inches of compacted cover material, for a total cover thickness of at least 12 inches. The intermediate cover will be graded and maintained to prevent ponding. In addition, the top 6 inches of earthen material used for intermediate cover will be suitable for sustaining native plant growth and will be seeded within 180 days from the placement of intermediate cover soils. The establishment of vegetation is desirable to reduce erosion, which helps to maintain the cover's integrity and improve the aesthetic appearance of the landfill, and aid in sediment control (refer to Part III, Appendix IIIF-F for the Erosion Control Plan for all Phases of Operation).

The sequence of intermediate cover placement with respect to waste placement is included in detail in Parts I/II, Appendix I/IIA – Facility Layout Maps. The Operations Manager or his designee will inspect intermediate cover at the site consistent with the schedule and requirements listed in Section 4.23 of this SOP (Site Inspection and Maintenance List). This includes the inspection of intermediate cover following significant rainfall events as described in Section 4.23. Erosion gullies or washed-out areas will be repaired within 5 days of detection by restoring the cover material, grading, compacting, and seeding, if necessary, unless the TCEQ 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 Operations Manager or his designee will inspect for seeps from intermediate cover. All seepage water from waste below the intermediate cover will be controlled by placement of soil berms and diverted to contaminated water collection area. Contaminated water will be treated as outlined in the Leachate and Contaminated Water Management Plan (refer to Section 4.22).

4.18.4 Final Cover

Final cover placement will occur as areas of the site are filled to the design top-of-waste grades. Final cover placement over individual areas will be in accordance with the Closure Plan (Part III, Appendix IIIJ) and will permit ongoing landfill operations to continue until the time of final closure. Surface water will be managed throughout the active life of the site to minimize infiltration into the filled areas and to minimize contact with solid waste. Erosion of final or intermediate cover will be repaired within 5 days after the initial inspection by restoring the cover material, grading, compacting, and seeding unless the TCEQ 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 date of detection of erosion and date of completion of repairs, including reasons for any delays, must be documented in the Cover Application Log (refer to Section 4.18.5). Such periodic inspections and restorations are required during the entire operational life and for the postclosure maintenance period. Refer to Section 4.23 of this SOP for a Site Inspection and Maintenance list.

Final cover placement over completed portions of the site will consist of the following steps:

- Survey controls will be implemented to control the filling of solid waste to the bottom level of the final cover system.
- A surveyed grid system on 100-foot centers will be established, or other suitable surveying or plans will be used to control placement of final cover.
- When the appropriate design landfill height of the proposed final cover is reached, the top of the landfill will be regraded and reshaped if needed.
- During the first growing season following application of the final cover system, the site will be vegetated with appropriate grasses to minimize erosion.
- The surface water management system will be constructed as indicated in the stormwater management plan.

- The final cover system layers will be constructed. Testing of the various components of the final cover system will be performed in accordance with the Final Closure Plan.
- A final cover certification report complete with an as-built survey will be prepared by an independent licensed professional engineer and submitted to the TCEQ for approval.
- The TCEQ-approved final cover certification report will be maintained in the Site Operating Record and the Final Cover Application Log (see Section 4.18.5 of this SOP) will be updated to reflect the area where final cover has been placed, the date final cover was constructed, and the thickness applied that date. The TCEQ Regional Office will also be notified that final cover placement has occurred at the site.

The final cover system, including the erosion control structures (drainage swales and chutes) will be maintained during and after construction. During the active life of the site, the Operations Manager or his designee will inspect the final cover system consistent with the schedule and requirements listed in Section 4.23 of this SOP (Site Inspection and Maintenance List). This includes inspection of final cover following significant rainfall events as described in Section 4.23.

Postclosure care inspection procedures are outlined in the Postclosure Care Plan.

4.18.5 Cover Application Log

Throughout the landfill operation, a Cover Application Log will be maintained by the Operations Manager or his designee and be readily available for inspection in accordance with §330.65(h). For intermediate cover and daily cover, the log will specify the date cover (no exposed waste) was accomplished, the area covered (by use of the grid system), how it was placed, when it was completed, and the last area covered. For final cover, the log will show the final cover area, specify the area covered, the date cover was applied, the thickness applied that date, and reference the final cover certification report for each area. The signature of the Operations Manager, or his designee, will certify each entry that the work was accomplished as stated in the log. Repairs will be documented in the log. The date of detection of erosion, or other repair issue, date of completion of repair (including reasons for any delays) will be included to document the report. In addition, both the volume of earthen material required to be maintained within 1,000 feet of each working face and the volume of the earthen material to cover each working face with at least a one-day application of 6 inches of daily cover will be recorded each day on the Cover Application Log.

4.19 Prevention of Ponded Water

Site grading and maintenance will minimize the ponding of water over areas containing waste. Should ponding occur, the water will be removed as soon as practicable from areas not designated as stormwater collection areas in the Site Development Plan. Records of ponding preventive and corrective activities will be kept in the Site Operating Record. The depressions will be filled and regraded as quickly as possible, but no later than 7 days from the end of the rainfall event (i.e., the end of the rainfall event is equivalent to the term "occurrence" as defined by §330.167). If the ponded water has come into contact with waste, leachate, or contaminated soils, it will be treated as contaminated water and handled in accordance with the Leachate and Contaminated Water Management Plan. As discussed in the Leachate and Contaminated Water Management Plan, contaminated water will be pumped into tanker trucks and transported to a properly permitted treatment facility (refer to Section 4 of the Leachate and Contaminated Water Management Plan). Contained or ponded contaminated water will be removed in a timely manner.

The site will be inspected to verify that no unauthorized ponded water areas exist consistent with the schedule and requirements listed in Section 4.23 of this SOP (Site Inspections and Maintenance List). Ponded water in areas not over waste, such as in excavations, and detention ponds, is not prohibited so long as ponding in other areas does not cause or contribute to nuisance conditions. In addition, excavations will be pumped out when necessary to maintain the area as accessible to earth-moving equipment. Detention ponds will be maintained to perform as designed. Water contained in basins or excavations may be used for dust control.

4.20 Disposal of Special Waste

Special wastes, as defined in §330.3, will be accepted at the facility in accordance with §330.171(b) and (c) and the Special Waste Acceptance Plan (SWAP) included in Appendix IVC. Special wastes other than those approved in the following paragraphs may be accepted if these wastes meet the acceptance requirements listed in the SWAP. As specified in §330.171(b)(2) and the SWAP, requests for approval to accept certain types of special wastes shall be submitted to the TCEQ or maintained in the Site Operating Record and will include the following:

- A complete description of the chemical and physical characteristics of each waste and the quantity and rate at which each waste is produced and/or the expected frequency of disposal.
- If special handling instructions are required, they will be provided as part of the pre-approval process; including, the proposed procedures for handling waste and listing required protective equipment for operating personnel and onsite emergency equipment.

- Procedures and responsibilities for containment and cleanup of any accidental spills occurring during the delivery and/or disposal operation will be conducted. Typically, this will include:
  - Employees involved in cleanup should make use of their spill control kits which may include respirators, disposable coveralls, shoe covers, gloves, and safety glasses or goggles.
  - Other site personnel will be directed away from the area until cleanup is complete.
  - Excavate the waste material and transport it to the working face.
  - Wash any contaminated equipment or machinery.
  - If applicable, wash all other personal protective equipment with soap and water.
  - If applicable, check respirator, refit with new filter cartridges, and place into a resealable, air-tight container for future use.

When special wastes are to be disposed of at the facility, a complete transporter and/or generator profile will be required prior to acceptance of the special wastes. This profile includes:

- A list of customers generating these special wastes, identifying each of the generator's special wastes (with supporting chemical analysis, where applicable) for which disposal is being requested.
- A copy of any generator registrations (TCEQ and USEPA) that further identifies the character of those wastes.
- A written declaration by the generator that the waste stream is non-hazardous waste.
- An estimate of the anticipated quantity, rate, and frequency of disposal for each special waste.

The above-listed information will be maintained in the Site Operating Record.

Following review of this information, the Operations Manager or his designee or an appropriate Royal Oaks Landfill representative will notify the generator in writing as to which, if any, of the requested wastes will be accepted for disposal. The above-listed information will be maintained in the Site Operating Record.

A waste discrepancy form or similar documentation will be placed in the Site Operating Record when one or more of the following occurs:

1. A special waste arrives without a waste manifest or required shipping document.

2. A special waste arrives and the waste material does not match the description on the waste manifest or other shipping document.
3. A special waste arrives and the waste differs from the approved waste based upon QA/QC review or other monitoring.
4. The volume of the waste is not consistent with the information on the shipping documents.

The Scale Operators, Operations Manager, Special Waste Analyst, or Environmental Manager will attempt to resolve any waste discrepancies. If the discrepancy can be resolved, the waste may be accepted and the discrepancy form will be filed to document the resolution of the discrepancy in the Site Operating Record. If the discrepancy cannot be resolved, the waste shipment will be rejected and a discrepancy form prepared and filed for the rejected waste shipment.

In addition, the special wastes identified in Sections 4.20.1 through 4.20.7 may be accepted at the facility without prior written authorization in accordance with §330.171(c).

4.20.1 Sludges

Sludges, grease trap waste, grit trap waste or liquid waste from municipal sources will be accepted if the material has been treated or processed and has passed the paint filter test and is certified to contain no free liquid, as prescribed in §330.171(c)(7). The material will be required to have passed a paint filter test, as documented on the Generator Waste Profile, prior to disposal at the working face of the landfill.

4.20.2 Dead Animals

The facility may receive dead animals or slaughterhouse wastes. Dead animals and slaughterhouse wastes will be buried at the working face and covered with a minimum of 3 feet of other solid waste or a minimum of 2 feet of soil immediately upon receipt. Additional waste or soil will be added over the dead animals if objectionable odors are created by the dead animals or slaughterhouse wastes.

4.20.3 Empty Containers

Empty containers, which have been used for pesticides, herbicides, fungicides, or rodenticides will be accepted and disposed of in accordance with Title 30 TAC §330.171(c)(5) and as outlined below.

1. These containers may be disposed of at the landfill working face provided that:
   (i) the containers are triple rinsed prior to receipt at the site; and

(ii) the containers are rendered unusable prior to or upon receipt at the site.

2. Empty containers accepted at the site will be covered by the end of the same working day they are received.
3. Those containers for which triple-rinsing is not feasible or practical (e.g., paper bags, cardboard containers) may be disposed of by placing them in the active working face and covering them with three feet of waste by the end of the day they were received. Containers from industrial locations must be classified as a Class 2 waste or Class 3 waste.

4.20.4 Nonregulated Asbestos-Containing Materials

Non-regulated asbestos-containing materials (non-RACM) will be accepted for disposal provided the wastes are placed on the active working face and covered in accordance with Section 4.18 of this SOP. Under no circumstances shall any material containing non-RACM be placed on any surface or roadway which is subject to vehicular traffic or disposed of by any other means by which the material could be crumbled into a friable state.

4.20.5 Regulated Asbestos-Containing Material (RACM)

RACM may be accepted at the facility in accordance with §330.171(c)(3). Prior to initial receipt of RACM at this facility, the Operations Manager will dedicate a specific area of the site for receipt of RACM and notify the TCEQ in writing of the designated area. RACM disposal locations will be identified by surveying and marked on a current site drawing at the site. The identified area will be surveyed by a registered professional surveyor. Each load of RACM that arrives on-site will be documented. This documentation will include the volume of material, and the location and depth of its disposal. As the operation continues, the Operations Manager or his designee will notify the TCEQ in writing of any new dedicated areas for RACM. The RACM disposal area will not be larger than 50 feet by 50 feet.

Delivery of RACM will be coordinated by the Operations Manager so that the waste will arrive during times that it can be properly managed by site personnel.

RACM will be accepted at the site only if it is contained in tightly closed containers or bags, or wrapped as necessary with 6-mil-thick polyethylene.

RACM will be placed in landfill cells such that it will not be exposed as a result of erosion or weathering. At a minimum, the RACM will be placed at least 20 feet away from exterior final sideslopes, and at least 10 feet below final grade. During unloading and placement of RACM in the waste fill, care will be exercised to prevent breaking open the bags or containers. One foot of soil cover or 3 feet of asbestos-free municipal solid waste will be placed over the RACM immediately after it is placed in the landfill.

RACM that has been designated as Class 1 industrial solid waste will be disposed of in accordance with §330.173(c) and in accordance with this section of the Site Operating Plan.

Shipments of Class 1 RACM must be accompanied by a waste manifest document. The waste manifest is to be completed by the generator and transporter, and shall accompany the driver of each waste load. The facility will then verify pre-authorization for disposal and complete the destination section of each manifest and return one copy of the completed manifest to the driver. One copy of the completed waste manifest will also be returned to the waste generator within 30 days after receipt of the waste. Manifests are prepared in triplicate and the remaining copy will be filed in the Site Operating Record. Acceptable manifests will include at least the following information:

1. Identity and telephone number of the generator;
2. Type and quantity of waste obtained from the generator;
3. TCEQ registration number and TCEQ waste code (if applicable);
4. Specific site for disposal.

A waste discrepancy form or similar documentation will be completed when:

1. Class 1 RACM arrives without a properly completed waste manifest;
2. Class 1 RACM arrives and the waste material does not match the description on the waste manifest;
3. Class 1 RACM arrives and the information on the manifest is determined to be incorrect, or Class 1 RACM arrives which does not match the information given in the original approval submitted by the generator.

The Scale Operators, Operations Manager or his designee, Special Waste Analyst, Environmental Manager, or General Manager will attempt to resolve any waste discrepancies. If the discrepancy can be resolved, the waste may be accepted and the discrepancy form will be filed with the shipping documents to document the resolution of the discrepancy. If the discrepancy cannot be resolved, the waste shipment will be rejected and a discrepancy form prepared and filed for the rejected waste shipment.

The Operations Manager or his designee will contact the transporter and/or generator and notify them of the identification of any unauthorized waste. The transporter and/or generator will be required to take all necessary steps to determine the origin and to assure that in the future such wastes are either not collected or are taken to a facility approved to accept such waste. The appropriate state agency will also be contacted to provide the name and contact information of the transporter and to report measures taken to resolve the arrival of unauthorized waste (e.g. returned to the transporter or disposed of by Royal Oaks Landfill at an approved facility). Multiple instances of unauthorized wastes found from the same transporter or generator may result in Royal Oaks Landfill refusing to accept waste from that transporter or generator.

All information and documents pertaining to Class 1 RACM profiled for disposal and delivered to the landfill for disposal including but not limited to, all records concerning measurements and analyses performed at the site, shall be retained in the Site Operating Record.

Additionally, the TCEQ Monthly Waste Receipt Summary will be prepared by the Operations Manager, or his designee, and submitted to the TCEQ no later than the 25th of each month. This report will be submitted consistent with TCEQ requirements. Reports will be on forms provided by the TCEQ and submitted to the Registration and Reporting Section. The facility will file reports including those months in which they receive no Class 1 RACM at the facility unless the TCEQ grants an exception. The reports will summarize the quantity, character, generator identity, and the method of storage, processing and disposal of each Class 1 RACM shipment received, and itemizes by manifest document number as required by the TCEQ.

In addition and according to 30 TAC §330.675, a Quarterly Municipal Solid Waste Fee Report will be submitted to the TCEQ on a form provided by the TCEQ. In addition to a statement of the amount of Class 1 RACM received for processing or disposal, the report will contain other information requested on the form, typically including amount of other wastes received, the facility operator's name, address, and phone number, the permit number, and other information as requested. The required quarterly report will be submitted to the TCEQ within the timeframe required by the TCEQ.

In the event that bags or containers that contain RACM rupture, they will be immediately contained by spraying the area with water to prevent the spread of RACM. Also, earthen dikes, berms or by other appropriate measures will be constructed to contain the spill. The Operations Manager, or designee, shall be promptly notified of the spill and shall coordinate the collection and disposal of the spilled RACM. The spilled RACM will be picked up mechanically or by employees wearing proper protective equipment and re-packaged for disposal.

Upon closure of the facility, a notation indicating that the site accepted RACM will be placed in the real property records of Cherokee County. This notation will indicate where the RACM was disposed of on the property by showing its location on a site diagram. A copy of this documentation will be provided to the TCEQ.

4.20.6 Industrial Waste

Class 2 and Class 3 industrial solid wastes will be accepted at the facility. No Class 1 industrial solid waste will be accepted at this facility. Industrial waste (nonhazardous) is defined by §330.3 as solid waste resulting from or incidental to any process of industry or manufacturing, or mining or agricultural operations, classified as follows:

- Class 2 Industrial Solid Waste – Any individual solid waste or combination of industrial solid wastes that cannot be described as Class 1 or Class 3, as defined in §335.506 (relating to Class 2 waste determination). Examples of Class 2 Industrial Waste include "plant trash" or waste originating in the facility offices or plant production areas that are composed of paper and/or wooden packaging materials, glass, aluminum foil, aluminum cans, aluminum scrap, stainless steel, steel, iron scrap, plastics, styrofoam, rope, twine, uncontaminated rubber, uncontaminated wooden materials, equipment belts, wiring, uncontaminated cloth, metal buildings, empty containers with a holding capacity of five gallons or less, uncontaminated floor sweepings, or food packaging, that are produced as a result of plant production.
- Class 3 Industrial Solid Waste – Any inert and essentially insoluble industrial solid waste, usually including, but not limited to, materials such as rock, brick, glass, dirt, and certain plastics and rubber, etc. that are not readily decomposable as defined in §335.507 (relating to Class 3 waste determination).
- Class 1 Industrial Solid Waste that is defined as Class 1 only because of its asbestos content will be accepted and handled in accordance with the procedures listed in Section 4.20.5. No other Class 1 industrial solid waste will be accepted.

4.20.7 Municipal Hazardous Waste from a Conditionally Exempt Small Quantity Generator (CESQG)

Industrial waste from a CESQG will be accepted at this facility provided the amount of waste does not exceed 220 pounds (100 kilograms) per month per generator and provided the Operations Manager or his designee authorizes the acceptance of the waste. CESQG will be properly handled and safeguarded in the facility.

4.20.8 Used Oil Filters

In accordance with Title 30 TAC §330.15(e), used oil filters from internal combustion engines will not be intentionally and knowingly accepted for disposal at the landfill unless the filter has been (1) crushed to less than 20 percent of its original volume to remove all free-flowing used oil or (2) processed by a method other than crushing to remove all free-flowing used oil in accordance with §330.171(d)(1). Additionally, as noted in §330.171(d)(2), used oil filters (including filters that have been crushed and/or processed to remove free-flowing used oil) from any non-household generator will not be intentionally or knowingly accepted at the facility.

4.21 Prevention of Discharge of Contaminated Water

The Operations Manager or his designee shall implement necessary steps to control and prevent the discharge of contaminated water from the facility. No discharge of contaminated water shall occur without obtaining specific written authorization from the TCEQ prior to the discharge. All water coming in contact with waste or contaminated soils will be treated as contaminated water. Runon and runoff for the 25-year, 24-hour storm event will be controlled following the procedures set forth in the Surface Water Drainage Plan and the Leachate and Contaminated Water Management Plan. The landfill will be operated consistent with §330.15(h) regarding discharge of solid wastes or pollutants into waters of the United States.

As discussed in Part III, Appendix IIIC, contaminated water that collects behind the containment berm will be pumped into tanker trucks and transported to a properly permitted privately-owned treatment facility or a POTW for treatment. Contaminated water will be removed as soon as practicable from the area behind the contaminated water containment berm (refer to Section 4.23 for additional information and record keeping requirements). Contaminated water may also be transported to the leachate storage tanks. When contaminated water is stored in the leachate storage tanks, no leachate recirculation will occur, and a sign will be posted on the tank stating "No Recirculation." When the tank containing the contaminated water is emptied, the sign will be removed.

Purged water from the site's groundwater monitoring wells will be disposed of consistent with the methods and procedures listed in the Groundwater Sampling and Analysis Plan (e.g., purged water can be disposed in the facility leachate collection system via storage tanks, accessible risers, or other access points; facility condensate tanks; facility working face; or at a wastewater treatment plant connection).

As discussed in Section 4.2.1, the Citizens Convenience Center is located over an impervious area. In addition, waste spilled at the working face will be picked up daily, thus eliminating the potential for contaminated water.

4.22 Leachate and Contaminated Water Management Plan

Leachate and contaminated water will be controlled at the facility as specified in the Leachate and Contaminated Water Management Plan. Leachate storage tank information is included in Part III, Appendix IIIC. Consistent with Title 30 TAC §330.177, recirculation of leachate will only occur over the areas underlain by a Subtitle D liner system (i.e., composite liner system as defined by Title 30 TAC 330.3(29) with a leachate collection system). Leachate may be distributed from a tanker truck or other comparable equipment using a spray bar or hose to distribute leachate back to the working face (i.e., within the active waste fill area that is contained by the containment berm).

The following performance standards will govern the application rate of leachate recirculation.

- The rate of leachate recirculation will not exceed the moisture holding capacity of the landfill. For example, the application rate will be applied so that no seeps or ponding is observed in the vicinity of the recirculation area. In addition, leachate recirculation over a specific phase will cease if the leachate flow rate to a sump approaches the capacity of the pump within the sump. If this occurs, recirculation activities will move to another phase.
- Leachate recirculation will not occur immediately before, during, or immediately after rainfall events, or during freezing temperatures that could affect the holding-capacity of the waste.
- Leachate recirculation will not occur during high wind events.

The leachate generated from the landfill may be recirculated to the landfill working face, and excess quantities of leachate will be directed to the leachate storage facilities where it will be directed to the liquid waste bulking facility, directly discharged to a POTW or transferred by an authorized hauler to a properly permitted privately-owned treatment facility, POTW, or other approved disposal facility. Per Title 30 TAC §330.991(a)(7), leachate recirculation will not exceed 100,000 gallons per day. Refer to Appendix IIIC, Section 5.2 for further information regarding the site's Leachate Recirculation Plan.

4.23 Site Inspection and Maintenance List

Item	Task	Frequency	Inspector	Inspection Documentation
Fence/Gates/Natural Barriers	Inspect perimeter fence and gates for damage. Make repairs if necessary. Verify that natural barriers continue to provide access control and that "No Trespassing" signs are in-place and visible.	Weekly	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 if necessary.	Daily as specified in Section 4.5.	Operations Manager or Designee	Document inspection in the Site Operating Record
Waste Spilled on Route to the Site	Police the entrance areas and all roads at least 2 miles from the site entrances for loose trash. Clean up if necessary.	Daily as specified in Section 4.8.	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	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 if needed with crushed rock or stone. Grading equipment will be used at least once per week to minimize depressions, ruts, and potholes. Tracked mud and associated debris at the entrance to the facility must be removed at least once per day on days when mud and associated debris are being tracked onto public roadways to the extent that mud can be reasonably considered to be associated with landfill operations.	Tracked mud and debris will be removed daily. Grading equipment will be used at a minimum of once per week to minimize depressions, ruts, and potholes.	Operations Manager or Designee	Document inspection and repairs in the Site Operating Record
Daily Cover	Inspect for proper placement, thickness, and compaction. Correct problems if needed. Verify that vectors are not an issue.	Daily at the active face and all daily cover areas will be inspected within 72 hours of a rainfall event of 0.5 inches or more.	Operations Manager or Designee	Document inspection in the Site Operating Record
Intermediate Cover	Inspect for proper placement, thickness, erosion, compaction and for presence of waste or other contamination. Correct problems as needed. Maintain erosion control structures and repair/restore in the event of a wash-out or failure from an extreme storm event.	Weekly and within 72 hours of a rainfall event of 0.5 inches or more.	Operations Manager or Designee	Document in the Site Operating Record
Final Cover	Inspect for proper placement, thickness, compaction, slope, settlement and erosion. Also, the trees on the landscape bench located on the eastern side slope will be inspected to verify that they are functioning as designed. Maintenance will be ongoing throughout postclosure care period. Correct problems as needed. Maintain erosion control structures and repair/restore in the event of a wash-out or failure from an extreme storm event.	Weekly and within 72 hours of a rainfall event of 0.5 inches or more.	Operations Manager or Designee	Document in the Site Operating Record
Leachate	Verify that leachate sump controls are functioning (refer to Table 3-5 in Appendix IIIC for specific information).	1. Leachate controls and storage systems (e.g., pump controls and tanks) – Measurement is documented on a daily basis. 2. Leachate depth in sumps which are operating between the lip of the sump and the pump intake – Measurement is documented on a weekly basis. 3. Leachate depth in sumps which are operating above the lip of the sump – Measurement is documented on a daily basis.	Operations Manager or Designee	Document in the Site Operating Record
Leachate Storage Tanks	Measure leachate levels in storage tank and volume of leachate removed from the site.	Daily	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	Operations Manager or Designee	Document in the Site Operating Record
Ponded Water	Inspect site for unauthorized ponded water areas as described in Section 4.19. Correct problems if needed. Document all corrective actions taken to remove ponded water.	Weekly and within 72 hours of a rainfall event of 0.5 inches or more.	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	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, and erosion control measures intact). Maintain erosion control structures and repair/restore in the event of a wash-out or failure from an extreme storm event.	Weekly and within 72 hours of a rainfall event of 0.5 inches or more.	Operations Manager or Designee	Document in the Site Operating Record
GCCS	Verify GCCS is operating and maintained in accordance with all applicable requirements.	Monthly	Environmental Manager or Designee	Document in the Site Operating Record
Landfill Gas Monitoring	The landfill gas monitoring system will be inspected to verify that it is functioning as designed.	Quarterly	Operations Manager or Designee	Document in the Site Operating Record
Easements / Buffer Zones	The buffer zones and easement areas will be inspected to verify that the applicable markers are in place and that access has not been obstructed.	Monthly	Operations Manager or Designee	Document in the Site Operating Record
Fire Protection Plan	Consistent with Section 7, inspections will be completed to verify that the various components of the Fire Protection Plan are functioning as designed (e.g., fire extinguishers, stockpile requirements, water trucks or storage tanks).	Stockpile and water truck or tanks will be inspected daily, fire extinguishers will be inspected annually.	Operations Manager or Designee	Document in the Site Operating Record
Groundwater Monitoring System	The groundwater monitoring system will be inspected to verify the groundwater wells are functioning as designed.	Monthly	Operations Manager or Designee	Document in the Site Operating Record
Random Waste Inspections	Consistent with Sections 6.2 and 6.3, random inspections will be completed on a daily basis. Record Keeping requirements are listed in Section 6.3.	Daily	Operations Manager or Designee	Document in the Site Operating Record
Liquid Waste Bulking Facility	Inspect basins, when in use, to verify there are no indications of leaks from the basins (e.g., sudden drop in static levels).	Daily	Operations Manager or Designee	Document in the Site Operating Record

4.24 Visual Screening of Daily Operations

The facility will continue to operate the landfill in a manner that will provide the maximum screening practical within the requirements of the design. Existing vegetation in the buffer zones shall be maintained, where possible, to provide visual screening. As shown on Drawing I/IIA.14 (Access Control Plan) in Appendix I/IIA of Parts I/II, existing trees and vegetation provide a visual buffer for the site.

