CITY OF CITY OF CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN

SITE DEVELOPMENT PLAN

Prepared for
City of Del Rio

September 2023



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LIST OF ACRONYMS

ASTM - American Society for Testing and Materials

BER - Ballast Evaluation Report

BMPs - Best Management Practices

CFR - Code of Federal Regulations

CLOMR - Conditional Letter of Map Revision

CMP - Corrugated Metal Pipe

CN - Curve Number

COC - Chain-Of-Custody

CQA - Construction Quality Assurance

CU - Consolidated-Undrained

EDE - Elevation of The Deepest Excavation

EPA - Environmental Protection Agency

ETJ - Extra Territorial Jurisdiction

FAA - Federal Aviation Administration

FEMA - Federal Emergency Management Agency

FIRM - Flood Insurance Rate Map

FT-MSL - Feet Above Mean Sea Level

FWS - U.S. Fish and Wildlife Service

GWSAP - Groundwater Sampling and Analysis Plan

HDPE - High Density Polyethylene

LCS - Leachate Collection System

LEL - Lower Explosive Limit

LFG - Landfill Gas

LQCP - Liner Quality Control Plan

MCLs - Maximum Contaminant Levels

MRGDC – Middle Rio Grande Development Council

MSL - Mean Sea Level

MSW - Municipal Solid Waste

NAAQS - National Ambient Air Quality Standards

NFIP - National Flood Insurance Program

NOI - Notice of Intent

NSF - National Sanitation Foundation

NSPS - New Source Performance Standards

NWP - Nationwide Permit

NWS - National Weather Service

O&M - Operations and Maintenance

PCBs - Polychlorinated Biphenyls

PI - Point of Intersection

PVI - Point of Vertical Intersection

POR - Professional of Record

POTW - Publicly Owned Treatment Works

QA/QC - Quality Assurance/Quality Control

RCRA - Resource Conservation Recovery Act

SBP - Soil Boring Plan

SCS - Soil Conservation Service

SDP - Site Development Plan

SLER - Soils and Liner Evaluation Report

SOP - Site Operating Plan

TAC - Texas Administrative Code

TCEQ - Texas Commission on Environmental Quality

TDH - Texas Department of Health

THC - Texas Historical Commission

TPDES - Texas Pollutant Discharge Elimination System

TPWD - Texas Parks and Wildlife Department

TWC - Texas Water Commission

TWDB - Texas Water Development Board

TxDOT - Texas Department of Transportation

UEL - Upper Explosive Limit

USACE - United States Army Corps of Engineers

USCS - Unified Soil Classification System

USGS - United States Geological Survey

USLE - Universal Soil Loss Equation

UTM - Universal Transverse Mercator System

1.0 INTRODUCTION (§330.63(a))

This Site Development Plan (SDP) for the City of Del Rio Landfill has been prepared consistent with the MSW regulations within Title 30 TAC Chapter 330, including §330.63. This SDP provides the design details needed to provide for the safeguarding of the health, welfare, and physical property of the people and the environment through consideration of geology, soil conditions, drainage, land use, zoning, and adequacy of access roads and highways.

This Major Permit Amendment is prepared to obtain authorization for a vertical and lateral expansion of the City of Del Rio Landfill. The existing 79-acre waste disposal and 105.6-acre permit boundary area will be expanded to 110.3 acres and 180.6 acres respectively. The maximum permitted final cover elevation will be increased from 1113 ft-msl to 1124 ft-msl. The permitted capacity will be increased by 3.65 million cubic yards, resulting in a total remaining capacity of 5.6 million cubic yards.

2.0 GENERAL FACILITY DESIGN (§330.63(b))

2.1 Facility Access (§330.63(b)(1))

2.1.1 Site Access

The existing permit boundary of the City of Del Rio Landfill is located within the limits of the City of Del Rio (City) in Val Verde County, Texas. The 75-acre expansion area sits just outside the City limits and is located in the unincorporated area of Val Verde County. The site is accessed via US 90. The site entrance is located approximately 2.5 miles west of the intersection of US 90 and Loop 79. Access to the site is controlled by a gate. The gate is locked when the site is not in operation.

2.1.2 Access Control

Vehicle access to the landfill will be controlled at the site entrance by signs that direct all landfill traffic to the scalehouse during site operating hours. Personnel on duty at the entrance regulate access to the landfill. Outside operating hours, the gate to the site will be locked to prevent unauthorized vehicle access. An existing minimum 4-foot-high, 3-strand barbed wire fence is located along the property boundary limits to prevent unauthorized access to the site.

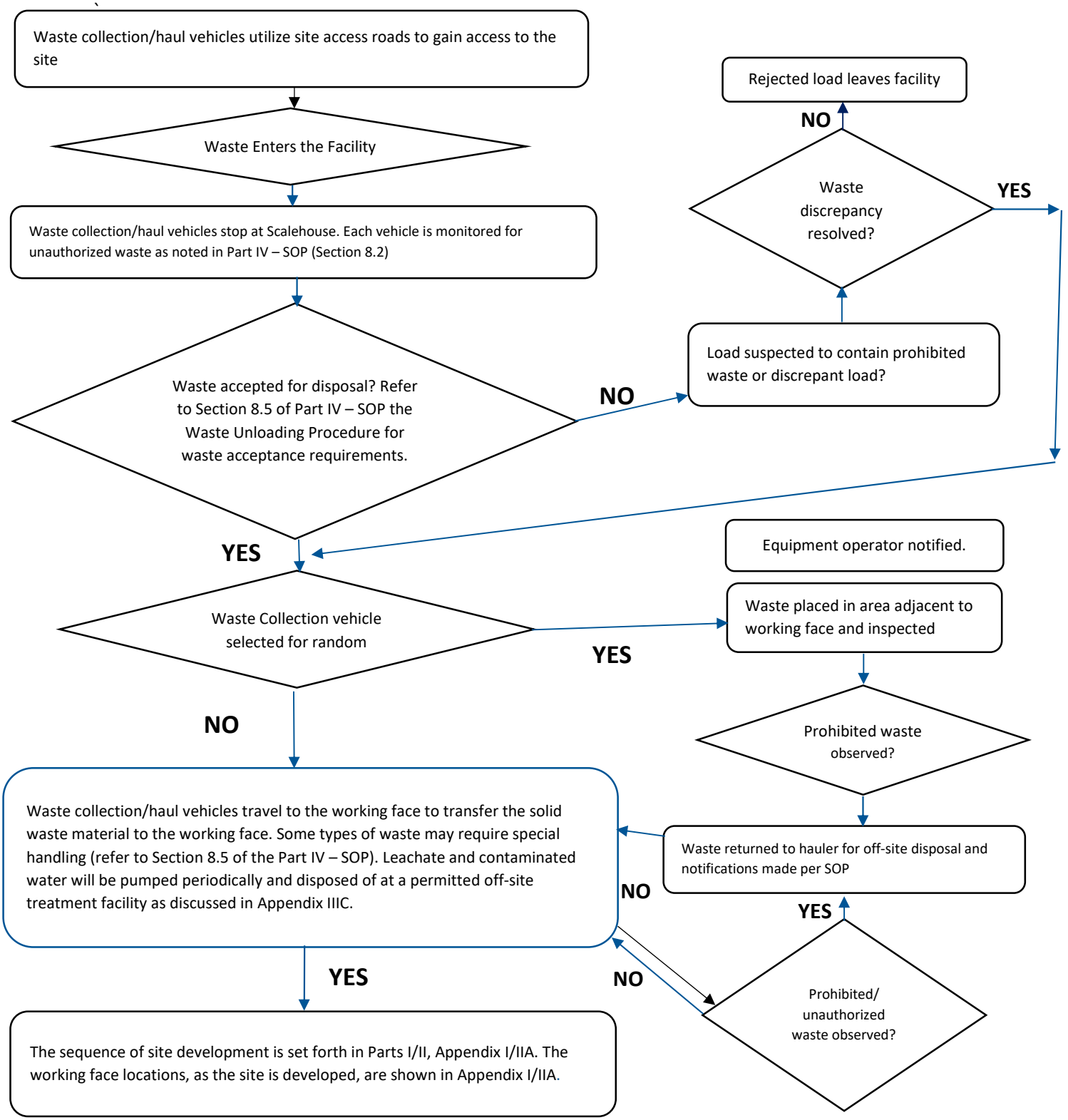
The City of Del Rio will restrict entry to the landfill to designated site operations personnel, solid waste haulers authorized to use the facility, TCEQ personnel, and properly identified persons whose entry is authorized by the Landfill Coordinator or his designee. The City reserves the right to deny access to the landfill to persons not demonstrating a legitimate purpose for visiting. Visitors are allowed on the active area of the landfill only when accompanied by the Landfill Coordinator or his designee.

2.2 Waste Movement (§330.63(b)(2))

2.2.1 Waste Movement Flow Diagram (§330.63(b)(2)(A))

Figure III-2.1 provides a waste movement flow diagram for the City of Del Rio Landfill. The flow diagram provides a summary of the disposal sequence for waste that is accepted at the facility. Detailed waste acceptance procedures are detailed in Part IV – Site Operating Plan (SOP).

Figure III-2.1
Waste Movement Flow Diagram



2.2.2 Waste Disposal Schematic View (§330.63(b)(2)(B))

Figure III-2.2 provides a schematic view of the City of Del Rio Landfill. There are no additional waste processing units within the permit boundary. Additional detailed drawings are provided in Parts I/II, Appendix I/IIA; Part III, Appendix IIIA; and throughout the SDP.

2.2.3 Ventilation and Odor Control (§330.63(b)(2)(C))

Landfill disposal operation will occur in open areas within the permitted waste disposal footprint; therefore, adequate ventilation will be provided. The site will comply with all the applicable air quality rules and regulations. The site will operate in accordance with the New Source Performance Standards (NSPS) for MSW landfills, if applicable.

Steps will be taken to limit the impact of the facility's operation on air quality. Among the measures set forth in the SOP to be employed are:

- Accidental fires will be controlled,
- Open burning of waste will not be permitted,
- Incoming waste will be promptly compacted into the working face area, and
- Ponded water at the site will be controlled.

Odors shall be controlled at the site and will be reduced if they occur in accordance with the Odor Management Plan included in Section 19 of the SOP. 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, 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. Leachate may also be a source of odor if not properly handled or disposed of in a timely manner. Among the measures listed in the SOP that may be employed to reduce potential odors are:

- Minimize the size of the working face area.
- Increase the thickness of soil daily cover and/or ADC applied to the working face.
- Prevent ponded water. Ponded water will be prevented through the use of lateral drainage.
- Identify any waste stream that requires special attention to control odor.

2.2.4 Generalized Construction Details (§330.63(b)(2)(D))

Generalized construction details for the landfill are included in Appendix IIIA of this SDP. Details of the leachate management system are included in Appendix IIIC.

2.3 Water Pollution Control (§330.63(b)(4))

The site is designed to prevent discharge of pollutants into waters of the state or waters of the United States, as defined by the Texas Water Code and the Federal Clean Water Act, respectively. The City of Del Rio Landfill is subject to TCEQ's storm water permit requirements. A copy of the TPDES permit is included in Appendix I/IID. Surface water monitoring will be conducted consistent with TPDES requirements.

2.4 Protection of Endangered Species (§330.63(b)(5))

Information regarding the protection of endangered species in accordance with Title 30 TAC §330.61(n) and §330.63(b)(5) is provided in Parts I/II, Section 12 – Protection of Endangered Species; and Part IV, Section 23. No federally endangered or threatened species have been documented at the site nor has a critical habitat for such species been identified at the site. Neither the facility nor its operation will result in the destruction or adverse modification of the critical habitat of federally endangered or threatened species. If endangered or threatened species are encountered during site operations, Texas Parks and Wildlife and U.S. Fish and Wildlife will be notified. A site specific Threatened and Endangered Species Habitat Assessment is included in Parts I/II, Appendix I/IIB.

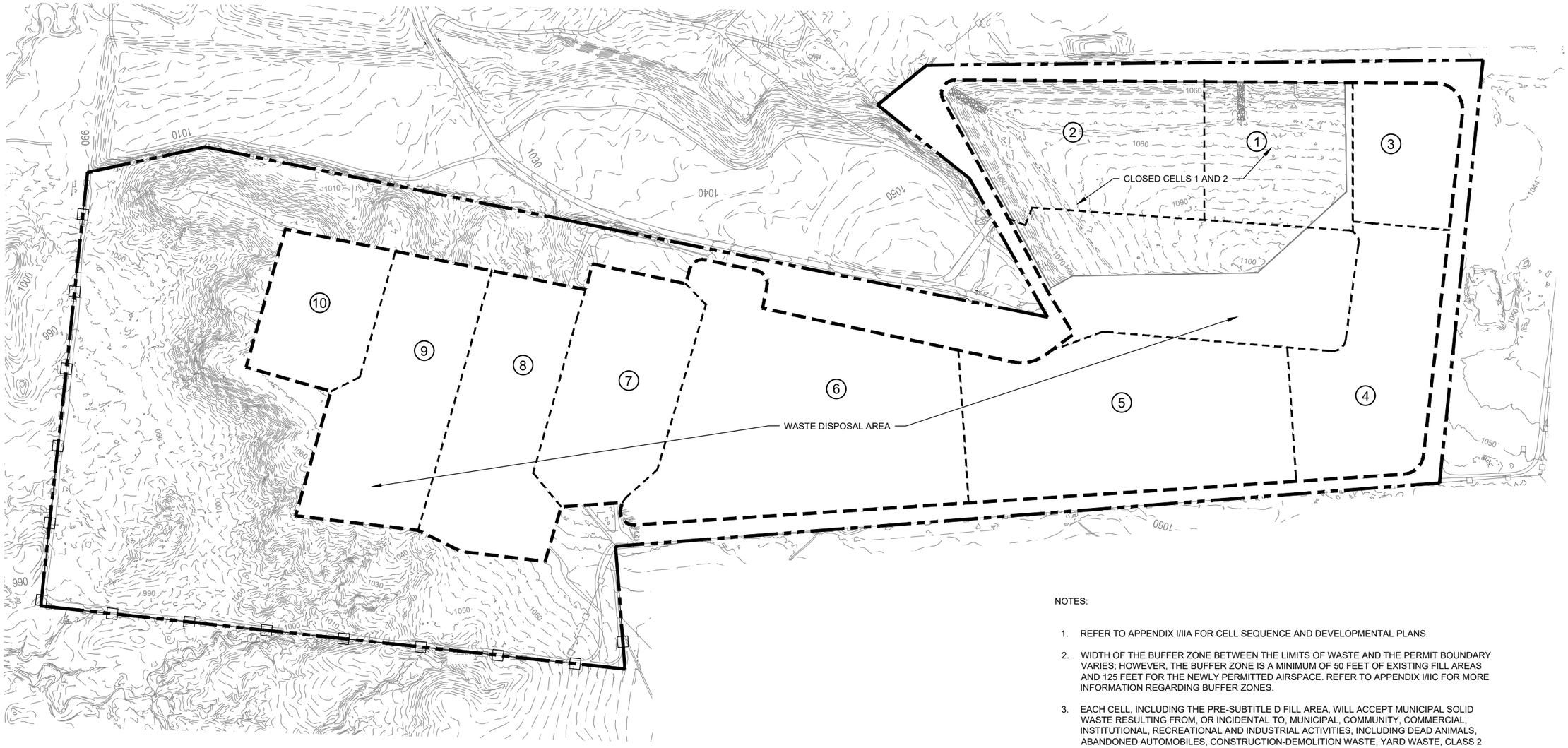
LEGEND

- PROPOSED PERMIT BOUNDARY
- PROPOSED LIMITS OF WASTE
- 1084 — EXISTING CONTOURS
- EXISTING SITE FENCE
- PROPOSED SITE FENCE
- (10) CELL DESIGNATION
- CELL BOUNDARY

N

0 200 400

SCALE IN FEET



NOTES:

1. REFER TO APPENDIX I/IIA FOR CELL SEQUENCE AND DEVELOPMENTAL PLANS.
2. WIDTH OF THE BUFFER ZONE BETWEEN THE LIMITS OF WASTE AND THE PERMIT BOUNDARY VARIES; HOWEVER, THE BUFFER ZONE IS A MINIMUM OF 50 FEET OF EXISTING FILL AREAS AND 125 FEET FOR THE NEWLY PERMITTED AIRSPACE. REFER TO APPENDIX I/IIC FOR MORE INFORMATION REGARDING BUFFER ZONES.
3. EACH CELL, INCLUDING THE PRE-SUBTITLE D FILL AREA, WILL ACCEPT MUNICIPAL SOLID WASTE RESULTING FROM, OR INCIDENTAL TO, MUNICIPAL, COMMUNITY, COMMERCIAL, INSTITUTIONAL, RECREATIONAL AND INDUSTRIAL ACTIVITIES, INCLUDING DEAD ANIMALS, ABANDONED AUTOMOBILES, CONSTRUCTION-DEMOLITION WASTE, YARD WASTE, CLASS 2 NON-HAZARDOUS INDUSTRIAL SOLID WASTE, CLASS 3 NON-HAZARDOUS INDUSTRIAL SOLID WASTE, AND CERTAIN SPECIAL WASTES.

FOR PERMITTING PURPOSES ONLY

stv
TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

CITY OF DEL RIO

STATE OF TEXAS
TEMOBISTA METAFERIA
123183
LICENSED
PROFESSIONAL
ENGINEER
09/29/2023

NO.	REVISION	BY	DATE

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.

0 1"

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

LANDFILL SCHEMATIC PLAN

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

FIGURE
III2.2

PRINTED BY: JohnsoG DATE: 9/21/2023
FILE PATH: C:\pwworking\stv\pw_stv\gjohnson\d0942282\DELR2000302 Figure III 2.2.dwg

3.0 FACILITY SURFACE WATER DRAINAGE REPORT (§330.63(c))

3.1 General

This facility has been designed to comply with the requirements of Title 30 TAC §330.303 and §330.63(c). Part III, Appendix IIIH contains the Surface Water Drainage Plan (also refer to Section 3.7).

In accordance with Title 30 TAC §330.15(h), the facility has been designed to prevent discharge of pollutants into waters of the State or waters of the United States, as follows:

- No discharge of solid waste or pollutants into or adjacent to waters of the State, including wetlands, that is in violation of the requirements of the Texas Water Code, §26.121 will occur. During the active life of the facility all stormwater coming into contact with solid waste will be retained as contaminated water and treated or disposed of as outlined in Part III, Appendix IIIC - Leachate and Contaminated Water Management Plan.
- No discharge of pollutants into or adjacent to waters of the United States, including wetlands, that violates any requirement of the Clean Water Act, including, but not limited to, the TPDES requirements, pursuant to §402 as amended, and demonstrated in Part III, Appendix IIIH - Surface Water Drainage Plan, will occur. A copy of the TPDES permit is included in Parts I/II, Appendix I/IID. Surface water monitoring will be conducted consistent with the TPDES requirements.
- No discharge of nonpoint source pollutants to waters of the United States, including wetlands, that violates any requirement of an area-wide or statewide water quality management plan that has been approved under the Federal Clean Water Act, §208 or §319, as amended will occur. The site will comply with §208 of the Federal Clean Water Act.
- No discharge of dredged or fill materials to waters of the United States, including wetlands, that is in violation of the requirements under the Federal Clean Water Act, §404, as demonstrated in Parts I/II, Appendix I/IIB (USACE coordination letter) will occur.

3.2 Site Drainage Patterns

The permit boundary encompasses approximately 180.6 acres located southeast of Calaveras Creek. A portion of the site drains northwest to Calaveras Creek. The other portion of the site drains southeast to the Zorro Creek. Both the Calaveras and Zorro Creeks discharge into the Rio Grande.

For the proposed expansion, the final cover system will include erosion control structures to effectively minimize erosion of final cover soils. The proposed drainage system also includes a perimeter channel system that will convey stormwater collected from the landfill area to a detention pond or directly into an existing drainage channel that feeds the Calaveras and Zorro Creeks. The stormwater detention ponds are designed to attenuate stormwater flow before stormwater is discharged into existing drainage features located downstream of the site. As discussed in Appendix IIIH the site's stormwater management system is designed to not adversely alter existing permitted drainage patterns or have any adverse impact on offsite drainage features.

3.3 Perimeter Drainage System

The stormwater controls for the landfill have been designed consistent with the TCEQ regulations for Type I MSW landfills. The runon/runoff stormwater controls have been designed for a 25-year storm event. These include drainage controls for the final cover, perimeter drainage channels, culverts, and a detention pond. Details for the perimeter drainage system and associated calculations are included in Part III, Appendix IIIH.

The drainage system is detailed in Part III, Drawing IIIH.1 – Drainage Structure Plan. Drainage from the landfill itself is directed through a system of swales, chutes, and perimeter channels to the stormwater detention pond. The detention pond and pond outlet structures are detailed in Part III, Appendix IIIH.

3.4 Below Grade Stormwater Controls

Control of stormwater runon and runoff within excavation areas will be achieved using temporary stormwater control structures (e.g., diversion berms, channels, and containment areas) as needed. The temporary stormwater control structures are used to divert uncontaminated stormwater runoff.

The uncontaminated stormwater will be used for liner construction, control of dust, and establishing vegetation. If discharge of uncontaminated stormwater is required, it will be discharged consistent with TPDES requirements.

Contaminated stormwater consists of stormwater that has come into contact with waste. Control of the contaminated stormwater will be provided through temporary diversion berms, channels, and containment areas. Temporary runon and runoff controls are detailed in Appendix IIIC – Leachate and Contaminated Water Management Plan, Appendix IIIC-C – Containment Berm and Diversion Berm Calculations. Contaminated stormwater will be diverted and contained on approved areas only. Contaminated stormwater and leachate will be managed in accordance with the guidelines set forth in Appendix IIIC – Leachate and Contaminated Water Management Plan.

3.5 Aerial Fill Stormwater Controls

Additional stormwater controls will be necessary as the site is brought above grade. Temporary diversion berms, channels, and containment areas will continue to be used for control of uncontaminated and contaminated stormwater runon and runoff. Runon and runoff temporary diversion berm sizing is provided in Part III, Appendix IIIC – Leachate and Contaminated Water Management Plan. Separation of the contaminated stormwater and uncontaminated stormwater runoff will be provided. Diversion berms, channels, and containment areas will be implemented for the aerial fill portions of the landfill.

The final cover will incorporate drainage swales and letdown structures or chutes for conveyance of stormwater off of the final cover. These swales and chutes have been designed to protect the final cover from erosion. As areas of the final cover are completed, vegetation will be established to provide additional erosion protection. Details of the final cover design are provided in Part III, Appendix IIIA-A - Liner and Final Cover System Details.

Surface water runon and runoff will be managed consistent with the TCEQ regulations. Specifically, areas that have received waste but will be inactive for longer than 180 days will be provided with intermediate cover. As such, runoff from these areas will be considered uncontaminated consistent with Title 30 TAC §330.207. Also, the site design and proper operating practices will minimize contaminated water. Routine daily cover, in combination with the other operating practices, will minimize the generation of

contaminated water. Contaminated water will be managed consistent with the practices outlined in Part III, Appendix IIIC - Leachate and Contaminated Water Management Plan.

The City of Del Rio Landfill will use various interim and permanent erosion and sedimentation controls throughout the life of the site. The interim controls will be used around active areas and external embankment sideslopes and top dome surfaces. These controls will include temporary letdown structures, soil berms, and vegetation of intermediate cover areas to minimize the erosion potential from these areas. These interim controls will be used during all phases of landfill development to provide effective erosion stability for the external sideslopes and top dome surfaces. Refer to Appendix IIIH-F - Erosion Control Plan for All Phases of Landfill Operation for more information.

3.6 Erosion and Sedimentation Control

Erosion and sedimentation control is provided on site during construction activities and is incorporated into the design of the perimeter drainage system and final cover system. During construction of the subsequent Cells, perimeter berms, perimeter drainage channels, and detention pond, erosion and sedimentation control will be provided through the use of temporary diversion berms, drainage channels, silt fences, and hay bales. These measures will provide for control of erosion and sediment prior to stormwater flows leaving the site. An erosion and sedimentation control plan is presented in Appendix IIIH - Surface Water Drainage Plan.

Permanent erosion control features have been included in the site design. These features include design of perimeter channels for non-erodible velocities. In areas where erosion has been anticipated, erosion protection of the channels in the form of gabions, rock riprap, or turf reinforcement matting will be provided. Permanent erosion protection measures are also shown in Appendix IIIH - Surface Water Drainage Plan. In addition to grass cover, permanent erosion features included in the final cover design are drainage swales and chutes shown on Figure IIIA-A.2 - Landfill Completion Plan in Appendix IIIA.

3.7 Floodplain Information (§330.63(c)(2))

As shown on Figure I/II-11.1 in Parts I/II, the landfill waste boundary is outside the 100-year floodplain as defined by the Federal Emergency Management Agency (FEMA), Flood Insurance Rate Map (FIRM) for Val Verde County, Texas and incorporated areas (Map Number 48465C1755D).

3.8 Wetlands Information

The City of Del Rio Landfill proposed permit boundary was examined for compliance with wetlands as described in Title 30 TAC §330.553, which states that new MSWLF units, lateral expansions, and material recovery operations from a landfill shall not be located in wetlands, unless the owner or operator makes appropriate demonstrations involving wetlands. As noted in Parts I/II - Section 11.2, although the landfill will require Department of the Army authorization under Section 404 of the Clean Water Act to fill parts of the wetlands for channel grading purposes, no waste will be placed within any wetlands.

4.0 LANDFILL UNIT DESIGN (§330.63(d)(4))

Consistent with Title 30 Texas Administrative Code (TAC) §330.63(d)(4), this SDP was prepared to address the requirements for the landfill unit at the City of City of City of Del Rio Landfill. The following subsections discuss provisions for all-weather operations and access, the proposed landfill method, minimum and maximum design elevations, solid waste acceptance rates, site life, cross-sections and design details, and a liner quality control plan. In addition to these items as required by §330.63(d)(4), additional information regarding the geotechnical analyses, the liner design, and leachate management are also presented.

4.1 All-Weather Operation (§330.63(d)(4)(A))

Railway Avenue is an asphalt paved roadway that provides access to the entrance facilities. The landfill perimeter roads (15 feet minimum), haul road, and interior access roads will be constructed of crushed stone, gravel, or other suitable material and will provide access from the entrance road to the fill area. From the entrance facilities, the landfill haul road is a asphalt road that extends approximately one mile and then transitions from asphalt to an un-improved haul road within the limits of the cell boundaries. The paved access road and haul road will serve as mud control for waste hauling vehicles prior to exiting the site and returning to the site access roads. The paved asphalt road and perimeter um-improved road will be maintained for all-weather access by site personnel. As necessary crushed stones may be added to perimeter un-improved roads using on-site stockpiles of crushed stone, concrete rubble, masonry demolition debris, or other similar material will be provided as needed for use in maintaining passable access roads. Grading equipment or other appropriate equipment will be used, as necessary, to control or remove mud accumulations on the perimeter access road around the landfill, the landfill haul road, and the paved entrance facility area. The landfill haul road and perimeter roads will be passable under inclement weather conditions to allow access to the working face area.

4.2 Landfill Methods (§330.63(d)(4)(B))

The proposed landfill development method for the site is a combination of area-excavation fill followed by aerial fill to the proposed landfill completion height. The landfill drawings depicting existing site conditions, excavation, final fill height, sector fill layout, sector sections, sequence of development plans, site contour maps, and landfill completion plan are included in Parts I/II, Appendix I/IIA - Facility Layout Maps.

The proposed excavation side slopes will be no steeper than 3 horizontal to 1 vertical (3H:1V), the aerial fill side slopes will be approximately 4H:1V, and the aerial fill top slope will be approximately 5 percent. Final cover placement will generally follow the sequence of development as shown in Parts I/II, Figure I/IIA.4, and will be ongoing as the site is developed. Sectors will be closed according to the closure plan provided in Appendix IIIE - Closure Plan.

4.3 Liner and Final Cover System Design (§330.63(d)(4)(C))

4.3.1 Liner System for the Developed and Undeveloped Areas

The liner system provides a low permeable barrier to reduce the migration of leachate. Table 4-1 lists the components of the approved alternative liner for the City of Del Rio Landfill. The details of the liner system are shown on Figures IIIA-A.3 and IIIA-A.4 in Appendix IIIA. The developed areas, Cells 1 through 6, have been constructed with the approved liner system.

It is proposed in this permit amendment that the liner system for the undeveloped/expansion area, Cells 7 through 10, will be constructed with the approved liner system for the City of Del Rio Landfill. The approval letter for the alternate liner system in included in Appendix IIID-A. Information regarding liner materials and construction quality assurance are included in Appendix IIID.

Table 4-1 Liner System Components

Liner System
2-foot-thick Soil Protective Cover
Drainage Geocomposite Leachate Collection System Layer
2-foot-thick Compacted Clay Liner (CCL)

Figure IIIA-A.1 shows the permitted and proposed excavation grades for the City of Del Rio Landfill. The deepest excavation elevation is 1007 ft-msl and is located in the leachate sump of Cell 9. Therefore, the deepest top liner, minimum waste, elevation is 1009 ft-msl. The leachate collection system details are shown on Figure IIIA-A.5 in Appendix IIIA.

4.3.2 Overliner System for the Pre-Subtitle D Area

The permitted overliner system for the pre-Subtitle D area of the landfill is designed consistent with Title 30 TAC §330.331(a)(1). The system is designed to convey leachate generated over the existing pre-Subtitle D area to the Subtitle D area with a leachate collection system. The overliner system is described below with layers listed from top to bottom. The overliner system design and details are also summarized in Appendix IIIA – Landfill Unit Design Information.

Table 4-2 Overliner System Components

Composite Overliner System
24-inch-thick Soil Protective Cover
Drainage Geocomposite Leachate Collection Layer
40-mil LLDPE Texture Geomembrane
Geosynthetic Clay Liner (GCL)

4.3.3 Leachate Collection System

A Leachate Collection System (LCS) has been designed to remove leachate from the Subtitle-D areas of the landfill. The LCS layout is shown on Drawing A.1 - Excavation Plan in Appendix IIIA-A. Design of the proposed LCS and a demonstration of the adequacy of the existing LCS is discussed in Part III, Appendix IIIC - Leachate and Contaminated Water Management Plan. LCS details are provided in Part III, Appendix IIIA - Landfill Unit Design Information. Information regarding materials and construction quality assurance are included in Part III, Appendix IIID –Liner Quality Control Plan (LQCP).

4.3.4 Final Cover System

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 Appendix IIIA, Figure IIIA-A.2 - Landfill Completion Plan, a maximum of 5 percent topslopes and 4H:1V sideslopes are provided to minimize erosion and facilitate drainage of the landfill. A final cover will be constructed over the existing pre-Subtitle D and Subtitle D waste disposal areas. The final cover system components are described in Table 4-3 with layers listed from top to bottom. The maximum waste and final cover elevations are 1120.5 ft-msl and 1124 ft-msl, respectively.

A demonstration that the specified final cover design will provide effective long-term erosional stability is included in Part III, Appendix IIIH - Surface Water Drainage Plan (Appendix IIIH-D). The final cover system will be constructed as outlined in Appendix E – Closure Plan.

Table 4-3 Final Cover System Components

Top Slopes	Side Slopes
12-inch-thick erosion layer	24-inch-thick erosion layer
18-inch-thick compacted clay infiltration layer with K =10^{-5} cm/s	18-inch-thick compacted clay infiltration layer with K = 10^{-5} cm/s

4.4 Estimated Rate of Solid Waste Deposition (§330.63(d)(4)(D))

The City of Del Rio Landfill primary serves residences and businesses in the City of Del Rio and Val Verde County. The major classifications of solid waste to be accepted by this facility for disposal include both residential and commercial MSW. Such waste consists of household wastes, construction-demolition waste, and various non-hazardous industrial and special wastes as authorized by the TCEQ. Based on the 2022 fiscal year TCEQ Annual Report, the landfill waste inflow is 47,067 tons (152 tons per day based on a 309-day operating schedule).

After 2022, the waste inflow rate is assumed to increase consistent with the projected growth rate for the facility's general service area. The projected growth rate is based on the TWDB population growth projections for the area and may vary. Based on the projected yearly waste inflow over the site life of the facility, this service area will generate an average of approximately 60,486 tons per year (196 tons per day based on a 309-day operating schedule).

The population equivalent, as defined in §330.3, is "the hypothetical population that would generate an amount of solid waste equivalent to that actually being managed based on a generation rate of five pounds per capita per day and applied to situations involving solid waste not necessarily generated by individuals." Based on this definition, the population equivalent for the average waste stream over the active life of the site (46.6 years - refer to Appendix IIIB) was calculated as follows:

$$\frac{(60{,}486^{1} \text{ tons/year}) \times (2{,}000 \text{ pounds/ton})}{(5\text{pounds/person/day}) \times (365 \text{ days/year})} = 66{,}286 \text{ persons}$$

[1] Average yearly waste inflow was obtained from Appendix IIIB and is based on the projected yearly inflow over the site life of the facility.

4.5 Typical Unit Cross-Sections (§§330.63(d)(4)(E) and (F))

Consistent with the requirements of Title 30 TAC §§330.63(d)(4)(E) and (F), typical unit cross-section have been developed. The typical landfill unit cross-sections are included in Appendix IIIA-B.

4.6 Liner Quality Control Plan (§330.63(d)(4)(G)

Liner materials and construction quality assurance are included in Part III, Appendix IIID – Liner Quality Control Plan (LQCP).

5.0 COMPLIANCE WITH §330.63(e) THROUGH §330.63(j)

The following table provides references to each SDP appendix that was developed to meet the specified rule.

Rule	SDP Appendix
§330.63(e)	Appendix IIIJ – Geology Report and Appendix IIIL – Geotechnical Report
§330.63(f)	Appendix IIII – Groundwater and Sampling Analysis Plan
§330.63(g)	Appendix IIIM – Landfill Gas Management Plan
§330.63(h)	Appendix IIIE – Closure Plan
§330.63(i)	Appendix IIIF – Post-closure Care Plan
§330.63(j)	Appendix IIIG – Closure and Post-closure Care Cost Estimates

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN

APPENDIX IIIA
LANDFILL UNIT DESIGN INFORMATION

Prepared for
City of Del Rio

September 2023



Prepared by
STV Inc
TPBE Registration No. F-1741
1820 Regal Row, Suite 200
Dallas, TX 75235
214-638-0500

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2.0 PERMITTED LINER SYSTEM FOR THE SUBTITLED D AREA IIIA-1
3.0 PERMITTED OVERLINER SYSTEM IIIA-2
4.0 FINAL COVER SYSTEM IIIA-3

Appendix IIIA-A Liner, Overliner, and Final Cover System Details
Appendix IIIA-B Landfill Unit Cross Sections

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Table 2-2 Leachate Collection Layer Analysis Summary for the Developed Subtitle D Areas IIIA-1
Table 3-1 Overliner System Components IIIA-2
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1.0 INTRODUCTION

The purpose of this appendix is to present the details of the liner system and final cover system consistent with Title 30 Texas Administrative Code (TAC) §330.331, §330.333, and §330.457. The following subsections have been developed to provide detailed information for the existing liner system and final cover system.

2.0 PERMITTED LINER SYSTEM FOR THE SUBTITLED D AREA

The permitted liner system is designed to meet the requirements of Title 30 TAC §330.331(a)(2) and §330.331(e). Table 2-1 lists the components of the permitted liner system at the City of Del Rio Landfill. Cells 1 through 6 were constructed to Subtitle D standards under Permit No. MSW-207A using the permitted liner system. The expansion area Cells 7 through 10 are proposed to be built with the approved liner system for the facility.

Table 2-1 Liner System Components

Permitted Subtitle D Composite Liner System
2-foot-thick Soil Protective Cover
Drainage Geocomposite Leachate Collection Layer
2-foot-thick Compacted Clay Liner

Figure IIIA-A.1 in Appendix IIIA-A shows the excavation plan for the expansion area and the permitted excavation grades for the facility. The site does not have any shallow groundwater. Therefore, the liner system does not include any hydrostatic pressure relief system. The permitted liner system is designed with a leachate collection system as shown on Figures IIIA-A.3 through IIIA-A.5. The design of the leachate collection system components, including the drainage geocomposite leachate collection layer, leachate collection piping, chimney drains, sumps, and pumps are provided in Appendix IIIC. Material specifications, construction, and testing requirements for the permitted liner and leachate collection system are provided in Appendix IIID - Liner Quality Control Plan.

The impact of differential settlement on the performance of the currently constructed leachate collection systems in the Subtitle D areas is analyzed in Appendix IIIL and summarized in Table 2-2. A demonstration that the existing leachate collection system will continue to function in a manner that meets all regulatory requirements is included in Appendix IIIC.

Table 2-2 Leachate Collection Layer Analysis Summary for the Developed Subtitle D Areas

Sector	Design Slope between Cell Ridgeline and Leachate Collection Pipe (percent)	Design Slope of Leachate Collection Pipe (percent)	Post-Settlement Slope between Cell Ridgeline and Leachate Collection Pipe (percent)	Post-Settlement Slope of Leachate Collection Pipe (percent)
Cells 1 - 6	1.08 %	1.08 %	1.15%	1.15%

3.0 PERMITTED OVERLINER SYSTEM

The pre-Subtitle D area is located in between the Subtitle D Areas as shown on Figure IIIA-A.1a and is approximately 12.3 acres. Consistent with MSW regulations at that time, the pre-Subtitle D liners consisted of in-situ clay liners. The overliner system for the pre-Subtitle D area of the landfill has been previously permitted and is designed consistent with the requirements listed in Title 30 TAC §330.331(a)(1). The system is designed to convey leachate generated over the existing pre-Subtitle D area to sumps located in the Subtitle D area. The overliner system is described in Table IIIA 3-1.

The top of overliner plan and details are shown on Figure IIIA-A.8. Material specifications, construction, and testing requirements for the overliner system are provided in Appendix IIID - LQCP.

Table 3-1 Overliner System Components

Component	Description
Geosynthetic Clay Liner (GCL)	The reinforced GCL will be installed on top of the prepared soil foundation layer. Detailed specifications and construction procedures foundation preparation for the overliner GCl are listed in Appendix IIID - LQCP provides.
40-mil LLDPE Textured Geomembrane Liner	The 40-mil LLDPE geomembrane textured on both sides will be installed on top of the GCL. Refer to Appendix IIID - LQCP for detailed specifications and construction procedures for the overliner geomembrane.
Leachate Collection Layer	The leachate collection layer will consist of a geocomposite layer (double-sided for all slopes) that will be placed directly over the textured 40-mil LLDPE textured geomembrane to collect and convey leachate to the leachate collection system sumps through pipes. The geocomposite will consist of a 300-mil-thick HDPE geonet with a 6 oz/sy non-woven geotextile heat-bonded to both sides of the geonet. CQA procedures for the geocomposite layer are detailed in Appendix IIID.
Leachate Collection Piping	The leachate collection layer discussed above will convey collected leachate to leachate collection system trenches which will contain a perforated leachate collection pipe surrounded by drainage stone and separated from the protective cover layer by a geotextile. The leachate collection pipes will direct collected leachate to the Subtitle D area. The proposed leachate collection pipes will be SDR 17 HDPE smooth wall pipe or equivalent. The leachate collection system is designed with cleanout risers at the end of each of the collection pipes to allow the pipes to be periodically flushed to remove any collected sediment.

As noted in Appendix IIID, prior to the construction of the overliner system, the existing intermediate cover will be reworked to provide a 12-inch overliner foundation layer between existing waste and the GCL.

The overliner area grades will be at permitted top of waste grades included in TCEQ Permit No. 207B. The slope of the overliner varies between 20 to 5 percent.

4.0 FINAL COVER SYSTEM

Once the site reaches the permitted waste fill grades, a final cover system will be installed to limit the infiltration of stormwater into the landfill. The completion plan for the City of Del Rio Landfill is shown on Figure IIIA-A.2. The final cover system for the City of Del Rio Landfill is shown in Table IIIA 4-1. Details of the final cover system design is discussed in section below and shown on Figures IIIA-A.6 and IIIA-A.7.

Material specifications along with construction and testing procedures for the final cover system are provided in Appendix IIID.

Table 4-1 Final Cover System Components

Subtitle D Composite Final Cover System	
Top Slopes	Side Slopes
12-inch-thick erosion layer	24-inch-thick erosion layer
18-inch-thick compacted clay infiltration layer with $k \leq 10^{-7}$ cm/s	18-inch-thick compacted clay infiltration layer with $k \leq 10^{-7}$ cm/s

As part of the final cover construction, an erosion layer capable of sustaining native vegetation will be constructed. Areas that receive final cover will be seeded upon completion of final cover placement. A soil loss and sheet flow velocity demonstration for the erosion layer is included in Appendix IIIH. The erosion layer will include a vegetation layer that provides for a 90 percent ground coverage. If there are areas that do not maintain at least 90 percent coverage they will be re-seeded until at least 90 percent coverage is maintained.

In addition, permanent final cover erosion control structures (swales and chutes) will be constructed upon installation of the final cover. The stormwater controls for the landfill have been designed consistent with the TCEQ regulations for Type I MSW landfills. The stormwater runon/runoff controls have been designed for a 25-year frequency storm event. These include drainage controls for the final cover, perimeter drainage channels, culverts, and detention ponds, including pond outfalls. The design details of the final cover system erosion control structures is provided in Appendix IIIH - Surface Water Drainage Report.

Final cover has been constructed over Cells 1, 2 and a portion of the pre-Subtitle D as shown in Figure IIIA-A.2. The TCEQ acceptance letter for the closure is included in Appendix IIID-A. The constructed final cover over the portion of the pre-Subtitle D and subtitled D areas will remain in place.

A stability analysis for the proposed excavation and proposed final cover systems is provided in Appendix IIIL - Geotechnical Report.

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT

APPENDIX IIIA-A
LINER, OVERLINER AND FINAL COVER SYSTEM DETAILS

Prepared for
City of Del Rio

September 2023



Prepared by
STV Inc
TPBE Registration No. F-1741
1820 Regal Row, Suite 200
Dallas, TX 75235
214-638-0500

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Figure IIIA-A.1 – Excavation Plan

Figure IIIA-A .1a – Overliner Plan

Figure IIIA-A.2 – Completion Plan

Figure IIIA-A.3 - Liner System Details I (Currently Approved Plan)

Figure IIIA-A.4 - Liner System Details II (Currently Approved Plan)

Figure IIIA-A.5 - Leachate Collection System Details

Figure IIIA-A.6 - Final Cover Details I (Currently Approved Plan)

Figure IIIA-A.7 - Final Cover Details II (Currently Approved Plan)

Figure IIIA-A.8 – Overliner Details (Currently Approved Plan)



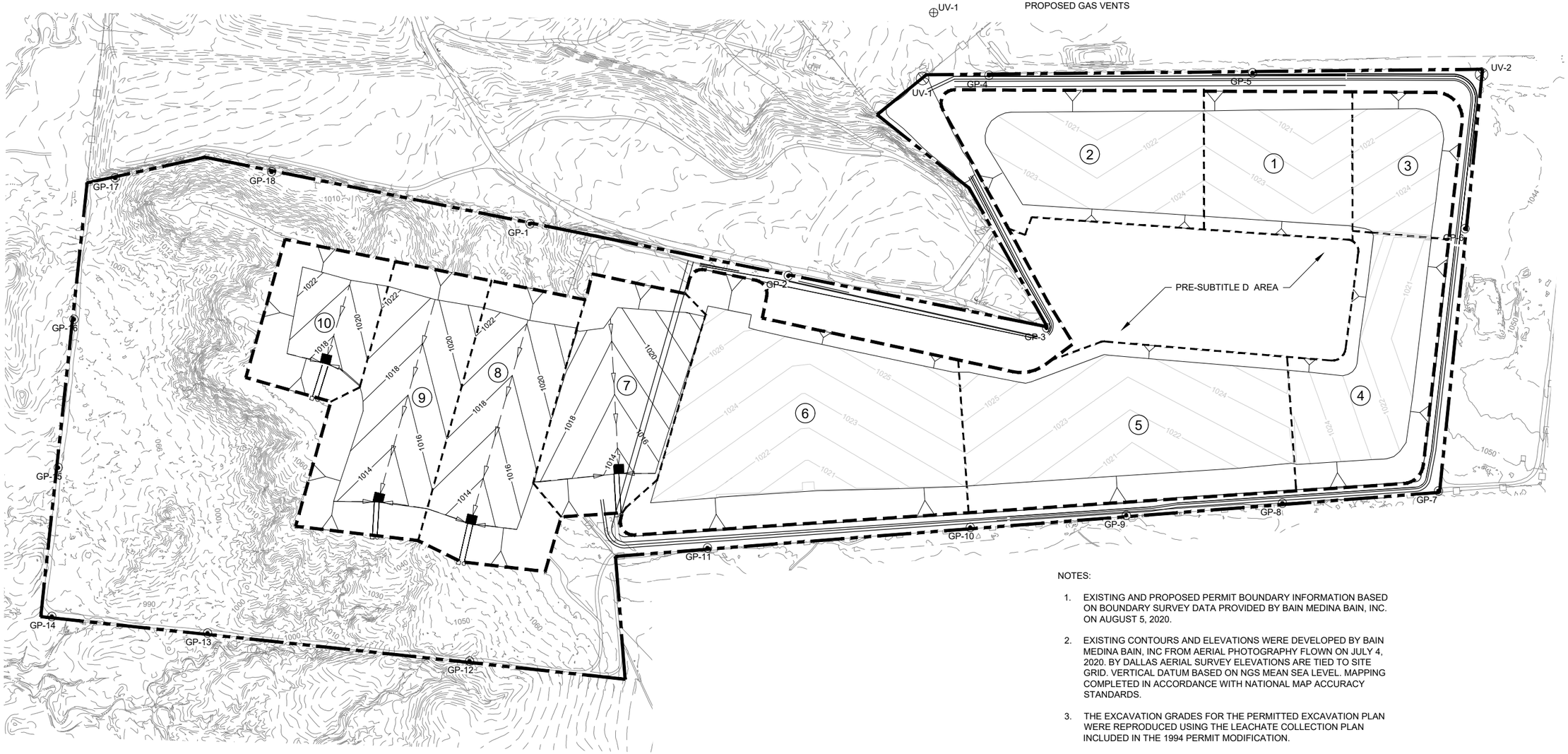
LEGEND

- PERMIT BOUNDARY
- LIMIT OF WASTE
- CELL BOUNDARY
- 1080 — EXISTING GRADES
- 1010 — PROPOSED EXCAVATION GRADES
- 1022 — PERMITTED EXCAVATION GRADES
- (10) CELL DESIGNATION
- LEACHATE COLLECTION RISER
- LEACHATE COLLECTION CLEANOUT
- LEACHATE COLLECTION SUMP
- LEACHATE COLLECTION LINE
- GP-5 PROPOSED GAS PROBE
- UV-1 PROPOSED GAS VENTS

N

0 200 400

SCALE IN FEET



NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. BY DALLAS AERIAL SURVEY ELEVATIONS ARE TIED TO SITE GRID. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP ACCURACY STANDARDS.
3. THE EXCAVATION GRADES FOR THE PERMITTED EXCAVATION PLAN WERE REPRODUCED USING THE LEACHATE COLLECTION PLAN INCLUDED IN THE 1994 PERMIT MODIFICATION.
4. EXCAVATION SLOPES ARE TYPICALLY 3H:1V.
5. MINIMUM EXCAVATION ELEVATION IS IN LEACHATE COLLECTION SYSTEM SUMP IS 1007 FT-MSL.
6. LINER AND LEACHATE COLLECTION SYSTEM DETAILS ARE INCLUDED IN APPENDIX IIIA-A.

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TBPE F-1741

TOMBISTA METAFERIA
124183
LICENSED PROFESSIONAL ENGINEER
09/29/2023

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CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

LANDFILL EXCAVATION PLAN

DESIGN:	T. METAFERIA
DRAWN:	T. METAFERIA
REVIEW:	B. HINDMAN
CP&Y:	DELR200302
CLIENT:	CITY OF DEL RIO

FIGURE
IIIA-A.1

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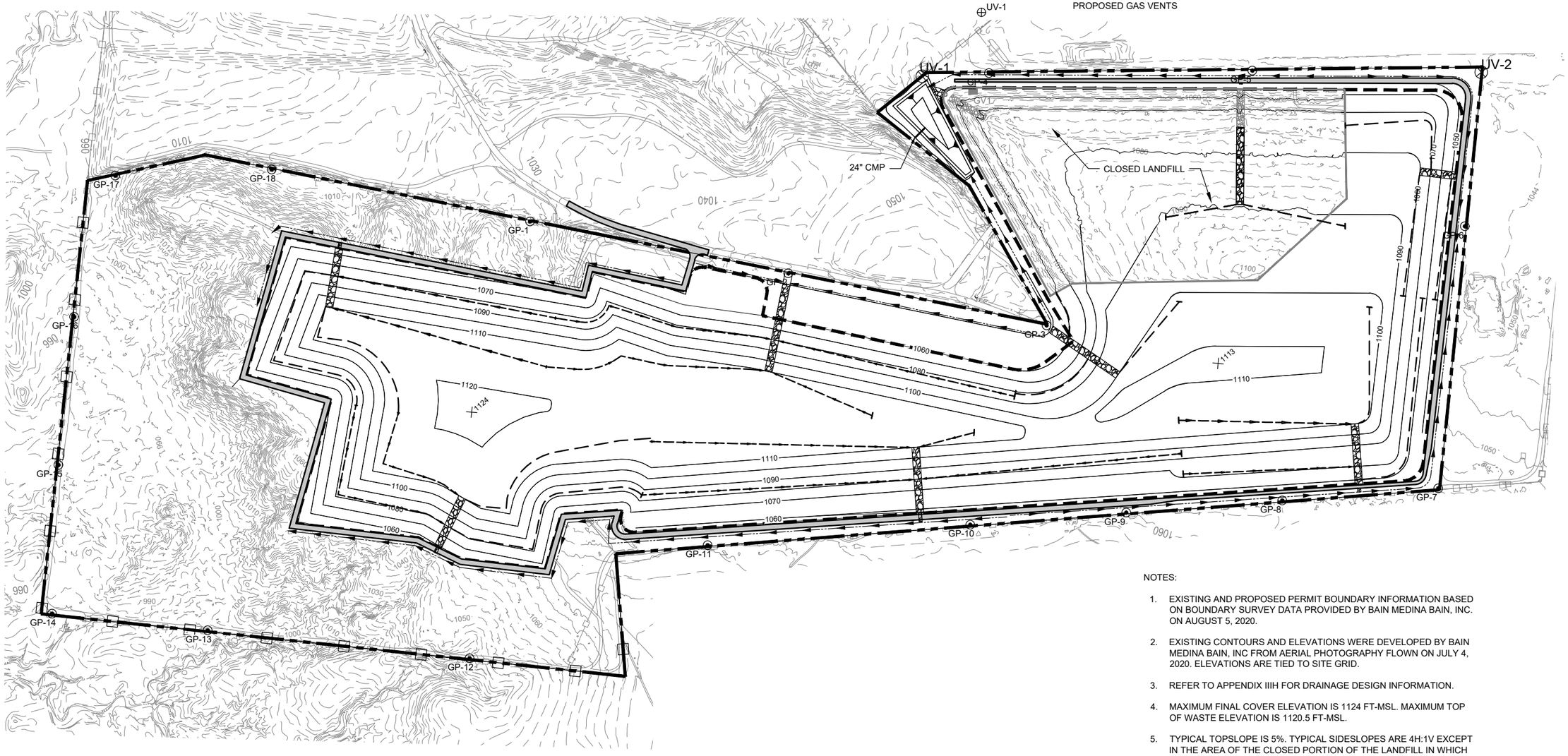
LEGEND

- PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- LIMIT OF WASTE
- 1090 FINAL COVER CONTOURS
- 1084 EXISTING CONTOURS
- SWALES
- EXISTING SITE FENCE
- PROPOSED SITE FENCE
- EXISTING CHUTE
- CHUTES
- GP-5 PROPOSED GAS PROBE
- UV-1 PROPOSED GAS VENTS

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SCALE IN FEET



NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. ELEVATIONS ARE TIED TO SITE GRID.
3. REFER TO APPENDIX IIIH FOR DRAINAGE DESIGN INFORMATION.
4. MAXIMUM FINAL COVER ELEVATION IS 1124 FT-MSL. MAXIMUM TOP OF WASTE ELEVATION IS 1120.5 FT-MSL.
5. TYPICAL TOPSLOPE IS 5%. TYPICAL SIDESLOPES ARE 4H:1V EXCEPT IN THE AREA OF THE CLOSED PORTION OF THE LANDFILL IN WHICH THE SIDESLOPES ARE 5H:1V.

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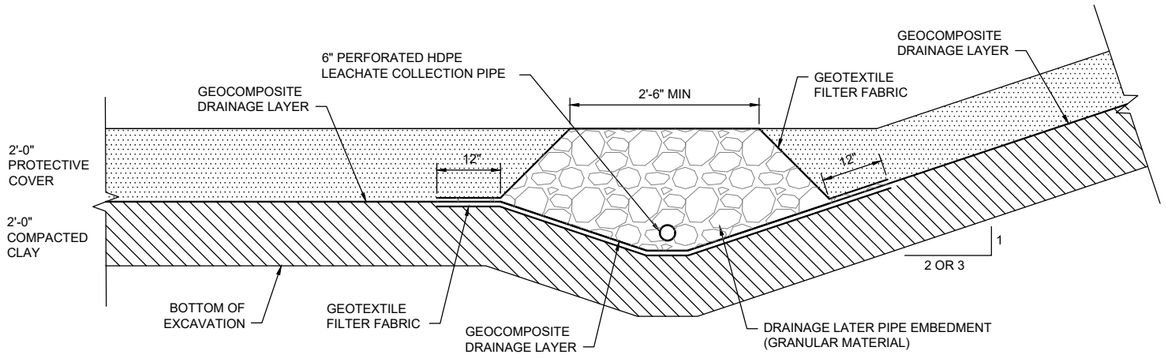
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LANDFILL COMPLETION PLAN

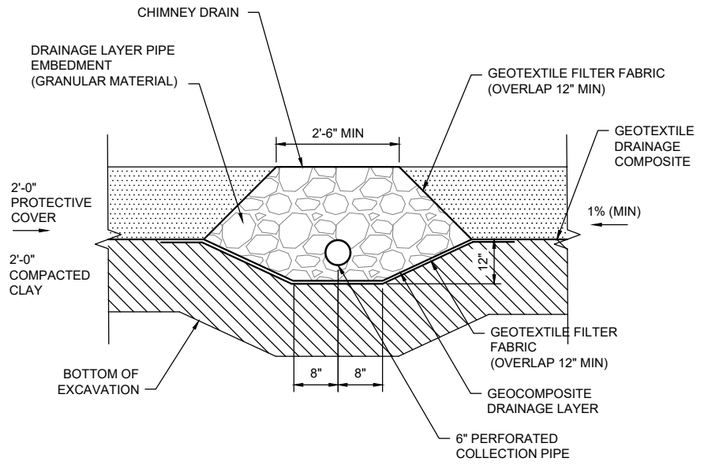
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DRAWN:	T. METAFERIA
REVIEW:	B. HINDMAN
CP&Y:	DELR200302
CLIENT:	CITY OF DEL RIO

FIGURE
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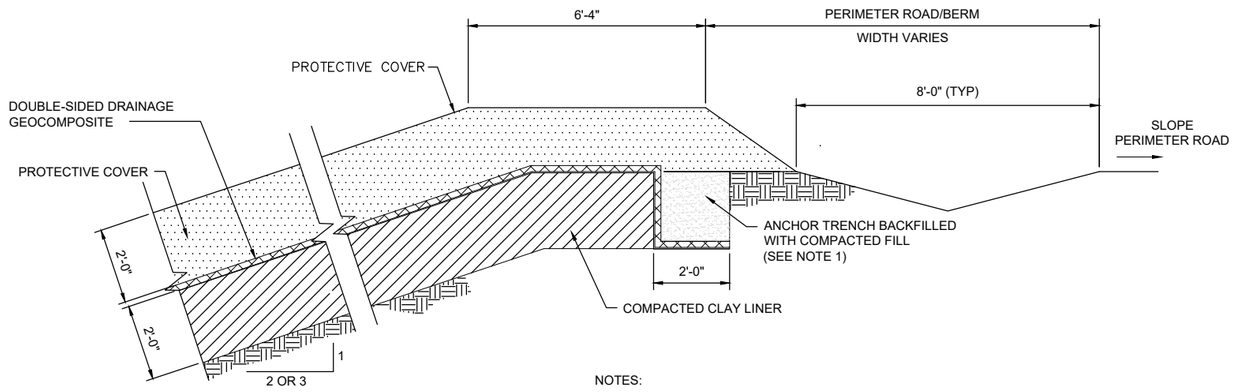
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A SIDEWALL LINER TRANSITION WITH PIPE
NTS



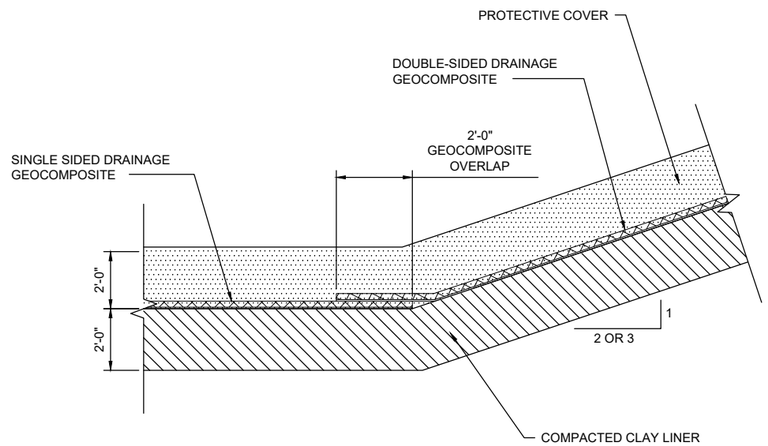
B LINER SYSTEM (TYP)
NTS



NOTES:

1. SUBGRADE PREPARATION, CONSTRUCTION OF THE COMPACTED CLAY LINER, AND PLACEMENT OF PROTECTIVE COVER WILL BE IN ACCORDANCE WITH APPENDIX IIID.

C SIDEWALL LINER/ANCHOR TRENCH
NTS



D SIDEWALL LINER TRANSITION
NTS

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STATE OF TEXAS
TEMOBISTA METAFERIA
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LICENSED
PROFESSIONAL ENGINEER
09/29/2023

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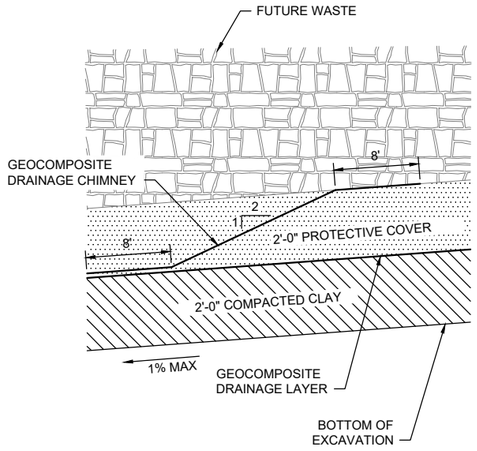
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LINER SYSTEM DETAILS I

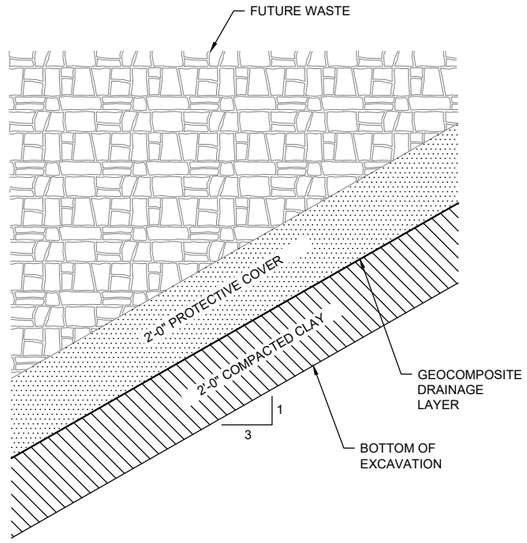
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FIGURE
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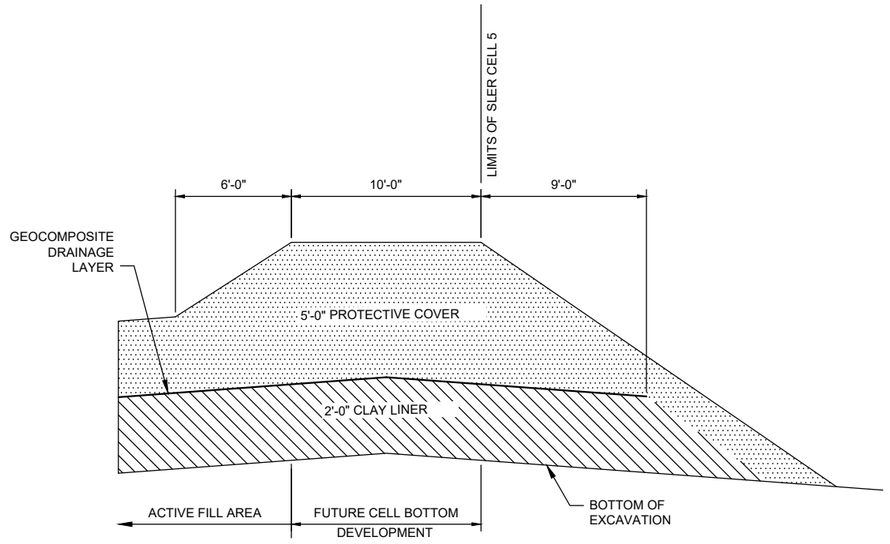
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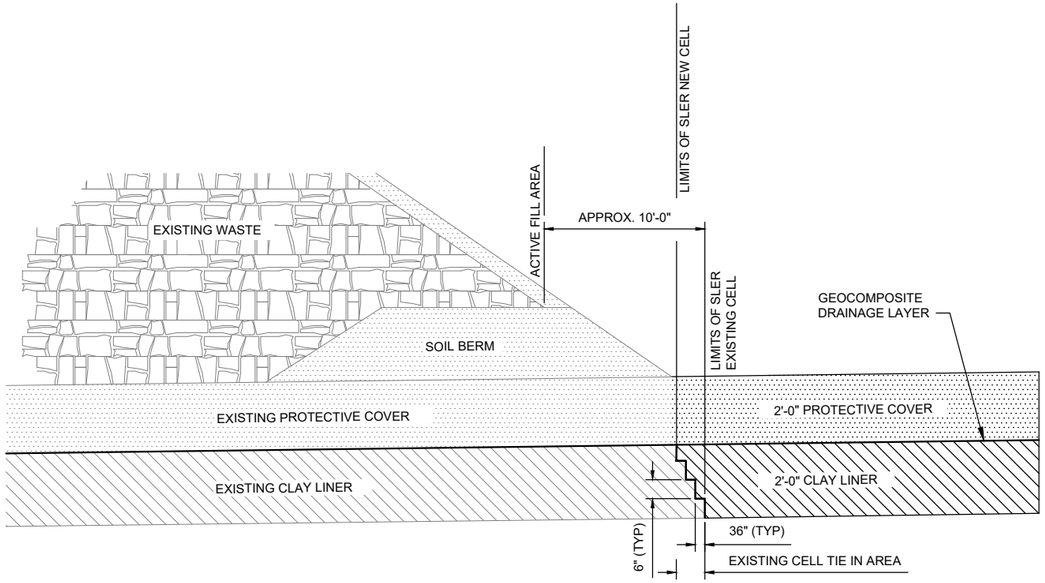
A GEOCOMPOSITE DRAINAGE CHIMNEY
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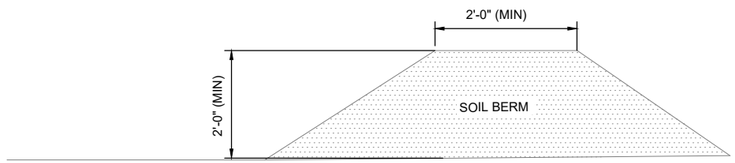
B SIDESLOPE LINER
NTS



C LINER TERMINATION



D EXISTING LINER TERMINATION



E CONTAINMENT BERM

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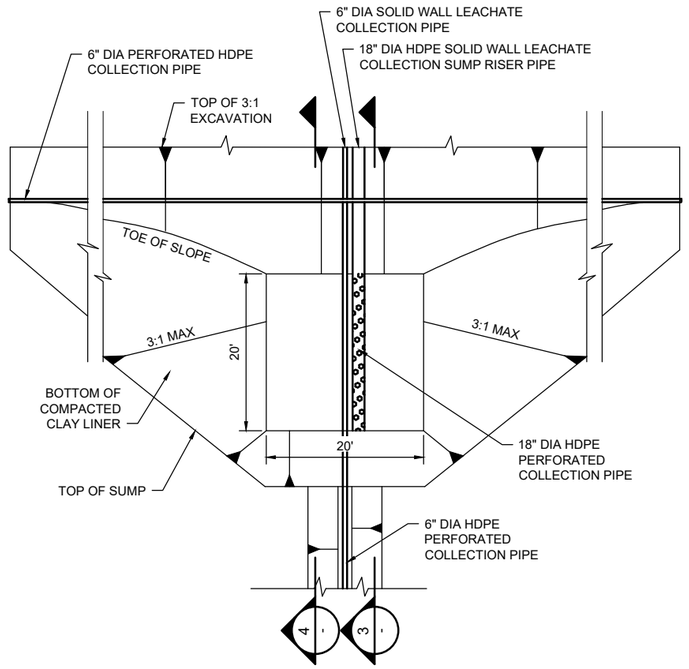
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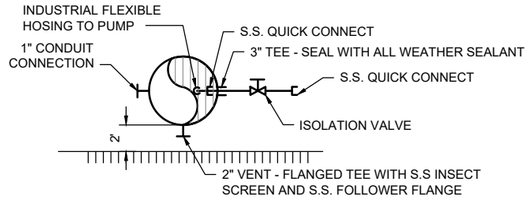
LINER SYSTEM DETAILS II

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REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

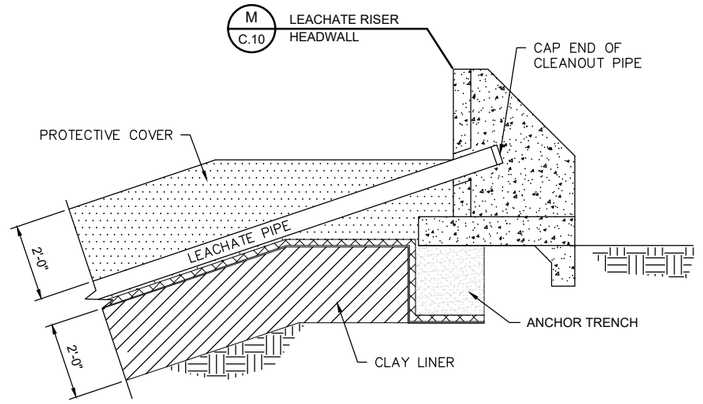
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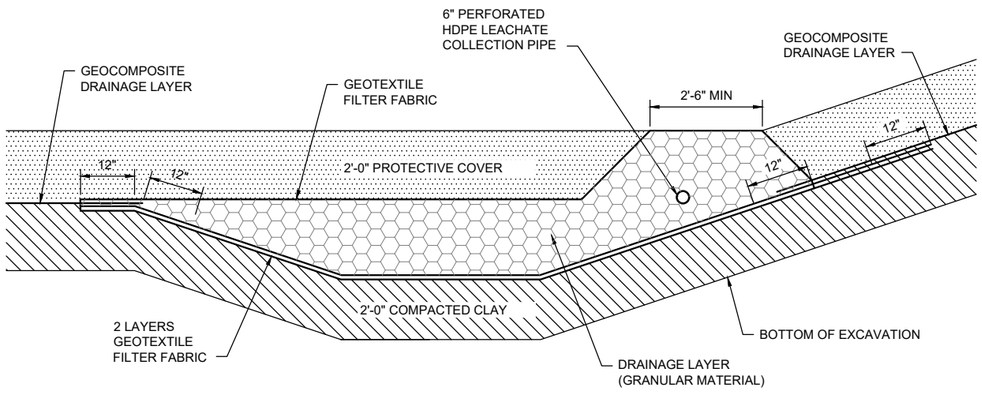
A SUMP PIT PLAN
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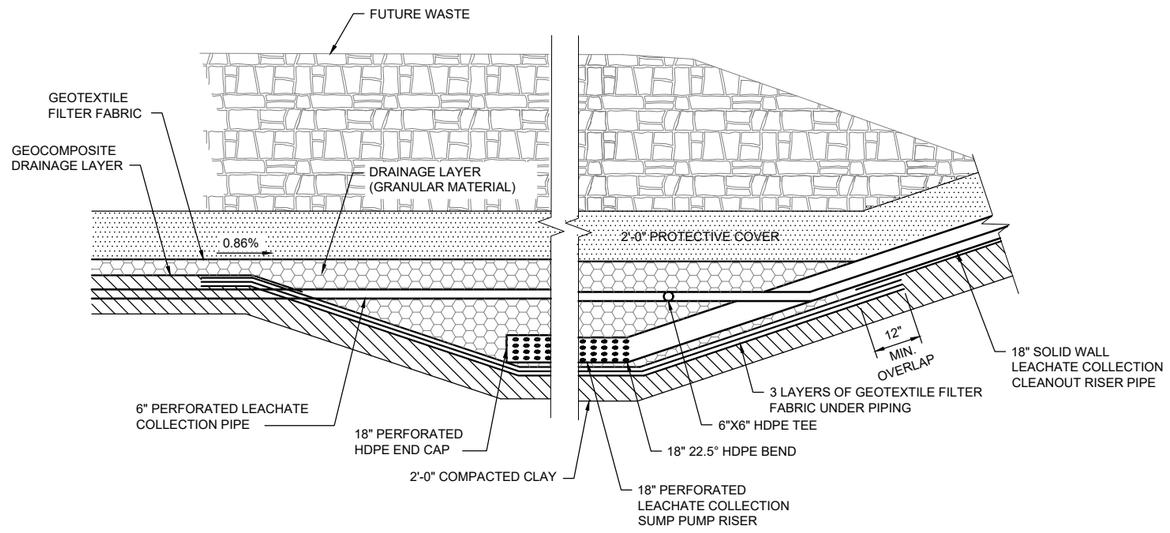
B SUMP RISER ELEVATION
NTS



C DETAIL - CLEANOUT RISER
NTS



D BEYOND SUMP RISER
NTS



E SUMP RISER
NTS

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TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

CITY OF DEL RIO
TEXAS

STATE OF TEXAS
TEMOBISTA METAFERIA
123183
LICENSED PROFESSIONAL ENGINEER
09/29/2023

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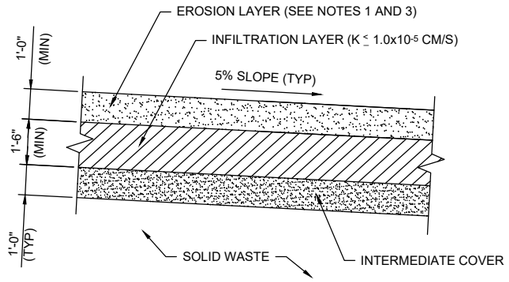
CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

LEACHATE COLLECTION SYSTEM DETAILS

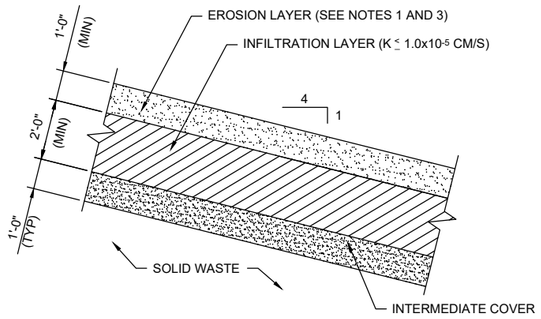
DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

FIGURE
IIIA-A.5

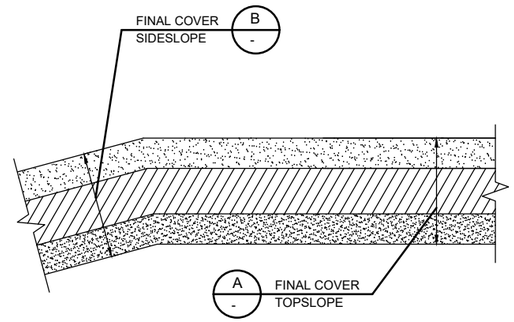
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FILE PATH: c:\pwworkingstvpw_stvgjohnson\d0942271\DELR2000302 Figure IIIA-A.5.dwg



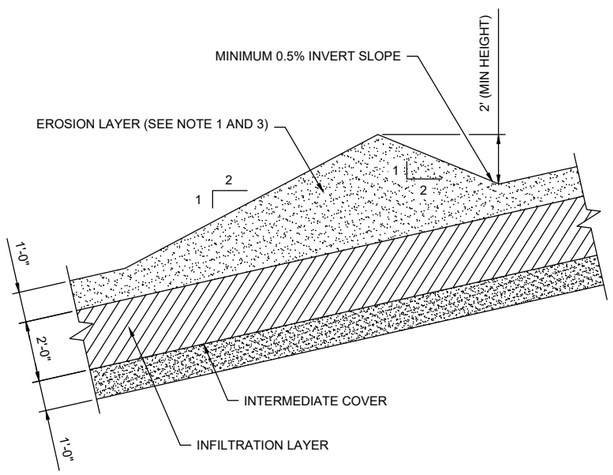
A FINAL COVER-TOPSLOPE
NTS



B FINAL COVER-SIDESLOPE
NTS



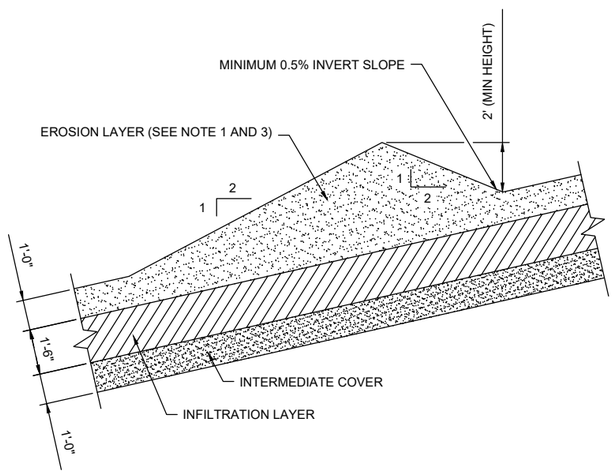
C FINAL COVER- TOP/SIDESLOPE TRANSITION
NTS



D SIDESLOPE SWALE (TYP)
NTS

NOTES:

1. FINAL COVER OF EROSION LAYER WILL BE CAPABLE OF SUSTAINING SELECTED VEGETATION.
2. FINAL COVER COMPONENTS WILL BE CONSTRUCTED ACCORDING TO FCSQCP (APPENDIX IIIJ-A).
3. EROSION LAYER MAY CONSIST OF BOTH ONSITE AND OFF-SITE SOILS. BORROW SOURCE TO BE SELECTED BY OWNER PRIOR TO CONSTRUCTION.



E TOP SLOPE SWALE (TYP)
NTS

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VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.
0 1"

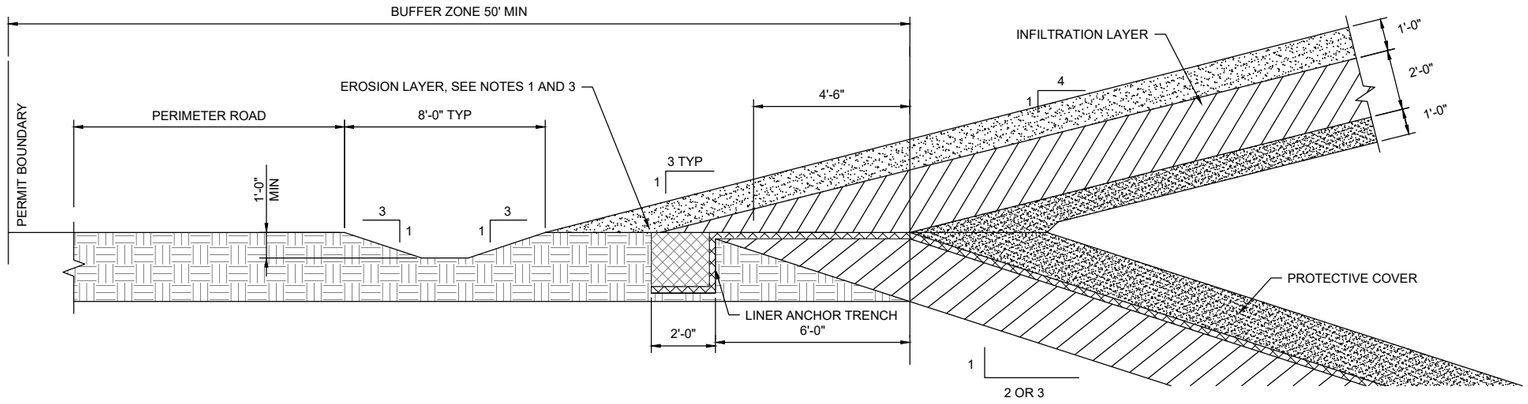
CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

FINAL COVER DETAILS I

DESIGN: T. METAFERIA
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REVIEW: B. HINDMAN
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CLIENT: CITY OF DEL RIO

FIGURE
IIIA-A.6

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FILE PATH: c:\pwworking\stv\pw_stv\gjohnson\d0942271\DELR2000302 Figure IIIA-A.6.dwg



NOTES:

1. EROSION LAYER WILL BE CAPABLE OF SUSTAINING SELECTED VEGETATION.
2. FINAL COVER COMPONENTS WILL BE CONSTRUCTED ACCORDING TO FCQCP (APPENDIX IIIJ-A)
3. EROSION LAYER MAY CONSIST OF BOTH ONSITE AND OFF-SITE SOILS. BORROW SOURCE TO BE SELECTED BY OWNER PRIOR TO CONSTRUCTION.
4. REFER TO APPENDIX H FOR THE PERIMETER CHANNEL DESIGN.

F LINER/FINAL COVER TIE-IN
NTS

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0 1"

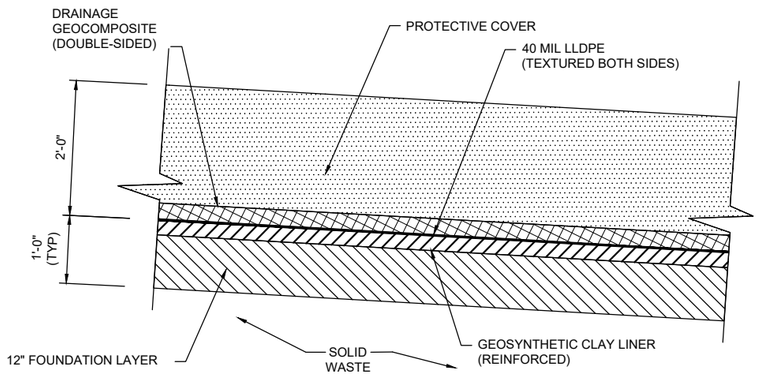
CITY OF DEL RIO LANDFILL NO. 207C
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FINAL COVER DETAILS II

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
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CP&Y: DELR200302
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FIGURE
IIIA-A.7

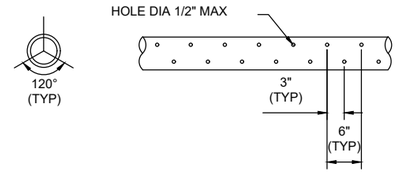
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FILE PATH: c:\pwworking\stv\pw_stvgjohnson\d0942271\DELR2000302 Figure IIIA-A.7.dwg



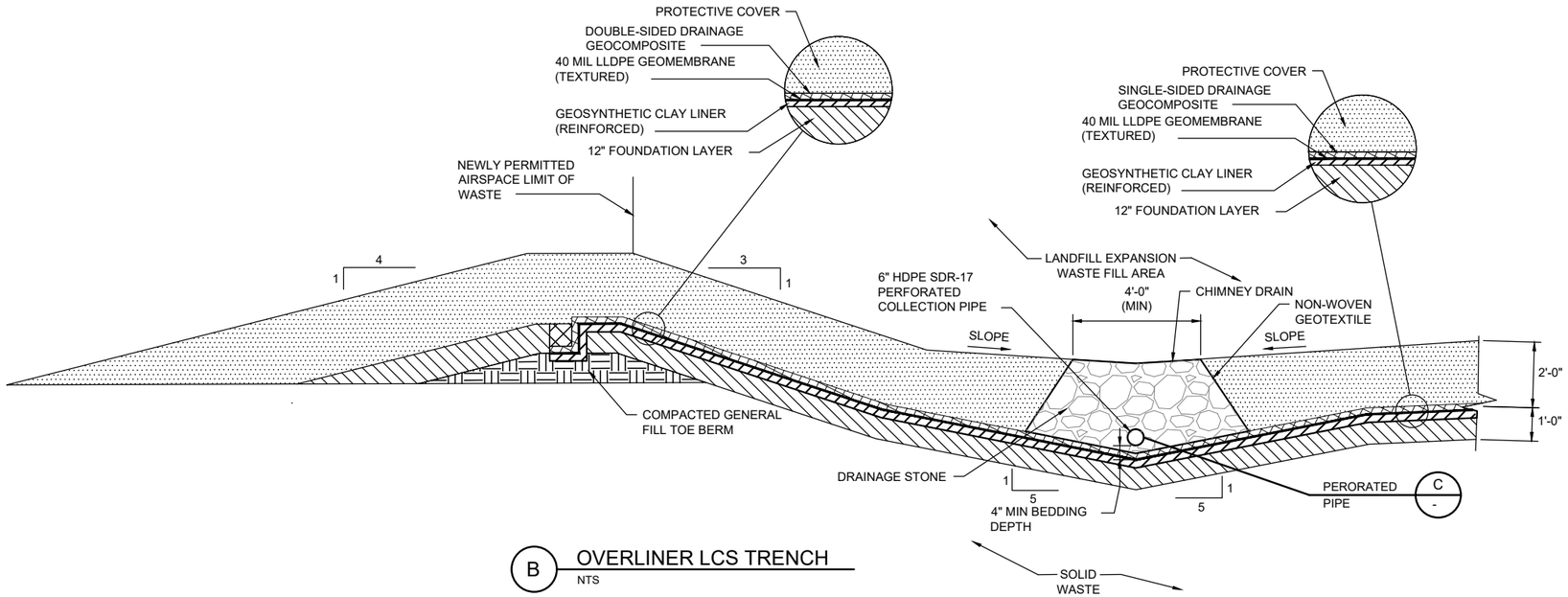
A OVERLINER SYSTEM
NTS

NOTES:

1. FOUNDATION LAYER PREPARATION, INSTALLATION OF GEOSYNTHETIC CLAY LINER, AND PLACEMENT OF PROTECTIVE COVER WILL BE IN ACCORDANCE WITH APPENDIX IIID-LQCP.
2. DRAINAGE GEOCOMPOSITE FOR OVERLINER AREAS CONSISTS OF A 300-MIL GEONET WITH 6 OZ/SY GEOTEXTILES HEAT BONDED ON BOTH SIDES.
3. THE DETAIL IS SHOWN WITH INITIAL CONDITION SLOPES. THE SETTLEMENT ANALYSIS THAT INCLUDES THE DETERMINATION OF AFTER SETTLEMENT SLOPES FOR THE LEACHATE COLLECTION LAYER AS WELL AS FOR THE LEACHATE COLLECTION PUPING IS INCLUDED IN APPENDIX IIIE (APPENDIX IIIE-B). ALSO A DEMONSTRATION SHOWING THAT THE LEACHATE COLLECTION SYSTEM WILL FUNCTION AS DESIGNED IS INCLUDED IN APPENDIX IIIC.



C PERFORATED PIPE
NTS



B OVERLINER LCS TRENCH
NTS

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0 1"

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OVERLINER DETAILS

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FIGURE
IIIA-A.8

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CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT

APPENDIX IIIA-B
LANDFILL UNIT CROSS SECTIONS

Prepared for
City of Del Rio

September 2023



Prepared by
STV Inc
TPBE Registration No. F-1741
1820 Regal Row, Suite 200
Dallas, TX 75235
214-638-0500

This document is intended for permitting purposes only.

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Figure IIIA-B.6 - Typical Cross Section C

Figure IIIA-B.7 - Typical Cross Section D

Figure IIIA-B.8 - Typical Cross Section E

Figure IIIA-B.9 - Typical Cross Section F



LEGEND

PERMIT BOUNDARY

1084 EXISTING GRADES

LIMITS OF WASTE

BP1 GAS PROBE (SEE NOTE 3)

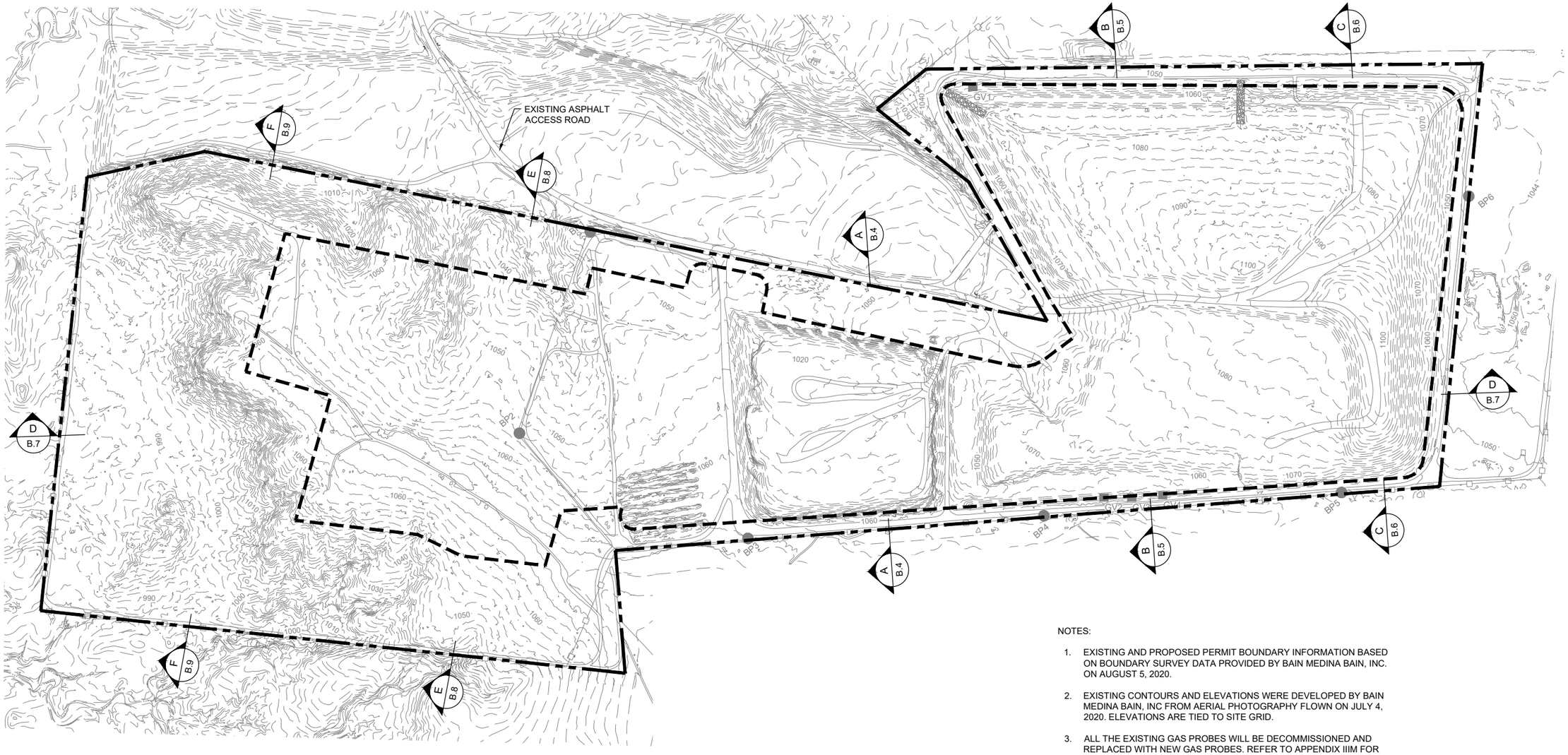
GV2 GAS VENT

EXISTING SITE FENCE

N

0 200 400

SCALE IN FEET



NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. ELEVATIONS ARE TIED TO SITE GRID.
3. ALL THE EXISTING GAS PROBES WILL BE DECOMMISSIONED AND REPLACED WITH NEW GAS PROBES. REFER TO APPENDIX IIIM FOR ADDITIONL INFORMATION. REFER TO FIGURES IIIA-B.3 FOR THE PROPOSED GAS PROBE LOCATION.

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0 1"

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

TYPICAL SECTION SITE PLAN

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FIGURE
IIIA-B.1

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FILE PATH: c:\pwworking\stv\pw_stvgjohnson\d0942271\DELR200302 Figure IIIA-B.1.dwg

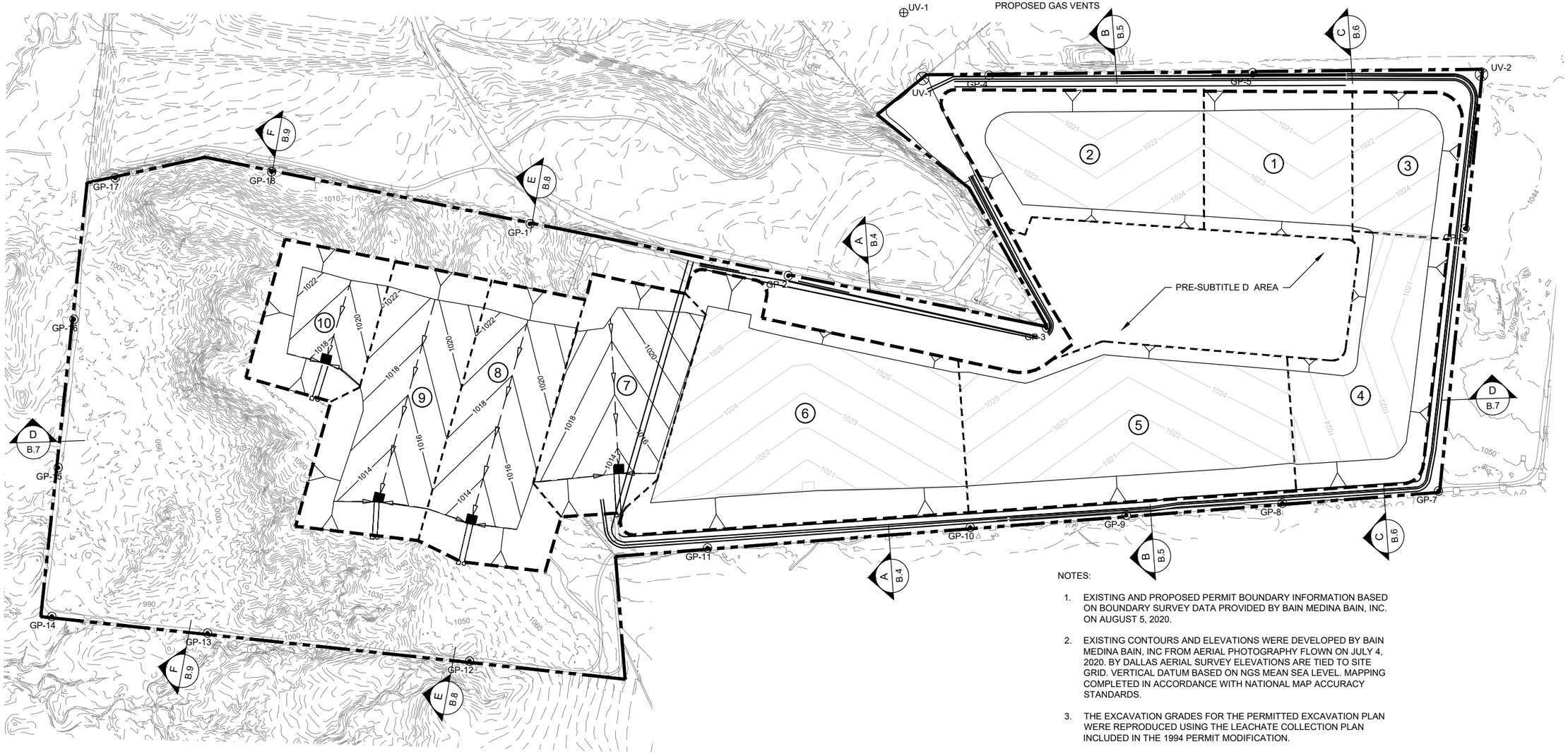
LEGEND

- PROPOSED PERMIT BOUNDARY
- PROPOSED LIMIT OF WASTE
- CELL BOUNDARY
- 1080 EXISTING GRADES
- 1010 PROPOSED EXCAVATION GRADES
- 1022 PERMITTED EXCAVATION GRADES
- (10) CELL DESIGNATION
- LEACHATE COLLECTION RISER
- LEACHATE COLLECTION CLEANOUT
- LEACHATE COLLECTION SUMP
- LEACHATE COLLECTION LINE
- GP-5 PROPOSED GAS PROBE
- UV-1 PROPOSED GAS VENTS

N

0 200 400

SCALE IN FEET



NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. BY DALLAS AERIAL SURVEY ELEVATIONS ARE TIED TO SITE GRID. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP ACCURACY STANDARDS.
3. THE EXCAVATION GRADES FOR THE PERMITTED EXCAVATION PLAN WERE REPRODUCED USING THE LEACHATE COLLECTION PLAN INCLUDED IN THE 1994 PERMIT MODIFICATION.
4. EXCAVATION SLOPES ARE TYPICALLY 3H:1V.
5. MINIMUM EXCAVATION ELEVATION AT LEACHATE COLLECTION SYSTEM SUMP IS 1007 FT-MSL.
6. LINER AND LEACHATE COLLECTION SYSTEM DETAILS ARE INCLUDED IN APPENDIX IIIA-A.

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VERIFY SCALE 0 1"

BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

LANDFILL EXCAVATION PLAN

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FIGURE
IIIA-B.2

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FILE PATH: c:\pwworkingstv\pw_avgjohnson\d0942271\DELR2000302 Figure IIIA-B.2.dwg

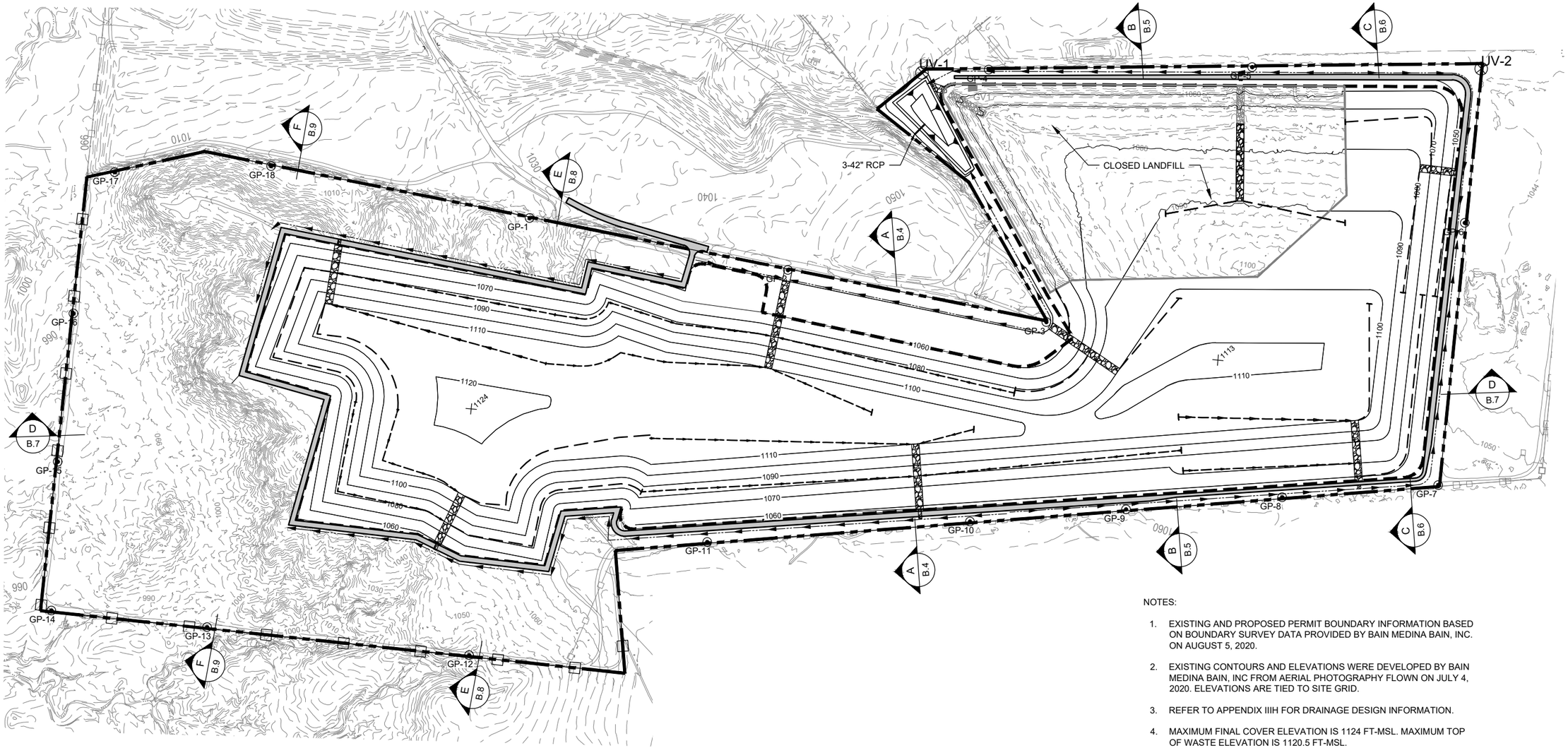
LEGEND

- PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- LIMIT OF WASTE
- 1090 FINAL COVER GRADES
- 1084 EXISTING GRADES
- SWALES
- PROPOSED SITE FENCE
- EXISTING CHUTE
- CHUTES
- GP-5 PROPOSED GAS PROBE
- UV-1 PROPOSED GAS VENTS

N

0 200 400

SCALE IN FEET



NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. ELEVATIONS ARE TIED TO SITE GRID.
3. REFER TO APPENDIX IIIH FOR DRAINAGE DESIGN INFORMATION.
4. MAXIMUM FINAL COVER ELEVATION IS 1124 FT-MSL. MAXIMUM TOP OF WASTE ELEVATION IS 1120.5 FT-MSL.
5. TYPICAL TOPSLOPE IS 5%. TYPICAL SIDESLOPES ARE 4H:1V EXCEPT IN THE AREA OF THE CLOSED PORTION OF THE LANDFILL IN WHICH THE SIDESLOPES ARE 5H:1V.

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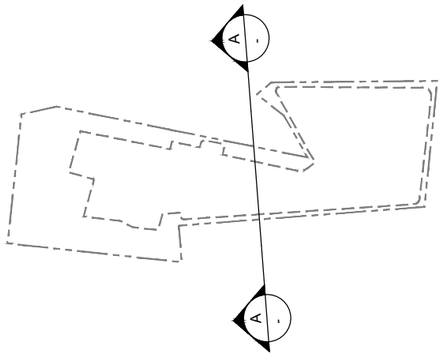
LANDFILL COMPLETION PLAN

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REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

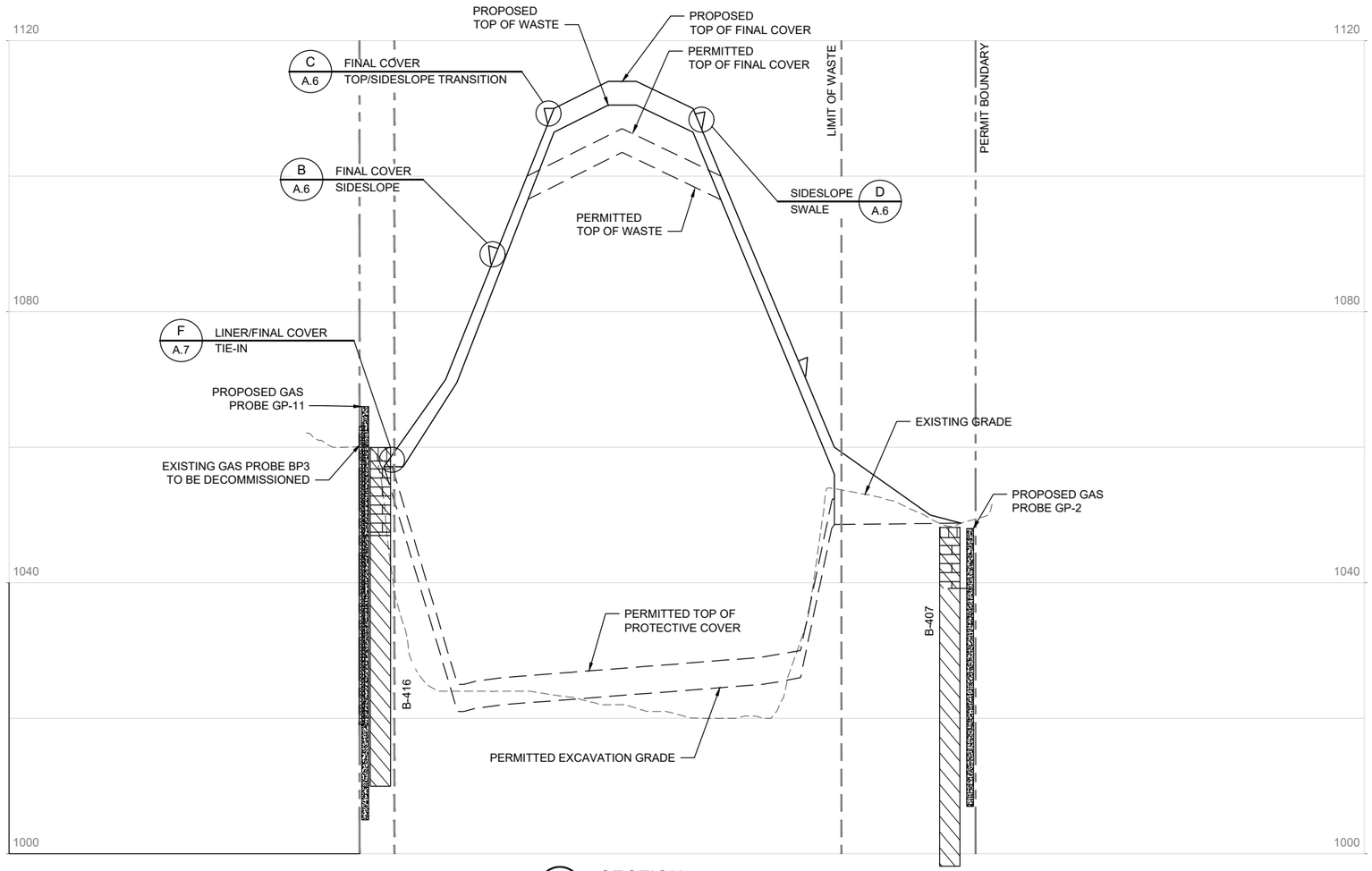
FIGURE
IIIA-B.3

NOTES:

1. TOPOGRAPHIC MAP WAS COMPLETED FROM PHOTOGRAMMETRIC METHODS BY DALLAS AERIAL SURVEY. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP ACCURACY STANDARDS.
2. REFER TO APPENDIX IIIA-A FOR LINER, LEACHATE COLLECTION, AND FINAL COVER SYSTEM DETAILS.
3. SEE APPENDIX IIIG FOR BORING DATA. BORINGS PROJECTED INTO THE LINE OF SECTION.
4. AS SHOWN IN APPENDIX I/IIC, THE BUFFER ZONES VARY AROUND THE PERIMETER OF THE SITE, BUT IN NO CASE ARE THEY LESS THAN 50-FEET FOR EXISTING WASTE.
5. REFER TO APPENDIX IIIM, FOR DETAILS OF THE LANDFILL GAS MANAGEMENT PLAN.
6. DRAINAGE DESIGN INFORMATION IS PROVIDED IN APPENDIX IIIH-SURFACE WATER DRAINAGE PLAN.
7. MAXIMUM TOP OF FINAL COVER ELEVATION IS 1124 FT-MSL.
8. REFER TO APPENDIX IIIC FOR LEACHATE COLLECTION SYSTEM (LCS) INFORMATION.
9. THE SITE DOES NOT HAVE ANY GROUNDWATER MONITORING WELLS. GROUNDWATER HAS NOT BEEN ENCOUNTERED IN OF THE BORINGS OR DURING CONSTRUCTION OF CELLS 1 THROUGH 6.
10. THIS SITE DOES NOT ACCEPT ANY CLASS 1 WASTE.



KEY MAP
NTS



A B.2 SECTION

HORZ 0 100 200
VERT 0 10 20
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMIT OF WASTE
- CLAY
- CLAY AND CALICHE
- SILTY CLAY

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CITY OF DEL RIO LANDFILL NO. 207C
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CROSS SECTION A

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0 1"

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DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

FIGURE
IIIA-B.4

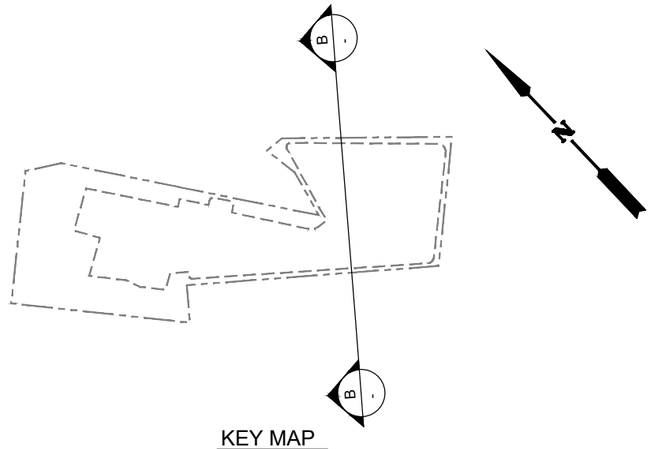
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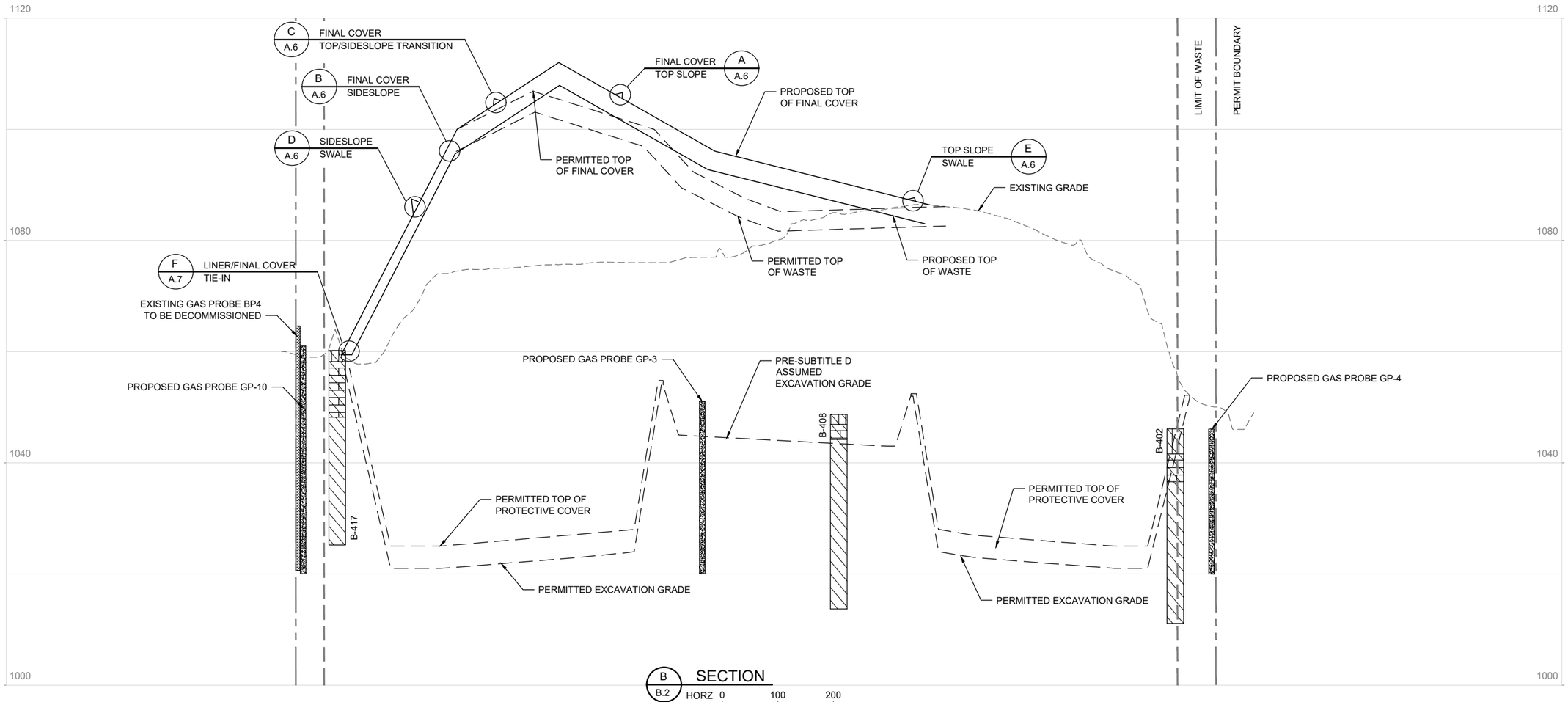
1. TOPOGRAPHIC MAP WAS COMPLETED FROM PHOTOGRAMMETRIC METHODS BY DALLAS AERIAL SURVEY. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP ACCURACY STANDARDS.
2. REFER TO APPENDIX IIIA-A FOR LINER, LEACHATE COLLECTION, AND FINAL COVER SYSTEM DETAILS.
3. SEE APPENDIX IIIG FOR BORING DATA. BORINGS PROJECTED INTO THE LINE OF SECTION.
4. AS SHOWN IN APPENDIX I/IIC, THE BUFFER ZONES VARY AROUND THE PERIMETER OF THE SITE, BUT IN NO CASE ARE THEY LESS THAN 50-FEET FOR EXISTING WASTE.
5. REFER TO APPENDIX IIIM, FOR DETAILS OF THE LANDFILL GAS MANAGEMENT PLAN.
6. DRAINAGE DESIGN INFORMATION IS PROVIDED IN APPENDIX IIIH-SURFACE WATER DRAINAGE PLAN.
7. MAXIMUM TOP OF FINAL COVER ELEVATION IS 1124 FT-MSL.
8. REFER TO APPENDIX IIIC FOR LEACHATE COLLECTION SYSTEM (LCS) INFORMATION.
9. THE SITE DOES NOT HAVE ANY GROUNDWATER MONITORING WELLS. GROUNDWATER HAS NOT BEEN ENCOUNTERED IN OF THE BORINGS OR DURING CONSTRUCTION OF CELLS 1 THROUGH 6.
10. THIS SITE DOES NOT ACCEPT ANY CLASS 1 WASTE.

LEGEND

- PERMIT BOUNDARY
- LIMIT OF WASTE
- CLAY
- CLAY AND CALICHE
- SILTY CLAY



KEY MAP
NTS



B / B.2 SECTION

HORZ 0 100 200

VERT 0 10 20

SCALE IN FEET

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0 1"

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CROSS SECTION B

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CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

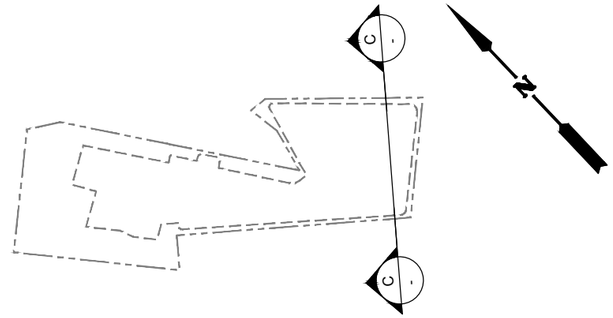
FIGURE
IIIA-B.5

NOTES:

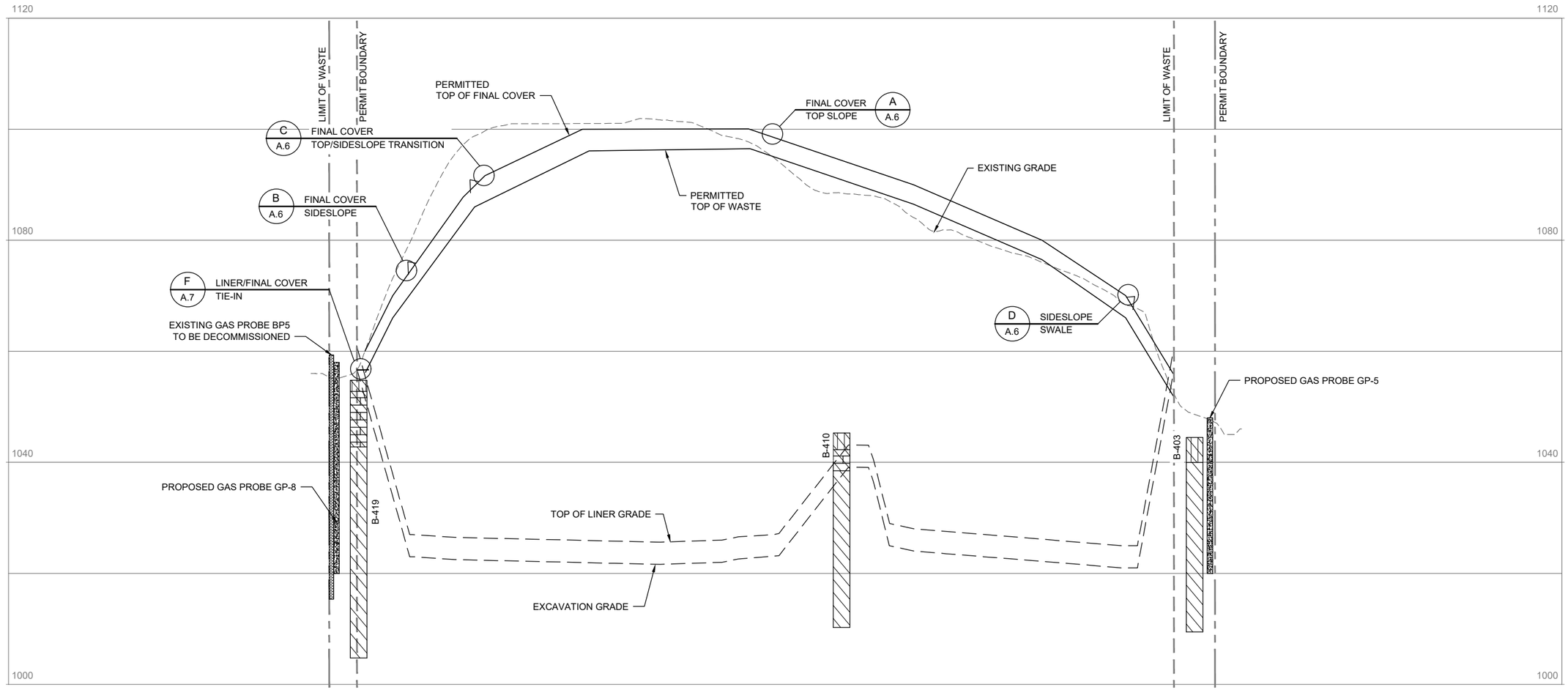
1. TOPOGRAPHIC MAP WAS COMPLETED FROM PHOTOGRAMMETRIC METHODS BY DALLAS AERIAL SURVEY. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP ACCURACY STANDARDS.
2. REFER TO APPENDIX IIIA-A FOR LINER, LEACHATE COLLECTION, AND FINAL COVER SYSTEM DETAILS.
3. SEE APPENDIX IIIG FOR BORING DATA. BORINGS PROJECTED INTO THE LINE OF SECTION.
4. AS SHOWN IN APPENDIX I/IIC, THE BUFFER ZONES VARY AROUND THE PERIMETER OF THE SITE, BUT IN NO CASE ARE THEY LESS THAN 50-FEET FOR EXISTING WASTE.
5. REFER TO APPENDIX IIIM, FOR DETAILS OF THE LANDFILL GAS MANAGEMENT PLAN.
6. DRAINAGE DESIGN INFORMATION IS PROVIDED IN APPENDIX IIIH-SURFACE WATER DRAINAGE PLAN.
7. MAXIMUM TOP OF FINAL COVER ELEVATION IS 1124 FT-MSL.
8. REFER TO APPENDIX IIIC FOR LEACHATE COLLECTION SYSTEM (LCS) INFORMATION.
9. THE SITE DOES NOT HAVE ANY GROUNDWATER MONITORING WELLS. GROUNDWATER HAS NOT BEEN ENCOUNTERED IN OF THE BORINGS OR DURING CONSTRUCTION OF CELLS 1 THROUGH 6.
10. THIS SITE DOES NOT ACCEPT ANY CLASS 1 WASTE.

LEGEND

- PERMIT BOUNDARY
- LIMIT OF WASTE
- CLAY
- CLAY AND CALICHE
- SILTY CLAY



KEY MAP
NTS



C B.2 SECTION

HORZ 0 100 200

VERT 0 10 20

SCALE IN FEET

FOR PERMITTING PURPOSES ONLY

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STATE OF TEXAS TEMOBISTA METAFERIA 123183 LICENSED PROFESSIONAL ENGINEER 09/29/2023

NO.	REVISION	BY	DATE

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0 1"

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

CROSS SECTION C

DESIGN:	T. METAFERIA
DRAWN:	T. METAFERIA
REVIEW:	B. HINDMAN
CP&Y:	DELR200302
CLIENT:	CITY OF DEL RIO

FIGURE
IIIA-B.6

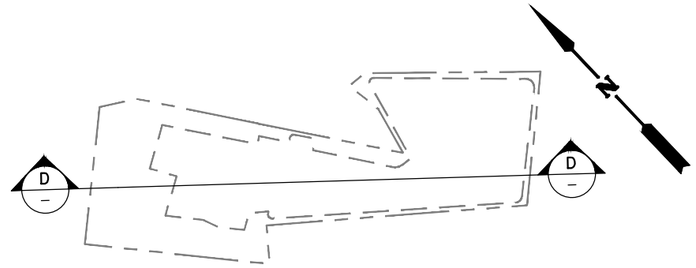
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FILE PATH: C:\pwworking\stv\pw_stvgjohnson\d0942271\DELR200302 Figure IIIA-B.6.dwg

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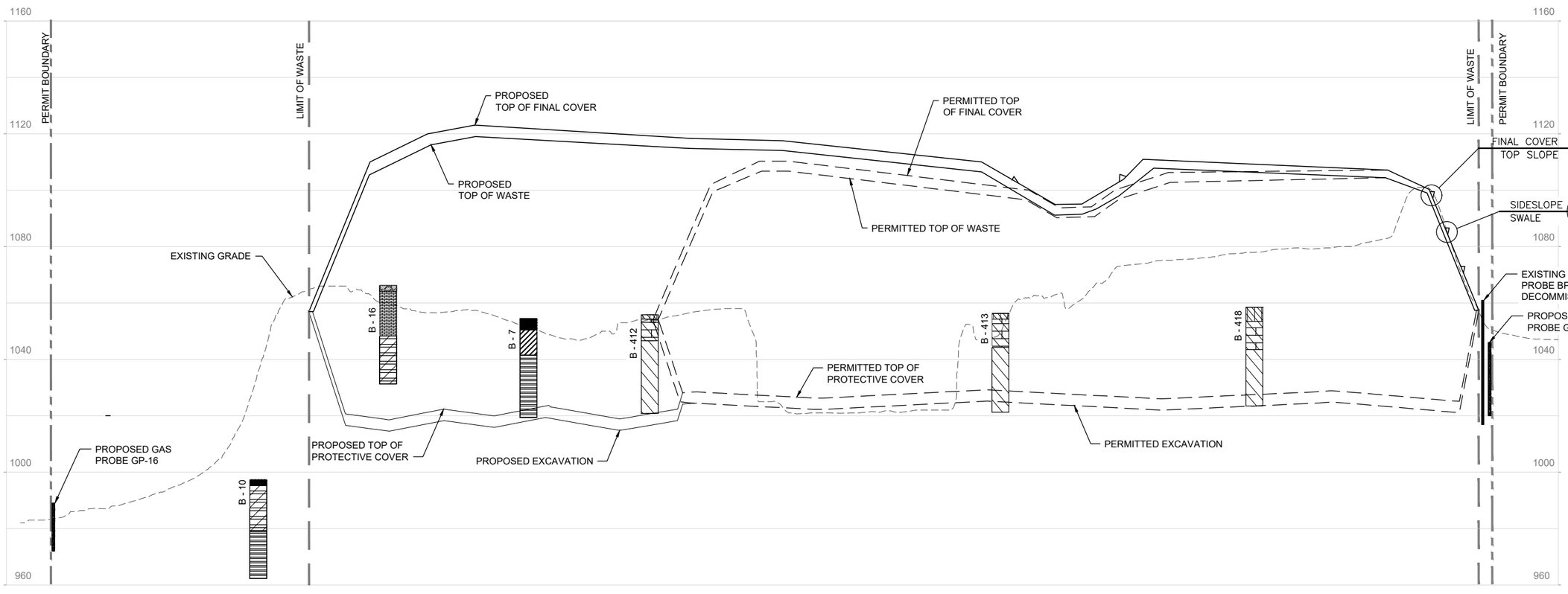
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2. REFER TO APPENDIX IIIA-A FOR LINER, LEACHATE COLLECTION, AND FINAL COVER SYSTEM DETAILS.
3. SEE APPENDIX IIIL FOR BORING DATA. BORINGS PROJECTED INTO THE LINE OF SECTION.
4. AS SHOWN IN APPENDIX I/IIC, THE BUFFER ZONES VARY AROUND THE PERIMETER OF THE SITE, BUT IN NO CASE ARE THEY LESS THAN 50-FEET FOR EXISTING WASTE.
5. REFER TO APPENDIX IIIM, FOR DETAILS OF THE LANDFILL GAS MANAGEMENT PLAN.
6. DRAINAGE DESIGN INFORMATION IS PROVIDED IN APPENDIX IIIH-SURFACE WATER DRAINAGE PLAN.
7. MAXIMUM TOP OF FINAL COVER ELEVATION IS 1124 FT-MSL.
8. REFER TO APPENDIX IIIC FOR LEACHATE COLLECTION SYSTEM (LCS) INFORMATION.
9. THE SITE DOES NOT HAVE ANY GROUNDWATER MONITORING WELLS. GROUNDWATER HAS NOT BEEN ENCOUNTERED IN OF THE BORINGS OR DURING CONSTRUCTION OF CELLS 1 THROUGH 6.
10. THIS SITE DOES NOT ACCEPT ANY CLASS 1 WASTE.

LEGEND

- PERMIT BOUNDARY
- LIMIT OF WASTE
- CLAY
- CLAY AND CALICHE
- SILTY CLAY
- CLAYEY GRAVEL
- CLAY
- FAT CLAY
- WEATHERED CLAY-SHALE
- CLAY-SHALE



KEY MAP
NTS



D / B.2 SECTION

HORZ 0 200 400

VERT 0 20 40

SCALE IN FEET

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TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

CITY OF DEL RIO, TEXAS
TEWOBISTA METAFERIA
123183
LICENSED
PROFESSIONAL ENGINEER
09/29/2023

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CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

CROSS SECTION D

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REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

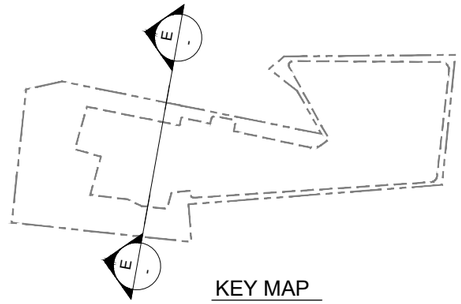
FIGURE
IIIA-B.7

NOTES:

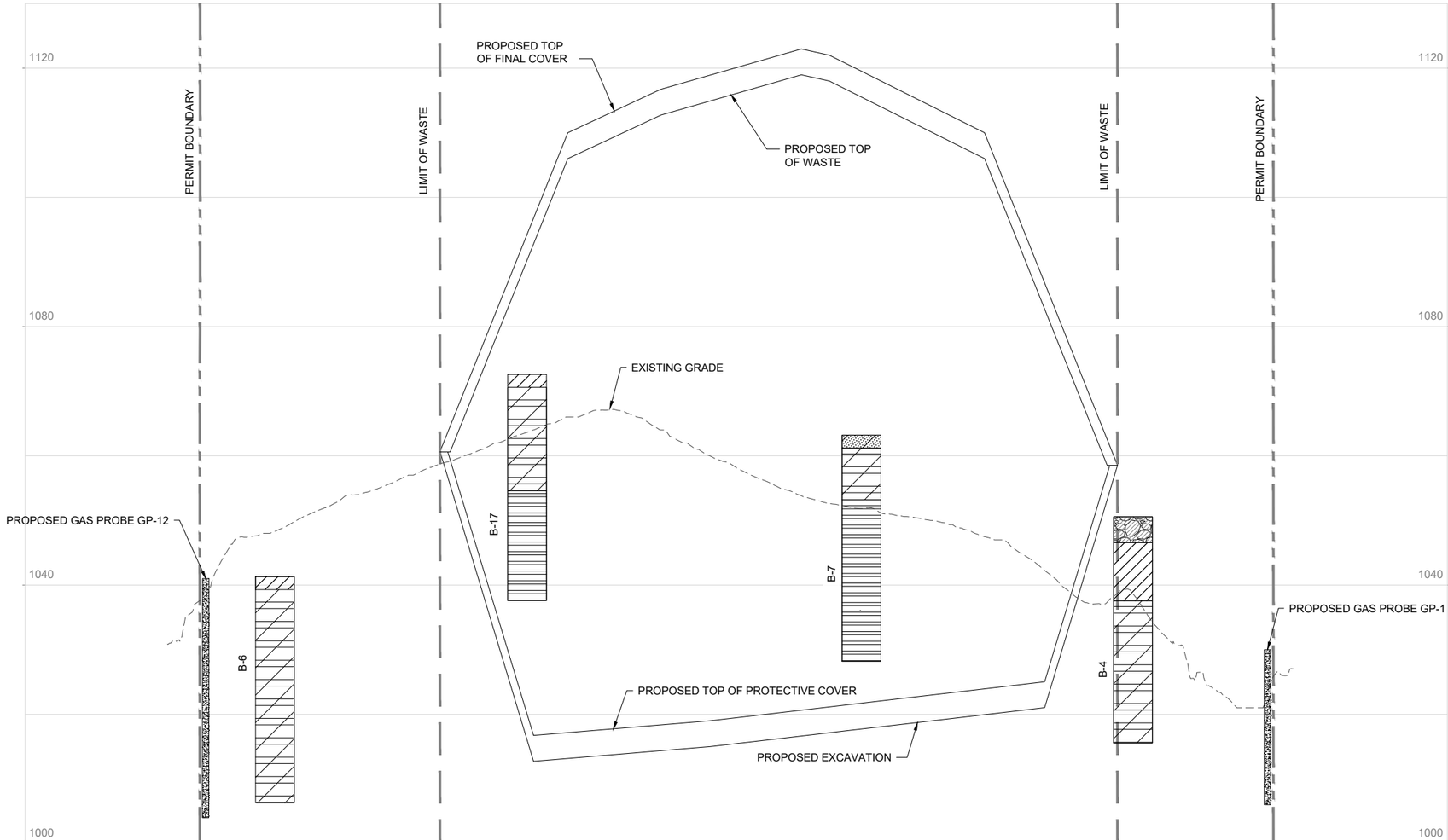
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7. MAXIMUM TOP OF FINAL COVER ELEVATION IS 1124 FT-MSL.
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9. THE SITE DOES NOT HAVE ANY GROUNDWATER MONITORING WELLS. GROUNDWATER HAS NOT BEEN ENCOUNTERED IN OF THE BORINGS OR DURING CONSTRUCTION OF CELLS 1 THROUGH 6.
10. THIS SITE DOES NOT ACCEPT ANY CLASS 1 WASTE.

LEGEND

- PERMIT BOUNDARY
- LIMIT OF WASTE
- CLAYEY GRAVEL
- CLAY
- FAT CLAY
- WEATHERED CLAY-SHALE
- CLAY-SHALE



KEY MAP
NTS



E / B.2 SECTION

HORZ 0 100 200
VERT 0 10 20
SCALE IN FEET

FOR PERMITTING PURPOSES ONLY

TEXAS REGISTERED ENGINEERING FIRM TBPE F-1741

CITY OF DEL RIO TEXAS

STATE OF TEXAS — TEWOBISTA METAFERIA — 123183 — LICENSED PROFESSIONAL ENGINEER — 09/29/2023

NO.	REVISION	BY	DATE

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CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

CROSS SECTION E

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CP&Y:	DELR200302
CLIENT:	CITY OF DEL RIO

FIGURE
IIIA-B.8

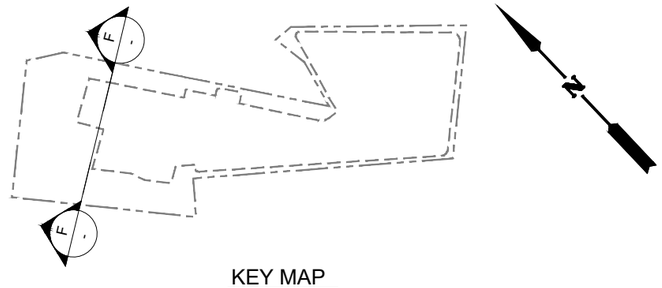
PRINTED BY: Metafe1T DATE: 7/2/2023
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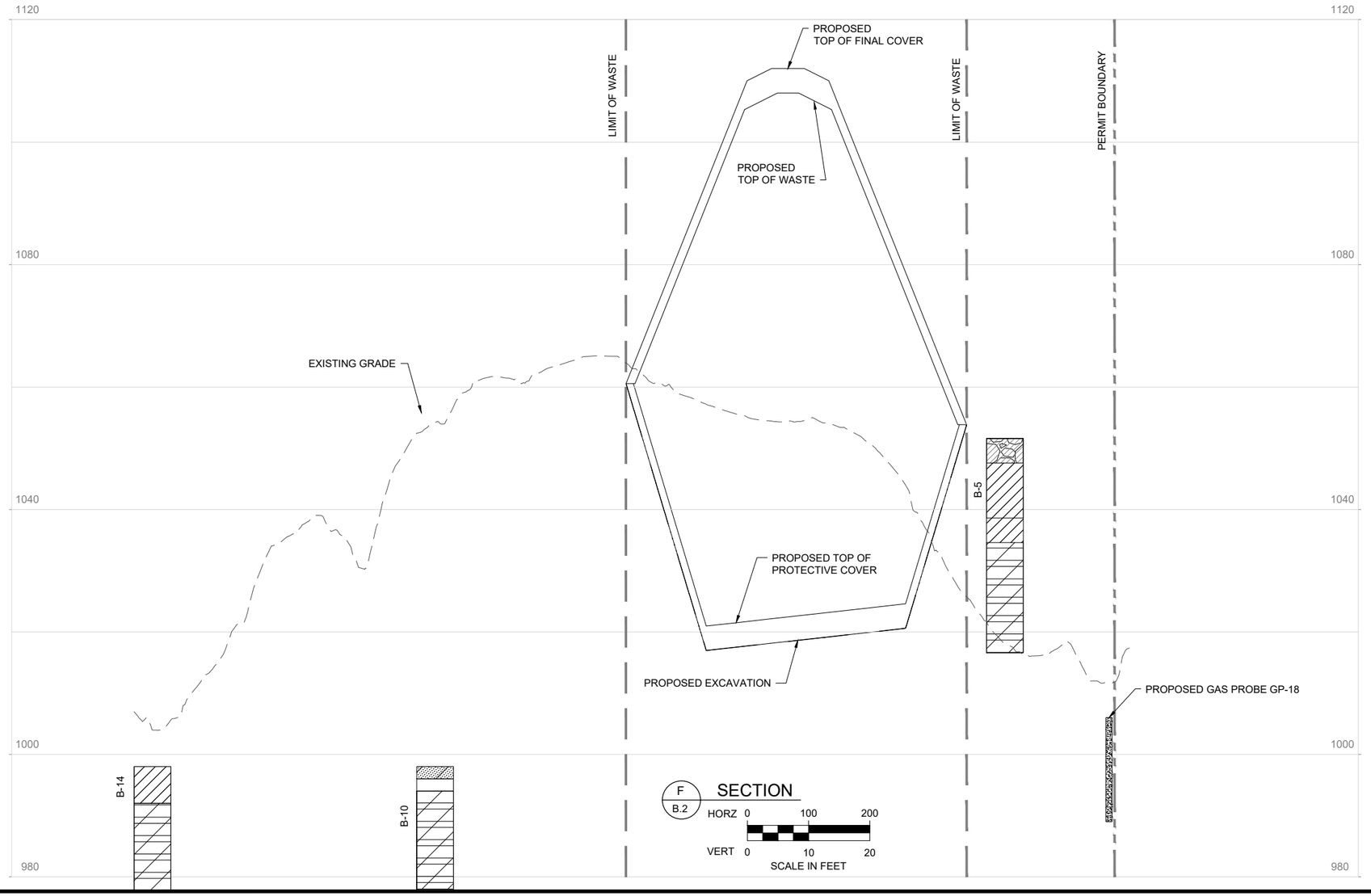
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LEGEND

- PERMIT BOUNDARY
- LIMIT OF WASTE
- CLAYEY GRAVEL
- CLAY
- FAT CLAY
- WEATHERED CLAY-SHALE
- CLAY-SHALE



KEY MAP
NTS



F / B.2 SECTION

HORZ 0 100 200
VERT 0 10 20
SCALE IN FEET

FOR PERMITTING PURPOSES ONLY

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CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

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CP&Y:	DELR200302
CLIENT:	CITY OF DEL RIO

FIGURE
IIIA-B.9

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN

APPENDIX IIIB
SITE LIFE CALCULATIONS

Prepared for
City of Del Rio

September 2023



Prepared by
STV Inc
TPBE Registration No. F-1741
1820 Regal Row, Suite 200
Dallas, TX 75235
214-638-0500

This document is intended for permitting purposes only.

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4.0 SITE LIFE CALCULATIONS IIIB-3

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Figure IIIB.1 Average Depth of Waste



1.0 SITE LIFE

1.1 Solid Waste Generation

Two estimates have been developed provide an assessment of the solid waste generation rate for the Del Rio Landfill. The estimate included in Section 1.1.1 is based on the City's knowledge of the current market condition and population. The estimate included in Section 1.1.2 is based on historical waste inflow data. The projection based on historical data is provided for informational purposes and is not considered in any calculation or demonstration in this application

It is important to note that the estimates included in both sections are based on numerous assumptions and may vary as market conditions change.

1.1.1 Solid Waste Generation Information Using Population Projections

Over the last few years, the waste inflow rate at Del Rio Landfill has varied from 136 tons per day to 188 tons per day as listed below. Since Del Rio is a US/Mexico border city, the yearly fluctuation in the flow of waste is partly due to the migration of people through the city. So the waste inflow is impacted by the permanent population as well as the migratory population.

Table 1-1 Del Rio Landfill Historical Waste Acceptance

Fiscal Year	Waste Inflow	Typical Daily Waste Inflow Rate Based on a 309-Day Operating Schedule
2015	44,708 tons/year	145 tons/day
2016	54,092 tons/year	175 tons/day
2017	51,764 tons/year	168 tons/day
2018	42,072 tons/year	136 tons/day
2019	45,399 tons/year	147 tons/day
2020	54,488 tons/year	176 tons/day
2021	58,055 tons/year	188 tons/day
2022	47,067 tons/year	152 tons/day
Average	**49,706 tons/year**	**161 tons/day**

1. Information obtained from the TCEQ MSW Annual Reports.

After 2022, the waste inflow rate is assumed to increase consistent with the projected population growth rate for the facility's general service area which for this analysis is assumed to be Val Verde County. The census information and growth trends for Del Rio and Val Verde are presented on page IIIB-5. The population growth projections were obtained from the Texas Water Development Board (TWDB). It is assumed that area growth patterns will be consistent with the growth patterns published by the TWDB. Therefore, the 2022 waste inflow was increased by the annual population growth percentage until the landfill capacity was reached as shown on page IIIB-6.

Using this methodology, the expected maximum annual waste acceptance rate is 72,967 tons in 2068 (236 tons per day based on a 309-day operating schedule). The above projections are based on current population growth projects and may vary as conditions change. Over the life of the facility, the expected average daily volume of incoming waste is projected to be approximately 196 tons per day (60,486 tons per year based on a 309-day operating schedule as shown on page IIIB-7). Site life calculations based on the population growth projections are shown on pages IIIB-5 through IIIB-7.

1.1.2 Solid Waste Generation Information Using Historical Data

This estimate is based on historical waste inflow data reported in the Texas Commission on Environmental Quality (TCEQ) Municipal Solid Waste (MSW) Annual Report. As shown in Table 1-1, the waste inflow data for the site varies from year to year. Using the data from Table 1-1 a trendline was developed to project the waste acceptance for the facility as shown on page IIIB-8. The equation for the trendline was used to calculate the waste inflow for the different years. Using this methodology, the expected maximum annual waste acceptance rate is 76,752 tons in 2066 (248 tons per day based on a 309-day operating schedule). Over the life of the facility, the expected average daily volume of incoming waste is projected to be approximately 204 tons per day (63,174 tons per year based on a 309-day operating schedule). Supplementary calculations are included on pages IIIB-8 through IIIB-10.

2.0 POPULATION EQUIVALENT

2.1 Del Rio Landfill Population Projections

Using the average waste inflow rate of 60,486 tons per year discussed in Section 1.1.1 (an average daily volume of 196 tons per day based on a 309-day operating schedule) and assuming 5 pounds of waste is generated per capita per day, the population equivalent is:

$$\frac{(60{,}486\ \ tons\ per\ year)x\ (2{,}000\frac{pounds}{ton})}{(5\ pounds\ per\ person/day)x\left(365\frac{days}{year}\right)} = 66{,}286\ persons$$

2.2 Historical Data

Using the average of the actual waste inflow rate of 63,174 tons per year discussed in Section 1.1.2 (an average daily volume of 204 tons per day based on a 309-day operating schedule) and assuming 5 pounds of waste is generated per capita per day, the population equivalent is:

$$\frac{(63{,}174\ tons\ per\ year)x\ (2{,}000\frac{pounds}{ton})}{(5\ pounds\ per\ person/day)x\left(365\frac{days}{year}\right)} = 69{,}232\ persons$$

3.0 LANDFILL CAPACITY

The estimated total capacity of in-place waste and daily cover over the active life of the facility, as of January 19,2023, is approximately 35.02 million cubic yards. The total volume available for solid waste and daily cover is estimated to be 5,646,162 cubic yards. This airspace estimate includes the remaining available volume in the existing permitted area and the proposed 75-acre horizontal expansion.

4.0 SITE LIFE CALCULATIONS

The site life calculations based on projected population growth rates in Val Verde County are presented on pages IIIB-5 and IIIB-7. The site life is projected to be approximately 46.6 years, which would result in the site's closure during the year 2069.

The site life calculations based on historical waste inflow data are presented on pages IIIB-8 and IIIB-10. The site life is projected to be approximately 44.1 years, which would result in the site's closure during the year 2067.

Average Density for Site Life Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Site Life Calculations

Date: 9/29/2023
Job No: DELR200302
By: T. Metaferia
Checked By: B. Hindman

Purpose - **Determine average density for the landfill between the permitted bottom of waste contours and proposed top of waste contours.**

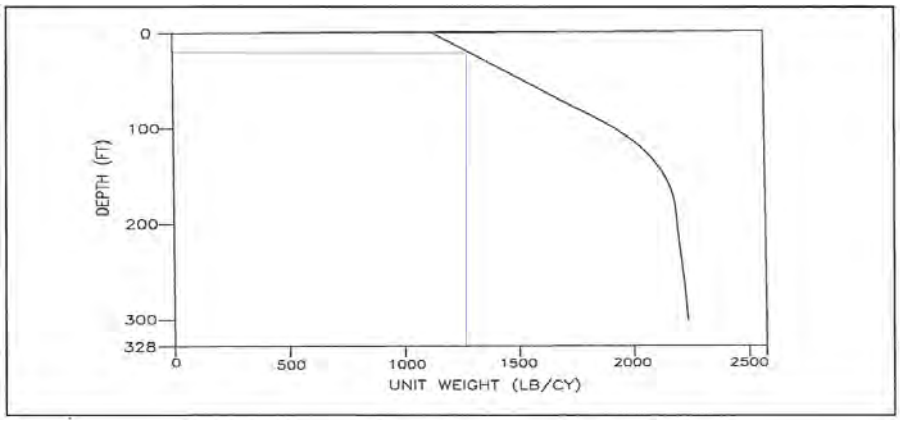
Step 1 - Determine average thickness of waste throughout the landfill profile.:

Using the permitted excavation plan and proposed final cover plan in Appendix IIIA-A, it was determined that the average thickness of was over the entire site is approximatley 54 feet

The average density is calculated from the midpoint of the average depth (27 feet) to determine the average density.

Step 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 Profiles for Waste/Daily Cover Within a MAW Landfill [1]



1. Graph is derived from Acar, Yalcin B.& Daniel, David E., *Geoenvironment 2000 Characterization, Containment, Remediation, and Performance in Environmental Geotechnics,* Volume 2, American Society of Civil Engineers, 1995.

Midpoint of Average Depth = 27 ft (Refer to Figure IIIB.1)

The average density is calculated at the midpoint of the average depth of (27 feet) to represent the average density of waste/cover soil within the landfill.

D_{avg} = 1,250 lb/yd^3

Site Life Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Site Life Calculations

Date: 9/29/2023
Job No: DELR200302
By: T. Metaferia
Checked By: B. Hindman

Purpose - **Determine approximate site life in years for the site using waste inflow projections based on population growth. The site typically operates 309 days per year.**

Step 1 - Determine available landfill tonnage

Permitted remaining airspace =	1,988,178	cy
Expansion airspace =	3,657,984	cy
Remaining airspace (permitted and expansion) =	5,646,162	cy
Percent daily cover =	10	%
γ_{soil} =	2,430	
In-place density (waste and soil) *=	1,250	lb/cy

* Refer to page IIIB-4 for additional information regarding the average in-place density of waste

- Estimate density of waste only

(γ_{soil})(10% of 5,646,162 cy)+(γ_{waste})(90% of 5,646,162 cy) = $(\gamma_{soil/waste})$(5,646,162 cy)

γ_{waste} = 1118.9 lb/cy

Remaining permitted available airspace = (90%)(5,646,162 cy)*(1118.9 lb/cy)(1/2000 tons/lb)
= 2,842,843 tons

Step 2 - Determine the annual waste inflow rate and project waste inflow rate:

Val Verde County

	Population Growth	Growth %	% Annual Growth	
Population 2020 =	47,582	-		(2020 population is obtained from US Census Bureau Val Verde County,Texas)
Population (2020-2029) =	54,694	14.95%	1.40%	
Population (2030-2039) =	60,389	10.41%	1.00%	Population growth was obtained from the Texas Water Development Board
Population (2040-2049) =	65,902	9.13%	0.88%	
Population (2050-2059) =	71,566	8.59%	0.83%	
Population (2060-2069) =	76,960	7.54%	0.73%	

2022 Waste Stream = 47,067 tons/yr
Days of Operation = 309 days

Site Life Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Site Life Calculations

Date: 9/29/2023
Job No: DELR200302
By: T. Metaferia
Checked By: B. Hindman

Step 3 - Waste Stream Growth

Based on historical date from 2015 and waste stream growth based on population projections

Year	Waste Inflow (tons)	Ton Consumed (tons)
2023	47,727	47,727
2024	48,397	96,124
2025	49,076	145,200
2026	49,764	194,964
2027	50,462	245,426
2028	51,170	296,596
2029	51,888	348,483
2030	52,616	401,099
2031	53,139	454,238
2032	53,668	507,906
2033	54,203	562,109
2034	54,742	616,851
2035	55,287	672,138
2036	55,837	727,975
2037	56,393	784,369
2038	56,955	841,323
2039	57,522	898,845
2040	58,094	956,939
2041	58,604	1,015,543
2042	59,118	1,074,661
2043	59,637	1,134,298
2044	60,160	1,194,458
2045	60,688	1,255,146
2046	61,220	1,316,366
2047	61,758	1,378,124
2048	62,300	1,440,423
2049	62,846	1,503,270
2050	63,398	1,566,667
2051	63,923	1,630,590
2052	64,452	1,695,041
2053	64,985	1,760,027
2054	65,523	1,825,550
2055	66,066	1,891,616
2056	66,613	1,958,229
2057	67,164	2,025,393
2058	67,720	2,093,114
2059	68,281	2,161,395
2060	68,846	2,230,241
2061	69,348	2,299,590
2062	69,854	2,369,444
2063	70,364	2,439,808
2064	70,877	2,510,684
2065	71,394	2,582,078
2066	71,914	2,653,993
2067	72,439	2,726,432
2068	72,967	2,799,399
2069	43,444	2,842,843

Available tonnage is consumed during year 2069

Site Life = 46.6 yrs

Site Life Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Site Life Calculations

Date: 9/29/2023
Job No: DELR200302
By: T. Metaferia
Checked By: B. Hindman

Step 4 - Maximum and Average Inflow

Maximum tonnage accepted throughout the site life (72,967 tons) /309 days of operation per year

Maximum inflow = 236 tons/day

Average Tonnage accepted throughout the site life (60,486 tons) /309 days of operation per year

Average inflow = 196 tons/day

Site Life Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Site Life Calculations

Date: 9/29/2023
Job No: DELR200302
By: T. Metaferia
Checked By: B. Hindman

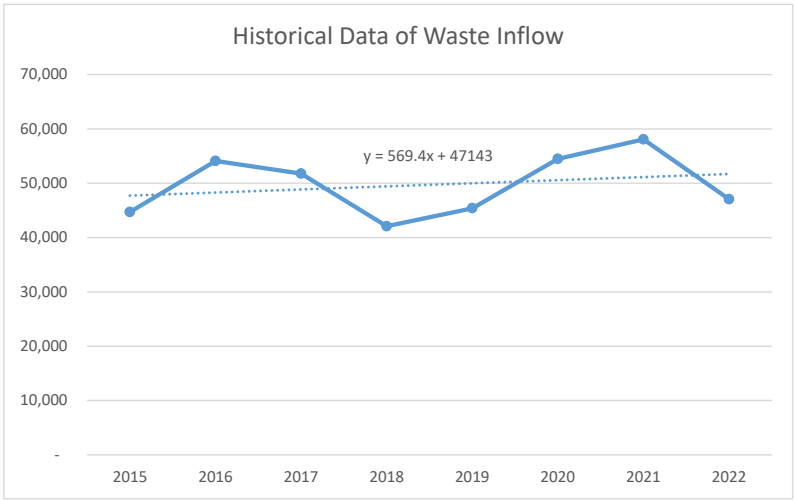
Purpose - **Determine approximate site life in years for the site based on historical data obtained from the TCEQ Annual reports. The site typically operates 309 days per year.**

Step 1 - Determine the annual waste inflow rate and project waste inflow rate:

Fiscal Year	Actual Waste Inflow (tons/yr)	Daily Waste Inflow- 309-day operation (tons/day)
2015	44,708	145
2016	54,092	175
2017	51,763	168
2018	42,072	136
2019	45,399	147
2020	54,488	176
2021	58,055	188
2022	47,067	152

Average Waste Inflow (tons/yr) = 49,706

Avg. Waste Inflow 309 day operation (tons/day)= 161



*Due to the fluctuation of waste inflow, a trendline was develop based on historical data to project the waste acceptance at the facility.

Step 2 - Determine available landfill tonnage:

Permitted remaining airspace = 1,988,178
Expansion airspace = 3,657,984
Remaining airspace (permitted and expansion) = 5,646,162 cy
Percent daily cover = 10 %
In-place density (waste and soil) = 1,250 lb/cy
γ_{soil} = 2,430 lb/cy

(γ_{soil})(10% of 5,646,162 cy)+(γ_{waste})(90% of 5,646,162 cy) = $(\gamma_{soil/waste})$(5,646,162 cy)
γ_{waste} = 1118.9 lb/cy

Remaining available airspace = (90%)(5,646,162 cy)*(1118.9 lb/cy)(1/2000 tons/lb)
= 2,842,843 tons

Site Life Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Site Life Calculations

Date: 9/29/2023
Job No: DELR200302
By: T. Metaferia
Checked By: B. Hindman

Step 3 - Waste Stream Growth

Trendline base years*	Fiscal Year	Waste Inflow (tons)**	Tonnage Consumed (tons)
9	2023	49,706	49,706
10	2024	52,837	102,543
11	2025	53,406	155,949
12	2026	53,976	209,925
13	2027	54,545	264,470
14	2028	55,115	319,585
15	2029	55,684	375,269
16	2030	56,253	431,522
17	2031	56,823	488,345
18	2032	57,392	545,737
19	2033	57,962	603,699
20	2034	58,531	662,230
21	2035	59,100	721,330
22	2036	59,670	781,000
23	2037	60,239	841,239
24	2038	60,809	902,048
25	2039	61,378	963,426
26	2040	61,947	1,025,373
27	2041	62,517	1,087,890
28	2042	63,086	1,150,976
29	2043	63,656	1,214,632
30	2044	64,225	1,278,857
31	2045	64,794	1,343,651
32	2046	65,364	1,409,015
33	2047	65,933	1,474,948
34	2048	66,503	1,541,451
35	2049	67,072	1,608,523
36	2050	67,641	1,676,164
37	2051	68,211	1,744,375
38	2052	68,780	1,813,155
39	2053	69,350	1,882,505
40	2054	69,919	1,952,424
41	2055	70,488	2,022,912
42	2056	71,058	2,093,970
43	2057	71,627	2,165,597
44	2058	72,197	2,237,794
45	2059	72,766	2,310,560
46	2060	73,335	2,383,895
47	2061	73,905	2,457,800
48	2062	74,474	2,532,274
49	2063	75,044	2,607,318
50	2064	75,613	2,682,931
51	2065	76,182	2,759,113
52	2066	76,752	2,835,865
53	2067	6,978	2,842,843

*The trendline base years start with 2015 as year 1

**The waste inflow was calculated using the trendline base years and the trendline equation.

Available tonnage is consumed during year 2067

Site Life = 44.1 yrs.

Site Life Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Site Life Calculations

Date: 9/29/2023
Job No: DELR200302
By: T. Metaferia
Checked By: B. Hindman

Step 4 - Maximum and Average Inflow

Maximum tonnage accepted during final year of operation (76,752 tons) /309 days of operation per year

Maximum inflow = 248 tons/day

Average Tonnage accepted throughout the site life (63,174 tons) /309 days of operation per year

Average inflow = 204 tons/day

LEGEND

PROPOSED PERMIT BOUNDARY

PROPOSED LIMIT OF WASTE

1090 TOP OF WASTE

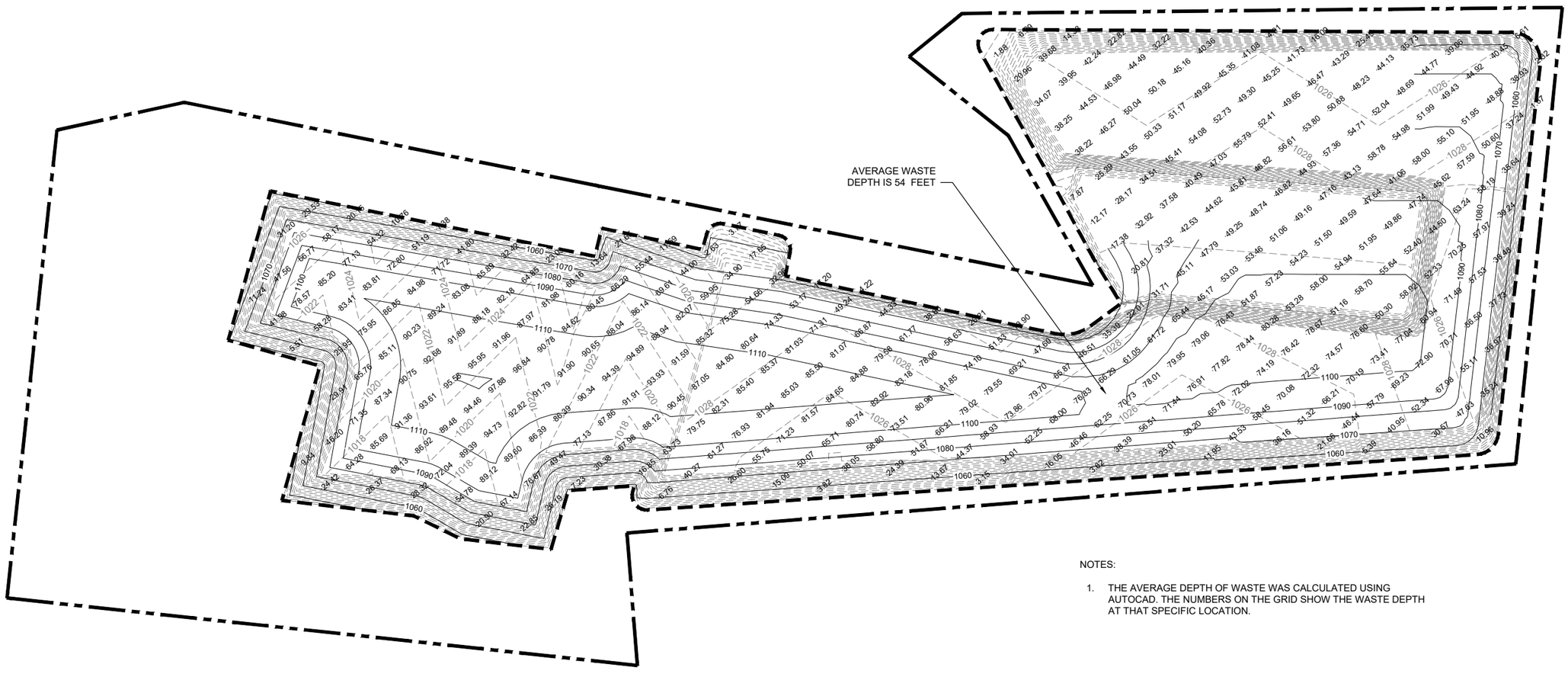
1022 TOP OF PROTECTIVE COVER

51.67 HEIGHT OF WASTE

N

0 200 400

SCALE IN FEET



NOTES:

1. THE AVERAGE DEPTH OF WASTE WAS CALCULATED USING AUTOCAD. THE NUMBERS ON THE GRID SHOW THE WASTE DEPTH AT THAT SPECIFIC LOCATION.

FOR PERMITTING PURPOSES ONLY

TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

CITY OF DEL RIO

STATE OF TEXAS
TEMOBISTA METAFERIA
123183
LICENSED
PROFESSIONAL ENGINEER
09/29/2023

NO.	REVISION	BY	DATE

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.

0 1"

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

WASTE DEPTTH

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

FIGURE
IIIB.1

PRINTED BY: MetafeT DATE: 8/1/2023
FILE PATH: C:\pwworkingst\pw_stv\gjohnson\d0942272\DELR200302 Figure IIIB.1.dwg

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN

APPENDIX IIIC
LEACHATE AND CONTAINATED WATER MANAGEMENT PLAN

Prepared for
City of Del Rio

September 2023



Prepared by
STV Inc
TPBE Registration No. F-1741
1820 Regal Row, Suite 200
Dallas, TX 75235
214-638-0500

This document is intended for permitting purposes only.

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1.0 INTRODUCTION

This Leachate and Contaminated Water Management Plan for the City of Del Rio Landfill was prepared consistent with Title 30 Texas Administrative Code (TAC) §§330.305(g), 330.177, 330.207, and 330.333. This plan provides the details of the collection, storage, treatment and disposal of contaminated water, and leachate generated during the active and post-closure periods of the landfill. The design details for the liner and final cover systems are included in Appendix IIIA-A - Liner, and Final Cover System Details.

2.0 LEACHATE AND CONTAMINATED WATER GENERATION

2.1 Generation Process

Leachate is generated when water percolates through the layers of solid waste as moisture is released from high moisture content waste. The capacity of solid waste to absorb moisture is known as field capacity. When the field capacity is exceeded, leachate is generated. However, leachate may also flow within the landfill through preferential pathways; therefore, some downward flow of leachate will occur before the field capacity of waste is reached. The quantity of leachate produced will depend upon the climate, site topography, type of cover, construction and landfilling procedures, and waste characteristics.

Contaminated water is defined in Title 30 TAC §330.3(36) as "leachate, gas condensate, or water that has come into contact with waste." Contaminated water is generated when stormwater runoff has come into contact with solid waste at the working face of the landfill or any other area at the site where water contacts solid waste, leachate, or gas condensate.

2.2 Leachate Generation and Contaminated Stormwater Modeling

The Hydrologic Evaluation of Landfill Performance (HELP) model, Version 4.0, was used to estimate the amount of leachate that will be generated at the City of Del Rio Landfill. The HELP model is a quasi-two-dimensional hydrologic model of water movement across, into, through, and out of landfills. 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.

Leachate generation was evaluated for both active and closed landfill conditions. An explanation of the assumed conditions, methodologies, models and printouts of the results are included as Appendix IIIC-A. The leachate generation rates produced by HELP are used for the leachate collection system (LCS) design.

2.3 Stormwater Management

The City of Del Rio Landfill will manage surface water throughout the active life of the landfill to minimize the amount of stormwater that will come in contact with waste or leachate. Uncontaminated surface water will be controlled through the use of diversion berms, stormwater diversion ditches, and sumps. To promote runoff and prevent ponding, the operational cover will be graded and maintained.

Stormwater that comes into contact with waste will be considered contaminated water and handled consistent with Title 30 TAC §330.207. Contaminated water will be contained by the containment berm at the working face. At no time will contaminated water be allowed to discharge into waters of the United States. Storage of contaminated water and its disposal are discussed in Section 4 and Section 5.

The final cover has been designed to minimize infiltration and promote runoff. Uncontaminated surface water will be managed throughout the active life of the landfill to minimize infiltration into the filled areas and to minimize contact with solid waste. Also, daily and intermediate cover will be graded and maintained to promote runoff and prevent ponding as described in Part IV - Site Operating Plan (SOP).

Procedures for verifying the adequacy of daily cover placement to cover all waste material is discussed in SOP, Section 27.1. Runoff generated from fill areas covered with a minimum 6 inches of earthen daily cover having no exposed waste or 12 inches of intermediate cover will be considered as uncontaminated and allowed to drain to the perimeter drainage system. In the event that the 6 inches of daily cover does not prevent stormwater from contacting solid waste or leachate, this stormwater will be collected and managed as contaminated and disposed of in an authorized manner. Uncontaminated surface water runoff will be diverted around the working face.

3.0 LEACHATE COLLECTION SYSTEM

3.1 System Layout and Design Criteria

The LCS for the Subtitle D area will consist of: (1) a collection layer placed over the liner system, (2) the leachate collection piping, and (3) the leachate collection sumps and pumps. An overliner LCS will be placed above the overliner system geomembrane liner within the pre-Subtitle D area to collect leachate generated from the waste placed in the vertical expansion area. The plan for the LCS piping and grading is shown in Part III, Appendix IIIA-A, Figures IIIA-A.1 and IIIA-A.1a. LCS details are also provided in Part III, Appendix IIIA-A - Liner and Final Cover System Details.

3.1.1 Design Criteria

The leachate management system is designed and operated to collect and remove leachate from each cell, maintain leachate levels below 12 inches (or 30 cm) above the liner systems, channel leachate to designated collection sumps, and effectively manage leachate through collection and disposal. The system is designed to eliminate potential migration of landfill leachate into the environment and to meet the following requirements of Title 30 TAC §330.333:

- constructed of materials that are chemically resistant to the leachate expected to be generated;
- of sufficient strength and thickness to prevent collapse under the pressures exerted by overlying wastes, waste cover materials, and by equipment used at the facility; and
- designed to function through the scheduled closure and post-closure period of the facility.