During below ground disposal operations, the landfill will not require visual screening of deposited waste. As the landfill is developed above ground, the landfill will construct final cover as the landfill reaches final contours. As the site is developed, the visual effect of the disposal activities will be minimized through the use of screening provided by fencing, planted vegetation, and natural vegetation located within the buffer zone.

5 SEQUENCE OF DEVELOPMENT

The sequence of development for the facility is provided in Parts I/II, Appendix I/IIA. The site will be developed according to the Sector Development Plans shown in Appendix I/IIA of Parts I/II.

6 DETECTION AND PREVENTION OF DISPOSAL OF PROHIBITED WASTES

6.1 General

In accordance with EPA's RCRA Subtitle D criteria, 40 CFR 258.20, and 30 TAC §330.127(5), the Royal Oaks Landfill will implement a program to exclude prohibited wastes as defined in 30 TAC §330.15(e), including but not limited to, regulated hazardous and PCB waste as defined in 40 CFR 261 and 30 TAC §330.3. Consistent with applicable portions of these regulations (and other TCEQ applicable regulations, such as §330.171 and §335 Subchapter R) PCB wastes subject to the disposal requirements of 40 CFR Part 761 will not be accepted for disposal at the Royal Oaks Landfill. The program will include training site personnel to know in detail what the prohibited wastes are, how to perform a random inspection, how to control site access, what training will be provided for site personnel, and what procedures are required in the event of identification of prohibited wastes. The detection and exclusion program at the Royal Oaks Landfill will include at least the following steps:

- Inform customers of the types of wastes that are excluded from disposal (refer to Section 4.2.2 for an example list of materials that are excluded from disposal at this facility).
- Inform vehicle drivers and transfer station operators of the wastes that are to be excluded.
- Verify that waste within vehicles entering the site is consistent with the waste description list on the manifest (refer to Section 4.2.3 for additional information).
- Random inspections of incoming loads.
- Records of all inspections.
- Training for facility personnel to recognize prohibited waste.
- Notification to TCEQ and any local pollution agency with jurisdiction that has requested to be notified of any incident involving the disposal of regulated hazardous or PCB waste at the landfill.
- Provisions for remediation of the incident.

6.2 Load Inspection Procedure

As noted in Section 4.2, Scale Operators, Equipment Operators, Spotters, and Laborers will monitor the incoming waste. Should any indication of prohibited waste be detected, the Operations Manager, or his designee, will conduct a thorough evaluation of the load. The driver will be directed to a load inspection area located at or near the working face where the load will be discharged from the vehicle. The inspector will break up the waste pile and inspect the material for any prohibited waste.

Prohibited waste that is not discovered until after it is unloaded shall be promptly returned to the vehicle that delivered the waste. That party shall be responsible for the proper disposal of this rejected waste at a permitted facility. In the event the unauthorized waste is not discovered until after the vehicle that delivered it is gone, the waste shall be segregated and controlled to the extent possible (e.g., the unauthorized waste will be covered with soil and/or ADC and no additional filling will occur over the unauthorized waste until it is properly disposed of). Survey stakes or similar markings will be placed around the perimeter of the area that contains the unauthorized waste so that it is clear where the unauthorized waste is located. Alternately, the unauthorized waste may be segregated by placing the unauthorized waste in a roll-off or similar container.

An effort shall 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, Royal Oaks Landfill will notify the TCEQ and seek guidance on how properly to dispose of the waste within 24 hours.

In addition to inspecting suspicious loads, random inspections will be undertaken. Random inspections will be supervised by the Operations Manager or designee. Staff (including Operations Manager, Operators, Equipment Operators and Laborers, and the Special Waste Analyst) conducting random inspections will receive training on the random inspection procedures in this plan and instruction on the recognition of regulated hazardous waste and PCB waste. Random inspections will be conducted at or near the working face to facilitate disposal of authorized waste after random inspections have been completed.

Except as provided herein, all waste loads will be subject to random inspections. At least one vehicle per day, that the site is in operation, shall be scheduled for a random inspection. The Operations Manager shall determine the procedure for the random selection of the waste hauling vehicle that will be selected. The following criteria shall be utilized in the development of the selection procedure:

- The random selection procedure shall objectively select a waste hauling vehicle each day that the facility accepts waste.

- The random selection procedure shall ensure that waste hauling vehicles are selected at varying times during the appropriate days of each week.
- The random selection procedure shall apply to all non-excluded waste hauling vehicles that transport waste to the site.

If inclement weather or other conditions preclude the random inspection from being performed on the scheduled day, the delayed random inspection shall be performed at the same scheduled time on the next day that the site is operating. Thus, if a scheduled random inspection is delayed, there will be two random inspections performed the next operating day.

The loads which are excluded from random inspections are listed below:

- Waste from transfer stations (meeting the criteria stated below)
- Liquid wastes
- Asbestos wastes
- Loads for which other steps have been taken to ensure that regulated hazardous wastes or PCB wastes are excluded

The facility may accept waste from transfer stations. Wastes received from transfer stations will not be screened at the site if the transfer station is permitted or registered by the TCEQ and random screening procedures are conducted at the transfer station. Copies of the transfer station TCEQ permit or registration number, and a letter from the transfer station owner or operator certifying that random waste screening is conducted at the transfer station, will be included in the documentation for transfer station loads excluded from random inspection procedures. Transfer station loads not meeting these criteria and vehicles containing special waste will be subject to random inspections.

Spreading of the waste for inspection may be accomplished by using mechanized equipment or hand implements. Inspectors shall observe the waste materials as the waste discharged from the truck is spread and separated. The waste shall be sufficiently spread to determine its character and composition. Inspectors shall wear appropriate personal protective equipment during the inspection which includes, at a minimum, the following:

1. Gloves;
2. Work boots;
3. Clothing which minimizes contact of waste;
4. High visibility clothing; and
5. Hardhat.

Additional personal protective equipment will be used if regulated hazardous waste or PCB waste is identified. In the event that regulated hazardous waste or PCB waste is identified during an inspection, waste inspection activities shall cease until inspection personnel obtain sufficient protective equipment, if needed. This additional equipment may include:

1. Respirator with appropriate cartridge filters (i.e., organic vapor or particulate);
2. Tyvek suit or coveralls;
3. Eye protection.

6.3 Recordkeeping

The Operations Manager is required to maintain and include in the Site Operating Record the following:

- Load inspection reports
- Reports on quantities and disposal of authorized waste
- Records of regulated hazardous or PCB waste notifications sent to TCEQ
- Personnel training records

Load inspection reports, recorded on standardized forms, will be completed for each inspected load. The reports should include, at a minimum, the date and time of inspection, the name of the hauling company and driver, the size of the load, indicators of prohibited waste, and results of the inspection. A copy of an example load inspection report form is included in Appendix IVA of this SOP. The actual form that will be used at the time of inspection may vary from the sample provided in Appendix IVA but must contain at least the information specified in this paragraph.

The TCEQ will be notified within 24 hours whenever regulated hazardous or PCB waste is detected. 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.

6.4 Training

Individuals responsible for inspecting incoming loads shall receive at least annual training in the provisions and procedures of this section (refer to Section 2.2 for additional information). Training shall be conducted by site employees or contract personnel experienced in waste inspection and detection requirements. Training shall be scheduled, and attendance will be recorded. The training outline shall incorporate the requirements and procedures of this section. Training shall include state and federal laws and regulations for managing prohibited waste. The training will at a minimum include the following topics:

1. Safety requirements during inspection procedures
2. Wastes prohibited from disposal at the site
3. Methods of identifying prohibited wastes
4. Various labels used for waste identification
5. Safety procedures if prohibited wastes are encountered
6. Procedures for managing prohibited wastes encountered

Documentation of training will be placed in the Site Operating Record.

6.5 Managing Prohibited Wastes

Unknown wastes undergoing analysis by Royal Oaks Landfill personnel must be properly segregated and protected against the elements, secured against unauthorized removal, and isolated from other waste and activities.

Known prohibited wastes detected during the inspection will be returned immediately to the transporter or generator. If the transporter or generator is not available, the waste will be safely stored until provisions for removal can be arranged.

Prohibited waste that is not discovered until after it is unloaded shall be promptly returned to the vehicle that delivered the waste. That party shall be responsible for the proper disposal of this rejected waste at a permitted facility. In the event the unauthorized waste is not discovered until after the vehicle that delivered it is gone, the waste shall be segregated and controlled to the extent possible. The unauthorized waste will be covered with soil and no additional filling will occur over that area until the unauthorized waste is removed and properly disposed of. Survey stakes or similar markings will be placed around the perimeter of the area that contains the unauthorized waste so that it is clear where the unauthorized waste is located. An effort shall 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, Royal Oaks Landfill will notify the TCEQ and seek guidance on how properly to dispose of the waste within 24 hours. A record of each unauthorized material removal event shall be maintained in the Site Operating Record.

If regulated hazardous waste or PCB wastes are detected, the TCEQ will be notified. As soon as is practical, the transporter will be required to remove the regulated hazardous waste or PCB waste from the site. Prior to removal, the transporter must obtain an EPA identification number, package the waste in accordance with TxDOT regulations, and properly manifest the waste designating a permitted facility to treat, store, or dispose of the hazardous waste.

6.6 Managing Mishandled or Undeclared Special Waste

If a mishandled or undeclared special waste is not discovered until after it is unloaded, site personnel will notify the Operations Manager or his designee. The special waste will be segregated and controlled. The mishandled or undeclared special waste will be covered with soil and/or ADC and no additional filling will occur over that area until the special waste is removed and properly disposed of. Survey stakes or similar markings will be placed around the perimeter of the area that contains the special waste so that it is clear where the special waste is located. The Operations Manager or his designee will then develop a plan to properly dispose of the mishandled or undeclared special waste material consistent with the approved special waste handling procedures outlined in Section 4.20. A record of unauthorized material removal will be maintained in the Site Operating Record.

7 FIRE PROTECTION PLAN

The purpose of this section is to set forth the Fire Protection Plan for the site. This plan addresses each operational activity that stores, processes, or disposes of combustible materials. These areas at the facility include:

- Each Unloading Area (Working Face, RACM Unloading Area, Liquid Waste Bulking Facility, and Citizen Convenience Center). Refer to Sections 7.7, 7.8, 7.9, and 7.10 for fire fighting information regarding these areas.
- Vehicles and Heavy Equipment used at the site. Refer to Section 7.5 for fire fighting information for vehicles and heavy equipment.
- On-site Structures (scale house and maintenance building). Refer to Section 7.6 for fire fighting information regarding on-site structures.

In addition to the above, the following subsections present information regarding fire protection training, fire protection standards, accidental fires, fire prevention procedures, and contacting the fire department and TCEQ.

7.1 Fire Protection Training

All employees, except personnel with administrative duties only, will receive the following fire training and instruction.

1. Detailed review and discussion of the Fire Protection Plan.
2. Training on fire prevention and hazard awareness.
3. Specific instruction on operation, use and limitation of the portable fire extinguishers and other fire fighting equipment (e.g., water cannon and water truck).
4. Instruction on the properties of methane gas and proper safety procedures.
5. Facility evacuation procedures.
6. Fire fighting techniques.
7. Emergency response.
8. First aid.

Personnel with administrative duties only will receive annual fire protection training on facility evacuation procedures and fire prevention as designated by the Operations Manager or his designee. Each training session for both operating and administrative personnel will be documented with a form identifying the type of training, topics covered, trainer, and attendees. Training records will be retained in the site operating record.

7.2 Fire Protection Standards

7.2.1 Posted Information

The following fire protection information will be posted at the site:

1. Emergency contact phone number(s) for site personnel at the main entrance to the site.
2. "No Smoking" signs posted at the entrance and/or near scales/scalehouse.

7.2.2 Fire Safety Rules

The following fire safety rules may be posted at the scale house.

1. Do not attempt to fight fire alone.
2. Be familiar with the use and limitations of fire-fighting equipment.
3. Alert other facility personnel in the area.
4. Assess extent of fire and likelihood that the fire will spread.
5. Contact the local fire department at 911, if necessary.
6. Attempt to contain or extinguish the fire until the fire department arrives if the fire can be safely fought with onsite fire-fighting equipment.

7.2.3 Burning Waste Loads (Hot Loads)

Steps will be taken to identify incoming "hot loads" prior to their being unloaded for disposal at the working face. The Scale Operators, Equipment Operators, Spotters, and Laborers must be alert for signs of hot loads, such as smoke, steam, or heat being released from incoming waste loads.

Fire-fighting methods include smothering with soil, separating burning material from other waste, or spraying with water from the water truck. A small fire may be controlled with a hand-held extinguisher.

In the event of a fire within a vehicle or piece of equipment, the vehicle will be brought to a safe stop away from any fuel storage area or exposed waste. The vehicle or equipment will be driven away from the active area(s) and the load ejected in the hot load area, which is any space, with either no waste deposited or waste with at least six inches of soil cover. A water truck, bulldozer, or other equipment will be used to extinguish the burning waste load. The waste will be covered with an adequate amount of soil to ensure it is extinguished. The load will be inspected by the Operations Manager, or his designee, before disposal. During inspection, if the soil is removed, which would allow oxygen to contact the waste, the load will be observed for hot spots or flare-ups. No smoldering or smoking waste will be placed in the working face area for permanent burial until all hot spots or flare-ups have been extinguished.

If it is not possible to move a burning vehicle away from fuel storage or exposed waste, the local fire department shall be called at 911, if necessary. While awaiting the arrival of the local fire department, all reasonable measures should be employed to extinguish the fire and prevent it from spreading beyond the vehicle.

7.3 Accidental Fires

Open burning of waste at the site is not permissible per Title 30 TAC §330.15(d). All fires will be extinguished using the protocols stated in this section. Proper compaction and earthen cover will be used to minimize the potential for accidental fires.

7.4 Preventive Procedures

Fuel spills will be controlled immediately. Soil contaminated with spilled fuel will be excavated and, if authorized by TCEQ, disposed of at the active face. Contaminated soils may be excavated using a shovel for small areas or with heavy equipment as appropriate. Onsite brush and vegetation will be controlled through mowing at least annually to reduce the possibility of brush fires from spreading to the landfill or off-site.

The compaction of the waste as it is disposed, and the subsequent covering with daily soil cover or ADC, will reduce the potential for fires by reducing voids within the waste and the amount of oxygen available for combustion. The daily cover or ADC serves as a physical, non-combustible barrier to a fire.

In addition, equipment that is used at the working face will be routinely cleaned through the use of high-pressure water or steam cleaners. The high-pressure water or steam cleaning will remove combustible waste and caked material which can cause equipment overheating and increase fire potential. The amount of water used to clean the equipment will be minimized.

Each piece of heavy equipment at the site listed in Table 3.1 will carry a portable fire extinguisher. Fire extinguishers will be inspected and certified at least annually. Once any extinguisher has been used, it will be refilled or replaced as soon as possible. The piece of equipment shall not be returned to normal service without a fire extinguisher installed.

7.5 Vehicle or Equipment Fire

If equipment or other site vehicles experience a fire, the operator will attempt to bring the vehicle or equipment to a safe stop, away from fuel supplies, uncovered solid waste, and other vehicles. The operator will attempt to shut off the engine and engage the brake. Lowering of any implements should be attempted as a means to prevent subsequent movement of the vehicle.

7.6 Structure Fire

The local fire department will be called at 911 for all structure fires. No site personnel will enter a structure on fire. Fire extinguishers will be placed in all of the onsite structures (e.g., scale house, maintenance building, and office building). The fire extinguishers will be checked and certified annually. Once an extinguisher is used, it is to be replaced as soon as possible.

7.7 Working Face(s) Fire Protection Plan

7.7.1 Working Face Fire Protection Requirements

§330.129 sets forth the following two methods for fire protection:

- Maintain a source of earthen material large enough to cover the working face with 6 inches of earth material within a 1-hour period, or
- An alternate method that is approved by the Executive Director of the TCEQ.

The plan set forth in this section provides an alternate method to the prescriptive fire protection plan included in the first bullet listed above. This plan utilizes both water and earthen material (as well as fire extinguishers for small fires) to provide fire protection for each working face. This alternate plan provides a more comprehensive fire protection plan than the prescriptive plan. By keeping a water source at the facility, the site will be able to fight and control fires more effectively than just through the use of covering working face fires with soil. For example, fires can be controlled much more quickly with the application of water as soon as a fire is detected rather than having to move equipment to cover the burning area with soil.

7.7.2 Working Face Fire Fighting Plan

If a fire is detected within material at the working face, the spotter (or Equipment Operator) will first redirect incoming loads away from the affected area. Working face fires will be extinguished by one of the following techniques.

- If the area of burning waste is small (e.g., an area of 10 feet by 10 feet or less), and is a surface fire, it will be extinguished using a fire extinguisher located on the equipment at the working face. Additional measures will be used, if necessary, to fully extinguish the fire. After the fire is extinguished, the affected portion of the working face will remain closed while the area is inspected to verify the fire is completely extinguished. Inspection of the fire area will be conducted by the Operations Manager or his designee.
- The burning waste material will be removed (i.e., "cut out" of the working face by a dozer or similar equipment) from the working face to an area where it can be covered with 6 inches of soil. The water truck may also be used to extinguish the burning waste. The working face area in which the burning waste was removed will be covered with 6-inces of soil. The affected portion of the working face will remain closed while the area is inspected to verify the fire is completely extinguished. Water that is used to fight the fire will be contained by the contaminated water containment berm. Contaminated water will be managed as specified in the Leachate and Contaminated Water Management Plan. This option is applicable to an approximate burning waste area of 30 feet by 30 feet.
- The burning waste material within the working face will be sprayed with water from one of the water trucks (or tanks) stationed at the facility. The working face area which contained the burning waste will be covered with 6 inches of soil to smother the fire. Upon extinguishing a fire at the working face through smothering with soil, that portion of the working face will remain closed while the area is inspected to verify the fire is completely extinguished. Inspection of the fire area will be conducted by the Operations Manager or his designee. Water that is used to fight the fire will be contained by the contaminated water containment berm. Contaminated water will be managed as specified in the Leachate and Contaminated Water Management Plan. This option is applicable to an approximate burning waste area of 50 feet by 50 feet.
- The burning waste material within the working face will be sprayed with water from one of the water trucks (or tanks) stationed at the facility. Then the burned (or burning) waste material will be removed from the working face to an area where it can be covered with 6 inches of soil. The working face area in which the burning waste was removed will be covered with 6-inces of soil. The affected portion of the working face will remain closed while the area is inspected to verify the fire is completely extinguished. Inspection of the fire area will be conducted by the Operations Manager or

his designee. Contaminated water will be managed as specified in the Leachate and Contaminated Water Management Plan. This option is applicable to the entire working face.

In each case listed above, after the Operations Manager or his designee confirms that the fire has been extinguished, waste filling operations in that area may resume. In the event that the fire cannot be controlled using the methods above, the local fire department will be called at 911 (refer to Section 7.11 for additional information regarding contacting the fire department).

7.7.3 Water Trucks or Storage Tank Requirements

A water source (either a water truck(s) or storage tank(s)) equipped with a water cannon will be maintained in a readily accessible location to assist the fighting of any potential working face fire. The water truck or storage tank may be used in the support of other landfill activities (e.g., dust suppression, compaction of earth fills).

Maximum Working Face Size (width by length)	No. of Water Trucks or Tanks[1] (minimum capacity of 2,000 gallons)
30 feet by 30 feet (or 900 sf)[2]	N/A[2]
150 feet by 175 feet (or 26,250 sf)	1 (or 2,000 gallons)
250 feet by 325 feet (or 81,250 sf)	1 (or 2,000 gallons)
375 feet by 450 feet (or 168,750 sf)	2 (or 4,000 gallons)
525 feet by 600 feet (or 315,000 sf)	3 (or 6,000 gallons)

1 The tank or truck size will be based on the required volume. For example, a water truck that has a 4,000-gallon tank is acceptable for a working face size of 375 by 450 feet.

2 When the facility accepts less than 40 tons per day, the maximum working face area will be 30 feet by 30 feet (900 square feet) and a stockpile of earthen material adequately sized to cover the working face with 6 inches of soil (17 cubic yards) will be maintained immediately adjacent to the working face.

The on-site stormwater detention ponds may also be used as a source of water for fire control. A minimum of 2,000 gallons of water will be available for firefighting purposes. Also, during periods of freezing temperatures measures will be taken to ensure that the tank(s) remain operational.

7.7.4 Soil Stockpile Requirements

A soil stockpile will be maintained within 1,000 feet of each working face. The stockpile will be used to (1) smother burning waste material at the working face or (2) placed over burning waste material that has been cut out of the working face. The stockpile will be sized to cover at least 25 percent of the size of each working face. In addition, enough earthen material (i.e., soil stockpiles and soil within borrow areas) will be maintained on-site to cover the entire working face within 24 hours. The earthen material requirements are listed in the following table.

Size of Working Face	Earthen Material Volume Requirements		
Area of Working Face in Square Feet	Volume of Earthen Material Required to Cover the Working Face Area with 6 inches of Soil	Volume of Earthen Material Required to Cover the Working Face Area with 6 inches of Soil	Volume of Earthen Material Required to be Maintained Within 1,000 feet of the Working Face
900 ft^2**	450 ft^3**	17 yd^3**	N/A**
26,250 ft^2	13,125 ft^3*	486 yd^3	122 yd^3
81,250 ft^2	40,625 ft^3*	1,505 yd^3	377 yd^3
168,750 ft^2	84,375 ft^3*	3,125 yd^3	781 yd^3
315,000 ft^2	157,500 ft^3*	5,833 yd^3	1,458 yd^3

* 26,250 ft^2 x 0.5 ft (0.5-foot thickness is obtained by using a 6-inch thickness of cover for a 1-day period over the working face).

** When the site receives less than 40 tons/day, the maximum working face area will be 30 feet by 30 feet (900 square feet) and a stockpile of earthen material adequately sized to cover the working face with 6 inches of soil (17 cubic yards minimum) will be maintained immediately adjacent to the working face.

Along with the list of equipment, calculations that show how the specified equipment can cover 25 percent of the working face in one hour will also be maintained in the Site Operating Record. The calculations will consider the following.

- Capacities of loading and unloading equipment
- Transportation route to the stockpile and working face
- Time needed to spread available soil on the working face (note that the top 6 inches of areas adjacent to the working face that have 12 inches of intermediate cover may be used as a soil source).

An example calculation is listed below.

Largest stockpile to be located within 1,000 feet for 100 percent coverage of 0 to 1,500 tons/day working face (refer to the table in Section 7.7.4).

Volume of Cover = V_c = 486 cy

Assume:

Truck Capacity = TR_c = 20 cy
Number of Trucks = N_{TR} = 3
Average Truck Velocity = ν_A = 12 mph = 1,056 fpm
Time to Cover Working Face = t = 60 min

Total Number of Loads (L):

$L = V_c / TR_c$ = 486 cy / 20 cy = 25 loads

Number of Feet Traveled for Truck (D_{TR}) in t:

$D_{TR} = \nu_A \times t$ = 1,056 fpm x 60 min = 63,360 ft

Distance of Stockpile from Working Face (D_s):

$D_s = (D_{TR} / (L / N_{TR}))$ = 63,360 ft / (25 loads/3 trucks) = 2,534 ft (round trip)
D_s = 2,534 ft / 2 = 1,267 ft

Therefore, in this case a 486 cy stockpile could be maintained within 1,267 feet of the working face. However, a minimum distance of 1,000 feet is specified.

Largest stockpile to be located within 1,000 feet for 25% coverage (refer to the table in Section 7.7.4).

Volume of Cover = V_c = 1,458 cy

Assume:

Truck Capacity = TR_c = 20 cy
Number of Trucks = N_{TR} = 3
Average Truck Velocity = ν_A = 12 mph = 1,056 fpm
Time to Cover Working Face = t = 60 min

Total Number of Loads (L):

$L = V_c / TR_c$ = 1,458 cy / 20 cy = 73 loads

Number of Feet Traveled for Truck (D_{TR}) in t:

$D_{TR} = \nu_A \times t$ = 1,056 fpm x 60 min = 63,360 ft

Distance of Stockpile from Working Face (D_s):

$D_s = (D_{TR} / (L / N_{TR}))$ = 63,360 ft / (73 loads/3 trucks) = 2,604 ft (round trip)
D_s = 2,604 ft / 2 = 1,302 ft

Therefore, in this case a 1,458 cy stockpile could be maintained within 1,302 feet of the working face. However, a minimum distance of 1,000 feet is specified.

A readily accessible water source and a soil stockpile within 1,000 feet will facilitate a quick response to fires at the working face. Any working face fire will be controlled quickly so that it will not spread. Because of the quick response provided by this plan, working face fires are not expected to encompass more than 10 percent to 15 percent of the working face. Therefore, by maintaining a soil stockpile within 1,000 feet of the working face, which is large enough to cover 25 percent of the working face, enough soil will be available to cover the area with burning waste, including a significant contingency.