The LCS is designed to maintain the maximum leachate depth on the liner to less than 12 inches, in accordance with 30 TAC §330.331(a)(2). The leachate levels will be monitored and manually pumped to maintain the required levels. The drainage geocomposite leachate collection layer is designed to convey the estimated peak leachate flow rate without the leachate level within the geocomposite exceeding the thickness of the geocomposite. The operation of the leachate sump and the conveyance capacity of the geocomposite leachate collection layer work in tandem to maintain compliance with the design standard listed in Title 30 TAC §330.331(a)(2). The LCS piping network is designed to convey collected leachate to the leachate collection sumps. The LCS piping is designed for post-settlement slopes and to meet each of the three criteria listed above.

The geotextiles used for the geocomposite drainage layer utilize 100% continuous-filament polyester or polypropylene. Extensive testing, including EPA 9090 for chemical resistance, has demonstrated that polyester and polypropylene are resistant to a wide range of chemical classes encountered in soil and to typical leachate. The LCS piping and the geonet portion of the geocomposite are constructed of polyethylene. Polyethylene is an industry standard material and is resistant to a wide range of chemical constituents, including those typically found in leachate.

3.1.2 Leachate Collection System Layout

The LCS layout is shown on Figure IIIC-3.1. Subtitle D Cells 1 - 6 have been constructed to date. For the constructed Subtitle D cells, the leachate collection layer includes a geocomposite placed over the liner system to collect and transfer leachate to the leachate collection pipes and sumps. The currently constructed LCS has been evaluated considering the leachate collection layer and leachate collection header pipe grades under the proposed landfill expansion conditions (i.e., after landfill foundation

settlement - refer to Appendix IIIL – Geotechnical Report). Leachate collection layer slopes and slope lengths have been estimated for the proposed closed landfill conditions. Table 3-1 provides a design summary for the developed Subtitle D Cells. As shown in each case, the maximum depth of leachate that occurs in the liner system is less than 12 inches and the flow depth is less than the thickness of the drainage geocomposite.

The leachate collection layer will also be placed directly over the liner system for the undeveloped cells (Cells 7-10). The undeveloped cells have been designed for the estimated overburden pressure that will be created by waste placement. Material specifications are included in the following subsections for the cells. Table 3-1 shows that the maximum leachate depth for these cells are also less than 12 inches and the flow depth is less than the thickness of the drainage geocomposite. A leachate flow path slope of 1.0 percent was conservatively selected to represent post-settlement slopes for the Subtitle D cells to use in the HELP analysis included in Appendix IIIC-A. Table 3-1 presents a summary of the initial and post-settlement/design slope for each Subtitle D cell and the maximum depth of leachate over the liner based on the HELP generated peak.

Table 3-1 LCS Maximum Depth of Leachate on Liner

Cells	Location	Initial Slope	Post-Settlement Slope/Slope Used for Design	Maximum Depth of Leachate on Liner Using Peak Flow Rate Generated by HELP	Flow Depth Less than Thickness of Drainage
Developed Cells 3-6	Slope between cell ridgeline and leachate collection pipe	2.2	2.0	0.3519	Yes
	Slope of leachate collection pipe	1.0	0.9	Peak flow less than the capacity of the collection pipe	
Undeveloped Cells 7-10	Slope between cell ridgeline and leachate collection pipe	2	2	0.0685	Yes
	Slope of leachate collection pipe	2	1.8	Peak flow less than the capacity of the collection pipe	

1. Maximum depth of leachate on liner was determined using the design slope. Refer to Appendices IIIC-A for additional information.
2. The leachate collection pipe is a 6-inch-diameter pipe.
3. For LCS design purposes, a post-settlement slope was conservatively selected to be at least ten percent less than the design slope. Foundation settlement is discussed in Appendix IIIL.

3.2 Leachate Collection Layer

As mentioned above, the leachate collection layer for the undeveloped cells will be placed directly over the liner system to collect and transfer leachate to the LCS pipes and sumps. The leachate collection layer placed over the floor grades for the undeveloped cells will consist of a 250-mil-thick HDPE geonet with a 6 oz/sy(minimum) non-woven geotextile heat bonded to the top side of the HDPE geonet. The geocomposite was selected to maintain less than 12 inches of head above the bottom liner. The leachate collection layer placed over the sideslope will consist of an HDPE geonet with a geotextile heat bonded to both sides. Calculations indicating the required properties of the geocomposite drainage layer (after accounting for losses due to clogging) are presented in Appendix IIIC-B. The drainage geocomposite for the undeveloped cell will comply with the specifications listed in Table 3-2.

3.2.1 Chimney Drains

The chimney drains will be installed above the LCS pipes and the top of the chimney drain gravel will match the top of protective cover grades as shown on Drawings located in Appendix IIIA-A – Liner and Final Cover System Details. The chimney drains will be constructed with drainage material having a hydraulic conductivity of 1.0 cm/s or greater and will be covered by a geotextile to restrict migration of the protective cover soil into the LCS. The chimney drains will allow leachate to flow into the LCS without a buildup of head above the protective cover layer. Calculations for chimney drains are provided in Appendix IIIC-B.

3.3 Leachate Collection Piping

The clay liner and overlying leachate collection layer will slope to drain toward the LCS trenches, which will contain a perforated leachate collection pipe surrounded by drainage stone and separated from the adjacent protective cover and waste layers by a geotextile fabric. The leachate collection pipe will direct the leachate to the landfill sumps. The proposed leachate collection pipes will be SDR 11 HDPE smooth wall pipe. The existing leachate collection pipes are perforated 6-inch SDR 17 HDPE smooth wall pipes. As shown in Table 3-1, the LCS pipes are designed for slopes that are at least ten percent less than the design slope.

The geotextile fabric and pipe perforations are designed to prevent clogging of the fabric or pipe. The LCS is designed with cleanout risers at the end of each of the collection pipes to allow cleaning. Proposed leachate collection pipe design calculations are provided in Appendix IIIC-B. These calculations demonstrate the adequacy of the pipes to convey leachate to the sumps, the structural stability of the pipes, and the satisfaction of the perforation requirements. Details of the LCS layer and pipe trench are shown in Part III, Appendix IIIA-A – Liner and final Cover System Details.

Table 3-2 Geotextile and Drainage Geocomposite Required Testing and Properties

Responsible Party	Material	Test	Standard	Standard Required Property[4]
Manufacturer	Geotextile	Unit Weight	ASTM D 5261	6 oz/sy
		Apparent Opening Size	ASTM D 4751	80 sieve (max)
		Grab Strength	ASTM D 4632	157 lb
		Tear Strength	ASTM D 4533	56 lb
		Puncture Strength	ASTM D 6241	309 lb
		Permeability	ASTM D 4491	0.2 cm/s
Manufacturer	HDPE Geonet	Specific Gravity	ASTM D 1505	0.94 g/cm3
		Thickness	ASTM D 5199	0.25 inch
		Carbon Black	ASTM D 1603	2%
		Tensile Strength	ASTM D 5035	55 lb/in (Peak)
Third Party Laboratory	Drainage Geocomposite	Transmissivity	ASTM D 4716	See Note 2
		Strength	ASTM D 5321	See Note 3
Manufacturer		Peel Adhesion	ASTM D 7005	1.0 lb/in

1. The minimum testing frequency will be one test sample per 100,000 square feet.
2. As noted in Appendix IIIC, Appendix IIIC-A, the transmissivity of the bottom liner single-sided geocomposite will be measured at a gradient of 0.02 under normal pressures of 1,000, 10,000 and 18,285 psf (or higher), boundary conditions consisting of soil/geocomposite with minimum seating time of 100 hours and will be run for the first 100,000 square feet of liner construction. For each additional 100,000 square feet of single-sided geocomposite placement area, one additional transmissivity test will be run under the maximum normal stress (i.e., 18,285 psf) with all the other assumptions the same as the first three tests. The minimum transmissivity will be 6.25×10^{-4} m^2/s. The transmissivity of the bottom sidewall liner double-sided geocomposite will be measured at a minimum gradient of 0.33 under normal pressures of 1,000, 10,000 and 16,720 psf (or higher), boundary conditions consisting of soil/geocomposite with a minimum seating time of 100 hours. The minimum transmissivity will be 5.51×10^{-5} m^2/s. For each additional 100,000 square feet of double-sided geocomposite placement area, one additional transmissivity test will be run under the maximum normal stress (i.e., 16,720 psf) with all the other assumptions the same as the first three tests.The leachate collection pipe is a 6-inch-diameter pipe.
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 IIIL-A. This test may be performed using stack testing (i.e., performing a single test combining all components of the liner system). Refer to Appendix IIIL-A for detailed strength information and procedures for calculating factors of safety. The slope stability analysis may be repeated using strength data for actual materials used for construction to demonstrate an acceptable factor of safety.
4. Minimum required property values for the geotextile and drainage geocomposite transmissivity are based on calculations provided in Appendices IIIC-A and IIIC-B. The geonet properties are based on values specified in GRI standard GM-13. In additonal, each material will be tested prior to constrction to verifty that it meets the minimum rquired properites.

3.4 Leachate Sumps and Pumps

The leachate collection sumps and pumps have been sized to comply with the regulatory design standard listed in §330.331(a)(2). The leachate collection sumps and pumps have been designed to maintain less than 12 inches (30 cm) depth of leachate over the liner. The leachate sump operating plan is included in Table 3-3.

Each leachate sump will be sized based on the amount of leachate generation taking into consideration the contributing area from the Subtitle D cells. The minimum sump size for the undeveloped cells and overliner will be 2 feet deep with minimum dimensions of approximately 27 by 27 feet at the landfill floor and 15 by 15 feet at the sump base and will store a minimum of 906 cubic feet of leachate. The size and capacity of the sumps are presented in Appendix IIIC-B. New sump will be backfilled with drainage stone meeting the gradation in accordance with ASTM D 448, size number 467 (nominal aggregate size is 2 inches to 3/16 inches). Each sump will be emptied by a submersible pump located in an 18-inch nominal diameter sidewall riser pipe which extends into the bottom of the sump and is perforated in the sump. Pumps will be operated manually. Control levels for the pump will be set to maintain sump liquid levels between the lip of the sump and pump intake. The objective of the pump operation is to ensure that a free-flowing condition is maintained in the LCS. If the pump malfunctions, the pump will be removed, repaired, and replaced, or a new pump will be used (see Table 3-3 for additional information). The leachate depth monitoring procedure and leachate removal will be the same for all disposal areas.

The specified pump will have the capacity to pump leachate at a rate of 20 gpm or 28,800 gpd. The maximum estimated flow to be pumped from the largest cell is 745 gpd. If the specified leachate sump pumps are not able to empty the sump and maintain less than 12 inches of head on the liner at reasonable cycle times, then a pump with more capacity will be used (refer to Section 4.1 for more information).

Table 3-3 Leachate Sump Operating Plan

Leachate Level Description	Condition	Action Required
Leachate level between lip of sump and pump intake at the bottom of the sump.	System is functioning as designed. The drainage geocomposite leachate collection layer installed on the floor of the landfill is designed to convey the estimated peak leachate flow rate without the leachate level within the geocomposite exceeding the thickness of the geocomposite. The operation of the leachate sump and the conveyance capacity of the geocomposite leachate collection layer work in tandem to maintain compliance with the design standard listed in §330.331(a)(2).	The depth of leachate in the sump is monitored by a landfill personnel periodically. Leachate flow to the sump and sump pump capacity are listed in Table 4-1. The sump design is discussed in Section 3.4.
Leachate level between the lip of the sump and 12 inches (30 cm) above the lip of the sump.	The 12-inch design standard listed in §330.331(a)(2) has not been exceeded.	For these two conditions, the sump operation will be monitored daily until the leachate is pumped out by the Operator. For both conditions, the leachate levels in the sump will be recorded daily. As noted in the EPA Technical Manual Solid Waste Disposal Facility Criteria, EPA530-R-93-017, "The 30-cm head allowance is a design standard and the [EPA] recognizes that this design standard may be exceeded for relatively short periods of time during the active life of the unit."
Leachate level over 12 inches above the lip of the sump.	The design standard listed in §330.331(a)(2) has been exceeded.	

3.5 Drainage Stone (Coarse Aggregate)

Granular drainage material around the leachate collection pipes and in the LCS sumps in the pre-subtitle D and Subtitle D areas will consist of typical (e.g., unit weight of 90 to 110 pcf) or lightweight (e.g., unit weight less than 70 pcf) materials that comply with the following criteria. The aggregate will have a loss of mass due to calcium carbonate of less than 15 percent (in accordance with JLT-S-105-89 or ASTM D3042 method modified to use a solution of hydrochloric acid having a pH of 5). The drainage stone will meet the following gradation in accordance with ASTM D448, size number 467.

Sieve Size Square Opening	Percent Passing
2 inches	100
1-1/2 inches	95 - 100
3/4 inch	35 - 70
3/8 inch	10 - 30
No. 4 (3/16 inch)	0 - 5

Drainage materials not complying with the above gradations may also be approved by the professional of record if demonstrated to have a hydraulic conductivity of at least 1.0 cm/s and meet the gradation requirements of the filter and leachate collection pipe (in no case will the maximum rock size be greater than 2 inches). At a minimum, the drainage stone will meet the following criteria:

For circular holes:

$$\frac{85\%\ Size\ of\ Filter\ Material}{Hole\ Diameter} > 1.7$$

For slots:

$$\frac{85\%\ Size\ of\ Filter\ Material}{Slot\ Width} > 2.0$$

The drainage stone will be covered by a geotextile to maintain separation of drainage stone from the overlying layers. The geotextile will be resistant to commonly encountered chemicals, hydrocarbons and mildew, and will be rot resistant.

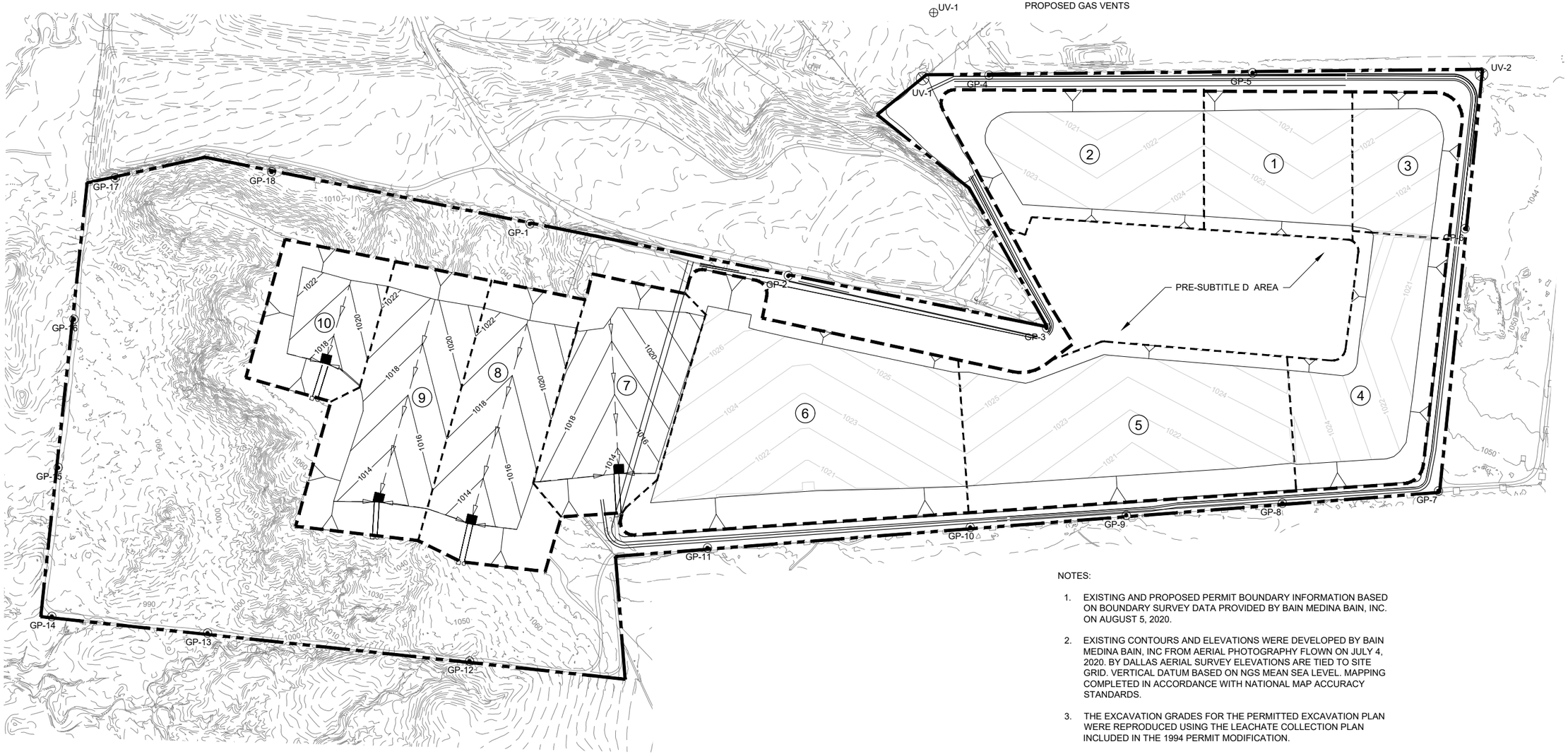
LEGEND

- PERMIT BOUNDARY
- LIMIT OF WASTE
- CELL BOUNDARY
- 1080 EXISTING GRADES
- 1010 PROPOSED EXCAVATION GRADES
- 1022 PERMITTED EXCAVATION GRADES
- (10) CELL DESIGNATION
- LEACHATE COLLECTION RISER
- LEACHATE COLLECTION CLEANOUT
- LEACHATE COLLECTION SUMP
- LEACHATE COLLECTION LINE
- GP-5 PROPOSED GAS PROBE
- UV-1 PROPOSED GAS VENTS

N

0 200 400

SCALE IN FEET



NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. BY DALLAS AERIAL SURVEY ELEVATIONS ARE TIED TO SITE GRID. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP ACCURACY STANDARDS.
3. THE EXCAVATION GRADES FOR THE PERMITTED EXCAVATION PLAN WERE REPRODUCED USING THE LEACHATE COLLECTION PLAN INCLUDED IN THE 1994 PERMIT MODIFICATION.
4. EXCAVATION SLOPES ARE TYPICALLY 3H:1V.
5. MINIMUM EXCAVATION ELEVATION IS IN LEACHATE COLLECTION SYSTEM SUMP IS 1007 FT-MSL.
6. LINER AND LEACHATE COLLECTION SYSTEM DETAILS ARE INCLUDED IN APPENDIX IIIA-A.

FOR PERMITTING PURPOSES ONLY

STV
TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

CITY OF DEL RIO, TEXAS

TEMOBISTA METAFERIA
123183
LICENSED PROFESSIONAL ENGINEER
09/29/2023

NO.	REVISION	BY	DATE

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.

0 1"

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

LEACHATE COLLECTION SYSTEM PLAN

DESIGN:	T. METAFERIA
DRAWN:	T. METAFERIA
REVIEW:	B. HINDMAN
CP&Y:	DELR200302
CLIENT:	CITY OF DEL RIO

FIGURE
IIIC-3.1

PRINTED BY: MetafeT DATE: 7/18/2023
FILE PATH: C:\pwworking\stv\pw_stvgjohnson\d0942273\DELR200302 Figure IIIC-3.1.dwg

4.0 LEACHATE AND CONTAMINATED WATER STORAGE

4.1 Leachate Storage

Temporary leachate storage will be provided in the leachate collection sumps. The leachate collection sumps have been sized based on the amount of leachate generated. Table 4-1 summarizes the estimated leachate flow into the sump. The estimated leachate generation rate is based on the average leachate generation produced by the HELP model analysis. Details of the leachate sumps are provided in Appendix IIIA-A – Liner and Final Cover System Details.

Leachate levels in the sumps will be measured and recorded to evaluate leachate production and fluctuations. A form to record leachate measurements will be kept in the Site Operating Record. The sumps will be emptied by submersible pumps located within the sump section of the sidewall riser pipes to meet the design objective as required by the leachate sump operating plan presented on Table 3-3. Disposal of leachate is discussed in Section 5.

Table 4-1 Sump Flow

Condition	Rate (gpd/ac)	Sump Storage Summary				
		Sump for Cells 7-10				
		Active		Closed		Storage Provided (days)
		Area (ac)	Rate (gpd)	Area (ac)	Rate (gpd)	
Active, 10' Waste	0.0	1.0	0.0	0.0	0.0	5
Interim, 25' Waste	21.7	2.0	43.5	0.0	0.0	
Interim, 50' Waste	142.4	2.0	284.8	0.0	0.0	
Interim, 75' Waste	189.1	2.0	378.2	0.0	0.0	
Interim, 110' Waste	315.0	1.7	535.6	0.0	0.0	
Closed, 110' Waste	142.2	1.0	142.2	9.7	1,379.7	
Total		9.7	1,384.3	9.7	1,379.7	

1. Sumps for the largest drainage area (Cell 9) 9.7 acres.

4.2 Contaminated Water Management

All water coming in contact with waste or contaminated soils shall be treated as contaminated water. Contaminated water will be contained at the working face. Contaminated water shall be controlled by site personnel as described in Section 33 of the Site Operating Plan and shall not be discharged from the facility without prior written authorization from the TCEQ.

5.0 LEACHATE AND CONTAMINATED WATER DISPOSAL

5.1 Leachate Storage System Operation and Disposal

Leachate that is generated at the site will be conveyed to the leachate collection sumps. Leachate levels in the sumps are measured and recorded to evaluate leachate production and fluctuations. A form to record leachate measurements is kept in the Site Operating Record and is used to evaluate the effectiveness of the leachate monitoring and control facilities. The depth of leachate in the sump will be monitored by the pressure transducer which will be calibrated to provide direct read-out of the leachate level in the sump. Leachate will be pumped from the leachate sumps and disposed.

The collected leachate will be pumped into a truck for discharge into the off-site manhole for treatment at the City's wastewater treatment plant or transported off-site for disposal. For leachate transported off-site, sampling and analysis will be limited to the disposal facility's requirements. The results of leachate monitoring required by the off-site permitted disposal facility will be kept in the Site Operating Record.

5.2 Contaminated Water Disposal

Contaminated water that collects behind the containment berm will be pumped into a truck and transported to the off-site manhole for treatment at the City's wastewater treatment plant. Contaminated water will be removed as soon as practicable from the area behind the contaminated water containment berm (refer to Section 33 of the SOP for additional information and record keeping requirements).

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN

APPENDIX IIIC-A
HELP MODEL ANALYSIS

Prepared for
City of Del Rio

September 2023



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This document is intended for permitting purposes only.

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09/29/2023

1.0 Introduction

The Hydrologic Evaluation of Landfill Performance (HELP) Model, Version 4.0 was used to estimate quantity of leachate that will be generated during the active life and post-closure period of the Del Rio Landfill. The HELP Model is a quasi-two-dimensional hydrologic model of water movement across, into, through, and out of the 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.

2.0 HELP Model Setup

The site was modeled as a 1-acre unit area for the following stages of landfill development:

Developed Subtitle D areas:

- 25 feet of waste with intermediate cover
- 50 feet of waste with intermediate cover
- 80 feet of waste with intermediate cover
- 90 feet of waste with final cover

Undeveloped Subtitle D areas:

- Working face with 10 feet of waste
- 25 feet of waste with intermediate cover
- 50 feet of waste with intermediate cover
- 75 feet of waste with intermediate cover
- 100 feet of waste with intermediate cover
- 100 feet of waste with final cover

The active stage was modeled for one year with no intermediate or daily cover. The interim stages with intermediate cover were modeled for various lengths of time selected based on the projected duration each condition is likely to occur. The closed landfill condition was modeled for 30 years. The evaporative zone depth was selected to be 10 inches for the active and interim cases and 12 inches for the closed case. The leaf area index was selected to be 0 for the active case, 2 for the interim cases and 4.5 for the closed case based on the selected ground area. The Soil Conservation Service (SCS) runoff curve numbers were calculated by HELP based on soil data and expected ground cover, surface slope, and slope length. The active case models a curve number of 53.3 and percent runoff area of zero, which is representative given that this condition assumes complete infiltration (minus evapotranspiration). The interim cases utilize the default curve number assigned by the HELP model which is 87.9 and corresponds to "fair" ground cover. The percent runoff area used varies between 70 to 90. This is representative of the intermediate cover, which will be 12 inches of compacted soil with 60 percent or more vegetation coverage. The final case models a curve number of 82 and percent runoff area of 100, which corresponds to "good" ground cover. This is representative of the final cover, which will have a minimum 90 percent vegetation coverage.

2.1 Moisture Content and Field Capacity

For a conservative analysis, HELP automatically sets the initial moisture content at field capacity. In addition, HELP automatically sets the initial moisture content for a compacted clay barrier layer at porosity (i.e., fully saturated). The initial moisture content for all profile layers was set to field capacity (HELP default) except the waste layer. The initial moisture content for the waste layer was selected to be 0.272. Typical data on the moisture content municipal solid waste components are shown in Tabel 1-2 and were obtained from Solid Wastes Engineering Principles and Management Issues written by George Tchobanoglous, Hilary Theisen, and Rolf Eliassen published in 1977. As shown in the Table, the typical value for municipal solid waste is 20% but can range between 15% to 40% depending on the composition of the wastes, the season of the year and the humidity and weather conditions. Due to the arid climate in the Del Rio region the moisture for the waste layer was modified from the field capacity value of 0.292 to 0.272. As shown in the table this is well above the typical value of moisture content for municipal solid waste.

Table 2-1 Typical Data on Moisture Content of Municipal Solid Waste Components

Material	Moisture (%)	
	Range	Typical
Food Waste	50 – 80	70
Paper	4 – 10	6
Cardboard	4 – 8	5
Plastics	1 – 4	2
Textiles	6 – 15	10
Rubber	1 – 4	2
Leather	8 – 12	10
Garden Trimmings	30 – 80	60
Wood	15 – 40	20
Glass	1 – 4	2
Tin Cans	2 – 4	3
Nonferrous Metals	2 – 4	2
Ferrous Metals	2 – 6	3
Dirt, ashes, brick, etc.	6 – 12	8
Municipal Solid Waste	**15 – 40**	**20**

1. Table was reproduced using Table 4-3 of the Solid Wastes Engineering Principles and Management Issues written by George Tchobanoglous, Hilary Theisen, and Rolf Eliassen published in 1977.

2.2 Climate Data Input

Precipitation data was synthetically simulated based on HELP V4 model program simulation using the latitude and longitude for Del Rio, Texas. The average annual precipitation over the modeled 30-year period was 22.30 inches. Temperature and solar radiation data were also synthetically generated by the HELP model using program defaults for Del Rio, Texas.

2.3 Landfill Profile

The landfill profiles for various stages of the landfill development are presented in the attached HELP Model summary sheets. The profile presented below includes a clay liner with a standard Subtitle D final cover system.

2.3.1 Liner Systems

The Subtitle D clay liner designed for developed and undeveloped cells consists of a 24-inch-thick compacted clay liner with a hydraulic conductivity of $1x10^{-7}$ cm/s. Default soil characteristics from the HELP model were selected for the compacted clay liner.

2.3.2 Leachate Collection System

Developed Subtitle D Cells 1 through 6 were constructed with an LCS that includes a 200-mil thick single-sided geocomposite for floor grades and double-sided geocomposite for the sideslopes. Cells 7 through 10 will be constructed with a 250-mil thick single-sided geocomposite for floor grades and double-sided geocomposite for the sideslopes.

2.3.3 Waste Layers

Various waste thicknesses were modeled to represent the various stages of landfill development in the Subtitle D and pre-subtitle D areas. A default wilting point was selected from HELP to represent municipal solid waste. The waste column was split into two layers. The top 50-foot layer was modeled with a hydraulic conductivity of $1x10^{-3}$ cm/s. The moisture content, field capacity, and porosity values were selected as discussed previously.

2.3.4 Intermediate Cover

The intermediate cover consists of a 12-inch-thick layer of soil placed over the waste. Default soil characteristics were selected from HELP to represent the available onsite soils with a hydraulic conductivity of $6.4x10^{-5}$ cm/s.

2.3.5 Final Cover

The final cover over the Subtitle D and pre-Subtitle D areas consists of a 12-inch erosion layer with the top 6 inches capable of sustaining growth of vegetation and an 18-inch infiltration layer. The infiltration layer consists of compacted soil with a hydraulic conductivity of $1x10^{-5}$ cm/s.

HELP Model Summary Sheet

Client: City of Del Rio
Project: Major Permit Amendment
Description: HELP Model Summary Sheet

Date: 9/29/2023
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

DEVELOPED SUBTITLE D AREAS
CELLS 3-6

		INTERIM (25 FT WASTE)	INTERIM (50 FT WASTE)	INTERIM (80 FT WASTE)	CLOSED (80 FT WASTE)
GENERAL	Case No.	1	2	3	4
INFORMATION	No. of Years	10	15	10	30
	Ground Cover	FAIR	FAIR	FAIR	GOOD
	SCS Runoff Curve No.	86.5	86.5	86.5	80.4
	Model Area (acre)	1	1	1	1
	Runof Area (%)	70	80	90	100
	Maximum Leaf Area Index	2	2	2	4.5
	Evaporative Zone Depth (inch)	10	10	10	12
TOPSOIL LAYER	Thickness (in)				12
(TEXTURE = 10)	Porosity (vol/vol)				0.398
	Field Capacity (vol/vol)				0.244
	Wilting Point (vol/vol)				0.136
	Init. Moisture Content (vol/vol)				0.25
	Hyd. Conductivity (cm/s)				1.20E-04
INFILTRATION	Thickness (in)				18
LAYER	Porosity (vol/vol)				0.427
(TEXTURE = 16)	Field Capacity (vol/vol)				0.418
	Wilting Point (vol/vol)				0.367
	Init. Moisture Content (vol/vol)				0.427
	Hyd. Conductivity (cm/s)				1.00E-05
INTERMEDIATE	Thickness (in)	12	12	12	12
COVER	Porosity (vol/vol)	0.464	0.464	0.464	0.464
(TEXTURE = 11)	Field Capacity (vol/vol)	0.31	0.31	0.31	0.31
	Wilting Point (vol/vol)	0.187	0.187	0.187	0.187
	Init. Moisture Content (vol/vol)	0.31	0.31	0.31	0.31
	Hyd. Conductivity (cm/s)	6.40E-05	6.40E-05	6.40E-05	6.40E-05
WASTE TOP	Thickness (in)	300	600	960	960
(TEXTURE = 18)	Porosity (vol/vol)	0.671	0.671	0.671	0.671
	Field Capacity (vol/vol)	0.272	0.272	0.272	0.272
	Wilting Point (vol/vol)	0.077	0.077	0.077	0.077
	Init. Moisture Content (vol/vol)	0.25	0.272	0.272	0.272
	Hyd. Conductivity (cm/s)	1.00E-03	1.00E-03	1.00E-03	1.00E-03
PROTECTIVE	Thickness (in)	24	24	24	24
COVER	Porosity (vol/vol)	0.398	0.398	0.398	0.398
(TEXSTURE = 10)	Field Capacity (vol/vol)	0.244	0.244	0.244	0.244
	Wilting Point (vol/vol)	0.136	0.136	0.136	0.136
	Init. Moisture Content (vol/vol)	0.244	0.244	0.244	0.244
	Hyd. Conductivity (cm/s)	1.20E-04	1.20E-04	1.20E-04	1.20E-04
LEACHATE	Thickness (in)	0.19	0.19	0.18	0.18
COLLECTION	Porosity (vol/vol)	0.85	0.85	0.85	0.85
LAYER	Field Capacity (vol/vol)	0.01	0.01	0.01	0.01
(TEXTURE = 44)	Wilting Point (vol/vol)	0.005	0.005	0.005	0.005
	Init. Moisture Content (vol/vol)	0.01	0.01	0.01	0.01
	Hyd. Conductivity (cm/s)	9.06E+00	7.11E+00	5.27E+00	5.11E+00
COMPACTED	Thickness (in)	24	24	24	24
CLAY LINER	Porosity (vol/vol)	0.427	0.427	0.427	0.427
(TEXTURE = 16)	Field Capacity (vol/vol)	0.418	0.418	0.418	0.418
	Wilting Point (vol/vol)	0.367	0.367	0.367	0.367
	Init. Moisture Content (vol/vol)	0.427	0.427	0.427	0.427
	Hyd. Conductivity (cm/s)	1.00E-07	1.00E-07	1.00E-07	1.00E-07
PRECIPITATION	Average Annual (in)	18.47	19.27	18.47	18.67
RUNOFF	Average Annual (in)	0.347	0.462	0.441	0.121
EVAPOTRANSPIRATION	Average Annual (in)	17.074	17.619	17.072	17.579
LATERAL DRAINAGE	Average Annual (cf/yr)	1388.8	7,251.50	12,184.90	5738.7
COLLECTED	Peak Daily (cf/day)	256.3	323.50	325.50	315.20
JEAD ON	Average Annual (in)	0.0012	0.0081	0.0431	0.3519
LINER	Peak Daily (in)	0.1630	0.2609	8.1073	0.1956

1. The field capacity and porosity values for the waste layer were obtained from: Zornberg, Jorge G. et. al, *Retention of Free Liquids in Landfills Undergoing Vertical Expansion.* Journal of Geotechincal and Geoenvironmental Engineering, July 1999, pp. 583-594.

HELP Model Summary Sheet

Client: City of Del Rio
Project: Major Permit Amendment
Description: HELP Model Summary Sheet

Date: 9/29/2023
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

UNDEVELOPED SUBTITLE D AREAS
CELLS 7-12

		ACTIVE (10 FT WASTE)	INTERIM (25 FT WASTE)	INTERIM (50 FT WASTE)	INTERIM (75 FT WASTE)	INTERIM (110 FT WASTE)	CLOSED (110 FT WASTE)
GENERAL	Case No.	1	2	3	4	5	6
INFORMATION	No. of Years	1	10	15	15	10	30
	Ground Cover	BARE	FAIR	FAIR	FAIR	FAIR	GOOD
	SCS Runoff Curve No.	81.6	86.5	86.5	86.5	87.1	80.4
	Model Area (acre)	1	1	1	1	1	1
	Runof Area (%)	0	70	80	80	90	100
	Maximum Leaf Area Index	0	2	2	2	2	4.5
	Evaporative Zone Depth (inch)	10	10	10	10	10	12
TOPSOIL LAYER	Thickness (in)						12
(TEXTURE = 10)	Porosity (vol/vol)						0.398
	Field Capacity (vol/vol)						0.244
	Wilting Point (vol/vol)						0.136
	Init. Moisture Content (vol/vol)						0.25
	Hyd. Conductivity (cm/s)						1.20E-04
INFILTRATION	Thickness (in)						18
LAYER	Porosity (vol/vol)						0.427
(TEXTURE = 16)	Field Capacity (vol/vol)						0.418
	Wilting Point (vol/vol)						0.367
	Init. Moisture Content (vol/vol)						0.427
	Hyd. Conductivity (cm/s)						1.00E-05
INTERMEDIATE	Thickness (in)		12	12	12	12	12
COVER	Porosity (vol/vol)		0.464	0.464	0.464	0.464	0.464
(TEXTURE = 11)	Field Capacity (vol/vol)		0.31	0.31	0.31	0.31	0.31
	Wilting Point (vol/vol)		0.187	0.187	0.187	0.187	0.187
	Init. Moisture Content (vol/vol)		0.31	0.31	0.31	0.31	0.31
	Hyd. Conductivity (cm/s)		6.40E-05	6.40E-05	6.40E-05	6.40E-05	6.40E-05
WASTE TOP	Thickness (in)	120	300	600	900	1320	1320
(TEXTURE = 18)	Porosity (vol/vol)	0.671	0.671	0.671	0.671	0.671	0.671
	Field Capacity (vol/vol)	0.272	0.272	0.272	0.272	0.272	0.272
	Wilting Point (vol/vol)	0.077	0.077	0.077	0.077	0.077	0.077
	Init. Moisture Content (vol/vol)	0.25	0.25	0.272	0.272	0.272	0.272
	Hyd. Conductivity (cm/s)	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03
PROTECTIVE	Thickness (in)	24	24	24	24	24	24
COVER	Porosity (vol/vol)	0.398	0.398	0.398	0.398	0.398	0.398
(TEXSTURE = 10)	Field Capacity (vol/vol)	0.244	0.244	0.244	0.244	0.244	0.244
	Wilting Point (vol/vol)	0.136	0.136	0.136	0.136	0.136	0.136
	Init. Moisture Content (vol/vol)	0.244	0.244	0.244	0.244	0.244	0.244
	Hyd. Conductivity (cm/s)	1.20E-04	1.20E-04	1.20E-04	1.20E-04	1.20E-04	1.20E-04
LEACHATE	Thickness (in)	0.25	0.23	0.23	0.23	0.21	0.21
COLLECTION	Porosity (vol/vol)	0.85	0.85	0.85	0.85	0.85	0.85
LAYER	Field Capacity (vol/vol)	0.01	0.01	0.01	0.01	0.01	0.01
(TEXTURE = 44)	Wilting Point (vol/vol)	0.005	0.005	0.005	0.005	0.005	0.005
	Init. Moisture Content (vol/vol)	0.01	0.01	0.01	0.01	0.01	0.01
	Hyd. Conductivity (cm/s)	2.68E+01	1.65E+01	1.39E+01	9.39E+00	7.67E+00	7.63E+00
COMPACTED	Thickness (in)	24	24	24	24	24	24
CLAY LINER	Porosity (vol/vol)	0.427	0.427	0.427	0.427	0.427	0.427
(TEXTURE = 16)	Field Capacity (vol/vol)	0.418	0.418	0.418	0.418	0.418	0.418
	Wilting Point (vol/vol)	0.367	0.367	0.367	0.367	0.367	0.367
	Init. Moisture Content (vol/vol)	0.427	0.427	0.427	0.427	0.427	0.427
	Hyd. Conductivity (cm/s)	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07
PRECIPITATION	Average Annual (in)	16.25	18.47	19.27	19.27	18.47	18.67
RUNOFF	Average Annual (in)	0.00	0.347	0.462	0.462	0.451	0.121
EVAPOTRANSPIRATION	Average Annual (in)	16.307	17.177	17.72	17.619	17.165	18.408
LATERAL DRAINAGE	Average Annual (cf/yr)	0.00	1,060.2	6,949.2	9,226.4	15,371.7	6,940.1
COLLECTED	Peak Daily (cf/day)	0.00	270.7	323.4	332.1	339.9	324.5
HEAD ON	Average Annual (in)	0.0000	0.0002	0.0013	0.0026	0.0027	0.0024
LINER	Peak Daily (in)	0.0000	0.0069	0.0451	0.0685	0.0429	0.0823

1. The field capacity and porosity values for the waste layer were obtained from: Zornberg, Jorge G. et. al, *Retention of Free Liquids in Landfills Undergoing Vertical Expansion.* Journal of Geotechincal and Geoenvironmental Engineering, July 1999, pp. 583-594.

Single-Sided Geocomposite Leachate Collection Layer Properties

Client: City of Del Rio
Project: Major Permit Amendment
Description: Geocomposite Leachate Collection Layer Properties

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose: **Estimate the properties of the geocomposite leachate collection layer for the Subtitle D sectors.**

Note: Cells 3-6 were constructed with a 200-mil-thick single-sided geocomposite on floor grades. The undeveloped Cells 7-12 will be constructed with 250-mil-thick single-sided geocomposite on floor grades.

Step 1 - Determine the geocomposite leachate collection layer thickness under the expected loading conditions.

Assumption: Geocomposite leachate collection layer will undergo compression due to the weight of soil (in the form of intermediate cover, protective cover, or final cover) and waste.

200-mil Unloaded Geocomposite Thickness (Cells 3-6) =	0.20	in
250-mil Unloaded Geocomposite Thickness (Cells 7-12) =	0.25	in
Unit Weight of Soil =	120	pcf

Table 1-1 - Geocomposite Thickness for Cells 3-6

Fill Condition	d_w[1] (ft]	d_s[2] (ft)	g[3] (pcf)	P[4] (psf)	t[5] (in)	t[5] (m)
Interim - 25'	25	3	55	1,735	0.19	0.005
Interim -50'	50	3	55	3,110	0.19	0.005
Interim - 80'	80	3	55	4,760	0.18	0.005
Closed	80	5.5	55	5,060	0.18	0.004

Table 1-2 - Geocomposite Thickness for Cells 7-12

Fill Condition	d_w[1] (ft)	d_s[2] (ft)	g[3] (pcf)	P[4] (psf)	t[5] (in)	t[5] (m)
Active - 10'	10	2	55	790	0.248	0.006
Interim - 25'	25	3	55	1,735	0.230	0.006
Interim- 50'	50	3	55	3,110	0.234	0.006
Interim- 75'	75	3	55	4,485	0.227	0.006
Interim - 110'	110	3	57	6,630	0.214	0.005
Closed	110	5.5	57	6,930	0.214	0.005

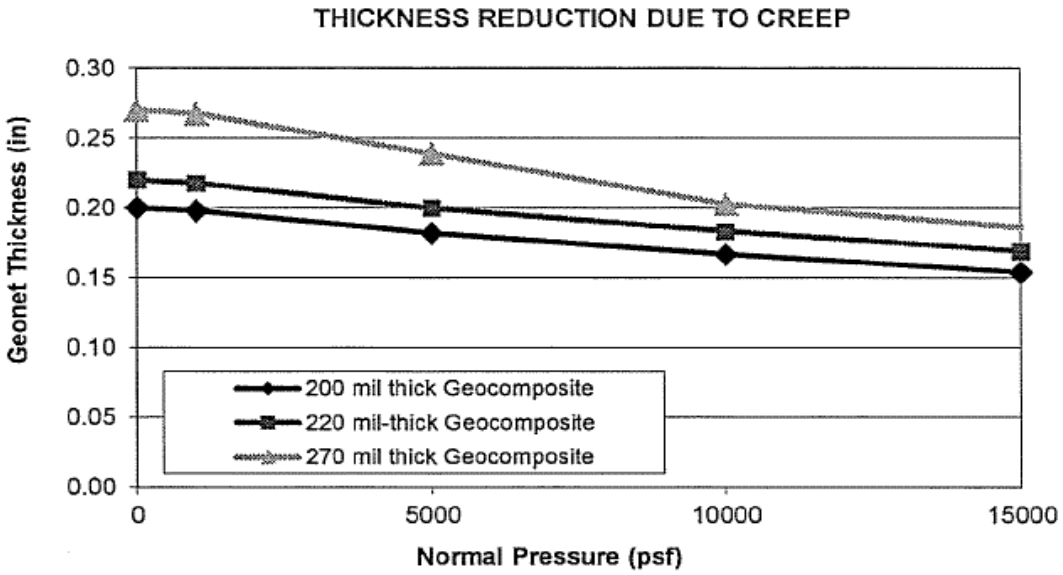
1 d_w is the depth of waste and daily cover soil above the geocomposite leachate collection layer.

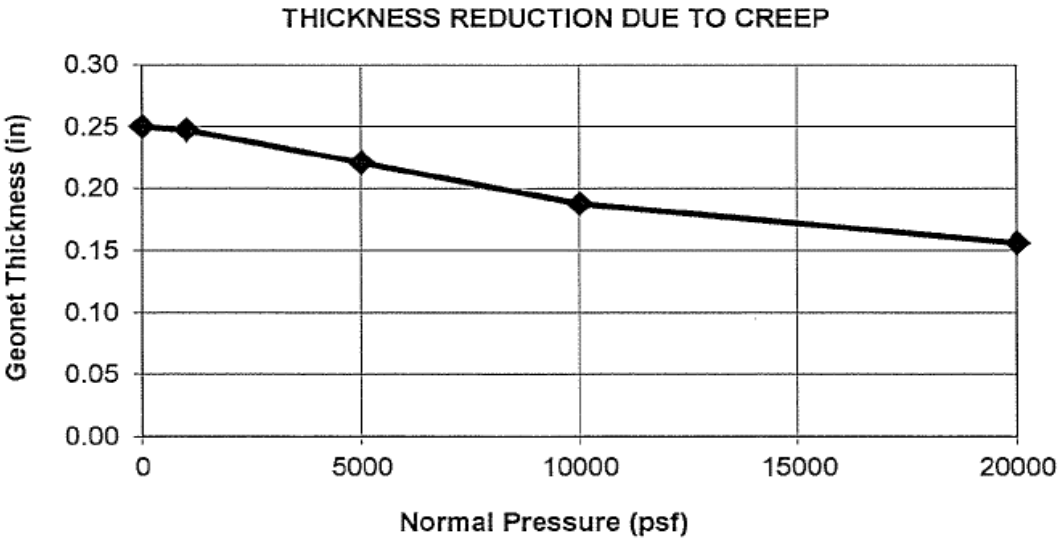
2 d_s is the depth of soil (protective cover, intermediate cover, and final cover) above the geocomposite leachate collection layer.

3 The unit weight of waste/soil is selected at the midpoint of the waste column thickness using the Unit Weight Profile for MSW graph provided in Acar, Yalcin B.& Daniel, David E., Geoenvironment 2000 Characterization, Containment, Remediation, and Performance in Environmental Geotechnics, Volume 2, American Society of Civil Engineers, 1995.

4 P is the pressure on the geocomposite leachate collection layer due to the weight of the waste and soil.

5 t is the thickness of the geocomposite leachate collection layer after being subjected to compression based on the chart below adapted from GSE Drainage Design Manual, June 2007.


THICKNESS REDUCTION DUE TO CREEP
Geonet Thickness (in)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
5000
10000
15000
Normal Pressure (psf)
200 mil thick Geocomposite
220 mil-thick Geocomposite
270 mil thick Geocomposite


THICKNESS REDUCTION DUE TO CREEP
Geonet Thickness (in)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
5000
10000
15000
20000
Normal Pressure (psf)

Step 2 - Determine factors of safety for strength and environmental conditions based on the expected duration of each stage of landfill development

Table 2 - Reduction Factors and Factor of Safety

Reduction Factors[1]		Fill Condition					
		Active (10 Waste)	Interim (25' Waste)	Interim (50' Waste)	Interim (75' Waste)	Interim (110' Waste)	Closed Final Cover
RF_{IN}	Delayed Intrusion	1.1	1.1	1.1	1.1	1.1	1.1
RF_{CC}	Chemical Clogging	1.0	1.3	1.3	1.4	1.5	1.5
RF_{BC}	Biological Clogging	1.0	1.0	1.1	1.2	1.2	1.2
Total Reduction Factor[2]		1.10	1.43	1.57	1.85	1.98	1.98
Overall Factor of Safety to Account For Uncertainties		2.0	2.0	2.0	2.0	2.0	2.0
Overall Reduction Factor (ORF)[3]		2.20	2.86	3.15	3.70	3.96	3.96

1 Values are obtained from References 1, 2, and 3.

2 The Total Reduction Factors are a product of all the reduction factors for each fill condition.

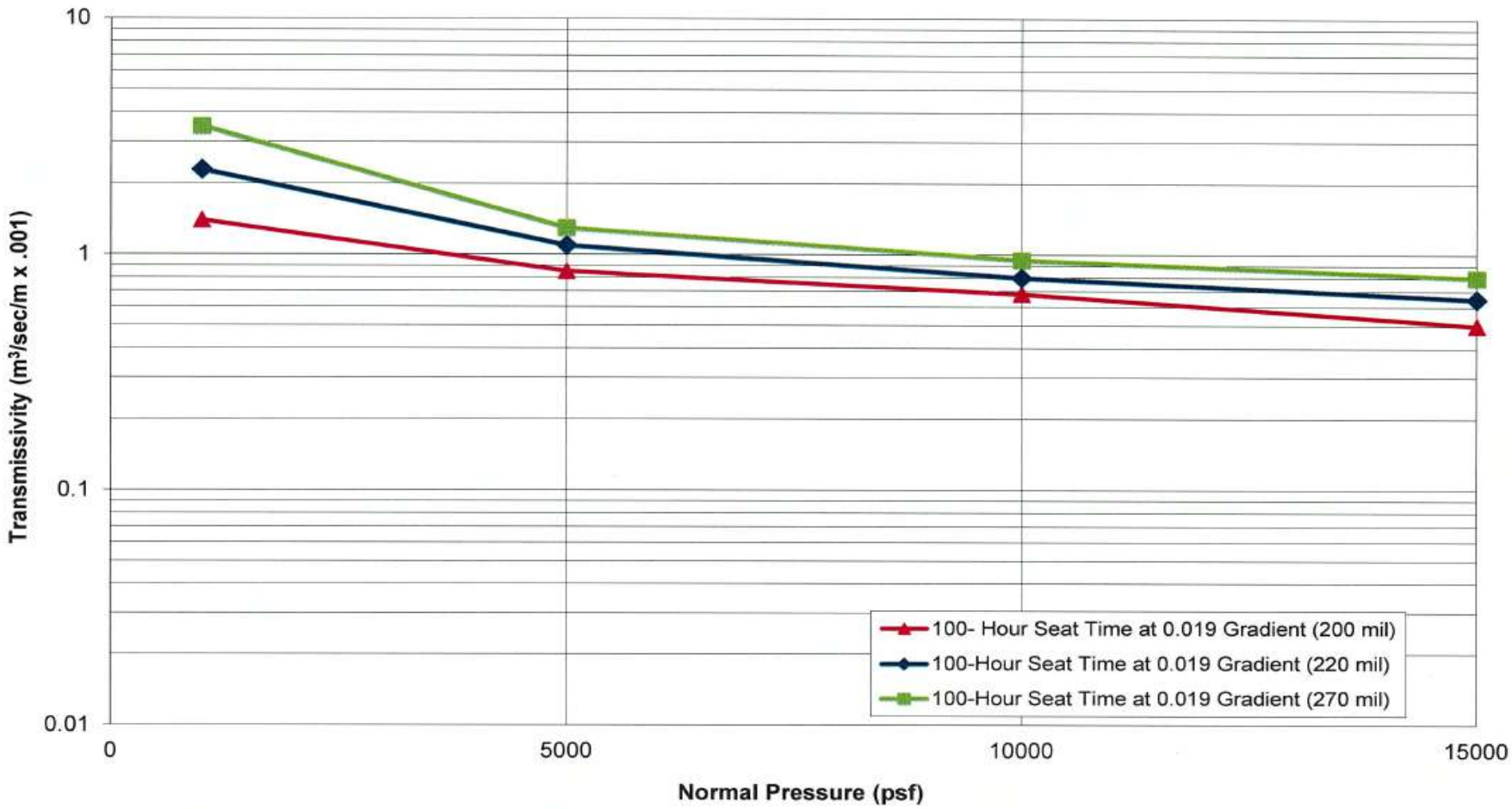
3 The Overall Reduction Factors are a product of the Total Reduction Factor and Overall Factor of Safety to Account For Uncertainties for each fill condition.

Step 3 - Identify the minimum transmissivity for the geocomposite collection layer.

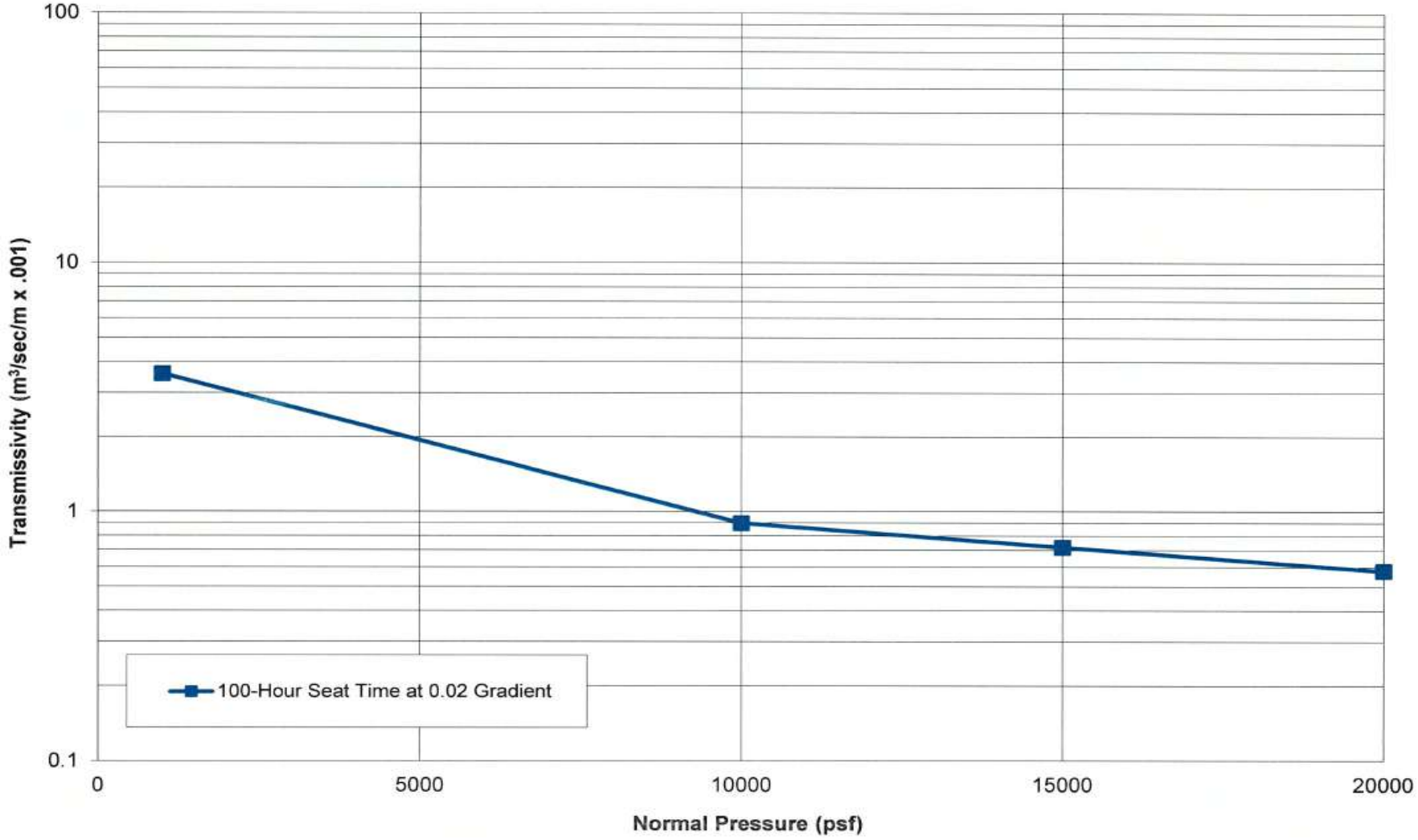
The minimum required transmissivity for the 200-mil and 250-mil thick single-sided geocompsite is shown on the following pages.

These values were developed based on engineering judgment and experience with similar geocomposite products at numerous MSW sites in Texas

TRANSMISSIVITY OF SINGLE-SIDED GEOCOMPOSITE
6/8 oz/sy Polypropylene Geotextile with 200/220/270 mil Drainage Net
(Soil/Geocomposite/Geomembrane)



TRANSMISSIVITY OF SINGLE-SIDED GEOCOMPOSITE
6/8 oz/sy Polypropylene Geotextile with 250-mil Drainage Net
(Soil/Geocomposite/Geomembrane)



Step 4 - Compute the transmissivity of the geocomposite leachate collection layer for each stage of landfill development using the calculated thicknesses and the reduction factors.

Table 3-1 - Estimate the Transmissivity for Cells 3-6

Fill Condition	d_w[1] (ft)	P[2] (psf)	t[3] (m)	T[4] (m^2/s)	ORF[5]	T_{DES}[6] (m^2/s)	k[7] (cm/s)
Interim - 25'	25	1,735	0.005	1.25E-03	2.86	4.37E-04	9.06
Interim -50'	50	3,110	0.005	1.08E-03	3.15	3.43E-04	7.11
Interim - 80'	80	4,760	0.005	8.90E-04	3.70	2.41E-04	5.27
Closed	80	5,060	0.004	8.40E-04	3.70	2.27E-04	5.11

Table 3-2 - Estimate the Transmissivity for Cells 7-12

Fill Condition	d_w[1] (ft)	P[2] (psf)	t[3] (m)	T[4] (m^2/s)	ORF[5]	T_{DES}[6] (m^2/s)	k[7] (cm/s)
Active - 10'	10	790	0.006	3.72E-03	2.20	1.69E-03	26.84
Interim - 25'	25	1,735	0.006	2.75E-03	2.86	9.62E-04	16.46
Interim- 50'	50	3,110	0.006	2.60E-03	3.15	8.26E-04	13.90
Interim- 75'	75	4,485	0.006	2.00E-03	3.70	5.41E-04	9.39
Interim - 110'	110	6,630	0.005	1.65E-03	3.96	4.17E-04	7.67
Closed	110	6,930	0.005	1.64E-03	3.96	4.14E-04	7.62

1 d_w is the depth of waste above the geocomposite leachate collection layer.

2 P is the pressure on the geocomposite leachate collection layer due to the weight of the waste and soil from Tables 1-1 through 1-3.

3 t is the calculated geocomposite leachate collection layer thickness from Tables 1-1 through 1-3 for the drainage geocomposites.

4 T is obtained from the specified transmissivity values for a representative geocomposite leachate collection layer as shown on previous sheets.

5 ORF is the Overall Reduction Factor obtained from Table 2.

6 T_{DES} is the design transmissivity value calculated using the following equation: $T_{DES} = T / ORF$

7 k is hydraulic conductivity and calculated using the following equation: $k = T_{DES}/t$

Step 5 - Specify drainage geocomposite properties for the leachate collection layer.

As shown on the HELP model summary sheet, a geocomposite with characteristics similar to the graph shown on the previous two pages will provide a drainage layer that will maintain less than twelve inches of head on the liner system.

The drainage geocomposite requiremed transmissivity values will be measurd at a gradient of 0.02 under normal pressures of 1,000, 5,000, and 6,930 psf (or higher), boundary conditions consisting of soil/geocomposite/geomembrane with minimum seat time of 100 hours and will be run for the 100,000 square feet of liner constrcution. For each additional 100,000 square feet of single-sided geocomposite placement area, one additional transmissivity test will be run under the maximum normal stress (i.e. 6,930 psf) with all the asame assumptions as the first three tests. The minimum transmissivity will be 1.64 x 10-3 m^2/s.

Developed Cells 3-6
HELP Model Output

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: CDR LF Undeveloped 25' Interim **Simulated On:** 7/11/2023 13:10

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
CL - Clay Loam
Material Texture Number 11

Thickness	=	12	inches
Porosity	=	0.464	vol/vol
Field Capacity	=	0.31	vol/vol
Wilting Point	=	0.187	vol/vol
Initial Soil Water Content	=	0.31	vol/vol
Effective Sat. Hyd. Conductivity	=	6.40E-05	cm/sec

Layer 2

Type 1 - Vertical Percolation Layer (Waste)
Municipal Solid Waste (MSW)
Material Texture Number 83

Thickness	=	300	inches
Porosity	=	0.671	vol/vol
Field Capacity	=	0.272	vol/vol
Wilting Point	=	0.077	vol/vol
Initial Soil Water Content	=	0.25	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-03	cm/sec

Layer 3

Type 1 - Vertical Percolation Layer
SCL - Sandy Clay Loam
Material Texture Number 10

Thickness	=	24	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.244	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 4

Type 2 - Lateral Drainage Layer
Lateral Drainage Layer

Material Texture Number 43

Thickness	=	0.19	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	9.06E+00	cm/sec
Slope	=	1	%
Drainage Length	=	600	ft

Layer 5

Type 3 - Barrier Soil Liner

Liner Soil (High)

Material Texture Number 16

Thickness	=	24	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Note: Initial moisture content of the layers and snow water were specified by the user.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	86.5	
Fraction of Area Allowing Runoff	=	70	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	10	inches
Initial Water in Evaporative Zone	=	3.1	inches
Upper Limit of Evaporative Storage	=	4.64	inches
Lower Limit of Evaporative Storage	=	1.87	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	94.826	inches
Total Initial Water	=	94.826	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	29.73	Degrees
Maximum Leaf Area Index	=	2	

Start of Growing Season (Julian Date)	=	0	days
End of Growing Season (Julian Date)	=	367	days
Average Wind Speed	=	3.3	mph
Average 1st Quarter Relative Humidity	=	68	%
Average 2nd Quarter Relative Humidity	=	67	%
Average 3rd Quarter Relative Humidity	=	70	%
Average 4th Quarter Relative Humidity	=	49	%

Note: Evapotranspiration data was obtained for Del Rio , Texas

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
0.616774	0.723341	0.960808	1.154046	2.950789	2.232191
1.981769	1.46836	2.812696	1.93622	1.222019	0.614324

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
65.7	65.9	71.5	80.4	85.4	92.2
94.3	92	85.4	80.7	72.5	66.5

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Average Annual Totals Summary

Title: CDR LF Undeveloped 25' Interim
Simulated on: 7/11/2023 13:11

	Average Annual Totals for Years 1 - 10*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	18.47	[5.02]	67,033.0	100.00
Runoff	0.347	[0.434]	1,258.4	1.88
Evapotranspiration	17.074	[4.21]	61,980.2	92.46
Subprofile1				
Lateral drainage collected from Layer 4	0.3826	[0.7725]	1,388.8	2.07
Percolation/leakage through Layer 5	0.110226	[0.190165]	400.1	0.60
Average Head on Top of Layer 5	0.0012	[0.0025]	---	---
Water storage				
Change in water storage	0.5525	[0.8852]	2,005.5	2.99

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: CDR LF Undeveloped 25' Interim
Simulated on: 7/11/2023 13:11

	Peak Values for Years 1 - 10*		
	(inches)		(cubic feet)
Precipitation	3.93		14,251.3
Runoff	1.236		4,485.3
Subprofile1			
Drainage collected from Layer 4	0.0706		256.3
Percolation/leakage through Layer 5	0.003413		12.4
Average head on Layer 5	0.0825		---
Maximum head on Layer 5	0.1630		---
Location of maximum head in Layer 4	6.93	(feet from drain)	
Other Parameters			
Snow water	0.6431		2,334.6
Maximum vegetation soil water	0.4625	(vol/vol)	
Minimum vegetation soil water	0.1870	(vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: CDR LF Undeveloped 25' Interim
Simulated on: 7/11/2023 13:11
Simulation period: 10 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	2.6446	0.2204
2	81.6000	0.2720
3	5.8560	0.2440
4	0.0019	0.0100
5	10.2480	0.4270
Snow water	0.0000	---

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: CDR LF Developed 50' Interim **Simulated On:** 7/11/2023 17:21

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
CL - Clay Loam
Material Texture Number 11

Thickness	=	12	inches
Porosity	=	0.464	vol/vol
Field Capacity	=	0.31	vol/vol
Wilting Point	=	0.187	vol/vol
Initial Soil Water Content	=	0.31	vol/vol
Effective Sat. Hyd. Conductivity	=	6.40E-05	cm/sec

Layer 2

Type 1 - Vertical Percolation Layer (Waste)
Municipal Solid Waste (MSW) (900 pcy)
Material Texture Number 18

Thickness	=	600	inches
Porosity	=	0.671	vol/vol
Field Capacity	=	0.292	vol/vol
Wilting Point	=	0.077	vol/vol
Initial Soil Water Content	=	0.269	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-03	cm/sec

Layer 3

Type 1 - Vertical Percolation Layer
SCL - Sandy Clay Loam
Material Texture Number 10

Thickness	=	24	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.244	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 4

Type 2 - Lateral Drainage Layer
Lateral Drainage Layer

Material Texture Number 43

Thickness	=	0.19	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	7.11E+00	cm/sec
Slope	=	1	%
Drainage Length	=	600	ft

Layer 5

Type 3 - Barrier Soil Liner

Liner Soil (High)

Material Texture Number 16

Thickness	=	24	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Note: Initial moisture content of the layers and snow water were specified by the user.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	86.5	
Fraction of Area Allowing Runoff	=	80	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	10	inches
Initial Water in Evaporative Zone	=	3.1	inches
Upper Limit of Evaporative Storage	=	4.64	inches
Lower Limit of Evaporative Storage	=	1.87	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	181.226	inches
Total Initial Water	=	181.226	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	29.73	Degrees
Maximum Leaf Area Index	=	2	

Start of Growing Season (Julian Date)	=	0	days
End of Growing Season (Julian Date)	=	367	days
Average Wind Speed	=	3.3	mph
Average 1st Quarter Relative Humidity	=	68	%
Average 2nd Quarter Relative Humidity	=	67	%
Average 3rd Quarter Relative Humidity	=	70	%
Average 4th Quarter Relative Humidity	=	49	%

Note: Evapotranspiration data was obtained for Del Rio , Texas

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
0.616774	0.723341	0.960808	1.154046	2.950789	2.232191
1.981769	1.46836	2.812696	1.93622	1.222019	0.614324

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
65.7	65.9	71.5	80.4	85.4	92.2
94.3	92	85.4	80.7	72.5	66.5

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Average Annual Totals Summary

Title: CDR LF Developed 50' Interim
Simulated on: 7/11/2023 17:21

	Average Annual Totals for Years 1 - 15*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	19.27	[4.98]	69,952.6	100.00
Runoff	0.462	[0.496]	1,677.1	2.40
Evapotranspiration	17.597	[3.902]	63,878.0	91.32
Subprofile1				
Lateral drainage collected from Layer 4	0.2513	[0.5262]	912.3	1.30
Percolation/leakage through Layer 5	0.099472	[0.175101]	361.1	0.52
Average Head on Top of Layer 5	0.0010	[0.0021]	---	---
Water storage				
Change in water storage	0.8606	[1.222]	3,124.1	4.47

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: CDR LF Developed 50' Interim
Simulated on: 7/11/2023 17:21

	Peak Values for Years 1 - 15*		
	(inches)		(cubic feet)
Precipitation	3.93		14,251.3
Runoff	1.375		4,992.8
Subprofile1			
Drainage collected from Layer 4	0.0593		215.4
Percolation/leakage through Layer 5	0.003414		12.4
Average head on Layer 5	0.0883		---
Maximum head on Layer 5	0.1745		---
Location of maximum head in Layer 4	7.32	(feet from drain)	
Other Parameters			
Snow water	0.6431		2,334.6
Maximum vegetation soil water	0.4532	(vol/vol)	
Minimum vegetation soil water	0.1870	(vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: CDR LF Developed 50' Interim
Simulated on: 7/11/2023 17:21
Simulation period: 15 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	2.5780	0.2148
2	175.2000	0.2920
3	6.0964	0.2540
4	0.0129	0.0681
5	10.2480	0.4270
Snow water	0.0000	---

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: CDR LF Developed 80' Interim **Simulated On:** 7/11/2023 17:58

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
CL - Clay Loam
Material Texture Number 11

Thickness	=	12	inches
Porosity	=	0.464	vol/vol
Field Capacity	=	0.31	vol/vol
Wilting Point	=	0.187	vol/vol
Initial Soil Water Content	=	0.31	vol/vol
Effective Sat. Hyd. Conductivity	=	6.40E-05	cm/sec

Layer 2

Type 1 - Vertical Percolation Layer (Waste)
Municipal Solid Waste (MSW) (900 pcy)
Material Texture Number 18

Thickness	=	960	inches
Porosity	=	0.671	vol/vol
Field Capacity	=	0.292	vol/vol
Wilting Point	=	0.077	vol/vol
Initial Soil Water Content	=	0.282	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-03	cm/sec

Layer 3

Type 1 - Vertical Percolation Layer
SCL - Sandy Clay Loam
Material Texture Number 10

Thickness	=	24	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.244	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 4

Type 2 - Lateral Drainage Layer
Lateral Drainage Layer

Material Texture Number 43

Thickness	=	0.18	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	5.27E+00	cm/sec
Slope	=	1	%
Drainage Length	=	600	ft

Layer 5

Type 3 - Barrier Soil Liner

Liner Soil (High)

Material Texture Number 16

Thickness	=	24	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Note: Initial moisture content of the layers and snow water were specified by the user.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	86.5	
Fraction of Area Allowing Runoff	=	90	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	10	inches
Initial Water in Evaporative Zone	=	3.1	inches
Upper Limit of Evaporative Storage	=	4.64	inches
Lower Limit of Evaporative Storage	=	1.87	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	290.546	inches
Total Initial Water	=	290.546	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	29.73	Degrees
Maximum Leaf Area Index	=	2	

Start of Growing Season (Julian Date)	=	0	days
End of Growing Season (Julian Date)	=	367	days
Average Wind Speed	=	3.3	mph
Average 1st Quarter Relative Humidity	=	68	%
Average 2nd Quarter Relative Humidity	=	67	%
Average 3rd Quarter Relative Humidity	=	70	%
Average 4th Quarter Relative Humidity	=	49	%

Note: Evapotranspiration data was obtained for Del Rio , Texas

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
0.616774	0.723341	0.960808	1.154046	2.950789	2.232191
1.981769	1.46836	2.812696	1.93622	1.222019	0.614324

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
65.7	65.9	71.5	80.4	85.4	92.2
94.3	92	85.4	80.7	72.5	66.5

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Average Annual Totals Summary

Title: CDR LF Developed 80' Interim
Simulated on: 7/11/2023 17:59

	Average Annual Totals for Years 1 - 10*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	18.47	[5.02]	67,033.0	100.00
Runoff	0.442	[0.548]	1,602.7	2.39
Evapotranspiration	17.082	[4.195]	62,008.2	92.50
Subprofile1				
Lateral drainage collected from Layer 4	0.0432	[0.0726]	156.8	0.23
Percolation/leakage through Layer 5	0.043984	[0.073188]	159.7	0.24
Average Head on Top of Layer 5	0.0002	[0.0004]	---	---
Water storage				
Change in water storage	0.8556	[1.1133]	3,105.7	4.63

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: CDR LF Developed 80' Interim
Simulated on: 7/11/2023 17:59

	Peak Values for Years 1 - 10*		
	(inches)		(cubic feet)
Precipitation	3.93		14,251.3
Runoff	1.547		5,615.9
Subprofile1			
Drainage collected from Layer 4	0.0088		32.0
Percolation/leakage through Layer 5	0.003404		12.4
Average head on Layer 5	0.0177		---
Maximum head on Layer 5	0.0353		---
Location of maximum head in Layer 4	1.89	(feet from drain)	
Other Parameters			
Snow water	0.6431		2,334.6
Maximum vegetation soil water	0.4377	(vol/vol)	
Minimum vegetation soil water	0.1870	(vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: CDR LF Developed 80' Interim
Simulated on: 7/11/2023 17:59
Simulation period: 10 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	2.6757	0.2230
2	280.3200	0.2920
3	5.8560	0.2440
4	0.0018	0.0100
5	10.2480	0.4270
Snow water	0.0000	---

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: CDR LF Undeveloped 80' Closed **Simulated On:** 7/11/2023 13:53

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
SCL - Sandy Clay Loam
Material Texture Number 10

Thickness	=	12	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.25	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 2

Type 3 - Barrier Soil Liner
Infiltration Layer
Material Texture Number 44

Thickness	=	18	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-05	cm/sec

Layer 3

Type 1 - Vertical Percolation Layer
CL - Clay Loam
Material Texture Number 11

Thickness	=	12	inches
Porosity	=	0.464	vol/vol
Field Capacity	=	0.31	vol/vol
Wilting Point	=	0.187	vol/vol
Initial Soil Water Content	=	0.31	vol/vol
Effective Sat. Hyd. Conductivity	=	6.40E-05	cm/sec

Layer 4

Type 1 - Vertical Percolation Layer (Waste)
Municipal Solid Waste (MSW)

Material Texture Number 83

Thickness	=	960	inches
Porosity	=	0.671	vol/vol
Field Capacity	=	0.272	vol/vol
Wilting Point	=	0.077	vol/vol
Initial Soil Water Content	=	0.3	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-03	cm/sec

Layer 5

Type 1 - Vertical Percolation Layer

SCL - Sandy Clay Loam

Material Texture Number 10

Thickness	=	24	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.244	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 6

Type 2 - Lateral Drainage Layer

Lateral Drainage Layer

Material Texture Number 43

Thickness	=	0.18	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	5.11E+00	cm/sec
Slope	=	1	%
Drainage Length	=	600	ft

Layer 7

Type 3 - Barrier Soil Liner

Liner Soil (High)

Material Texture Number 16

Thickness	=	24	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Note: Initial moisture content of the layers and snow water

were specified by the user.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	80.4	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	12	inches
Initial Water in Evaporative Zone	=	3	inches
Upper Limit of Evaporative Storage	=	4.776	inches
Lower Limit of Evaporative Storage	=	1.632	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	318.512	inches
Total Initial Water	=	318.512	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	29.73	Degrees
Maximum Leaf Area Index	=	4.5	
Start of Growing Season (Julian Date)	=	0	days
End of Growing Season (Julian Date)	=	367	days
Average Wind Speed	=	3.3	mph
Average 1st Quarter Relative Humidity	=	68	%
Average 2nd Quarter Relative Humidity	=	67	%
Average 3rd Quarter Relative Humidity	=	70	%
Average 4th Quarter Relative Humidity	=	49	%

Note: Evapotranspiration data was obtained for Del Rio , Texas

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
0.616774	0.723341	0.960808	1.154046	2.950789	2.232191
1.981769	1.46836	2.812696	1.93622	1.222019	0.614324

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec

65.7	65.9	71.5	80.4	85.4	92.2
94.3	92	85.4	80.7	72.5	66.5

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Average Annual Totals Summary

Title: CDR LF Undeveloped 80' Closed
Simulated on: 7/11/2023 13:54

	Average Annual Totals for Years 1 - 30*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	18.67	[4.31]	67,784.2	100.00
Runoff	0.121	[0.24]	438.7	0.65
Evapotranspiration	17.579	[3.693]	63,812.8	94.14
Subprofile1				
Percolation/leakage through Layer 2	0.997118	[1.115049]	3,619.5	5.34
Average Head on Top of Layer 2	0.0128	[0.0225]	---	---
Subprofile2				
Lateral drainage collected from Layer 6	1.5809	[4.0476]	5,738.7	8.47
Percolation/leakage through Layer 7	0.312202	[0.268699]	1,133.3	1.67
Average Head on Top of Layer 7	0.0090	[0.023]	---	---
Water storage				
Change in water storage	-0.9199	[4.3623]	-3,339.3	-4.93

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: CDR LF Undeveloped 80' Closed
Simulated on: 7/11/2023 13:54

	Peak Values for Years 1 - 30*	
	(inches)	(cubic feet)
Precipitation	3.93	14,251.3
Runoff	1.046	3,796.3
Subprofile1		
Percolation/leakage through Layer 2	0.533669	1,937.2
Average head on Layer 2	10.2403	
Subprofile2		
Drainage collected from Layer 6	0.0868	315.2
Percolation/leakage through Layer 7	0.003427	12.4
Average head on Layer 7	0.1798	---
Maximum head on Layer 7	0.3519	---
Location of maximum head in Layer 6	12.87 (feet from drain)	
Other Parameters		
Snow water	1.0861	3,942.4
Maximum vegetation soil water	0.3980 (vol/vol)	
Minimum vegetation soil water	0.1360 (vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: CDR LF Undeveloped 80' Closed
Simulated on: 7/11/2023 13:54
Simulation period: 30 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	2.2828	0.1902
2	7.6859	0.4270
3	3.7200	0.3100
4	261.1200	0.2720
5	5.8560	0.2440
6	0.0018	0.0100
7	10.2480	0.4270
Snow water	0.0000	---

Undeveloped Cells 7-10
Help Model Output

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: Del Rio 207C 10ft Undev **Simulated On:** 7/10/2023 10:22

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
Municipal Solid Waste (MSW) (900 pcy)
Material Texture Number 18

Thickness	=	120	inches
Porosity	=	0.671	vol/vol
Field Capacity	=	0.272	vol/vol
Wilting Point	=	0.077	vol/vol
Initial Soil Water Content	=	0.25	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-03	cm/sec

Layer 2

Type 1 - Vertical Percolation Layer
SCL - Sandy Clay Loam
Material Texture Number 10

Thickness	=	24	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.244	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 3

Type 2 - Lateral Drainage Layer
Lateral Drainage Layer
Material Texture Number 43

Thickness	=	0.25	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	2.68E+01	cm/sec
Slope	=	2	%
Drainage Length	=	400	ft

Layer 4

Type 3 - Barrier Soil Liner
Liner Soil (High)
Material Texture Number 16

Thickness	=	24	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Note: Initial moisture content of the layers and snow water were specified by the user.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	81.6	
Fraction of Area Allowing Runoff	=	0	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	10	inches
Initial Water in Evaporative Zone	=	2.5	inches
Upper Limit of Evaporative Storage	=	6.71	inches
Lower Limit of Evaporative Storage	=	0.77	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	46.106	inches
Total Initial Water	=	46.106	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	29.73	Degrees
Maximum Leaf Area Index	=	0	
Start of Growing Season (Julian Date)	=	63	days
End of Growing Season (Julian Date)	=	367	days
Average Wind Speed	=	3.3	mph
Average 1st Quarter Relative Humidity	=	68	%
Average 2nd Quarter Relative Humidity	=	67	%
Average 3rd Quarter Relative Humidity	=	70	%
Average 4th Quarter Relative Humidity	=	49	%

Note: Evapotranspiration data was obtained for Del Rio, Texas

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
0.700841	0.609581	1.162217	1.221361	2.796806	2.413408
1.855572	1.597929	2.986707	1.852661	0.837559	0.585914

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
62.9	64.4	69	77.6	85	92.7
94.7	92	88.5	78.1	70.6	65.7

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Average Annual Totals Summary

Title: Del Rio 207C 10ft Undev
Simulated on: 7/10/2023 10:22

	Average Annual Totals for Years 1 - 1*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	16.25	[0]	58,974.5	100.00
Runoff	0.000	[0]	0.0000	0.00
Evapotranspiration	16.307	[0]	59,194.1	100.37
Subprofile1				
Lateral drainage collected from Layer 3	0.0000	[0]	0.0000	0.00
Percolation/leakage through Layer 4	0.000000	[0]	0.0000	0.00
Average Head on Top of Layer 4	0.0000		---	---
Water storage				
Change in water storage	-0.0605		-219.6	-0.37

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: Del Rio 207C 10ft Undev
Simulated on: 7/10/2023 10:22

	Peak Values for Years 1 - 1*		
	(inches)		(cubic feet)
Precipitation	1.28		4,630.6
Runoff	0.000		0.0000
Subprofile1			
Drainage collected from Layer 3	0.0000		0.0000
Percolation/leakage through Layer 4	0.000000		0.0000
Average head on Layer 4	0.0000		---
Maximum head on Layer 4	0.0000		---
Location of maximum head in Layer 3	0.00	(feet from drain)	
Other Parameters			
Snow water	0.0681		247.2
Maximum vegetation soil water	0.3204	(vol/vol)	
Minimum vegetation soil water	0.0901	(vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: Del Rio 207C 10ft Undev
Simulated on: 7/10/2023 10:22
Simulation period: 1 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	29.9395	0.2495
2	5.8560	0.2440
3	0.0025	0.0100
4	10.2480	0.4270
Snow water	0.0000	---

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: CDR LF Undeveloped 25' Interim **Simulated On:** 7/10/2023 10:31

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
CL - Clay Loam
Material Texture Number 11

Thickness	=	12	inches
Porosity	=	0.464	vol/vol
Field Capacity	=	0.31	vol/vol
Wilting Point	=	0.187	vol/vol
Initial Soil Water Content	=	0.31	vol/vol
Effective Sat. Hyd. Conductivity	=	6.40E-05	cm/sec

Layer 2

Type 1 - Vertical Percolation Layer (Waste)
Municipal Solid Waste (MSW)
Material Texture Number 85

Thickness	=	300	inches
Porosity	=	0.671	vol/vol
Field Capacity	=	0.272	vol/vol
Wilting Point	=	0.077	vol/vol
Initial Soil Water Content	=	0.25	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-03	cm/sec

Layer 3

Type 1 - Vertical Percolation Layer
SCL - Sandy Clay Loam
Material Texture Number 10

Thickness	=	24	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.244	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 4

Type 2 - Lateral Drainage Layer
Lateral Drainage Layer

Material Texture Number 43

Thickness	=	0.23	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	1.65E+01	cm/sec
Slope	=	2	%
Drainage Length	=	400	ft

Layer 5

Type 3 - Barrier Soil Liner

Liner Soil (High)

Material Texture Number 16

Thickness	=	24	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Note: Initial moisture content of the layers and snow water were specified by the user.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	86.5	
Fraction of Area Allowing Runoff	=	70	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	10	inches
Initial Water in Evaporative Zone	=	3.1	inches
Upper Limit of Evaporative Storage	=	4.64	inches
Lower Limit of Evaporative Storage	=	1.87	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	94.826	inches
Total Initial Water	=	94.826	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	29.73	Degrees
Maximum Leaf Area Index	=	2	

Start of Growing Season (Julian Date)	=	0	days
End of Growing Season (Julian Date)	=	367	days
Average Wind Speed	=	3.3	mph
Average 1st Quarter Relative Humidity	=	68	%
Average 2nd Quarter Relative Humidity	=	67	%
Average 3rd Quarter Relative Humidity	=	70	%
Average 4th Quarter Relative Humidity	=	49	%

Note: Evapotranspiration data was obtained for Del Rio , Texas

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
0.616774	0.723341	0.960808	1.154046	2.950789	2.232191
1.981769	1.46836	2.812696	1.93622	1.222019	0.614324

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
65.7	65.9	71.5	80.4	85.4	92.2
94.3	92	85.4	80.7	72.5	66.5

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Average Annual Totals Summary

Title: CDR LF Undeveloped 25' Interim
Simulated on: 7/10/2023 10:31

	Average Annual Totals for Years 1 - 10*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	18.47	[5.02]	67,033.0	100.00
Runoff	0.347	[0.433]	1,260.8	1.88
Evapotranspiration	17.177	[4.253]	62,351.5	93.02
Subprofile1				
Lateral drainage collected from Layer 4	0.2921	[0.5975]	1,060.2	1.58
Percolation/leakage through Layer 5	0.092882	[0.148965]	337.2	0.50
Average Head on Top of Layer 5	0.0002	[0.0004]	---	---
Water storage				
Change in water storage	0.5574	[0.8411]	2,023.3	3.02

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: CDR LF Undeveloped 25' Interim
Simulated on: 7/10/2023 10:31

	Peak Values for Years 1 - 10*		
	(inches)		(cubic feet)
Precipitation	3.93		14,251.3
Runoff	1.226		4,449.3
Subprofile1			
Drainage collected from Layer 4	0.0746		270.7
Percolation/leakage through Layer 5	0.003404		12.4
Average head on Layer 5	0.0160		---
Maximum head on Layer 5	0.0319		---
Location of maximum head in Layer 4	0.77	(feet from drain)	
Other Parameters			
Snow water	0.6431		2,334.6
Maximum vegetation soil water	0.4234	(vol/vol)	
Minimum vegetation soil water	0.1870	(vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: CDR LF Undeveloped 25' Interim
Simulated on: 7/10/2023 10:31
Simulation period: 10 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	2.6923	0.2244
2	81.6000	0.2720
3	5.8571	0.2440
4	0.0027	0.0119
5	10.2480	0.4270
Snow water	0.0000	---

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: CDR LF Undeveloped 50' Interim **Simulated On:** 7/10/2023 18:16

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)

CL - Clay Loam

Material Texture Number 11

Thickness	=	12	inches
Porosity	=	0.464	vol/vol
Field Capacity	=	0.31	vol/vol
Wilting Point	=	0.187	vol/vol
Initial Soil Water Content	=	0.31	vol/vol
Effective Sat. Hyd. Conductivity	=	6.40E-05	cm/sec

Layer 2

Type 1 - Vertical Percolation Layer (Waste)

Municipal Solid Waste (MSW)

Material Texture Number 83

Thickness	=	600	inches
Porosity	=	0.671	vol/vol
Field Capacity	=	0.272	vol/vol
Wilting Point	=	0.077	vol/vol
Initial Soil Water Content	=	0.3	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-03	cm/sec

Layer 3

Type 1 - Vertical Percolation Layer

SCL - Sandy Clay Loam

Material Texture Number 10

Thickness	=	24	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.244	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 4

Type 2 - Lateral Drainage Layer

Lateral Drainage Layer

Material Texture Number 43

Thickness	=	0.23	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	1.39E+01	cm/sec
Slope	=	2	%
Drainage Length	=	400	ft

Layer 5

Type 3 - Barrier Soil Liner

Liner Soil (High)

Material Texture Number 16

Thickness	=	24	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Note: Initial moisture content of the layers and snow water were specified by the user.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	86.5	
Fraction of Area Allowing Runoff	=	80	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	10	inches
Initial Water in Evaporative Zone	=	3.1	inches
Upper Limit of Evaporative Storage	=	4.64	inches
Lower Limit of Evaporative Storage	=	1.87	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	199.826	inches
Total Initial Water	=	199.826	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	29.73	Degrees
Maximum Leaf Area Index	=	2	

Start of Growing Season (Julian Date)	=	0	days
End of Growing Season (Julian Date)	=	367	days
Average Wind Speed	=	3.3	mph
Average 1st Quarter Relative Humidity	=	68	%
Average 2nd Quarter Relative Humidity	=	67	%
Average 3rd Quarter Relative Humidity	=	70	%
Average 4th Quarter Relative Humidity	=	49	%

Note: Evapotranspiration data was obtained for Del Rio , Texas

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
0.616774	0.723341	0.960808	1.154046	2.950789	2.232191
1.981769	1.46836	2.812696	1.93622	1.222019	0.614324

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
65.7	65.9	71.5	80.4	85.4	92.2
94.3	92	85.4	80.7	72.5	66.5

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Average Annual Totals Summary

Title: CDR LF Undeveloped 50' Interim
Simulated on: 7/10/2023 18:17

	Average Annual Totals for Years 1 - 15*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	19.27	[4.98]	69,952.6	100.00
Runoff	0.465	[0.501]	1,687.8	2.41
Evapotranspiration	17.720	[3.951]	64,322.0	91.95
Subprofile1				
Lateral drainage collected from Layer 4	1.9144	[3.9819]	6,949.2	9.93
Percolation/leakage through Layer 5	0.338180	[0.291647]	1,227.6	1.75
Average Head on Top of Layer 5	0.0013	[0.0028]	---	---
Water storage				
Change in water storage	-1.1664	[4.4804]	-4,234.1	-6.05

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: CDR LF Undeveloped 50' Interim
Simulated on: 7/10/2023 18:17

	Peak Values for Years 1 - 15*		
	(inches)		(cubic feet)
Precipitation	3.93		14,251.3
Runoff	1.399		5,078.5
Subprofile1			
Drainage collected from Layer 4	0.0891		323.4
Percolation/leakage through Layer 5	0.003405		12.4
Average head on Layer 5	0.0226		---
Maximum head on Layer 5	0.0451		---
Location of maximum head in Layer 4	1.10	(feet from drain)	
Other Parameters			
Snow water	0.6431		2,334.6
Maximum vegetation soil water	0.4058	(vol/vol)	
Minimum vegetation soil water	0.1870	(vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: CDR LF Undeveloped 50' Interim
Simulated on: 7/10/2023 18:17
Simulation period: 15 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	2.6025	0.2169
2	163.2000	0.2720
3	6.2750	0.2615
4	0.0047	0.0204
5	10.2480	0.4270
Snow water	0.0000	---

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
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Title: CDR LF Undeveloped 75' Interim **Simulated On:** 7/10/2023 18:11

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)

CL - Clay Loam

Material Texture Number 11

Thickness	=	12	inches
Porosity	=	0.464	vol/vol
Field Capacity	=	0.31	vol/vol
Wilting Point	=	0.187	vol/vol
Initial Soil Water Content	=	0.31	vol/vol
Effective Sat. Hyd. Conductivity	=	6.40E-05	cm/sec

Layer 2

Type 1 - Vertical Percolation Layer (Waste)

Municipal Solid Waste (MSW)

Material Texture Number 83

Thickness	=	900	inches
Porosity	=	0.671	vol/vol
Field Capacity	=	0.272	vol/vol
Wilting Point	=	0.077	vol/vol
Initial Soil Water Content	=	0.3	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-03	cm/sec

Layer 3

Type 1 - Vertical Percolation Layer

SCL - Sandy Clay Loam

Material Texture Number 10

Thickness	=	24	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.244	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 4

Type 2 - Lateral Drainage Layer

Lateral Drainage Layer

Material Texture Number 43

Thickness	=	0.23	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	9.39E+00	cm/sec
Slope	=	2	%
Drainage Length	=	400	ft

Layer 5

Type 3 - Barrier Soil Liner

Liner Soil (High)

Material Texture Number 16

Thickness	=	24	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Note: Initial moisture content of the layers and snow water were specified by the user.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	86.5	
Fraction of Area Allowing Runoff	=	80	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	10	inches
Initial Water in Evaporative Zone	=	3.1	inches
Upper Limit of Evaporative Storage	=	4.64	inches
Lower Limit of Evaporative Storage	=	1.87	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	289.826	inches
Total Initial Water	=	289.826	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	29.73	Degrees
Maximum Leaf Area Index	=	2	

Start of Growing Season (Julian Date)	=	0	days
End of Growing Season (Julian Date)	=	367	days
Average Wind Speed	=	3.3	mph
Average 1st Quarter Relative Humidity	=	68	%
Average 2nd Quarter Relative Humidity	=	67	%
Average 3rd Quarter Relative Humidity	=	70	%
Average 4th Quarter Relative Humidity	=	49	%

Note: Evapotranspiration data was obtained for Del Rio , Texas

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
0.616774	0.723341	0.960808	1.154046	2.950789	2.232191
1.981769	1.46836	2.812696	1.93622	1.222019	0.614324

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
65.7	65.9	71.5	80.4	85.4	92.2
94.3	92	85.4	80.7	72.5	66.5

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Average Annual Totals Summary

Title: CDR LF Undeveloped 75' Interim
Simulated on: 7/10/2023 18:12

	Average Annual Totals for Years 1 - 15*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	19.27	[4.98]	69,952.6	100.00
Runoff	0.462	[0.496]	1,676.7	2.40
Evapotranspiration	17.619	[3.906]	63,957.1	91.43
Subprofile1				
Lateral drainage collected from Layer 4	2.5417	[5.4491]	9,226.4	13.19
Percolation/leakage through Layer 5	0.373931	[0.315133]	1,357.4	1.94
Average Head on Top of Layer 5	0.0026	[0.0056]	---	---
Water storage				
Change in water storage	-1.7259	[5.9849]	-6,264.9	-8.96

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: CDR LF Undeveloped 75' Interim
Simulated on: 7/10/2023 18:12

	Peak Values for Years 1 - 15*		
	(inches)		(cubic feet)
Precipitation	3.93		14,251.3
Runoff	1.375		4,992.4
Subprofile1			
Drainage collected from Layer 4	0.0915		332.1
Percolation/leakage through Layer 5	0.003406		12.4
Average head on Layer 5	0.0344		---
Maximum head on Layer 5	0.0685		---
Location of maximum head in Layer 4	1.63	(feet from drain)	
Other Parameters			
Snow water	0.6431		2,334.6
Maximum vegetation soil water	0.4532	(vol/vol)	
Minimum vegetation soil water	0.1870	(vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: CDR LF Undeveloped 75' Interim
Simulated on: 7/10/2023 18:12
Simulation period: 15 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	2.5877	0.2156
2	244.8000	0.2720
3	6.2965	0.2624
4	0.0060	0.0259
5	10.2480	0.4270
Snow water	0.0000	---

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: CDR LF Undeveloped 110' Interi… **Simulated On:** 7/10/2023 11:49

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
CL - Clay Loam
Material Texture Number 11

Thickness	=	12	inches
Porosity	=	0.464	vol/vol
Field Capacity	=	0.31	vol/vol
Wilting Point	=	0.187	vol/vol
Initial Soil Water Content	=	0.31	vol/vol
Effective Sat. Hyd. Conductivity	=	6.40E-05	cm/sec

Layer 2

Type 1 - Vertical Percolation Layer (Waste)
Municipal Solid Waste (MSW)
Material Texture Number 83

Thickness	=	1320	inches
Porosity	=	0.671	vol/vol
Field Capacity	=	0.272	vol/vol
Wilting Point	=	0.077	vol/vol
Initial Soil Water Content	=	0.3	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-03	cm/sec

Layer 3

Type 1 - Vertical Percolation Layer
SCL - Sandy Clay Loam
Material Texture Number 10

Thickness	=	24	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.244	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 4

Type 2 - Lateral Drainage Layer
Lateral Drainage Layer

Material Texture Number 43

Thickness	=	0.21	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	7.67E+00	cm/sec
Slope	=	2	%
Drainage Length	=	200	ft

Layer 5

Type 3 - Barrier Soil Liner

Liner Soil (High)

Material Texture Number 16

Thickness	=	24	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Note: Initial moisture content of the layers and snow water were specified by the user.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	86.5	
Fraction of Area Allowing Runoff	=	90	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	10	inches
Initial Water in Evaporative Zone	=	3.1	inches
Upper Limit of Evaporative Storage	=	4.64	inches
Lower Limit of Evaporative Storage	=	1.87	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	415.826	inches
Total Initial Water	=	415.826	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	29.73	Degrees
Maximum Leaf Area Index	=	2	

Start of Growing Season (Julian Date)	=	0	days
End of Growing Season (Julian Date)	=	367	days
Average Wind Speed	=	3.3	mph
Average 1st Quarter Relative Humidity	=	68	%
Average 2nd Quarter Relative Humidity	=	67	%
Average 3rd Quarter Relative Humidity	=	70	%
Average 4th Quarter Relative Humidity	=	49	%

Note: Evapotranspiration data was obtained for Del Rio , Texas

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
0.616774	0.723341	0.960808	1.154046	2.950789	2.232191
1.981769	1.46836	2.812696	1.93622	1.222019	0.614324

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
65.7	65.9	71.5	80.4	85.4	92.2
94.3	92	85.4	80.7	72.5	66.5

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Average Annual Totals Summary

Title: CDR LF Undeveloped 110' Interim
Simulated on: 7/10/2023 11:49

	Average Annual Totals for Years 1 - 10*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	18.47	[5.02]	67,033.0	100.00
Runoff	0.451	[0.561]	1,635.9	2.44
Evapotranspiration	17.165	[4.238]	62,310.5	92.95
Subprofile1				
Lateral drainage collected from Layer 4	4.2346	[8.0251]	15,371.7	22.93
Percolation/leakage through Layer 5	0.414381	[0.431469]	1,504.2	2.24
Average Head on Top of Layer 5	0.0027	[0.0051]	---	---
Water storage				
Change in water storage	-3.7987	[8.6129]	-13,789.3	-20.57

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: CDR LF Undeveloped 110' Interim
Simulated on: 7/10/2023 11:49

	Peak Values for Years 1 - 10*		
	(inches)		(cubic feet)
Precipitation	3.93		14,251.3
Runoff	1.575		5,716.1
Subprofile1			
Drainage collected from Layer 4	0.0936		339.9
Percolation/leakage through Layer 5	0.003405		12.4
Average head on Layer 5	0.0215		---
Maximum head on Layer 5	0.0429		---
Location of maximum head in Layer 4	1.00	(feet from drain)	
Other Parameters			
Snow water	0.6431		2,334.6
Maximum vegetation soil water	0.3938	(vol/vol)	
Minimum vegetation soil water	0.1870	(vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: CDR LF Undeveloped 110' Interim
Simulated on: 7/10/2023 11:49
Simulation period: 10 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	2.6929	0.2244
2	359.0400	0.2720
3	5.8560	0.2440
4	0.0021	0.0100
5	10.2480	0.4270
Snow water	0.0000	---

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: CDR LF Undeveloped 110' Closed **Simulated On:** 7/10/2023 17:03

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
SCL - Sandy Clay Loam
Material Texture Number 10

Thickness	=	12	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.25	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 2

Type 3 - Barrier Soil Liner
Infilteration Layer
Material Texture Number 44

Thickness	=	18	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-05	cm/sec

Layer 3

Type 1 - Vertical Percolation Layer
CL - Clay Loam
Material Texture Number 11

Thickness	=	12	inches
Porosity	=	0.464	vol/vol
Field Capacity	=	0.31	vol/vol
Wilting Point	=	0.187	vol/vol
Initial Soil Water Content	=	0.31	vol/vol
Effective Sat. Hyd. Conductivity	=	6.40E-05	cm/sec

Layer 4

Type 1 - Vertical Percolation Layer (Waste)
Municipal Solid Waste (MSW)

Material Texture Number 83

Thickness	=	1320	inches
Porosity	=	0.671	vol/vol
Field Capacity	=	0.272	vol/vol
Wilting Point	=	0.077	vol/vol
Initial Soil Water Content	=	0.3	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-03	cm/sec

Layer 5

Type 1 - Vertical Percolation Layer

SCL - Sandy Clay Loam

Material Texture Number 10

Thickness	=	24	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.244	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 6

Type 2 - Lateral Drainage Layer

Lateral Drainage Layer

Material Texture Number 43

Thickness	=	0.21	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	7.63E+00	cm/sec
Slope	=	2	%
Drainage Length	=	400	ft

Layer 7

Type 3 - Barrier Soil Liner

Liner Soil (High)

Material Texture Number 16

Thickness	=	24	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Note: Initial moisture content of the layers and snow water

were specified by the user.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	80.4	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	12	inches
Initial Water in Evaporative Zone	=	3	inches
Upper Limit of Evaporative Storage	=	4.776	inches
Lower Limit of Evaporative Storage	=	1.632	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	426.512	inches
Total Initial Water	=	426.512	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	29.73	Degrees
Maximum Leaf Area Index	=	4.5	
Start of Growing Season (Julian Date)	=	0	days
End of Growing Season (Julian Date)	=	367	days
Average Wind Speed	=	3.3	mph
Average 1st Quarter Relative Humidity	=	68	%
Average 2nd Quarter Relative Humidity	=	67	%
Average 3rd Quarter Relative Humidity	=	70	%
Average 4th Quarter Relative Humidity	=	49	%

Note: Evapotranspiration data was obtained for Del Rio , Texas

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
0.616774	0.723341	0.960808	1.154046	2.950789	2.232191
1.981769	1.46836	2.812696	1.93622	1.222019	0.614324

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec

65.7	65.9	71.5	80.4	85.4	92.2
94.3	92	85.4	80.7	72.5	66.5

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Average Annual Totals Summary

Title: CDR LF Undeveloped 110' Closed
Simulated on: 7/10/2023 17:04

	Average Annual Totals for Years 1 - 30*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	18.67	[4.31]	67,784.2	100.00
Runoff	0.121	[0.24]	438.7	0.65
Evapotranspiration	17.579	[3.693]	63,812.8	94.14
Subprofile1				
Percolation/leakage through Layer 2	0.997118	[1.115049]	3,619.5	5.34
Average Head on Top of Layer 2	0.0128	[0.0225]	---	---
Subprofile2				
Lateral drainage collected from Layer 6	1.9119	[4.8536]	6,940.1	10.24
Percolation/leakage through Layer 7	0.317254	[0.298696]	1,151.6	1.70
Average Head on Top of Layer 7	0.0024	[0.0062]	---	---
Water storage				
Change in water storage	-1.2559	[5.1256]	-4,558.9	-6.73

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: CDR LF Undeveloped 110' Closed
Simulated on: 7/10/2023 17:04

	Peak Values for Years 1 - 30*	
	(inches)	(cubic feet)
Precipitation	3.93	14,251.3
Runoff	1.046	3,796.3
Subprofile1		
Percolation/leakage through Layer 2	0.533669	1,937.2
Average head on Layer 2	10.2403	
Subprofile2		
Drainage collected from Layer 6	0.0894	324.5
Percolation/leakage through Layer 7	0.003407	12.4
Average head on Layer 7	0.0414	---
Maximum head on Layer 7	0.0823	---
Location of maximum head in Layer 6	1.93 (feet from drain)	
Other Parameters		
Snow water	1.0861	3,942.4
Maximum vegetation soil water	0.3980 (vol/vol)	
Minimum vegetation soil water	0.1360 (vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: CDR LF Undeveloped 110' Closed
Simulated on: 7/10/2023 17:04
Simulation period: 30 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	2.2828	0.1902
2	7.6859	0.4270
3	3.7200	0.3100
4	359.0400	0.2720
5	5.8560	0.2440
6	0.0021	0.0100
7	10.2480	0.4270
Snow water	0.0000	---

Appendix IIIC-B. Leachate Collection System Design Calculation



Leachate Collection System (LCS)
Pipe Capacity Calculation

Client: City of Del Rio
Project: Major Permit Amendment
Description: LCS Pipe Capacity Calculations

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: B. Hindman

Purpose: **Size LCS pipes in the undeveloped aea and analyze the leachate collection pipe in the**

Step 1: Determine the peak daily flow rate estimate:

The following tables summarize the fill conditions that are likely to be present and have the greatest contribution of leachate into the LCS. The peak flow rate (lateral drainage in the LCS layer) is shown for each

Developed Cells:

From the HELP model results in Appendix IIIC-A

CONDITION	PEAK cfd/ac	PEAK gpd/ac
Interim, 25' Waste	256.3	1,917.1
Interim, 50' Waste	323.5	2,419.8
Interim, 80' Waste	325.5	2,434.7

For the developed sectors the largest area draining to a leachate collection pipe is 18.9 acres (pipe in Cells 3-6).

Therefore, the maximum leachate production expected in the leachate collection pipe is predicted to occur assuming the following scenario:

1. Interim condition, 25' waste over 3.0 ac
2. Interim condition, 50' waste over 9.9 ac
3. Interim condition, 80' waste over 6.0 ac

CONDITION	AREA ac	PEAK gpd/ac	PEAK gpd	PEAK cfs
Interim, 25' Waste	3.0	1,917.1	5,751.4	8.90E-03
Interim, 50' Waste	9.9	2,419.8	23,955.8	3.71E-02
Interim, 80' Waste	6.0	2,434.7	14,608.4	2.26E-02
Total =	18.9		44,315.6	6.86E-02

Leachate Collection System (LCS)
Pipe Capacity Calculation

Undeveloped Cells:

From the HELP model results in Appendix IIIC-A

CONDITION	PEAK' cfd/ac	PEAK gpd/ac
Active, 10' Waste	0.0	0.0
Interim, 25' Waste	270.7	2,024.8
Interim, 50' Waste	323.4	2,419.0
Interim, 75' Waste	332.1	2,484.1
Interim, 110' Waste	339.9	2,542.5

For the undeveloped sectors, the largest area draining to a leachate collection pipe is 9.7 acres (pipe in Cell 9).

Therefore, the maximum leachate production expected in the leachate collection pipe is predicted to occur assuming the following scenario:

1. Active, 10' Waste	1.4	ac
2. Interim, 25' Waste	3.8	ac
3. Interim, 50' Waste	2.5	ac
4. Interim, 75' Waste	3.5	ac
5. Interim, 110' Waste	2.0	ac

CONDITION	AREA ac	PEAK gpd/ac	PEAK gpd	PEAK cfs
Active, 10' Waste	1.4	0.0	0.0	0.00E+00
Interim, 50' Waste	3.8	2,024.8	7,694.4	1.19E-02
Interim, 100' Waste	2.5	2,419.0	6,047.6	9.36E-03
Interim, 150' Waste	2.0	2,542.5	5,084.9	7.87E-03
Total=	9.7		18,826.9	2.91E-02

Developed Sectors Peak Leachate Production = 6.86E-02 cfs

Undeveloped Sectors Peak Leachate Production = 2.91E-02 cfs

The undeveloped sectors peak leachate production rate was used for the pipe capacity calculation for a 6" SDR 17 pipe.

Leachate Collection System (LCS)
Pipe Capacity Calculation

Step 2: Determination of flow capacity (Q_{full}) for proposed 6-inch SDR 17 perforated pipe:

Flow capacity (O_{full}) for a 6-inch perforated pipe:

$$Q_{full} = \frac{1.486}{n} AR^{2/3}S^{1/2}$$

Where: A = Cross-sectional area of pipe, with d representing the inside diameter in fe
R = Hydraulic radius of pipe in feet under full flow conditions
S = Design slope of pipe
n = Manning's number

From Pipe Structural Stability Calculations:

Standard Dimension Ratio (SDR) = 17

ID = 5.845 in
= 0.487 ft

A = 0.186 sq ft

R = 0.122 ft

S^1= 0.009 ft/ft

1. The 0.9 percent slope was chosen as the minimum slope for the leachate collection pipes. Refer to Appendix IIIE-B.

n = Manning's number n = 0.015

Q_{full} =	0.43	cfs

Compare Peak Q_{max} and Q_{full} for the 6" SDR 17 pipe:

Q_{full} =	0.43	cfs	>>	Q_{max} =	0.069	cfs

An SDR 17 pipe with a nominal diameter of 6 inches exceeds flow capacity requirements.

Leachate Collection System (LCS)
Pipe Capacity Calculation

Step 3: Perforation configuration for a 6-inch SDR 17 perforated pipes:

Pipe perforations must allow free passage of leachate and also prevent migration of drainage media into collection pipes. Therefore, size of perforations depends on media particle size. Two perforations alternatives

For leachate collection pipes with slotted perforations:

$$\frac{D_{85} \text{ of Filter}}{\text{Slot Width}} > 2.0$$

Where: D85 = Particle size for which 85% of all particles are smaller than

	D_{85} =	25	mm
	=	0.984	in
Standard slot width:	d =	0.125	in

Check values to find that:

$$\frac{D_{85} \text{ of Filter}}{\text{Slot Width}} = 7.9 > 2 \quad \text{(acceptable)}$$

For leachate collection pipes with circular holes:

$$\frac{D_{85} \text{ of Filter}}{\text{Hole Diameter}} > 1.7$$

Where: D_{85} = Particle size for which 85% of all particles are smaller than

	D_{85} =	25	mm
		0.984	in
standard hole diameter	d =	0.5	in

$$\frac{D_{85} \text{ of Filter}}{\text{Hole Diameter}} = 2.0 > 1.7 \quad \text{(acceptable)}$$

In Addition:

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.

LEACHATE COLLECTION SYSTEM (LCS)
PIPE STRUCTURAL STABILITY

Client: City of Del Rio
Project: Major Permit Amendment
Description: Pipe Structural Stability

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose: Analyze structural stability of the 6 inch diameter leachate collection system pipe.

A. Determine the critical load and calculate stress under the following two conditions:

1. Construction loading
2. Overburden loading

B. Use the critical loading pressure to analyze pipe stability under the following three possible failure conditions:

1. Wall crushing
2. Wall buckling
3. Ring deflection

Note: The leachate trench details shown on pages IIIC-B-24 and IIIC-B-25 are for illustration purposes only to show parameters used in the following calculations. Leachate collection system details can be found in Appendix IIIA-A.

Step 1: Determine the critical load and stress:

1a. Maximum construction loading:

Assume: CAT 637E Series II scraper with an even load distribution

Loaded weight =	190,500	lb
Tire pressure =	80	psi
Number of tires =	4	

For a circular tire imprint:

$$F = \frac{\text{Loaded Weight}}{\text{Number of Tires}}$$

Where: F = Force exerted by one tire (lb)

F = 47,625 lb

Determine area of contact for circular tire imprint:

$$r = (F/pi*p)^{1/2}$$

Where: r = Radius of contact (in)
F = Force exerted by one tire (lb)
p = Tire pressure (psi)

r = 13.8 in

LEACHATE COLLECTION SYSTEM (LCS)
PIPE STRUCTURAL STABILITY

Use Boussinesq's solution to find the stress at a point below a uniformly loaded circular area:

$$y = p\left(1 - ((r/z)^2+1)^{-3/2}\right)$$

Where:
- y = Change in vertical stress (psi)
- p = Tire pressure (psi)
- r = Radius of contact (in)
- z = Protective cover thickness (in)

z = 24 in

y =	27.8	psi

Assume only one wheel load on pipe and add 50% for impact loading:

$$P_L = 1.5y$$

Where: P_L = Maximum live load (psi)

P_L =	41.7	psi

$$P_D = (zw)/1728$$

Where:
- P_D = Maximum dead load (psi)
- z = Protective cover thickness (in)
- w = Unit weight of protective cover (pcf)

z = 24 in
w = 120 pcf

P_D =	1.67	psi

$$P_T = P_L + P_D$$

Where: P_T = Maximum construction load (psi)

P_T =	43.3	psi

1b. Overburden loading (post closure load):

For maximum fill load on pipe:

2.0	ft protective cover @	120	pcf =	240	psf		
3.5	ft final & interim cover @	120	pcf =	420	psf		
110.0	ft solid waste/soil @	57	pcf=	6270	psf	Highest waste column thickness	
			Sum =	6930	psf	over a 6" LCS pipe.	

P_T =	48.1	psi

LEACHATE COLLECTION SYSTEM (LCS)
PIPE STRUCTURAL STABILITY

Determine critical loading condition:

Construction loading:	P_T =	43.3	psi
Overburden loading:	P_T =	48.1	psi

Overburden loading is most critical to the structural stability of the pipe and will be used to determine the design pipe stress.

Determine design stress:

1. Adjust critical stress to account for loss of strength in the pipe due to perforations:

$$P_{DESI} = 12P_T / (12 - 1_p)$$

Where:
1_p = Cumulative length of perforations per foot of pipe
P_T = Critical pipe stress (psi)
P_{DESI} = Pipe stress adjusted for loss of strength (psi)

6	holes / foot
0.5	in / hole

1_p = 3.0 in/ft

From determination of critical loading:

P_T = 48.1 psi

P_{DESI} = 64.2 psi

Adjust pipe stress determined above to account for effects of soil arching:

2.The design pipe stress is estimated by accounting for the soil structure interaction between the buried leachate collection pipe and its backfill to obtain a realistic loading condition on the pipe.

2a. For the burial conditions shown on Figure 1 (page IIIC-B-14), the pipe may be classified as a positive projecting conduit.

2b. Because the pipe is flexible and will deflect in the vertical plane as shown on Figure 2 (page IIIC-B-15), the pipe will experience a reduction in loading due to soil arching. Soil arching is present when the soil column over the pipe settles and creates shear stresses in the surrounding soil. Those shear stresses will support the soil column, thereby reducing the load experienced by the pipe (see Figure 3, page IIIC-B-15).

2c. The load on the pipe will be estimated using Marston's Formula:

$$C_c = \frac{e^{\pm k\mu(He/Bc)} - 1}{\pm 2k\mu} + \left(\frac{H - He}{B_c}\right) e^{\pm k\mu(He/Bc)}$$

Where:
W_c = Load per unit length of conduit (lb/ft)
Unit weight of soil above conduit (pcf)
B_c = Outer diameter of conduit (ft)
H = Height of fill above conduit (ft)
H_e = Height of plane of equal settlement above critical plane (ft)
k = Lateral pressure ratio (earth pressure coefficient)
μ = tanϕ
ϕ = Angle of internal friction of pipe-zone backfill (PZB) (degrees)

$$H_e = \pm r_{sd} p (H/B_c)$$

Where:
r_{sd} = Settlement ratio
p = Ratio of the conduit projection above the compacted soil liner to its diameter

$$r_{sd} = \frac{(S_m + S_g) - (S_f + dc)}{S_m}$$

Where:
S_m = Compression deformation of soil column adjacent to conduit
S_g = Settlement of natural ground adjacent to conduit
S_f = Settlement of conduit into foundation material
dc = Vertical deflection of the conduit

It is assumed that for a leachate collection pipe S_g and S_f are equivalent. The equation settlement ratio, therefore, reduces to the following:

$$r_{sd} = \frac{S_m - dc}{S_m}$$

Since the trench aggregate (PZB) is much stiffer than the pipe, de is larger than S_m implying that r_{sd} will be negative. Because r_{sd} is negative, the pipe is categorized as an incomplete ditch as specified by Marston. Note that in the above equations, where a + and a - sign are used together, the upper sign corresponds to a positive r_{sd} and a the lower sign to a negative r_{sd}.

2d. Load analysis solution by trial and error

Step 1: Assume a value for the settlement ratio, $r_{sd.}$

r_{sd} = -0.65

Step 2: Calculate Sm based on the estimated vertical stress at the level of the pipe and the deformation modulus E of the PZB.

$$S_m = P_{DESI}\, D / E_s$$

Where:
P_{DESI} = Pipe stress adjusted for loss of strength (psi)
D = Pipe diameter (in)
E_s = PZB soil modulus (psi)

P_{DESI} =	64.2	psi
D=	6.625	in
E_s =	3,000	psi

S_m =	0.142	in

Step 3: Calculate dc using Equation (5):

$$dc = S_m (I - r_{sd})$$

dc = 0.234 in

Step 4: Use the Iowa Formula (provided below) to calculate load per unit length (W_c).

$$W_c = \frac{(dc)}{((DL)k)} \frac{EI}{r^3} + 0.061E'$$

Where:
- DL = Deflection lag factor
- k = Bedding factor
- E = Young's modulus for pipe material (psi)
- I = Moment of inertia for pipe wall = $t^3/12$ (in^4/in)
- r = Pipe radius (in)
- E' = Modulus of soil reaction (psi)

DL =	2.5	Quian, Xuede, R.M. Koerner, D. H. Gray, "Geotechnical Aspects of
k =	0.1	Landfill Design and Construction." Prentice-Hall, Inc., New Jersey, 2002.
E =	29,500	psi (refer to chart 25 on page IIIC-B-17, based on P_{DES1} above)
t =	0.390	in (SDR 17 pipe)
I =	0.005	in^4/in
r=	3.3	in
E' =	3,000	psi

W_C = 175 lb/in

Step 5: Calculate C_C using Equation 1:

$$C_C = \frac{W_C}{YB_C^2}$$

Composite unit weight for waste and soil:

5.5	ft soil @	120	pcf =	660	psf
110.0	ft waste @	57	pcf =	6270	psf
			Total =	6,930	psf

Y = 60 pcf (weighted average based on above table)

B_C = 6.625 in

C_e = 114.8 (unitless)

Step 6: Solve for He/Bc using Equation 2 in an iterative manner:

H =	110	ft
H/B_C =	199.2	

Assume: H_e/B_C = 1.31

kμ =	0.13	Landfill Design Series, Leachate Gas Management Systems Design, Volume 5, Leachate Management and Storage, Appendix A, 1993.
$e^{-2k\mu(He/Bc)}-1$ =	-0.29	
$-2k\mu$ =	-0.26	
$(H/B_e - H_e/B_c)$ =	197.9	
$e^{-2k\mu(He/Bc)}$ =	0.71	

Left-hand-side of equation (LHS) = 130
Right-hand-side of equation (RHS) = 130

Step 7: Substitute He/Bc into equation given below to determine if proper value for r_{sd} was used.

$$\left[\frac{1}{2k\mu}\pm\left(\frac{H}{B_c}-\frac{H_e}{B_c}\right)\pm\frac{r_{sd}\,p}{3}\right]\frac{e^{\pm 2k\mu(H_e/B_c)}-1}{\pm 2k\mu}\pm\frac{1}{2}\left(\frac{H_e}{B_c}\right)^2$$
$$\pm\frac{r_{sd}\,p}{3}\left(\frac{H}{B_c}-\frac{H_e}{B_c}\right)e^{\pm 2k\mu(H_e/B_c)}-\frac{1}{2k\mu}\left(\frac{H_e}{B_c}\right)\mu\left(\frac{H}{B_e}\right)\left(\frac{H_e}{B_c}\right)=\pm r_{sd}\,p\left(\frac{H}{B_c}\right)$$

Because r_{sd} is negative for the incomplete ditch condition, the lower signs in the above equation are used.

p =	1
kμ =	0.13
H/B_c =	199.2
H_e/B_c =	1.30767016
r_{sd} =	-0.65
LHS =	278
RHS =	278

If LHS is not approximately equal to RHS, adjust value for r_{sd} in Step 1 and repeat solution procedure.

2e. Once the solutions to the above equations are determined, the design pipe stress may be calculated and the deflection of the pipe determined.

$P_{DES2} = W_C/D$

Where: P_{DES2} = Load on pipe adjusted to account for effects of soil arching (psi)

W_C =	175	lb/in
D =	6.6	in

P_{DES2} =	27	psi

A summary table for the structural stability analysis is provided on page IIIC-B-13 for the 6-inch-diameter leachate collection pipe. A pipe will be selected from this table for use in the collection system based on the calculated factors of safety for each possible failure condition. An example calculation is provided below that outlines the procedures used to determine the factors of safety for all pipe SDR sizes shown in the summary table.

B. Use the critical loading pressure to analyze pipe stability:

Example pipe structural stability calculations:

SDR =	Standard dimension ratio =	17	
S_Y =	compressive yield strength =	1,500	psi
RD_{all} =	allowable ring deflection =	4.2	%

1. Wall crushing (Phillips 66 Driscopipe, System Design, 1991)

$$S_A = P_{DES2} (SDR - 1) / 2 \qquad FS = S_Y / S_A$$

Where:
- S_A = Actual compressive stress (psi)
- SDR = Standard dimension ratio
- P_{DES2} = Load pipe adjusted to account for effects of soil arching (psi)
- S_Y = Compressive yield strength (psi)
- FS = Factor of safety against wall crushing

P_{DES2} = 27 psi

S_A =	212.1	psi
FS =	7.1	

Compare calculated and suggested factor of safety:	7.1	>	1.0

2. Wall buckling (Ref: Phillips 66 Driscopipe, System Design, 1991.)

$$P_{cb} = 0.8 (E' (2.32E / SDR^3))^{1/2} \qquad FS = P_{cb} / P_{DES2}$$

Where:
- P_{cb} = Critical buckling pressure at top of pipe (psi)
- E' = Soil modulus (psi)
- E = Stress/time dependent tensile modulus for design loading conditions (psi)
- P_{DES2} = Load pipe adjusted to account for effects of soil arching (psi)
- FS = Factor of safety against wall buckling

E' = 3,000 psi

E = 18,000 psi for 50 years based on SA above (see chart page IIIC-B-17)

P_{DES2} = 27 psi

P_{cb} =	127.7	psi
FS =	4.8	

Compare calculated and suggested factor of safety:	4.8	>	1.0

3. Ring deflection (Ref: Phillips 66 Driscopipe, System Design, 1991.)

$$E_s = P_{DES2} / E'$$

Where:
E_s = Soil strain (%)
P_{DES2} = Load pipe adjusted to account for effects of soil arching (psi)
E' = Soil modulus (psi)

P_{DES2} = 27 psi
E' = 3,000 psi

E_s = 0.9 %

Ring deflection for buried HDPE pipe is conservatively the same (no more than) the vertical compression of the soil envelope around the pipe. Therefore, assumed actual ring deflection (RDa„) is equal to soil strain.

RD_{act} = 0.9 %

Allowable ring deflection, RD_{all} = 4.2 %

$RD_{act} < RD_{all}$, design is acceptable

Note: An additional factor of safety is inherent to the design of the leachate collection system due to the presence of a gravel envelope surrounding the leachate collection pipe. The gravel layer will transmit leachate in the event that the leachate collection pipe becomes plugged or crushed.

LEACHATE COLLECTION SYSTEM (LCS)
PIPE STRUCTURAL STABILITY

Client: City of Del Rio
Project: Major Permit Amendment
Description: Pipe Structural Stability

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Required:

Adjusted load to account for soil arching = 27 psi

SDR	Wall Crushing			Wall Buckling				Ring Deflection			
	S_Y	S_A	FS_{WC}	E^2	E'	P_{cb}	FS_{WB}	RD_{all}	E'	RD_{act}	FS_{RD}
32.5	1,500	417.6	3.6	13,000	3,000	41.1	1.5	8.1	3,000	0.9	9.2
26.0	1,500	331.4	4.5	13,000	3,000	57.4	2.2	6.5	3,000	0.9	7.4
21.0	1,500	265.1	5.7	15,000	3,000	84.9	3.2	5.2	3,000	0.9	5.9
19.0	1,500	238.6	6.3	16,500	3,000	103.5	3.9	4.7	3,000	0.9	5.3
17.0	1,500	212.1	7.1	18,000	3,000	127.7	4.8	4.2	3,000	0.9	4.8
15.5	1,500	192.2	7.8	19,000	3,000	150.8	5.7	3.9	3,000	0.9	4.4
13.5	1,500	165.7	9.1	21,000	3,000	195.0	7.4	3.4	3,000	0.9	3.8
11.0	1,500	132.6	11.3	23,000	3,000	277.4	10.5	2.7	3,000	0.9	3.1

[1]Select 6-inch-diameter HDPE SDR 17.0 pipe for use in the leachate collection system based on the calculated factors of safety.

[2] Values for the modulus of elasticity were selected from the attached chart (page IIIC-B-17), using the calculated stress in the pipe wall (SA under the wall crushing heading in the above table) for a 50 year duration (maximum loading is the overburden load on the pipe).

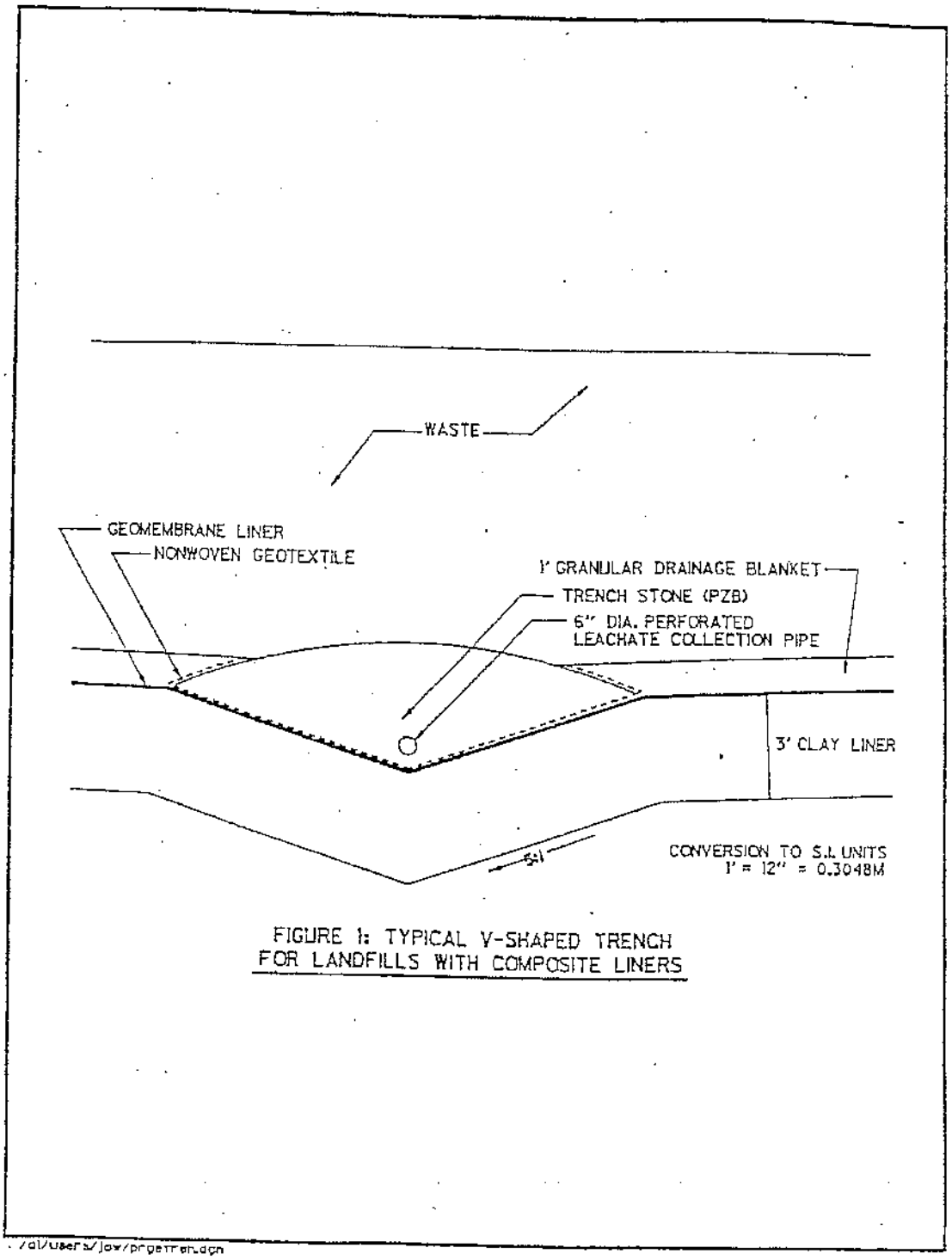


FIGURE 1: TYPICAL V-SHAPED TRENCH
FOR LANDFILLS WITH COMPOSITE LINERS

/al/users/jaw/progs/trench.dgn

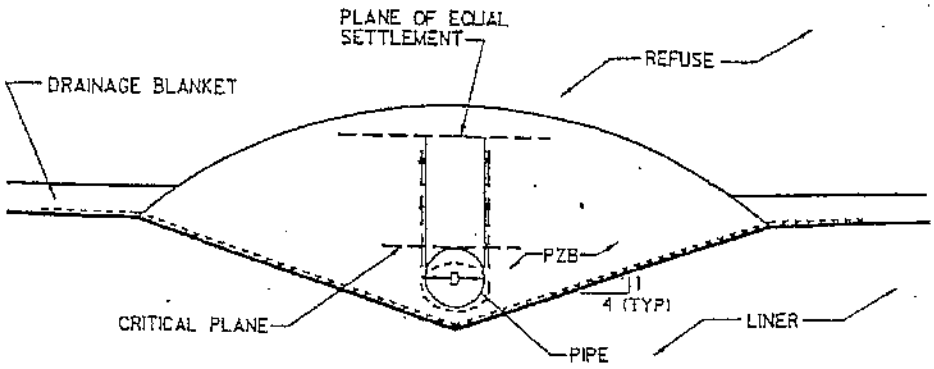


FIGURE 2: SETTLEMENT OF LEACHATE PIPE INDUCING SHEAR STRESSES IN PZB

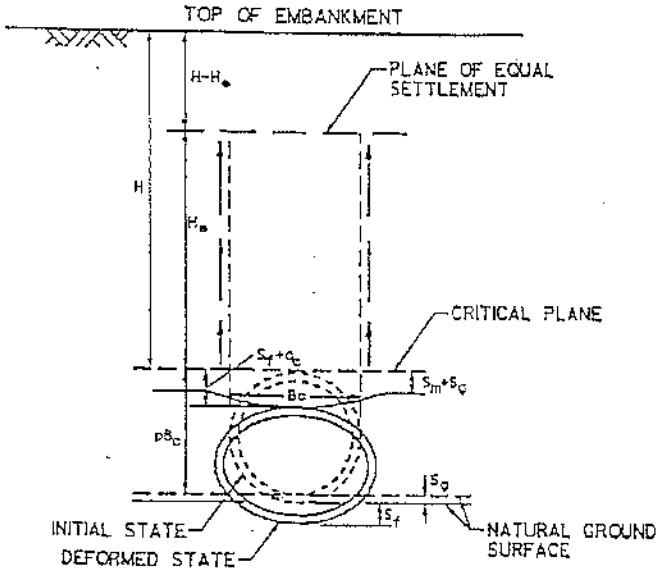


FIGURE 3: CASE OF AN INCOMPLETE DITCH CONDITION FOR A POSITIVE PROJECTING CONDUIT

/dl/users/jaw/prgen.bn.cgn

here: S_A = Actual compressive stress, psi
SDR = Standard Dimension Ratio
P_T = External Pressure, psi

Safety Factor = 1500 psi ÷ S_A where 1500 psi is the Compressive Yield Strength of Driscopipe.

Design by Wall Buckling: Local wall buckling is a longitudinal wrinkling of the pipe wall. Tests of *non-pressurized* Driscopipe show that buckling and collapse do not occur when the soil envelope is in full contact with the pipe and is compacted to a dense state. However, it can be forced to occur over the long term in *non-pressurized* pipe if the total external soil pressure, P_t, is allowed to exceed the pipe-soil system's critical buckling pressure, P_{cb}. If $P_t > P_{cb}$, gradual collapse may occur over the long term. A calculated, conservative value for the critical buckling pressure may be obtained by the following approximate formula. All pipe diameters with the same SDR in the same burial situation have the same critical collapse and critical buckling endurance

$$P_{cb} = 0.8\sqrt{E' \times P_c}$$

Where:

P_t = Total vertical soil pressure at the top of the pipe, psi

P_{cb} = Critical buckling soil pressure at the top of the pipe, psi

E' = Soil modulus in psi calculated as the ratio of the vertical soil pressure to vertical soil strain at a specified density

P_c = Hydrostatic, critical-collapse differential pressure, psi

$$P_c = \frac{2E\,(t/D)^3\,(D_{MIN}/D_{MAX})^3}{(1-\mu^2)}$$

$$P_c = \frac{2.32\,E}{(SDR)^3}$$

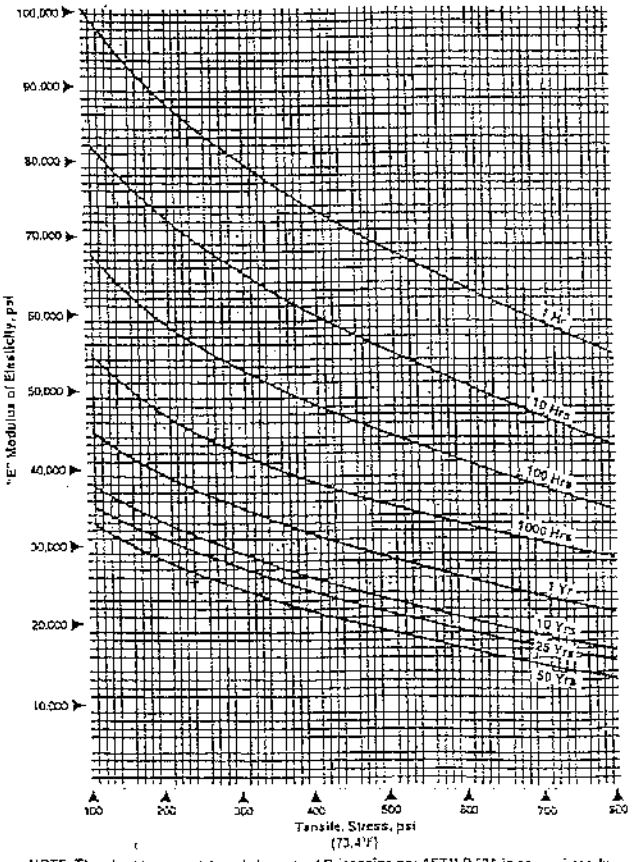
Where: (D_{MIN}/D_{MAX}) = .95
μ = Poission's Ratio
μ = .45 for Driscopipe
E = stress and time dependent tensile modulus of elasticity, psi

In a direct burial pressurized pipeline, the internal pressure is usually great enough to exceed the external critical-buckling soil pressure. When a pressurized line is to be shut down for a period, wall buckling should be examined.

Design by Wall Buckling Guidelines:
Although wall buckling is seldom the limiting factor in the design of a Driscopipe system, a check of non-pressurized pipelines can be made according to the following steps to insure $P_t < P_{cb}$.

1. Calculate or estimate the total soil pressure, P_t, at the top of the pipe.
2. Calculate the stress "S_A" in the pipe wall according to the formula:
$$S_A = \frac{(SDR - 1)\,P_t}{2}$$
3. Based upon the stress "S_A" and the estimated time duration of non-pressurization, use Chart 25 to find the value of the pipe's modulus of elasticity, E, in psi.

Chart 25
Time Dependent Modulus of Elasticity for Polyethylene Pipe vs. Stress Intensity (73.4°F)



NOTE: The short term modulus of elasticity of Driscopipe per ASTM D 638 is approximately 100,000 psi. Due to the cold flow (creep) characteristic of the pipe material, this modulus is dependent upon the stress intensity and the time duration of the applied stress.

LEACHATE COLLECTION SYSTEM (LCS)
SUMP DESIGN

Client: City of Del Rio
Project: Major Permit Amendment
Description: Leachate Sump Design Calculations

Date: 9/29/2023
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Purpose: **Size leachate collection sumps.**

Step 1: **Determine the average flow rate into sump**

1a. Determine the per acre flow rate for specific leachate collection sumps.

The following tables summarize the fill conditions that are likely to be present within each cell and have the greatest contribution of leachate into the LCS and sump system. The average flow rates (lateral drainage in the LCS layer) are shown for each condition.

Developed Sectors:

From the HELP model results in Appendix IIIC-A
For the developed sectors, the largest area draining to the sump is 18.9 acres (sump located in Cell 6).

Condition	Average cfy/ac	Average gpd/ac
Interim, 25' Waste	1,388.8	28.5
Interim, 50' Waste	7,251.5	148.6
Interim, 80' Waste	12,184.9	249.7
Closed, 80' Waste	5,738.7	117.6

Undeveloped Sectors:

From the HELP model results in Appendix IIIC-A:
For the undeveloped sectors, the largest area draining to a sump is 9.7 cres (sump located in Cell 9).

Condition	Average[1] cfy/ac	Average gpd/ac
Active, 10' Waste	0.0	0.0
Interim, 50' Waste	1,060.2	21.7
Interim, 100' Waste	6,949.2	142.4
Interim, 200' Waste	9,226.4	189.1
Interim, 235' Waste	15,371.7	315.0
Closed, 235' Waste	6,940.1	142.2

LEACHATE COLLECTION SYSTEM (LCS)
SUMP DESIGN

Client: City of Del Rio
Project: Major Permit Amendment
Description: Leachate Sump Design Calculations

Date: 9/29/2023
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Sump for Developed Sectors = 18.9 acres

Condition	Rate (gpd/ac)	Active		Inactive		Closed	
		area (ac)	rate (gpd)	area (ac)	rate (gpd)	area (ac)	rate (gpd)
Interim, 25' Waste	28.5	3.0	85.4	0.0	0.0	0.0	0.0
Interim, 50' Waste	148.6	5.5	817.4	0.0	0.0	0.0	0.0
Interim, 80' Waste	249.7	7.4	1,848.0	18.9	4,719.8	0.0	0.0
Closed, 80' Waste	117.6	3.0	352.8	0.0	0.0	18.9	2,222.9
Total		18.9	3,103.6	18.9	4,719.8	18.9	2,222.9

Sump for Developed Sectors = 9.7 acres

Condition	Rate (gpd/ac)	Active		Inactive		Closed	
		area (ac)	rate (gpd)	area (ac)	rate (gpd)	area (ac)	rate (gpd)
Active, 10' Waste	0.0	1.0	0.0	0.0	0.0	0.0	0.0
Interim, 25' Waste	21.7	2.0	43.5	0.0	0.0	0.0	0.0
Interim, 50' Waste	142.4	2.0	284.8	0.0	0.0	0.0	0.0
Interim, 75' Waste	189.1	2.0	378.2	0.0	0.0	0.0	0.0
Interim, 110' Waste	315.0	1.7	535.6	9.7	3,055.9	0.0	0.0
Closed, 110' Waste	142.2	1.0	142.2	0.0	0.0	9.7	1,379.7
Total		9.7	1,384.3	9.7	3,055.9	9.7	1,379.7

B. Required storage capacity of sump

Assumed porosity of drainage stone: P = 0.35

$V_{Daily\ Inflow} = V_C / P$

1. Active

	V_c (gpd)	V_c *(cu ft/day)*	$V_{Daily\ Inflow}$ (cu ft/day)
Developed Sectors	3,103.6	414.9	1,185.4
Undeveloped Sectors	1,384.3	185.1	528.7

2. Inactive with Intermediate Cover

	V_c (gpd)	V_c *(cu ft/day)*	$V_{Daily\ Inflow}$ (cu ft/day)
Developed Sectors	4,719.8	630.9	1,802.7
Undeveloped Sectors	3,055.9	408.5	1,167.2

3. Closed

	V_c (gpd)	V_c *(cu ft/day)*	$V_{Daily\ Inflow}$ (cu ft/day)
Developed Sectors	2,222.9	297.2	849.0
Undeveloped Sectors	1,379.7	184.4	527.0

LEACHATE COLLECTION SYSTEM (LCS)
SUMP DESIGN

Client: City of Del Rio
Project: Major Permit Amendment
Description: Leachate Sump Design Calculations

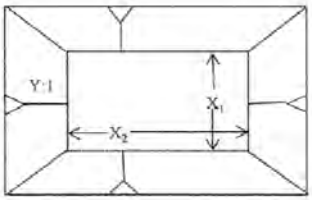
Date: 9/29/2023
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Total sump volume:

$$V_{TOT} = 1/3(A_1 + A_2 + \text{sqrt}(A_1 * A_2))h$$

(Heisler, Sanford I., RE., Wiley Engineer's Desk Reference, John Wiley & Sons, Inc., New York, 1998., page 17)

Where:



A_1 = Area of bottom of sump
A_2 = Area of top of sump
h = Depth of sump

Y = Slope of sump side walls
$A_1 = X_1 * X_2$
$A_2 = (X_1 + 2(h*Y))*(X_2 + 2(h*Y))$

	X_1 (ft)	X_2 (ft)	Y (ft)	h (ft)	A_1 (ft^2)	A_2 (ft^2)	V_{TOT} (ft^3)
Developed Sectors	20	20	3	3	400	1444	2604
Undeveloped Sectors	20	20	3	3	400	1444	2604

Compute the number of days storage provided for the following:

$$\text{STORAGE (Detention Time)} = \frac{V_{TOT}}{V_{\text{Daily Inflow}}}$$

1. Active

	$V_{\text{Daily Inflow}}$ (ft^3/day)	V_{TOT} (ft^3)	Storage (days)
Developed Sectors	1,185.4	2604	2.2
Undeveloped Sectors	528.7	2604	4.9

2.Inactive with Intermediate Cover

	$V_{\text{Daily Inflow}}$ (ft^3/day)	V_{TOT} (ft^3)	Storage (days)
Developed Sectors	1,802.7	2604	1.4
Undeveloped Sectors	1,167.2	2604	2.2

3.Closed

	$V_{\text{Daily Inflow}}$ (ft^3/day)	V_{TOT} (ft^3)	Storage (days)
Developed Sectors	849.0	2604	3.1
Undeveloped Sectors	527.0	2604	4.9

LEACHATE COLLECTION SYSTEM (LCS)
CHIMNEY DRAIN CPACITY CALCULATIONS

Client: City of Del Rio
Project: Major Permit Amendment
Description: Chimney Drain Capacity Calculations

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: B. Hindman

Purpose: The purpose of this calculation is to demonstrate that the capacity of the chimney drain is sufficient to carry the expected leachate flow rate to the sump to provide redundancy.

Step 1: Determine the expected leachate inflow rate into the chimney drain.

$$Q_{exp} = q * A$$

Where:
Q_{exp} = Expected leachate inflow rate into chimney drain during active life (flow will decrease after final cover is installed)
q = Expected leachate generation rate (refer to Appendix IIIC-A)
A = Largest area draining to a chimney drain

q =	12,704	gal/ac/yr	=	1.24E-09	cfs/sf
A =	31.3	ac	=	1,363,428	sf

Q_{exp} = 0.0017 cfs

Step 2: Determine the capacity of the chimney drain.

$$Q_{cd} = (k/h) * i * A$$

Where:
Q_{cd} = Maximum capacity of chimney drain, cfs/ft
k = Permeability of drainage stone, ft/s
h = Porosity of drainage stone
i = Slope of chimney drain, ft/ft
A = Cross-sectional area of chimney drain assuming 12 inches of head on liner, sf

k =	1.0	cm/s	=	0.033	ft/s
h =	0.35				
i =	0.009	ft/ft (assumed post-settlement slope of LCS pipe)			
A =	19.6	sf (refer to Detail L1 on Drawing A.4)			

Q_{cd} = 0.0165 cfs

Step 2: Compare the chimney drain capacity to the expected inflow rate.

Q_{cd} = 0.0165 cfs >> Q_{exp} = 0.0017 cfs

Conclusion:

The chimney drain design is adequate to convey the expected generated leachate to the sump to provide redundancy.

Appendix IIIC-C. Containment Berm Calculation



CONTAINMENT / DIVERSION BERM CALCULATIONS

Client: City of Del Rio
Project: Major Permit Amendment
Description: Containment / Diversion Berm Calculations for the Landfill

Date: 9/29/2023
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Purpose - Evaluate the Containment/Diversion Berm Calculations for the Landfill

Required:

1. Determine the height of the contaminated water berm required at the working face.

2. Determine the height of the diversion berm required for run-on control of the working face.

PROCEDURE:

Containment Berm Calculations
1.Determine the 25-year, 24-hour rainfall.
2.Calculate the volume of water captured behind the containment berm for 25-year, 24-hour rainfall event
3.Calculate the height of the containment berm required to hold the volume of water calculated in step 2.

Diversion Berm Calculations

1.Determine the 25-year frequency runoff flow rates for the diversion berm run-on drainage areas by the Rational Method.

2.Calculate the capacity of the diversion berm swales at various slopes.
3.Calculate the height of the diversion berm required for the flow rate of run-on surface water.

REFRENCES:

1. Precipitation-Frequency Atlas of the United States, Volume 11 Version 2.0 (National Oceanic and Atmospheric Administration Atlas 14, 2018) was used to estimate precipitation storm events.

2.State of Texas, Department of Transportation, Bridge Division, *Hydraulic Design Manual* , July 2016

SOLUTION:

Containment Berm Calculations

1. Based on the HEC-1 calculated total excess rainfall for the 25-year, 24-hour rainfall depth for Val Verde County is:

R = 5.9 in

2. Determine the volume of storage required, V_R.

$V_R = CAR$

Where:

C =	Runoff coefficient =	0.5		
A =	Drainage area =	varies	ac	
R =	25-year, 24-hour rainfall depth =	5.9	in	

The storage volume required for varying drainage areas are shown on the attached table.

3.Determine the height of the containment berm for a non-sloping water storage area.

$$H = \frac{V_R}{A_{stor}}$$ **Where:** A_{stor} = Storage area (sf)

Client: City of Del Rio
Project: Major Permit Amendment
Description: Containment / Diversion Berm Calculations for the Landfill

Date: 9/29/2023
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

4. Determine the height of the berm for a sloping water storage area.

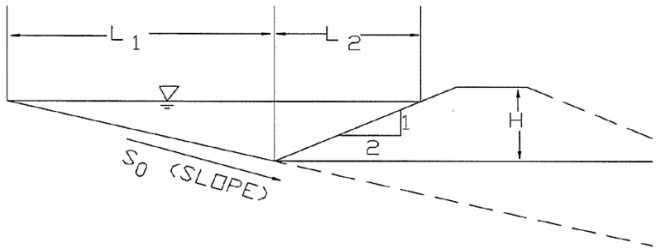
The volume contained by the berm is equal to the cross-sectional storage area multiplied by the width of the berm. The computed volume must be greater than the volume found in step 2.

$V_c = AsW$

Where: A, = Cross-sectional storage area (sf)
W = Width (ft)

The minimum width of the downstream berm is 100 feet.

Figure 1. Cross Section of Berm and Storage Area



$$A_s = \frac{(L_1 + L_2)H}{2}$$

Where:

$$L_1 = \frac{H}{S_0} \text{ (ft)}$$

L_2 = 2H (ft)
S_o = Slope of active cell (ft/ft)

Example calculations:

1. Non-sloping water storage area:

Variables:	S_o =	0.00	%	R =	5.9	in
	A_{stor} =	0.25	ac	C =	0.5	
	A =	0.50	ac	W =	100	ft
Volume:	V_R =	5,354	cf			
Height:	H =	0.492	ft			

2. Sloping water storage area:

Variables:	S_o=	1.00	%	R =	5.9	in
	A_{stor} =	0.25	ac	C =	0.5	
	A =	0.5	ac	W =	100	ft

Height: An iterative process is used to determine the height of the berm required to meet the storage volume requirement for a non-sloping storage area.

CONTAINMENT / DIVERSION BERM CALCULATIONS

Client: City of Del Rio
Project: Major Permit Amendment
Description: Containment / Diversion Berm Calculations for the Landfill

Date: 9/29/2023
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

H = 1.03 ft

Check to ensure that the above berm height is adequate:

L_1 = 103 ft
L_2 = 2.06 ft
A_s = 54.11 sf
V_c = 5,411 cf

V_c is larger than V_R; berm has adequate height.

3. Sloping water storage area:

Variables: S_o = 2.00 %, R = 5.9 in
A_{stor} = 0.25 ac, C = 0.5
A = 0.5 ac, W = 100 ft

Height: An iterative process is used to determine the height of the berm required to meet the storage volume requirement for a non-sloping storage area.

H = 1.44 ft

Check to ensure that the above berm height is adequate:

L_1 = 72 ft
L_2 = 2.88 ft
A_s = 53.91 sf
V_c = 5,391 cf

V_c is larger than V_R; berm has adequate height.

Containment Berm Calculation Summary

Drainage Area	Storage Area	Volume Required	Slope	Berm Height	Cross Sectional Area	Width	Water Surface Area	Volume Provided	L_1[1]	L_2[1]
(ac)	(ac)	(cf)	(%)	(ft)	(sf)	(ft)	(ac)	(cf)	(ft)	(ft)
0.5	0.25	5,354	0	0.49	---	---	---	---	---	---
			1	1.03	54.11	100	0.241	5411	103.0	2.06
			2	1.44	53.91	100	0.172	5391	72.0	2.88
1.0	0.50	10,709	0	0.49	---	---	---	---	---	---
			1	1.45	107.23	100	0.340	10723	145.0	2.9
			2	2.03	107.14	100	0.242	10714	101.5	4.06
2.0	1.00	21,417	0	0.49	---	---	---	---	---	---
			1	2.05	214	100	0.480	21433	205.0	4.1
			2	2.88	216	100	0.344	21565	144.0	5.76
4.0	2.00	42,834	0	0.49	---	---	---	---	---	---
			1	2.90	429	100	0.679	42891	290.0	5.8
			2	4.10	437	100	0.489	43706	205.0	8.2

CONTAINMENT / DIVERSION BERM CALCULATIONS

Client: City of Del Rio
Project: Major Permit Amendment
Description: Containment / Diversion Berm Calculations for the Landfill

Date: 9/29/2023
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Diversion Berm Calculations

The swales were analyzed by the Rational Method.

From Reference 2 for Val Verde County:

$Q = CIA$

C= 0.5 (intermediate cover)
I= 7.86 intensity, in/hr (see calculation below)
A= varies drainage area, ac

$$I = \frac{b}{(t_c + d)^e}$$

b= 124.19
d = 15.51
e = 0.8522

t_c is assumed to be 10 min. for all cases

I = 7.86 in/hr

Diversion Berm Flow Rate Summary

Area (ac)	Flow Rate (cfs)
0.5	2.0
1.0	3.9
1.5	5.9
2.0	7.9
2.5	9.8
3.0	11.8

CONTAINMENT / DIVERSION BERM CALCULATIONS

Client: City of Del Rio
Project: Major Permit Amendment
Description: Containment / Diversion Berm Calculations for the Landfill

Date: 9/29/2023
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

For 33H:1V Diversion Berm Area Slope

Drainage Area	Flow Rate (cfs)	Bottom Slope(ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width(ft)	Normal Depth(ft)	Flow Vel. (fps)	Froude Number	Velocity Head(ft)	Specific Enegry (ft)	Flow Area (sf)	Flow Top Width(ft)
0.5	2.0	0.01	0.03	2	33.0	0	0.29	1.36	0.630	0.03	0.32	1.47	10.14
1.0	3.9	0.01	0.03	2	33.0	0	0.37	1.61	0.660	0.04	0.41	2.43	13.03
1.5	5.9	0.01	0.03	2	33.0	0	0.43	1.78	0.670	0.05	0.48	3.31	15.22
2.0	7.9	0.01	0.03	2	33.0	0	0.49	1.92	0.690	0.06	0.54	4.12	16.98
2.5	9.8	0.01	0.03	2	33.0	0	0.53	2.02	0.700	0.06	0.59	4.84	18.41
3.0	11.8	0.01	0.03	2	33.0	0	0.56	2.12	0.700	0.07	0.63	5.57	19.74

Note: Calculations were performed using FlowMaster

For 3H:1V Diversion Berm Area Slope

Drainage Area	Flow Rate (cfs)	Bottom Slope(ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width(ft)	Normal Depth(ft)	Flow Vel. (fps)	Froude Number	Velocity Head(ft)	Specific Enegry (ft)	Flow Area (sf)	Flow Top Width(ft)
0.5	2.0	0.01	0.03	2	3	0	0.61	2.14	0.680	0.07	0.68	0.94	3.06
1.0	3.9	0.01	0.03	2	3	0	0.79	2.53	0.710	0.10	0.89	1.54	3.93
1.5	5.9	0.01	0.03	2	3	0	0.92	2.80	0.730	0.12	1.04	2.11	4.59
2.0	7.9	0.01	0.03	2	3	0	1.02	3.01	0.740	0.14	1.17	2.62	5.12
2.5	9.8	0.01	0.03	2	3	0	1.11	3.18	0.750	0.16	1.27	3.08	5.55
3.0	11.8	0.01	0.03	2	3	0	1.19	3.33	0.760	0.17	1.36	3.54	5.95

Note: Calculations were performed using FlowMaster

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN

APPENDIX IIID
LINER QUALITY CONTROL PLAN

Prepared for
City of Del Rio

September 2023



Prepared by
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This document is intended for permitting purposes only.

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1.0 INTRODUCTION

1.1 General

This Liner Quality Control Plan (LQCP) is prepared to fulfill the requirements of Title 30 Texas Administrative Code (30 TAC) Chapter 330, Subchapter H, relating to Liner System Design and Operation. This document presents the 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 Rules (MSWR). More specifically, the LQCP addresses the soil and geosynthetic components of the liner system. The provisions of this LQCP were developed based on the latest technical guidelines of the TCEQ, including quality control of construction, testing frequencies and procedures, and quality assurance of sampling and testing procedures.

The LQCP shall be used in conjunction with the Site Development Plan Appendices and final construction drawings and specifications. The 24-inch clay/soil liner will be constructed in the new cells with drainage geocomposte leachate collection system layer. The overliner will be constructed in the portion of the pre-Subtitle D area and will consist of a geosynthetic clay liner, a 40-mill LLDPE texture geomembrane and drainage geocomposite leachate collection layer. The LQCP address the following:

- Construction Quality Assurance for Earthwork
- Construction Quality Assurance for Geosynthetics
- Construction Quality Assurance for Leachate Drainage Aggregates and Piping
- Geotechnical Strength Testing Requirements
- Documentation

1.2 Definitions

This section provides the definitions for terms used in this LQCP.

- **ASTM –** The American Society for Testing and Materials
- **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. 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 Professional of Record (POR) –** The POR is an authorized representative of the Owner and has overall responsibility for construction quality assurance that confirms that the facility was constructed in accordance with plans and specifications approved by the permitting agency. The POR must be registered as a Professional Engineer in Texas and experienced in geotechnical testing and its interpretations. Experience and education must 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. POR or his designated representative will be on-site during all liner 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).
- **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 onsite tests and observations. The CQA monitor is on site full-time during construction and reports directly to the POR. The CQA monitor performing daily QA/QC observation and testing will be NICET-certified in geotechnical engineering technology at level II or higher for soils testing; a CQA monitor with a minimum of four years of directly related experience; a CQA monitor with 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 with one year of directly related experience. 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 direction of a qualified CQA monitor who is onsite full-time.
- **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.
- **Design Engineer –** 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 –** A construction activity involving the use of soil materials as defined in the construction 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.
- **Geocomposite –** A composition/combination of two or more geosynthetic materials used to perform drainage applications that need filtration to keep silt and soil particles from clogging flow.
- **Geomembrane Liner (GM) –** A synthetic lining material, also referred to as geomembrane, membrane liner, or sheet. The term Flexible Membrane Liner (FML) is also used for GM. A 40-mil-thick linear low-density polyethylene (LLDPE) geomembrane is used for the overliner.
- **Geomembrane Liner Evaluation Report (GLER) –** Certification report for the geomembrane liner, prepared and sealed by the POR that is submitted to the TCEQ for approval.

- **Geosynthetic Clay Liner (GCL) –** A synthetic lining material, which in the most basic form consist of bentonite sandwiched between two geotextiles.
- **Geosynthetic Clay Liner Evaluation Report (GCLER) –** Certification report for the geosynthetic clay liner, prepared and sealed by the POR that is submitted to the TCEQ for approval.
- **Geosynthetics Contractor –** 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 geotextile, even if not his primary function.
- **Geotextile –** A permeable fabric which, when used in association with soil, can separate, filter, reinforce, protect, or drain.
- **Independent Testing Laboratory –** A laboratory that is independent of ownership or control by the permittee or any party to the construction of the liner system or the manufacturer of the liner system 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 –** A deficiency in characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate. Examples of non-conformances include, but are not limited to, physical defects, test failures, and inadequate documentation.
- **Operator –** The organization that will operate the disposal unit.
- **Organics –** Material that may be capable of decay (e.g., plant material), the product of decay, or both.
- **Permittee's Representative –** The person that is an official representative of the permittee responsible for planning, organizing, and controlling the design and construction activities.
- **Panel** – This is a unit area of the geotextile, which will be seamed in the field.
- **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.
- **Soil Liner Evaluation** Report (SLER) – Construction report for the soil liner prepared and sealed by the POR and submitted to the TCEQ.

2.0 Earthwork Construction Quality Assurance

2.1 General

The general construction procedures to be used for in the soil liner, overliner and various earthwork components within the landfill are described in this section. In addition, this section outlines the LQCP program to be implemented regarding materials selection and evaluation, laboratory test requirements, field test requirements, and treatment of problems.

The scope of earthwork and related construction quality assurance includes the following elements:

- Subgrade preparation
- Soil liner stockpile
- Soil liner placement
- Anchor trench backfill
- General fill

2.2 Subgrades

Subgrade refers to a surface which is exposed after stripping topsoil or excavating to establish the grade directly beneath the clay liner. The prepared subgrade must conform to the Excavation Plan included in Appendix IIIA - Landfill Unit Design Information. The groundwater is below the elevation of deepest excavations. No ground water will be encountered during cell construction.

2.2.1 Soil Liner

Prior to beginning liner construction, the subgrade area will be stripped to a depth sufficient to remove all loose surface soils or soft zones within the exposed excavation. The liner subgrade area will be proof rolled with heavy, rubber-tired construction equipment to detect unstable areas. Unstable areas will be undercut to firm material and refilled with suitable compacted general fill. Soil used for backfill will meet the same material requirements as the soil liner and will be installed in accordance with the soil liner installation procedures. The fill will be free of organic matter, foreign objects, and other deleterious matter, and compacted sufficiently to provide a firm base for liner placement. The subgrade will also be scarified a minimum of 6 inches prior to placement of the first lift of clay liner. The subgrade preparation specifications for each liner construction event will be developed in accordance with this section. Construction project specifications and construction plans will be developed for each cell construction event in accordance with this LQCP and consistent with the Excavation Plan (Drawing A.1 included in Appendix IIIA) and the sector design as contained in the approved Site Development Plan.

Subgrade voids and cracks are expected to be minor. However, the subgrade will be re-worked as necessary to provide a foundation suitable for soil liner placement. Visual examination of the subgrade preparation by the CQA monitor will generally be sufficient to evaluate its suitability as a foundation for the subgrade. The CQA monitor may find that physical testing is necessary to evaluate the prepared subgrade or fill placed in large voids.

The POR will approve the prepared subgrade prior to the placement of soil liner or structural fill. Approval will be based on a review of test information, if applicable, and CQA monitoring of the subgrade

preparation. Additionally, during the subgrade acceptance, the POR will verify that the underlying material is consistent with the geotechnical design assumptions included in Appendix IIIL.

Surveying will be performed to verify that the finished subgrade is to the lines and grades specified in design with a vertical tolerance of 0.0 feet to +0.2 feet to ensure that the clay liner will achieve a 2-foot minimum thickness. The surface slope of the top layer of clay liner will conform to the slope requirements of the leachate collection layer.

2.2.2 Overliner

The GCL subgrade prepared using the existing cover soil will have to be verified to have a minimum of 12 inches finished thickness. The existing soil final cover, where it exists, will be stripped to leave at least 12 inches of soil for GCL subgrade. As an alternative to verifying the thickness of existing cover soils, a 12-inch-thick soil layer may be placed as a single layer to establish GCL subgrade. The GCL subgrade will have elevations, slopes, thickness, and widths as depicted on the overliner plan and details in Appendix IIIA - Landfill Unit Design Information. Refer to Section 3.3.1 for GCL subgrade preparation.

The GCL subgrade construction and testing will be conducted in a systematic and timely fashion. Delays will be avoided in overliner construction. Construction and testing of the overliner will generally not exceed 60 working days from beginning of GCL installation to completion of placement of protective cover. The TCEQ will be notified during construction if delays in excess of 60 days are anticipated. Reasons for overliner construction taking more than 60 days to complete will be fully explained in the GCLER submittal.

The existing soil intermediate cover will be reworked to include at least 12 inches of soil for GCL subgrade. The finished surface of the GCL subgrade must be rolled with a smooth, steel-wheeled roller to obtain a hard, uniform, and smooth surface. The surface of the GCL subgrade will then be inspected by the CQA monitor. All undesired materials will be removed from the GCL subgrade surface, and any voids created by removing undesired materials will be backfilled with subgrade material to the density specifications outlined for overliner construction and tested at the discretion of the CQA monitor.

Surveying will be performed to verify that the finished GCL subgrade layer has been constructed to a minimum thickness of 12 inches. Thickness verification may be performed by using settlement plates. The thickness verification locations will be established by a Texas registered surveyor or professional engineer on a 100-foot grid. The shaft extending upward from the base will be marked to indicate the minimum required thickness of the GCL subgrade. The GCL subgrade will be constructed to the minimum thickness marked on the shaft of the settlement plate. The POR and CQA monitor will verify that the GCL subgrade is placed uniformly between each settlement plate.

A GCL subgrade thickness drawing at each of the survey measurement grid points will be provided. Coordinates defining the perimeter of the overliner geomembrane subgrade will be called out on one of the final drawings. The GCL subgrade thickness drawing will be sealed by a Texas registered surveyor or professional engineer. After the construction of the GCL subgrade is complete, the Texas registered surveyor will survey the final elevation of the subgrade. The certification drawings will be included in the GCLER. The surveying will verify that the GCL subgrade slopes are consistent with the approved top of overliner plan. A statement that confirms that the as-built slopes are consistent with the approved top of overliner plan will be included in the GCLER.

Once the survey is complete, the settlement plate shaft will be removed and the resulting hole will be backfilled with bentonite or a bentonite/soil mixture consisting of at least 20 percent bentonite and compacted by hand tamping.

The POR will incorporate the subgrade-related information into the GCLER.

2.3 Soil/Clay Liner

The soil liner will consist of a minimum 2-foot-thick compacted clay liner (measured perpendicular to the subgrade surface) that will extend along the floor and side slopes of the landfill. The soil liner will be constructed in continuous, single, compacted lifts (6 inches thick) parallel to the floor and sideslope subgrades. Details depicting the liner system are included in Appendix IIIA - Landfill Unit Design Information.

2.3.1 Borrow Source Material

Adequate clayey soil liner material will be available from proposed landfill excavations and/or onsite or offsite borrow sources. The liner soil will be free of debris, rock greater than 1 inch in diameter, vegetative matter, frozen materials, foreign objects, and organics. Laboratory tests will verify that materials are adequate to meet the compacted clay liner requirements listed in §330.339(c)(5) prior to liner construction.

Table 2-1 Clay Liner Requirements

Soil Property	Specifications[1]
Plasticity Index (PI)	≥ 15
Liquid Limit (LL)	≥ 30
Percent Passing No. 200 Mesh Sieve	≥ 30%
Percent Passing 1-inch Sieve	=100%
Permeability	≤ 1x 10^{-7} cm/s

1. Testing will be performed in accordance with the test methods included in Section 2.4

Representative preliminary sampling and testing will be performed on stockpiled soils to be used as liner material or on off-site borrow source material. Prior to construction of each new cell, conformance tests that include USCS classification, liquid limit, plastic limit, percent passing the No. 200 sieve, Standard Proctor (ASTM D 698) compaction test, and coefficient of permeability test will be performed for each material proposed for each individual liner construction. The coefficient of permeability test specimens will be prepared by laboratory compaction to a dry density of approximately 95 percent of the Standard Proctor maximum dry density at or above the optimum moisture content. One Proctor moisture-density relationship and remolded coefficient of permeability test will be required for each different material. The soil is considered as a separate soil borrow source if the liquid limit or plasticity index is determined to vary by more than 10 points. Additional conformance tests will be conducted if there are visual changes (color, texture, etc.) in borrow material or as determined necessary by the POR. The liquid limit and plastic limit testing will be performed on the separate borrow source as an initial determination. If the liquid limit or plasticity index varies by more than 10 points, then all other testing listed in Table 2-1 will be performed on the separate borrow source.

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.

The physical characteristics of the liner materials will be evaluated through visual observation before and during construction. To adjust moisture of the material properly, any clod sizes will first be crushed into manageable sizes of 4 inches in diameter or less. Rocks and clods within the compacted liner must be less than 1 inch in diameter. Soil clod size will be reduced to the smallest size necessary to achieve the coefficient of permeability reported by the testing laboratory. Additionally, the rock content of the clay liner will not be more than 10 percent by weight. Water used for the clay liner moisture adjustment must be clean and not contaminated by waste or any objectionable material. Stormwater collected onsite may be used if it has not come into contact with solid waste.