7.8 RACM Area Fire

A soil stockpile of at least 50 cubic yards will be maintained within 100 feet of the RACM disposal area. This stockpile will cover the 50 foot by 50 foot maximum disposal area size with 6 inches of soil in the event of a fire in this area.

7.9 Citizens Convenience Center Fire

If a fire occurs in the Convenience Center, site personnel will first redirect incoming loads away from the affected area. Fire-fighting methods include the use of fire extinguishers and/or smothering with soil, or spraying with water from the water truck. Upon extinguishing the fire, the portion of the Convenience Center area affected by the fire will remain closed while the area is inspected to verify the fire is completely extinguished. Inspection of the fire area will be conducted by the Operations Manager or his designee. The Convenience Center will be equipped with a minimum of one 10A rated fire extinguisher or equivalent. The fire extinguishers shall be located in an area that is clearly visible, and easily accessible from the Convenience Center unloading area.

7.10 Liquid Waste Bulking Facility Area

Refer to Appendix IVD for a detailed fire protection plan for the liquid waste bulking facility.

7.11 Contacting Fire Department and TCEQ

In the event of a fire at the facility, the Operations Manager, or his designee, if needed will call 911, or the local fire department, and report the fire. The Operations Manager will notify Scale Operators, who will direct the fire department personnel to the scene of the fire.

If a fire occurs that is not extinguished within 10-minutes of detection, the TCEQ's Regional Office will be contacted no later than four hours after detection of the fire by telephone, and in writing within 14 days with a description of the fire and the resulting response.

In addition, this fire protection plan will be reviewed by the Operations Manager or his designee and the landfill management team after the occurrence of a significant fire to determine if modifications to the plan are warranted.

8 SAFETY

8.1 General Site Safety

Properly trained personnel using well-maintained equipment to perform standard work procedures in accordance with OSHA guidelines will promote site safety. Limiting access to the active areas to only authorized personnel will enhance site safety. In the event of an emergency, planned emergency response procedures will be followed.

All site personnel will receive appropriate site-specific training in at least the following areas:

- Safe work practices
- Equipment and vehicle safety
- Site access controls
- Hazardous material communication
- Fire safety
- Emergency response
- Employee rights and responsibilities

A record of training will be maintained to confirm that each employee has received the proper training (refer to Section 2.2 for additional information).

Well-maintained equipment is vital to the safe conduct of daily landfill operations. Therefore, all site equipment will be maintained in proper working order and all safety guards, backup alarms, and engine kill switches will be operational. Equipment Operators will perform an equipment check at the beginning of each workday. Fire extinguishers will be inspected routinely (refer to Section 7 for additional information). Records of all inspections will be maintained as part of the Site Operating Record.

Access to the site will be limited to authorized personnel as described in Section 4.1 of this SOP. Access is controlled by a combination of signs and physical barriers. Site personnel are responsible to be alert for the entrance of unauthorized personnel or the entrance of authorized personnel into prohibited areas.

In the event of an emergency, site personnel will assess the situation, notify the Operations Manager or designee, and take appropriate actions such as rendering aid, calling for assistance, or closing access to the emergency scene. Emergency numbers will be posted.

These include:

Ambulance	911
Fire	911
Sheriff/Police	911

8.2 Preparedness and Prevention Measures

Preparedness and prevention measures have been developed to minimize both frequency and severity of accidents and emergency situations threatening human health. Preparedness and prevention measures depend largely on the attentiveness and state of readiness of facility personnel. Preparedness and prevention measures have been developed for one general category and two specific areas of the site: the Scale House and the onsite access routes. These preparedness and prevention measures are detailed in the following sections.

8.2.1 General

General preparedness and prevention measures that will be followed at the Royal Oaks Landfill are:

- Access controls will provide for the safety of non-landfill personnel.
- Routine preventive maintenance of equipment will be provided.
- A management representative will perform site inspections as noted in Section 4.23.
- Appropriate personnel safety equipment will be kept onsite and maintained in good repair.
- Adequate turning area for hauling vehicles will be provided.
- Scavenging will not be allowed. Salvaging will be allowed as described in Section 4.13 of this SOP.
- Waste unloading will be restricted to designated areas only.
- Site personnel will be alert for possible hazardous or other unauthorized wastes.
- Nonapproved wastes will be controlled or contained and removed if necessary.

8.2.2 Scale House

Preventive measures that will be implemented at the Scale House include the following:

- Visually screen all incoming wastes for unauthorized wastes.
- Monitor incoming wastes to ensure that all wastes loads are adequately covered, or otherwise secured or contained.
- Visually observe incoming vehicles for evidence of improper operation, faulty equipment, or other conditions that could be hazardous to personnel or other persons on site.
- Maintain access to appropriate emergency equipment and first-aid materials.
- Provide emergency telephone numbers that are conspicuously posted in the scale house, office (if separate from the scale house), and the breakroom.

8.2.3 Landfill Access Road

Preventive measures that will be implemented for the landfill access road include:

- Display speed limit, directional, and other precautionary signs on-site.
- Provide road passable for two-way traffic.
- Maintain roadway free from obstructions.
- Enforce requirements for safe operation of vehicles onsite.

9 RECORDKEEPING REQUIREMENTS

Consistent with Title 30 TAC §330.121(a) and 30 TAC §330.125(d), the Operations Manager will maintain a copy of the permit (including any permit modifications), the approved SDP, the SOP, the Groundwater Sampling and Analysis Plan, the Final Closure Plan, the Postclosure Care Plan, the Landfill Gas Management Plan, the Leachate and Contaminated Water Management Plan, a copy of all state and federal regulations referred to in this plan, and any other required plans or documents onsite (in the Site Operating Record) at all times during the active life of the facility, including the post-closure care period. Consistent with §330.125(c), the landfill will maintain the Site Operating Record in an organized format which allows the information to be easily located and retrieved. In accordance with Title 30 TAC §330.125(h), the Operations Manager will maintain documentation of the quarterly solid waste summary reports and the annual solid waste summary reports for the annual waste acceptance rate records of the facility. If the annual waste acceptance rate exceeds the rate estimated in the landfill permit application and the waste increase is not due to a temporary occurrence, a permit modification will be submitted to TCEQ in accordance with 30 TAC §305.70(k) within 90 days of the exceedance as established by the sum of the previous four quarterly summary reports. Additionally, all information contained in the Site Operating Record will be furnished upon request to the Executive Director and will be made available for inspection by the Executive Director. As required by the TCEQ, the Site Operating Record will be maintained at the site and made available to the TCEQ upon request.

The Operations Manager is responsible for recording and retaining in the Site Operating Record the information listed in Table 9.1.

The Operations Manager or his designee will retain all information contained within the Site Operating Record and all plans required for the facility for the life of the facility including the postclosure care period. The above listed items will be incorporated into the Site Operating Record within seven working days of the completion of the item/record or receipts of the analytical data.

In addition to the above, the permittee shall provide written notice in the form of a Soils and Liner Evaluation Report (SLER) and/or Geomembrane Liner Evaluation Report (GLER) detailing the final construction and lining of a new disposal cell, as described in Title 30 TAC §330.341. In accordance with Title 30 TAC §330.123, the reports shall be submitted to the TCEQ for review 14 days prior to the placement of any waste in the new cell. If verbal or written response from the TCEQ is not provided by the end of the 14th day following TCEQ receipt of the report(s), placement of solid waste may begin. All SLER and GLER approvals will be maintained in the Site Operating Record.

Table 9.1
Record Keeping Requirements

Item	Rule Citation
All location restriction demonstrations	§330.125(b)(1)
Inspection logs and records, training procedures, and notification procedures relating to excluding the receipt of prohibited waste	§330.125(b)(2)
Inspection records and training procedures relating to fire prevention and site safety	§330.125(c)
All inspection documentation noted on Table 4.23 – Site Inspection and Maintenance List	§330.125(b)(12)
Fire Occurrence Notices	§330.129
Personnel training records and operator licenses. Training records (including operator licenses) for current employees will be kept for at least three years from the date the employee last worked at the facility.	§330.125(e), §330.125(f), §335.586(d), and §335.586(e)
Landfill Gas Management Plan	§330.159
Cover Application Logs (including documentation of soil stockpile and earthen material as noted in Section 4.18)	§330.165(h)
Results from gas monitoring events and any remediation plans relating to explosive and other gases	§330.125(b)(3)
Unit design documentation for the placement of leachate or gas condensate in the landfill	§330.125(b)(4)
Bird Abatement Plan	§330.151
Documentation of Vector Inspections	§330.151
Leachate sump level measurements	§330.125(b)(12)
Leachate disposal records	§330.125(b)(12)
All inspection logs and reports and all demonstrations, certifications, findings, monitoring, testing, and analytical data relating to groundwater monitoring and corrective action	§330.125(b)(5)
Closure plans and monitoring, testing, or analytical data relating to postclosure requirements	§330.125(b)(6)
Postclosure care plans and monitoring, testing, or analytical data relating to postclosure requirements	§330.125(b)(6)
Cost estimates and financial assurance documentation relating to financial assurance for closure and postclosure care	§330.125(b)(7)
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.	§330.125(b)(9)
Any and all documents, manifests, scale tickets, generator waste profile sheets, etc., involving special waste	§330.125(b)(10) §330.171(c)(3)(B)
A record of each unauthorized material removal event	§330.133(b)
Annual waste acceptance rate documentation including Quarterly and Annual Solid Waste Summary Reports required by §330.675	§330.125(h)
A record of alternate operations hours	§330.135(d)
Access control breach and repair notices	§330.131
Special Waste Operating Plan Compliance Documentation	§330.145(b)(11)
Special Waste Contingency Plan Compliance Documentation	§330.145(b)(11)
Other documents as specified by the approved permit or by the Executive Director of the TCEQ	§330.125(b)(12)
Monthly Marker Inspection Reports	§330.143(a)
For any spray-applied alternative daily cover (ADC) material, records of the application rate and total amount of ADC applied to the working face on those days in which ADC is applied.	§330.125(b)(11)
The Executive Director may set alternative schedules for recordkeeping and notification requirements if contaminants migrate off-site as indicated by groundwater sampling, except for notification requirements for any proposed lateral expansion located within a six-mile radius of any airport runway end used by turbojet or piston-type aircraft or notification relating to landowners whose property overlies any part of the plume of contamination.	§330.125(g)

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1614B

MAJOR PERMIT AMENDMENT APPLICATION

PART IV – SITE OPERATING PLAN
APPENDIX IVA
EXAMPLE LOAD INSPECTION REPORT

Prepared for

Pine Hill Farms Landfill TX, LP

May 2024

STATE OF TEXAS
JASON E. EDWARDS
99336
LICENSED
PROFESSIONAL ENGINEER

Prepared by

05/20/2024

Weaver Consultants Group, LLC
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817-735-9770

WCG Project No. 0120-076-11-106

This document is intended for permitting purposes only.

LOAD INSPECTION REPORT

LOAD INSPECTION DESCRIPTION					
Date of Inspection:		Time of Inspection:		Ticket Number:	
Name of Inspector:					
Name of Hauling Company:					
Driver's Name:					
Vehicle Identification:				Load Size:	

SOURCE IDENTIFICATION		
LOW RISK SOURCES	MEDIUM RISK SOURCES	HIGH RISK SOURCES
___ Residential	___ Dry Cleaners	___ Large Manufacturing
___ Office Buildings	___ Auto Body Repair	___ Doctor's Office
___ Schools	___ Small Manufacturing	___ Hospital
___ Farms	___ Nursing Homes	___ Paint Manufacturers
___ Apartments	___ Other	___ Print Shops
___ Restaurants		___ Waste Brokers
___ Department Stores		___ POTW's
___ Other		___ Other

LOAD CONTENTS					
Household Wastes	Yes ☐	No ☐	Transformers/Capacitors	Yes ☐	No ☐
Wood, Sawdust	Yes ☐	No ☐	Labeled Hazardous Waste	Yes ☐	No ☐
Metal	Yes ☐	No ☐	Batteries	Yes ☐	No ☐
Paper, Cardboard	Yes ☐	No ☐	Oil	Yes ☐	No ☐
Yard Waste, Brush, Stumps	Yes ☐	No ☐	Medical	Yes ☐	No ☐
Containers > 5 gallons	Yes ☐	No ☐	Radioactive	Yes ☐	No ☐
Bulk Liquids	Yes ☐	No ☐	Soil	Yes ☐	No ☐
Powders, Dusts	Yes ☐	No ☐	Asphalt, Concrete, Rock	Yes ☐	No ☐
Roofing Material	Yes ☐	No ☐	Food Waste	Yes ☐	No ☐
Tires	Yes ☐	No ☐	Other	Yes ☐	No ☐
			Does Waste Match the Waste Hauler's Description?	Yes ☐	No ☐
Unusual Odors?	Yes ☐	No ☐	Unusual Colors?	Yes ☐	No ☐
Heat, Excessive Smoke?	Yes ☐	No ☐			

ACTION TAKEN	
Signature of Inspector:	Signature of Driver:

ROYAL OAKS LANDFILL
CHEROKEE COUNTY
TCEQ PERMIT NO. MSW-1614B

MAJOR PERMIT AMENDMENT APPLICATION

PART IV – SITE OPERATING PLAN
APPENDIX IVB
ALTERNATIVE DAILY COVER OPERATING PLAN

Prepared for

Pine Hill Farms Landfill TX, LP

May 2024

STATE OF TEXAS
JASON E. EDWARDS
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LICENSED
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05/20/2024

Prepared by

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APPENDIX IVB-1
Quick Cover Information

APPENDIX IVB-2
VERDac Landfill Cover Pellets Information

STATE OF TEXAS
JASON E. EDWARDS
99336
LICENSED
PROFESSIONAL ENGINEER

05/20/2024

1 INTRODUCTION

This Alternative Daily Cover Operating Plan (ADCOP) has been prepared for the Royal Oaks Landfill consistent with Title 30 Texas Administrative Code (TAC) §330.165(d). The purpose of this ADCOP is to address the following issues associated with alternative daily cover (ADC) materials:

- Description and thickness of the proposed ADC materials
- Chemical composition of the materials
- Operation methods to be utilized at the site when using the ADCs
- Effect of the ADC on vectors, fires, odors, and windblown litter

As specified in the Site Operating Plan (SOP), ADC may be used to cover exposed waste that will be filled again within a 24-hour period. However, if the area in which ADC has been used is not filled over with waste within 24 hours (i.e., the site is closed for a period longer than 24 hours), the area will be covered with a minimum of six inches of daily cover soil.

Under TCEQ Permit No. MSW-1614A, the site was approved to use contaminated soils, quick cover, and VERDac landfill cover pellets. The contaminated soil was approved by TCEQ on October 7, 2015. Quick cover was approved by TCEQ on October 12, 2017. VERDac landfill cover pellets were approved by TCEQ on November 22, 2022.

2 MATERIAL CHARACTERISTICS

2.1 Description of ADC Materials

The following ADC materials may be used at the site.

Contaminated Soils

Contaminated soil materials that are not classified as Class 1 non-hazardous industrial solid waste and are authorized to be accepted at the Royal Oaks Landfill, may be applied as ADC.

The contaminated soil will be applied with a minimum thickness of 6 inches. Clean soil will be added to the contaminated soil if necessary to achieve the minimum thickness. Additionally, other approved ADC material may be used in conjunction with contaminated soil.

Quick Cover

Quick Cover is produced by Tascon, Inc. Quick Cover is a blend of cellulose fiber mulch and a binding agent that forms a slurry when mixed with water. The mulch is manufactured from recycled fiber stock (mixed papers) and the binding agent is composed of guar gum powder and applied with a hydromulch machine. This ADC spray material will form a crust-like barrier after application. Additional information for Quick Cover is included in Appendix IVB-1-A.

VERDac Landfill Cover Pellets

VERDac Landfill Cover Pellets (VERDac) is a spray-applied mulch and mineral mortar slurry product manufactured by LSC Environmental Products, LLC. VERDac Landfill Cover Pellets ADC is a non-flammable blend of mulch and mineral binder providing a thin, non-toxic coating which has been demonstrated as effective for controlling odors, windblown waste, and vectors at numerous facilities.

2.2 Chemical Characteristics

Contaminated Soils

Soil materials contaminated with petroleum, pesticides, and metals that are accepted at the site as special waste (in accordance with the site's permitted waste acceptance plan) and soil contaminated with Class 2 industrial waste may be used as ADC. Consistent with 30 TAC §330.165(d)(4) (A), contaminated soil used as ADC will not contain polychlorinated biphenyl wastes that are subject to the disposal requirements of 40 Code of Federal Regulations Part 761. Consistent with 30 TAC §330.165(d) (4)(3), the TPH of the petroleum contaminated soil must be equal to or below 1500 milligrams per kilogram. Soils contaminated with pesticides will be tested for TCLP pesticides and herbicides and TCLP metals (RCRA 8 metals). Soils contaminated with metals will be tested for TCLP metals (RCRA 8 metals). Other contaminated soils will be tested for process knowledge driven constituents of concern. Contaminated soils used as ADC will not contain constituents of concern exceeding the concentration totals in Table 1 of 30 TAC §335.521(a)(1) (i.e., soil classified as non-Class 1 waste), consistent with 30 TAC §330.165(d)(4). The contaminated soils chemical characteristics will be attached to the generator waste profile sheet that accompanies the waste at the time of acceptance and will be maintained in the Site Operating Record.

Quick Cover

The MSDS for Quick Cover is included in Appendix IVB-1-A. Quick Cover is not reactive, ignitable, or corrosive under the expected conditions (i.e., high temperature, intense sunlight).

VERDac

VERDac is comprised of cellulose fiber, powdered clay, adhesives, and water conditioners. The chemical analysis of VERDac, as well as other pertinent characteristics, are included in Appendix IVB-1-B.

3 OPERATIONAL METHODS

This section discusses the operational procedures that will be used to employ the approved ADC material. Site personnel will verify that the waste fill area has been covered with the minimum required thickness at the completion of each working day.

3.1 Contaminated Soil

Contaminated soils will be stockpiled near the working face or fill area and spread over the working face with a dozer or similar equipment to achieve a minimum thickness of 6 inches of well-compacted material. Additionally, clean soil will be added as necessary to ensure the appropriate thickness is applied.

Stormwater runon to and runoff from the contaminated soil piles will be controlled by containment berms and/or diversion berms in accordance with Section 4.22 of the SOP. The contaminated soil stockpiles will be located within the containment berms constructed around the working face. Stormwater that comes into contact with the contaminated soil in a stockpile will be considered contaminated water and managed consistent with the requirements for contaminated water in the facility's Leachate and Contaminated Water Plan. The maximum size of the contaminated soil stockpile area will be 0.5 acres (maximum volume = 10,000 cy). The size of the contaminated soil stockpile area will be added to the working face area to determine the "Working Face and Daily Cover Area" (shown in Section 2.3 of Appendix IIIC) to calculate the "Approximate Containment Area" and dimensions.

Contaminated water will be contained at the working face as discussed in Appendix IIIC of the permit. Contaminated water will be collected at the working face and removed using a vacuum truck no later than 7 days from the end of the rainfall event (also refer to Part IV, SOP, Section 4.19 for additional information regarding ponded water). The collected contaminated water will be transported via tanker trucks directly to a properly permitted privately owned off-site wastewater treatment facility or publicly owned treatment works (POTW) as discussed below.

3.2 Quick Cover

Quick Cover will be applied to the working face using a FINN T90 (900-gallon capacity) or similar equipment following the procedure listed below.

1. The operator will become familiar with this ADCOP and Quick Cover. Specifically, the mixing ratio and application rate for the spray-type ADC material. This ADCOP includes information on Quick Cover in Appendix IVB-1-A as well as the MSDS for this product; however, manufacturer's instructions included with the ADC material itself should be followed as well.
2. The operator will not operate the hydroseed machine until they have been trained by qualified personnel. Site personnel that are responsible for the application of ADC materials will receive training in the operation of the equipment, mixing procedures, and application methods.
3. The operator will mix the spray ADC according to the manufacturer's recommendation (1-50 pound bag per 100 gallons of water). Then, using the hydromulch machine, the operator will apply the ADC from at least two different directions to achieve a minimum thickness of 0.25 inches over the exposed waste at the working face. The operator will visually inspect the ADC to ensure that the minimum thickness is achieved and that no waste is left exposed.
4. The operator will not use the spray ADC around or near ignition sources.
5. The operator will be responsible for storing the spray ADC material in a dry location that is not susceptible to ponding water. The spray ADC material will be stored under a tarp, or equivalent, at all times to protect the material from moisture damage and direct sunlight. The operator will be responsible for inspecting the spray ADC material for moisture damage or other defects before each use. Any damaged or defective materials will not be allowed for use as ADC.
6. No more than 1,000 bags of spray ADC material will be stored at the site at any time. Additional spray ADC material will be ordered periodically to replenish the material used.

3.3 VERDac Landfill Cover Pellets

VERDac ADC is a spray-applied mulch and mineral mortar slurry comprised of water and a combination of cellulose fiber, powdered clay, adhesives, and water conditioners. This ADC will be applied to the working face using a FINN T90 (900-gallon capacity) or similar equipment following the procedures listed below:

1. The operator will become familiar with this ADCOP and VERDac. Specifically the mixing ratio and application rate for the spray-type ADC material. This ADCOP includes information on VERDac in Appendix IVB-1-B as well as the SDS; however, the manufacturer’s instructions included with the ADC material itself should be followed as well.

2. The operator will mix the spray ADC according to the manufacturer's recommendations (50-pound bag to 80 gallons). Then using the hydromulch machine, the operator will apply the ADC from at least two different directions to achieve a minimum thickness of 0.25 inches over the exposed waste at the working face. The operator will visually inspect the ADC to ensure that the minimum thickness is achieved and that no waste is exposed.

3. The operator will not use the spray ADC around or near ignition sources.

4. The operator will be responsible for storing the spray ADC material in a location that is not susceptible to ponding water. The spray ADC material will be stored in the manufacturer's protective plastic wrapping, under a tarp, or equivalent, at all times to protect the material from moisture damage and direct sunlight. The operator will be responsible for inspecting the spray ADC material for moisture damage or other defects before each use. Any damaged or defective materials will not be allowed for use as ADC.

5. No more than 1,000 bags/bails of spray ADC material will be stored at the site at any time.

6. Stormwater that comes into contact with the VERDac ADC during use or storage will be treated as contaminated water and controlled in accordance with Section 4.21 of the Site Operating Plan (i.e., contained within the containment berms around the active area).

4 ADC MATERIAL PERFORMANCE AND INSPECTION PROCEDURES

4.1 ADC Performance

Contaminated soil ADC has been successfully used at other MSW landfill sites in Texas to control vectors, fires, odors, and windblown litter and waste. Contaminated soil forms a barrier over waste and this surface serves as a barrier much like clean soil. Contaminated soil will control vectors and windblown litter by creating a physical barrier between the atmosphere and the waste. Contaminated soil also minimizes airflow between the active face and the atmosphere, which minimizes fire hazards and odor potential.

The Quick Cover spray-type ADC material included in this plan has been successfully used at other MSW landfill sites in Texas to control vectors, fires, odors, and windblown litter and waste. This type of ADC forms a crust-like barrier over the waste and this crust-like surface serves as a barrier much like the tarp ADC material. The spray-type ADC will control vectors and windblown waste by creating a physical barrier between the atmosphere and waste (e.g., the cohesive nature of the ADC material will prevent windblown waste and the crust-like barrier of Quick Cover has been proven to prevent vectors). The cohesive nature of the spray-type ADC also minimizes the airflow between the active face and the atmosphere, which minimizes the fire hazard and odor potential.

The VERDac ADC specified in this plan creates a thin, non-toxic barrier over the waste. VERDac ADC will control vectors, odor, and windblown waste, as well as minimize fire hazards by creating a physical barrier between the atmosphere and waste due to the cohesive nature of the ADC material.

4.2 Verification and Inspection Procedures

At the end of each working day, landfill personnel will inspect the working face to confirm that the minimum thickness of an approved ADC has been placed over the working face in accordance with this ADCOP. Landfill personnel will routinely assess the effectiveness of each ADC in controlling vectors, fires, odors, and windblown litter and waste. Daily application of ADC will be documented and maintained in the Site Operating Record.

In the event ADC does not control vectors, fires, odors, or windblown waste, the ADC application process will be re-evaluated to ensure this ADC material adequately covers the working face and serves its intended purpose. Any required changes to the ADC operational procedures will be authorized through a permit modification.

5 STATUS REPORTS

In accordance with Title 30 TAC §330.165(d), the site will obtain a temporary authorization before trial use of a new ADC. Consistent with Title 30 TAC §330.165(d)(2), a status report for new ADC materials will be submitted on a two month basis to the TCEQ describing the effectiveness of the alternative materials, any problems that may have occurred, and corrective actions required as a result of such problems. If no problems occur within six consecutive months of use, a permit modification completed consistent with Title 30 TAC §305.70(k)(1) will be submitted to the TCEQ to use the new ADC materials on a permanent basis.

APPENDIX IVB-1

QUICK COVER INFORMATION

Safety Data Sheet – SDS

Product Type:	Cellulose Fiber Hydraulic Mulch with Tackifer
Revision Date:	May 2016

1. Identification and Product Identification

Product Name: Quick Cover Alternate Daily Cover

Company Name: Space Savers, Inc.
136 Pecan Street
Keller, TX 76248

Emergency Contact: 817.337.0112

Recommended Use: Hydraulic Mulch used as alternate daily cover for landfills

Restrictions: None known

Manufactured By: Tascon, Inc.
P.O. Box 41846
Houston, TX 77241

2. Hazardous Identification

WARNING! MAY FORM COMBUSTIBLE DUST CONCENTRATIONS IN AIR (DURING PROCESSING). CAUSES EYE IRRITATION (AT HIGH CONCENTRATIONS).

PRECAUTIONS: Wear protective gloves / protective clothing / eye protection / face protection. Avoid generating dust. Keep away from heat, sparks, open flames, and hot surfaces. No Smoking.

3. Composition, Information on Ingredients

CAS NUMBER	NAME	PERCENT
9004-34-6	Cellulose Fiber	85%
7732-18-5	Water	<12%
Proprietary	Polysaccharide Tackifier	2%
41272-40-6	Green Dye	1%

4. First-Aid Measures

Inhalation: Avoid breathing dust. Remove to fresh air. No acute hazard known.

Eye contact: Flush eyes with copious amounts of water. No acute hazard known.

Skin contact: Wash exposed skin with soap and water. No acute hazard known.

Ingestion: Call poison control. Do not induce vomiting. No acute hazard known.

5. Fire Fighting Measures

Explosion:	Fine dust dispersed in air in sufficient concentration and in the presence of an ignition source is a potential dust explosion hazard. Avoid generating dust.
Extinguishing media:	Water spray, CO_2

6. Accidental Release Measures

Dust:	Remove with explosion-proof vacuum. Avoid generating dust.
Spill:	Sweep up excess material while avoiding generating dust.
Disposal:	In accordance with federal, state, and local refuse regulations.

7. Handling and Storage

Avoid dust formation and accumulation with routine housekeeping. Avoid use around or near ignition sources. Store in a dry location, avoid moisture.

8. Exposure Controls / Personal Protection

Component	ACGIH TLV	OSHA PEL
Cellulose	TLV-TWA 10mg/m^3 Total	PEL-TWA 15mg/m^3 Total PEL-TWA 5mg/m^3 Respirable

Respiratory Protection:	Use NIOSH approved respiratory masks
Eye Protection:	Use goggles or eye glasses
Hand Protection:	If sensitive, wear gloves
Other Protective Clothing:	None
Ventilation:	Normal & ventilation
Work/Hygiene:	Practice standard hygiene

Use in a processing environment designed to contain combustible dusts, which is free of ignition sources and has an explosion and fire suppression system.

9. Physical and Chemical Properties

Flash Point:	Not Applicable
Boiling Point (F):	Not Applicable
Vapor Pressure (mm Hg):	Not Applicable
Vapor Density:	Not Applicable
Solubility in Water:	Insoluble, Dispersible
Bulk Density (packaged product):	12.9 lb/ft^3
Reactivity in Water:	Dispersible
Melting Point:	Not Applicable
Appearance & Odor:	Fibrous material, green or blue-green in color. No discernible odor.
LEL/UEL:	No data available

10. Stability & Reactivity

Stability:	Stable
Conditions to Avoid:	Avoid extreme heat and flame
Hazardous Decomposition:	May produce carbon monoxide and carbon dioxide
Hazardous Polymerization:	Will not occur

11. Toxicological Information

Component*	LD50 Oral	LD50 Dermal	LC50 Inhales (dust)
Cellulose	Non-toxic	Non-toxic	Non-toxic

*Components not listed are not hazardous substances.

May cause irritation to eye and respiratory system. Persons with respiratory problems should avoid breathing dust. Can cause irritation to mucous membrane and upper respiratory system. Remove to fresh air.

12. Ecological Information

Cellulose fiber slowly biodegrades in water, is not eco-toxic and persists in arid soils (landfills). The green or blue dye used in this product is not believed to be eco-toxic at concentrations found in this product. The polysaccharide tackifier used in this product is biodegradable and is not eco-toxic.

13. Disposal Considerations

No special requirements. Dispose of in accordance with federal, state, and local regulations.

14. Transportation Information

Not regulated as a hazardous material for transport.

15. Regulatory Information

EU Classification:	9004-34-6 is classified as non-hazardous.
WHMIS:	Not considered a controlled product or not listed.
TSCA:	All ingredients of this product are either listed on the TSCA Inventory or are exempt from TSCA Inventory requirements under 40 CFR 720.30.
State Right-to-know:	California Proposition 65. PA, MA, NJ not listed or regulated.
SARA 313 Information:	This product does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, section 313 and 40 CFR section 372.
CERCLA:	This product does not contain ingredients which are subject to the Reporting requirements of CERCLA.
DSL:	Cellulose is on the Domestic Substance List.
OSHA:	Cellulose dust is a regulated hazard under the OSHA Hazard Communication Standard (29 CFR 1910.1200).
REACH:	Cellulose is exempt from registration under the European REACH regulations.
ENCS:	Cellulose is not listed or is exempt from the Japanese Existing and New Chemical Substances List as regulated by the Ministry of International Trade and Industry.

16. Other Information

See NFPA 654 for safe handling of combustible particulate solids.
Information presented herein has been compiled from sources considered dependable and is accurate and reliable to the best of our knowledge and belief, but it is not guaranteed to be so. Nothing herein is to be construed as recommending any practice or any product in violation of any patents or in violation of any laws or regulations. It is the user's responsibility to determine the suitability of any material for a specific purpose and adopt necessary safety precautions. We make no warranty as to results to be obtained in using any material and, since conditions of use are not under our control, we must necessarily disclaim all liability with respect to the use of any material supplied by us.

APPENDIX IVB-2

VERDac LANDFILL COVER PELLETS INFORMATION

ENVIRONMENTAL PRODUCTS, LLC

GHS Safety Data Sheet SDS

LSC Environmental Products, LLC
Issue Date: July 10, 2020

VERDac Landfill Cover Pellets

1 Identification

Supplier	LSC Environmental Products, LLC 2183 Pennsylvania Ave Apalachin, NY 13732
Telephone:	607-625-3050
Fax:	607-625-2688
Web:	www.lscenv.com
Product Name	**VERDac Landfill Cover Pellets**
Description:	Green Dyed Cellulose Fiber from Shredded Wastepaper and Corn Fiber and Sodium Montmorillonite Clay with Additives
CAS Number:	N/A
Recommended Use:	Alternative Daily Cover and Hydroseeding.

2 Hazards Identification

Route of Entry:		Eye Contact, Skin Contact, Inhalation
Hazards:	Eye:	May cause mechanical irritation.
	Skin:	May cause mild skin irritation.
	Ingestion:	No known health effects.
	Inhalation:	Acute: Short term exposure may cause mechanical irritation resulting in dry cough. May aggravate existing respiratory illness. Chronic: Repeated inhalation of respirable* crystalline silica above exposure limits can cause lung disease, including silicosis and lung cancer.

3 Composition / Information on Ingredients

Components in order of Volume:
Cellulose Fiber, Corn Fiber, Sodium Montmorillonite Clay* (Cas # 1318-93-0), Proprietary ingredients and biodegradable green coloring.

*Typical western SMC contains 1-6% crystalline silica as quartz CAS# 14808-60-7.

4 First-Aid Measures

Eye:	Flush eyes and under eye lids with plenty of water until irritation ceases. Contact physician if irritation persists.
Skin:	Wash with soap and water until clean. Contact physician if irritation develops.
Ingestion:	None known.
Inhalation:	Move to area free from dust. If symptoms of irritation persist, contact physician.

Inhalation may aggravate existing respiratory illness.

5 Fire Fighting Measures

Flammability:	Combustible product
Auto-ignition Temp:	400-500 F
Fire Extinguishing Media:	Water, Carbon Dioxide, Sand.

6 Accidental Release Measures

Personal Precaution: Avoid breathing dust; wear respirator approved for silica bearing dust.

Cleanup: Vacuum to avoid generating airborne dust. Avoid using water. Material becomes slippery when wet.

7 Handling and Storage

Handling: Use NIOSH/MSHA respirators approved for silica bearing dust when airborne SMC dust levels exceed PEL/TLVs. Clean up spills promptly to avoid making dust. Storage area floors may become slippery if wetted.

Storage: Store in a dry place. Keep away from ignition sources.

8 Exposure Controls / Personal Protection

Exposure Guidelines (Inhalation):

Component	OSHA PEL (8 hr TWA)	ACGIH TVL
Crystalline Silica as Quartz	0.1 mg/m³	0.1 mg/m³
Wood Dust	1 mg/m³	1 mg/m³
Particles Not Otherwise Regulated		
Total Dust	15 mg/m³	N/A
Respirable Dust	5 mg/m³	N/A

Engineering Controls: None required for outdoor mixing and application. Use local ventilation to maintain PELs/TLVs if handling indoors.

Personal Protective Equipment:

Eye and Face Protection: Wear safety glasses or goggles during loading and application to protect from dust, splashing, and spray mist.

Skin Protection: Wear gloves and overalls to protect skin and clothing from contact with product. Personal hygiene measures, such as washing hands and face after working with materials, are recommended.

Respiratory Protection:	When handling generates dust levels above exposure limits, use respirators approved by NIOSH/MSHA for silica bearing dust.

9 Physical and Chemical Properties

Appearance:	Green Pellets
Odor:	N/A
Physical State:	Granular Mixture of Cellulose Fiber, Corn Fiber, Sodium Montmorillonite Clay, Proprietary Ingredients, Dye
pH:	5.5-7.0
Specific Density:	20-35#'s/ft³ (approximate)
Specific Gravity:	N/A
Solubility in Water:	<2%
Vapor Pressure (mm Hg):	N/A

10 Stability and Reactivity

Stability:	Stable
Conditions to Avoid:	Avoid open flame. Store in dry areas.
Materials to Avoid:	N/A
Hazardous Polymerization:	No.

11 Toxicological Information

Carcinogenicity:

- Sodium Montmorillonite Clay is not listed by ACGIH, IARC, NTP, or OSHA.
- IARC, 1997, concludes that there is sufficient evidence in humans for the carcinogenicity of inhaled crystalline silica from occupational sources (IARC Class 1), that carcinogenicity was not detected in all industrial circumstances studied and that carcinogenicity may depend on characteristics of the crystalline silica or on external factors affecting its biological activity. NTP classifies respirable crystalline silica as "known to be a human carcinogen" (NTP 9th Report on Carcinogens - 2000). ACGIH classifies crystalline silica quartz as a suspected human carcinogen (A2).

12 Ecological Information

No information available.

13 Disposal Considerations

Bury in licensed landfill according to local, state, and federal regulations.

GHS Safety Data Sheet SDS

LSC Environmental Products, LLC
Issue Date: July 10, 2020

14 Transportation Information

US DOT: Non-regulated

15 Regulatory Information

None of the components in this product are known to be regulated by national or international regulatory bodies.

16 Other Information

SDS Status: Revised from MSDS format in 2015 to comply with GHS requirements.

All information presented herein is believed to be accurate; however, it is the user's responsibility to determine in advance of need that the information is current and suitable for their circumstances.
No warranty or guarantee, expressed or implied, is made by LSC Environmental Products, LLC as to this information or as to the safety, toxicity, or effect of the use of this product.

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1614B

MAJOR PERMIT AMENDMENT APPLICATION

PART IV – SITE OPERATING PLAN
APPENDIX IVC
SPECIAL WASTE ACCEPTANCE PLAN

Prepared for

Pine Hill Farms Landfill TX, LP

May 2024

STATE OF TEXAS
JASON E. EDWARDS
99336
LICENSED
PROFESSIONAL ENGINEER

05/20/2024

Prepared by

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WCG Project No. 0120-076-11-106

This document is intended for permitting purposes only.

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APPENDIX IVC-A
Special Waste Profile (SWP) Sheet

APPENDIX IVC-B
Non-Hazardous Waste Manifests

05/20/2024

1 INTRODUCTION

1.1 Objectives of Special Waste Acceptance Plan

This Special Waste Acceptance Plan (SWAP) outlines the acceptance criteria and the review and approval process that will be used to accept certain "special waste" as defined by the Texas Commission on Environmental Quality (TCEQ) for disposal at the Royal Oaks Landfill (MSW Permit No. 1614B). This SWAP defines the procedures to be followed in determining whether the landfill may accept a waste for disposal, and it outlines the procedures for identifying and preventing the disposal of unacceptable wastes which are delivered to the facility.

The objectives of the SWAP are as follows.

- Verify that the waste is not a regulated hazardous waste.
- Verify that the waste meets permit criteria for acceptance at the landfill.
- Verify that the waste meets facility criteria for acceptance at the landfill.
- Establish the necessary conditions to ensure the safe and environmentally sound management (handling, storage, processing and disposal) of the waste.

1.2 Special Wastes Regulations

The TCEQ's solid waste regulations define a special waste as a "solid waste or combination of solid wastes that because of its quantity, concentration, physical or chemical characteristics, or biological properties requires handling and disposal to protect the human health or the environment" (refer to Title 30 TAC §330.3(154)). Although the regulations identify specific waste streams as special wastes, the rules also include the above catch-all provision. This broad definition of special waste covers many wastes that are routinely disposed at Municipal Solid Waste Landfill Facilities (MSWLFs).

The TCEQ rules specifically provide that the receipt of certain types of special waste does not require waste-specific or site-specific written approval of the Executive Director if handled in accordance with the noted provisions for each waste (e.g., Title 30 TAC §330.171(c) and (d) and §330.173(e) and (i) – (j) of the rules). By way of example, the receipt of properly treated medical waste, dead animals or slaughterhouse wastes, empty containers that are properly rinsed, municipal hazardous waste from small quantity generators that are conditionally exempt, sludge, grease/grit trap waste and liquid wastes from municipal sources that are properly processed, and used oil filters from household generators that are properly crushed or otherwise processed to remove all free-flowing used oil do not require waste-specific and/or site-specific written approval from the TCEQ's Executive Director prior to acceptance and disposal as noted in the regulations. Similarly, soils contaminated by petroleum products, crude oils, or other chemicals may be accepted and disposed of, subject to limitations set forth in Title 30 TAC §330.171 (relating to Disposal of Wastes), and certain industrial solid wastes, such as Class 2 or Class 3 industrial solid wastes that do not interfere with facility operations, may be accepted and disposed of without a waste-specific and/or site-specific written approval from the Executive Director, subject to limitations set forth in Title 30 TAC §330.173 (relating to Disposal of Industrial Wastes).

The special wastes enumerated in Title 30 TAC §330.171(c) and (d) and §330.173(c) and (i) – (j) (generally referenced above) will be accepted for disposal at the Royal Oaks Landfill by operation of rule (with the exception of regulated asbestos containing material), without the necessity for any waste-specific or site-specific approvals. They will be managed at the facility in accordance with the methods set forth in those rules and any applicable requirements set forth in the Site Operating Plan (SOP), as further detailed in Section 6 of this SWAP.

Title 30 TAC §330.171(b)(1) provides that approvals for any other (non-enumerated) wastes must be waste-specific and/or site-specific in nature (i.e., not authorized by operation of rule); however, Title 30 TAC §330.171(b)(2) allows a generator to request approval to dispose of special waste directly from a landfill operator who has an approved Special Waste Acceptance Plan under Title 30 TAC §330.61(b) that authorizes the acceptance of such waste on a site-specific basis. This SWAP addresses requirements of the TCEQ rules allowing site-specific authorization to accept special waste meeting the facility's waste acceptance criteria set forth in Section 3 – Evaluation Guidelines of this SWAP. Unless otherwise approved by the Executive Director, only those non-enumerated special wastes that meet the waste acceptance criteria of this SWAP will be disposed of at the Royal Oaks Landfill in accordance with the disposal requirements set forth in the SOP and further detailed in Section 6 of this SWAP.

2 DEFINITIONS

Listed below are definitions of some common terms used in this SWAP. Terms not defined below carry the common industry definition. Note that if any of the definitions listed below conflict with a definition listed in State or Federal regulations applicable to the landfill, the regulatory definition will govern.

Conditionally Exempt Small Quantity Generator

A very small quantity generator who generates 100 kg (220 pounds) or less of hazardous waste in a calendar month and meets the independent requirements and the conditions for exemption for a very small quantity generator under Title 30 TAC §335.53.

Commercial Solid Waste

All types of solid waste generated by stores, offices, restaurants, warehouses, and other non-manufacturing activities, excluding residential and industrial wastes.

Household Waste

Any solid waste (including garbage, trash, and sanitary waste in septic tanks) derived from households (including single and multiple-family residences, hotels and motels, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds, and day-use recreation areas).

Industrial Solid Waste

Solid waste resulting from or incidental to any process of industry or manufacturing, or mining or agricultural operations.

Class 1 Industrial Solid Waste:

Any industrial solid waste or mixture of industrial solid wastes that because of its concentration, or physical or chemical characteristics is toxic, corrosive, flammable, a strong sensitizer or irritant, a generator of sudden pressure by decomposition, heat, or other means, or may pose a substantial present or potential danger to human health or the environment when improperly processed, stored, transported, or disposed of or otherwise managed, as further defined in §335.505 (relating to Class 1 Waste Determination).

Class 2 Industrial Solid Waste:

Any individual solid waste or combination of industrial solid waste that are not described as Hazardous, Class 1, or Class 3 as defined in §335.506 (relating to Class 2 Waste Determination).

Class 3 Industrial Solid Waste:

Inert and essentially insoluble industrial solid waste, usually including, but not limited to, materials such as rock, brick, glass, dirt, and certain plastics and rubber, etc., that are not readily decomposable, as further defined in §335.507 (relating to Class 3 Waste Determination).

Leachate

A liquid that has passed through or emerged from solid waste and contains soluble, suspended, or miscible materials removed from such waste.

Municipal Solid Waste Landfill Facility (MSWLF) Unit

A discrete area of land or an excavation that receives household waste and that is not a land application unit, surface impoundment, injection well, or waste pile under 40 CFR §257.2. A MSWLF unit also may receive other types of RCRA Subtitle D wastes, such as commercial solid waste, non-hazardous sludge, conditionally-exempt, small-quantity generator waste, and industrial solid waste. A MSWLF unit may be a new unit, an existing unit, or a lateral expansion of a unit.

Pollution Control Waste

Any solid waste generated as a direct or indirect result from the removal of contaminants from the air, water, or land which may pose a present or potential threat to human health or the environment or with inherent properties which make the disposal of such waste in a landfill difficult to manage by normal means.

RCRA

Resource Conservation and Recovery Act of 1976, as amended, 42 U.S.C. §§ 6901 *et seq.*

Sludge

Any solid, semi-solid, or liquid waste generated from a municipal, commercial, or industrial wastewater treatment plant, water supply treatment plant, or air pollution control facility, exclusive of the treated effluent from a wastewater treatment plant.

Solid Waste

Any garbage, or refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility, and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, municipal, commercial, mining, and agricultural operations, and from community activities. This term does not include (i) solid or dissolved materials in domestic sewage, irrigation return flows or industrial discharges subject to regulation by permit under Texas Water Code, Chapter 26, or (ii) nonhazardous waste materials that result from activities associated with the exploration, development, or production of oil or gas or geothermal resources regulated by the Railroad Commission of Texas under Section 91.101, Natural Resources Code.

Special Waste

Any solid waste or combination of solid wastes that because of its quantity, concentration, physical or chemical characteristics or biological properties requires handling and disposal to protect human health or the environment. If improperly handled, transported, stored, processed, disposed of or otherwise managed, special waste may pose a present or potential danger to human health or the environment.

Special wastes are:

- hazardous waste from conditionally exempt small quantity generators;
- industrial solid waste;
- untreated medical waste;
- municipal wastewater treatment plant sludges, other types of domestic sewage treatment plant sludges, and water-supply treatment plant sludges;
- septic tank pumpings;
- grease and grit trap wastes;
- wastes from commercial or industrial wastewater treatment plants; air pollution control facilities; and tanks, drums, or containers used for shipping or storing any material that has been listed as a hazardous constituent in 40 CFR Part 261, Appendix VIII, but has not been listed as a commercial chemical product in 40 CFR §261.33(e) or
- slaughterhouse wastes;
- dead animals;
- drugs, contaminated foods, or contaminated beverages, other than those contained in normal household waste;
- pesticide (insecticide, herbicide, fungicide, or rodenticide) containers;
- discarded materials containing asbestos;

- incinerator ash;
- soil contaminated by petroleum products, crude oils, or chemicals in concentrations of greater than 1,500 milligrams per kilogram total petroleum hydrocarbons, or contaminated by constituents of concern that exceed the concentrations listed in Table 1 of 30 TAC §335.521(a)(1) (relating to Waste Classification; Appendices);
- used oil;
- waste from oil, gas, and geothermal activities subject to regulation by the Railroad Commission of Texas when those wastes are to be processed, treated, or disposed of at a MSWLF Unit;
- waste generated out-of-state as defined below;
- lead acid storage batteries; and
- used-oil filters from internal combustion engines.

SWP Sheet

Special Waste Profile (SWP) Sheet or other facility-approved waste profile documentation containing equivalent information.

Special Waste Coordinator/Analyst

Facility personnel authorized to review and approve SWP Sheets. This person is typically located in the corporate office and is trained in waste acceptance procedures and regulations.

TCEQ

Texas Commission on Environmental Quality

USEPA

United States Environmental Protection Agency

Wastes Generated Out-of-State

All solid waste generated outside the boundaries of the State of Texas and transported into Texas for processing, storage, or disposal at a MSWLF Unit that contains (i) any industrial solid waste; (ii) any waste associated with oil, gas or geothermal exploration, production, or development activities; or (iii) any special waste as defined above.

Waste Stream

A separate and distinct waste type generated from a particular process at a generating location.

3 EVALUATION GUIDELINES

The waste evaluation guidelines, pre-receipt and recordkeeping requirements, and recertification frequency obligations of Sections 3 – 5 of this SWAP are not applicable to the acceptance of municipal solid waste or any materials authorized for disposal by operation of rule under Title 30 TAC §§330.171 and 330.173. These guidelines will be applied to wastes for which waste-specific or site-specific written approval is required under Title 30 TAC §330.171(b).

Before accepting any such waste for disposal at the facility, Royal Oaks Landfill will verify the waste generator has the following: (1) TCEQ waste code (for industrial wastes); (2) TCEQ registration number (for industrial waste); (3) TCEQ authorization (if applicable); and (4) facility approved SWP Sheet (including any appropriate analytical data). Appendix IVC-A contains a standard SWP Sheet. Alternative forms of documentation containing information equivalent to the SWP Sheet found in Appendix IVC-A can be used. References to the information used to classify the waste based on analytical testing and/or process knowledge (e.g., MSDS, manufacturers' literature, or other documentation generated in conjunction with a particular process, etc.) will be included on the SWP Sheet as applicable (see Section 3.2 for more information). Each waste must be evaluated by a Special Waste Coordinator/Analyst to ensure that it is acceptable for disposal at this facility. The following guidelines are provided to assist in reviewing SWP Sheets.

3.1 Hazardous Waste and Industrial Solid Waste Determinations

In accordance with USEPA and TCEQ regulations, a waste is considered hazardous if it is listed as mixed with, or derived from, a listed hazardous waste or it exhibits any characteristic of a hazardous waste as further detailed in the following subsections. The generator should determine if the material is hazardous using the following method:

- Determine if the material is excluded from being a solid waste or hazardous waste per Title 30 TAC §330.3(151) (relating to Definitions) or 40 CFR Part 261, Subpart A, as amended through January 2, 2008 (73 FR 57);
- If the material is a solid waste, determine if the waste is listed as, or mixed with, or derived from a listed hazardous waste identified in 40 CFR Part 261, Subpart D, as amended through June 4, 2008 (73 FR 31756); and

- If the material is a solid waste, determine whether the waste exhibits any characteristics of a hazardous waste as identified in 40 CFR Part 261, Subpart C, as amended through July 14, 2006 (71 FR 40254).

If the material is determined to be a nonhazardous industrial solid waste, the generator should then classify the waste as Class 1, Class 2, or Class 3 waste as defined in Section 2 of this SWAP.

3.1.1 Listed Wastes

Listed wastes are solid wastes listed, by name, as hazardous by the USEPA. Listed wastes are categorized by the USEPA in the following categories:

- 40 CFR §261.31 lists more than 25 hazardous wastes resulting from non-specific sources (i.e., common manufacturing and industrial activities). These wastes include spent solvents, sludges, and similar materials. It is important to closely evaluate dried paints, paint strippings, and spray paint booth wastes for the potential to fall under this category. If a waste falls under this category it is considered an F-listed waste.
- 40 CFR §261.32 lists more than 100 hazardous wastes resulting from specific sources (i.e., specific waste generating industries). These wastes include various types of sludges, still bottoms, spent catalysts, and other materials from specific industrial operations. If a waste falls under this category it is considered a K-listed waste.
- 40 CFR §261.33(e) lists over 400 chemical products defined as acute hazardous wastes. If a waste falls under this category it is considered a P-listed waste.
- 40 CFR §261.33(f) lists more than 900 chemical products that are classified as toxic hazardous wastes. If a waste falls under this category it is considered a U-listed waste.

Listed wastes identified above and those wastes that may be included as listed wastes in the future by the USEPA and TCEQ will not be accepted for disposal at the Royal Oaks Landfill.

3.1.2 Characteristic Wastes

Wastes can be designated as hazardous based upon certain characteristics of the respective waste. A waste may be hazardous based on any one or more of the following characteristics: toxicity, ignitability, corrosivity, or reactivity. A general summary for determining if a waste exhibits one or more of the four characteristics is described below:

- Ignitability (40 CFR §261.21): In general, any liquid waste having a flash point less than 60˚ Celsius (140° F) is considered ignitable. A non-liquid waste is also considered hazardous for ignitability when under standard temperature and pressure is capable of causing a lire through friction, absorption of moisture, or spontaneous chemical change, and which will vigorously and persistently burn when ignited. Also included are ignitable compressed gases and certain substances that readily yield oxygen and stimulate the combustion of organic matter (oxidizers). These are classified as D001 wastes.

- Corrosivity (40 CFR §261.22): In general, any aqueous waste that exhibits a pH of less than or equal to 2.0 or greater than or equal to 12.5 is considered corrosive. Liquids that that corrode steel at rates exceeding 1/4 inch per year at 55° Celsius (130° F) are also characteristic hazardous wastes. The literal reading of the regulations state that these values are for liquid wastes. These are classified as D002 wastes.
- Reactivity (40 CFR §26I.23): Any waste that is normally unstable and readily undergoes violent change without detonating, reacts violently with water, or forms potentially explosive mixtures or generates toxic fumes in sufficient quantities when mixed with water is considered reactive. This category also addresses wastes which contain sulfide and cyanide. These are classified as D003 wastes.
- Toxicity (40 CFR §261.24): Toxicity testing was developed to simulate the leaching of contaminants from a landfill. The current procedure involves the extraction of contaminants using the Toxicity Characteristic Leaching Procedure (TCLP). The extraction is analyzed for up to 40 different constituents. These are classified as D004 – D043 wastes.