2.3.2 Clay Liner Installation

The clay liner material will be placed in maximum 8-inch-thick loose lifts to produce compacted lift thickness of approximately 6 inches. The clay liner will have elevations, slopes, thickness, and widths as depicted on Drawing A.1 - Excavation Plan, and Drawings A.3 and A.4 - Liner System Details in Appendix IIIA - Landfill Unit Design Information.

The liner material will be compacted to a minimum of 95 percent of the maximum dry density at or above the optimum moisture content as determined by Standard Proctor (ASTM D 698). The compaction of the clay liner will be verified by a third-party independent laboratory to result in a coefficient of permeability of $1x10^{-7}$ cm/s or less. The POR will perform strength testing for clay (internal/interface) at the highest established moisture content and reduce the allowable highest moisture content if necessary.

The clay liner must be compacted with a pad/tamping-foot (preferable) 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. Use of pad/tamping-foot or prong-foot rollers will provide sufficient roughening of liner lifts 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 (in no case ground pressure should be less than 1,500 lbs per linear foot for each drum or wheel length), and a minimum of four passes are recommended for the compaction process. A pass is defined as one pass (1 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 clay liner will not be compacted with a bulldozer or any track-mobilized equipment unless it is used to pull a pad-footed drum which is at a minimum 1,500 lbs per linear foot of drum length.

During the construction of continuous liners, the new liner segment will not be constructed by "butting" the entire thickness of the new liner directly against the edge of the old liner. The tie-in will be constructed by a stair-step method. The edge of the old section of liner is cut back on off-set layers (stair-step) so that each unit thickness of the existing liner edge is tied to new construction without superimposed construction joints. The length of the tie-in area should be at least 5 feet per foot thickness of liner. The tie-in will be scarified prior to placement of the next lift.

CQA testing of the clay liner will be performed as the liner is being constructed (refer to Section 2.4). Sections of compacted clay liner which do not pass both the density and moisture requirements will be reworked with additional passes of the compactor until the section in question passes. All field density and moisture test results will be incorporated in the SLER. Each lift of the reconstructed liner area will be tested for hydraulic conductivity. Reconstruction activities, including additional testing and surveying, will be incorporated into the SLER.

The finished surface of the final lift of clay liner must be rolled with a smooth, steel-wheeled roller to obtain a hard, uniform, and smooth surface. The surface of the final lift of clay liner will then be inspected by the CQA monitor. All undesired materials will be removed from the liner surface, and any voids created by removing undesired materials will be backfilled with liner material to the density specifications outlined for liner construction and tested at the discretion of the CQA monitor.

The clay liner will be prevented from losing moisture during the construction and SLER approval process. Optimum soil moisture must be maintained at all times during construction. If any of lifts including the final lift dries and cracks, the entire area affected must be scarified, moisture adjusted, recompacted, and retested for compliance. Preserving the moisture content of the installed clay liner will be dependent on the earthwork contractors means and methods and is subject to POR approval.

The surface of a constructed clay liner should be covered or otherwise protected within a period of six months to mitigate the effects of desiccation, surface erosion, and rutting due to traffic. Liner surfaces not covered within six months shall be checked by the clay liner evaluation report evaluator, who shall then submit a letter report on the findings to the executive director. Any required repairs shall be performed promptly. A new report shall be submitted on the new construction for all liners that need repair due to damage.

This LQCP has been developed in accordance with the TCEQ MSWR. The requirements for testing and evaluation of the clay liner during construction are included in this LQCP. The construction methods and test procedures documented in the SLER will be consistent with this LQCP and TCEQ regulations. The POR will submit to the TCEQ a SLER for approval of each clay liner area.

Upon completion of clay liner construction SLER markers will be installed to clearly indicate the limits of constructed and approve liner areas in accordance with Landfill Markers and Benchmark, Section 16 of the Site Operating Plan. SLER markers will be located so that they are not destroyed during operations. All markers must be replaced within 15 days of removal, destruction, or a determination that the markers do not meet regulatory requirements.

2.3.3 Construction Timing

Clay liner construction and testing will be conducted in a systematic and timely fashion on each lift. Delays will be avoided in liner construction. Construction and testing of the clay liner will generally not exceed 60 working days from beginning of liner installation to completion. The TCEQ will be notified during construction if delays more than 60 days are anticipated. Reasons for liner construction taking more than 60 days to complete will be fully explained in the SLER submittal.

2.3.4 Liner Protection

Constructed and tested liners for which a SLER has been submitted shall have sufficient surface-drainage controls to prevent the accumulation of both contaminated and non-contaminated water. Remove ponded water that accumulates on newly constructed liner surfaces promptly and appropriately. The surface of the completed soil liner must be kept moist prior to placement of geomembrane or other overlying materials to reduce shrinkage cracking, but saturation of these soils by ponding water is not an acceptable practice. Complete saturation of any portion of the liner and its protective cover compromises their structural integrity and increases the degree of shrinkage cracking in the event of drying.

2.4 Testing Requirements

2.4.1 Borrow Source Material

Quality assurance and quality control (QA/QC) testing for all borrow source material used to construct the clay component of the liner system must conform to the tests, test methods, and testing frequencies outlined in Table 2-2. Borrow source material must be retested for the requirements listed in Table 2-2 if there is a change in borrow source material.

Table 2-2 Standard Tests for Borrow Source Material

Type of Test	Standard Test Methods[1]	Minimum Frequency of Testing
Unified Soil Classification	ASTM D2487	One per soil type
Moisture/Density Relationship	ASTM D698 or D1557	
Sieve	ASTM D422 or D1140	
Atterberg Limits	ASTM D4318	
Coefficient of Permeability	ASTM D5084 or CoE EM1110-2-1906	One per Moisture/Density Relationship

1. The POR may propose equivalent or better tests.

A soil classification system, such as the United States Department of Agriculture Soil Classification System, American Association of State Highway and Transportation Officials system, and the Unified Soil Classification System may be used to determine whether there is a change in borrow source material.

The liquid limit (LL) and plasticity index (PI) of the soil may also be used to determine if there is a change in borrow source material. If either the LL or the PI varies by 10 or more points when compared against the appropriate moisture/density curve used for that soil borrow source, the soil is considered as a separate soil borrow source. Due to the high shrink/swell and desiccation cracking characteristics of high plasticity clays it is suggested that, where possible, the PI of clay liner soils be limited to be between 15 and 30.

2.4.2 Constructed Clay Liners

For CQA monitors with qualified professional experience in geotechnical engineering and/or engineering geology will perform field and laboratory tests in accordance with applicable standards specified in this LQCP. All quality control testing and evaluation of soil liners will be performed during construction of the liner and must be complete before placement of the leachate collection system, except for the testing required for the final constructed lift, verification of liner thickness, or cover material thickness. Standard operating and test procedures will be utilized per the POR's direction. Sampling from the constructed soil liner lifts will be performed in accordance with ASTM D 1587. The sampling holes (e.g., samples for

coefficient of permeability test) will be backfilled with bentonite or bentonite/liner soil material mixture. Prior written approval from the TCEQ via a permit modification will be obtained if any changes will be made to material requirements or procedures set forth on this LQCP.

2.4.2.1 Testing Frequency

Constructed liner sidewall and floor area developed as a separate segment (non-monolithically) must be considered as separately evaluated areas independent of each other for the purpose of calculating dimensions to determine the required number of samples. Those sidewall and floor areas constructed or excavated as a bowl (monolithically) may be added together for the determination of their testing frequency and locations. Backfill all holes dug or created during any sampling or testing with a mixture of at least 20 percent bentonite-enriched liner soil and compacted by hand tamping or filled with an approved bentonite grout.

The tests, test methods, and testing frequencies outlined in Table 2-3 must be used to perform QA/QC testing for constructed soil liners.

Table 2-3 Standard Tests for Constructed Clay Liner

Type of Test	Standard Test Methods[1]	Minimum Frequency of Testing[2]
Field Density	ASTM D1556, D2167, or D6938	One per 8,000 ft^2 per 6-inch parallel lift; one per 100 lineal ft per 12-inch sidewall horizontal lift
Sieve	ASTM D422 or D1140	One per 100,000 ft^2 per 6-inch parallel lift; one per 2,000 lineal ft per 12-inch sidewall horizontal lift
Atterberg Limits	ASTM D4318	
Permeability	ASTM D5084 or CoE EM1110-2-1906 (laboratory) Air Entry Permeameter (field)	
Thickness	Registered Surveyor or Professional Engineer	One per 5,000 ft^2 (parallel lifts); 50-ft cross sections (horizontal-lift sidewall liners)

1. The POR may propose equivalent or better tests.
2. A minimum of one test must be conducted for each lift, regardless of liner area or length.

Sidewall liner evaluations for lifts constructed parallel to the surface of the excavation will be evaluated by using the same criteria and rate of testing as for the bottom. Sidewall evaluations for lifts constructed horizontally may be evaluated at a frequency not to exceed 12 inches in thickness (i.e. 2 lifts). Sample locations for field density testing should not exceed 100 linear feet and should be located within the 4 feet closest to the protected wall.

The usual sampling practice for quality assurance laboratory testing of the constructed liner is to retrieve representative samples from the same sampling tube. The location of the sampling/testing is adjacent to a field density/moisture test for comparing field and laboratory results.

2.4.2.2 Field Densities and Moisture Content

All field densities and moisture contents must compare with these limits, and to the proper ASTM D698 or ASTM D1557 moisture/density curve for the corresponding soil borrow source in order to be considered passing:

- When using the Standard Proctor Test (ASTM D698), the dry density and moisture content of the compacted clay liner must be at least 95 percent of maximum dry density and at or above the optimum moisture content, respectively.
- When using the Modified Proctor Test (ASTM D1557) the dry density and moisture content of the compacted clay liner must be at least 90 percent of the maximum dry density and at or above a moisture content 1 percent dryer than optimum, respectively.
- For both compaction tests (ASTM D698 and D1557) the moisture content should not exceed a maximum value, which is governed by shear strength requirements and the need to minimize the possibility of rutting under construction equipment or desiccation cracking upon drying.

As an alternative to these as the acceptance criteria, the "line of optimums" (described by Benson et al [1991]) may be used as the basis in field control. Under this alternative procedure, 80 percent of the field densities must lie on or above the line optimums.

The line of optimums as described by Benson et al is essentially a line drawn through the points corresponding to the optimum moisture content/maximum dry density on the moisture/density relationship curves for the modified proctor test, the standard proctor test, and a third compaction test using a reduced energy from the standard proctor test. (It has been shown by Benson et al that compacted soil liners that have approximately 80 percent or more of the field density data points above, or wet, of the line of optimums have a significantly higher probability of achieving the 1 x 10-7 cm/sec permeability standard than liners constructed using the conventional percent compaction basis). If this procedure is used, those field density points that do not lie above the line of optimums must not be concentrated in any specific lift or section of fill.

Sections of compacted soil liner that do not pass both the density and moisture requirements must be reworked and retested until the section in question does pass. All field density test results must be reported in the SLER, whether they indicate passing or failing values. The frequency of testing differ for these two lift placement methods:

- Parallel Lifts—one test for each 8,000 ft^2 of surface area per lift (but no less than 3 density tests per 6 inch lift).
- Horizontal Lifts—one test for each 100 linear feet per each 12 inches of thickness

2.4.2.3 Thickness Verification

Thickness of constructed soil liners will be determined by instrument survey methods only. Surveying will be performed to verify that the finished top of liner grade is to the lines and grades specified in construction plans for a particular cell. There should be a minimum of one verification point per 5,000 ft^2 of surface area. If the area under evaluation is less than 5,000 ft^2, a minimum of two reference points are required for verification. Reference locations will be noted on a drawing of the area evaluated. All elevation calculations necessary for the thickness determination will be attached as part of the supporting documentation to the SLER including any necessary corrections for the true thickness measured perpendicularly to sidewalls. Cross-sections at approximately 100 feet spacing showing true liner thickness for sidewall liners that are constructed in horizontal lifts should be provided if appropriate. Top of clay liner surveying will be performed within a tolerance of 0.0 feet to +0.2 feet. The surface slope of the top layer will conform to the slope requirements of the leachate collection layer.

2.4.2.4 Material Strength Requirements

The geotechnical analysis is included in Appendix IIIL – Geotechnical Report and includes slope stability, foundation heave, and settlement analyses for the proposed excavation. Soil parameters used in the geotechnical analysis were obtained from subsurface investigations and geotechnical reports, as well as from geotechnical testing performed on soil samples recovered at the site. The POR will verify that the proposed liner material meets the minimum soil properties used in the geotechnical analysis included in Appendix IIIL prior to liner construction, as applicable. These soil properties include unit weight, moisture content, cohesion, friction angle, and consolidation strength parameters used in the slope stability and settlement analyses. The POR will verify that the underlying material below the liner is consistent with design assumptions. If the POR determines that the underlying material or borrow material is not consistent with design assumptions, the appropriate geotechnical analysis (e.g., slope stability) will be updated consistent with the procedures in Appendix IIIL. The updated analysis will be incorporated into the SLER.

2.5 Surface Water Removal

The excavation may encounter water from storm events. Clay liner will not be placed in standing water. The excavation area will therefore have a temporary sump area to collect water entering the excavation and be graded to allow drainage at planned areas. Portable pumps will be on site to dewater the sumps. Temporary earthen berms will be constructed to divert surface flow away from the excavation. Surface water that accumulates on the constructed liner or geosynthetics surface will be removed promptly after the end of a rainfall event. POR will inspect and approve the constructed area that received rainfall prior to placement of overlying liner system component. The criteria for approval of the finished surface of the soil liner for geocomposite placement will follow the requirements of Section 4.3.3. Surface water from the site will be discharged per the site's TPDES permit requirement.

2.6 General Fill/Structural Fill

General fill/structural fill material will be uncontaminated earthen fill. General fill material placed below the bottom liner (e.g., over-excavated areas within the liner construction area) will be placed in uniform lifts which do not exceed 8 inches in loose thickness similar to compacted clay liners that will be placed over the back-filled area. The fill placed below the liner will be compacted to at least 95 percent of Standard Proctor maximum dry density (ASTM D 698) at a moisture content range at or above the optimum moisture content when it is used for below liner grades. Structural fill material (e.g., perimeter berm construction) will be placed in uniform lifts which do not exceed 12 inches in loose thickness and will be compacted to at least 90 percent of Standard Proctor maximum dry density (ASTM D 698).

2.7 Protective Cover Requirements

Protective cover is required to be placed over the liner system and the installation and design requirements are summarized in Table 2-4. Full-time observation by the POR or representative is required during protective cover installation.

After the protective cover has been placed the protective cover layer placed over the compacted clay liner and overliner will be verified with survey procedures at a minimum of 1 survey point per 5,000 sf of constructed area by a registered surveyor or professional engineer with a minimum 2 reference points. If surveyor is a P.E., they will have experience in surveying and will provide a resume as appropriate. A P.E. can only sign the drawings if they conducted the surveying themselves. The survey results and method of surveying for the protective cover will be included in the SLER.

Table 2-4 Protective Cover Requirements

Topic	Installation and Design Requirements
Material	Earthen material not previously mixed with garbage, rubbish, or other solid waste. Material shall be free of organic matter, foreign objects, or other deleterious materials.
Permeability	Protective cover overlying a leachate collection and removal system (LCRS) in general must have permeabilities ≥ 1 x 10^{-4} cm/sec, or be provided with appropriate passageways for moisture, such as chimney drains, that allow leachate to readily drain to the LCRS
Protective Cover Thickness	• Thickness ≥ 24 inches for a liner system that includes a geosynthetic clay liner (GCL), a geomembrane, or both. • Thickness of ≥ 24 inches between clay liners and waste.
Installation General	• The protective cover does not require compaction under density-controlled construction procedures. • Place protective cover as soon as possible, typically after installation of the soil liner, GCL, geomembrane, and any overlying geosynthetics.
Installation over Geomembrane	• Place all soil materials over a geomembrane during the coolest part of the day. Deploy soil in "fingers" along the surface to control the amount of slack and minimize wrinkles and folds in the geomembrane. Deploy soil only up-slope on side slopes to minimize stress on the geomembrane. • Use clean protective cover (no rocks > 3/8 inch, no vegetation, and no other material that could damage the geomembrane). If the protective cover contains material > than 3/8-inch in size, place a layer of protective geotextile over the geomembrane's surface. • Place protective cover with light equipment (such as dozers with less than 5 psi contact pressure) while maintaining at least 12-inches of material between the dozer and the geomembrane
Maintenance	Wet the surface of the protective cover during dry periods to keep the liner moist and to prevent desiccation cracking.
CQA Monitor	• Verify that grade control is performed prior to work. • Verify that underlying geosynthetic installations are not damaged during placement operations or by survey grades controls. Mark damaged geosynthetics and verify that damaged is repaired. • Verify that cover soil for sideslopes is pushed from the toe up the slope. • Monitor haul road thickness over geosynthetic installations and verify that equipment hauling, and materials placement meet equipment specifications.

3.0 Geosynthetic Clay Liner (GCL) Construction Quality Assurance

3.1 General

GCL will be placed as a part of the overliner (reinforced GCL only) above a 12-inch-thick soil subgrade. The GCL: will be covered by the 40-mil geomembrane. After placement of the geomembrane, it will be covered with a minimum 24-inch-thick protective cover. A geotechnical analysis of the overliner system with a GCL is included in Appendix IIIL - Geotechnical Report. Material properties based on Geosynthetic Research Institute recommendations as described in GRI-GCL3 have been included in Table 3-1 - Required Testing for GCL Materials. The GCL used for the overliner will meet or exceed the required properties.

3.2 Material Requirements

1. A reinforced GCL which consists of bentonite encapsulated between two geotextiles, one nonwoven and one woven, which are needle punched together will be used for the entire overliner area. The GCL materials and its components will be tested in accordance with Table 3-1 by the supplier/GCL manufacturer and a third-party independent laboratory and will have the required values listed in Table 3-2. A certificate of analysis for each GCL panel will be submitted as part of the quality control documentation. The GCL permeability will be certified by the manufacturer and will be tested by an independent laboratory at frequencies included in Table 3-1. The manufacturer will provide recommended seaming procedures and supporting test (flow box or other suitable device). The manufacturer will provide documentation showing the GCL seams are no more permeable than the GCL itself at a confining pressure anticipated in the field. The minimum shear strength of hydrated GCL (reinforced) will meet the requirements set forth in Section 6. The nonwoven side of the GCL will be in contact with the geomembrane. Table 3-2 includes further details for the GCL material.

2. The GCL will be shipped in rolls, which are wrapped individually in relatively impermeable and opaque protective covers. GCL rolls will be offloaded with equipment that will not damage the GCL rolls. The roll may be stacked only as allowed by manufacturer's recommendations. The GCL rolls must be stored above ground (i.e., wooden pallets) and covered with a waterproof tarpaulin.

3. GCL testing will be performed by the manufacturer and a third-party independent laboratory. The POR will review the manufacturer's certification (quality control certificate) and verify that the GCL meets the values given in the plan or specifications for those tests listed in Table 3-1. Required quality control documentation will be submitted to the POR a minimum of 7 days prior to deployment of any GCL. Requirements for GCL materials are listed in Table 3-2.

4. The POR will perform verification testing as required by additional detailed construction specifications or as required by the POR.

3.3 GCL Installation

Installation of GCL will have continuous on-site monitoring during construction by the POR or his designated representative. 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 revised panel layout plan if the field conditions vary from the original plan layout.

3.3.1 Subgrade Preparation

The surface of subgrade for the GCL installation will be stable. It will be smooth and free of foreign and organic material, sharp objects, exposed soil or aggregate particles greater than 3/4 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 (e.g., proof rolling), as necessary. The thickness of the subgrade will be verified (i.e., 1-foot minimum thickness) with surveying procedures in accordance with Section 2.2.1.

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 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. The subgrade will be rolled with a smooth-drum compactor. Protrusions extending more than $^{3}/_{4}$ inches (or less if recommended by the manufacturer) from the base grade surface will be either removed or pushed into the surface with a smooth-drum compactor

3.3.2 Deployment

Equipment used to deploy GCL over soil must not cause excessive rutting of the GCL subgrade. 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 seams will be constructed overlapping their adjacent edges a minimum of 12 inches. GCL seams will be constructed per manufacturer's directions. The CQA monitor will verify that steps are taken to minimize the presence of loose soil or other debris within the overlap zone.

GCL on sideslopes must not be unrolled in a direction perpendicular to the direction of the slope. GCL should be anchored temporarily (e.g., sandbags) at the top of the slope and then unrolled working from the top of the slope so as to keep the material free of wrinkles and folds, and GCL should be anchored at the bottom of the slope.

Horizontal seams will only be allowed on the slopes under one of the following conditions:

- 2 feet of overlap with horizontal seams being staggered.
- 1 foot of overlap with the underlying panel having a 1-foot runout anchored with 6 inches of subgrade.

Manufacturer hydraulic conductivity testing of GCL seams must be performed by using a flow box or other suitable device per adjoining material and type. Hydraulic conductivity value must be equal to or less than the specified hydraulic conductivity value for the GCL ($5x10^{-9}$ cm/s).

The POR or his designated representative will observe the GCL as it is deployed for even bentonite distribution, thin spots, or other panel defects. Defects and the disposition of the defects (panel rejected, patch installed, etc.) will be recorded. 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 on the same day with an FML 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.
- Observe that broken needle pieces do not exist within needle-punched GCL.
- Observe that wind speed is less than 40 miles per hour unless a lower wind speed is recommended by the manufacturer. At a minimum, a hand-held anemometer will be used, and readings will be taken at least once a day during GCL deployment to verify that the wind speed is less than 40 miles per hour.

The POR will observe the GCL for premature hydration visually and by walking over the GCL to locate soft spots. GCL that has prematurely hydrated according to the specifications will be removed and replaced with new GCL. These observations will be documented in the GCLER.

3.3.3 GCL Anchor Trench

The GCL anchor trench will be left open to allow installation of FML. Temporary anchoring will be provided until the placement of FML by using sand bags as discussed in Section 3.3.2. Slightly rounded corners will be provided in anchor trenches where the GCL enters the trench so as to avoid sharp bends in the GCL. No loose soil (e.g., excessive water content) will be allowed to underlie the anchored components of the liner system. Backfilling of soil will be in accordance with Section 4.6.

3.3.4 Patching

Torn or otherwise damaged GCL (with no loss of bentonite from the GCL) must be patched with the same type of GCL. The GCL patch must extend at least 12 inches beyond the damaged area and must be bonded to the main GCL to avoid shifting during backfilling. If the GCL damage includes loss of bentonite, the patch must consist of full GCL extending at least 12 inches beyond the damaged area. Lapping procedures must be the same as specified for original laps of GCL panels.

3.4 GCL Protection

Protection of GCL will be verified from production to deployment using the procedures discussed in this section. The manufacturer will provide inspection reports demonstrating that needle-punched nonwoven geotextile were inspected using metal detectors for the presence of broken needles and were found to be needle free. GCL must be rolled by the manufacturer in a fashion to prevent collapse during transit. Rolls will be labeled and bagged in a packaging that is resistant to water.

Visual inspection of each GCL roll will be made during unloading to identify any packaging that has been damaged. Rolls with damaged packaging will be marked and set aside for further inspection. The packaging will be repaired, for acceptable GCL rolls, prior to being placed in storage. If necessary, the party responsible for unloading the GCL will contact the manufacturer prior to shipment to ascertain the suitability of the proposed unloading methods and equipment.

The GCL-installing contractor will be responsible for the storage of GCL material. A dedicated storage area will be selected at the job site or at an alternate offsite area per owner's direction. The selected area will be level, dry, and well drained. Rolls will be stored in a manner that prevents sliding or rolling from the stacks. Rolls should be stacked no higher than three rolls to protect the integrity of roll cores and ensure safe material handling. Stored GCL materials will be covered with a plastic sheet or tarpaulin until it is installed. The integrity and legibility of the labels will be preserved during storage.

Construction equipment (other than low contact pressure rubber-tired vehicles such as ATVs or golf carts) on the GCL will not be allowed. The CQA monitor will verify that small equipment such as generators is placed on scrap FML material (rub sheets). The protective cover will be placed (using low ground pressure equipment as discussed under Table 2-4) as soon as possible after installation of FML and drainage layer. Refer to Section 4.7 for equipment operating requirements over geosynthetic materials.

The CQA monitor will verify that GCL (or overlying geosynthetics) are not displaced or damaged while overlying materials are being placed.

3.5 Reporting

The POR will submit to the TCEQ a GCLER for approval of the GCL. Section 7 describes the documentation requirements.

Table 3-1 Required Testing for GCL Materials

Responsible Party	Material	Test	Test Method	Frequency of Test
Supplier or GCL Manufacturer	Bentonite[1]	Free Swell	ASTM D 5890	per 50 tons (minimum of 1 test for each construction event)
		Fluid Loss	ASTM D 5891	
	Geotextile	Mass/Unit Area	ASTM D 5261	per 25,000 sy
		Grab Tensile Strength	ASTM D 4632	
GCL Manufacturer	GCL Product	Clay Mass/Unit Area	ASTM D 5993	
		Bentonite Moisture Content	per 5,000 sy ASTM D 5993	
		Tensile Strength	ASTM D 6768	per 25,000 sy
		Peel Strength	ASTM D 6496	per 5,000 sy
		Permeability[2]	ASTM D 5887	per 30,000 sy
		Lap Joint Permeability	Flow box or other suitable device	per GCL adjoining material and lap type[3]
Third Party Laboratory (Conformance Testing)	GCL Product	Clay Mass/Unit Area	ASTM D 5993	per 100,000 sf
		Permeability	ASTM D 5887	
		Direct Shear[4]	ASTM D 6243	One per GCL/adjoining material type

1. Tests to be performed on bentonite before incorporation into GCL.
2. Report last 20 permeability values, ending on production date of supplied GCL.
3. May also be performed by independent laboratory as part of conformance testing.
4. Not applicable for slopes of 4 percent or flatter. Testing must be on material in hydrated states 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 the entire overliner area. The nonwoven side of the GCL will be in contact with the geomembrane. Refer to Appendix IIIL - Geotechnical Report for the stability analysis.

Table 3-2 Required Properties for Reinforced GCL Materials

Property	Required Values[1]
Free Swell (milliliters)	24 (minimum)
Fluid Loss (milliliters)	18 (maximum)
Bentonite Mass per Unit Area[2] (lb/sf)	0.75 (minimum)
Tensile Strength[3] (1b/in)	23 (minimum)
Peel Strength (lb/in)	2.1 (minimum)
GCL Permeability[4] (cm/s)	$5x10^{-9}$ (maximum)
Lab Joint Permeability[5,6] (cm/s)	$5x10^{-9}$ (maximum)

1. Manufacturer will demonstrate that the above listed values will be met prior to shipment in accordance with Table 3-1.
2. Bentonite mass per unit area of GCL must be reported at zero percent moisture content for the finished product.
3. Value is required for GCL and geotextile.
4. Permeability is listed for the finished product at a gradient of 1.0.
5. Minimum overlap is 6 inches. The values listed are minimum dry bentonite amount for 6 inches of overlap. Manufacturer specified value will be used if it is higher.
6. Manufacturer will provide certification that seams are no more permeable than the GCL material under similar normal stress conditions

4.0 GEOMEMBRANE CONSTRUCTION QUALITY ASSURANCE

4.1 General

The scope of geosynthetic related construction quality assurance includes the following elements:

- Overliner Geomembrane

  40-mil LLDPE – textured on both sides

- Geotextile
- Drainage Layer (0.25 inches thick)

  Doube-sided drainage geocomposite (bottom liner sideslopes and overliner)

  Single-sided drainage geocomposite (on bottom liner floor grades)

The overall goal of the geosynthetics quality assurance program is to assure that proper construction techniques and procedures are used, the geosynthetic contractor implements a quality control plan in accordance with this LQCP, and that the project is built in accordance with the project construction drawings and technical specifications that will be developed in accordance with this LQCP for each liner construction. 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. A GLER, prepared after project completion, will document that the constructed facility meets design intent and specifications outlined in this LQCP.

4.2 Geosynthetics Quality Assurance

A geomembrane is a component of the overliner. Proper geomembrane installation is a crucial work element, which greatly affects the performance of the liner systems. Construction quality control for the geomembrane installation will be performed by the geomembrane installation contractor. Construction quality assurance for the geomembrane installation will be performed by the POR to assure the geomembrane is constructed as specified in the design. Construction must be conducted in accordance with the procedures outlined in this LQCP. To monitor compliance, a quality assurance program will include the following:

- A review of the manufacturer's quality control testing
- Material conformance testing by an independent third-party laboratory
- Field and construction testing
- Construction monitoring

The manufacturer's quality control testing will include resin and geomembrane testing. The required tests for overliner material properties are included in Section 4.3.2.

Conformance testing refers to material testing performed by an independent third-party laboratory that takes place prior to material installation. Field and construction testing includes testing that occurs during geosynthetics installation.

Quality assurance testing will be conducted in accordance with this LQCP. Field testing will be observed by the CQA monitor. Documentation must meet the requirements of this LQCP.

4.3 Overliner Geomembrane

This section describes material types, handling, installation, and testing of overliner geomembrane. LLDPE geomembrane that is textured on both sides will be used for the overliner. The required tests for 40-mil LLDPE are summarized in Table 4-1. Required material properties for 40-mil LLDPE are included in Table 4-2.

Table 4-1 Required Testing for 40-mil-thick Textured (Both Sides) LLDPE Geomembrane

Test Category	Type of Test	Standard Test Methods	Frequency of Testing
Resin	Density	ASTM D 1505	Per 200,000 pounds and every resin lot
	Melt Flow Index	ASTM D 1238 (90/2.16 and 190/21.6)	
Resin/Compound Evaluation	Per manufacturer's quality control specifications	Per manufacturer's quality control	Per manufacturer's quality control specifications
Manufacturer's Quality Control	Testing per GRI Standard, GRI Test Method GM17 for 40 mil LLDPE		
Conformance Testing by 3rd Party Independent Laboratory	Thickness[1]	ASTM 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	
Destructive Seam Field Testing[2]	Shear & Peel	ASTM D 6392	Various for field, lab, and archive
Non-Destructive Seam Field Testing	Air Pressure	GRI GM6	All dual-track fusion weld seams
	Vacuum	ASTM D 5641	All non-air pressure tested seams when possible
	Other		Concurrence of TCEQ

1. Field thickness measurements for each panel must be conducted. Use ASTM 374/D 5994 and perform 1 series of measurements among the leading edge of each panel, with individual measurements no greater than 5 feet apart. No single measurement will be less then 15% below the required nominal thickness in order for the panel to be acceptable. As an alternative to field thickness measurements, the conformance thickness testing will be performed in a third party laboratory and the test frequency will be doubled.
2. Passing criteria for the geomembrane materials are listed in Table 4-2. Passing criteria for seams are listed in Section 4.3.5.

Table 4-2 Minimum Required Properties of 40-mil-thick Textured (Both Sides) LLDPE Geomembrane

Property	Standard Test Methods	Minimum Required Property[7]
Thickness, mils Minimum average Lowest individual reading Lowest individual of 8 of 10 readings	ASTM D 5199	 38 34 36
Density, g/cc (maximum)	ASTM D 1505/D 792	0.939
Asperity Height, mils	GRI GM12	16
Tensile Properties[1] Break Strength, lb/in Break Elongation, %	ASTM D 6693, Type IV	 60 250
Tear Resistance, lb	ASTM D 1004	22
Puncture Resistance, lb	ASTM D 4833	44
Break Resistance Strain, % (min)	ASTM D 5617	30
Carbon Black Content[2], %	ASTM D 1603	2.0 – 3.0
Carbon Black Dispersions[4] Category	ASTM D 5596	(See note 3)
Oxidative Induction Time (OIT),[6] minimum average Standard OIT, minutes or High Pressure OIT, minutes	ASTM D 3895 ASTM D 5885	100 400
Oven Aging at 85°C 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
UV Resistance[5] High Pressure OITs - % retained after 1600 hrs	GRI GM 11 ASTM D 5885	35
Seam Properties (4 out of 5 specimens, 5th specimen can be as low as 80% per GRI-GM19) Shear Strength, lb/in Peel Strength, lb/in	ASTM D 6392	60 50 (44, Extrusion Weld) & FTB

1. Machine direction (MD) and cross machine direction (XMD) average values will 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 will be 20 hr UV cycle at 752C 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. The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
7. Minimum required properties are based on GRI-GM13, except for the seam properties which are based on GRI-GM19. At the time of each liner construction event, an updated GRI-GM13 will be used if available.

4.3.1 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 or pallets does not damage the geomembrane.

- The geomembrane is stored in an acceptable location in accordance with the manufacturer's 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 outlined in this LQCP has been received and reviewed for compliance. This documentation will be included in the GLER.
- The geosynthetics receipt log form has been completed for materials received.

Damaged geomembrane will 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.

4.3.2 Conformance Testing

One geomembrane sample will be obtained for every resin lot of material supplied and for each 100,000 square feet of geomembrane. 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 5994 for textured geomembrane)
- Tensile properties (ASTM D 638/Type IV Specimen, ASTM D 6693 may be used upon approval by POR)

4.3.3 Geomembrane Installation

Surface Preparation.

Prior to any geomembrane installation, the GCL on which the geomembrane will be placed will be inspected by the CQA and geosynthetics contractor. The POR or CQA monitor must observe the following:

- All lines and grades for the GCL have been verified by the surveyor or accepted by the contractor for geosynthetic installation. The POR or representative, the owner, and geomembrane installer will certify and accept in writing the finished final lift of the GCL surface.
- The GCL has been prepared in accordance with the earthwork construction plans and specifications as outlined in Section 3.
- The GCL surface does not contain stones or other objects that could damage the geomembrane and underlying GCL. The surface of the GCL will be smooth and free of foreign and organic material, sharp objects, exposed soil or aggregate particles greater than ¾ inches (or less recommended by the geosynthetic manufacturer), 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.

- No standing water is present above the GCL.
- The geosynthetics contractor has 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 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 geomembrane is placed in direct and uniform contact with the underlying GCL.
- 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 (15 percent for textured) below the required nominal thickness.
- Observe the sheet surface as it is deployed and record all panel defects and repair of the defects (panel rejected, patch installed, extradite placed over the defect, etc.) on the repair sheet. All repairs must be made in accordance with the specifications as outlined in Section 4.3.5 and located on a repair drawing.
- Observe that support equipment is not allowed on the geomembrane during handling (see Section 4.7 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 (fog, dew, mist, or wind, etc.). In addition, geomembrane will not be placed when the air temperature is less than 41°F, or when standing water or frost is on the ground, unless this requirement is waived by the design engineer and TCEQ. 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 will 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 there are no horizontal seams on side slopes, and the textured material extends a minimum of approximately 5 feet out past the toe of the slope where textured geomembrane is used.

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 will 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 welders), must be tested, at a minimum, at daily start-up and at midday break, or any break that the seaming machine is stopped more than 30 minutes to determine if the equipment is functioning properly. The GLER will 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. 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 4.3.4 - Construction Testing. The CQA monitor must observe all 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 and GRI-GM19:

Hot Wedge: AD and AD-Brk>25%
Extrusion Fillet: AD1, AD2, AD-WLD (unless strength is achieved)

Additionally, there will 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 the 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. If, at any time, the CQA monitor believes that an owner 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 will 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 performed by placing additional geomembrane over the failed area or removing the failed area geomembrane weld and patching it with additional geomembrane per POR's direction. 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 all the heat-degraded extradite 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° and 104° Fahrenheit unless more stringent limits are required by the manufacturer.
- 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 will 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 specifications that will be developed in accordance with this section for each liner construction. Seams will be oriented parallel to the line of maximum slope with no horizontal seams on side slopes. In corners and odd-shaped geometric locations, the number of field seams will 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, all unseamed edges are anchored with sandbags or other approved device. Penetration anchors will not be used to secure the geomembrane.

4.3.4 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 document the date, time and location of seaming and testing, and to observe and document that testing was performed in compliance with this section 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, which 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 (i.e., dual-track fusion welds). Both ends of the air channel will 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 or 1/2 psi per mil of geomembrane thickness, whichever is greater. 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 that will be developed in accordance with this LQCP for each liner construction.
- Observe that the entire length of each seam is tested in accordance with the specifications outlined in this section.
- Observe all continuity testing and record results on the appropriate log.
- Observe that all testing is completed in accordance with the specifications outlined in this section.
- 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 all repairs are completed and tested in accordance with the project specifications outlined in this section and Section 4.3.5.

- Record all 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 intervals of at least one test per 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 performed for individual repairs (or additional seaming for the failed seams) of more than 10 feet of seaming. The CQA monitor must perform additional tests if he suspects a seam does not meet specification requirements outlined in this section. 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 will 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 Owner/Permittee 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, which 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. 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 Film Tear Bond (FTB) and the seam strength meets the required strength values for peel and shear given previously for trial seams under field seaming and below for 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 (i.e., greater than 1/8 inch) 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 will be identified by assigning an identifying letter to the initial destructive test sample number (e.g., 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 Owner/Permittee to archive. The laboratory sample will be shipped to the third-party laboratory for over-night delivery and next day 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. All 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 5 bonded seam shear strength tests and 5 peel adhesion tests (10 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). At least four of the 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 passing criteria listed below. Additionally, 4 out of 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 two out of compliance coupons cause the weld to fail. The third-party laboratory must provide test results within 24 hours, in writing or via telephone, to the CQA monitor. Certified test results are to be provided within 5 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 Geosynthetic Institute GRI Test Method 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 4 out of 5 test specimens (the 5th specimen can be as low as 80 percent of the listed values) for 40-mil textured LLDPE. Elongation measurements will be omitted for field testing.

- Shear strength (lb/in) 60
- Shear elongation at break (%) 50
- Peel strength (lb/in)50 (44, Extrusion Weld) & FTB
- Peel separation (%) 25

A passing extrusion or fusion welded seam will be achieved in peel when:

- Yield strength for 4 of 5 specimens (10 tests for dual-track welds) is not less than the above minimum peel strength value and the average of all 5 specimens is not less than the minimum value.
- No greater than 25 percent of the seam width peels (separates) at any point for 4 of 5 specimens (both inner and outer welds for dual-track welds).

A passing extrusion or fusion weld will be achieved in shear when:

- Yield strength for 4 of 5 specimens is not less than the above minimum shear strength value and the average for all 5 specimens is not less than the minimum value.
- Break strain for 4 out of 5 specimens is at least 50 percent.

4.3.5 Repairs

Any portion of the geomembrane with a detected flaw, which fails a nondestructive or destructive test, 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 overliner construction and consistent with application parts (e.g., material requirements, installation, testing, etc.) of Section 4.3 of this LQCP. 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 will 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 procedures include the following:

- 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 4.3.4 - Construction Testing

4.3.6 Wrinkles

During placement of cover materials over the geomembrane, temperature change or creep can cause wrinkles to develop in the geomembrane. 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.

4.3.7 Folded Material

All folded geomembrane must be removed. Remnant folds evident after deployment of the roll, which are due to manufacturing process, are acceptable.

4.3.8 Geomembrane Anchor Trench

The geomembrane anchor trench will be left open until seaming is completed. Expansion and contraction of the geomembrane will 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 will be filled in the morning when temperatures are coolest to reduce bridging of the geomembrane. The material used will meet the criteria outlined in Section 4.6.

4.3.9 Geomembrane Acceptance

The contractor retains all ownership and responsibility for the geomembrane until acceptance by the Owner/Permittee. 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 Owner/Permittee'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 GLER by TCEQ.

4.3.10 Bridging

Bridging must be removed.

4.4 Drainage Geocomposite — Geonet and Geotextile

A drainage geocomposite will be used for the liner and overliner LCS. The drainage geocomposite will meet the requirements set forth in Appendix IIIL - Geotechnical Report and Appendix IIIC - Leachate and Contaminated Water Management Plan of the Site Development Plan along with this LQCP.

4.4.1 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. All rolls which do not have proper manufacturer's documentation will also be stored at a separate location until all documentation has been received and approved.

4.4.2 Testing

The drainage geocomposite manufacturer (or supplier) will conduct quality control testing and certify that all materials delivered to the site comply with the specifications listed in Table 4-1. The minimum testing frequency will be one test sample per 100,000 square feet of geocomposite (or geonet/geotextile). See footnote 2 of Table 4-3 for testing frequency for transmissivity. The material certifications will be reviewed by the POR to verify that the geocomposite meets the values given in Table 4-2.

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, tear strength, puncture strength, permeability and AOS per the ASTM standards listed in Table 4-3. The finished geocomposite will be tested for peel adhesion and transmissivity (note that the geocomposite transmissivity tests need to be conducted by a third-party laboratory). The manufacturer's testing for drainage material is also summarized in Table 4-1. Additionally, material strength parameters (e.g., cohesion, friction angle) used for geotechnical analysis in Appendix IIIL - Geotechnical Report will be verified prior to construction using actual construction materials, and slope stability analysis will be updated as necessary based on site-specific material data, as discussed in Section 6.

Where optional procedures are noted in the test method, the specification requirements of this LQCP prevail. The CQA monitor will review all test results and will report any nonconformance to the POR and to the contractor.

4.4.3 Installation

Surface Preparation. Prior to drainage geocomposite installation, the CQA monitor will observe the following:

- All lines and grades have been verified by the surveyor (where required).
- The subgrade has been prepared in accordance with the earthwork specifications outlined in Section 2.
- The supporting surface does not contain stones that could damage the geocomposite or the geomembrane.

Drainage Geocomposite Placement. During placement, the CQA monitor must:

- Verify that single-sided geocomposite is placed on floor grades and double-sided geocomposite is placed on sideslopes with minimum required runouts.
- Observe the drainage geocomposite as it is deployed and record defects and disposition of the defects (panel rejected, patch installed, etc.). Repairs are to be made in accordance with the specifications outlined in Section 4.4.4.
- 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 drainage geocomposite, or engage in activities that could damage the drainage 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 drainage geocomposite).
- Verify that the drainage geocomposite remains free of contaminants such as soil, grease, fuel, etc.
- Observe that the drainage geocomposite is laid smooth and free of tension, stress, folds, wrinkles, or creases.
- Observe that equipment or geocomposite complies with Section 4.7.
- Observe that on slopes the drainage geocomposite is secured in the liner anchor trench and the material roll out method is consistent with TCEQ's guidelines or the manufacturers' specifications when rolled down the slope.
- Observe that adjacent rolls of drainage geocomposite are overlapped a minimum of six inches, tied, and seamed in accordance with the manufacturer's recommendations.
- Observe that tying is with plastic fasteners in accordance with the manufacturer's recommendations. In the absence of other specifications, the drainage geocomposite panels will be tied approximately every 5 feet along the roll length (edges) and every 1 foot along the roll width (ends).

- Observe that the geotextile component is overlapped and either heat bonded or sewn together.

Table 4-3 Geotextile and Drainage Geocomposite Required Testing and Properties

Responsible Party	Material	Test	Test Method	Required Property[4]
Manufacturer	Geotextile	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 80 sieve 157 lbs 56 lbs 309 lbs 0.2 cm/s
Third Party Laboratory		Transmissivity Strength	ASTM D 4716 ASTM D 5321	See Notes 2 and 3 See Table 7-1
Manufacturer		Peel Adhesion	ASTM D 7005	1.0 lb/in

1. The minimum testing frequency will be one test sample per 100,000 square feet. The drainage geocomposite is single-sided for the floor grades of the bottom liner.
2. Liner: As noted in Appendix IIIC, Appendices IIIC-A, the transmissivity of single-sided geocomposite will be measured at a gradient of 0.02 under normal pressure of 1,000, 10,000 and 18,285 (or higher) psf, boundary conditions consisting of soil/geocomposite/geomembrane with minimum seating time of 100 hours and will be performed for the first 100,000 square feet of liner constructions. For each additional 100,000 square feet of single-sided geocomposite placement area, one additional transmissivity test will be performed under the maximum normal stress (i.e., 18,285 psf) or higher with all the same assumptions as the first three tests. The minimum transmissivity will 6.25×10^{-4} m^2/s. The transmissivity of the double-sided geocomposite will be measured at a gradient of 0.33 under a minimum normal pressure of 1,000, 10,000 and 16,720 (or higher) psf, boundary conditions consisting of soil/geocomposite/geomembrane with a minimum seating time of 100 hours and will be performed for the first 100,000 square feet of liner construction. For each additional 100,000 square feet of double-sided geocomposite placement area, one additional transmissivity test will be performed under the maximum normal stress (I.e., 16,720 psf) or higher with all the same assumptions as the first three tests. The minimum transmissivity will be 5.51×10^{-5} m^2/s.
3. Overliner: As noted in Appendix IIIC, Appendix IIIC-A, the transmissivity of the overliner double-sided geocomposite will be measured at a minimum gradient of 0.01 under a minimum normal pressure of 1,000, 2,000 and 4,080 (or higher) psf, boundary conditions consisting of soil/geocomposite/geomembrane with minimum seating time of 100 hours and will be performed for the first 100,000 square feet of liner construction. The minimum transmissivity will be 7.40×10^{-4} m^2/s. For each additional 100,000 square feet of single-sided geocomposite placement area, one additional transmissivity test will be performed under the minimum normal stress of 4,080 psf with all the same assumptions as the first three tests.
4. Minimum required property values for the geotextile and drainage geocomposite transmissivity are based on calculations provided in Appendix IIIC-A and IIIC-B. 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.

4.4.4 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.

4.5 Geotextiles

Geotextiles will be used to prevent clogging of drainage materials. The main usage of geotextiles will be enveloping drainage stone used for chimney drains in the leachate collection system (LCS). Geotextiles for the LCS will meet the design requirements set forth in Appendix IIIC - Leachate and Contaminated Water Management Plan.

4.5.1 Delivery

During delivery the CQA monitor must observe the following:

- Equipment used to unload the rolls will not damage the geotextile.
- Rolls are wrapped in impermeable and opaque protection covers.
- Care is used when unloading the rolls.
- All documentation required by this LQCP and the specifications has been received and reviewed for compliance with this LQCP.
- Each roll is marked or tagged with the manufacturer's name, project identification, lot number, roll number, and roll dimensions.
- Materials are stored in a location that will protect the rolls from precipitation, mud, dirt, dust, puncture, cutting, or any other damaging or deleterious conditions.

Any damaged rolls must be rejected and removed from the site or stored at a location separate from accepted rolls, designated by the Operator. All rolls which do not have proper manufacturer's documentation must also be stored at a separate location until all documentation has been received and approved.

4.5.2 Testing

The geotextile manufacturer will conduct manufacturer quality control (MQC) testing and certify that the materials delivered to the site comply with project specifications outlined in this LQCP. The material certification will be reviewed by the POR and approved for the project prior to acceptance of any of the material. The MQC testing will include the following tests with at least one test for each 100,000 square feet of geotextile delivered.

- Grab tensile strength/elongation (ASTM D 4632)
- Puncture Strength (ASTM D 6241)

- Mass per unit area (ASTM D 5261)
- Thickness (ASTM D 5199)
- Puncture resistance (ASTM D 4833)
- Trapezoidal tear strength (ASTM D 4533)
- Hydraulic tests (ASTM D 4491)
- Apparent opening size (ASTM D 4751)

Where optional procedures are noted in the test method, the specification requirements of this LQCP prevail. The POR will review all test results and report any nonconformance.

4.5.3 Geotextile Installation

Surface Preparation. Prior to geotextile installation, the CQA monitor must observe the following:

- All lines and grades have been verified by the surveyor.
- The supporting surface does not contain stones that could damage the geotextile or the underlying geomembrane.
- There are no excessively soft areas that could result in damage to the geotextile, or other components of the liner system.
- Construction stakes and hubs have been removed.

Geotextile Placement. During geotextile placement, the CQA monitor must:

- Observe the geotextile as it is deployed and record all defects and disposition of the defects (panel rejected, patch installed, etc.). Repairs are to be made in accordance with the specifications outlined in Section 4.5.4.
- Observe that equipment used does not damage the geotextile by handling, equipment transit, leakage of hydrocarbons, or other means.
- Observe that people working on the geotextile do not smoke, wear shoes that could damage the geotextile, or engage in activities that could damage the geotextile.
- Observe that the geotextile is securely anchored in an anchor trench.
- Observe that the geotextiles are anchored to prevent movement by the wind.
- Observe that the panels are overlapped a minimum of six inches.
- Examine the geotextile after installation to ensure that no potentially harmful foreign objects are present.
- Observe that seams (where required) are continuously sewn or thermal bonded in accordance with the manufacturer's recommendations and the project specifications outlined in this LQCP.

The CQA monitor must inform both the contractor and POR if the above conditions are not met.

4.5.4 Repairs

Repair procedures include:

- Patching – used to repair large holes, tears, and large defects.
- Removal – used to replace areas with large defects where the preceding method is not appropriate.

Holes, tears, and defects must be repaired in the following manner. Soil or other material which may have penetrated the defect must be removed completely prior to repair. If located on a slope, the defect must be patched using the same type of geotextile and continuously seamed into place. Should any tear, hole, or defect exceed 30 percent of the width of the roll, the roll will be cut off and the defect removed, or the roll removed and replaced. If the defect is not located on a slope, the patch must be made using the same type of material seamed into place with a minimum of 24 inches overlap in all directions. Seams will be either thermal bonded or sewn in accordance with the manufacturer's recommendations.

4.6 Anchor Trench Backfill

The anchor trench backfill material for geocomposite anchoring will be uncontaminated earthen material and will be placed in uniform lifts which do not exceed 12 inches in loose thickness and will be compacted. In-place moisture/density tests will be performed at the discretion of the CQA monitor to evaluate the quality of the backfill. When testing is performed, the compaction will be at least 90 percent of standard Proctor maximum dry density (ASTM D698).

4.7 Equipment on Geosynthetic Materials

Construction equipment on the bottom liner and overliner systems will be minimized to reduce the potential for liner puncture. The CQA monitor will verify that small equipment such as generators are placed on scrap liner material (rub sheets) above geosynthetic materials in the liner system. Aggregate drainage layers and/or protective cover will be placed using low ground pressure equipment. The CQA monitor will verify that the geosynthetics are not displaced while the soil layers are being placed.

Unless otherwise specified by the POR, all lifts of protective soil material placed over geosynthetics will conform with the following guidelines.

Equipment Ground Pressure (psi)	Minimum Lift Thickness (in)
<5.0	12
5.1 - 8.0	18
8.1 - 16.0	24
>16.0	36

No equipment will be left running and unattended over the lined area.

4.8 Reporting

The POR will submit to the TCEQ a GLER for approval of the leachate collection system and protective cover. Section 7 describes the documentation.

5.0 LEACHING AGGREGATE AND PIPING

5.1 Introduction

This section describes CQA procedures for the installation of HDPE pipe for the leachate collection system used for the clay liner. This plan stresses careful documentation during the quality assurance process, from the selection of materials through installation.

The goal of the pipe quality assurance program is to assure that proper construction techniques and procedures are used, and that the project is built in accordance with the project construction drawings and specifications that will be developed in accordance with this LQCP for each liner construction. The following specifications apply to the leachate collection system piping:

- Minimum internal diameter = 5.845 inches for leachate collection pipe and nominal diameter of 18 inches for riser pipe
- Standard dimension ratio = 17
- Perforation hole diameter = 0.5 inches (if slotted pipe is used, standard slot width = 0.125 inches)
- Young's modulus for pipe material = 33,000 psi
- For LCS design/requirements regarding chemical resistance, refer to Appendix IIIC.

The quality assurance program is intended to identify and define problems that may occur during construction and to observe that these problems are corrected before construction is complete. A construction report, prepared after project completion, will document that the constructed facility meets design standards and specifications.

The coarse aggregate selected for placement around the leachate collection pipes used in the leachate collection system (LCS) for the compacted clay liner and overliner discussed in Section 3 and 4 will consist of normal (e.g., unit weight of 90 to 110 pcf) or lightweight (e.g., unit weight less than 70 pcf) materials that comply with the following criteria. The LCS aggregate will have a calcium carbonate content less than 15 percent. Either the J&L Testing method or the ASTM D 3042 method, modified to use a solution of hydrochloric acid having a pH of 5, can be used to determine calcium carbonate content. The drainage aggregate will meet the following gradation for ASTM D 448, size number 467.

Table 5-1 Leachate Drainage Aggregate Gradation

Sieve Size Square Opening	Percent Passing
2 inches	100
1 ½ inches	95 – 100
¾ inch	35 – 70
3/8 inch	10 – 30
No. 4 (3/16 inch)	0 – 5

However, if approved by the POR, coarse aggregates not complying with the size number 467 gradation may also be used if demonstrated to have a hydraulic conductivity of at least $1X10^{-2}$ cm/s and meet the filter gradation requirements given below (in no case will the maximum rock size be more than 2 inches) for the specific leachate collection pipe perforation design:

For circular holes in the leachate collection pipe:

$$\frac{85\ Percent\ Size\ of\ Filter\ Material}{Hole\ Diameter} > 1.7$$

For slots in the leachate collection pipe:

$$\frac{85\ Percent\ Size\ of\ Filter\ Material}{Slot\ Width} > 2.0$$

The coarse aggregate will be tested for gradation (ASTM D 448) at the supply source or from the on-site stockpile prior to acceptance. Gradation testing will be conducted at a minimum frequency of 1 test per 3,000 cubic yards of coarse aggregate or per liner construction event if less than 3,000 cubic yards of coarse aggregate is required for the specific construction. The aggregate will be free of organics, angular rocks, foreign objects, or other deleterious materials. The physical characteristics of the aggregate will be evaluated through visual observation and laboratory classification testing before construction and visual observation during construction. The coarse aggregate may be tested during construction at the discretion of the CQA monitor. Results obtained during the drainage aggregate testing will be included in the SLER.

5.2 Pipe and Fittings

5.2.1 General

Construction must be conducted in accordance with the project construction drawings and specifications for each liner constructed. Piping design and specifications are provided in Appendix IIIC - Leachate and Contaminated Water Management Plan. To monitor compliance, a quality assurance program will be implemented that includes: (1) a review of the manufacturer's quality control testing, (2) material conformance testing, and (3) construction monitoring. Conformance testing refers to testing by an independent third-party laboratory that will take place prior to material installation on materials delivered to the site.

5.2.2 Delivery

The CQA monitor will observe:

- That upon delivery, the pipe and pipe fittings are in compliance with the requirements of the construction specifications that will be developed in accordance with this LQCP for each liner construction.
- That a storage location is selected in which the pipe and pipe fittings are protected from excessive heat, cold, construction traffic, hazardous chemicals, and solvents. If the pipe and pipe fittings are stored at a location where other construction materials are present, the CQA monitor will assure that stacking or insertion of the other construction materials onto or into the pipe and pipe fitting is prohibited. The CQA monitor will periodically examine the storage area to observe that the pipe fittings are undamaged, and have been protected.
- That upon transporting pipe and fittings from the storage location to the construction site, the contractor will use pliable straps, slings, or rope to lift the pipe. Steel cables or chains will not be allowed to transport or lift the pipe.
- That the contractor will provide that a pipe greater than 20 feet in length will be lifted with at least two support points. The contractor will not drop, impact, or bump into the pipe,

particularly at the pipe ends. Pipe and fitting ends must be cleaned of all dirt, debris, oil, or any other contaminant which may prohibit making a sound joint.

The CQA monitor will document all activities associated with the handling and storage of this material in order to maintain compliance with this portion of the CQA plan.

5.2.3 Conformance Testing

Prior to the installation of pipe, the pipe manufacturer will provide to the Operator and the POR a quality control certificate for each lot or batch of pipe provided. The quality control certificate will be signed by a responsible party employed by the pipe manufacturer, such as the quality control manager. The quality control certificate and documentation will include:

- A description of the pipe delivered to the project, including but not limited to the strength classification, diameter, perforations, and production lot.
- Properties sheet including, at a minimum, all specified properties, measured using test methods indicated in the specifications that will be developed in accordance with this LQCP for each liner construction, or equivalent.
- A certification that property values given in the properties sheet are minimum values and are guaranteed by the pipe manufacturer.
- A list of quantities and descriptions of materials other than the base resin which comprise the pipe.
- The sampling procedure and results of testing for actual samples manufactured in the same lot as the pipe delivered to the project.

The CQA monitor will observe that:

- The property values certified by the pipe manufacturer meet all of the specifications that will be developed in accordance with this LQCP for each liner construction.
- The measurements of properties by the pipe manufacturer are properly documented and that the test methods used are acceptable.
- Verification that the quality control certificates have been provided at the specified frequency for all lots or batches of pipe, and that each certificate identifies the pipe lot/batch related to it.
- The certified properties meet the specifications that will be developed in accordance with this LQCP for each liner construction.

5.2.4 Pipe and Fitting Installation

Surface Preparation. Prior to pipe installation, the CQA monitor must observe the following:

- All lines and grades have been verified by the contractor and project surveyor.
- The pipe trenches are swept clean of any deleterious material which may damage the pipe or geomembrane or may clog the pipe.
- Pipe perforations for leachate collection system are drilled in the pipe outside of the drainage trench where the pipe is to be laid. The drill cuttings must be completely removed from the pipe prior to being placed in the drainage trench.

- Pipe perforations are to the correct size and spacing according to the project specifications that will be developed in accordance with this LQCP for each liner construction. Perforations can be either factory installed slots or factory predrilled holes or field drilled holes.

Pipe and Fitting Placement. During pipe and fitting installation, the CQA monitor will:

- Observe all pipe, pipe fittings, and joints as the pipe is being laid. The CQA monitor will observe that pipes and fittings are not broken, cracked, or otherwise damaged or unsatisfactory. Prior to fusing (if fusion welding is utilized), the pipe installer will provide for a fusion surface area which is clean and free of moisture, dust, dirt, debris of any kind, and foreign material.
- If fusion welding is utilized, verify welder credentials and that the procedure is consistent with the pipe manufacturer's recommendations.
- Observe that the pipe and fittings are being constructed in accordance with specifications that will be developed in accordance with this LQCP for each liner construction and accepted practices.
- Observe that the people and equipment utilized to install the pipe do not damage the pipe or any other component of the liner system.

6.0 GEOTECHNICAL STRENGTH TESTING REQUIREMENTS

This section of the LQCP addresses the geotechnical strength requirements for the pre-Subtitle D overliner system. Each component of the overliner system is subject to the material testing requirements outlined in Sections 2 through 5 of this LQCP, as applicable. Prior to each overliner construction event, the geotechnical testing outlined in Table 6-1 will be performed using actual materials to verify that the overliner meets the material strength requirements.

The testing outlined in Table 6-1 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 are met, or (2) provide an updated geotechnical analysis in the GLER that will be submitted to TCEQ after each liner construction event.

Table 6-1 Minimum Required Strength for Overliner Components

Overliner Interface Description	Peak Strength		Residual Strength	
	Adhesion (psf)	Friction Angle (degree)	Adhesion (psf)	Friction Angle (degree)
Overliner Protective Cover (Internal)	100	18	80	10
Overliner Protective Cover/Double-sided Geocomposite-Geotextile	100	18	80	14
Double-sided Geocomposite/Textured LLDPE Geomembrane	100	21	80	10
Textured LLDPE Geomembrane/Reinforced GCL Interface	100	18	80	10
Reinforced GCL (Internal)	100	24	80	11
Double-sided Geocomposite/Textured LLDPE Geomembrane	100	21	80	10

7.0 DOCUMENTATION

The quality assurance plan depends on thorough monitoring and documentation of all construction activities. Therefore, the POR and CQA monitor will document that all quality assurance requirements have been addressed and satisfied. Documentation will consist of daily recordkeeping, testing and installation reports, nonconformance reports (if necessary), progress reports, photographic records, and design and specification revisions. The appropriate documentation will be included in the SLER, GCLER, and GLER. Standard report forms will be provided by the POR prior to construction.

7.1 Preparation of SLER, GCLER, and GLER

The POR will submit to the TCEQ a SLER for review and acceptance for each soil liner portion. After construction of the geosynthetics portion of the liner, the POR will submit a GCLER and GLER to the TCEQ for review and acceptance. All of these reports will be approved by TCEQ prior to placement of solid waste over the specified constructed area.

Testing, evaluation, and submission of the SLER, GCLER, and GLERs for the liner system will be in accordance with this LQCP. The construction methods and test procedures documented in the SLERs, GCLERs, and GCLERs will be consistent with this LQCP, the TCEQ MSWR, and specifications outlined in this LQCP.

At a minimum, the SLER, GCLER, and GLER will contain:

- A summary of all construction activities.
- A summary of all laboratory and field test results.
- Sampling and testing location drawings.
- A description of significant construction problems and the resolution of these problems.
- As-built record drawings signed and sealed by a Texas registered surveyor or professional engineer. If surveyor is a P.E., they will have experience in surveying and will provide a resume as appropriate. A P.E. can only sign the drawings if they conducted the surveying themselves.
- A statement of compliance with the permit LQCP and construction plans.
- The reports will be signed and stamped by a professional engineer(s) licensed to practice in the state of Texas.

The as-built record drawings will accurately identify the constructed location of all work items, including the piping and anchor trenches. The POR will review and verify that as-built drawings are correct. As-built drawings will be included in the SLER, GCLER, and GLER as appropriate.

7.2 Reporting Requirements

The SLER, GCLER, and GLER will be signed and sealed by the POR and signed by the Site Manager and submitted in triplicate (including all attachments) to the MSW Permits Section of the Waste Permits Division of the TCEQ for review and acceptance. If the Executive Director provides no response, either written or verbal, within 14 days of receipt, the owner or operator may continue facility construction or operation. Any notice of deficiency received from the TCEQ will be promptly addressed and incorporated into the SLER/GCLER/GLER report. No solid waste will be placed over the constructed liner areas until the final acceptance is obtained from the TCEQ. Additionally, upon approval of this application if a new liner area is developed, prior to accepting any solid waste to the newly developed liner area, a pre-opening

inspection will be requested. The TCEQ staff will conduct a pre-opening inspection within 14 days of the request. If the TCEQ does not provide a written or verbal response 14 days after conducting the pre-opening inspection, the newly developed liner area will be considered acceptable for solid waste placement, given that the SLER, GCLER, and GLER for the area is also submitted to the TCEQ in accordance with this section.

Appendix A. Alternative Liner Approval

John Hall, *Chairman*
Pam Reed, *Commissioner*
Peggy Garner, *Commissioner*
Dan Pearson, *Executive Director*

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

March 28, 1995

Tina E. Hanson, P.E.
Chiang, Patel and Associates, Inc.
4100 Amon Carter Blvd.
Suite 104
Fort Worth, Texas 76155

Re: City of Del Rio Landfill
MSW Permit No. 207A

Dear Ms. Hanson:

On March 16, 1995, the Texas Natural Resource Conservation Commission (TNRCC) Municipal Solid Waste (MSW) Permits Section received a letter requesting approval of a leachate collection system (LCS) drainage layer and protective cover that differs from the system proposed in the permit modification approved on December 20, 1995. The City of Del Rio does not have a local aggregate source that can meet the criteria of 15% or less calcium carbonate. They are proposing the following two options:

> 1-foot thick 3/4" - 1 1/2" river run gravel drainage layer, free of fines and percent weight loss not to exceed 26 percent by J&L Test Designation S-105-89. An 8 ounce geotextile filter will be placed between the drainage layer and 1-foot thick onsite protective cover. Drainage chimneys (2'-6" wide) will be placed through the protective cover along the length of each leachate collection and header pipe.
>
> Alternate System-2'-3" thick layer of tire chips which will serve as the leachate drainage layer and protective cover. Waste will be placed directly on top of the tire chips. The tire chips are expected to compact to a 2-foot thick layer under landfill loading conditions.

TNRCC staff has reviewed the proposed alternatives and determined that the "Alternate System" consisting of a layer of tire chips is acceptable. Considering the semi-arid climate of Del Rio, the aggregate with a maximum of 26% weight loss as proposed is acceptable for the leachate drainage blanket. However, with clogging of leachate collection systems becoming a concern within the industry, it is recommended that all leachate collection pipes be enveloped in an aggregate that meets the 15% $CaCO_3$ criteria and a geotextile. This aggregate should also extend up through the

protective cover. To increase the probability of leachate reaching the LCS and reducing the effects of some clogging, it is recommended that the width of the chimneys be increased from the 2'-6" width currently specified. The above is only a suggested means of improving the reliability of the LCS, however the TNRCC will consider other options that would reduce the potential of clogging of the LCS.

If you have any questions concerning this letter, please contact Mark Dollins, P.E. at (512) 239-6675.

Sincerely,

Chris Macomb

Chris Macomb
Senior Director
Waste Divisions

cc: TNRCC Regional Office 13 - San Antonio

John Hall, *Chairman*
Pam Reed, *Commissioner*
Peggy Garner, *Commissioner*
Dan Pearson, *Executive Director*

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

February 8, 1995

Tina Hanson, P.E.
Chiang, Patel, and Associates, Inc.
4100 Amon Carter Blvd.
Ft. Worth, Texas 76155

Re: Del Rio Municipal Landfill
MSW Permit No. 207A

Dear Ms. Hanson:

Per your request to clarify the approval of the permit modification for the above referenced facility, the Texas Natural Resource Conservation Commission (TNRCC) Municipal Solid Waste (MSW) Permit Section staff has tabulated the various components of the permit modification and the approval dates. They are as follows:

Location Restrictions	November 10, 1994
Liner Design	December 20, 1994
SLQCP (Not Approved)*	December 29, 1994
Contaminated Water Plan	January 12, 1995
Methane Gas Plan	January 12, 1995
Closure Plan	January 12, 1995
Post-Closure Plan	January 12, 1995
Site Operating Plan	November 10, 1994
GWSAP +	January 19, 1995

* Date comments on SLQCP was mailed.
+ Request for suspension from ground-water monitoring approved.

If you have any questions concerning this letter, please contact Mark Dollins, P.E. at (512) 239-6675.

Sincerely,

Ronald R. Pedde, P.E.
Special Assistant
Office of Waste Management

cc: TNRCC Regional Office-San Antonio

John Hall, *Chairman*
Pam Reed, *Commissioner*
Peggy Garner, *Commissioner*
Dan Pearson, *Executive Director*

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

December 20, 1994

Carlos E. Martinez
Assistant City Manager
City of Del Rio
P.O. Box 4239
Del Rio, Texas 78841

Re: Del Rio Municipal Landfill
MSW Permit No. 207A
Alternate Liner Demonstration

Dear Mr. Martinez:

On August 1, 1994, the Texas Natural Resource Conservation Commission (TNRCC) Municipal Solid Waste (MSW) Permits Section received a request from the above referenced facility to use an alternate liner pursuant to 30 Texas Administrative Code (TAC) §330.202-Alternate Design. After reviewing the submitted response, the TNRCC MSW Permits Section returned comments to you in a letter dated November 7, 1994. On November 23, 1994, the TNRCC received a response to those comments. The TNRCC Permits Section staff has reviewed the responses and has determined that the proposed alternate liner design has been adequately demonstrated. This letter serves as approval for the proposed alternate liner design.

The City of Del Rio's proposal to eliminate groundwater monitoring is currently being reviewed by the TNRCC Groundwater Protection Section. Please be advised that this letter does not serve as an approval for the elimination of groundwater monitoring.

If you have any questions concerning this letter, please contact Mark Dollins, P.E. at (512) 239-6675.

Sincerely,

Mary B. Adrian, P.E.
Manager
Permits Section
Municipal Solid Waste Division

cc: TNRCC Regional Office -San Antonio 13

Tina E. Hanson, P.E.
Chiang, Patel and Associates, Inc.
4100 Amon Carter Blvd.
Suite 104
Ft. Worth, Texas 76155

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN

APPENDIX IIIE
CLOSURE PLAN

Prepared for
City of Del Rio

September 2023



Prepared by
STV Inc
TPBE Registration No. F-1741
1820 Regal Row, Suite 200
Dallas, TX 75235
214-638-0500

This document is intended for permitting purposes only.

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1.0 Introduction

This Final Closure Plan has been prepared for the City of Del Rio 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 IIIE-1.

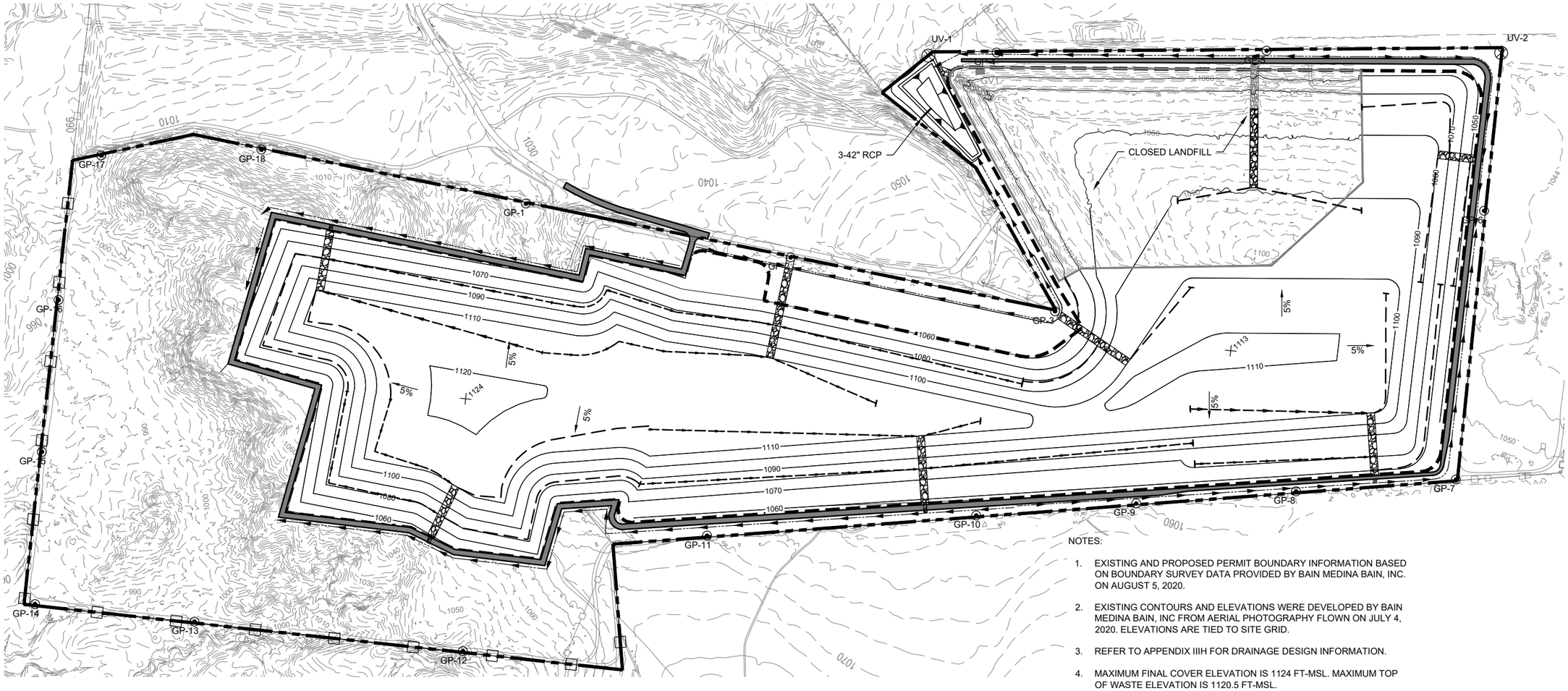
LEGEND

- PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- LIMIT OF WASTE
- 1090 FINAL COVER CONTOURS
- 1084 EXISTING CONTOURS
- SWALES
- EXISTING CHUTES
- PROPOSED CHUTES
- EXISTING SITE FENCE
- GV1 EXISTING GAS VENT
- GP-5 PROPOSED GAS PROBE
- UV-1 PROPOSED GAS VENTS

N

0 200 400

SCALE IN FEET



NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. ELEVATIONS ARE TIED TO SITE GRID.
3. REFER TO APPENDIX IIIH FOR DRAINAGE DESIGN INFORMATION.
4. MAXIMUM FINAL COVER ELEVATION IS 1124 FT-MSL. MAXIMUM TOP OF WASTE ELEVATION IS 1120.5 FT-MSL.
5. TYPICAL TOPSLOPE IS 5%. TYPICAL SIDESLOPES ARE 4H:1V EXCEPT IN THE AREA OF THE CLOSED PORTION OF THE LANDFILL IN WHICH THE SIDESLOPES ARE 5H:1V.

FOR PERMITTING PURPOSES ONLY

stv
TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

Del Rio TEXAS

STATE OF TEXAS
TEWOBISTA METAFERIA
123183
LICENSED
PROFESSIONAL
ENGINEER
09/30/2023

NO	REVISION	BY	DATE

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.

1" 0

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

LANDFILL CLOSURE PLAN

DESIGN:	T. METAFERIA
DRAWN:	T. METAFERIA
REVIEW:	B. HINDMAN
CP&Y:	DELR200302
CLIENT:	CITY OF DEL RIO

FIGURE
IIIE.1

PRINTED BY: TorresJJ DATE: 6/22/2023
FILE PATH: C:\pwworking\stv\pw_stv\jjohnson\d0942274\DELR200302 Figure IIIE.1.dwg

2.0 Final Cover System

2.1 Introduction

The final cover system for the City of Del Rio 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 a 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 recent 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 receipt of wastes). Such a system will include installation of a final cover system and a storm water runoff control system. The storm water runoff controls are addressed in Appendix IIIH – 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 cover system for both 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 IIIE-1, a maximum slope of 5 percent is provided for the top slopes. Side slopes of the final cover for all above-ground disposal areas are 4H:1V and will not exceed a 25% grade. The top and side slopes specified are sufficient grades to preclude ponding of surface water when total fill height and expected subsidence are taken into consideration.

Subtitle D Composite Final Cover System

- An erosion layer consisting of a earthen material 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, wildflowers, and other flowering plants capable of providing 90 percent coverage over the cover system. The erosion layer will be 12-in thick on the top slope and 24-in thick on the sideslopes.
- An 18-inch-thick compacted clay infiltration layer with a coefficient of permeability of less than or equal to $1x10^{-7}$ cm/s.

The low permeability component of the final cover system (the 18-inch-thick clay infiltration layer) is designed to minimize infiltration of surface water into the underlying waste material. Details of the final cover system are shown on Drawings A.6 and A.7 in Appendix IIIA-A. Material specifications, construction, and testing procedures are provided in Appendix IIIE-A Final Cover System Quality Control Plan.

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 IIIH – Surface Water Drainage Plan.

Landfill gas generated in the landfill will be managed as discussed in Appendix IIIM – Landfill Gas Management Plan. The landfill gas system will monitor the gas generated by deposited waste.

Similar to the proposed final cover areas, permanent final cover erosion control structures include swales and chutes that will be constructed on the existing final cover. The design of the final cover system erosion control structures is provided in Appendix IIIH-B. A soil loss and sheet flow velocity demonstration for the erosion layer is included in Appendix IIIH-D – Erosion Layer Evaluation.

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 presented in Appendix IIIE-A. Testing and evaluation of the final cover system during construction will be in accordance with Appendix IIIE-A.

3.0 Closure Procedures

3.1 Sequence of Final Cover Placement

The City of Del Rio Landfill may place final cover over the landfill unit throughout the active life of the landfill. The final cover placement procedure 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 27.4) 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.
- 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 final cover system will be constructed according to specifications.
- The top of the landfill will be regraded and reshaped as needed to provide the proper slope for positive drainage.
- As noted above (first bullet), a revised final closure plan will be developed and submitted to the TCEQ for approval.
- Following application of final cover, the site will be vegetated with appropriate grasses to minimize erosion. The established grasses will provide a minimum of 90 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 IIIG.1 and is 55.5 acres. Consistent with this rule and TCEQ guidelines for financial assurance to complete Closure and Post-closure activities, financial assurance will be posted for the 55.5-acre current active area as discussed in Appendix IIIG - Closure and Post-closure Care Cost Estimate. The entire 180.6-acre site will also need to be administratively closed.

Supporting calculations are presented in Appendix IIIG - Closure and Post-closure 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 35.02 million cubic yards. The site life calculations show that approximately 5,646,162 cubic yards of airspace, will remain on the approval of this amendment. Supporting calculations are included in Appendix IIIB – Site Life Calculations.

3.3 Leachate Management

The leachate piping and sump pumps will continue to operate throughout the active life of the site and post-closure period. Once the post-closure period has ended, the pumps will be decommissioned and disposed of at a permitted disposal facility or recycled per the City's choice. The remaining leachate will be transferred to a properly permitted off-site treatment or disposal facility.

4.0 SCHEDULE OF UNIT AND FACILITY FINAL CLOSURE

4.1 Landfill 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. The City of Del Rio will also make a copy of the approved final closure and post-closure plan available 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 post-closure care period begins immediately upon the date of final closure.

4.2 Provisions for Extending Closure Period

If the Del Rio 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 Del Rio Landfill has taken all steps necessary to prevent threats to human health and the environment.

Table 4-1 Landfill Closure Schedule

	30 DAYS	30 DAYS	30 DAYS	30 DAYS	30 DAYS	30 DAYS	30 DAYS	30 DAYS	30 DAYS	30 DAYS
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. Green 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.

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN

APPENDIX IIIE-A
FINAL COVER SYSTEM QUALITY CONTROL PLAN

Prepared for
City of Del Rio

September 2023



Prepared by
CP&Y Inc
TPBE Registration No. F-1741
1820 Regal Row, Suite 200
Dallas, TX 75235
214-638-0500

This document is intended for permitting purposes only.

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1.0 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 components of the final cover system.

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 onsite tests and observations. The CQA monitor is on site full-time during construction and reports directly to the POR. The CQA monitor performing daily QA/QC observation and testing will be NICET-certified in geotechnical

engineering technology at level two or higher for soils testing; a CQA monitor with a minimum of four years of directly related experience; or a graduate engineer or geologist with one year of directly related experience. Field observations, testing, or other activities associated with CQA may be performed by the CQA monitor(s) under the direction of the POR. Additional CQA monitors may be used. If working under the direction of a CQA monitor, the second CQA monitor will have a minimum of one year of directly related experience.

- **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. C
- **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.
- **Final Cover System Evaluation Report (FCSER)** – Upon completion of closure activities, the certification will be in the form of the FCSER which will be signed by the POR and include all the documentation necessary for certification
- **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 non-conformances 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.
- **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.
- **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.

2.0 SOIL INFILTRATION LAYER QUALITY ASSURANCE

2.1.1 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 regarding 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 Final Cover

The cover system includes an 18-inch-thick compacted clay infiltration layer, and 12-inch-thick erosion layer on the top slope and 24-inch-thick erosion layer on the side slopes that can sustain vegetative growth. 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

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 IIIE) at the time of each final cover 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.

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 compacted to prepare the working surface for the first lift of infiltration layer soil. The CQA monitor will visually inspect and approve the prepared intermediate cover prior to the placement of the soil infiltration layer or structural fill. Approval will be based on a review of test information, if applicable, and CQA monitoring of the intermediate cover preparation.

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.

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 points.

The 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 between the Standard Proctor optimum and 5 percentage points above optimum. 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 into manageable sizes of 1 inch in diameter or less. Rocks within the infiltration layer should be less than 1 inch in diameter and will not total more than 10 percent by weight.

Clod-size reduction, if necessary, may be achieved using a disc harrow or soil pulverizer. 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 onsite stormwater may be utilized if it has not come into contact with the solid 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 pass (1 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. 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 14 days). Reasons for any delays in infiltration layer construction (greater than 14 days) should be fully explained in the FCSER submittal.

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. 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.

Surveying will be performed to document that the finished soil infiltration layer has been constructed to a minimum thickness of 18 inches. Thickness verification may be performed by using settlement plates (e.g., plywood sheet or similar material) on a 100-foot grid. 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.

An infiltration layer thickness drawing at 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 (Drawing A.3 in Appendix IIIA-A). A statement that confirms that the as-built slopes are consistent with the approved landfill completion plan will be included in the FCSER.

Testing and evaluation of the soil infiltration layer during construction will be in accordance with this FCSQCP. The construction methods and test procedures documented in the FCSER will be consistent with the FCSQCP.

The soil infiltration layer will be prevented from losing moisture prior to placement of the erosion layer. Preserving the moisture content of the installed soil infiltration layer will be dependent on the earthwork contractors means and methods and is subject to POR approval.

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 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.

2.3.3 Structural Fill

Structural fill material (if necessary) 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) at a moisture content ranging from 2 percentage points below optimum to 3 percentage points above optimum (-2 to +3). Structural 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.

2.4 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 (e.g., sample for hydraulic conductivity) 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 4 describes the documentation requirements.

Table 2-1 Standard Tests on Infiltration Layer Soils

Soil Test Category	Type of Test	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 or D 1557	
	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[1]	1/8,000 SF per 6-inch lifts
	Grain Size	ASTM D 422 or D 1140	1/100,000 SF per 6-inch lifts[2]
	Atterberg Limits	ASTM D 4318	
	Coefficient of Permeability	ASMT D 5084 or CoE EM1110-2-1906	1/surface acre (evenly distributed through all lifts) [2,4]
	Thickness[3]	Texas Licensed Surveyor	1/10,000 SF

1. This method is not applicable if the field measuring device (i.e., nuclear gauge) also measures moisture.
2. A minimum of 1 of each of the designated tests must be conducted for each lift, regardless of cover area.
3. 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.
4. 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

3.0 EROSION LAYER QUALITY ASSURANCE

The erosion layer will consist of a minimum of 12 inches of earthen material on the top slope and 24 inches on the 4:1 side slopes 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 minimal compaction required for stability. Under no circumstances will the construction equipment come in direct contact with the infiltration layer. Equipment used to install the erosion layer must meet the requirement of Section 2.3.2.

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 licensed Texas 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 installations are not damaged during placement operations or by survey grade controls. Mark damaged infiltration layer and verify that damage is repaired.
- Monitor haul-road thickness over installed infiltration layer and verify that equipment hauling, and material placement meet equipment specifications. (See Section 2.3.2).
- 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 shown in Table 2-1.

4.0 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.

4.1 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.
- 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. The POR will review and verify that as-built drawings are correct. As-built drawings will be included in the FCSER.

4.2 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 IIIE-B TCEQ FORM 20720

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: **City of Del Rio Landfill**

MSW Permit No.: **207C**

Site Operator/Permittee Name: **City of Del Rio**

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
City of Del Rio Landfill	**Active**	**Subtitle D and Pre-subtitle D**	☐	☐	☐	**110.30**	**35,023,779**	**Waste = Waste plus Daily Cover**
			☐	☐	☐			
			☐	☐	☐			
			☐	☐	☐			
Totals						**110.30**	**35,023,779**	

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)
N/A			☐cubic yards ☐tons	
			☐cubic yards ☐tons	
			☐cubic yards ☐tons	
			☐cubic yards ☐tons	
Totals		enter total size of areas used for storage or processing or operation here	enter total maximum inventory of waste here	

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)	**35,023,779** ☒cubic yards or ☐tons
Maximum inventory of waste in storage or processing units or operations (total from Table 2)	**35,023,779** ☒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)	**35,023,779** ☒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-B	**B.2**	**Excavation Plan**	**Waste footprint, permit boundary, and dimensions of the landfill cells**
Part III, App. IIIA-B	**B.3**	**Completion Plan**	**Final cover plan, maximum elevations of waste and final cover of the landfill, waste footprint, permit boundary**

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)
City of Del Rio Landfill	**Low-permeability soil**	**The final cover is comprised of 18" low permeability ($1x10^{-5}$ cm/sec) soil infiltration layer and a 12" 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)
City of Del Rio Landfill	**1120.5**	**1124**	**5%**	**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)*:

The stormwater controls for the landfill have been designed consistent with the TCEQ regulations for Type I MSW landfills. The stormwater runon/runoff controls have been designed for a 25-year frequency storm event. These include drainage controls for the final cover, perimeter drainage channels, culverts, and detention ponds, including pond outfalls. Details for the perimeter drainage system and associated calculations are included in Appendix IIIH.

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 **N/A**, 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: **90**%. 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)
N/A						

E. Final Contour Map

Figure **IIIE.1**, 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.4 to 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
City of Del Rio Landfill	**55.5**	☒	☐	**Final cover has been placed over Cells 1 and 2.**
		☐	☐	

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
Figures B.4 to B.9 (Part III, App. IIIA-B)	**Varies**	**Cross Sections**
Figure IIIH-1	**Drainage Structure Plan**	
Figure IIIG-1	**Area Requiring Final Cover**	
Figure IIIE-1	**Final Cover Plan**	

C. Final Cover Quality Control Plan

A final cover quality control plan (FCQCP), Attachment **III E-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, Table 4-1, is attached as part of Appendix IIIE upfront text. 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).

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 **109 W Broadway, Del Rio, TX 78840** (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 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:

(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 **Table 4-1** included in the upfront text of Appendix IIIE, Landfill 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 **IIIE.1**, Final Contour Map.
- Figures **B.4 to B.9 (Part III, App. IIIA-B)**, Cross-Section Drawings of the Landfill Units at Closure.
- Figures **IIIE.1 & IIIH.1**, Final Cover and Drainage Features Installation Drawings.
- Other Drawings/Maps: Figures

B. Documents

- Attachment **IIIE-A** , Final Cover Quality Control Plan (FCQCP).
- Attachment **IIIE - Table 4-1** , Landfill Closure Schedule
- Other: Attachment

C. Additional Items Attached (enter as applicable)

VII. Professional Engineer's Statement, Seal, and Signature

Name: **Tewobista Metaferia**

Title: **Project Engineer**

Date: **September 29, 2023**

Company Name: **STV Inc.**

Firm Registration Number: **F-1741**

Professional Engineer's Seal



09/29/2023

Signature

Appendix IIIE-C CELLS 1 AND 2 CLOSURE APPROVAL

Bryan W. Shaw, Ph.D., *Chairman*
Carlos Rubinstein, *Commissioner*
Toby Baker, *Commissioner*
Zak Covar, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

June 28, 2013

Mr. Hector Canales, P.E.
Public Works Director
City of Del Rio
109 W. Broadway Street
Del Rio, Texas 78840-5502

Re: City of Del Rio Landfill – Val Verde County
Municipal Solid Waste - Permit No. 207A
Report - Final Cover System Evaluation Report (FCSER)
Tracking No. 17171718; RN102143294/CN602718405

Dear Mr. Canales:

On May 20, 2013, the Texas Commission on Environmental Quality received a FCSER for the referenced landfill. It consists of an evaluation of the construction of a final cover system over Cells 1, 2, and approximately half of the Pre-subtitle D landfill area, as indicated on Sheet C-01 (Appendix A) of the FCSER. The FCSER was prepared by Arias & Associates, and was signed and sealed by Mr. Rene P. Gonzales, P.E., as the Professional of Record, and by Mr. Hector Canales, P.E., as the permittee representative, on May 14, 2013. On behalf of the facility, the FCSER was submitted with a cover letter signed by Mr. Frank E. Pugsley, P.E., CP&Y, Dallas.

The FCSER is accepted as Mr. Gonzales, as the Professional of Record, is of the opinion that the constructed final cover system for the facility complies with the current Final Cover Quality Control Plan and the groundwater protection requirements contained in the State of Texas MSW Rules.

Please contact me at (512) 239-6727 if you have any questions concerning this matter. When addressing written correspondence, please use mail code MC 124.

Sincerely,

Chandra S Yadav, Project Manager
Municipal Solid Waste Permits Section
Waste Permits Division

CY/dp

cc: Mr. Rene P. Gonzales, P.E., Arias & Associates, San Antonio
Mr. Frank E. Pugsley, P.E., CP&Y, Dallas

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN

APPENDIX IIIF
POST-CLOSURE CARE PLAN

Prepared for
City of Del Rio

September 2023

Prepared by
STV Inc
TPBE Registration No. F-1741
1820 Regal Row, Suite 200
Dallas, TX 75235
214-638-0500



This document is intended for permitting purposes only.

Table of Contents

1.0 Introduction 1



1.0 Introduction

This Post-Closure Maintenance Plan (TCEQ Form 20722) has been prepared for the Del Rio 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 Post-Closure Maintenance 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 I/IIA.5 Landfill Completion Plan in Parts I/II.

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: **City of Del Rio Landfill**

MSW Permit No.: **207C**

Site Operator/Permittee Name: **City of Del Rio**

II. Party Responsible for Overseeing and Conducting Post Closure Care Activities

Name (Person or Office Responsible): **City of Del Rio Engineering Department**

Position or Title: **Landfill Coordinator**

Mailing Address: **1897 Railway Ave**

City: **Del Rio**

State: **Texas**

Zip Code: **78840**

Telephone Number: **(830) 703-5320**

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
Cells 1 & 2	**IIIA-B, Figure B.3**	**June 2013**	**July 2013**	**July 2043**

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	**Cells 3, 4, 5, and 6**	**IIIA-A, Figure A.1b**
Proposed to be Constructed	**Cells 7, 8 ,9, and 10**	
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	**Weekly and within 72-hours of a rainfall event of 0.5 inches or more.**	**Inspect for proper placement, thickness, compaction, slope, settlement and erosion. Maintenance will be ongoing throughout post-closure care period. Correct problems as needed.**
Vegetation	**Weekly and within 72-hours of a rainfall event of 0.5 inches or more.**	**Inspect for proper placement, thickness, compaction, slope, settlement and erosion. Maintenance will be ongoing throughout post-closure care period. Correct problems as needed.**
Leachate Management Systems	**Weekly for sump and monthly for caps**	**Measure depth of leachate in sump, as required and Inspect the caps and piping of the cleanout riser and sump riser of the leachate collection system to prevent potential odor escape.**
Landfill Gas Monitoring and Control Systems	**Quarterly**	**Samples of gas from probes installed at evenly spaced intervals not to exceed 1000 feet will be analyzed and checked against the allowable maximum of the LEL (lower explosive limit). Methane detection for on-site structures is also conducted in accordance with the Methane Detection Plan.**
Groundwater Monitoring Systems	**N/A**	**Site currently does not have a groundwater monitoring system.**
Drainage Structures	**Weekly and within 72-hours of a rainfall event of 0.5 inches or more.**	**Inspect perimeter channels and berms/dikes to verify that they are functioning as designed.**

Post-Closure Care Inspection Item	Frequency of Inspection	Types of Deficiency Conditions to be looked for during Inspection
Ponding of Water	**Weekly and within 72-hours of a rainfall event of 0.5 inches or more.**	**Inspect site for ponded water areas. Correct problems as needed.**
Other:		

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	**Quarterly**	**Update site Operating Record within seven days of quarterly inspection.**
Other:		

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	Conduct maintenance and/or remediation activities, as 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 90 percent coverage.
Settlement	Areas of excessive settlement
Subsidence	Areas of excessive subsident (localized settlement sufficient to pond water or disrupt drainage features
Ponded Water	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	Surface erosion damage of finally cover and reviewing conditions that may be contributing to erosion
Other (enter other events or failures detrimental to the integrity and effectiveness of the final cover):	
Other (enter other events or failures detrimental to the integrity and effectiveness of the final cover):	

(b) ***Drainage Control System Inspection***

Inspection Frequency: **Semiannually**

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, or excess
Wash Outs	Washouts on sideslope swale
Sediment Build Up	Sediment deposition sufficient to pond water or reverse or impede drainage in sideslope swale 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

(c) ***Access and Rights-of-Way***

Inspection Frequency: **Weekly**

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	Inspect perimeter gates for damage and repair if necessary.
Fence and other Access Control Barriers	Inspect perimeter gates for damage and repair if necessary.
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):	Retain the right of entry and maintain all rights-of-way to the closed landfill. Access controls will be inspected on a monthly basis.

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 **IIIC- Leachate and Contaminated Water 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 **quarterly** basis to assure continuous compliance with the design criteria and inspect the LCRS components on a **quarterly** 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 **IIIC- Leachate and Contaminated Water 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 and piping	Broken or inoperable pumps, distressed or damaged piping
Ground condition in vicinity of leach systems	Localized subsidence, erosion
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 no longer poses 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 **III I** of the Site Development Plan. **The site currently does not have a Groundwater Monitoring System Design**.

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
N/A	N/A

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
Permanent Gas Mitigation Probes	Static gas pressure with a suitable pressure gauge.
Permanent Gas Mitigation Probes	Combustible gas with a GasTech Model NP-204 dual range gas indicator. Hand pump will be used to assure constant concentration for at least 30 seconds.
Permanent Gas Mitigation Probes	The barometric pressure shall be recorded with a barometer with adequate range.

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, App. IIIG

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: **Tewobista Metaferia, P.E.** Title: **Project Manager**

Date: 09/29/2023

Company Name: **STV Inc** Firm Registration Number: **F-1741**

Professional Engineer's Seal



09/29/2023

Signature

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN

APPENDIX IIIG
CLOSURE AND POST-CLOSURE CARE COST ESTIMATE

Prepared for
City of Del Rio

September 2023



Prepared by
STV Inc
TPBE Registration No. F-1741
1820 Regal Row, Suite 200
Dallas, TX 75235
214-638-0500

This document is intended for permitting purposes only.

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LIST OF FIGURES

Figure IIIG.1 Area Requiring Final Cover



1.0 Introduction

This cost estimate for closure and post-closure care has been prepared consistent with Title 30 Texas Administrative Code (TAC) Chapter 330. This attachment addresses TAC §330.63(j), §330.501, §330.503, §330.505, and §330.507.

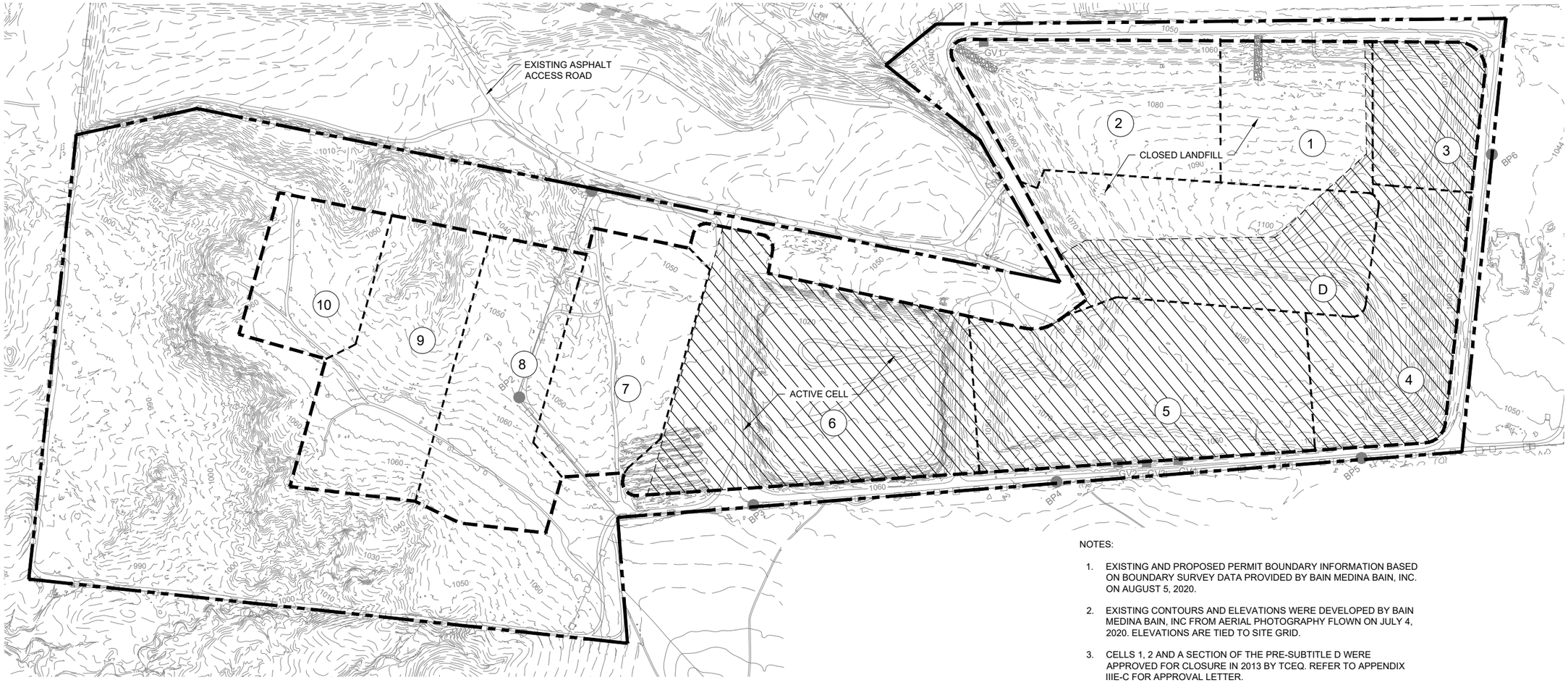
LEGEND

- PROPOSED PERMIT BOUNDARY
- PROPOSED LIMITS OF WASTE
- 1084 — EXISTING GRADES
- BP1 — GAS PROBE
- GV1 — GAS VENT
- EXISTING SITE FENCE
- EXISTING CHUTE
- AREA REQUIRING FINAL COVER (REFER TO NOTE 4)
- 1 — CELL DESIGNATION

N

0 200 400

SCALE IN FEET



NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. ELEVATIONS ARE TIED TO SITE GRID.
3. CELLS 1, 2 AND A SECTION OF THE PRE-SUBTITLE D WERE APPROVED FOR CLOSURE IN 2013 BY TCEQ. REFER TO APPENDIX IIIE-C FOR APPROVAL LETTER.
4. THE 55.5 ACRES OF AREA REQUIRING FINAL COVER INCLUDES 6.9 ACRES OF THE PRE-SUBTITLE D AREA.

FOR PERMITTING PURPOSES ONLY

TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

TEWOBISTA METAFERIA
123183
LICENSED PROFESSIONAL ENGINEER
STATE OF TEXAS
09/29/2023

NO.	REVISION	BY	DATE

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY

0 1"

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

AREA REQUIRING FINAL COVER

DESIGN:	T. METAFERIA
DRAWN:	T. METAFERIA
REVIEW:	B. HINDMAN
CP&Y:	DELR200302
CLIENT:	CITY OF DEL RIO

FIGURE
IIIG.1

PRINTED BY: MetafeT DATE: 7/31/2023
FILE PATH: C:\pwworking\stv\pw_stv\gjohnson\d0942276\DELR200302 Figure IIIG.1.dwg

Appendix A. TCEQ Forms 20721 and 20723



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: **City of Del Rio Landfill**

MSW Permit No.: **207C**

Site Operator/Permittee Name and Mailing Address: **City of Del Rio, 114 W Martin St**

Del Rio, TX 78840

Total Closure Cost Estimate (2022 Dollar Amount): **$3,173,736.98**

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: **Tewobista Metaferia, P.E.** Title: **Project Manager**

Date: **09/29/2023**

Company Name: **CP&Y, Inc.** Firm Registration Number: **F-1741**

Professional Engineer's Seal



09/29/2023

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.

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.

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.

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.

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.

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.

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.

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: **Affidavit to the public ($1,755.56)**

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.

1.9. Engineering Costs Subtotal

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.

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.

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.

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.

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.

2.6. Groundwater Monitoring System – The City has a groundwater monitoring waiver for the Del Rio Landfill.

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.

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.

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.

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.

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: **TCEQ administrative fees have been included and is estimated to be 5% of the construction cost.** 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.

Construction Costs Subtotal

Enter the sum of construction costs in Items 2.1 through 2.9.

3. Storage and Processing Unit Closure Costs – This section is not applicable to the site.

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.

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.

3.3. Demolition and Disposal

The cost of dismantling and/or disinfection of storage and/or processing units and disposal, as applicable.

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

4. Sum of Cost Subtotals

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

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

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

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

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: **110.3** acres

Largest Area Requiring Final Cover in the year to follow: **55.5** acres

Total Filled Area with Constructed Final Cover: **20.7** acres

Total Area Certified Closed: **20.7** 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: 0 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	$22,984.35	$22,984.35	4
1.2	Boundary Survey	Lump Sum	1	$10,810.00	$10,810.00	4
1.3	Site Evaluation	Acres	1	$6,442.97	$6,442.97	4
1.4	Development of Plans	Lump Sum			$52,100.00	2
1.5	Contract Administration (bidding and award)	Lump Sum			$14,588.00	2
1.6	Closure Inspection and Testing	Lump Sum	1	$173,138.06	$173,138.06	4
1.7	TPDES and other Permits	Lump Sum			$8,102.59	4
1.8	Additional Engineering Cost Items (describe in attachments)	Lump Sum			$74,236.09	
1.9 Engineering Costs Subtotal						
1.9.1	Engineering Costs Subtotal (including Legal Fees)				$362,401.91	
2. Construction Costs						
2.1	Mobilization of Personnel and Equipment	Lump Sum			$209,514.85	4
2.2 Final Cover System						
2.2.1 Side Slope Cover						
2.2.1a	Infiltration Layer – Compacted Clay	Cubic Yards	134,310	$7.70	$1,378,916.00	4

Item No.	Item Description	Units[1]	Quantity	Unit Cost	Cost	Source of Unit Cost Estimate[2]
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	NA	NA	NA	NA
2.2.1e	Drainage Layer – Aggregate	Cubic Yards	NA	NA	NA	NA
2.2.1f	Drainage Layer – Drainage Geocomposite Material	Square Feet	NA	NA	NA	NA
2.2.1g	Erosion Layer	Cubic Yards	139,715	$5.40	$483,516.00	4
2.2.1h	Vegetation	Acres	55.5	$2,653.60	$147,274.80	4
2.2.2 Top Slope Cover						
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	NA	NA	NA	NA	NA
2.3 Site Grading						

Item No.	Item Description	Units[1]	Quantity	Unit Cost	Cost	Source of Unit Cost Estimate[2]
2.3.1	Site Grading	Acres	55.5	$1,539.49	$85,441.70	4
2.4 Site Fencing and Security						
2.4.1	Site Fencing and Security	NA	NA	NA	NA	NA
2.5 Landfill Gas Monitoring and Control System						
2.5.1	Gas Control Wells	specify				
2.5.2	Gas Header Piping	specify				
2.5.3	Gas Lateral Piping	specify				
2.5.4	Flare Station	Lump Sum			NA	NA
2.5.5	Condensate Sumps	specify				
2.5.6	Completion of LFG Monitoring System	specify				
2.6 Groundwater Monitoring System – City has a waiver for groundwater monitoring						
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	NA	NA	NA	NA	NA
2.8 Stormwater Management						
2.8.1	Stormwater Drainage Management System	NA	NA	NA	NA	NA
2.9 Other Cost Items						
2.9.1	Additional Construction Cost Items (describe in attachments)	Refer to page IIIG-2			$104,757.43	
2.10 Construction Costs Subtotal						

Closure Cost Estimate for MSW Type I Landfill

Facility Name: City of Del Rio Landfill | Revision No.: 0

Permit No: 207C | Date: 09/29/23

Item No.	Item Description	Units[1]	Quantity	Unit Cost	Cost	Source of Unit Cost Estimate[2]
2.10.1	Construction Costs Subtotal				$2,409,420.78	
3. Storage and Processing Unit Closure Costs						
3.1	Waste Disposal	☐ Tons ☐ Cubic Yards	NA	NA	NA	NA
3.2	Material Removal and Disinfection	NA	NA	NA	NA	NA
3.3	Demolition and Disposal Units	NA	NA	NA	NA	NA
3.4	Additional Storage and Processing Unit Closure Cost Items (describe in attachments)	NA			NA	
3.5 Storage and Processing Unit Closure Costs Subtotal						
3.5.1	Storage and Processing Unit Closure Costs Subtotal				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 **Legal fees is estimated to be 25% of the total engineering cost**				2,771,822.69	
5. Contingency						
5.1	Contingency (10% of Sum of Engineering, Construction, and Storage and Processing Unit Closure Cost Subtotals)				$277,182.27	

Closure Cost Estimate for MSW Type I Landfill

Facility Name: City of Del Rio Landfill Revision No.: 0

Permit No: 207C Date: 09/29/23

Item No.	Item Description	Units[1]	Quantity	Unit Cost	Cost	Source of Unit Cost Estimate[2]
6. Contract Performance Bond						
6.1	Contract Performance Bond (2% of Sum of Engineering, Construction, and Storage and Processing Unit Closure Cost Subtotals)				$55,436.45	
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	$69,295.57	NA
8. Total Closure Costs						
8.1	Total Closure Costs (sum of amounts in Sections 4, 5, 6, and 7)				$3,173,736.98	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.

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: **City of Del Rio Landfill**

MSW Permit No.: **207C**

Date: **09/29/2023**

Revision Number: **0**

Site Operator/Permittee Name and Mailing Address: **City of Del Rio 114 W Martin St Del Rio, TX 78840**

Total Post-Closure Care Cost Estimate (2023 Dollar Amount): **$2,346,189.62**

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: **Tewobista Metaferia, P.E.** Title: **Project Engineer**

Date: **09/29/2023**

Company Name: **CP&Y, Inc.** Firm Registration Number: **F-1741**

Professional Engineer's Seal



09/29/2023

Signature

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.

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.

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.

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).

One-time instrument replacement = $9,257.21 (Refer to page IIIG-3)

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.

2.2. Mowing and Vegetation Control

The cost of controlling vegetation growth on the final cover and other areas of the landfill.

2.3. Groundwater Monitoring System Maintenance

The cost of repairs/replacement and routine maintenance. Site has a groundwater waiver and does not have any monitoring wells.

2.4. LFG Monitoring Probes Maintenance

The cost of repairs/replacement and routine maintenance.

2.5. LFG Collection System Maintenance

The cost of repairs and routine maintenance.

2.6. Perimeter Fence and Gates Maintenance

The cost of maintaining perimeter fence and gates to restrict unauthorized access to the closed landfill.

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.

2.8. Drainage System Cleanout and Repairs

The cost to include costs for maintaining and repairing ditches, conveyance structures, and ponds/basins.

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.)

3. Leachate Management Costs

3.1. Leachate Collection and Removal System Operation and Maintenance

The cost of operation, routine maintenance and repairs.

3.2. Leachate Disposal

The cost of leachate disposal off-site.

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.)

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.

5. Contingency

The cost added to cover unanticipated events during implementation of post-closure activities. (Enter additional work or cost element information as necessary)

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)

V. Post-Closure Care Cost Estimates Worksheet

Post-Closure Care Period – 30 years

Total Permitted Acreage: 180.60 acres

Total Permitted Waste Footprint: 110.3 acres

Number of Groundwater Monitoring Wells: The site has a groundwater waiver.

Number of GW Monitoring Events: No groundwater monitoring wells at the site.

Number of Gas Probes: 18

Number of LFG Monitoring Events:4/year (120 total for 30 years)

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]	YR	30	$1,316.67	$39,500.10	4
1.2	Correctional Plans and Specifications	YR	30	$1,542.19	$46,265.70	4
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	NA	NA	NA	NA
1.3.1(b)	Piezometers/Well Abandonment	Each	NA	NA	NA	NA
1.3.2 LFG Monitoring System						
1.3.2(a)	LFG Quarterly Monitoring (Quarterly)	Year	30	$5,246.43	$157,392.90	4
1.3.2(b)	LFG Probe Plugging and Abandonment	Each	18	$9,257.21	$166,629.78	2
1.4 Additional Engineering Cost Items (Detail in Attachments)						
1.4.1	Additional Engineering Cost Items (describe in attachments)	NA			NA	
1.5 Engineering Costs Subtotal						
1.5.1	Engineering Costs Subtotal				$409,788.48	
2.0 Construction and Maintenance Costs						
2.1	Cap and Sideslopes Repairs and Revegetation	YR	30	$9,413.83	$282,414.90	4
2.2	Mowing and Vegetation Management	Acres	The cost for this line item is included in line item 2.1			

Item No.	Item Description	Units	Annual Qty.	Unit Cost	Annual Cost	Source of Unit Cost Estimate[i]
2.3	Groundwater Monitoring System Maintenance	NA	NA	NA	NA	NA
2.4	LFG Monitoring Probes Maintenance	YR	30	$410.55	$12,316.50	4
2.5	LFG Collection System Maintenance	YR	30			
2.6	Perimeter Fence and Gates Maintenance	LS	1	$6,252.00	$6,252.00	1
2.7	Access Roads Maintenance	LS	1	$10,420.00	$10,420.00	1
2.8	Drainage System Cleanout/Repairs	The cost for this line item is included in line item 2.1				
2.9 Additional Construction and Maintenance Cost Items (Details in Attachments)						
2.9.1	Additional Construction and Maintenance Cost Items (details in attachments)	NA			NA	
2.10 Construction and Maintenance Costs Subtotal						
2.10.1	Construction and Maintenance Costs Subtotal				$311,403.40	
3.0 Leachate Management						
3.1	Leachate Management System Operation and Maintenance	NA	NA	NA	NA	NA
3.2	Leachate Disposal	Gals/yr	75,795.24	$0.60	$1,364,310.00	2
3.3 Additional Leachate Management Cost Items (Details in Attachments)						
3.4	Additional Leachate Management Cost Items (details in attachments)	NA			NA	
3.5 Leachate Management Costs Subtotal						
3.5.1	Leachate Management Costs Subtotal				$1,364,310.00	

Post-Closure Care Cost Estimate for MSW Type I Landfills

Facility Name: City of Del Rio Landfill | Revision No.: 0

Permit No: 207C | Date: 09/29/23

Item No.	Item Description	Units	Annual Qty.	Unit Cost	Annual Cost	Source of Unit Cost Estimate[i]
4.0 Sum of Engineering, Construction, and Leachate Management Costs						
4.1	Sum of Engineering, Construction, and Leachate Management Cost Subtotals				$2,085,501.88	
5.0 Contingency						
5.1	Contingency (10% of Sum of Engineering, Construction, and Leachate Management Cost Subtotals)				$208,550.19	
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)				$52,137.55	
7. Total Post-Closure Cost						
7.1	Total Annual Post-Closure Cost (Sum of amounts in Sections 4, 5, and 6)				$2,346,189.62	
7.2	30 Year Post-Closure Costs (Total Annual Post-Closure Cost x 30)				$70,385,688.60	

[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."

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT

APPENDIX IIIH
SURFACE WATER DRAINAGE PLAN

Prepared for
City of Del Rio

September 2023



Prepared by
STV Inc
TPBE Registration No. F-1741
1820 Regal Row, Suite 200
Dallas, TX 75235
214-638-0500

This document is intended for permitting purposes only.

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1.0 INTRODUCTION

The Surface Water Drainage Plan is prepared as part of a permit amendment application for the Del Rio Landfill consistent with Title 30 Texas Administrative Code (TAC) Chapter 330. This plan addresses surface water drainage design and erosion control. Permit level plans and details are presented for the proposed drainage system in this appendix. This appendix also includes a demonstration consistent with Title 30 TAC §330.305(a) that the proposed landfill development will not adversely alter permitted drainage patterns. Parts I/II, Section 11.1 includes a demonstration showing that the site is in compliance with the floodplain location restriction. The 100-year floodplain as defined by the Federal Emergency Management Agency (FEMA) is shown in Figure I/II.

This appendix includes the design of the final cover erosion layer and drainage structures (i.e., chutes and swales), perimeter drainage channels, detention pond, as well as hydrologic and hydraulic calculations. Consistent with Title 30 TAC §330.63(c) and §330.305(b) and (c), these facilities are designed to convey run-off produced from the 25-year storm event. In addition, an Erosion Control Plan for all phases of landfill development is included in Appendix IIIH-F. All drainage facilities will be constructed and maintained in accordance with this plan.

This appendix also includes (Section 4) a demonstration that shows that the proposed landfill development will not adversely alter the existing permitted drainage patterns. As noted in Section 4, the proposed condition represents the proposed configuration of the site after the landfill has been completely developed. Consistent with Title 30 TAC §330.63(c)(1)(C), §330.63(c)(1)(D)(iii), and §330.305(a), the proposed completion condition is compared to the existing permitted condition to demonstrate that the continued development of the Del Rio Landfill will not adversely alter the existing permitted drainage patterns.

2.0 SITE STORMWATER MANAGEMENT

2.1 Drainage System Layout

Stormwater runoff collected in swales located on the top dome and side slopes of the landfill will be conveyed to drainage letdown structures (chutes) down the slopes to the perimeter channels. The perimeter channels collect runoff from drainage letdowns and convey the runoff to stormwater detention ponds. The perimeter channels will be constructed before fill is placed above existing grade in each adjacent landfill sector.

The Del Rio Landfill permit boundary is located southeast of Calaveras Creek. A portion of the site drains northwest to Calaveras Creek. The other portion of the site drains southeast to the Zorro Creek. Both the Calaveras and Zorro Creeks discharge into the Rio Grande.

For the proposed expansion, the final cover system will include erosion control structures to effectively minimize erosion of final cover soils. The proposed drainage system also includes a perimeter channel system that will convey stormwater collected from the landfill area to a detention pond or directly into an existing drainage channel that feeds the Calaveras and Zorro Creeks. The stormwater detention pond is designed to attenuate stormwater flow before stormwater is discharged into existing drainage features located downstream of the site.

The facility has been designed to prevent discharge of pollutants into waters of the State or waters of the United States, as defined by the Texas Water Code and the Federal Clean Water Act, respectively. Del Rio

Landfill has a current Texas Pollution Discharge Elimination System (TPDES) multi-sector general permit (MSGP) for industrial activity as stipulated under Section 402 of the Clean Water Act and under Chapter 26 of the Texas Water Code, the TPDES program. A copy of the multi-sector permit is included in Parts I/II, Appendix I/IID. Any stormwater that has become contaminated by contact with the working face or with leachate will be handled in accordance with Appendix IIIC - Leachate and Contaminated Water Management Plan. The facility maintains a current Stormwater Pollution Prevention Plan prepared consistent with the provisions of TPDES MSGP TXR050000.

2.2 Erosion and Sedimentation Control Plan

The Del Rio Landfill will use various interim and permanent erosion and sedimentation controls during all phases of site development to provide effective erosion stability for the external sideslopes and top dome surfaces. The interim controls will be used around active areas and external embankment sideslopes and top dome surfaces. These controls will include soil berms and seeding of intermediate cover areas to minimize the erosion potential. These interim controls will be used during all phases of landfill development to provide effective erosion stability for the external sideslopes and top dome surfaces until final cover is installed.

Permanent controls include swales and chutes that will be constructed upon completion of the final cover installation. As part of the final cover construction, an erosion layer capable of sustaining vegetation will be constructed. Areas that receive final cover will be vegetated in accordance with Appendix IIIE - Closure Plan upon completion of final cover placement. Final cover vegetation will protect the erosion layer soil against erosive runoff velocities. A soil loss and sheet flow velocity demonstration for the erosion layer is included in Appendix IIIH-E. The erosion layer will include a vegetation layer that provides for a 90 percent ground coverage, to keep soil loss below the required design values. If there are areas that do not maintain at least 90 percent vegetative coverage, vegetation in these areas will be reestablished to maintain at least 90 percent vegetative cover.

Erosion will be controlled by vegetation in drainage structures with flow velocities less than or equal to 5 feet per second (fps). For drainage structures with flow velocities greater than 5 fps, rock riprap, gabions, or other surface reinforcing materials as designed will be used for surface reinforcement.

During site development, non-structured and structural best management practices (BMPs) will be employed to control erosion and sedimentation ponds will be installed to prevent sediment discharge from the site. BMPs may include the use of temporary rock riprap, silt fences, straw bales, check dams, interceptor swales and berms, temporary and permanent seeding and sodding, surface roughening, matting and mulching, sediment traps, and surface wetting for dust control (refer to Appendix IIIH-F for more information).

Runoff volume (25-year, 24-hour storm event) from the active fill area (i.e., working face of the landfill operation) will be contained by the containment berm (refer to Part III, Appendix IIIC - Leachate and Contaminated Water Management Plan for details) to prevent potential discharge of contaminated runoff from the site.

2.3 Stormwater System Maintenance Plan

In accordance with Title 30 TAC §330.305(e)(1), the constructed stormwater systems such as channels, drainage swales, and chutes will be repaired and restored in the event of wash-out or failure from extreme storm events. Stormwater BMPs installed during all phases of landfill development will also be replaced

or repaired in the event of failure. Excessive sediment will be removed, as needed, so that the drainage structures, such as the perimeter channels and detention ponds, function as designed. Site inspections by landfill personnel will be performed weekly or within 24 hours after any significant rainfall event of 0.5 inches or more, or as soon as the areas are accessible. Documentation of the inspection will be included in the Site Operating Record.

The following items will be evaluated during the inspections as further discussed in Appendix IIIH-E and Part IV - SOP:

- Erosion of daily and intermediate cover areas, final cover areas, perimeter ditches, chutes, swales, detention ponds, berms, and other drainage features.
- Settlement of intermediate cover areas, final cover areas, perimeter ditches, chutes, swales, and other drainage features.
- Silt and sediment build-up in perimeter ditches, chutes, swales, and detention ponds. Removed silt and sediment used as daily cover or to replenish intermediate cover soils.
- Obstructions in drainage features.
- Presence of erosion or sediment discharge at offsite stormwater discharge locations.
- Presence of sediment discharges along the site boundary in areas which have been disturbed by site activities.

Maintenance activities will be performed to correct damaged or deficient items noted during the site inspections. These activities will be performed as soon as possible after the inspection. The time frame for correction of damaged or deficient items will vary based on weather, ground conditions, and other site-specific conditions.

Maintenance activities will consist of the following, as needed:

- Vegetation reestablishment.
- Placement, grading, and stabilization of additional soils in eroded areas or in areas which have settled.
- Replacement or repair of riprap or other surface lining materials.
- Placement of additional riprap in eroded areas.
- Removal of obstructions from drainage features.
- Removal of silt and sediment build-up from drainage features.
- Repairs to erosion and sedimentation controls.
- Installation of additional erosion and sedimentation controls.

3.0 DRAINAGE SYSTEM DESIGN

3.1 Methodology

Drainage calculations for the final cover system erosion control structures and perimeter drainage system are based on the peak flow rates resulting from the 25-year frequency rainfall event for the area. 100-year frequency rainfall calculations are also included in this analysis as a point of comparison to the currently permitted condition. The United States Army Corps of Engineers (USACE) HEC-1 computer program was used to compute peak flow rates produced from the design storm. The hydraulic methods employed in this study are consistent with those presented in the TCEQ Guidelines for Preparing a Surface Water Drainage Report for Municipal Solid Waste Facility (RG-417, May 2018) and TxDOT Hydraulic Manual, September 201.

Water surface profiles were determined for the perimeter channels using the Channel Analysis Program (Bentley FlowMaster V8i) that is based on Manning's formula for uniform flow. The perimeter channels are designed to collect and route runoff from the 25-year frequency storm event to the detention pond.

3.2 Hydrologic Analysis

3.2.1 Description of Computer Program

HEC-1 was developed by the USACE Hydrologic Engineering Center to simulate the surface runoff response of a watershed. The HEC-1 model represents a watershed as a network of hydrologic and hydraulic components. The modeling process results in the computation of stream-flow hydrographs at desired locations in the watershed. The hydrologic analysis for the post-development condition is presented in Appendix IIIH-B. The hydrologic analysis for the permitted landfill completion condition is included in Appendix IIIH-A.

3.2.2 Watershed Subareas and Schematization

The landfill areas that contribute flow to each discharge point were delineated into subareas to derive peak flow rates for the design of the perimeter channel and final cover drainage letdowns. Hydrographs are developed for each subarea and appropriately combined and routed through the swales and perimeter channels. The subareas are shown on Drawing IIIH-A-17 for the permitted condition and Drawing IIIH-B-16 for the proposed completion condition.

Offsite areas (areas outside the permit boundary) incorporated into the hydrologic analyses as appropriate have been delineated using topography obtained from the United States Geological Survey 7.5-Minute Quadrangle for Del Rio, TX. The offsite drainage area delineation is shown on Drawing IIIH-B-20 for the post-development discharge analysis.

3.2.3 Time Step

The time step, or the program computation interval, is the time interval at which the flow rates for the hydrographs are generated by the program. Time step used for a design storm event hydrograph generation is 5 minutes.

3.2.4 Hypothetical Precipitation

The hypothetical storm data used in the post-project analysis was obtained from the National Oceanic and Atmospheric Administration Atlas Precipitation-Frequency Atlas of the United Sates, Volume 11

Version 2.0 for the project area. This data is different from the data used to create the existing permitted analysis. To make the comparison between existing and proposed, the existing permitted condition was modified to be consistent with the hypothetical precipitation data in the post-development condition. For both conditions design storm event analysis, a return period (frequency) of 25 years and a duration of 24 hours is used. Additionally, a 100-year storm evaluation has also been included. The precipitation is assumed to be evenly distributed over the entire area modeled for each time interval.

3.2.5 Precipitation Losses

Precipitation losses (the precipitation that does not contribute to the runoff) are calculated using the Soil Conservation Service (SCS) Curve Number (CN) method. CN is a function of soil cover, land use, and antecedent moisture conditions. A CN of 86 was selected to represent the final cover side slopes, and a CN of 85 was selected for final cover top dome surfaces. A CN of 100 was used for the detention pond areas. Further discussion on selection of CN values is provided in Appendix IIIH-A and IIIH-B for the permitted and post-development conditions respectively.

3.2.6 Hydrograph Information

Two different types of hydrograph generation methods have been used in the drainage analyses: distributed runoff methods and the Snyder unit hydrograph method using the Espey "10-Minute" method for parameter estimation. Muskingum-Cunge and pond storage discharge methods were used for hydrograph routings. Example hydrograph development information for both distributed runoff and Snyder unit hydrograph methods is provided in Appendix IIIH-A and Appendix IIIH-B.

Distributed Runoff Methods

The distributed runoff method (e.g., kinematic wave method) is applicable to small-water catchments with uniformly sloped overland flow plains that drain into channels. Landfill final cover areas consist of relatively short (typically 180 feet on 4H:IV side slopes) overland flow lengths that drain into landfill final cover swales. Distributed runoff estimation methods are applicable to landfill final cover areas because of the following:

- These methods were developed for uniform slopes that drain to collection channels. For a landfill final cover area, this translates to an overland flow segment of final cover that drains to a swale.
- These methods were developed for a network of relatively small drainage areas. Typically, to design the various perimeter channels, landfill drainage areas need to be subdivided to determine a peak flow at several points.
- These methods are also inherently conservative because it is based on watershed dimensions as opposed to other methods that use empirical information. Also, this method is conservative because flow attenuation is not accounted for.
- This method is also more conservative than the rational method because watershed lag time is computed as a function of real flow time without any limitations such as using a minimum time of concentration (i.e., 10 minutes), which is common practice for the rational method.

The kinematic wave method has been used for estimating peak runoff rates from the landfill final cover areas. A hydrograph from each drainage area with channelized flow (e.g., landfill final cover areas to swales) was developed using the kinematic wave method to simulate both overland and channelized flow. This method utilizes a simplified form of the energy equation and is based on the characteristics of the

drainage area, swale, or channel. This method uses physical (measurable) characteristics (e.g., flow lengths, slopes, surface roughness coefficients, channel cross sections) of a watershed to estimate peak discharges.

Snyder Unit Hydrograph Method

The Snyder unit hydrograph method has been used mainly for non-landfill drainage areas (e.g., offsite drainage areas). The method is applicable to drainage areas with a wide range of characteristics. Several different methods have been developed to estimate Snyder unit hydrograph parameters (watershed lag and peaking coefficient). Espey "10-Minute" method was used in this project to estimate Snyder unit hydrograph parameters. The Espey "10-Minute" method was developed using flow records from 41 different watersheds in Texas and other states. The main advantage of the Espey "10-Minute" method is that it is one of the most widely used and accepted methods for determining hydrograph input values for small-size drainage areas.

Hydrograph Routing

The Muskingum-Cunge Method (RD record in HEC-1) was used for routing of the flood wave through the drainage channels. This method is capable of accounting for hydrograph attenuation based on physical channel properties such as length, bottom slope, channel shape, and channel roughness.

Hydrographs at pond outlets were generated by routing the combined incoming flow hydrographs through the ponds. Pond routings (RS - Storage Routing record in HEC-1) were performed by using storage/elevation relationships for each pond by defining pond surface area versus depth. Additionally, discharge structure (low level outlet and spillway) characteristics of each pond are used for pond routing.

3.3 Hydraulic Analysis

3.3.1 Swale and Channel Analysis

Drainage structure details are illustrated on Drawings IIIH.3 through IIIH.6. The swales and channels are designed to convey the peak flow rate generated by the design storm event. These swales and channels will also reduce maintenance at the site after closure by minimizing erosion.

Hydraulic analyses of the swales and channels are conducted using Manning's uniform flow formula. The uniform flow assumption is applicable to long prismatic channels of uniform slope, as proposed at the site.

The general form of Manning's equation is:

$$V = \frac{1.49\ R^{0.667}\ S^{0.5}}{n}$$

In which,

$V = Velocity\ of\ flow, fps\ (feet\ per\ second)$

$n = Manning's$ n $(unitless)$

$R = \frac{A}{P} = Hydraulic\ Radius, ft\ (feet)$

$S = Friction\ slope\ for\ nonuniform\ flow\ or\ channel\ slope\ for\ uniform\ flow, ft/ft$

$A = Area\ of\ water\ perpendicular\ to\ direction\ of\ flow, sf\ (square\ feet)$

$P = Wetted\ perimeter, ft$

Using the relationship:

$Q = V\ A$

$Q = Flow, cfs\ (cubic\ foot\ per\ second)$

Manning's equation can be written as:

$$Q = \frac{1.49\ A\ R^{0.667}\ S^{0.5}}{n}$$

The uniform flow assumption equates the channel slope to the friction slope; therefore, the slope of the channel can be used for "S" in Manning's formula for computation of uniform flow.

Typical values for Manning's "n" are presented in the 2019 TXDOT Bridge Division Hydraulic Manual ("Suggested Manning's Roughness Coefficients" Table, Chapter 6, Section 1). A value of 0.030 is used for "n" for swales, a value of 0.040 is used for gabion-lined chutes, and a value of 0.030 is used for perimeter channels. These values represent typical roughness coefficients to the proposed drainage structures, after vegetation has become established.

3.3.2 Drainage Letdown Structure (or Chute) Analysis

A typical chute detail is illustrated on Drawing IIIH.3. The final cover drainage letdown structures are designed to convey the flow rate generated by the design storm event. Hydraulic analysis of the letdown structures is conducted under the principles of tumbling flow. Tumbling flow is a function of channel slope, discharge, spacing and sizing of energy dissipating elements. The tumbling flow regime consists of a series of hydraulic jumps and overfalls that maintain critical velocity down the chute. The spacing and sizing of the energy dissipators controls the velocity and flow of the water in the chutes, thereby reducing erosive conditions at slope transitions with the perimeter road low water crossings and chute/perimeter channel confluences.

4.0 DRAINAGE PATTERNS

Consistent with Title 30 TAC §330.63(c)(1)(C), §330.63(c)(1)(D)(iii), and §330.305(a), this section provides a demonstration showing that the proposed landfill development will not adversely alter the existing permitted landfill completion condition drainage patterns. The appendices containing the two drainage conditions analyzed are listed below.

- Appendix IIIH-A (Permitted Condition Hydrologic Calculations) This appendix contains the updated HEC-1 modeling based on the new permit boundary. Section 4.3.1 includes a discussion of additional analyses performed to facilitate a comparison between the existing permitted and post-development conditions.
- Appendix IIIH-B (Post-Development Condition Hydrologic Calculations) - This appendix contains analysis and supporting calculations for the proposed configuration of the site after development of the expanded landfill is complete.

The following two sections discuss: (1) site drainage patterns and (2) effect of the proposed development on peak flows, volumes, and velocities discharged from the site.

4.1 Site Drainage Patterns

The permitted and post-development site drainage patterns are detailed on Figure IIIH.1 – Site Drainage Patterns. As shown on Figure IIIH.1, the post-development drainage patterns are consistent with the currently permitted drainage patterns. The drainage patterns that include the discharge points at the permit boundary and individual runon locations (locations where upstream offsite areas flow onto the permit boundary) for both the permitted and proposed conditions are the same.

4.2 Effect of Site Development on Drainage from the Site

The purpose of this section is to evaluate the peak flow rates, runoff volumes, and peak flow velocities of the existing permitted- and post-development hydrologic conditions. Due to the construction and content of the permitted drainage condition, runoff volumes and velocities were calculated as supplemental data, based on the existing condition analyses. A summary of peak flow rates, runoff volumes, and peak flow velocities entering and exiting the permit boundary is provided in Figure IIIH.1 Site Drainage Patterns, Runon/Runoff. As shown on Figure IIIH.1 the flow rates at the discharge points for the proposed conditions are less than that of the permitted condition. Although the volume increased slightly at discharge points 1 and 3 the overall volume exiting the permit boundary is the same for the existing and post-development condition. The post development velocity is lower at all the discharge points than the permitted condition.

4.2.1 Comparison of Permitted and Post-Development Analyses

As noted in Section 1.2, to comply with Title 30 TAC §330.63(c)(1)(C), the proposed landfill completion condition is compared to the existing permitted condition of the landfill to demonstrate that the continued development of the landfill will not adversely alter the existing permitted drainage patterns. The permitted condition hydrologic models that were developed in 2020 did not take into account the 75-acre expansion area. The addition of this area will add a discharge point for the site and change the flow rates at some of the existing discharge points. Therefore, to develop a direct comparison between the permitted and post-development conditions, new hydrologic models were developed for the existing permitted condition utilizing the new drainage area boundary. This analysis is included in Appendix IIIH-A. The volume and velocity calculations for the existing condition have been updated based on the new hydrologic modeling.

The methods and input parameters used for the permitted and the post-development condition analysis are consistent with those used in recently approved TCEQ applications. To evaluate the impacts of the proposed improvements on the existing drainage patterns, a 25-year and 100-year hydrologic models were prepared to compare between the two site conditions. The peak flow rates at the permit boundary are calculated for the 25-year and 100-year return periods. The existing permitted and proposed hydrologic models are included in Appendix IIIH-A and IIIH-B respectively. To retain consistency, offsite areas OA1 and OA2 were assumed to be the same for both analyzed conditions. The peak flow rates, volumes, and velocities for the 25-year and 100-year return periods are shown and summarized in Table 4-1 and Figure IIIH.1 respectively.

Table 4-1 Summary of 25-Year Hydrologic Analysis

	Discharge Point 1		Discharge Point 2		Discharge Point 3		Discharge Point 4		Discharge Point 5	
	Exist	Prop	Exist	Prop	Exist	Prop	Exist	Prop	Exist	Prop
Q – Flow Rate (cfs)	293.4	286.7	350.8	337.5	212.8	117.6	79.7	70.8	104.1	85.6
V – Velocity (fps)	6.4	5.9	4.7	4.6	6.5	8.3	11.6	9.3	8.6	6.0
Vol – Runoff Volume (ac-ft)	112.4	110.9	62.6	60.1	16.7	16.1	11.1	10.9	17.4	15.2

4.2.2 Peak Flow Rates

As shown on Figure IIIH.1 and Table 4-1, the peak flow rates entering the permit boundary from OA1 and OA2 are identical for the permitted and post-development conditions. As discussed above, the offsite drainage areas are assumed to be identical for both conditions. Stormwater that enters the site from an off-site area and stormwater that is generated from within the permit boundary discharges at five separate locations along the permit boundary (DC1, DC2, DC3, DC4 and DC5 as shown on Figure IIIH.1). At these discharge points, the peak flow rates from the 25-year and 100-year frequency storm events that are discharged from the site for the post-development condition are all less than the permitted conditions.

4.2.3 Volumes

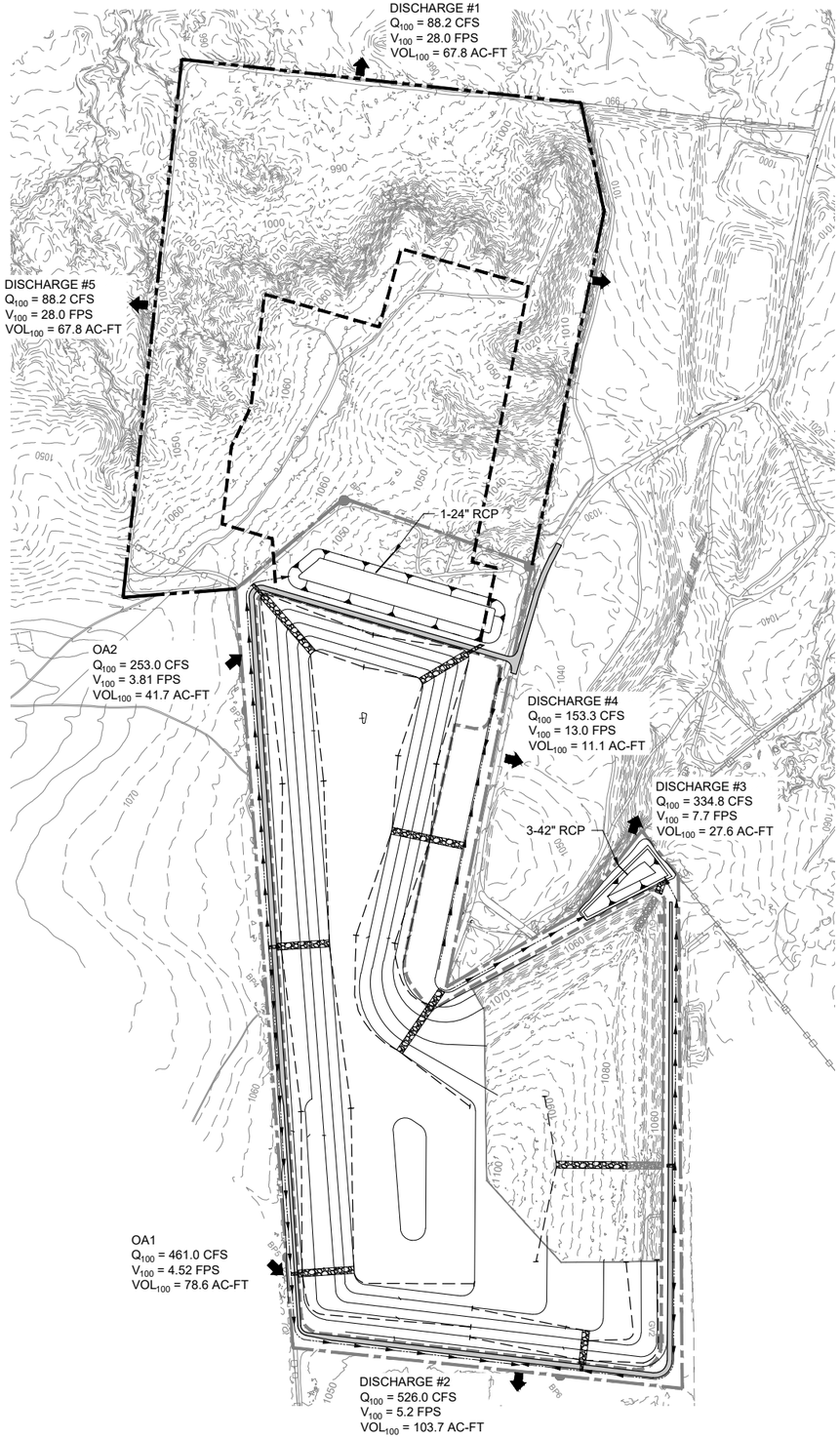
As shown on Figure IIIH.1, the volumes entering the permit boundary are consistent for the permitted and post-development landfill conditions. Runoff volumes are obtained from the hydrologic models and tabulated for each discharge point. The volume calculations are provided in Appendix IIIH-A and IIIH-B for the existing and post-development conditions respectively. As shown in Table 4-1, all the proposed condition volume runoff are less than the permitted condition. Therefore, the expansion does not adversely alter the existing volume runoff condition in this area.

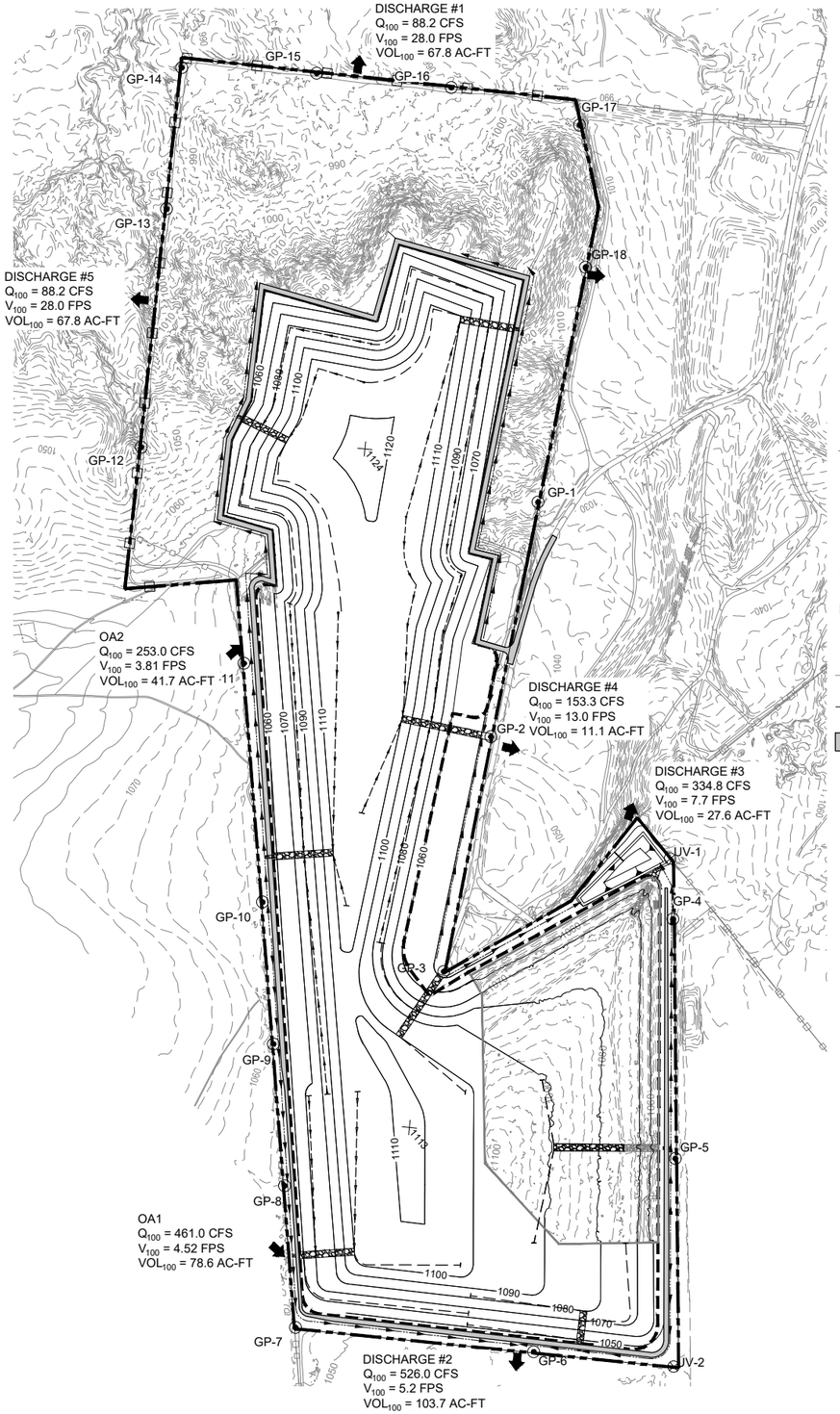
4.2.4 Velocities

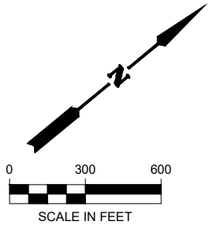
A summary of the 100-year frequency storm peak flow velocities that enter and exit the site are shown on Figure IIIH.1. As shown, the velocities at each discharge point are lower for the post-development condition compared to the permitted conditions except at DC3. No adverse condition is created by the proposed condition. Velocity calculations are provided in Appendices IIIH-A and IIIH-B for the permitted conditions and post-development, respectively.

4.2.5 Summary

From the hydrologic evaluations of the updated permitted and proposed conditions, the existing drainage conditions at the permit boundary will not be adversely altered by the proposed development. Given that: (1) drainage patterns are not adversely altered, (2) design stormwater peak discharge rate at each of the discharge locations is less than the permitted discharge rate (and the post-development peak flows entering the site are equal to the permitted peak flows entering the site), (3) total volume of stormwater entering and leaving the permit boundary does not increase, and (4) the stormwater discharge outfall locations are consistent with the permitted configuration, it is concluded that the proposed landfill development will not adversely alter permitted drainage patterns consistent with Title 30 TAC 330.63(c)(1)(C), §330.63(c)(1)(D)(iii), and §330.305(a).







LEGEND

- PERMITTED PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- PERMITTED LIMIT OF WASTE
- PROPOSED PERMIT BOUNDARY
- PROPOSED LIMIT OF WASTE
- 1090 — FINAL COVER GRADES
- 1084 — EXISTING GRADES
- SWALES
- PERIMETER CHANNEL
- CHUTES
- BP1 — EXISTING GAS PROBE
- EXISTING SITE FENCE
- PROPOSED SITE FENCE
- PROPOSED ACCESS ROAD
- CUT/FILL MARKERS
- EXISTING CHUTE
- GV2 — EXISTING GAS VENT
- GP-5 — PROPOSED GAS PROBE
- UV-1 — PROPOSED GAS VENTS

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TBPE F-1741



NO.	REVISION	BY	DATE

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.

0 1"

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

SITE DRAINAGE PATTERNS
RUNON/RUNOFF

DESIGN:	T. METAFERIA
DRAWN:	T. METAFERIA
REVIEW:	B. HINDMAN
CP&Y:	DELR200302
CLIENT:	CITY OF DEL RIO

FIGURE
IIIH.1

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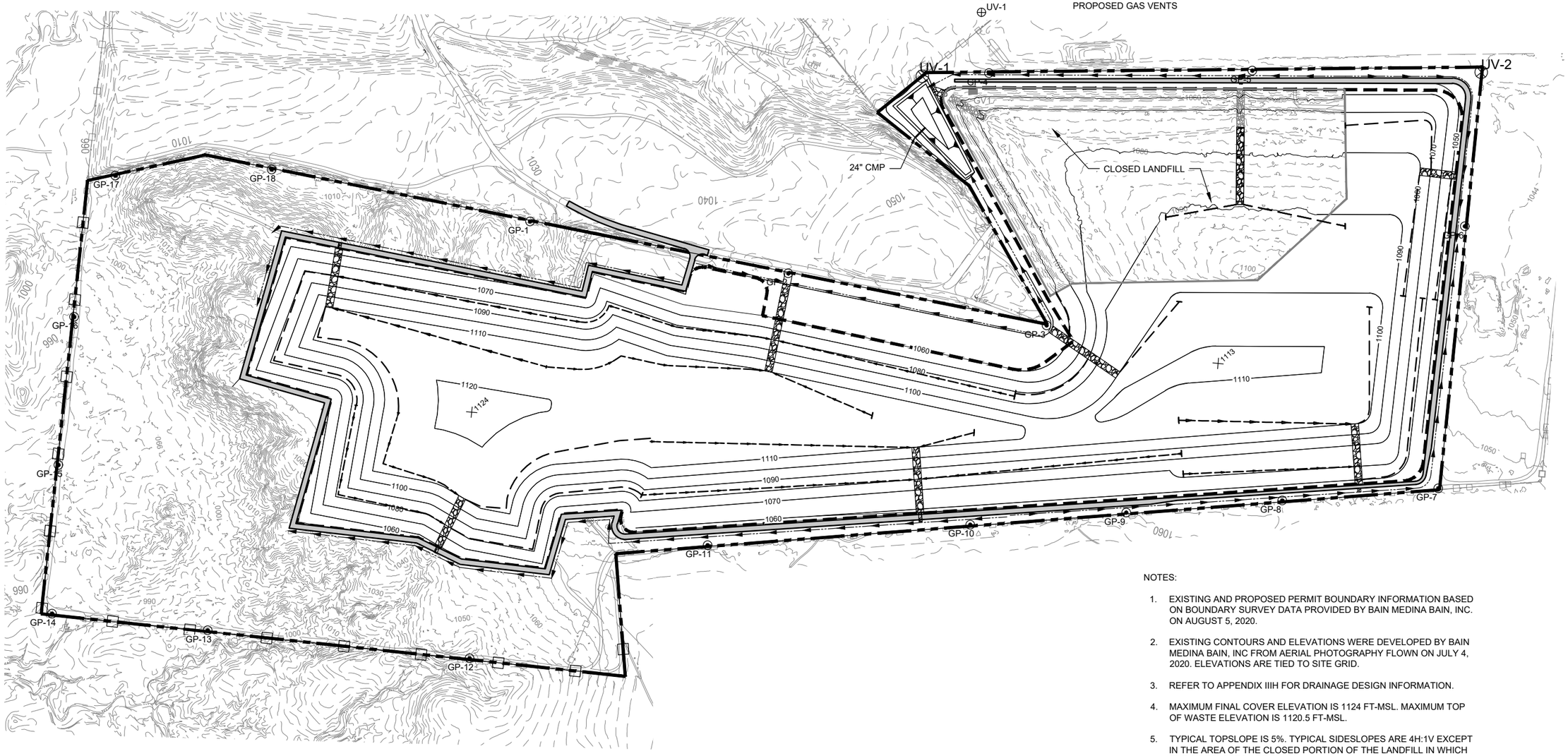
LEGEND

- PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- LIMIT OF WASTE
- 1090 FINAL COVER CONTOURS
- 1084 EXISTING CONTOURS
- SWALES
- EXISTING SITE FENCE
- PROPOSED SITE FENCE
- EXISTING CHUTE
- CHUTES
- GP-5 PROPOSED GAS PROBE
- UV-1 PROPOSED GAS VENTS

N

0 200 400

SCALE IN FEET



NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. ELEVATIONS ARE TIED TO SITE GRID.
3. REFER TO APPENDIX IIIH FOR DRAINAGE DESIGN INFORMATION.
4. MAXIMUM FINAL COVER ELEVATION IS 1124 FT-MSL. MAXIMUM TOP OF WASTE ELEVATION IS 1120.5 FT-MSL.
5. TYPICAL TOPSLOPE IS 5%. TYPICAL SIDESLOPES ARE 4H:1V EXCEPT IN THE AREA OF THE CLOSED PORTION OF THE LANDFILL IN WHICH THE SIDESLOPES ARE 5H:1V.

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TBPE F-1741

CITY OF DEL RIO TEXAS

STATE OF TEXAS
TEWOBISTA METAFERIA
123183
LICENSED PROFESSIONAL ENGINEER
09/30/2023

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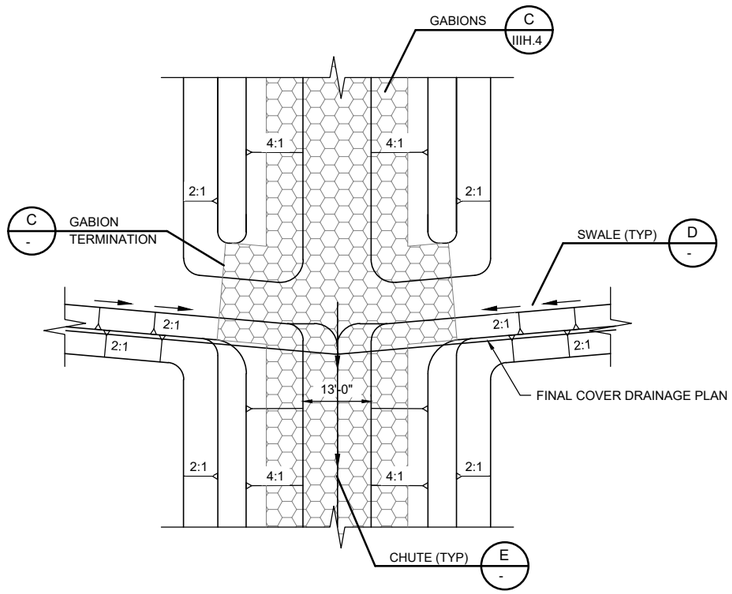
CITY OF DEL RIO LANDFILL NO. 207C
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DRAINAGE STRUCTURE PLAN

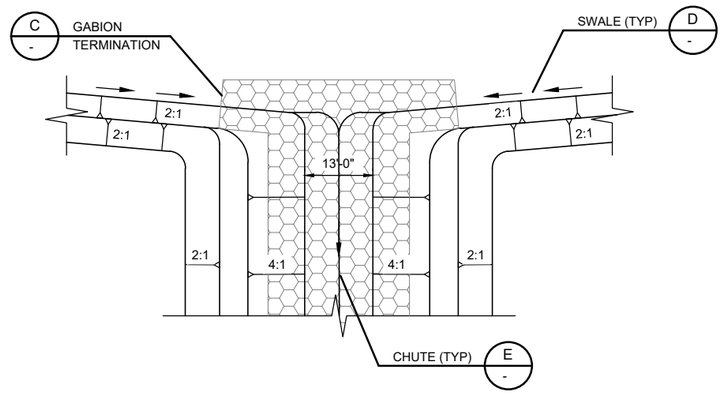
DESIGN:	T. METAFERIA
DRAWN:	T. METAFERIA
REVIEW:	B. HINDMAN
CP&Y:	DELR200302
CLIENT:	CITY OF DEL RIO

FIGURE
IIIH.2

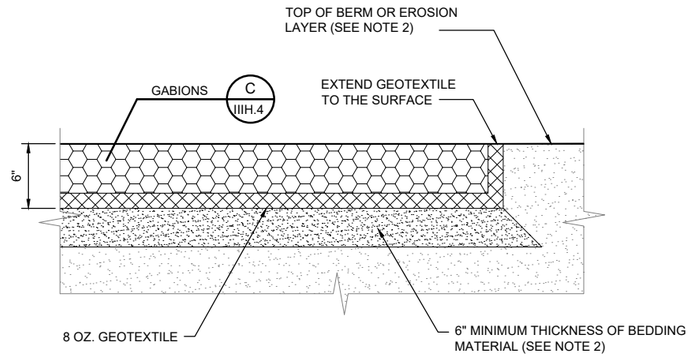
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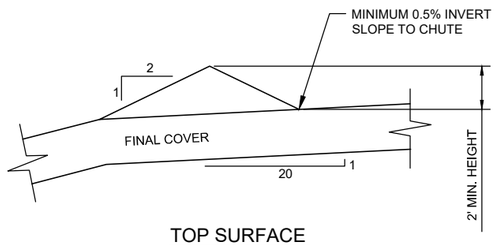
A SWALE/CHUTE CONFLUENCE (TYP)
NTS



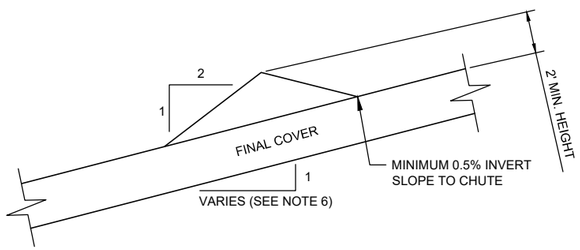
B SWALE/CHUTE CONFLUENCE (TYP)
NTS



C GABION TERMINATION
NTS

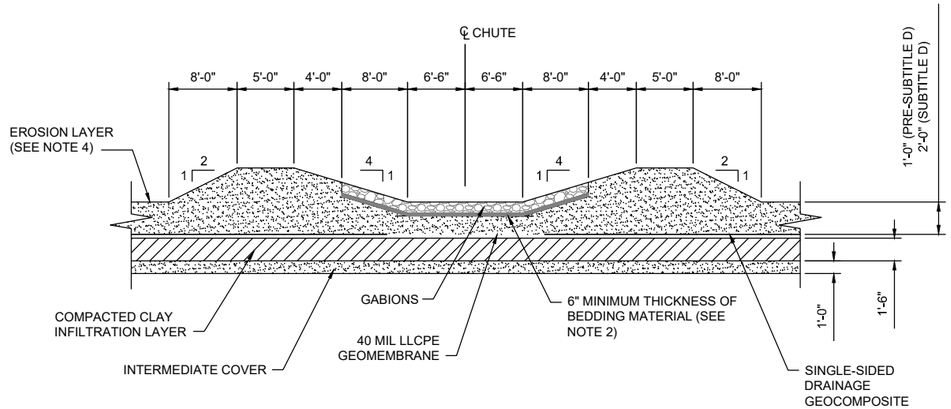


TOP SURFACE



SIDE SLOPE

D SWALE (TYP)
NTS



E CHUTE DETAIL
NTS

NOTES:

1. REFER TO DRAWING IIIH.2 DRAINAGE STRUCTURE PLAN FOR LOCATION OF DETAILS.
2. BEDDING MATERIAL WILL CONSIST OF CLAYEY SOILS COMPACTED TO PROVIDE FIRM BASE THAT WILL OVERLAIN BY 8 OZ/SY GEOTEXTILE PRIOR TO PLACEMENT OF GABIONS.
3. CHUTE DETAILS ARE SHOWN WITH 13 FEET OF BOTTOM WIDTH.
4. EROSION LAYER WILL BE CAPABLE OF SUSTAINING VEGETATIVE GROWTH.
5. THE EDGES OF THE INSTALLED GABIONS TIE EITHER TO THE TOP OF THE EROSION LAYER. (I.E., AT UPSTREAM END OF DRAINAGE LETDOWN) OR TO SOIL BERMS THAT ESTABLISH THE TOP OF THE DRAINAGE LETDOWN SIDE SLOPES.
6. THE SIDE SLOPES OF THE LANDFILL VARY FROM 20% TO 25% AS SHOWN ON FIGURE IIIH.2. SWALE CALCULATIONS ARE INCLUDED IN APPENDIX IIIH-D.

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CITY OF DEL RIO
TEXAS

STATE OF TEXAS
TEMOBISTA METAFERIA
121183
LICENSED
PROFESSIONAL ENGINEER
09/29/2023

NO.	REVISION	BY	DATE

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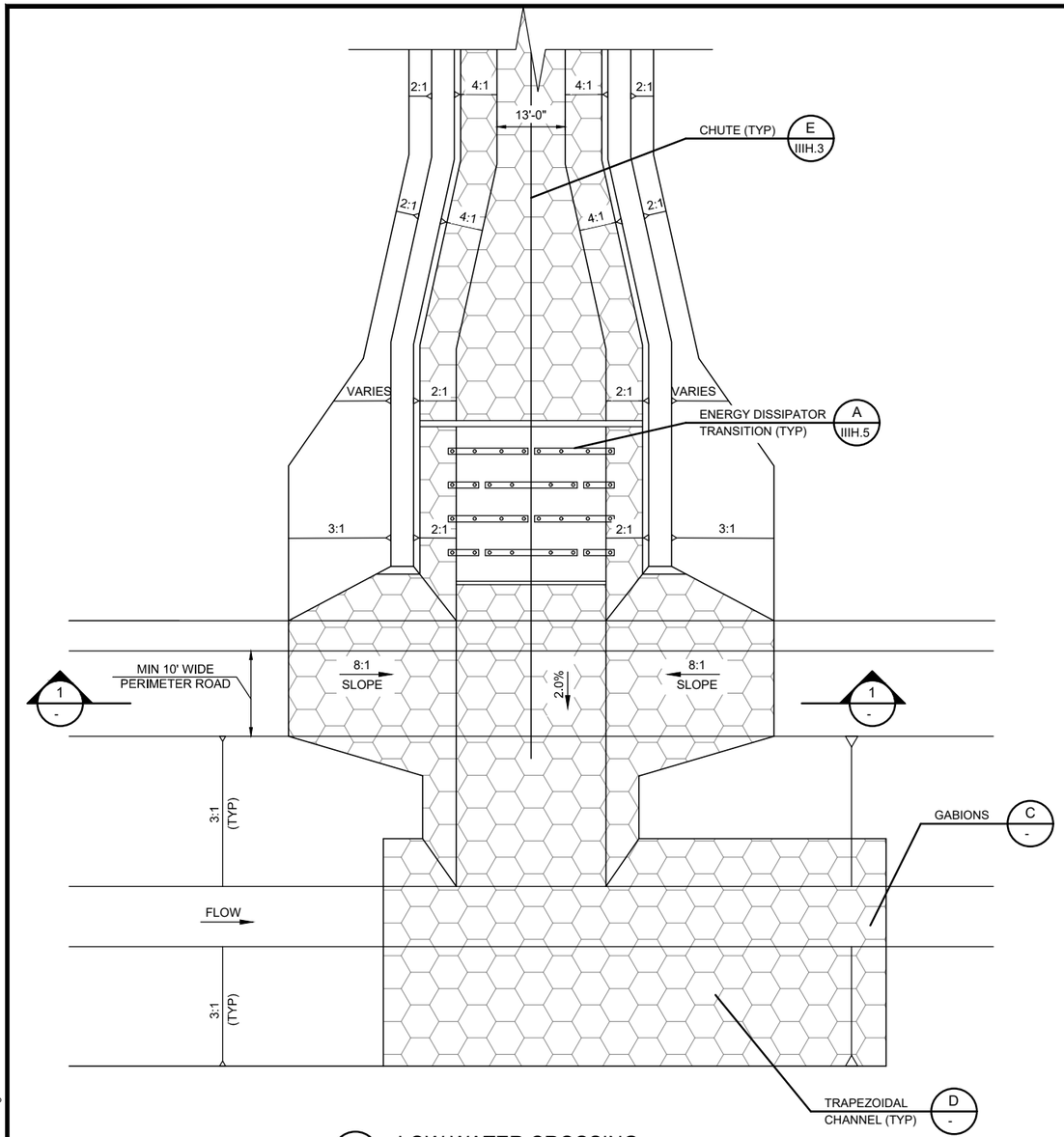
CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

DRAINAGE DETAILS I

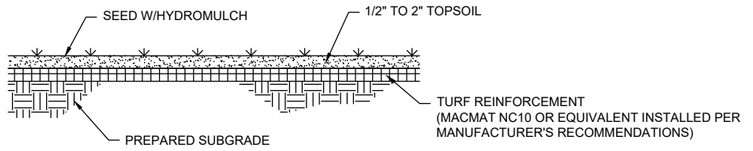
DESIGN:	T. METAFERIA
DRAWN:	T. METAFERIA
REVIEW:	B. HINDMAN
CP&Y:	DELR200302
CLIENT:	CITY OF DEL RIO

FIGURE
IIIH.3

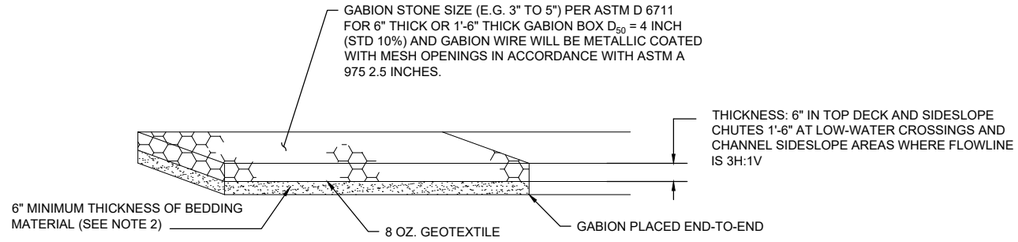
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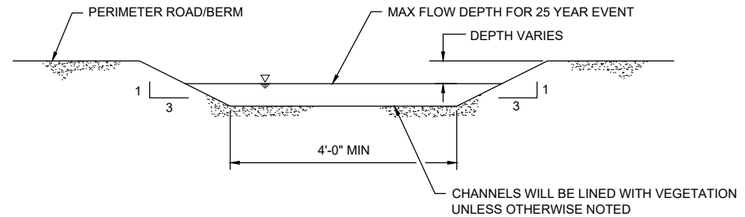
A LOW WATER CROSSING
NTS



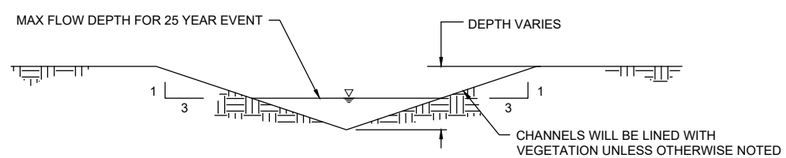
B TURF REINFORCEMENT
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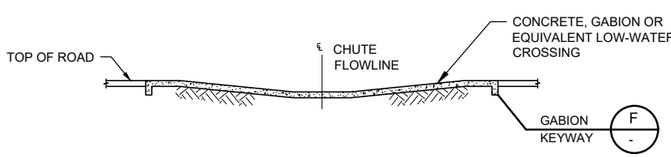
C GABIONS
NTS



D TRAPEZOIDAL CHANNEL (TYP)
NTS



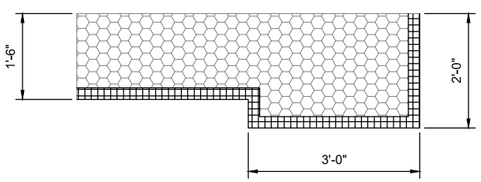
E "V" CHANNEL (TYP)
NTS



1 LOW-WATER CROSSING SECTION
NTS

NOTES:

1. REFER TO DRAWING IIIH-1 DRAINAGE STRUCTURE PLAN FOR LOCATION OF DETAILS.
2. BEDDING MATERIAL WILL CONSIST OF CLAYEY SOILS COMPACTED TO PROVIDE A FIRM BASE THAT WILL BE OVERLAIN BY 8 OZ/SY GEOTEXTILE PRIOR TO PLACEMENT OF GABIONS.



F GABION KEYWAY
NTS

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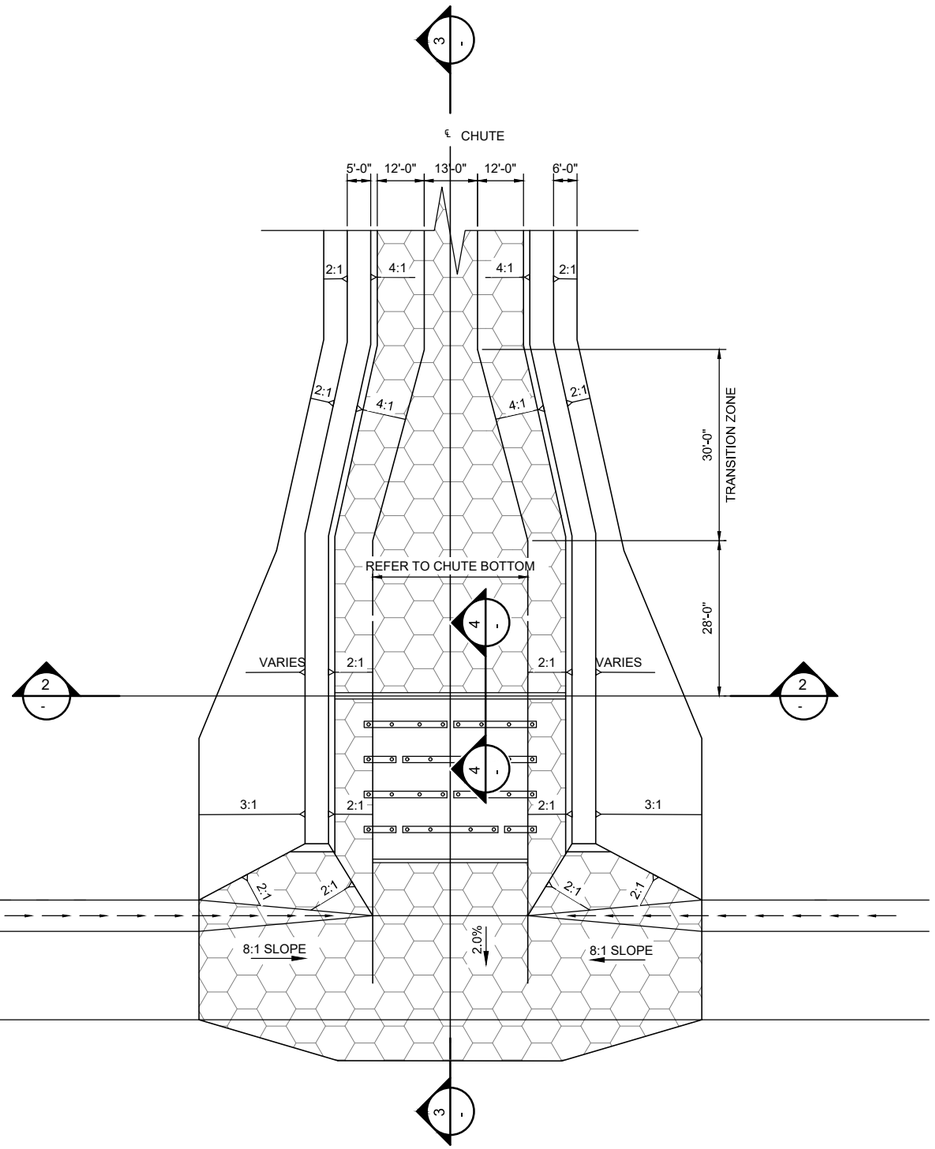
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CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

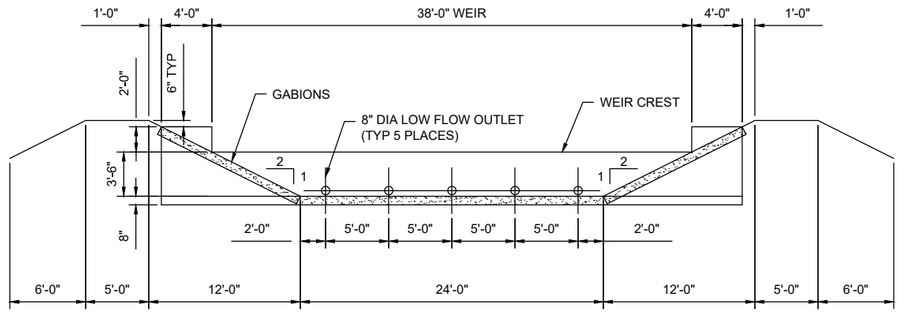
DRAINAGE DETAILS II

DESIGN:	T. METAFERIA
DRAWN:	T. METAFERIA
REVIEW:	B. HINDMAN
CP&Y:	DELR200302
CLIENT:	CITY OF DEL RIO

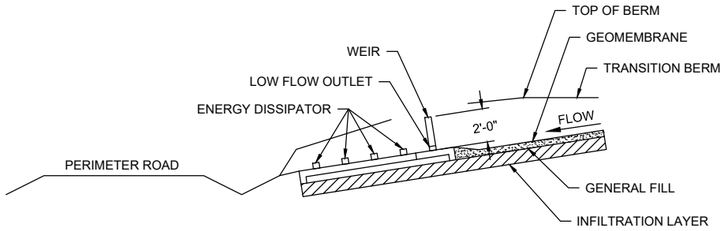
FIGURE
IIIH.4



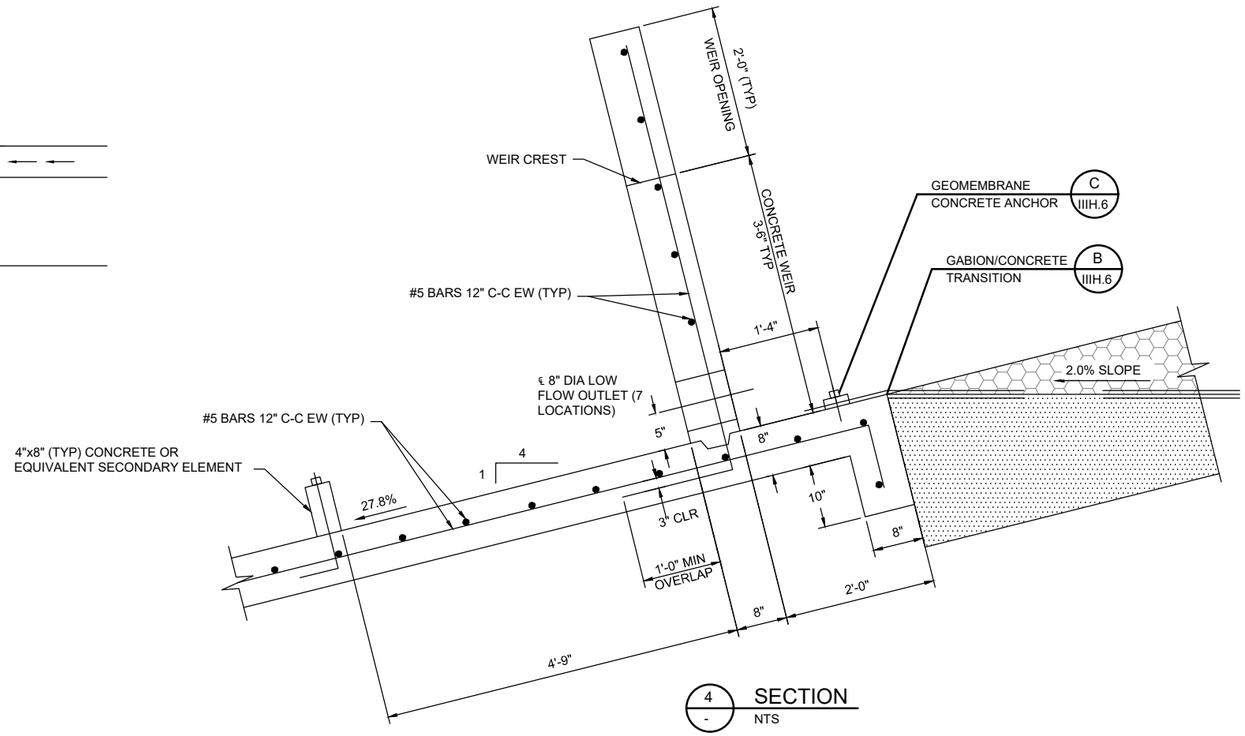
A ENERGY DISSIPATOR TRANSITION (TYP)
NTS



2 - SECTION
NTS



3 - SECTION
NTS



4 - SECTION
NTS

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VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.
0 1"

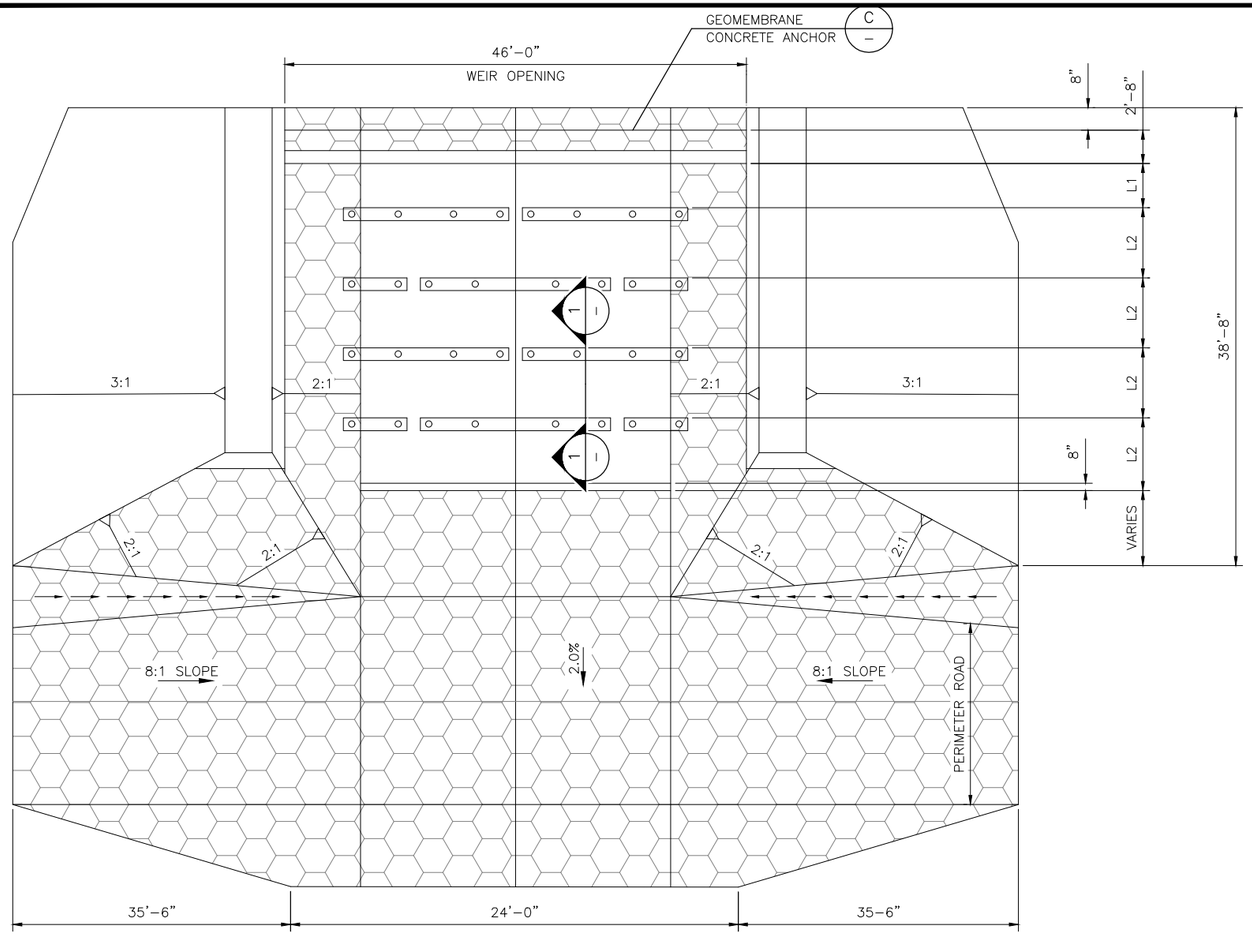
CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

DRAINAGE DETAILS III

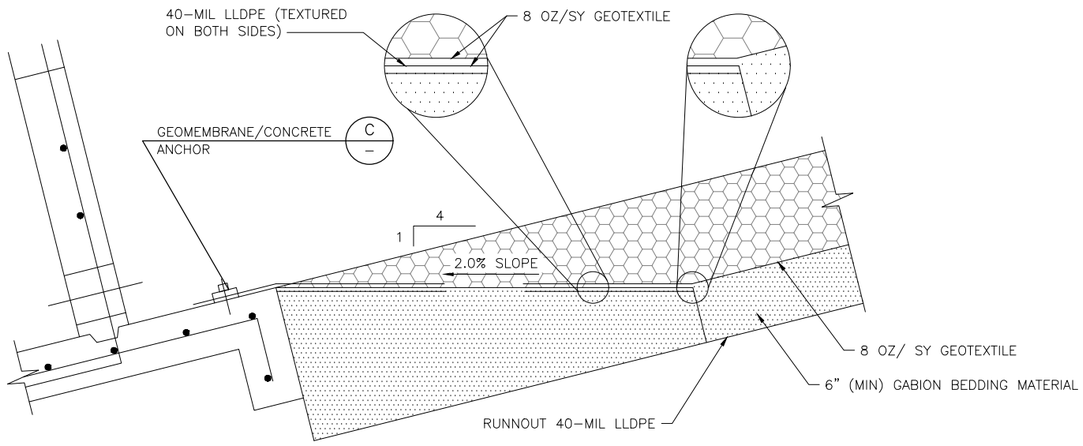
DESIGN:	T. METAFERIA
DRAWN:	T. METAFERIA
REVIEW:	B. HINDMAN
CP&Y:	DELR200302
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FIGURE
IIIH.5

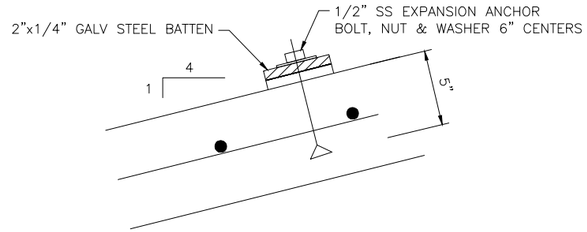
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FILE PATH: c:\pwworking\stv\pw_stv\gjohnson\d0942276\DELR200302 Figure IIIH.5.dwg



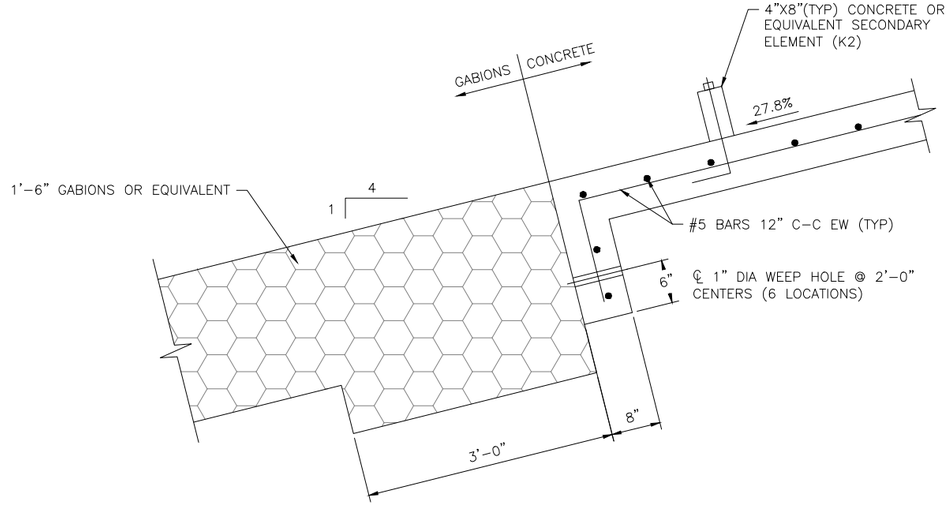
A ENERGY DISSIPATOR
NTS



B GABION/CONCRETE TRANSITION
NTS



C GEOMEMBRANE/CONCRETE ANCHOR
NTS



1 DISSIPATOR SECTION
NTS

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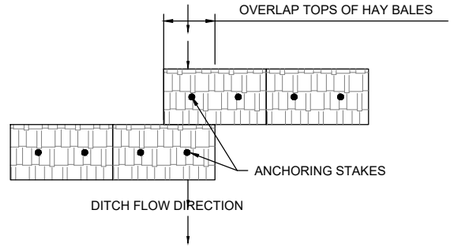
CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

DRAINAGE DETAILS IV

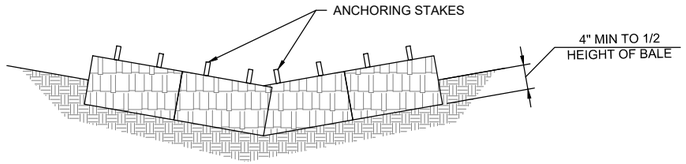
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DRAWN:	T. METAFERIA
REVIEW:	B. HINDMAN
CP&Y:	DELR200302
CLIENT:	CITY OF DEL RIO

FIGURE
IIIH.6

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FILE PATH: C:\pwworking\stv\pw_stv\tmetaferia\d0942276\DELR2000302 Figure IIIH.6.dwg

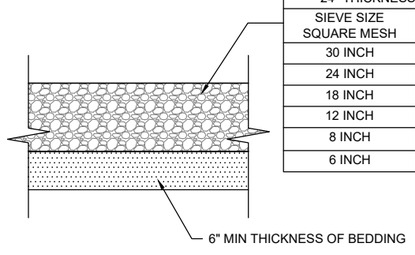


PLAN

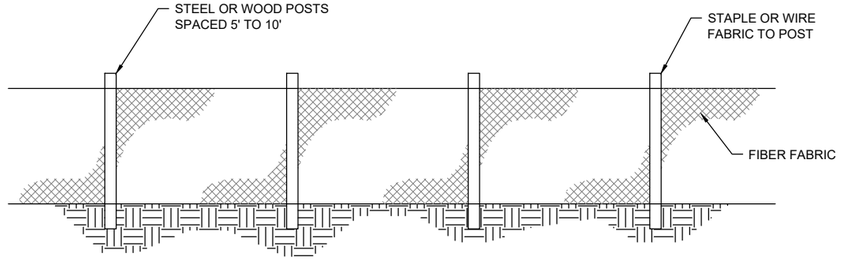


A BALED HAY FOR EROSION CONTROL
NTS

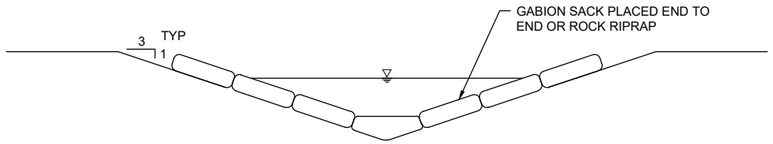
24" THICKNESS OF RIPRAP	
SIEVE SIZE SQUARE MESH	PERCENT PASSING
30 INCH	100
24 INCH	65-100
18 INCH	45-75
12 INCH	25-50
8 INCH	10-30
6 INCH	0-15



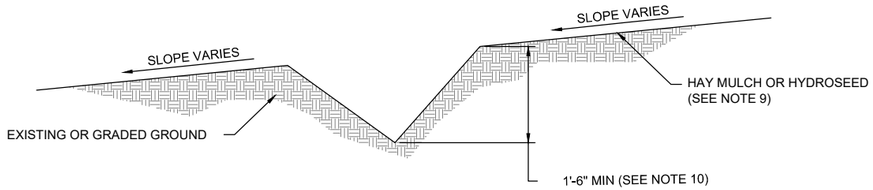
B ROCK RIPRAP
NTS



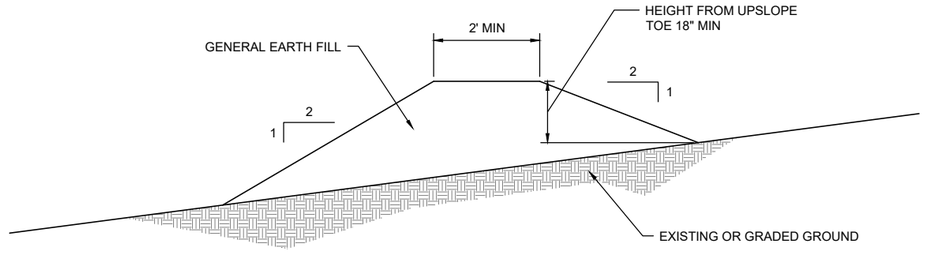
C TEMPORARY SEDIMENT CONTROL FENCE
NTS



D ROCK CHECK DAM
NTS



E TEMPORARY DIVERSION CHANNEL
NTS



F TEMPORARY DIVERSION BERM
NTS

NOTES:

1. BALED HAY MAY BE USED IN NEWLY ESTABLISHED COVER AREAS OR DISTURBED/REGRADED SURFACES TO MAINTAIN SHEET FLOW UNTIL VEGETATION IS ESTABLISHED.
2. ROCK RIPRAP MAY BE USED IN AREAS WHERE CONCENTRATED FLOW WITH HIGH VELOCITIES MAY OCCUR (E.G., CULVERT INLETS/OUTLETS).
3. A TEMPORARY SEDIMENT CONTROL FENCE MAY BE USED IN CAPTURING SEDIMENT TRANSPORTED BY SHEET FLOW AND FOR DIVERSION OF FLOW FOR CONTROLLING SEDIMENT DISCHARGE.
4. TURF REINFORCEMENT MAY BE USED ON NEWLY ESTABLISHED SURFACES SUCH AS INTERMEDIATE COVER AND IN CHANNELS WHERE MODERATELY HIGH FLOW VELOCITIES ARE EXPECTED.
5. A ROCK CHECK DAM MAY BE USED IN CHANNELS TO SLOW DOWN FLOW VELOCITIES AND IMPROVE SEDIMENT CAPTURE.
6. A TEMPORARY DIVERSION CHANNEL MAY BE USED FOR SHORTENING SHEET FLOW DISTANCES IN UNDEVELOPED AREAS OR IN LARGER CHANNELS TO PROVIDE MEANDERING AND SLOWER FLOW VELOCITIES TO PREVENT IN-CHANNEL EROSION.
7. A TEMPORARY DIVERSION BERM MAY BE USED IN ARES TO DIVERT FLOW FROM ENTERING STEEP SLOPED AREAS (E.G., TOP OF EXCAVATION) AND TO REDUCE SHEET FLOW LENGTHS.
8. A SWALE MAY BE USED IN AREAS TO DIVERT FLOW FORM ENTERING STEEP SLOPED AREAS (E.G., TOP OF EXCAVATION) AND TO REDUCE SHEET FLOW LENGTHS.
9. HAY MULCH AND HYDROSEED MAY ALSO BE USED FOR NEWLY ESTABLISHED SURFACES TO PROMOTE VEGETATION ESTABLISHMENT AND PREVENT EROSION.
10. THE VALUE SHOWN IS AT THE TIME OF CHANNEL INSTALLATION; CHANNEL WIDTH AND DEPTH MAY VARY.

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0 1"

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

DRAINAGE DETAILS V

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

FIGURE
IIIH.7

TEMOBISTA METAFERIA
123183
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PROFESSIONAL ENGINEER
STATE OF TEXAS

09/29/2023

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Appendix IIIH-A. Permitted Condition Hydrologic Calculations

Pages IIIH-A-1 and IIIH-A-120



Table of Contents

Hypothetical Storm Data	IIIH-A-1
Precipitation Loss Data	IIIH-A-3
Hydrograph Development Information	IIIH-A-12
HEC-1 Output — Permitted-Development 100-Year, 24-Hour Storm Event	IIIH-A-22
HEC-1 Output — Permitted-Development 25-Year, 24-Hour Storm Event	IIIH-A-67
Volume Calculations	IIIH-A-113
Velocity Calculations	IIIH-A-118



HYPOTHETICAL STORM DATA

Hypothetical Storm Data

Client: City of Del Rio
Project: Major Permit Amendment
Description: Hypothetical Storm Data

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose - To collect data for hypothetical rainfall amounts.

Hypothetical Storm Data:

Time	5 min	15 min	60 min	2 hr	3 hr	6 hr	12 hr	24 hr
25-Year	1.02	2.04	3.70	4.71	5.34	6.32	7.10	7.85
100-Year	1.43	2.76	5.19	6.82	7.90	9.54	10.80	11.90

Precipitation-Frequency Atlas of the United States, Volume 11 Version 2.0 (*National Oceanic and Atmospheric Administration Atlas 14, 2018*) was used to estimate precipitation storm events.

PRECIPITATION LOSS DATA

Precipitation Loss Data

Client: City of Del Rio
Project: Major Permit Amendment
Description: Precipitation Loss Data

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose - **Determine the SCS curve numbers for both on-site and off-site drainage areas for use in the HEC-1 analysis.**

Precipitation Loss Data:

Based on the soil survey information found on the *United StatesDepartment of Agriculture, National Resource Conservation Service, Web Soil Survey for Del Rio Country, Texas (http://websoilsurvey.nrcs.usda.gov)* , hydrologic group D soils predominate the soils within the permit boundary drainage area (see pages IIIH-A-5 through IIIH-A-8).

All on-site drainage areas and off-site drainage areas near the site (01, 02, DA1, and DA2) were considered pasture land in fair conditions. A curve number was selected using the table on page IIIH-A-11.

Approximate non landfill areas within the permit boundary on SCS map (page IIIH-A-5).

Use:	84

The final cover system was assumed to be in place and the erosion layer will control precipitation loss. A curve number that is corrected for the surface slope of the erosion layer may be computed first using the chart on page IIIH-A-11 to select an un-adjusted curve number.

Calculate the adjusted curve number.

Using equation 34 from *The Hydrolic Evaluation of Landfill Performance (HELP) Model - Engineering Documentation for version 3. EPA/600/R-94/168b,September 1994* (see page IIIH-A-10).

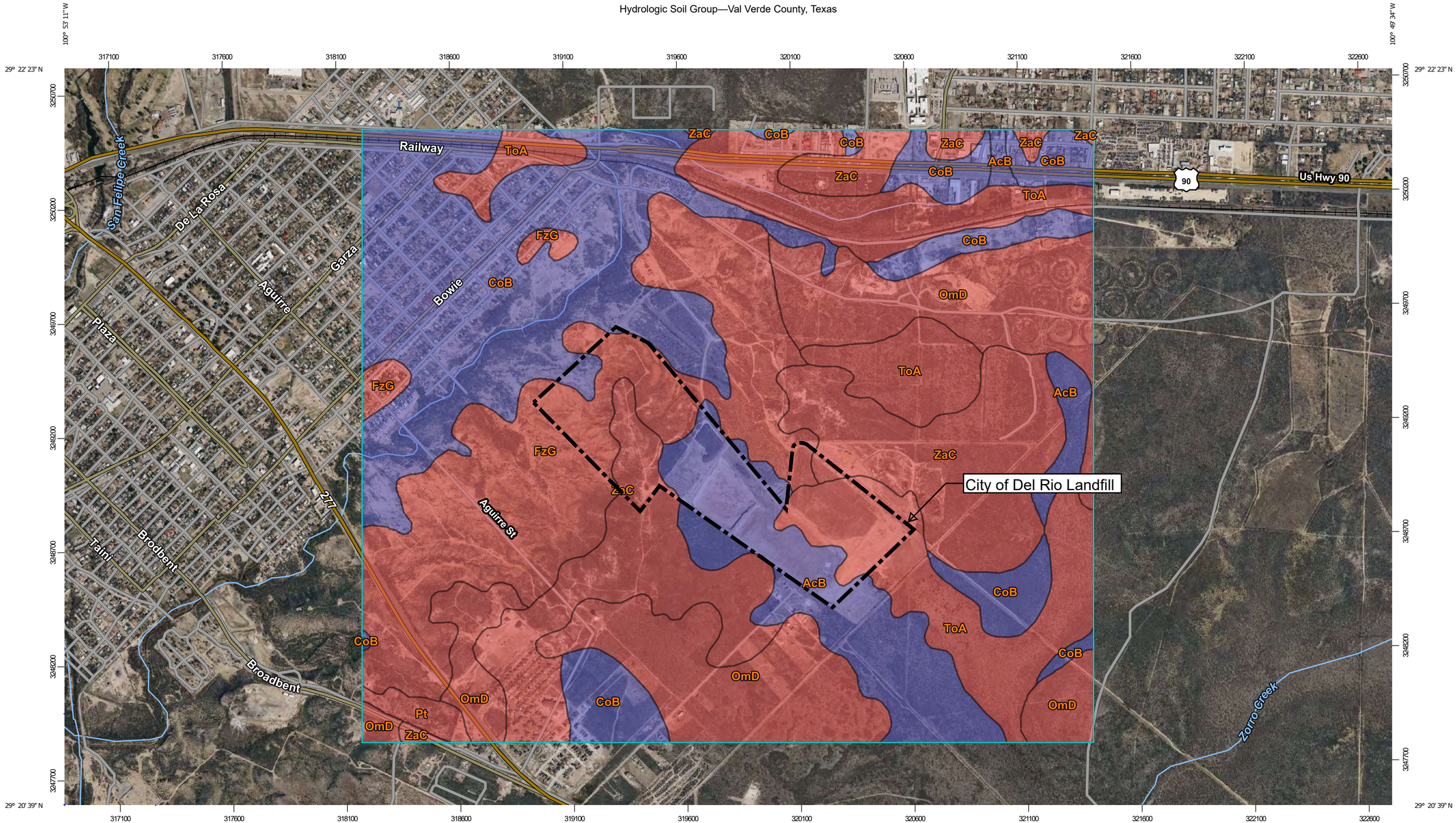
$$CN_{II} = 100 - (100 - CN_{IIo}) * (\frac{L^{*2}}{S^*})^{(CN_{IIo}^{-0.81})}$$

Use:	CN_{IIo} = 84	L* = 0.6	S* =	1.25	For top dome surfaces
Use:	CN_{IIo} = 84	L* = 0.4	S* =	6.25	For side slopes

Calculate:	CN = 85	For top dome surfaces
Calculate:	CN = 86	For side slopes

The pond areas are assumed to collect all precipitation for their areas:

Use:	CN = 100



Map Scale: 1:15,700 if printed on B landscape (17" x 11") sheet.

N

Meters: 0 200 400 800 1200

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 14N WGS84

IIIH-A-5

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Val Verde County, Texas
Survey Area Data: Version 20, Aug 24, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Nov 11, 2021—Nov 23, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AcB	Acuna silty clay, 0 to 3 percent slopes	B	188.8	8.8%
CoB	Coahuila clay loam, 0 to 3 percent slopes	B	537.2	25.1%
FzG	Felipe and Zorra soils, very rocky, 8 to 40 percent slopes	D	380.9	17.8%
OmD	Olmos very gravelly loam, 1 to 8 percent slopes	D	346.6	16.2%
Pt	Pits	D	14.0	0.7%
ToA	Tobosa clay, 0 to 1 percent slopes	D	318.6	14.9%
ZaC	Zapata-Vinegarroon complex, 1 to 5 percent slopes	D	356.1	16.6%
Totals for Area of Interest			**2,142.3**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Inset excel spreadsheet and hydrologic soil group information here

[PAGES IIIH-A-4 THROUGH IIIH-A-11]

HYDROGRAPH DEVELOPMENT INFORMATION

1.0 HYDROGRAPH DEVELOPMENT INFORMATION

1.1 Landfill Areas

Direct runoff methods, (i.e., kinematic wave) have been used for the majority of the landfill final cover areas. The kinematic wave method has been used to model the 5 percent topslope areas and 25 percent side slope areas before the flow is intercepted by the drainage swales. The kinematic wave method is a physically based method using slope, surface roughness, catchment lengths and areas. This method does not consider attenuation for flood wave; as a consequence, this method provides for a conservative analysis. The following typical parameters for the kinematic wave method have been developed for landfill areas.

Kinematic wave parameters for overland flow:

Slope: Varies from 0.05 to 0.25 ft/ft landfill slopes

N: 0.30 Manning's friction coefficient (based on using a value between dense grass (N = 0.24) and Bermuda grass (N = 0.41) listed in Soil Conservation Services TR-55)

L: Represents a typical distance between swales for overland flow for each drainage area. For example, the swale spacing on 4H:1V sideslopes is 160 feet.

Percentage of drainage area represented by this element is 100 percent.

Kinematic Wave routing for channels:

- Channel length (ft): The length of the channel section.
- Channel slope (ft/ft): 0.0015 (0.005 for swales).
- Channel roughness coefficient: 0.03 for grass lined channels and swales.
- Channel type: A trapezoidal channel was used with varying width and 3:1 side slope ("V" ditch with varying side slopes for swales).

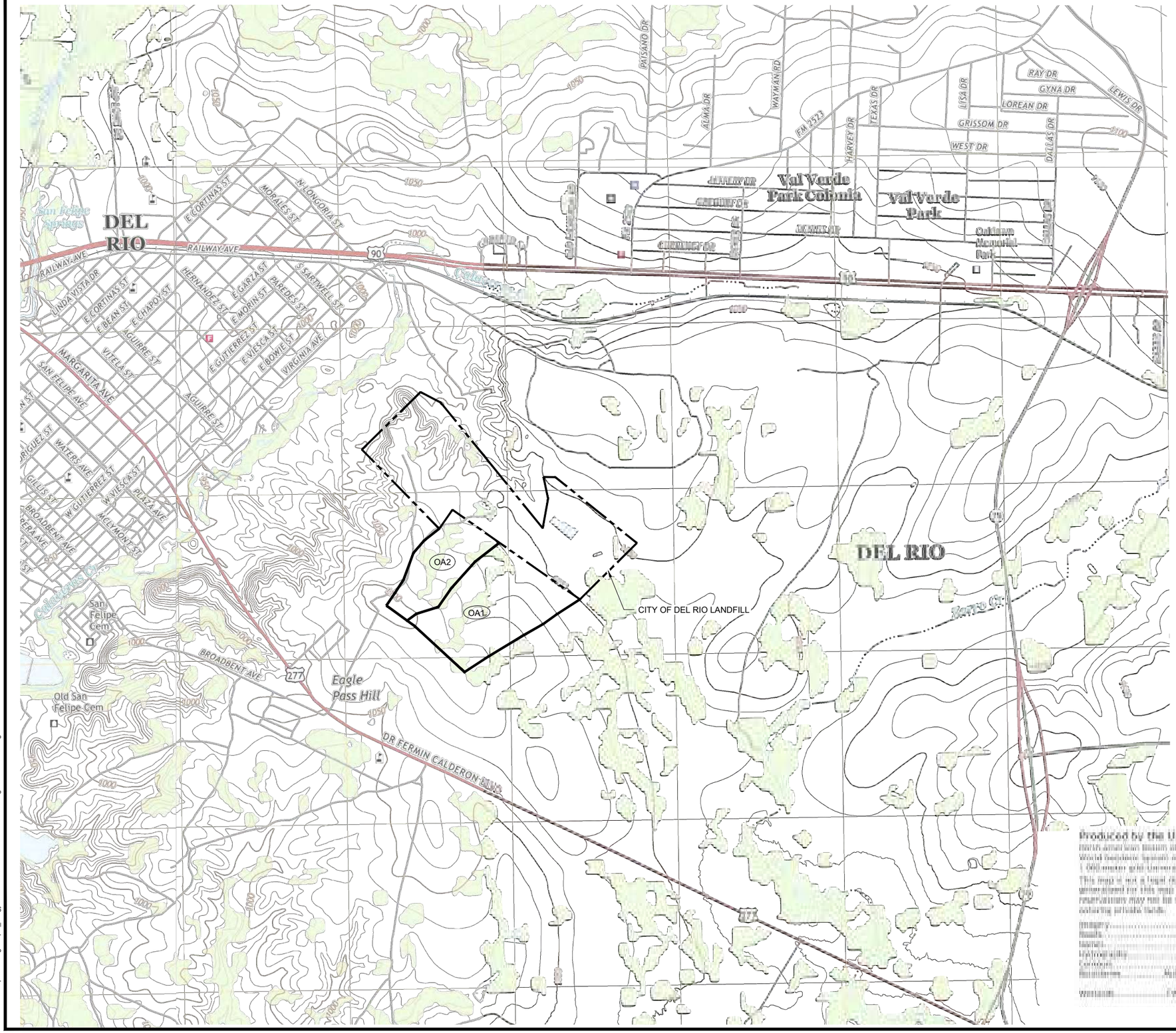
1.2 Non-Landfill Final Cover Areas

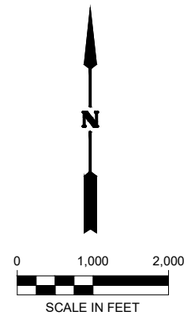
Hydrographs for the majority of non-landfill final cover areas within and near the permit boundary (e.g., pond areas) were developed using the Snyder unit hydrograph method. Espey "10-Minute" method has been used to estimate Snyder parameters. Snyder parameter estimations are provided on pages IIIH-B-19 through IIIH-A-20.

As discussed in Section 2 of Appendix IIIH, hydrographs for the areas outside of the permit boundary (01 and 02), and larger areas inside the permit boundary (S1 through S9) were developed using the Snyder unit hydrograph method. The percent imperviousness ranges from 2 percent to 89 percent, for the majority of the non-landfill on-site and off-site areas, which represents the majority of the watershed as undeveloped. Pond area are assumed to be 100 percent impervious, and areas with significant channel surface or paved surfaces were assigned higher percentages of impervious area.

1.3 Drainage Areas

The drainage areas used for this analysis are shown on Sheet IIIH-B-26. The routing scheme for the post-development condition is shown in the HEC-1 output file presented on pages IIIH-B-28 through IIIH-B-81.





LEGEND

PROPERTY BOUNDARY

DRAINAGE AREA BOUNDARY

OA1 DRAINAGE AREA DESIGNATION

DRAINAGE AREA NO.	AREA (ACRES)
OA1	94.95
OA2	48.93
TOTAL	143.88

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STATE OF TEXAS
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0 1"

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

OFF SITE DRAINAGE AREAS

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

FIGURE
IIIH-A-15

LEGEND

T7 — DRAINAGE AREA DESIGNATION

DRAINAGE BOUNDARY

PROPOSED ACCESS ROAD

CUT/FILL MARKERS

EXISTING CHUTES

CHUTES

PERMITTED PERMIT BOUNDARY

PROPOSED PERMIT BOUNDARY

CLOSED CELL BOUNDARY

PERMITTED LIMIT OF WASTE

1090 — PERMITTED FINAL COVER GRADES

1084 - EXISTING GRADES

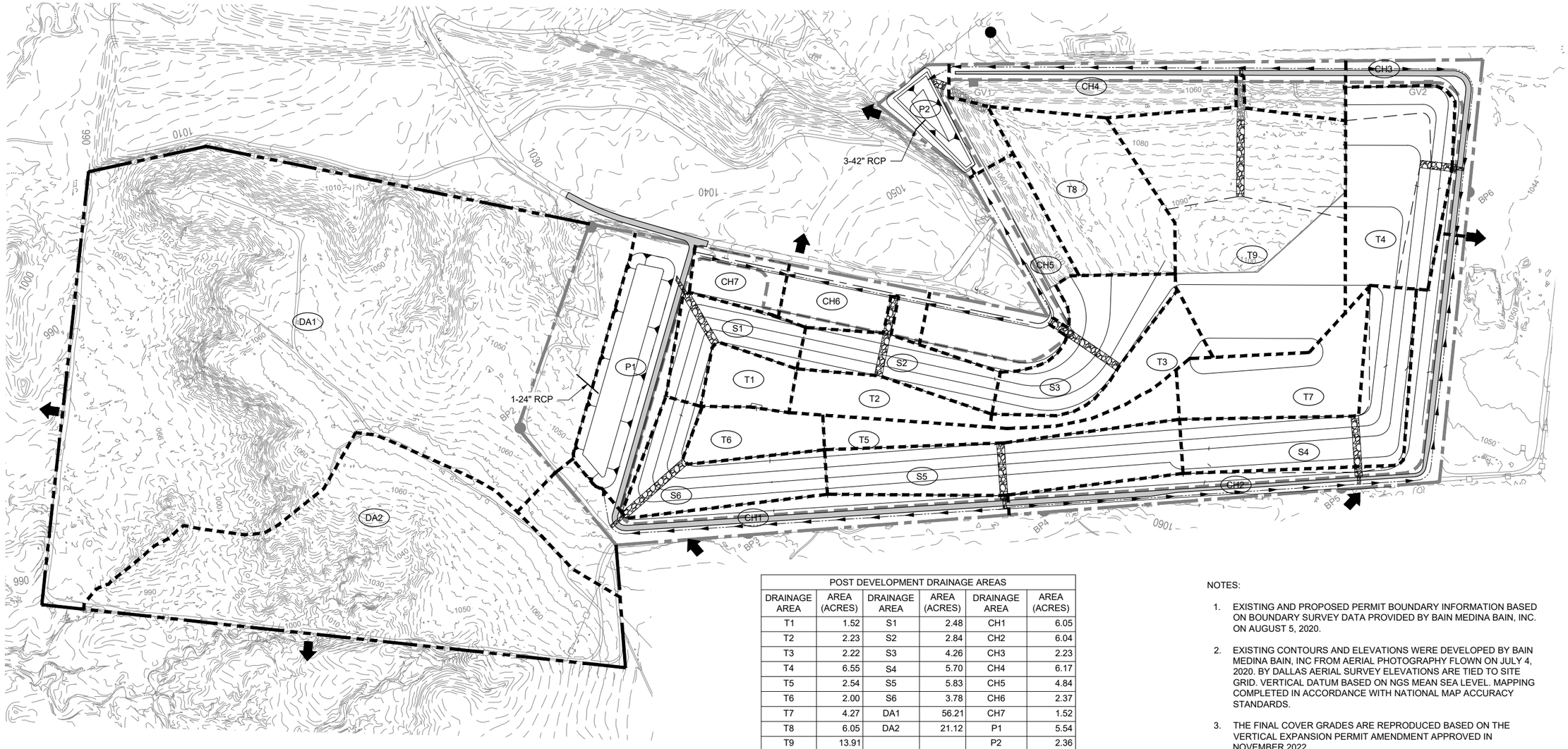
SWALES

PERIMETER CHANNEL

N

0 200 400

SCALE IN FEET



POST DEVELOPMENT DRAINAGE AREAS					
DRAINAGE AREA	AREA (ACRES)	DRAINAGE AREA	AREA (ACRES)	DRAINAGE AREA	AREA (ACRES)
T1	1.52	S1	2.48	CH1	6.05
T2	2.23	S2	2.84	CH2	6.04
T3	2.22	S3	4.26	CH3	2.23
T4	6.55	S4	5.70	CH4	6.17
T5	2.54	S5	5.83	CH5	4.84
T6	2.00	S6	3.78	CH6	2.37
T7	4.27	DA1	56.21	CH7	1.52
T8	6.05	DA2	21.12	P1	5.54
T9	13.91			P2	2.36

NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. BY DALLAS AERIAL SURVEY ELEVATIONS ARE TIED TO SITE GRID. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP ACCURACY STANDARDS.
3. THE FINAL COVER GRADES ARE REPRODUCED BASED ON THE VERTICAL EXPANSION PERMIT AMENDMENT APPROVED IN NOVEMBER 2022.

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TEWOBSTA METAFERIA
123183
LICENSED PROFESSIONAL ENGINEER
09/30/2023

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0 1"

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

PERMITTED CONDITION
DRAINAGE AREAS

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DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

FIGURE
IIIH-A-16

PRINTED BY: MetafeT DATE: 8/8/2023
FILE PATH: C:\pwworking\stv\pw_stv\johnsoni\d0942276\DELR2000302 Figure IIIH-A-16.dwg

ESPEY 10-MINUTE METHOD PARAMETERS

ESPEY 10-Minute Method

Client: City of Del Rio
Project: Major Permit Amendment
Description: Unit Hydrograph Data

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Unit Hydrograph Data

Area No.	Area (acres)	Max. Flow Length (L) (ft)	S (ft/ft)	I (%)	Manning "n"[1]	ϕ[1]	T_r[2] (min)	T_{lag}[3] (min)	T_{lag} (hr)	Area (sq mi)	q_p[4] (cfs/sq mi)	C_p[5]
OA1	94.95	2461	0.016	2	0.04	0.86	36.4	33.9	0.57	0.1484	727.7	0.64
OA2	48.93	2336	0.017	2	0.04	0.86	35.5	33.0	0.55	0.0765	767.5	0.66
DA1	56.21	2420	0.031	2	0.04	0.86	30.8	28.3	0.47	0.0878	890.0	0.66
DA2	21.20	791	0.076	2	0.04	0.86	19.1	16.6	0.28	0.0331	1542.7	0.67

[1] Conveyance efficiency coefficient from Dodson & Associates Inc., *ProHec-1 Program Documentation* , 1995, pages 6-19 and 6-20.

[2] $T_r = 3.1(L^{0.23})(S^{-0.25})(I^{-0.18})(\varphi^{1.57})$

[3] $T_{lag} = T_r - 5/2$

[4] $q_p = 31600(A^{-0.04})(T_r^{-1.07})$

[5] $C_p = 49.375(A^{-0.04})(T_r^{-1.07})(T_{lag})$

T_r = Surface runoff to unit hydrograph peak (min)
L = Distance along main channel from study point to watershed boundry (ft)
S = Main channel slope (ft/ft)
I = Impervious cover within the watershed (%)
T_{lag} = Watershed lag time (min)
q_p = Unit hydrograph peak discharge (cfs/sq mi)
C_p = Snyder's peaking coefficient

ESPEY 10-Minute Method

Client: City of Del Rio
Project: Major Permit Amendment
Description: Unit Hydrograph Data

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Unit Hydrograph Data: Sample Calculations

Drainage area "0A1" is used in this example.
Estimated Watershed specific parameters:

A =	94.95	acres	Watershed Area (acres)
L =	2461.0	ft	Maximum flow length with this watershed (ft)
S =	0.016	ft/ft	Watershed Slope (ft/ft)
I =	2	percent (%)	Watershed imperviousness
n =	0.04		Manning's coefficient

Calculate T_r, time beginning of surface runoff to the unit hydrograph peak in minutes:

$$Tr = 3.1(L^{0.23})(S^{-0.25})(I^{-0.18})(\phi^{1.57})$$

φ = 0.86 Estimate conveyance efficiency coefficient, see Figure 6.12 on page IIIF-A-20 for estimating. For 2 percent impervious cover and n = 0.04.

T_r = 36.4 minutes

Calculate T_{lag}, watershed lag time:

T_{lag} = Tr - (Δt/2) Δt is the calculation interval, and 5 minutes is used in the HEC-1 modeling in this project.

T_{lag} = 33.9 minutes
T_{lag} = 0.57 hours

A = A/640
A = 0.1484 sq. miles

Calculate q_p, peak discharge of unit hydrograph per unit area (cfs/sq. mi):

$$q_p = 31600(A^{-0.04})(T_r^{-1.07})$$

q_p = 727.7 cfs/sq.mi

Calculate peaking coefficient, C_p:

$$C_p = 49.375(A^{-0.04})(T_r^{-1.07})(T_{lag})$$

C_p = 0.64

DISTRIBUTED RUNOFF METHOD
KINEMATIC WAVE EXAMPLE

Kinematic Wave Method

Client: City of Del Rio
Project: Major Permit Amendment
Description: Kinematic Wave

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose - Ditributed Runoff Method - Kinematic Wave Example:

Watershed Specific Parameters for drainage area T3

A =	8.99	acres	Watershed Area (acres)
A =	0.0140	sq-miles	Watershed Area (sq-miles)
CN =	85		SCS Curve Number (see sheet IIIH-H-4 for more information)

Kinematic Wave Parameters for overland flow:

L =	0	ft	Typical overland flow (ft)
S =	0.050	ft/ft	Landfill slope (ft/ft)
N =	0.30		Manning's Coefficient

Percentage of the drainage area represented by this element is 100 percent.

Kinematic Wave routing data for the swale:

L =	0	ft	Typicalswale length (ft)
S =	0.005	ft/ft	Swale bottom slope (ft/ft)
N =	0.03		Manning's Coefficient
Channel =	TRAP		Swale Type*

*A trapezoidal channel with no bottom width was used to simulate a triangular channel.

HEC-1 OUTPUT – PERMITTED 100-YEAR 24-HOURS STORM EVENT

```
1*************************************
 *                                   *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
 *        JUN 1998 AND FEB 2010          *
 *            VERSION 4.1R               *
 *       RGMHEC2000 WWW.HEC-1.COM        *
 *  RUN DATE   24JUL23  TIME  10:11:54   *
 *                                   *
 *************************************
```

```
*************************************
*                                   *
*    U.S. ARMY CORPS OF ENGINEERS     *
*    HYDROLOGIC ENGINEERING CENTER    *
*          609 SECOND STREET          *
*       DAVIS, CALIFORNIA 95616       *
*           (916) 756-1104            *
*                                   *
*************************************
```

```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```
          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID  DEL RIO LF EXPANSION
            2           ID  100-YR, 24-HR
                        *DIAGRAM
            3           IT       5       0    2400     416       0       0
            4           IO       3       0       0
                        *

            5           KK      T6
            6           PH               0    1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90
            7           KO       0       0       0       7      21
            8           BA  0.0031
            9           LS       0      85
           10           UK     179    0.05     0.3     100
           11           RD     312   0.005    0.03            TRAP       0       2      NO
                        *

           12           KK      S8
           13           KO       0       0       0       7      21
           14           BA  0.0059
           15           LS       0      85
           16           UK   139.6    0.25     0.3     100
           17           RD   540.7   0.005    0.03            TRAP       0       2      NO
                        *

           18           KK    C/S8
           19           KO       0       0       0       7      21
           20           HC       2
                        *

           21           KK      T5
           22           KO       0       0       0       7      21
           23           BA  0.0040
           24           LS       0      85
           25           UK   175.7    0.05     0.3     100
           26           RD   437.6   0.005    0.03            TRAP       0       2      NO
                        *

           27           KK      S7
           28           KO       0       0       0       7      21
           29           BA  0.0091
           30           LS       0      86
           31           UK     160    0.25     0.3     100
           32           RD   437.6   0.005    0.03            TRAP       0       2      NO
                        *

           33           KK    C/S7
           34           KO       0       0       0       7      21
           35           HC       2
                        *
```

1 HEC-1 INPUT PAGE 2

```
          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

           36           KK     OA2
           37           KO       0       0       0       7      21
           38           BA  0.0765
           39           LS       0      84
```

```
 40          US    0.55    0.66
             *

 41          KK   C/CH1
 42          KO       0       0       0       7      21
 43          HC       3
             *

 44          KK     CH1
 45          KO       0       0       0       7      21
 46          BA  0.0095
 47          LS       0      86
 48          UK      47    0.25     0.3     100
 49          RD    3079    0.02    0.03            TRAP      10       3     YES
             *

 50          KK      T1
 51          KO       0       0       0       7      21
 52          BA  0.0024
 53          LS       0      85
 54          UK   166.5    0.05     0.3     100
 55          RD     305   0.005    0.03            TRAP       0       2      NO
             *

 56          KK      S1
 57          KO       0       0       0       7      21
 58          BA  0.0039
 59          LS       0      86
 60          UK   158.6    0.25     0.3     100
 61          RD   521.8   0.005    0.03            TRAP       0       2      NO
             *

 62          KK    C/S1
 63          KO       0       0       0       7      21
 64          HC       2
             *

 65          KK      P1
 66          KO       0       0       0       7      21
 67          BA  0.0087
 68          LS       0     100
 69          UD       0
             *

 70          KK    C/P1
 71          KO       0       0       0       7      21
 72          HC       3
             *
1                                        HEC-1 INPUT                                                    PAGE  3

          LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 73          KK    R/P1
 74          KO       0       0       0       7      21
 75          RS       1    ELEV    1044
 76          SA       0    1.58    1.85    2.10    2.35    2.61    2.87    3.14    3.41
 77          SE    1044  1044.2    1046    1048    1050    1052    1054    1056    1058
 78          SS  1056.5      10     2.6     1.5
 79          SL    1041    3.14     0.6     0.5
             *

 80          KK     DA1
 81          KO       0       0       0       7      21
 82          BA  0.0475
 83          LS       0      84
 84          US     .32     .66
             *

 85          KK   C/DP1
 86          KO       0       0       0       7      21
 87          HC       2
             *

 88          KK      T7
 89          KO       0       0       0       7      21
 90          BA  0.0067
 91          LS       0      85
 92          UK   244.1    0.05     0.3     100
 93          RD   437.6   0.005    0.03            TRAP       0       2      NO
             *

 94          KK      S5
 95          KO       0       0       0       7      21
 96          BA  0.0089
 97          LS       0      86
 98          UK   175.6    0.25     0.3     100
 99          RD   643.6   0.005    0.03            TRAP       0       2      NO
             *

100          KK    C/S5
101          KO       0       0       0       7      21
102          HC       2
             *

103          KK     OA1
```

```
 104          KO       0       0       0       7      21
 105          BA  0.1492
 106          LS       0      84
 107          US    0.56    0.64
              *
1                                        HEC-1 INPUT                                                    PAGE  4

 LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 108          KK   C/CH2
 109          KO       0       0       0       7      21
 110          HC       2
              *

 111          KK     CH2
 112          KO       0       0       0       7      21
 113          BA  0.0094
 114          LS       0      86
 115          UK      47    0.25     0.3     100
 116          RD     865    0.01    0.03            TRAP      10       3     YES
              *

 117          KK      T4
 118          KO       0       0       0       7      21
 119          BA  0.0102
 120          LS       0      86
 121          UK   175.6    0.25     0.3     100
 122          RD   696.8   0.005    0.03            TRAP       0       2      NO
              *

 123          KK     CH3
 124          KO       0       0       0       7      21
 125          BA  0.0035
 126          LS       0      86
 127          UK   155.7    0.25     0.3     100
 128          RD    1456    0.01    0.03            TRAP      10       3     YES
              *

 129          KK  C/DC#2
 130          KO       0       0       0       7      21
 131          HC       2
              *

 132          KK      T9
 133          KO       0       0       7      21
 134          BA  0.0217
 135          LS       0      85
 136          UK   919.3    0.05     0.3     100
 137          RD     232   0.005    0.03            TRAP       0       2      NO
              *

 138          KK     CH4
 139          KO       0       0       0       7      21
 140          BA  0.0096
 141          LS       0      86
 142          UK   155.8    0.25     0.3     100
 143          RD    1064    0.01    0.03            TRAP      10       3     YES
              *
1                                        HEC-1 INPUT                                                    PAGE  5

 LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 144          KK      T8
 145          KO       0       0       0       7      21
 146          BA  0.0095
 147          LS       0      85
 148          UK   359.7    0.05     0.3     100
 149          RD   720.5   0.005    0.03            TRAP       0       2      NO
              *

 150          KK      T3
 151          KO       0       0       0       7      21
 152          BA  0.0035
 153          LS       0      85
 154          UK      49    0.05     0.3     100
 155          RD     535   0.005    0.03            TRAP       0       2      NO
              *

 156          KK      S3
 157          KO       0       0       0       7      21
 158          BA  0.0067
 159          LS       0      86
 160          UK     160    0.25     0.3     100
 161          RD     304   0.005    0.03            TRAP       0       2      NO
              *

 162          KK    C/S3
 163          KO       0       0       0       7      21
 164          HC       2
              *

 165          KK     CH5
 166          KO       0       0       0       7      21
 167          BA  0.0076
```

```
          168          LS       0      86
          169          UK     200    0.25     0.3     100
          170          RD    1996    0.01    0.03            TRAP       2       2     YES
                       *

          171          KK      P2
          172          KO       0       0       0       7      21
          173          BA  0.0037
          174          LS       0     100
          175          UD       0
                       *

          176          KK    C/P2
          177          KO       0       0       0       7      21
          178          HC       4
                       *
1                                                HEC-1 INPUT                                                 PAGE  6

          LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


          179          KK    R/P2
          180          KO       0       0       0       7      21
          181          RS       1    ELEV    1034
          182          SA       0   0.167   0.215   0.245   0.283   0.319   0.429   0.492
          183          SE    1034  1034.2    1035    1036    1037    1038    1040    1042
          184          SS    1040      10     2.6     1.5
          185          SL  103328.86338     0.6     0.5
                       *

          186          KK      T2
          187          KO       0       0       0       7      21
          188          BA  0.0035
          189          LS       0      85
          190          UK      49    0.05     0.3     100
          191          RD     434   0.005    0.03            TRAP       0       2      NO
                       *

          192          KK      S2
          193          KO       0       0       0       7      21
          194          BA  0.0044
          195          LS       0      86
          196          UK     160    0.25     0.3     100
          197          RD     434   0.005    0.03            TRAP       0       2      NO
                       *

          198          KK    C/S2
          199          KO       0       0       0       7      21
          200          HC       2
                       *

          201          KK     CH6
          202          KO       0       0       0       7      21
          203          BA  0.0037
          204          LS       0      86
          205          UK     200    0.05     0.3     100
          206          RD     537    0.01    0.03            TRAP       2       2     YES
                       *

          207          KK     CH7
          208          KO      00       0       7      21
          209          BA  0.0024
          210          LS       0      86
          211          UK     210    0.05     0.3     100
          212          RD     317    0.01    0.03            TRAP       2       2      NO
                       *

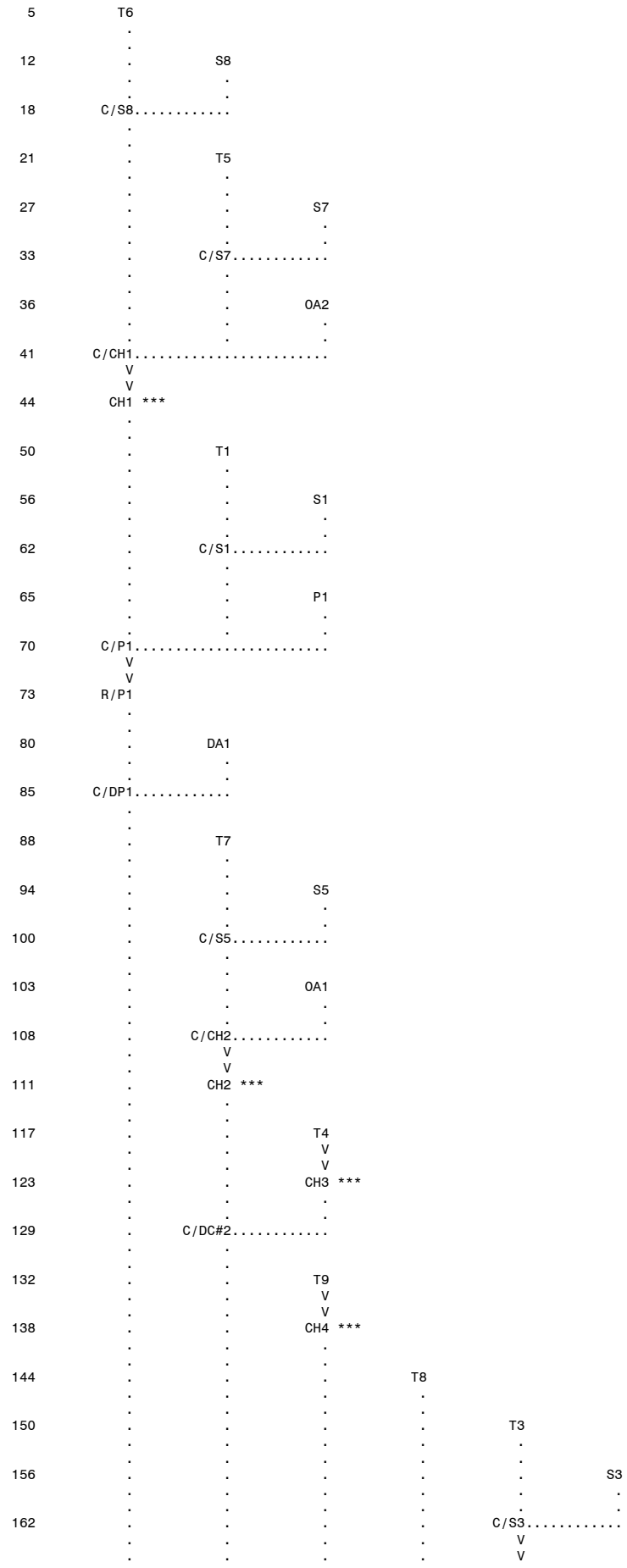
          213          KK   C/DC4
          214          KO       0       0       0       7      21
          215          HC       2
                       *
1                                                HEC-1 INPUT                                                 PAGE  7

          LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


          216          KK  DA3/DP5
          217          KO       0       0       0       7      21
          218          BA  0.0331
          219          LS       0      84
          220          US     .28     .67
                       *

          221          KK  DA2/DP6
          222          KO       0       0       0       7      21
          223          BA  0.0403
          224          LS       0      84
          225          US    0.29    0.66
          226          ZZ
1
               SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (---->) DIVERSION OR PUMP FLOW

    NO.     (.) CONNECTOR        (<----) RETURN OF DIVERTED OR PUMPED FLOW
```


5 T6
12 S8
18 C/S8
21 T5
27 S7
33 C/S7
36 OA2
41 C/CH1
44 CH1 ***
50 T1
56 S1
62 C/S1
65 P1
70 C/P1
73 R/P1
80 DA1
85 C/DP1
88 T7
94 S5
100 C/S5
103 OA1
108 C/CH2
111 CH2 ***
117 T4
123 CH3 ***
129 C/DC#2
132 T9
138 CH4 ***
144 T8
150 T3
156 S3
162 C/S3

```
  165          .          .          .          .        CH5 ***
               .          .          .          .          .
               .          .          .          .          .
  171          .          .          .          .          .          P2
               .          .          .          .          .           .
               .          .          .          .          .           .
  176          .          .       C/P2.................................
               .          .          V
               .          .          V
  179          .          .       R/P2
               .          .          .
               .          .          .
  186          .          .          .         T2
               .          .          .          .
               .          .          .          .
  192          .          .          .          .          S2
               .          .          .          .          .
               .          .          .          .          .
  198          .          .          .       C/S2............
               .          .          .          V
               .          .          .          V
  201          .          .          .        CH6 ***
               .          .          .          .
               .          .          .          .
  207          .          .          .          .         CH7
               .          .          .          .          .
               .          .          .          .          .
  213          .          .          .       C/DC4............
               .          .          .          .
               .          .          .          .
  216          .          .          .          .      DA3/DP
               .          .          .          .          .
               .          .          .          .          .
  221          .          .          .          .          .      DA2/DP

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1****************************************                                    ****************************************
*                                      *                                    *                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                    *    U.S. ARMY CORPS OF ENGINEERS      *
*        JUN 1998 AND FEB 2010         *                                    *    HYDROLOGIC ENGINEERING CENTER     *
*           VERSION 4.1R               *                                    *          609 SECOND STREET           *
*       RGMHEC2000 WWW.HEC-1.COM       *                                    *       DAVIS, CALIFORNIA 95616        *
*  RUN DATE   24JUL23  TIME  10:11:54  *                                    *          (916) 756-1104              *
*                                      *                                    *                                      *
****************************************                                    ****************************************
```

DEL RIO LF EXPANSION
100-YR, 24-HR

```
   4 IO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                        NMIN           5  MINUTES IN COMPUTATION INTERVAL
                       IDATE      1    0  STARTING DATE
                       ITIME        0000  STARTING TIME
                          NQ         416  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE      3    0  ENDING DATE
                      NDTIME        1035  ENDING TIME
                       ICENT          19  CENTURY MARK

                  COMPUTATION INTERVAL     .08 HOURS
                       TOTAL TIME BASE   34.58 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *              *
   5 KK     *         T6   *
            *              *
            **************

   7 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
```

```
                    ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

  8 BA         SUBBASIN CHARACTERISTICS
                    TAREA         .00  SUBBASIN AREA

               PRECIPITATION DATA

  6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                            STORM AREA =     .00

  9 LS         SCS LOSS RATE
                    STRTL         .35  INITIAL ABSTRACTION
                   CRVNBR       85.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
 10 UK           OVERLAND-FLOW ELEMENT NO. 1
                       L         179.  OVERLAND FLOW LENGTH
                       S        .0500  SLOPE
                       N         .300  ROUGHNESS COEFFICIENT
                      PA        100.0  PERCENT OF SUBBASIN
                    DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
 11 RD           MAIN CHANNEL
                       L         312.  CHANNEL LENGTH
                       S        .0050  SLOPE
                       N         .030  CHANNEL ROUGHNESS COEFFICIENT
                      CA          .00  CONTRIBUTING AREA
                   SHAPE         TRAP  CHANNEL SHAPE
                      WD          .00  BOTTOM WIDTH OR DIAMETER
                       Z         2.00  SIDE SLOPE
                  RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        1.11      1.67       1.10     35.80     28.14    724.81     10.01       .60
                    MAIN          1.63      1.33       1.40    312.00     26.46    724.88      8.83      3.71


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1656E+01 OUTFLOW= .1459E+01 BASIN STORAGE= .2888E-03 PERCENT ERROR=  11.8


                                           INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          1.63      1.33       5.00              26.41    725.00      8.84

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION       T6

      TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

    PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+     (CFS)       (HR)
                     (CFS)
+      26.41     12.08                  2.63         .74         .51          .51
                (INCHES)     7.889       8.840       8.842       8.842
                 (AC-FT)     1.30         1.46        1.46        1.46

                CUMULATIVE AREA =    .00310 SQ MI   ACRES=            1.9840


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
 12 KK        *         S8 *
              *            *
              **************

 13 KO        OUTPUT CONTROL VARIABLES
                    IPRNT           3  PRINT CONTROL
                    IPLOT           0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE
                    IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                     IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
```

```
                    TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  14 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .01

  15 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
  16 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L        140.  OVERLAND FLOW LENGTH
                          S       .2500  SLOPE
                          N        .300  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
  17 RD            MAIN CHANNEL
                          L        541.  CHANNEL LENGTH
                          S       .0050  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .01  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD         .00  BOTTOM WIDTH OR DIAMETER
                          Z        2.00  SIDE SLOPE
                     RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                           COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                     PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        2.48      1.67        .51     27.92     61.36    724.63     10.01       .95
                     MAIN          1.63      1.33       1.99    270.35     60.39    724.73      9.82      4.53

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .3152E+01 OUTFLOW= .3091E+01 BASIN STORAGE= .3316E-03 PERCENT ERROR=   1.9


                                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                     MAIN          1.63      1.33       5.00               58.27    725.00      9.88

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION       S8

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
 +   (CFS)       (HR)
                           (CFS)
 +    58.27     12.08                   5.46        1.57        1.09         1.09
                         (INCHES)     8.604       9.878       9.879        9.879
                          (AC-FT)      2.71        3.11        3.11         3.11

                         CUMULATIVE AREA =    .00590 SQ MI   ACRES=            3.7760


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


               **************
               *            *
  18 KK        *      C/S8  *
               *            *
               **************

  19 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS
```

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  20 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

      ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION     C/S8

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                        (CFS)
+     84.68     12.08                 8.09        2.30        1.60         1.60
                      (INCHES)      8.357       9.520       9.521        9.521
                       (AC-FT)       4.01        4.57        4.57         4.57

                      CUMULATIVE AREA =    .00900 SQ MI   ACRES=            5.7600


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *             *
  21 KK     *         T5  *
            *             *
            **************

  22 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  23 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                 STORM AREA =     .00

  24 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
  25 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L         176.  OVERLAND FLOW LENGTH
                          S        .0500  SLOPE
                          N         .300  ROUGHNESS COEFFICIENT
                         PA        100.0  PERCENT OF SUBBASIN
                       DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
  26 RD            MAIN CHANNEL
                          L         438.  CHANNEL LENGTH
                          S        .0050  SLOPE
                          N         .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA          .00  CONTRIBUTING AREA
                      SHAPE         TRAP  CHANNEL SHAPE
                         WD          .00  BOTTOM WIDTH OR DIAMETER
                          Z         2.00  SIDE SLOPE
                     RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                          ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                      PEAK                CELERITY
                                                                (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        1.11      1.67       1.03     35.14     36.10    724.66     10.01        .59
                     MAIN          1.63      1.33       1.85    218.80     35.15    725.64      9.88       3.95


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2137E+01 OUTFLOW= .2108E+01 BASIN STORAGE= .3904E-03 PERCENT ERROR=   1.3

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL
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                  MAIN          1.63      1.33       5.00              34.09    725.00      9.88

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION       T5

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                        (CFS)
+    34.09     12.08                3.68        1.06         .74          .74
                       (INCHES)     8.550       9.877       9.878        9.878
                        (AC-FT)     1.82        2.11        2.11         2.11

                       CUMULATIVE AREA =    .00400 SQ MI   ACRES=            2.5600


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  27 KK     *        S7  *
            *            *
            **************

  28 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

  29 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .01  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                              STORM AREA =     .01

  30 LS          SCS LOSS RATE
                      STRTL         .33  INITIAL ABSTRACTION
                     CRVNBR       86.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
  31 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L        160.  OVERLAND FLOW LENGTH
                          S       .2500  SLOPE
                          N        .300  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
  32 RD            MAIN CHANNEL
                          L        438.  CHANNEL LENGTH
                          S       .0050  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .01  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD         .00  BOTTOM WIDTH OR DIAMETER
                          Z        2.00  SIDE SLOPE
                     RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .62     32.00     94.50    724.51     10.14      1.00
                    MAIN          1.63      1.33       1.45    437.60     90.12    724.01      8.81      5.05

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .4924E+01 OUTFLOW= .4276E+01 BASIN STORAGE= .3388E-03 PERCENT ERROR=  13.2

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          1.63      1.33       5.00              88.10    725.00      8.82
```

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      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION       S7

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                      (CFS)
+    88.10     12.08                 7.75        2.16        1.50         1.50
                     (INCHES)      7.922       8.818       8.819        8.819
                      (AC-FT)       3.84        4.28        4.28         4.28

                     CUMULATIVE AREA =    .00910 SQ MI   ACRES=            5.8240


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  33 KK     *      C/S7  *
            *            *
            **************

  34 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


  35 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION     C/S7

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                      (CFS)
+   122.19     12.08                11.43        3.22        2.23         2.23
                     (INCHES)      8.112       9.141       9.142        9.142
                      (AC-FT)       5.67        6.39        6.39         6.39

                     CUMULATIVE AREA =    .01310 SQ MI   ACRES=            8.3840


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  36 KK     *       OA2  *
            *            *
            **************

  37 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  38 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .08  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .08

  39 LS          SCS LOSS RATE
                       STRTL         .38  INITIAL ABSTRACTION
                      CRVNBR       84.00  CURVE NUMBER
```

```
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

  40 US          SNYDER UNITGRAPH
                   TP          .55  LAG
                   CP          .66  PEAKING COEFFICIENT

                 SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                          ***

                                                UNIT HYDROGRAPH PARAMETERS
                                             CLARK   TC=   .64 HR,       R=   .45 HR
                                            SNYDER   TP=   .55 HR,      CP=   .67

                                                    UNIT HYDROGRAPH
                                                33 END-OF-PERIOD ORDINATES
               3.       12.       24.       37.       49.       57.       60.       57.       50.       41.
              34.       28.       24.       20.       16.       13.       11.        9.        8.        6.
               5.        4.        4.        3.        3.        2.        2.        1.        1.        1.
               1.        1.        1.

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION      OA2

    TOTAL RAINFALL =   11.90, TOTAL LOSS =    2.02, TOTAL EXCESS =    9.88

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                       (CFS)
+   245.09     12.58              69.33       20.23       14.04        14.04
                     (INCHES)     8.427       9.837       9.837        9.837
                      (AC-FT)     34.38       40.13       40.13        40.13

                     CUMULATIVE AREA =    .07650 SQ MI   ACRES=           48.9600


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  41 KK     *     C/CH1  *
            *            *
            **************

  42 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


  43 HC          HYDROGRAPH COMBINATION
                      ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION    C/CH1

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                       (CFS)
+   302.78     12.08              88.74       25.76       17.88        17.88
                     (INCHES)     8.368       9.716       9.716        9.716
                      (AC-FT)     44.00       51.09       51.09        51.09

                     CUMULATIVE AREA =    .09860 SQ MI   ACRES=           63.1040


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  44 KK     *       CH1  *
            *            *
            **************

  45 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
```

```
                    ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

   46 BA        SUBBASIN CHARACTERISTICS
                     TAREA         .01  SUBBASIN AREA

                PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .01

   47 LS        SCS LOSS RATE
                     STRTL         .33  INITIAL ABSTRACTION
                    CRVNBR       86.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
   48 UK          OVERLAND-FLOW ELEMENT NO. 1
                         L         47.  OVERLAND FLOW LENGTH
                         S       .2500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                     DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
   49 RD          MAIN CHANNEL
                         L       3079.  CHANNEL LENGTH
                         S       .0200  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .01  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD       10.00  BOTTOM WIDTH OR DIAMETER
                         Z        3.00  SIDE SLOPE
                    RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                                ***
         MCUNGE FATAL ERROR - NUMBER OF ORDINATES FOR CONSTANT TIME STEP OVERLAND FLOW EXCEEDS ARRAY DIMENSIONS - REDUCE DURATION OF RUN
ON IT - RECORD
                                      COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                                COMPUTATION TIME STEP
                       ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                       PEAK                CELERITY
                                                       (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                       PLANE1        2.48      1.67        .27      9.40    100.26    723.03     10.14       .62
                       MAIN          1.95      1.42       4.74   1539.50    314.53    730.59      9.78     10.82


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5109E+02  EXCESS= .5141E+01 OUTFLOW= .5640E+02 BASIN STORAGE= .9255E-01 PERCENT ERROR=   -.5


                                               INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                       MAIN          1.95      1.42       5.00              311.87    730.00      9.79

          ***             ***             ***             ***             ***

                            HYDROGRAPH AT STATION      CH1

        TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

     PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                         6-HR       24-HR       72-HR     34.58-HR
+       (CFS)       (HR)
                           (CFS)
+       311.87     12.17                97.59       28.34       19.74        19.74
                         (INCHES)      8.394       9.749       9.785        9.785
                          (AC-FT)      48.39       56.21       56.42        56.42

                         CUMULATIVE AREA =    .10810 SQ MI   ACRES=           69.1840


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
   50 KK      *         T1 *
              *            *
              **************

   51 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
```

```
                    ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

  52 BA         SUBBASIN CHARACTERISTICS
                     TAREA         .00  SUBBASIN AREA

                PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .00

  53 LS         SCS LOSS RATE
                     STRTL         .35  INITIAL ABSTRACTION
                    CRVNBR       85.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
  54 UK           OVERLAND-FLOW ELEMENT NO. 1
                         L        167.  OVERLAND FLOW LENGTH
                         S       .0500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
  55 RD           MAIN CHANNEL
                         L        305.  CHANNEL LENGTH
                         S       .0050  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .00  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD         .00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                        ***
                                    COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                             COMPUTATION TIME STEP
                       ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                      PEAK                CELERITY
                                                                (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                       PLANE1        1.11      1.67       1.03     33.30     22.07    724.77     10.02       .59
                       MAIN          1.63      1.33       1.45    305.00     21.24    724.71      8.83      3.51


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1282E+01 OUTFLOW= .1130E+01 BASIN STORAGE= .2446E-03 PERCENT ERROR=  11.8


                                             INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                       MAIN          1.63      1.33       5.00               21.09    725.00      8.85

          ***             ***             ***             ***             ***

                            HYDROGRAPH AT STATION       T1

        TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

      PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                          6-HR        24-HR       72-HR     34.58-HR
    +   (CFS)       (HR)
                         (CFS)
    +    21.09     12.08                 2.03         .57         .40          .40
                          (INCHES)     7.874       8.853       8.854        8.854
                           (AC-FT)      1.01        1.13        1.13         1.13

                         CUMULATIVE AREA =    .00240 SQ MI   ACRES=            1.5360


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
  56 KK       *        S1  *
              *            *
              **************

  57 KO         OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS
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              SUBBASIN RUNOFF DATA

   58 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .00

   59 LS          SCS LOSS RATE
                        STRTL         .33  INITIAL ABSTRACTION
                       CRVNBR       86.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
   60 UK            OVERLAND-FLOW ELEMENT NO. 1
                            L         159.  OVERLAND FLOW LENGTH
                            S       .2500  SLOPE
                            N        .300  ROUGHNESS COEFFICIENT
                           PA       100.0  PERCENT OF SUBBASIN
                         DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
   61 RD            MAIN CHANNEL
                            L         522.  CHANNEL LENGTH
                            S       .0050  SLOPE
                            N        .030  CHANNEL ROUGHNESS COEFFICIENT
                           CA         .00  CONTRIBUTING AREA
                        SHAPE        TRAP  CHANNEL SHAPE
                           WD         .00  BOTTOM WIDTH OR DIAMETER
                            Z        2.00  SIDE SLOPE
                       RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                    COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                           COMPUTATION TIME STEP
                      ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                      PEAK               CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                      PLANE1        2.48      1.67        .60     31.72     40.65    724.75     10.15      1.00
                      MAIN          1.63      1.33       2.13    260.90     38.23    725.34      9.97      4.09


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2110E+01 OUTFLOW= .2075E+01 BASIN STORAGE= .3091E-03 PERCENT ERROR=   1.7


                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                      MAIN          1.63      1.33       5.00               37.89    725.00     10.00

          ***             ***             ***             ***             ***

                             HYDROGRAPH AT STATION       S1

        TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

      PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                              6-HR       24-HR       72-HR     34.58-HR
    +   (CFS)       (HR)
                          (CFS)
    +    37.89     12.08                   3.64        1.05         .73          .73
                         (INCHES)     8.670      10.002      10.002       10.002
                          (AC-FT)      1.80        2.08        2.08         2.08

                         CUMULATIVE AREA =    .00390 SQ MI   ACRES=            2.4960


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
   62 KK      *      C/S1  *
              *            *
              **************

   63 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS
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  64 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

      ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION     C/S1

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                        (CFS)
+    58.98     12.08                 5.67        1.62        1.12         1.12
                       (INCHES)     8.366       9.564       9.565        9.565
                        (AC-FT)     2.81        3.21        3.21         3.21

                       CUMULATIVE AREA =    .00630 SQ MI   ACRES=            4.0320


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  65 KK     *        P1  *
            *            *
            **************

  66 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  67 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

               PRECIPITATION DATA

   6 PH                               DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .01

  68 LS          SCS LOSS RATE
                       STRTL         .00  INITIAL ABSTRACTION
                      CRVNBR      100.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

  69 UD          SCS DIMENSIONLESS UNITGRAPH
                        TLAG         .00  LAG

                                                          ***

                                                     UNIT HYDROGRAPH
                                                  5 END-OF-PERIOD ORDINATES
              50.       14.        3.        1.        0.

      ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION       P1

    TOTAL RAINFALL =   11.90, TOTAL LOSS =     .00, TOTAL EXCESS =   11.90

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                        (CFS)
+    83.99     12.08                 8.92        2.78        1.93         1.93
                       (INCHES)     9.533      11.897      11.900       11.900
                        (AC-FT)     4.42        5.52        5.52         5.52

                       CUMULATIVE AREA =    .00870 SQ MI   ACRES=            5.5680


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  70 KK     *      C/P1  *
            *            *
            **************
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  71 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


  72 HC          HYDROGRAPH COMBINATION
                       ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

      ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION     C/P1

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR     34.58-HR
+    (CFS)        (HR)
                        (CFS)
+    424.61     12.08               111.91        32.71       22.79        22.79
                      (INCHES)      8.453        9.881       9.923        9.923
                       (AC-FT)     55.49        64.87       65.15        65.15

                      CUMULATIVE AREA =    .12310 SQ MI   ACRES=           78.7840


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *             *
  73 KK      *      R/P1   *
             *             *
             **************

  74 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


               HYDROGRAPH ROUTING DATA

  75 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                      RSVRIC     1044.00  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

  76 SA               AREA          .0       1.6       1.9       2.1       2.3       2.6       2.9       3.1       3.4

  77 SE          ELEVATION     1044.00   1044.20   1046.00   1048.00   1050.00   1052.00   1054.00   1056.00   1058.00

  79 SL          LOW-LEVEL OUTLET
                       ELEVL     1041.00  ELEVATION AT CENTER OF OUTLET
                       CAREA        3.14  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

  78 SS          SPILLWAY
                        CREL     1056.50  SPILLWAY CREST ELEVATION
                       SPWID       10.00  SPILLWAY WIDTH
                        COQW        2.60  WEIR COEFFICIENT
                        EXPW        1.50  EXPONENT OF HEAD

                                                          ***

                                              COMPUTED STORAGE-ELEVATION DATA

          STORAGE        .00       .11      3.19      7.14     11.58     16.54     22.02     28.03     34.58
        ELEVATION    1044.00   1044.20   1046.00   1048.00   1050.00   1052.00   1054.00   1056.00   1058.00

                                              COMPUTED OUTFLOW-ELEVATION DATA

          OUTFLOW        .00     27.91     29.89     32.18     34.84     37.99     41.76     46.37     52.12     59.49
        ELEVATION    1044.00   1044.41   1044.91   1045.54   1046.32   1047.32   1048.64   1050.42   1052.90   1056.50

          OUTFLOW      59.66     60.24     61.48     63.65     66.98     71.74     78.17     86.54     97.08    110.06
        ELEVATION    1056.53   1056.58   1056.66   1056.77   1056.91   1057.07   1057.26   1057.48   1057.73   1058.00


                                          COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00       .11       .44      1.27      2.35      3.19      3.78      5.74      7.14      8.51
          OUTFLOW      26.17     27.03     27.91     29.89     32.18     33.79     34.84     37.99     39.98     41.76
```

```
          ELEVATION    1044.00   1044.20   1044.41   1044.91   1045.54   1046.00   1046.32   1047.32   1048.00   1048.64

            STORAGE      11.58     12.58     16.54     18.93     22.02     28.03     29.61     29.70     29.87     30.13
            OUTFLOW      45.33     46.37     50.11     52.12     54.48     58.52     59.49     59.66     60.24     61.48
          ELEVATION    1050.00   1050.42   1052.00   1052.90   1054.00   1056.00   1056.50   1056.53   1056.58   1056.66

            STORAGE      30.48     30.93     31.46     32.09     32.82     33.65     34.58
            OUTFLOW      63.65     66.98     71.74     78.17     86.54     97.08    110.06
          ELEVATION    1056.77   1056.91   1057.07   1057.26   1057.48   1057.73   1058.00

      ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION     R/P1

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                             (CFS)
+    87.77     14.00                64.05       40.72       36.27        36.27
                            (INCHES)     4.837      12.302      15.789       15.789
                             (AC-FT)     31.76       80.77      103.66       103.66

 PEAK STORAGE   TIME                        MAXIMUM AVERAGE STORAGE
                                    6-HR        24-HR       72-HR     34.58-HR
+  (AC-FT)      (HR)
    32.916     14.00                27.72        9.94        6.89         6.87

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                    6-HR        24-HR       72-HR     34.58-HR
+   (FEET)      (HR)
   1057.51     14.00              1055.86     1048.54     1047.15      1047.15

                        CUMULATIVE AREA =    .12310 SQ MI   ACRES=           78.7840


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   80 KK    *       DA1  *
            *            *
            **************

   81 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

   82 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .05  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                 STORM AREA =     .05

   83 LS          SCS LOSS RATE
                       STRTL         .38  INITIAL ABSTRACTION
                      CRVNBR       84.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

   84 US          SNYDER UNITGRAPH
                        TP         .32  LAG
                        CP         .66  PEAKING COEFFICIENT

                  SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                        ***

                                                UNIT HYDROGRAPH PARAMETERS
                                             CLARK   TC=   .38 HR,       R=   .26 HR
                                            SNYDER   TP=   .32 HR,      CP=   .66

                                                    UNIT HYDROGRAPH
                                                19 END-OF-PERIOD ORDINATES
                  7.       26.       48.       62.       59.       46.       33.       24.       17.       12.
                  9.        7.        5.        3.        2.        2.        1.        1.        1.

      ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      DA1
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     TOTAL RAINFALL =   11.90, TOTAL LOSS =    2.02, TOTAL EXCESS =    9.88

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                     (CFS)
+   203.77     12.33                43.17       12.56        8.72         8.72
                     (INCHES)     8.450       9.837       9.837        9.837
                      (AC-FT)     21.41       24.92       24.92        24.92

                     CUMULATIVE AREA =    .04750 SQ MI   ACRES=           30.4000


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   85 KK    *     C/DP1  *
            *            *
            **************

   86 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


   87 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION    C/DP1

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                     (CFS)
+   252.13     12.33               102.08       53.28       44.99        44.99
                     (INCHES)     5.564      11.616      14.131       14.131
                      (AC-FT)     50.62      105.69      128.58       128.58

                     CUMULATIVE AREA =    .17060 SQ MI   ACRES=          109.1840


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   88 KK    *        T7  *
            *            *
            **************

   89 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

   90 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .01

   91 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
   92 UK            OVERLAND-FLOW ELEMENT NO. 1
```

```
                        L        244.  OVERLAND FLOW LENGTH
                        S       .0500  SLOPE
                        N        .300  ROUGHNESS COEFFICIENT
                       PA       100.0  PERCENT OF SUBBASIN
                     DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
  93 RD             MAIN CHANNEL
                        L        438.  CHANNEL LENGTH
                        S       .0050  SLOPE
                        N        .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA         .01  CONTRIBUTING AREA
                    SHAPE        TRAP  CHANNEL SHAPE
                       WD         .00  BOTTOM WIDTH OR DIAMETER
                        Z        2.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                      PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        1.11      1.67       1.33     48.82     56.10    724.85     10.01       .66
                     MAIN          1.63      1.33       1.65    437.60     53.57    725.31      8.80      4.41


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .3579E+01 OUTFLOW= .3145E+01 BASIN STORAGE= .6710E-03 PERCENT ERROR=  12.1


                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                     MAIN          1.63      1.33       5.00               52.29    725.00      8.82

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION       T7

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                         (CFS)
+     52.29     12.08                 5.70        1.59        1.10         1.10
                        (INCHES)     7.907       8.814       8.817        8.817
                         (AC-FT)      2.83        3.15        3.15         3.15

                        CUMULATIVE AREA =    .00670 SQ MI   ACRES=            4.2880


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  94 KK      *        S5  *
             *            *
             **************

  95 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  96 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .01

  97 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
  98 UK           OVERLAND-FLOW ELEMENT NO. 1
                        L        176.  OVERLAND FLOW LENGTH
                        S       .2500  SLOPE
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                          N        .300  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                       DXMIN          5  MINIMUM NUMBER OF DX INTERVALS
                    MUSKINGUM-CUNGE
  99 RD               MAIN CHANNEL
                          L        644.  CHANNEL LENGTH
                          S       .0050  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .01  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD         .00  BOTTOM WIDTH OR DIAMETER
                          Z        2.00  SIDE SLOPE
                     RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                      ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                      PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                      PLANE1        2.48      1.67        .69     35.12     92.81    724.92     10.15      1.05
                      MAIN          1.63      1.33       2.14    321.80     89.43    724.97      9.91      5.02

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .4816E+01 OUTFLOW= .4706E+01 BASIN STORAGE= .4555E-03 PERCENT ERROR=   2.3

                                           INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                      MAIN          1.63      1.33       5.00               89.07    725.00      9.99

       ***             ***             ***             ***             ***

                            HYDROGRAPH AT STATION       S5

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                       6-HR        24-HR       72-HR     34.58-HR
+    (CFS)        (HR)
                          (CFS)
+     89.07     12.08                  8.34        2.39        1.66         1.66
                        (INCHES)     8.716       9.988       9.989        9.989
                         (AC-FT)      4.14        4.74        4.74         4.74

                        CUMULATIVE AREA =    .00890 SQ MI   ACRES=            5.6960


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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              *            *
  100 KK      *      C/S5  *
              *            *
              **************

  101 KO           OUTPUT CONTROL VARIABLES
                        IPRNT          3  PRINT CONTROL
                        IPLOT          0  PLOT CONTROL
                        QSCAL         0.  HYDROGRAPH PLOT SCALE
                        IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                         IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT       .083  TIME INTERVAL IN HOURS


  102 HC           HYDROGRAPH COMBINATION
                        ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                    ***

       ***             ***             ***             ***             ***

                            HYDROGRAPH AT STATION     C/S5

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                       6-HR        24-HR       72-HR     34.58-HR
+    (CFS)        (HR)
                          (CFS)
+    141.36     12.08                 14.04        3.98        2.76         2.76
                        (INCHES)     8.366       9.484       9.486        9.486
                         (AC-FT)      6.96        7.89        7.89         7.89

                        CUMULATIVE AREA =    .01560 SQ MI   ACRES=            9.9840


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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          *           *
103 KK    *       OA1 *
          *           *
          *************

104 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

105 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .15  SUBBASIN AREA

                PRECIPITATION DATA

  6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .15

106 LS          SCS LOSS RATE
                     STRTL         .38  INITIAL ABSTRACTION
                    CRVNBR       84.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

107 US          SNYDER UNITGRAPH
                       TP         .56  LAG
                       CP         .64  PEAKING COEFFICIENT

                SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                        ***

                                                UNIT HYDROGRAPH PARAMETERS
                                          CLARK   TC=   .64 HR,       R=   .49 HR
                                         SNYDER   TP=   .56 HR,      CP=   .64

                                                    UNIT HYDROGRAPH
                                                36 END-OF-PERIOD ORDINATES
                    6.       22.       44.       68.       90.      105.      112.      107.       94.       79.
                   67.       57.       48.       40.       34.       29.       24.       20.       17.       15.
                   12.       10.        9.        7.        6.        5.        4.        4.        3.        3.
                    2.        2.        2.        1.        1.        1.

     ***            ***            ***            ***            ***

                          HYDROGRAPH AT STATION      OA1

    TOTAL RAINFALL =   11.90, TOTAL LOSS =    2.02, TOTAL EXCESS =    9.88

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+   460.68     12.58               135.12       39.47       27.39       27.39
                        (INCHES)     8.420       9.838       9.838       9.838
                         (AC-FT)    67.00       78.28       78.28       78.28

                        CUMULATIVE AREA =    .14920 SQ MI   ACRES=          95.4880


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
108 KK    *     C/CH2  *
          *            *
          **************

109 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


110 HC          HYDROGRAPH COMBINATION
                     ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***
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      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION    C/CH2

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                  6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                     (CFS)
+   481.90     12.58              149.06       43.44       30.15       30.15
                     (INCHES)     8.410       9.804       9.804       9.804
                      (AC-FT)    73.91       86.17       86.17       86.17

                    CUMULATIVE AREA =    .16480 SQ MI   ACRES=          105.4720


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 111 KK    *       CH2  *
           *            *
           **************

 112 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

 113 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .01  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                              STORM AREA =     .01

 114 LS          SCS LOSS RATE
                      STRTL         .33  INITIAL ABSTRACTION
                     CRVNBR       86.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 115 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L          47.  OVERLAND FLOW LENGTH
                          S       .2500  SLOPE
                          N        .300  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 116 RD            MAIN CHANNEL
                          L         865.  CHANNEL LENGTH
                          S       .0100  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .01  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD       10.00  BOTTOM WIDTH OR DIAMETER
                          Z        3.00  SIDE SLOPE
                     RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                                ***
       MCUNGE FATAL ERROR - NUMBER OF ORDINATES FOR CONSTANT TIME STEP OVERLAND FLOW EXCEEDS ARRAY DIMENSIONS - REDUCE DURATION OF RUN
ON IT - RECORD
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                           COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .27      9.40     99.22    723.03     10.14       .62
                    MAIN          1.38      1.42       1.60    432.50    491.89    756.09      9.86      9.00


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .8617E+02  EXCESS= .5087E+01 OUTFLOW= .9159E+02 BASIN STORAGE= .4916E-01 PERCENT ERROR=   -.4


                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          1.38      1.42       5.00              489.94    755.00      9.86

      ***            ***            ***            ***            ***
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                        HYDROGRAPH AT STATION      CH2

    TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                        (CFS)
+   489.94     12.58              157.73       45.99       32.05        32.05
                        (INCHES)    8.418       9.818       9.860        9.860
                         (AC-FT)   78.21       91.22       91.61        91.61

                        CUMULATIVE AREA =    .17420 SQ MI   ACRES=          111.4880


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 117 KK     *        T4  *
            *            *
            **************

 118 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

 119 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .01  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .01

 120 LS          SCS LOSS RATE
                      STRTL         .33  INITIAL ABSTRACTION
                     CRVNBR       86.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 121 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L         176.  OVERLAND FLOW LENGTH
                          S        .2500  SLOPE
                          N         .300  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 122 RD            MAIN CHANNEL
                          L         697.  CHANNEL LENGTH
                          S        .0050  SLOPE
                          N         .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA          .01  CONTRIBUTING AREA
                      SHAPE         TRAP  CHANNEL SHAPE
                         WD          .00  BOTTOM WIDTH OR DIAMETER
                          Z         2.00  SIDE SLOPE
                     RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .69     35.12    106.37    724.92     10.15      1.05
                    MAIN          1.63      1.33       2.24    348.40    102.30    725.01      9.90      5.19

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .5520E+01 OUTFLOW= .5383E+01 BASIN STORAGE= .4973E-03 PERCENT ERROR=   2.5

                                       INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          1.63      1.33       5.00             102.25    725.00      9.97

      ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION       T4
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```
    TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                        (CFS)
+   102.25     12.08                 9.55        2.73        1.90         1.90
                        (INCHES)    8.708       9.966       9.966        9.966
                         (AC-FT)     4.74        5.42        5.42         5.42

                        CUMULATIVE AREA =    .01020 SQ MI   ACRES=            6.5280


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  123 KK    *       CH3  *
            *            *
            **************

  124 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  125 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .00

  126 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  127 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        156.  OVERLAND FLOW LENGTH
                           S       .2500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
  128 RD            MAIN CHANNEL
                           L       1456.  CHANNEL LENGTH
                           S       .0100  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .00  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD       10.00  BOTTOM WIDTH OR DIAMETER
                           Z        3.00  SIDE SLOPE
                      RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                                (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        2.48      1.67        .65     31.14     36.40    724.45     10.15      1.00
                     MAIN          1.38      1.42       3.93    728.00    107.79    727.41      9.91      6.17

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5422E+01  EXCESS= .1894E+01 OUTFLOW= .7239E+01 BASIN STORAGE= .1090E-02 PERCENT ERROR=   1.0

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                     MAIN          1.38      1.42       5.00               97.16    730.00      9.86

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION      CH3

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15
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```
  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                        (CFS)
+    97.16     12.17                12.69        3.63        2.52         2.52
                     (INCHES)      8.610       9.859       9.860        9.860
                      (AC-FT)      6.29        7.20        7.20         7.20

                     CUMULATIVE AREA =    .01370 SQ MI   ACRES=            8.7680


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  129 KK    *    C/DC#2  *
            *            *
            **************

  130 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


  131 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

       ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION   C/DC#2

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                        (CFS)
+   510.21     12.58               170.34       49.62       34.57        34.57
                     (INCHES)      8.429       9.821       9.860        9.860
                      (AC-FT)      84.47       98.42       98.81        98.81

                     CUMULATIVE AREA =    .18790 SQ MI   ACRES=          120.2560


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  132 KK    *        T9  *
            *            *
            **************

  133 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          7.  HYDROGRAPH PLOT SCALE
                       IPNCH          21  PUNCH COMPUTED HYDROGRAPH
                        IOUT           0  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

  134 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .02  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                 STORM AREA =     .02

  135 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  136 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        919.  OVERLAND FLOW LENGTH
```

```
                         S       .0500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                   MUSKINGUM-CUNGE
 137 RD              MAIN CHANNEL
                         L        232.  CHANNEL LENGTH
                         S       .0050  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .02  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD         .00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                     PEAK                CELERITY
                                                        (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        1.11      1.67       3.43    183.86    111.47    732.11       9.99       .91
                     MAIN          1.63      1.33        .74    232.00    110.02    730.53       9.44      5.25


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1159E+02 OUTFLOW= .1093E+02 BASIN STORAGE= .1005E-01 PERCENT ERROR=   5.7


                                           INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                     MAIN          1.63      1.33       5.00              109.67    730.00      9.44

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION       T9

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR     34.58-HR
 +   (CFS)        (HR)
                          (CFS)
 +   109.67     12.17                19.60        5.51        3.82         3.82
                          (INCHES)    8.398       9.436       9.441        9.441
                           (AC-FT)    9.72        10.92       10.93        10.93

                          CUMULATIVE AREA =    .02170 SQ MI   ACRES=           13.8880


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


               **************
               *              *
 138 KK        *       CH4    *
               *              *
               **************

 139 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

 140 BA         SUBBASIN CHARACTERISTICS
                      TAREA         .01  SUBBASIN AREA

                PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .01

 141 LS         SCS LOSS RATE
                      STRTL         .33  INITIAL ABSTRACTION
                     CRVNBR       86.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
 142 UK           OVERLAND-FLOW ELEMENT NO. 1
                         L        156.  OVERLAND FLOW LENGTH
                         S       .2500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
```

```
                      PA       100.0  PERCENT OF SUBBASIN
                    DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
143 RD            MAIN CHANNEL
                       L       1064.  CHANNEL LENGTH
                       S       .0100  SLOPE
                       N        .030  CHANNEL ROUGHNESS COEFFICIENT
                      CA         .01  CONTRIBUTING AREA
                   SHAPE        TRAP  CHANNEL SHAPE
                      WD       10.00  BOTTOM WIDTH OR DIAMETER
                       Z        3.00  SIDE SLOPE
                  RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .54     31.16    100.62    725.00     10.14       .99
                    MAIN          1.38      1.42       2.58    532.00    166.69    726.36      9.58      6.86


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1093E+02  EXCESS= .5195E+01 OUTFLOW= .1599E+02 BASIN STORAGE= .8624E-03 PERCENT ERROR=    .8


                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          1.38      1.42       5.00              165.86    725.00      9.57

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      CH4

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                         (CFS)
+    165.86     12.08                28.45        8.05        5.59         5.59
                        (INCHES)     8.452       9.567       9.572        9.572
                         (AC-FT)     14.11       15.97       15.98        15.98

                        CUMULATIVE AREA =    .03130 SQ MI   ACRES=           20.0320


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
  144 KK      *         T8 *
              *            *
              **************

  145 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  146 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .01

  147 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  148 UK            OVERLAND-FLOW ELEMENT NO. 1
                       L        360.  OVERLAND FLOW LENGTH
                       S       .0500  SLOPE
                       N        .300  ROUGHNESS COEFFICIENT
                      PA       100.0  PERCENT OF SUBBASIN
                    DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
```

```
                MUSKINGUM-CUNGE
 149 RD           MAIN CHANNEL
                         L        721.  CHANNEL LENGTH
                         S       .0050  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .01  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD         .00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        1.11      1.67       1.81     71.94     69.91    724.93     10.01       .73
                    MAIN          1.63      1.33       2.58    360.25     66.96    727.97      9.84      4.65


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .5075E+01 OUTFLOW= .4985E+01 BASIN STORAGE= .1508E-02 PERCENT ERROR=   1.7


                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          1.63      1.33       5.00               64.47    725.00      9.84

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION       T8

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
 +   (CFS)       (HR)
                          (CFS)
 +    64.47     12.08                8.75        2.51        1.74         1.74
                         (INCHES)     8.559       9.839       9.843        9.843
                          (AC-FT)     4.34        4.98        4.99         4.99

                         CUMULATIVE AREA =    .00950 SQ MI   ACRES=            6.0800


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
 150 KK       *        T3  *
              *            *
              **************

 151 KO           OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

 152 BA           SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                 STORM AREA =     .00

 153 LS           SCS LOSS RATE
                        STRTL         .35  INITIAL ABSTRACTION
                       CRVNBR       85.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
 154 UK             OVERLAND-FLOW ELEMENT NO. 1
                         L          49.  OVERLAND FLOW LENGTH
                         S       .0500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
 155 RD             MAIN CHANNEL
```

```
                        L        535.  CHANNEL LENGTH
                        S       .0050  SLOPE
                        N        .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA         .00  CONTRIBUTING AREA
                    SHAPE        TRAP  CHANNEL SHAPE
                       WD         .00  BOTTOM WIDTH OR DIAMETER
                        Z        2.00  SIDE SLOPE
                   RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                 ***
                              COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                      COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                        (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        1.11      1.67        .56      9.80     36.55    724.52     10.01       .39
                    MAIN          1.63      1.33       2.24    267.50     35.31    723.77      9.84      3.98


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1870E+01 OUTFLOW= .1836E+01 BASIN STORAGE= .2948E-03 PERCENT ERROR=   1.8


                                           INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          1.63      1.33       5.00               32.50    725.00      9.82

       ***             ***             ***             ***             ***

                            HYDROGRAPH AT STATION       T3

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                        (CFS)
+     32.50     12.08                3.21         .92         .64          .64
                          (INCHES)    8.518       9.823       9.823        9.823
                           (AC-FT)    1.59        1.83        1.83         1.83

                          CUMULATIVE AREA =    .00350 SQ MI   ACRES=            2.2400


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
   156 KK     *        S3  *
              *            *
              **************

   157 KO           OUTPUT CONTROL VARIABLES
                         IPRNT           3  PRINT CONTROL
                         IPLOT           0  PLOT CONTROL
                         QSCAL          0.  HYDROGRAPH PLOT SCALE
                         IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                          IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                         ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                         ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                        TIMINT        .083  TIME INTERVAL IN HOURS


                 SUBBASIN RUNOFF DATA

   158 BA           SUBBASIN CHARACTERISTICS
                         TAREA         .01  SUBBASIN AREA

                    PRECIPITATION DATA

     6 PH                                 DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                    ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                    5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                     1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                  STORM AREA =     .01

   159 LS           SCS LOSS RATE
                         STRTL         .33  INITIAL ABSTRACTION
                        CRVNBR       86.00  CURVE NUMBER
                         RTIMP         .00  PERCENT IMPERVIOUS AREA

                    KINEMATIC WAVE
   160 UK             OVERLAND-FLOW ELEMENT NO. 1
                            L        160.  OVERLAND FLOW LENGTH
                            S       .2500  SLOPE
                            N        .300  ROUGHNESS COEFFICIENT
                           PA       100.0  PERCENT OF SUBBASIN
                         DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                    MUSKINGUM-CUNGE
   161 RD             MAIN CHANNEL
                            L        304.  CHANNEL LENGTH
                            S       .0050  SLOPE
```

```
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .01  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD         .00  BOTTOM WIDTH OR DIAMETER
                          Z        2.00  SIDE SLOPE
                      RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                   PLANE1        2.48      1.67        .62     32.00     69.58    724.51     10.14      1.00
                   MAIN          1.63      1.33       1.08    304.00     68.14    725.01      8.93      4.68


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .3626E+01 OUTFLOW= .3190E+01 BASIN STORAGE= .2383E-03 PERCENT ERROR=  12.0


                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                   MAIN          1.63      1.33       5.00               68.12    725.00      8.99

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION       S3

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

   PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                       6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+     68.12     12.08                  5.82        1.62        1.12         1.12
                         (INCHES)     8.074       8.985       8.985        8.985
                          (AC-FT)      2.88        3.21        3.21         3.21

                         CUMULATIVE AREA =    .00670 SQ MI   ACRES=            4.2880


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   162 KK    *      C/S3  *
             *            *
             **************

   163 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


   164 HC          HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                  ***

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION     C/S3

   PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                       6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+    100.63     12.08                  9.02        2.54        1.76         1.76
                         (INCHES)     8.226       9.272       9.273        9.273
                          (AC-FT)      4.48        5.04        5.04         5.04

                         CUMULATIVE AREA =    .01020 SQ MI   ACRES=            6.5280


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   165 KK    *       CH5  *
             *            *
             **************

   166 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
```

```
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

 167 BA        SUBBASIN CHARACTERISTICS
                     TAREA         .01  SUBBASIN AREA

               PRECIPITATION DATA

   6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                          STORM AREA =     .01

 168 LS        SCS LOSS RATE
                     STRTL         .33  INITIAL ABSTRACTION
                    CRVNBR       86.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
 169 UK          OVERLAND-FLOW ELEMENT NO. 1
                        L         200.  OVERLAND FLOW LENGTH
                        S       .2500  SLOPE
                        N        .300  ROUGHNESS COEFFICIENT
                       PA       100.0  PERCENT OF SUBBASIN
                    DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
 170 RD          MAIN CHANNEL
                        L        1996.  CHANNEL LENGTH
                        S       .0100  SLOPE
                        N        .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA         .01  CONTRIBUTING AREA
                    SHAPE        TRAP  CHANNEL SHAPE
                       WD        2.00  BOTTOM WIDTH OR DIAMETER
                        Z        2.00  SIDE SLOPE
                   RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                           COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .70     40.00     77.80    724.67     10.14      1.09
                    MAIN          2.16      1.35       4.36    998.00    135.39    727.81      9.52      7.63

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5045E+01  EXCESS= .4113E+01 OUTFLOW= .9036E+01 BASIN STORAGE= .9904E-03 PERCENT ERROR=   1.3

                                           INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          2.16      1.35       5.00              126.29    725.00      9.49

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      CH5

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

  PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+   126.29     12.08                15.98        4.54        3.15         3.15
                         (INCHES)     8.346       9.485       9.486        9.486
                          (AC-FT)      7.92        9.00        9.00         9.00

                         CUMULATIVE AREA =    .01780 SQ MI   ACRES=           11.3920


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


               **************
               *              *
 171 KK        *         P2   *
               *              *
               **************

 172 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
```

```
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

  173 BA       SUBBASIN CHARACTERISTICS
                     TAREA         .00  SUBBASIN AREA

               PRECIPITATION DATA

    6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .00

  174 LS       SCS LOSS RATE
                     STRTL         .00  INITIAL ABSTRACTION
                    CRVNBR      100.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

  175 UD       SCS DIMENSIONLESS UNITGRAPH
                      TLAG         .00  LAG

                                                          ***

                                                      UNIT HYDROGRAPH
                                                   5 END-OF-PERIOD ORDINATES
                21.        6.        1.        0.        0.

       ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION       P2

     TOTAL RAINFALL =   11.90, TOTAL LOSS =     .00, TOTAL EXCESS =   11.90

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                        (CFS)
+     35.72     12.08                 3.79        1.18         .82          .82
                       (INCHES)     9.533      11.897      11.900       11.900
                        (AC-FT)      1.88        2.35        2.35         2.35

                       CUMULATIVE AREA =    .00370 SQ MI   ACRES=            2.3680


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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             *            *
  176 KK     *      C/P2  *
             *            *
             **************

  177 KO       OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


  178 HC       HYDROGRAPH COMBINATION
                     ICOMP           4  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

       ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION     C/P2

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                        (CFS)
+    392.34     12.08                56.86       16.26       11.31        11.31
                       (INCHES)     8.486       9.707       9.727        9.727
                        (AC-FT)     28.20       32.25       32.32        32.32

                       CUMULATIVE AREA =    .06230 SQ MI   ACRES=           39.8720


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
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          *            *
179 KK    *      R/P2  *
          *            *
          **************

180 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


              HYDROGRAPH ROUTING DATA

181 RS          STORAGE ROUTING
                     NSTPS           1  NUMBER OF SUBREACHES
                      ITYP        ELEV  TYPE OF INITIAL CONDITION
                    RSVRIC     1034.00  INITIAL CONDITION
                         X         .00 WORKING R AND D COEFFICIENT

182 SA              AREA          .0        .2        .2        .2        .3        .3        .4        .5

183 SE          ELEVATION     1034.00   1034.20   1035.00   1036.00   1037.00   1038.00   1040.00   1042.00

185 SL          LOW-LEVL OUTLET
                     ELEVL     1033.00  ELEVATION AT CENTER OF OUTLET
                     CAREA       28.86  CROSS-SECTIONAL AREA
                      COQL         .60  COEFFICIENT
                      EXPL         .50  EXPONENT OF HEAD

184 SS          SPILLWAY
                      CREL     1040.00  SPILLWAY CREST ELEVATION
                     SPWID       10.00  SPILLWAY WIDTH
                      COQW        2.60  WEIR COEFFICIENT
                      EXPW        1.50  EXPONENT OF HEAD

                                                  ***

                                          COMPUTED STORAGE-ELEVATION DATA

          STORAGE        .00       .01       .16       .39       .66       .96      1.70      2.62
        ELEVATION    1034.00   1034.20   1035.00   1036.00   1037.00   1038.00   1040.00   1042.00

                                          COMPUTED OUTFLOW-ELEVATION DATA

          OUTFLOW        .00    149.21    161.17    175.22    191.96    212.23    237.29    269.07    310.66    367.47
        ELEVATION    1034.00   1034.15   1034.35   1034.59   1034.91   1035.33   1035.92   1036.75   1038.00   1040.00

          OUTFLOW     392.69    399.17    406.61    415.06    424.58    435.23    447.05    460.12    474.49    490.21
        ELEVATION    1040.56   1040.67   1040.80   1040.94   1041.09   1041.25   1041.42   1041.60   1041.80   1042.00


                                       COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00       .01       .01       .04       .08       .14       .16       .24       .37       .39
          OUTFLOW     138.89    149.21    152.14    161.17    175.22    191.96    196.42    212.23    237.29    240.57
        ELEVATION    1034.00   1034.15   1034.20   1034.35   1034.59   1034.91   1035.00   1035.33   1035.92   1036.00

          STORAGE        .59       .66       .96      1.70      1.95      2.00      2.06      2.12      2.19      2.26
          OUTFLOW     269.07    277.78    310.57    367.47    392.69    399.17    406.61    415.06    424.58    435.23
        ELEVATION    1036.75   1037.00   1038.00   1040.00   1040.56   1040.67   1040.80   1040.94   1041.09   1041.25

          STORAGE       2.34      2.43      2.52      2.62
          OUTFLOW     447.05    460.12    474.49    490.21
        ELEVATION    1041.42   1041.60   1041.80   1042.00

 *** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN      139. TO      175.
                 THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
                 THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

      ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION     R/P2

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+   322.54     12.17               148.91      141.39      140.63       140.63
                         (INCHES)    22.223      84.406     120.967      120.967
                          (AC-FT)    73.84      280.45      401.93       401.93

 PEAK STORAGE   TIME                         MAXIMUM AVERAGE STORAGE
                                      6-HR        24-HR       72-HR     34.58-HR
+  (AC-FT)      (HR)
     1.115     12.17                 .00         .00         .00         -.46

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                      6-HR        24-HR       72-HR     34.58-HR
+   (FEET)      (HR)
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  1038.42     12.17              1034.22     1034.06     1034.04      1034.04

                      CUMULATIVE AREA =    .06230 SQ MI   ACRES=           39.8720


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 186 KK    *        T2  *
           *            *
           **************

 187 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

 188 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .00  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .00

 189 LS          SCS LOSS RATE
                      STRTL         .35  INITIAL ABSTRACTION
                     CRVNBR       85.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 190 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L          49.  OVERLAND FLOW LENGTH
                          S       .0500  SLOPE
                          N        .300  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 191 RD            MAIN CHANNEL
                          L        434.  CHANNEL LENGTH
                          S       .0050  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .00  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD         .00  BOTTOM WIDTH OR DIAMETER
                          Z        2.00  SIDE SLOPE
                     RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                      ***
                                   COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                            COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                      PEAK                CELERITY
                                                                (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        1.11      1.67        .56      9.80     36.55    724.52     10.01       .39
                     MAIN          1.63      1.33       1.82    217.00     34.90    723.46      9.86      3.98


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1870E+01 OUTFLOW= .1840E+01 BASIN STORAGE= .2401E-03 PERCENT ERROR=   1.6

                                            INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                     MAIN          1.63      1.33       5.00               34.70    725.00      9.88

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION       T2

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR     34.58-HR
 +   (CFS)       (HR)
                    (CFS)
 +    34.70     12.08                3.22         .93         .65          .65
                        (INCHES)     8.563       9.878       9.879        9.879
                         (AC-FT)      1.60        1.84        1.84         1.84
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                    CUMULATIVE AREA =    .00350 SQ MI   ACRES=            2.2400


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
192 KK    *        S2  *
          *            *
          **************

193 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

194 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .00  SUBBASIN AREA

                PRECIPITATION DATA

  6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                              STORM AREA =     .00

195 LS          SCS LOSS RATE
                     STRTL         .33  INITIAL ABSTRACTION
                    CRVNBR       86.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
196 UK            OVERLAND-FLOW ELEMENT NO. 1
                         L        160.  OVERLAND FLOW LENGTH
                         S       .2500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
197 RD            MAIN CHANNEL
                         L        434.  CHANNEL LENGTH
                         S       .0050  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .00  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD         .00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                      ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                   ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                   PEAK                CELERITY
                                                    (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                   PLANE1        2.48      1.67        .62     32.00     45.69    724.51     10.14      1.00
                   MAIN          1.63      1.33       1.72    217.00     43.97    725.24      9.98      4.21


CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2381E+01 OUTFLOW= .2343E+01 BASIN STORAGE= .2786E-03 PERCENT ERROR=   1.6


                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                   MAIN          1.63      1.33       5.00               43.74    725.00     10.00

      ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION       S2

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

   PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                         (CFS)
+     43.74     12.08                 4.10        1.18         .82          .82
                        (INCHES)     8.661       9.996       9.997        9.997
                         (AC-FT)      2.03        2.35        2.35         2.35

                    CUMULATIVE AREA =    .00440 SQ MI   ACRES=            2.8160
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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  198 KK    *      C/S2  *
            *            *
            **************

  199 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


  200 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION     C/S2

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                        (CFS)
+    78.44     12.08                 7.32        2.11        1.47         1.47
                     (INCHES)     8.618       9.944       9.944        9.944
                      (AC-FT)      3.63        4.19        4.19         4.19

                     CUMULATIVE AREA =    .00790 SQ MI   ACRES=            5.0560


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  201 KK    *       CH6  *
            *            *
            **************

  202 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  203 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                 STORM AREA =     .00

  204 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  205 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        200.  OVERLAND FLOW LENGTH
                           S       .0500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
  206 RD            MAIN CHANNEL
                           L        537.  CHANNEL LENGTH
                           S       .0100  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .00  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
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                        WD        2.00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                     RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                 ***
                                COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                  ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                 PEAK                CELERITY
                                                    (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                  PLANE1        1.11      1.67       1.14     40.00     32.23    725.63     10.15       .62
                  MAIN          2.16      1.35       1.33    268.50    104.01    726.53      9.97      6.73


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4190E+01  EXCESS= .2002E+01 OUTFLOW= .6167E+01 BASIN STORAGE= .4051E-03 PERCENT ERROR=    .4


                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                  MAIN          2.16      1.35       5.00              101.22    725.00      9.98

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION      CH6

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

   PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                         (CFS)
+    101.22     12.08                10.79        3.11        2.16         2.16
                        (INCHES)     8.652       9.977       9.979        9.979
                         (AC-FT)      5.35        6.17        6.17         6.17

                        CUMULATIVE AREA =    .01160 SQ MI   ACRES=            7.4240


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  207 KK     *       CH7  *
             *            *
             **************

  208 KO          OUTPUT CONTROL VARIABLES
                       IPRNT          3  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL          7.  HYDROGRAPH PLOT SCALE
                       IPNCH         21  PUNCH COMPUTED HYDROGRAPH
                        IOUT          0  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT       .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  209 BA          SUBBASIN CHARACTERISTICS
                       TAREA        .00  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .00

  210 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  211 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L         210.  OVERLAND FLOW LENGTH
                           S       .0500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
  212 RD            MAIN CHANNEL
                           L         317.  CHANNEL LENGTH
                           S       .0100  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .00  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD        2.00  BOTTOM WIDTH OR DIAMETER
                           Z        2.00  SIDE SLOPE
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                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                          ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                           COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                                (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        1.11      1.67       1.15     42.00     21.34    725.09     10.15       .63
                    MAIN          2.16      1.35       1.21    158.50     20.24    724.94      9.94      4.35


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1299E+01 OUTFLOW= .1272E+01 BASIN STORAGE= .2699E-03 PERCENT ERROR=   2.0


                                               INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          2.16      1.35       5.00                 20.23    725.00      9.95

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      CH7

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

   PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                           (CFS)
+     20.23     12.08                   2.23         .64         .45          .45
                         (INCHES)     8.625       9.948       9.950        9.950
                          (AC-FT)      1.10        1.27        1.27         1.27

                         CUMULATIVE AREA =    .00240 SQ MI   ACRES=            1.5360


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
   213 KK     *     C/DC4  *
              *            *
              **************

   214 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


   215 HC          HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION    C/DC4

   PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                           (CFS)
+    121.45     12.08                  13.02         3.75        2.61         2.61
                         (INCHES)     8.647       9.972       9.974        9.974
                          (AC-FT)      6.46        7.45        7.45         7.45

                         CUMULATIVE AREA =    .01400 SQ MI   ACRES=            8.9600


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
   216 KK     *    DA3/DP  *     5
              *            *
              **************

   217 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
```

```
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

 218 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .03  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .03

 219 LS          SCS LOSS RATE
                       STRTL         .38  INITIAL ABSTRACTION
                      CRVNBR       84.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

 220 US          SNYDER UNITGRAPH
                         TP         .28  LAG
                         CP         .67  PEAKING COEFFICIENT

                 SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                        ***

                                                   UNIT HYDROGRAPH PARAMETERS
                                             CLARK   TC=   .34 HR,       R=   .22 HR
                                            SNYDER   TP=   .28 HR,      CP=   .67

                                                       UNIT HYDROGRAPH
                                                   17 END-OF-PERIOD ORDINATES
                 7.       24.       42.       50.       42.       29.       20.       13.        9.        6.
                 4.        3.        2.        1.        1.        1.        0.

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION   DA3/DP

    TOTAL RAINFALL =   11.90, TOTAL LOSS =    2.02, TOTAL EXCESS =    9.88

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+   153.97     12.33                30.13        8.76        6.08        6.08
                         (INCHES)     8.462       9.847       9.847       9.847
                          (AC-FT)     14.94       17.38       17.38       17.38

                        CUMULATIVE AREA =    .03310 SQ MI   ACRES=           21.1840


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


               **************
               *            *
 221 KK        *    DA2/DP  *     6
               *            *
               **************

 222 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

 223 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .04  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .04

 224 LS          SCS LOSS RATE
                       STRTL         .38  INITIAL ABSTRACTION
                      CRVNBR       84.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA
```

```
 225 US          SNYDER UNITGRAPH
                         TP         .29  LAG
                         CP         .66  PEAKING COEFFICIENT

                 SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                    ***

                                                UNIT HYDROGRAPH PARAMETERS
                                             CLARK   TC=   .34 HR,       R=   .24 HR
                                            SNYDER   TP=   .29 HR,      CP=   .66

                                                   UNIT HYDROGRAPH
                                                18 END-OF-PERIOD ORDINATES
                 8.       27.       48.       58.       50.       36.       25.       18.       13.        9.
                 6.        4.        3.        2.        2.        1.        1.        1.

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION   DA2/DP

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    2.02, TOTAL EXCESS =    9.88

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+    181.93     12.33               36.65       10.67        7.40        7.40
                           (INCHES)  8.456       9.843       9.843       9.843
                            (AC-FT)  18.18       21.15       21.15       21.15

                          CUMULATIVE AREA =    .04030 SQ MI   ACRES=           25.7920
1
                                                    RUNOFF SUMMARY
                                                FLOW IN CUBIC FEET PER SECOND
                                               TIME IN HOURS,  AREA IN SQUARE MILES

                                    PEAK   TIME OF     AVERAGE FLOW FOR MAXIMUM PERIOD      BASIN     MAXIMUM     TIME OF
          OPERATION       STATION   FLOW    PEAK                                            AREA      STAGE     MAX STAGE
+                                                                  6-HOUR     24-HOUR     72-HOUR

          HYDROGRAPH AT
+                            T6     26.41   12.08          3.          1.          1.        .00

          HYDROGRAPH AT
+                            S8     58.27   12.08          5.          2.          1.        .01

          2 COMBINED AT
+                          C/S8     84.68   12.08          8.          2.          2.        .01

          HYDROGRAPH AT
+                            T5     34.09   12.08          4.          1.          1.        .00

          HYDROGRAPH AT
+                            S7     88.10   12.08          8.          2.          1.        .01

          2 COMBINED AT
+                          C/S7    122.19   12.08         11.          3.          2.        .01

          HYDROGRAPH AT
+                           OA2    245.09   12.58         69.         20.         14.        .08

          3 COMBINED AT
+                         C/CH1    302.78   12.08         89.         26.         18.        .10

          HYDROGRAPH AT
+                           CH1    311.87   12.17         98.         28.         20.        .11

          HYDROGRAPH AT
+                            T1     21.09   12.08          2.          1.          0.        .00

          HYDROGRAPH AT
+                            S1     37.89   12.08          4.          1.          1.        .00

          2 COMBINED AT
+                          C/S1     58.98   12.08          6.          2.          1.        .01

          HYDROGRAPH AT
+                            P1     83.99   12.08          9.          3.          2.        .01

          3 COMBINED AT
+                          C/P1    424.61   12.08        112.         33.         23.        .12

          ROUTED TO
+                          R/P1     87.77   14.00         64.         41.         36.        .12
+                                                                                          1057.51       14.00

          HYDROGRAPH AT
+                           DA1    203.77   12.33         43.         13.          9.        .05

          2 COMBINED AT
+                         C/DP1    252.13   12.33        102.         53.         45.        .17

          HYDROGRAPH AT
+                            T7     52.29   12.08          6.          2.          1.        .01
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```
          HYDROGRAPH AT
+                          S5      89.07   12.08          8.          2.          2.        .01
          2 COMBINED AT
+                        C/S5     141.36   12.08         14.          4.          3.        .02
          HYDROGRAPH AT
+                         OA1     460.68   12.58        135.         39.         27.        .15
          2 COMBINED AT
+                        C/CH2    481.90   12.58        149.         43.         30.        .16
          HYDROGRAPH AT
+                         CH2     489.94   12.58        158.         46.         32.        .17
          HYDROGRAPH AT
+                          T4     102.25   12.08         10.          3.          2.        .01
          HYDROGRAPH AT
+                         CH3      97.16   12.17         13.          4.          3.        .01
          2 COMBINED AT
+                      C/DC#2     510.21   12.58        170.         50.         35.        .19
          HYDROGRAPH AT
+                          T9     109.67   12.17         20.          6.          4.        .02
          HYDROGRAPH AT
+                         CH4     165.86   12.08         28.          8.          6.        .03
          HYDROGRAPH AT
+                          T8      64.47   12.08          9.          3.          2.        .01
          HYDROGRAPH AT
+                          T3      32.50   12.08          3.          1.          1.        .00
          HYDROGRAPH AT
+                          S3      68.12   12.08          6.          2.          1.        .01
          2 COMBINED AT
+                        C/S3     100.63   12.08          9.          3.          2.        .01
          HYDROGRAPH AT
+                         CH5     126.29   12.08         16.          5.          3.        .02
          HYDROGRAPH AT
+                          P2      35.72   12.08          4.          1.          1.        .00
          4 COMBINED AT
+                        C/P2     392.34   12.08         57.         16.         11.        .06
          ROUTED TO
+                        R/P2     322.54   12.17        149.        141.        141.        .06
+                                                                                        1038.42       12.17
          HYDROGRAPH AT
+                          T2      34.70   12.08          3.          1.          1.        .00
          HYDROGRAPH AT
+                          S2      43.74   12.08          4.          1.          1.        .00
          2 COMBINED AT
+                        C/S2      78.44   12.08          7.          2.          1.        .01
          HYDROGRAPH AT
+                         CH6     101.22   12.08         11.          3.          2.        .01
          HYDROGRAPH AT
+                         CH7      20.23   12.08          2.          1.          0.        .00
          2 COMBINED AT
+                        C/DC4     121.45   12.08         13.          4.          3.        .01
          HYDROGRAPH AT
+                       DA3/DP     153.97   12.33         30.          9.          6.        .03
          HYDROGRAPH AT
+                       DA2/DP     181.93   12.33         37.         11.          7.        .04
1
                                    SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                        (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                  INTERPOLATED TO
                                                                                COMPUTATION INTERVAL
          ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                    PEAK                                    PEAK

                                (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

               T6  MANE         1.40     26.46    724.88      8.83      5.00     26.41    725.00        8.84

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1656E+01 OUTFLOW= .1459E+01 BASIN STORAGE= .2888E-03 PERCENT ERROR=  11.8

               S8  MANE         1.99     60.39    724.73      9.82      5.00     58.27    725.00        9.88
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CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3152E+01 OUTFLOW= .3091E+01 BASIN STORAGE= .3316E-03 PERCENT ERROR=   1.9

                T5  MANE         1.85     35.15    725.64      9.88      5.00     34.09    725.00        9.88

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2137E+01 OUTFLOW= .2108E+01 BASIN STORAGE= .3904E-03 PERCENT ERROR=   1.3

                S7  MANE         1.45     90.12    724.01      8.81      5.00     88.10    725.00        8.82

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4924E+01 OUTFLOW= .4276E+01 BASIN STORAGE= .3388E-03 PERCENT ERROR=  13.2

               CH1  MANE         4.74    314.53    730.59      9.78      5.00    311.87    730.00        9.79

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5109E+02 EXCESS= .5141E+01 OUTFLOW= .5640E+02 BASIN STORAGE= .9255E-01 PERCENT ERROR=   -.5

                T1  MANE         1.45     21.24    724.71      8.83      5.00     21.09    725.00        8.85

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1282E+01 OUTFLOW= .1130E+01 BASIN STORAGE= .2446E-03 PERCENT ERROR=  11.8

                S1  MANE         2.13     38.23    725.34      9.97      5.00     37.89    725.00       10.00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2110E+01 OUTFLOW= .2075E+01 BASIN STORAGE= .3091E-03 PERCENT ERROR=   1.7

                T7  MANE         1.65     53.57    725.31      8.80      5.00     52.29    725.00        8.82

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3579E+01 OUTFLOW= .3145E+01 BASIN STORAGE= .6710E-03 PERCENT ERROR=  12.1

                S5  MANE         2.14     89.43    724.97      9.91      5.00     89.07    725.00        9.99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4816E+01 OUTFLOW= .4706E+01 BASIN STORAGE= .4555E-03 PERCENT ERROR=   2.3

               CH2  MANE         1.60    491.89    756.09      9.86      5.00    489.94    755.00        9.86

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8617E+02 EXCESS= .5087E+01 OUTFLOW= .9159E+02 BASIN STORAGE= .4916E-01 PERCENT ERROR=   -.4

                T4  MANE         2.24    102.30    725.01      9.90      5.00    102.25    725.00        9.97

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .5520E+01 OUTFLOW= .5383E+01 BASIN STORAGE= .4973E-03 PERCENT ERROR=   2.5

               CH3  MANE         3.93    107.79    727.41      9.91      5.00     97.16    730.00        9.86

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5422E+01 EXCESS= .1894E+01 OUTFLOW= .7239E+01 BASIN STORAGE= .1090E-02 PERCENT ERROR=   1.0

                T9  MANE          .74    110.02    730.53      9.44      5.00    109.67    730.00        9.44

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1159E+02 OUTFLOW= .1093E+02 BASIN STORAGE= .1005E-01 PERCENT ERROR=   5.7

               CH4  MANE         2.58    166.69    726.36      9.58      5.00    165.86    725.00        9.57

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1093E+02 EXCESS= .5195E+01 OUTFLOW= .1599E+02 BASIN STORAGE= .8624E-03 PERCENT ERROR=    .8

                T8  MANE         2.58     66.96    727.97      9.84      5.00     64.47    725.00        9.84

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .5075E+01 OUTFLOW= .4985E+01 BASIN STORAGE= .1508E-02 PERCENT ERROR=   1.7

                T3  MANE         2.24     35.31    723.77      9.84      5.00     32.50    725.00        9.82

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1870E+01 OUTFLOW= .1836E+01 BASIN STORAGE= .2948E-03 PERCENT ERROR=   1.8

                S3  MANE         1.08     68.14    725.01      8.93      5.00     68.12    725.00        8.99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3626E+01 OUTFLOW= .3190E+01 BASIN STORAGE= .2383E-03 PERCENT ERROR=  12.0

               CH5  MANE         4.36    135.39    727.81      9.52      5.00    126.29    725.00        9.49
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CONTINUITY SUMMARY (AC-FT) - INFLOW= .5045E+01 EXCESS= .4113E+01 OUTFLOW= .9036E+01 BASIN STORAGE= .9904E-03 PERCENT ERROR=   1.3

                T2  MANE         1.82     34.90    723.46      9.86      5.00     34.70    725.00        9.88

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1870E+01 OUTFLOW= .1840E+01 BASIN STORAGE= .2401E-03 PERCENT ERROR=   1.6

                S2  MANE         1.72     43.97    725.24      9.98      5.00     43.74    725.00       10.00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2381E+01 OUTFLOW= .2343E+01 BASIN STORAGE= .2786E-03 PERCENT ERROR=   1.6

               CH6  MANE         1.33    104.01    726.53      9.97      5.00    101.22    725.00        9.98

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4190E+01 EXCESS= .2002E+01 OUTFLOW= .6167E+01 BASIN STORAGE= .4051E-03 PERCENT ERROR=    .4

               CH7  MANE         1.21     20.24    724.94      9.94      5.00     20.23    725.00        9.95

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1299E+01 OUTFLOW= .1272E+01 BASIN STORAGE= .2699E-03 PERCENT ERROR=   2.0


*** NORMAL END OF HEC-1 ***
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HEC-1 OUTPUT- PERMITTED 25-YEAR 24-HOUR STORM EVENT

```
1****************************************                    ****************************************
 *                                      *                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *        JUN 1998 AND FEB 2010         *                    *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1R              *                    *          609 SECOND STREET           *
 *       RGMHEC2000 WWW.HEC-1.COM       *                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   24JUL23  TIME  10:15:59  *                    *          (916) 756-1104              *
 *                                      *                    *                                      *
 ****************************************                    ****************************************

                                        X     X  XXXXXXX   XXXXX           X
                                        X     X  X        X     X         XX
                                        X     X  X        X               X
                                        XXXXXXX  XXXX     X        XXXXX   X
                                        X     X  X        X                X
                                        X     X  X        X     X          X
                                        X     X  XXXXXXX   XXXXX          XXX

          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                  HEC-1 INPUT                                                 PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID  DEL RIO LF EXPANSION
            2           ID  25-YR, 24-HR
                        *DIAGRAM
            3           IT       5       0    2400     416       0       0
            4           IO       3       0       0
                        *

            5           KK      T6
            6           PH               0    1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85
            7           KO       0       0       0       7      21
            8           BA  0.0031
            9           LS       0      85
           10           UK     179    0.05     0.3     100
           11           RD     312   0.005    0.03            TRAP       0       2      NO
                        *

           12           KK      S8
           13           KO       0       0       0       7      21
           14           BA  0.0059
           15           LS       0      85
           16           UK   139.6    0.25     0.3     100
           17           RD   540.7   0.005    0.03            TRAP       0       2      NO
                        *

           18           KK    C/S8
           19           KO       0       0       0       7      21
           20           HC       2
                        *

           21           KK      T5
           22           KO       0       0       0       7      21
           23           BA  0.0040
           24           LS       0      85
           25           UK   175.7    0.05     0.3     100
           26           RD   437.6   0.005    0.03            TRAP       0       2      NO
                        *

           27           KK      S7
           28           KO       0       0       0       7      21
           29           BA  0.0091
           30           LS       0      86
           31           UK     160    0.25     0.3     100
           32           RD   437.6   0.005    0.03            TRAP       0       2      NO
                        *

           33           KK    C/S7
           34           KO       0       0       0       7      21
           35           HC       2
                        *
1                                                  HEC-1 INPUT                                                 PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

           36           KK     0A2
           37           KO       0       0       0       7      21
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   38          BA  0.0765
   39          LS       0      84
   40          US    0.55    0.66
               *

   41          KK   C/CH1
   42          KO       0       0       0       7      21
   43          HC       3
               *

   44          KK     CH1
   45          KO       0       0       0       7      21
   46          BA  0.0095
   47          LS       0      86
   48          UK      47    0.25     0.3     100
   49          RD    3079    0.02    0.03            TRAP      10       3     YES
               *

   50          KK      T1
   51          KO       0       0       0       7      21
   52          BA  0.0024
   53          LS       0      85
   54          UK   166.5    0.05     0.3     100
   55          RD     305   0.005    0.03            TRAP       0       2      NO
               *

   56          KK      S1
   57          KO       0       0       0       7      21
   58          BA  0.0039
   59          LS       0      86
   60          UK   158.6    0.25     0.3     100
   61          RD   521.8   0.005    0.03            TRAP       0       2      NO
               *

   62          KK    C/S1
   63          KO       0       0       0       7      21
   64          HC       2
               *

   65          KK      P1
   66          KO       0       0       0       7      21
   67          BA  0.0087
   68          LS       0     100
   69          UD       0
               *

   70          KK    C/P1
   71          KO       0       0       0       7      21
   72          HC       3
               *
1                                        HEC-1 INPUT                                                    PAGE  3

  LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

   73          KK    R/P1
   74          KO       0       0       0       7      21
   75          RS       1    ELEV    1044
   76          SA       0    1.58    1.85    2.10    2.35    2.61    2.87    3.14    3.41
   77          SE    1044  1044.2    1046    1048    1050    1052    1054    1056    1058
   78          SS  1056.5      10     2.6     1.5
   79          SL    1041    3.14     0.6     0.5
               *

   80          KK     DA1
   81          KO       0       0       0       7      21
   82          BA  0.0475
   83          LS       0      84
   84          US     .32     .66
               *

   85          KK   C/DP1
   86          KO       0       0       0       7      21
   87          HC       2
               *

   88          KK      T7
   89          KO       0       0       0       7      21
   90          BA  0.0067
   91          LS       0      85
   92          UK   244.1    0.05     0.3     100
   93          RD   437.6   0.005    0.03            TRAP       0       2      NO
               *

   94          KK      S5
   95          KO       0       0       0       7      21
   96          BA  0.0089
   97          LS       0      86
   98          UK   175.6    0.25     0.3     100
   99          RD   643.6   0.005    0.03            TRAP       0       2      NO
               *

  100          KK    C/S5
  101          KO       0       0       0       7      21
```

```
 102          HC       2
              *

 103          KK     OA1
 104          KO       0       0       0       7      21
 105          BA  0.1492
 106          LS       0      84
 107          US    0.56    0.64
              *
1                                   HEC-1 INPUT                                        PAGE  4

 LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 108          KK   C/CH2
 109          KO       0       0       0       7      21
 110          HC       2
              *

 111          KK     CH2
 112          KO       0       0       0       7      21
 113          BA  0.0094
 114          LS       0      86
 115          UK      47    0.25     0.3     100
 116          RD     865    0.01    0.03            TRAP      10       3     YES
              *

 117          KK      T4
 118          KO       0       0       0       7      21
 119          BA  0.0102
 120          LS       0      86
 121          UK   175.6    0.25     0.3     100
 122          RD   696.8   0.005    0.03            TRAP       0       2      NO
              *

 123          KK     CH3
 124          KO       0       0       0       7      21
 125          BA  0.0035
 126          LS       0      86
 127          UK   155.7    0.25     0.3     100
 128          RD    1456    0.01    0.03            TRAP      10       3     YES
              *

 129          KK  C/DC#2
 130          KO       0       0       0       7      21
 131          HC       2
              *

 132          KK      T9
 133          KO       0       0       7      21
 134          BA  0.0217
 135          LS       0      85
 136          UK   919.3    0.05     0.3     100
 137          RD     232   0.005    0.03            TRAP       0       2      NO
              *

 138          KK     CH4
 139          KO       0       0       0       7      21
 140          BA  0.0096
 141          LS       0      86
 142          UK   155.8    0.25     0.3     100
 143          RD    1064    0.01    0.03            TRAP      10       3     YES
              *
1                                   HEC-1 INPUT                                        PAGE  5

 LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 144          KK      T8
 145          KO       0       0       0       7      21
 146          BA  0.0095
 147          LS       0      85
 148          UK   359.7    0.05     0.3     100
 149          RD   720.5   0.005    0.03            TRAP       0       2      NO
              *

 150          KK      T3
 151          KO       0       0       0       7      21
 152          BA  0.0035
 153          LS       0      85
 154          UK      49    0.05     0.3     100
 155          RD     535   0.005    0.03            TRAP       0       2      NO
              *

 156          KK      S3
 157          KO       0       0       0       7      21
 158          BA  0.0067
 159          LS       0      86
 160          UK     160    0.25     0.3     100
 161          RD     304   0.005    0.03            TRAP       0       2      NO
              *

 162          KK    C/S3
 163          KO       0       0       0       7      21
```

```
          164          HC       2
                       *

          165          KK     CH5
          166          KO       0       0       0       7      21
          167          BA  0.0076
          168          LS       0      86
          169          UK     200    0.25     0.3     100
          170          RD    1996    0.01    0.03            TRAP       2       2     YES
                       *

          171          KK      P2
          172          KO       0       0       0       7      21
          173          BA  0.0037
          174          LS       0     100
          175          UD       0
                       *

          176          KK    C/P2
          177          KO       0       0       0       7      21
          178          HC       4
                       *
1                                          HEC-1 INPUT                                                PAGE  6

        LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          179          KK    R/P2
          180          KO       0       0       0       7      21
          181          RS       1    ELEV    1034
          182          SA       0   0.167   0.215   0.245   0.283   0.319   0.429   0.492
          183          SE    1034  1034.2    1035    1036    1037    1038    1040    1042
          184          SS    1040      10     2.6     1.5
          185          SL  103328.86338     0.6     0.5
                       *

          186          KK      T2
          187          KO       0       0       0       7      21
          188          BA  0.0035
          189          LS       0      85
          190          UK      49    0.05     0.3     100
          191          RD     434   0.005    0.03            TRAP       0       2      NO
                       *

          192          KK      S2
          193          KO       0       0       0       7      21
          194          BA  0.0044
          195          LS       0      86
          196          UK     160    0.25     0.3     100
          197          RD     434   0.005    0.03            TRAP       0       2      NO
                       *

          198          KK    C/S2
          199          KO       0       0       0       7      21
          200          HC       2
                       *

          201          KK     CH6
          202          KO       0       0       0       7      21
          203          BA  0.0037
          204          LS       0      86
          205          UK     200    0.05     0.3     100
          206          RD     537    0.01    0.03            TRAP       2       2     YES
                       *

          207          KK     CH7
          208          KO      00       0       7      21
          209          BA  0.0024
          210          LS       0      86
          211          UK     210    0.05     0.3     100
          212          RD     317    0.01    0.03            TRAP       2       2      NO
                       *

          213          KK   C/DC4
          214          KO       0       0       0       7      21
          215          HC       2
                       *
1                                          HEC-1 INPUT                                                PAGE  7

        LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

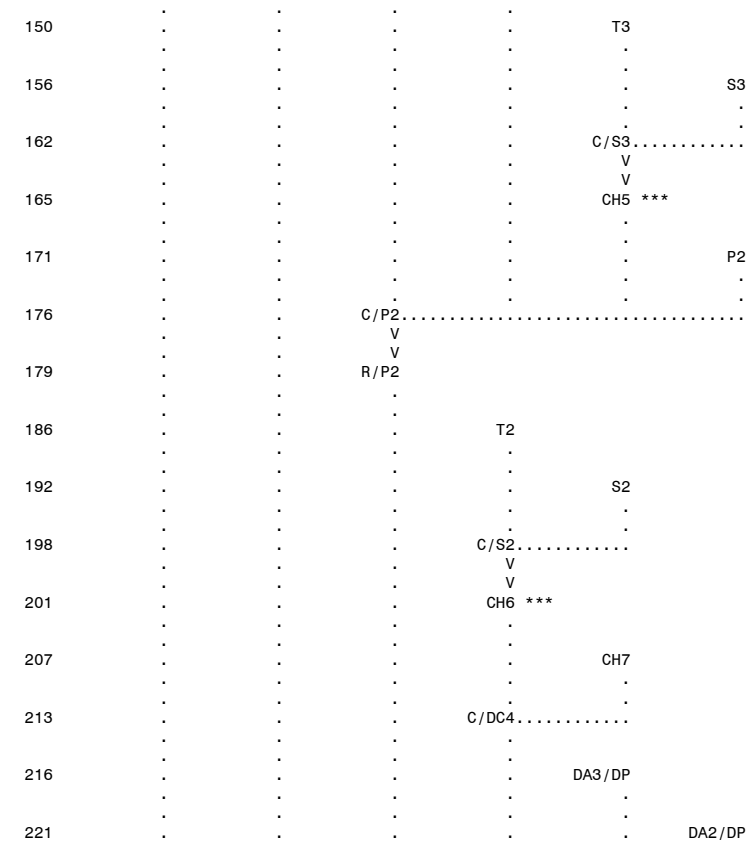
          216          KK  DA3/DP5
          217          KO       0       0       0       7      21
          218          BA  0.0331
          219          LS       0      84
          220          US     .28     .67
                       *

          221          KK  DA2/DP6
          222          KO       0       0       0       7      21
          223          BA  0.0403
          224          LS       0      84
          225          US    0.29    0.66
```

```
          226           ZZ
1
               SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     5          T6
                .
                .
    12          .          S8
                .           .
                .           .
    18        C/S8...........
                .
                .
    21          .          T5
                .           .
                .           .
    27          .           .          S7
                .           .           .
                .           .           .
    33          .        C/S7...........
                .           .
                .           .
    36          .           .         OA2
                .           .           .
                .           .           .
    41       C/CH1.......................
                V
                V
    44         CH1 ***
                .
                .
    50          .          T1
                .           .
                .           .
    56          .           .          S1
                .           .           .
                .           .           .
    62          .        C/S1...........
                .           .
                .           .
    65          .           .          P1
                .           .           .
                .           .           .
    70        C/P1........................
                V
                V
    73        R/P1
                .
                .
    80          .         DA1
                .           .
                .           .
    85       C/DP1...........
                .
                .
    88          .          T7
                .           .
                .           .
    94          .           .          S5
                .           .           .
                .           .           .
   100          .        C/S5...........
                .           .
                .           .
   103          .           .         OA1
                .           .           .
                .           .           .
   108          .       C/CH2...........
                .           V
                .           V
   111          .         CH2 ***
                .           .
                .           .
   117          .           .          T4
                .           .           V
                .           .           V
   123          .           .         CH3 ***
                .           .           .
                .           .           .
   129          .      C/DC#2...........
                .           .
                .           .
   132          .           .          T9
                .           .           V
                .           .           V
   138          .           .         CH4 ***
                .           .           .
                .           .           .
   144          .           .           .          T8
                .           .           .           .
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*        JUN 1998 AND FEB 2010          *
*            VERSION 4.1R               *
*       RGMHEC2000 WWW.HEC-1.COM        *
*  RUN DATE   24JUL23  TIME  10:15:59   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

DEL RIO LF EXPANSION
100-YR, 24-HR

```
   4 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT           HYDROGRAPH TIME DATA
                       NMIN           5  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ         416  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      3    0  ENDING DATE
                     NDTIME        1035  ENDING TIME
                     ICENT           19  CENTURY MARK

                   COMPUTATION INTERVAL     .08 HOURS
                        TOTAL TIME BASE   34.58 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
```

```
          **************
          *            *
    5 KK  *        T6  *
          *            *
          **************

    7 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

    8 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .00

    9 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
   10 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L         179.  OVERLAND FLOW LENGTH
                           S        .0500  SLOPE
                           N         .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                        DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
   11 RD            MAIN CHANNEL
                           L         312.  CHANNEL LENGTH
                           S        .0050  SLOPE
                           N         .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA          .00  CONTRIBUTING AREA
                       SHAPE         TRAP  CHANNEL SHAPE
                          WD          .00  BOTTOM WIDTH OR DIAMETER
                           Z         2.00  SIDE SLOPE
                      RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                          ***
                                    COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                           COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                      PEAK              CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        1.11      1.67       1.26     35.80     18.13    724.93      6.07       .50
                     MAIN          1.63      1.33       1.57    156.00     17.29    726.21      6.01      3.31

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1003E+01 OUTFLOW= .9942E+00 BASIN STORAGE= .2899E-03 PERCENT ERROR=    .9

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                     MAIN          1.63      1.33       5.00                16.83    725.00      6.01

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION       T6

      TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

    PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                       6-HR        24-HR       72-HR     34.58-HR
+     (CFS)       (HR)
                        (CFS)
+      16.83     12.08                 1.76         .50         .35          .35
                        (INCHES)     5.274       6.013       6.014        6.014
                         (AC-FT)       .87         .99         .99          .99

                           CUMULATIVE AREA =    .00310 SQ MI   ACRES=            1.9840


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
```

```
          **************
          *            *
  12 KK   *        S8  *
          *            *
          **************

  13 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

  14 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .01  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .01

  15 LS          SCS LOSS RATE
                      STRTL         .35  INITIAL ABSTRACTION
                     CRVNBR       85.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
  16 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L         140.  OVERLAND FLOW LENGTH
                          S        .2500  SLOPE
                          N         .300  ROUGHNESS COEFFICIENT
                         PA        100.0  PERCENT OF SUBBASIN
                       DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
  17 RD            MAIN CHANNEL
                          L         541.  CHANNEL LENGTH
                          S        .0050  SLOPE
                          N         .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA          .01  CONTRIBUTING AREA
                      SHAPE         TRAP  CHANNEL SHAPE
                         WD          .00  BOTTOM WIDTH OR DIAMETER
                          Z         2.00  SIDE SLOPE
                     RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                          ***
                                    COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                           COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK               CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .70     27.92     41.27    724.94      6.07       .81
                    MAIN          1.63      1.33       2.20    270.35     37.80    723.63      5.96      4.10

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1909E+01 OUTFLOW= .1874E+01 BASIN STORAGE= .3379E-03 PERCENT ERROR=   1.8


                                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          1.63      1.33       5.00               37.16    725.00      5.95

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION       S8

      TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

    PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                       6-HR       24-HR       72-HR     34.58-HR
+     (CFS)       (HR)
                        (CFS)
+      37.16     12.08                 3.32         .94         .65          .65
                        (INCHES)     5.231       5.948       5.948        5.948
                         (AC-FT)      1.65        1.87        1.87         1.87

                        CUMULATIVE AREA =    .00590 SQ MI   ACRES=            3.7760


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
```

```
            **************
            *            *
   18 KK    *      C/S8  *
            *            *
            **************

   19 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


   20 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION     C/S8

  PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                        (CFS)
+    53.99     12.08                 5.08         1.44        1.00         1.00
                      (INCHES)     5.246        5.970       5.971        5.971
                       (AC-FT)      2.52         2.87        2.87         2.87

                      CUMULATIVE AREA =    .00900 SQ MI   ACRES=            5.7600


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   21 KK    *        T5  *
            *            *
            **************

   22 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

   23 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

              PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .00

   24 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

              KINEMATIC WAVE
   25 UK        OVERLAND-FLOW ELEMENT NO. 1
                         L        176.  OVERLAND FLOW LENGTH
                         S       .0500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
              MUSKINGUM-CUNGE
   26 RD        MAIN CHANNEL
                         L        438.  CHANNEL LENGTH
                         S       .0050  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .00  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD         .00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH
```

```
                                                  ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                           COMPUTATION TIME STEP
     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                      PEAK                CELERITY
                                                (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

    PLANE1        1.11      1.67       1.21     35.14     23.32    725.38      6.07       .50
    MAIN          1.63      1.33       2.06    218.80     22.40    724.94      6.00      3.54


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1295E+01 OUTFLOW= .1280E+01 BASIN STORAGE= .3915E-03 PERCENT ERROR=   1.1


                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


    MAIN          1.63      1.33       5.00                22.38    725.00      6.02

      ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION       T5

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                        (CFS)
+    22.38     12.08                2.28         .65         .45          .45
                       (INCHES)     5.289       6.020       6.021        6.021
                        (AC-FT)     1.13         1.28        1.28         1.28

                      CUMULATIVE AREA =    .00400 SQ MI   ACRES=            2.5600


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   27 KK    *        S7  *
            *            *
            **************

   28 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

   29 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .01

   30 LS          SCS LOSS RATE
                        STRTL         .33  INITIAL ABSTRACTION
                       CRVNBR       86.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
   31 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        160.  OVERLAND FLOW LENGTH
                           S       .2500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
   32 RD            MAIN CHANNEL
                           L        438.  CHANNEL LENGTH
                           S       .0050  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .01  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD         .00  BOTTOM WIDTH OR DIAMETER
                           Z        2.00  SIDE SLOPE
                      RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH
```

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                                                  ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                              COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                                (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .77     32.00     62.97    724.49      6.18       .85
                    MAIN          1.63      1.33       1.60    437.60     60.23    725.29      5.36      4.56


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .3002E+01 OUTFLOW= .2602E+01 BASIN STORAGE= .3265E-03 PERCENT ERROR=  13.3


                                               INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          1.63      1.33       5.00               59.78    725.00      5.38

       ***             ***             ***             ***             ***

                            HYDROGRAPH AT STATION       S7

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

  PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+    59.78     12.08                  4.79        1.32         .91          .91
                         (INCHES)     4.892       5.384       5.384        5.384
                          (AC-FT)     2.37        2.61        2.61         2.61

                         CUMULATIVE AREA =    .00910 SQ MI   ACRES=            5.8240


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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              *            *
   33 KK      *      C/S7  *
              *            *
              **************

   34 KO           OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


   35 HC           HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                  ***

       ***             ***             ***             ***             ***

                            HYDROGRAPH AT STATION     C/S7

  PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+    82.16     12.08                  7.06        1.96        1.36         1.36
                         (INCHES)     5.012       5.578       5.578        5.578
                          (AC-FT)     3.50        3.90        3.90         3.90

                         CUMULATIVE AREA =    .01310 SQ MI   ACRES=            8.3840


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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              *            *
   36 KK      *       OA2  *
              *            *
              **************

   37 KO           OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
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                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT       .083  TIME INTERVAL IN HOURS


            SUBBASIN RUNOFF DATA

  38 BA       SUBBASIN CHARACTERISTICS
                    TAREA         .08  SUBBASIN AREA

              PRECIPITATION DATA

   6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
               1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .08

  39 LS       SCS LOSS RATE
                    STRTL         .38  INITIAL ABSTRACTION
                    CRVNBR      84.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

  40 US       SNYDER UNITGRAPH
                      TP          .55  LAG
                      CP          .66  PEAKING COEFFICIENT

              SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                       ***

                                                UNIT HYDROGRAPH PARAMETERS
                                             CLARK   TC=   .64 HR,       R=   .45 HR
                                            SNYDER   TP=   .55 HR,      CP=   .67

                                                   UNIT HYDROGRAPH
                                                33 END-OF-PERIOD ORDINATES
               3.       12.       24.       37.       49.       57.       60.       57.       50.       41.
              34.       28.       24.       20.       16.       13.       11.        9.        8.        6.
               5.        4.        4.        3.        3.        2.        2.        1.        1.        1.
               1.        1.        1.