Characteristic wastes identified above, and those wastes that may be included as characteristic listed wastes in the future by the USEPA and TCEQ, will not be accepted for disposal at the Royal Oaks Landfill.

3.2 Analytical Requirements and Process Knowledge

The analytical data and/or process knowledge used to conduct the hazardous waste and industrial solid waste determinations referenced in Section 3.1 of this SWAP will be included with or referenced on a completed SWP Sheet as applicable. The Special Waste Coordinator/Analyst will have a thorough understanding of the regulations referenced above and any applicable sampling and testing requirements referenced on the SWP Sheet (see Appendix IVC-A).

Analytical Requirements – Any analytical data submitted to the Royal Oaks Landfill for use in the waste evaluation process shall meet the following criteria:

- Analytical data must be less than 18 months old (unless the generator demonstrates there has been no material change in the process generating the waste stream).

- The analytical report must be a final copy, legible, complete in all material respects, and signed.
- The analytical data must "correlate" with information contained in the SWP Sheet.
- The results must have the units of measure identified. (c) The detection limits should be included for results that are "non-detect."
- The analytical methods employed must accompany the analytical data, and
- Analytical sampling, analysis, and interpretations must be in material conformance with currently applicable State and Federal regulatory requirements.

Process Knowledge Requirements – Process knowledge may be used to demonstrate that a waste stream is not a prohibited hazardous or industrial solid waste. The following are examples of information that may be used to support a process knowledge determination:

- Review of MSDS sheets and manufacturers' literature.
- Historical analysis of representative samples from the waste stream.
- Review of constituents present in the waste stream and their physical properties.
- Consideration of potential contaminants, by-products or decomposition products.
- Review of the waste generating process to ensure that hazardous characteristics are not imparted on the waste stream.

3.3 Waste Acceptance Criteria

The Special Waste Coordinator/Analyst will utilize the waste-specific chemical and characteristic information submitted by the generator on the SWP Sheet and any accompanying analytical test results to determine the acceptability of a waste for disposal at the Royal Oaks Landfill. The objective is to confirm that the generator's waste stream is not a prohibited hazardous or industrial solid waste and is acceptable for disposal at the Royal Oaks Landfill in accordance with the regulations referenced above. The Special Waste Coordinator/Analyst will be responsible for maintaining and utilizing current regulatory guidelines and constituent limits for evaluation of wastes. The Special Waste Coordinator/Analyst also will be responsible for knowing and applying any applicable future changes to State and Federal disposal regulations, review and acceptance procedures.

Waste review procedures will include the following:

- The SWP Sheet will be reviewed for completeness.

- The SWP Sheet must be legibly filled out with addresses, contact names, phone numbers, and signatures.
- The "Waste Stream Information" must include sufficient information to provide the Special Waste Coordinator/Analyst a clear understanding of the waste type, origin, shipping method, and anticipated volume and frequency of disposal. This information will he used by the Special Waste Coordinator/Analyst to compare the waste with the appropriate State and Federal regulations. If the description is not explicit, additional information will be requested of the generator.
- The "Physical Characteristics of Waste" must include information on the chemical and physical properties of the waste sufficient to allow the Special Waste Coordinator/Analyst to confirm the generator's waste characterization and correlate the waste properties to the appropriate State and Federal regulations. It is important that all portions of this section of the SWP Sheet be completed by the generator of the waste, and that the generator executes the certification statement in the subsequent section on the SWP Sheet.

- Site Specific Evaluation – The Special Waste Coordinator/Analyst will confirm that each site-specific approval to accept and dispose of waste at the Royal Oaks Landfill complies with the following: (1) applicable TCEQ regulations governing the acceptance and disposal of wastes; (2) TCEQ Permit No. 1614B for the Royal Oaks Landfill; and (3) any TCEQ orders or other official directives concerning the acceptance and disposal of special waste at the facility.
- Request for Additional Information – The Special Waste Coordinator/Analyst may request additional information from the generator before rendering a decision. This may include additional analytical data, process descriptions, MSDS, or other applicable information. After review of the SWP Sheet is completed, the Special Waste Coordinator/Analyst will complete the appropriate section of the SWP Sheet, and copies of the approval will be provided to the generator.
- Executive Director Approval – The facility may receive additional types of waste pursuant to waste-specific and/or site-specific approvals issued by the Executive Director in response to requests by generators under Title 30 TAC §330.171(b)(2) or as otherwise authorized by the Executive Director pursuant to §§330.171 or 330.173.

4 PRE-RECEIPT AND RECORDKEEPING

The landfill operator must receive an approved SWP Sheet from the Special Waste Coordinator/Analyst prior to acceptance of the special waste for disposal. The landfill must keep a copy of the approved SWP Sheet on file in the Site Operating Record for the life of the site including the post-closure care period.

Landfill personnel will visually compare the material presented for disposal to the approved SWP Sheet to confirm that the physical characteristics (i.e., color, odor, and appearance) of the material match those detailed on the SWP Sheet. In the event that the physical characteristics of the waste are determined to differ from the approved waste stream, the Special Waste Coordinator/Analyst will be notified. The generator will be contacted and an attempt made to resolve the differences and the resolution will be documented on the SWP Sheet. If the differences in the waste load cannot be resolved at that time, the waste load will be rejected. The generator will be notified of the reasons for rejecting the load. Additional process and chemical analyses may be required to further characterize the waste.

A complete Non-Hazardous Manifest (if applicable) or Non-Hazardous Sludge Manifest (if applicable) will accompany each load of special waste delivered to the facility. Alternative versions of these manifests may be used where the forms are in accordance with applicable regulations.

5 RECERTIFICATION FREQUENCY

Generators of special waste are required to recertify their waste annually. If the waste has not significantly changed from the most recent characterization, generators of special waste are required to submit a recertification form annually stating that there are no changes in the waste characterization. At a minimum, every 3 years after the original analytical date special waste generators are required to recertify their waste (including providing updated analytical data) unless otherwise specified in the plan. This requirement is needed to verify that the waste has not significantly changed from the initial characterization. A new laboratory analysis and special waste profile will be required during the recertification process if there is a change of raw material used in the waste generating process, a change in the waste generating process itself, a change in a physical characteristic of the waste, or if new information has been documented concerning the human health effects of exposure to the waste. If any of the preceding information for a special waste changes prior to the annual recertification, the generator is required to submit a recertification form with the appropriate analytical data and special waste profile prior to the site accepting the waste for disposal. This requirement does not apply to wastes that are accepted for disposal on a one-time basis (i.e., spill clean-ups).

The facility may require a generator to recertify its waste stream more frequently than every three (3) years. This is recommended for waste streams that are variable due to process variations or if changes in the manufacturing process have occurred.

6 DISPOSAL AND SPILL PROCEDURES

6.1 Disposal

The landfill personnel will exercise appropriate care and safeguards when disposing of wastes. Only onsite personnel who have received waste training will be utilized for disposal of special wastes. In general, special wastes will be handled and disposed of at the site in a similar manner as municipal solid waste. The special waste will be off-loaded from transport trucks and disposed of at the appropriate unloading area/working face. The special waste will then be placed and spread using standard landfill equipment listed in Section 3 of the SOP. Specific handling/disposal procedures for certain wastes (e.g., dead animals, certain empty containers) will be in accordance with the TCEQ regulations governing their proper disposal and as described further in Section 4.20 of the SOP. The U.S. Drug Enforcement Agency will be contacted for specific destruction and disposal requirements of controlled substances (e.g., nonhazardous drugs, prescription medication) approved for acceptance and disposal.

6.2 Spill Procedures

In the event that there is a spill during the delivery and/or on-site management of the waste, the landfill personnel will first attempt to abate and contain the release at the source. Then the landfill personnel will recover or clean up the spilled material. Any cover soils (e.g., intermediate cover) that have come in contact with the waste will be collected and disposed of at the active working face. The affected area will then be re-covered consistent with the requirements of the Site Operating Plan (SOP). A notation of the incident will be made in the facility's Site Operating Record by landfill personnel.

7 WASTE DISCREPANCIES AND REJECTED LOADS

Documentation for approved wastes that arrive at the landfill for disposal will be reviewed by facility personnel. Any discrepancies (i.e., incomplete documentation, questionable waste characteristics) will be resolved prior to acceptance of the waste. In the event the discrepancies cannot be resolved, the waste load will be rejected. Discrepancies which will cause a load to be rejected include but are not limited to:

- An approval SWP Sheet is not on file at the landfill.
- A waste arrives without a required manifest.
- A waste arrives, and the waste does not match the description on the waste manifest.
- A waste arrives, and the information on the manifest is not sufficiently complete, is incorrect, or does not match the information provided on the SWP Sheet such that a correlation between the waste being shipped and the approved SWP Sheet cannot be made.
- A waste arrives and the SWP is expired or outdated.

In the event that the description or physical characteristics of a waste being presented for disposal at the landfill is determined to differ from that of an approved waste stream, the vehicle will be stopped, the waste will not be offloaded, and the generator/customer will be required to provide additional process knowledge and/or chemical analysis data to adequately identify the waste as required by this SWAP. If this additional information resolves the discrepancy(ies), the SWP Sheet will he annotated as such and the resolved load accepted. The request for additional information may not always result in resolving the issues, and in the event the discrepancy(ies) cannot be resolved, the waste load will be rejected.

Regulated hazardous waste, PCBs, radioactive, or other prohibited wastes are not authorized for disposal at the landfill facility. If such wastes are suspected or discovered, they will be isolated until the material can be adequately characterized. Appropriate handling procedures will be used to manage the material.

If the suspect material is determined to be a regulated hazardous waste or contain regulated levels of PCBs, radioactive, or other prohibited materials, the TCEQ will be notified of the incident and the planned disposition/remediation of the material. The proper disposition/remediation of the prohibited waste will be specific to the waste and will be implemented upon TCEQ concurrence and approval.

8 PERSONNEL TRAINING

Appropriate facility personnel will receive initial training on waste identification, screening, and management procedures. Refresher training will be provided to appropriate personnel on a regular basis. The training will be conducted by either in-house staff or outside specialists familiar with proper waste management procedures and the requirements of this SWAP. Documentation of the training will be placed in the facility's Site Operating Record and personnel files.

APPENDIX IVC-A

SPECIAL WASTE PROFILE (SWP) SHEET

Special Waste Profile

REPUBLIC SERVICES

Disposal Facility: --Select Facility--

Waste Profile #:

Sales Rep #:

I. Generator Information

Generator Name:

Generator Site Address:

City: County: State: --Select State-- Zip:

State ID/Reg No: State Approval/Waste Code: NAICS #:

Generator Mailing Address ☐ (if different)

City: County: State: --Select State-- Zip:

Generator Contact Name: Email:

Phone Number: Ext: Fax Number:

II. Billing Information

Bill To: Contact Name:

Billing Address: Email:

City: State: --Select State-- Zip: Phone:

III. Waste Stream Information

Name of Waste:

Process Generating Waste:

Type of Waste: --Select Waste Type-- Physical State: --Select Physical Stat Method of Shipment: --Select Shipment Methc

Estimated Volume: Volume Type: --Select Volume Type--

Frequency: --Select Frequency-- Disposal Consideration: --Select Disposal Consideration--

IV. Representative Sample Certification

☐ **No Sample Taken**

☐ **Sample Taken** **Type of Sample** --Select Sample Type--

Is the representative sample collected to prepare this profile and laboratory analysis, collected in accordance with U.S. EPA 40 CFR 261.20(c) guidelines or equivalent? ☐ **Yes** ☐ **No**

Sample Date: Sample ID Numbers or SDS:

Remember to attach Laboratory Analytical Report (and/or Material Safety Data Sheet) including Chain of Custody and required parameters provided for this profile.

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Special Waste Profile

REPUBLIC SERVICES

V. Physical Characteristics of Waste

Characteristic Components (must equal 100%:)	% By Weight (out of 100% - ranges acceptable):
1.	
2.	
3.	
4.	
5.	

Color:

Odor (describe):

Does Waste Contain Free Liquids? ☐ Yes ☐ No

% Solids:

pH:

Flash Point: °F

Attach Laboratory Analytical Report (and/or Material Safety Data Sheet) including Chain of Custody and required parameters provided for this profile.

RCRA Regulatory Questions

1. Does this waste or generating process contain regulated concentrations of the following Pesticides and/ or Herbicides: Chlordane, Endrin, Heptachlor (and its epoxides), Lindane, Methoxychlor, Toxaphene, 2,4-D, or 2,4,5-TP Silvex as defined in 40 CFR 261.33? ☐ Yes ☐ No
2. Does this waste contain reactive sulfides (greater than 500 ppm) or reactive cyanide (greater than 250 ppm) [reference 40 CFR 261.23(a)(5)]? ☐ Yes ☐ No
3. Does this waste contain regulated concentrations of Polychlorinated Biphenyls (PCBs) as defined in 40 CFR Part 761? ☐ Yes ☐ No
4. Does this waste contain concentrations of listed hazardous wastes defined in 40 CFR 261.31, 261.32, 261.33, including RCRA F-Listed Solvents? ☐ Yes ☐ No
5. Has this waste been delisted under 40 CFR 260.20 and 260.22? If yes, attach the final decision to delist the waste as published in the Federal Register. ☐ Yes ☐ No
6. Does this waste exhibit a Hazardous Characteristic as defined by Federal and/or State regulations? If Yes, identify the applicable waste code and specify if the waste is hazardous as defined by Federal, State or both? ☐ Yes ☐ No
7. Does this waste contain regulated concentrations of 2,3,7,8-Tetrachlorodibenzodioxin (2,3,7,8-TCCD), or any other dioxin as defined in 40 CFR 261.31? ☐ Yes ☐ No
8. Is this a regulated Medical or Infectious Waste as defined by Federal and/or State regulations? ☐ Yes ☐ No
9. Is this a regulated Radioactive Waste as defined by Federal and/or State regulations? ☐ Yes ☐ No
10. Is this a solid waste that is not a hazardous waste in accordance with 40 CFR 261.4(b)? If yes, please provide the corresponding regulatory citation. ☐ Yes ☐ No

Republic Services Waste Handling Questions

1. Does this waste generate heat or react when contacted with water/moisture? ☐ Yes ☐ No
2. Does the waste contain sulfur or sulfur by-products? ☐ Yes ☐ No
3. Is this waste generated at a State or Federal Superfund cleanup site subject to regulation under CERCLA? ☐ Yes ☐ No

4a. Is this waste from a TSD facility, TSD-like facility or consolidator (i.e. multiple wastes/multiple generators)? ☐ Yes ☐ No

4b. If yes to the above question, please provide clarification.

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Special Waste Profile

REPUBLIC SERVICES

VI. Certification

I hereby certify that I have knowledge about the waste material being offered for disposal ("Waste") and have the requisite authority to bind the Generator to the information contained in this Special Waste Profile ("Profile"). I further certify that to the best of my knowledge and belief, the information contained herein is a true, complete and accurate description of the Waste and all known or suspected hazards have been disclosed. All Analytical Results/Safety Data Sheets submitted are truthful and complete and are representative of the Waste.

I further certify that by utilizing this Profile, neither myself nor any other employee or representative of the company identified below ("Company") will deliver for disposal or attempt to deliver for disposal any Waste that: (i) is classified as toxic waste, hazardous waste or infectious waste; (ii) that does not conform to this Profile; or (iii) that this Disposal Facility is prohibiting from accepting by law. I shall immediately give written notice of any change or condition pertaining to the Waste not provided herein. Our Company hereby agrees to fully indemnify this Disposal Facility against any damages resulting from this Profile or Certification being inaccurate or untrue.

I understand that by attaching an electronic signature, I am signing this document and Company consents to complete this transaction and receive all related communications electronically, and agrees this document will be binding as though it had been physically signed. A printout of this Profile may be accepted with the same authority as the original.

Authorized Representative Name (Printed)	Title (Printed)	Company Name

Representative Signature	Date

Express Waste Profile

REPUBLIC SERVICES

Disposal Facility: --Select Facility--

Waste Profile #

Sales Rep #

I. Generator Information

Generator Name:

Generator Site Address:

City: County: State: --Select State-- Zip:

State ID/Reg No: State Approval/Waste Code: NAICS #:

Generator Mailing Address ☐ (if different)

City: County: State: --Select State-- Zip:

Generator Contact Name: Email:

Phone Number: Ext: Fax Number:

II. Billing Information

Bill To: Contact Name:

Billing Address: Email:

City: State: --Select State-- Zip: Phone:

III. Waste Stream Information

Name of Waste: ☐ Weathered Wood ☐ RCRA Empty Containers ☐ Treated Medical Waste ☐ Animal Carcass (non-infectious) ☐ Friable Asbestos ☐ Nonfriable Asbestos ☐ Tires ☐ Meth Contaminated Debris

Has a sample of this waste been taken? ☐ Yes ☐ No

Process Generating Waste:

Method of Shipment: --Select Shipment Method-- Complete if "other"

Frequency: --Select Frequency--

Estimated Annual Volume: Volume Type: --Select Volume Type--

Color: Odor:

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Express Waste Profile

REPUBLIC SERVICES

IV. Certification

I hereby certify that I have knowledge about the waste material being offered for disposal ("Waste") and have the requisite authority to bind the Generator to the information contained in this Special Waste Profile ("Profile"). I further certify that to the best of my knowledge and belief, the information contained herein is a true, complete and accurate description of the Waste and all known or suspected hazards have been disclosed. All Analytical Results/Safety Data Sheets submitted are truthful and complete and are representative of the Waste.

I further certify that by utilizing this Profile, neither myself nor any other employee or representative of the company identified below ("Company") will deliver for disposal or attempt to deliver for disposal any Waste that: (i) is classified as toxic waste, hazardous waste or infectious waste; (ii) that does not conform to this Profile; or (iii) that this Disposal Facility is prohibiting from accepting by law. I shall immediately give written notice of any change or condition pertaining to the Waste not provided herein. Our Company hereby agrees to fully indemnify this Disposal Facility against any damages resulting from this Profile or Certification being inaccurate or untrue.

I understand that by attaching an electronic signature, I am signing this document and Company consents to complete this transaction and receive all related communications electronically, and agrees this document will be binding as though it had been physically signed. A printout of this Profile may be accepted with the same authority as the original.

Authorized Representative Name (Printed)	Title (Printed)	Company Name
Authorized Representative Signature		Date

IVC-A-5

Special Waste Profile - Change

REPUBLIC SERVICES

I. Generator Information

This form may be used to request changes to an existing Special Waste Profile

Generator Name:

Name of Waste

Waste Profile #

II. Purpose of Change

Description of change requested and reason for change
(provide detailed explanation of why the change is requested following the appropriate checked circle below).

☐ Volume Increase By:

Is the analysis originally submitted with the Profile representative of the volume increase? ☐ Yes ☐ No ***If no, complete Section III below***

☐ Extend Expiration Date:

☐ Change or Add Landfill:

☐ Add Additional Laboratory Reports: ***Complete Representative Sample Certification; Section III below***

☐ Add MSDS:

☐ Generator Name Change:

☐ Other:

III. Representative Sample Certification

☐ **No Sample Taken**

☐ **Sample Taken** Type of Sample --Select Sample Type--

Is the representative sample collected to prepare this profile and laboratory analysis, collected in accordance with U.S. EPA 40 CFR 261.20(c) guidelines or equivalent? ☐ Yes ☐ No

Sample Date:

Sample ID Numbers:

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Special Waste Profile - Change

REPUBLIC SERVICES

IV. Certification

I hereby certify that I have knowledge about the waste material being offered for disposal ("Waste") and have the requisite authority to bind the Generator to the information contained in this Special Waste Profile – Change form ("Change Form"). I further certify that to the best of my knowledge and belief, the information contained herein is a true, complete and accurate description of all changes to the Waste since its last approved Profile and all known or suspected hazards have been disclosed. All Analytical Results/Safety Data Sheets submitted are truthful and complete and are representative of the Waste.

Our Company hereby agrees to fully indemnify this Disposal Facility against any damages resulting from this Change Form or Certification being inaccurate or untrue. I understand that by attaching an electronic signature, I am signing this document and Company consents to complete this transaction and receive all related communications electronically, and agrees this document will be binding as though it had been physically signed. A printout of this Change Form may be accepted with the same authority as the original.

Authorized Representative Name (Printed)	Title (Printed)	Company Name

Representative Signature	Date

IVC-A-7

Special Waste Profile - Recertification

Disposal Facility: --Select Facility--

Waste Profile #:

Sales Rep #:

I. Generator Information

Generator Name:

Generator Site Address:

City: County: State: --Select State-- Zip:

State ID/Reg No: State Approval/Waste Code: NAICS:

Generator Mailing Address ☐ (If different)

City: County: State: --Select State-- Zip:

Generator Contact Name: Email:

Phone Number: Ext: Fax Number:

II. Waste Stream Information

Name of Waste:

Check Section 1 or 2 below

1. ☐ ***There has been a change*** in the characteristics of the waste stream due to the following:
   a. Change of a raw material used in the waste generating process.
   b. Change in the waste generating process itself.
   c. Change in a physical characteristic of the waste.
   d. New information has been documented concerning the human health effects of exposure to the waste.

   If any of these changes have occurred, a new profile sheet must be completed, and new analysis and/or SDS must be provided as appropriate.

2. ☐ ***There have been no changes*** that would alter the physical characteristics of the special waste stream. Updated analytical may be required.

III. Representative Sample Certification

☐ **No Sample Taken**

☐ **Sample Taken** **Type of Sample** --Select Sample Type--

Is the representative sample collected to prepare this profile and laboratory analysis, collected in accordance with U.S. EPA 40 CFR 261.20(c) guidelines or equivalent? ☐ **Yes** ☐ **No**

Sample Date:

Sample ID Numbers:

IVC-A-8

IV. Certification

I hereby certify that I have knowledge about the waste material being offered for disposal ("Waste") and have the requisite authority to bind the Generator to the information contained in this Special Waste Profile ("Profile"). I further certify that to the best of my knowledge and belief, the information contained herein is a true, complete and accurate description of the Waste and all known or suspected hazards have been disclosed. All Analytical Results/Safety Data Sheets submitted are truthful and complete and are representative of the Waste.

I further certify that by utilizing this Profile, neither myself nor any other employee or representative of the company identified below ("Company") will deliver for disposal or attempt to deliver for disposal any Waste that: (i) is classified as toxic waste, hazardous waste or infectious waste; (ii) that does not conform to this Profile; or (iii) that this Disposal Facility is prohibiting from accepting by law. I shall immediately give written notice of any change or condition pertaining to the Waste not provided herein. Our Company hereby agrees to fully indemnify this Disposal Facility against any damages resulting from this Profile or Certification being inaccurate or untrue.

I understand that by attaching an electronic signature, I am signing this document and Company consents to complete this transaction and receive all related communications electronically, and agrees this document will be binding as though it had been physically signed. A printout of this Profile may be accepted with the same authority as the original.

Authorized Representative Name (Printed)	Title (Printed)	Company Name

Authorized Representative Signature	Date

Third Party Signature Authorization For Special Waste Disposal

REPUBLIC SERVICES

Date:

Profile Number:

This Authorization is only valid for 3 years from the above date.

For office use only.

To Whom It May Concern:

Name of Waste

Please be advised that the following company/individual has been appointed to work as our agent for purposes of managing waste materials that we may generate.

Name of Authorized Agent

Title

Name of Company

Telephone Number

The above broker/individual is authorized to act as our authorized agent for the following purposes:

- ☐ Complete and sign Special Waste Profile
- ☐ Complete and sign Special Waste Profile-Recertification
- ☐ Authorize amendments to Special Waste Profile
- ☐ Sign contracts to dispose and/or transport material
- ☐ Sign certifications necessary to comply with landfill requirements
- ☐ Sign manifests to initiate shipment to disposal facilities

I hereby certify that I have the requisite authority to grant agency authority on the behalf of Company to the Authorized Agent identified on this Third Party Signature Authorization form ("Authorization"). Our Authorized Agent will notify Company prior to taking any of the actions authorized above and will provide Company with copies of any documents bearing Company's name.

I understand that by attaching an electronic signature, I am signing this document and Company consents to complete this transaction and receive all related communications electronically, and agrees this document will be binding as though it had been physically signed. A printout of this Authorization may be accepted with the same authority as the original.

Name of Company

Mailing Address

Generator Contact (Print Name)

Title

Signature

Telephone Number

APPENDIX IVC-B

NON-HAZARDOUS WASTE MANIFESTS

05/20/2024

REPUBLIC SERVICES

Please print or type.

NON-HAZARDOUS WASTE MANIFEST

1598076

1. ☐ Generator's US EPA ID Number	☐ Generator's State ID Number	Manifest Document Number	2. Page 1 of

3. Generator's Name and Mailing Address	5. Generating Location (if different)
4. Phone ( )	6. Phone ( )

7. Transporter #1 Company Name	8. US EPA ID Number	9. Transporter #1's Phone
10. Transporter #2 Company Name	11. US EPA ID Number	12. Transporter #2's Phone
13. Designated T/S/D Facility Name and Site Address	14. US EPA ID Number	15. Facility's Phone

16. Waste Shipping Name and Description	17. Republic Services Approval # and Exp. Date	18. Containers		19. Total Quantity	20. Unit Wt/Vol
		No.	Type		
a.					
b.					
c.					

GENERATOR

21. Additional Descriptions for Materials Listed Above

22. Special Handling Instructions and Additional Information

23. **GENERATOR'S CERTIFICATION:** I hereby certify that the above named material is not a hazardous waste as defined by 40 CFR 261 or any applicable state law, has been properly described, classified and packaged, and is in proper condition for transportation according to applicable regulations; AND, if this waste is a treatment residue of a previously restricted hazardous waste subject to the Land Disposal Restrictions. I certify and warrant that the waste has been treated in accordance with the requirements of 40 CFR 268 and is no longer a hazardous waste as defined by 40 CFR 261.