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION      OA2

    TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.90, TOTAL EXCESS =    5.95

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                      (CFS)
+   162.61     12.58               42.40       12.18        8.45         8.45
                     (INCHES)     5.153       5.923       5.923        5.923
                      (AC-FT)     21.03       24.16       24.16        24.16

                     CUMULATIVE AREA =    .07650 SQ MI   ACRES=           48.9600


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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            *            *
  41 KK     *     C/CH1  *
            *            *
            **************

  42 KO       OUTPUT CONTROL VARIABLES
                    IPRNT           3  PRINT CONTROL
                    IPLOT           0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE
                    IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                     IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT       .083  TIME INTERVAL IN HOURS


  43 HC       HYDROGRAPH COMBINATION
                    ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                       ***

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION    C/CH1

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                      (CFS)
```

```
+   191.54     12.08                54.50       15.59       10.82        10.82
                          (INCHES)     5.139       5.881       5.881        5.881
                           (AC-FT)     27.02       30.93       30.93        30.93

                          CUMULATIVE AREA =    .09860 SQ MI   ACRES=           63.1040


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


                 **************
                 *            *
  44 KK          *       CH1  *
                 *            *
                 **************

  45 KO            OUTPUT CONTROL VARIABLES
                         IPRNT           3  PRINT CONTROL
                         IPLOT           0  PLOT CONTROL
                         QSCAL          0.  HYDROGRAPH PLOT SCALE
                         IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                          IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                         ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                         ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                        TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  46 BA            SUBBASIN CHARACTERISTICS
                         TAREA         .01  SUBBASIN AREA

                   PRECIPITATION DATA

   6 PH                                 DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                    1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                 STORM AREA =     .01

  47 LS            SCS LOSS RATE
                         STRTL         .33  INITIAL ABSTRACTION
                        CRVNBR       86.00  CURVE NUMBER
                         RTIMP         .00  PERCENT IMPERVIOUS AREA

                   KINEMATIC WAVE
  48 UK              OVERLAND-FLOW ELEMENT NO. 1
                            L          47.  OVERLAND FLOW LENGTH
                            S       .2500  SLOPE
                            N        .300  ROUGHNESS COEFFICIENT
                           PA       100.0  PERCENT OF SUBBASIN
                         DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                   MUSKINGUM-CUNGE
  49 RD              MAIN CHANNEL
                            L        3079.  CHANNEL LENGTH
                            S       .0200  SLOPE
                            N        .030  CHANNEL ROUGHNESS COEFFICIENT
                           CA         .01  CONTRIBUTING AREA
                        SHAPE        TRAP  CHANNEL SHAPE
                           WD       10.00  BOTTOM WIDTH OR DIAMETER
                            Z        3.00  SIDE SLOPE
                       RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                          ***
                                       COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                              COMPUTATION TIME STEP
                          ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                          PEAK                CELERITY
                                                                  (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                          PLANE1        2.48      1.67        .36      9.40     68.18    724.96      6.18       .54
                          MAIN          1.95      1.42       5.00   1539.50    215.35    730.00      5.90      9.49


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3093E+02  EXCESS= .3134E+01 OUTFLOW= .3403E+02 BASIN STORAGE= .1750E-02 PERCENT ERROR=    .1


                                            INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                          MAIN          1.95      1.42       5.00              215.35    730.00      5.90

      ***             ***             ***             ***             ***

                              HYDROGRAPH AT STATION      CH1

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

  PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                               (CFS)
```

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+   215.35     12.17                59.96       17.16       11.91        11.91
                          (INCHES)     5.157       5.902       5.902        5.902
                           (AC-FT)     29.73       34.03       34.03        34.03

                          CUMULATIVE AREA =    .10810 SQ MI   ACRES=           69.1840


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


                 **************
                 *            *
  50 KK          *        T1  *
                 *            *
                 **************

  51 KO            OUTPUT CONTROL VARIABLES
                         IPRNT           3  PRINT CONTROL
                         IPLOT           0  PLOT CONTROL
                         QSCAL          0.  HYDROGRAPH PLOT SCALE
                         IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                          IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                         ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                         ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                        TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  52 BA            SUBBASIN CHARACTERISTICS
                         TAREA         .00  SUBBASIN AREA

                   PRECIPITATION DATA

   6 PH                                 DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                    1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                 STORM AREA =     .00

  53 LS            SCS LOSS RATE
                         STRTL         .35  INITIAL ABSTRACTION
                        CRVNBR       85.00  CURVE NUMBER
                         RTIMP         .00  PERCENT IMPERVIOUS AREA

                   KINEMATIC WAVE
  54 UK              OVERLAND-FLOW ELEMENT NO. 1
                            L        167.  OVERLAND FLOW LENGTH
                            S       .0500  SLOPE
                            N        .300  ROUGHNESS COEFFICIENT
                           PA       100.0  PERCENT OF SUBBASIN
                        DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                   MUSKINGUM-CUNGE
  55 RD              MAIN CHANNEL
                            L        305.  CHANNEL LENGTH
                            S       .0050  SLOPE
                            N        .030  CHANNEL ROUGHNESS COEFFICIENT
                           CA         .00  CONTRIBUTING AREA
                        SHAPE        TRAP  CHANNEL SHAPE
                           WD         .00  BOTTOM WIDTH OR DIAMETER
                            Z        2.00  SIDE SLOPE
                       RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                        ***
                                      COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                             COMPUTATION TIME STEP
                         ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                        PEAK                CELERITY
                                                                  (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                         PLANE1        1.11      1.67       1.16     33.30     14.09    725.54      6.07       .49
                         MAIN          1.63      1.33       1.62    152.50     13.83    725.33      6.02      3.13


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .7767E+00 OUTFLOW= .7699E+00 BASIN STORAGE= .2497E-03 PERCENT ERROR=    .9


                                           INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                         MAIN          1.63      1.33       5.00                13.52    725.00      6.02

      ***             ***             ***             ***             ***

                             HYDROGRAPH AT STATION       T1

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

   PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                              (CFS)
```

```
+    13.52     12.08                1.36         .39         .27          .27
                        (INCHES)     5.283       6.018       6.019        6.019
                         (AC-FT)      .68         .77         .77          .77

                        CUMULATIVE AREA =    .00240 SQ MI   ACRES=           1.5360


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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              *            *
   56 KK      *        S1  *
              *            *
              **************

   57 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

   58 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .00

   59 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
   60 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        159.  OVERLAND FLOW LENGTH
                           S       .2500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                        DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
   61 RD            MAIN CHANNEL
                           L        522.  CHANNEL LENGTH
                           S       .0050  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .00  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD         .00  BOTTOM WIDTH OR DIAMETER
                           Z        2.00  SIDE SLOPE
                      RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                      ***
                                    COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                           COMPUTATION TIME STEP
                        ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                       PEAK                CELERITY
                                                                 (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                        PLANE1        2.48      1.67        .71     31.72     27.04    724.50      6.19       .85
                        MAIN          1.63      1.33       2.36    260.90     25.00    723.69      6.08      3.69


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1287E+01 OUTFLOW= .1265E+01 BASIN STORAGE= .3119E-03 PERCENT ERROR=   1.7


                                           INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                        MAIN          1.63      1.33       5.00               24.36    725.00      6.08

      ***             ***             ***             ***             ***

                            HYDROGRAPH AT STATION       S1

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                             (CFS)
```

```
+    24.36     12.08                2.24         .64         .44          .44
                        (INCHES)     5.337       6.076       6.076        6.076
                         (AC-FT)      1.11        1.26        1.26         1.26

                        CUMULATIVE AREA =    .00390 SQ MI   ACRES=            2.4960


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              **************
              *            *
   62 KK      *      C/S1  *
              *            *
              **************

   63 KO           OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


   64 HC           HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION     C/S1

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                         (CFS)
+     37.88     12.08                3.60         1.03         .71          .71
                        (INCHES)     5.315       6.054       6.055        6.055
                         (AC-FT)      1.79        2.03        2.03         2.03

                        CUMULATIVE AREA =    .00630 SQ MI   ACRES=            4.0320


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
   65 KK      *        P1  *
              *            *
              **************

   66 KO           OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

   67 BA           SUBBASIN CHARACTERISTICS
                        TAREA         .01  SUBBASIN AREA

                   PRECIPITATION DATA

    6 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                    1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                 STORM AREA =     .01

   68 LS           SCS LOSS RATE
                        STRTL         .00  INITIAL ABSTRACTION
                       CRVNBR      100.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

   69 UD           SCS DIMENSIONLESS UNITGRAPH
                         TLAG         .00  LAG

                                                          ***

                                                      UNIT HYDROGRAPH
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                                                  5 END-OF-PERIOD ORDINATES
               50.       14.        3.        1.        0.

      ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION       P1

     TOTAL RAINFALL =    7.85, TOTAL LOSS =     .00, TOTAL EXCESS =    7.85

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                    (CFS)
+    60.46     12.08                 5.91        1.84        1.27         1.27
                  (INCHES)     6.316       7.848       7.850        7.850
                   (AC-FT)      2.93        3.64        3.64         3.64

                  CUMULATIVE AREA =    .00870 SQ MI   ACRES=            5.5680


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            *            *
  70 KK     *      C/P1  *
            *            *
            **************

  71 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


  72 HC          HYDROGRAPH COMBINATION
                      ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

      ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION     C/P1

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                    (CFS)
+   280.49     12.08                69.24       19.99       13.89        13.89
                  (INCHES)     5.230       6.040       6.048        6.048
                   (AC-FT)     34.34       39.65       39.70        39.70

                  CUMULATIVE AREA =    .12310 SQ MI   ACRES=           78.7840


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  73 KK     *      R/P1  *
            *            *
            **************

  74 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


             HYDROGRAPH ROUTING DATA

  75 RS          STORAGE ROUTING
                      NSTPS           1  NUMBER OF SUBREACHES
                       ITYP        ELEV  TYPE OF INITIAL CONDITION
                     RSVRIC     1044.00  INITIAL CONDITION
                          X         .00 WORKING R AND D COEFFICIENT

  76 SA              AREA          .0       1.6       1.9       2.1       2.3       2.6       2.9       3.1       3.4

  77 SE          ELEVATION     1044.00   1044.20   1046.00   1048.00   1050.00   1052.00   1054.00   1056.00   1058.00
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 79 SL          LOW-LEVEL OUTLET
                      ELEVL     1041.00  ELEVATION AT CENTER OF OUTLET
                      CAREA        3.14  CROSS-SECTIONAL AREA
                       COQL         .60  COEFFICIENT
                       EXPL         .50  EXPONENT OF HEAD

 78 SS          SPILLWAY
                       CREL     1056.50  SPILLWAY CREST ELEVATION
                      SPWID       10.00  SPILLWAY WIDTH
                       COQW        2.60  WEIR COEFFICIENT
                       EXPW        1.50  EXPONENT OF HEAD

                                                  ***

                                          COMPUTED STORAGE-ELEVATION DATA

          STORAGE        .00       .11      3.19      7.14     11.58     16.54     22.02     28.03     34.58
        ELEVATION    1044.00   1044.20   1046.00   1048.00   1050.00   1052.00   1054.00   1056.00   1058.00

                                          COMPUTED OUTFLOW-ELEVATION DATA

          OUTFLOW        .00     27.91     29.89     32.18     34.84     37.99     41.76     46.37     52.12     59.49
        ELEVATION    1044.00   1044.41   1044.91   1045.54   1046.32   1047.32   1048.64   1050.42   1052.90   1056.50

          OUTFLOW      59.66     60.24     61.48     63.65     66.98     71.74     78.17     86.54     97.08    110.06
        ELEVATION    1056.53   1056.58   1056.66   1056.77   1056.91   1057.07   1057.26   1057.48   1057.73   1058.00


                                       COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00       .11       .44      1.27      2.35      3.19      3.78      5.74      7.14      8.51
          OUTFLOW      26.17     27.03     27.91     29.89     32.18     33.79     34.84     37.99     39.98     41.76
        ELEVATION    1044.00   1044.20   1044.41   1044.91   1045.54   1046.00   1046.32   1047.32   1048.00   1048.64

          STORAGE      11.58     12.58     16.54     18.93     22.02     28.03     29.61     29.70     29.87     30.13
          OUTFLOW      45.33     46.37     50.11     52.12     54.48     58.52     59.49     59.66     60.24     61.48
        ELEVATION    1050.00   1050.42   1052.00   1052.90   1054.00   1056.00   1056.50   1056.53   1056.58   1056.66

          STORAGE      30.48     30.93     31.46     32.09     32.82     33.65     34.58
          OUTFLOW      63.65     66.98     71.74     78.17     86.54     97.08    110.06
        ELEVATION    1056.77   1056.91   1057.07   1057.26   1057.48   1057.73   1058.00

     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION     R/P1

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                        (CFS)
+    51.83     14.00               47.83       32.91       30.85       30.85
                      (INCHES)     3.612       9.943      13.429      13.429
                       (AC-FT)     23.72       65.28       88.17       88.17

 PEAK STORAGE   TIME                       MAXIMUM AVERAGE STORAGE
                                    6-HR       24-HR       72-HR     34.58-HR
+  (AC-FT)      (HR)
    18.587     14.00                14.32        4.14        2.87        2.84

  PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                    6-HR       24-HR       72-HR     34.58-HR
+   (FEET)      (HR)
   1052.77     14.00              1051.08     1046.13     1045.48     1045.48

                      CUMULATIVE AREA =    .12310 SQ MI   ACRES=          78.7840


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 80 KK    *       DA1  *
          *            *
          **************

 81 KO          OUTPUT CONTROL VARIABLES
                      IPRNT          3  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                       IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT       .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

 82 BA          SUBBASIN CHARACTERISTICS
                      TAREA        .05  SUBBASIN AREA

                PRECIPITATION DATA
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  6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                              STORM AREA =     .05

  83 LS          SCS LOSS RATE
                       STRTL         .38  INITIAL ABSTRACTION
                      CRVNBR       84.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

  84 US          SNYDER UNITGRAPH
                         TP         .32  LAG
                         CP         .66  PEAKING COEFFICIENT

                 SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                      ***

                                            UNIT HYDROGRAPH PARAMETERS
                                       CLARK   TC=   .38 HR,       R=   .26 HR
                                      SNYDER   TP=   .32 HR,      CP=   .66

                                                UNIT HYDROGRAPH
                                            19 END-OF-PERIOD ORDINATES
                 7.       26.       48.       62.       59.       46.       33.       24.       17.       12.
                 9.        7.        5.        3.        2.        2.        1.        1.        1.

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION      DA1

    TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.90, TOTAL EXCESS =    5.95

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                         (CFS)
+   136.90     12.33                26.38        7.56        5.25         5.25
                        (INCHES)     5.163       5.923       5.923        5.923
                         (AC-FT)     13.08       15.00       15.00        15.00

                       CUMULATIVE AREA =    .04750 SQ MI   ACRES=           30.4000


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            *            *
  85 KK     *     C/DP1  *
            *            *
            **************

  86 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


  87 HC          HYDROGRAPH COMBINATION
                      ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                      ***

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION    C/DP1

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                         (CFS)
+   177.36     12.33                71.75       40.48       36.10        36.10
                        (INCHES)     3.910       8.823      11.339       11.339
                         (AC-FT)     35.58       80.28      103.17       103.17

                       CUMULATIVE AREA =    .17060 SQ MI   ACRES=          109.1840


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 88 KK     *        T7  *
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 89 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

 90 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .01  SUBBASIN AREA

                PRECIPITATION DATA

  6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                              STORM AREA =     .01

 91 LS          SCS LOSS RATE
                     STRTL         .35  INITIAL ABSTRACTION
                    CRVNBR       85.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
 92 UK            OVERLAND-FLOW ELEMENT NO. 1
                         L        244.  OVERLAND FLOW LENGTH
                         S       .0500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                     DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
 93 RD            MAIN CHANNEL
                         L        438.  CHANNEL LENGTH
                         S       .0050  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .01  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD         .00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                      ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                   ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                  PEAK                CELERITY
                                                     (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                   PLANE1        1.11      1.67       1.60     48.82     35.46    725.18      6.06       .54
                   MAIN          1.63      1.33       1.85    218.80     34.36    726.41      5.99      3.94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2168E+01 OUTFLOW= .2140E+01 BASIN STORAGE= .6671E-03 PERCENT ERROR=   1.3

                                       INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                   MAIN          1.63      1.33       5.00                32.26    725.00      5.99

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION       T7

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                      (CFS)
+    32.26     12.08                3.78         1.08         .75          .75
                    (INCHES)      5.248        5.985       5.986        5.986
                     (AC-FT)       1.88         2.14        2.14         2.14

                    CUMULATIVE AREA =    .00670 SQ MI   ACRES=            4.2880


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 94 KK     *        S5  *
           *            *
           **************

 95 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

 96 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .01  SUBBASIN AREA

               PRECIPITATION DATA

  6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                              STORM AREA =     .01

 97 LS          SCS LOSS RATE
                     STRTL         .33  INITIAL ABSTRACTION
                    CRVNBR       86.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
 98 UK           OVERLAND-FLOW ELEMENT NO. 1
                        L        176.  OVERLAND FLOW LENGTH
                        S       .2500  SLOPE
                        N        .300  ROUGHNESS COEFFICIENT
                       PA       100.0  PERCENT OF SUBBASIN
                     DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
 99 RD           MAIN CHANNEL
                        L        644.  CHANNEL LENGTH
                        S       .0050  SLOPE
                        N        .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA         .01  CONTRIBUTING AREA
                    SHAPE        TRAP  CHANNEL SHAPE
                       WD         .00  BOTTOM WIDTH OR DIAMETER
                        Z        2.00  SIDE SLOPE
                   RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .70     35.12     60.99    724.49      6.18       .88
                    MAIN          1.63      1.33       2.37    321.80     57.79    724.09      6.05      4.52

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2936E+01 OUTFLOW= .2870E+01 BASIN STORAGE= .4313E-03 PERCENT ERROR=   2.2

                                       INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          1.63      1.33       5.00               55.58    725.00      6.04

      ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION       S5

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR     34.58-HR
+   (CFS)        (HR)
                          (CFS)
+    55.58     12.08                5.10        1.45        1.00         1.00
                         (INCHES)    5.323       6.041       6.042        6.042
                          (AC-FT)    2.53        2.87        2.87         2.87

                         CUMULATIVE AREA =    .00890 SQ MI   ACRES=            5.6960


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100 KK     *      C/S5  *
           *            *
           **************

101 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


102 HC          HYDROGRAPH COMBINATION
                     ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

     ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION     C/S5

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                  6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                    (CFS)
+    87.84     12.08                8.87        2.52        1.75         1.75
                  (INCHES)     5.289       6.017       6.018        6.018
                   (AC-FT)      4.40        5.01        5.01         5.01

                  CUMULATIVE AREA =    .01560 SQ MI   ACRES=            9.9840


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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           *            *
103 KK     *       OA1  *
           *            *
           **************

104 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

105 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .15  SUBBASIN AREA

                PRECIPITATION DATA

  6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                              STORM AREA =     .15

106 LS          SCS LOSS RATE
                     STRTL         .38  INITIAL ABSTRACTION
                    CRVNBR       84.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

107 US          SNYDER UNITGRAPH
                       TP         .56  LAG
                       CP         .64  PEAKING COEFFICIENT

                SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                        ***

                                              UNIT HYDROGRAPH PARAMETERS
                                         CLARK   TC=    .64 HR,       R=    .49 HR
                                        SNYDER   TP=    .56 HR,      CP=    .64

                                                  UNIT HYDROGRAPH
                                              36 END-OF-PERIOD ORDINATES
                  6.       22.       44.       68.       90.      105.      112.      107.       94.       79.
                 67.       57.       48.       40.       34.       29.       24.       20.       17.       15.
                 12.       10.        9.        7.        6.        5.        4.        4.        3.        3.
                  2.        2.        2.        1.        1.        1.
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      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION      OA1

    TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.90, TOTAL EXCESS =    5.95

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                      (CFS)
+   304.79     12.58               82.65       23.76       16.49       16.49
                     (INCHES)     5.150       5.923       5.923       5.923
                      (AC-FT)    40.98       47.13       47.13       47.13

                     CUMULATIVE AREA =    .14920 SQ MI   ACRES=          95.4880


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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           *            *
  108 KK   *     C/CH2  *
           *            *
           **************

  109 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


  110 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION    C/CH2

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                      (CFS)
+   319.42     12.58               91.48       26.29       18.24       18.24
                     (INCHES)     5.161       5.932       5.932       5.932
                      (AC-FT)    45.36       52.14       52.14       52.14

                     CUMULATIVE AREA =    .16480 SQ MI   ACRES=         105.4720


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
  111 KK   *       CH2  *
           *            *
           **************

  112 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

  113 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                              STORM AREA =     .01

  114 LS          SCS LOSS RATE
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                    STRTL         .33  INITIAL ABSTRACTION
                   CRVNBR       86.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

              KINEMATIC WAVE
 115 UK         OVERLAND-FLOW ELEMENT NO. 1
                       L         47.  OVERLAND FLOW LENGTH
                       S       .2500  SLOPE
                       N        .300  ROUGHNESS COEFFICIENT
                      PA       100.0  PERCENT OF SUBBASIN
                    DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
              MUSKINGUM-CUNGE
 116 RD         MAIN CHANNEL
                       L        865.  CHANNEL LENGTH
                       S       .0100  SLOPE
                       N        .030  CHANNEL ROUGHNESS COEFFICIENT
                      CA         .01  CONTRIBUTING AREA
                   SHAPE        TRAP  CHANNEL SHAPE
                      WD       10.00  BOTTOM WIDTH OR DIAMETER
                       Z        3.00  SIDE SLOPE
                  RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .36      9.40     67.47    724.96      6.18       .54
                    MAIN          1.38      1.42       1.81    432.50    324.98    756.24      5.94      7.97


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5214E+02  EXCESS= .3101E+01 OUTFLOW= .5522E+02 BASIN STORAGE= .6339E-03 PERCENT ERROR=    .0


                                           INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          1.38      1.42       5.00              323.44    755.00      5.94

       ***             ***             ***             ***             ***

                            HYDROGRAPH AT STATION      CH2

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

   PEAK FLOW     TIME                            MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
 +   (CFS)       (HR)
                          (CFS)
 +   323.44     12.58                  96.83       27.83       19.31        19.31
                         (INCHES)     5.168       5.942       5.942        5.942
                          (AC-FT)     48.02       55.20       55.20        55.20

                         CUMULATIVE AREA =    .17420 SQ MI   ACRES=          111.4880


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *             *
 117 KK       *        T4   *
              *             *
              **************

 118 KO           OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

 119 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                               DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .01

 120 LS          SCS LOSS RATE
```

```
                    STRTL         .33  INITIAL ABSTRACTION
                   CRVNBR       86.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

              KINEMATIC WAVE
 121 UK         OVERLAND-FLOW ELEMENT NO. 1
                       L        176.  OVERLAND FLOW LENGTH
                       S       .2500  SLOPE
                       N        .300  ROUGHNESS COEFFICIENT
                      PA       100.0  PERCENT OF SUBBASIN
                    DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
              MUSKINGUM-CUNGE
 122 RD         MAIN CHANNEL
                       L        697.  CHANNEL LENGTH
                       S       .0050  SLOPE
                       N        .030  CHANNEL ROUGHNESS COEFFICIENT
                      CA         .01  CONTRIBUTING AREA
                   SHAPE        TRAP  CHANNEL SHAPE
                      WD         .00  BOTTOM WIDTH OR DIAMETER
                       Z        2.00  SIDE SLOPE
                  RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .70     35.12     69.90    724.49      6.18       .88
                    MAIN          1.63      1.33       2.48    348.40     67.46    725.31      6.04      4.68


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .3365E+01 OUTFLOW= .3288E+01 BASIN STORAGE= .4782E-03 PERCENT ERROR=   2.3


                                           INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          1.63      1.33       5.00               66.21    725.00      6.05

       ***             ***             ***             ***             ***

                            HYDROGRAPH AT STATION       T4

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

   PEAK FLOW     TIME                            MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
 +   (CFS)       (HR)
                          (CFS)
 +    66.21     12.08                   5.86        1.66        1.15         1.15
                         (INCHES)     5.340       6.054       6.054        6.054
                          (AC-FT)      2.90        3.29        3.29         3.29

                         CUMULATIVE AREA =    .01020 SQ MI   ACRES=            6.5280


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
 123 KK       *       CH3  *
              *            *
              **************

 124 KO           OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

 125 BA           SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

   6 PH                               DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .00

 126 LS           SCS LOSS RATE
```

```
                    STRTL         .33  INITIAL ABSTRACTION
                   CRVNBR       86.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
 127 UK           OVERLAND-FLOW ELEMENT NO. 1
                        L        156.  OVERLAND FLOW LENGTH
                        S       .2500  SLOPE
                        N        .300  ROUGHNESS COEFFICIENT
                       PA       100.0  PERCENT OF SUBBASIN
                     DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
 128 RD           MAIN CHANNEL
                        L       1456.  CHANNEL LENGTH
                        S       .0100  SLOPE
                        N        .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA         .00  CONTRIBUTING AREA
                    SHAPE        TRAP  CHANNEL SHAPE
                       WD       10.00  BOTTOM WIDTH OR DIAMETER
                        Z        3.00  SIDE SLOPE
                   RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                      ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                           COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                    (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .75     31.14     24.33    724.48      6.18       .84
                    MAIN          1.38      1.42       4.47    728.00     73.82    729.14      6.06      5.42


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3293E+01  EXCESS= .1155E+01 OUTFLOW= .4428E+01 BASIN STORAGE= .1084E-02 PERCENT ERROR=    .4


                                               INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          1.38      1.42       5.00               70.27    730.00      6.07

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION      CH3

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

   PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+     70.27     12.17                   7.90        2.24        1.55         1.55
                         (INCHES)     5.364       6.069       6.070        6.070
                          (AC-FT)      3.92        4.43        4.43         4.43

                         CUMULATIVE AREA =    .01370 SQ MI   ACRES=            8.7680


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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              *            *
 129 KK       *    C/DC#2  *
              *            *
              **************

 130 KO           OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


 131 HC           HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                      ***

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION   C/DC#2

   PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+    337.46     12.58                 104.70       30.07       20.87        20.87
                         (INCHES)     5.181       5.951       5.951        5.951
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                    (AC-FT)     51.92       59.64       59.64        59.64

                   CUMULATIVE AREA =    .18790 SQ MI   ACRES=          120.2560


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
132 KK    *        T9  *
          *            *
          **************

133 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          7.  HYDROGRAPH PLOT SCALE
                     IPNCH          21  PUNCH COMPUTED HYDROGRAPH
                      IOUT           0  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

134 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .02  SUBBASIN AREA

                PRECIPITATION DATA

  6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                              STORM AREA =     .02

135 LS          SCS LOSS RATE
                     STRTL         .35  INITIAL ABSTRACTION
                    CRVNBR       85.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
136 UK            OVERLAND-FLOW ELEMENT NO. 1
                         L        919.  OVERLAND FLOW LENGTH
                         S       .0500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                     DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
137 RD            MAIN CHANNEL
                         L        232.  CHANNEL LENGTH
                         S       .0050  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .02  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD         .00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                      ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                      PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        1.11      1.67       4.25    183.86     68.27    734.73      6.05       .74
                     MAIN          1.63      1.33        .83    232.00     67.88    735.01      5.67      4.65


CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .7023E+01 OUTFLOW= .6563E+01 BASIN STORAGE= .8647E-02 PERCENT ERROR=   6.4


                                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                     MAIN          1.63      1.33       5.00                67.87    735.00      5.67

      ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION       T9

    TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

  PEAK FLOW     TIME                              MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+    67.87     12.25                   11.91        3.31        2.30         2.30
                         (INCHES)     5.104       5.670       5.673        5.673
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                    (AC-FT)      5.91        6.56        6.57         6.57

                   CUMULATIVE AREA =    .02170 SQ MI   ACRES=           13.8880


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
138 KK    *       CH4  *
          *            *
          **************

139 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


            SUBBASIN RUNOFF DATA

140 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .01  SUBBASIN AREA

                PRECIPITATION DATA

  6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                              STORM AREA =     .01

141 LS          SCS LOSS RATE
                     STRTL         .33  INITIAL ABSTRACTION
                    CRVNBR       86.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
142 UK            OVERLAND-FLOW ELEMENT NO. 1
                         L        156.  OVERLAND FLOW LENGTH
                         S       .2500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                     DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
143 RD            MAIN CHANNEL
                         L       1064.  CHANNEL LENGTH
                         S       .0100  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .01  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD       10.00  BOTTOM WIDTH OR DIAMETER
                         Z        3.00  SIDE SLOPE
                    RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                      PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        2.48      1.67        .75     31.16     66.82    724.50      6.18       .84
                     MAIN          1.38      1.42       3.00    532.00    101.18    726.67      5.78      5.91


CONTINUITY SUMMARY (AC-FT) - INFLOW= .6565E+01  EXCESS= .3167E+01 OUTFLOW= .9653E+01 BASIN STORAGE= .8531E-03 PERCENT ERROR=    .8


                                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                     MAIN          1.38      1.42       5.00                99.36    725.00      5.77

      ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION      CH4

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

   PEAK FLOW     TIME                            MAXIMUM AVERAGE FLOW
                                          6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+     99.36     12.08                  17.35        4.86        3.37         3.37
                         (INCHES)     5.153       5.769       5.771        5.771
```

```
                    (AC-FT)      8.60        9.63        9.63         9.63

                   CUMULATIVE AREA =    .03130 SQ MI   ACRES=           20.0320


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
144 KK    *        T8  *
          *            *
          **************

145 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

146 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .01  SUBBASIN AREA

                PRECIPITATION DATA

  6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                            STORM AREA =     .01

147 LS          SCS LOSS RATE
                     STRTL         .35  INITIAL ABSTRACTION
                    CRVNBR       85.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
148 UK            OVERLAND-FLOW ELEMENT NO. 1
                         L        360.  OVERLAND FLOW LENGTH
                         S       .0500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
149 RD            MAIN CHANNEL
                         L        721.  CHANNEL LENGTH
                         S       .0050  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .01  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD         .00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                      PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        1.11      1.67       2.12     71.94     43.17    726.29      6.06       .60
                     MAIN          1.63      1.33       2.89    360.25     41.79    729.22      5.96      4.15


CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .3075E+01 OUTFLOW= .3021E+01 BASIN STORAGE= .1484E-02 PERCENT ERROR=   1.7


                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                     MAIN          1.63      1.33       5.00                40.84    730.00      5.95

      ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION       T8

    TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

  PEAK FLOW     TIME                              MAXIMUM AVERAGE FLOW
                                          6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                            (CFS)
+    40.84     12.17                      5.35         1.52        1.06         1.06
                           (INCHES)     5.233        5.952       5.955        5.955
```

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                    (AC-FT)      2.65        3.02        3.02         3.02

                   CUMULATIVE AREA =    .00950 SQ MI   ACRES=            6.0800


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
150 KK    *        T3  *
          *            *
          **************

151 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

152 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .00  SUBBASIN AREA

                PRECIPITATION DATA

  6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                            STORM AREA =     .00

153 LS          SCS LOSS RATE
                     STRTL         .35  INITIAL ABSTRACTION
                    CRVNBR       85.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
154 UK            OVERLAND-FLOW ELEMENT NO. 1
                         L         49.  OVERLAND FLOW LENGTH
                         S       .0500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                     DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
155 RD            MAIN CHANNEL
                         L        535.  CHANNEL LENGTH
                         S       .0050  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .00  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD         .00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                      ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                      PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        1.11      1.67        .55      9.80     24.62    724.64      6.07       .33
                     MAIN          1.63      1.33       2.48    267.50     23.56    725.26      5.97      3.60


CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1133E+01 OUTFLOW= .1115E+01 BASIN STORAGE= .3026E-03 PERCENT ERROR=   1.6


                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                     MAIN          1.63      1.33       5.00               23.32    725.00      5.98

      ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION       T3

    TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

  PEAK FLOW     TIME                            MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+    23.32     12.08                    1.98         .56         .39          .39
                         (INCHES)     5.269       5.982       5.982        5.982
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                    (AC-FT)       .98        1.12        1.12         1.12

                   CUMULATIVE AREA =    .00350 SQ MI   ACRES=            2.2400


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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          *            *
156 KK    *        S3  *
          *            *
          **************

157 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

158 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .01  SUBBASIN AREA

                PRECIPITATION DATA

  6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                              STORM AREA =     .01

159 LS          SCS LOSS RATE
                     STRTL         .33  INITIAL ABSTRACTION
                    CRVNBR       86.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
160 UK            OVERLAND-FLOW ELEMENT NO. 1
                         L        160.  OVERLAND FLOW LENGTH
                         S       .2500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                     DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
161 RD            MAIN CHANNEL
                         L        304.  CHANNEL LENGTH
                         S       .0050  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .01  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD         .00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                      ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                      PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        2.48      1.67        .77     32.00     46.36    724.49      6.18       .85
                     MAIN          1.63      1.33       1.20    304.00     44.71    725.21      5.42      4.22


CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2210E+01 OUTFLOW= .1937E+01 BASIN STORAGE= .2307E-03 PERCENT ERROR=  12.3


                                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                     MAIN          1.63      1.33       5.00                44.55    725.00      5.44

      ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION       S3

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

   PEAK FLOW     TIME                            MAXIMUM AVERAGE FLOW
                                          6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+     44.55     12.08                    3.56         .98         .68          .68
                          (INCHES)     4.941       5.441       5.441        5.441
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                     (AC-FT)      1.77        1.94        1.94         1.94

                    CUMULATIVE AREA =    .00670 SQ MI   ACRES=            4.2880


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          *            *
 162 KK   *      C/S3  *
          *            *
          **************

 163 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


 164 HC          HYDROGRAPH COMBINATION
                      ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION     C/S3

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                        (CFS)
+    67.88     12.08                 5.54         1.54        1.07         1.07
                     (INCHES)     5.053        5.626       5.627        5.627
                      (AC-FT)      2.75         3.06        3.06         3.06

                     CUMULATIVE AREA =    .01020 SQ MI   ACRES=            6.5280


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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          *            *
 165 KK   *       CH5  *
          *            *
          **************

 166 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

 167 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .01  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .01

 168 LS          SCS LOSS RATE
                      STRTL         .33  INITIAL ABSTRACTION
                     CRVNBR       86.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 169 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L        200.  OVERLAND FLOW LENGTH
                          S       .2500  SLOPE
                          N        .300  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
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 170 RD           MAIN CHANNEL
                         L       1996.  CHANNEL LENGTH
                         S       .0100  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .01  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD        2.00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                    RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                           COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                      PEAK                CELERITY
                                                                (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        2.48      1.67        .86     40.00     51.86    724.82      6.19       .92
                     MAIN          2.16      1.35       4.84    998.00     91.44    726.52      5.80      6.87


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3061E+01  EXCESS= .2507E+01 OUTFLOW= .5509E+01 BASIN STORAGE= .1029E-02 PERCENT ERROR=   1.0


                                           INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                     MAIN          2.16      1.35       5.00               83.96    730.00      5.80

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION      CH5

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

   PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
 +   (CFS)        (HR)
                            (CFS)
 +    83.96     12.17                   9.90        2.78        1.93         1.93
                            (INCHES)    5.173       5.801       5.801        5.801
                             (AC-FT)    4.91        5.51        5.51         5.51

                           CUMULATIVE AREA =    .01780 SQ MI   ACRES=           11.3920


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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                 *            *
 171 KK          *        P2  *
                 *            *
                 **************

 172 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                    SUBBASIN RUNOFF DATA

 173 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .00

 174 LS          SCS LOSS RATE
                       STRTL         .00  INITIAL ABSTRACTION
                      CRVNBR      100.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

 175 UD          SCS DIMENSIONLESS UNITGRAPH
                        TLAG         .00  LAG

                                                      ***

                                                  UNIT HYDROGRAPH
                                               5 END-OF-PERIOD ORDINATES
                      21.        6.        1.        0.        0.
```

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      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION       P2

    TOTAL RAINFALL =    7.85, TOTAL LOSS =     .00, TOTAL EXCESS =    7.85

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                        (CFS)
+    25.72     12.08                2.51         .78         .54          .54
                      (INCHES)     6.316       7.848       7.850        7.850
                       (AC-FT)      1.25        1.55        1.55         1.55

                      CUMULATIVE AREA =    .00370 SQ MI   ACRES=            2.3680


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  176 KK    *      C/P2  *
            *            *
            **************

  177 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


  178 HC          HYDROGRAPH COMBINATION
                       ICOMP           4  NUMBER OF HYDROGRAPHS TO COMBINE

                                                              ***

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION     C/P2

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                        (CFS)
+   244.85     12.08               35.00        9.91        6.90         6.90
                      (INCHES)     5.224       5.915       5.931        5.931
                       (AC-FT)     17.36       19.65       19.71        19.71

                      CUMULATIVE AREA =    .06230 SQ MI   ACRES=           39.8720


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  179 KK    *      R/P2  *
            *            *
            **************

  180 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


              HYDROGRAPH ROUTING DATA

  181 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                      RSVRIC     1034.00  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

  182 SA               AREA          .0        .2        .2        .2        .3        .3        .4        .5

  183 SE          ELEVATION     1034.00   1034.20   1035.00   1036.00   1037.00   1038.00   1040.00   1042.00

  185 SL          LOW-LEVEL OUTLET
                       ELEVL     1033.00  ELEVATION AT CENTER OF OUTLET
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                    CAREA       28.86  CROSS-SECTIONAL AREA
                     COQL         .60  COEFFICIENT
                     EXPL         .50  EXPONENT OF HEAD

 184 SS          SPILLWAY
                     CREL     1040.00  SPILLWAY CREST ELEVATION
                    SPWID       10.00  SPILLWAY WIDTH
                     COQW        2.60  WEIR COEFFICIENT
                     EXPW        1.50  EXPONENT OF HEAD

                                                ***

                                          COMPUTED STORAGE-ELEVATION DATA

          STORAGE        .00       .01       .16       .39       .66       .96      1.70      2.62
        ELEVATION    1034.00   1034.20   1035.00   1036.00   1037.00   1038.00   1040.00   1042.00

                                          COMPUTED OUTFLOW-ELEVATION DATA

          OUTFLOW        .00    149.21    161.17    175.22    191.96    212.23    237.29    269.07    310.66    367.47
        ELEVATION    1034.00   1034.15   1034.35   1034.59   1034.91   1035.33   1035.92   1036.75   1038.00   1040.00

          OUTFLOW     392.69    399.17    406.61    415.06    424.58    435.23    447.05    460.12    474.49    490.21
        ELEVATION    1040.56   1040.67   1040.80   1040.94   1041.09   1041.25   1041.42   1041.60   1041.80   1042.00


                                       COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00       .01       .01       .04       .08       .14       .16       .24       .37       .39
          OUTFLOW     138.89    149.21    152.14    161.17    175.22    191.96    196.42    212.23    237.29    240.57
        ELEVATION    1034.00   1034.15   1034.20   1034.35   1034.59   1034.91   1035.00   1035.33   1035.92   1036.00

          STORAGE        .59       .66       .96      1.70      1.95      2.00      2.06      2.12      2.19      2.26
          OUTFLOW     269.07    277.78    310.57    367.47    392.69    399.17    406.61    415.06    424.58    435.23
        ELEVATION    1036.75   1037.00   1038.00   1040.00   1040.56   1040.67   1040.80   1040.94   1041.09   1041.25

          STORAGE       2.34      2.43      2.52      2.62
          OUTFLOW     447.05    460.12    474.49    490.21
        ELEVATION    1041.42   1041.60   1041.80   1042.00

 *** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN      139. TO      175.
                 THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
                 THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION     R/P2

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+   224.25     12.17                141.52      139.55      139.35       139.35
                          (INCHES)    21.120      83.304     119.865      119.865
                          (AC-FT)     70.18      276.79      398.27       398.27

 PEAK STORAGE   TIME                        MAXIMUM AVERAGE STORAGE
                                      6-HR       24-HR       72-HR     34.58-HR
+  (AC-FT)      (HR)
      .303     12.17                  .00         .00         .00         -.47

  PEAK STAGE    TIME                         MAXIMUM AVERAGE STAGE
                                      6-HR       24-HR       72-HR     34.58-HR
+   (FEET)      (HR)
   1035.61     12.17               1034.05     1034.01     1034.01      1034.01

                          CUMULATIVE AREA =    .06230 SQ MI   ACRES=           39.8720


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  186 KK     *         T2 *
             *            *
             **************

  187 KO          OUTPUT CONTROL VARIABLES
                       IPRNT          3  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE
                       IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                        IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT       .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  188 BA          SUBBASIN CHARACTERISTICS
                       TAREA        .00  SUBBASIN AREA
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               PRECIPITATION DATA

  6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                              STORM AREA =     .00

189 LS         SCS LOSS RATE
                    STRTL         .35  INITIAL ABSTRACTION
                   CRVNBR       85.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
190 UK           OVERLAND-FLOW ELEMENT NO. 1
                        L         49.  OVERLAND FLOW LENGTH
                        S       .0500  SLOPE
                        N        .300  ROUGHNESS COEFFICIENT
                       PA       100.0  PERCENT OF SUBBASIN
                    DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
191 RD           MAIN CHANNEL
                        L        434.  CHANNEL LENGTH
                        S       .0050  SLOPE
                        N        .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA         .00  CONTRIBUTING AREA
                    SHAPE        TRAP  CHANNEL SHAPE
                       WD         .00  BOTTOM WIDTH OR DIAMETER
                        Z        2.00  SIDE SLOPE
                   RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                     PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        1.11      1.67        .55      9.80     24.62    724.64      6.07       .33
                     MAIN          1.63      1.33       2.01    217.00     24.21    724.89      5.98      3.60


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1133E+01 OUTFLOW= .1116E+01 BASIN STORAGE= .2449E-03 PERCENT ERROR=   1.4


                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                     MAIN          1.63      1.33       5.00               23.84    725.00      6.02

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION       T2

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+     23.84     12.08                2.00         .57         .39         .39
                         (INCHES)    5.306       6.024       6.024       6.024
                          (AC-FT)      .99        1.12        1.12        1.12

                         CUMULATIVE AREA =    .00350 SQ MI   ACRES=            2.2400


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
192 KK        *        S2  *
              *            *
              **************

193 KO         OUTPUT CONTROL VARIABLES
                    IPRNT           3  PRINT CONTROL
                    IPLOT           0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE
                    IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                     IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

194 BA         SUBBASIN CHARACTERISTICS
                    TAREA         .00  SUBBASIN AREA
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               PRECIPITATION DATA

  6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .00

 195 LS         SCS LOSS RATE
                     STRTL         .33  INITIAL ABSTRACTION
                    CRVNBR       86.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
 196 UK          OVERLAND-FLOW ELEMENT NO. 1
                         L        160.  OVERLAND FLOW LENGTH
                         S       .2500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                     DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
 197 RD          MAIN CHANNEL
                         L        434.  CHANNEL LENGTH
                         S       .0050  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .00  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD         .00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                          ***
                                    COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                           COMPUTATION TIME STEP
                       ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                      PEAK                CELERITY
                                                                (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                       PLANE1        2.48      1.67        .77     32.00     30.45    724.49      6.18       .85
                       MAIN          1.63      1.33       1.90    217.00     29.22    725.42      6.09      3.80

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1452E+01 OUTFLOW= .1430E+01 BASIN STORAGE= .2734E-03 PERCENT ERROR=   1.5

                                            INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                       MAIN          1.63      1.33       5.00                28.89    725.00      6.10

           ***             ***             ***             ***             ***

                             HYDROGRAPH AT STATION       S2

         TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

       PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                          6-HR        24-HR       72-HR     34.58-HR
     +   (CFS)       (HR)
                          (CFS)
     +    28.89     12.08                 2.53         .72         .50         .50
                           (INCHES)     5.356       6.101       6.102       6.102
                            (AC-FT)      1.26        1.43        1.43        1.43

                           CUMULATIVE AREA =    .00440 SQ MI   ACRES=            2.8160


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


                **************
                *             *
 198 KK         *      C/S2   *
                *             *
                **************

 199 KO         OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


 200 HC         HYDROGRAPH COMBINATION
                     ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***
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      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION     C/S2

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                  6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+    52.73     12.08                4.53        1.29         .89          .89
                        (INCHES)    5.334       6.067       6.067        6.067
                         (AC-FT)    2.25        2.56        2.56         2.56

                       CUMULATIVE AREA =    .00790 SQ MI   ACRES=            5.0560


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 201 KK     *       CH6  *
            *            *
            **************

 202 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

 203 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .00  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .00

 204 LS          SCS LOSS RATE
                      STRTL         .33  INITIAL ABSTRACTION
                     CRVNBR       86.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 205 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L        200.  OVERLAND FLOW LENGTH
                          S       .0500  SLOPE
                          N        .300  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 206 RD            MAIN CHANNEL
                          L         537.  CHANNEL LENGTH
                          S       .0100  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .00  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD        2.00  BOTTOM WIDTH OR DIAMETER
                          Z        2.00  SIDE SLOPE
                     RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        1.11      1.67       1.28     40.00     21.29    725.13       6.18       .52
                    MAIN          2.16      1.35       1.48    268.50     70.34    726.18       6.08      6.06

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2556E+01  EXCESS= .1221E+01 OUTFLOW= .3761E+01 BASIN STORAGE= .4156E-03 PERCENT ERROR=    .4

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          2.16      1.35       5.00                 66.95    725.00       6.09

      ***            ***            ***            ***            ***
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                        HYDROGRAPH AT STATION      CH6

    TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+    66.95     12.08                 6.68        1.90        1.32         1.32
                        (INCHES)    5.357       6.088       6.088        6.088
                         (AC-FT)    3.31        3.77        3.77         3.77

                       CUMULATIVE AREA =    .01160 SQ MI   ACRES=            7.4240


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 207 KK     *       CH7  *
            *            *
            **************

 208 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          7.  HYDROGRAPH PLOT SCALE
                      IPNCH          21  PUNCH COMPUTED HYDROGRAPH
                       IOUT           0  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

 209 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .00  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .00

 210 LS          SCS LOSS RATE
                      STRTL         .33  INITIAL ABSTRACTION
                     CRVNBR       86.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 211 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L        210.  OVERLAND FLOW LENGTH
                          S       .0500  SLOPE
                          N        .300  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 212 RD            MAIN CHANNEL
                          L        317.  CHANNEL LENGTH
                          S       .0100  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .00  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD        2.00  BOTTOM WIDTH OR DIAMETER
                          Z        2.00  SIDE SLOPE
                     RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                           COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                                (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        1.11      1.67       1.34     42.00     13.40    724.99      6.18       .52
                    MAIN          2.16      1.35       1.35    158.50     13.09    726.04      6.07      3.90

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .7918E+00 OUTFLOW= .7772E+00 BASIN STORAGE= .2553E-03 PERCENT ERROR=   1.8

                                           INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          2.16      1.35       5.00                 12.75    725.00      6.07

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                        HYDROGRAPH AT STATION      CH7

    TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR     34.58-HR
+   (CFS)       (HR)
                      (CFS)
+    12.75     12.08                 1.38         .39          .27          .27
                    (INCHES)     5.343        6.072        6.073        6.073
                     (AC-FT)       .68          .78          .78          .78

                    CUMULATIVE AREA =    .00240 SQ MI   ACRES=            1.5360


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  213 KK    *     C/DC4  *
            *            *
            **************

  214 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


  215 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

       ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION    C/DC4

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR     34.58-HR
+   (CFS)       (HR)
                      (CFS)
+    79.70     12.08                 8.06         2.29         1.59         1.59
                    (INCHES)     5.354        6.085        6.086        6.086
                     (AC-FT)      4.00         4.54         4.54         4.54

                    CUMULATIVE AREA =    .01400 SQ MI   ACRES=            8.9600


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  216 KK    *    DA3/DP  *     5
            *            *
            **************

  217 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  218 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .03  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .03

  219 LS          SCS LOSS RATE
                       STRTL         .38  INITIAL ABSTRACTION
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                     CRVNBR       84.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

  220 US          SNYDER UNITGRAPH
                          TP         .28  LAG
                          CP         .67  PEAKING COEFFICIENT

                  SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                       ***

                                                UNIT HYDROGRAPH PARAMETERS
                                             CLARK   TC=   .34 HR,       R=   .22 HR
                                            SNYDER   TP=   .28 HR,      CP=   .67

                                                    UNIT HYDROGRAPH
                                                17 END-OF-PERIOD ORDINATES
                  7.       24.       42.       50.       42.       29.       20.       13.        9.        6.
                  4.        3.        2.        1.        1.        1.        0.

       ***             ***             ***             ***             ***

                            HYDROGRAPH AT STATION   DA3/DP

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.90, TOTAL EXCESS =    5.95

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
 +   (CFS)       (HR)
                             (CFS)
 +   104.12     12.33                18.41        5.28        3.66         3.66
                            (INCHES)     5.170       5.929       5.929        5.929
                             (AC-FT)      9.13       10.47       10.47        10.47

                            CUMULATIVE AREA =    .03310 SQ MI   ACRES=           21.1840


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


               **************
               *            *
  221 KK       *    DA2/DP  *     6
               *            *
               **************

  222 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  223 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .04  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .04

  224 LS          SCS LOSS RATE
                       STRTL         .38  INITIAL ABSTRACTION
                      CRVNBR       84.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

  225 US          SNYDER UNITGRAPH
                          TP         .29  LAG
                          CP         .66  PEAKING COEFFICIENT

                  SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                       ***

                                                UNIT HYDROGRAPH PARAMETERS
                                             CLARK   TC=   .34 HR,       R=   .24 HR
                                            SNYDER   TP=   .29 HR,      CP=   .66

                                                    UNIT HYDROGRAPH
                                                18 END-OF-PERIOD ORDINATES
                  8.       27.       48.       58.       50.       36.       25.       18.       13.        9.
                  6.        4.        3.        2.        2.        1.        1.        1.
```

*** *** *** *** ***

HYDROGRAPH AT STATION DA2/DP

TOTAL RAINFALL = 7.85, TOTAL LOSS = 1.90, TOTAL EXCESS = 5.95

PEAK FLOW (CFS)	TIME (HR)	MAXIMUM AVERAGE FLOW (CFS) 6-HR	24-HR	72-HR	34.58-HR
122.77	12.33	22.40	6.42	4.46	4.46
		(INCHES) 5.167	5.926	5.926	5.926
		(AC-FT) 11.11	12.74	12.74	12.74

CUMULATIVE AREA = .04030 SQ MI ACRES= 25.7920

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	T6	16.83	12.08	2.	1.	0.	.00		
HYDROGRAPH AT	S8	37.16	12.08	3.	1.	1.	.01		
2 COMBINED AT	C/S8	53.99	12.08	5.	1.	1.	.01		
HYDROGRAPH AT	T5	22.38	12.08	2.	1.	0.	.00		
HYDROGRAPH AT	S7	59.78	12.08	5.	1.	1.	.01		
2 COMBINED AT	C/S7	82.16	12.08	7.	2.	1.	.01		
HYDROGRAPH AT	OA2	162.61	12.58	42.	12.	8.	.08		
3 COMBINED AT	C/CH1	191.54	12.08	54.	16.	11.	.10		
HYDROGRAPH AT	CH1	215.35	12.17	60.	17.	12.	.11		
HYDROGRAPH AT	T1	13.52	12.08	1.	0.	0.	.00		
HYDROGRAPH AT	S1	24.36	12.08	2.	1.	0.	.00		
2 COMBINED AT	C/S1	37.88	12.08	4.	1.	1.	.01		
HYDROGRAPH AT	P1	60.46	12.08	6.	2.	1.	.01		
3 COMBINED AT	C/P1	280.49	12.08	69.	20.	14.	.12		
ROUTED TO	R/P1	51.83	14.00	48.	33.	31.	.12	1052.77	14.00
HYDROGRAPH AT	DA1	136.90	12.33	26.	8.	5.	.05		
2 COMBINED AT	C/DP1	177.36	12.33	72.	40.	36.	.17		
HYDROGRAPH AT	T7	32.26	12.08	4.	1.	1.	.01		
HYDROGRAPH AT	S5	55.58	12.08	5.	1.	1.	.01		
2 COMBINED AT	C/S5	87.84	12.08	9.	3.	2.	.02		
HYDROGRAPH AT	OA1	304.79	12.58	83.	24.	16.	.15		
2 COMBINED AT	C/CH2	319.42	12.58	91.	26.	18.	.16		
HYDROGRAPH AT	CH2	323.44	12.58	97.	28.	19.	.17		

```
          HYDROGRAPH AT
+                          T4      66.21   12.08          6.          2.          1.        .01
          HYDROGRAPH AT
+                          CH3     70.27   12.17          8.          2.          2.        .01
          2 COMBINED AT
+                        C/DC#2   337.46   12.58        105.         30.         21.        .19
          HYDROGRAPH AT
+                          T9      67.87   12.25         12.          3.          2.        .02
          HYDROGRAPH AT
+                          CH4     99.36   12.08         17.          5.          3.        .03
          HYDROGRAPH AT
+                          T8      40.84   12.17          5.          2.          1.        .01
          HYDROGRAPH AT
+                          T3      23.32   12.08          2.          1.          0.        .00
          HYDROGRAPH AT
+                          S3      44.55   12.08          4.          1.          1.        .01
          2 COMBINED AT
+                         C/S3     67.88   12.08          6.          2.          1.        .01
          HYDROGRAPH AT
+                          CH5     83.96   12.17         10.          3.          2.        .02
          HYDROGRAPH AT
+                          P2      25.72   12.08          3.          1.          1.        .00
          4 COMBINED AT
+                         C/P2    244.85   12.08         35.         10.          7.        .06
          ROUTED TO
+                         R/P2    224.25   12.17        142.        140.        139.        .06
+                                                                                        1035.61       12.17
          HYDROGRAPH AT
+                          T2      23.84   12.08          2.          1.          0.        .00
          HYDROGRAPH AT
+                          S2      28.89   12.08          3.          1.          1.        .00
          2 COMBINED AT
+                         C/S2     52.73   12.08          5.          1.          1.        .01
          HYDROGRAPH AT
+                          CH6     66.95   12.08          7.          2.          1.        .01
          HYDROGRAPH AT
+                          CH7     12.75   12.08          1.          0.          0.        .00
          2 COMBINED AT
+                        C/DC4     79.70   12.08          8.          2.          2.        .01
          HYDROGRAPH AT
+                        DA3/DP   104.12   12.33         18.          5.          4.        .03
          HYDROGRAPH AT
+                        DA2/DP   122.77   12.33         22.          6.          4.        .04
1
                                    SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                        (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                 INTERPOLATED TO
                                                                               COMPUTATION INTERVAL
          ISTAQ    ELEMENT      DT       PEAK    TIME TO      VOLUME      DT       PEAK    TIME TO     VOLUME
                                                    PEAK                                     PEAK

                                (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

               T6  MANE         1.57     17.29    726.21      6.01      5.00     16.83    725.00        6.01

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1003E+01 OUTFLOW= .9942E+00 BASIN STORAGE= .2899E-03 PERCENT ERROR=    .9

               S8  MANE         2.20     37.80    723.63      5.96      5.00     37.16    725.00        5.95

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1909E+01 OUTFLOW= .1874E+01 BASIN STORAGE= .3379E-03 PERCENT ERROR=   1.8

               T5  MANE         2.06     22.40    724.94      6.00      5.00     22.38    725.00        6.02

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1295E+01 OUTFLOW= .1280E+01 BASIN STORAGE= .3915E-03 PERCENT ERROR=   1.1

               S7  MANE         1.60     60.23    725.29      5.36      5.00     59.78    725.00        5.38
```

```
CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3002E+01 OUTFLOW= .2602E+01 BASIN STORAGE= .3265E-03 PERCENT ERROR=  13.3

              CH1  MANE         5.00    215.35    730.00      5.90      5.00    215.35    730.00        5.90

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3093E+02 EXCESS= .3134E+01 OUTFLOW= .3403E+02 BASIN STORAGE= .1750E-02 PERCENT ERROR=    .1

               T1  MANE         1.62     13.83    725.33      6.02      5.00     13.52    725.00        6.02

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .7767E+00 OUTFLOW= .7699E+00 BASIN STORAGE= .2497E-03 PERCENT ERROR=    .9

               S1  MANE         2.36     25.00    723.69      6.08      5.00     24.36    725.00        6.08

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1287E+01 OUTFLOW= .1265E+01 BASIN STORAGE= .3119E-03 PERCENT ERROR=   1.7

               T7  MANE         1.85     34.36    726.41      5.99      5.00     32.26    725.00        5.99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2168E+01 OUTFLOW= .2140E+01 BASIN STORAGE= .6671E-03 PERCENT ERROR=   1.3

               S5  MANE         2.37     57.79    724.09      6.05      5.00     55.58    725.00        6.04

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2936E+01 OUTFLOW= .2870E+01 BASIN STORAGE= .4313E-03 PERCENT ERROR=   2.2

              CH2  MANE         1.81    324.98    756.24      5.94      5.00    323.44    755.00        5.94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5214E+02 EXCESS= .3101E+01 OUTFLOW= .5522E+02 BASIN STORAGE= .6339E-03 PERCENT ERROR=    .0

               T4  MANE         2.48     67.46    725.31      6.04      5.00     66.21    725.00        6.05

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3365E+01 OUTFLOW= .3288E+01 BASIN STORAGE= .4782E-03 PERCENT ERROR=   2.3

              CH3  MANE         4.47     73.82    729.14      6.06      5.00     70.27    730.00        6.07

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3293E+01 EXCESS= .1155E+01 OUTFLOW= .4428E+01 BASIN STORAGE= .1084E-02 PERCENT ERROR=    .4

               T9  MANE          .83     67.88    735.01      5.67      5.00     67.87    735.00        5.67

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .7023E+01 OUTFLOW= .6563E+01 BASIN STORAGE= .8647E-02 PERCENT ERROR=   6.4

              CH4  MANE         3.00    101.18    726.67      5.78      5.00     99.36    725.00        5.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6565E+01 EXCESS= .3167E+01 OUTFLOW= .9653E+01 BASIN STORAGE= .8531E-03 PERCENT ERROR=    .8

               T8  MANE         2.89     41.79    729.22      5.96      5.00     40.84    730.00        5.95

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3075E+01 OUTFLOW= .3021E+01 BASIN STORAGE= .1484E-02 PERCENT ERROR=   1.7

               T3  MANE         2.48     23.56    725.26      5.97      5.00     23.32    725.00        5.98

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1133E+01 OUTFLOW= .1115E+01 BASIN STORAGE= .3026E-03 PERCENT ERROR=   1.6

               S3  MANE         1.20     44.71    725.21      5.42      5.00     44.55    725.00        5.44

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2210E+01 OUTFLOW= .1937E+01 BASIN STORAGE= .2307E-03 PERCENT ERROR=  12.3

              CH5  MANE         4.84     91.44    726.52      5.80      5.00     83.96    730.00        5.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3061E+01 EXCESS= .2507E+01 OUTFLOW= .5509E+01 BASIN STORAGE= .1029E-02 PERCENT ERROR=   1.0

               T2  MANE         2.01     24.21    724.89      5.98      5.00     23.84    725.00        6.02

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1133E+01 OUTFLOW= .1116E+01 BASIN STORAGE= .2449E-03 PERCENT ERROR=   1.4

               S2  MANE         1.90     29.22    725.42      6.09      5.00     28.89    725.00        6.10
```

```
CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1452E+01 OUTFLOW= .1430E+01 BASIN STORAGE= .2734E-03 PERCENT ERROR=   1.5

               CH6  MANE         1.48     70.34    726.18      6.08      5.00     66.95    725.00        6.09

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2556E+01 EXCESS= .1221E+01 OUTFLOW= .3761E+01 BASIN STORAGE= .4156E-03 PERCENT ERROR=    .4

               CH7  MANE         1.35     13.09    726.04      6.07      5.00     12.75    725.00        6.07

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .7918E+00 OUTFLOW= .7772E+00 BASIN STORAGE= .2553E-03 PERCENT ERROR=   1.8


*** NORMAL END OF HEC-1 ***
```

VOLUME CALCULATIONS

Volume Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Permitted Volume Calculations

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose - **Determine the 25-year 24-hour storm volume generated by the existing permitted site and offsite areas using the excess rainfall calculated in the HEC-1 analysis of the proposed expansion site conditions.**

Use the excessive rainfall data generated by the HEC-1 analysis for the 25-year storm to determine the volume produced by the site for the existing condition.

Existing Condition

1. Volume at Discharge Point #1

Area No.	Area (sq. mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
T6	0.0031	6.07	2.00	1.0
S8	0.0059	6.07	3.78	1.9
T5	0.0040	6.07	2.54	1.3
S7	0.0091	6.19	5.83	3.0
CH1	0.0095	6.19	6.05	3.1
OA2	0.0765	5.95	48.93	24.3
T1	0.0024	6.07	1.52	0.8
S1	0.0039	6.19	2.48	1.3
P1	0.0087	7.85	5.54	3.6
DA1	0.0878	5.95	56.21	27.9
			Total Volume at Discharge Point 1 =	68.1

2. Volume at Discharge Point #2

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
LD6	0.0022	6.07	1.42	0.7
LD7	0.0092	6.07	5.88	3.0
LD8	0.0117	6.07	7.46	3.8
OA1	0.1483	5.95	94.94	47.1
CH2	0.0157	6.19	10.06	5.2
CH3	0.0078	6.19	4.98	2.6
			Total Volume at Discharge Point #2 =	62.3

3. Volume at Discharge Point #3

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
LD3	0.0103	6.07	6.59	3.3
CH4	0.0097	6.19	6.19	3.2
LD4	0.0084	6.07	5.37	2.7
LD5	0.0130	6.07	8.30	4.2
CH5	0.0100	6.19	6.40	3.3
			Total Volume at Discharge Point #3 =	16.7

Volume Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Permitted Volume Calculations

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose - **Determine the 25-year 24-hour storm volume generated by the existing permitted site and offsite areas using the excess rainfall calculated in the HEC-1 analysis of the proposed expansion site conditions.**

4. Volume at Discharge Point #4

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
LD1	0.0058	6.07	3.69	1.9
CH6	0.0031	6.19	1.96	1.0
LD2	0.0100	6.07	6.38	3.2
CH7	0.0019	6.19	1.22	0.6
			Total Volume at Discharge Point #4 =	6.7

5. Volume at Discharge Point #5

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
DA2	0.0330	5.95	21.12	10.5
			Total Volume at Discharge Point #4 =	10.5

Total Volume Exiting Permit Boundary = 164.4 acre-ft

Volume Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Permitted Volume Calculations

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose - **Determine the 100-year 24-hour storm volume generated by the existing permitted site and offsite areas using the excess rainfall calculated in the HEC-1 analysis of the proposed expansion site conditions.**

Use the excessive rainfall data generated by the HEC-1 analysis for the 100-year storm to determine the volume produced by the site for the existing condition.

Existing Condition

1. Volume at Discharge Point #1

Area No.	Area (sq. mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
T6	0.0031	10.02	2.00	1.7
S8	0.0059	10.02	3.78	3.2
T5	0.0040	10.02	2.54	2.1
S7	0.0091	10.15	5.83	4.9
CH1	0.0095	10.15	6.05	5.1
OA2	0.0765	9.88	48.93	40.3
T1	0.0024	10.02	1.52	1.3
S1	0.0039	10.15	2.48	2.1
P1	0.0087	11.90	5.54	5.5
DA1	0.0878	9.88	56.21	46.3
			Total Volume at Discharge Point 1 =	112.4

2. Volume at Discharge Point #2

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
LD6	0.0022	10.02	1.42	1.2
LD7	0.0092	10.02	5.88	4.9
LD8	0.0117	10.02	7.46	6.2
OA1	0.1483	9.88	94.94	78.2
CH2	0.0157	10.15	10.06	8.5
CH3	0.0078	10.15	4.98	4.2
			Total Volume at Discharge Point #2 =	103.2

3. Volume at Discharge Point #3

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
LD3	0.0103	10.02	6.59	5.5
CH4	0.0097	10.15	6.19	5.2
LD4	0.0084	10.02	5.37	4.5
LD5	0.0130	10.02	8.30	6.9
CH5	0.0100	10.15	6.40	5.4
			Total Volume at Discharge Point #3 =	27.6

Volume Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Permitted Volume Calculations

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose - **Determine the 100-year 24-hour storm volume generated by the existing permitted site and offsite areas using the excess rainfall calculated in the HEC-1 analysis of the proposed expansion site conditions.**

4. Volume at Discharge Point #4

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
LD1	0.0058	10.02	3.69	3.1
CH6	0.0031	10.15	1.96	1.7
LD2	0.0100	10.02	6.38	5.3
CH7	0.0019	10.15	1.22	1.0
			Total Volume at Discharge Point #4 =	11.1

5. Volume at Discharge Point #5

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
DA2	0.0330	9.88	21.12	17.4
			Total Volume at Discharge Point #4 =	17.4

Total Volume Exiting Permit Boundary = 271.7 acre-ft

VELOCITY CALCULATIONS

Velocity Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Velocity Calculations

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose : Determine the flow velocities entering and exiting the permit boundary using FlowMaster for the flows calculated for the 100-year and 25- year storm event in the HEC-1 analysis.

1. Flow Velocity entering the landfill permit boundary

OA1

Q_{100} = 460.7 cfs
Q_{25} = 304.8 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Velocity (fps)
100	461	0.017	0.03	50.00	50.00	100.00	0.74	4.52
25	305	0.017	0.03	50.00	50.00	100.00	0.59	3.97

OA2

Q_{100} = 245.1 cfs
Q_{25} = 162.6 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Velocity (fps)
100	245	0.018	0.03	50.00	50.00	100.00	0.53	3.81
25	163	0.018	0.03	50.00	50.00	100.00	0.42	3.33

2. Flow Velocity exiting the landfill permit boundary

Discharge #1

Q_{100} = 424.92 cfs
Q_{25} = 293.44 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Velocity (fps)
100	425	0.021	0.03	3.00	3.00	50.00	1.09	7.29
25	293	0.021	0.03	3.00	3.00	50.00	0.88	6.35

Discharge #2

Q_{100} = 510.21 cfs
Q_{25} = 337.46 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Velocity (fps)
100	510	0.003	0.03	3.00	3.00	12.00	4.14	5.19
25	337	0.003	0.03	3.00	3.00	12.00	3.40	4.66

Velocity Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Velocity Calculations

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose : **Determine the flow velocities entering and exiting the permit boundary using FlowMaster for the flows calculated for the 100-year and 25- year storm event in the HEC-1 analysis.**

Discharge #3

Q_{100} = 322.54 cfs
Q_{25} = 224.25 cfs

Low Water Outlet

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Length of 3-42" RCP (ft)	Flow Velocity (fps)
100	323	0.038	52.00	11.18
25	224	0.038	52.00	7.77

Discharge #4

Q_{100} = 121.45 cfs
Q_{25} = 79.70 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Velocity (fps)
100	121	0.015	0.03	3.00	3.00	0.00	1.98	13.01
25	80	0.015	0.03	3.00	3.00	0.00	1.66	11.58

Discharge #5

Q_{100} = 153.97 cfs
Q_{25} = 104.12 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Velocity (fps)
100	154	0.071	0.03	3.00	3.00	30.00	0.56	8.63
25	104	0.071	0.03	3.00	3.00	30.00	0.45	7.45

Appendix IIIH-B. Post-Development Conditions Hydrologic Calculations

Pages IIIH-B-1 and IIIH-B-119



09/29/2023

Table of Contents

Hydrograph Development Information	IIIH-B-1
HEC-1 Output — Post-Development 100-Year, 24-Hour Storm Event	IIIH-B-21
HEC-1 Output — Post-Development 25-Year, 24-Hour Storm Event	IIIH-B-66
Volume Calculations	IIIH-B-111
Velocity Calculations	IIIH-B-114



HYDROGRAPH DEVELOPMENT INFORMATION

1.0 HYDROGRAPH DEVELOPMENT INFORMATION

1.1 Landfill Areas

Direct runoff methods, (i.e., kinematic wave) have been used for the majority of the landfill final cover areas. The kinematic wave method has been used to model the 5 percent topslope areas and 25 percent side slope areas before the flow is intercepted by the drainage swales. The kinematic wave method is a physically based method using slope, surface roughness, catchment lengths and areas. This method does not consider attenuation for flood wave; as a consequence, this method provides for a conservative analysis. The following typical parameters for the kinematic wave method have been developed for landfill areas.

Kinematic wave parameters for overland flow:

Slope: Varies from 0.05 to 0.25 ft/ft landfill slopes

N: 0.30 Manning's friction coefficient (based on using a value between dense grass (N = 0.24) and Bermuda grass (N = 0.41) listed in Soil Conservation Services TR-55)

L: Represents a typical distance between swales for overland flow for each drainage area. For example, the swale spacing on 4H:1V sideslopes is 160 feet.

Percentage of drainage area represented by this element is 100 percent.

Kinematic Wave routing for channels:

- Channel length (ft): The length of the channel section.
- Channel slope (ft/ft): 0.0015 (0.005 for swales).
- Channel roughness coefficient: 0.03 for grass lined channels and swales.
- Channel type: A trapezoidal channel was used with varying width and 3:1 side slope ("V" ditch with varying side slopes for swales).

1.2 Non-Landfill Final Cover Areas

Hydrographs for the majority of non-landfill final cover areas within and near the permit boundary (e.g., pond areas) were developed using the Snyder unit hydrograph method. Espey "10-Minute" method has been used to estimate Snyder parameters. Snyder parameter estimations are provided on pages IIIH-B-19 through IIIH-A-20.

As discussed in Section 2 of Appendix IIIH, hydrographs for the areas outside of the permit boundary (01 and 02), and larger areas inside the permit boundary (S1 through S9) were developed using the Snyder unit hydrograph method. The percent imperviousness ranges from 2 percent to 89 percent, for the majority of the non-landfill on-site and off-site areas, which represents the majority of the watershed as undeveloped. Pond area are assumed to be 100 percent impervious, and areas with significant channel surface or paved surfaces were assigned higher percentages of impervious area.

1.3 Drainage Areas

The drainage areas used for this analysis are shown on Sheet IIIH-B-26. The routing scheme for the post-development condition is shown in the HEC-1 output file presented on pages IIIH-B-28 through IIIH-B-81.

LEGEND

T7 — DRAINAGE AREA DESIGNATION

DRAINAGE BOUNDARY

PERIMETER CHANNEL

PERMIT BOUNDARY

CLOSED CELL BOUNDARY

LIMIT OF WASTE

1090 — FINAL COVER CONTOURS

1084 — EXISTING CONTOURS

SWALES

EXISTING SITE FENCE

PROPOSED SITE FENCE

EXISTING CHUTE

CHUTES

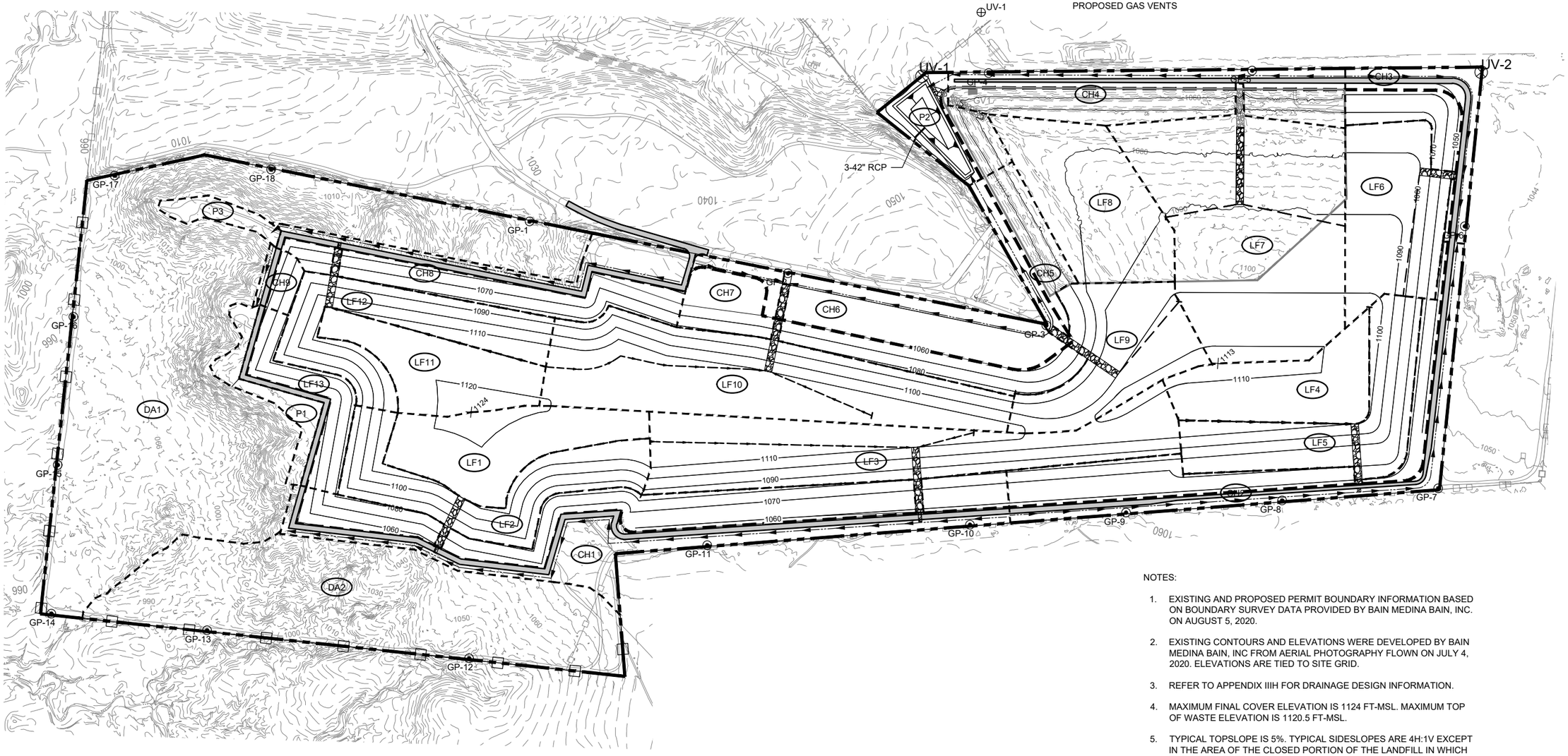
GP-5 — PROPOSED GAS PROBE

UV-1 — PROPOSED GAS VENTS

N

0 200 400

SCALE IN FEET



NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. ELEVATIONS ARE TIED TO SITE GRID.
3. REFER TO APPENDIX IIIH FOR DRAINAGE DESIGN INFORMATION.
4. MAXIMUM FINAL COVER ELEVATION IS 1124 FT-MSL. MAXIMUM TOP OF WASTE ELEVATION IS 1120.5 FT-MSL.
5. TYPICAL TOPSLOPE IS 5%. TYPICAL SIDESLOPES ARE 4H:1V EXCEPT IN THE AREA OF THE CLOSED PORTION OF THE LANDFILL IN WHICH THE SIDESLOPES ARE 5H:1V.

FOR PERMITTING PURPOSES ONLY

TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

STATE OF TEXAS
TEWOBISTA METAFERIA
123183
LICENSED PROFESSIONAL ENGINEER
09/30/2023

NO.	REVISION	BY	DATE

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.

0 1"

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

POST-DEVELOPMENT CONDTION
DRAINAGE AREAS

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

FIGURE
IIIH-B-4

PRINTED BY: MetafeT DATE: 8/16/2023
FILE PATH: C:\pwworking\stvpw_stv\glohnson\d0942276\DELR2000302 Figure IIIH-B-4.dwg

ESPEY 10-MINUTE METHOD PARAMETERS

Insert excel spreadsheet for the espey 10-minute

Method parameters [PAGES 6-8]

DISTRIBUTED RUNOFF METHOD
KINEMATIC WAVE EXAMPLE

Insert excel spreadsheet for distributed runoff method

Kinematic wave example here

HEC-1 OUTPUT – PERMITTED 100-YEAR 24-HOURS STORM EVENT

Insert hec-1 output files for the permitted 100-year 24-hour storm event [pages 22-65]

HEC-1 OUTPUT- PERMITTED 25-YEAR 24-HOUR STORM EVENT

Insert HEC-1 output files for the permitted 25-year 24-hour storm event [pages 67-111]

VOLUME CALCULATIONS

Insert Excel Spreadsheet Volume Calculations here. Pages [113-116]

VELOCITY CALCULATIONS

Insert Excel Spreadsheet Velocity Calculations here. Pages [117-119]

Appendix IIIH-C. Channel and Pond Design



Appendix IIIH-D. Final Cover Erosion Control Structure Design

Figures IIIH-D-1 and IIIH-D-11



Table of Contents

Drainage Swale Design IIIH-D-1

Drainage Letdown/Chute Design IIIH-D-7



1.0 DRAINAGE SWALE DESIGN

Typical Swale Design Summary:

- Typical swale drainage areas analyzed are shown on sheet IIIH-D-2.
- Hydraulic calculations are summarized on page IIIH-D-4.
- Maximum normal depth is 1.43 feet (Drainage Area SW3).
- Maximum flow velocity is 2.70 fps (Drainage Area SW3).
- Vegetation will be established on the swales to protect against erosion.

Typical swale drainage areas were selected such that all slope conditions (5% and 25%) are included in this analysis. Additionally, swales with large individual drainage areas and short and long swale lengths are included in this analysis.

2.0 DRAINAGE LETDOWN/CHUTE DESIGN

The letdown structures are designed using gabions as a liner. Bedding for the gabions will be prepared subgrade soil overlain by 8 oz/sy geotextile. The gabions are placed along the entire chute to protect the chute bottom and the final cover from erosion due to potential erosive velocities. Tumbling flow concrete energy dissipators will be placed at the bottom end of the letdown structure to dissipate excess energy present in the water as it travels down the two and three percent slopes in the low-water crossings over the perimeter road.

The following design information is included in this Appendix:

- 25-year Flow rates used in the chutes are presented in the HEC-1 computer program output file, pages IIIH-B-67 to IIIH-B-110.
- Chute layouts and drainage areas are shown on Sheet IIIH-D-11.

Appendix IIIH-E. Erosion Layer Evaluation

Figures IIIH-E-1 and IIIH-E-23



1.0 INTRODUCTION

This appendix has been developed to address the requirements identified in Title 30 Texas Administrative Code (30 TAC) §330.305.

As required by 30 TAC §330.305(d), the landfill has been designed to provide effective erosional stability to top dome surfaces and external side slopes during all phases of landfill operation, closure, and post-closure care. Top dome surfaces and external side slopes are:

- those above grade slopes that directly drain to the facility surface water management system (i.e., areas where the surface water directly flows to a perimeter channel or surface water pond);.
- have received intermediate or final cover; and
- have either reached their permitted elevation, or will subsequently remain inactive for longer than 180 days.

Slopes that drain to areas of ongoing waste placement, pre-excavated areas, areas that have received only weekly cover, or areas under construction which have not received waste are not considered external side slopes.

The top dome surfaces and external side slopes will be covered with daily cover, intermediate cover, or final cover. Daily cover as defined in 30 TAC §330.165(a) will consists of six inches of well-compacted earthen material (or approved alternative) not previously mixed with garbage, rubbish, or other solid waste.

Intermediate cover is defined in 30 TAC §330.165(c) as at least 12 inches of suitable earthen material and is graded and maintained to prevent erosion and ponding of water. All areas that have received waste but will be inactive for longer than 180 days will be provided with intermediate cover. Information regarding the erosion and sediment control practices for intermediate cover is provided in Section 2 of this Plan. Additional information regarding placement, maintenance, inspection, and recordkeeping requirements for intermediate cover is located in Section 3.3 of this appendix.

Final cover is defined in 30 TAC §330, Subchapter K. As areas of the landfill reach final grade, the final cover system and the permanent surface water management system will be installed, which includes vegetated top dome and side slopes, swales, letdowns, and channels. The long-term erosional stability of the final cover slopes is presented in Appendix IIIH-D. Maintenance requirements for areas with final cover during operations and after closure are addressed in the SOP and the Post-Closure Care Plan.

2.0 FINAL COVER EROSION LAYER EVALUATION

This appendix presents the supporting documentation for evaluation of the thickness of the erosion layer for the final cover system at the Del Rio Landfill. The evaluation is based on the premise of adding excess soil to increase the time required before maintenance is needed as recommended in the EPA Solid Waste Disposal Facility Criteria Technical Manual (EPA 530-R-93-017, November 1993). The design procedure is as follows:

- Minimum thickness of the erosion layer at the end of the 30-year post-closure period is evaluated based on the depth of frost penetration or 6 inches, whichever is greater. For Val Verde County, the approximate depth of frost penetration is approximately 6.1 inches (see IIIH-D-10). Therefore, the minimum erosion layer thickness is 6.1 inches.
- Soil loss is calculated using the Universal Soil Loss Equation (USLE) by following SCS procedures. The soil loss is adjusted by a safety factor of 2 and is then converted to a thickness. The thickness of the soil loss over a 30-year post-closure period is added to the minimum thickness of the erosion layer (from Step 1) to yield an initial thickness to be placed at closure of the site. According to the USLE, the typical 5 percent topslope and 25 percent side slope require a minimum of 6.03 inches and 6.71 inches, respectively, for the erosion layer. These USLE requirements include the 6-inch minimum required by regulations. Conservatively, a 12-inch erosion layer is proposed over final cover.
- Stormwater flows over the final cover system by (1) sheet flow over the topslope and sideslopes and (2) channelized flow in the drainage berms (or swales). The letdown structures are lined with gabions to prevent erosion given that the velocities in the letdowns are over 5 ft/sec.
- Sheet flow velocities for the topslope and sideslope cases for a 25-year storm event are calculated to be less than permissible nonerosive velocities. A permissible nonerosive velocity is defined as 5.0 ft/sec or less.
- Channelized flow for drainage swales is also calculated to be less than permissible nonerosive velocities. The supporting calculations are presented on pages IIIH-D-4.
- Vegetation for the site will be native and introduced grasses with root depths of 6 inches to 8 inches. The erosion layer shall also include a mixture of Bermuda, vetch, rye, wheat grass, wildflowers, and flowering plants. The TxDOT seeding for Val Verde County (Laredo District) is shown on pages IIIH-E-20 through IIIH-E-23.
- Native and introduced grasses will be hydroseeded with fertilizer on the disked (parallel to contours) erosion layer upon final grading. Temporary cold weather vegetation will be established if needed. Irrigation will be employed for 6 to 8 weeks or until vegetation is well established. Erosion control measures such as silt fences and straw bales will be used to minimize erosion until the vegetation is established. Areas that experience erosion or do not readily vegetate after hydroseeding will be reseeded until vegetation is established or the soil will be replaced with soil that will support the grasses.

3.0 INTERMEDIATE COVER EROSION AND SEDIMENTATION CONTROL

Erosion control for above grade top dome surfaces and external embankment side slopes that drain directly to the site perimeter stormwater management system, have received intermediate cover, and either reached their permitted configuration or will remain inactive for longer than 180 days will be managed using a system of nonstructural and structural erosion and sediment controls to meet rule requirements for the intermediate cover phase of landfill construction.

The structural controls will consist of a combination of vegetation, temporary add-on swales, and chute structures. These structural controls will be configured in a manner that will result in a permissible soil loss of 50 tons/acre/year or less from the external slopes. The purpose will be to establish the vegetative cover percentage and swale spacing distance on all external top dome surfaces and external embankment slopes. These criteria will result in a net soil loss of 50/tons/acres/year or less for each drainage swale and chute combination specified in Appendix IIIH-D.

Mulch will be used as a layer placed over the intermediate cover to protect the exposed soil surface from erosive forces and conserve soil moisture until vegetation can be established. The mulch will be used to stabilize recently graded or seeded areas. If needed, the mulch will be spread evenly over a recently seeded area and tracked into the surface to protect the soil from erosion and moisture loss, and provide additional erosional stability to the intermediate cover surface during the establishment of vegetation. This material is not required for the establishment of vegetation on the intermediate cover unless it is needed to provide additional erosional stability to the intermediate cover surface. The mulch will be placed so as not to inhibit the growth of vegetation. In the event that the indicated vegetative ground cover required for a specific swale spacing distance is not obtained within 180 days after intermediate cover is placed on a top dome external side slope, mulch will be used as a secondary measure to limit soil loss to 50 tons/acre/year or less until vegetation is established. In the above reference cases, other erosion protection measures will only be used upon prior written authorization by TCEQ. Stormwater discharge from the site must comply with the current Texas Pollutant Discharge Elimination System for the site.

3.1 Surface Water Diversions

The type, size, and number of chute will be determined based on the size of the drainage area using the design information specified in Appendix IIIH-D.

If vegetative coverage and swale spacing configuration results in a soil loss greater than 50 ton/acre/year, the following procedure will be used to verify that an acceptable intermediate cover thickness is maintained.

- Intermediate cover areas will be inspected to detect erosion gullies and vegetation loss.
- After identifying the areas requiring additional soil, these areas will be replenished with additional soil and graded to provide uniform surfaces prior to reseeding.
- Any damaged concentrated flow drainage structures such as swales will be repaired to eliminate uncontrolled concentrated flow.

Temporary open channel chute will be inspected for erosion/hollowing through and under the lining materials (gabions, grouted riprap, and turf reinforcement) and repaired as necessary to ensure the chute is functioning as designed.

3.2 Erosion Control Best Management Practices (BMPs)

Other BMPs used in conjunction with the above erosion control measures are listed below

- Silt fences – These structures will be used in capturing sediment transported by sheet flow and for diversion of flow for controlling sediment discharge.
- Berms – These structures will be used to intercept and filter sheet flow and can be constructed from soil or a mix of mulch and compost.
- Check dams – These structures will be used in channels to slow down flow velocities and improve sediment capture.
- Biodegradable logs/filter socks – These structures consist of a biodegradable core material contained in a synthetic mesh sock or tube and are installed above, across, or below slopes to intercept and filter sheet flow.

Nonstructural controls used at the site to minimize erosion loss will include:

- plans and designs to minimize disruption of the natural features, drainage, topography, and vegetative cover features;
- phased development to minimize the area of bare soil exposed at any given time;
- plans to disturb only the smallest area necessary to perform current activities;
- scheduling of construction activities during the time of year with the least erosion potential; and
- specific plans for the stabilization of exposed surfaces in a timely manner.

3.3 Schedule, Maintenance and Recordkeeping

After an external side slope or top dome surface reaches the final permitted grade or will remain inactive for longer than 180 days, the structural erosion control features and chutes will be in place within 180 days from when intermediate cover is placed. During this 180-day period, the structural erosion control structures will be constructed, and vegetation stablished. In place of vegetation establishment, mulch may be used at the site.

At the end of the 180-day period, the cover log will be updated to document the external side slope and top dome surface area, the structural controls that were installed, and demonstration showing how the structural controls meet the 50 tons/acre/year or less soil loss requirement. Inspection requirements and schedules are listed in the SOP for all drainage features, including intermediate cover areas. Inspection and maintenance of the erosion and sediment control structures of the top dome surfaces and external embankment side slopes will follow the same schedule and methods as described in facility's SOP.

During the inspection of structural controls, if significant soil loss is identified in a given intermediate cover area, impacted areas will be replenished with additional soil. Prior to application of temporary erosion

control and seeding, the area will be graded to eliminate preferential pathways or any other uneven surface due to settlement to prevent concentrated flow over the intermediate cover areas.

Occasionally, top dome surfaces and external side slopes that have been stabilized through the use of swales, chutes and compliances with the minimum required vegetation cover specification will be disturbed due to various construction activities such as the installation or repair of a landfill gas system, regrading of an area due to ponded water caused by uneven waste settlement, the repair of erosion rills, or damage due to an extreme storm event or natural disaster. Each of these events will be documented in the SOP. Recorded information will include the date of construction, approximate area disturbed, and the date re-seeding of the disturbed area occurred. In accordance with TAC §330.165(g), previously stabilized surfaces will be repaired within 5 days of detection of the disturbances of these surfaces.

4.0 DAILY COVER AND NON-EXTERNAL SIDE SLOPES EROSION AND SEDIMNTATIONAL CONTROL

BMPs will include the use of temporary silt fences, check dams, interceptor swale and berms, temporary and permanent seeding and sodding, surface roughening, matting and mulching, sediment traps, and surface wetting for dust control. The following general guidelines provide how the erosion control features will minimize sediment discharge from the site.

- Vegetation and mulch will be used on intermediate cover areas that remain inactive to minimize erosion potential.
- Typically, uncontaminated stormwater runoff from the site will be channeled through the perimeter channel system to detention ponds before being discharged from the site. Sediment that collects in the channels and detention ponds will be removed. Erosion will be controlled by vegetation in drainage structures with flow velocities less than or equal to 5 ft/sec. For drainage structures with flow velocities greater than 5 ft/sec, rock riprap or gabions will be used for surface reinforcement.

Typical erosion control features inspection items and schedules are listed in the SOP for all drainage features, daily cover, and intermediate cover areas.

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN

APPENDIX III I
GROUNDWATER SAMPLING AND ANALYSIS PLAN

Prepared for
City of Del Rio

September 2023

Prepared by
STV Inc
TPBE Registration No. F-1741
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214-638-0500



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1.0 INTRODUCTION

Under their existing permit the City of Del Rio does not have or operate a groundwater monitoring system at the Del Rio Landfill. The purpose of this section is to provide a summary of past groundwater investigations, as well as a status report of present on-going investigations to further characterize groundwater at the site. This section does not, at this time, include a plan for groundwater monitoring.

2.0 GROUNDWATER MONITORING WAIVER REQUESTS

The City of Del Rio originally obtained a groundwater monitoring waiver in December 1994 from TCEQ as part of an alternative liner permit modification. This waiver was extended in 2022 as part of the Major Permit Amendment to expand the landfill vertically. The City is looking to extend the groundwater waiver with this amendment. A no-migration demonstration in accordance with §330.401(d) has been prepared for this application and is included in Appendix IIIN.

2.1 1994 Groundwater Waiver

As part of the initial landfill application Raba-Kistner conducted a geotechnical investigation in 1986 with 19 boring logs. A shallow perched groundwater was encountered in one of the borings that was likely related to the surface pond water located near the boring. No water was encountered in any of the other 18 boring logs. In accordance with rule §330.63(e)(4)(B) if no aquifers exist within 50 feet of the elevation of the deepest excavation, at least one test hole shall be drilled to the top of the first perennial aquifer beneath the site, if sufficient data does not exist to accurately locate it. So as part of the 1986 Raba-Kistner geotechnical investigation, the uppermost (perennial) aquifer was penetrated in deep boring B-3. Deep boring B-3 was drilled to a total depth of 162 feet which penetrated the upper 27 feet of the Salmon Peak limestone but did not encounter groundwater at the time the hole was drilled.

In 1994 Trinity Engineering Testing Corporation (TETCO) installed eight piezometers to investigate groundwater in the shallow weathered, and one isolated within relatively untethered strata. No groundwater was observed during the drilling or during subsequent field checking of the piezometers. Based on the data from these two investigations, it was concluded that there was no shallow groundwater system in the Del Rio Clay. A groundwater monitoring waiver was requested as part of alternative liner permit modification submitted to TCEQ in 1994. The alternative liner and the groundwater waiver requests were granted to the City of Del Ro in December 1994.

2.2 2020 Waiver Request

The City requested to extend the 1994 groundwater waiver as part of a Major Permit Amendment Application in 2020 when the facility was being expanded vertically. The City had installed piezometers on the 75-ac tract of land located adjacent to the landfill (current expansion area) to provide recent site-specific groundwater data for the site. The goal was to use the data obtained from the new piezometers along with previous data as part of the groundwater monitoring waiver request. Arias Geoprofessionals, Inc. (Arias) installed seventeen (17) boring logs of which ten (10) were converted to piezometers in November 2020 on the 75-ac tract of land. During installation, water was encountered at three of the 10 piezometers. Refer to the Geology Report (Appendix IIIJ) for location of the boring logs and piezometers. It was determined that in all three cases these groundwater systems “daylight” to the southwest in the drainage of Calaveras Creek. The fact that all three groundwater zones “daylight” in the drainage of the creek clearly demonstrates these are perched systems and not part of the groundwater. A no migration

demonstration was submitted in the application and approved by TCEQ in November 2022. The waiver extension was granted as a part of the approved permit amendment.

2.3 Current Waiver Request

As mentioned above, the City is requesting an extension of the groundwater monitoring waiver with this amendment application. A no-migration demonstration in accordance with §330.401(d) has been prepared for this application and is included in Appendix IIIN.

CITY OF DEL RIO LANDFILL
VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW 207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN

APPENDIX IIIJ
GEOLOGY REPORT



Prepared by:

WSP USA Environment & Infrastructure Inc.
16414 San Pedro Avenue, Suite 425
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Project No. 5020210002
February 2023

This document is intended for permitting purposes only.

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GEOLOGY REPORT CERTIFICATION

Site Information

Site: City of Del Rio Landfill Expansion
Site Location: Val Verde County, TX
MSW Permit No. 207C

Qualified Groundwater Scientist Statement

I, David L. Hartsfield, am a Texas-licensed professional geoscientist and a qualified groundwater scientist as defined in §330.3(120). I have prepared the Geology Report which constitutes Appendix IIIJ of this permit application. In my professional opinion, the geology report is in compliance with the requirements specified in 30 TAC 330.63(e). This report has been completed specifically for the City of Del Rio Landfill. The only warranty made by me in connection with this report 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:

WSP USA Environment & Infrastructure Inc.
16414 San Pedro Avenue, Suite 425
San Antonio, Texas 78232
Texas Registered Geoscience Firm No. 50184



Signature: _____

David L. Hartsfield, PG
Texas Professional Geoscientist License No. 2707

Date: 2-24-2023

1.0 REGIONAL GEOLOGIC/HYDROGEOLOGIC INFORMATION

1.1 Regional Physiographic and Site Topography

The City of Del Rio Landfill is located within the Edwards Plateau regional physiographic province. The Edwards Plateau typically has a relatively "flat upper surface with box canyons" and is "capped by hard Cretaceous limestones" (Bureau of Economic Geology, 1996). Local streams are incised into the plateau and sinkholes/karst features are common.

Surface elevations vary significantly within the landfill area. The topography is almost mesa-like over much of the landfill, with downward slopes to the west, northwest, north, northeast, and east. Elevations at the site range from about 980 feet above mean sea level (amsl) near the northwest portion of the site to about 1100 feet amsl near the south portion of the site.

The nearest perennial surface water body is San Felipe Creek, approximately 1.3 miles to the west. As shown on **Figure 1** (Site Location and Area Topographic Map), an intermittent stream (Calaveras Creek) with unnamed intermittent tributaries is present off-site along three sides of the site, the southwest, northwest, and northeast. The land surface of the expansion area slopes downwards towards these intermittent stream features.

1.2 Regional Geology

1.2.1 Geologic History

About 100 million years ago during the Cretaceous period, thick sequences of the Edwards Group limestones began to be deposited into the depositional Maverick Basin, followed by the later Cretaceous deposition of the Del Rio and Buda Formations (Rose, 1972). Subsequent erosion of the Cretaceous formations has continued through the present time, accompanied by deposition of Quaternary alluvium and terrace deposits along streams and in low-lying areas.

1.2.2 Regional Structural Geology

The landfill expansion site is located within the Maverick Basin, a large ellipsoidal depositional basin created about 100 million years ago during the Cretaceous period (Rose, 1972). The Edwards Plateau structure is that of a broad monocline with a slight warping that produces gentle arches or structural platforms that dip into the Maverick Basin to the southwest or towards the Balcones trend of faults (**Figure 2**) to the east and southeast (Reeves and Small, 1973). The southern edge of the basin is bounded by the Stuart City Reef, and the northern and eastern portions of the basin are bounded by the Devils River Trend as shown in **Figure 3**.

Within this basin, thick sequences of limestones were deposited. These deposits include (from top to bottom) the Salmon Peak, McKnight, and West Nueces Formations. Together these formations make up the Edwards Group (Lozo and Smith, 1964; Rose, 1972). The overlying Del Rio and Buda Formations were deposited later in the Cretaceous. Regionally, the dip of the rock is toward the south and southwest between 40 to 70 feet per mile (Reeves and Small, 1973).

1.2.3 Regional Stratigraphy

According to the Bureau of Economic Geology, Geologic Atlas of Texas-Del Rio Sheet (1977) geologic units in the vicinity of the landfill expansion include Quaternary Alluvium, the Tertiary period Uvalde Gravel, and the Cretaceous Period Buda Limestone and the Del Rio Clay. Regional geologic units are summarized in **Table 1-1**. An area Geologic Map is provided on **Figure 4**.

The Quaternary alluvium consists primarily of clay, gravelly clays, clayey gravels, sandy clay, and clayey sand associated with stream depositional processes. According to the Geology of Texas (Sellards, 1932), the Uvalde Gravel is comprised of upland gravels and interstream deposits that occur on divides and ancient surfaces south of the Balcones fault zone and north of the Pliocene deposits of the Gulf Coast. Uvalde deposits consist of gravel composed almost entirely of rounded flint cobbles with pieces of limestone, quartz and flint pebbles set in a matrix of chalky marl and caliche.

The Buda Limestone has a thickness of 50 feet or more in Val Verde County. The Buda Limestone is a hard, dense, fine-grained limestone of a “porcelaneous” or semi-lithographic type with some beds of marl and nodular limestone (Reeves and Small, 1973). The Del Rio Clay lies unconformably below the Buda Limestone with a maximum thickness more than 200 feet in the County (Cross, 1989). The Del Rio Clay consists of shale, which weathers yellow, along with thin beds of sandy limestone, sandstone, and silty sandstone (Reeves and Small, 1973). The Del Rio Clay serves as a confining bed for the underlying limestones of the Edwards Aquifer.

Below the Del Rio Clay lies limestones of the Edwards Aquifer. In this region of the Edwards Plateau the Edwards can be divided into the Salmon Peak, McKnight, and West Nueces Limestones (Anaya and Jones, 2009). The Salmon Peak Formation (Humphreys, 1984) is a dense, thickbedded, deep-water mudstone that grades upward to a crossbedded, rudist-shell grainstone (Smith, 1979, p. 16). The McKnight Formation is a predominately euxinic deposit grading upward from thin-bedded carbonate mudstones to petroliferous shales and evaporites and terminates in a layer of pelleted grainstone (Maclay and Small, 1983, pg. 132). The West Nueces Formation consists of an upper, massive unit of miliolid and mollusc-bearing grainstone overlying a nodular dense mudstone. Total thickness of the combined Salmon Peak Formation, McKnight Formation and West Nueces Formation is estimated to be approximately 670 feet (Maclay and Small, 1984).

A diagrammatic regional geologic cross-section prepared by Trinity Engineering Testing Corporation (TETCO) in 1994 is presented on **Figure 5**. TETCO prepared the cited Geotechnical Evaluation in support of the existing portion of the Del Rio Municipal Landfill.

Table 1-1: Regional Stratigraphy in the Vicinity of the City Del Rio Landfill

System	Series	Group	Group or Formation	Approximate Formation Thickness in Feet	Lithologic Characteristics and Depositional Environment	Hydrostratigraphy
Quaternary	Recent		Alluvium	Variable	Deposits of clay, silt, sand, and gravel left by stream depositional processes	Not present in study area
Tertiary	Paleo-Pliocene		Uvalde Gravel	up to 80	Caliche-cemented gravel	Not present in study area
Cretaceous	Edwards	Washita	Buda	100	Limestone, fine-grained, bioclastic, glauconitic, hard, massive, nodular, argillaceous towards the top	Little permeability
			Del Rio	120	Clay and shale, calcareous and gypsiferous, some thin beds of siltstone	Negligible permeability
			Salmon Peak	380	Limestone, upper 80 feet contains reef talus grainstones and caprinid boundstones, crossbedding of grainstones; the lower 300 feet is a uniform dense carbonate mudstone.	Deep water deposits except towards the top. Upper part is moderately to very permeable. Lower part is almost impermeable except where fractured.
			McKnight	150	Limestone and shale; upper 55 feet is a mudstone containing thin zones of collapse breccias; middle 24 feet is shaley, lime mudstone; lower part is limestone containing breccias in upper part.	Deep basal, euxinic deposits. Little permeability
			West Nueces	140	Limestone; upper 80 feet is largely a massive unit of miliolid and mollusk-bearing grainstone; lower 60 feet is a nodular, dense mudstone.	Upper part is moderately permeable. Lower part is almost impermeable.
		Trinity	Glen Rose	1,000-1,500	Limestone, dolomite, and marl; limestone is fine-grained, hard to soft, marly; dolomite is porous and finely crystallized.	Little permeability; more permeable toward base

Reference: Modified from Maclay and Small, 1984

1.3 Geologic Processes

Available published information and previous studies were reviewed to evaluate geological processes at the landfill expansion. A discussion of pertinent geologic processes is summarized below.

1.3.1 Fault and Seismic Data

There are no active faults or seismic impact zones identified within one mile of the landfill expansion site. The fault study performed by TETCO (1994) for the existing City of Del Rio Landfill involved an extensive site inspection along outcrops and creek beds, evaluation of possible fault lineations on aerial photographs for the years 1947, 1983 and 1990, and review of geologic maps of the area. TETCO (1994) reported the possible presence of a fault about ¾-mile to the west along Highway 277. Several small displacement faults (less than 25 feet) were also reported more than one mile away from the site.

The faults in the area are anticipated to be associated with the Balcones Fault Zone. Faulting occurred throughout most of the Cretaceous Period and continued into early Tertiary time. Faulting along the Balcones Fault Zone has been inactive since Pleistocene time, some two million years ago and future movement is not expected.

Del Rio is located near the Rio Grande Rift where several earthquakes were reported. The most recent was a magnitude 4.0 earthquake near Sanderson, Texas about 7 years ago (Earthquake Track, 2023). The largest reported earthquake was a magnitude 6.5 that occurred 91 years ago near Ft. Stockton, Texas (Earthquake Track, 2023). In addition, earthquakes with magnitude of approximately 3.5 (5 km in depth) have also been documented approximately 75 miles south-southeast of Del Rio (Earthquake Track, 2023).

1.3.2 Erosional Processes

Erosion is the primary active geologic process in the landfill expansion area. Sheet, rill, and gully erosion have been observed at the site and are largely associated with the Calaveras Creek drainage system. Calaveras Creek is an intermittent tributary of San Felipe Creek that traverses the area north and west of the landfill expansion area. Surface water from rain events flows from higher elevations across the expansion area into rills, channels and gullies that eventually coalesce into the Calaveras Creek. During surface water flow, the generally unconsolidated sediments which are exposed at the surface across the landfill expansion area are eroded away, creating deeper rills, channels and gullies that results in further erosion towards the creek system.

Natural topographic relief on the order of about 120 feet exists across the site and ranges from a low elevation of about 980 feet amsl in the northwestern portion of the landfill expansion area to a high elevation of about 1100 feet amsl near the south portion of the site as shown on **Figure 6** (Bain Medina Bain, 2020). The higher elevations form a primarily north-south trending ridge that result in surface water flow towards the northwest and west in the western portion of the landfill expansion area, and towards the northeast in the eastern portion of the expansion area. Based on the natural topography, the potential for continued erosional processes at the site appears high. Once cut and fill activities are initiated to establish the footprint of the landfill expansion, erosional processes can be mitigated by the construction of berms and slopes engineered to prevent continued erosion.

1.3.3 Unstable Areas

According to the Texas Administrative Code, Title 30, Chapter 330, Subchapter M: Location Restrictions (March 27, 2006), an unstable area is defined to be a location that is susceptible to natural or human induced events or forces capable of impairing the integrity of some or all of a landfill's structural components responsible for preventing releases from the landfill. Unstable areas can include poor foundation conditions, areas susceptible to mass movement and karst terrains.

Based on geotechnical data and the provided elevation of deepest excavation (EDE) of 1000 feet amsl, the landfill excavation bottom will be within the very stiff to very hard fat clay and/or recompacted Del Rio Clay. Accordingly, the soils at the landfill site are anticipated to provide a stable foundation.

Relatively few solution cavities were reported within the Edwards Limestones near the site (TETCO, 1994). Due to the thickness of Del Rio Clay above the Edwards Limestones, we do not anticipate that the landfill structures and activities will be impacted by the presence of sinkholes and solution cavities.

During Geotechnical drilling operations and site visits, no man-made features were observed within the landfill expansion area that can impair structural integrity of the landfill expansion.

Natural and excavated slopes may be subject to instability within the Del Rio Clay. We recommend the design engineer perform slope stability analyses to determine the permissible grades of temporary and permanent slopes.

1.3.4 Subsidence

Borings drilled within the expansion area encountered medium dense to very dense clayey sand with gravel, dense to very dense clayey gravel with sand, very stiff to very hard fat to lean clay with various amount of sand and gravel, hard to very hard and very hard clay-shale. Accordingly, subsidence is not anticipated within the Del Rio Clay consisting of over consolidated clay and clay-shale. Furthermore, active faults are not documented within one mile of the site; therefore, differential subsidence because of active faulting is not anticipated.

1.3.5 Wetlands Identification

Details regarding jurisdictional wetland areas are provided in Section 11.2 of the location's restriction demonstrations in Appendix I/IIC.

1.4 Regional Aquifers

The primary source of groundwater in Val Verde County is the carbonate rocks of the Fredericksburg Group and the lower part of the Washita Group, collectively known as the Edwards Aquifer. These include the Fort Terrett and Segovia formations, the Devils River Formation, and the West Nueces, McKnight, and Salmon Peak formations. The Edwards Aquifer is variable in nature due to factors including surface topography, geology structure, lithology, and stratigraphy of the member formations. The upper zone of the Edwards Aquifer (the Salmon Peak Formation) is generally the most prolific source of water in the landfill area and is shown on the Regional Cross-Section on **Figure 5**.

Regionally, the hydraulic relationship between the Edwards and the Trinity aquifers is variable and complex. Throughout much of the Edwards Plateau, the Edwards Aquifer is hydraulically connected to the underlying Trinity Aquifer and is mapped as the Edwards-Trinity (Plateau) Aquifer by the Texas Water Development Board (Weinberg, 2018). **Table 1-2** provides a summary of regional hydraulic properties and water quality parameters of the Edwards portion of the Edwards-Trinity Aquifer.

Groundwater yields in the Edwards Aquifer may exceed 150 gallons per minute (gpm) and have been documented as high as 1,000 gpm (Reeves and Small, 1973). Yields in the Salmon Peak aquifer member in the landfill vicinity, however, are on the order of 15 to 25 gpm. It is likely the Salmon Peak is not as fractured and has fewer dissolution zones than other Edwards member formations, resulting in the lower yields observed. Groundwater is under confined conditions as a result of the overlying aquiclude formed by the Del Rio Clay. Based on published data, piezometric levels in the Salmon Peak aquifer range from about 65 to 150 feet below ground surface (bgs) (Reeves and Small, 1973). A Potentiometric Map of the Edwards Aquifer is provided on **Figure 8**.

Regional groundwater flow is towards the south-southwest at a hydraulic gradient of about 0.004 feet/foot (20 feet/mile). Locally, groundwater flow is controlled by dissolution channels formed preferentially along bedding planes, joints, and fractures (Weinberg, 2018). Flow may also be influenced by localized pumping. Recharge to the aquifer occurs via losing streams, sinkholes, and infiltration from the surface. Springs associated with faults, fractures and dissolution zones result in natural discharge.

Groundwater from the Salmon Peak aquifer is classified as potable and is characterized as a hard, calcium bicarbonate water. In the Del Rio area, the average total dissolved solids (TDS) ranges from about 320 to 450 milligrams per liter (mg/L) north of the City, and generally higher south of the City with an average of about 1750 mg/L (Reeves and Small, 1973).

Table 1-2: Regional Hydraulic Properties and Water Quality Parameters of the Edwards Portion of the Edwards-Trinity (Plateau) Aquifer

Hydraulic Properties	Edwards Aquifer
Composition[1]	Limestone and dolomite
Transmissivity[1]	Range <1 - 8000 ft^2/day
Hydraulic conductivity[1]	~ $2.36x10^{-3}$ cm/sec
Recharge zones[1]	~800 feet northwest of the site
Potentiometric surface[5]	see **Figure 8**
Present water uses[3]	Public supply, industrial, irrigation, domestic, and stock
Water wells within 1 mile[4]	9
Average Water Quality Parameters[3] (mg/L)	**Edwards Aquifer (fresh wells)**
Total dissolved solids	370
Chloride (Cl)	42
Sodium (Na)	28.9
Calcium (Ca)	84.5
Sulfate (SO_4)	59
Magnesium (Mg)	12.9
Potassium (K)	1.6

References: [1]Anaya and Jones, 2009; [2]Collins, 2007; [3]Weinberg et.al, 2018; [4]ERIS Report; [5]Kuniansky and Ardis, 2004

1.5 Water Well Search

According to a water well search provided by Environmental Risk Information Services (ERIS), there are eleven (11) documented water wells within a one-mile radius of the landfill site (**Appendix IIIJ-A**). A map depicting the water well locations is provided as **Figure 9**. A table summarizing the available well data is provided as **Table 1-3**. Two wells (Map IDs# 4 and 5) are listed in the ERIS report as oil/gas wells located 0.56 miles west of the site and 0.60 miles east-southeast of the site, respectively. These two wells are not actually water wells. Five of the wells are in the TCEQ database and six wells are in the TWDB database. All of these wells (except Map IDs# 4 and 5) produce water from the Edwards Aquifer.

Table 1-3: Registered Water Wells Within One Mile of the Landfill[1]

Map Key	Well ID	Total Depth (ft)	Aquifer	Use	Depth to Edwards (ft)[3]	Depth to Trinity (ft)[2]
1	70-33-9	400	nr	domestic	nr	nr
2	70-42-102	125	Edwards	domestic	nr	ne
3	TX238701	120	Edwards	domestic	84	ne
4	70-42-104*	3332	Not applicable	oil/gas well	Not applicable	Not applicable
5	40-42-105	1001	Not applicable	oil/gas well	Not applicable	Not applicable
6	70-42-106	145	Edwards	unused	nr	ne
7	70-42-101	134	Edwards	domestic	nr	ne
8	TX238702	200	Edwards	domestic	135	ne
9	70-34-701	135	Edwards	domestic	nr	ne
10	TX238699	300	Edwards	domestic	128	ne
11	TX238700	120	Edwards	domestic	98	ne

[1] ERIS water well information obtained from USGS, TWDB and TCEQ records.
[2] "ne" denotes formation "not encountered" according to driller's well log information.
[3] "nr" indicates "not recorded".
* Well was found with a manual search of the TWDB's website Water Data Interactive and confirmed to be an oil/gas well.

1.6 Petroleum Well Search

According to ERIS, there are two oil wells drilled near the expansion area (**Appendix IIIJ-B**). A map depicting the oil well locations is provided on **Figure 10**. According to the ERIS report the wells were dry holes and were abandoned. Additional dry holes and abandoned drilling locations are documented in the area east of the landfill beyond the ½-mile radius; however, currently no producing petroleum wells are present in the vicinity of Del Rio. Two permitted oil/gas locations are present just beyond the ½-mile radius southeast of the landfill (Texas Railroad Commission, 2022).

ERIS also located an abandoned gas pipeline southeast of the site. It appears to start about 1,000 feet east of the site and extends to the southeast. The approximate location of the abandoned pipeline is shown on **Figure 11**.

2.0 SUBSURFACE INVESTIGATION REPORT

2.1 Site Stratigraphy

The landfill permit boundary is depicted on the Geologic Map presented on **Figure 4**. According to the Bureau of Economic Geology, Geologic Atlas of Texas-Del Rio Sheet (1977) the site lies within the outcrop area of Quaternary period alluvium, the Tertiary period Uvalde Gravel and the Cretaceous period Buda Limestone and Del Rio Clay.

A total of 17 borings (B-1 through B-17) were drilled at the expansion site by Arias to confirm site geology and to characterize the site-specific subsurface stratigraphy. The borings ranged in depth from 25 feet to 95 feet below the ground surface. A boring plan is provided on **Figure 6**. Boring logs are provided in **Appendix IIIJ-C**.

Previous Geotechnical Studies performed by Raba Kistner Consultants, Inc. (RKCI,1986, 1987-1988) and TETCO (1994) indicated that the geologic formation of the existing operational landfill consists of Del Rio Clay. A thin capstone of Buda Limestone was reported along the southwestern boundary of the existing operational landfill. Boring logs for the RCKI studies (B-401 through B-420 and Deep B-3) and TETCO study (B-1 through B-4) were utilized as a resource to evaluate stratigraphy. Boring locations for previous Geotechnical studies are provided on **Figure 7**.

A summary of the site-specific stratigraphy for the expansion area, based on the Geotechnical drilling program, is summarized below.

2.1.1 Talus Deposits

Talus materials along topographic slopes comprised of clay, clayey gravel, gravelly clay, sandy clay, and clayey sand was encountered in B-1, B-4, B-7, B-8, B-10, B-12, and B-15. Thickness of the talus materials ranged from 2 feet (B-1) to 4 feet (B-4).

2.1.2 Quaternary Alluvium

No materials interpreted as alluvium were encountered during drilling activities.

2.1.3 Uvalde Gravel

No materials interpreted as Uvalde Gravel were encountered during drilling activities.

2.1.4 Buda Limestone

The Buda Limestone is a medium, even-bedded, dense, fine-grained limestone of a “porcelaneous” or semi-lithographic type and is only sparsely fossiliferous. This formation overlies the Del Rio Clay. At the site, the Buda Limestone was encountered as weathered clay, sandy clay, gravelly clay, clayey gravel, and marl (residual state) with limestone seams in Borings B-3, B-13, B-16, and B-17 at topographically higher areas of the site. Based on the Geotechnical drilling program, the thickness of the Buda Limestone (residual) at the site ranges from 13 feet (B-17) to 28 feet (B-3).

2.1.5 Del Rio Clay

The Del Rio Clay is comprised of clay, which weathers yellow, and some thin sandy limestone beds (Cross, 1989). At the site, the Del Rio Clay exists as weathered sandstone (clayey sand), clays with occasional gypsum, and both weathered and un-weathered clay-shale. The Del Rio Clay was encountered at depths ranging from the ground surface (in B-2, B-6, B-9, B-11, and B-14) to 28 feet (B-3) and extended to the termination depths of all borings drilled at the site.

Site stratigraphic cross-sections developed utilizing data provided by Arias (2022) as part of a supporting Geotechnical study are provided in **Appendix IIIJ-D**.

2.2 Previous Site Exploration Summary

Two (2) previous Geotechnical studies, conducted to support previous landfill permit applications for the City of Del Rio Landfill, have been conducted in the vicinity of the landfill expansion. One (1) study was conducted by RKCI (1986,1987-1988) to support the original landfill permit application. The second study was performed by TETCO in 1994 to support permit modification and alternate liner design. A Supplemental Evaluation was also prepared by TETCO in 1994. Please note that information regarding the RKCI study is limited and was largely derived from reference material provided in the TETCO reports.

2.3 Previous Landfill Stratigraphic Characterizations

Based on available information in the TETCO report, RKCI drilled a boring (B-3) to a depth of 160 feet below the existing grade (penetrating the base of the Del Rio Clay) in 1986 in the previous 106-acre landfill expansion and developed a northeast-southwest stratigraphic cross-section interpolating their boring data as shown in **Figure 12**. According to the interpolated cross-section, Del Rio Clay extends to about 130+ feet at the southern boundary of the existing landfill (terminating at an elevation of approximately 910 feet). In addition to the deep boring, RKCI also installed twenty additional soil borings (B-401 through B-420) to depths ranging from 35 to 50 feet bgs.

The TETCO study included the installation of 4 soil borings to depths of 60 feet each with each boring converted to a piezometer. A second, nested piezometer was also installed at each location to depths of 30 to 40 feet bgs. All total, 8 piezometers were installed by TETCO.

Stratigraphy encountered in soil borings for the RKCI and TETCO studies is similar to that observed in soil borings installed by Arias for the current landfill expansion. With the exception of the deep boring (B-3) installed by RKCI, all borings installed by RKCI and TETCO terminated in the Del Rio Clay.

2.4 Soil Boring Plan

Arias installed 17 soil borings at the site to evaluate stratigraphy and physical properties of the site strata. Ten of the borings were also converted to piezometers to evaluate groundwater conditions. Boring depths ranged from 25 to 95 feet bgs and all terminated in the Del Rio Clay. A summary of boring depths relative to the landfill expansion EDE is provided in **Table 2-1**.

Detailed boring information for the expansion area is provided in **Table 2-2**. The EDE for the landfill expansion area is 1000 feet amsl.

Detailed boring log information for the existing landfill is provided in **Table 2-3**.

Table 2-1: Expansion Area Borehole Summary

Soil Borings	Number Completed
Existing soil borings in the expansion area used to assist in characterization	**0**
New borings 30 ft below the EDE within the expansion area	**11**
Total number of borings ≥30 ft below the EDE to characterize the expansion area	**10**
Existing borings within/adjacent to the expansion area used to assist in characterization	**5**
New borings ≥5 ft below the EDE within/adjacent to the expansion area	**16**
New borings ≥ 25 ft below the EDE to characterize the expansion area	**12**

Table 2-2: Summary of Boring Depths and Elevations

Boring	Northing	Easting	Surface Elevation	Total Depth	Bottom Elevation	Boring Depth below EDE	Top Elevation of Buda Limestone	Top Elevation of Del Rio Clay	Boring Penetration into Clay	Water Depth at Drilling	Static Water Elevation
B-1	13684130.48	1375589.86	994.42	35.0	959.42	40.58	---	992.42	33.0	25.0	973.08
B-2	13683181.06	1374634.82	991.59	25.0	966.59	33.41	---	991.59	25.0	Dry	---
B-3	13681801.55	1375882.48	1060.67	90.0	970.67	29.33	---	1032.67	62.0	Dry	---
B-4	13682729.42	1376525.21	1043.59	75.0	968.59	31.41	---	1039.59	71.0	NA	---
B-5	13683671.98	1376032.10	1051.65	55.0	996.65	3.35	---	1051.65	55.0	NA	---
B-6	13682234.92	1375346.15	1028.01	35.0	993.01	6.99	---	1028.01	35.0	Dry	---
B-7	13682645.58	1376245.09	1052.46	60.0	992.46	7.54	---	1048.46	56.0	Dry	---
B-8	13683342.65	1375327.52	995.52	50.0	945.52	54.48	---	993.52	48.0	NA	---
B-9	13683726.92	1375607.76	1002.05	40.0	962.05	37.95	---	1000.05	40.0	NA	---
B-10	13683181.40	1375334.69	997.82	45.0	952.82	47.18	---	995.82	43.0	NA	---
B-11	13683629.32	1375079.24	986.07	25.0	961.07	38.93	---	986.07	25.0	Dry	---
B-12	13683138.40	1376072.10	1045.00	75.0	970.00	30.00	---	1045.00	71.0	Dry	---
B-13	13682239.04	1376149.05	1059.94	65.0	994.94	5.06	---	1035.94	41.0	28.0	1038.34
B-14	13682762.62	1375017.31	998.14	30.0	968.14	31.86	---	998.14	30.0	NA	---
B-15	13683474.98	1376491.54	1019.87	50.0	969.87	30.13	---	1015.87	46.0	Dry	1002.42
B-16	13682763.29	1375731.63	1064.25	95.0	969.25	30.75	---	1046.25	77.0	NA	---
B-17	13682385.22	1375804.72	1059.31	65.0	994.31	5.69	---	1046.31	52.0	NA	---

Table 2-3: Summary of Boring Depths and Elevations for the Existing Landfill

Boring No.	Borehole Surface Elevation (ft-msl)	Borehole Total Depth (ft)	Borehole Bottom Elevations (ft-msl)	Depth (ft) Above or Below EDE[1]
1986 Raba-Kistner Consultants Inc.				
B-401	1047.3	50	997.3	25.4
B-402	1045.4	35	1010.4	22.0
B-403	1045.0	35	1010.0	9.5
B-404	1044.6	50	994.6	20.9
B-405	1048.0	50	998.0	7.0
B-406	1045.5	35	1010.5	24.9
B-407	1049.1	50	999.1	9.2
B-408	1048.0	35	1013.0	25.8
B-409	1045.1	50	995.1	-0.5
B-410	1045.8	35	1010.8	-1.0
B-411	1044.2	50	994.2	5.9
B-412	1055.5	35	1020.5	-9.8
B-413	1056.0	35	1021.0	9.1
B-414	1064.1	50	1014.1	-4.5
B-415	1064.8	35	1029.8	-3.2
B-416	1060.9	50	1010.9	14.7
B-417	1059.5	35	1024.5	5.8
B-418	1058.2	35	1023.2	135
B-419	1055.3	50	1005.3	25.4
B-420	1049.2	35	1014.2	22
Deep B-3	1045.0	160	885.0	9.5
1994 Trinity Engineering Testing Corporation				
B-1	1050.0	61	989.0	31.0
B-2	1050.0	61.5	988.5	31.5
B-3	1050.0	61	989.0	31.0
B-4	1050.0	60.5	989.5	30.5
1. EDE for the existing landfill is at an Elevation of 1,020 ft-msl				

3.0 GROUNDWATER INVESTIGATION REPORT

3.1 Water Level Measurements

Ten (10) piezometers (B-1 through B-3, B-6, B-7, and B-11 through B-15) were placed at the site to evaluate groundwater conditions with groundwater measurements collected by Arias in December 2020, January 2021, February 2021, March 2021, April 2021, May 2021, June 2021, July 2021, August 2021, September 2021, October 2021, November 2021, December 2021, January 2022, February 2022, April 2022, May 2022, June 2022, July 2022, August 2022, September 2022, October 2022 and November 2022 . Measurable groundwater was encountered at the site in B-1, B-13, and B-15 only. Static water level measurements collected during the last monitoring event on November 7, 2022, indicated groundwater levels at elevations of 973.58 feet in B-1, dry in B-13, and 1007.42 feet in B-15. Cumulative static water levels are summarized in Table 3-1. Piezometer completion logs are provided in **Appendix IIIJ-E**.

Table 3-1: Static Water Level Measurements

Piezometers	Date of Groundwater (GW) Measurements	Depth of GW from Top of the PVC Pipe (feet)	Elevation of GW (feet)
B-1	12/8/2020	25.00	973.08
	1/4/2021	27.92	970.16
	2/8/2021	27.60	970.48
	3/4/2021	27.50	970.58
	4/5/2021	27.50	970.58
	5/4/2021	27.50	970.58
	6/1/2021	25.42	972.66
	7/22/2021	28.17	969.91
	8/10/2021	28.30	969.78
	9/9/2021	27.33	970.75
	10/11/2021	27.17	970.91
	11/8/2021	24.00	974.08
	12/9/2021	27.33	970.75
	1/3/2022	27.60	970.48
	2/11/2022	27.58	970.50
	2/28/2022	27.40	970.68

Piezometers	Date of Groundwater (GW) Measurements	Depth of GW from Top of the PVC Pipe (feet)	Elevation of GW (feet)
B-1	4/7/2022	28.17	969.91
	5/4/2022	26.33	971.75
	6/9/2022	27.80	970.28
	7/7/2022	27.20	970.88
	8/4/2022	27.80	970.28
	9/7/2022	27.00	971.08
	10/3/2022	27.70	970.38
	11/7/2022	24.50	973.58
B-2	12/8/2020	Dry	N/A
	1/4/2021	Dry	N/A
	2/8/2021	Dry	N/A
	3/4//2021	Dry	N/A
	4/5/2021	Dry	N/A
	5/4/2021	Dry	N/A
	6/1/2021	Dry	N/A
	7/22/2021	Dry	N/A
	8/10/2021	Dry	N/A
	9/9/2021	Dry	N/A
	10/11/2021	Dry	N/A
	11/8/2021	Dry	N/A
	12/9/2021	Dry	N/A
	1/3/2022	Dry	N/A
	2/11/2022	Dry	N/A
	2/28/2022	Dry	N/A

Piezometers	Date of Groundwater (GW) Measurements	Depth of GW from Top of the PVC Pipe (feet)	Elevation of GW (feet)
B-2	4/7/2022	Dry	N/A
	5/4/2022	Dry	N/A
	6/2/2022	Dry	N/A
	7/7/2022	Dry	N/A
	8/4/2022	Dry	N/A
	9/7/2022	Dry	N/A
	10/3/2022	Dry	N/A
	11/7/2022	Dry	N/A
B-3	12/8/2020	Dry	N/A
	1/4/2021	Dry	N/A
	2/8/2021	Dry	N/A
	3/4//2021	Dry	N/A
	4/5/2021	Dry	N/A
	5/4/2021	Dry	N/A
	6/1/2021	Dry	N/A
	7/22/2021	Dry	N/A
	8/10/2021	Dry	N/A
	9/9/2021	Dry	N/A
	10/11/2021	Dry	N/A
	11/8/2021	Dry	N/A
	12/9/2021	Dry	N/A
	1/3/2022	Dry	N/A
	2/11/2022	Dry	N/A
	2/28/2022	Dry	N/A

Piezometers	Date of Groundwater (GW) Measurements	Depth of GW from Top of the PVC Pipe (feet)	Elevation of GW (feet)
B-3	4/7/2022	Dry	N/A
	5/4/2022	Dry	N/A
	6/2/2022	Dry	N/A
	7/7/2022	Dry	N/A
	8/4/2022	Dry	N/A
	9/7/2022	Dry	N/A
	10/3/2022	Dry	N/A
	11/7/2022	Dry	N/A
B-6	12/8/2020	Dry	N/A
	1/4/2021	Dry	N/A
	2/8/2021	Dry	N/A
	3/4//2021	Dry	N/A
	4/5/2021	Dry	N/A
	5/4/2021	Dry	N/A
	6/1/2021	Dry	N/A
	7/22/2021	Dry	N/A
	8/10/2021	Dry	N/A
	9/9/2021	Dry	N/A
	10/11/2021	Dry	N/A
	11/8/2021	Dry	N/A
	12/9/2021	Dry	N/A
	1/3/2022	Dry	N/A
	2/11/2022	Dry	N/A
	2/28/2022	Dry	N/A

Piezometers	Date of Groundwater (GW) Measurements	Depth of GW from Top of the PVC Pipe (feet)	Elevation of GW (feet)
B-6	4/7/2022	Dry	N/A
	5/4/2022	Dry	N/A
	6/2/2022	Dry	N/A
	7/7/2022	Dry	N/A
	8/4/2022	Dry	N/A
	9/7/2022	Dry	N/A
	10/3/2022	Dry	N/A
	11/7/2022	Dry	N/A
B-7	12/8/2020	Dry	N/A
	1/4/2021	Dry	N/A
	2/8/2021	Dry	N/A
	3/4//2021	Dry	N/A
	4/5/2021	Dry	N/A
	5/4/2021	Dry	N/A
	6/1/2021	Dry	N/A
	7/22/2021	Dry	N/A
	8/10/2021	Dry	N/A
	9/9/2021	Dry	N/A
	10/11/2021	Dry	N/A
	11/8/2021	Dry	N/A
	12/9/2021	Dry	N/A
	1/3/2022	Dry	N/A
	2/11/2022	Dry	N/A
	2/28/2022	Dry	N/A
	4/7/2022	Dry	N/A

Piezometers	Date of Groundwater (GW) Measurements	Depth of GW from Top of the PVC Pipe (feet)	Elevation of GW (feet)
B-7	5/4/2022	Dry	N/A
	6/2/2022	Dry	N/A
	7/7/2022	Dry	N/A
	8/4/2022	Dry	N/A
	9/7/2022	Dry	N/A
	10/3/2022	Dry	N/A
	11/7/2022	Dry	N/A
B-11	12/8/2020	Dry	N/A
	1/4/2021	Dry	N/A
	2/8/2021	Dry	N/A
	3/4//2021	Dry	N/A
	4/5/2021	Dry	N/A
	5/4/2021	Dry	N/A
	6/1/2021	Dry	N/A
	7/22/2021	Dry	N/A
	8/10/2021	Dry	N/A
	9/9/2021	Dry	N/A
	10/11/2021	Dry	N/A
	11/8/2021	Dry	N/A
	12/9/2021	Dry	N/A
	1/3/2022	Dry	N/A
	2/11/2022	Dry	N/A
	2/28/2022	Dry	N/A

Piezometers	Date of Groundwater (GW) Measurements	Depth of GW from Top of the PVC Pipe (feet)	Elevation of GW (feet)
B-11	4/7/2022	Dry	N/A
	5/4/2022	Dry	N/A
	6/2/2022	Dry	N/A
	7/7/2022	Dry	N/A
	8/4/2022	Dry	N/A
	9/7/2022	Dry	N/A
	10/3/2022	Dry	N/A
	11/7/2022	Dry	N/A
B-12	12/8/2020	Dry	N/A
	1/4/2021	Dry	N/A
	2/8/2021	Dry	N/A
	3/4//2021	Dry	N/A
	4/5/2021	Dry	N/A
	5/4/2021	Dry	N/A
	6/1/2021	Dry	N/A
	7/22/2021	Dry	N/A
	8/10/2021	Dry	N/A
	9/9/2021	Dry	N/A
	10/11/2021	Dry	N/A
	11/8/2021	Dry	N/A
	12/9/2021	Dry	N/A
	1/3/2022	Dry	N/A
	2/11/2022	Dry	N/A

Piezometers	Date of Groundwater (GW) Measurements	Depth of GW from Top of the PVC Pipe (feet)	Elevation of GW (feet)
B-12	2/28/2022	Dry	N/A
	4/7/2022	Dry	N/A
	5/4/2022	Dry	N/A
	6/2/2022	Dry	N/A
	7/7/2022	Dry	N/A
	8/4/2022	Dry	N/A
	9/7/2022	Dry	N/A
	10/3/2022	Dry	N/A
	11/7/2022	Dry	N/A
B-13	12/8/2020	25.50	1038.34
	1/4/2021	32.67	1031.17
	2/8/2021	29.00	1034.84
	3/4/2021	29.00	1034.84
	4/5/2021	28.10	1035.74
	5/4/2021	29.08	1034.76
	6/1/2021	29.08	1034.76
	7/22/2021	29.75	1034.09
	8/10/2021	30.60	1033.24
	9/9/2021	31.08	1032.76
	10/11/2021	37.13	1026.72
	11/8/2021	36.58	961.50
	12/9/2021	46.58	951.50
	1/3/2022	52.00	946.08

Piezometers	Date of Groundwater (GW) Measurements	Depth of GW from Top of the PVC Pipe (feet)	Elevation of GW (feet)
B-13	2/11/2022	52.33	945.75
	2/28/2022	53.20	944.88
	4/7/2022	53.08	945.00
	5/4/2022	68.33	929.75
	6/2/2022	68.33	929.75
	7/7/2022	68.40	929.68
	8/4/2022	Dry	N/A
	9/7/2022	Dry	N/A
	10/3/2022	Dry	N/A
	11/7/2022	Dry	N/A
B-14	12/8/2020	Dry	N/A
	1/4/2021	Dry	N/A
	2/8/2021	Dry	N/A
	3/4//2021	Dry	N/A
	4/5/2021	Dry	N/A
	5/4/2021	Dry	N/A
	6/1/2021	Dry	N/A
	7/22/2021	Dry	N/A
	8/10/2021	Dry	N/A
	9/9/2021	Dry	N/A
	10/11/2021	Dry	N/A
	11/8/2021	Dry	N/A
	12/9/2021	Dry	N/A

Piezometers	Date of Groundwater (GW) Measurements	Depth of GW from Top of the PVC Pipe (feet)	Elevation of GW (feet)
B-14	1/3/2022	Dry	N/A
	2/11/2022	Dry	N/A
	2/28/2022	Dry	N/A
	4/7/2022	Dry	N/A
	5/4/2022	Dry	N/A
	6/2/2022	Dry	N/A
	7/7/2022	Dry	N/A
	8/4/2022	Dry	N/A
	9/7/2022	Dry	N/A
	10/3/2022	Dry	N/A
	11/7/2022	Dry	N/A
B-15	12/8/2020	20.75	1002.42
	1/4/2021	20.00	1003.17
	2/8/2021	20.10	1003.07
	3/4/2021	20.00	1003.17
	4/5/2021	20.80	1002.37
	5/4/2021	20.58	1002.59
	6/1/2021	20.83	1002.34
	7/22/2021	20.75	1002.42
	8/10/2021	20.50	1002.67
	9/9/2021	20.33	1002.84
	10/11/2021	19.25	1003.92
	11/8/2021	19.50	1003.67

Piezometers	Date of Groundwater (GW) Measurements	Depth of GW from Top of the PVC Pipe (feet)	Elevation of GW (feet)
B-15	12/9/2021	19.42	1003.75
	1/3/2022	20.75	1002.42
	2/11/2022	20.75	1002.42
	2/28/2022	19.50	1003.67
	4/7/2022	21.75	1001.42
	5/4/2022	18.50	1004.67
	6/2/2022	18.50	1004.67
	7/7/2022	18.80	1004.37
	8/4/2022	19.70	1003.47
	9/7/2022	19.67	1003.50
	10/3/2022	17.10	1006.07
	11/7/2022	15.75	1007.42

Groundwater in B-1 and B-15 was encountered in clay-shale of the Del Rio Clay. B-13 yielded measurable groundwater at the stratigraphic transition between the Buda Limestone (marl) and the Del Rio Clay. The limited occurrences of groundwater at the site within the depths investigated indicates B-1, B-13 and B-15 represent isolated zones of perched groundwater. Groundwater encountered at these locations has been interpreted to be related to isolated movement of water recharged at the surface through joints or fractures of the various formations. Connectivity of the encountered groundwater at these locations is considered unlikely. As such, a site-specific potentiometric surface map was not generated for this evaluation.

The Edwards-Trinity (Plateau) Aquifer is the most productive aquifer in the site area and lies stratigraphically below the Del Rio Clay. Groundwater flow in the aquifer generally moves from north to south through the Del Rio, Texas area (Weinberg and French, 2018). No borings at the site penetrated the top of the Edwards-Trinity Aquifer during the current study.

For historical stratigraphic studies, no groundwater was encountered in the deep RKCI boring designated as B-3. Shallow perched groundwater was encountered in Boring B-411 drilled by RKCI in 1987 about 26.7 feet below the existing grade. The encountered shallow perched water was likely related to a surface pond located near the boring.

In addition, no groundwater was reported in the eight (8) piezometers installed by TETCO in 1994.

The findings in the RKCI and TETCO studies are consistent with the findings of the Arias Geotechnical study. No pervasive aquifers are present within the landfill site. The presence of groundwater at the site appears to be limited to isolated zones of perched groundwater.

3.2 Permeability of the Uppermost Groundwater Zone

As mentioned previously, groundwater was observed in isolated perched zones at the site. In January of 2021, slug tests were performed in the three piezometers installed at the B-1, B-13 and B-15 locations in which water was found. The slug tests were conducted by CRG Texas Environmental Services, Inc. (CRG). Slug testing was performed using a rapid water-level change and measuring the water-level response at one second intervals with a submersible pressure transducer. The rapid change in water level was induced by adding or removing a sand-filled fully enclosed bailer. The slug test data was processed using a USGS spreadsheet to estimate the hydraulic conductivity using the Bouwer and Rice method. According to the CRG report, hydraulic conductivities for the piezometer locations were estimated in the 10^{-6} to 10^{-7} range with an average conductivity of 1.8 x 10^{-6} cm/sec. CRG noted this value is consistent with minimally to non-transmissive shale/ clays with minor silt/sand content.

CRG noted that data from field slug and pump testing can overestimate hydraulic conductivities (by at least one order of magnitude) based on the effects of vertical anomalies within the annular spacing and sand pack. The sand pack can contribute to quick recoveries that can mask true formation data.

CRG also provided estimated groundwater yields based on their collected site data. Calculated well yields were estimated at 3 gallons or less per day. CRG assumed a saturated thickness of 5 feet based on available information but noted that boring logs did not provide enough information to accurately estimate the saturated thickness. The CRG report is provided in **Appendix IIIJ-F**.

Data reported above corresponds to depths within weathered portions of the Del Rio Clay where strata would typically have more fissures and fractures than the deeper, impermeable unweathered clay-shale strata.

TETCO (1994) conducted aquifer testing of both shallow piezometers (30 to 40 feet in depth) and deep piezometers (60 feet in depth) in other areas of the landfill. Testing yielded permeabilities ranging from 1.5 x 10^{-5} cm/sec to 2.7 x 10^{-8} cm/sec. Since all piezometers were dry, TETCO added water to each piezometer to facilitate testing. TETCO concluded the range in values was reflective of shallower weathered zones versus deeper less weathered zones, where lower permeabilities would be expected.

The TETCO report (1994) references calculated permeabilities for the Del Rio Clay derived from work performed by both TETCO and RKCI in other areas of the landfill. The report indicates that the permeability of the Del Rio Clay was examined through a total of twelve undisturbed laboratory permeability tests. According to the TETCO report, coefficient of permeability results for the undisturbed samples ranged from 4.0 x 10^{-8} to 3.3 x 10^{-9} cm/sec (with an average of 5.9 x 10^{-9} cm/sec) and confirmed the expected low permeability of the Del Rio Clay. Permeabilities were evaluated for samples from depths ranging from 10 to 56 feet bgs.

According to the TETCO report (1994), remolded clay soil samples from depths of 10 to 30 feet (two samples from RKCI) as well as bulk samples (two samples) were also subjected to permeability testing. The coefficient of permeabilities for the samples were in the order of 10^{-9} cm/sec. Based on the results, TETCO concluded that the on-site clays could be used as a soil liner material.

Arias (2022) conducted permeability tests on four (4) remolded samples prepared using bulk samples from the landfill expansion area. Tests were performed in accordance with ASTM D 5084, Method A using a flexible wall permeameter. The remolded specimens were prepared at optimum moisture contents and compacted to about 95 percent of maximum density. Coefficient

of permeability was then calculated for the remolded specimens. The results are summarized in **Table 3-2**.

Table 3-2: Permeability Test Results for Remolded Bulk Samples from the Landfill Expansion Area

Bulk Samples near Boring	Dry Density (lb/ft^3)	Optimum Moisture Content (OMC) (%)	Liquid Limit	Plasticity Index	(%) Passing No. 200 Sieve	Soil Type	Coefficient of Permeability (cm/sec)
B-1	99.4	19.7	53	33	88	Fat Clay	8.49×10^{-8}
B-2	98.0	19.4	59	37	93	Weathered Clay-shale	7.22×10^{-8}
B-4	106.4	11.2	35	18	65	Sandy Lean Clay with Gravel (CL)	6.55×10^{-7}
B-12	113.1	11.0	35	18	37	Clayey Gravel with Sand (GC)	9.02×10^{-7}

Additional permeability tests were performed by Arias (2022) on three (3) remolded samples from borings within the expansion area. After completion of visual classifications, Atterberg limits, and percent passing US. Sieve No. 200, samples from similar strata were combined to perform permeability testing. Dry density and moisture content of the remolded samples were estimated based on the moisture contents, Atterberg limits, and percent passing US. Sieve No. 200 of the representative layer. Coefficient of permeability results are summarized in **Table 3-3**.

Table 3-3: Permeability Test Results of Remolded Samples from Borings in the Landfill Expansion Area

Boring	Depth of Composite Sample (feet)	Dry Density (lb/ft^3)	Moisture Content (%)	Liquid Limit	Plasticity Index	(%) Passing No. 200 Sieve	Soil Type	Coefficient of Permeability (cm/sec)
B-5	4 - 12	104.7	19.4	63	42	77	Fat Clay with Sand	6.47×10^{-7}
B-6	23 - 35	105.9	27.6	60	39	98	Clay Shale	1.16×10^{-8}
B-15	13 - 33	92.1	28.5	62	41	97	Fat Clay	1.32×10^{-8}

Based on Arias test results, the coefficient of permeabilities for the expansion area clay soils are on the order of 10^{-7} to 10^{-8} cm/sec. In reference to the Arias results, CRG noted in their slug testing report that fine-grained cohesive soils often lack sufficient permeability or transmissivity to support water movement. Furthermore, the remolding process can reduce or negate preferred pathways for water movement. CRG noted that remolded samples cannot simulate in-situ soil conditions but noted that the reported permeabilities are within the nominal ranges of laboratory-generated

data. CRG concluded that this information along with their slug test data, supports 10^{-7} to 10^{-8} cm/sec ranges for the tested formation.

3.3 Groundwater Analytical Testing

Groundwater sampling and analytical testing was performed by Medina Consulting Company, Inc. (MCC) in January 2021. Groundwater samples were collected from piezometers at the B-1, B-13 and B-15 locations using low-flow sampling procedures and analyzed for volatile organic compounds (VOCs) by EPA Method 8260B, Resource Conservation and Recovery Act (RCRA) metals, as well as beryllium, nickel, thallium, vanadium, and zinc (by EPA Methods 6010B/7417A). Analytical testing also included calcium, magnesium, potassium, and sodium (also Method 6010B) and analyses for chloride, sulfate, bicarbonate, and carbonate alkalinities (as $CaCO_3$), specific conductance, total dissolved solids (TDS), and pH.

According to the MCC report (see **Appendix IIIJ-G**), VOC and metals analysis yielded results below Texas Risk Reduction Program (TRRP) Tier 1 Commercial/Industrial (C/I) Protective Concentration Levels (PCLs) for a Class 2 or Class 3 groundwater resource with pH values near neutral. Chloride and sulfate exceeded Secondary PCLs in all samples analyzed. Bicarbonate alkalinity (as $CaCO_3$) was elevated as were calcium, magnesium, sodium, and potassium ions. TDS ranged from 3650 milligrams per liter (mg/L) in B-13 to 16,900 mg/L in B-1.

MCC noted most of the water quality parameters were elevated to highly elevated over fresh water that is typical of the Edwards-Trinity Plateau Aquifer groundwater from the Salmon Peak unit in the vicinity.

Based on the groundwater sampling results, MCC concluded that the subsurface water found in the piezometers wells are not from the Edwards-Trinity Plateau Aquifer. The subsurface waters encountered in the piezometers are each from very small, discontinuous (i.e., separate), perched aquifers. The chemistry of each water sample was distinctly different not only from the Edwards-Trinity Plateau Aquifer, but also between B-1, B-13, and B-15.

3.4 Hydrogeologic Interpretation

3.4.1 Isolated Perched Aquifers

Isolated perched aquifers were encountered in the Del Rio Clay and at the stratigraphic transition between the Buda Limestone and the Del Rio Clay. These perched aquifers are not pervasive and are not likely to be interconnected.

3.4.2 Edwards-Trinity (Plateau) Aquifer

Strata of the Edwards-Trinity Aquifer were not encountered in any of the site soil borings. At the expansion area site, the Del Rio Clay encountered serves as the confining unit for the Edwards-Trinity Aquifer.

3.4.3 Effectiveness of the Del Rio Clay as a Barrier Layer

The Del Rio Clay was encountered in every soil boring in the expansion area installed by Arias. Based on the Geotechnical drilling program, there is at least 55 feet of Del Rio Clay underlying the EDE for the expansion area. Coefficient of permeability values on the order of 10^{-7} cm/sec or

less have been reported for the Del Rio Clay by Arias during the current study and from historical studies performed in other areas of the landfill by other consultants. These permeabilities are consistent with minimally transmissive clay materials. Given the thickness and measured permeabilities, the Del Rio Clay is considered an effective barrier for the base of the landfill expansion.

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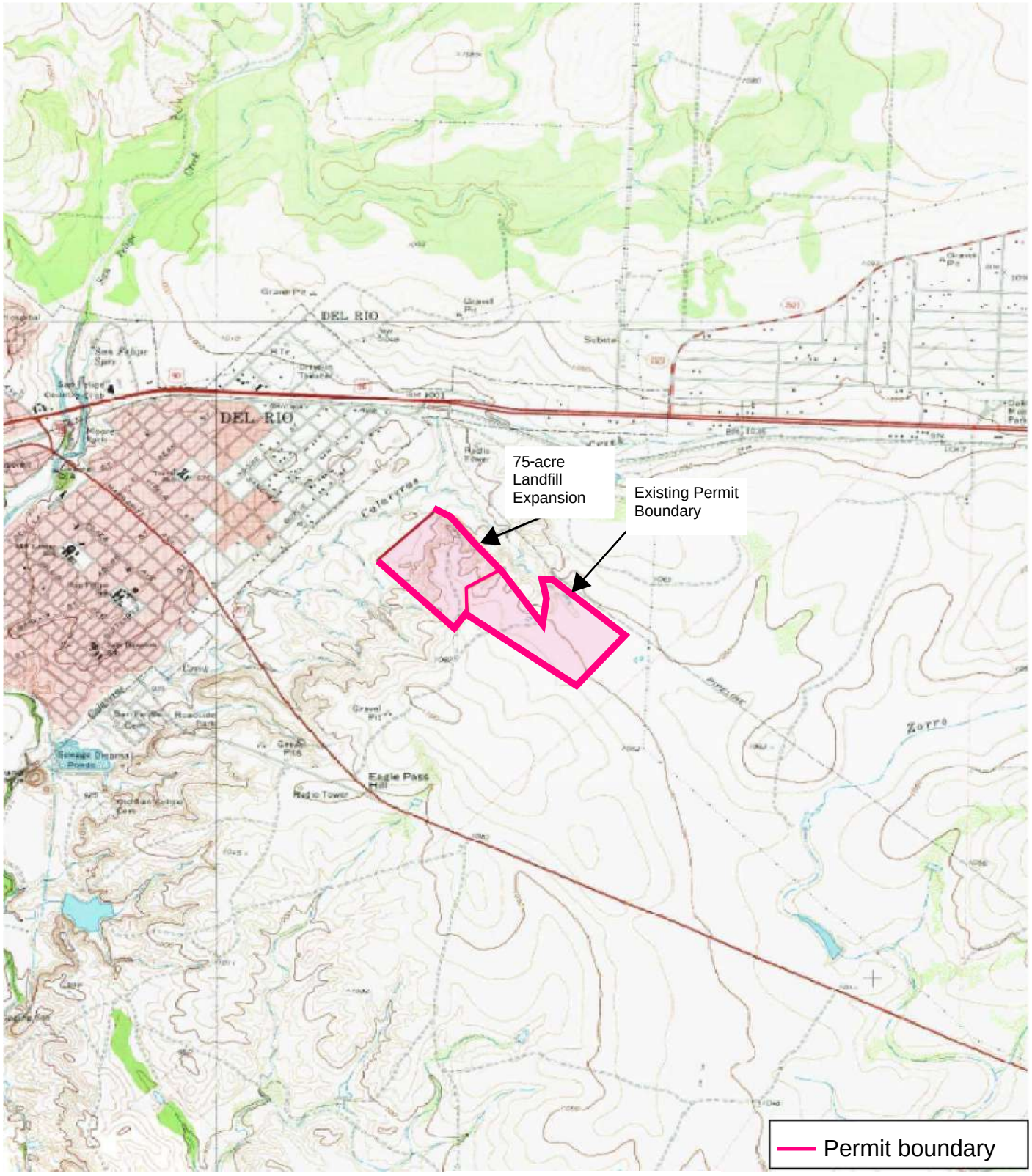
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FIGURES



Source: © Caltopo 2018, USGS Topographic Maps

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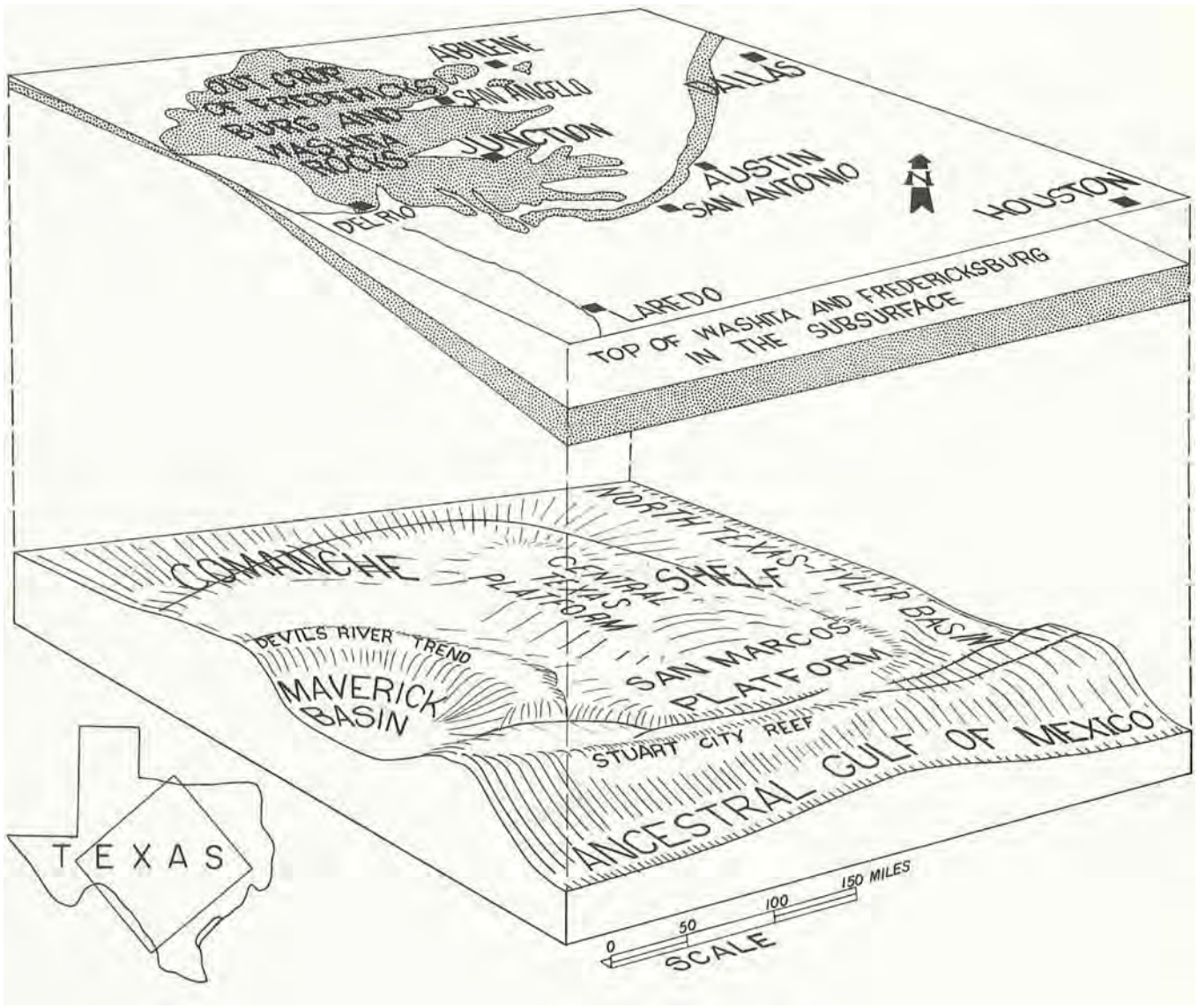
Figure 1
Site Location & Topographic Map

Drawing by: B. Barnes
Checked by: D. Hartsfield
File No.: 5020210002 Fig. 1
Date: November 2022



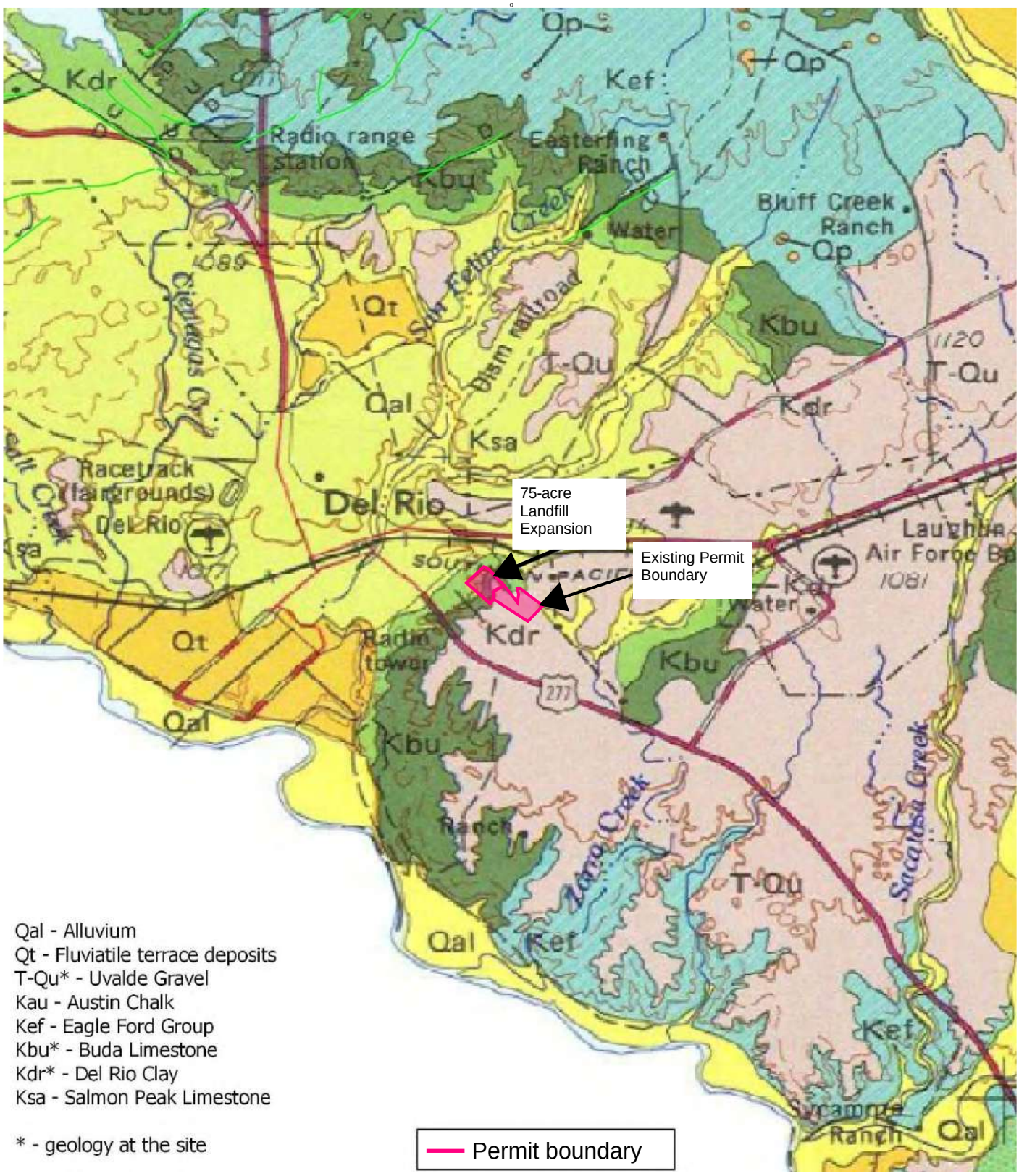
Source: Collins & Laubach, 1990.

IIIJ - Geology Report City of Del Rio Landfill MSW No. 207C Del Rio, Val Verde County, Texas Major Permit Amendment	**Figure 2** **Balcones Fault Trend**	Drawing by: B. Barnes Checked by: D. Hartsfield File No.: 5020210002 Fig. 2 Date: February 2022



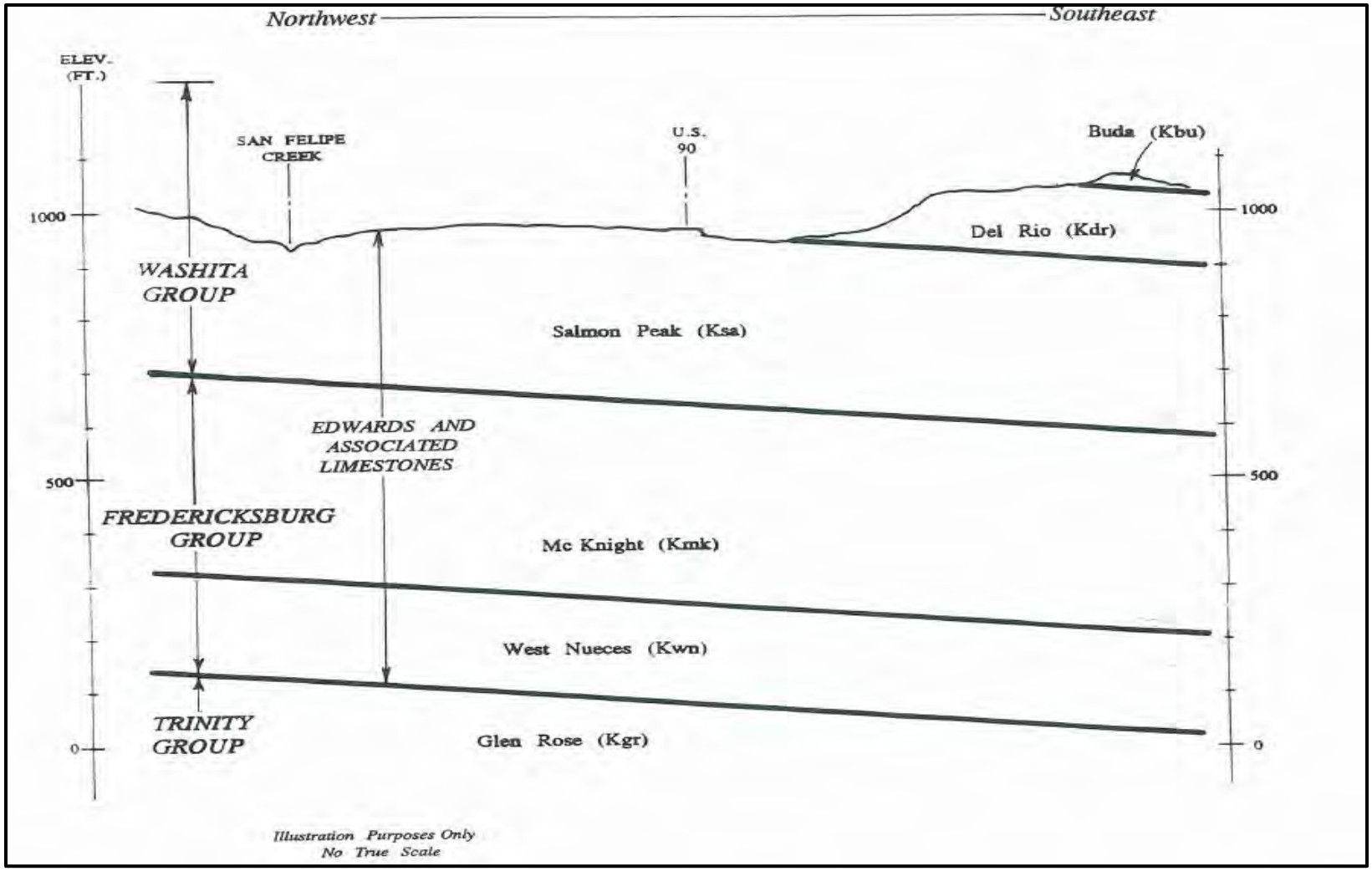
Source: Rose, 1972.

IIIJ - Geology Report City of Del Rio Landfill MSW No. 207C Del Rio, Val Verde County, Texas Major Permit Amendment	**Figure 3** **Regional Geologic Framework**	Drawing by: B. Barnes Checked by: D. Hartsfield File No.: 5020210002 Fig. 3 Date: November 2022



Source: Geologic Atlas of Texas Del Rio Sheet, Bureau of Economic Geology, University of Texas at Austin, 1977.

IIIJ - Geology Report City of Del Rio Landfill MSW No. 207C Del Rio, Val Verde County, Texas Major Permit Amendment	**Figure 4** **Geologic Map**	Drawing by: B. Barnes Checked by: D. Hartsfield File No.: 5020210002 Fig. 4 Date: November 2022

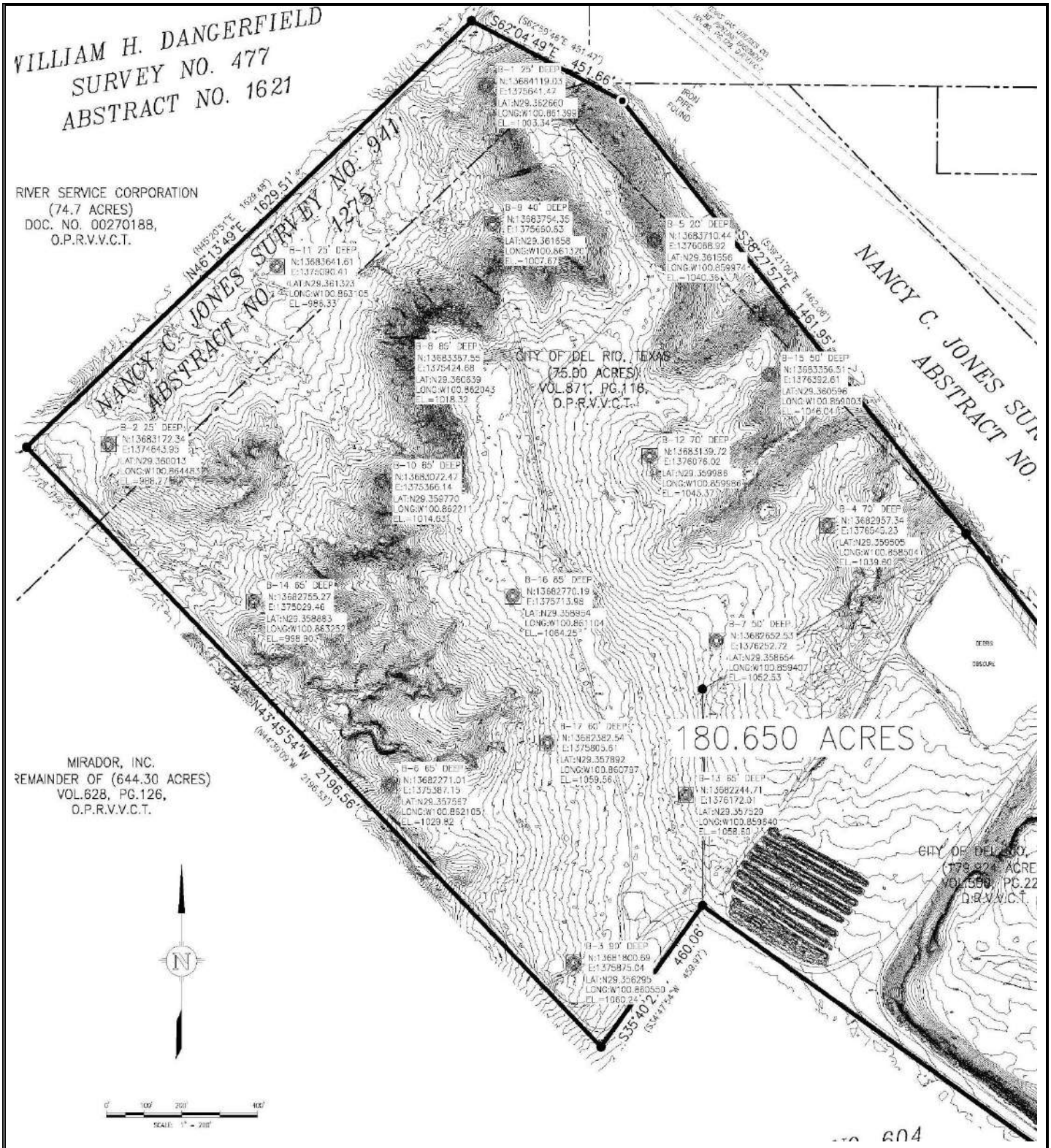


Source: TETCO, 1994

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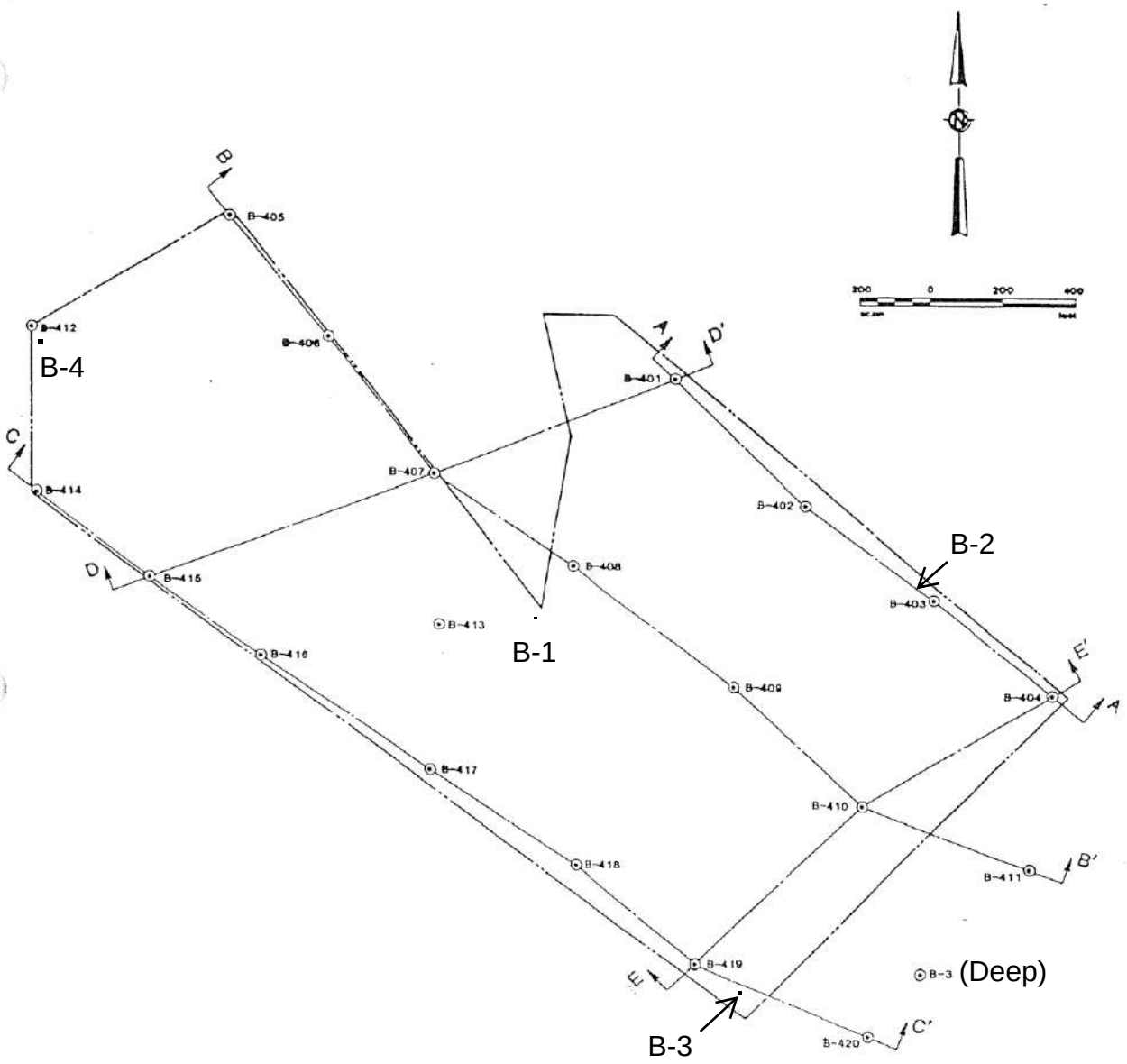
Figure 5
Regional Cross-Section

Drawing by: B. Barnes
Checked by: D. Hartsfield
File No.: 5020210002 Fig. 5
Date: November 2022



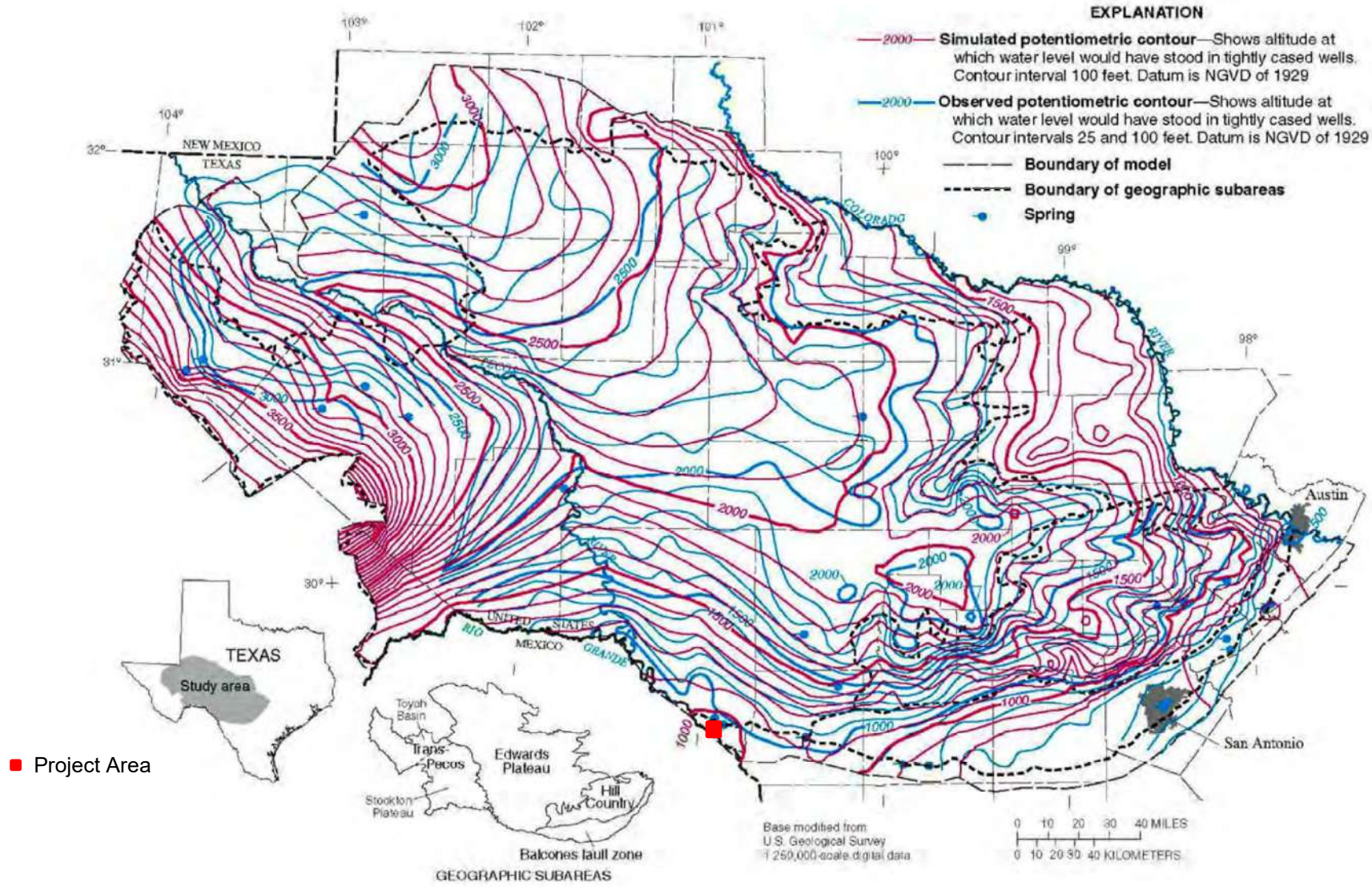
Source: Bain Medina Bain, 2020

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Source: Derived from Raba Kistner (1986 and 1987) and TETCO (1994)

IIIJ - Geology Report City of Del Rio Landfill MSW No. 207C Del Rio, Val Verde County, Texas Major Permit Amendment	**Figure 7 Boring Locations for Existing Landfill**	Drawing by: B. Barnes Checked by: D. Hartsfield File No.: 5020210002 Fig. 7 Date: November 2022

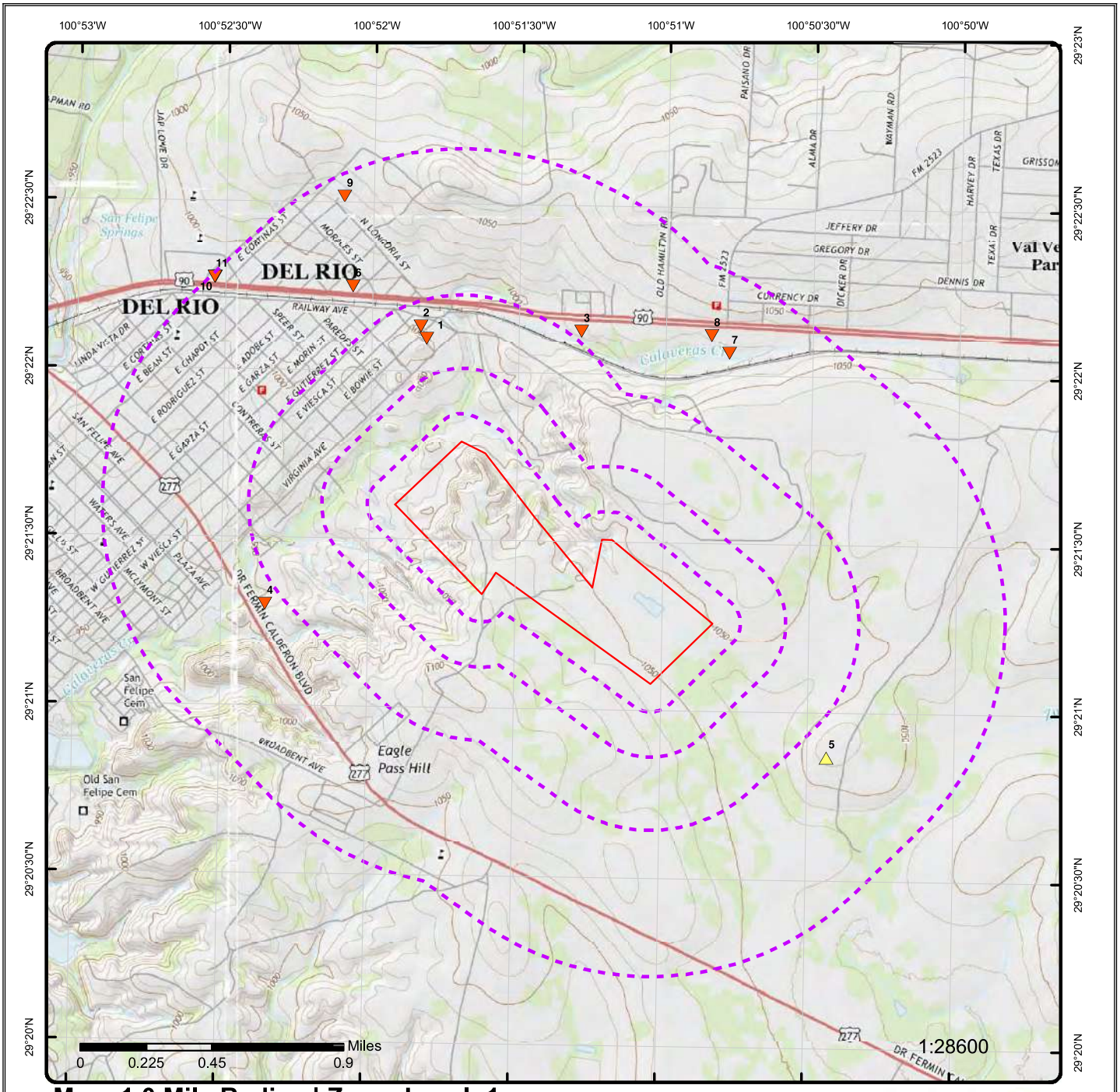


Source: Kuniansky and Ardis, 2004.

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Figure 8
Potentiometric Surface Map of the Edwards Aquifer

Drawing by: B. Barnes
Checked by: D. Hartsfield
File No.: 5020210002 Fig. 8
Date: November 2022



Map: 1.0 Mile Radius | Zoom Level: 1
Order Number: 22111500308
Address: Railway Road, Del Rio, TX

ERIS

Plotted Water Wells

- Project Property
- Buffer Outline
- Eris Sites with Higher Elevation
- Eris Sites with Same Elevation
- Eris Sites with Lower Elevation
- Eris Sites with Unknown Elevation
- Eris Areas with Higher Elevation
- Eris Areas with Same Elevation
- Eris Areas with Lower Elevation
- Eris Areas with Unknown Elevation

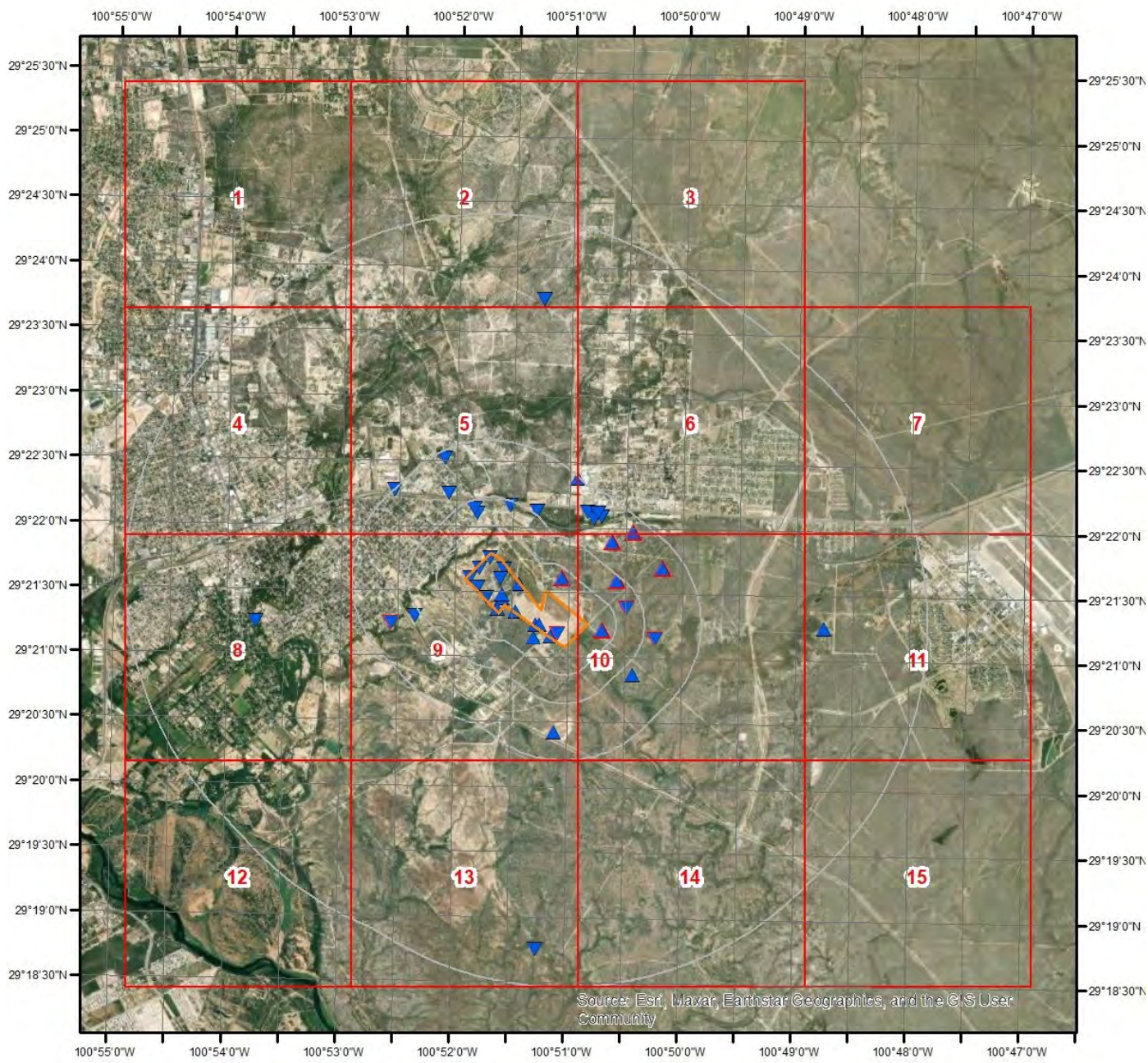
Source: Modified from ERIS, 2022.

IIIJ - Geology Report
City of Del Rio Landfill MSW No. 207C
Del Rio, Val Verde County, Texas
Major Permit Amendment

Figure 9
ERIS Water Well Map

WSP

Drawing by: B. Barnes
Checked by: D. Hartsfield
File No.: 5020210002 Fig. 9
Date: December 2022



Wells & Additional Sources

N

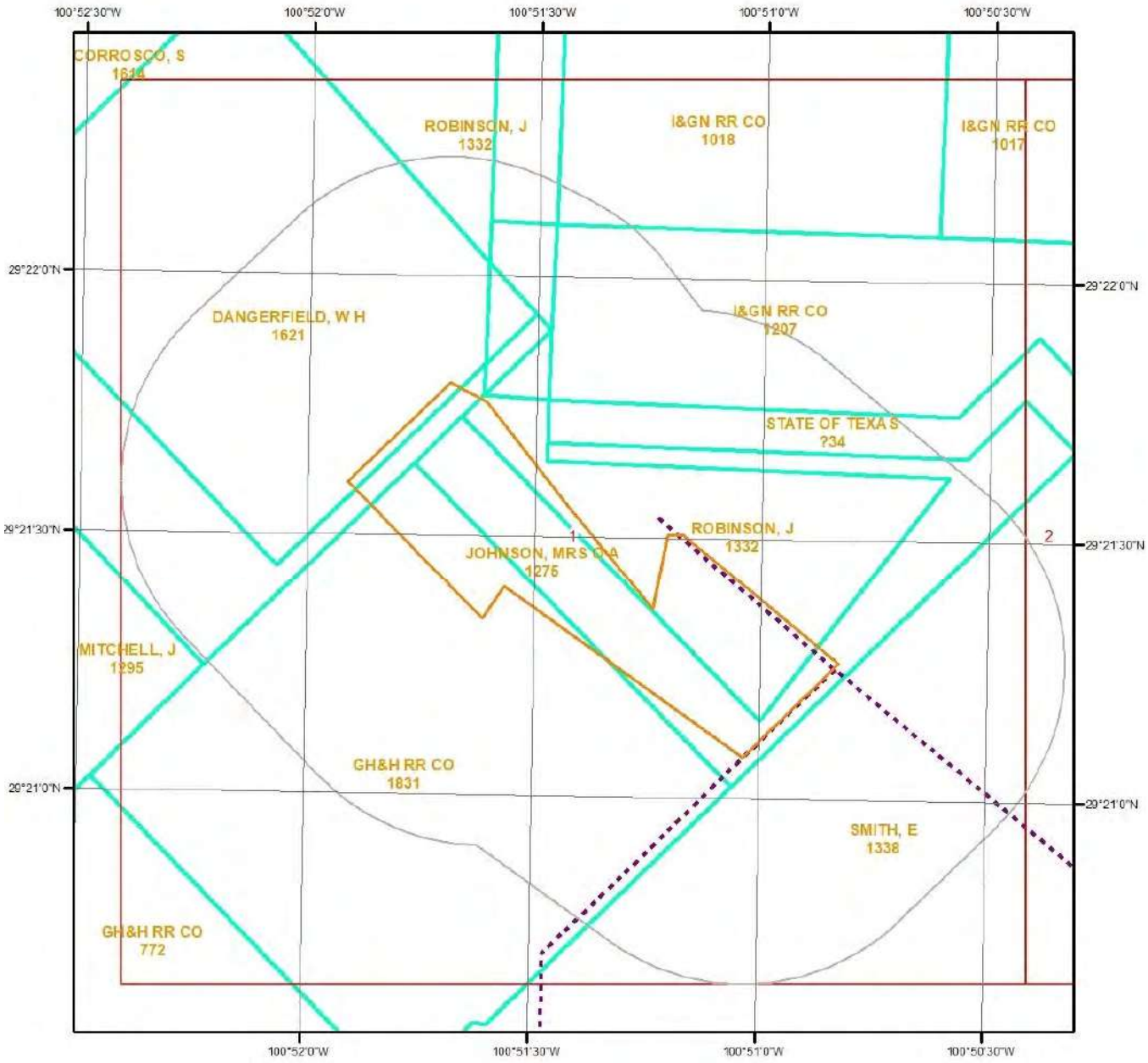
0 0.5 1 2 Miles

- Sites with Higher Elevation
- Sites with Same Elevation
- Sites with Lower Elevation
- Sites with Unknown Elevation
- OGW Sites with Higher Elevation
- OGW Sites with Same Elevation
- OGW Sites with Lower Elevation
- OGW Sites with Unknown Elevation

ERIS

Source: Modified from ERIS, 2022.

IIIJ - Geology Report City of Del Rio Landfill MSW No. 207C Del Rio, Val Verde County, Texas Major Permit Amendment	**Figure 10** **ERIS Oil & Gas Well Map**	Drawing by: B. Barnes Checked by: D. Hartsfield File No.: 5020210002 Fig. 10 Date: December 2022



Survey & Pipeline

0 0.2 0.4 0.8 Miles

N

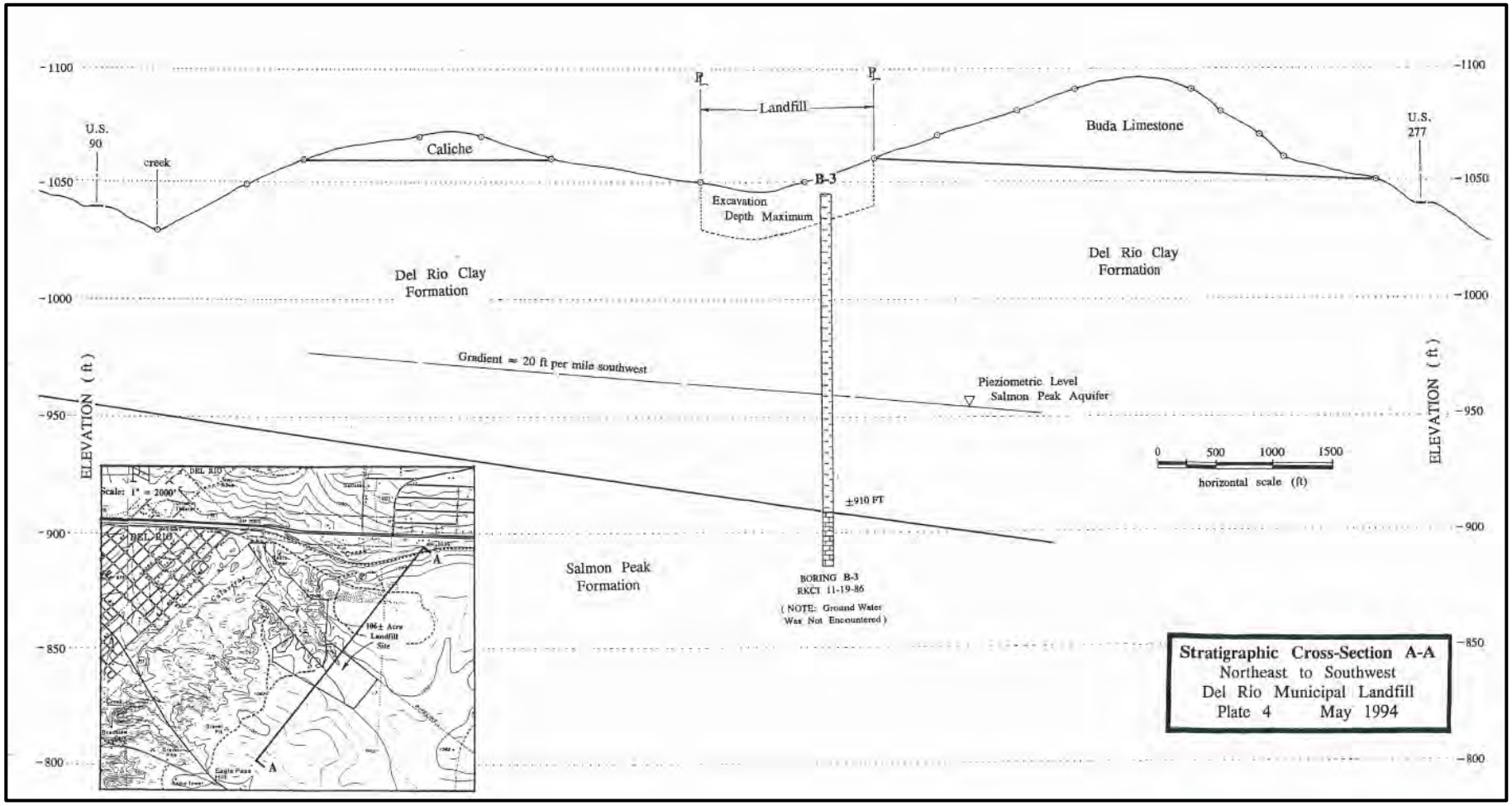
This maps shows Survey & Pipeline around the target property. Please refer to the report for detailed descriptions.

Legend

- Pipeline
- Survey
- Permit Boundary

Source: Modified from ERIS, 2022.

IIIJ - Geology Report City of Del Rio Landfill MSW No. 207C Del Rio, Val Verde County, Texas Major Permit Amendment	**Figure 11** **ERIS Oil & Gas Pipeline Map**	Drawing by: B. Barnes Checked by: D. Hartsfield File No.: 5020210002 Fig. 11 Date: December 2022



Source: Raba-Kistner Consultants, Inc., 1986

IIIJ - Geology Report
City of Del Rio Landfill MSW No. 207C
Del Rio, Val Verde County, Texas
Major Permit Amendment

Figure 12
Previous Stratigraphic Cross-Section

Drawing by: B. Barnes
Checked by: D. Hartsfield
File No.: 5020210002 Fig. 12
Date: November 2022

APPENDIX IIIJ-A

ERIS Water Well Search Report

TEXAS WATER WELL REPORT

Project Property:	*Del Rio Landfill Expansion* *Railway Road* *Del Rio TX 78840*
Project No:	*5020210002*
Order No:	*22111500308*
Requested by:	*WSP USA*
Date Completed:	*December 16, 2022*

Environmental Risk Information Services
A division of Glacier Media Inc.
1.866.517.5204 | info@erisinfo.com | erisinfo.com

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Executive Summary: Site Report Summary - Surrounding Properties.....6
Map.....7
Aerial.....10
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Definitions.....46

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Executive Summary

Property Information:

Project Property:	*Del Rio Landfill Expansion* *Railway Road Del Rio TX 78840*
Project No:	*5020210002*

Coordinates:

Latitude:	*29.35973683*
Longitude:	*-100.8611875*
UTM Northing:	*3,248,986.34*
UTM Easting:	*319,794.74*
UTM Zone:	*UTM Zone 14R*
Target Property Geometry:	*POLYGON*

County/Parish Covered:	*Val Verde (TX)*
Zipcode(s) Covered:	*Del Rio TX: 78840*
State(s) Covered:	*TX*

Executive Summary: Report Summary

Database	Searched	Project Property	Within 1.00mi	Total
Federal				
FED USGS	Y	0	0	0
State				
TCEQ WELL LOGS	Y	0	**5**	**5**
SDRW WELLS	Y	0	0	0
GWDB	Y	0	**6**	**6**
WW FORT BEND	Y	0	0	0
WW HIGH PLAINS	Y	0	0	0
WW HARRIS GAL	Y	0	0	0
WUD	Y	0	0	0
	Total:	0	**11**	**11**

**** PO – Property Only***

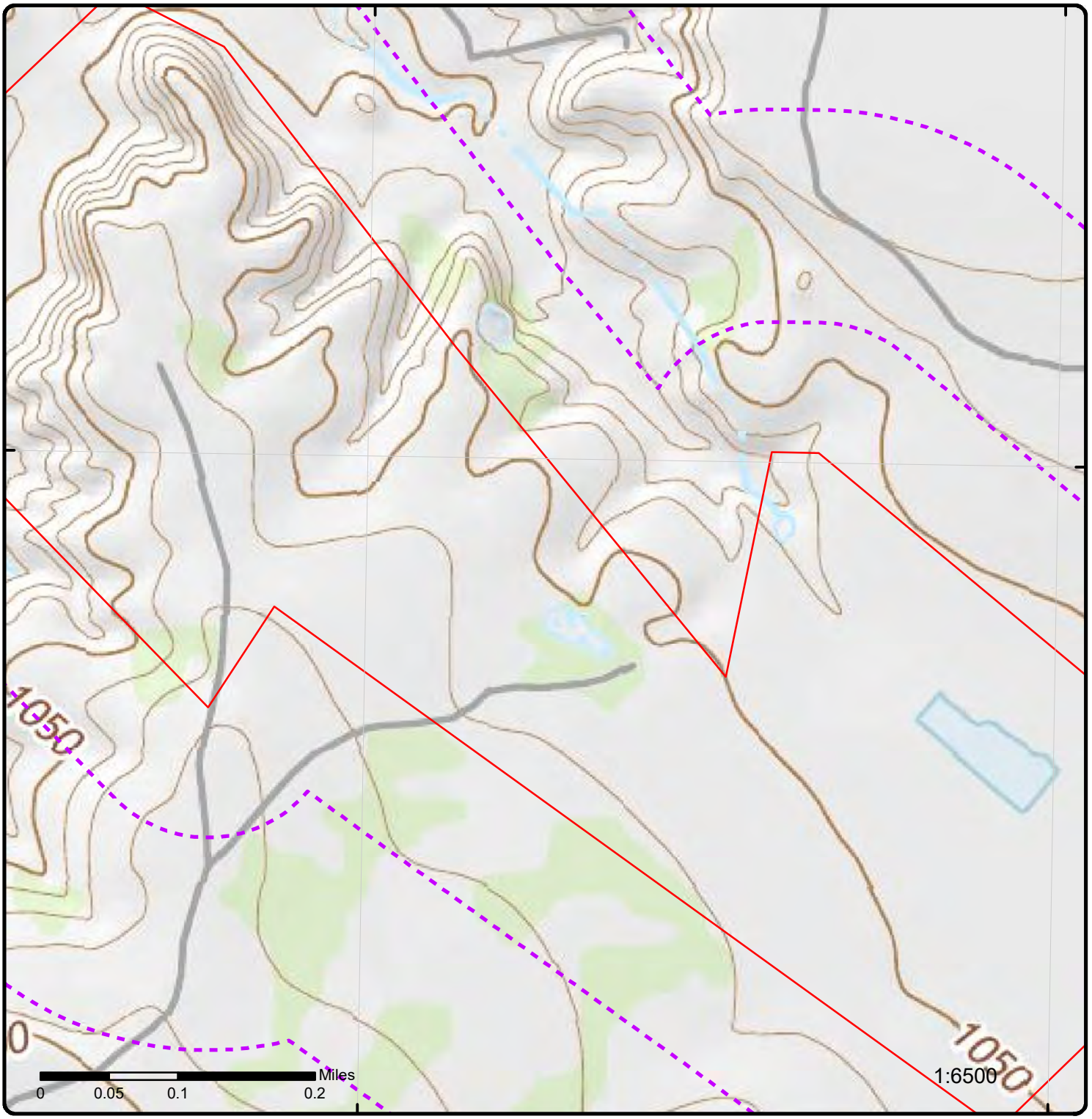
Executive Summary: Site Report Summary - Project Property

Map Key	DB	Company/Site Name	Address	Direction	Distance (mi/ft)	Page Number

No records found in the selected databases for the project property.

Executive Summary: Site Report Summary - Surrounding Properties

Map Key	DB	Company/Site Name	Address	Direction	Distance (mi/ft)	Page Number
1	TCEQ WELL LOGS	PETE TERLAJE	TX	NNW	0.37 / 1,963.88	12
			Grid No* | *Owners Name: *70-33-9 | PETE TERLAJE*			
2	GWDB	A. Y. Shely	TX	NNW	0.42 / 2,201.77	14
			State Well NO* | *Owner Name: *7042102 | A. Y. Shely*			
3	TCEQ WELL LOGS	JUAN J TORRESCONO	TX	N	0.53 / 2,801.76	17
			Grid No* | *Owners Name: *70-42-1A | JUAN J TORRESCONO*			
4	GWDB	Russell & Neatherby Well 1	TX	W	0.56 / 2,953.12	20
			State Well NO* | *Owner Name: *7042104 | Russell & Neatherby Well 1*			
5	GWDB	T. Brite Well 1	TX	ESE	0.60 / 3,169.15	22
			State Well NO* | *Owner Name: *7042105 | T. Brite Well 1*			
6	GWDB	J. Coronado	TX	NW	0.65 / 3,420.07	24
			State Well NO* | *Owner Name: *7042106 | J. Coronado*			
7	GWDB	Robert Kusenberger	TX	NE	0.75 / 3,977.27	31
			State Well NO* | *Owner Name: *7042101 | Robert Kusenberger*			
8	TCEQ WELL LOGS	JOSE MONIESANO	TX	NE	0.78 / 4,100.10	34
			Grid No* | *Owners Name: *70-72-1 | JOSE MONIESANO*			
9	GWDB	A. Green	TX	NNW	0.93 / 4,899.94	37
			State Well NO* | *Owner Name: *7034701 | A. Green*			
10	TCEQ WELL LOGS	DARRELL HARGROVE	TX	NW	0.99 / 5,215.73	40
			Grid No* | *Owners Name: *70-42-1 | DARRELL HARGROVE*			
11	TCEQ WELL LOGS	DARRELL HARGROVE	TX	NW	0.99 / 5,218.29	42
			Grid No* | *Owners Name: *70-42-1 | DARRELL HARGROVE*			



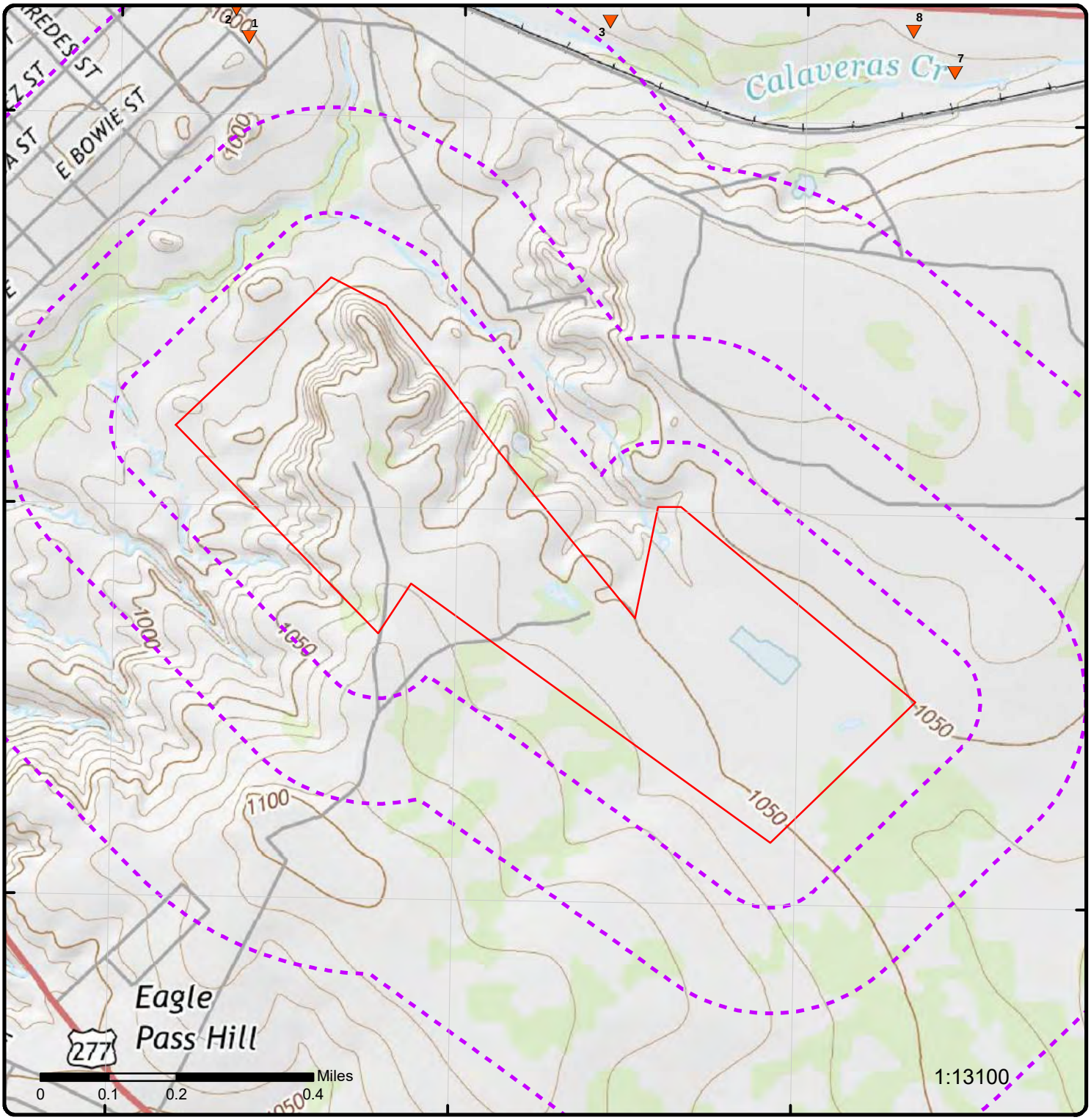
Map: 1.0 Mile Radius | Zoom Level: 3
Order Number: 22111500308
Address: Railway Road, Del Rio, TX

ERIS

Plotted Water Wells

- Project Property
- Buffer Outline
- Eris Sites with Higher Elevation
- Eris Sites with Same Elevation
- Eris Sites with Lower Elevation
- Eris Sites with Unknown Elevation
- Eris Areas with Higher Elevation
- Eris Areas with Same Elevation
- Eris Areas with Lower Elevation
- Eris Areas with Unknown Elevation

Source: © US Geological Survey
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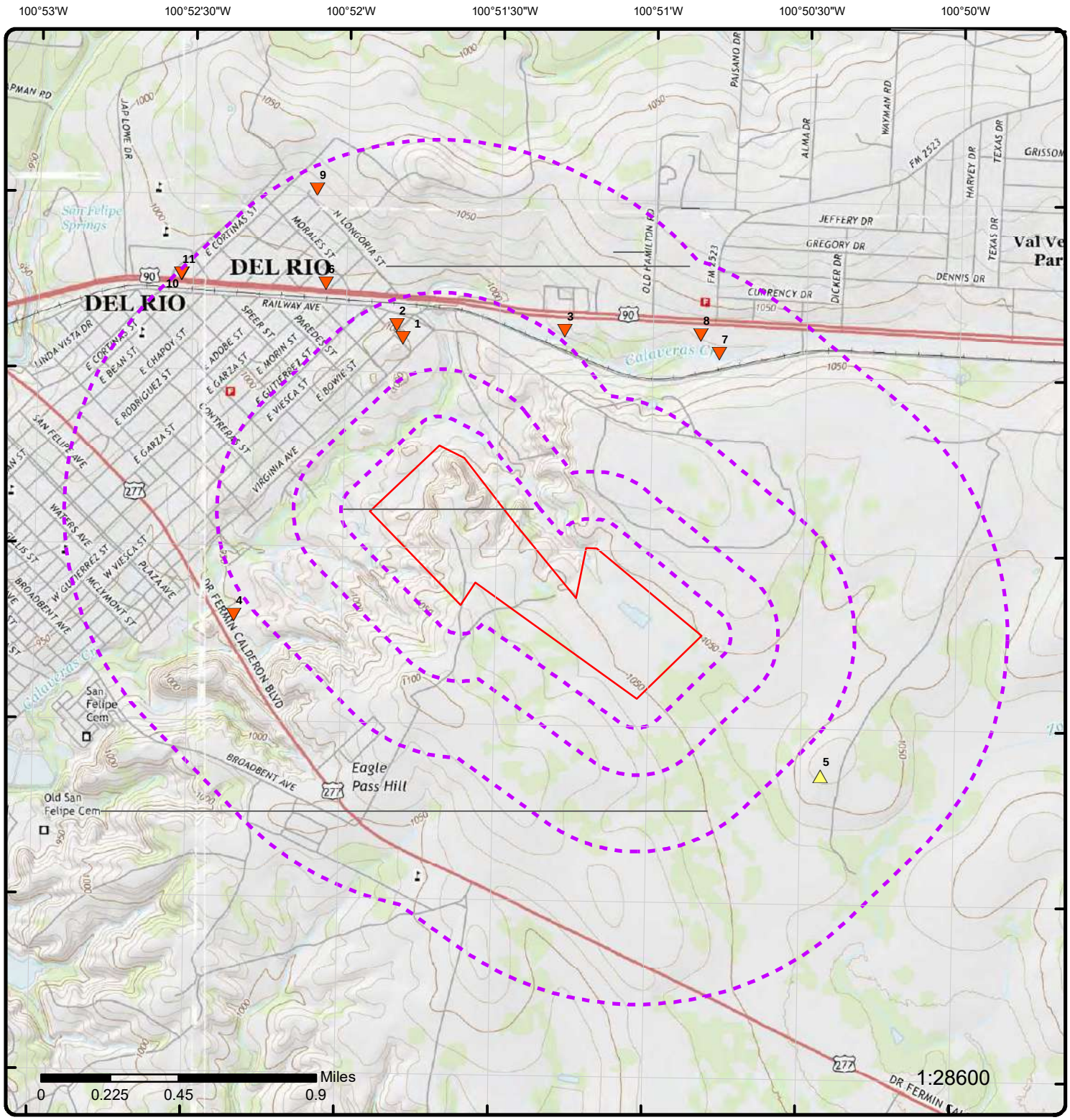
Map: 1.0 Mile Radius | Zoom Level: 2
Order Number: 22111500308
Address: Railway Road, Del Rio, TX

ERIS

Plotted Water Wells

- Project Property
- Buffer Outline
- Eris Sites with Higher Elevation
- Eris Sites with Same Elevation
- Eris Sites with Lower Elevation
- Eris Sites with Unknown Elevation
- Eris Areas with Higher Elevation
- Eris Areas with Same Elevation
- Eris Areas with Lower Elevation
- Eris Areas with Unknown Elevation

Source: © US Geological Survey
© ERIS Information Inc.



Map: 1.0 Mile Radius | Zoom Level: 1
Order Number: 22111500308
Address: Railway Road, Del Rio, TX

Plotted Water Wells

- Project Property
- Buffer Outline
- Eris Sites with Higher Elevation
- Eris Sites with Same Elevation
- Eris Sites with Lower Elevation
- Eris Sites with Unknown Elevation
- Eris Areas with Higher Elevation
- Eris Areas with Same Elevation
- Eris Areas with Lower Elevation
- Eris Areas with Unknown Elevation

Source: © US Geological Survey
© ERIS Information Inc.



Aerial **Year: 2021**

Order Number: 22111500308

Address: Railway Road, Del Rio, TX

Source: ESRI World Imagery

© ERIS Information Inc.

Detail Report

Map Key	Number of Records	Direction	Distance (mi/ft)	Site	DB
1	1 of 1	NNW	0.37 / 1,963.88	PETE TERLAJE TX	TCEQ WELL LOGS

Grid No: 70-33-9
Date Drilled: 09/03/1996
Owners Name: PETE TERLAJE
County: VAL VERDE
Water Usage: DOMESTIC
Static Level: 70
Depth Drilled: 400
Latitude: 29.368295645188514
Longitude: -100.86356666324204

Send original copy by certified return receipt requested r

TNRCC, MC 177, P.O. Box 13087, Austin, TX 78711-3

ATTENTION OWNER: *Confidentiality Privilege Notice on on reverse side of Well Owner's copy (pink)*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
MC 177
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Pete Terlaje (Name) ADDRESS 1003 E. Bowie Del Rio, TX 78840 (Street or RFD) (City) (State) (Zip)

2) ADDRESS OF WELL: County Val Verde (Street, RFD or other) (City) (State) (Zip) GRID # 7039

3) TYPE OF WORK (Check): [X] New Well [ ] Deepening [ ] Reconditioning [ ] Plugging

4) PROPOSED USE (Check): [ ] Monitor [ ] Environmental Soil Boring [X] Domestic [ ] Industrial [ ] Irrigation [ ] Injection [ ] Public Supply [ ] De-watering [ ] Testwell
If Public Supply well, were plans submitted to the TNRCC? [ ] Yes [ ] No

5)

6) WELL LOG:
Date Drilling: Started 8/29 19 96 Completed 9/3 19 96

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
7 7/8	Surface	400

7) DRILLING METHOD (Check): [ ] Driven [X] Air Rotary [ ] Mud Rotary [ ] Bored [ ] Air Hammer [ ] Cable Tool [ ] Jetted [ ] Other

From (ft.)	To (ft.)	Description and color of formation material
0	40	Caliche
40	124	Chalk
124	190	Chalk
190		Lost Circulation
350	400	
Total Depth 400		

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion (Check): [ ] Open Hole [ ] Straight Wall [ ] Underreamed [X] Gravel Packed [ ] Other
If Gravel Packed give interval ... from 20 ft. to 400 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
5	N	Plastic	0	400	

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 0 ft. to 20 ft. No. of sacks used 1 1/2
ft. to ft. No. of sacks used
Method used
Cemented by Hutto Drilling Co., INc.
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

RECEIVED

13) TYPE PUMP:
[ ] Turbine [ ] Jet [ ] Submersible [ ] Cylinder
[ ] Other
Depth to pump bowls, cylinder, jet, etc., ft.

10) SURFACE COMPLETION
[X] Specified Surface Slab Installed [Rule 338.44(2)(A)]
[ ] Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
[ ] Pitless Adapter Used [Rule 338.44(3)(b)]
[ ] Approved Alternative Procedure Used [Rule 338.71]

14) WELL TESTS:
Type test: [ ] Pump [ ] Bailer [ ] Jetted [ ] Estimated
Yield: gpm with ft. drawdown after hrs.

11) WATER LEVEL:
Static level 70 ft. below land surface Date 8/29/96
Artesian flow gpm. Date

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
[ ] Yes [X] No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? [ ] Yes [ ] No

12) PACKERS: Type Depth

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Hutto Drilling Co., INc. (Type or print) WELL DRILLER'S LICENSE NO. 2472WI

ADDRESS P.O. Box 421760 (Street or RFD) DEL RIO (City) TX (State) 78842 (Zip)

(Signed) (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 05-21-96) White - TNRCC Yellow - DRILLER Pink - WELL OWNER

Map Key	Number of Records	Direction	Distance (mi/ft)	Site	DB
2	1 of 1	NNW	0.42 / 2,201.77	A. Y. Shely TX	GWDB

Well Rep Track No:	
State Well NO:	7042102
Owner Name:	A. Y. Shely
Drilling Start Dt:	
Drilling Month:	
Drilling Day:	
Drilling Year:	1936
Well Depth:	125
Well Usage:	Domestic
Water Level Status:	
Latitude:	29.3688890
Longitude:	-100.8638890
Data Source:	Groundwater Database (GWDB) Reports; GIS shapefile of GWDB well locations
Well Info Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive//GetReports.aspx?Num=7042102&Type=GWDB
Document Link:	https://www3.twdb.texas.gov/apps/waterdatainteractive//GetScannedImage.aspx?Num=7042102&Cnty=Val Verde

WRD Exp. (
April 1966

No. YR-70-42-102

WELL SCHEDULE

U. S. DEPT. OF THE INTERIOR — GEOLOGICAL SURVEY — WATER RESOURCES DIVISION

1/62,500

MASTER CARD

Record by RDR Source of data Owner Date 8-8-68 Map Del Rio Quad

State Texas 49 County (or town) Val Verde YR

Latitude: 29 22 08 N Longitude: 100 51 50 Sequential number: .1

Lat-long accuracy: 2 T. S, R W, Sec , k, k, k B & M

Local well number: YR-70-42-102 Other number:

Local use: Owner or name: AH, Shely

Owner or name: A. H. SHELY Address:

Ownership: (C) County, (F) Fed Gov't, (M) City, (N) Corp or Co, (P) Private, (S) Grace Agency, (W) Water Dist P

Use of water: (A) Air cond, (B) Bottling, (C) Comm, (D) Dewater, (E) Power, (F) Fire, (H) Irr, (I) Irr, Med, (M) Ind, (N) P S, (P) Rec, (R) Stock, (T) Institt, (U) Unused, (V) Repressure, (W) Recharge, (X) Desal-P S, (Y) Desal-other, (S) Other H

Use of well: (A) Anode, (D) Drain, (G) Seismic, (H) Heat Exs, (O) Obs, (P) Oil-gas, (R) Recharge, (T) Test, (U) Unused, (W) Withdraw, (X) Waste, (S) Destroyed W

DATA AVAILABLE: Well data 1 Freq. W/L meas.: original C Field aquifer char.

Hyd. lab. data:

Qual. water data; type: Partial P

Freq. sampling: original C Pumpage inventory: yes no period:

Aperture cards: yes

Log data:

WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD Depth well: 125 ft 125 Meas. rept accuracy 6

Depth cased (first perf.) 80 ft 80 Casing type: Steel ; Diam. 6 in 6

Finish: (C) porous concrete, (F) gravel w. (perf.), (G) gravel w. (screen), (H) horiz. gallery, (O) open and, (P) perf., screen, (S) sd. pt., (T) shored, (W) open hole, (X) other X

Method Drilled: (A) air rot, (B) bored, (C) cable, (D) dug, (H) hyd rot., (J) jetted, (F) air percussion, (R) reverse rotary, (T) trenching, (V) driven, (W) drive wash, (S) other C

Date Drilled: 1936 9 3 6 Pump intake setting: ft

Driller: Owner (name) (address)

Lift (type): (A) air, (B) bucket, (C) cent, (J) jet, (L) multiple (cent.), (M) multiple (turb.), (N) none, (P) piston, (R) rot, submerg, (T) turb, (S) other P Deep Shallow D

Power (type): diesel, elec, gas, gasoline, hand, gas, nat, wind, LP, H.P. 6 Trans. or meter no.

Descrip. MP Top of WPC + 0.7 ft above below LSD. Alt. MP

Alt. LSD: 1000 1 0 0 0 Accuracy: (source) Contours - Topo 5

Water Level 33.00 ft above below MP; Ft above below LSD 3 2 Accuracy: Tape A

Date meas: 8-8-68 8 6 8 Yield: 5 gpm 5 Method determined 1

Drawdown: 0.15 ft 0 Accuracy: Tape 0 Pumping period 24 hrs 2 4

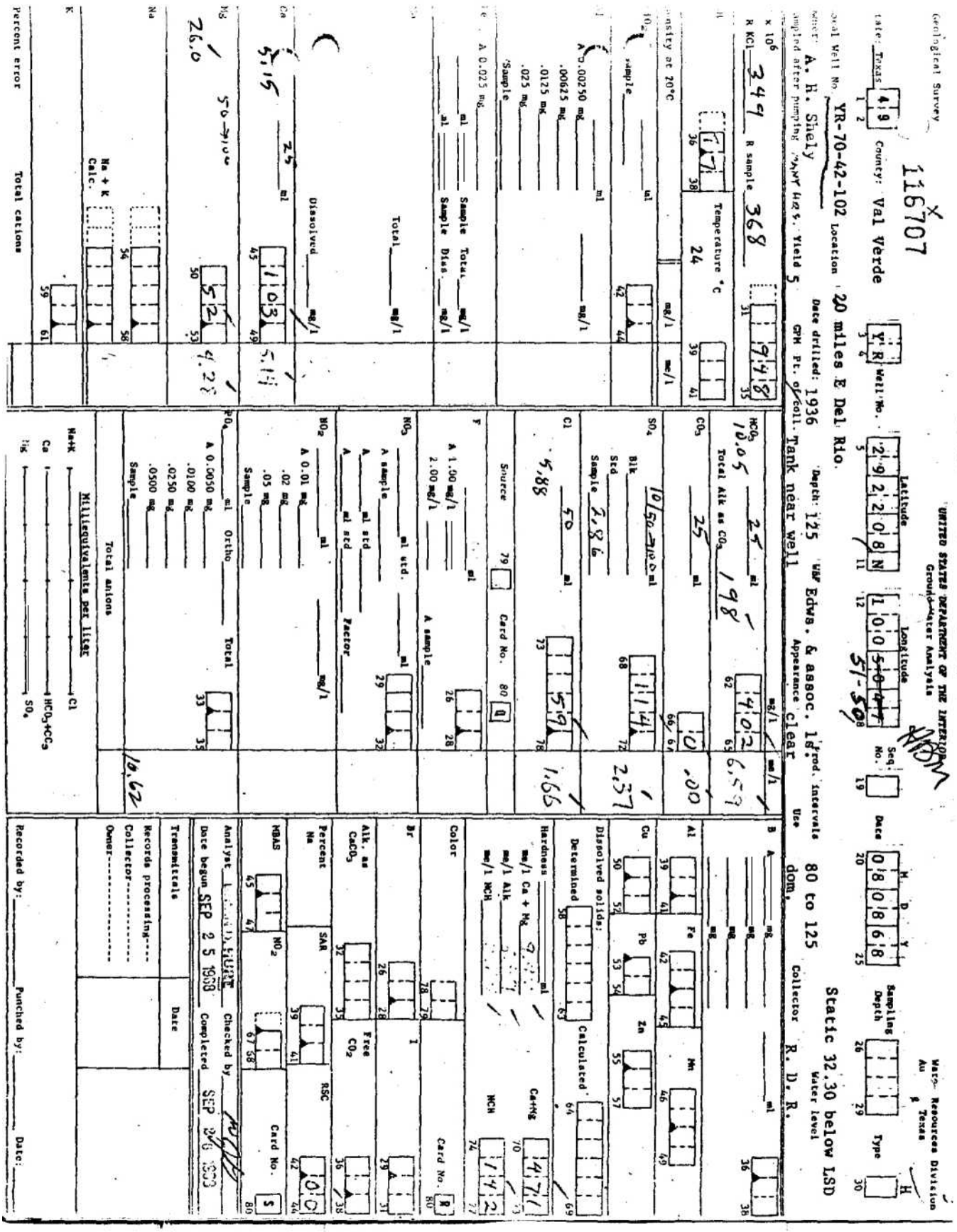
QUALITY OF WATER DATA: Iron ppm Sulfate ppm Chloride ppm Hard ppm

Sp. Conduct K x 10^6 Temp. °F K 4 Date sampled 8-8-68 8 6 8

Taste, color, etc. Rept. good H

Well No.

(over) *


Geological Survey
UNITED STATES DEPARTMENT OF THE INTERIOR
Ground-Water Analysis
Water Resources Division
Texas
X 11607
State: Texas
County: Val Verde
Latitude
Longitude
Seq. No.
Date
Sampling Depth
Type
Local Well No. YR-70-42-102 Location 20 miles E Del Rio.
Owner: A. H. Shely
Date drilled: 1936 Depth: 125 USF Edws. & assoc. lg. prod. interval 80 to 125
Sampled after pumping ANY HRS. Yield 5 GPM Pt. of Coll. Tank near well
Appearance clear Use dom. Collector R. D. R.
Static 32.30 below LSD
Water level
Temperature °C
Total
Dissolved
Sample
Source
Card No.
Total cations
Total anions
Milliequivalents per liter
Percent error
Analyst
Checked by
Date began SEP 2 5 1959
Completed SEP 2 6 1959
Transmittals
Records processing----
Collector----------
Owner----------
Recorded by:
Punched by:
Date:

Map Key	Number of Records	Direction	Distance (mi/ft)	Site	DB
3	1 of 1	N	0.53 / 2,801.76	JUAN J TORRESCONO TX	TCEQ WELL LOGS

Grid No: 70-42-1A
Date Drilled: 04/04/1984
Owners Name: JUAN J TORRESCONO
County: VAL VERDE
Water Usage: DOMESTIC
Static Level: NOT REPORTED
Depth Drilled: 120
Latitude: 29.36875
Longitude: -100.854792

#5

Send original copy by certified mail to the Texas Department of Water Resources P. O. Box 13087 Austin, Texas 78711

State of Texas
WATER WELL REPORT
ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

Texas Water Well Drillers Board P. O. Box 13087 Austin, Texas 78711

1) OWNER Juan J Torres Cond (Name) Address RT-2 Box 4K Hwy90E Del Rio Tex 78840 (Street or RFD) (City) (State) (Zip)

2) LOCATION OF WELL: County VAL VERDE 4 miles in E (N.E., S.W., etc.) direction from Del Rio Tex. 78840 (Town)

Driller must complete the legal description to the right with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ Legal description:
Section No. _____ Block No. _____ Township _____
Abstract No. _____ Survey Name _____
Distance and direction from two intersecting section or survey lines _____
☐ See attached map. mapon Dwg 70-33-4F

3) TYPE OF WORK (Check): ☐ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Domestic ☐ Industrial ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Other _____

5) DRILLING METHOD (Check): ☐ Mud Rotary ☐ Air Hammer ☐ Driven ☐ Bored ☐ Air Rotary ☒ Cable Tool ☐ Jetted ☐ Other _____

6) WELL LOG:

Date drilled 4-4-84

Dia. (in.)	From (ft.)	To (ft.)
6½	Surface 0	120

From (ft.)	To (ft.)	Description and color of formation material
0	4	Top Soil
4	65	Yellow clay
65	84	blue Shale
84	94	gray lime
94	97	water formation
97	101	gray lime
101	105	water formation
105	120	gray lime

7) BOREHOLE COMPLETION: ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other _____
If Gravel Packed give interval . . . from 84 ft. to 120 ft.

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mgf., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casing Screen
5"			0	120	Sch 40

CEMENTING DATA
Cemented from 0 ft. to 84 ft.
Method used Mixer
Cemented by Floyd Hanusch (Company or Individual)

9) WATER LEVEL:
Static level _____ ft. below land surface Date _____
Artesian flow _____ gpm. Date _____

10) PACKERS: Type Depth

RECEIVED
APR 23 1984
DEPT. OF WATER RESOURCES

11) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other _____
Depth to pump bowls, cylinder, jet, etc., _____ ft.

(Use reverse side if necessary)

13) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable water? ☐ Yes ☒ No
If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Fresh Depth of strata 7 Ft
Was a chemical analysis made? ☐ Yes ☒ No

12) WELL TESTS:
☐ Type Test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: 20 gpm with ho ft. drawdown after 3 hrs.

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief.

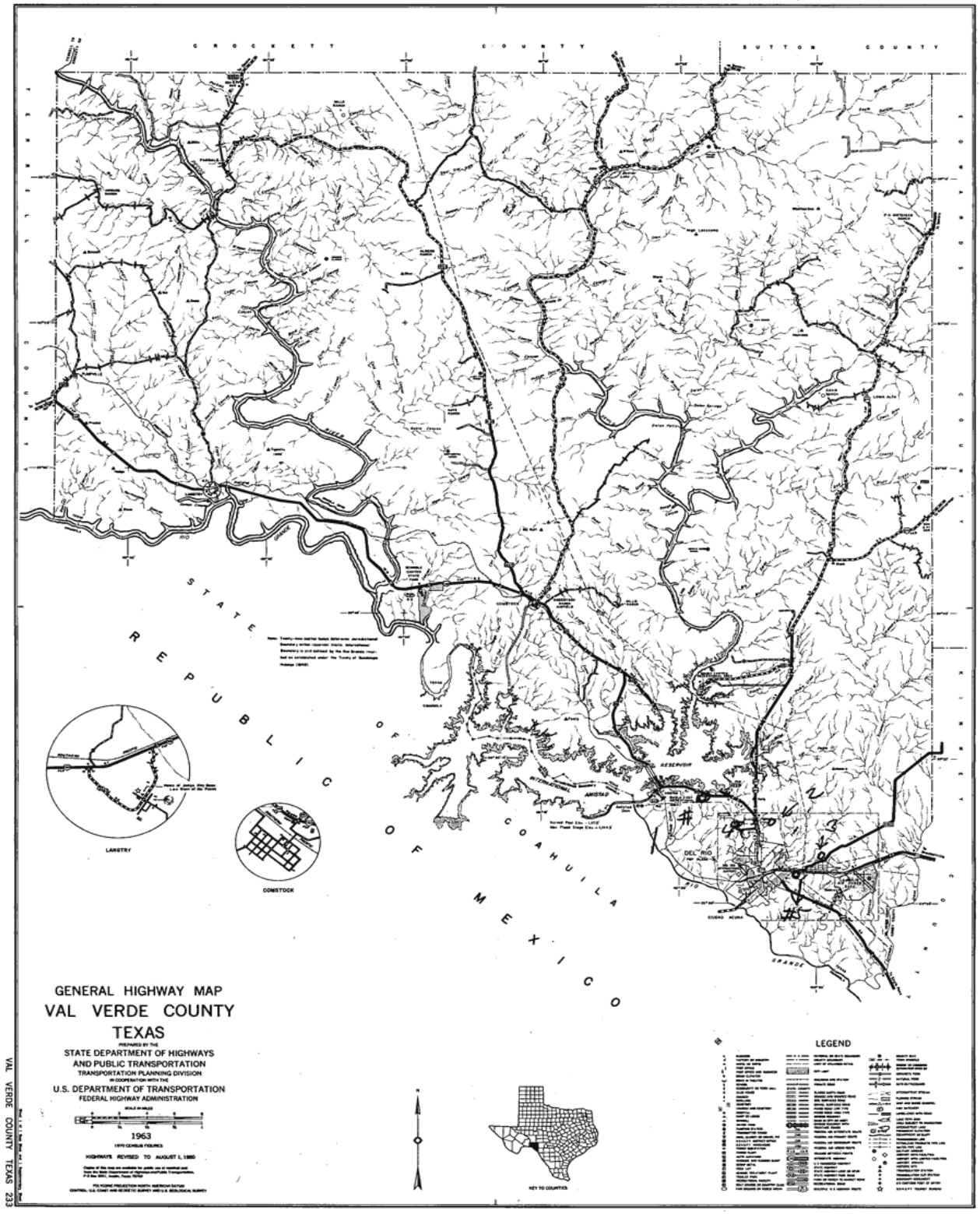
COMPANY NAME Hanusch Drilling Co (Type or Print) Water Well Driller's License No. 665
ADDRESS Star Rt 2 Box 10M (Street or RFD) Del Rio (City) Tex 25 (State) 78840 (Zip)
(Signed) Floyd Hanusch (Licensed Water Well Driller) (Signed) Floyd Hanusch DUP (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TDWR use only
Well No. 70-42-1A
Located on map yes C.F.S.

TDWR-0392 (Rev. 5-27-82)

DEPARTMENT OF WATER RESOURCES COPY


CROCKETT COUNTY
SUTTON COUNTY
REPUBLIC OF MEXICO
COAHUILA
LANGTRY
COMSTOCK
DEL RIO
AMISTAD RESERVOIR
GENERAL HIGHWAY MAP
VAL VERDE COUNTY
TEXAS
PREPARED BY THE
STATE DEPARTMENT OF HIGHWAYS
AND PUBLIC TRANSPORTATION
TRANSPORTATION PLANNING DIVISION
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
1963
1970 CENSUS FIGURES
HIGHWAYS REVISED TO AUGUST 1, 1980
LEGEND
VAL VERDE COUNTY TEXAS 233

Map Key	Number of Records	Direction	Distance (mi/ft)	Site	DB
4	1 of 1	W	0.56 / 2,953.12	Russell & Neatherby Well 1 TX	GWDB

Well Rep Track No:	
State Well NO:	7042104
Owner Name:	Russell & Neatherby Well 1
Drilling Start Dt:	
Drilling Month:	
Drilling Day:	
Drilling Year:	1928
Well Depth:	3332
Well Usage:	
Water Level Status:	
Latitude:	29.3550010
Longitude:	-100.8725000
Data Source:	Groundwater Database (GWDB) Reports; GIS shapefile of GWDB well locations
Well Info Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive//GetReports.aspx?Num=7042104&Type=GWDB
Document Link:	https://www3.twdb.texas.gov/apps/waterdatainteractive//GetScannedImage.aspx?Num=7042104&Cnty=Val Verde

Texas Water Development Board
Well Schedule

State Well Number: **70-42-104** Previous Well Number: County: **Val Verde** **465**

Latitude (dms): **292118** Longitude (dms): **1005221** Coordinate Accuracy: **+/- 10 Seconds**

River Basin: **Rio Grande** GMA: **7** RWPA: **J** GCD:

Owner: **Russell & Neatherby Well 1** Driller: **East Del Rio Oil Co.** Aquifer ID:

Aquifer Code: **NOT-APPL**

AQUIFER CODE IS NOT APPLICABLE TO THIS WELL

Depth (ft): **3332** Elevation (ft): **958**

Source of Depth: **Geophysical Log** Source of Elevation: **Digital Elevation Model -DEM**

Date Drilled: **00/00/1928** Well Type: **Oil or Gas**

Type of Lift: Power: Horsepower:

Construction: Completion:

Casing Material: Screen Material:

WATER USE

Primary: Secondary: Tertiary:

Water Levels: Water Quality: **N**

Other Data: Logs: **E**

REMARKS:
Oil test listed in TWDB R-172.

Reporting Agency: **TWDB or Predecessor Agency**

Date Collected or Reported: **06/00/1973**

Recorded by:

CASING INTERVALS:
Casing/Blank Pipe (C)
Well Screen/Slotted Zone (S)
Open Hole (O)

Dia. (in.)	Top (ft.)	Bottom (ft.)

Tuesday, February 02, 2010 State Well Number: **70-42-104**

Map Key	Number of Records	Direction	Distance (mi/ft)	Site	DB
5	1 of 1	ESE	0.60 / 3,169.15	T. Brite Well 1 TX	GWDB

Well Rep Track No:	
State Well NO:	7042105
Owner Name:	T. Brite Well 1
Drilling Start Dt:	
Drilling Month:	
Drilling Day:	
Drilling Year:	1955
Well Depth:	1001
Well Usage:	
Water Level Status:	
Latitude:	29.3477780
Longitude:	-100.8405560
Data Source:	Groundwater Database (GWDB) Reports; GIS shapefile of GWDB well locations
Well Info Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive//GetReports.aspx?Num=7042105&Type=GWDB
Document Link:	https://www3.twdb.texas.gov/apps/waterdatainteractive//GetScannedImage.aspx?Num=7042105&Cnty=Val Verde

Texas Water Development Board
Well Schedule

groundwater resources

State Well Number: **70-42-105** Previous Well Number: County: **Val Verde** 465

Latitude (dms): **292052** Longitude (dms): **1005026** Coordinate Accuracy: **+/- 10 Seconds**

River Basin: **Rio Grande** GMA: **7** RWPA: **J** GCD:

Owner: **T. Brite**
Well 1

Driller: **K. Hobiltzelle**

Aquifer ID:

Aquifer Code: **NOT-APPL**

AQUIFER CODE IS NOT APPLICABLE TO THIS WELL

Depth (ft): **1001**

Elevation (ft): **1061**

Source of Depth: **Geophysical Log**

Source of Elevation: **Digital Elevation Model -DEM**

Date Drilled: **00/00/1955** Well Type: **Oil or Gas**

Type of Lift: Power: Horsepower:

Construction: Completion:

Casing Material: Screen Material:

WATER USE

Primary: Secondary: Tertiary:

CASING INTERVALS:
Casing/Blank Pipe (C)
Well Screen/Slotted Zone (S)
Open Hole (O)

Dia. (in.)	Top (ft.)	Bottom (ft.)

Water Levels: Water Quality: **N**

Other Data: Logs: **E**

REMARKS:
Oil test listed in TWDB R-172.

Reporting Agency: **TWDB or Predecessor Agency**

Date Collected or Reported: **06/00/1973**

Recorded by: _____

Tuesday, February 02, 2010 State Well Number: **70-42-105**

Map Key	Number of Records	Direction	Distance (mi/ft)	Site	DB
6	1 of 1	NW	0.65 / 3,420.07	J. Coronado TX	GWDB

Well Rep Track No:	
State Well NO:	7042106
Owner Name:	J. Coronado
Drilling Start Dt:	
Drilling Month:	9
Drilling Day:	
Drilling Year:	1935
Well Depth:	145
Well Usage:	Unused
Water Level Status:	
Latitude:	29.3708330
Longitude:	-100.8677780
Data Source:	Groundwater Database (GWDB) Reports; GIS shapefile of GWDB well locations
Well Info Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive//GetReports.aspx?Num=7042106&Type=GWDB
Document Link:	https://www3.twdb.texas.gov/apps/waterdatainteractive//GetScannedImage.aspx?Num=7042106&Cnty=Val Verde

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer Edwards & Assoc. Field No. _____ State Well No. 70-42-106

Owner's Well No. _____ County Val Verde

Joslui's Coronado

1. Location: _____ l/h, _____ l/4 Sec. _____, Block _____ Survey _____ 3½ Miles East of Del Rio Hwy 90 E Box 12F

2. Owner: ~~J.C. McReynolds~~ Address: ~~Rt 2, Box 6, Del Rio Tx~~ 78840

Tenant: _____ Address: _____

Driller: J.T. Crawford Address: _____

3. Elevation of _____ LSD is 1047 ft. above msl, determined by Topo

4. Drilled: _____ 1935; Dug, Cable Tool, Rotary, _____

5. Depth: Rept. 145 ft. Meas. _____ ft.

6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed _____

7. Pump: Mfgr. _____ Type S.N.B.M.

No. Stages _____, Bowls Diam. _____ in., Setting _____ ft.

Column Diam. _____ in., Length Tailpipe _____ ft.

8. Motor: Fuel Elec Make & Model _____ HP. _____

9. Yield: Flow _____ gpm, Pump _____ gpm, Meas., Rept., Est. _____

10. Performance Test: Date _____ Length of Test _____ Made by _____

Static Level _____ ft. Pumping Level _____ ft. Drawdown _____ ft.

Production _____ gpm Specific Capacity _____ gpm/ft.

CASING & BLANK PIPE

Cemented From _____ ft. to _____ ft.

Diam. (in.)	Type	Setting, ft. from	to
8"			

11. Water Level: 65.46 ft. rept. meas. 5-25 1976 above below M.P. - Breather Cap Access Plug which is 1.80 ft. above below surface.

_____ ft. rept. meas. _____ 19__ above below which is _____ ft. above below surface.

_____ ft. rept. meas. _____ 19__ above below which is _____ ft. above below surface.

_____ ft. rept. meas. _____ 19__ above below which is _____ ft. above below surface.

12. Use: Dom. Stock Public Supply, Ind., Irr., Waterflooding, Observation, Not Used, _____

13. Quality: (Remarks on taste, odor, color, etc.) _____

Temp. 76 °F, Date sampled for analysis 10/17/84 Laboratory TSDH

Temp. ___ °F, Date sampled for analysis _____ Laboratory _____

Temp. ___ °F, Date sampled for analysis _____ Laboratory _____

WELL SCREEN

Screen Openings _____

Diam. (in.)	Type	Setting, ft. from	to

14. Other data available as circled: Driller's Log, Radioactivity Log, Electric Log, Formation Samples, Pumping Test, _____

15. Record by: Crim Date 5-25 1976

Source of Date Owner Rept 172

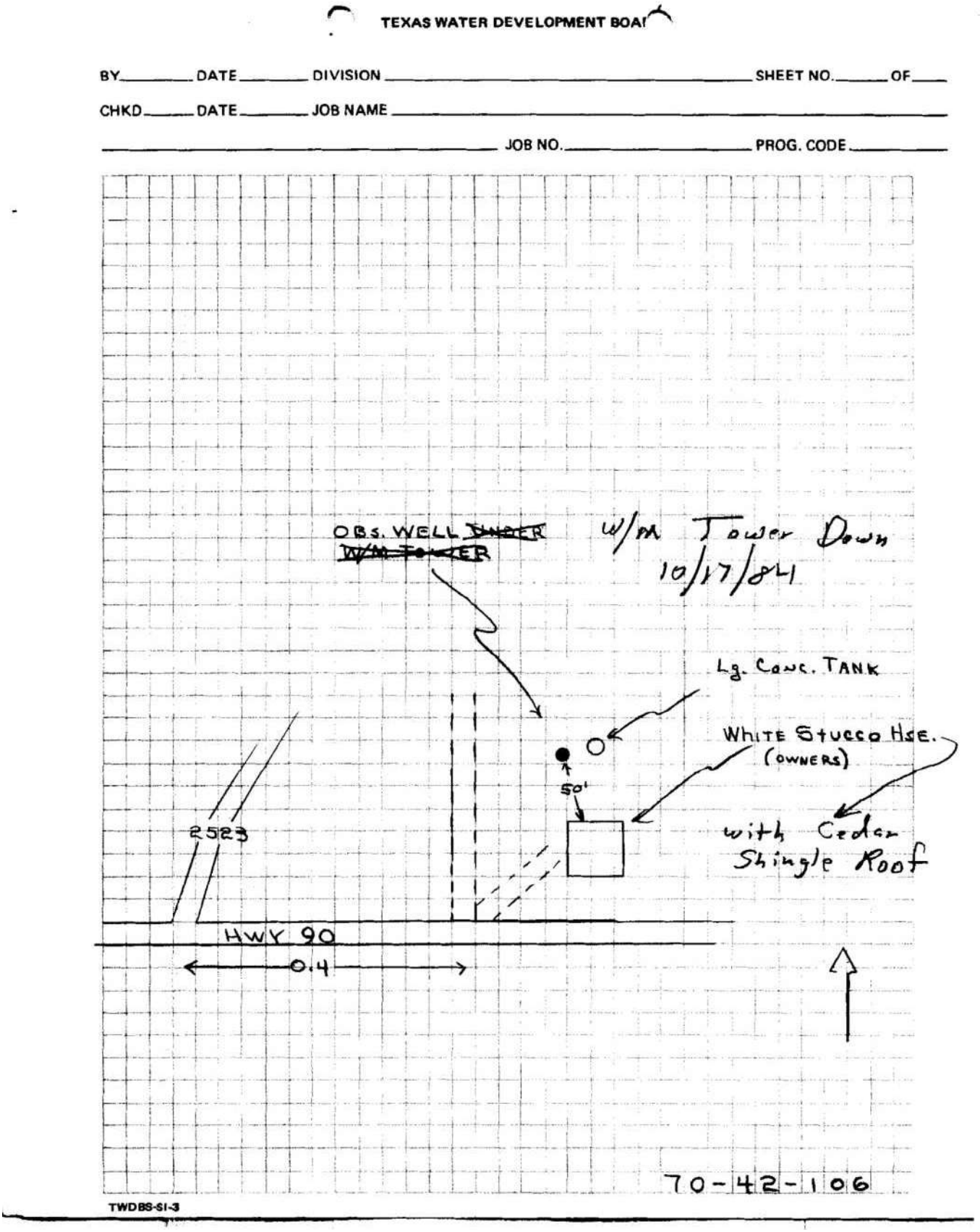
16. Remarks: _____

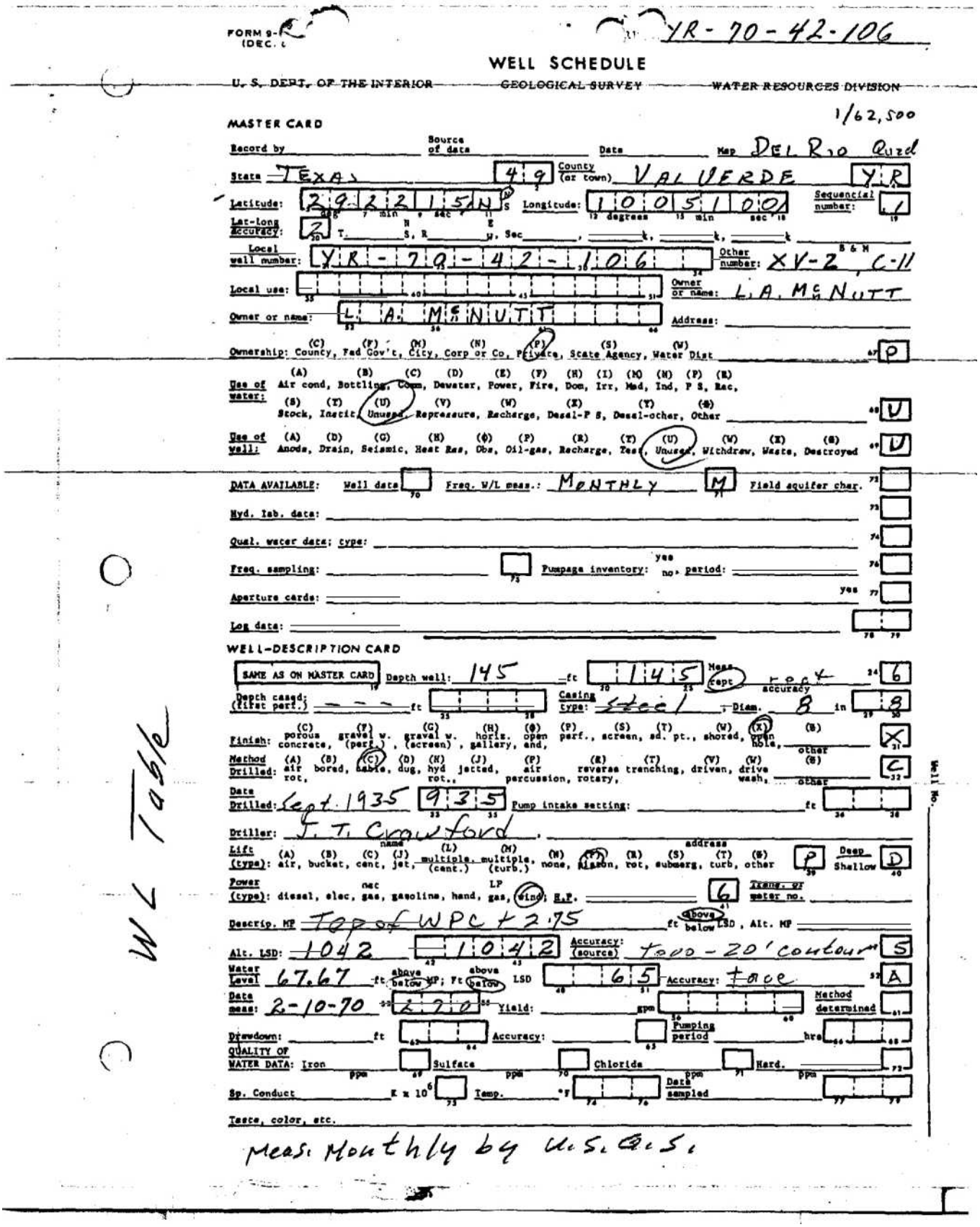
Hole

M.P. + 1.80 Breather Cap

Rectangle Access Plug

TWDBE-WD-2 (Sketch) 70-42-106


TEXAS WATER DEVELOPMENT BOAI
BY_____ DATE_____ DIVISION _____ SHEET NO._____ OF____
CHKD_____ DATE_____ JOB NAME _____
_____ JOB NO._____ PROG. CODE_____
OBS. WELL ~~UNDER W/M TOWER~~
W/M Tower Down 10/17/84
Lg. Conc. TANK
WHITE Stucco Hse. (OWNERS)
with Cedar Shingle Roof
50'
2523
HWY 90
0.4
70-42-106
TWDBS-SI-3



FORM 9-[illegible]
(DEC. [illegible])

YR-70-42-106

WELL SCHEDULE

U. S. DEPT. OF THE INTERIOR — GEOLOGICAL SURVEY — WATER RESOURCES DIVISION

1/62,500

MASTER CARD

Record by _____ Source of data _____ Date _____ Map DEL RIO Quad

State TEXAS 49 County (or town) VAL VERDE YR

Latitude: 29 22 15 N Longitude: 100 51 00 Sequencial number: 1

Lat-Long accuracy: 2 T. _____ S, R _____ W, Sec _____, _____ k, _____ k, _____ k _____

Local well number: YR-70-42-106 Other number: XV-2, C-11 B & M

Local use: _____ Owner or name: L. A. McNUTT

Owner or name: L. A. McNUTT Address: _____

Ownership: (C) County, (F) Fed Gov't, (M) City, (N) Corp or Co, (P) Private, (S) State Agency, (W) Water Dist P

Use of water: (A) Air cond, (B) Bottling, Comm, (D) Dewater, (E) Power, (F) Fire, Dom, (I) Irr, (M) Mad, Ind, (P) P S, (R) Rec, (S) Stock, (T) Insecticide, (U) Unused, (V) Repressure, Recharge, (W) Desal-P S, (X) Desal-other, (Z) Other U

Use of well: (A) Anode, (D) Drain, (G) Seismic, (H) Heat Exs, (O) Obs, (O) Oil-gas, (R) Recharge, (T) Test, (U) Unused, (W) Withdraw, (X) Waste, (Z) Destroyed U

DATA AVAILABLE: Well data _____ Freq. W/L meas.: MONTHLY M Field aquifer char. _____

Hyd. lab. data: _____

Qual. water data; type: _____

Freq. sampling: _____ Pumpage inventory: yes / no period: _____

Aperture cards: _____ yes

Log data: _____

WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD Depth well: 145 ft 145 Meas. (rept) rept accuracy 6

Depth casgd (first perf.): _____ ft Casing type: Steel ; Diam. 8 in 8

Finish: (C) porous concrete, (F) gravel w. (perf.), (G) gravel w. (screen), (H) horiz. gallery, (O) open and, (P) perf., screen, (S) sd. pt., (T) shored, (X) open hole, (Z) other X

Method Drilled: (A) air rot, (B) bored, cable, (C) dug, (D) hyd rot., (H) jetted, (J) air percussion, (R) reverse rotary, (T) trenching, (V) driven, (W) drive wash, (Z) other C

Date Drilled: Sept. 1935 9 3 5 Pump intake setting: _____ ft

Driller: name F. T. Crawford address _____

Lift (type): (A) air, (B) bucket, cent, (C) jet, (J) multiple, (cent.) multiple, (turb.) (N) none, (P) Pison, (R) rot, submerg, (S) turb, (T) other P Deep / Shallow D

Power (type): diesel, elec, gas, gasoline, hand, gas, LP, wind; H.P. _____ 6 Trans. or meter no. _____

Descrip. MP Top of WPC + 2.75 ft above / below LSD, Alt. MP _____

Alt. LSD: 1042 1042 Accuracy: (source) Topo - 20' contour S

Water Level 67.67 ft above / below MP; Ft above / below LSD 65 Accuracy: Face A

Date meas: 2-10-70 2 7 0 Yield: _____ gpm Method determined _____

Drawdown: _____ ft Accuracy: _____ Pumping period _____ hrs

QUALITY OF WATER DATA: Iron _____ ppm Sulfate _____ ppm Chloride _____ ppm Hard. _____ ppm

Sp. Conduct _____ K x 10^6 Temp. _____ °F Date sampled _____

Taste, color, etc.

Meas. Monthly by U.S.G.S.

WL Table

Well No.

Typewrite (Black ribbon) or Print Plainly
(soft pencil or black ink)
Do not use ball point pen

Texas Department of Health Laboratories
1100 West 49th Street
Austin, Texas 78756

TDWR ONLY
Organization No. 410 Lab No. 01
Work No. 6040

CHEMICAL WATER ANALYSIS REPORT

Send report to:

Data Collection and Evaluation Section
Texas Department of Water Resources
P.O. Box 13087
Austin, Texas 78711

County 233 Val Verde
State Well No. 70-42-106
Well No.
Date Collected 10-17-84

Owner Jos luis Coronado ✓ Send copy to owner Sample No. 1 By D.R. Jones
Address Hwy. 90 East Box 12 E Del Rio Tex. 78840 Well Location
Date Drilled 1935 Depth 145 ft. WBF Edwards (066) Source (type of well) Suban
Producing intervals Water level 69.74 ft. Sample depth ft.
Sampled after pumping 10 min. hrs. Yield GPM meas. est. Temperature 076 °F °C
Point of collection Faucet after pressure tank Appearance ☒ clear ☐ turbid ☐ colored ☐ other
Use Dom. Stock Remarks

(FOR LABORATORY USE ONLY)

Laboratory [redacted]

CHEMICAL ANALYSIS
Date Received OCT. 22. 1984
Date Reported NOV. 07. 1984

WATER ANALYSIS
State Well No: 70-42-106 Date: 102584 Sample No: EW5-415

	MG/L	ME/L		MG/L	ME/L
Silica: 00955:	20		Carbonate: 00445:	0	0
Calcium: 00910:	103	5.18	Bicarbonate: 00440:	334	5.48
Magnesium: 00920:	20	1.64	Sulfate: 00945:	24	.5
Sodium: 00929:	16	.7	Chloride: 00940:	54	1.52
T. Cations		7.54	Fluoride: 00951:	.6	.03
Potassium: 00937:	1	.03	Nitrate: 71850:	6.51	.11
Manganese: 01055:		%Na	T. Anions		7.64
			pH: 00403:	7.6	
Boron: 01022:		SAR			
			180 deg TDS: 70300:	424	
Total Iron: 01045:		RSC	P. Alk.: 00415:	0	
			T. Alk.: 00410:	274	
Other					
(Specific Cond.: 00095:		665	T. Hardness: 00900:	341	

Diluted Conductance (micromhos/cm3)
5 x159 =795

__ items will be analyzed if checked.

Ammonia-N: 00610:
Nitrite-N: 00615:
Nitrate-N: 00620:
OrganicNitrogen: 00605:

TDWR-0611 (Rev. 10-28-83)

Typewrite (Black ribbon) or Print Plainly
(soft pencil or black ink)
Do not use ball point pen

Texas Department of Health Laboratories
1100 West 49th Street
Austin, Texas 78756

TDWR ONLY
Program No. _____ Lab No. _____
Work No. 6040-410

CHEMICAL WATER ANALYSIS REPORT

Send report to:
Data Collection and Evaluation Section
Texas Department of Water Resources
P.O. Box 13087
Austin, Texas 78711

County 233 Val Verde
State Well No. 71-42-106
Well No. _____
Date Collected 06-11-79

Location 3.5 East of Del Rio Sample No. 2 By CRim
Source (type of well) Submi. Owner J.C. McReynolds, Rt 2, Box 12, Del Rio, TX
Date Drilled 1955 Depth 145 ft. WBF Ed. Assoc-KEA
Producing intervals _____ Water level _____ ft. Sample depth _____ ft.
Sampled after pumping 5 min hrs. Yield _____ GPM meas. est. Temperature 074 °F _____ °C
Point of collection Faucet 40' from well Appearance ☒ clear ☐ turbid ☐ colored ☐ other
Use Dom-Stock Remarks _____

FOR LABORATORY USE

Laboratory No. C9 11300
Date Received JUN 22 1979
Date Reported JUL 26 '79

CHEMICAL ANALYSIS

	MG/L	ME/L
Silica	22	
Calcium	121	6.04
Magnesium	29	2.36
Sodium	31	1.34
Total		9.74
☐ Potassium		
[3] ☐ Manganese		%Na _____
☐ Boron		SAR _____
[3] ☐ Total Iron		RSC _____
☐ (other) _____	MG/L	
Specific Conductance (micromhos/cm[3])	843	
Diluted Conductance (micromhos/cm[3])	2 x 150 = 1050	

"☐" items will be analyzed if checked.

	MG/L	ME/L
Carbonate	0	
Bicarbonate 169	343	5.62
Sulfate	40	.83
Chloride	115	3.24
Fluoride	0.7	
Nitrate	8.9	.14
pH 7.8	Total	9.83
[1] Dissolved Solids (residue at 180°C)		560
Phenolphthalein Alkalinity as C aCO_3		0
Total Alkalinity as C aCO_3 (5.62)		281
Total Hardness as C aCO_3 (8.40)		420
[2] Nitrogen Cycle		
Ammonia - N		
Nitrite - N		
Nitrate - N		
Organic Nitrogen		

[1] The bicarbonate reported in this analysis can be converted by computation (multiplying by 0.4917) to an equivalent amount of carbonate, and the carbonate figure used in the computation of dissolved solids.
[2] Nitrogen cycle requires separate sample.
[3] Total Iron and Manganese require separate sample.

Analyst _____ Checked By _____

TDWR-0148 (Rev. 7-78)

Typewrite (Black ribbon) or Print Plainly
(soft pencil or black ink)
Do not use ball point pen

Texas State Department of Health Laboratories
1100 West 49th Street
Austin, Texas 78756

TWDBE-GW ONLY
Program No. _____
Proj. No. _____

CHEMICAL WATER ANALYSIS REPORT

County 233 Val Verde
State Well No. 70-42-806
Well No. _____
Date Collected 05-25-76
By Cain

Send report to:
Ground Water Data and Protection Division
Texas Water Development Board
P.O. Box 13087
Austin, Texas 78711

Location _____
Source (type of well) ~~Well~~ Spring Owner J.C. McReynolds
Date Drilled 1930's Depth ~~Unk~~ ft. WBF _____
Producing intervals _____ Water level 65.4C ft.
Sampled after pumping _____ hrs. Yield _____ GPM ~~Meas. est.~~ Temperature 074 °F °C
Point of collection Faucet 30' away Appearance ☑ clear ☐ turbid ☐ colored ☐ other
Use Dom-Stock Remarks _____

(FOR LABORATORY USE ONLY)

Laboratory No. 313161
Date Received JUN 4 1976
Date Reported JUN 14 1976

CHEMICAL ANALYSIS

	MG/L	ME/L
Silica	22	
Calcium	120	6.00
Magnesium	29	2.35
Sodium	34	1.48
Total		9.83
☐ Potassium		
☐ Manganese		%Na _____
☐ Boron		SAR _____
3/☐ Total Iron		RSC _____
☐ (other) _____	MG/L	
Specific Conductance (micromhos/cm³)	905	
Diluted Conductance (micromhos/cm³)	7 x 149 = 1043	

	MG/L	ME/L
Carbonate	171	0
Bicarbonate	348	5.70
Sulfate	41	0.86
Chloride	108	3.04
Fluoride	0.9	
Nitrate	8.0	0.13
pH	7.5	Total 9.73
1/ Dissolved Solids (sum in MG/L)		530
Phenolphthalein Alkalinity as C aCO_3		0
Total Alkalinity as C aCO_3	5.70	285
Total Hardness as C aCO_3	8.35	418
2/ Nitrogen Cycle		
Ammonia - N		
Nitrite - N		
Nitrate - N		
Organic Nitrogen		

"☐" items will be analyzed if checked.

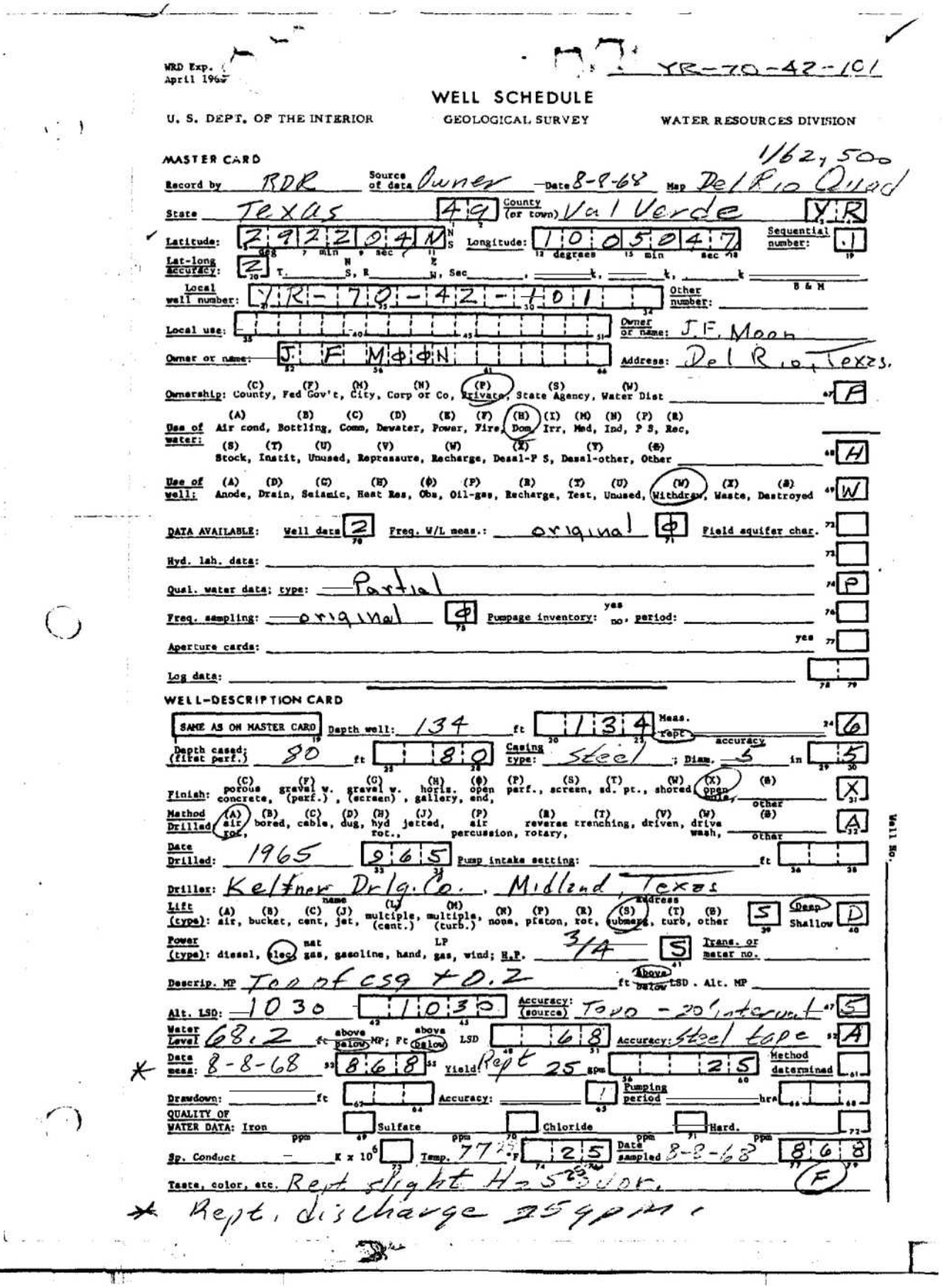
1/ The bicarbonate reported in this analysis is converted by computation (multiplying by 0.4917) to an equivalent amount of carbonate, and the carbonate figure is used in the computation of this sum.
2/ Nitrogen cycle requires separate sample.
3/ Total iron requires separate sample.

TWDBE-WD-1 (Rev. 2-17-76)

Analyst _____ Checked By _____

Map Key	Number of Records	Direction	Distance (mi/ft)	Site	DB
7	1 of 1	NE	0.75 / 3,977.27	Robert Kusenberger TX	GWDB

Well Rep Track No:	
State Well NO:	7042101
Owner Name:	Robert Kusenberger
Drilling Start Dt:	
Drilling Month:	
Drilling Day:	
Drilling Year:	1965
Well Depth:	134
Well Usage:	Domestic
Water Level Status:	
Latitude:	29.3677780
Longitude:	-100.8463890
Data Source:	Groundwater Database (GWDB) Reports; GIS shapefile of GWDB well locations
Well Info Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive//GetReports.aspx?Num=7042101&Type=GWDB
Document Link:	https://www3.twdb.texas.gov/apps/waterdatainteractive//GetScannedImage.aspx?Num=7042101&Cnty=Val Verde



WRD Exp.
April 1965

YR-70-42-101

WELL SCHEDULE

U. S. DEPT. OF THE INTERIOR — GEOLOGICAL SURVEY — WATER RESOURCES DIVISION

1/62,500

MASTER CARD

Record by RDR Source of data Owner Date 8-9-68 Map Del Rio Quad

State Texas 49 County (or town) Val Verde YR

Latitude: 29 22 04 N Longitude: 100 50 47 Sequential number: .1

Lat-long accuracy: 2 T. ___ N S, R ___ W, Sec ___, ___ ¼, ___ ¼, ___ ¼ B & M

Local well number: YR-70-42-101 Other number: ___

Local use: ___ Owner of name: J.F. Moon

Owner or name: J F MOON Address: Del Rio, Texas.

Ownership: (C) County, (F) Fed Gov't, (M) City, (N) Corp or Co, (P) Private, (S) State Agency, (W) Water Dist — P

Use of water: (A) Air cond, (B) Bottling, (C) Comm, (D) Dewater, (E) Power, (F) Fire, (H) Dom, (I) Irr, (M) Med, (N) Ind, (P) S, (R) Rec, (S) Stock, (T) Instit, (U) Unused, (V) Repressure, (W) Recharge, (X) Desal-P S, (Y) Desal-other, (Z) Other — H

Use of well: (A) Anode, (D) Drain, (C) Seismic, (H) Heat Res, (O) Obs, (P) Oil-gas, (R) Recharge, (T) Test, (U) Unused, (W) Withdraw, (X) Waste, (Z) Destroyed — W

DATA AVAILABLE: Well data 2 Freq. W/L meas.: original Ø Field aquifer char. ___

Hyd. lab. data: ___

Qual. water data; type: Partial — P

Freq. sampling: original Ø Pumpage inventory: yes no. period: ___

Aperture cards: ___ yes

Log data: ___

WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD Depth well: 134 ft 134 Meas. rept accuracy 6

Depth cased: (first perf.) 80 ft 80 Casing type: Steel ; Diam. 5 in 5

Finish: (C) porous concrete, (F) gravel w. (perf.), (G) gravel w. (screen), (H) horiz. gallery, (Ø) open end, (P) perf., screen, sd. pt., (S) shored, (T) (W) (X) open hole, (Z) other — X

Method Drilled: (A) air rot, (B) bored, (C) cable, (D) dug, (H) hyd rot., (J) jetted, (P) air percussion, (R) reverse rotary, (T) trenching, (V) driven, (W) drive wash, (Z) other — A

Date Drilled: 1965 9 65 Pump intake setting: ___ ft

Driller: Keltner Drlg. Co. (name), Midland, Texas (address)

Lift (type): (A) air, (B) bucket, (C) cent, (J) jet, (L) multiple (cent.), (M) multiple (turb.), (N) none, (P) piston, (R) rot, (S) submers, (T) turb, (Z) other — S Deep/Shallow D

Power (type): diesel, elec, nat gas, gasoline, hand, LP gas, wind; H.P. 3/4 S Trans. or meter no. ___

Descrip. MP Top of csg +0.2 ft above/below LSD. Alt. MP ___

Alt. LSD: 1030 1030 Accuracy: (source) Topo - 20' interval 5

Water Level 68.2 ft above/below MP; ft above/below LSD 68 Accuracy: Steel tape A

Date meas: 8-8-68 8 6 8 Yield: Rept 25 gpm 25 Method determined ___

Drawdown: ___ ft Accuracy: ___ 1 Pumping period ___ hrs

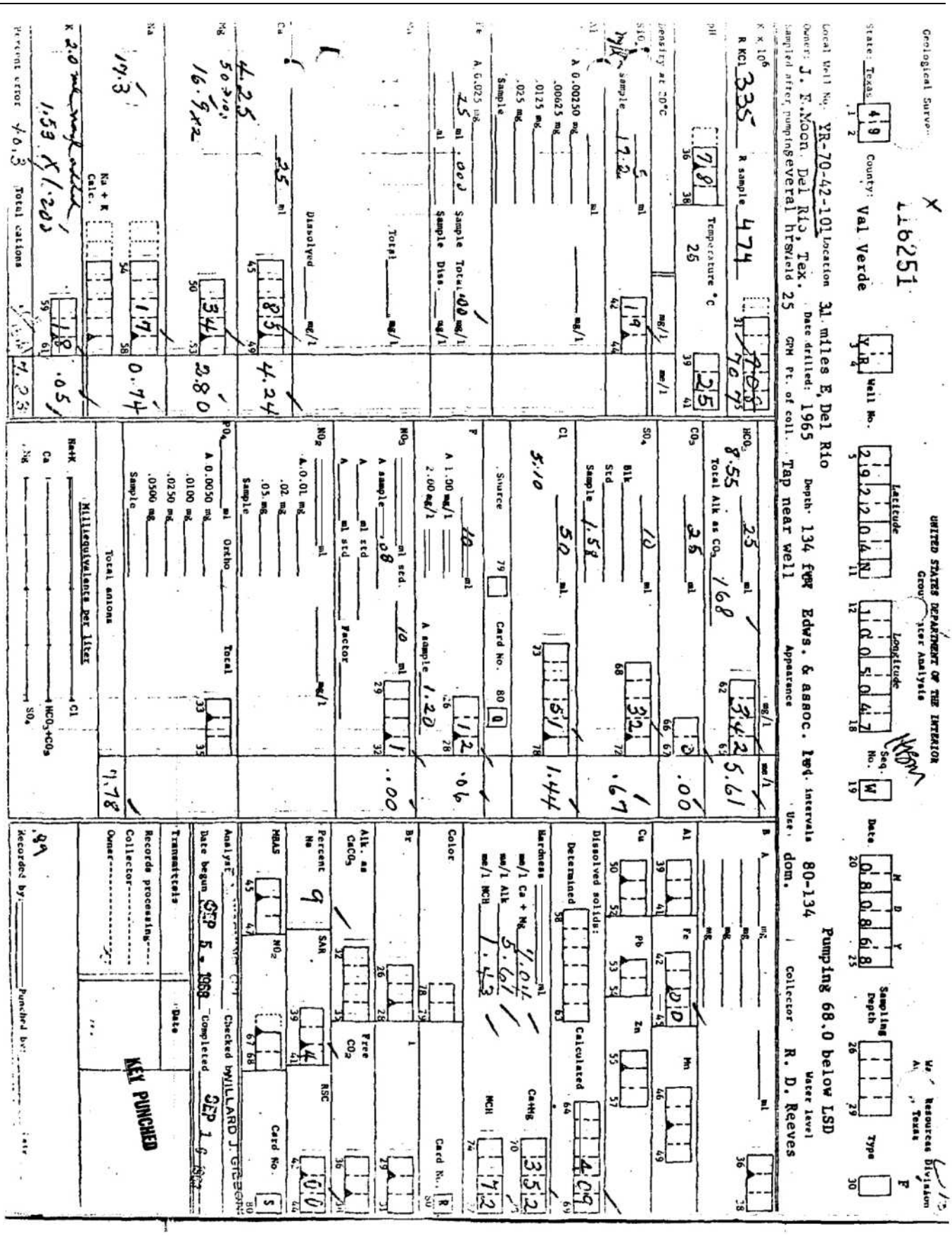
QUALITY OF WATER DATA: Iron ___ ppm Sulfate ___ ppm Chloride ___ ppm Hard. ___ ppm

Sp. Conduct ___ K x 10^6 Temp. 77 °F 25 Date sampled 8-8-68 8 6 8

Taste, color, etc. Rept slight H2S odor. F

* Rept. discharge 25 gpm.

Well No.


UNITED STATES DEPARTMENT OF THE INTERIOR
Geological Survey
Ground Water Analysis
X 16251
State: Texas
County: Val Verde
Well No. YR-70-42-101
Latitude
Longitude
Seq. No.
Date
Sampling Depth
Type
Water Resources Division
Texas
Local Well No. YR-70-42-101 Location 31 miles E, Del Rio
Owner: J. E. Noon, Del Rio, Tex. Date drilled: 1965 Depth: 134 feet Edws. & assoc. Ind. Intervals 80-134
Sampled after pumping several hrs Yield 25 GPM Ft. of coll. Tap near well Appearance Use: dom. Collector R. D. Reeves
Pumping 68.0 below LSD
Water Level
Resistivity at 20°C
Temperature °C 25
Total Alk as CO3 168
Sample
Dissolved
Total
Total anions
Milliequivalents per liter
Analyst
Checked by WILLARD J. GIBBONS
Date begun SEP 5 1968 Completed SEP 1 6 1968
Records processing
Collector
Owner
Transmittals
Date
KEY PUNCHED
Recorded by
Punched by

Map Key	Number of Records	Direction	Distance (mi/ft)	Site	DB
8	1 of 1	NE	0.78 / 4,100.10	JOSE MONIESANO TX	TCEQ WELL LOGS

Grid No:	70-72-1
Date Drilled:	07/22/1986
Owners Name:	JOSE MONIESANO
County:	VAL VERDE
Water Usage:	DOMESTIC
Static Level:	40
Depth Drilled:	200
Latitude:	29.368642
Longitude:	-100.847411

.4m: SIN
.8m: WIEL

Send original copy by certified mail to the Texas Department of Water Resources P. O. Box 13087 Austin, Texas 78711

State of Texas
WATER WELL REPORT
ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

Texas Water Well Drillers Board P. O. Box 13087 Austin, Texas 78711

1) OWNER Jose Montesano (Name) Address 218 Albert (Street or RFD) Del Rio (City) Tx (State) 78840 (Zip)

2) LOCATION OF WELL: County Val Verde 1 miles in F (N.E., S.W., etc.) direction from Del Rio (Town)

Driller must complete the legal description to the right with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ Legal description:
Section No. _____ Block No. _____ Township _____
Abstract No. _____ Survey Name _____
Distance and direction from two intersecting section or survey lines _____
☑ See attached map.

3) TYPE OF WORK (Check): ☑ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☑ Domestic ☐ Industrial ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Other _____

5) DRILLING METHOD (Check): ☐ Mud Rotary ☐ Air Hammer ☐ Driven ☐ Bored ☑ Air Rotary ☐ Cable Tool ☐ Jetted ☐ Other _____

6) WELL LOG:

Date drilled 7-22-84

DIAMETER OF HOLE Dia. (in.)	From (ft.)	To (ft.)
7 7/8	Surface 0	200

From (ft.)	To (ft.)	Description and color of formation material
0	38	Caliche
38	75	Red Clay
75	135	Gray Shell & Clay
135	200	White Limestone

7) BOREHOLE COMPLETION: ☐ Open Hole ☑ Straight Wall ☐ Underreamed ☐ Gravel Packed ☐ Other _____
If Gravel Packed give interval . . . from 100 ft. to 200 ft.

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mgf., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casing Screen
5	New	Plastic	0	200	

CEMENTING DATA
Cemented from 0 ft. to 10 ft.
Method used _____
Cemented by _____ (Company or Individual)

9) WATER LEVEL:
Static level 40 ft. below land surface Date 7-24-84
Artesian flow _____ gpm. Date _____

10) PACKERS: Type Depth

RECEIVED
AUG 28 84
Texas Water Commission

(Use reverse side if necessary)

11) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other _____
Depth to pump bowls, cylinder, jet, etc., _____ ft.

12) WELL TESTS:
☐ Type Test: ☐ Pump ☐ Bailer ☑ Jetted ☐ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

13) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable water? ☐ Yes ☑ No
If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? _____ Depth of strata _____
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief.

COMPANY NAME Hutto Drilling Inc (Type or Print) Water Well Driller's License No. 2472

ADDRESS 905 N Main (Street or RFD) Del Rio (City) Tx (State) 78840 (Zip)

(Signed) Glen Hutto (Licensed Water Well Driller) (Signed) _____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

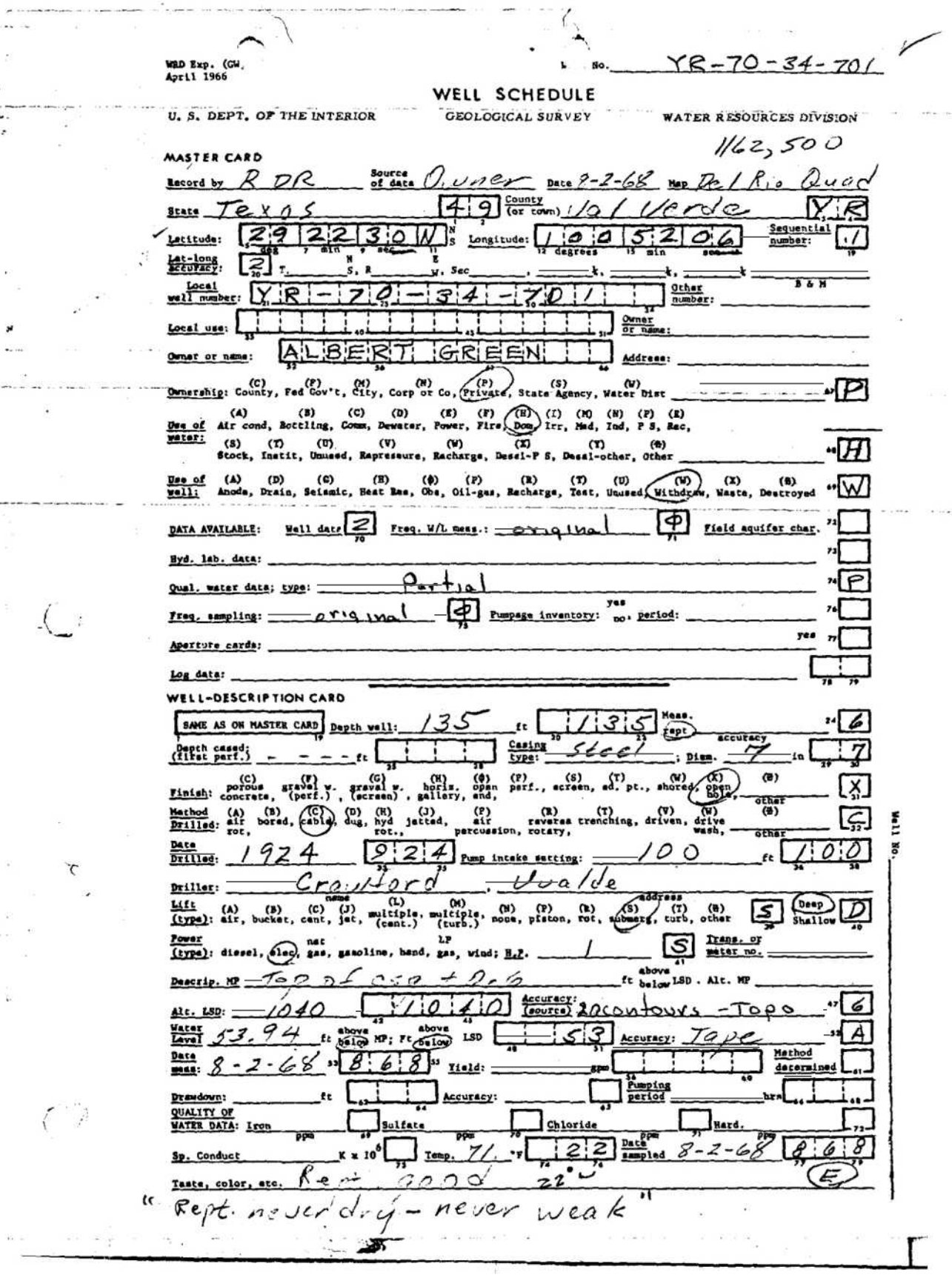
For TDWR use only
Well No. 70-42-1
Located on map _____

TDWR-0392 (Rev. 5-27-82) DEPARTMENT OF WATER RESOURCES COPY


Jose Montejano
CROCKETT COUNTY
SUTTON COUNTY
STATE OF COAHUILA REPUBLIC OF MEXICO
LANGTRY
COMSTOCK
GENERAL HIGHWAY MAP
VAL VERDE COUNTY
TEXAS
STATE DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION
TRANSPORTATION PLANNING DIVISION
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
1963
LEGEND
VAL VERDE COUNTY TEXAS 233

Map Key	Number of Records	Direction	Distance (mi/ft)	Site	DB
9	1 of 1	NNW	0.93 / 4,899.94	A. Green TX	GWDB

Well Rep Track No:	
State Well NO:	7034701
Owner Name:	A. Green
Drilling Start Dt:	
Drilling Month:	
Drilling Day:	
Drilling Year:	1924
Well Depth:	135
Well Usage:	Domestic
Water Level Status:	
Latitude:	29.3752780
Longitude:	-100.8683330
Data Source:	Groundwater Database (GWDB) Reports; GIS shapefile of GWDB well locations
Well Info Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive//GetReports.aspx?Num=7034701&Type=GWDB
Document Link:	https://www3.twdb.texas.gov/apps/waterdatainteractive//GetScannedImage.aspx?Num=7034701&Cnty=Val Verde



WRD Exp. (GW, April 1966)

No. YR-70-34-701

WELL SCHEDULE

U. S. DEPT. OF THE INTERIOR — GEOLOGICAL SURVEY — WATER RESOURCES DIVISION

1/62,500

MASTER CARD

Record by R DR Source of data Owner Date 8-2-68 Map Del Rio Quad

State Texas 49 County (or town) Val Verde YR

Latitude: 29 22 30 N S Longitude: 100 52 06 Sequential number: 11

Lat-long accuracy: 2 T. N S, R E W, Sec , , ,

Local well number: YR-70-34-701 Other number: B & H

Local use: Owner or name:

Owner or name: ALBERT GREEN Address:

Ownership: (C) County, (F) Fed Gov't, (M) City, (N) Corp or Co, (P) Private, (S) State Agency, (W) Water Dist P

Use of water: (A) Air cond, (B) Bottling, (C) Comm, (D) Dewater, (E) Power, (F) Fire, (H) Dom, (I) Irr, (M) Mnd, (N) Ind, (P) P S, (R) Rec, (S) Stock, (T) Instit, (U) Unused, (V) Repressure, (W) Recharge, (X) Desal-P S, (Y) Desal-other, (Z) Other H

Use of well: (A) Anode, (D) Drain, (G) Seismic, (H) Heat Exc, (O) Obs, (P) Oil-gas, (R) Recharge, (T) Test, (U) Unused, (W) Withdraw, (X) Waste, (Z) Destroyed W

DATA AVAILABLE: Well data 2 Freq. W/L meas.: original Φ Field aquifer char.

Hyd. lab. data:

Qual. water data; type: Partial P

Freq. sampling: original Φ Pumpage inventory: yes no; period:

Aperture cards: yes

Log data:

WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD Depth well: 135 ft 135 Meas. rept 6

Depth cased; (first perf.) - - - - ft Casing type: steel ; Diam. 7 in 7

Finish: (C) porous concrete, (F) gravel w. (perf.), (G) gravel w. (screen), (H) horiz. gallery, (Φ) open end, (P) perf., screen, sd. pt., (S) shored, (T) open hole, (W) other X

Method Drilled: (A) air rot, (B) bored, (C) cable, (D) dug, (H) hyd rot., (J) jetted, (P) air percussion, (R) reverse rotary, (T) trenching, (V) driven, (W) drive wash, (Z) other C

Date Drilled: 1924 9 24 Pump intake setting: 100 ft 100

Driller: Crawford name Uvalde address

Lift (type): (A) air, (B) bucket, (C) cent, (J) jet, (L) multiple (cent.), (M) multiple (turb.), (N) none, (P) piston, (R) rot, (S) submerg, (T) turb, (Z) other S Deep D Shallow

Power (type): diesel, elec, nat gas, gasoline, hand, LP gas, wind; H.P. 1 S Trans. or water no.

Descrip. MP Top of csg + 2.6 ft above below LSD . Alt. MP

Alt. LSD: 1040 1040 Accuracy: (source) 20 contours - Topo 6

Water Level 53.94 ft above below MP; Ft above below LSD 53 Accuracy: Tape A

Date meas: 8-2-68 8 68 Yield: gpm Method determined

Drawdown: ft Accuracy: Pumping period hrs

QUALITY OF WATER DATA: Iron ppm Sulfate ppm Chloride ppm Hard. ppm

Sp. Conduct K x 10⁶ Temp. 71 °F 22 °C Date sampled 8-2-68 8 68 E

Taste, color, etc. Rec good

Rept. never dry - never weak

Geological Survey

16247

UNITED STATES DEPARTMENT OF THE INTERIOR
Ground Water Analysis

Water Resources Division
Austin, Texas

State: Texas 4 9 | County: Val Verde | Y R Well No. | Latitude 2 9 2 2 3 0 N | Longitude 1 0 0 5 2 0 6 | Seq. No. W | Date M 0 8 D 0 2 Y 6 8 | Sampling Depth | Type E

Local Well No. YR-70-34-701 Location 19 miles E of Del Rio

Owner A, Green Del Rio, Texas Date drilled: 1924 Depth 135 ft. WBF Edws. & assoc. 16' Prod. intervals Static 53.3 below LSD Water level

Sampled after pumping several hrs. Yield 25 GPM Pt. of coll. Tap at well Appearance clear Use dom., irr. Collector R. D. Reeves

x 10^6				
R KCl 335	R sample 572	586		
	77	Temperature °C 22	22	
Density at 20°C		mg/l	me/l	
SiO_2	5 ml sample 14.8	15		
	ml			
A 0.00250 mg		mg/l		
.00625 mg				
.0125 mg				
.025 mg				
Sample				
A 0.025 mg				
ml	ml Sample Total	mg/l		
ml	ml Sample Diss.	mg/l		
	Total	mg/l		
	Dissolved	mg/l		
Ca	25 ml	186	4.29	
4.30				
Mg		20	1.65	
19.8				
Na		98	.43	
9.8	Na + K Calc.			
K 2.0 ml read plotted		12	.03	
1.00 x 1.200				
Percent error 0.1	Total cations 12.80		6.40	

HCO_3	25 ml	296	4.85	
7.40	Total Alk as CO_3 146			
CO_3	25 ml	0	.00	
SO_4	10 ml	30	.62	
	Blk			
	Std			
	Sample 1.52			
Cl	50 ml	29	.82	
2.87				
Source	79	Card No. 80 Q		
F	10 ml	5	.03	
	A 1.00 mg/l	.502		
	2.00 mg/l	A sample		
NO_3	ml std. 10 ml	49	.08	
	A sample 4.90			
	A ml std			
	A ml std Factor			
NO_2	ml mg/l			
	A 0.01 mg			
	.02 mg			
	.05 mg			
	Sample			
PO_4	ml Ortho Total			
	A 0.0050 mg			
	.0100 mg			
	.0250 mg			
	.0500 mg			
	Sample			
Total anions			6.40	

Milliequivalents per liter

Na+K — Cl
Ca — HCO_3+CO_3
Mg — SO_4

B	A mg .064	5 ml	06
	mg		.00028 x 200
	mg		
	mg		
Al	Fe	Mn	
Cu	Pb	Zn	
Dissolved solids:			
Determined	Calculated	342	
Hardness	ml		
me/l Ca + Mg	5.94	Ca+Mg	297 54
me/l Alk	4.85		
me/l NCH	1.09	NCH	5
Color		Card No. R	
Br	I		
Alk. as $CaCO_3$	Free CO_2		
Percent Na 7	SAR 2	RSC 00	
MBAS	NO_2	Card No. S	

Analyst F. L. WASHINGTON Checked by WILLARD J. CLEVELAND

Date begun SEP 5 - 1968 Completed SEP 16 1968

Transmittals	Date
Records processing----	
Collector----	
Owner----	

KEY PUNCHED

Recorded by: Punched by: Date:

Map Key	Number of Records	Direction	Distance (mi/ft)	Site	DB
10	1 of 1	NW	0.99 / 5,215.73	DARRELL HARGROVE TX	TCEQ WELL LOGS

Grid No:	70-42-1
Date Drilled:	11/27/2000
Owners Name:	DARRELL HARGROVE
County:	VAL VERDE
Water Usage:	DOMESTIC
Static Level:	50
Depth Drilled:	300
Latitude:	29.371192
Longitude:	-100.875594

Send original copy by certified mail to; TNRCC, P.O. Box [redacted]7, Austin, TX 78711-3087 — Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Darrell Hargrove (Name) ADDRESS P.O. Box 1187 (Street or RFD) Del Rio (City) Tx. (State) 78841 (Zip)

2) ADDRESS OF WELL: County Valverde Hwy 90 west (Street, RFD or other) Del Rio (City) Tx. (State) 78840 (Zip) GRID # [redacted]

3) TYPE OF WORK (Check): [X] New Well [ ] Deepening [ ] Reconditioning [ ] Plugging

4) PROPOSED USE (Check): [ ] Monitor [ ] Environmental Soil Boring [X] Domestic [ ] Industrial [ ] Irrigation [ ] Injection [ ] Public Supply [ ] De-watering [ ] Testwell
If Public Supply well, were plans submitted to the TNRCC? [ ] Yes [ ] No

5)

6) WELL LOG:
Date Drilling: Started 11-27 2000 Completed 11-27 2000

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
7 7/8	Surface	20
6 1/2	20	300

7) DRILLING METHOD (Check): [ ] Driven [X] Air Rotary [ ] Mud Rotary [ ] Bored [ ] Air Hammer [ ] Cable Tool [ ] Jetted [ ] Other

From (ft.)	To (ft.)	Description and color of formation material
0	2	Topsoil
2	29	Red Caliche
29	30	Gravel
30	57	White Caliche
57	88	Red Caliche
88	103	Yellow Caliche
103	128	Dark yellow Clay
128	140	Limestone
140	144	Grey Gravel
144	210	Glen Rose
210	290	Tan Limestone
290	300	Grey Limestone
215-220		Water formation

(Use reverse side if necessary)

8) Borehole Completion (Check): [ ] Open Hole [ ] Straight Wall [ ] Underreamed [X] Gravel Packed [ ] Other
If Gravel Packed give interval ... from 50 ft. to 300 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
4 1/2	New	PVC Sch 40	0	240	
4 1/2	New	PVC Slotted	240	300	

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 0 ft. to 50 ft. No. of sacks used 7
ft. to ft. No. of sacks used
Method used Gravity flow
Cemented by Self
Distance to septic system field lines or other concentrated contamination ____ ft.
Method of verification of above distance

10) SURFACE COMPLETION
[ ] Specified Surface Slab Installed [Rule 338.44(2)(A)]
[X] Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
[ ] Pitless Adapter Used [Rule 338.44(3)(b)]
[ ] Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level 50 ft. below land surface Date 11-27-00
Artesian flow gpm. Date

13) TYPE PUMP:
[ ] Turbine [ ] Jet [ ] Submersible [ ] Cylinder
[ ] Other
Depth to pump bowls, cylinder, jet, etc., ____ ft.

14) WELL TESTS:
Type test: [X] Pump [ ] Bailer [ ] Jetted [ ] Estimated
Yield: 40 gpm with 10 ft. drawdown after 1 hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
[ ] Yes [X] No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Good Depth of strata 215-220
Was a chemical analysis made? [X] Yes [ ] No

12) PACKERS:

Type	Depth
None	

FILE ID ____ SEQ # ____ GMP # ____ DESC CO ____ MAY 3 1 2001 COMMENT

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Seargeant well service (Type or print) WELL DRILLER'S LICENSE NO. 4906 PLW

ADDRESS P.O. Box 828 (Street or RFD) Brackettville (City) Tx. (State) 78832 (Zip)

(Signed) David Seargeant (Licensed Well Driller)

(Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94) TNRCC COPY

Map Key	Number of Records	Direction	Distance (mi/ft)	Site	DB
11	1 of 1	NW	0.99 / 5,218.29	DARRELL HARGROVE TX	TCEQ WELL LOGS

Grid No:	70-42-1
Date Drilled:	11/28/2000
Owners Name:	DARRELL HARGROVE
County:	VAL VERDE
Water Usage:	DOMESTIC
Static Level:	50
Depth Drilled:	120
Latitude:	29.371195
Longitude:	-100.875602

Send original copy by certified mail to: TNRCC, P.O. Box [redacted]7, Austin, TX 78711-3087 — Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Darrell Hargrove (Name) ADDRESS P.O. Box 1187 (Street or RFD) Del Rio (City) Tx (State) 78841 (Zip)

2) ADDRESS OF WELL: County Val Verde Hwy 90 west (Street, RFD or other) Del Rio (City) Tx (State) 78840 (Zip) GRID # [redacted]

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☐ Monitor ☐ Environmental Soil Boring ☒ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5)

6) WELL LOG:
Date Drilling: Started 11-28-2000 Completed 11-28-2000

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
7⅞	Surface	20
6½	20	120

7) DRILLING METHOD (Check): ☐ Driven ☒ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

N

From (ft.)	To (ft.)	Description and color of formation material
0	2	Topsoil
2	18	Red Caliche
18	22	Gravel
22	32	Red Caliche & Gravel
32	45	White Caliche
45	60	Red Clay
60	88	Red Caliche & Gravel
88	98	Yellow Caliche & Clay
98	108	White Limestone
108	118	Yellow Clay
118	120	Limestone
55	60	water formation

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 48 ft. to 120 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
4½	New	PVC Sch. 40	0	70	
4½	New	Slotted	70	120	

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 0 ft. to 48 ft. No. of sacks used 7
ft. to ft. No. of sacks used
Method used Gravity Flow
Cemented by Self
Distance to septic system field lines or other concentrated contamination ____ ft.
Method of verification of above distance

13) TYPE PUMP: ☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other
Depth to pump bowls, cylinder, jet, etc., ____ ft.

10) SURFACE COMPLETION
☐ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

14) WELL TESTS:
Type test: ☒ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: 40 gpm with 10 ft. drawdown after 1 hrs.

11) WATER LEVEL:
Static level 50 ft. below land surface Date 11-28-00
Artesian flow ____ gpm. Date

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? good Depth of strata 55-60
Was a chemical analysis made? ☐ Yes ☒ No

12) PACKERS: Type None Depth

FILED MAY 31 2001

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Seargeant well service (Type or print) WELL DRILLER'S LICENSE NO. 4905 PLW

ADDRESS P.O. Box 828 (Street or RFD) Brackettville (City) Tx. (State) 78832 (Zip)

(Signed) David Seargeant (Licensed Well Driller) (Signed) ____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94) TNRCC COPY

Appendix: Database Descriptions

Environmental Risk Information Services (ERIS) can search the following databases. The extent of historical information varies with each database and current information is determined by what is publicly available to ERIS at the time of update.

Federal

Wells from NWIS: FED USGS

The U.S. Geological Survey's National Water Information System (NWIS) is the nation's principal repository of water resources data. The NWIS includes comprehensive information of well-construction details, time-series data for gage height, streamflow, groundwater level, and precipitation and water use data. This NWIW dataset contains select Site Types from the overall NWIS Sites data, limited to the following Group Site Types only: Groundwater Group Site Types: Well, Collector or Ranney type well, Hyporheic-zone well, Interconnected Wells, Multiple wells; Spring Group Site Type: Spring; and Other Group Site Types: Aggregate groundwater use, Cistern.

Government Publication Date: Mar 21, 2022

State

Well Log Reports from Plotted Water Wells: TCEQ WELL LOGS

Locations of TCEQ Water Wells as derived from well logs in the Texas Commission on Environmental Quality (TCEQ) Water Well Report Viewer, which includes unnumbered water wells and those plotted to 2.5 minute grid locations (2-3 miles). In this collection of Well Log Reports, locations have been manually verified.

Government Publication Date: Jul 26, 2022

Select Wells from SDR: SDRW WELLS

Locations of wells from the Submitted Drillers Report (SDR) Database with select proposed usage: Domestic, Fracking Supply, Industrial, Irrigation, Other, Public Supply, Rig Supply, Stock, Unknown. SDR is populated from the online Texas Well Report Submission and Retrieval System (TWRSRS), a cooperative Texas Department of Licensing and Regulation (TDLR) and Texas Water Development Board (TWDB) application requiring registered water-well drillers to submit reports. Excludes SDR records with the following proposed usage: Closed-Loop Geothermal, De-watering, Environmental Soil Boring, Extraction, Injection, Monitor, Test Well.

Government Publication Date: Sep 6, 2022

Groundwater Database: GWDB

The Texas Water Development Board (TWDB) Groundwater Database (GWDB) contains information on selected water wells, springs, oil/gas tests (that were originally intended to be or were converted to water wells), water levels and water quality.

Government Publication Date: Oct 19, 2022

Fort Bend Subsidence District Water Wells: WW FORT BEND

List of water wells in the Fort Bend Subsidence District, boundaries of which are defined as all the territory within Fort Bend County. The Fort Bend Subsidence District was created by the Texas Legislature in 1989 as a conservation and reclamation district to control land subsidence and manage groundwater resources through regulation, conservation, and coordination with suppliers of alternative water sources to assure an adequate quantity and quality of water for the future. The District's purpose is to provide for the regulation of the withdrawal of groundwater within the District to prevent subsidence that contributes to flooding, inundation or overflow of areas within the District, including rising waters resulting from storms or hurricanes.

Government Publication Date: May 18, 2022

High Plains Water Wells: WW HIGH PLAINS

Inventory of water wells in the High Plains Underground Water Conservation District No. 1 (HPUWCD), which was created in 1951. As a political subdivision of Texas, HPUWCD is charged with protecting, preserving and conserving aquifers within the District's 16-county service area.

Government Publication Date: Apr 20, 2022

Harris Galveston Subsidence District Water Wells: WW HARRIS GAL

List of water wells in the Harris-Galveston Subsidence District (HGSD). The HGSD was created by the 64th Texas Legislature as an underground water conservation district in 1975 to provide regulation of groundwater withdrawal to control subsidence.

Government Publication Date: May 18, 2022

Water Utility Database: WUD

The Water Utility Database is defined as a collection of data from Texas Water Districts, Public Drinking Water Systems and Water and Sewer Utilities who submit information to the TCEQ. This database is an integrated database designed and developed to replace over 160 stand alone legacy systems representing over 5 million records of the former Texas Water Commission and the Texas Department of Health.

Government Publication Date: Oct 1, 2020

Definitions

Database Descriptions: This section provides a detailed explanation for each database including: source, information available, time coverage, and acronyms used. They are listed in alphabetic order.

Detail Report: This is the section of the report which provides the most detail for each individual record. Records are summarized by location, starting with the project property followed by records in closest proximity.

Distance: The distance value is the distance between plotted points, not necessarily the distance between the sites' boundaries. All values are an approximation.

Direction: The direction value is the compass direction of the site in respect to the project property and/or center point of the report.

Executive Summary: This portion of the report is divided into 3 sections:

'Report Summary'- Displays a chart indicating how many records fall on the project property and, within the report search radii.

'Site Report Summary'-Project Property'- This section lists all the records which fall on the project property. For more details, see the 'Detail Report' section.

'Site Report Summary-Surrounding Properties'- This section summarizes all records on adjacent properties, listing them in order of proximity from the project property. For more details, see the 'Detail Report' section.

Map Key: The map key number is assigned according to closest proximity from the project property. Map Key numbers always start at #1. The project property will always have a map key of '1' if records are available. If there is a number in brackets beside the main number, this will indicate the number of records on that specific property. If there is no number in brackets, there is only one record for that property.

The symbol and colour used indicates 'elevation': the red inverted triangle will dictate 'ERIS Sites with Lower Elevation', the yellow triangle will dictate 'ERIS Sites with Higher Elevation' and the orange square will dictate 'ERIS Sites with Same Elevation.'

APPENDIX IIIJ-B

ERIS Physical Setting Report (including Oil/Gas Well and Pipeline Information)

PSR
PHYSICAL SETTING REPORT

Property Information

Order Number:		22111500308p
Date Completed:		December 12, 2022
Project Number:		5020210002
Project Property:		Del Rio Landfill Expansion Railway Road Del Rio TX 78840
Coordinates:		
	Latitude:	29.35973683
	Longitude:	-100.8611875
	UTM Northing:	3248986.34311 Meters
	UTM Easting:	319794.735257 Meters
	UTM Zone:	UTM Zone 14R
	Elevation:	1,050.72 ft
	Slope Direction:	E

Topographic Information....2
Hydrologic Information....12
Geologic Information....21
Soil Information....25
Pipeline and Survey Map....32
Wells and Additional Sources....36
Summary....52
Detail Report....56
Radon Information....92
Appendix....93
Liability Notice....96

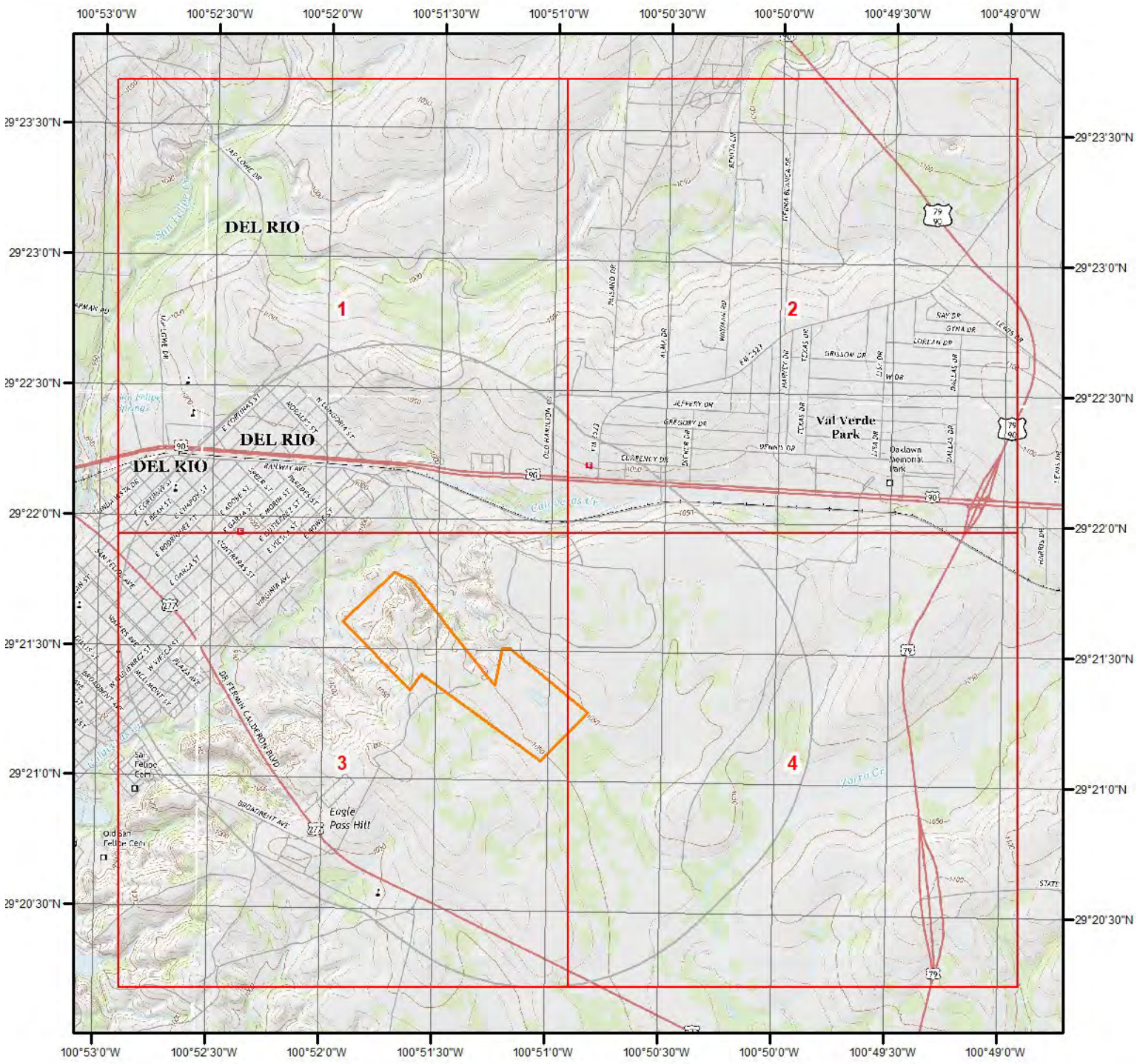
The ERIS ***Physical Setting Report - PSR*** provides comprehensive information about the physical setting around a site and includes a complete overview of topography and surface topology, in addition to hydrologic, geologic and soil characteristics. The location and detailed attributes of oil and gas wells, water wells, public water systems and radon are also included for review.

The compilation of both physical characteristics of a site and additional attribute data is useful in assessing the impact of migration of contaminants and subsequent impact on soils and groundwater.

Disclaimer

This Report does not provide a full environmental evaluation for the site or adjacent properties. Please see the terms and disclaimer at the end of the Report for greater detail.

Topographic Information



Current USGS Topo (2016)

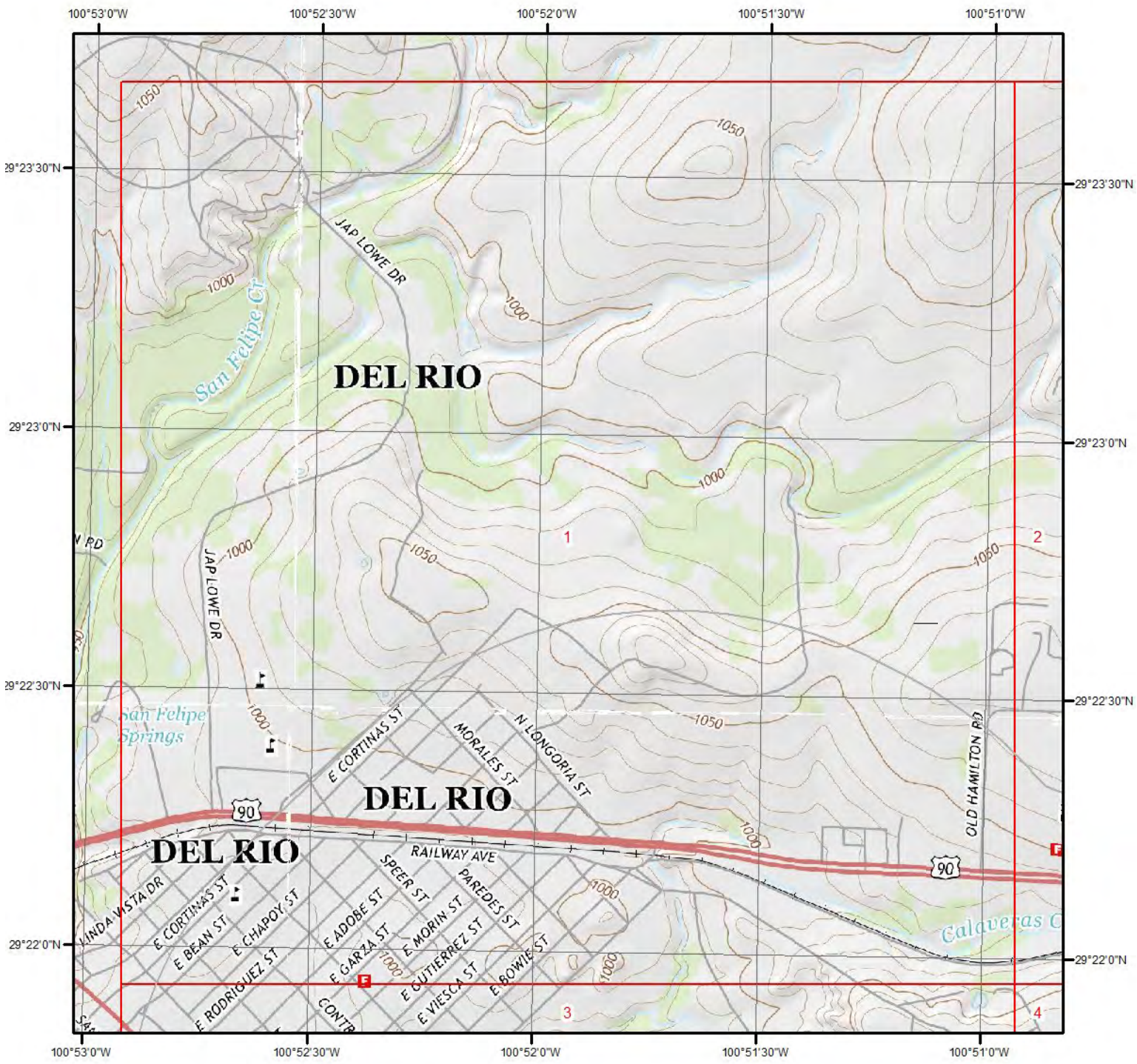
0 0.2 0.4 0.8 1.2 1.6 Miles

N

Quadrangle(s): Del Rio NE,TX; Del Rio NW,TX; Del Rio SE,TX; Del Rio SW,TX

Source: USGS 7.5 Minute Topographic Map

Topographic Information



Current USGS Topo - Page 1

Quadrangle(s): Del Rio NE,TX; Del Rio NW,TX; Del Rio SE,TX; Del Rio SW,TX

Source: USGS 7.5 Minute Topographic Map

Topographic Information



Current USGS Topo - Page 2

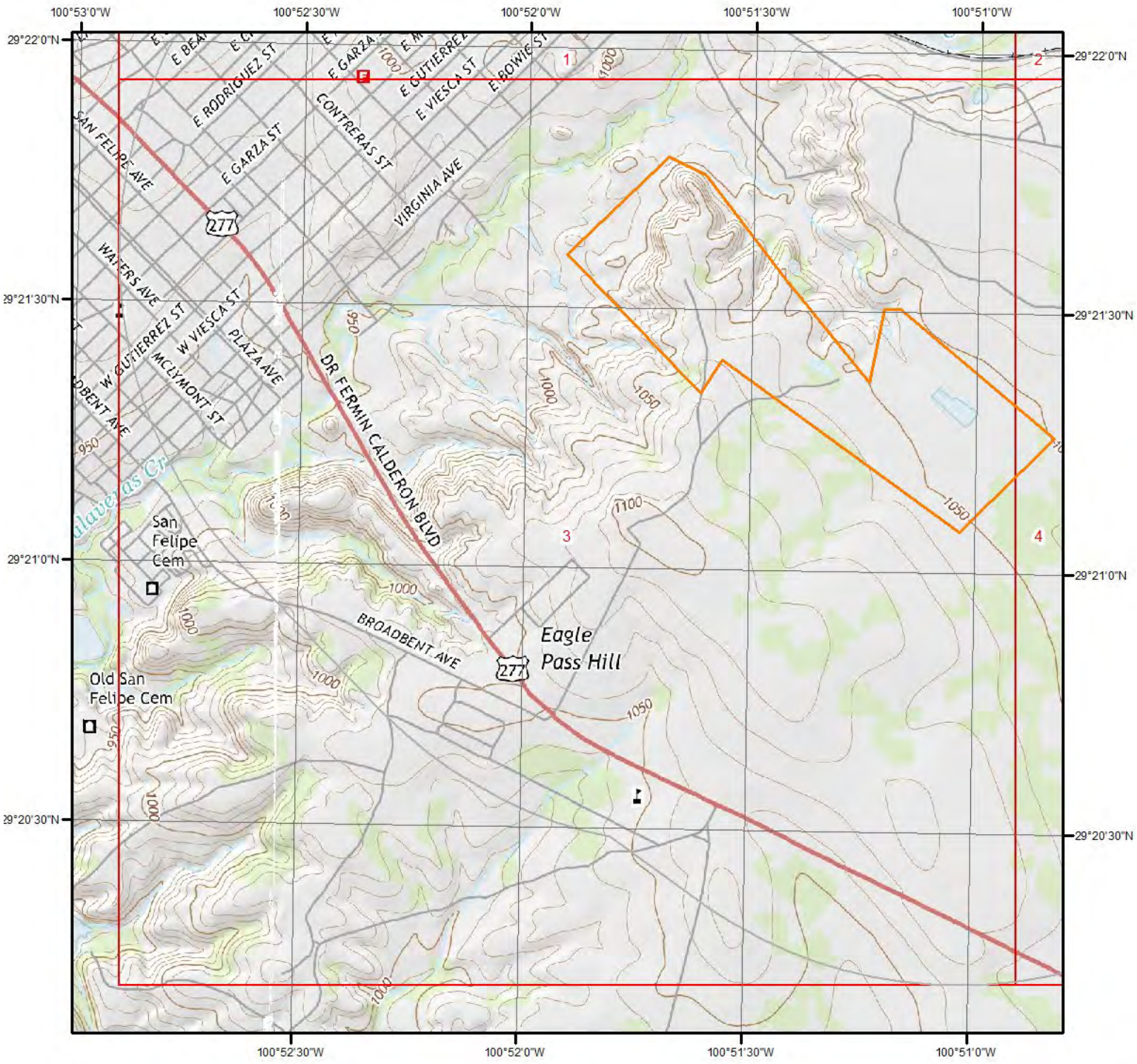
0 0.2 0.4 0.8 Miles

N

Quadrangle(s): Del Rio NE,TX; Del Rio SE,TX

Source: USGS 7.5 Minute Topographic Map

Topographic Information



Current USGS Topo - Page 3

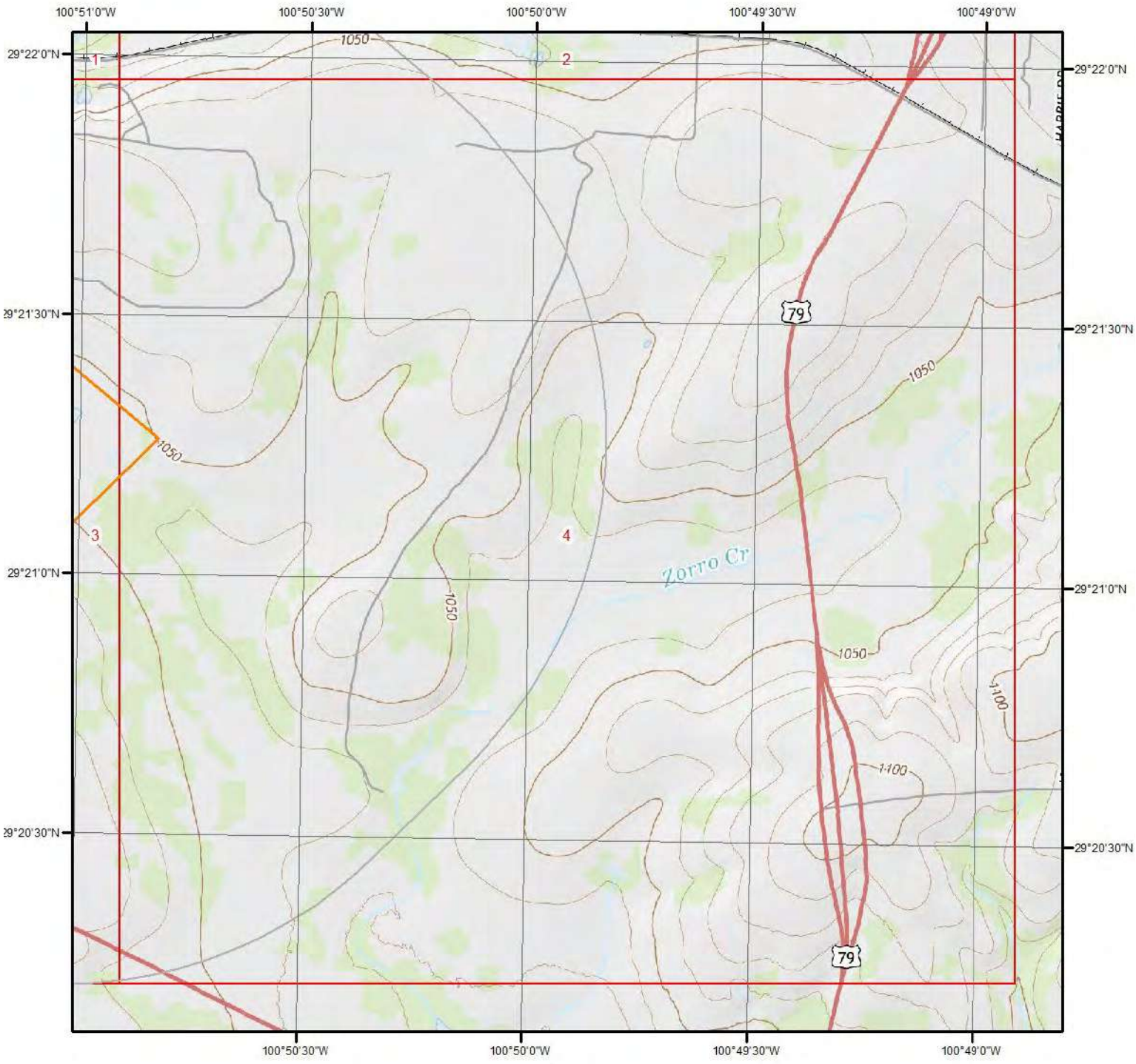
0 0.2 0.4 0.8 Miles

N

Quadrangle(s): Del Rio SE,TX; Del Rio SW,TX

Source: USGS 7.5 Minute Topographic Map

Topographic Information



Current USGS Topo - Page 4

0 0.2 0.4 0.8 Miles

N

Quadrangle(s): Del Rio SE,TX

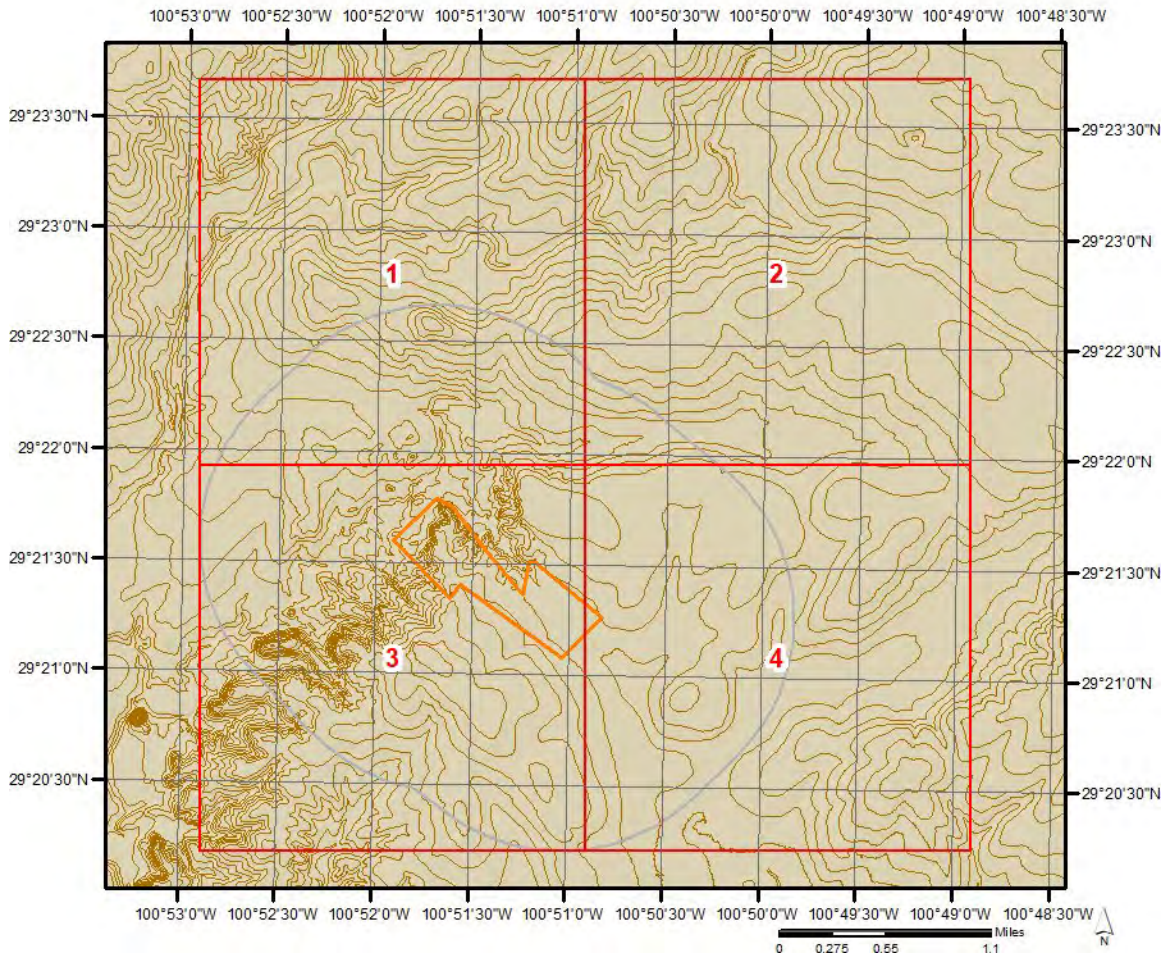
Source: USGS 7.5 Minute Topographic Map

Topographic Information

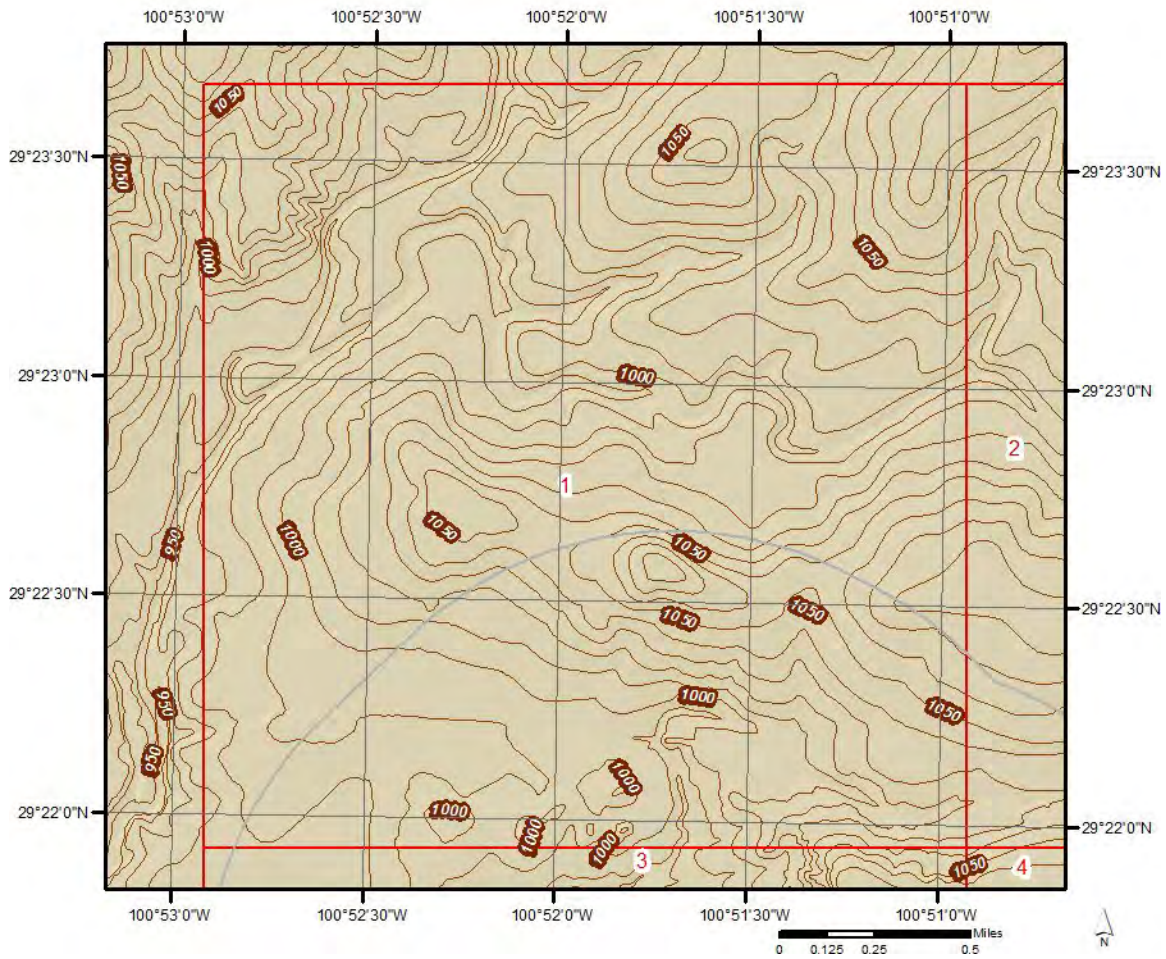
The previous topographic map(s) are created by seamlessly merging and cutting current USGS topographic data. Below are shaded relief map(s), derived from USGS elevation data to show surrounding topography in further detail.

Topographic information at project property:

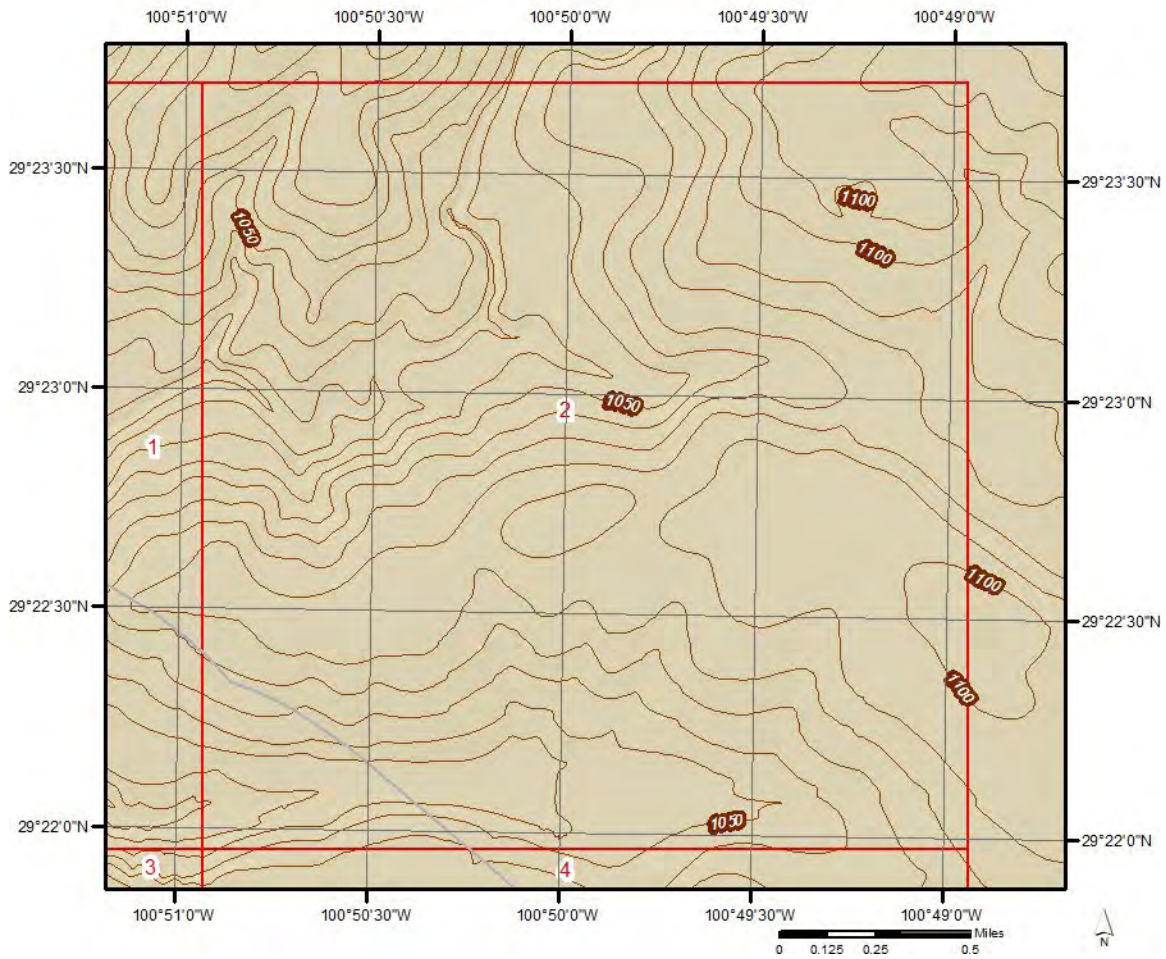
Elevation:	1,050.72 ft
Slope Direction:	E



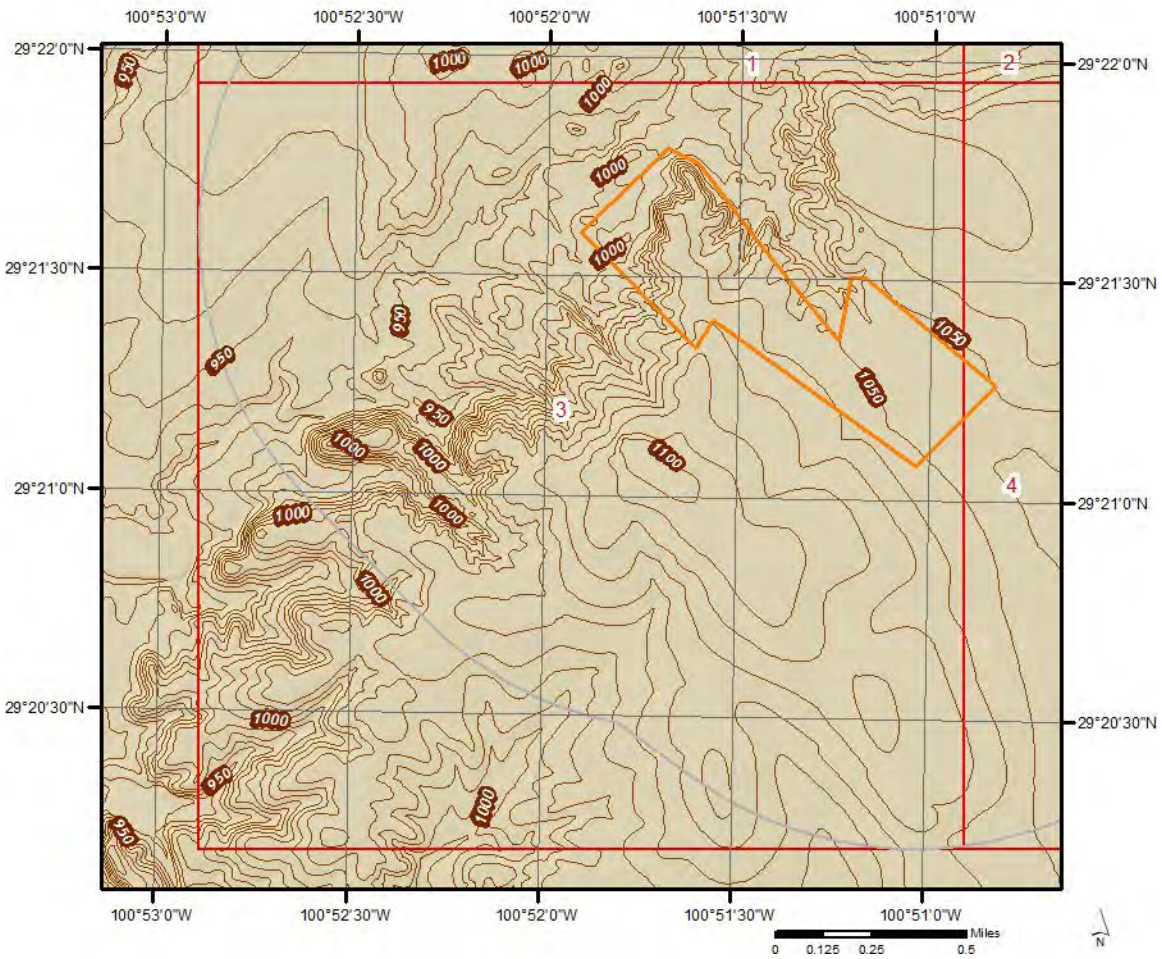
Topographic Information



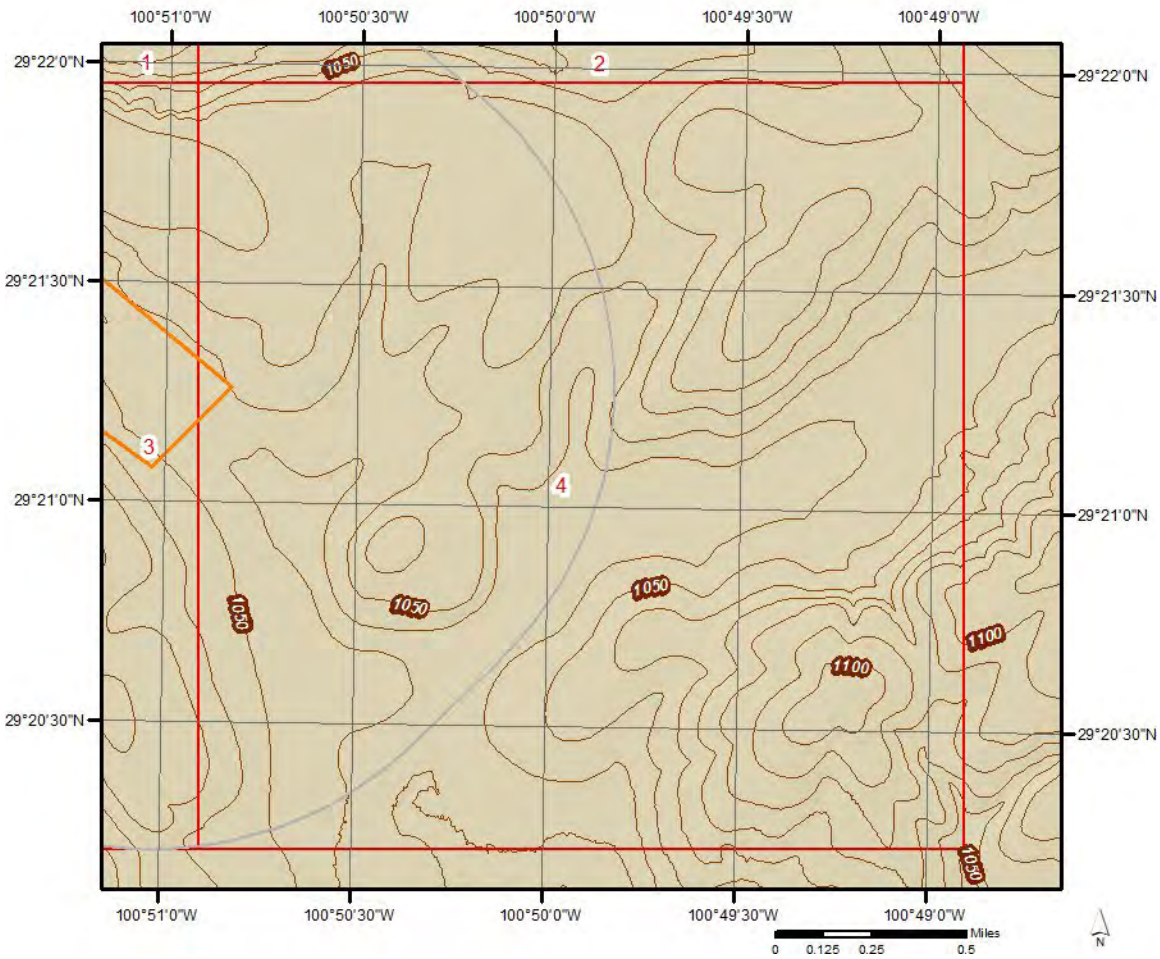
Topographic Information



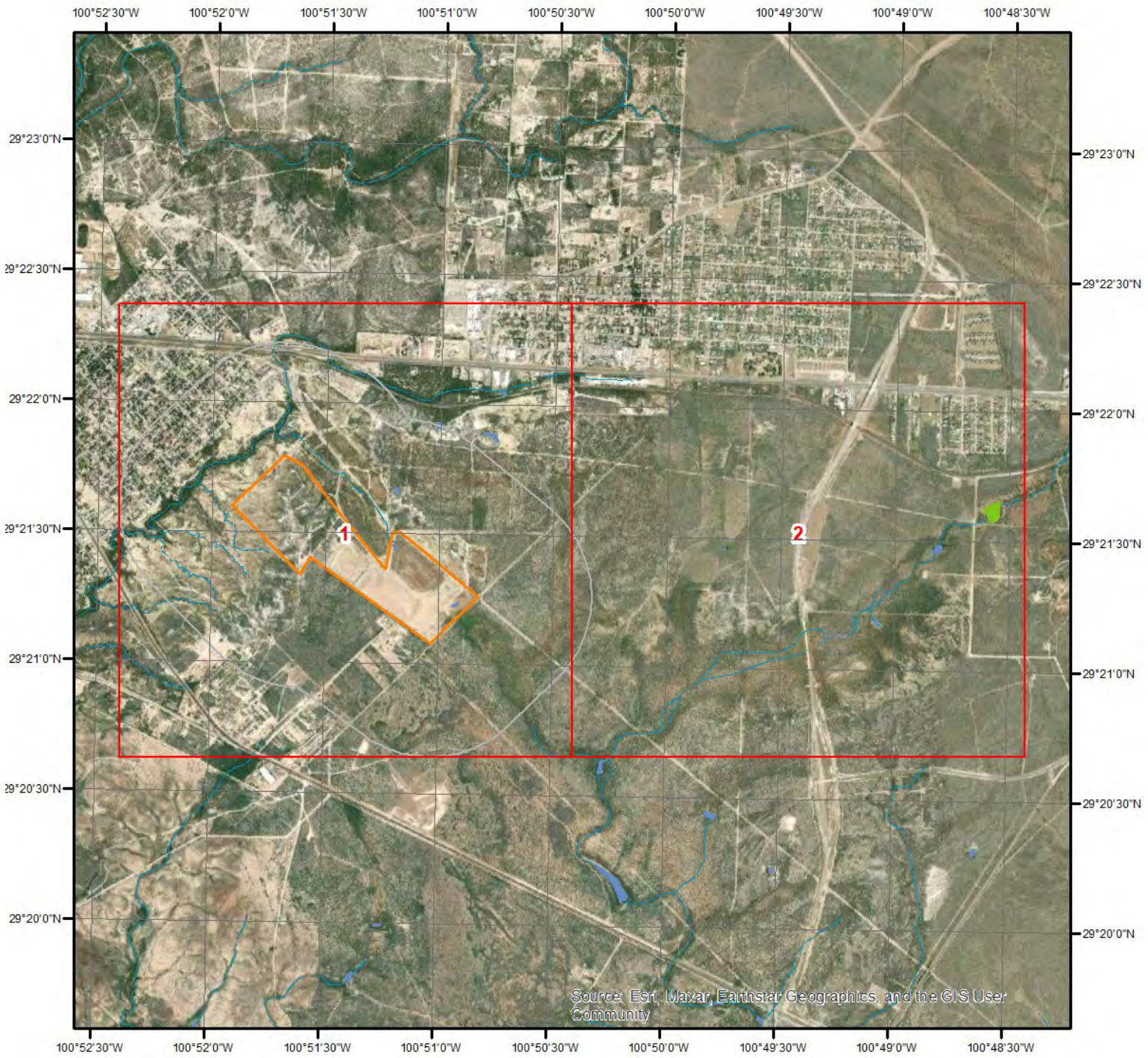
Topographic Information



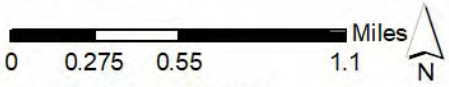
Topographic Information



Hydrologic Information



Wetland



This map shows wetland existence using data from US Fish & Wildlife.
Data coverage is shown to the right. Gray indicates no data available in the area.