Printed/Typed Name	Signature	Month	Day	Year

TRANSPORTER

24. **Transporter #1:** Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Month	Day	Year

25. **Transporter #2:** Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Month	Day	Year

T/S/D FACILITY

26. Discrepancy Indication Space

27. **Facility Owner or Operator:** Certification of receipt of waste materials covered by this manifest (except as noted in Item 19)

Printed/Typed Name	Signature	Month	Day	Year

REV. 09/20

ORIGINAL - RETURN TO GENERATOR

COM0000 RS-F15

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1614B

MAJOR PERMIT AMENDMENT APPLICATION

PART IV – SITE OPERATING PLAN
APPENDIX IVD
LIQUID WASTE BULKING FACILITY
OPERATING PLAN

Prepared for

Pine Hill Farms Landfill TX, LP

May 2024

STATE OF TEXAS
JASON E. EDWARDS
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LICENSED
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05/20/2024

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This document is intended for permitting purposes only.

STATE OF TEXAS
JASON E. EDWARDS
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PROFESSIONAL ENGINEER

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05/20/2024

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Liquid Waste Bulking Facility Drawings

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05/20/2024

LIST OF ACRONYMS

CFR – Code of Federal Regulations

EPA – U.S. Environmental Protection Agency

MSW – Municipal Solid Waste

OSHA – Occupational Health and Safety Administration

PCBs – polychlorinated biphenyls

SDP – Site Development Plan

SOP – Site Operating Plan

SWP – Special Waste Profile

SPCC – Spill Prevention Control and Countermeasure Plan

SWPPP – Storm Water Pollution Prevention Plan

TAC – Texas Administrative Code

TCEQ – Texas Commission on Environmental Quality

WAP – Waste Acceptance Plan

1 INTRODUCTION (TITLE 30 TAC §330.201)

This Liquid Waste Bulking Facility Operating Plan has been prepared for the liquid waste bulking facility at the Royal Oaks Landfill and contains the information required by Title 30 Texas Administrative Code (TAC) §330.201. The proposed liquid waste bulking facility will be located on the north portion of the waste footprint (Cell 9) as shown on Drawing 1 of Appendix IVD-A. Prior to closure of the site the liquid waste bulking facility will be relocated to its final location south of the footprint (refer to Drawing 2 of Appendix IVD-A). The proposed and final liquid waste bulking facilities will generally consist of a bulking agent storage area and a solidification area containing four separate mixing basins. The mixing basins will be constructed of metal (proposed bulking facility) or concrete (final bulking facility) with secondary containment for the liquid waste bulking facilities, respectively. Secondary containment consists of a geosynthetic clay liner beneath the mixing basins, containment of the 25-year, 24-hour storm event, and a 2-foot perimeter stormwater berm as an additional containment measure. Refer to Part IV, Section 4.2.4 for the maximum liquid waste bulking facility size.

As the proposed liquid waste bulking facility will be located in the footprint of the site, relocation of the facility will be required from time to time as the site develops. Relocation of the liquid waste bulking facility will be covered via a permit modification.

This operating plan includes provisions for facility management and facility operating personnel to meet the general and facility-specific requirements included in Subchapter E – Operational Standards for Municipal Solid Waste (MSW) Storage and Processing Units for the day-to-day operation of the facility. This operating plan will be retained onsite throughout the active life of the facility and until after certification of closure.

Since this liquid waste bulking facility is located within the Royal Oaks Landfill permit boundary, some requirements of Subchapter E are addressed in Part IV – SOP. Consistent with Title 30 TAC §330.201, this liquid waste bulking facility operating plan references the applicable section in the landfill SOP to minimize duplication and/or competing requirements. For example, the facility operating hours, sign requirements, and access road requirements listed in Sections 8.4, 8.5, and 8.7 of this plan all reference the landfill SOP. In addition, the waste acceptance procedures listed in Section 3 also reference the waste acceptance information listed in the landfill SOP and the facility Waste Acceptance Plan (WAP) included in Appendix IVA. The bulking facility will be operated within the parameters of the existing permit conditions (e.g., operating parameters listed in the existing SDP and SOP, waste acceptance rates, and traffic impact).

This operating plan provides guidance for facility management and operating personnel for daily operation of the liquid waste bulking facility. This operating plan also includes provisions for facility management and operating personnel to meet the general and facility-specific requirements.

2 PERSONNEL AND TRAINING

Personnel and training requirements are discussed in Section 2.1 and 2.2 of the SOP. As noted in the SOP, the operations manager will assign equipment operators, and other personnel to the liquid waste bulking facility, as needed, to operate this facility in compliance with this operating plan.

3 WASTE ACCEPTANCE AND ANALYSIS (TITLE 30 TAC §330.203 AND §330.205)

3.1 Properties and Characteristics of Waste (§330.203(a))

Typical liquid waste streams that will be accepted at the facility include, but are not limited to, sludges; septic tank pumpings (septic wastes); grease and grit trap wastes; Class 2 and 3 nonhazardous industrial wastes; Railroad Commission waste; wastes that are not classified as bulk liquids but do not pass the paint filter test; and other nonhazardous bulk liquids. These liquids will be transported to the facility by private or public haulers in vacuum trucks, tank trucks, and sealed containers. The liquids will originate from restaurants and food processing plants, car and truck washes, oil and gas related industrial operations, and other commercial and industrial facilities.

As discussed in Section 4.20 of Part IV – SOP, special waste and industrial waste will be pre-characterized prior to acceptance of the waste material following the guidelines in Part IV – SOP, Section 4.20 and the WAP included in Appendix IVA.

As required by the SOP and WAP included in Appendix IVA, incoming liquid waste will be documented on a Special Waste Profile (SWP) Sheet or other required manifest. An example of a SWP is included in Appendix IVD-B. The pre-characterization by the generator will include analytical testing and/or process information as necessary to make the determination that the waste is nonhazardous. No waste material will be accepted at the site that is not pre-characterized or does not have the proper manifest(s). Regulated hazardous wastes that require authorization under Title 30 TAC Chapter 335 will not be accepted at the site.

General expected characteristics of the grease trap waste stream to be handled are:

Fats, oils and greases:	6 – 8%
Solids:	20 – 25%
Water:	65 – 75%
pH:	4.5 – 5.5
BOD_5/COD:	10,000 – 60,000 mg/l

Grit trap solids are dirt and sand, with occasional small amounts of large solids (e.g., gravel and rocks). The grit trap liquid fraction will likely contain some oil, normally in small quantities. This is petroleum oils from crankcase drippings, road oils, grease and oil washed from engines, and other similar sources. This liquid will normally have a low BOD_5 (Biological Oxygen Demand). Additionally some retail/commercial and industrial facilities have grit traps to collect sediment from floor washing activities.

Septic waste and portable toilet waste is typically composed of approximately 2 to 5 percent total solids with the remainder being water. BOD_5 and COD (Chemical Oxygen Demand) levels may be in the 3000-9000 mg/l range. Non-hazardous grease may be about 500 mg/l and the pH is in the range of 4.0 to 8.0.

The parameters listed above provide typical characteristics for the respective liquid waste. Parameters for the above waste streams are not limiting parameters that will impact or influence the design or operation of this liquid waste bulking facility. Liquid wastes that exhibit characteristics outside of the typical characteristic ranges may be accepted at the facility provided that they are reviewed and approved by site personnel prior to receipt. Wastes will be reviewed by the site's Special Waste Analyst and the Operations Manager or his designee to verify that the waste is not incompatible. In addition, Republic will utilize the experience gained at this facility and others in verifying that wastes are not incompatible. In general, there are no incompatibilities with the diverse waste streams listed above. However, if a new or unique waste stream is introduced, the site may perform bench scale compatibility tests (e.g., pH, flammability, acid and base reaction, pit compatibility, etc.) on incoming wastes to verify that the wastes are not incompatible with other wastes or bulking agents. Bulking agents listed in Section 3.3 may be considered for use for solidifying any liquid wastes. Bulking agents are not limiting parameters that impact or influence the design or operation of this liquid waste bulking facility.

Documentation of the waste characterization process will be maintained at the facility in the Site Operating Record, as discussed in the SOP and WAP. Sampling and analysis completed will be done according to EPA-approved methods. Liquid wastes processed at the liquid waste bulking facility will be disposed of at the working face after the material is solidified. No other discharge of waste material will come from this facility.

3.2 Volume and Rate of Transfer (§330.203(b) and §330.205(a) and (b))

The solidification capacity, storage capacity, and maximum storage time for the proposed solidification basins is summarized in the following table.

Criteria	Proposed Solidification Basins	Final Solidification Basins[2]
Solidification Capacity Per Day	78,750	242,500 gallons
Storage Capacity	31,500	97,000 gallons
Maximum Storage Time	72 hours[1]	72 hours[1]

[1] Liquid wastes will be processed within 72 hours except certain liquid wastes as noted in Sections 5.1 and 8.10. Solidification of liquid waste being stored in the basins will be initiated within 24 hours.
[2] Capacity includes capacity in basin for liquid waste and bulking agents.

The Royal Oaks Landfill will maintain documentation at the facility that all wastes leaving the liquid waste bulking facility for landfill disposal are being adequately managed by the site.

In the event of equipment failure or other operational breakdown expected to last longer than the allowable maximum storage time, acceptance of liquid waste will cease and any unprocessed liquid waste in the basins will be transported to another licensed or permitted facility.

Incoming loads of liquid waste will be inspected to verify that the contents and nature of the liquid waste is consistent with the Special Waste Profile. After the load has been determined to be acceptable, it will be directed to the solidification area for discharge into the solidification basins. Bulking agents will be added intermittently during the bulking process or once the solidification basin contains enough liquid waste. The bulking will be conducted in the solidification basin using an excavator or equivalent machinery to add and mix the bulking agent with the liquids. The bulking agent may include crushed cement/wood fiber wallboard, fly ash, kiln dust, foundry dust, saw dust, wood chips, and auto shredder fluff or other approved materials listed in Section 3.3 which have been classified by the generator as being non-hazardous. The solidified liquid material must be able to pass a paint filter test, as described in EPA publication #SW-846, before it is transferred to the working face for disposal.

Operators at the liquid waste bulking facility will use radio communication with the working face operators prior to transporting loads of solidified liquids to ensure that all loads are disposed of in the proper manner. In the event the solidified liquid does not pass the paint filter test, additional bulking agents will be added and mixed until the desired solidification is achieved. Liquid waste as defined in Title 30 TAC §330.15(e)(6), except as allowed in §330.177, will not be disposed of at the landfill.

3.3 Bulking Agents

The bulking agent used in the liquid waste solidification process may be crushed cement/wood fiber wallboard, lime, fly ash, kiln dust, foundry dust fines or dust from inert waste material, sawdust, wood chips, auto shredder fluff, rice hulls, or other acceptable materials, as approved by the TCEQ. All bulking agents will meet the waste acceptance limitations for disposal at the facility. Bulking agents will be stored on the all-weather surface area for the existing solidification operation, and within the secondary containment berm for the future solidification operation. The following is a brief description of selected bulking agents.

Crushed Cement/Wood Fiber Wallboard

Crushed cement/wood fiber wallboard is a fibrous cement board used in construction (i.e., siding, shingles, etc.). When crushed, it is very effective in solidifying many types of sludge.

Lime

Lime is a grayish-white powder, often called quicklime. It is obtained by heating (calcimining) limestone and releasing carbon dioxide from the calcium carbonate. Lime has been used in similar processes for many years and is very effective in solidifying many types of sludges.

Fly Ash

Fly ash is the particulate matter collected in air pollution control equipment used for cleaning flue gas from burning pulverized coal. It has been used in similar processes almost as long as lime and is very effective in solidifying many types of sludges.

Kiln Dust

Kiln dust is the particulate matter collected in air pollution control equipment used for cleaning exhaust gases from kilns in the manufacture of cement. It is very effective in solidifying many types of sludges.

Foundry Dust

Foundry dust is the particulate matter collected in air pollution control equipment used for cleaning exhaust gases from the casting of metals in a foundry. It is very effective in solidifying many types of sludges. Foundry dust mixing ratios vary greatly depending on the foundry process.

Fines or Dust from Inert Waste Material

This material consists of inert particulate matter that is typically disposed of at the landfill. The material typically has a relatively small grain size and has absorbent properties. Examples of this material include off-spec powder material, fibrous textiles, or foam material.

Sawdust

Woodworking machines produce large quantities of sawdust. The particulate matter that is removed from the air exhaust systems for these machines can be used to solidify grease trap waste. Other types of sawdust material (e.g., dust from industrial processes) with larger particles may be placed on the waste to temporarily control odors.

Wood Chips

Wood chips are produced through the grinding and chipping of wood material such as trees, stumps, and clean wood products. It has been effective in solidifying liquids and may be placed on top of the waste to control odors.

Auto Shredder Fluff

Auto shredder fluff (ASF) consists of the residual light fraction of shredder residue and may contain fibrous textiles, polyurethane foams, plastics, rubber, and a wide variety of light metal content. Prior to acceptance at the site, this material will be characterized following the procedures listed in the WAP (refer to Appendix IVA). In addition, Royal Oaks Landfill will require the ASF generator to submit waste profile information quarterly to document that the ASF contains less than 50 ppm of PCBs. Only ASF that has been classified by the generator as being non-hazardous may be accepted for disposal at the facility.

Rice Hulls

Rice hulls are produced as a by-product of rice production. It is an organic material that consists of the outer shell of grains of rice during the growing season. It contains absorbent properties that are effective for solidifying liquids.

4 CONTAMINATED WATER MANAGEMENT (TITLE 30 TAC §330.207)

The Royal Oaks Landfill will take the steps necessary to control and prevent the discharge of contaminated water from the liquid waste bulking facility. As noted in Part III – Site Development Plan, all liquids resulting from the operation of the Royal Oaks Landfill will be disposed of in a manner that will not cause surface water or groundwater pollution. All water coming in contact with waste will be treated as contaminated water. Runon and runoff for the 25-year, 24-hour storm event will be controlled following the procedures set forth in the SDP. Surface water will be directed away from the mixing basins by site grading. The facility will be operated consistent with Title 30 TAC §330.15(h)(1)-(4) regarding discharge of solid wastes or pollutants into waters of the United States.

Secondary containment for the liquid waste bulking facilities will be provided by maintaining 1 foot of freeboard in the basins and sloping the surrounding area toward the basins to contain rainfall for a 25-year, 24-hour storm event. The solidification basins for the liquid waste bulking facility will be constructed of concrete. The area under the concrete basins will be lined with a reinforced geosynthetic clay liner.

5 STORAGE REQUIREMENTS (TITLE 30 TAC §330.209 THROUGH §330.211)

5.1 Waste Storage (§330.209(a))

Consistent with Title 30 TAC §330.241 and Section 8.10, the facility will only accumulate waste in quantities that can be solidified within such time as will preclude the creation of odors, insect breeding, or harborage of other vectors. Solidification of liquid waste in a basin will be completed within 24 hours from its addition into the basins; and, subject to the total processing time limit specified below, multiple liquid waste additions and multiple completions of solidification in a basin may be allowed before the basin is emptied. If a mixing basin is processing grease trap waste, grit trap waste, or septage, the maximum processing time (i.e., starting from the receipt of the first waste to the time the basin is emptied) is 72 hours. The maximum processing time (i.e., starting from the receipt of the first waste to the time the basin is emptied) for non-grease trap, grit trap, or septage waste material is 7 days provided that the waste material does not create nuisance odors, insect breeding, or harborage of vectors. If such accumulations occur beyond these specified time limits, additional liquid waste materials will not be received until the adverse conditions are abated.

As noted above, the liquid waste material will be processed in the mixing basins. The actual time the waste material is stored in the mixing basin is a function of the rate of incoming liquid waste material. Solidification of liquid waste being stored in the basins will be initiated within 24 hours. Typically, the mixing basin is "pre-loaded" with the bulking agent. The liquid waste is added until the mixing basin reaches its capacity. For certain types of liquid waste material, the incoming waste is relatively slow and will take a few days to fully load the mixing basin. The processing period will vary depending upon the type and quantity of waste in each mixing basin. However, the storage period for processed waste in the basin will not exceed 72 hours for grease trap waste, grit trap waste, and septage (and the processing period will not exceed 7 days for other waste types) or a shorter period if the liquid waste material being processed has the potential to create a nuisance odor condition at the site.

Prior to the end of the 72-hour or 7-day period, the bulked waste will be disposed of in the landfill or transported and processed at a permitted offsite facility in the event of an operational breakdown. Bulked wastes must be able to pass the paint filter test (EPA SW-846/9095) before the solidified material is transported to the landfill working face for disposal.

The solidification basins will be covered while not in use (i.e., empty; processing not taking place; or storage of processed, unprocessed, or partially processed waste material) with a portable synthetic daily cover, a fitted, rigid cover, or equivalent. By covering the solidification basins the waste will be stored in a manner that does not constitute a fire, safety, or health hazard or provide food or harborage for animals and vectors.

5.2 Approved Containers (§330.211)

Liquid waste entering the facility is typically transported in vacuum trucks, tanker trucks, and sealed containers. These trucks are designed to prevent spillage or leakage during storage, handling, or transport.

The proposed liquid waste bulking facilities will consist of metal or concrete lined mixing basins with secondary containment. The mixing basins will be equipped with a portable synthetic daily cover, a fitted rigid cover, or equivalent that will be able to close the basins during mixing or down time. The solidification basins will be maintained in a manner so that they do not constitute a nuisance and to retard the harborage, feeding, and propagation of vectors.

As noted in Section 4.23 of the SOP, the mixing basins will be inspected daily, when in use, for damage to the basin walls and floors and to verify there are no indications of leaks from the basins (i.e., sudden drop in static liquid level). Mixing basins will be repaired on an as needed basis to prevent leaks. Damage repairs and maintenance activities will be documented in the Site Operating Record.

6 RECORDKEEPING AND REPORTING REQUIREMENTS (TITLE 30 TAC §330.219)

6.1 Documents (§330.219(a) and (b))

The Royal Oaks Landfill will maintain records on site as part of the Site Operating Record in accordance with Section 9 of the Site Operating Plan. Consistent with Title 30 TAC §330.219(a), copies of documents that are considered part of the operating record for the facility are listed in Section 9 of the SOP. In addition to the information listed in Section 9, the information listed below will also be maintained in the Site Operating Record.

Records to be Maintained in the Site Operating Record[1]	Frequency	Rule Citation
Documentation that wastes leaving the facility are being adequately managed by other licensed or permitted facilities	As needed	§330.205(a)
As-built set of construction plans for the Liquid Waste Bulking Facility	As needed	§330.219(a)
Additional analytical testing performed at the facility to verify compliance with this plan.	As needed	§330.219(b)(5)

[1] Also refer to Section 9 of the Site Operating Plan.

These documents will be made available for inspection by TCEQ representatives upon request.

6.2 Report Signatories (§330.219(c))

Royal Oaks Landfill personnel or an authorized representative of the Royal Oaks Landfill will sign all reports and other information requested by the Executive Director as described in Title 30 TAC §305.44(a). For a person to be an authorized representative of the Royal Oaks Landfill, the authorization must: (1) be made in writing as described in Title 30 TAC §305.44(a), (2) specify either an individual or a position having responsibility for the overall operation of the Royal Oaks Landfill, and (3) submitted in writing to the Executive Director.

If an authorization is no longer accurate because of a change in individuals or position, a new authorization must be submitted to the Executive Director prior to or with any submittal to be signed by an authorized representative. Any person signing a report will make the certification included in Title 30 TAC §305.44(b).

6.3 Notification (§330.219(e))

In accordance with Title 30 TAC §330.219(e), the Royal Oaks Landfill will furnish the operating record to the Executive Director upon request and will be made available at all reasonable times at the facility for inspection by the Executive Director. The operating record will be maintained in an organized format which allows the information to be easily located and retained in accordance with Title 30 TAC §330.125(c).

6.4 Record Retention (§330.219(f))

In accordance with Title 30 TAC §330.219(f), the site will retain all information contained within the operating record of the facility, and all plans required for the facility for the life of the facility until after certification of closure. The records will be kept on site and maintained as part of the Site Operating Record in accordance with Section 9 of the Site Operating Plan.

6.5 Alternative Schedules (§330.219(g))

In accordance with Title 30 TAC §330.219(g), the Executive Director, may set alternative schedules for recordkeeping and notification requirements as specified in §330.219(a).

6.6 Personnel Training Records and Licenses

The Royal Oaks Landfill will maintain personnel training records. Personnel training requirements will be consistent with Section 2 – Personnel and Training of the currently permitted SOP. Personnel training records for current facility personnel will be maintained until closure of the facility or for three years from the date the employee last worked at the facility. Records of former employees will be maintained for three years from the date the employee last worked at the facility. Records of the job title for each position at the Royal Oaks Landfill related to facility operations, and the name of the employee filling each job will be maintained at the facility. Records for each employee will include name, job title, job description, introductory training, continuing training, and documentation of training. The facility will maintain operator licenses for municipal solid waste supervisors as required by 30 TAC Chapter 30, Subchapter F. Personnel training records and personnel operator licenses will be maintained in the operating record as discussed in the SOP.

7 FIRE PREVENTION PROCEDURES (TITLE 30 TAC §330.221)

7.1 Fire Prevention Procedures

The following steps will be taken regularly by designated site personnel to prevent fires. Refer to Section 7 of the Site Operating Plan for additional fire prevention procedures.

- Open burning of waste is prohibited.
- Equipment used at the facility will be routinely cleaned through the use of water or steam cleaners. The water or steam cleaning will remove combustible waste and caked material which can cause equipment overheating and increase fire potential.
- Fuel spills will be contained and cleaned up immediately.
- Smoking is not allowed in the working areas of the site. Smoking is confined to designated areas only, away from the liquid waste bulking facility, fuel stations, and other fire-sensitive areas.
- In the event of an accidental fire, the fire will be extinguished by (1) smothering with soil, (2) applying water from a water truck, or (3) the use of a fire extinguisher. The facility will be equipped with fire extinguishers of a type, size, location, and number as recommended by the local fire department. 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. These inspections will be performed by a qualified service company, and all extinguishers will display a current inspection tag. Inspection and recharging will be performed following each use. At a minimum, all applicable equipment will have fire extinguishers.

7.2 General Rules for Fires

The following rules will be implemented in the event of a fire at the liquid waste bulking facility. Refer to Section 7 of the SOP for additional fire safety rules.

- Contact the local Fire Department by calling 911.
- Immediately contact the Operations Supervisor.
- Alert other facility personnel.

- Assess extent of fire, possibilities for the fire to spread, and alternatives for extinguishing the fire.
- If it appears that the fire can be safely fought with available firefighting devices until arrival of the Fire Department, attempt to contain or extinguish the fire.
- Upon arrival of 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.
- Firefighting methods include spraying the burning material with water from the hose. If detected soon enough, a small fire may be fought with a hand-held fire extinguisher.
- TCEQ notification will be handled consistent with Section 7.10 of the Site Operating Plan.

7.3 Specific Fire-Fighting Procedures

The following procedures will be followed in the event of a fire.

- If a fire occurs on a vehicle or piece of equipment, the operators should bring the vehicle or equipment to a safe stop. If safety of personnel will allow, the vehicle must be parked away from fuel supplies, wastes, and other vehicles. The engine should be shut off and the brake engaged to prevent movement of the vehicle. Fire extinguishers should be used to extinguish fire if possible, without risk to operators.
- If a fire is within the mixing basin, the burning area should be (1) extinguished with a fire extinguisher, (2) sprayed with water from the water truck, or (3) smothered with soil.
- Use the fire extinguishers located on the piece of equipment or the vehicle or the hose, as appropriate, to extinguish a fire.

7.4 Fire Protection Training

Site personnel will be trained in the contents of Section 7 – Fire Protection Plan of the SOP.

8 OPERATIONAL PROCEDURES (TITLE 30 TAC §330.223 THROUGH §330.249)

8.1 Access Control (§330.223)

8.1.1 Facility Security

Facility security will be handled consistent with Section 4.1.1 of the SOP. Entry to the facility will be restricted to designated personnel, appropriate subcontractors, approved waste haulers, the public, TCEQ personnel, and properly identified persons whose entry is authorized by facility management. Visitors may be allowed in the site only when accompanied by a facility representative.

8.1.2 Traffic Control

Traffic control will be handled consistent with Section 4.1.2 of the SOP. As discussed in the SOP, solid waste collection vehicles are directed to the liquid waste bulking facility by signs located along the entrance road. These vehicles will deposit their loads within the facility and depart the site. Waste hauling vehicles will be directed to the appropriate unloading area. Roads not being used for access will be blocked or otherwise marked for no entry. An adequate turning radius for the vehicles utilizing the facility will be provided to maintain normal traffic flow.

8.2 Unloading of Waste (§330.225)

8.2.1 Waste Unloading Procedures

General waste unloading procedures are discussed in Section 4.2 of the SOP. As discussed in the SOP, incoming liquid waste transport vehicles will be directed to the liquid waste bulking facility by the Scale House Staff once the vehicle incoming weight has been recorded. Signs directing traffic from the scale house to the liquid waste bulking facility will be located, as needed, along the route to the liquid waste bulking facility. Personnel working at the liquid waste bulking facility will inspect the load and direct the transport vehicle to the proper solidification basin. The unloading of waste will be directed by personnel working at the liquid waste bulking facility.

Unloading of waste in unauthorized areas will be prohibited. Any waste which is identified as having been deposited in an unauthorized area will be immediately contained and moved to the unloading areas.

Prohibited waste will not be allowed to enter the site. All waste loads will be visually inspected and accompanied by a generator waste profile sheet prior to being approved to unload. In the event prohibited wastes are identified in the load, the entire load will be turned away from the gate and not allowed entrance to the facility.

8.2.2 Procedures for the Detection and Prevention of Hazardous and PCB Waste

Procedures for the detection and prevention of the disposal of regulated hazardous waste as defined in 40 CFR Part 261 and polychlorinated biphenyl (PCB) wastes as defined in 40 CFR Part 761 are provided in this section.