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine



ERIS

Hydrologic Information



Wetland Type - Page 1

0 0.125 0.25 0.5 Miles

N

This map shows wetland existence using data from US Fish & Wildlife.
Data coverage is shown to the right. Gray indicates no data available in the area.

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

ERIS

Hydrologic Information



Wetland Type - Page 2

Miles
0 0.125 0.25 0.5

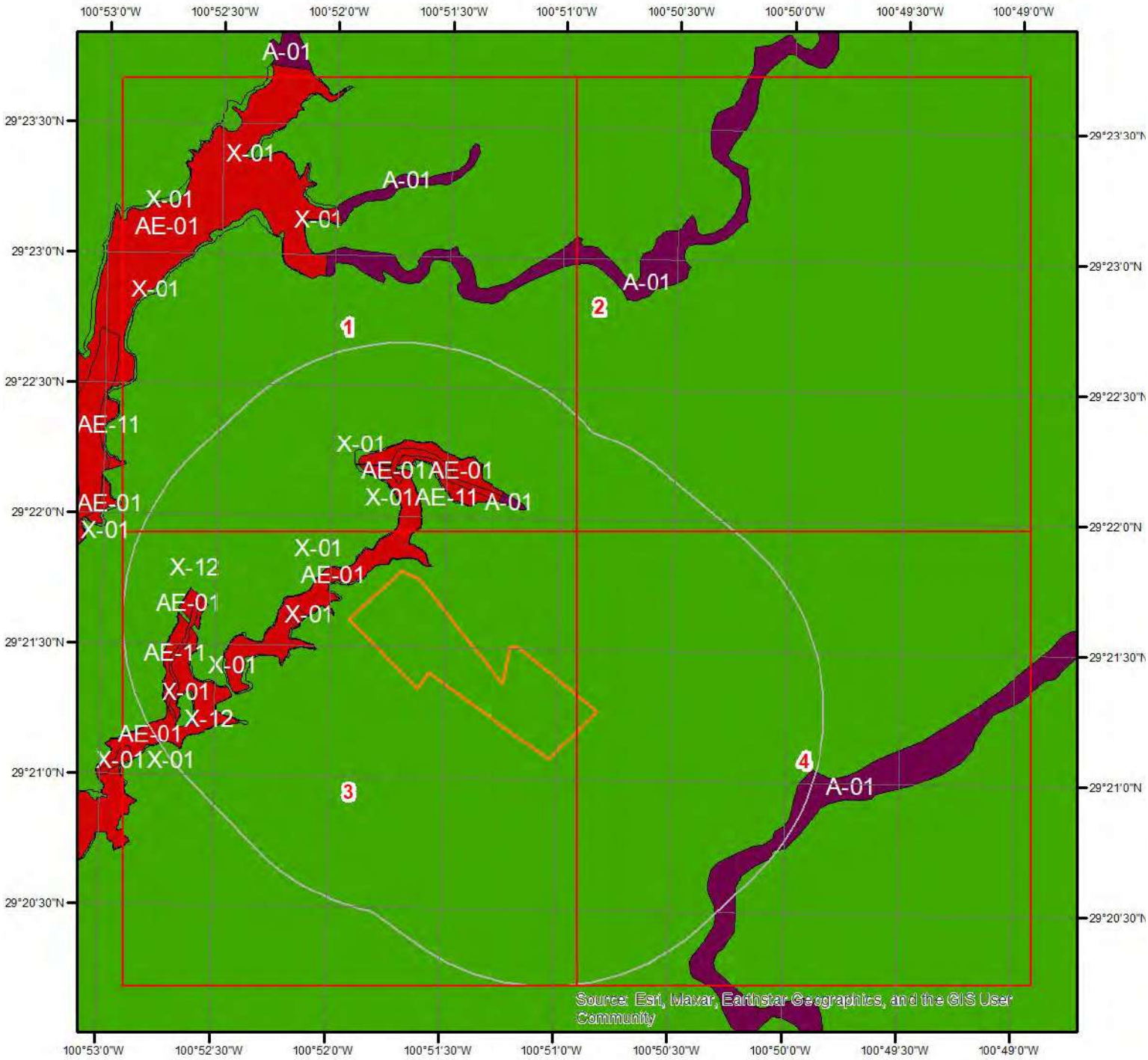
N

This map shows wetland existence using data from US Fish & Wildlife.
Data coverage is shown to the right. Gray indicates no data available in the area.

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

ERIS

Hydrologic Information

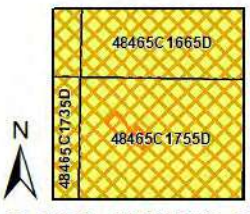


Flood Hazard Zones

This map shows FEMA flood hazard zones. FIRM panels are shown to the right, and blank indicates no data is available.

Miles
0 0.2 0.4 0.8

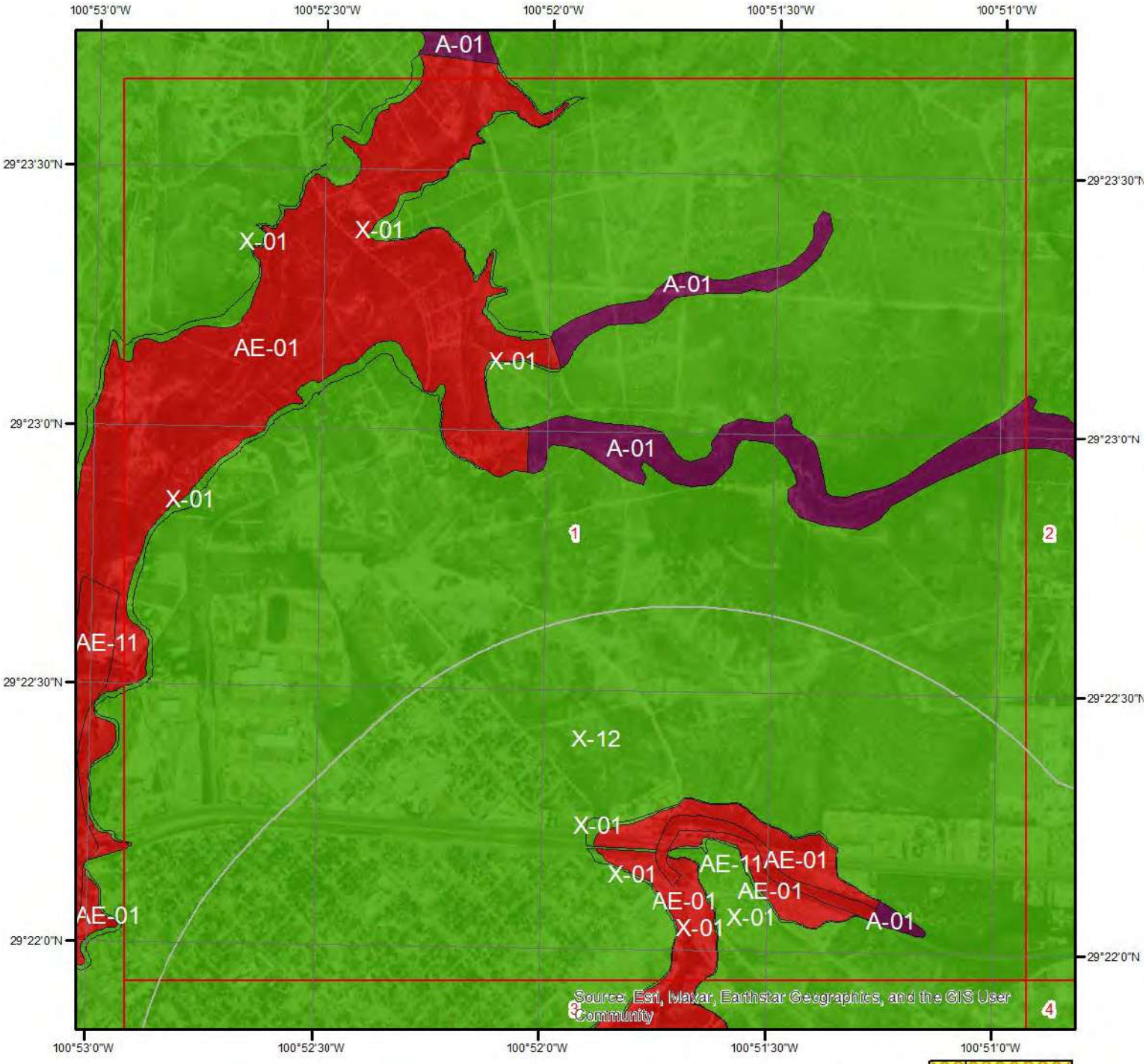
A	AO	X
A99	V	OPEN WATER
AE	VE	NOT POPULATED
AH	D	AREA NOT INCLUDED



Quadrangle(s): Del Rio NE,TX; Del Rio NW,TX; Del Rio SE,TX; Del Rio SW,TX

ERIS

Hydrologic Information



Flood Hazard Zones - Page 1

This map shows FEMA flood hazard zones. FIRM panels are shown to the right, and blank indicates no data is available.

Miles
0 0.2 0.4

N

48465C1665D
48465C1645D
48465C1755D

A	AO	X
A99	V	OPEN WATER
AE	VE	NOT POPULATED
AH	D	AREA NOT INCLUDED

Quadrangle(s): Del Rio NE,TX; Del Rio NW,TX; Del Rio SE,TX; Del Rio SW,TX

ERIS

Hydrologic Information



Flood Hazard Zones - Page 2

This map shows FEMA flood hazard zones. FIRM panels are shown to the right, and blank indicates no data is available.

Miles
0 0.2 0.4

N

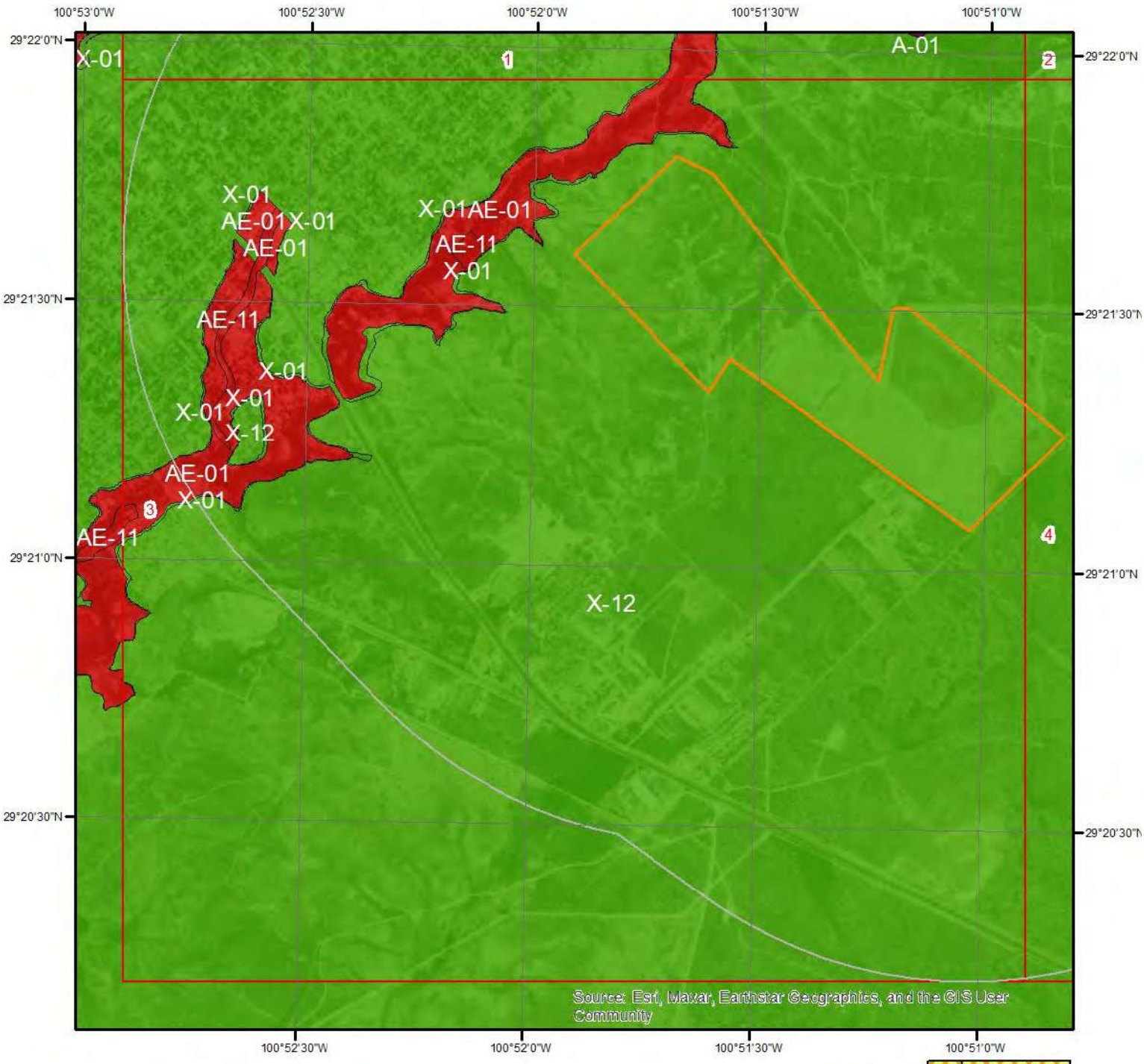
48465C1665D
48465C1755D

A	AO	X
A99	V	OPEN WATER
AE	VE	NOT POPULATED
AH	D	AREA NOT INCLUDED

Quadrangle(s): Del Rio NE,TX; Del Rio SE,TX

ERIS

Hydrologic Information



Flood Hazard Zones - Page 3

This map shows FEMA flood hazard zones. FIRM panels are shown to the right, and blank indicates no data is available.

Miles
0 0.2 0.4

N

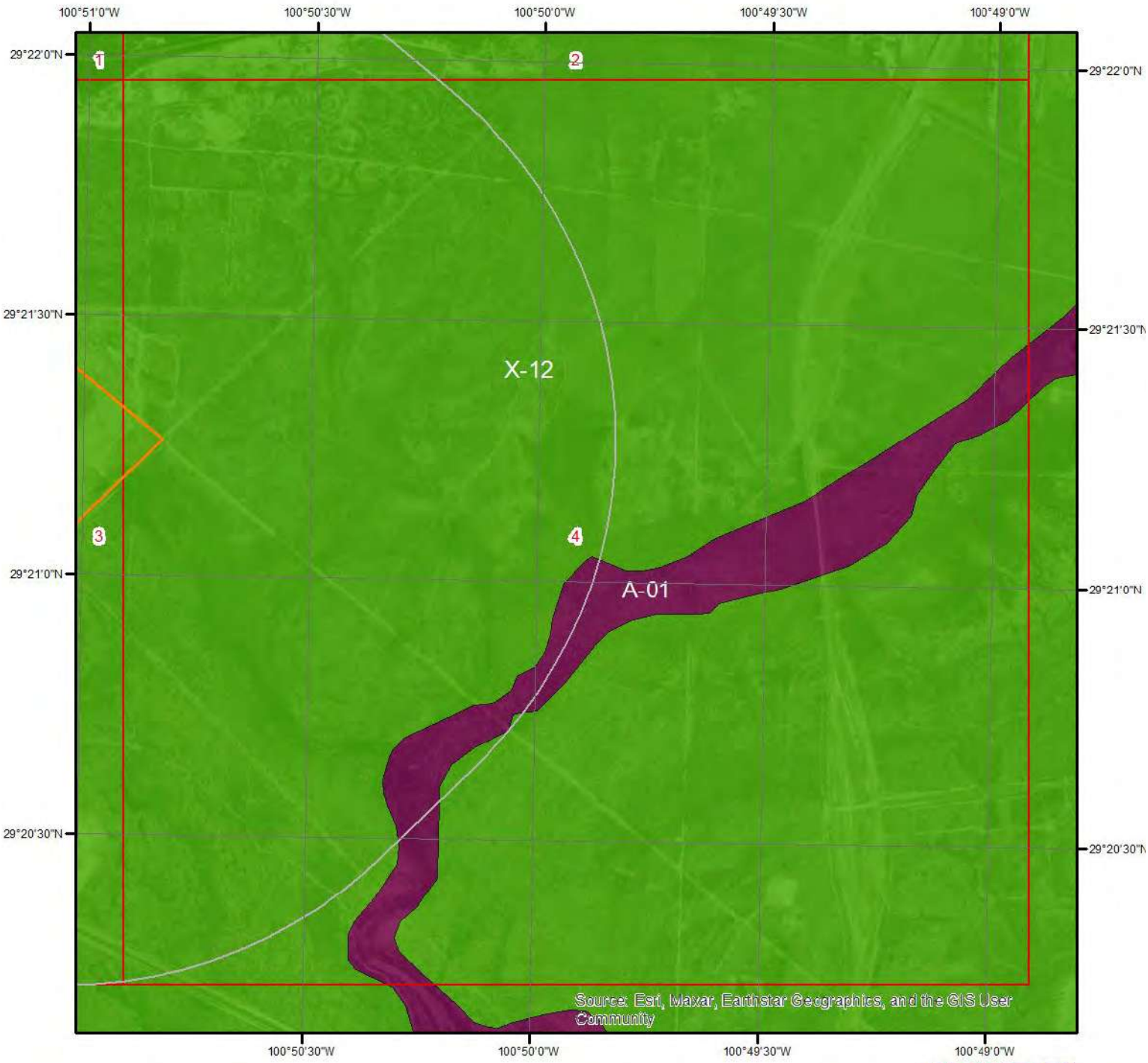
48465C1735D
48465C1755D

A	AO	X
A99	V	OPEN WATER
AE	VE	NOT POPULATED
AH	D	AREA NOT INCLUDED

Quadrangle(s): Del Rio SE,TX; Del Rio SW,TX

ERIS

Hydrologic Information



Flood Hazard Zones - Page 4

This map shows FEMA flood hazard zones. FIRM panels are shown to the right, and blank indicates no data is available.

Miles
0 0.2 0.4

N

48465C1755D

A	AO	X
A99	V	OPEN WATER
AE	VE	NOT POPULATED
AH	D	AREA NOT INCLUDED

Quadrangle(s): Del Rio SE,TX

ERIS

Hydrologic Information

The Wetland Type map shows wetland existence overlaid on an aerial imagery. The Flood Hazard Zones map shows FEMA flood hazard zones overlaid on an aerial imagery. Relevant FIRM panels and detailed zone information is provided below.
For detailed Zone descriptions please click the link: https://floodadvocate.com/fema-zone-definitions

Available FIRM Panels in area:	48465C1755D(effective:2010-07-22) 48465C1665D(effective:2010-07-22) 48465C1735D(effective:2010-07-22)

Flood Zone A-01

Zone:	A
Zone subtype:	

Flood Zone AE-01

Zone:	AE
Zone subtype:	

Flood Zone AE-11

Zone:	AE
Zone subtype:	FLOODWAY

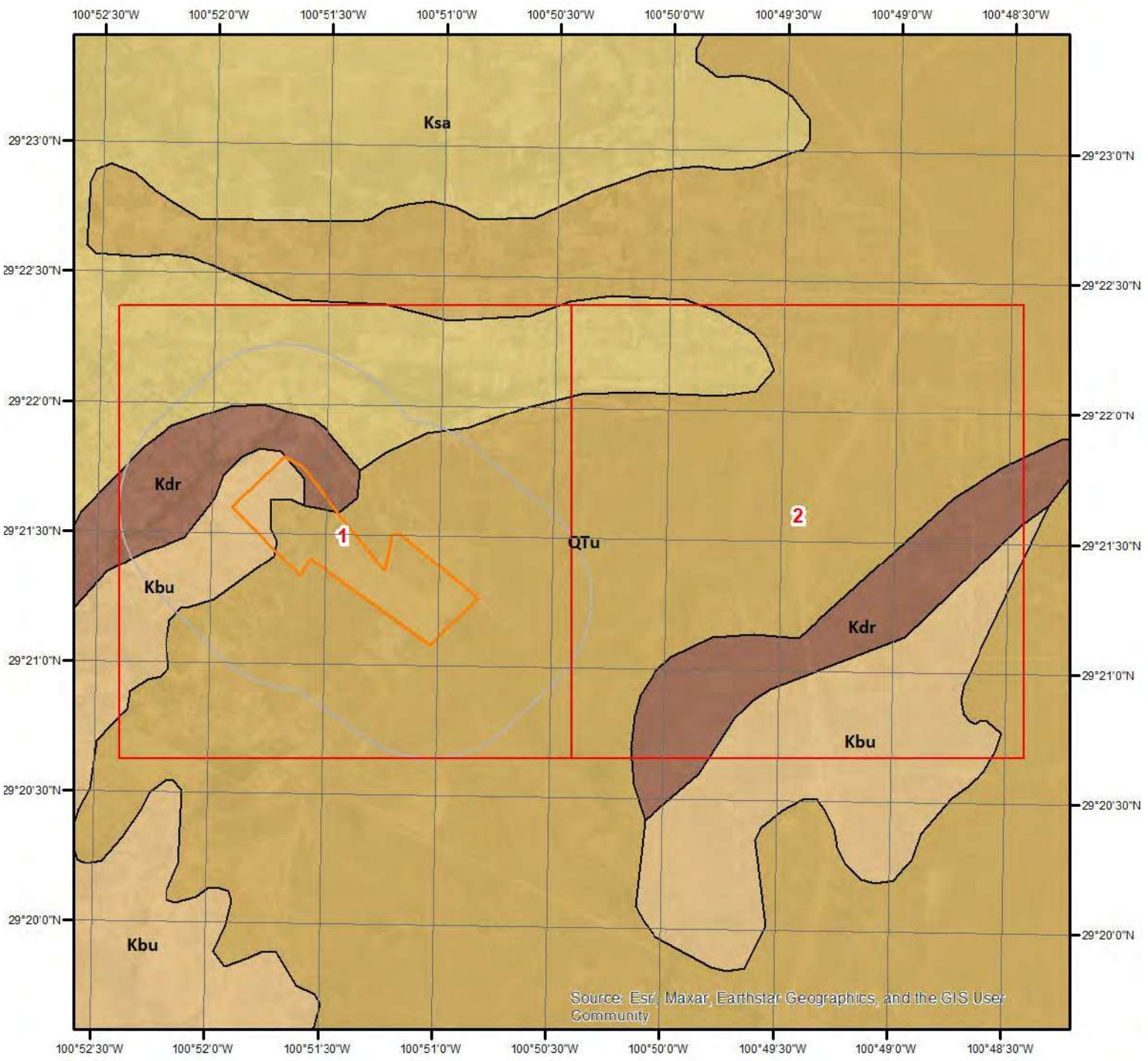
Flood Zone X-01

Zone:	X
Zone subtype:	0.2 PCT ANNUAL CHANCE FLOOD HAZARD

Flood Zone X-12

Zone:	X
Zone subtype:	AREA OF MINIMAL FLOOD HAZARD

Geologic Information



0 0.75 1.5 Miles

N

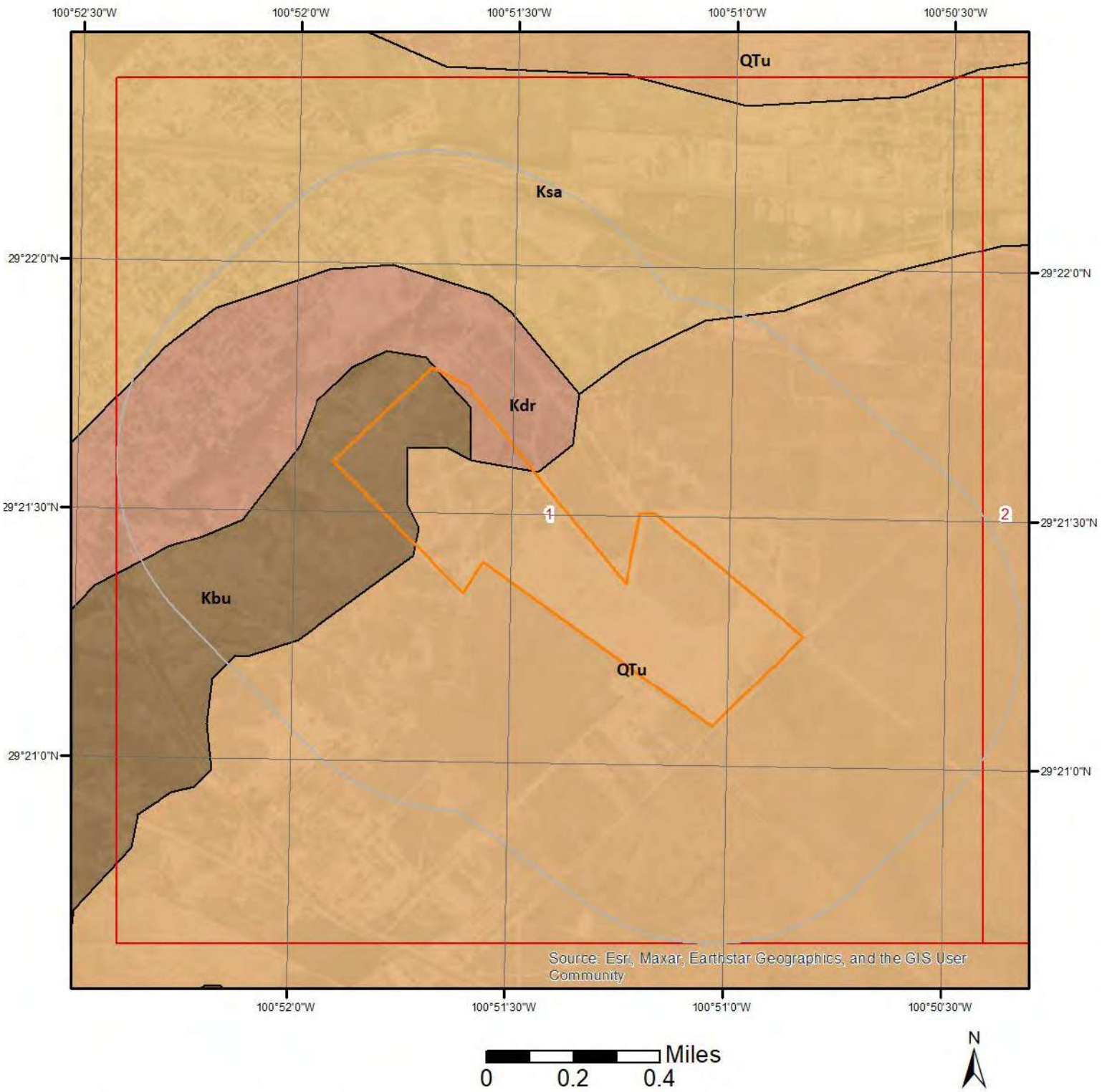
Geologic Units

This maps shows geologic units in the area. Please refer to the report for detailed descriptions.

ERIS

0 0.4 0.8 1.6 Miles

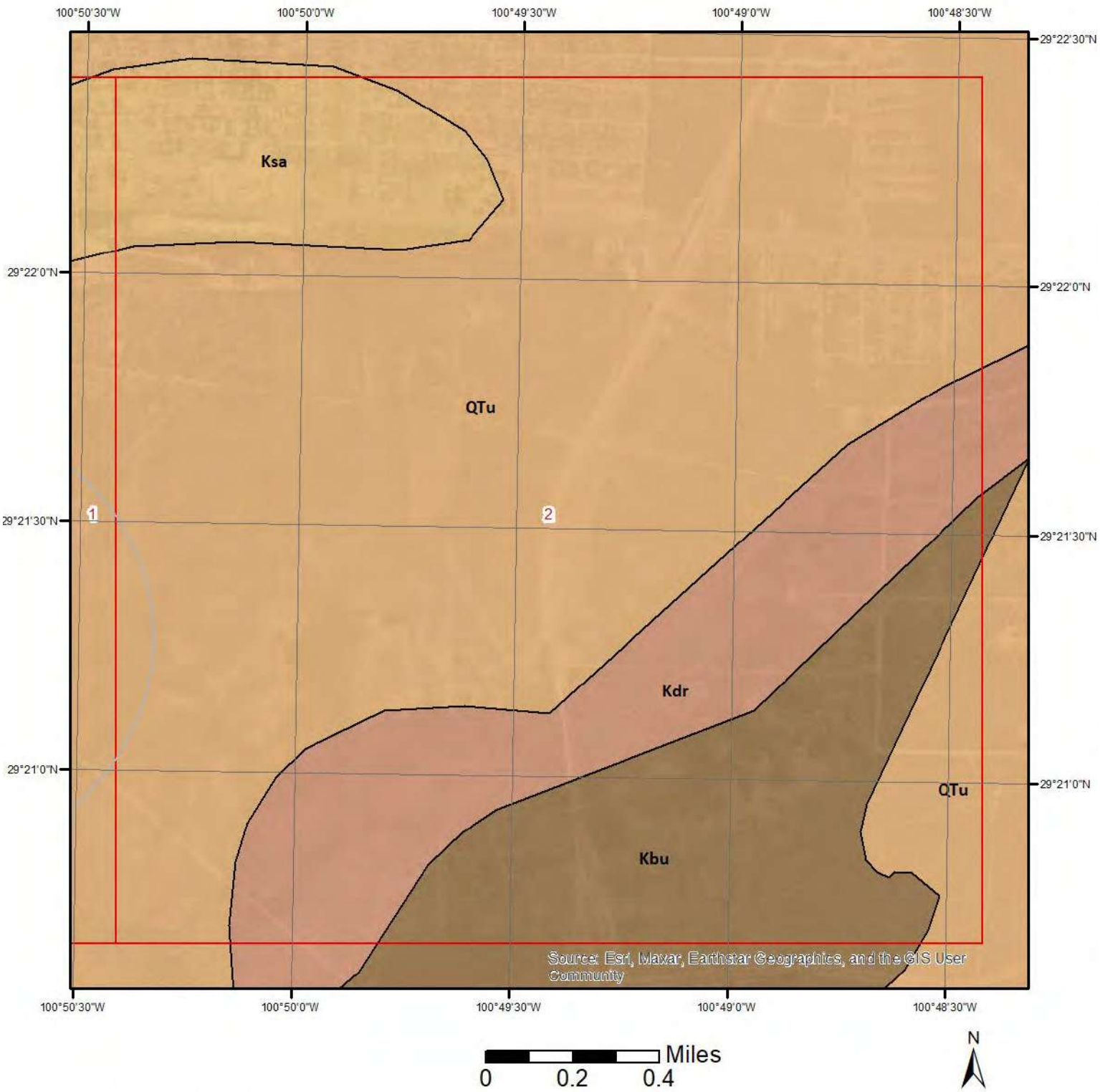
Geologic Information



Geologic Units - Page 1

This maps shows geologic units in the area. Please refer to the report for detailed descriptions.

Geologic Information



Geologic Units - Page 2

This maps shows geologic units in the area. Please refer to the report for detailed descriptions.

Geologic Information

The previous page shows USGS geology information. Detailed information about each unit is provided below.

Geologic Unit Ksa

Unit Name:	Salmon Peak Limestone
Unit Age:	Phanerozoic | Mesozoic | Cretaceous-Early
Primary Rock Type:	limestone
Secondary Rock Type:	mudstone
Unit Description:	Salmon Peak Limestone

Geologic Unit QTu

Unit Name:	Uvalde Gravel
Unit Age:	Phanerozoic | Cenozoic | Tertiary Quaternary | Pliocene Pleistocene
Primary Rock Type:	gravel
Secondary Rock Type:	chert
Unit Description:	Uvalde Gravel

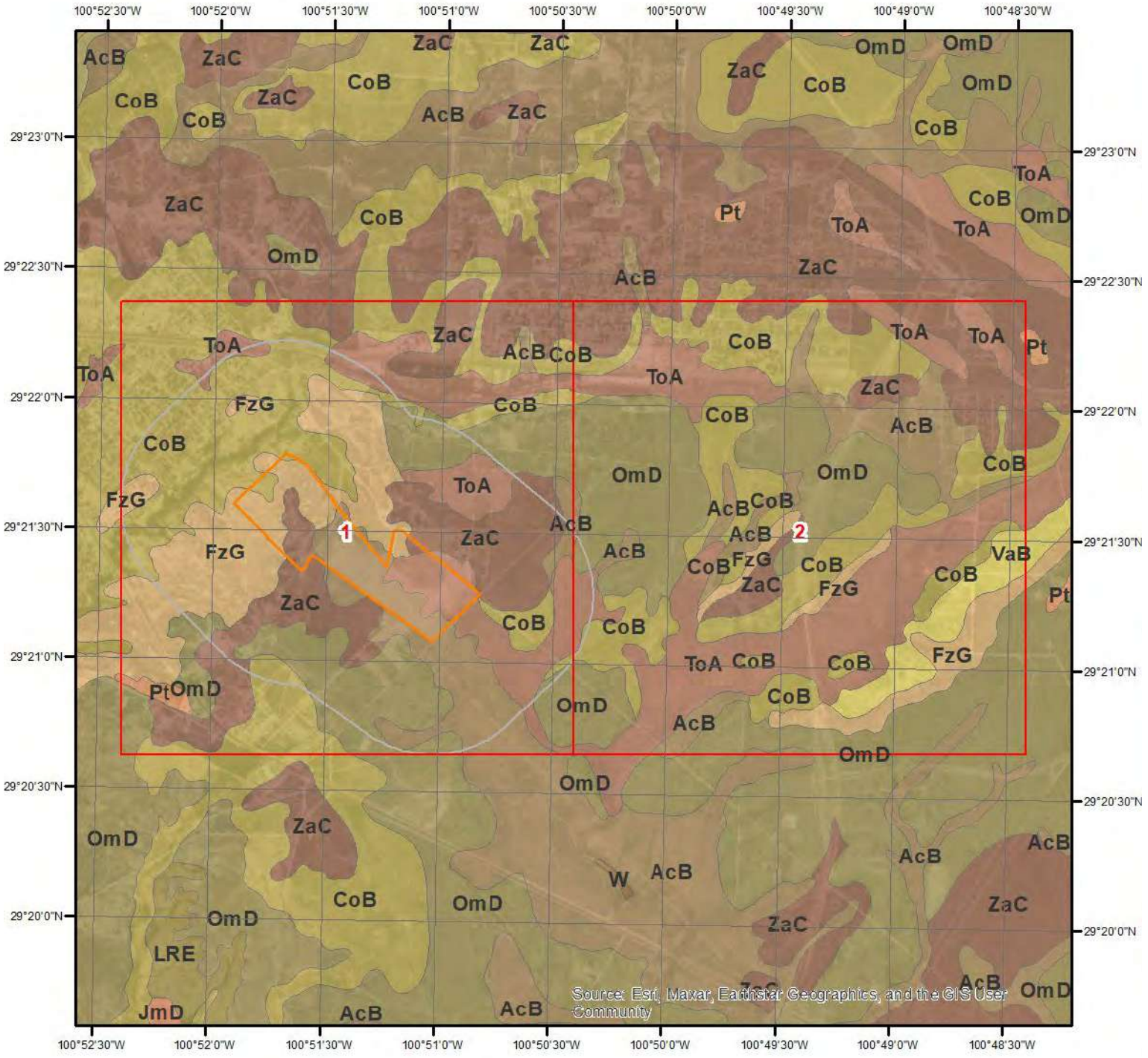
Geologic Unit Kdr

Unit Name:	Del Rio Clay
Unit Age:	Phanerozoic | Mesozoic | Cretaceous-Late
Primary Rock Type:	mudstone
Secondary Rock Type:	limestone
Unit Description:	Del Rio Clay

Geologic Unit Kbu

Unit Name:	Buda Limestone
Unit Age:	Phanerozoic | Mesozoic | Cretaceous-Early
Primary Rock Type:	limestone
Secondary Rock Type:	
Unit Description:	Buda Limestone

Soil Information



SSURGO Soils

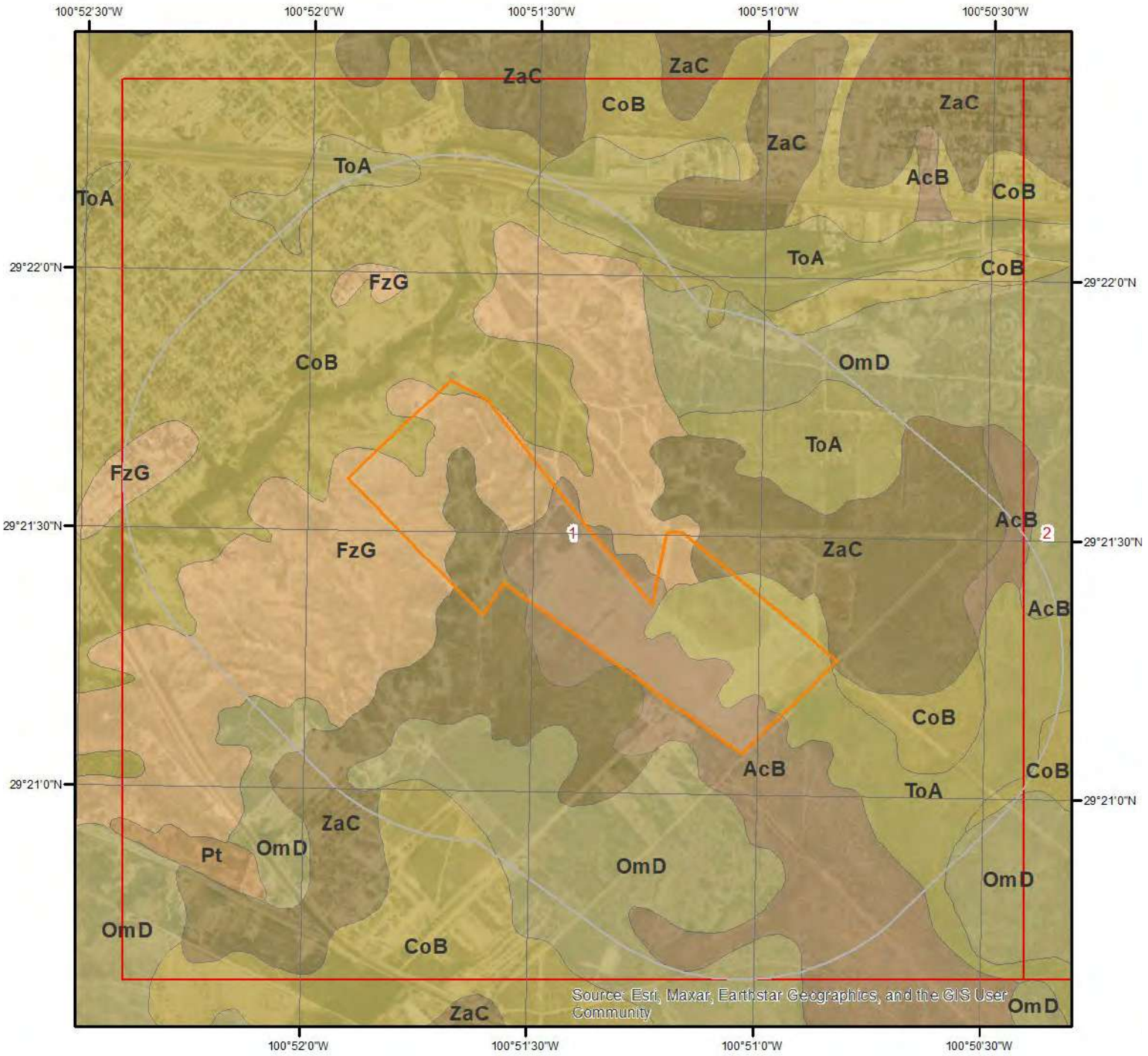
0 0.2 0.4 0.8 1.2 Miles

N

This maps shows SSURGO soil units around the target property. Please refer to the report for detailed soil descriptions.

ERIS

Soil Information



SSURGO Soils - Page 1

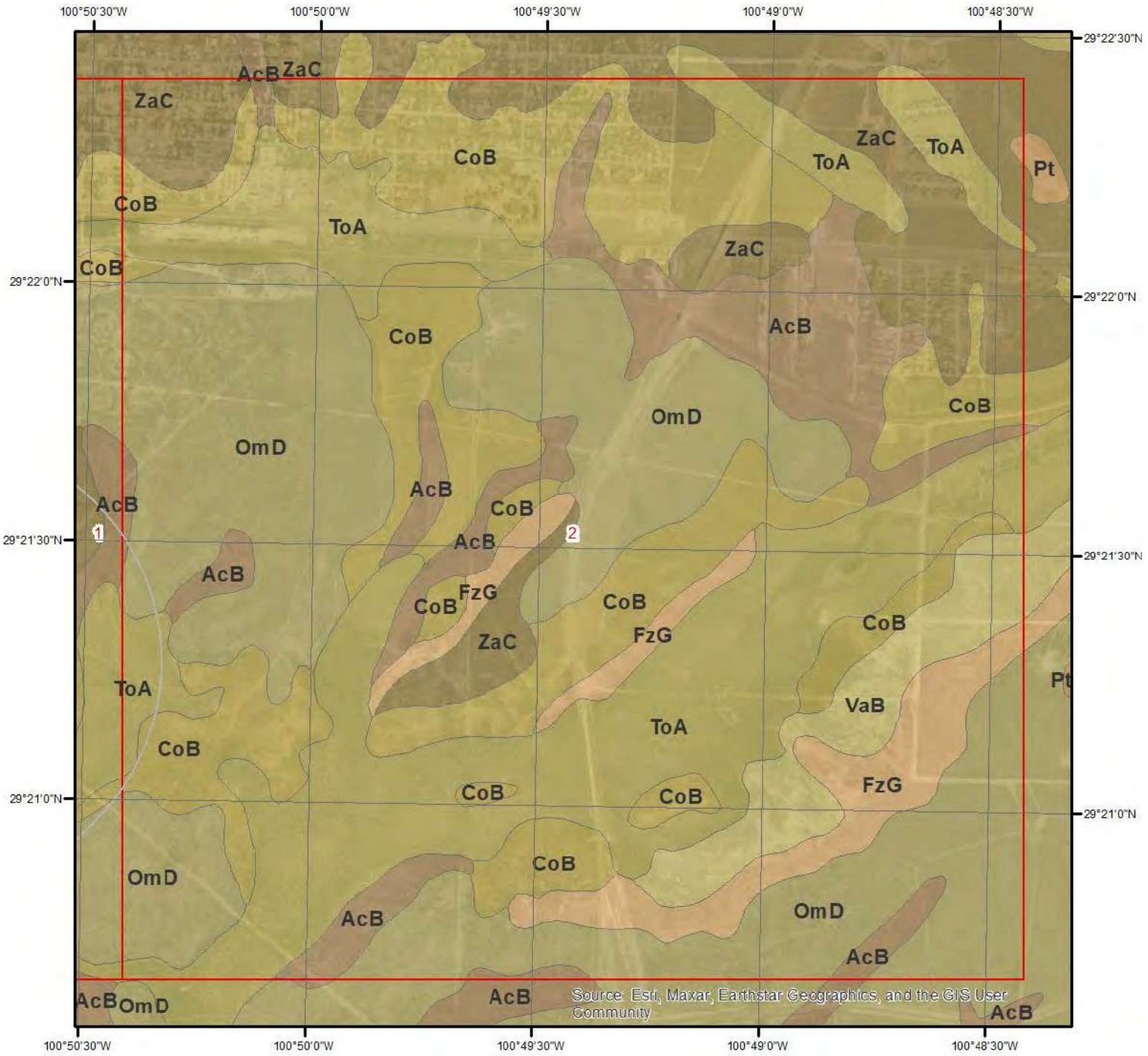
Miles
0 0.2 0.4

N

This maps shows SSURGO soil units around the target property. Please refer to the report for detailed soil descriptions.

ERIS

Soil Information



SSURGO Soils - Page 2

This maps shows SSURGO soil units around the target property. Please refer to the report for detailed soil descriptions.

ERIS

Soil Information

The previous page shows a soil map using SSURGO data from USDA Natural Resources Conservation Service. Detailed information about each unit is provided below.

Map Unit AcB (14.4%)

Map Unit Name:	Acuna silty clay, 0 to 3 percent slopes
Bedrock Depth - Min:	null
Watertable Depth - Annual Min:	null
Drainage Class - Dominant:	Well drained
Hydrologic Group - Dominant:	B - Soils in this group have moderately low runoff potential when thoroughly wet. Water transmission through the soil is unimpeded.

Major components are printed below

Acuna(100%)

horizon H1(0cm to 46cm)	Silty clay
horizon H2(46cm to 76cm)	Clay
horizon H3(76cm to 203cm)	Silty clay

Component Description:

Minor map unit components are excluded from this report.

Map Unit: AcB - Acuna silty clay, 0 to 3 percent slopes

Component: Acuna (100%)
The Acuna component makes up 100 percent of the map unit. Slopes are 0 to 3 percent. This component is on stream terraces on inland, dissected coastal plains. The parent material consists of calcareous loamy alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is moderate. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent. This component is in the R083BY025TX Clay Loam ecological site. Nonirrigated land capability classification is 4e. Irrigated land capability classification is 2e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 48 percent. There are no saline horizons within 30 inches of the soil surface.

Map Unit CoB (39.18%)

Map Unit Name:	Coahuila clay loam, 0 to 3 percent slopes
Bedrock Depth - Min:	null
Watertable Depth - Annual Min:	null
Drainage Class - Dominant:	Well drained
Hydrologic Group - Dominant:	B - Soils in this group have moderately low runoff potential when thoroughly wet. Water transmission through the soil is unimpeded.

Major components are printed below

Coahuila(100%)

horizon H1(0cm to 23cm)	Clay loam
horizon H2(23cm to 157cm)	Silty clay loam

Component Description:

Minor map unit components are excluded from this report.

Map Unit: CoB - Coahuila clay loam, 0 to 3 percent slopes

Component: Coahuila (100%)
The Coahuila component makes up 100 percent of the map unit. Slopes are 0 to 3 percent. This component is on stream terraces on inland, dissected coastal plains. The parent material consists of calcareous loamy alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is moderate. This soil is not flooded. It is not

ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent. This component is in the R083BY025TX Clay Loam ecological site. Nonirrigated land capability classification is 4e. Irrigated land capability classification is 2e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 50 percent. There are no saline horizons within 30 inches of the soil surface.

Map Unit FzG (6.97%)

Map Unit Name:	Felipe and Zorra soils, very rocky, 8 to 40 percent slopes
Bedrock Depth - Min:	30cm
Watertable Depth - Annual Min:	null
Drainage Class - Dominant:	Well drained
Hydrologic Group - Dominant:	D - Soils in this group have high runoff potential when thoroughly wet. Water movement through the soil is restricted or very restricted.

Major components are printed below

Felipe(55%)	
horizon H1(0cm to 13cm)	Very gravelly clay
horizon H2(13cm to 46cm)	Clay
horizon H3(46cm to 183cm)	Shaly clay
Zorra(30%)	
horizon H1(0cm to 20cm)	Very stony loam
horizon H2(20cm to 30cm)	Cemented material
horizon H3(30cm to 51cm)	Bedrock

Component Description:

Minor map unit components are excluded from this report.

Map Unit: FzG - Felipe and Zorra soils, very rocky, 8 to 40 percent slopes

Component: Felipe (55%)
The Felipe component makes up 55 percent of the map unit. Slopes are 8 to 40 percent. This component is on ridges on dissected plateaus. The parent material consists of residuum weathered from claystone. Depth to a root restrictive layer, bedrock, paralithic, is 10 to 20 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is low. Available water to a depth of 60 inches (or restricted depth) is very low. Shrink-swell potential is high. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R081BY320TX Adobe 23-31 Pz ecological site. Nonirrigated land capability classification is 7e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 35 percent. There are no saline horizons within 30 inches of the soil surface.

Component: Zorra (30%)
The Zorra component makes up 30 percent of the map unit. Slopes are 8 to 15 percent. This component is on ridges on dissected plateaus. The parent material consists of residuum weathered from limestone. Depth to a root restrictive layer, petrocalcic, is 4 to 19 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches (or restricted depth) is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 3 percent. This component is in the R081BY336TX Low Stony Hill 19-23 Pz ecological site. Nonirrigated land capability classification is 7s. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 50 percent. There are no saline horizons within 30 inches of the soil surface.

Component: Unnamed (15%)
Generated brief soil descriptions are created for major soil components. The Unnamed soil is a minor component.

Map Unit OmD (25.26%)

Map Unit Name:	Olmos very gravelly loam, 1 to 8 percent slopes
Bedrock Depth - Min:	null
Watertable Depth - Annual Min:	null
Drainage Class - Dominant:	Well drained

Soil Information

Hydrologic Group - Dominant:	D - Soils in this group have high runoff potential when thoroughly wet. Water movement through the soil is restricted or very restricted.

Major components are printed below

Olmos(100%)

horizon H1(0cm to 46cm)	Very gravelly loam
horizon H2(46cm to 152cm)	Cemented material
horizon H3(152cm to 203cm)	Gravelly loam

Component Description:

Minor map unit components are excluded from this report.

Map Unit: OmD - Olmos very gravelly loam, 1 to 8 percent slopes

Component: Olmos (100%)
The Olmos component makes up 100 percent of the map unit. Slopes are 1 to 8 percent. This component is on ridges on inland, dissected coastal plains. The parent material consists of calcareous loamy alluvium. Depth to a root restrictive layer, petrocalcic, is 10 to 20 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches (or restricted depth) is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 3 percent. This component is in the R083BY002TX Shallow Ridge ecological site. Nonirrigated land capability classification is 7s. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 65 percent. There are no saline horizons within 30 inches of the soil surface.

Map Unit ToA (10.59%)

Map Unit Name:	Tobosa clay, 0 to 1 percent slopes
Bedrock Depth - Min:	null
Watertable Depth - Annual Min:	null
Drainage Class - Dominant:	Well drained
Hydrologic Group - Dominant:	D - Soils in this group have high runoff potential when thoroughly wet. Water movement through the soil is restricted or very restricted.

Major components are printed below

Tobosa(100%)

horizon H1(0cm to 86cm)	Clay
horizon H2(86cm to 130cm)	Clay
horizon H3(130cm to 157cm)	Clay

Component Description:

Minor map unit components are excluded from this report.

Map Unit: ToA - Tobosa clay, 0 to 1 percent slopes

Component: Tobosa (100%)
The Tobosa component makes up 100 percent of the map unit. Slopes are 0 to 1 percent. This component is on flat plains on plateaus. The parent material consists of calcareous clayey alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is low. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is very high. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 3 percent. This component is in the R081BY323TX Clay Flat 19-23 Pz ecological site. Nonirrigated land capability classification is 3s. Irrigated land capability classification is 2s. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 16 percent. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 4 within 30 inches of the soil surface.

Map Unit ZaC (3.6%)

Map Unit Name:	Zapata-Vinegarroon complex, 1 to 5 percent slopes
Bedrock Depth - Min:	null

Soil Information

Watertable Depth - Annual Min:	null
Drainage Class - Dominant:	Well drained
Hydrologic Group - Dominant:	D - Soils in this group have high runoff potential when thoroughly wet. Water movement through the soil is restricted or very restricted.

Major components are printed below

Zapata(50%)	
horizon H1(0cm to 20cm)	Clay loam
horizon H2(20cm to 152cm)	Cemented material
Vinegarroon(40%)	
horizon H1(0cm to 43cm)	Gravelly loam
horizon H2(43cm to 61cm)	Cemented material
horizon H3(61cm to 152cm)	Gravelly loam

Component Description:

Minor map unit components are excluded from this report.

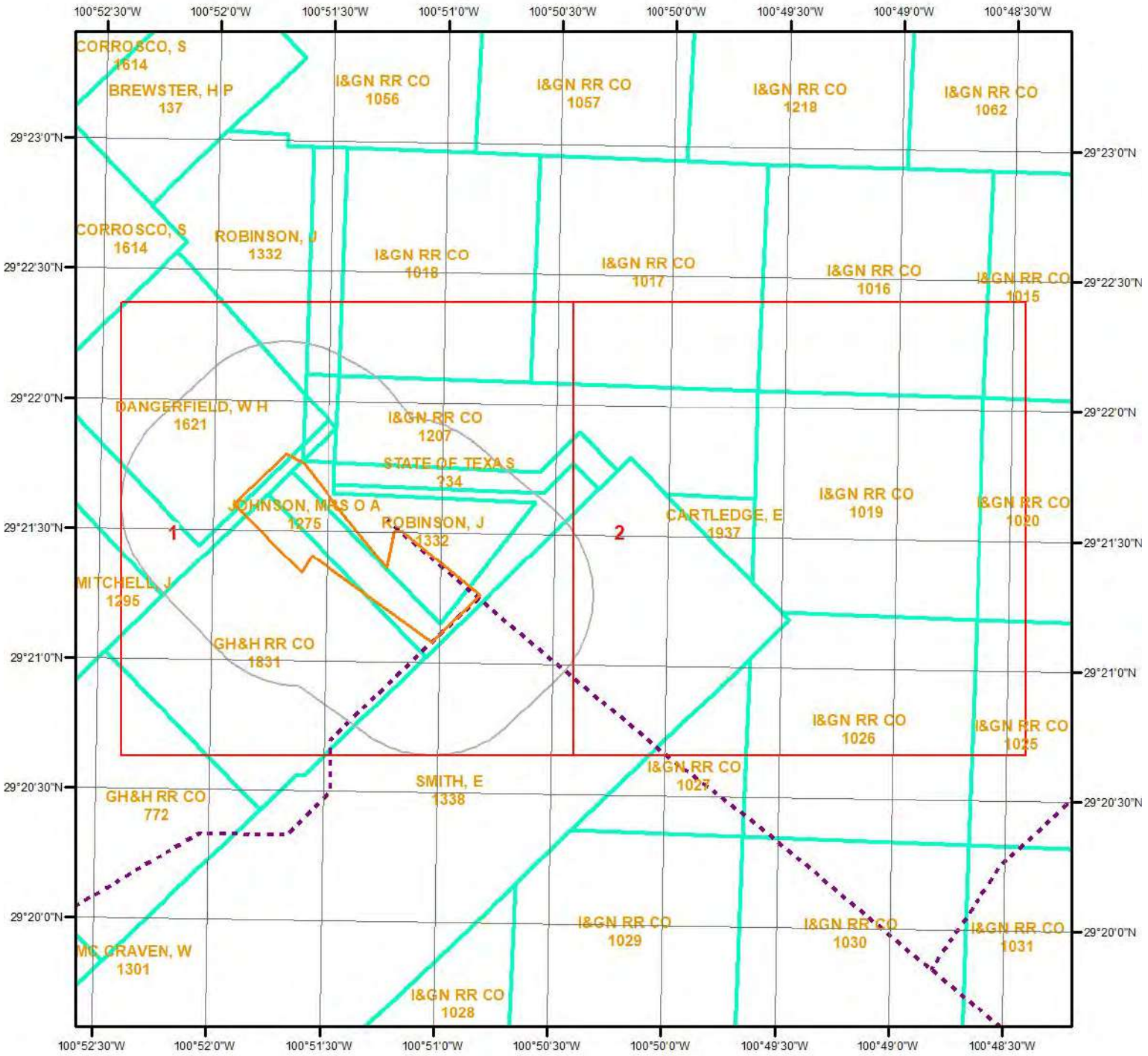
Map Unit: ZaC - Zapata-Vinegarroon complex, 1 to 5 percent slopes

Component: Zapata (50%)
The Zapata component makes up 50 percent of the map unit. Slopes are 1 to 5 percent. This component is on ridges on inland, dissected coastal plains. The parent material consists of calcareous loamy alluvium. Depth to a root restrictive layer, petrocalcic, is 4 to 10 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches (or restricted depth) is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent. This component is in the R083BY002TX Shallow Ridge ecological site. Nonirrigated land capability classification is 7s. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 21 percent. There are no saline horizons within 30 inches of the soil surface.

Component: Vinegarroon (40%)
The Vinegarroon component makes up 40 percent of the map unit. Slopes are 1 to 3 percent. This component is on interfluves on inland, dissected coastal plains. The parent material consists of calcareous loamy alluvium. Depth to a root restrictive layer, petrocalcic, is 10 to 20 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches (or restricted depth) is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent. This component is in the R083BY002TX Shallow Ridge ecological site. Nonirrigated land capability classification is 6e. Irrigated land capability classification is 4e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 70 percent. There are no saline horizons within 30 inches of the soil surface.

Component: Unnamed (10%)
Generated brief soil descriptions are created for major soil components. The Unnamed soil is a minor component.

Pipeline and Survey Information



Survey & Pipeline Map

Miles
0 0.2 0.4 0.8 1.2

N

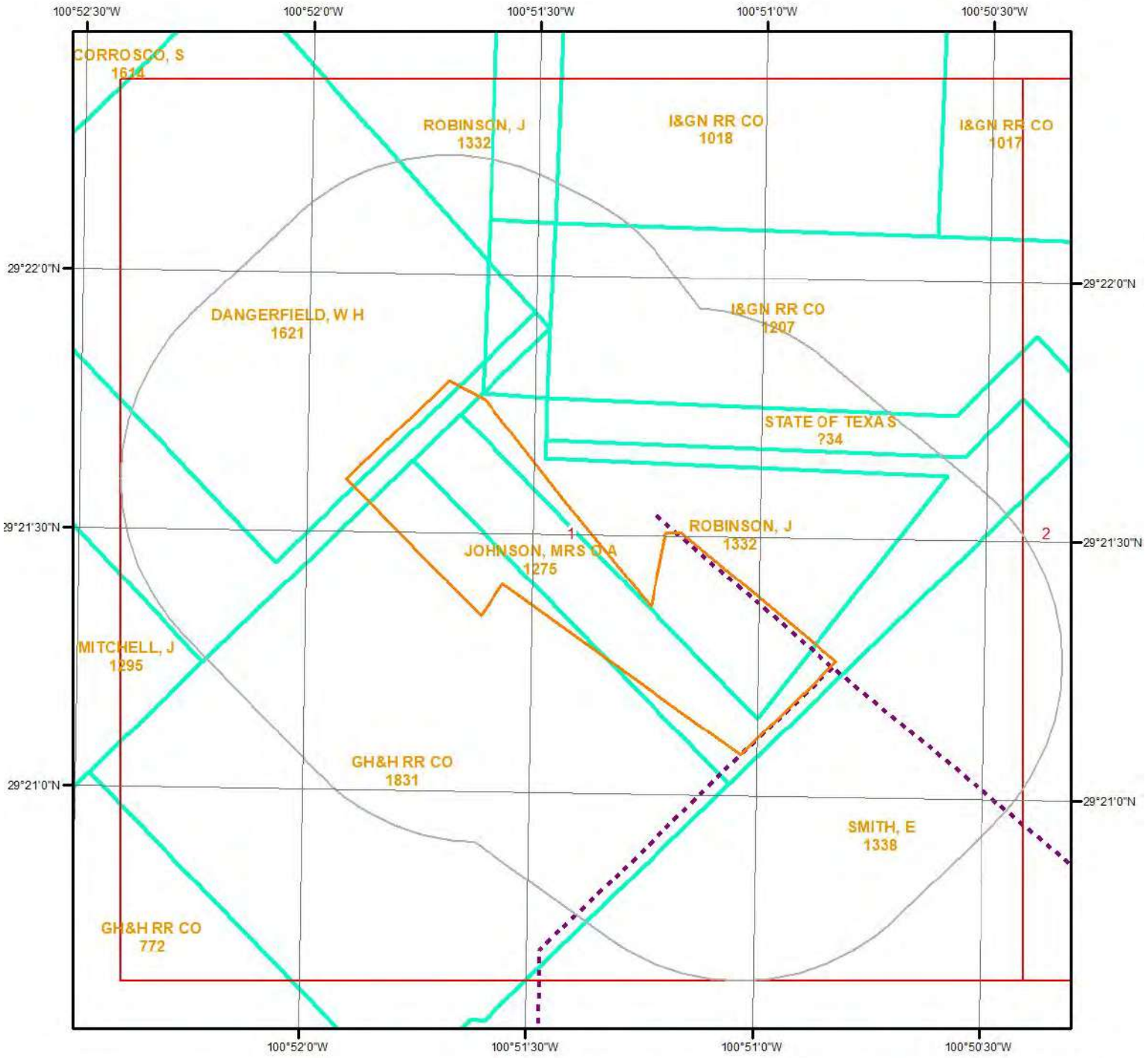
This maps shows Survey & Pipeline around the target property. Please refer to the report for detailed descriptions.

Legend

Pipeline

Survey

Pipeline and Survey Information



Survey & Pipeline - Page 1

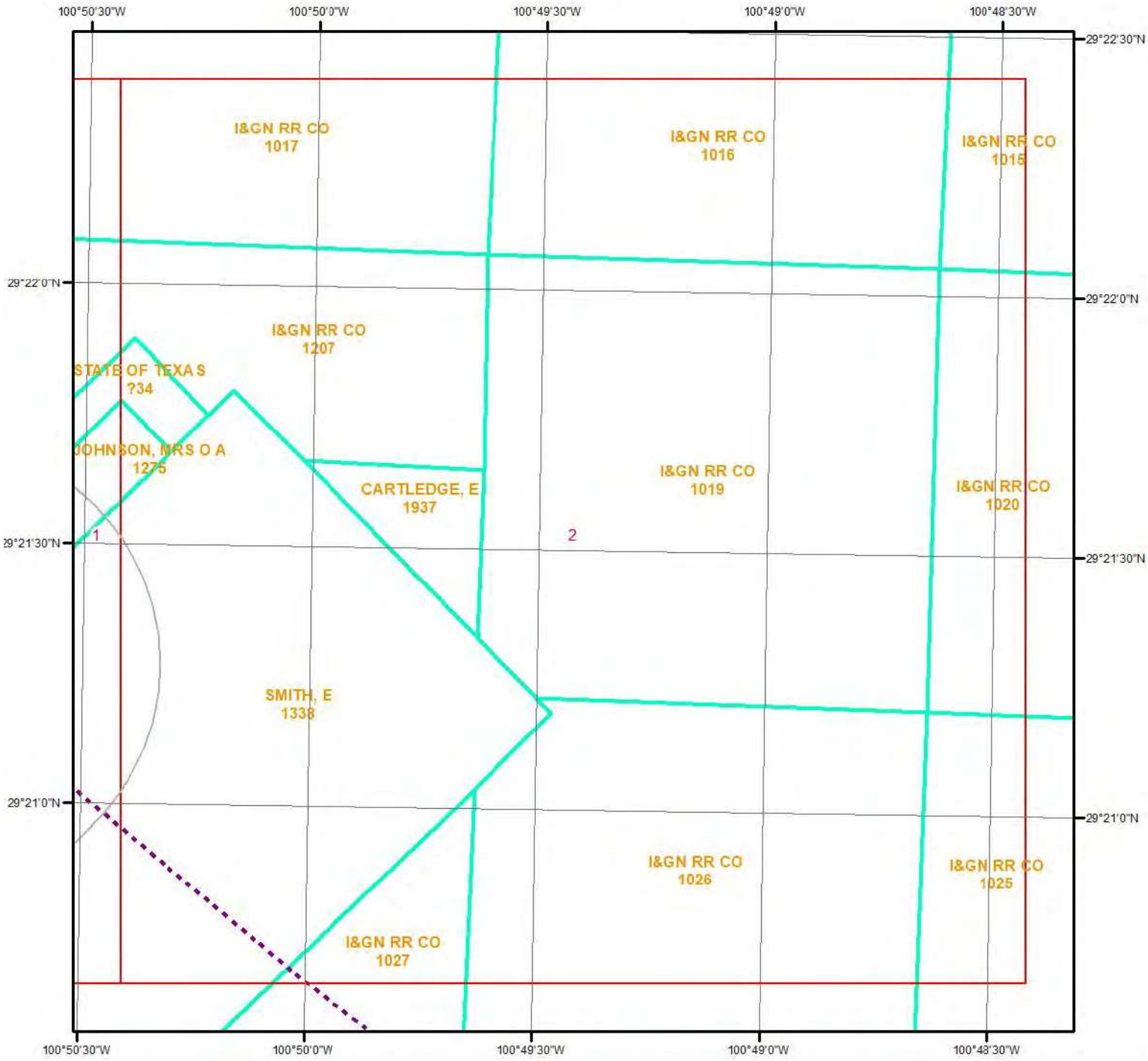
0 0.2 0.4 0.8 Miles

N

This maps shows Survey & Pipeline around the target property. Please refer to the report for detailed descriptions.

ERIS

Pipeline and Survey Information



Survey & Pipeline - Page 2

0 0.2 0.4 0.8 Miles

N

This maps shows Survey & Pipeline around the target property. Please refer to the report for detailed descriptions.

ERIS

Pipeline and Survey Detail Report

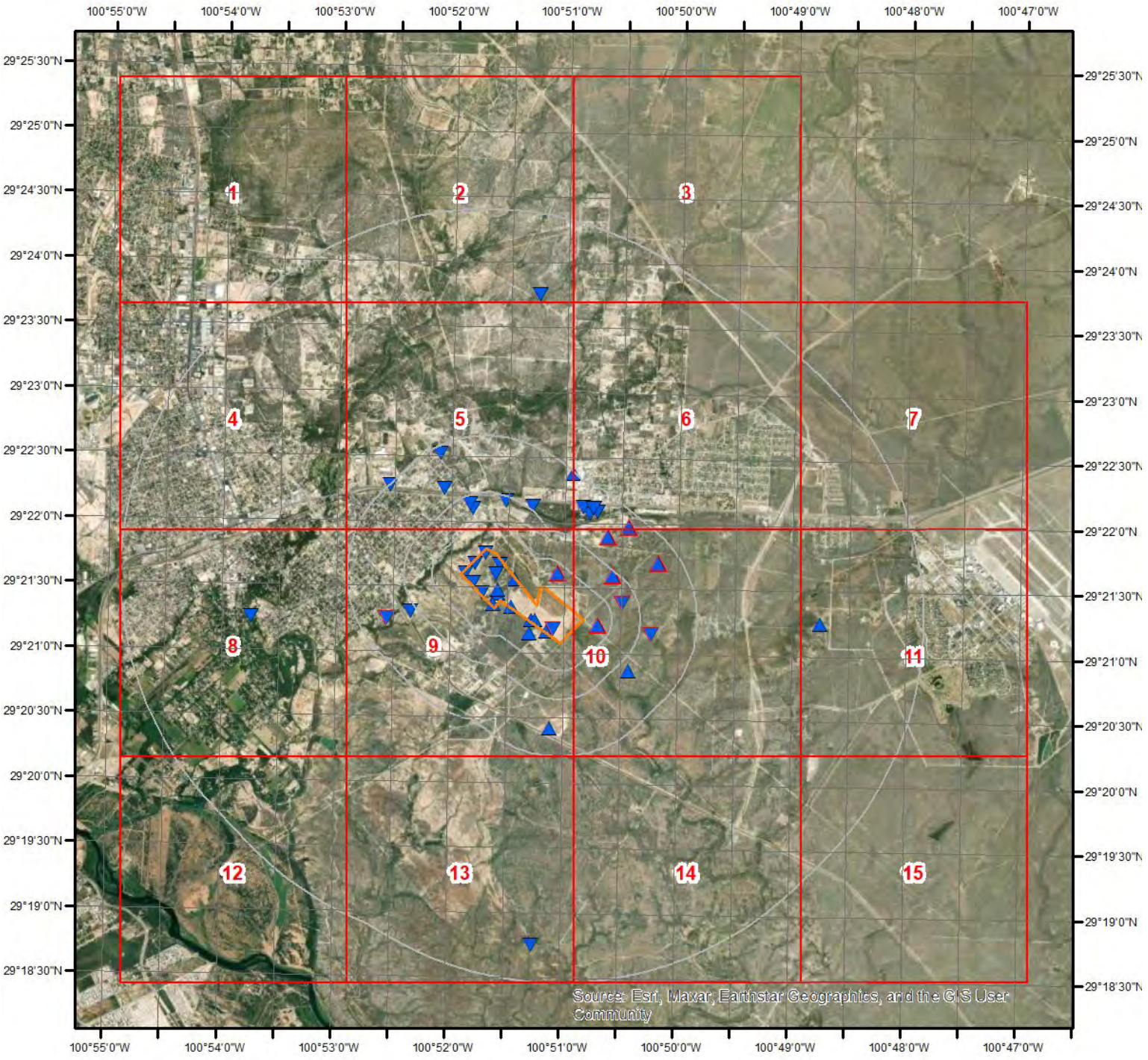
The previous page shows a pipeline and survey map. Detailed information about each unit is provided below.

Pipe Line ID	6E/50
Status	I
T4 Permit NO	00748
Commodity	NGT
Cmdty Desc	NATURAL GAS
Operator	WEST TEXAS GAS, INC.
System Name	WTG TGU
Diameter (inches)	6.63

Pipe Line ID	6E
Status	I
T4 Permit NO	00748
Commodity	NGT
Cmdty Desc	NATURAL GAS
Operator	WEST TEXAS GAS, INC.
System Name	WTG TGU
Diameter (inches)	10.75

Pipe Line ID	6E/42
Status	I
T4 Permit NO	00748
Commodity	NGT
Cmdty Desc	NATURAL GAS
Operator	WEST TEXAS GAS, INC.
System Name	WTG TGU
Diameter (inches)	4.5

Wells and Additional Sources



Wells & Additional Sources

N

0 0.5 1 2 Miles

- Sites with Higher Elevation
- Sites with Same Elevation
- Sites with Lower Elevation
- Sites with Unknown Elevation
- OGW Sites with Higher Elevation
- OGW Sites with Same Elevation
- OGW Sites with Lower Elevation
- OGW Sites with Unknown Elevation

ERIS

Wells and Additional Sources



Wells & Additional Sources - Page 1

N

0 0.15 0.3 0.6 Miles

- Sites with Higher Elevation
- Sites with Same Elevation
- Sites with Lower Elevation
- Sites with Unknown Elevation
- OGW Sites with Higher Elevation
- OGW Sites with Same Elevation
- OGW Sites with Lower Elevation
- OGW Sites with Unknown Elevation

ERIS

Wells and Additional Sources



Wells & Additional Sources - Page 2

N

0 0.15 0.3 0.6 Miles

- Sites with Higher Elevation
- Sites with Same Elevation
- Sites with Lower Elevation
- Sites with Unknown Elevation
- OGW Sites with Higher Elevation
- OGW Sites with Same Elevation
- OGW Sites with Lower Elevation
- OGW Sites with Unknown Elevation

ERIS

Wells and Additional Sources



Wells & Additional Sources - Page 3

N

0 0.15 0.3 0.6 Miles

- Sites with Higher Elevation
- Sites with Same Elevation
- Sites with Lower Elevation
- Sites with Unknown Elevation
- OGW Sites with Higher Elevation
- OGW Sites with Same Elevation
- OGW Sites with Lower Elevation
- OGW Sites with Unknown Elevation

ERIS

Wells and Additional Sources



Wells & Additional Sources - Page 4

N

0 0.15 0.3 0.6 Miles

- Sites with Higher Elevation
- Sites with Same Elevation
- Sites with Lower Elevation
- Sites with Unknown Elevation
- OGW Sites with Higher Elevation
- OGW Sites with Same Elevation
- OGW Sites with Lower Elevation
- OGW Sites with Unknown Elevation

ERIS

Wells and Additional Sources



Wells & Additional Sources - Page 5

N

0 0.15 0.3 0.6 Miles

- Sites with Higher Elevation
- Sites with Same Elevation
- Sites with Lower Elevation
- Sites with Unknown Elevation
- OGW Sites with Higher Elevation
- OGW Sites with Same Elevation
- OGW Sites with Lower Elevation
- OGW Sites with Unknown Elevation

ERIS

Wells and Additional Sources



Wells & Additional Sources - Page 6

N

0 0.15 0.3 0.6 Miles

- Sites with Higher Elevation
- Sites with Same Elevation
- Sites with Lower Elevation
- Sites with Unknown Elevation
- OGW Sites with Higher Elevation
- OGW Sites with Same Elevation
- OGW Sites with Lower Elevation
- OGW Sites with Unknown Elevation

ERIS

Wells and Additional Sources



Wells & Additional Sources - Page 7

N

0 0.15 0.3 0.6 Miles

- Sites with Higher Elevation
- Sites with Same Elevation
- Sites with Lower Elevation
- Sites with Unknown Elevation
- OGW Sites with Higher Elevation
- OGW Sites with Same Elevation
- OGW Sites with Lower Elevation
- OGW Sites with Unknown Elevation

ERIS

Wells and Additional Sources



Wells & Additional Sources - Page 8

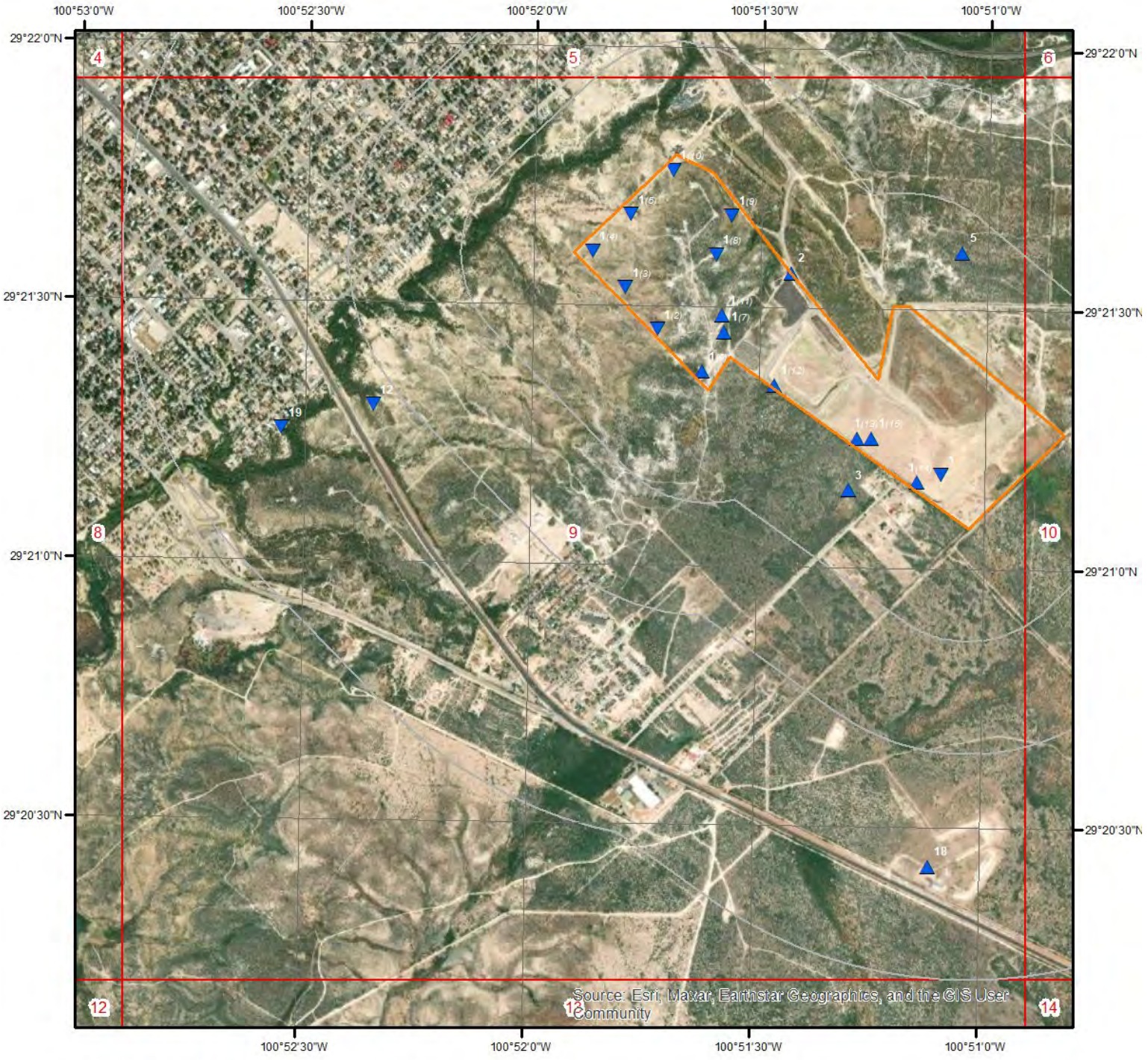
N

0 0.15 0.3 0.6 Miles

- Sites with Higher Elevation
- Sites with Same Elevation
- Sites with Lower Elevation
- Sites with Unknown Elevation
- OGW Sites with Higher Elevation
- OGW Sites with Same Elevation
- OGW Sites with Lower Elevation
- OGW Sites with Unknown Elevation

ERIS

Wells and Additional Sources



Wells & Additional Sources - Page 9

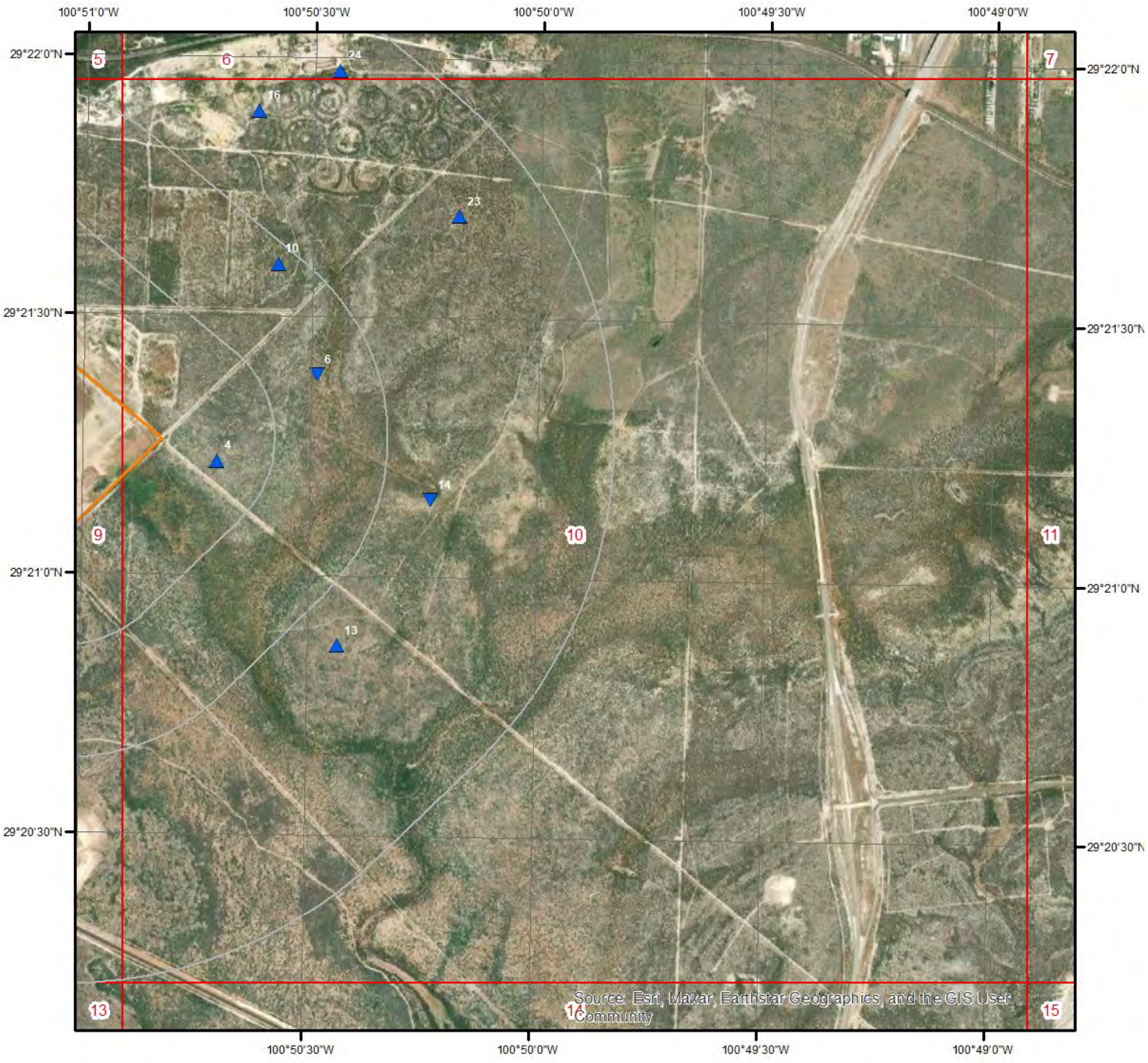
N

0 0.15 0.3 0.6 Miles

- Sites with Higher Elevation
- Sites with Same Elevation
- Sites with Lower Elevation
- Sites with Unknown Elevation
- OGW Sites with Higher Elevation
- OGW Sites with Same Elevation
- OGW Sites with Lower Elevation
- OGW Sites with Unknown Elevation

ERIS

Wells and Additional Sources



Wells & Additional Sources - Page 10

N

0 0.15 0.3 0.6 Miles

- Sites with Higher Elevation
- Sites with Same Elevation
- Sites with Lower Elevation
- Sites with Unknown Elevation
- OGW Sites with Higher Elevation
- OGW Sites with Same Elevation
- OGW Sites with Lower Elevation
- OGW Sites with Unknown Elevation

ERIS

Wells and Additional Sources



Wells & Additional Sources - Page 11

N

0 0.15 0.3 0.6 Miles

- Sites with Higher Elevation
- Sites with Same Elevation
- Sites with Lower Elevation
- Sites with Unknown Elevation
- OGW Sites with Higher Elevation
- OGW Sites with Same Elevation
- OGW Sites with Lower Elevation
- OGW Sites with Unknown Elevation

ERIS

Wells and Additional Sources



Wells & Additional Sources - Page 12

N

0 0.15 0.3 0.6 Miles

- Sites with Higher Elevation
- Sites with Same Elevation
- Sites with Lower Elevation
- Sites with Unknown Elevation
- OGW Sites with Higher Elevation
- OGW Sites with Same Elevation
- OGW Sites with Lower Elevation
- OGW Sites with Unknown Elevation

ERIS

Wells and Additional Sources



Wells & Additional Sources - Page 13

N

0 0.15 0.3 0.6 Miles

- Sites with Higher Elevation
- Sites with Same Elevation
- Sites with Lower Elevation
- Sites with Unknown Elevation
- OGW Sites with Higher Elevation
- OGW Sites with Same Elevation
- OGW Sites with Lower Elevation
- OGW Sites with Unknown Elevation

ERIS

Wells and Additional Sources



Wells & Additional Sources - Page 14

N

0 0.15 0.3 0.6 Miles

- Sites with Higher Elevation
- Sites with Same Elevation
- Sites with Lower Elevation
- Sites with Unknown Elevation
- OGW Sites with Higher Elevation
- OGW Sites with Same Elevation
- OGW Sites with Lower Elevation
- OGW Sites with Unknown Elevation

ERIS

Wells and Additional Sources



Wells & Additional Sources - Page 15

N

0 0.15 0.3 0.6 Miles

- Sites with Higher Elevation
- Sites with Same Elevation
- Sites with Lower Elevation
- Sites with Unknown Elevation
- OGW Sites with Higher Elevation
- OGW Sites with Same Elevation
- OGW Sites with Lower Elevation
- OGW Sites with Unknown Elevation

ERIS

Wells and Additional Sources Summary

Federal Sources

Public Water Systems Violations and Enforcement Data

Map Key	ID	Distance (ft)	Direction
	No records found		

Safe Drinking Water Information System (SDWIS)

Map Key	ID	Distance (ft)	Direction
	No records found		

USGS National Water Information System

Map Key	ID	Distance (ft)	Direction
	No records found		

Wells from NWIS

Map Key	ID	Distance (ft)	Direction
	No records found		

State Sources

Fort Bend Subsidence District Water Wells

Map Key	ID	Distance (ft)	Direction
	No records found		

Groundwater Database

Map Key	Owner Name	Distance (ft)	Direction
8	A. Y. Shely	2201.78	NNW
8	7042102	2201.78	NNW
12	Russell & Neatherby Well 1	2953.13	W
12	7042104	2953.13	W
13	T. Brite Well 1	3169.16	SE
13	7042105	3169.16	SE
15	J. Coronado	3420.08	NW
15	7042106	3420.08	NW
17	Robert Kusenberger	3977.28	NE
17	7042101	3977.28	NE
25	A. Green	4899.95	NNW
25	7034701	4899.95	NNW

Harris Galveston Subsidence District Water Wells

Map Key	ID	Distance (ft)	Direction

Wells and Additional Sources Summary

No records found

High Plains Water Wells

Map Key	ID	Distance (ft)	Direction
No records found			

Oil and Gas Wells

Map Key	API	Distance (ft)	Direction
1	465	0.00	-
4	46580040	701.95	ESE
5	465	882.55	ENE
6	465	1957.88	E
10	46530420	2439.85	ENE
14	46580041	3221.31	ESE
16	465	3676.39	NE
19	465	3989.36	W
23	465	4337.37	ENE
24	465	4638.96	ENE

Plotted Water Wells

Map Key	WWD ID	Distance (ft)	Direction
1	1020110	0.00	-
28	1020104	9982.47	W
29	1020115	11026.67	E
30	2375477	12089.61	N
30	1019687	12089.61	N
31		14160.02	S

Plugged Water Wells

Map Key	Well Rpt Track No	Distance (ft)	Direction
18		3981.29	SSE
22		4327.96	NE
22		4327.96	NE
22		4327.96	NE
22		4327.96	NE
22		4327.96	NE
22		4327.96	NE
22		4327.96	NE
22		4327.96	NE
22		4327.96	NE
22		4327.96	NE
22		4327.96	NE
22		4327.96	NE
26		5216.29	NNE

Public Water Systems Wells and Surface Intakes

Map Key	ID	Distance (ft)	Direction
No records found			

Select Wells from SDR

Wells and Additional Sources Summary

Map Key	ID	Distance (ft)	Direction
	No records found		

Submitted Drillers Report Database

Map Key	Well Rpt Track No	Distance (ft)	Direction
1	564780	0.00	-
1	City of Del Rio Landfill	0.00	-
1	564755	0.00	-
1	City of Del Rio Landfill	0.00	-
1	564782	0.00	-
1	City of Del Rio Landfill	0.00	-
1	City of Del Rio Landfill	0.00	-
1	564778	0.00	-
1	564781	0.00	-
1	City of Del Rio Landfill	0.00	-
1	564775	0.00	-
1	City of Del Rio Landfill	0.00	-
1	City of Del Rio Landfill	0.00	-
1	564776	0.00	-
1	564779	0.00	-
1	City of Del Rio Landfill	0.00	-
1	564783	0.00	-
1	City of Del Rio Landfill	0.00	-
1	34659	0.00	-
1	City of Del Rio Texas	0.00	-
1	City of Del Rio Texas	0.00	-
1	34657	0.00	-
1	City of Del Rio Texas	0.00	-
1	34656	0.00	-
1	34653	0.00	-
1	City of Del Rio Texas	0.00	-
2	34660	3.35	NNW
2	City of Del Rio Texas	3.35	NNW
3	City of Del Rio Texas	450.27	SSE
3	34651	450.27	SSE
9	City of Del Rio Landfill	2418.06	N
9	564774	2418.06	N
21	8457	4254.75	NE
21	Carson Dist. Co., Inc.	4254.75	NE
21	Carson Dist. Co., Inc.	4254.75	NE
21	8458	4254.75	NE
21	8456	4254.75	NE
21	Carson Dist. Co., Inc.	4254.75	NE

Underground Injection Control

Map Key	ID	Distance (ft)	Direction
	No records found		

Water Utility Database

Map Key	ID	Distance (ft)	Direction
	No records found		

Well Log Reports from Plotted Water Wells

Map Key	Owners Name	Distance (ft)	Direction

Wells and Additional Sources Summary

7	PETE TERLAJE	1963.88	NNW
7	70-33-9	1963.88	NNW
11	70-42-1A	2801.77	N
11	JUAN J TORRESCONO	2801.77	N
20	70-72-1	4100.11	NE
20	JOSE MONIESANO	4100.11	NE
27	70-42-1	5217.02	NW
27	DARRELL HARGROVE	5217.02	NW
27	DARRELL HARGROVE	5217.02	NW
27	70-42-1	5217.02	NW

Wells and Additional Sources Detail Report

Groundwater Database

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
8	NNW	0.42	2,201.78	999.13	GWDB

Well Rep Track No:	
State Well NO:	7042102
Owner Name:	A. Y. Shely
Drilling Start Dt:	
Drilling Month:	
Drilling Day:	
Drilling Year:	1936
Well Depth:	125
Well Usage:	Domestic
Water Level Status:	
Latitude:	29.3688890
Longitude:	-100.8638890
Data Source:	Groundwater Database (GWDB) Reports; GIS shapefile of GWDB well locations
Well Info Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive//GetReports.aspx?Num=7042102&Type=GWDB
Document Link:	https://www3.twdb.texas.gov/apps/waterdatainteractive//GetScannedImage.aspx?Num=7042102&Cnty=Val Verde

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
12	W	0.56	2,953.13	954.25	GWDB

Well Rep Track No:	
State Well NO:	7042104
Owner Name:	Russell & Neatherby Well 1
Drilling Start Dt:	
Drilling Month:	
Drilling Day:	
Drilling Year:	1928
Well Depth:	3332
Well Usage:	
Water Level Status:	
Latitude:	29.3550010
Longitude:	-100.8725000
Data Source:	Groundwater Database (GWDB) Reports; GIS shapefile of GWDB well locations
Well Info Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive//GetReports.aspx?Num=7042104&Type=GWDB
Document Link:	https://www3.twdb.texas.gov/apps/waterdatainteractive//GetScannedImage.aspx?Num=7042104&Cnty=Val Verde

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
13	SE	0.60	3,169.16	1,062.52	GWDB

Wells and Additional Sources Detail Report

Well Rep Track No:
State Well NO: 7042105
Owner Name: T. Brite Well 1
Drilling Start Dt:
Drilling Month:
Drilling Day:
Drilling Year: 1955
Well Depth: 1001
Well Usage:
Water Level Status:
Latitude: 29.3477780
Longitude: -100.8405560
Data Source: Groundwater Database (GWDB) Reports; GIS shapefile of GWDB well locations
Well Info Report: https://www3.twdb.texas.gov/apps/waterdatainteractive//GetReports.aspx?Num=7042105&Type=GWDB
Document Link: https://www3.twdb.texas.gov/apps/waterdatainteractive//GetScannedImage.aspx?Num=7042105&Cnty=Val Verde

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
15	NW	0.65	3,420.08	997.21	GWDB

Well Rep Track No:
State Well NO: 7042106
Owner Name: J. Coronado
Drilling Start Dt:
Drilling Month: 9
Drilling Day:
Drilling Year: 1935
Well Depth: 145
Well Usage: Unused
Water Level Status:
Latitude: 29.3708330
Longitude: -100.8677780
Data Source: Groundwater Database (GWDB) Reports; GIS shapefile of GWDB well locations
Well Info Report: https://www3.twdb.texas.gov/apps/waterdatainteractive//GetReports.aspx?Num=7042106&Type=GWDB
Document Link: https://www3.twdb.texas.gov/apps/waterdatainteractive//GetScannedImage.aspx?Num=7042106&Cnty=Val Verde

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
17	NE	0.75	3,977.28	1,028.30	GWDB

Well Rep Track No:
State Well NO: 7042101
Owner Name: Robert Kusenberger
Drilling Start Dt:
Drilling Month:
Drilling Day:
Drilling Year: 1965

Well Depth:	134
Well Usage:	Domestic
Water Level Status:	
Latitude:	29.3677780
Longitude:	-100.8463890
Data Source:	Groundwater Database (GWDB) Reports; GIS shapefile of GWDB well locations
Well Info Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive//GetReports.aspx?Num=7042101&Type=GWDB
Document Link:	https://www3.twdb.texas.gov/apps/waterdatainteractive//GetScannedImage.aspx?Num=7042101&Cnty=Val Verde

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
25	NNW	0.93	4,899.95	1,026.09	GWDB

Well Rep Track No:	
State Well NO:	7034701
Owner Name:	A. Green
Drilling Start Dt:	
Drilling Month:	
Drilling Day:	
Drilling Year:	1924
Well Depth:	135
Well Usage:	Domestic
Water Level Status:	
Latitude:	29.3752780
Longitude:	-100.8683330
Data Source:	Groundwater Database (GWDB) Reports; GIS shapefile of GWDB well locations
Well Info Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive//GetReports.aspx?Num=7034701&Type=GWDB
Document Link:	https://www3.twdb.texas.gov/apps/waterdatainteractive//GetScannedImage.aspx?Num=7034701&Cnty=Val Verde

Oil and Gas Wells

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
1	-	0.00	0.00	1,049.07	OGW

API:	465	Object ID:	
Uniq ID:	1084623	GIS Lat27:	29.3527829
GIS API5:		GIS Long27:	-100.8512398
GIS Well No:	1	GIS Lat83:	29.35301341
Sym No:	2	GIS Long83:	-100.85161057
GIS Symbol Desc:	Permitted Location	X:	-100.85161052726158
Reliab:	15	Y:	29.35301345860611
GIS Location Source:	Commission`s hardcopy map		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
4	ESE	0.13	701.95	1,051.37	OGW

Wells and Additional Sources Detail Report

API:	46580040	Object ID:	
Uniq ID:	1084622	GIS Lat27:	29.3534303
GIS API5:	80040	GIS Long27:	-100.8446869
GIS Well No:	2	GIS Lat83:	29.35366088
Sym No:	3	GIS Long83:	-100.8450575
GIS Symbol Desc:	Dry Hole	X:	-100.84505745226498
Reliab:	15	Y:	29.353660933000228
GIS Location Source:	Commission`s hardcopy map		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
5	ENE	0.17	882.55	1,069.04	OGW

API:	465	Object ID:	
Uniq ID:	1084619	GIS Lat27:	29.3599521
GIS API5:		GIS Long27:	-100.8505699
GIS Well No:	1	GIS Lat83:	29.36018243
Sym No:	3	GIS Long83:	-100.85094074
GIS Symbol Desc:	Dry Hole	X:	-100.85094073157815
Reliab:	15	Y:	29.36018242783477
GIS Location Source:	Commission`s hardcopy map		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
6	E	0.37	1,957.88	1,049.27	OGW

API:	465	Object ID:	
Uniq ID:	1084621	GIS Lat27:	29.3562278
GIS API5:		GIS Long27:	-100.8410811
GIS Well No:	1	GIS Lat83:	29.35645836
Sym No:	2	GIS Long83:	-100.84145163
GIS Symbol Desc:	Permitted Location	X:	-100.84145156142573
Reliab:	15	Y:	29.356458395264514
GIS Location Source:	Commission`s hardcopy map		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
10	ENE	0.46	2,439.85	1,063.05	OGW

API:	46530420	Object ID:	
Uniq ID:	1084620	GIS Lat27:	29.3597862
GIS API5:	30420	GIS Long27:	-100.8425474
GIS Well No:	3	GIS Lat83:	29.36001664
Sym No:	9	GIS Long83:	-100.84291801
GIS Symbol Desc:	Canceled / Abandoned Location	X:	-100.84291794074574
Reliab:	15	Y:	29.360016657662843
GIS Location Source:	Commission`s hardcopy map		

Wells and Additional Sources Detail Report

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
14	ESE	0.61	3,221.31	1,050.43	OGW

API:	46580041	Object ID:	
Uniq ID:	1084624	GIS Lat27:	29.3522581
GIS API5:	80041	GIS Long27:	-100.8368578
GIS Well No:	1	GIS Lat83:	29.35248882
Sym No:	3	GIS Long83:	-100.83722817
GIS Symbol Desc:	Dry Hole	X:	-100.83722810164436
Reliab:	15	Y:	29.352488855595936
GIS Location Source:	Commission`s hardcopy map		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
16	NE	0.70	3,676.39	1,061.52	OGW

API:	465	Object ID:	
Uniq ID:	1084616	GIS Lat27:	29.3647002
GIS API5:		GIS Long27:	-100.8433199
GIS Well No:	1	GIS Lat83:	29.3649305
Sym No:	9	GIS Long83:	-100.84369059
GIS Symbol Desc:	Canceled / Abandoned Location	X:	-100.84369053914227
Reliab:	15	Y:	29.36493053217393
GIS Location Source:	Commission`s hardcopy map		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
19	W	0.76	3,989.36	940.25	OGW

API:	465	Object ID:	
Uniq ID:	1084001	GIS Lat27:	29.3539887
GIS API5:		GIS Long27:	-100.8754701
GIS Well No:		GIS Lat83:	29.35421885
Sym No:	3	GIS Long83:	-100.87584156
GIS Symbol Desc:	Dry Hole	X:	-100.87584147549329
Reliab:	15	Y:	29.354218881478705
GIS Location Source:	Commission`s hardcopy map		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
23	ENE	0.82	4,337.37	1,066.03	OGW

API:	465	Object ID:	
Uniq ID:	1084618	GIS Lat27:	29.361393
GIS API5:		GIS Long27:	-100.8359416
GIS Well No:	1	GIS Lat83:	29.36162349
Sym No:	2	GIS Long83:	-100.83631205

GIS Symbol Desc:	Permitted Location	X:	-100.83631199402022
Reliab:	15	Y:	29.361623579421206
GIS Location Source:	Commission`s hardcopy map		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
24	ENE	0.88	4,638.96	1,059.26	OGW

API:	465	Object ID:	
Uniq ID:	1084615	GIS Lat27:	29.3660231
GIS API5:		GIS Long27:	-100.840379
GIS Well No:	2	GIS Lat83:	29.36625341
Sym No:	3	GIS Long83:	-100.84074963
GIS Symbol Desc:	Dry Hole	X:	-100.84074957781748
Reliab:	15	Y:	29.366253479796697
GIS Location Source:	Commission`s hardcopy map		

Plotted Water Wells

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
1	-	0.00	0.00	1,057.37	WATER WELLS

WWD ID:	1020110	Deg:	70
Grid No:	70-42-1	Sev Min:	42
TX Grid ID:	61636.0	Two Min:	1
TX Grid:	62158.0	Shape Length:	0.0
Perimeter:	17298.578	Shape Area:	0.00173564929216
County:	VAL VERDE		
Data Source :	Water Well Report Viewer, 2.5 Minute Quad Grid (Map); TCEQ Water Well Public AGO		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
28	W	1.89	9,982.47	919.84	WATER WELLS

WWD ID:	1020104	Deg:	70
Grid No:	70-41-3	Sev Min:	41
TX Grid ID:	61635.0	Two Min:	3
TX Grid:	62156.0	Shape Length:	0.0
Perimeter:	17298.691	Shape Area:	0.00173567245737
County:	VAL VERDE		
Data Source :	Water Well Report Viewer, 2.5 Minute Quad Grid (Map); TCEQ Water Well Public AGO		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
29	E	2.09	11,026.67	1,061.44	WATER WELLS

WWD ID:	1020115	Deg:	70
Grid No:	70-42-2	Sev Min:	42

TX Grid ID:	61637.0	Two Min:	2
TX Grid:	62164.0	Shape Length:	0.0
Perimeter:	17304.529	Shape Area:	0.00173692858015
County:	VAL VERDE		
Data Source :	Water Well Report Viewer, 2.5 Minute Quad Grid (Map); TCEQ Water Well Public AGO		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
30	N	2.29	12,089.61	1,050.69	WATER WELLS

WWD ID:	2375477	Deg:	70
Grid No:	70-34-7	Sev Min:	34
TX Grid ID:	61300.0	Two Min:	7
TX Grid:	61822.0	Shape Length:	0.0
Perimeter:	17295.016	Shape Area:	0.00173566193667
County:	VAL VERDE		
Data Source :	Water Well Report Viewer, 2.5 Minute Quad Grid (Map); TCEQ Water Well Public AGO		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
30	N	2.29	12,089.61	1,050.69	WATER WELLS

WWD ID:	1019687	Deg:	70
Grid No:	70-34-7	Sev Min:	34
TX Grid ID:	61300.0	Two Min:	7
TX Grid:	61822.0	Shape Length:	0.0
Perimeter:	17295.016	Shape Area:	0.00173566193667
County:	VAL VERDE		
Data Source :	Water Well Report Viewer, 2.5 Minute Quad Grid (Map); TCEQ Water Well Public AGO		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
31	S	2.68	14,160.02	1,004.66	WATER WELLS

WWD ID:		Deg:	70
Grid No:	70-42-4	Sev Min:	42
TX Grid ID:	61972.0	Two Min:	4
TX Grid:	62496.0	Shape Length:	0.0
Perimeter:	17302.703	Shape Area:	0.00173574304128
County:			
Data Source :	Water Well Report Viewer, 2.5 Minute Quad Grid (Map)		

Plugged Water Wells

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
18	SSE	0.75	3,981.29	1,080.06	PLUGGED WELLS

License No:	54639	Well Address 1:	

Variance No:		Well Address 2:	
Plug Rpt Track No:	210333	Well City:	Del Rio
Well Rpt Track No:		Well Zip:	
Date Submitted:	2021-07-19	Owner Well No:	
No Wells Plugged:	1	Owner Name:	Frank Hargrove
Plugger Name:	Roger Bollinger	Owner Address 1:	PO Box 420124
Plugging Mtd Descr:	well cuttings	Owner Address 2:	
Plugging Date:	2021-05-05	Owner City:	Del Rio
Orig License No:	54639	Owner State:	TX
Orig Driller Name:	Roger Bollinger	Owner Zip:	
Original Well Use:	Domestic	Owner Oth Cntry:	
Orig Wel Use Descr:		Owner Country:	
Orig Drill Date:	2021-05-04	County:	Val Verde
Apprentice Reg No:		Latitude:	29.340423
Apprentice Signed:		Lat Degree:	29
Driller Signed:	Roger Bollinger	Lat Minute:	20
Driller Address 1:	2400 veterans blvd ste 16c#448	Lat Second:	25.52
Driller Address 2:		Longitude:	-100.85189
Driller City:	Del Rio	Long Degree:	100
Driller State:	TX	Long Minute:	51
Driller Zip:	78840	Long Second:	6.8
Driller Oth Cntry:		Hor Datum Type:	
Driller Country:		Grid No:	70-42-1
Elevation:		Loc Verfd by Drllr:	Yes
Company Name:	Bollinger Drilling		
Original Company Name:	Bollinger Drilling		
Plugging Method:	Other		
Comments:			
Well Location Description:	Hwy 277 south of Del Rio headed to Eagle Pass		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
22	NE	0.82	4,327.96	1,033.82	PLUGGED WELLS

License No:	3180	Well Address 1:	3801 Highway 90 East
Variance No:		Well Address 2:	
Plug Rpt Track No:	41206	Well City:	Del Rio
Well Rpt Track No:		Well Zip:	78840
Date Submitted:	2007-09-05	Owner Well No:	MW - 2
No Wells Plugged:		Owner Name:	Carson Distributing
Plugger Name:	John E. Talbot	Owner Address 1:	4917 East Highway 90
Plugging Mtd Descr:		Owner Address 2:	
Plugging Date:	2007-08-31	Owner City:	Del Rio
Orig License No:		Owner State:	TX
Orig Driller Name:		Owner Zip:	78840
Original Well Use:	Monitor	Owner Oth Cntry:	
Orig Wel Use Descr:		Owner Country:	

Wells and Additional Sources Detail Report

Orig Drill Date:		County:	Val Verde
Apprentice Reg No:	57214	Latitude:	29.368611
Apprentice Signed:	Martin Casarez	Lat Degree:	29
Driller Signed:	John E. Talbot	Lat Minute:	22
Driller Address 1:	4412 Bluemel Road	Lat Second:	7
Driller Address 2:		Longitude:	-100.845834
Driller City:	San Antonio	Long Degree:	100
Driller State:	TX	Long Minute:	50
Driller Zip:	78240	Long Second:	45
Driller Oth Cntry:		Hor Datum Type:	
Driller Country:		Grid No:	70-42-1
Elevation:		Loc Verfd by Drllr:	No
Company Name:	Vortex Drilling Inc.		
Original Company Name:			
Plugging Method:	Pour in 3/8 bentonite chips when standing water in well is less than 100 feet depth, cement top 2 feet		
Comments:	No Data		
Well Location Description:			

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
22	NE	0.82	4,327.96	1,033.82	PLUGGED WELLS

License No:	3180	Well Address 1:	3801 Highway 90 East
Variance No:		Well Address 2:	
Plug Rpt Track No:	41209	Well City:	Del Rio
Well Rpt Track No:		Well Zip:	78840
Date Submitted:	2007-09-05	Owner Well No:	MW - 5
No Wells Plugged:		Owner Name:	Carson Distributing
Plugger Name:	John E. Talbot	Owner Address 1:	4917 East Highway 90
Plugging Mtd Descr:		Owner Address 2:	
Plugging Date:	2007-08-31	Owner City:	Del Rio
Orig License No:		Owner State:	TX
Orig Driller Name:		Owner Zip:	78840
Original Well Use:	Monitor	Owner Oth Cntry:	
Orig Wel Use Descr:		Owner Country:	
Orig Drill Date:		County:	Val Verde
Apprentice Reg No:	57214	Latitude:	29.368611
Apprentice Signed:	Martin Casarez	Lat Degree:	29
Driller Signed:	John E. Talbot	Lat Minute:	22
Driller Address 1:	4412 Bluemel Road	Lat Second:	7
Driller Address 2:		Longitude:	-100.845834
Driller City:	San Antonio	Long Degree:	100
Driller State:	TX	Long Minute:	50
Driller Zip:	78240	Long Second:	45
Driller Oth Cntry:		Hor Datum Type:	
Driller Country:		Grid No:	70-42-1
Elevation:		Loc Verfd by Drllr:	No

Wells and Additional Sources Detail Report

Company Name: Vortex Drilling Inc.
Original Company Name:
Plugging Method: Pour in 3/8 bentonite chips when standing water in well is less than 100 feet depth, cement top 2 feet
Comments: No Data
Well Location Description:

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
22	NE	0.82	4,327.96	1,033.82	PLUGGED WELLS

License No: 3180
Variance No:
Plug Rpt Track No: 41212
Well Rpt Track No:
Date Submitted: 2007-09-05
No Wells Plugged:
Plugger Name: John E. Talbot
Plugging Mtd Descr:
Plugging Date: 2007-08-31
Orig License No:
Orig Driller Name:
Original Well Use: Monitor
Orig Wel Use Descr:
Orig Drill Date:
Apprentice Reg No: 57214
Apprentice Signed: Martin Casarez
Driller Signed: John E. Talbot
Driller Address 1: 4412 Bluemel Road
Driller Address 2:
Driller City: San Antonio
Driller State: TX
Driller Zip: 78240
Driller Oth Cntry:
Driller Country:
Elevation:
Company Name: Vortex Drilling Inc.
Original Company Name:
Plugging Method: Pour in 3/8 bentonite chips when standing water in well is less than 100 feet depth, cement top 2 feet
Comments: No Data
Well Location Description:

Well Address 1: 3801 Highway 90 East
Well Address 2:
Well City: Del Rio
Well Zip: 78840
Owner Well No: MW - 7
Owner Name: Carson Distributing
Owner Address 1: 4917 East Highway 90
Owner Address 2:
Owner City: Del Rio
Owner State: TX
Owner Zip: 78840
Owner Oth Cntry:
Owner Country:
County: Val Verde
Latitude: 29.368611
Lat Degree: 29
Lat Minute: 22
Lat Second: 7
Longitude: -100.845834
Long Degree: 100
Long Minute: 50
Long Second: 45
Hor Datum Type:
Grid No: 70-42-1
Loc Verfd by Drllr: No

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
22	NE	0.82	4,327.96	1,033.82	PLUGGED WELLS

License No: 3180
Variance No:
Plug Rpt Track No: 41216

Well Address 1: 3801 Highway 90 East
Well Address 2:
Well City: Del Rio

Wells and Additional Sources Detail Report

Well Rpt Track No:		Well Zip:	78840
Date Submitted:	2007-09-05	Owner Well No:	
No Wells Plugged:		Owner Name:	Carson Distributing
Plugger Name:	John E. Talbot	Owner Address 1:	4917 East Highway 90
Plugging Mtd Descr:		Owner Address 2:	
Plugging Date:	2007-08-31	Owner City:	Del Rio
Orig License No:		Owner State:	TX
Orig Driller Name:		Owner Zip:	78840
Original Well Use:	Withdrawal of Water	Owner Oth Cntry:	
Orig Wel Use Descr:		Owner Country:	
Orig Drill Date:		County:	Val Verde
Apprentice Reg No:	57214	Latitude:	29.368611
Apprentice Signed:	Martin Casarez	Lat Degree:	29
Driller Signed:	John E. Talbot	Lat Minute:	22
Driller Address 1:	4412 Bluemel Road	Lat Second:	7
Driller Address 2:		Longitude:	-100.845834
Driller City:	San Antonio	Long Degree:	100
Driller State:	TX	Long Minute:	50
Driller Zip:	78240	Long Second:	45
Driller Oth Cntry:		Hor Datum Type:	
Driller Country:		Grid No:	70-42-1
Elevation:		Loc Verfd by Drllr:	No
Company Name:	Vortex Drilling Inc.		
Original Company Name:			
Plugging Method:	Pour in 3/8 bentonite chips when standing water in well is less than 100 feet depth, cement top 2 feet		
Comments:	No Data		
Well Location Description:			

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
22	NE	0.82	4,327.96	1,033.82	PLUGGED WELLS

License No:	3180	Well Address 1:	3801 Highway 90 East
Variance No:		Well Address 2:	
Plug Rpt Track No:	41207	Well City:	Del Rio
Well Rpt Track No:		Well Zip:	78840
Date Submitted:	2007-09-05	Owner Well No:	MW - 3
No Wells Plugged:		Owner Name:	Carson Distributing
Plugger Name:	John E. Talbot	Owner Address 1:	4917 East Highway 90
Plugging Mtd Descr:		Owner Address 2:	
Plugging Date:	2007-08-31	Owner City:	Del Rio
Orig License No:		Owner State:	TX
Orig Driller Name:		Owner Zip:	78840
Original Well Use:	Monitor	Owner Oth Cntry:	
Orig Wel Use Descr:		Owner Country:	
Orig Drill Date:		County:	Val Verde
Apprentice Reg No:	57214	Latitude:	29.368611

Apprentice Signed:	Martin Casarez	Lat Degree:	29
Driller Signed:	John E. Talbot	Lat Minute:	22
Driller Address 1:	4412 Bluemel Road	Lat Second:	7
Driller Address 2:		Longitude:	-100.845834
Driller City:	San Antonio	Long Degree:	100
Driller State:	TX	Long Minute:	50
Driller Zip:	78240	Long Second:	45
Driller Oth Cntry:		Hor Datum Type:	
Driller Country:		Grid No:	70-42-1
Elevation:		Loc Verfd by Drllr:	No
Company Name:	Vortex Drilling Inc.		
Original Company Name:			
Plugging Method:	Pour in 3/8 bentonite chips when standing water in well is less than 100 feet depth, cement top 2 feet		
Comments:	No Data		
Well Location Description:			

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
22	NE	0.82	4,327.96	1,033.82	PLUGGED WELLS

License No:	3180	Well Address 1:	3801 Highway 90 East
Variance No:		Well Address 2:	
Plug Rpt Track No:	41205	Well City:	Del Rio
Well Rpt Track No:		Well Zip:	78840
Date Submitted:	2007-09-05	Owner Well No:	MW - 1
No Wells Plugged:		Owner Name:	Carson Distributing
Plugger Name:	John E. Talbot	Owner Address 1:	4917 East Highway 90
Plugging Mtd Descr:		Owner Address 2:	
Plugging Date:	2007-08-31	Owner City:	Del Rio
Orig License No:		Owner State:	TX
Orig Driller Name:		Owner Zip:	78840
Original Well Use:	Monitor	Owner Oth Cntry:	
Orig Wel Use Descr:		Owner Country:	
Orig Drill Date:		County:	Val Verde
Apprentice Reg No:	57214	Latitude:	29.368611
Apprentice Signed:	Martin Casarez	Lat Degree:	29
Driller Signed:	John E. Talbot	Lat Minute:	22
Driller Address 1:	4412 Bluemel Road	Lat Second:	7
Driller Address 2:		Longitude:	-100.845834
Driller City:	San Antonio	Long Degree:	100
Driller State:	TX	Long Minute:	50
Driller Zip:	78240	Long Second:	45
Driller Oth Cntry:		Hor Datum Type:	
Driller Country:		Grid No:	70-42-1
Elevation:		Loc Verfd by Drllr:	No
Company Name:	Vortex Drilling Inc.		
Original Company Name:			

Plugging Method: Pour in 3/8 bentonite chips when standing water in well is less than 100 feet depth, cement top 2 feet
Comments: No Data
Well Location Description:

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
22	NE	0.82	4,327.96	1,033.82	PLUGGED WELLS

License No: 3180
Variance No:
Plug Rpt Track No: 41211
Well Rpt Track No:
Date Submitted: 2007-09-05
No Wells Plugged:
Plugger Name: John E. Talbot
Plugging Mtd Descr:
Plugging Date: 2007-08-31
Orig License No:
Orig Driller Name:
Original Well Use: Monitor
Orig Wel Use Descr:
Orig Drill Date:
Apprentice Reg No: 57214
Apprentice Signed: Martin Casarez
Driller Signed: John E. Talbot
Driller Address 1: 4412 Bluemel Road
Driller Address 2:
Driller City: San Antonio
Driller State: TX
Driller Zip: 78240
Driller Oth Cntry:
Driller Country:
Elevation:
Company Name: Vortex Drilling Inc.
Original Company Name:
Well Address 1: 3801 Highway 90 East
Well Address 2:
Well City: Del Rio
Well Zip: 78840
Owner Well No: MW - 8
Owner Name: Carson Distributing
Owner Address 1: 4917 East Highway 90
Owner Address 2:
Owner City: Del Rio
Owner State: TX
Owner Zip: 78840
Owner Oth Cntry:
Owner Country:
County: Val Verde
Latitude: 29.368611
Lat Degree: 29
Lat Minute: 22
Lat Second: 7
Longitude: -100.845834
Long Degree: 100
Long Minute: 50
Long Second: 45
Hor Datum Type:
Grid No: 70-42-1
Loc Verfd by Drllr: No

Plugging Method: Pour in 3/8 bentonite chips when standing water in well is less than 100 feet depth, cement top 2 feet
Comments: No Data
Well Location Description:

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
22	NE	0.82	4,327.96	1,033.82	PLUGGED WELLS

License No: 3180
Variance No:
Plug Rpt Track No: 41213
Well Rpt Track No:
Date Submitted: 2007-09-05
Well Address 1: 3801 Highway 90 East
Well Address 2:
Well City: Del Rio
Well Zip: 78840
Owner Well No: MW - 9

No Wells Plugged:		Owner Name:	Carson Distributing
Plugger Name:	John E. Talbot	Owner Address 1:	4917 East Highway 90
Plugging Mtd Descr:		Owner Address 2:	
Plugging Date:	2007-08-31	Owner City:	Del Rio
Orig License No:		Owner State:	TX
Orig Driller Name:		Owner Zip:	78840
Original Well Use:	Monitor	Owner Oth Cntry:	
Orig Wel Use Descr:		Owner Country:	
Orig Drill Date:		County:	Val Verde
Apprentice Reg No:	57214	Latitude:	29.368611
Apprentice Signed:	Martin Casarez	Lat Degree:	29
Driller Signed:	John E. Talbot	Lat Minute:	22
Driller Address 1:	4412 Bluemel Road	Lat Second:	7
Driller Address 2:		Longitude:	-100.845834
Driller City:	San Antonio	Long Degree:	100
Driller State:	TX	Long Minute:	50
Driller Zip:	78240	Long Second:	45
Driller Oth Cntry:		Hor Datum Type:	
Driller Country:		Grid No:	70-42-1
Elevation:		Loc Verfd by Drllr:	No
Company Name:	Vortex Drilling Inc.		
Original Company Name:			
Plugging Method:	Pour in 3/8 bentonite chips when standing water in well is less than 100 feet depth, cement top 2 feet		
Comments:	No Data		
Well Location Description:			

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
22	NE	0.82	4,327.96	1,033.82	PLUGGED WELLS

License No:	3180	Well Address 1:	3801 Highway 90 East
Variance No:		Well Address 2:	
Plug Rpt Track No:	41210	Well City:	Del Rio
Well Rpt Track No:		Well Zip:	78840
Date Submitted:	2007-09-05	Owner Well No:	MW - 6
No Wells Plugged:		Owner Name:	Carson Distributing
Plugger Name:	John E. Talbot	Owner Address 1:	4917 East Highway 90
Plugging Mtd Descr:		Owner Address 2:	
Plugging Date:	2007-08-31	Owner City:	Del Rio
Orig License No:		Owner State:	TX
Orig Driller Name:		Owner Zip:	78840
Original Well Use:	Monitor	Owner Oth Cntry:	
Orig Wel Use Descr:		Owner Country:	
Orig Drill Date:		County:	Val Verde
Apprentice Reg No:	57214	Latitude:	29.368611
Apprentice Signed:	Martin Casarez	Lat Degree:	29
Driller Signed:	John E. Talbot	Lat Minute:	22

Driller Address 1:	4412 Bluemel Road	Lat Second:	7
Driller Address 2:		Longitude:	-100.845834
Driller City:	San Antonio	Long Degree:	100
Driller State:	TX	Long Minute:	50
Driller Zip:	78240	Long Second:	45
Driller Oth Cntry:		Hor Datum Type:	
Driller Country:		Grid No:	70-42-1
Elevation:		Loc Verfd by Drllr:	No
Company Name:	Vortex Drilling Inc.		
Original Company Name:			
Plugging Method:	Pour in 3/8 bentonite chips when standing water in well is less than 100 feet depth, cement top 2 feet		
Comments:	No Data		
Well Location Description:			

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
22	NE	0.82	4,327.96	1,033.82	PLUGGED WELLS

License No:	3180	Well Address 1:	3801 Highway 90 East
Variance No:		Well Address 2:	
Plug Rpt Track No:	41208	Well City:	Del Rio
Well Rpt Track No:		Well Zip:	78840
Date Submitted:	2007-09-05	Owner Well No:	MW - 4
No Wells Plugged:		Owner Name:	Carson Distributing
Plugger Name:	John E. Talbot	Owner Address 1:	4917 East Highway 90
Plugging Mtd Descr:		Owner Address 2:	
Plugging Date:	2007-08-31	Owner City:	Del Rio
Orig License No:		Owner State:	TX
Orig Driller Name:		Owner Zip:	78840
Original Well Use:	Monitor	Owner Oth Cntry:	
Orig Wel Use Descr:		Owner Country:	
Orig Drill Date:		County:	Val Verde
Apprentice Reg No:	57214	Latitude:	29.368611
Apprentice Signed:	Martin Casarez	Lat Degree:	29
Driller Signed:	John E. Talbot	Lat Minute:	22
Driller Address 1:	4412 Bluemel Road	Lat Second:	7
Driller Address 2:		Longitude:	-100.845834
Driller City:	San Antonio	Long Degree:	100
Driller State:	TX	Long Minute:	50
Driller Zip:	78240	Long Second:	45
Driller Oth Cntry:		Hor Datum Type:	
Driller Country:		Grid No:	70-42-1
Elevation:		Loc Verfd by Drllr:	No
Company Name:	Vortex Drilling Inc.		
Original Company Name:			
Plugging Method:	Pour in 3/8 bentonite chips when standing water in well is less than 100 feet depth, cement top 2 feet		
Comments:	No Data		

Wells and Additional Sources Detail Report

Well Location Description:

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
26	NNE	0.99	5,216.29	1,069.63	PLUGGED WELLS

License No:	2972	Well Address 1:	
Variance No:		Well Address 2:	
Plug Rpt Track No:	80377	Well City:	Del Rio
Well Rpt Track No:		Well Zip:	78840
Date Submitted:	2012-03-21	Owner Well No:	
No Wells Plugged:		Owner Name:	SWS Engineering
Plugger Name:	T-Bar Drilling Inc.	Owner Address 1:	600 Grand Panama Blvd.
Plugging Mtd Descr:	See Comments	Owner Address 2:	
Plugging Date:	2012-02-21	Owner City:	Beach
Orig License No:		Owner State:	FL
Orig Driller Name:	unknown	Owner Zip:	32407
Original Well Use:	Withdrawal of Water	Owner Oth Cntry:	
Orig Wel Use Descr:		Owner Country:	
Orig Drill Date:		County:	Val Verde
Apprentice Reg No:		Latitude:	29.373055
Apprentice Signed:		Lat Degree:	29
Driller Signed:	Abel Clarl Lu Ann Hutto	Lat Minute:	22
Driller Address 1:	8072 HWY 277	Lat Second:	23
Driller Address 2:		Longitude:	-100.848889
Driller City:	Del Rio	Long Degree:	100
Driller State:	TX	Long Minute:	50
Driller Zip:	78840	Long Second:	56
Driller Oth Cntry:		Hor Datum Type:	
Driller Country:		Grid No:	70-42-1
Elevation:		Loc Verfd by Drllr:	No
Company Name:	T-Bar Drilling Inc.		
Original Company Name:			
Plugging Method:	Other		
Comments:	pour in bentonite 2 ft on bottom pressure cement from bottom to surface		
Well Location Description:			

Submitted Drillers Report Database

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
1	-	0.00	0.00	1,029.18	SDR WELLS

License No:	54752	Well Address1:	1987 Railway Avenue
PWS No:		Well Addr2:	
Plug Rpt Track No:		Well City:	Del Rio
Well Rpt Track No:	564780	Well Zip:	77884
Orig Well Rpt Trk No:		Owner Well No:	B-6P
Apprentice Reg No:		Owner Name:	City of Del Rio Landfill

Wells and Additional Sources Detail Report

No of Wells Drill:	1	Owner Addr1:	114 W. Martin St.
Date Submitted:	2021-01-25	Owner Addr2:	
Type of Work:	New Well	Owner City:	Del Rio
Typ of Wrk Oth Descr:		Owner State:	TX
Seal Method:	Poured	Owner Zip:	78840
Seal Mthd Oth Desc:		Owner Country:	
Plugged w/i 48Hrs:	No	Driller Name:	Nathan O Yoakley
Drilling Start Dt:	2020-11-10	Driller Address1:	9532 FM 682
Drilling End Dt:	2020-11-17	Driller Addr2:	
Proposed Use:	Monitor	Driller City:	Yoakum
Prop Use Oth Descr:		Driller State:	TX
TCEQ Approve Plans:		Driller Zip:	77995
Apprve by Variance:		Driller Oth Cntry:	
Loc Vfy by Driller:	Yes	Driller Country:	
Sealed by Driller:	Yes	Dist to Sep Contam:	na
Sealed by Name:		Dist to Septic Tk:	na
Driller Signed:	Nathan Yoakley	Dist to Prop Line:	1000
Apprentice Signed:		Dist Verifi Method:	visual
Surface Compl:	Surface Slab Installed	Horizon Datum Type:	NAD27
Surf Comp Oth Desc:		Elevation:	
Complt by Driller:	Yes	Latitude:	29.35757
Pump Type:		Lat Degree:	29
Pump Type Oth Desc:		Lat Minute:	21
Pump Depth:		Lat Second:	27.25
Chemical Analysis:	No	Longitude:	-100.862105
Injurious Water:	No	Long Degree:	100
County:	Val Verde	Long Minute:	51
Known Loc Error:	No	Long Second:	43.58
Grid No:	70-42-1		
Company Name:	Terra Power Drilling LLC		
Well Location Description:			
Comments:	no water encountered dry hole		
Data Source:	Full SDR Database; SDRDB Well Location (Map)		
Drillers Well Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive/GetReports.aspx?Num=564780&Type=SDR-Well		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
1	-	0.00	0.00	999.49	SDR WELLS

License No:	54752	Well Address1:	1987 Railway Avenue
PWS No:		Well Addr2:	
Plug Rpt Track No:		Well City:	Del Rio
Well Rpt Track No:	564755	Well Zip:	77884
Orig Well Rpt Trk No:		Owner Well No:	B-14
Apprentice Reg No:		Owner Name:	City of Del Rio Landfill
No of Wells Drill:	1	Owner Addr1:	114 W. Martin St
Date Submitted:	2021-01-25	Owner Addr2:	

Wells and Additional Sources Detail Report

Type of Work:	New Well	Owner City:	Del Rio
Typ of Wrk Oth Descr:		Owner State:	TX
Seal Method:	Poured	Owner Zip:	78840
Seal Mthd Oth Desc:		Owner Country:	
Plugged w/i 48Hrs:	No	Driller Name:	Nathan O Yoakley
Drilling Start Dt:	2020-11-13	Driller Address1:	9532 FM 682
Drilling End Dt:	2020-11-18	Driller Addr2:	
Proposed Use:	Monitor	Driller City:	Yoakum
Prop Use Oth Descr:		Driller State:	TX
TCEQ Approve Plans:		Driller Zip:	77995
Apprve by Variance:		Driller Oth Cntry:	
Loc Vfy by Driller:	Yes	Driller Country:	
Sealed by Driller:	Yes	Dist to Sep Contam:	na
Sealed by Name:		Dist to Septic Tk:	
Driller Signed:	Nathan Yoakley	Dist to Prop Line:	1000
Apprentice Signed:		Dist Verifi Method:	visual
Surface Compl:	Surface Slab Installed	Horizon Datum Type:	
Surf Comp Oth Desc:		Elevation:	
Complt by Driller:	Yes	Latitude:	29.35889
Pump Type:		Lat Degree:	29
Pump Type Oth Desc:		Lat Minute:	21
Pump Depth:		Lat Second:	32
Chemical Analysis:	No	Longitude:	-100.8633
Injurious Water:	No	Long Degree:	100
County:	Val Verde	Long Minute:	51
Known Loc Error:	No	Long Second:	47.88
Grid No:	70-42-1		
Company Name:	Terra Power Drilling LLC		
Well Location Description:			
Comments:			
Data Source:	Full SDR Database; SDRDB Well Location (Map)		
Drillers Well Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive/GetReports.aspx?Num=564755&Type=SDR-Well		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
1	-	0.00	0.00	989.85	SDR WELLS

License No:	54752	Well Address1:	1987 Railway Avenue
PWS No:		Well Addr2:	
Plug Rpt Track No:		Well City:	Del Rio
Well Rpt Track No:	564782	Well Zip:	77884
Orig Well Rpt Trk No:		Owner Well No:	B-2P
Apprentice Reg No:		Owner Name:	City of Del Rio Landfill
No of Wells Drill:	1	Owner Addr1:	114 W. Martin
Date Submitted:	2021-01-25	Owner Addr2:	
Type of Work:	New Well	Owner City:	Del Rio
Typ of Wrk Oth Descr:		Owner State:	TX

Wells and Additional Sources Detail Report

Seal Method:	Other	Owner Zip:	78840
Seal Mthd Oth Desc:	bentonite	Owner Country:	
Plugged w/i 48Hrs:	No	Driller Name:	Nathan O Yoakley
Drilling Start Dt:	2020-11-16	Driller Address1:	9532 FM 682
Drilling End Dt:	2020-11-20	Driller Addr2:	
Proposed Use:	Monitor	Driller City:	Yoakum
Prop Use Oth Descr:		Driller State:	TX
TCEQ Approve Plans:		Driller Zip:	77995
Apprve by Variance:		Driller Oth Cntry:	
Loc Vfy by Driller:	Yes	Driller Country:	
Sealed by Driller:	Yes	Dist to Sep Contam:	na
Sealed by Name:		Dist to Septic Tk:	na
Driller Signed:	Nathan Yoakley	Dist to Prop Line:	1000
Apprentice Signed:		Dist Verifi Method:	visual
Surface Compl:	Surface Slab Installed	Horizon Datum Type:	NAD27
Surf Comp Oth Desc:		Elevation:	
Complt by Driller:	Yes	Latitude:	29.36005
Pump Type:		Lat Degree:	29
Pump Type Oth Desc:		Lat Minute:	21
Pump Depth:		Lat Second:	36.18
Chemical Analysis:	No	Longitude:	-100.86452
Injurious Water:	No	Long Degree:	100
County:	Val Verde	Long Minute:	51
Known Loc Error:	No	Long Second:	52.27
Grid No:	70-42-1		
Company Name:	Terra Power Drilling LLC		
Well Location Description:	Piezometer number B-2P		
Comments:			
Data Source:	Full SDR Database; SDRDB Well Location (Map)		
Drillers Well Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive/GetReports.aspx?Num=564782&Type=SDR-Well		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
1	-	0.00	0.00	988.02	SDR WELLS

License No:	54752	Well Address1:	1987 Railway Avenue
PWS No:		Well Addr2:	
Plug Rpt Track No:		Well City:	Del Rio
Well Rpt Track No:	564778	Well Zip:	77884
Orig Well Rpt Trk No:		Owner Well No:	B-11P
Apprentice Reg No:		Owner Name:	City of Del Rio Landfill
No of Wells Drill:	1	Owner Addr1:	114 W. Martin St
Date Submitted:	2021-01-25	Owner Addr2:	
Type of Work:	New Well	Owner City:	Del Rio
Typ of Wrk Oth Descr:		Owner State:	TX
Seal Method:	Poured	Owner Zip:	78840
Seal Mthd Oth Desc:		Owner Country:	

Wells and Additional Sources Detail Report

Plugged w/i 48Hrs:	No	Driller Name:	Nathan O Yoakley
Drilling Start Dt:	2020-11-16	Driller Address1:	9532 FM 682
Drilling End Dt:	2020-11-20	Driller Addr2:	
Proposed Use:	Monitor	Driller City:	Yoakum
Prop Use Oth Descr:		Driller State:	TX
TCEQ Approve Plans:		Driller Zip:	77995
Apprve by Variance:		Driller Oth Cntry:	
Loc Vfy by Driller:	Yes	Driller Country:	
Sealed by Driller:	Yes	Dist to Sep Contam:	na
Sealed by Name:		Dist to Septic Tk:	na
Driller Signed:	Nathan Yoakley	Dist to Prop Line:	1000
Apprentice Signed:		Dist Verifi Method:	
Surface Compl:	Surface Slab Installed	Horizon Datum Type:	NAD27
Surf Comp Oth Desc:		Elevation:	
Complt by Driller:	Yes	Latitude:	29.36125
Pump Type:		Lat Degree:	29
Pump Type Oth Desc:		Lat Minute:	21
Pump Depth:		Lat Second:	40.5
Chemical Analysis:	No	Longitude:	-100.86314
Injurious Water:	No	Long Degree:	100
County:	Val Verde	Long Minute:	51
Known Loc Error:	No	Long Second:	47.3
Grid No:	70-42-1		
Company Name:	Terra Power Drilling LLC		
Well Location Description:			
Comments:	Dry hole		
Data Source:	Full SDR Database; SDRDB Well Location (Map)		
Drillers Well Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive/GetReports.aspx?Num=564778&Type=SDR-Well		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
1	-	0.00	0.00	1,066.31	SDR WELLS

License No:	54752	Well Address1:	1987 Railway Avenue
PWS No:		Well Addr2:	
Plug Rpt Track No:		Well City:	Del Rio
Well Rpt Track No:	564781	Well Zip:	77884
Orig Well Rpt Trk No:		Owner Well No:	B-3P
Apprentice Reg No:		Owner Name:	City of Del Rio Landfill
No of Wells Drill:	1	Owner Addr1:	114 W. Martin St.
Date Submitted:	2021-01-25	Owner Addr2:	
Type of Work:	New Well	Owner City:	Del Rio
Typ of Wrk Oth Descr:		Owner State:	TX
Seal Method:	Poured	Owner Zip:	78840
Seal Mthd Oth Desc:		Owner Country:	
Plugged w/i 48Hrs:	No	Driller Name:	Nathan O Yoakley
Drilling Start Dt:	2020-11-09	Driller Address1:	9532 FM 682

Wells and Additional Sources Detail Report

Drilling End Dt:	2020-11-13	Driller Addr2:	
Proposed Use:	Monitor	Driller City:	Yoakum
Prop Use Oth Descr:		Driller State:	TX
TCEQ Approve Plans:		Driller Zip:	77995
Apprve by Variance:		Driller Oth Cntry:	
Loc Vfy by Driller:	Yes	Driller Country:	
Sealed by Driller:	Yes	Dist to Sep Contam:	na
Sealed by Name:		Dist to Septic Tk:	na
Driller Signed:	Nathan Yoakley	Dist to Prop Line:	1000
Apprentice Signed:		Dist Verifi Method:	visual
Surface Compl:	Surface Slab Installed	Horizon Datum Type:	NAD27
Surf Comp Oth Desc:		Elevation:	
Complt by Driller:	Yes	Latitude:	29.356249
Pump Type:		Lat Degree:	29
Pump Type Oth Desc:		Lat Minute:	21
Pump Depth:		Lat Second:	22.5
Chemical Analysis:	No	Longitude:	-100.860443
Injurious Water:	No	Long Degree:	100
County:	Val Verde	Long Minute:	51
Known Loc Error:	No	Long Second:	37.59
Grid No:	70-42-1		
Company Name:	Terra Power Drilling LLC		
Well Location Description:			
Comments:			
Data Source:	Full SDR Database; SDRDB Well Location (Map)		
Drillers Well Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive/GetReports.aspx?Num=564781&Type=SDR-Well		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
1	-	0.00	0.00	1,059.91	SDR WELLS

License No:	54752	Well Address1:	1987 Railway Avenue
PWS No:		Well Addr2:	
Plug Rpt Track No:		Well City:	Del Rio
Well Rpt Track No:	564775	Well Zip:	77884
Orig Well Rpt Trk No:		Owner Well No:	B-13P
Apprentice Reg No:		Owner Name:	City of Del Rio Landfill
No of Wells Drill:	1	Owner Addr1:	114 W. Martin St.
Date Submitted:	2021-01-25	Owner Addr2:	
Type of Work:	New Well	Owner City:	Del Rio
Typ of Wrk Oth Descr:		Owner State:	TX
Seal Method:	Poured	Owner Zip:	78840
Seal Mthd Oth Desc:		Owner Country:	
Plugged w/i 48Hrs:	No	Driller Name:	Nathan O Yoakley
Drilling Start Dt:	2020-11-16	Driller Address1:	9532 FM 682
Drilling End Dt:	2020-11-20	Driller Addr2:	
Proposed Use:	Monitor	Driller City:	Yoakum

Wells and Additional Sources Detail Report

Prop Use Oth Descr:		Driller State:	TX
TCEQ Approve Plans:		Driller Zip:	77995
Apprve by Variance:		Driller Oth Cntry:	
Loc Vfy by Driller:	Yes	Driller Country:	
Sealed by Driller:	Yes	Dist to Sep Contam:	na
Sealed by Name:		Dist to Septic Tk:	na
Driller Signed:	Nathan Yoakley	Dist to Prop Line:	1000
Apprentice Signed:		Dist Verifi Method:	visual
Surface Compl:	Surface Slab Installed	Horizon Datum Type:	
Surf Comp Oth Desc:		Elevation:	
Complt by Driller:	Yes	Latitude:	29.357529
Pump Type:		Lat Degree:	29
Pump Type Oth Desc:		Lat Minute:	21
Pump Depth:		Lat Second:	27.1
Chemical Analysis:	No	Longitude:	-100.85964
Injurious Water:	No	Long Degree:	100
County:	Val Verde	Long Minute:	51
Known Loc Error:	No	Long Second:	34.7
Grid No:	70-42-1		
Company Name:	Terra Power Drilling LLC		
Well Location Description:			
Comments:			
Data Source:	Full SDR Database; SDRDB Well Location (Map)		
Drillers Well Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive/GetReports.aspx?Num=564775&Type=SDR-Well		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
1	-	0.00	0.00	1,049.29	SDR WELLS

License No:	54752	Well Address1:	1987 Railway Avenue
PWS No:		Well Addr2:	
Plug Rpt Track No:		Well City:	Del Rio
Well Rpt Track No:	564776	Well Zip:	77884
Orig Well Rpt Trk No:		Owner Well No:	B-12P
Apprentice Reg No:		Owner Name:	City of Del Rio Landfill
No of Wells Drill:	1	Owner Addr1:	114 W. Martin St
Date Submitted:	2021-01-25	Owner Addr2:	
Type of Work:	New Well	Owner City:	Del Rio
Typ of Wrk Oth Descr:		Owner State:	TX
Seal Method:	Poured	Owner Zip:	78840
Seal Mthd Oth Desc:		Owner Country:	
Plugged w/i 48Hrs:	No	Driller Name:	Nathan O Yoakley
Drilling Start Dt:	2020-11-16	Driller Address1:	9532 FM 682
Drilling End Dt:	2020-11-20	Driller Addr2:	
Proposed Use:	Monitor	Driller City:	Yoakum
Prop Use Oth Descr:		Driller State:	TX
TCEQ Approve Plans:		Driller Zip:	77995

Wells and Additional Sources Detail Report

Apprve by Variance:		Driller Oth Cntry:	
Loc Vfy by Driller:	Yes	Driller Country:	
Sealed by Driller:	Yes	Dist to Sep Contam:	na
Sealed by Name:		Dist to Septic Tk:	na
Driller Signed:	Nathan Yoakley	Dist to Prop Line:	1000
Apprentice Signed:		Dist Verifi Method:	visual
Surface Compl:	Surface Slab Installed	Horizon Datum Type:	NAD27
Surf Comp Oth Desc:		Elevation:	
Complt by Driller:	Yes	Latitude:	29.359986
Pump Type:		Lat Degree:	29
Pump Type Oth Desc:		Lat Minute:	21
Pump Depth:		Lat Second:	35.95
Chemical Analysis:	No	Longitude:	-100.859986
Injurious Water:	No	Long Degree:	100
County:	Val Verde	Long Minute:	51
Known Loc Error:	No	Long Second:	35.95
Grid No:	70-42-1		
Company Name:	Terra Power Drilling LLC		
Well Location Description:			
Comments:			
Data Source:	Full SDR Database; SDRDB Well Location (Map)		
Drillers Well Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive/GetReports.aspx?Num=564776&Type=SDR-Well		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
1	-	0.00	0.00	1,017.08	SDR WELLS

License No:	54752	Well Address1:	1987 Railway Avenue
PWS No:		Well Addr2:	
Plug Rpt Track No:		Well City:	Del Rio
Well Rpt Track No:	564779	Well Zip:	77884
Orig Well Rpt Trk No:		Owner Well No:	b-7P
Apprentice Reg No:		Owner Name:	City of Del Rio Landfill
No of Wells Drill:	1	Owner Addr1:	114 W Martin Street
Date Submitted:	2021-01-25	Owner Addr2:	
Type of Work:	New Well	Owner City:	Del Rio
Typ of Wrk Oth Descr:		Owner State:	TX
Seal Method:	Poured	Owner Zip:	78840
Seal Mthd Oth Desc:		Owner Country:	
Plugged w/i 48Hrs:	No	Driller Name:	Nathan O Yoakley
Drilling Start Dt:	2020-11-16	Driller Address1:	9532 FM 682
Drilling End Dt:	2020-11-20	Driller Addr2:	
Proposed Use:	Monitor	Driller City:	Yoakum
Prop Use Oth Descr:		Driller State:	TX
TCEQ Approve Plans:		Driller Zip:	77995
Apprve by Variance:		Driller Oth Cntry:	
Loc Vfy by Driller:	Yes	Driller Country:	

Wells and Additional Sources Detail Report

Sealed by Driller:	Yes	Dist to Sep Contam:	na
Sealed by Name:		Dist to Septic Tk:	na
Driller Signed:	Nathan Yoakley	Dist to Prop Line:	1000
Apprentice Signed:		Dist Verifi Method:	visual
Surface Compl:	Surface Slab Installed	Horizon Datum Type:	NAD27
Surf Comp Oth Desc:		Elevation:	
Complt by Driller:	Yes	Latitude:	29.36125
Pump Type:		Lat Degree:	29
Pump Type Oth Desc:		Lat Minute:	21
Pump Depth:		Lat Second:	40.5
Chemical Analysis:	No	Longitude:	-100.85944
Injurious Water:	No	Long Degree:	100
County:	Val Verde	Long Minute:	51
Known Loc Error:	No	Long Second:	33.98
Grid No:	70-42-1		
Company Name:	Terra Power Drilling LLC		
Well Location Description:			
Comments:	dry hole		
Data Source:	Full SDR Database; SDRDB Well Location (Map)		
Drillers Well Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive/GetReports.aspx?Num=564779&Type=SDR-Well		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
1	-	0.00	0.00	990.68	SDR WELLS

License No:	54752	Well Address1:	1987 Railway Avenue
PWS No:		Well Addr2:	
Plug Rpt Track No:		Well City:	Del Rio
Well Rpt Track No:	564783	Well Zip:	77884
Orig Well Rpt Trk No:		Owner Well No:	B-1P
Apprentice Reg No:		Owner Name:	City of Del Rio Landfill
No of Wells Drill:	1	Owner Addr1:	114 W. Martin St.
Date Submitted:	2021-01-25	Owner Addr2:	
Type of Work:	New Well	Owner City:	Del Rio
Typ of Wrk Oth Descr:		Owner State:	TX
Seal Method:	Other	Owner Zip:	78840
Seal Mthd Oth Desc:	Bentonite	Owner Country:	
Plugged w/i 48Hrs:	No	Driller Name:	Nathan O Yoakley
Drilling Start Dt:	2020-11-12	Driller Address1:	9532 FM 682
Drilling End Dt:	2020-11-17	Driller Addr2:	
Proposed Use:	Monitor	Driller City:	Yoakum
Prop Use Oth Descr:		Driller State:	TX
TCEQ Approve Plans:		Driller Zip:	77995
Apprve by Variance:		Driller Oth Cntry:	
Loc Vfy by Driller:	Yes	Driller Country:	
Sealed by Driller:	Yes	Dist to Sep Contam:	na
Sealed by Name:		Dist to Septic Tk:	na

Wells and Additional Sources Detail Report

Driller Signed:	Nathan Yoakley	Dist to Prop Line:	1200
Apprentice Signed:		Dist Verifi Method:	visual
Surface Compl:	Surface Slab Installed	Horizon Datum Type:	NAD27
Surf Comp Oth Desc:		Elevation:	
Complt by Driller:	Yes	Latitude:	29.36269
Pump Type:	Other	Lat Degree:	29
Pump Type Oth Desc:	none	Lat Minute:	21
Pump Depth:		Lat Second:	45.68
Chemical Analysis:	No	Longitude:	-100.8616
Injurious Water:	No	Long Degree:	100
County:	Val Verde	Long Minute:	51
Known Loc Error:	No	Long Second:	41.76
Grid No:	70-42-1		
Company Name:	Terra Power Drilling LLC		
Well Location Description:	Piezometer number B-1P		
Comments:			
Data Source:	Full SDR Database; SDRDB Well Location (Map)		
Drillers Well Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive/GetReports.aspx?Num=564783&Type=SDR-Well		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
1	-	0.00	0.00	1,060.88	SDR WELLS

License No:	4653	Well Address1:	Del Rio Municipal Solid Waste Landfill Cell No. 4
PWS No:		Well Addr2:	
Plug Rpt Track No:		Well City:	Del Rio
Well Rpt Track No:	34659	Well Zip:	78840
Orig Well Rpt Trk No:		Owner Well No:	MW-BP2
Apprentice Reg No:	WWDAPP00001694	Owner Name:	City of Del Rio Texas
No of Wells Drill:		Owner Addr1:	109 West Broadway
Date Submitted:	2004-03-25	Owner Addr2:	
Type of Work:	New Well	Owner City:	Del Rio
Typ of Wrk Oth Descr:		Owner State:	TX
Seal Method:	Other	Owner Zip:	78840
Seal Mthd Oth Desc:	Topload Pelletized Bentonite	Owner Country:	
Plugged w/i 48Hrs:	No	Driller Name:	Martin Straub
Drilling Start Dt:	2004-01-06	Driller Address1:	P.O. Box 192
Drilling End Dt:	2004-01-06	Driller Addr2:	
Proposed Use:	Monitor	Driller City:	Stanton
Prop Use Oth Descr:		Driller State:	TX
TCEQ Approve Plans:		Driller Zip:	79782
Apprve by Variance:		Driller Oth Cntry:	
Loc Vfy by Driller:	No	Driller Country:	
Sealed by Driller:	Yes	Dist to Sep Contam:	
Sealed by Name:		Dist to Septic Tk:	
Driller Signed:	Martin Straub	Dist to Prop Line:	
Apprentice Signed:	Edward Bryan	Dist Verifi Method:	

Wells and Additional Sources Detail Report

Surface Compl:	Alternative Procedure Used	Horizon Datum Type:	
Surf Comp Oth Desc:		Elevation:	
Complt by Driller:		Latitude:	29.358056
Pump Type:		Lat Degree:	29
Pump Type Oth Desc:		Lat Minute:	21
Pump Depth:		Lat Second:	29
Chemical Analysis:	No	Longitude:	-100.859723
Injurious Water:	No	Long Degree:	100
County:	Val Verde	Long Minute:	51
Known Loc Error:	No	Long Second:	35
Grid No:	70-42-1		
Company Name:	Straub Corporation		
Well Location Description:			
Comments:			
Data Source:	Full SDR Database; SDRDB Well Location (Map)		
Drillers Well Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive/GetReports.aspx?Num=34659&Type=SDR-Well		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
1	-	0.00	0.00	1,063.67	SDR WELLS

License No:	4653	Well Address1:	Del Rio Municipal Solid Waste Landfill Cell No. 4
PWS No:		Well Addr2:	
Plug Rpt Track No:		Well City:	Del Rio
Well Rpt Track No:	34657	Well Zip:	78840
Orig Well Rpt Trk No:		Owner Well No:	MW-BP3
Apprentice Reg No:	WWDAPP00001694	Owner Name:	City of Del Rio Texas
No of Wells Drill:		Owner Addr1:	109 West Broadway
Date Submitted:	2004-03-25	Owner Addr2:	
Type of Work:	New Well	Owner City:	Del Rio
Typ of Wrk Oth Descr:		Owner State:	TX
Seal Method:	Other	Owner Zip:	78840
Seal Mthd Oth Desc:	Topload Pelletized Bentonite	Owner Country:	
Plugged w/i 48Hrs:	No	Driller Name:	Martin Straub
Drilling Start Dt:	2004-01-06	Driller Address1:	P.O. Box 192
Drilling End Dt:	2004-01-06	Driller Addr2:	
Proposed Use:	Monitor	Driller City:	Stanton
Prop Use Oth Descr:		Driller State:	TX
TCEQ Approve Plans:		Driller Zip:	79782
Apprve by Variance:		Driller Oth Cntry:	
Loc Vfy by Driller:	No	Driller Country:	
Sealed by Driller:	Yes	Dist to Sep Contam:	
Sealed by Name:		Dist to Septic Tk:	
Driller Signed:	Martin Straub	Dist to Prop Line:	
Apprentice Signed:	Edward Bryan	Dist Verifi Method:	
Surface Compl:	Alternative Procedure Used	Horizon Datum Type:	
Surf Comp Oth Desc:		Elevation:	

Wells and Additional Sources Detail Report

Complt by Driller:		Latitude:	29.355834
Pump Type:		Lat Degree:	29
Pump Type Oth Desc:		Lat Minute:	21
Pump Depth:		Lat Second:	21
Chemical Analysis:	No	Longitude:	-100.857778
Injurious Water:	No	Long Degree:	100
County:	Val Verde	Long Minute:	51
Known Loc Error:	No	Long Second:	28
Grid No:	70-42-1		
Company Name:	Straub Corporation		
Well Location Description:			
Comments:			
Data Source:	Full SDR Database; SDRDB Well Location (Map)		
Drillers Well Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive/GetReports.aspx?Num=34657&Type=SDR-Well		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
1	-	0.00	0.00	1,059.95	SDR WELLS

License No:	4653	Well Address1:	Del Rio Municipal Solid Waste Landfill Cell No. 4
PWS No:		Well Addr2:	
Plug Rpt Track No:		Well City:	Del Rio
Well Rpt Track No:	34656	Well Zip:	78840
Orig Well Rpt Trk No:		Owner Well No:	MW-BP4
Apprentice Reg No:	WWDAPP00001694	Owner Name:	City of Del Rio Texas
No of Wells Drill:		Owner Addr1:	109 West Broadway
Date Submitted:	2004-03-25	Owner Addr2:	
Type of Work:	New Well	Owner City:	Del Rio
Typ of Wrk Oth Descr:		Owner State:	TX
Seal Method:	Other	Owner Zip:	78840
Seal Mthd Oth Desc:	Topload Pelletized Bentonite	Owner Country:	
Plugged w/i 48Hrs:	No	Driller Name:	Martin Straub
Drilling Start Dt:	2004-01-06	Driller Address1:	P.O. Box 192
Drilling End Dt:	2004-01-06	Driller Addr2:	
Proposed Use:	Monitor	Driller City:	Stanton
Prop Use Oth Descr:		Driller State:	TX
TCEQ Approve Plans:		Driller Zip:	79782
Apprve by Variance:		Driller Oth Cntry:	
Loc Vfy by Driller:	No	Driller Country:	
Sealed by Driller:	Yes	Dist to Sep Contam:	
Sealed by Name:		Dist to Septic Tk:	
Driller Signed:	Martin Straub	Dist to Prop Line:	
Apprentice Signed:	Edward Bryan	Dist Verifi Method:	
Surface Compl:	Alternative Procedure Used	Horizon Datum Type:	
Surf Comp Oth Desc:		Elevation:	
Complt by Driller:		Latitude:	29.354167
Pump Type:		Lat Degree:	29

Wells and Additional Sources Detail Report

Pump Type Oth Desc:		Lat Minute:	21
Pump Depth:		Lat Second:	15
Chemical Analysis:	No	Longitude:	-100.854723
Injurious Water:	No	Long Degree:	100
County:	Val Verde	Long Minute:	51
Known Loc Error:	No	Long Second:	17
Grid No:	70-42-1		
Company Name:	Straub Corporation		
Well Location Description:			
Comments:			
Data Source:	Full SDR Database; SDRDB Well Location (Map)		
Drillers Well Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive/GetReports.aspx?Num=34656&Type=SDR-Well		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
1	-	0.00	0.00	1,053.59	SDR WELLS

License No:	4653	Well Address1:	Del Rio Municipal Solid Waste Landfill Cell No. 4
PWS No:		Well Addr2:	
Plug Rpt Track No:		Well City:	Del Rio
Well Rpt Track No:	34653	Well Zip:	78840
Orig Well Rpt Trk No:		Owner Well No:	MW-BP5
Apprentice Reg No:	WWDAPP00001694	Owner Name:	City of Del Rio Texas
No of Wells Drill:		Owner Addr1:	109 West Broadway
Date Submitted:	2004-03-25	Owner Addr2:	
Type of Work:	New Well	Owner City:	Del Rio
Typ of Wrk Oth Descr:		Owner State:	TX
Seal Method:	Other	Owner Zip:	78840
Seal Mthd Oth Desc:	Topload Pelletized Bentonite	Owner Country:	
Plugged w/i 48Hrs:	No	Driller Name:	Martin Straub
Drilling Start Dt:	2004-01-06	Driller Address1:	P.O. Box 192
Drilling End Dt:	2004-01-06	Driller Addr2:	
Proposed Use:	Monitor	Driller City:	Stanton
Prop Use Oth Descr:		Driller State:	TX
TCEQ Approve Plans:		Driller Zip:	79782
Apprve by Variance:		Driller Oth Cntry:	
Loc Vfy by Driller:	No	Driller Country:	
Sealed by Driller:	Yes	Dist to Sep Contam:	
Sealed by Name:		Dist to Septic Tk:	
Driller Signed:	Martin Straub	Dist to Prop Line:	
Apprentice Signed:	Edward Bryan	Dist Verifi Method:	
Surface Compl:	Alternative Procedure Used	Horizon Datum Type:	
Surf Comp Oth Desc:		Elevation:	
Complt by Driller:		Latitude:	29.352778
Pump Type:		Lat Degree:	29
Pump Type Oth Desc:		Lat Minute:	21
Pump Depth:		Lat Second:	10

Wells and Additional Sources Detail Report

Chemical Analysis:	No	Longitude:	-100.852501
Injurious Water:	No	Long Degree:	100
County:	Val Verde	Long Minute:	51
Known Loc Error:	No	Long Second:	9
Grid No:	70-42-1		
Company Name:	Straub Corporation		
Well Location Description:			
Comments:			
Data Source:	Full SDR Database; SDRDB Well Location (Map)		
Drillers Well Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive/GetReports.aspx?Num=34653&Type=SDR-Well		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
2	NNW	0.00	3.35	1,050.92	SDR WELLS

License No:	4653	Well Address1:	Del Rio Municipal Solid Waste Landfill Cell No. 4
PWS No:		Well Addr2:	
Plug Rpt Track No:		Well City:	Del Rio
Well Rpt Track No:	34660	Well Zip:	78840
Orig Well Rpt Trk No:		Owner Well No:	MW-BP1
Apprentice Reg No:	WWDAPP00001694	Owner Name:	City of Del Rio Texas
No of Wells Drill:		Owner Addr1:	109 West Broadway
Date Submitted:	2004-03-25	Owner Addr2:	
Type of Work:	New Well	Owner City:	Del Rio
Typ of Wrk Oth Descr:		Owner State:	TX
Seal Method:	Other	Owner Zip:	78840
Seal Mthd Oth Desc:	Topload Pelletized Bentonite	Owner Country:	
Plugged w/i 48Hrs:	No	Driller Name:	Martin Straub
Drilling Start Dt:	2004-01-06	Driller Address1:	P.O. Box 192
Drilling End Dt:	2004-01-06	Driller Addr2:	
Proposed Use:	Monitor	Driller City:	Stanton
Prop Use Oth Descr:		Driller State:	TX
TCEQ Approve Plans:		Driller Zip:	79782
Apprve by Variance:		Driller Oth Cntry:	
Loc Vfy by Driller:	No	Driller Country:	
Sealed by Driller:	Yes	Dist to Sep Contam:	
Sealed by Name:		Dist to Septic Tk:	
Driller Signed:	Martin Straub	Dist to Prop Line:	
Apprentice Signed:	Edward Bryan	Dist Verifi Method:	
Surface Compl:	Alternative Procedure Used	Horizon Datum Type:	
Surf Comp Oth Desc:		Elevation:	
Complt by Driller:		Latitude:	29.359445
Pump Type:		Lat Degree:	29
Pump Type Oth Desc:		Lat Minute:	21
Pump Depth:		Lat Second:	34
Chemical Analysis:	No	Longitude:	-100.857223
Injurious Water:	No	Long Degree:	100

Wells and Additional Sources Detail Report

County:	Val Verde	Long Minute:	51
Known Loc Error:	No	Long Second:	26
Grid No:	70-42-1		
Company Name:	Straub Corporation		
Well Location Description:			
Comments:			
Data Source:	Full SDR Database; SDRDB Well Location (Map)		
Drillers Well Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive/GetReports.aspx?Num=34660&Type=SDR-Well		

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
3	SSE	0.09	450.27	1,066.35	SDR WELLS

License No:	4653	Well Address1:	Del Rio Municipal Solid Waste Landfill Cell No. 4
PWS No:		Well Addr2:	
Plug Rpt Track No:		Well City:	Del Rio
Well Rpt Track No:	34651	Well Zip:	78840
Orig Well Rpt Trk No:		Owner Well No:	MW-BP6
Apprentice Reg No:	WWDAPP00001694	Owner Name:	City of Del Rio Texas
No of Wells Drill:		Owner Addr1:	109 West Broadway
Date Submitted:	2004-03-25	Owner Addr2:	
Type of Work:	New Well	Owner City:	Del Rio
Typ of Wrk Oth Descr:		Owner State:	TX
Seal Method:	Other	Owner Zip:	78840
Seal Mthd Oth Desc:	Topload Pelletized Bentonite	Owner Country:	
Plugged w/i 48Hrs:	No	Driller Name:	Martin Straub
Drilling Start Dt:	2004-01-05	Driller Address1:	P.O. Box 192
Drilling End Dt:	2004-01-05	Driller Addr2:	
Proposed Use:	Monitor	Driller City:	Stanton
Prop Use Oth Descr:		Driller State:	TX
TCEQ Approve Plans:		Driller Zip:	79782
Apprve by Variance:		Driller Oth Cntry:	
Loc Vfy by Driller:	No	Driller Country:	
Sealed by Driller:	Yes	Dist to Sep Contam:	
Sealed by Name:		Dist to Septic Tk:	
Driller Signed:	Martin Straub	Dist to Prop Line:	
Apprentice Signed:	Edward Bryan	Dist Verifi Method:	
Surface Compl:	Alternative Procedure Used	Horizon Datum Type:	
Surf Comp Oth Desc:		Elevation:	
Complt by Driller:		Latitude:	29.352501
Pump Type:		Lat Degree:	29
Pump Type Oth Desc:		Lat Minute:	21
Pump Depth:		Lat Second:	9
Chemical Analysis:	No	Longitude:	-100.855001
Injurious Water:	No	Long Degree:	100
County:	Val Verde	Long Minute:	51
Known Loc Error:	No	Long Second:	18

Wells and Additional Sources Detail Report

Grid No:	70-42-1
Company Name:	Straub Corporation
Well Location Description:	
Comments:	
Data Source:	Full SDR Database; SDRDB Well Location (Map)
Drillers Well Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive/GetReports.aspx?Num=34651&Type=SDR-Well

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
9	N	0.46	2,418.06	1,002.99	SDR WELLS

License No:	54752	Well Address1:	1987 Railway Avenue
PWS No:		Well Addr2:	
Plug Rpt Track No:		Well City:	Del Rio
Well Rpt Track No:	564774	Well Zip:	77884
Orig Well Rpt Trk No:		Owner Well No:	B-15P
Apprentice Reg No:		Owner Name:	City of Del Rio Landfill
No of Wells Drill:	1	Owner Addr1:	114 W Maritin St
Date Submitted:	2021-01-25	Owner Addr2:	
Type of Work:	New Well	Owner City:	Del Rio
Typ of Wrk Oth Descr:		Owner State:	TX
Seal Method:	Poured	Owner Zip:	78840
Seal Mthd Oth Desc:		Owner Country:	
Plugged w/i 48Hrs:	No	Driller Name:	Nathan O Yoakley
Drilling Start Dt:	2020-11-18	Driller Address1:	9532 FM 682
Drilling End Dt:	2020-11-20	Driller Addr2:	
Proposed Use:	Monitor	Driller City:	Yoakum
Prop Use Oth Descr:		Driller State:	TX
TCEQ Approve Plans:		Driller Zip:	77995
Apprve by Variance:		Driller Oth Cntry:	
Loc Vfy by Driller:	Yes	Driller Country:	
Sealed by Driller:	Yes	Dist to Sep Contam:	na
Sealed by Name:		Dist to Septic Tk:	na
Driller Signed:	Nathan Yoakley	Dist to Prop Line:	1000
Apprentice Signed:		Dist Verifi Method:	visual
Surface Compl:	Surface Slab Installed	Horizon Datum Type:	
Surf Comp Oth Desc:		Elevation:	
Complt by Driller:	Yes	Latitude:	29.3694
Pump Type:		Lat Degree:	29
Pump Type Oth Desc:		Lat Minute:	22
Pump Depth:		Lat Second:	9.84
Chemical Analysis:	No	Longitude:	-100.85871
Injurious Water:	No	Long Degree:	100
County:	Val Verde	Long Minute:	51
Known Loc Error:	No	Long Second:	31.36
Grid No:	70-42-1		
Company Name:	Terra Power Drilling LLC		

Wells and Additional Sources Detail Report

Well Location Description:
Comments:
Data Source: Full SDR Database; SDRDB Well Location (Map)
Drillers Well Report: https://www3.twdb.texas.gov/apps/waterdatainteractive/GetReports.aspx?Num=564774&Type=SDR-Well

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
21	NE	0.81	4,254.75	1,030.33	SDR WELLS

License No:	5044	Well Address1:	4917 E. Hwy. 90
PWS No:		Well Addr2:	
Plug Rpt Track No:		Well City:	Del Rio
Well Rpt Track No:	8457	Well Zip:	78840
Orig Well Rpt Trk No:		Owner Well No:	MW-8
Apprentice Reg No:	WWWDAPP00001126	Owner Name:	Carson Dist. Co., Inc.
No of Wells Drill:		Owner Addr1:	1905-A Junction Hwy.
Date Submitted:	2002-06-21	Owner Addr2:	
Type of Work:	New Well	Owner City:	Kerrville
Typ of Wrk Oth Descr:		Owner State:	TX
Seal Method:	Other	Owner Zip:	78028
Seal Mthd Oth Desc:	Hand Mix	Owner Country:	
Plugged w/i 48Hrs:	No	Driller Name:	John Will White
Drilling Start Dt:	2002-06-06	Driller Address1:	P.O. Box 906
Drilling End Dt:	2002-06-06	Driller Addr2:	
Proposed Use:	Monitor	Driller City:	Clyde
Prop Use Oth Descr:		Driller State:	TX
TCEQ Approve Plans:		Driller Zip:	79510
Apprve by Variance:		Driller Oth Cntry:	
Loc Vfy by Driller:	No	Driller Country:	
Sealed by Driller:	Yes	Dist to Sep Contam:	
Sealed by Name:		Dist to Septic Tk:	
Driller Signed:	John W. White	Dist to Prop Line:	
Apprentice Signed:	William B. Atkins	Dist Verifi Method:	
Surface Compl:	Alternative Procedure Used	Horizon Datum Type:	
Surf Comp Oth Desc:		Elevation:	
Complt by Driller:		Latitude:	29.368055
Pump Type:		Lat Degree:	29
Pump Type Oth Desc:		Lat Minute:	22
Pump Depth:		Lat Second:	5
Chemical Analysis:	No	Longitude:	-100.845278
Injurious Water:	Yes	Long Degree:	100
County:	Val Verde	Long Minute:	50
Known Loc Error:	No	Long Second:	43
Grid No:	70-42-1		
Company Name:	White Drilling, Inc.		
Well Location Description:			
Comments:			

Wells and Additional Sources Detail Report

Data Source:	Full SDR Database; SDRDB Well Location (Map)
Drillers Well Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive/GetReports.aspx?Num=8457&Type=SDR-Well

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
21	NE	0.81	4,254.75	1,030.33	SDR WELLS

License No:	5044	Well Address1:	4917 E. Hwy. 90
PWS No:		Well Addr2:	
Plug Rpt Track No:		Well City:	Del Rio
Well Rpt Track No:	8458	Well Zip:	78840
Orig Well Rpt Trk No:		Owner Well No:	MW-9
Apprentice Reg No:	WWWDAPP00001126	Owner Name:	Carson Dist. Co., Inc.
No of Wells Drill:		Owner Addr1:	1905-A Junction Hwy.
Date Submitted:	2002-06-21	Owner Addr2:	
Type of Work:	New Well	Owner City:	Kerrville
Typ of Wrk Oth Descr:		Owner State:	TX
Seal Method:	Other	Owner Zip:	78028
Seal Mthd Oth Desc:	Hand Mix	Owner Country:	
Plugged w/i 48Hrs:	No	Driller Name:	John Will White
Drilling Start Dt:	2002-06-05	Driller Address1:	P.O. Box 906
Drilling End Dt:	2002-06-05	Driller Addr2:	
Proposed Use:	Monitor	Driller City:	Clyde
Prop Use Oth Descr:		Driller State:	TX
TCEQ Approve Plans:		Driller Zip:	79510
Apprve by Variance:		Driller Oth Cntry:	
Loc Vfy by Driller:	No	Driller Country:	
Sealed by Driller:	Yes	Dist to Sep Contam:	
Sealed by Name:		Dist to Septic Tk:	
Driller Signed:	John W. White	Dist to Prop Line:	
Apprentice Signed:	William B. Atkins	Dist Verifi Method:	
Surface Compl:	Alternative Procedure Used	Horizon Datum Type:	
Surf Comp Oth Desc:		Elevation:	
Complt by Driller:		Latitude:	29.368055
Pump Type:		Lat Degree:	29
Pump Type Oth Desc:		Lat Minute:	22
Pump Depth:		Lat Second:	5
Chemical Analysis:	No	Longitude:	-100.845278
Injurious Water:	Yes	Long Degree:	100
County:	Val Verde	Long Minute:	50
Known Loc Error:	No	Long Second:	43
Grid No:	70-42-1		
Company Name:	White Drilling, Inc.		
Well Location Description:			
Comments:			
Data Source:	Full SDR Database; SDRDB Well Location (Map)		
Drillers Well Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive/GetReports.aspx?Num=8458&Type=SDR-Well		

Wells and Additional Sources Detail Report

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
21	NE	0.81	4,254.75	1,030.33	SDR WELLS

License No:	5044	Well Address1:	4917 E. Hwy. 90
PWS No:		Well Addr2:	
Plug Rpt Track No:		Well City:	Del Rio
Well Rpt Track No:	8456	Well Zip:	78840
Orig Well Rpt Trk No:		Owner Well No:	MW-7
Apprentice Reg No:	WWWDAPP00001126	Owner Name:	Carson Dist. Co., Inc.
No of Wells Drill:		Owner Addr1:	1905-A Junction Hwy.
Date Submitted:	2002-06-21	Owner Addr2:	
Type of Work:	New Well	Owner City:	Kerrville
Typ of Wrk Oth Descr:		Owner State:	TX
Seal Method:	Other	Owner Zip:	78028
Seal Mthd Oth Desc:	Hand Mix	Owner Country:	
Plugged w/i 48Hrs:	No	Driller Name:	John Will White
Drilling Start Dt:	2002-06-05	Driller Address1:	P.O. Box 906
Drilling End Dt:	2002-06-05	Driller Addr2:	
Proposed Use:	Monitor	Driller City:	Clyde
Prop Use Oth Descr:		Driller State:	TX
TCEQ Approve Plans:		Driller Zip:	79510
Apprve by Variance:		Driller Oth Cntry:	
Loc Vfy by Driller:	No	Driller Country:	
Sealed by Driller:	Yes	Dist to Sep Contam:	
Sealed by Name:		Dist to Septic Tk:	
Driller Signed:	John W. White	Dist to Prop Line:	
Apprentice Signed:	William B. Atkins	Dist Verifi Method:	
Surface Compl:	Alternative Procedure Used	Horizon Datum Type:	
Surf Comp Oth Desc:		Elevation:	
Complt by Driller:		Latitude:	29.368055
Pump Type:		Lat Degree:	29
Pump Type Oth Desc:		Lat Minute:	22
Pump Depth:		Lat Second:	5
Chemical Analysis:	No	Longitude:	-100.845278
Injurious Water:	Yes	Long Degree:	100
County:	Val Verde	Long Minute:	50
Known Loc Error:	No	Long Second:	43
Grid No:	70-42-1		
Company Name:	White Drilling, Inc.		
Well Location Description:			
Comments:			
Data Source:	Full SDR Database; SDRDB Well Location (Map)		
Drillers Well Report:	https://www3.twdb.texas.gov/apps/waterdatainteractive/GetReports.aspx?Num=8456&Type=SDR-Well		

Well Log Reports from Plotted Water Wells

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
7	NNW	0.37	1,963.88	1,000.41	TCEQ WELL LOGS

Grid No: 70-33-9
Date Drilled: 09/03/1996
Owners Name: PETE TERLAJE
County: VAL VERDE
Water Usage: DOMESTIC
Static Level: 70
Depth Drilled: 400
Latitude: 29.368295645188514
Longitude: -100.86356666324204

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
11	N	0.53	2,801.77	1,016.57	TCEQ WELL LOGS

Grid No: 70-42-1A
Date Drilled: 04/04/1984
Owners Name: JUAN J TORRESCONO
County: VAL VERDE
Water Usage: DOMESTIC
Static Level: NOT REPORTED
Depth Drilled: 120
Latitude: 29.36875
Longitude: -100.854792

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
20	NE	0.78	4,100.11	1,032.61	TCEQ WELL LOGS

Grid No: 70-72-1
Date Drilled: 07/22/1986
Owners Name: JOSE MONIESANO
County: VAL VERDE
Water Usage: DOMESTIC
Static Level: 40
Depth Drilled: 200
Latitude: 29.368642
Longitude: -100.847411

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
27	NW	0.99	5,217.02	992.06	TCEQ WELL LOGS

Grid No: 70-42-1

Wells and Additional Sources Detail Report

Date Drilled:	11/28/2000
Owners Name:	DARRELL HARGROVE
County:	VAL VERDE
Water Usage:	DOMESTIC
Static Level:	50
Depth Drilled:	120
Latitude:	29.371195
Longitude:	-100.875602

Map Key	Direction	Distance (mi)	Distance (ft)	Elevation (ft)	DB
27	NW	0.99	5,217.02	992.06	TCEQ WELL LOGS

Grid No:	70-42-1
Date Drilled:	11/27/2000
Owners Name:	DARRELL HARGROVE
County:	VAL VERDE
Water Usage:	DOMESTIC
Static Level:	50
Depth Drilled:	300
Latitude:	29.371192
Longitude:	-100.875594

Radon Information

This section lists any relevant radon information found for the target property.