Visual inspections of all incoming waste will be conducted at the sampling station or at another location where containment is provided and/or potential spills of unauthorized waste would be minimized (i.e., adjacent to the bulking facility).

Vehicles containing suspicious loads will be inspected. Suspicious loads may include:

- Drums or containers with warning labels
- Loads which have a visible emission, smoke, strong chemical odor, or cause physical symptoms (e.g., irritation of eyes, nose, throat, skin, nausea, dizziness, or headache)

The inspector will not inspect any vehicle that appears to present possible physical danger. The Operations Manager or his designee shall be contacted immediately if such a load enters the facility.

The inspections shall be conducted in a manner that allows the inspector to view the contents of the waste load. The inspector shall make an effort to view as much of the waste load as possible. The inspections will be conducted in an expeditious manner to minimize disruption to normal operations.

8.3 Spill Prevention and Control (§330.227)

The liquid waste bulking facility has been designed to control and contain spills and contaminated water. The areas around the liquid waste bulking facility slope toward the solidification basins to ensure any potential spills from vehicles will flow back into the solidification basins. The liquid waste bulking facility solidification basins will be covered while not in use with a portable synthetic daily cover, a fitted, rigid cover, or equivalent to prevent rainfall from entering the solidification tanks. Unenclosed containment areas (e.g., area within secondary containment berm) account for precipitation from a 25-year, 24-hour storm. The solidification basins will be constructed of concrete. The area under the concrete basins will be lined with a reinforced geosynthetic clay liner.

The solidification area pad will be constructed above natural grade. A containment berm will be constructed around the perimeter of the pad to contain stormwater and potential spills from vehicles. Stormwater on the pad will be drained through a pipe. If a spill occurs, a valve at the drain pipe will be closed and the liquid will be pumped to the basins for solidification.

8.4 Operating Hours (§330.229)

The liquid waste bulking facility may operate during the waste acceptance hours of the Royal Oaks Landfill (refer to Section 4.3 of the SOP).

8.5 Facility Sign (§330.231)

Facility signs will be placed in accordance with the Royal Oaks Landfill's approved SOP (refer to Section 4.4 of the SOP).

8.6 Control of Windblown Material and Litter (§330.233)

Windblown material and litter will be collected and properly managed to control unhealthy, unsafe, or unsightly conditions by the following methods:

- Bulking agents will be stored on the all-weather surface area within the secondary containment berm. If stormwater run-off or wind becomes an issue, the bulking stockpile will be reconfigured (e.g., reduced in size).
- Solidification basin lids may be used to cover the solidification basins during the mixing process.

8.7 Materials Along the Route to the Facility (§330.235)

This requirement is addressed in Section 4.8 of the SOP.

8.8 Facility Access Roads (§330.223(b) and §330.237)

As discussed in Section 4.12 of the SOP, the Royal Oaks Landfill has an existing paved entrance road. The access road to the liquid waste bulking facility will be an all-weather surface that provides for all weather access. The all-weather surface access and internal roads will provide mud control for the waste hauling vehicles prior to exiting the facility and returning to public access roads. It is not anticipated that mud or other debris will be tracked offsite, given the all-weather surface that exists on these roads. The entrance, access, and internal roads will be maintained in a safe condition.

8.9 Noise Pollution and Visual Screening (§330.239)

Liquid waste solidification will occur within the permit boundary. The proposed location of the liquid waste bulking facility is over 125 feet from the landfill permit boundary.

8.10 Overloading and Breakdown (§330.241)

The facility will only accumulate waste in quantities that can be processed within such time as will preclude the creation of odors, insect breeding, or harborage of other vectors. If the mixing basins are processing grease trap waste, grit trap waste, or septage, the maximum time waste material will be stored is 72 hours. The maximum time other waste material will be allowed to be stored is 7 days provided that the waste material does not create nuisance odors, insect breeding, or harborage of vectors. Solidification of liquid waste being stored in the basins will be initiated within 24 hours. If accumulations occur beyond these specified time limits, additional liquid waste materials will not be received until the adverse conditions are abated.

If a significant work stoppage (longer than 24 hours) should occur at the facility due to a mechanical breakdown or other causes, the site will accordingly restrict the receiving of liquid waste materials. Under such circumstances, incoming liquid waste shall be diverted. If the work stoppage is anticipated to last long enough to create objectionable odors, insect breeding, or harborage of vectors, steps shall be taken to remove the accumulated waste materials from the liquid waste bulking facility to an approved permitted offsite disposal facility.

8.11 Sanitation (§330.243)

When in use, the solidification basins will be washed down on a weekly basis at the completion of processing. During times when the facility is operating on a continuous basis, the liquid waste bulking area will be washed down at least two times per week. Wash water will drain to the mixing basin and may be solidified or removed from the mixing basins and transferred via TCEQ-registered trucks to a permitted wastewater treatment plant or a registered or permitted facility capable of handling liquid waste. The wash water will be removed or solidified on the same day it is generated.

8.12 Ventilation and Air Pollution Control (§330.245)

No significant air pollution emissions are expected to result from the operation of the facility. The liquid waste bulking facility is covered under the Royal Oaks Landfill Standard Air Permit for the site.

The operator will prevent nuisance odors from leaving the boundary of the facility. If nuisance odors are found to be passing the facility boundary, the site will immediately take action to abate the nuisance. Odors are controlled by large buffer areas to the facility from the permit boundary and solidification basin lids which will limit the liquid waste exposure to the environment. The solidification basins will be covered while not in use with a portable synthetic daily cover, a fitted, rigid cover, or equivalent to prevent nuisance odors. Options to abate odors may include, but are not limited to, systematically removing waste until the odor is eliminated or the use of appropriate mister equipment. In addition, site personnel may also develop a plan to identify specific waste streams that are causing the odor. These waste streams will be processed under an accelerated schedule to prevent odors.

8.13 Health and Safety (§330.247)

Facility personnel will be trained in appropriate sections of the facility's health and safety plan in accordance with the procedures outlined in Section 2 of this plan and as set forth in Section 2 of the SOP.

8.14 Employee Sanitation Facilities (§330.249)

Potable water and sanitary facilities are provided for all employees and visitors within the landfill facility.

9 FACILITY CLOSURE

Upon closure of the facility, any remaining waste will be solidified and transported to the working face for disposal. The solidification facility will be washed down and all bulking agents and related equipment will be removed from the facility.

The concrete mixing basins will be demolished, and the concrete debris will be disposed of on-site. Mixing basins may be disposed of at the MSW working face. Any soil below the basins that is visually stained will be excavated and disposed of in the landfill. In addition, the area under the liquid waste bulking facility will be sampled. Four shallow (0 to 6-inch depth) grab soil samples will be collected and placed into appropriate laboratory-prepared soil containers. The soil samples will be analyzed at a NELAC certified laboratory for TPH (method TX 1005), BTEX (EPA method 8260B), and RCRA metals (EPA methods 6010B and 7471A). The analytical results will be compared to the Texas Risk Reduction Program (TRRP) commercial soil Protective Concentration Levels (PCLs). If the sample results indicate no PCL exceedances, the solidification area will be backfilled to adjacent grade. If the sample results exceed a PCL, the facility will obtain TCEQ approval of a work plan designed to remove and dispose of the soil exceedances. The work plan will:

- identify the areas that are contaminated above TRRP commercial soil PCLs and quantify the estimated volume of soil material that will be removed;
- identify the methods to be used for soil excavation and disposal; and
- include a detailed sampling plan that will be implemented to verify that the contaminated soils exceeding TRRP commercial soil PCLs have been removed.

Verification that the work plan has been successfully implemented will be included in the Closure Certification Report.

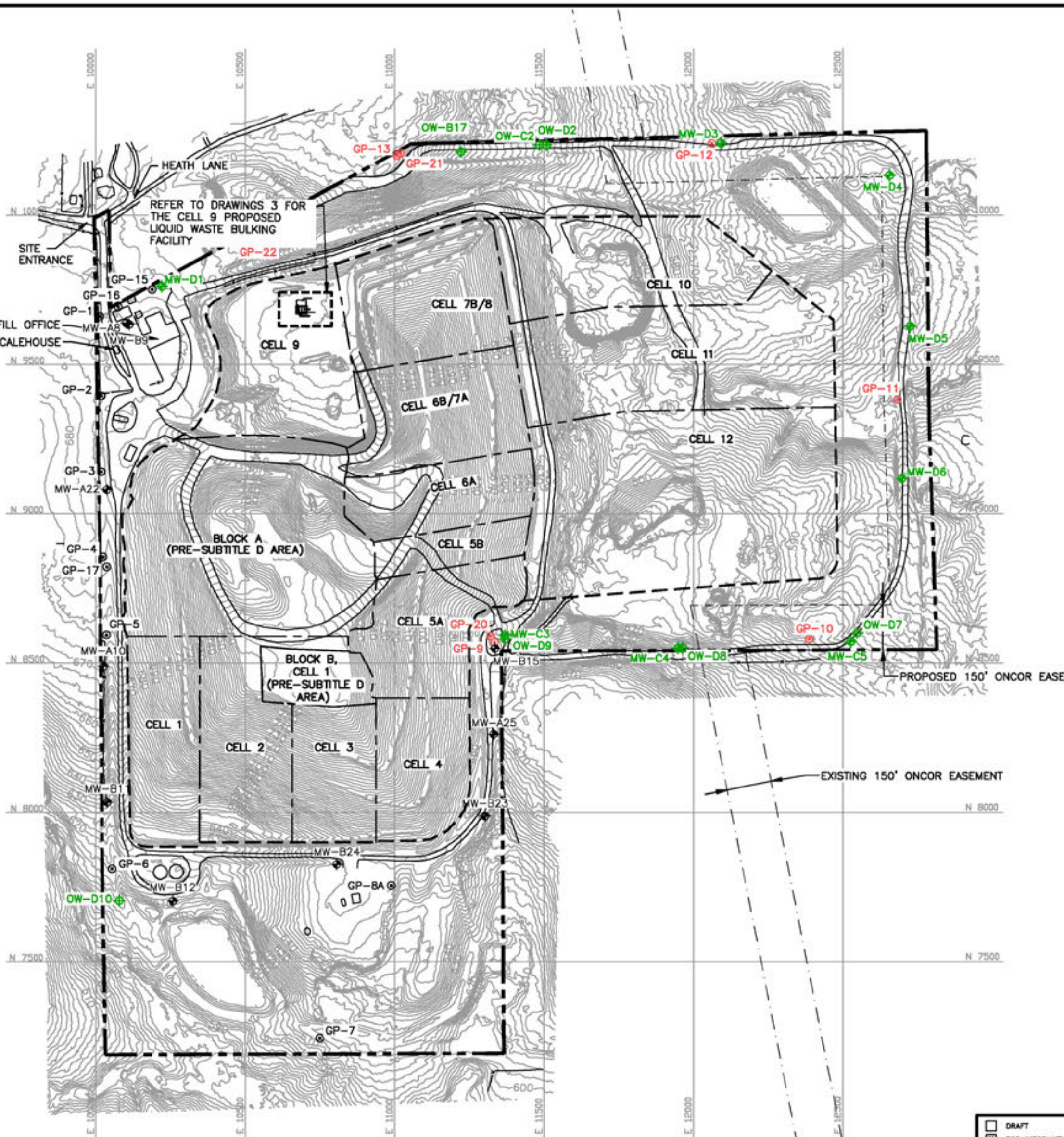
A description of the liquid waste bulking facility closure procedures (including soil sample results and verification that the work plan has been successfully implemented, if required) will be included in the closure certification report.

APPENDIX IVD-A

LIQUID WASTE BULKING FACILITY DRAWINGS

STATE OF TEXAS
JASON E. EDWARDS
99336
LICENSED
PROFESSIONAL ENGINEER

05/20/2024



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SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMIT OF WASTE
- CELL BOUNDARY
- EXISTING EASEMENT
- PROPOSED EASEMENT
- E 10500 SITE GRID
- 610 EXISTING CONTOUR (SEE NOTE 1)
- MW-10 EXISTING GROUNDWATER MONITORING WELL
- GP-1 EXISTING GAS PROBE

NOTES:

1. EXISTING CONTOURS DEVELOPED BY FIRMATEK FROM AERIAL PHOTOGRAPHY FLOWN NOVEMBER 10, 2022.
2. PERMIT BOUNDARY WAS REPRODUCED FROM LEGAL DESCRIPTION PROVIDED BY STANGER SURVEYING COMPANY, DATED APRIL 1995.

STATE OF TEXAS
JASON E. EDWARDS
99336
LICENSED
PROFESSIONAL ENGINEER
05/20/2024

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FILE: 0120-76-11	DESIGN BY: BPY
CAD: 1-SITE PLAN.DWG	REVIEWED BY: JAE

PREPARED FOR
PINE HILL FARMS LANDFILL TX, LP

REVISIONS

NO.	DATE	DESCRIPTION

Weaver Consultants Group
TBPE REGISTRATION NO. F-3727

MAJOR PERMIT AMENDMENT
SITE PLAN

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS

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DRAWING 1

LEGEND

- PERMIT BOUNDARY
- LIMIT OF WASTE
- E 10500 SITE GRID
- 610 EXISTING CONTOUR (SEE NOTE 1)
- EXISTING EASEMENT
- PROPOSED EASEMENT
- 700 PROPOSED FINAL COVER CONTOUR
- DRAINAGE SWALE
- DRAINAGE LETDOWN
- CHANNEL CENTERLINE
- MW-10 EXISTING GROUNDWATER MONITORING WELL
- MW-D1 PROPOSED GROUNDWATER MONITORING WELL
- GP-1 EXISTING GAS PROBE
- GP-10A PROPOSED GAS PROBE

NOTES:

1. EXISTING CONTOURS DEVELOPED BY FIRMATEK FROM AERIAL PHOTOGRAPHY FLOWN NOVEMBER 10, 2022. THE GRID SYSTEM IS BASED ON A SITE GRID SYSTEM. ELEVATIONS ARE BASED ON NAVD 88.
2. PERMIT BOUNDARY WAS REPRODUCED FROM LEGAL DESCRIPTION PROVIDED BY STANGER SURVEYING COMPANY, DATED APRIL 1995.

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CAD: 2-COMPLETION PLAN.DWG	REVIEWED BY: JAE

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MAJOR PERMIT AMENDMENT LANDFILL COMPLETION PLAN

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS

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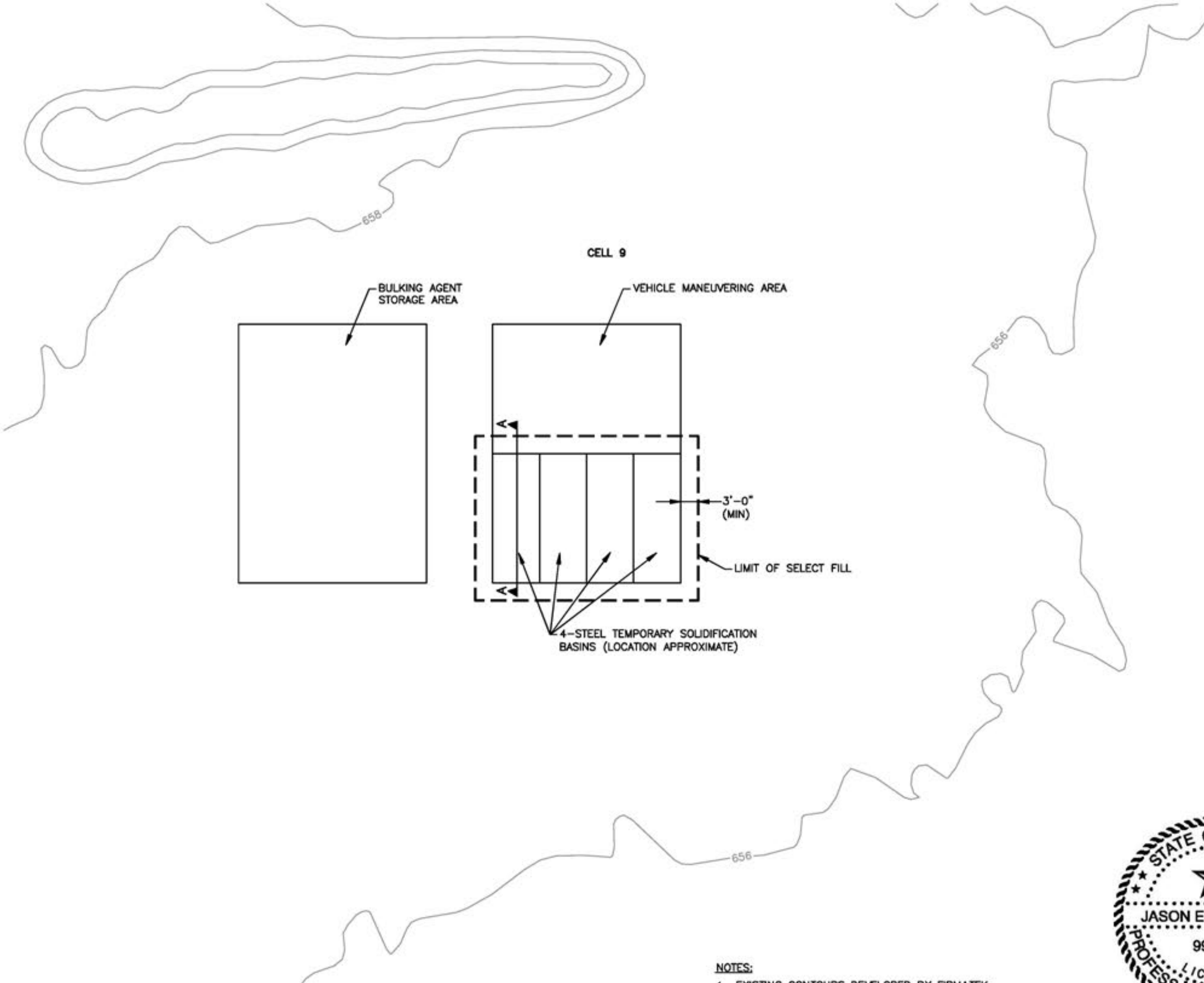
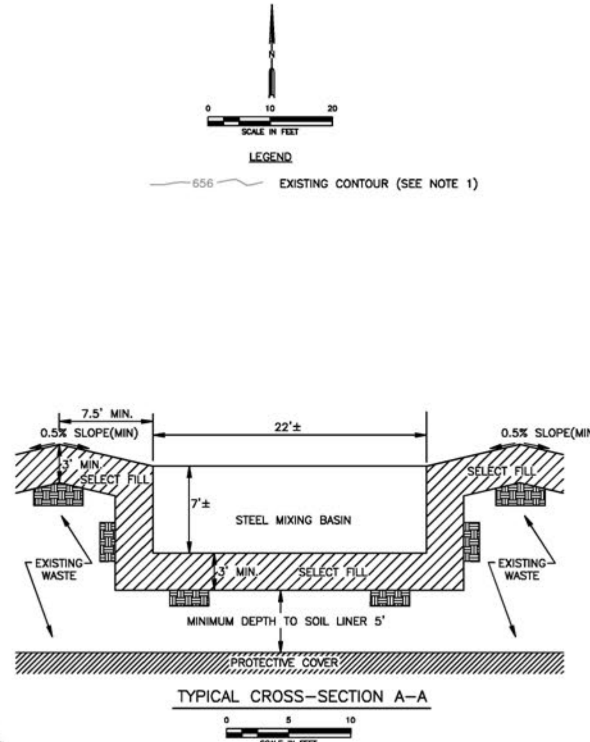
DRAWING 2





NOTES:

1. EXISTING CONTOURS DEVELOPED BY FIRMATEK FROM AERIAL PHOTOGRAPHY FLOWN NOVEMBER 10, 2022.

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CAD: 3-BULKING FACILITY.DWG

DRAWN BY: JDW
DESIGN BY: BPY
REVIEWED BY: JAE

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TBPE REGISTRATION NO. F-3727

PREPARED FOR
PINE HILL FARMS LANDFILL TX, LP

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
PROPOSED BULKING
FACILITY LAYOUT

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS

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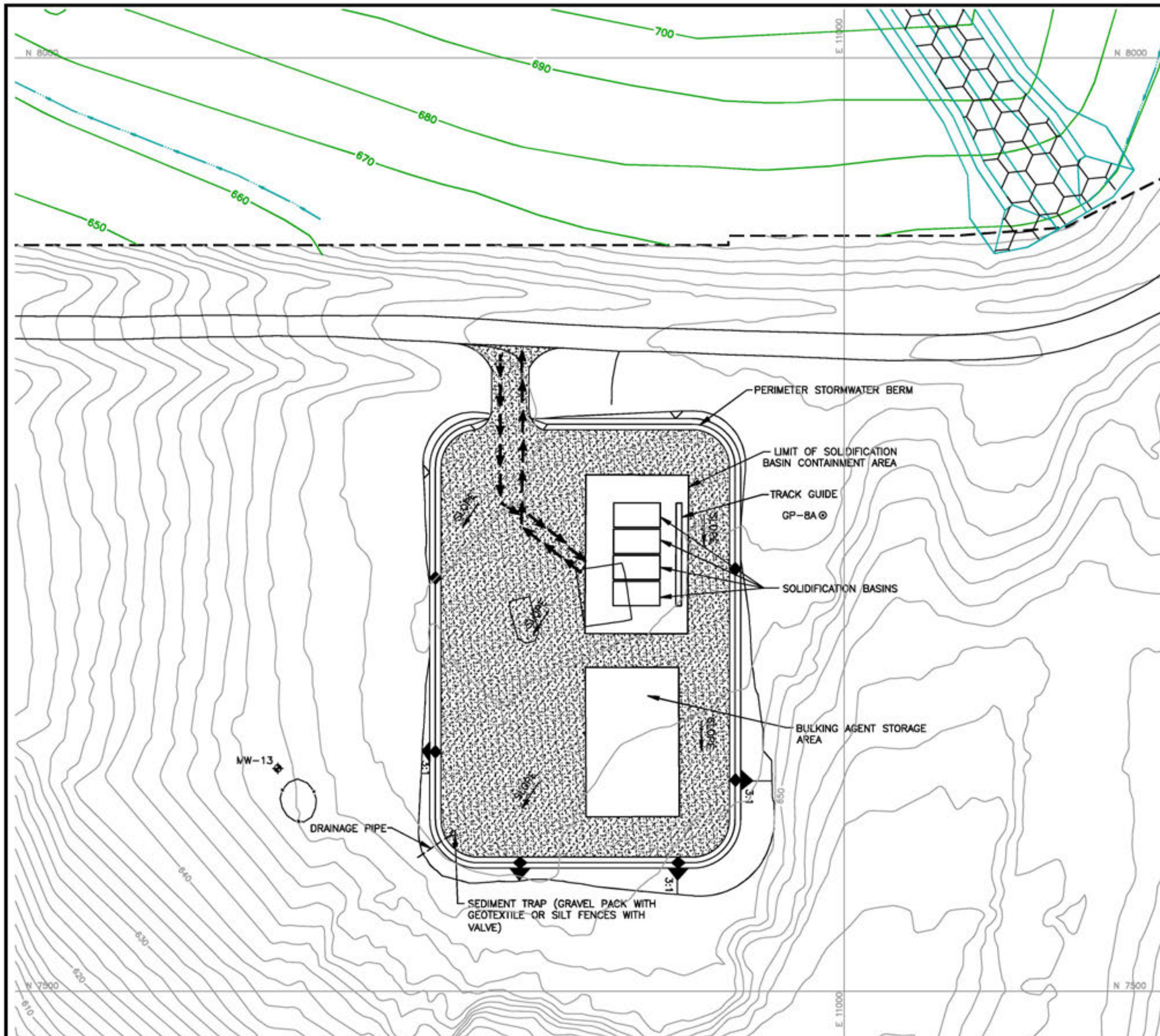
DRAWING 3



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SCALE IN FEET

LEGEND

(dashed line)	LIMIT OF WASTE
E 10500	SITE GRID
610	EXISTING CONTOUR (SEE NOTE 1)
700	PROPOSED FINAL COVER CONTOUR
	DRAINAGE SWALE
MW-13	EXISTING GROUNDWATER MONITORING WELL
GP-8A	EXISTING GAS PROBE
→	TRAFFIC FLOW
	ALL WEATHER ROAD AND PAD

NOTES:

1. EXISTING CONTOURS DEVELOPED BY FIRMATEK FROM AERIAL PHOTOGRAPHY FLOWN NOVEMBER 10, 2022.

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CAD: 4-TRAFFIC LAYOUT.DWG	REVIEWED BY: JAE

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PINE HILL FARMS LANDFILL TX, LP

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
FINAL LIQUID WASTE BULKING
TRAFFIC LAYOUT

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS

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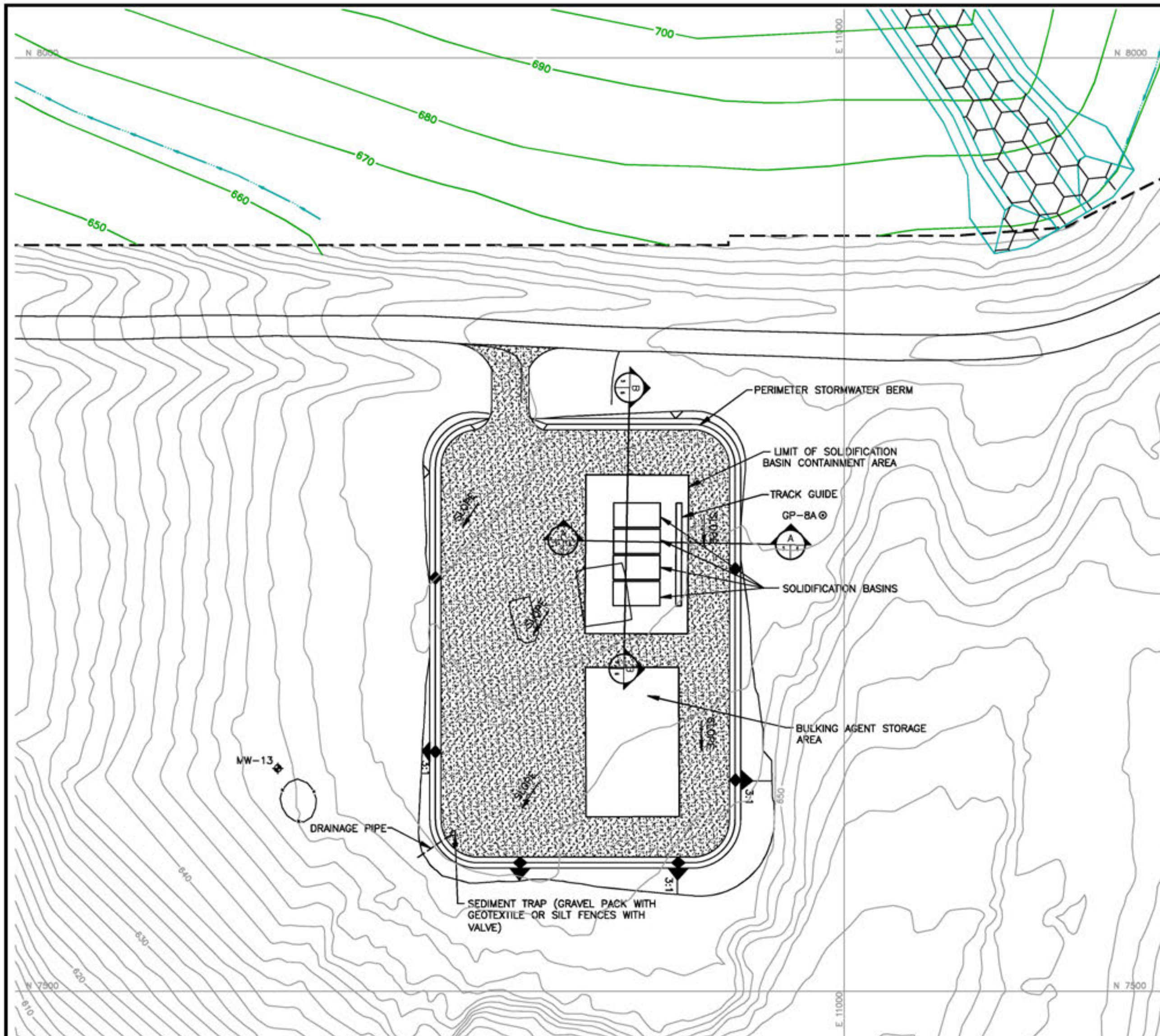

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SCALE IN FEET

STATE OF TEXAS
JASON E. EDWARDS
99336
LICENSED
PROFESSIONAL ENGINEER
05/20/2024

LEGEND

— — —	LIMIT OF WASTE
—700—	PROPOSED FINAL COVER CONTOUR
— · —	DRAINAGE SWALE
E 10500	SITE GRID
610	EXISTING CONTOUR (SEE NOTE 1)
MW-13	EXISTING GROUNDWATER MONITORING WELL
GP-8A	EXISTING GAS PROBE
	ALL WEATHER ROAD AND PAD

NOTES:

1. EXISTING CONTOURS DEVELOPED BY FIRMATEK FROM AERIAL PHOTOGRAPHY FLOWN NOVEMBER 10, 2022.
2. THE SOLIDIFICATION BASINS WILL HAVE PERIMETER RAILS THAT MEET ALL OSHA REQUIREMENTS. A TRACK GUIDE WILL BE INSTALLED ON ONE SIDE OF THE SOLIDIFICATION BASINS TO ALLOW MIXING EQUIPMENT TO MOVE SAFELY ALONG THE SOLIDIFICATION BASINS. IN ADDITION, PIPE WHEEL STOPS OR CURBING WILL BE INSTALLED ON THE UNLOADING SIDE OF THE BASINS TO PREVENT VEHICLES AND EQUIPMENT FROM ENTERING THE BASINS.
3. ACCESS TO THE LIQUID WASTE OPERATION AREA WILL BE PROVIDED BY THE ALL WEATHER ROAD MANUEVERING AREA.
4. A SECONDARY CONTAINMENT AREA WILL BE ESTABLISHED WITHIN THE MANUEVERING PAD AREA TO CAPTURE ANY SPILLAGE FROM THE TRANSPORT TRUCKS IF AN ACCIDENT OCCURS. LIQUID WASTE COLLECTED IN THE SECONDARY CONTAINMENT AREA WILL BE PUMPED INTO THE MIXING BASINS WHERE IT WILL BE PROCESSED FOR DISPOSAL.
5. SOLIDIFICATION BASINS ARE SHOWN FOR INFORMATIONAL PURPOSES ONLY. THE NUMBER OF BASINS AND THE SEQUENCE OF CONSTRUCTION MAY VARY. HOWEVER, THE LOCATION OF THE BASINS WILL BE CONSISTENT WITH THE CONFIGURATION SHOWN.
6. SOLIDIFICATION BASIN LIDS WILL BE USED OVER THE SOLIDIFICATION BASINS TO REDUCE AIRBORNE PARTICLES AND ODORS.
7. THE CONTAINMENT AREA WILL SLOPE TOWARD THE SOLIDIFICATION BASINS. THE REMAINDER OF THE ROAD AND PAD AREA WILL SLOPE AWAY FROM THE SOLIDIFICATION BASINS TO THE SEDIMENT TRAP. STORMWATER ON THE PAD AREA WILL CONTROLLED THROUGH THE SEDIMENT TRAP.
8. STORAGE MAY CONSIST OF A SILO AND/OR CONCRETE BUNKERS THAT MINIMIZE THE STORED BULKING AGENT'S EXPOSURE TO WIND. TYPICAL LOCATION IS SHOWN. IN ADDITION, BULKING AGENTS MAY ALSO BE STORED IN SOLIDIFICATION BASINS THAT ARE NOT BEING USED FOR SOLIDIFICATION.

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FILE: 0120-76-11 DESIGN BY: BPY
CAD: 5-FACILITY LAYOUT.DWG REVIEWED BY: JAE

Weaver Consultants Group
TBPE REGISTRATION NO. F-3727

PREPARED FOR
PINE HILL FARMS LANDFILL TX, LP

REVISIONS

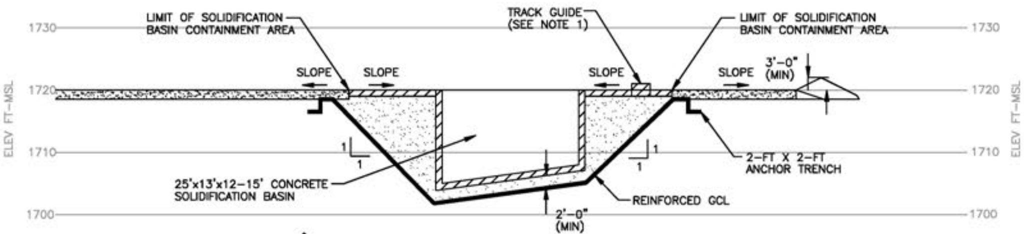
NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
FINAL LIQUID WASTE BULKING FACILITY PLAN

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS

WWW.WCGRP.COM DRAWING 5

O:\0120\76\EXPANSION 2023\PART IV\5-FACILITY LAYOUT.dwg, byoung, 1:2



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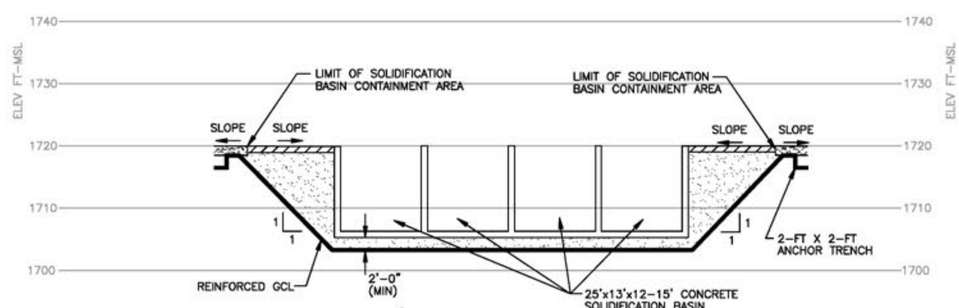

B TANK SECTION 5 6

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SCALE IN FEET

NOTES:

1. TRACK GUIDES WILL ALLOW MIXING EQUIPMENT TO MOVE SAFELY ALONG THE LENGTH OF THE SOLIDIFICATION BASINS.
2. THE PRE-MANUFACTURED LIQUID WASTE BULKING FACILITY BUILDING IS OPTIONAL. IF THE SITE CHOOSES NOT TO INSTALL A BUILDING, THE LIQUID WASTE BULKING SOLIDIFICATION AREA IS DESIGNED SO THAT THE VOLUME PROVIDED BY THE SOLIDIFICATION AREA IS GREATER THAN THE VOLUME OF THE 25-YR, 24 HR STORM EVENT AND 1 FOOT OF FREEBOARD. SEE THE SOLIDIFICATION BASIN AREA CONTAINMENT VOLUME CALCULATIONS.

SOLIDIFICATION BASIN AREA CONTAINMENT VOLUME CALCULATIONS

SOLIDIFICATION AREA CONTAINMENT WILL PROVIDE STORAGE TO CONTAIN THE 25-YEAR, 24-HOUR STORM EVENT (7.88 INCHES).

VOLUME OF 25-YR, 24-HR STORM = 7.88 INCHES x STORAGE AREA
= (7.88"/12") x 4,675 ft^2
STORAGE = 3,070 ft^3

VOLUME PROVIDED BY THE SOLIDIFICATION AREA:
VOLUME OF SOLIDIFICATION AREA=(25 ft. X 13 ft. X 13.5 ft.) x 4 basins
=4,387.5 ft^3 x 4
TOTAL CAPACITY=17,550 ft^3

VOLUME OF LIQUID IN THE SOLIDIFICATION AREA AT WORKING CAPACITY:
VOLUME OF WORKING CAPACITY=(25 ft. X 13 ft. X 10 ft.) x 4 basins
=3,250 ft^3 x 4
WORKING CAPACITY=13,000 ft^3

VOLUME NEEDED FOR THE REQUIRED 1 FOOT OF FREEBOARD PER TANK:
VOLUME OF 1 FOOT FREEBOARD=(25 ft. X 13 ft. X 1 ft.) x 4 basins
=325 ft^3 x 4
FREEBOARD=1,300 ft^3

VOLUME PROVIDED FOR THE 25-YR, 24-HR STORM EVENT AND 1 FOOT OF FREEBOARD PER TANK:
=TOTAL CAPACITY – WORKING CAPACITY
=17,550 ft^3 – 13,000 ft^3
=4,550 ft^3

VOLUME PROVIDED (4,550 ft^3) > VOLUME REQUIRED (STORAGE + FREEBOARD)
VOLUME PROVIDED (4,550 ft^3) > VOLUME REQUIRED (3,070 ft^3 + 1,300 ft^3)
VOLUME PROVIDED (4,550 ft^3) > VOLUME REQUIRED (4,370 ft^3)

THE VOLUME PROVIDED BY THE SOLIDIFICATION AREA IS GREATER THAN THE VOLUME OF THE 25-YR, 24 HR STORM EVENT AND 1 FOOT OF FREEBOARD.

05/20/2024

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DESIGN BY: BPY
REVIEWED BY: JAE

Weaver Consultants Group
TBPE REGISTRATION NO. F-3727

PREPARED FOR
PINE HILL FARMS LANDFILL TX, LP

REVISIONS

NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
BULKING FACILITY SECTIONS

ROYAL OAKS LANDFILL
CHEROKEE COUNTY, TEXAS

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DRAWING 6

APPENDIX IVD-B

EXAMPLE SPECIAL WASTE PROFILE (SWP) SHEET

Special Waste Profile

REPUBLIC SERVICES

Disposal Facility: --Select Facility--

Waste Profile #:

Sales Rep #:

I. Generator Information

Generator Name:

Generator Site Address:

City: County: State: --Select State-- Zip:

State ID/Reg No: State Approval/Waste Code: NAICS #:

Generator Mailing Address ☐ (if different)

City: County: State: --Select State-- Zip:

Generator Contact Name: Email:

Phone Number: Ext: Fax Number:

II. Billing Information

Bill To: Contact Name:

Billing Address: Email:

City: State: --Select State-- Zip: Phone:

III. Waste Stream Information

Name of Waste:

Process Generating Waste:

Type of Waste: --Select Waste Type-- Physical State: --Select Physical Stat Method of Shipment: --Select Shipment Metho

Estimated Volume: Volume Type: --Select Volume Type--

Frequency: --Select Frequency-- Disposal Consideration: --Select Disposal Consideration--

IV. Representative Sample Certification

☐ **No Sample Taken**

☐ **Sample Taken** **Type of Sample** --Select Sample Type--

Is the representative sample collected to prepare this profile and laboratory analysis, collected in accordance with U.S. EPA 40 CFR 261.20(c) guidelines or equivalent? ☐ **Yes** ☐ **No**

Sample Date: Sample ID Numbers or SDS:

Remember to attach Laboratory Analytical Report (and/or Material Safety Data Sheet) including Chain of Custody and required parameters provided for this profile.

Special Waste Profile

REPUBLIC SERVICES

V. Physical Characteristics of Waste

Characteristic Components (must equal 100%:)	% By Weight (out of 100% - ranges acceptable):
1.	
2.	
3.	
4.	
5.	

Color:	Odor (describe):	Does Waste Contain Free Liquids?	% Solids:	pH:	Flash Point:
		☐ Yes ☐ No			°F

Attach Laboratory Analytical Report (and/or Material Safety Data Sheet) including Chain of Custody and required parameters provided for this profile.

RCRA Regulatory Questions

1. Does this waste or generating process contain regulated concentrations of the following Pesticides and/ or Herbicides: Chlordane, Endrin, Heptachlor (and its epoxides), Lindane, Methoxychlor, Toxaphene, 2,4-D, or 2,4,5-TP Silvex as defined in 40 CFR 261.33? ☐ Yes ☐ No
2. Does this waste contain reactive sulfides (greater than 500 ppm) or reactive cyanide (greater than 250 ppm) [reference 40 CFR 261.23(a)(5)]? ☐ Yes ☐ No
3. Does this waste contain regulated concentrations of Polychlorinated Biphenyls (PCBs) as defined in 40 CFR Part 761? ☐ Yes ☐ No
4. Does this waste contain concentrations of listed hazardous wastes defined in 40 CFR 261.31, 261.32, 261.33, including RCRA F-Listed Solvents? ☐ Yes ☐ No
5. Has this waste been delisted under 40 CFR 260.20 and 260.22? If yes, attach the final decision to delist the waste as published in the Federal Register. ☐ Yes ☐ No
6. Does this waste exhibit a Hazardous Characteristic as defined by Federal and/or State regulations? If Yes, identify the applicable waste code and specify if the waste is hazardous as defined by Federal, State or both? ☐ Yes ☐ No
7. Does this waste contain regulated concentrations of 2,3,7,8-Tetrachlorodibenzodioxin (2,3,7,8-TCCD), or any other dioxin as defined in 40 CFR 261.31? ☐ Yes ☐ No
8. Is this a regulated Medical or Infectious Waste as defined by Federal and/or State regulations? ☐ Yes ☐ No
9. Is this a regulated Radioactive Waste as defined by Federal and/or State regulations? ☐ Yes ☐ No
10. Is this a solid waste that is not a hazardous waste in accordance with 40 CFR 261.4(b)? If yes, please provide the corresponding regulatory citation. ☐ Yes ☐ No

Republic Services Waste Handling Questions

1. Does this waste generate heat or react when contacted with water/moisture? ☐ Yes ☐ No
2. Does the waste contain sulfur or sulfur by-products? ☐ Yes ☐ No
3. Is this waste generated at a State or Federal Superfund cleanup site subject to regulation under CERCLA? ☐ Yes ☐ No

4a. Is this waste from a TSD facility, TSD-like facility or consolidator (i.e. multiple wastes/multiple generators)? ☐ Yes ☐ No

4b. If yes to the above question, please provide clarification.

REPUBLIC SERVICES

VI. Certification

I hereby certify that I have knowledge about the waste material being offered for disposal ("Waste") and have the requisite authority to bind the Generator to the information contained in this Special Waste Profile ("Profile"). I further certify that to the best of my knowledge and belief, the information contained herein is a true, complete and accurate description of the Waste and all known or suspected hazards have been disclosed. All Analytical Results/Safety Data Sheets submitted are truthful and complete and are representative of the Waste.

I further certify that by utilizing this Profile, neither myself nor any other employee or representative of the company identified below ("Company") will deliver for disposal or attempt to deliver for disposal any Waste that: (i) is classified as toxic waste, hazardous waste or infectious waste; (ii) that does not conform to this Profile; or (iii) that this Disposal Facility is prohibiting from accepting by law. I shall immediately give written notice of any change or condition pertaining to the Waste not provided herein. Our Company hereby agrees to fully indemnify this Disposal Facility against any damages resulting from this Profile or Certification being inaccurate or untrue.

I understand that by attaching an electronic signature, I am signing this document and Company consents to complete this transaction and receive all related communications electronically, and agrees this document will be binding as though it had been physically signed. A printout of this Profile may be accepted with the same authority as the original.

Authorized Representative Name (Printed)	Title (Printed)	Company Name

Representative Signature	Date

Express Waste Profile

REPUBLIC SERVICES

Disposal Facility: --Select Facility--

Waste Profile #

Sales Rep #

I. Generator Information

Generator Name:

Generator Site Address:

City: County: State: --Select State-- Zip:

State ID/Reg No: State Approval/Waste Code: NAICS #:

Generator Mailing Address ☐ (if different)

City: County: State: --Select State-- Zip:

Generator Contact Name: Email:

Phone Number: Ext: Fax Number:

II. Billing Information

Bill To: Contact Name:

Billing Address: Email:

City: State: --Select State-- Zip: Phone:

III. Waste Stream Information

Name of Waste: ☐ Weathered Wood ☐ RCRA Empty Containers ☐ Treated Medical Waste ☐ Animal Carcass (non-infectious)
☐ Friable Asbestos ☐ Nonfriable Asbestos ☐ Tires ☐ Meth Contaminated Debris

Has a sample of this waste been taken? ☐ Yes ☐ No

Process Generating Waste:

Method of Shipment: --Select Shipment Method-- Complete if "other"

Frequency: --Select Frequency--

Estimated Annual Volume: Volume Type: --Select Volume Type--

Color: Odor:

IVD-B-4

Express Waste Profile

REPUBLIC SERVICES

IV. Certification

I hereby certify that I have knowledge about the waste material being offered for disposal ("Waste") and have the requisite authority to bind the Generator to the information contained in this Special Waste Profile ("Profile"). I further certify that to the best of my knowledge and belief, the information contained herein is a true, complete and accurate description of the Waste and all known or suspected hazards have been disclosed. All Analytical Results/Safety Data Sheets submitted are truthful and complete and are representative of the Waste.

I further certify that by utilizing this Profile, neither myself nor any other employee or representative of the company identified below ("Company") will deliver for disposal or attempt to deliver for disposal any Waste that: (i) is classified as toxic waste, hazardous waste or infectious waste; (ii) that does not conform to this Profile; or (iii) that this Disposal Facility is prohibiting from accepting by law. I shall immediately give written notice of any change or condition pertaining to the Waste not provided herein. Our Company hereby agrees to fully indemnify this Disposal Facility against any damages resulting from this Profile or Certification being inaccurate or untrue.

I understand that by attaching an electronic signature, I am signing this document and Company consents to complete this transaction and receive all related communications electronically, and agrees this document will be binding as though it had been physically signed. A printout of this Profile may be accepted with the same authority as the original.

Authorized Representative Name (Printed)	Title (Printed)	Company Name

Authorized Representative Signature	Date

IVD-B-5

Special Waste Profile - Change

REPUBLIC SERVICES

I. Generator Information

This form may be used to request changes to an existing Special Waste Profile

Generator Name:

Name of Waste Waste Profile #

II. Purpose of Change

Description of change requested and reason for change
(provide detailed explanation of why the change is requested following the appropriate checked circle below).

☐ Volume Increase By:

Is the analysis originally submitted with the Profile representative of the volume increase? ☐ Yes ☐ No ***If no, complete Section III below***

☐ Extend Expiration Date:

☐ Change or Add Landfill:

☐ Add Additional Laboratory Reports: ***Complete Representative Sample Certification; Section III below***

☐ Add MSDS:

☐ Generator Name Change:

☐ Other:

III. Representative Sample Certification

☐ **No Sample Taken**

☐ **Sample Taken** **Type of Sample** --Select Sample Type--

Is the representative sample collected to prepare this profile and laboratory analysis, collected in accordance with U.S. EPA 40 CFR 261.20(c) guidelines or equivalent? ☐ **Yes** ☐ **No**

Sample Date: Sample ID Numbers:

REPUBLIC SERVICES

IV. Certification

I hereby certify that I have knowledge about the waste material being offered for disposal ("Waste") and have the requisite authority to bind the Generator to the information contained in this Special Waste Profile – Change form ("Change Form"). I further certify that to the best of my knowledge and belief, the information contained herein is a true, complete and accurate description of all changes to the Waste since its last approved Profile and all known or suspected hazards have been disclosed. All Analytical Results/Safety Data Sheets submitted are truthful and complete and are representative of the Waste.

Our Company hereby agrees to fully indemnify this Disposal Facility against any damages resulting from this Change Form or Certification being inaccurate or untrue. I understand that by attaching an electronic signature, I am signing this document and Company consents to complete this transaction and receive all related communications electronically, and agrees this document will be binding as though it had been physically signed. A printout of this Change Form may be accepted with the same authority as the original.

Authorized Representative Name (Printed)	Title (Printed)	Company Name

Representative Signature	Date

IVD-B-7

Special Waste Profile - Recertification

REPUBLIC SERVICES

Disposal Facility: --Select Facility--

Waste Profile #:

Sales Rep #:

I. Generator Information

Generator Name:

Generator Site Address:

City: County: State: --Select State-- Zip:

State ID/Reg No: State Approval/Waste Code: NAICS:

Generator Mailing Address ☐ (if different)

City: County: State: --Select State-- Zip:

Generator Contact Name: Email:

Phone Number: Ext: Fax Number:

II. Waste Stream Information

Name of Waste:

Check Section 1 or 2 below

1. ☐ ***There has been a change*** in the characteristics of the waste stream due to the following:
   a. Change of a raw material used in the waste generating process.
   b. Change in the waste generating process itself.
   c. Change in a physical characteristic of the waste.
   d. New information has been documented concerning the human health effects of exposure to the waste.

   If any of these changes have occurred, a new profile sheet must be completed, and new analysis and/or SDS must be provided as appropriate.

2. ☐ ***There have been no changes*** that would alter the physical characteristics of the special waste stream. Updated analytical may be required.

III. Representative Sample Certification

☐ **No Sample Taken**

☐ **Sample Taken** **Type of Sample** --Select Sample Type--

Is the representative sample collected to prepare this profile and laboratory analysis, collected in accordance with U.S. EPA 40 CFR 261.20(c) guidelines or equivalent? ☐ **Yes** ☐ **No**

Sample Date:

Sample ID Numbers:

IVD-B-8

Special Waste Profile - Recertification

REPUBLIC SERVICES

IV. Certification

I hereby certify that I have knowledge about the waste material being offered for disposal ("Waste") and have the requisite authority to bind the Generator to the information contained in this Special Waste Profile ("Profile"). I further certify that to the best of my knowledge and belief, the information contained herein is a true, complete and accurate description of the Waste and all known or suspected hazards have been disclosed. All Analytical Results/Safety Data Sheets submitted are truthful and complete and are representative of the Waste.

I further certify that by utilizing this Profile, neither myself nor any other employee or representative of the company identified below ("Company") will deliver for disposal or attempt to deliver for disposal any Waste that: (i) is classified as toxic waste, hazardous waste or infectious waste; (ii) that does not conform to this Profile; or (iii) that this Disposal Facility is prohibiting from accepting by law. I shall immediately give written notice of any change or condition pertaining to the Waste not provided herein. Our Company hereby agrees to fully indemnify this Disposal Facility against any damages resulting from this Profile or Certification being inaccurate or untrue.

I understand that by attaching an electronic signature, I am signing this document and Company consents to complete this transaction and receive all related communications electronically, and agrees this document will be binding as though it had been physically signed. A printout of this Profile may be accepted with the same authority as the original.

Authorized Representative Name (Printed)	Title (Printed)	Company Name

Authorized Representative Signature	Date

IVD-B-9

Third Party Signature Authorization For Special Waste Disposal

REPUBLIC® SERVICES

Date:

Profile Number:

This Authorization is only valid for 3 years from the above date.

For office use only.

To Whom It May Concern:

Please be advised that the following company/individual has been appointed to work as our agent for purposes of managing waste materials that we may generate.

Name of Waste

Name of Authorized Agent

Title

Name of Company

Telephone Number

The above broker/individual is authorized to act as our authorized agent for the following purposes:

- ☐ Complete and sign Special Waste Profile
- ☐ Complete and sign Special Waste Profile-Recertification
- ☐ Authorize amendments to Special Waste Profile
- ☐ Sign contracts to dispose and/or transport material
- ☐ Sign certifications necessary to comply with landfill requirements
- ☐ Sign manifests to initiate shipment to disposal facilities

I hereby certify that I have the requisite authority to grant agency authority on the behalf of Company to the Authorized Agent identified on this Third Party Signature Authorization form ("Authorization"). Our Authorized Agent will notify Company prior to taking any of the actions authorized above and will provide Company with copies of any documents bearing Company's name.

I understand that by attaching an electronic signature, I am signing this document and Company consents to complete this transaction and receive all related communications electronically, and agrees this document will be binding as though it had been physically signed. A printout of this Authorization may be accepted with the same authority as the original.

Name of Company

Mailing Address

Generator Contact (Print Name)

Title

Signature

Telephone Number

March 2021