Federal EPA Radon Zone for *VAL VERDE* County: **3**

Zone 1: Counties with predicted average indoor radon screening levels greater than 4 pCi/L
Zone 2: Counties with predicted average indoor radon screening levels from 2 to 4 pCi/L
Zone 3: Counties with predicted average indoor radon screening levels less than 2 pCi/L

Federal Area Radon Information for *VAL VERDE* County

No Measures/Homes:	8
Geometric Mean:	0.4
Arithmetic Mean:	0.5
Median:	0.4
Maximum:	1
% >4 pCi/L:	0
% >20 pCi/L:	0
Notes on Data Table:	TABLE 1. Screening indoor radon data from the State/EPA Residential Radon Survey of Texas conducted during 1990-91. Data represent 2-7 day charcoal canister measurements from the lowest level of each home tested.

Appendix

Federal Sources

FEMA National Flood Hazard Layer — **FEMA FLOOD**

The National Flood Hazard Layer (NFHL) data incorporates Flood Insurance Rate Map (FIRM) databases published by the Federal Emergency Management Agency (FEMA), and any Letters Of Map Revision (LOMRs) that have been issued against those databases since their publication date. The FIRM Database is the digital, geospatial version of the flood hazard information shown on the published paper FIRMs. The FIRM Database depicts flood risk information and supporting data used to develop the risk data. The FIRM Database is derived from Flood Insurance Studies (FISs), previously published FIRMs, flood hazard analyses performed in support of the FISs and FIRMs, and new mapping data, where available.

Indoor Radon Data — **INDOOR RADON**

Indoor radon measurements tracked by the Environmental Protection Agency(EPA) and the State Residential Radon Survey.

Public Water Systems Violations and Enforcement Data — **PWSV**

List of drinking water violations and enforcement actions from the Safe Drinking Water Information System (SDWIS) made available by the Drinking Water Protection Division of the US EPA's Office of Groundwater and Drinking Water. Enforcement sensitive actions are not included in the data released by the EPA. Address information provided in SWDIS may correspond either with the physical location of the water system, or with a contact address.

Radon Zone Level — **RADON ZONE**

Areas showing the level of Radon Zones (level 1, 2 or 3) by county. This data is maintained by the Environmental Protection Agency (EPA).

Safe Drinking Water Information System (SDWIS) — **SDWIS**

The Safe Drinking Water Information System (SDWIS) contains information about public water systems as reported to US Environmental Protection Agency (EPA) by the states. Addresses may correspond with the location of the water system, or with a contact address.

Soil Survey Geographic database — **SSURGO**

The Soil Survey Geographic database (SSURGO) contains information about soil as collected by the National Cooperative Soil Survey at the Natural Resources Conservation Service (NRCS). Soil maps outline areas called map units. The map units are linked to soil properties in a database. Each map unit may contain one to three major components and some minor components.

U.S. Fish & Wildlife Service Wetland Data — **US WETLAND**

The U.S. Fish & Wildlife Service Wetland layer represents the approximate location and type of wetlands and deepwater habitats in the United States.

USGS Current Topo — **US TOPO**

US Topo topographic maps are produced by the National Geospatial Program of the U.S. Geological Survey (USGS). The project was launched in late 2009, and the term "US Topo" refers specifically to quadrangle topographic maps published in 2009 and later.

USGS Geology — **US GEOLOGY**

Seamless maps depicting geological information provided by the United States Geological Survey (USGS).

USGS National Water Information System — **FED USGS**

The U.S. Geological Survey (USGS)'s National Water Information System (NWIS) is the nation's principal repository of water resources data. This database includes comprehensive information of well-construction details, time-series data for gage height, streamflow, groundwater level, and precipitation and water use data.

Wells from NWIS — **FED USGS**

The U.S. Geological Survey's National Water Information System (NWIS) is the nation's principal repository of water resources data. The NWIS includes comprehensive information of well-construction details, time-series data for gage height, streamflow, groundwater level, and precipitation and water use data. This NWIW dataset contains select Site Types from the overall NWIS Sites data, limited to the following Group Site Types only: Groundwater Group Site Types: Well, Collector or Ranney type well, Hyporheic-zone well,

Interconnected Wells, Multiple wells; Spring Group Site Type: Spring; and Other Group Site Types: Aggregate groundwater use, Cistern.

State Sources

Fort Bend Subsidence District Water Wells **WW FORT BEND**

List of water wells in the Fort Bend Subsidence District, boundaries of which are defined as all the territory within Fort Bend County. The Fort Bend Subsidence District was created by the Texas Legislature in 1989 as a conservation and reclamation district to control land subsidence and manage groundwater resources through regulation, conservation, and coordination with suppliers of alternative water sources to assure an adequate quantity and quality of water for the future. The District's purpose is to provide for the regulation of the withdrawal of groundwater within the District to prevent subsidence that contributes to flooding, inundation or overflow of areas within the District, including rising waters resulting from storms or hurricanes.

Groundwater Database **GWDB**

The Texas Water Development Board (TWDB) Groundwater Database (GWDB) contains information on selected water wells, springs, oil/gas tests (that were originally intended to be or were converted to water wells), water levels and water quality.

Harris Galveston Subsidence District Water Wells **WW HARRIS GAL**

List of water wells in the Harris-Galveston Subsidence District (HGSD). The HGSD was created by the 64th Texas Legislature as an underground water conservation district in 1975 to provide regulation of groundwater withdrawal to control subsidence.

High Plains Water Wells **WW HIGH PLAINS**

Inventory of water wells in the High Plains Underground Water Conservation District No. 1 (HPUWCD), which was created in 1951. As a political subdivision of Texas, HPUWCD is charged with protecting, preserving and conserving aquifers within the District's 16-county service area.

Oil and Gas Wells **OGW**

Oil and Gas Well Data made available by the Railroad Commission of Texas.

Pipelines **PIPELINE**

Locations of interstate and intrastate gas and liquids pipelines, made available by the Railroad Commission of Texas (RRC). Data is derived from RRC T-4 Permit applications ("Application for Permit to Operate a Pipeline in Texas"), which facilitate regulatory functions of the Pipeline Safety Section of the RRC. The digital data used to create the files was taken from the forms system within the RRC, from the General Land Office (GLO) county survey maps, and, United States Geological Survey (USGS) quadrangle maps.

Plotted Water Wells **WATER WELLS**

A list of water wells in Texas that are plotted in Texas Commission on Environmental Quality (TCEQ) Water Well Report Viewer. The database provides the best representation of water well driller's reports available to the TCEQ as of the date of records collected. Note: records are plotted using the Texas Land Survey Grid System, identifying the 2.5 minute grid where wells are located but do not contain the offset necessary to pinpoint a specific location. Therefore, plotted locations are accurate to a resolution of 2.5 minute (2-3 miles).

Plugged Water Wells **PLUGGED WELLS**

A list of plugged water wells from the Submitted Drillers Report (SDR) Database. This list is maintained by the Texas Water Development Board (TWDB).

Public Water Systems Wells and Surface Intakes **PWSW**

Public Water Supply Water Well Sites and Public Water Supply Surface Water Intake Sites in the State of Texas made available by the Texas Commission on Environmental Quality (TCEQ). The locations for these layers were obtained by the Water Supply Division as recorded from various sources, and the data provider indicates that some locational errors have been identified. As resources allow, TCEQ intends to improve the accuracy of these locations to meet the standards set forth in the agency's Positional Data Policy.

Select Wells from SDR **SDRW WELLS**

Locations of wells from the Submitted Drillers Report (SDR) Database with select proposed usage:

Domestic, Fracking Supply, Industrial, Irrigation, Other, Public Supply, Rig Supply, Stock, Unknown. SDR is populated from the online Texas Well Report Submission and Retrieval System (TWRSRS), a cooperative Texas Department of Licensing and Regulation (TDLR) and Texas Water Development Board (TWDB) application requiring registered water-well drillers to submit reports. Excludes SDR records with the following proposed usage: Closed-Loop Geothermal, De-watering, Environmental Soil Boring, Extraction, Injection, Monitor, Test Well.

Submitted Drillers Report Database **SDR WELLS**

The Submitted Drillers Report (SDR) Database is populated from the online Texas Well Report Submission and Retrieval System (TWRSRS) which is a cooperative Texas Department of Licensing and Regulation (TDLR) and Texas Water Development Board (TWDB) application that registered water-well drillers use to submit their required reports.

Surveys **SURVEY**

Survey boundaries made available by the Railroad Commission of Texas (RRC). A survey is a certified measured description of a piece of land. In Texas, original surveys were performed as part of the patenting process whereby land was transferred from the public domain. These "patent surveys", recorded at the Texas General Land Office (GLO), constitute an official land grid for the State and are the basis for subsequent land surveys. The digital data used to create surveys were taken from the forms system within the RRC, from the General Land Office (GLO) county survey maps, and United States Geological Survey (USGS) quadrangle maps.

Underground Injection Control **UIC**

List of underground injection control (UIC) permits in the Texas Commission on Environmental Quality (TCEQ) Central Registry database. Includes Class I, Class III, Class IV, Class 5, and non permitted UICs; does not include injection wells regulated by the Railroad Commission of Texas.

Water Utility Database **WUD**

The Water Utility Database is defined as a collection of data from Texas Water Districts, Public Drinking Water Systems and Water and Sewer Utilities who submit information to the TCEQ. This database is an integrated database designed and developed to replace over 160 stand alone legacy systems representing over 5 million records of the former Texas Water Commission and the Texas Department of Health.

Well Log Reports from Plotted Water Wells **TCEQ WELL LOGS**

Locations of TCEQ Water Wells as derived from well logs in the Texas Commission on Environmental Quality (TCEQ) Water Well Report Viewer, which includes unnumbered water wells and those plotted to 2.5 minute grid locations (2-3 miles). In this collection of Well Log Reports, locations have been manually verified.

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APPENDIX IIIJ-C

Site Boring Logs

Boring Log No. B-1

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/18/20
Elevation: 994.42 ft (By survey)
Coordinates: N: 13684130.48 E: 1375589.86
Backfill: Converted to piezometer

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION (ELEVATION)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
0		GRAVELLY FAT CLAY (CH), very stiff, gray and brown, ***[Talus]***	SS 1		26			9	53	35	8	67	
		(992.4)											
		FAT CLAY (CH), hard to very hard, gray, ***[Del Rio Clay (Kdr)]***	SS 2		42			13	55	36	5	95	
5		- with gypsum crystal below 4'	SS 3		50/5"			13					
		(988.4)											
		Weathered CLAY-SHALE, very hard, gray, with interbedded marl, with ferrous stains and gypsum crystal ***[Del Rio Clay (Kdr)]***	SS 4		50/4"			11					
			SS 5		**50/5"			13	52	33			
10			GB 6					13					
			SS 7		**50/5"			14					
15													
			SS 8		**50/6"								
20													
			SS 9		**50/5"			12					
25													
		- with tan clay seams below 28'	SS 10		**50/5"			10	45	28	7	85	
30													
			SS 11		**50/3"			16	46	28			
35		(959.4)											

Bottom of hole at 35.0 feet.

Groundwater Data:
First encountered during drilling: 25-ft depth
After 30 minutes: 24.25-ft depth
Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 35 ft

Nomenclature Used on Boring Log

Split Spoon (SS)
Grab Sample (GB)
Water encountered during drilling
Delayed water reading

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-2

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/20/20
Elevation: 987.97 ft (By survey)
Coordinates: N: 13683181.06 E: 1374634.82
Backfill: Converted to piezometer

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
0		(ELEVATION)											
		Weathered CLAY-SHALE, very stiff to very hard, gray, with calcareous deposits and ferrous stains, with trace of gypsum crystals ***[Del Rio Clay (Kdr)]***	SS 1		27			9	58	36	7	89	
			SS 2		50/2"			12					
5			SS 3		50/5"			12	56	34	4	96	
			SS 4		**50/6"			11					
			SS 5		**50/3"			11					
10			GB 6					11					
			SS 7		50/3"			11	54	32	3	88	
15													
			SS 8		**50/3"			12					
20													
			SS 9		**50/5"			11					
25		(963.0)											

Bottom of hole at 25.0 feet.

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 25 ft

Nomenclature Used on Boring Log

Split Spoon (SS)
Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

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Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-3

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/16/20
Elevation: 1060.67 ft (By survey)
Coordinates: N: 13681801.55 E: 1375882.48
Backfill: Converted to piezometer

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
0 (ELEVATION)	LEAN CLAY with Sand (CL), very stiff to hard, tan, ***[Buda Limestone (Kbu)]***	SS 1		17			4	37	21	15	82	
		SS 2		53			4	30	14	12	79	
	(1056.7)											
5	LIMESTONE, very hard, tan, ***[Buda Limestone (Kbu)]***	SS 3		50/3"								
		SS 4		**50/5"			5					
		SS 5		**50/1"								
10												
		SS 6		**50/1"			4					
15												
		SS 7		**50/2"			2	27	13			
20												
		SS 8		**50/5"			2					
25												
	(1032.7)											
	Weathered CLAY-SHALE, very hard, tan and gray, with ferrous stains ***[Del Rio Clay (Kdr)]***	SS 9		**50/4"			10					
30												
		SS 10		50/4"			15	67	45	7	90	
35												
	(1022.7)											
	Weathered CLAY-SHALE, very hard, brown, with calcareous deposits and ferrous stains ***[Del Rio Clay (Kdr)]***	SS 11		**50/6"			12	61	41	8	87	
40												

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 90 ft

Nomenclature Used on Boring Log

Split Spoon (SS) Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

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Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-3 (continued)

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/16/20
Elevation: 1060.67 ft (By survey)
Coordinates: N: 13681801.55 E: 1375882.48
Backfill: Converted to piezometer

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
40	(ELEVATION)											
	Weathered CLAY-SHALE, very hard, brown, with calcareous deposits and ferrous stains ***[Del Rio Clay (Kdr)]*** *(continued)*											
45		SS 12		50/4"			13					
50		SS 13		77/9"								
55		SS 14		**50/6"			12					
60	(1000.7)	SS 15		**50/6"			12					
	CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]***											
65		SS 16		**50/5"			13	61	40			
70		SS 17		50/5"			13					
75		SS 18		50/5"								
80		SS 19		**50/4"			12					

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 90 ft

Nomenclature Used on Boring Log

Split Spoon (SS) Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

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Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-3 (continued)

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/16/20
Elevation: 1060.67 ft (By survey)
Coordinates: N: 13681801.55 E: 1375882.48
Backfill: Converted to piezometer

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
80		(ELEVATION)											
		CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]*** *(continued)*											
85			SS 20		**50/3"								
90		(970.7)	GB 21					10					

Bottom of hole at 90.0 feet.

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 90 ft

Nomenclature Used on Boring Log

Split Spoon (SS)
Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-4

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/17/20
Elevation: 1043.59 ft (By survey)
Coordinates: N: 13682729.42 E: 1376525.21
Backfill: Bentonite pellets

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
0		(ELEVATION)											
		CLAYEY GRAVEL with Sand (GC), very dense to dense, light tan, ***[Talus]***	SS 1		58			2	39	22	16	27	
			SS 2		43			7					
		(1039.6)											
5		FAT CLAY with Gravel (CH), hard to very hard, tan, with ferrous stains ***[Del Rio Clay (Kdr)]***	SS 3		60			9	60	39			
			SS 4		63			8					
			SS 5		**50/6"			6					
10			GB 6					13					
		(1030.6)											
		Weathered CLAY-SHALE, very hard, reddish brown, ***[Del Rio Clay (Kdr)]***	SS 7		50/6"			9	57	37	7	83	
15													
			SS 8		**50/6"			11					
20													
			SS 9		**50/5"			15					
25													
			SS 10		**50/5"								
30													
			SS 11		**50/5"			16					
35		(1008.6)											
		Weathered CLAY-SHALE, very hard, tan and gray, with ferrous stains ***[Del Rio Clay (Kdr)]***											
			SS 12		**50/5"			14	62	40	3	90	
40													

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 75 ft

Nomenclature Used on Boring Log

Split Spoon (SS) Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-4 (continued)

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/17/20
Elevation: 1043.59 ft (By survey)
Coordinates: N: 13682729.42 E: 1376525.21
Backfill: Bentonite pellets

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
40		(ELEVATION)											
		Weathered CLAY-SHALE, very hard, tan and gray, with ferrous stains ***[Del Rio Clay (Kdr)]*** *(continued)*											
			SS 13		**50/4"			14					
45													
			SS 14		**50/4"			14					
50													
		(990.6)											
		CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]***	SS 15		**50/5"			13	60	40			
55													
			SS 16		**50/5"								
60													
			SS 17		**50/4"			11					
65													
			SS 18		**50/3"								
70													
			SS 19		**50/5"			10					
75		(968.6)											
		Bottom of hole at 75.0 feet.											

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 75 ft

Nomenclature Used on Boring Log

Split Spoon (SS) Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-5

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/16/20
Elevation: 1051.65 ft (By survey)
Coordinates: N: 13683671.98 E: 1376032.10
Backfill: Bentonite pellets

DEPTH (ft)	MATERIAL DESCRIPTION (ELEVATION)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
0	GRAVELLY LEAN CLAY (CL), hard to very hard, light tan, ***[Del Rio Clay (Kdr)]***	SS 1		40			6	42	24	14	68	
		SS 2		50/6"			3					
	(1047.7)											
5	FAT CLAY with Sand (CH), hard to very hard, tan, with calcareous deposits and ferrous stains ***[Del Rio Clay (Kdr)]***	SS 3		50			10					
		SS 4		55			11	63	42	17	77	
		SS 5		74/11"			12					
10		GB 6										
	(1038.7)											
	Weathered CLAY-SHALE, very hard, tan, with calcareous deposits and ferrous stains ***[Del Rio Clay (Kdr)]***	SS 7		**50/5"								
15												
		SS 8		50/6"			13	63	41			
20												
	(1028.7)											
	Weathered CLAY-SHALE, very hard, reddish brown, ***[Del Rio Clay (Kdr)]***	SS 9		50/6"			15	62	42	2	82	
25												
	(1023.7)											
	Weathered CLAY-SHALE, very hard, tan, with ferrous stains ***[Del Rio Clay (Kdr)]***	SS 10		50/5"			14					
30												
		SS 11		50/5"			14	62	42	2	74	
35												
		SS 12		50/5"			14					
40												

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 55 ft

Nomenclature Used on Boring Log

Split Spoon (SS) Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-5 (continued)

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/16/20
Elevation: 1051.65 ft (By survey)
Coordinates: N: 13683671.98 E: 1376032.10
Backfill: Bentonite pellets

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
40		(ELEVATION)											
		Weathered CLAY-SHALE, very hard, tan, with ferrous stains ***[Del Rio Clay (Kdr)]*** *(continued)*											
			SS 13		50/3"			14					
45		(1003.7)											
		CLAY-SHALE, very hard, tan and gray, with ferrous stains ***[Del Rio Clay (Kdr)]***	SS 14		50/3"			14	58	38			
50													
			SS 15		**50/5"			13					
55		(996.7)											

Bottom of hole at 55.0 feet.

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 55 ft

Nomenclature Used on Boring Log

Split Spoon (SS) Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-6

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/20/20
Elevation: 1028.01 ft (By survey)
Coordinates: N: 13682234.92 E: 1375346.15
Backfill: Converted to piezometer

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
0 (ELEVATION)	FAT CLAY with Gravel (CH), very hard, reddish brown, ***[Del Rio Clay (Kdr)]***	SS 1		50/5"			9	61	40	7	79	
		SS 2		**50/5"			11					
5		SS 3		**50/5"			13					
	(1022.0) Weathered CLAY-SHALE, very hard, reddish brown, ***[Del Rio Clay (Kdr)]***	SS 4		**50/5"			11	54	34	8	88	
		SS 5		**50/4"			10					
10												
	- with gypsum crystals below 13'	SS 6		**50/5"			15					
15												
		SS 7		50/4"			14	60	37	4	96	
20												
		SS 8		**50/6"			12					
25	(1000.0) CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]***	SS 9		**50/5"			13	60	39	2	98	
30												
		SS 10		**50/5"			12					
35	(993.0) Bottom of hole at 35.0 feet.											

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: L. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 35 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-7

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/12/20
Elevation: 1052.46 ft (By survey)
Coordinates: N: 13682645.58 E: 1376245.09
Backfill: Converted to piezometer

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
0		(ELEVATION)											
		SANDY LEAN CLAY (CL), very stiff to hard, light tan, ***[Talus]***	SS 1		23			5	37	18	24	68	
			SS 2		80			5					
		(1048.5)											
5		FAT CLAY (CH), very hard, light tan, with ferrous stains ***[Del Rio Clay (Kdr)]***	SS 3		50/6"			8	54	33	9	90	
			SS 4		92/9"			10					
		- with gravel at 8'	SS 5		**50/6"			9	56	37	11	81	
10		- with sand below 8.5'	GB 6					5					
		(1039.5)											
		Weathered CLAY-SHALE, very hard, tan and gray, with ferrous stains ***[Del Rio Clay (Kdr)]***	SS 7		92/9"			10	60	40	4	92	
15													
			SS 8		50/5"			14					
20													
			SS 9		50/5"			15					
25													
		(1024.5)											
		Weathered CLAY-SHALE, very hard, reddish brown, ***[Del Rio Clay (Kdr)]***	SS 10		**50/3"			13	58	39	3	95	
30													
			SS 11		**50/6"			13					
35													
			SS 12		50/5"			16					
40													

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 60 ft

Nomenclature Used on Boring Log

Split Spoon (SS) Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-7 (continued)

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/12/20
Elevation: 1052.46 ft (By survey)
Coordinates: N: 13682645.58 E: 1376245.09
Backfill: Converted to piezometer

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
40	(ELEVATION)											
	Weathered CLAY-SHALE, very hard, reddish brown, ***[Del Rio Clay (Kdr)]*** *(continued)*											
	- with calcareous deposits below 43'	SS 13		88/10"			16					
45	(1004.5)											
	CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]***	SS 14		**50/5"			13	57	37	3	97	
50												
		SS 15		**50/6"			13					
55												
	- 5" reddish brown clay seam at 57'	SS 16		**50/6"			14	57	37			
60	(992.5)											

Bottom of hole at 60.0 feet.

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 60 ft

Nomenclature Used on Boring Log

Split Spoon (SS) Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-8

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/18/20
Elevation: 995.52 ft (By survey)
Coordinates: N: 13683342.65 E: 1375327.52
Backfill: Bentonite pellets

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
0		(ELEVATION)											
		CLAYEY SAND with Gravel (SC), medium dense, brown, ***[Talus]***	SS 1		28			2	45	28	33	48	
		(993.5)											
		Weathered CLAY-SHALE, hard to very hard, gray, ***[Del Rio Clay (Kdr)]***	SS 2		57			11	50	31			
5			SS 3		86/11"			11					
			SS 4		**50/5"			10					
		- with gypsum crystals from 8' to 10'	SS 5		**50/2"								
10		(985.5)											
		CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]***	SS 6		**50/5"			10					
15													
			SS 7		**50/5"								
20													
			SS 8		**50/4"			8	43	26			
25													
			SS 9		**50/1"			10					
30													
			SS 10		**50/3"								
35													
			SS 11		**50/2"			7					
40													

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 50 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-8 (continued)

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/18/20
Elevation: 995.52 ft (By survey)
Coordinates: N: 13683342.65 E: 1375327.52
Backfill: Bentonite pellets

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
40		(ELEVATION)											
		CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]*** *(continued)*											
			SS 12		**50/0"								
45													
			SS 13		**50/0"			6					
50		(945.5)											

Bottom of hole at 50.0 feet.

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 50 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-9

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/18/20
Elevation: 1002.05 ft (By survey)
Coordinates: N: 13683726.92 E: 1375607.76
Backfill: Bentonite pellets

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
0	(ELEVATION)											
	FAT CLAY (CH), hard, brown, ***[Del Rio Clay (Kdr)]***	SS 1		39			12	60	38	6	92	
	(1000.1)											
	Weathered CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]***	SS 2		50/6"			13	55	33			
5		SS 3		50/3"			13					
	- gypsum crystals from 6' to 8'	SS 4		**50/3"			13					
	- with ferrous stains from 8' to 10'	SS 5		**50/5"			11	52	32			
10		GB 6					12					
	- with gypsum crystals from 13' to 15'	SS 7		**50/4"			12					
15	(987.1)											
	CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]***	SS 8		**50/5"								
20												
		SS 9		**50/4"			11					
25												
		SS 10		**50/3"								
30												
		SS 11		**50/1"			9					
35												
		SS 12		**50/1"			10					
40	(962.1)											

Bottom of hole at 40.0 feet.

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 40 ft

Nomenclature Used on Boring Log

Split Spoon (SS) Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-10

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/17/20
Elevation: 997.82 ft (By survey)
Coordinates: N: 13683181.40 E: 1375334.69
Backfill: Bentonite pellets

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
0		(ELEVATION)											
		SANDY FAT CLAY (CH), very stiff, brown, ***[Talus]***	SS 1		28			4	54	35	25	62	
		(995.8)											
		Weathered CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]***	SS 2		50/6"			12	61	40	5	93	
5			SS 3		**50/3"			12					
			SS 4		**50/5"								
			SS 5		**50/5"			11					
10			GB 6										
			SS 7		**50/6"			12					
15													
		(979.8)											
		CLAY-SHALE, very hard, gray, with ferrous stains ***[Del Rio Clay (Kdr)]***	SS 8		50/3"								
20													
			SS 9		**50/6"			11					
25													
			SS 10		**50/5"								
30													
			SS 11		**50/2"			7	50	31			
35													
			SS 12		**50/0"								
40													

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 45 ft

Nomenclature Used on Boring Log

Split Spoon (SS)
Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-10 (continued)

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/17/20
Elevation: 997.82 ft (By survey)
Coordinates: N: 13683181.40 E: 1375334.69
Backfill: Bentonite pellets

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
40		(ELEVATION)											
		CLAY-SHALE, very hard, gray, with ferrous stains ***[Del Rio Clay (Kdr)]*** *(continued)*											
			SS 13		**50/0"			7					
45		(952.8)											
		Bottom of hole at 45.0 feet.											

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 45 ft

Nomenclature Used on Boring Log

Split Spoon (SS) Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-11

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/18/20
Elevation: 986.07 ft (By survey)
Coordinates: N: 13683629.32 E: 1375079.24
Backfill: Converted to piezometer

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
0 (ELEVATION)	LEAN CLAY (CL), hard, brown, ***[Del Rio Clay (Kdr)]***	SS 1		49			5	46	28	9	91	
		SS 2		41			8	46	29	7	92	
(982.1)												
5	Weathered CLAY-SHALE, hard to very hard, gray, ***[Del Rio Clay (Kdr)]***	SS 3		88			11	55	35			
		SS 4		**50/5"			11					
	- with gypsum crystals from 8' to 10'	SS 5		50/5"			12	59	38			
10		GB 6										
		SS 7		**50/5"			9					
15												
	- with gypsum crystals below 18'	SS 8		**50/5"			11	48	30			
20												
		GB 9					10					
25 (961.1)												

Bottom of hole at 25.0 feet.

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 25 ft

Nomenclature Used on Boring Log

Split Spoon (SS) Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-12

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/11/20
Elevation: 1045.00 ft (By survey)
Coordinates: N: 13683138.40 E: 1376072.10
Backfill: Converted to piezometer

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
0		(ELEVATION)											
		CLAYEY GRAVEL (GC), very dense, tan, with limestone fragments and sand ***[Talus]***	SS 1		50/6"			4	49	31	29	34	
		(1043.0)											
		GRAVELLY LEAN CLAY (CL), very stiff, tan, with limestone fragments and ferrous stains ***[Talus]***	SS 2		24			6	48	30	12	52	
		(1041.0)											
5		FAT CLAY with Gravel (CH), very hard, tan, with ferrous stains ***[Del Rio Clay (Kdr)]***	SS 3		50/4"			9					
			SS 4		50/3"			9					
			SS 5		68			13	63	42	5	78	
10			GB 6					13					
			SS 7		50/5"			12					
15													
		(1027.0)											
		Weathered CLAY-SHALE, very hard, reddish brown, with ferrous stains ***[Del Rio Clay (Kdr)]***	SS 8		50/6"			10	61	41	4	93	
20													
			SS 9		50/4"			12					
25													
			SS 10		50/3"			13					
30													
			SS 11		**50/6"			13					
35													
		(1007.0)											
40		Weathered CLAY-SHALE, very hard, tan and gray, ***[Del Rio Clay (Kdr)]***	SS 12		50/4"			14	66	44	2	82	

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 75 ft

Nomenclature Used on Boring Log

Split Spoon (SS) Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-12 (continued)

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/11/20
Elevation: 1045.00 ft (By survey)
Coordinates: N: 13683138.40 E: 1376072.10
Backfill: Converted to piezometer

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
40		(ELEVATION)											
		Weathered CLAY-SHALE, very hard, tan and gray, ***[Del Rio Clay (Kdr)]*** *(continued)*											
			SS 13		**50/6"			12					
45													
			SS 14		**50/5"			14					
50													
		(992.0)											
		CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]***	SS 15		84/9"			13	61	40	3	93	
55													
			SS 16		50/5"			12					
60													
			SS 17		**50/4"			11					
65													
			SS 18		**50/4"			11					
70													
			GB 19					9					
75		(970.0)											
		Bottom of hole at 75.0 feet.											

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 75 ft

Nomenclature Used on Boring Log

Split Spoon (SS) Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-13

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/11/2020 - 11/12/2020
Elevation: 1059.94 ft (By survey)
Coordinates: N: 13682239.04 E: 1376149.05
Backfill: Converted to piezometer

DEPTH (ft)	MATERIAL DESCRIPTION (ELEVATION)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
0	LEAN CLAY with Sand (CL), very stiff to hard, light tan, with trace gravel ***[Buda Limestone (Kbu)]***	SS 1		22			4	36	19	18	74	
	(1057.9) LIMESTONE, hard to very hard, light tan, ***[Buda Limestone (Kbu)]***	SS 2		**50/3"			2					
5		SS 3		**50/3"			3					
		SS 4		**50/0"			4					
		SS 5		**50/0"			5					
10												
		SS 6		**50/1"			6					
15	(1041.9)											
	LIMESTONE, very hard, tan, with ferrous stains ***[Buda Limestone (Kbu)]***	SS 7		**50/1"			8	39	22	30	66	
20												
	(1035.9) ▼ CLAYEY SAND with Gravel (SC), very dense, tan, with ferrous stains ***[Del Rio Clay (Kdr)]***	SS 8		**50/0"			4	48	30	41	23	
25	(1031.9) ▽ Weathered CLAY-SHALE, very hard, tan, with ferrous stains ***[Del Rio Clay (Kdr)]***	SS 9		**50/3"			17	71	47			
30												
	(1026.9) Weathered CLAY-SHALE, very hard, reddish brown, ***[Del Rio Clay (Kdr)]***	SS 10		**50/6"			15					
35												
		SS 11		50/5"			18					
40												

Groundwater Data:
First encountered during drilling: 28-ft depth
After 24 hours: 24-ft depth
Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 65 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

▽ Water encountered during drilling
▼ Delayed water reading

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-13 (continued)

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/11/2020 - 11/12/2020
Elevation: 1059.94 ft (By survey)
Coordinates: N: 13682239.04 E: 1376149.05
Backfill: Converted to piezometer

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
40		(ELEVATION)											
		Weathered CLAY-SHALE, very hard, reddish brown, ***[Del Rio Clay (Kdr)]*** *(continued)*											
			SS 12		**50/1"			18					
45													
			SS 13		**50/5"			18	71	48			
50													
			SS 14		50/5"			14					
55													
		(1001.9)											
		CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]***	SS 15		**50/6"			15					
60													
			SS 16		50/5"			13	57	36			
65		(994.9)											
		Bottom of hole at 65.0 feet.											

Groundwater Data:
First encountered during drilling: 28-ft depth
After 24 hours: 24-ft depth
Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 65 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

Water encountered during drilling
Delayed water reading

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-14

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/13/20
Elevation: 998.14 ft (By survey)
Coordinates: N: 13682762.62 E: 1375017.31
Backfill: Converted to piezometer

DEPTH (ft)	MATERIAL DESCRIPTION (ELEVATION)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
0	FAT CLAY (CH), very stiff, brown, ***[Del Rio Clay (Kdr)]*** (996.1)	SS 1		26			8					
	Weathered CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]***	SS 2		50/2"			12	57	35	3	96	
5		SS 3		**50/4"			13					
		SS 4		50/3"			13					
		SS 5		**50/3"			12	58	36	3	97	
10		GB 6										
		SS 7		**50/5"			14					
15												
	- with ferrous stains below 18'	SS 8		**50/5"			13	55	34	2	97	
20												
		SS 9		**50/4"			12					
25												
		SS 10		**50/4"			13					
30	(968.1)											

Bottom of hole at 30.0 feet.

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 30 ft

Nomenclature Used on Boring Log

Split Spoon (SS) Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-15

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/19/20
Elevation: 1019.87 ft (By survey)
Coordinates: N: 13683474.98 E: 1376491.54
Backfill: Converted to piezometer

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION (ELEVATION)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
0		FAT CLAY with Sand (CH), hard, brown, ***[Talus]***	SS 1		38			7	58	37	14	75	
		(1017.9)											
		CLAYEY GRAVEL with Sand (GC), medium dense, tan and gray, with ferrous stains ***[Talus]***	SS 2		27			4			26	33	
		(1015.9)											
5		FAT CLAY with Gravel (CH), hard to very hard, gray and brown, with ferrous stains ***[Del Rio Clay (Kdr)]***	SS 3		38			11	67	45	2	84	
			SS 4		53			18					
			SS 5		50/6"			12					
10			GB 6					14					
		(1006.9)											
		FAT CLAY (CH), hard to very hard, tan and gray, with ferrous stains ***[Del Rio Clay (Kdr)]***	SS 7		63			16	62	41	3	97	
15		▼											
			SS 8		77			17					
20													
			SS 9		70			18					
25													
		- light gray, with gypsum below 28'	SS 10		**50/6"			15					
30													
		(986.9)											
		CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]***	SS 11		**50/5"			13	55	36			
35													
			SS 12		**50/6"								
40													

Groundwater Data:
During drilling: Not encountered
After : 17.45-ft depth
Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 50 ft

Nomenclature Used on Boring Log

Split Spoon (SS)
Grab Sample (GB)
Delayed water reading

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-15 (continued)

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/19/20
Elevation: 1019.87 ft (By survey)
Coordinates: N: 13683474.98 E: 1376491.54
Backfill: Converted to piezometer

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION (ELEVATION)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
40		CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]*** *(continued)*											
			SS 13		**50/2"			12					
45													
			SS 14		**50/0"			8					
50		(969.9)											

Bottom of hole at 50.0 feet.

Groundwater Data:
During drilling: Not encountered
After : 17.45-ft depth
Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 50 ft

Nomenclature Used on Boring Log

Split Spoon (SS)
Grab Sample (GB)
Delayed water reading

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-16

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/10/20
Elevation: 1064.25 ft (By survey)
Coordinates: N: 13682763.29 E: 1375731.63
Backfill: Bentonite pellets

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
0		(ELEVATION)											
		GRAVELLY FAT CLAY (CH), firm, light tan, ***[Buda Limestone (Kbu)]***	SS 1		6								
		(1062.3)											
		LIMESTONE, very hard, tan, ***[Buda Limestone (Kbu)]***	SS 2		50/3"			2	28	9			
5			SS 3		**50/0"			3					
			SS 4		**50/1"			3					
			SS 5		**50/1"			4					
10			GB 6					4					
			SS 7		**50/1"			6					
15		(1046.3)											
		Weathered CLAY-SHALE, very hard, tan, marly, with ferrous stains ***[Del Rio Clay (Kdr)]***	SS 8		50/6"			11	53	35	15	77	
20													
			SS 9		**50/5"			14					
25													
			SS 10		**50/5"			13					
30													
		- with calcareous deposits below 33'	SS 11		69			13	61	39			
35													
			SS 12		**50/6"			15					
40													

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 95 ft

Nomenclature Used on Boring Log

Split Spoon (SS)
Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-16 (continued)

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/10/20
Elevation: 1064.25 ft (By survey)
Coordinates: N: 13682763.29 E: 1375731.63
Backfill: Bentonite pellets

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
40		(ELEVATION)											
		Weathered CLAY-SHALE, very hard, tan, marly, with ferrous stains ***[Del Rio Clay (Kdr)]*** *(continued)*											
		- reddish brown silty sand seam at 43'	SS 13		**50/5"			14	58	38			
45		(1016.3)											
		Weathered CLAY-SHALE, very hard, reddish brown, ***[Del Rio Clay (Kdr)]***	SS 14		**50/4"			13					
50													
			SS 15		**50/4"			14	62	41	4	95	
55		(1006.3)											
		CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]***	SS 16		**50/5"			15					
60													
			SS 17		**50/4"			12	57	36	3	97	
65													
			SS 18		**50/4"			13					
70													
			SS 19		**50/4"			13					
75													
			SS 20		**50/4"			13					
80													

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 95 ft

Nomenclature Used on Boring Log

Split Spoon (SS) Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-16 (continued)

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/10/20
Elevation: 1064.25 ft (By survey)
Coordinates: N: 13682763.29 E: 1375731.63
Backfill: Bentonite pellets

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
80		(ELEVATION)											
		CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]*** *(continued)*											
			SS 21		**50/4"			12	56	35			
85													
			SS 22		**50/3"			12					
90													
			SS 23		**50/4"			11					
95		(969.3)											

Bottom of hole at 95.0 feet.

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 95 ft

Nomenclature Used on Boring Log

Split Spoon (SS)
Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-17

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/10/20
Elevation: 1059.31 ft (By survey)
Coordinates: N: 13682385.22 E: 1375804.72
Backfill: Bentonite pellets

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION (ELEVATION)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
0		GRAVELLY FAT CLAY (CH), hard, light tan, ***[Buda Limestone (Kbu)]***	SS 1		50			4	61	40	14	62	
		(1057.3)											
		LIMESTONE, very hard, light tan, ***[Buda Limestone (Kbu)]***	SS 2		**50/5"			2					
5			SS 3		**50/2"			1					
			SS 4		**50/1"			1					
			SS 5		**50/2"			2					
10			GB 6					5					
		(1046.3)											
		Weathered CLAY-SHALE, very hard, tan, marly ***[Del Rio Clay (Kdr)]***	SS 7		**50/6"			11	33	17	6	91	
15													
			SS 8		83/10"			13					
20													
		(1036.3)											
		Weathered CLAY-SHALE, very hard, tan and gray, ***[Del Rio Clay (Kdr)]***	SS 9		50/6"			15	42	25	23	56	
25													
			SS 10		50/2"			13					
30													
		(1026.3)											
		Weathered CLAY-SHALE, very hard, reddish brown, with calcareous deposits ***[Del Rio Clay (Kdr)]***	SS 11		50/5"			13	64	42	6	89	
35													
			SS 12		50/5"			13					
40													

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 65 ft

Nomenclature Used on Boring Log

Split Spoon (SS) Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-17 (continued)

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/10/20
Elevation: 1059.31 ft (By survey)
Coordinates: N: 13682385.22 E: 1375804.72
Backfill: Bentonite pellets

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SAND CONTENT (%)	FINES CONTENT (%)	UNCONFINED STRENGTH (tsf)
40		(ELEVATION)											
		Weathered CLAY-SHALE, very hard, reddish brown, with calcareous deposits ***[Del Rio Clay (Kdr)]*** *(continued)*											
			SS 13		**50/6"			13					
45													
			SS 14		**50/6"			14					
50													
			SS 15		**50/3"			14					
55		(1001.3)											
		CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]***	SS 16		**50/6"			11					
60													
			SS 17		**50/6"			13	67	44			
65		(994.3)											
		Bottom of hole at 65.0 feet.											

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 65 ft

Nomenclature Used on Boring Log

Split Spoon (SS) Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (TUNNEL BORING LOG (BA).ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

APPENDIX IIIJ-D

Site Stratigraphic Cross-Sections



wsp	Project Mngr: GK Drawn By: AM Checked By: GK Reviewed By: GK	Project No. 2020-221 Scale: NOT TO SCALE Date: November 2022	**BORING LOCATION PLAN** **City of Del Rio Landfill Expansion Project** Del Rio, Val Verde County, Texas



2-24-2023

Del Rio Landfill Expansion

Del Rio, Texas

Section A-A'

South West

North East

Talus

Del Rio Clay (Kdr)

Del Rio Clay (Kdr)

Elevation, ft

1,000
995
990
985
980
975
970
965
960
955

B-2 Pl -200 N
B-11 Pl -200 N
B-1 Pl -200 N

LEGEND: SOIL BORINGS

Gravelly Fat Clay

USCS High Plasticity Clay

Clay Shale

USCS Low Plasticity Clay

NOTES:
The represented stratigraphy is based on the geotechnical engineer's interpretation of field and laboratory data.
The depth where water was first encountered during drilling is depicted with an open triangle; the depth where water rose is depicted with a solid triangle.
Pl and -200 represent plasticity index and fines content for the sampled interval, with data shown at the top of interval indicated on the boring logs.

wsp

Project Mngr:	GK
Drawn By:	AM
Checked By:	GK
Reviewed By:	GK
Project No.	2020-221
Scale: Vertical:	As shown
Horizontal:	Not to scale
Date:	November 2022

GENERALIZED STRATIGRAPHY

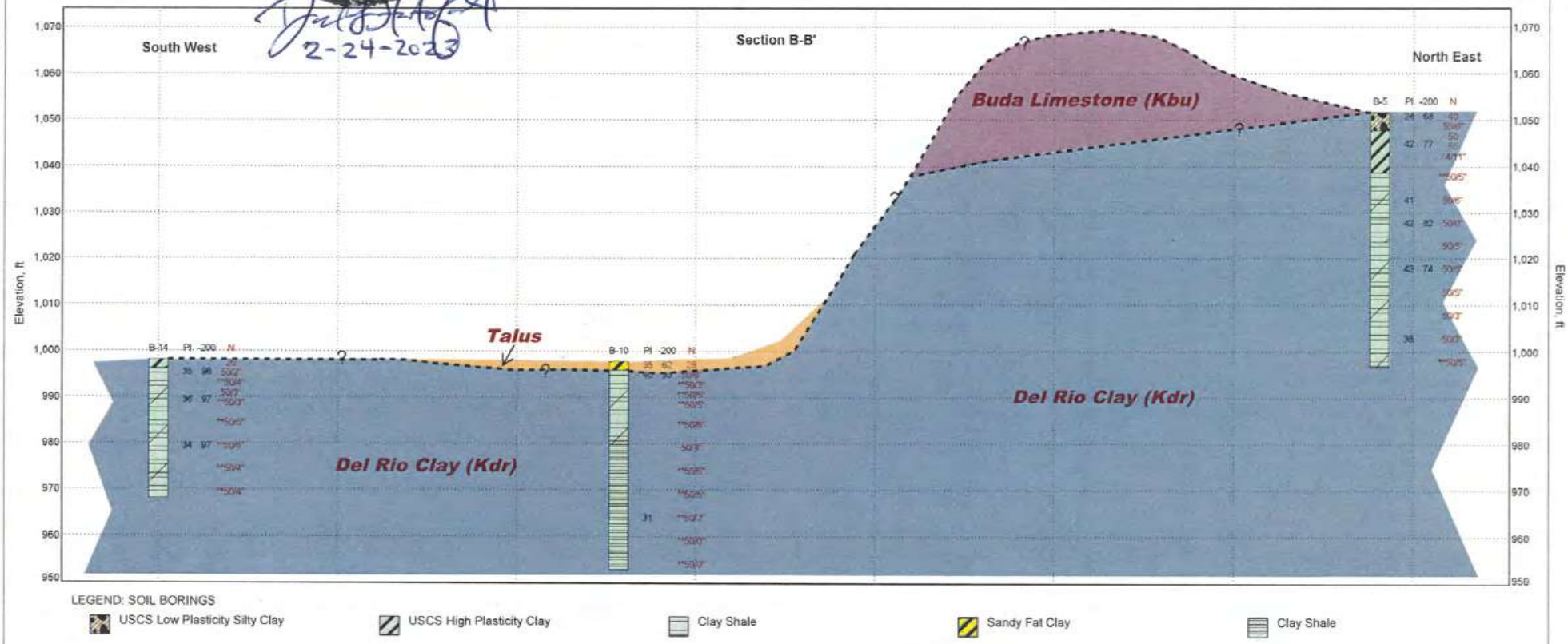
City of Del Rio Landfill Expansion Project

Del Rio, Val Verde County, Texas

STATE OF TEXAS
David L. Hartsfield
Geology
2707
LICENSED
PROFESSIONAL GEOSCIENTIST
2-24-2023

Del Rio Landfill Expansion

Del Rio, Texas



LEGEND: SOIL BORINGS

USCS Low Plasticity Silty Clay | USCS High Plasticity Clay | Clay Shale | Sandy Fat Clay | Clay Shale

NOTES:
The represented stratigraphy is based on the geotechnical engineer's interpretation of field and laboratory data.
The depth where water was first encountered during drilling is depicted with an open triangle; the depth where water rose is depicted with a solid triangle.
PI and -200 represent plasticity index and fines content for the sampled interval, with data shown at the top of interval indicated on the boring logs.

wsp

Project Mngr:	GK
Drawn By:	AM
Checked By:	GK
Reviewed By:	GK
Project No.	2020-221
Scale: Vertical:	As shown
Horizontal:	Not to scale
Date:	November 2022

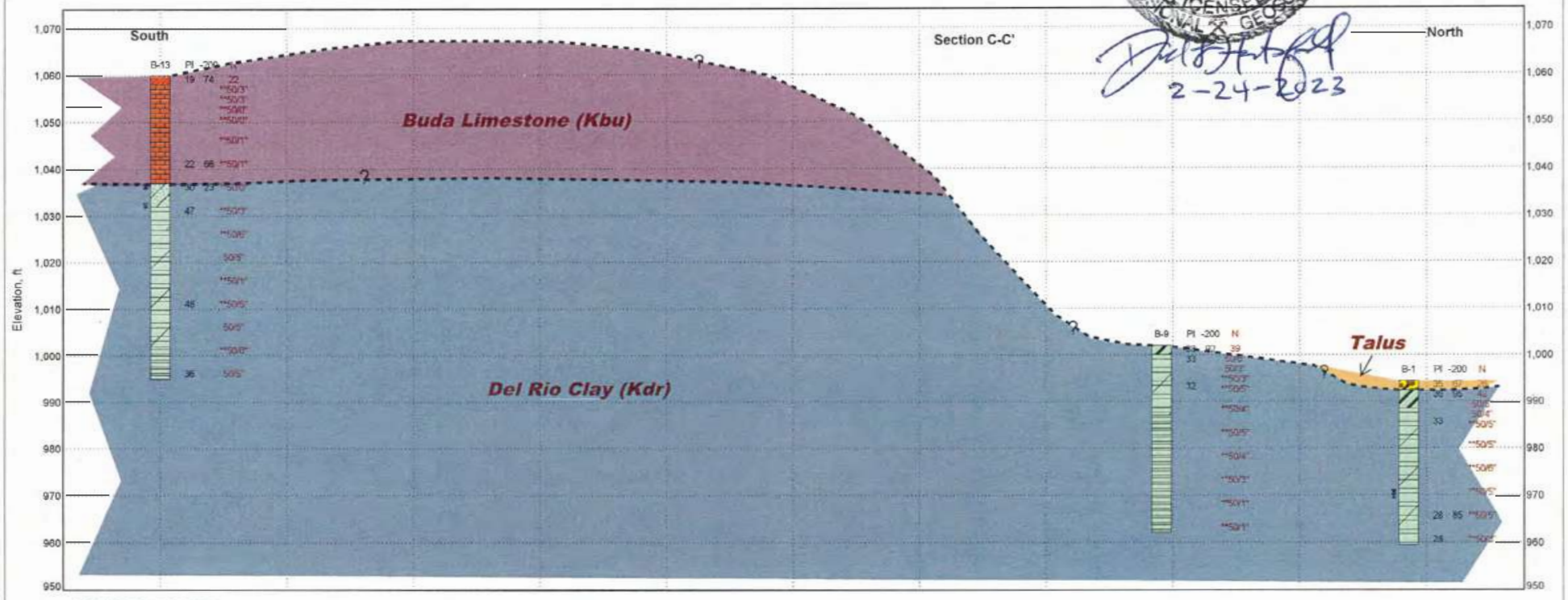
GENERALIZED STRATIGRAPHY

City of Del Rio Landfill Expansion Project

Del Rio, Val Verde County, Texas

Del Rio Landfill Expansion

Del Rio, Texas



LEGEND: SOIL BORINGS

- Gravelly Fat Clay
- USCS High Plasticity Clay
- Clay Shale
- Clay Shale
- USCS Low Plasticity Clay
- Limestone
- USCS Clayey Sand

NOTES:

The represented stratigraphy is based on the geotechnical engineer's interpretation of field and laboratory data.
The depth where water was first encountered during drilling is depicted with an open triangle; the depth where water rose is depicted with a solid triangle.
PI and -200 represent plasticity index and fines content for the sampled interval, with data shown at the top of interval indicated on the boring logs.

STATE OF TEXAS
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2-24-2023

Project Mngr:	GK
Drawn By:	AM
Checked By:	GK
Reviewed By:	GK
Project No.	2020-221
Scale: Vertical:	As shown
Horizontal:	Not to scale
Date:	November 2022

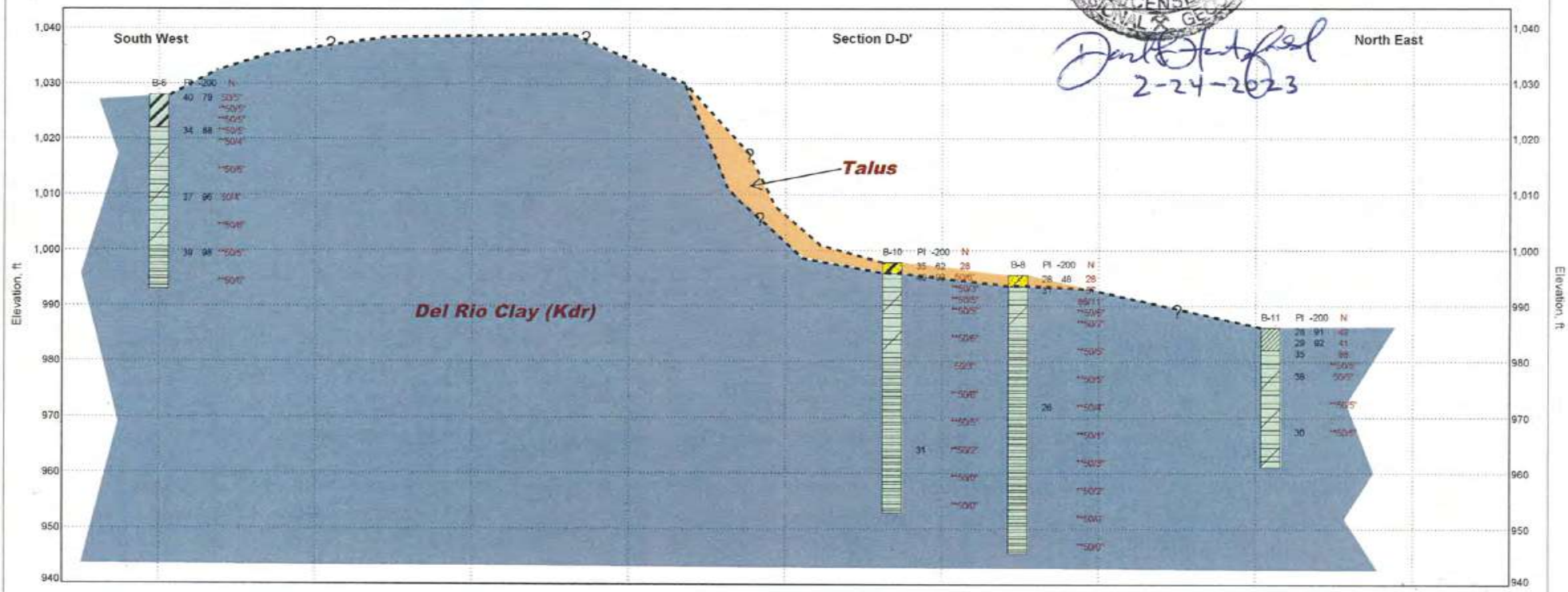
GENERALIZED STRATIGRAPHY

City of Del Rio Landfill Expansion Project

Del Rio, Val Verde County, Texas

Del Rio Landfill Expansion

Del Rio, Texas



LEGEND: SOIL BORINGS

- USCS High Plasticity Clay
- USCS Low Plasticity Clay
- Clay Shale
- Clay Shale
- USCS Clayey Sand
- Sandy Fat Clay

NOTES:
The represented stratigraphy is based on the geotechnical engineer's interpretation of field and laboratory data.
The depth where water was first encountered during drilling is depicted with an open triangle; the depth where water rose is depicted with a solid triangle.
PI and -200 represent plasticity index and fines content for the sampled interval, with data shown at the top of interval indicated on the boring logs.

STATE OF TEXAS
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2-24-2023

Project Mngr:	GK
Drawn By:	AM
Checked By:	GK
Reviewed By:	GK
Project No:	2020-221
Scale: Vertical: / Horizontal:	As shown / Not to scale
Date:	November 2022

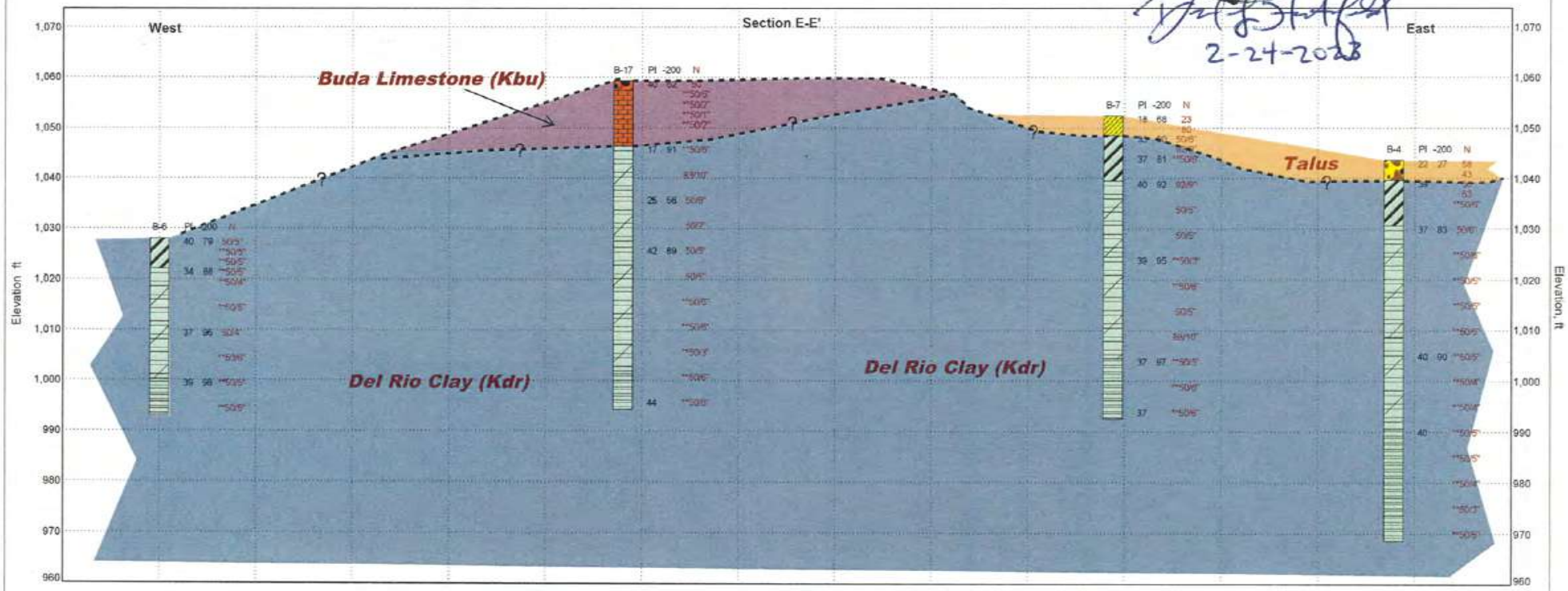
GENERALIZED STRATIGRAPHY

City of Del Rio Landfill Expansion Project

Del Rio, Val Verde County, Texas

Del Rio Landfill Expansion

Del Rio, Texas



LEGEND: SOIL BORINGS

- USCS Clayey Gravel
- USCS High Plasticity Clay
- Clay Shale
- Clay Shale
- USCS Low Plasticity Sandy Clay
- Gravelly Fat Clay
- Limestone

NOTES:
The represented stratigraphy is based on the geotechnical engineer's interpretation of field and laboratory data.
The depth where water was first encountered during drilling is depicted with an open triangle; the depth where water rose is depicted with a solid triangle.
PI and -200 represent plasticity index and fines content for the sampled interval, with data shown at the top of interval indicated on the boring logs.

STATE OF TEXAS
David L. Hartsfield
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2707
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2-24-2023

wsp

Project Mngr:	GK
Drawn By:	AM
Checked By:	GK
Reviewed By:	GK
Project No.	2020-221
Scale: Vertical:	As shown
Horizontal:	Not to scale
Date:	November 2022

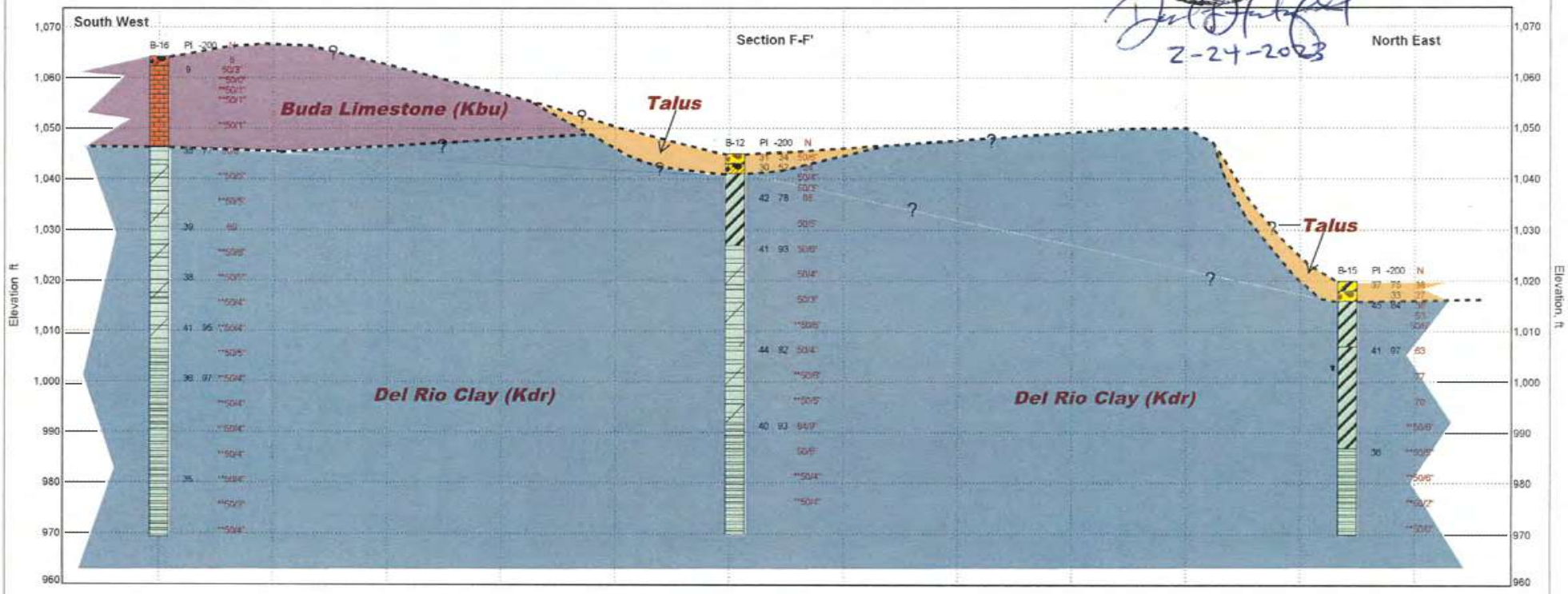
GENERALIZED STRATIGRAPHY

City of Del Rio Landfill Expansion Project

Del Rio, Val Verde County, Texas

Del Rio Landfill Expansion

Del Rio, Texas



LEGEND: SOIL BORINGS

- USCS Clayey Gravel
- USCS Low Plasticity Silty Clay
- USCS High Plasticity Clay
- Clay Shale
- Clay Shale
- USCS High Plasticity Clay
- Gravelly Fat Clay
- Limestone

NOTES:

The represented stratigraphy is based on the geotechnical engineer's interpretation of field and laboratory data.
The depth where water was first encountered during drilling is depicted with an open triangle, the depth where water rose is depicted with a solid triangle.
PI and -200 represent plasticity index and fines content for the sampled interval, with data shown at the top of interval indicated on the boring logs.

STATE OF TEXAS
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2-24-2023

Project Mngr:	GK
Drawn By:	AM
Checked By:	GK
Reviewed By:	GK
Project No.	2020-221
Scale: Vertical:	As shown
Horizontal:	Not to scale
Date:	November 2022

GENERALIZED STRATIGRAPHY

City of Del Rio Landfill Expansion Project

Del Rio, Val Verde County, Texas

APPENDIX IIIJ-E

Piezometer Completion Logs

Boring Log No. B-1

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/18/20
Elevation: 994.42 ft (By survey)
Coordinates: N: 13684130.48 E: 1375589.86
Backfill: Converted to piezometer

Soil Description	Depth (ft)	SN	WELL
GRAVELLY FAT CLAY (CH), very stiff, gray and brown, ***[Talus]***		SS	Protective Steel Casing over Concrete pad
FAT CLAY (CH), hard to very hard, gray, ***[Del Rio Clay (Kdr)]***		SS	
- with gypsum crystal below 4'	5	SS	Bentonite seal
Weathered CLAY-SHALE, very hard, gray, with interbedded marl, with ferrous stains and gypsum crystal ***[Del Rio Clay (Kdr)]***		SS	
		SS	
	10	GB	
		SS	
	15		Filter sand with screen pipe
		SS	
	20		11/08/21, 11/07/22
			12/08/20, 6/1/21
			05/04/22
		SS	10/11/21, 7/7/22, 9/7/22
			2/8/21,3/4/21, 4/5/21, 5/4/21, 9/9/21, 12/9/21, 1/3/22, 2/11/22,2/28/22
	25		1/4/21, 7/22/21, 8/10/21, 4/7/22, 6/2/22, 8/4/22, 10/3/22
- with tan clay seams below 28'		SS	
	30		
		SS	
	35		
Borehole terminated at 35 feet			

Groundwater Data:
First encountered during drilling: 25-ft depth
After 30 minutes: 24.25-ft depth
Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 35 ft

Nomenclature Used on Boring Log

Split Spoon (SS)
Grab Sample (GB)
Water encountered during drilling
Delayed water reading

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 11/9/22 (NO LAB - WELL ONLY LOG.ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-2

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/20/20
Elevation: 987.97 ft (By survey)
Coordinates: N: 13683181.06 E: 1374634.82
Backfill: Converted to piezometer

Soil Description	Depth (ft)	SN	WELL
Weathered CLAY-SHALE, very stiff to very hard, gray, with calcareous deposits and ferrous stains, with trace of gypsum crystals ***[Del Rio Clay (Kdr)]***	5 10 15 20 25	SS SS SS SS GB SS SS SS	Protective Steel Casing over Concrete pad Bentonite seal Filter sand with screen pipe
Borehole terminated at 25 feet			

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 25 ft

Nomenclature Used on Boring Log

Split Spoon (SS)
Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (NO LAB - WELL ONLY LOG,ARIASSA13-02.GDT,ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-3

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/16/20
Elevation: 1060.67 ft (By survey)
Coordinates: N: 13681801.55 E: 1375882.48
Backfill: Converted to piezometer

Soil Description	Depth (ft)	SN	WELL
LEAN CLAY with Sand (CL), very stiff to hard, tan, ***[Buda Limestone (Kbu)]***		SS	Protective Steel Casing over Concrete pad
		SS	
LIMESTONE, very hard, tan, ***[Buda Limestone (Kbu)]***	5	SS	Bentonite seal
		SS	
		SS	
	10		
		SS	
	15		
		SS	
	20		
		SS	
	25		
Weathered CLAY-SHALE, very hard, tan and gray, with ferrous stains ***[Del Rio Clay (Kdr)]***		SS	
	30		
		SS	
	35		
Weathered CLAY-SHALE, very hard, brown, with calcareous deposits and ferrous stains ***[Del Rio Clay (Kdr)]*** (continued)		SS	
	40		

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 90 ft

Nomenclature Used on Boring Log

Split Spoon (SS) Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (NO LAB - WELL ONLY LOG,ARIASSA13-02.GDT,ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-3 (continued)

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/16/20
Elevation: 1060.67 ft (By survey)
Coordinates: N: 13681801.55 E: 1375882.48
Backfill: Converted to piezometer

Soil Description	Depth (ft)	SN	WELL
Weathered CLAY-SHALE, very hard, brown, with calcareous deposits and ferrous stains ***[Del Rio Clay (Kdr)]*** *(continued)*	45	SS	
	50	SS	Filter sand with screen pipe
	55	SS	
	60	SS	
CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]***	65	SS	
	70	SS	
	75	SS	
(continued)	80	SS	

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 90 ft

Nomenclature Used on Boring Log

Split Spoon (SS)
Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (NO LAB - WELL ONLY LOG,ARIASSA13-02.GDT,ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

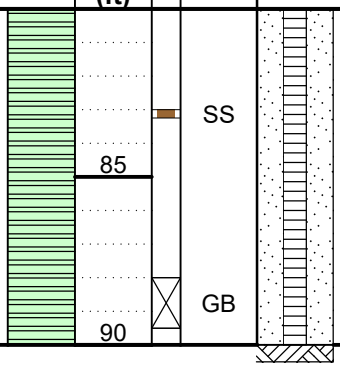
Boring Log No. B-3 (continued)

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/16/20
Elevation: 1060.67 ft (By survey)
Coordinates: N: 13681801.55 E: 1375882.48
Backfill: Converted to piezometer

Soil Description	Depth (ft)	SN	WELL
CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]*** *(continued)*			
	85	SS	
		GB	
	90		
Borehole terminated at 90 feet			



Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 90 ft

Nomenclature Used on Boring Log

Split Spoon (SS)
Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (NO LAB - WELL ONLY LOG,ARIASSA13-02.GDT,ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-6

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/20/20
Elevation: 1028.01 ft (By survey)
Coordinates: N: 13682234.92 E: 1375346.15
Backfill: Converted to piezometer

Soil Description	Depth (ft)	SN	WELL
FAT CLAY with Gravel (CH), very hard, reddish brown, ***[Del Rio Clay (Kdr)]***		SS	Protective Steel Casing over Concrete pad
		SS	
	5	SS	Bentonite seal
Weathered CLAY-SHALE, very hard, reddish brown, ***[Del Rio Clay (Kdr)]***		SS	
	10	SS	
- with gypsum crystals below 13'		SS	
	15		
		SS	
	20		Filter sand with screen pipe
		SS	
	25		
CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]***		SS	
	30		
		SS	
	35		
Borehole terminated at 35 feet			

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: L. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 35 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (NO LAB - WELL ONLY LOG,ARIASSA13-02.GDT,ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-7

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/12/20
Elevation: 1052.46 ft (By survey)
Coordinates: N: 13682645.58 E: 1376245.09
Backfill: Converted to piezometer

Soil Description	Depth (ft)	SN	WELL
SANDY LEAN CLAY (CL), very stiff to hard, light tan, ***[Talus]***		SS	Protective Steel Casing over Concrete pad
		SS	
FAT CLAY (CH), very hard, light tan, with ferrous stains ***[Del Rio Clay (Kdr)]***	5	SS	Bentonite seal
		SS	
- with gravel at 8'		SS	
- with sand below 8.5'	10	GB	
Weathered CLAY-SHALE, very hard, tan and gray, with ferrous stains ***[Del Rio Clay (Kdr)]***		SS	
	15		
		SS	
	20		
		SS	
	25		
Weathered CLAY-SHALE, very hard, reddish brown, ***[Del Rio Clay (Kdr)]***		SS	
	30		
		SS	
	35		Filter sand with screen pipe
(continued)		SS	
	40		

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 60 ft

Nomenclature Used on Boring Log

Split Spoon (SS)
Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (NO LAB - WELL ONLY LOG,ARIASSA13-02.GDT,ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-7 (continued)

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/12/20
Elevation: 1052.46 ft (By survey)
Coordinates: N: 13682645.58 E: 1376245.09
Backfill: Converted to piezometer

Soil Description	Depth (ft)	SN	WELL
Weathered CLAY-SHALE, very hard, reddish brown, ***[Del Rio Clay (Kdr)]*** *(continued)*			
- with calcareous deposits below 43'	45	SS	
CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]***	50	SS	
	55	SS	
- 5" reddish brown clay seam at 57'	60	SS	
Borehole terminated at 60 feet			

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 60 ft

Nomenclature Used on Boring Log

Split Spoon (SS)
Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (NO LAB - WELL ONLY LOG,ARIASSA13-02.GDT,ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-11

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/18/20
Elevation: 986.07 ft (By survey)
Coordinates: N: 13683629.32 E: 1375079.24
Backfill: Converted to piezometer

Soil Description	Depth (ft)	SN	WELL
LEAN CLAY (CL), hard, brown, ***[Del Rio Clay (Kdr)]***		SS	Protective Steel Casing over Concrete pad
		SS	
Weathered CLAY-SHALE, hard to very hard, gray, ***[Del Rio Clay (Kdr)]***	5	SS	Bentonite seal
		SS	
- with gypsum crystals from 8' to 10'		SS	
	10	GB	
		SS	
	15		Filter sand with screen pipe
- with gypsum crystals below 18'		SS	
	20		
		GB	
	25		
Borehole terminated at 25 feet			

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 25 ft

Nomenclature Used on Boring Log

Split Spoon (SS)
Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (NO LAB - WELL ONLY LOG,ARIASSA13-02.GDT,ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-12

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/11/20
Elevation: 1045.00 ft (By survey)
Coordinates: N: 13683138.40 E: 1376072.10
Backfill: Converted to piezometer

Soil Description	Depth (ft)	SN	WELL
CLAYEY GRAVEL (GC), very dense, tan, with limestone fragments and sand ***[Talus]***		SS	Protective Steel Casing over Concrete pad
GRAVELLY LEAN CLAY (CL), very stiff, tan, with limestone fragments and ferrous stains ***[Talus]***		SS	
FAT CLAY with Gravel (CH), very hard, tan, with ferrous stains ***[Del Rio Clay (Kdr)]***	5	SS	Bentonite seal
		SS	
		SS	
	10	GB	
		SS	
	15		
Weathered CLAY-SHALE, very hard, reddish brown, with ferrous stains ***[Del Rio Clay (Kdr)]***		SS	
	20		
		SS	
	25		
		SS	
	30		
		SS	
	35		
Weathered CLAY-SHALE, very hard, tan and gray, ***[Del Rio Clay (Kdr)]*** (continued)		SS	
	40		

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 75 ft

Nomenclature Used on Boring Log

Split Spoon (SS)
Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (NO LAB - WELL ONLY LOG,ARIASSA13-02.GDT,ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-12 (continued)

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/11/20
Elevation: 1045.00 ft (By survey)
Coordinates: N: 13683138.40 E: 1376072.10
Backfill: Converted to piezometer

Soil Description	Depth (ft)	SN	WELL
Weathered CLAY-SHALE, very hard, tan and gray, ***[Del Rio Clay (Kdr)]*** *(continued)*	45	SS	Filter sand with screen pipe
	50	SS	
CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]***	55	SS	
	60	SS	
	65	SS	
	70	SS	
	75	GB	
Borehole terminated at 75 feet			

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 75 ft

Nomenclature Used on Boring Log

Split Spoon (SS)
Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (NO LAB - WELL ONLY LOG,ARIASSA13-02.GDT,ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-13

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/11/2020 - 11/12/2020
Elevation: 1059.94 ft (By survey)
Coordinates: N: 13682239.04 E: 1376149.05
Backfill: Converted to piezometer

Soil Description	Depth (ft)	SN	WELL
LEAN CLAY with Sand (CL), very stiff to hard, light tan, with trace gravel ***[Buda Limestone (Kbu)]***		SS	Protective Steel Casing over Concrete pad
LIMESTONE, hard to very hard, light tan, ***[Buda Limestone (Kbu)]***		SS	
	5	SS	Bentonite seal
		SS	
	10	SS	
	15	SS	Filter sand with screen pipe
LIMESTONE, very hard, tan, with ferrous stains ***[Buda Limestone (Kbu)]***	20	SS	12/08/20
CLAYEY SAND with Gravel (SC), very dense, tan, with ferrous stains ***[Del Rio Clay (Kdr)]***	25		04/05/21 02/08/21, 03/04/21, 05/04/21,06/01/21 07/22/21
Weathered CLAY-SHALE, very hard, tan, with ferrous stains ***[Del Rio Clay (Kdr)]***	30	SS	08/10/21 09/09/21 01/04/21
Weathered CLAY-SHALE, very hard, reddish brown, ***[Del Rio Clay (Kdr)]***	35	SS	11/08/21 10/11/21
(continued)	40	SS	

Groundwater Data:
First encountered during drilling: 28-ft depth
After 24 hours: 24-ft depth
Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 65 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

Water encountered during drilling
Delayed water reading

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 11/9/22 (NO LAB - WELL ONLY LOG.ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-13 (continued)

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/11/2020 - 11/12/2020
Elevation: 1059.94 ft (By survey)
Coordinates: N: 13682239.04 E: 1376149.05
Backfill: Converted to piezometer

Soil Description	Depth (ft)	SN	WELL
Weathered CLAY-SHALE, very hard, reddish brown, ***[Del Rio Clay (Kdr)]*** *(continued)*	45	SS	12/09/21
	50	SS	01/03/22 02/11/22 02/28/22, 4/7/22
	55	SS	
CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]***	60	SS	
	65	SS	05/04/22, 6/2/22, 7/7/22
Borehole terminated at 65 feet			

Groundwater Data:
First encountered during drilling: 28-ft depth
After 24 hours: 24-ft depth
Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 65 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

Water encountered during drilling
Delayed water reading

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 11/9/22 (NO LAB - WELL ONLY LOG.ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-14

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/13/20
Elevation: 998.14 ft (By survey)
Coordinates: N: 13682762.62 E: 1375017.31
Backfill: Converted to piezometer

Soil Description	Depth (ft)	SN	WELL
FAT CLAY (CH), very stiff, brown, ***[Del Rio Clay (Kdr)]***		SS	Protective Steel Casing over Concrete pad
Weathered CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]***		SS	
		SS	Bentonite seal
	5		
		SS	
		SS	
	10		
		GB	
		SS	
	15		
- with ferrous stains below 18'		SS	
	20		Filter sand with screen pipe
		SS	
	25		
		SS	
	30		
Borehole terminated at 30 feet			

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 30 ft

Nomenclature Used on Boring Log

Split Spoon (SS)
Grab Sample (GB)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 4/9/21 (NO LAB - WELL ONLY LOG,ARIASSA13-02.GDT,ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

Boring Log No. B-15

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/19/20
Elevation: 1019.87 ft (By survey)
Coordinates: N: 13683474.98 E: 1376491.54
Backfill: Converted to piezometer

Soil Description	Depth (ft)	SN	WELL
FAT CLAY with Sand (CH), hard, brown, ***[Talus]***		SS	Protective Steel Casing over Concrete pad
CLAYEY GRAVEL with Sand (GC), medium dense, tan and gray, with ferrous stains ***[Talus]***		SS	
FAT CLAY with Gravel (CH), hard to very hard, gray and brown, with ferrous stains ***[Del Rio Clay (Kdr)]***	5	SS	Bentonite seal
		SS	
		SS	
	10	GB	
FAT CLAY (CH), hard to very hard, tan and gray, with ferrous stains ***[Del Rio Clay (Kdr)]***		SS	11/07/22 10/03/22
	15		05/04/22, 06/02/22, 07/07/22 10/11/21,11/08/21,12/09/21, 02/28/22,08/04/22,09/07/22 01/04/21, 02/08/21,03/04/21 12/08/20, 4/5/21,5/4/21,6/1/21, 7/22/21,8/10/21,9/9/21,1/3/22, 2/11/22 04/07/22
	20	SS	
	25	SS	
- light gray, with gypsum below 28'	30	SS	Filter sand with screen pipe
CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]***	35	SS	
(continued)	40	SS	

Groundwater Data:
During drilling: Not encountered
After : 17.45-ft depth
Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 50 ft

Nomenclature Used on Boring Log

Split Spoon (SS)
Grab Sample (GB)
Delayed water reading

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 11/9/22 (NO LAB - WELL ONLY LOG.ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

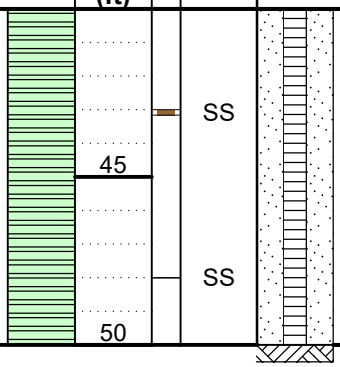
Boring Log No. B-15 (continued)

Project: **Del Rio Landfill Expansion**
Del Rio, Texas

Location: See Boring Location Plan

Sampling Date: 11/19/20
Elevation: 1019.87 ft (By survey)
Coordinates: N: 13683474.98 E: 1376491.54
Backfill: Converted to piezometer

Soil Description	Depth (ft)	SN	WELL
CLAY-SHALE, very hard, gray, ***[Del Rio Clay (Kdr)]*** *(continued)*	45	SS	
	50	SS	
Borehole terminated at 50 feet			



Groundwater Data:
During drilling: Not encountered
After : 17.45-ft depth
Field Drilling Data:
Coordinates: Survey
Logged By: R. Arizola
Driller: Terra Power Drilling
Equipment: ATV drill rig

Air rotary: 0 - 50 ft

Nomenclature Used on Boring Log

Split Spoon (SS)
Grab Sample (GB)
Delayed water reading

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve

2020-221.GPJ 11/9/22 (NO LAB - WELL ONLY LOG.ARIASSA13-02.GDT.ARIAS-ARWA LIBRARY.GLB)

Arias Geoprofessionals

Job No.: 2020-221

APPENDIX IIIJ-F

CRG Texas Environmental Services, Inc. Slug Testing and Hydraulic Conductivity Determination Report

April 7, 2021

Mr. Golam Kibria, Ph.D., P.E.
Arias Geoprofessionals
142 Chula Vista
San Antonio, TX 78232
Via Email: gkibria@ariasinc.com

RE: Slug Testing and Hydraulic Conductivity Determination
3 Piezometers – Del Rio Landfill

Dear Dr. Kibria:

CRG Texas Environmental Services, Inc. (CRG Texas or CRG) is pleased to provide you with this letter report detailing the results of the recent slug test / hydraulic conductivity assessment for the above-referenced project. This report provides an overview of the procedure and discusses the data and its interpretation.

CRG Texas conducted the slug testing on January 4, 2021. Three piezometers (designated B-1 P, B-13 P, and B-15 P) were found to contain water and were tested as part of this effort. The piezometers are located in an area designated for a proposed landfill expansion as illustrated on the attached site figure (Figure 1 – Site Map). Boring Logs (provided by Arias Geoprofessionals) for the three piezometers, the Hydraulic Conductivity Calculations and Well Yield Summary and Slug Test Data Summary Sheets are provided as attachments.

Slug Testing

The slug tests were performed by creating a rapid water-level change and measuring the water-level response at one second intervals. The rapid change in water level was induced by adding or removing a sand-filled, fully enclosed bailer. The subsequent water-level changes were measured with a submersible pressure transducer. The bailer is a functional "slug" as it displaces enough water to provide a measurable change in water level, but not so large as to significantly increase the saturated thickness of the aquifer, disturb the transducer, or affect the speed at which one can raise or lower the slug. A water-level rise between 0.5 and 3 feet (ft) was determined to be adequate. In low permeability formations, a smaller displacement takes less time for full recovery. In high permeability formations (1 to 100 ft per day), a larger displacement is desirable.

Water level measurements were collected initially by first determining the depth to water with a portable water level meter. A Level TROLL data logger was then deployed at a depth determined in the field to provide continuous measurements of water level, water pressure, and temperature. The data was recorded in the field on a Rugged Reader datalogger for later evaluation and data processing. Data were collected using both "slug-in" and "slug out" procedures. The slug-in procedure is as described, the slug is dropped into the well just below the static water level and the water level is monitored for a time until it generally stabilizes. The slug-out procedure reverses the process, removing the slug quickly and then monitoring the subsequent water level changes. The test was repeated 3-5 times in each piezometer.

Data Interpretation

The slug out data was processed using a USGS spreadsheet to estimate the hydraulic conductivity using the Bouwer and Rice method (Source: https://pubs.usgs.gov/of/2002/ofr02197/). Interpretation is based on a combination of calculation and curve matching to estimate the hydraulic conductivity. The resulting estimated hydraulic conductivities and well yields (normalized for a 4" well) are presented in Table 1. Individual spreadsheets for the slug out tests on the piezometer are provided as attachments. Slug in data, while gathered and is repetitive as expected, was not used in the overall hydraulic conductivity determination.

Hydraulic conductivities for the piezometer intervals were estimated in the 10^{-6} to 10^{-7} range with an average conductivity of 1.8E-06 cm/sec. This value is consistent with minimally to non-transmissive shale / clays with minor silt/sand content. The initial water level elevations were measured at depths from 27.18 to 29.98 below the top of casing. As reported on the attached boring logs provided by Arias, water was encountered during drilling in 2 of the 3 tested piezometers (B-1 P and B-13 P). Aquifer specific storage capacity, vertical anisotrophy ratio, and well skin (effects of drilling on strata) may all lead to errors in an aquifer's hydraulic conductivity estimates (Hyder and Butler, 1994).

It should be noted that data from field slug and pumping tests can over-estimate (by at least one order of magnitude) the hydraulic conductivity based on the effects of vertical anomalies within the annular spacing / sand pack. The sand pack contributes to quick well recoveries such that true formation data is masked. Data interpretation focused on the later test data to estimate the in-situ formation conductivities given the intended use of the data and the nature of the project.

The reported well yields were calculated using a saturated thickness based on the static water level and the depth of the piezometer. Hydraulic conductivities in sand intervals are often in the 10^{-3} to 10^{-5} range while shale / clay intervals are more often in the 10^{-6} to 10^{-7} range. A standard saturated thickness of 5 feet was used to estimate well yields in an effort to normalize the data across the site. Actual well yields will be influenced by numerous factors (i.e., actual saturated thicknesses, hydraulic head, etc.) and will likely vary.

Laboratory permeability data provided to CRG Texas by Arias indicate permeabilities in the 10^{-7} to 10^{-8} range from remolded bulk samples. While finer grained / cohesive soils typically contain higher porosity (i.e., increased residual water saturation), they often lack sufficient permeability / transmissivity to support water movement. The remolding process also has the potential to reduce or negate natural and/or preferred pathway (i.e., fracture) contributions. Given that remolded samples cannot necessarily simulate the in-situ soil condition (i.e., density/consistency, soil structure, fracture, etc.), particularly for fine-grained soil, CRG Texas acknowledges that the reported permeabilities are within the nominal ranges of laboratory-generated data. This, coupled with the observed slug test data, supports 10^{-7} to 10^{-8} ranges for the tested formation.

TABLE 1: Estimate of Hydraulic Conductivity and Well Yield

Well ID	Confined/Unconfined	Hydraulic Conductivity (cm/sec)	Initial DTW (ft btoc)	Saturated Thickness (ft)*	Yield gpd (4" Well)
P-1 SO No. 1	UNCONFINED	3.30E-06	27.18	5	2
P-1 SO No. 2	UNCONFINED	6.50E-06		5	3
P-1 SO No. 3	UNCONFINED	4.50E-06		5	3
P-13 SO No. 1	UNCONFINED	4.60E-07	29.98	5	0
P-13 SO No. 2	UNCONFINED	5.20E-07		5	0
P-13 SO No. 3	UNCONFINED	6.30E-07		5	1
P-15 SO No. 1	UNCONFINED	3.50E-07	28.58	5	0
P-15 SO No. 2	UNCONFINED	2.80E-07		5	0
P-15 SO No. 3	UNCONFINED	2.20E-07		5	0

ft btoc – feet below top of casing
* Assumed based on boring logs and observed water level measurements for calculation purposes only. Boring logs do not provide sufficient information to more accurately estimate the saturated thicknesses.

CRG Texas appreciates the opportunity to provide these services to you. Should you have any questions or comments, please contact me at 713-474-1570 or by email at john@crgtexas.com.

Sincerely,
CRG Texas Environmental Services, Inc.



John I. Hogue, P.G., CHMM
Project Manager



Attachments

Figure 1 – Site Map
Boring Log (provided by Arias Geoprofessionals)
Hydraulic Conductivity Calculations and Well Yield Summary
Slug Test Data Summary Sheets

References:

Bouwer, H., and Rice R. C. (1976). A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells. *Water Resources Research, 12*(3), 423-428.

Hvorslev, M. (1951). Time lag and soil permeability in ground-water observations. U.S. Army Corps of Engineers, Waterways Experiment Station, Bulletin No. 36.

Hyder, Z., J. J. Butler, Jr., C. D. McElwee, and W. Z. Liu. (1994). Slug tests in partially penetrating wells. *Water Resources Research, 30*(11), 2945-2957.

Rozkar Ismael. (2016). Slug Tests in Unconfined Aquifers, Master of Science Geosciences Thesis, Western Michigan University.

US Geological Survey (2020), Bouwer and Rice analysis of slug test, WRR 1976, Spreadsheets for the Analysis of Aquifer-Test and Slug-Test Data, Version 1.2, Open-File Report 02-197, https://pubs.usgs.gov/of/2002/ofr02197/spreadsheets.html.



Figure 1 – Site Map

Scale: As Shown / Source: Google Earth

CRG Texas
ENVIRONMENTAL SERVICES

Site Name: Del Rio Landfill – Slug Testing
Del Rio, Texas
Project Number: CRG 20-153

N

Calculated Yield (gal/day) / Groundwater Classification
Del Rio Landfill Project
Del Rio, TX

Well ID	Confined/Unconfined	Hydraulic Conductivity (cm/sec)	Initial DTW (ft btoc)	Saturated Thickness (ft)*	Yield gpd (4" Well)
P-1 SO No. 1	UNCONFINED	3.30E-06	27.18	5	2
P-1 SO No. 2	UNCONFINED	6.50E-06		5	3
P-1 SO No. 3	UNCONFINED	4.50E-06		5	3
P-13 SO No. 1	UNCONFINED	4.60E-07	29.98	5	0
P-13 SO No. 2	UNCONFINED	5.20E-07		5	0
P-13 SO No. 3	UNCONFINED	6.30E-07		5	1
P-15 SO No. 1	UNCONFINED	3.50E-07	28.58	5	0
P-15 SO No. 2	UNCONFINED	2.80E-07		5	0
P-15 SO No. 3	UNCONFINED	2.20E-07		5	0

AVERAGE	1.86E-06
MINIMUM K	2.20E-07
MAXIMUM K	6.50E-06

WELL ID: P-1 Slug Out No. 1

INPUT

Construction:

Casing dia. (d_c)	2	Inch
Annulus dia. (d_w)	4	Inch
Screen Length (L)	30	Feet

Depths to:

water level (DTW)	27.18	Feet
top of screen (TOS)	10	Feet
Base of Aquifer (DTB)	35	Feet

Annular Fill:

across screen -- Coarse Sand
above screen -- Bentonite

Aquifer Material -- Shale

COMPUTED

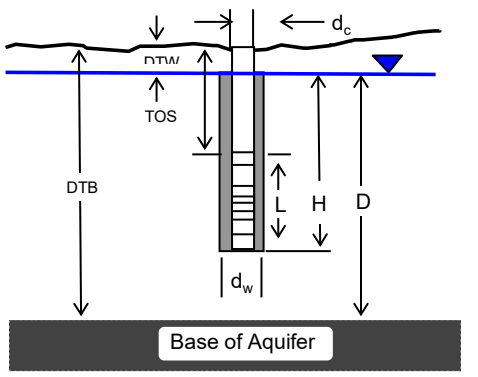
L_{wetted}	12.82	Feet
D =	7.82	Feet
H =	12.82	Feet
L/r_w =	76.92	
$y_{0\text{-DISPLACEMENT}}$ =	30.95	cm
$y_{0\text{-SLUG}}$ =	51.40	cm

From look-up table using L/r_w

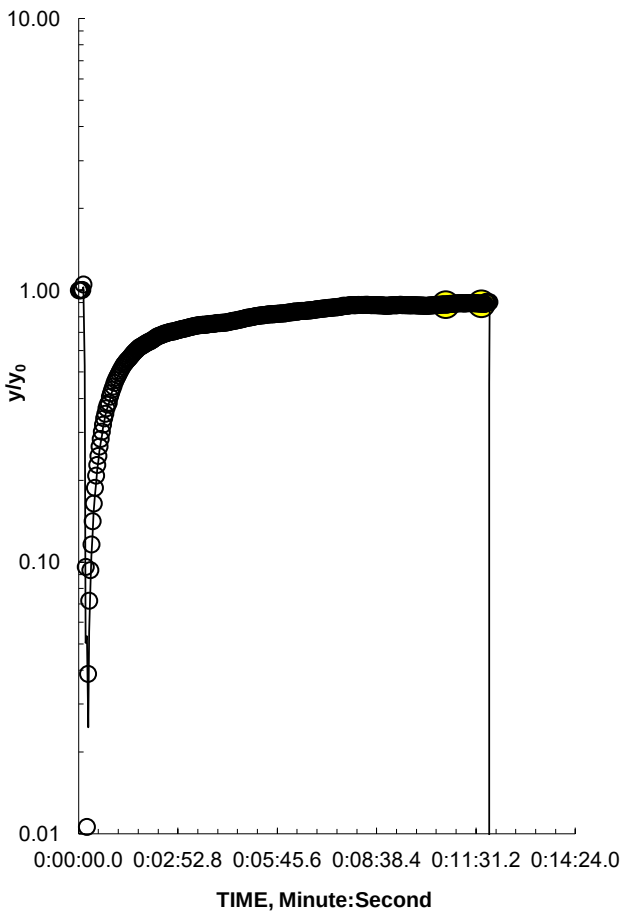
Fully penetrate C =	3.614	
ln(Re/rw) =	3.330	
Re =	4.66	cm
Slope =	5.23E-05	log_{10}/sec
$t_{90\%}$ recovery =	19130	sec

K = 3.3E-06 cm/Second

Date: 1/4/2021
Time: 11:40



Adjust slope of line to estimate K



REMARKS: Bouwer and Rice analysis of slug test, WRR 1976

Entry	Reduced Data Time, Hr:Min:Sec	Water Level
1	11:40:13.0	10.45
2	11:40:27.0	9.44
3	11:40:41.0	9.62
4	11:40:55.0	9.76
5	11:41:09.0	9.86
6	11:41:23.0	9.93
7	11:41:37.0	9.99
8	11:41:51.0	10.04
9	11:42:05.0	10.07
10	11:42:19.0	10.09
11	11:42:33.0	10.12
12	11:42:47.0	10.14
13	11:43:01.0	10.15
14	11:43:15.0	10.16
15	11:43:29.0	10.18
16	11:43:43.0	10.19
17	11:43:57.0	10.19
18	11:44:11.0	10.20
19	11:44:25.0	10.20
20	11:44:39.0	10.21
21	11:44:53.0	10.22
22	11:45:07.0	10.24
23	11:45:21.0	10.25
24	11:45:35.0	10.25
25	11:45:49.0	10.26
26	11:46:03.0	10.26
27	11:46:17.0	10.27
28	11:46:31.0	10.28
29	11:46:45.0	10.28
30	11:46:59.0	10.29
31	11:47:13.0	10.30
32	11:47:27.0	10.30
33	11:47:41.0	10.31
34	11:47:55.0	10.32
35	11:48:09.0	10.33
36	11:48:23.0	10.33
37	11:48:37.0	10.33
38	11:48:51.0	10.33
39	11:49:05.0	10.32
40	11:49:19.0	10.33
41	11:49:33.0	10.33
42	11:49:47.0	10.33
43	11:50:01.0	10.32
44	11:50:15.0	10.32
45	11:50:29.0	10.32
46	11:50:43.0	10.33
47	11:50:57.0	10.34
48	11:51:11.0	10.34



WELL ID: P-1 Slug Out No. 2

INPUT

Construction:

Casing dia. (d_c)	2	Inch
Annulus dia. (d_w)	4	Inch
Screen Length (L)	30	Feet

Depths to:

water level (DTW)	27.18	Feet
top of screen (TOS)	10	Feet
Base of Aquifer (DTB)	35	Feet

Annular Fill:

across screen -- Coarse Sand
above screen -- Bentonite

Aquifer Material -- Shale

COMPUTED

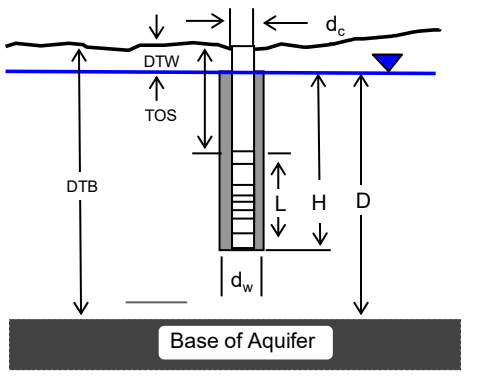
L_{wetted}	12.82	Feet
D =	7.82	Feet
H =	12.82	Feet
L/r_w =	76.92	
$y_{0\text{-DISPLACEMENT}}$ =	33.31	cm
$y_{0\text{-SLUG}}$ =	51.40	cm

From look-up table using L/r_w

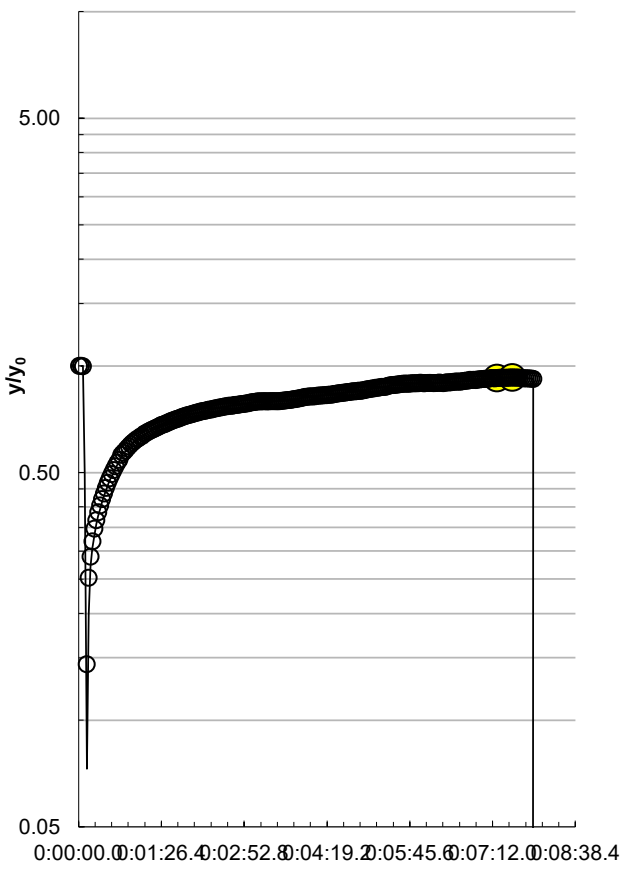
Fully penetrate C =	3.614	
ln(Re/rw) =	3.330	
Re =	4.66	cm
Slope =	0.000103	log_{10}/sec
$t_{90\%}$ recovery =	9664	sec

K = 6.5E-06 cm/Second

Date: 1/4/2021
Time: 11:51



Adjust slope of line to estimate K



REMARKS: Bouwer and Rice analysis of slug test, WRR 1976

Entry	Reduced Data Time, Hr:Min:Sec	Water Level
1	11:51:14.0	10.43
2	11:51:22.0	9.50
3	11:51:30.0	9.72
4	11:51:38.0	9.80
5	11:51:46.0	9.87
6	11:51:54.0	9.92
7	11:52:02.0	9.97
8	11:52:10.0	10.00
9	11:52:18.0	10.03
10	11:52:26.0	10.05
11	11:52:34.0	10.07
12	11:52:42.0	10.09
13	11:52:50.0	10.10
14	11:52:58.0	10.12
15	11:53:06.0	10.13
16	11:53:14.0	10.14
17	11:53:22.0	10.15
18	11:53:30.0	10.16
19	11:53:38.0	10.17
20	11:53:46.0	10.18
21	11:53:54.0	10.18
22	11:54:02.0	10.19
23	11:54:10.0	10.20
24	11:54:18.0	10.21
25	11:54:26.0	10.21
26	11:54:34.0	10.21
27	11:54:42.0	10.21
28	11:54:50.0	10.21
29	11:54:58.0	10.22
30	11:55:06.0	10.23
31	11:55:14.0	10.24
32	11:55:22.0	10.24
33	11:55:30.0	10.24
34	11:55:38.0	10.25
35	11:55:46.0	10.26
36	11:55:54.0	10.26
37	11:56:02.0	10.27
38	11:56:10.0	10.27
39	11:56:18.0	10.28
40	11:56:26.0	10.29
41	11:56:34.0	10.29
42	11:56:42.0	10.31
43	11:56:50.0	10.31
44	11:56:58.0	10.31
45	11:57:06.0	10.32
46	11:57:14.0	10.32
47	11:57:22.0	10.32
48	11:57:30.0	10.32



WELL ID: P-1 Slug Out No. 3

INPUT

Construction:

Casing dia. (d_c)	2	Inch
Annulus dia. (d_w)	4	Inch
Screen Length (L)	30	Feet

Depths to:

water level (DTW)	27.18	Feet
top of screen (TOS)	10	Feet
Base of Aquifer (DTB)	35	Feet

Annular Fill:

across screen -- Coarse Sand
above screen -- Bentonite

Aquifer Material -- Shale

COMPUTED

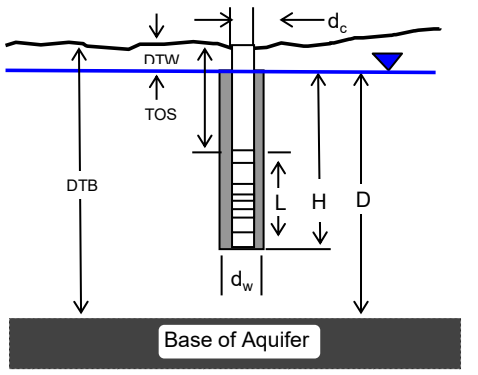
L_{wetted}	12.82	Feet
D =	7.82	Feet
H =	12.82	Feet
L/r_w =	76.92	
$y_{0\text{-DISPLACEMENT}}$ =	18.59	cm
$y_{0\text{-SLUG}}$ =	51.40	cm

From look-up table using L/r_w

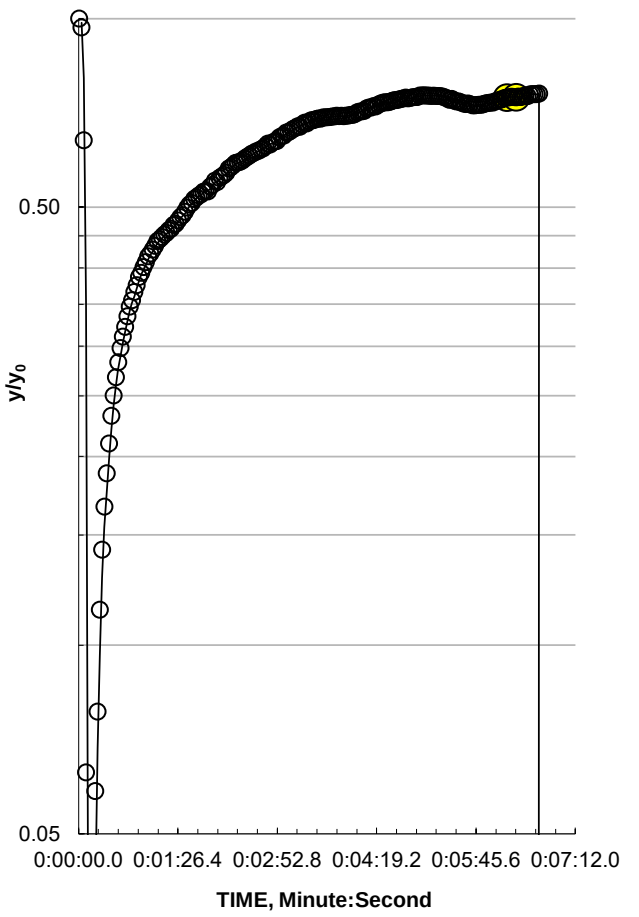
Fully penetrate C =	3.614	
ln(Re/rw) =	3.330	
Re =	4.66	cm
Slope =	7.13E-05	$\log_{10}$/sec
$t_{90\%}$ recovery =	14021	sec

K = 4.5E-06 cm/Second

Date: 1/4/2021
Time: 12:01



Adjust slope of line to estimate K



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Entry	Reduced Data Time, Hr:Min:Sec	Water Level
1	12:01:21.0	10.42
2	12:01:29.0	9.81
3	12:01:37.0	9.86
4	12:01:45.0	9.92
5	12:01:53.0	9.97
6	12:02:01.0	10.01
7	12:02:09.0	10.03
8	12:02:17.0	10.05
9	12:02:25.0	10.07
10	12:02:33.0	10.08
11	12:02:41.0	10.09
12	12:02:49.0	10.10
13	12:02:57.0	10.12
14	12:03:05.0	10.13
15	12:03:13.0	10.13
16	12:03:21.0	10.14
17	12:03:29.0	10.16
18	12:03:37.0	10.17
19	12:03:45.0	10.17
20	12:03:53.0	10.18
21	12:04:01.0	10.19
22	12:04:09.0	10.20
23	12:04:17.0	10.21
24	12:04:25.0	10.21
25	12:04:33.0	10.22
26	12:04:41.0	10.23
27	12:04:49.0	10.23
28	12:04:57.0	10.23
29	12:05:05.0	10.24
30	12:05:13.0	10.24
31	12:05:21.0	10.24
32	12:05:29.0	10.24
33	12:05:37.0	10.25
34	12:05:45.0	10.26
35	12:05:53.0	10.26
36	12:06:01.0	10.26
37	12:06:09.0	10.27
38	12:06:17.0	10.27
39	12:06:25.0	10.27
40	12:06:33.0	10.27
41	12:06:41.0	10.27
42	12:06:49.0	10.26
43	12:06:57.0	10.26
44	12:07:05.0	10.25
45	12:07:13.0	10.26
46	12:07:21.0	10.26
47	12:07:29.0	10.26
48	12:07:37.0	10.27



WELL ID: P-13 Slug Out No. 1

INPUT

Construction:

Casing dia. (d_c)	2	Inch
Annulus dia. (d_w)	4	Inch
Screen Length (L)	55	Feet

Depths to:

water level (DTW)	29.98	Feet
top of screen (TOS)	10	Feet
Base of Aquifer (DTB)	65	Feet

Annular Fill:

across screen -- Coarse Sand
above screen -- Bentonite

Aquifer Material -- Shale

COMPUTED

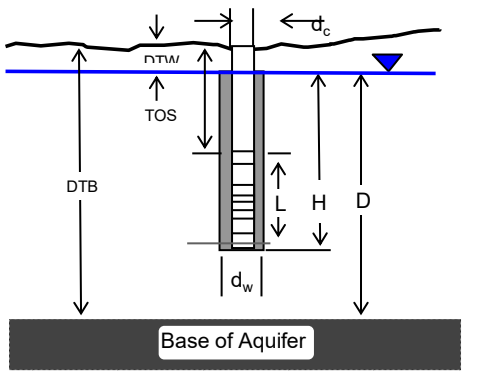
L_{wetted}	35.02	Feet
D =	35.02	Feet
H =	35.02	Feet
L/r_w =	210.12	
$y_{0\text{-DISPLACEMENT}}$ =	62.18	cm
$y_{0\text{-SLUG}}$ =	51.40	cm

From look-up table using L/r_w

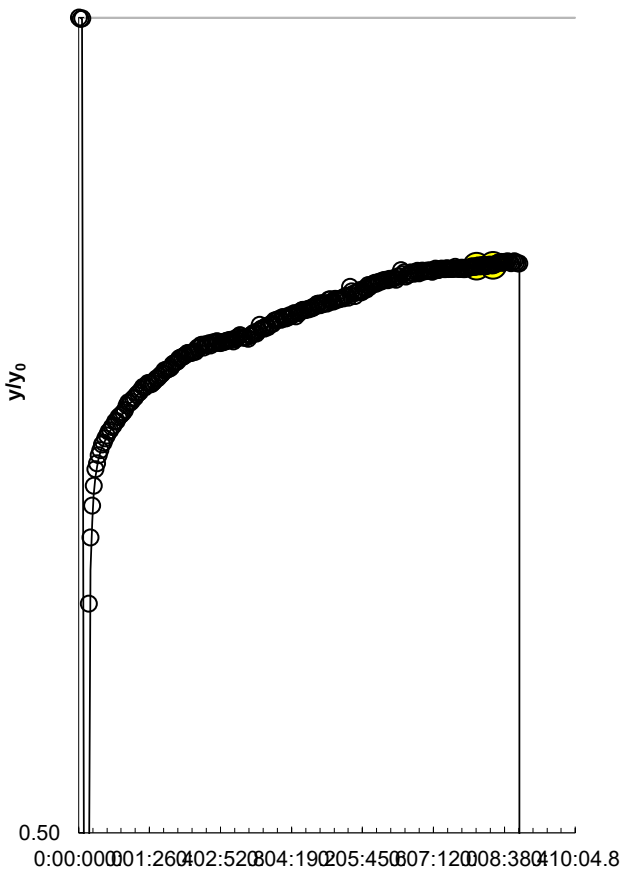
Fully penetrate C =	7.268	
ln(Re/rw) =	4.162	
Re =	10.70	cm
Slope =	1.6E-05	log_{10}/sec
$t_{90\%}$ recovery =	62405	sec

K = 4.6E-07 cm/Second

Date: 1/4/2021
Time: 14:06



Adjust slope of line to estimate K



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Entry	Reduced Data Time, Hr:Min:Sec	Water Level
1	14:06:01.0	20.80
2	14:06:11.0	19.38
3	14:06:21.0	20.15
4	14:06:31.0	20.18
5	14:06:41.0	20.20
6	14:06:51.0	20.22
7	14:07:01.0	20.23
8	14:07:11.0	20.24
9	14:07:21.0	20.25
10	14:07:31.0	20.26
11	14:07:41.0	20.27
12	14:07:51.0	20.27
13	14:08:01.0	20.28
14	14:08:11.0	20.29
15	14:08:21.0	20.30
16	14:08:31.0	20.31
17	14:08:41.0	20.30
18	14:08:51.0	20.31
19	14:09:01.0	20.31
20	14:09:11.0	20.31
21	14:09:21.0	20.32
22	14:09:31.0	20.32
23	14:09:41.0	20.33
24	14:09:51.0	20.33
25	14:10:01.0	20.34
26	14:10:11.0	20.34
27	14:10:21.0	20.35
28	14:10:31.0	20.35
29	14:10:41.0	20.35
30	14:10:51.0	20.36
31	14:11:01.0	20.36
32	14:11:11.0	20.36
33	14:11:21.0	20.37
34	14:11:31.0	20.38
35	14:11:41.0	20.38
36	14:11:51.0	20.38
37	14:12:01.0	20.39
38	14:12:11.0	20.39
39	14:12:21.0	20.39
40	14:12:31.0	20.40
41	14:12:41.0	20.40
42	14:12:51.0	20.40
43	14:13:01.0	20.41
44	14:13:11.0	20.40
45	14:13:21.0	20.41
46	14:13:31.0	20.41
47	14:13:41.0	20.41
48	14:13:51.0	20.41



WELL ID: P-13 Slug Out No. 2

INPUT

Date: 1/4/2021
Time: 14:17

Construction:

Casing dia. (d_c)	2	Inch
Annulus dia. (d_w)	4	Inch
Screen Length (L)	55	Feet

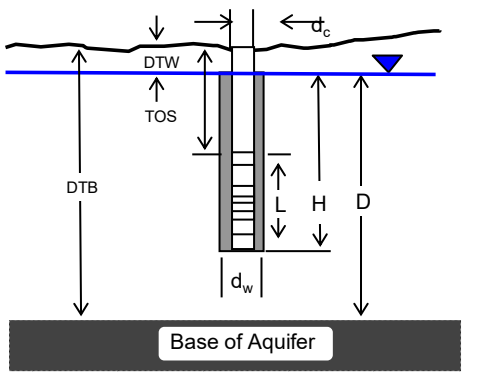
Depths to:

water level (DTW)	29.98	Feet
top of screen (TOS)	10	Feet
Base of Aquifer (DTB)	65	Feet

Annular Fill:

across screen -- Coarse Sand
above screen -- Bentonite

Aquifer Material -- Shale



COMPUTED

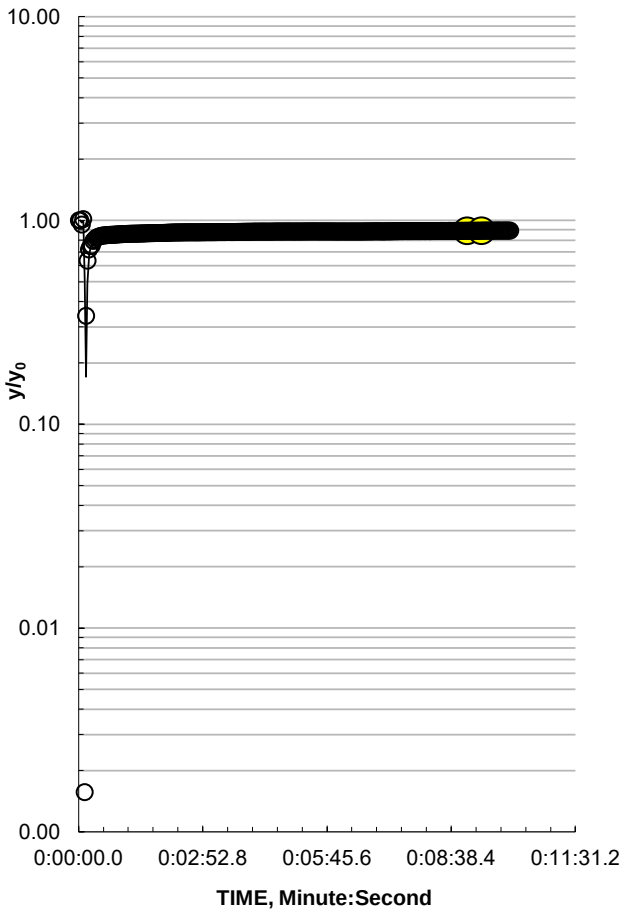
L_{wetted}	35.02	Feet
D =	35.02	Feet
H =	35.02	Feet
L/r_w =	210.12	
$y_{0\text{-DISPLACEMENT}}$ =	110.48	cm
$y_{0\text{-SLUG}}$ =	51.40	cm

From look-up table using L/r_w

Fully penetrate C =	7.268	
ln(Re/rw) =	4.162	
Re =	10.70	cm
Slope =	1.8E-05	$\log_{10}$/sec
$t_{90\%}$ recovery =	55640	sec

K = 5.2E-07 cm/Second

Adjust slope of line to estimate K



REMARKS: Bouwer and Rice analysis of slug test, WRR 1976

Entry	Reduced Data Time, Hr:Min:Sec	Water Level
1	14:17:15.0	20.75
2	14:17:21.0	19.42
3	14:17:27.0	20.10
4	14:17:33.0	20.18
5	14:17:39.0	20.20
6	14:17:45.0	20.22
7	14:17:51.0	20.24
8	14:17:57.0	20.24
9	14:18:03.0	20.26
10	14:18:09.0	20.26
11	14:18:15.0	20.27
12	14:18:21.0	20.28
13	14:18:27.0	20.29
14	14:18:33.0	20.29
15	14:18:39.0	20.29
16	14:18:45.0	20.29
17	14:18:51.0	20.30
18	14:18:57.0	20.30
19	14:19:03.0	20.30
20	14:19:09.0	20.31
21	14:19:15.0	20.31
22	14:19:21.0	20.31
23	14:19:27.0	20.31
24	14:19:33.0	20.32
25	14:19:39.0	20.32
26	14:19:45.0	20.32
27	14:19:51.0	20.32
28	14:19:57.0	20.32
29	14:20:03.0	20.32
30	14:20:09.0	20.32
31	14:20:15.0	20.32
32	14:20:21.0	20.32
33	14:20:27.0	20.32
34	14:20:33.0	20.32
35	14:20:39.0	20.32
36	14:20:45.0	20.32
37	14:20:51.0	20.32
38	14:20:57.0	20.33
39	14:21:03.0	20.33
40	14:21:09.0	20.33
41	14:21:15.0	20.33
42	14:21:21.0	20.34
43	14:21:27.0	20.34
44	14:21:33.0	20.34
45	14:21:39.0	20.34
46	14:21:45.0	20.34
47	14:21:51.0	20.35
48	14:21:57.0	20.35



WELL ID: P-13 Slug Out No. 3

INPUT

Construction:

Casing dia. (d_c)	2	Inch
Annulus dia. (d_w)	4	Inch
Screen Length (L)	55	Feet

Depths to:

water level (DTW)	29.98	Feet
top of screen (TOS)	10	Feet
Base of Aquifer (DTB)	65	Feet

Annular Fill:

across screen -- Coarse Sand

above screen -- Bentonite

Aquifer Material -- Shale

COMPUTED

L_{wetted}	35.02	Feet
D =	35.02	Feet
H =	35.02	Feet
L/r_w =	210.12	
$y_{0\text{-DISPLACEMENT}}$ =	63.11	cm
$y_{0\text{-SLUG}}$ =	51.40	cm

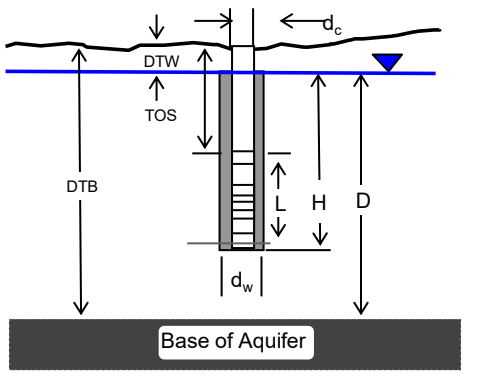
From look-up table using L/r_w

Fully penetrate C =	7.268	
ln(Re/rw) =	4.162	
Re =	10.70	cm
Slope =	2.18E-05	log_{10}/sec
$t_{90\%}$ recovery =	45804	sec

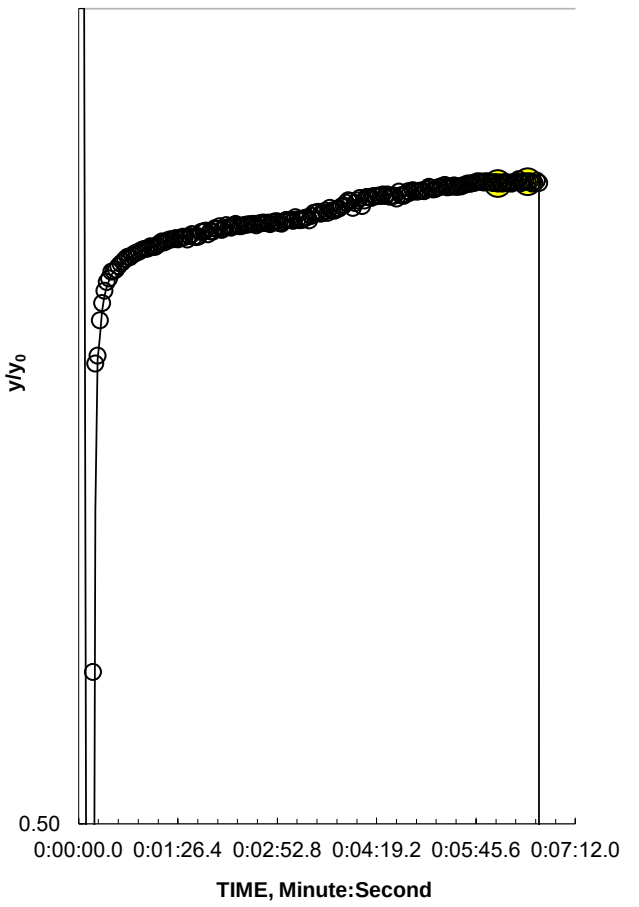
K = 6.3E-07 cm/Second

Date: 1/4/2021

Time: 14:33



Adjust slope of line to estimate K

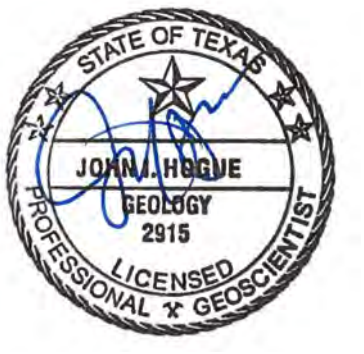


REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Reduced Data

Entry	Time, Hr:Min:Sec	Water Level
1	14:33:34.0	20.85
2	14:33:38.0	19.08
3	14:33:42.0	20.23
4	14:33:46.0	20.31
5	14:33:50.0	20.33
6	14:33:54.0	20.34
7	14:33:58.0	20.34
8	14:34:02.0	20.35
9	14:34:06.0	20.35
10	14:34:10.0	20.36
11	14:34:14.0	20.36
12	14:34:18.0	20.36
13	14:34:22.0	20.36
14	14:34:26.0	20.36
15	14:34:30.0	20.36
16	14:34:34.0	20.37
17	14:34:38.0	20.38
18	14:34:42.0	20.38
19	14:34:46.0	20.38
20	14:34:50.0	20.38
21	14:34:54.0	20.38
22	14:34:58.0	20.38
23	14:35:02.0	20.38
24	14:35:06.0	20.38
25	14:35:10.0	20.38
26	14:35:14.0	20.38
27	14:35:18.0	20.39
28	14:35:22.0	20.39
29	14:35:26.0	20.39
30	14:35:30.0	20.40
31	14:35:34.0	20.40
32	14:35:38.0	20.40
33	14:35:42.0	20.41
34	14:35:46.0	20.41
35	14:35:50.0	20.41
36	14:35:54.0	20.41
37	14:35:58.0	20.41
38	14:36:02.0	20.42
39	14:36:06.0	20.42
40	14:36:10.0	20.42
41	14:36:14.0	20.42
42	14:36:18.0	20.42
43	14:36:22.0	20.42
44	14:36:26.0	20.42
45	14:36:30.0	20.43
46	14:36:34.0	20.42
47	14:36:38.0	20.42
48	14:36:42.0	20.42



WELL ID: P-15 Slug Out No. 1

INPUT

Construction:

Casing dia. (d_c)	2	Inch
Annulus dia. (d_w)	4	Inch
Screen Length (L)	40	Feet

Depths to:

water level (DTW)	28.58	Feet
top of screen (TOS)	10	Feet
Base of Aquifer (DTB)	50	Feet

Annular Fill:

across screen -- Coarse Sand
above screen -- Bentonite

Aquifer Material -- Shale

COMPUTED

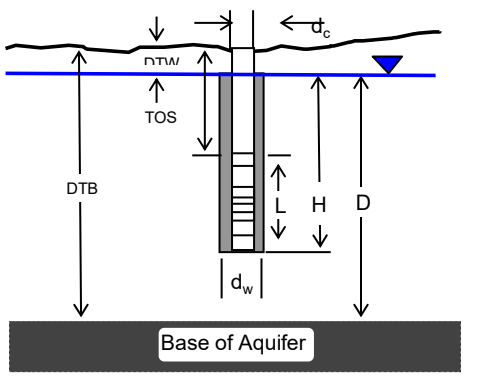
L_{wetted}	21.42	Feet
D =	21.42	Feet
H =	21.42	Feet
L/r_w =	128.52	
$y_{0\text{-DISPLACEMENT}}$ =	20.72	cm
$y_{0\text{-SLUG}}$ =	51.40	cm

From look-up table using L/r_w

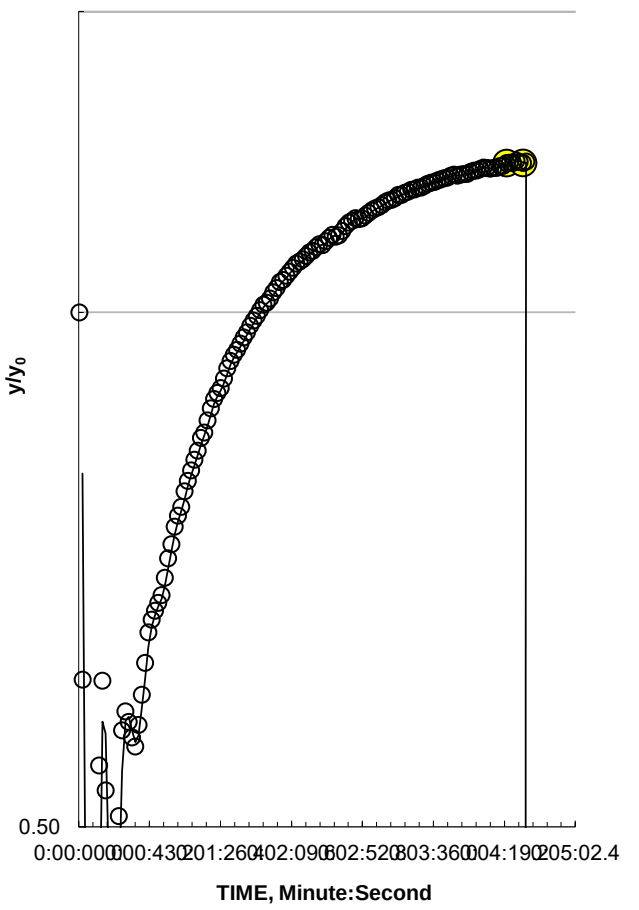
Fully penetrate C =	5.278	
ln(Re/rw) =	3.737	
Re =	7.00	cm
Slope =	8.35E-06	$\log_{10}$/sec
$t_{90\%}$ recovery =	119747	sec

K = 3.5E-07 cm/Second

Date: 1/4/2021
Time: 12:25



Adjust slope of line to estimate K



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Entry	Reduced Data Time, Hr:Min:Sec	Water Level
1	12:25:44.0	28.08
2	12:25:46.0	27.55
3	12:25:48.0	27.42
4	12:25:50.0	27.77
5	12:25:52.0	27.76
6	12:25:54.0	27.65
7	12:25:56.0	27.75
8	12:25:58.0	27.80
9	12:26:00.0	27.78
10	12:26:02.0	27.79
11	12:26:04.0	27.82
12	12:26:06.0	27.85
13	12:26:08.0	27.86
14	12:26:10.0	27.88
15	12:26:12.0	27.90
16	12:26:14.0	27.92
17	12:26:16.0	27.93
18	12:26:18.0	27.95
19	12:26:20.0	27.96
20	12:26:22.0	27.98
21	12:26:24.0	28.00
22	12:26:26.0	28.01
23	12:26:28.0	28.02
24	12:26:30.0	28.04
25	12:26:32.0	28.05
26	12:26:34.0	28.06
27	12:26:36.0	28.07
28	12:26:38.0	28.08
29	12:26:40.0	28.09
30	12:26:42.0	28.09
31	12:26:44.0	28.10
32	12:26:46.0	28.11
33	12:26:48.0	28.12
34	12:26:50.0	28.13
35	12:26:52.0	28.13
36	12:26:54.0	28.14
37	12:26:56.0	28.14
38	12:26:58.0	28.14
39	12:27:00.0	28.15
40	12:27:02.0	28.15
41	12:27:04.0	28.16
42	12:27:06.0	28.17
43	12:27:08.0	28.17
44	12:27:10.0	28.17
45	12:27:12.0	28.18
46	12:27:14.0	28.18
47	12:27:16.0	28.19
48	12:27:18.0	28.19



WELL ID: P-15 Slug Out No. 2

INPUT

Date: 1/4/2021
Time: 12:36

Construction:

Casing dia. (d_c)	2	Inch
Annulus dia. (d_w)	4	Inch
Screen Length (L)	40	Feet

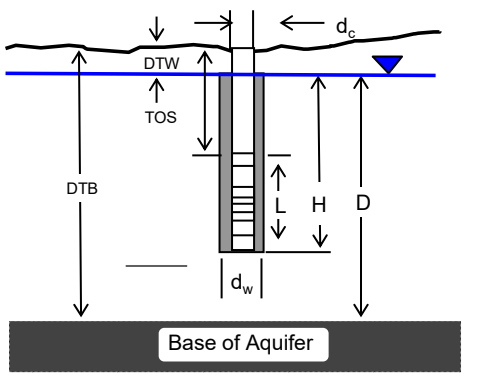
Depths to:

water level (DTW)	28.58	Feet
top of screen (TOS)	10	Feet
Base of Aquifer (DTB)	50	Feet

Annular Fill:

across screen -- Coarse Sand
above screen -- Bentonite

Aquifer Material -- Shale



COMPUTED

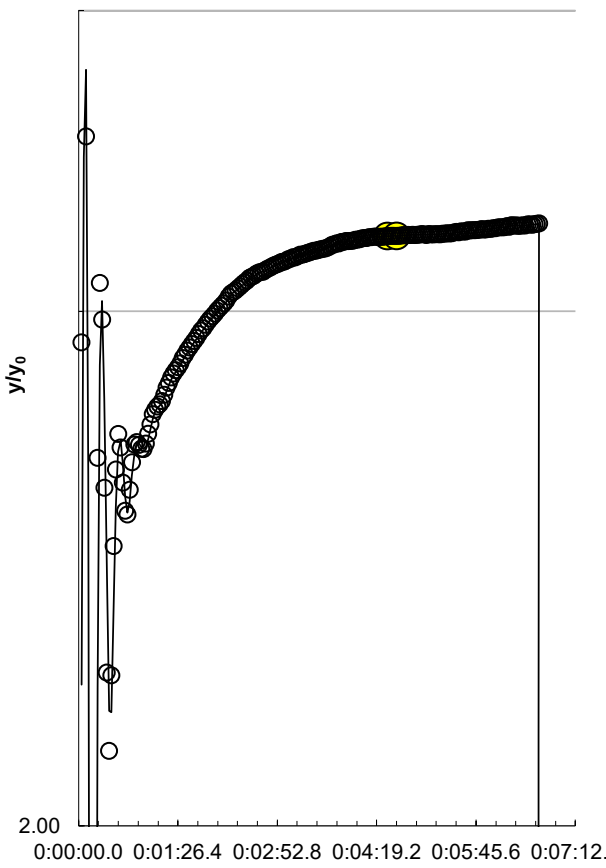
L_{wetted}	21.42	Feet
D =	21.42	Feet
H =	21.42	Feet
L/r_w =	128.52	
$y_{0\text{-DISPLACEMENT}}$ =	12.03	cm
$y_{0\text{-SLUG}}$ =	51.40	cm

From look-up table using L/r_w

Fully penetrate C =	5.278	
ln(Re/rw) =	3.737	
Re =	7.00	cm
Slope =	6.52E-06	log_{10}/sec
$t_{90\%}$ recovery =	153484	sec

K = 2.8E-07 cm/Second

Adjust slope of line to estimate K



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Entry	Reduced Data Time, Hr:Min:Sec	Water Level
1	12:36:11.0	26.89
2	12:36:15.0	27.02
3	12:36:19.0	27.79
4	12:36:23.0	27.46
5	12:36:27.0	27.77
6	12:36:31.0	27.70
7	12:36:35.0	27.81
8	12:36:39.0	27.80
9	12:36:43.0	27.87
10	12:36:47.0	27.89
11	12:36:51.0	27.94
12	12:36:55.0	27.96
13	12:36:59.0	28.00
14	12:37:03.0	28.02
15	12:37:07.0	28.05
16	12:37:11.0	28.07
17	12:37:15.0	28.09
18	12:37:19.0	28.12
19	12:37:23.0	28.13
20	12:37:27.0	28.15
21	12:37:31.0	28.16
22	12:37:35.0	28.17
23	12:37:39.0	28.18
24	12:37:43.0	28.19
25	12:37:47.0	28.20
26	12:37:51.0	28.20
27	12:37:55.0	28.21
28	12:37:59.0	28.21
29	12:38:03.0	28.22
30	12:38:07.0	28.23
31	12:38:11.0	28.23
32	12:38:15.0	28.23
33	12:38:19.0	28.24
34	12:38:23.0	28.24
35	12:38:27.0	28.24
36	12:38:31.0	28.24
37	12:38:35.0	28.24
38	12:38:39.0	28.24
39	12:38:43.0	28.24
40	12:38:47.0	28.24
41	12:38:51.0	28.25
42	12:38:55.0	28.25
43	12:38:59.0	28.25
44	12:39:03.0	28.25
45	12:39:07.0	28.25
46	12:39:11.0	28.26
47	12:39:15.0	28.26
48	12:39:19.0	28.27



WELL ID: P-15 Slug Out No. 3

INPUT

Construction:

Casing dia. (d_c)	2	Inch
Annulus dia. (d_w)	4	Inch
Screen Length (L)	40	Feet

Depths to:

water level (DTW)	28.58	Feet
top of screen (TOS)	10	Feet
Base of Aquifer (DTB)	50	Feet

Annular Fill:

across screen -- Coarse Sand
above screen -- Bentonite

Aquifer Material -- Shale

COMPUTED

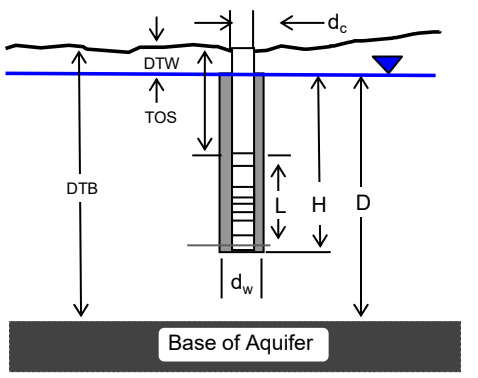
L_{wetted}	21.42	Feet
D =	21.42	Feet
H =	21.42	Feet
L/r_w =	128.52	
$y_{0\text{-DISPLACEMENT}}$ =	82.73	cm
$y_{0\text{-SLUG}}$ =	51.40	cm

From look-up table using L/r_w

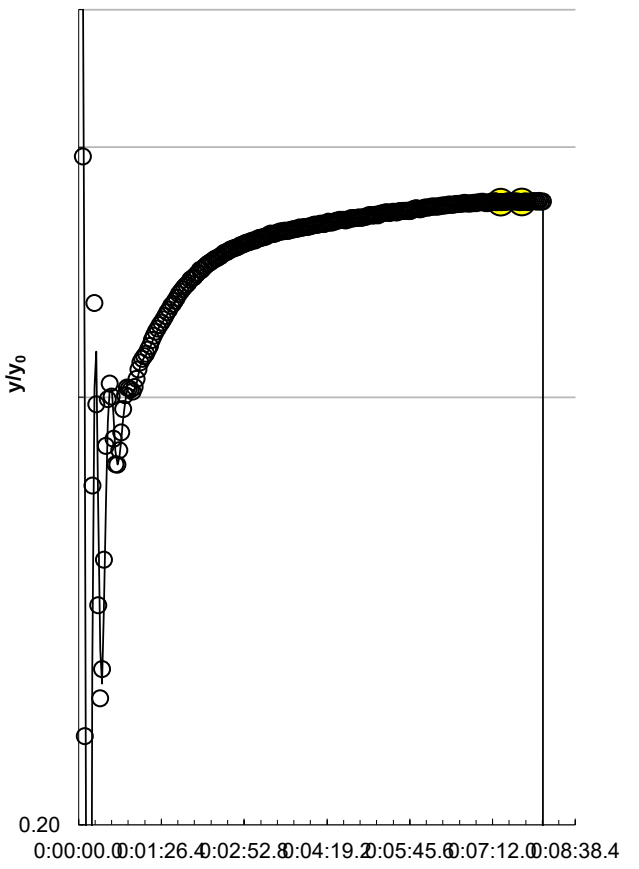
Fully penetrate C =	5.278	
ln(Re/rw) =	3.737	
Re =	7.00	cm
Slope =	5.16E-06	log_{10}/sec
$t_{90\%}$ recovery =	193674	sec

K = 2.2E-07 cm/Second

Date: 1/4/2021
Time: 12:47



Adjust slope of line to estimate K



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Entry	Reduced Data Time, Hr:Min:Sec	Water Level
1	12:47:28.0	29.52
2	12:47:32.0	26.80
3	12:47:36.0	28.07
4	12:47:40.0	27.50
5	12:47:44.0	27.91
6	12:47:48.0	27.77
7	12:47:52.0	27.89
8	12:47:56.0	27.90
9	12:48:00.0	27.95
10	12:48:04.0	27.97
11	12:48:08.0	28.01
12	12:48:12.0	28.03
13	12:48:16.0	28.06
14	12:48:20.0	28.08
15	12:48:24.0	28.10
16	12:48:28.0	28.12
17	12:48:32.0	28.14
18	12:48:36.0	28.15
19	12:48:40.0	28.16
20	12:48:44.0	28.17
21	12:48:48.0	28.18
22	12:48:52.0	28.19
23	12:48:56.0	28.20
24	12:49:00.0	28.20
25	12:49:04.0	28.21
26	12:49:08.0	28.22
27	12:49:12.0	28.22
28	12:49:16.0	28.22
29	12:49:20.0	28.23
30	12:49:24.0	28.23
31	12:49:28.0	28.23
32	12:49:32.0	28.24
33	12:49:36.0	28.24
34	12:49:40.0	28.24
35	12:49:44.0	28.25
36	12:49:48.0	28.25
37	12:49:52.0	28.25
38	12:49:56.0	28.25
39	12:50:00.0	28.26
40	12:50:04.0	28.26
41	12:50:08.0	28.27
42	12:50:12.0	28.27
43	12:50:16.0	28.27
44	12:50:20.0	28.27
45	12:50:24.0	28.28
46	12:50:28.0	28.28
47	12:50:32.0	28.28
48	12:50:36.0	28.28



APPENDIX IIIJ-G

Medina Consulting Company, Inc. Monitoring Well Investigation Report

Observation Well Investigation Report



DEL RIO LANDFILL EXPANSION APPLICATION
SUBSURFACE WATER SAMPLE COLLECTION AND ASSESSMENT
DEL RIO, VAL VERDE COUNTY, TEXAS

Prepared for:

Arias & Associates, Inc.
142 Chula Vista
San Antonio, Texas 78232

Prepared by:

Medina Consulting Company, Inc.

Medina Consulting Co., Inc.
6391 De Zavala, Suite 223D
San Antonio, Texas 78249

Project № 20051
January 19, 2023

Medina
Consulting
Company, Inc.

November 10, 2022

Dr. Golam Kibria, Ph.D., P.E.
Senior Geotechnical Engineer
Arias & Associates, Inc.
142 Chula Vista
San Antonio, Texas 78232
Telephone: (210) 499-6816
Email: gkibria@ariasinc.com

Re: Subsurface Water Sample Collection and Assessment
Del Rio Landfill Expansion Application
Del Rio, Val Verde County, Texas
MCC Project No. 20051

Dear Dr. Kibria:

Medina Consulting Company, Inc. (MCC) performed this subsurface water sample collection and assessment report as part of the Del Rio landfill expansion application project in Del Rio, Texas. As part of this effort subsurface water was collected and analyzed from three observation wells located at the site from January 5 to 6 and June 12 to 13, 2021. This report contains the results of the groundwater characterization.

MCC's services were performed for Arias, CP&Y, and the City of Del Rio (collectively, the Clients). The results and opinion contained in the report can be relied on by the Clients involved with the project in accordance with MCC Proposal No. 20023 dated March 24, 2020. MCC observed the standard of care generally exercised by the profession under similar circumstances and conditions to complete this. The contents should not be relied upon by other parties without the express written consent of MCC. The findings are relevant to the date of our site work and may change with time and changes in site conditions.

The information collected for this project is confidential and will not be released to anyone other than to those shown on the distribution without your authorization. If you have any questions, please do not hesitate to contact us. We appreciate the opportunity to perform this service for you.

Respectfully,
Medina Consulting Company, Inc.

Dawne Butler, G.I.T.
Staff Geologist

Douglas A. McGookey, P.G.
Principal Geologist

Copies Submitted: (1) Dr. Golam Kibria. Arias



1/19/23

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2.0 Sampling Procedures 1

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5.0 Conclusions 4

Attachments

Figure: Piezometer Location Map (provided by Arias)

Table 1: Water Samples B-1, B-13 & B-15: Analytical Results with Edwards Plateau Aquifer Comparisons

Eurofins TestAmerica Laboratory Analytical Reports

1.0 Groundwater Description

Groundwater was encountered during drilling in two of the boreholes, and observation wells were installed in those and eight other boreholes. Groundwater sample collection for groundwater characterization was completed in two visits on January 5 and 6 and June 12 and 13, 2021. The depth to water in observation well B-1 was 27.21 ft. below the top of casing (ft btoc) on January 6 and 27.34 ft. btoc on June 13, 2021. The depth to water in observation well B-13 was 25.54 ft. btoc on January 6, 2021, and 29.66 ft. btoc on June 13, 2021. The depth to water in observation well B-15 was 20.05 ft. btoc on January 6, 2021, and 20.31 ft. btoc on June 15, 2021. Standard low-flow well purging procedures were performed before samples were collected on January 6th and June 13th, except for B-1 in June when, due to an obstruction, a bailer was used. During the purging, it was noted that the water was silty. In January, all three wells were emptied within approximately 30 minutes. Despite several long pauses to allow for recharge, the formation could not provide water flow long enough to allow the water quality parameters (listed in Procedures) to stabilize as much as the samplers, Mr. Jeffrey Neathery and Ms. Dawne Butler, would have preferred. In June, the parameters at B-15 stabilized quickly (before the well emptied) and did not fully stabilize at B-13. B-1 was bailed until nearly emptied. Parameters were measured for each ~1 gallon bailed and were stable.

2.0 Sampling Procedures

Before purging, the depth to water was measured using a Solinst® 300-ft water level meter. Low-flow purging was performed through new, 3/8-inch, LDPE tubing using a 12-volt SS Monsoon® pump. Attached in-line to the tubing was a Horiba U-52 water quality meter with a flow-through cell. The calibrated meter measured temperature, pH, oxidation-reduction potential (ORP), conductivity, turbidity, dissolved oxygen, and total dissolved solids (TDS). These measurements were recorded, with times, in field notes. Readings were taken approximately every 5 minutes during water flow. At B-1 in June, an obstruction in the pipe prevented the pump from reaching the desired depth, so a bailer was used. B-1 was bailed into a clean 5-gallon bucket and parameters were measured for each separate ~1 gallon bailed (the bucket was emptied after each measurement).

January Groundwater Sampling: Observation wells B-15 and B-1 were purged on January 5 and B-Ĉ on January 6, 2021. Groundwater samples were collected on January 6.

June Groundwater Sampling: All three wells were purged on June 12, and groundwater samples were collected on June 13, 2021.

The groundwater samples were placed into laboratory-supplied, clean sample containers, immediately placed on ice in a laboratory-supplied cooler (used as a shuttle). The samples were logged, and a chain of custody was prepared. Ice was maintained throughout the collection and holding periods. A trip blank was also transported to the site, logged, and submitted. The samples

were transported to the Eurofins TestAmerica location in San Antonio for courier service to the Corpus Christi campus (a NELAC-accredited laboratory).

3.0 Analytical Testing

Laboratory analyses were performed on the samples for the presence of volatile organic compounds (VOCs), by EPA Method 8260B, Resource Conservation and Recovery Act (RCRA) 8 metals plus antimony, beryllium, nickel, thallium, vanadium, and zinc by EPA Methods 6010B/7417A. Other analytes tested for were calcium, magnesium, potassium, and sodium (also using EPA Method 6010B). General chemistry analyses included chloride, sulfate, bicarbonate and carbonate alkalinities (as $CaCO_3$), specific conductance, TDS, and pH. The samples were processed in the standard 7 to 10 business-day turnaround time.

3.1 Groundwater Analyses Results

Results of the January and June groundwater analyses are contained in *Table 1 - Water Samples B-1, B-13, & B-15: Analytical Results with Edwards-Trinity Plateau Aquifer Comparisons*. No detected VOCs or metals exceeded TCEQ Class 3 groundwater protective concentration limits (PCLs; see Table 1 for the PCLs). VOCs also did not exceed Class 1 PCLs at either sampling event. In the January samples, thallium was detected at B-1 above the Class 1 PCL. In the June samples, arsenic (B-13) and chromium (B-15) were detected above Class 1 PCLs. The trip blanks for both sampling events had no detections.

VOCs: *January 2021* - No VOCs were detected in the B-13 sample. B-1 and B-15 samples had low concentrations of several compounds (different in each sample). B-1 contained 1,4-dichlorobenzene (0.000391 mg/L, estimated) and 1,1-dichloroethane (0.00203 mg/L). B-15 contained benzene (0.000419 mg/L, est.), ethylbenzene (0.000315 mg/L, est.), toluene (0.000731 mg/L, est.), and total xylenes (0.000734 mg/L, est.).

June 2021 - No VOCs were detected in the B-13 sample. B-1 and B-15 samples had low concentrations of several compounds (with some overlap between the samples). B-1 contained 1,1-dichloroethane (0.00203 mg/L), cis-1,2-dichloroethene (0.000364 mg/L, est.), and dichlorodifluoromethane (0.000599 mg/L, est.). B-15 contained benzene (0.000412 mg/L, est.), chlorobenzene (0.00354 mg/L), 1,4-dichlorobenzene (0.000602 mg/L, est.), cis-1,2-dichloroethene (0.00112 mg/L), and dichlorodifluoromethane (0.000876 mg/L, est.).

Metals: Groundwater samples had low concentrations of most of the fourteen metals tested for. None of the samples contained detected silver or antimony. Beryllium and thallium were each detected in only one sample; thallium at B-1 in January and beryllium at B-13 in June.

January 2021 - B-1 contained arsenic (0.00399 mg/L, est.), barium (0.0264 mg/L), cadmium (0.00141 mg/L, est.), chromium (0.00316 mg/L, est.), mercury (0.000170 mg/L, est.), nickel

(0.0635 mg/L), selenium (0.00697 mg/L, est.), thallium (0.00441 mg/L, est.), vanadium (0.00505 mg/L, est.), and zinc (0.0124 mg/L, est.).

B-13 contained arsenic (0.00721 mg/L, est.), barium (0.0321 mg/L), cadmium (0.00100 mg/L, est.), chromium (0.00384 mg/L, est.), lead (0.00391 mg/L. est.), mercury (0.000194 mg/L, est.), nickel (0.0103 mg/L), selenium (0.0186 mg/L), vanadium (0.0171 mg/L), and zinc (0.0225 mg/L).

B-15 contained arsenic (0.00618 mg/L, est.), barium (0.0447 mg/L), cadmium (0.00156 mg/L, est.), chromium (0.00245 mg/L, est.), nickel (0.0346 mg/L), selenium (0.00566 mg/L, est.), vanadium (0.00531 mg/L), and zinc (0.0181 mg/L, est.).

June 2021 - B-1 contained barium (0.00991 mg/L, est.), cadmium (0.00260 mg/L, est.), mercury (0.000635 mg/L, est.), nickel (0.0717 mg/L), vanadium (0.00783 mg/L.), and zinc (0.0150 mg/L, est.).

B-13 contained arsenic (0.0208 mg/L), barium (0.0734 mg/L), beryllium (0.000710 mg/L, est.) cadmium (0.00126 mg/L, est.), chromium (0.0162 mg/L), lead (0.0115 mg/L. est.), mercury (0.000336 mg/L, est.), nickel (0.026 mg/L), selenium (0.0137 mg/L), vanadium (0.115 mg/L), and zinc (0.0689 mg/L).

B-15 contained barium (0.0341 mg/L), cadmium (0.000920 mg/L, est.), chromium (0.112 mg/L), mercury (0.00130 mg/L, est.), nickel (0.0694 mg/L), selenium (0.00616 mg/L, est.), vanadium (0.00882 mg/L), and zinc (0.0316 mg/L).

Water Quality and Other Parameters: Chloride and sulfate were above secondary PCLs in all three wells at both sampling events. Carbonate alkalinity (as $CaCO_3$) was below detection (< 5.00 mg/L) and pH was nearly neutral (6.5 to 7) in all samples. All other parameters were elevated to highly elevated over fresh water that is typical of the Edwards-Trinity Plateau Aquifer groundwater from the Salmon Peak Formation in the vicinity.

January 2021 - B-1 contained chloride at the concentration of 2,330 mg/L (vs. the secondary PCL of 250 mg/L). Sulfate was at 4,450 mg/L (vs. the secondary PCL of 300 mg/L). Calcium, magnesium, sodium, and potassium were 529 mg/L, 1,320 mg/L, 3,160 mg/L, and 77.8 mg/L, respectively. Bicarbonate alkalinity was 1,010 mg/L and pH was 6.7. TDS was 16,900 mg/L and specific conductance was 18,800 µmhos/cm (18.8 mmhos/cm).

B-13 contained chloride at the concentration of 967 mg/L and sulfate was 1,340 mg/L. Calcium, magnesium, sodium, and potassium were 331 mg/L, 215 mg/L, 618 mg/L, and 29.0 mg/L, respectively. Bicarbonate alkalinity was 418 mg/L and pH was 6.9. TDS was 3650 mg/L and specific conductance was 5090 µmhos/cm (5.09 mmhos/cm).

B-15 contained chloride at the concentration of 3010 mg/L and sulfate was 4260 mg/L. Calcium, magnesium, sodium, and potassium were 453 mg/L, 872 mg/L, 2660 mg/L, and 58.1 mg/L,

respectively. Bicarbonate alkalinity was 713 mg/L and pH was 6.8. TDS was 12,600 mg/L and specific conductance was 16,000 µmhos/cm (16.0 mmhos/cm).

June 2021 - B-1 contained chloride and sulfate at concentrations of 3,630 mg/L and 6,850 mg/L, respectively. Calcium, magnesium, sodium, and potassium were 517 mg/L, 1,420 mg/L, 3,340 mg/L (also found in the laboratory blank), and 82.3 mg/L, respectively. Bicarbonate alkalinity was 978 mg/L and pH was 6.6. TDS was 16,700 mg/L and specific conductance was 19,600 µmhos/cm (19.6 mmhos/cm).

B-13 contained chloride at the concentration of 752 mg/L and sulfate was 897 mg/L. Calcium, magnesium, sodium, and potassium were 274 mg/L, 141 mg/L, 544 mg/L (also found in the laboratory blank), and 18.4 mg/L, respectively. Bicarbonate alkalinity was 506 mg/L and pH was 7. TDS was 3,000 mg/L and specific conductance was 4,210 µmhos/cm (4.21 mmhos/cm).

B-15 contained chloride at the concentration of 2700 mg/L and sulfate was 4,670 mg/L. Calcium, magnesium, sodium, and potassium were 497 mg/L, 875 mg/L, 2580 mg/L (also found in the laboratory blank), and 52.3 mg/L, respectively. Bicarbonate alkalinity was 833 mg/L and pH was 6.5. TDS was 11,800 mg/L and specific conductance was 16,800 µmhos/cm (16.8 mmhos/cm).

4.0 Discussion

The VOCs and metals laboratory analytical results for all six water samples collected from the observation wells in January and June were below Tier 1 commercial/industrial PCLs that are protective of Class 3 groundwater and pH values were essentially neutral. The chloride and sulfate secondary PCLs were exceeded by a large amount in all six samples. While carbonate alkalinity (as $CaCO_3$) was not detected, bicarbonate alkalinity (as $CaCO_3$) was elevated. The high concentrations of calcium, magnesium, sodium and potassium ions in all three samples were reflected in the high specific conductance values measured. TDS was elevated in all samples. Most of the water quality parameters were elevated to highly elevated over fresh water that is typical of the Edwards-Trinity Plateau Aquifer groundwater from the Salmon Peak Formation that is present in the vicinity.

5.0 Conclusions

We conclude that the subsurface water found at the site is not from the Edwards-Trinity Plateau Aquifer. The subsurface water occurs as very small, discontinuous (i.e., separate), perched aquifers within the alluvium. The chemistry of each water sample was distinctly different not only from the Edwards-Trinity Plateau Aquifer (see the comparison values from local wells in Table 1), but also between the three observation wells. For example, B-1 water contained only four detected VOCs (1,4-dichlorobenzene and 1,1-dichloroethane in January and 1,1-dichloroethane, cis-1,2-dichloroethene, and dichlorodifluoromethane in June), B-13 had no detected VOCs, and B-15 had eight VOCs (benzene, chlorobenzene, 1,4-dichlorobenzene, 1,1-dichloroethane, cis-1,2-dichloroethene, dichlorodifluoromethane, ethylbenzene, toluene, and xylenes).

The Edwards-Trinity Plateau Aquifer water from the Salmon Peak Formation, in the vicinity of the landfill, is fresh (low TDS), Class 1, drinking water. The subsurface water found at the site would be classified as Class 3 groundwater. B-1 and B-15 waters exceed the TCEQ Class 3 groundwater TDS cut-off of 10,000 mg/L. The B-13 yield (according to the *Slug Testing and Hydraulic Conductivity Determination* report issued by CRG Texas Environmental Services, Inc. on January 8, 2021) meets the TCEQ's "< 150 gallons per day from a 4-inch diameter well" criterion.

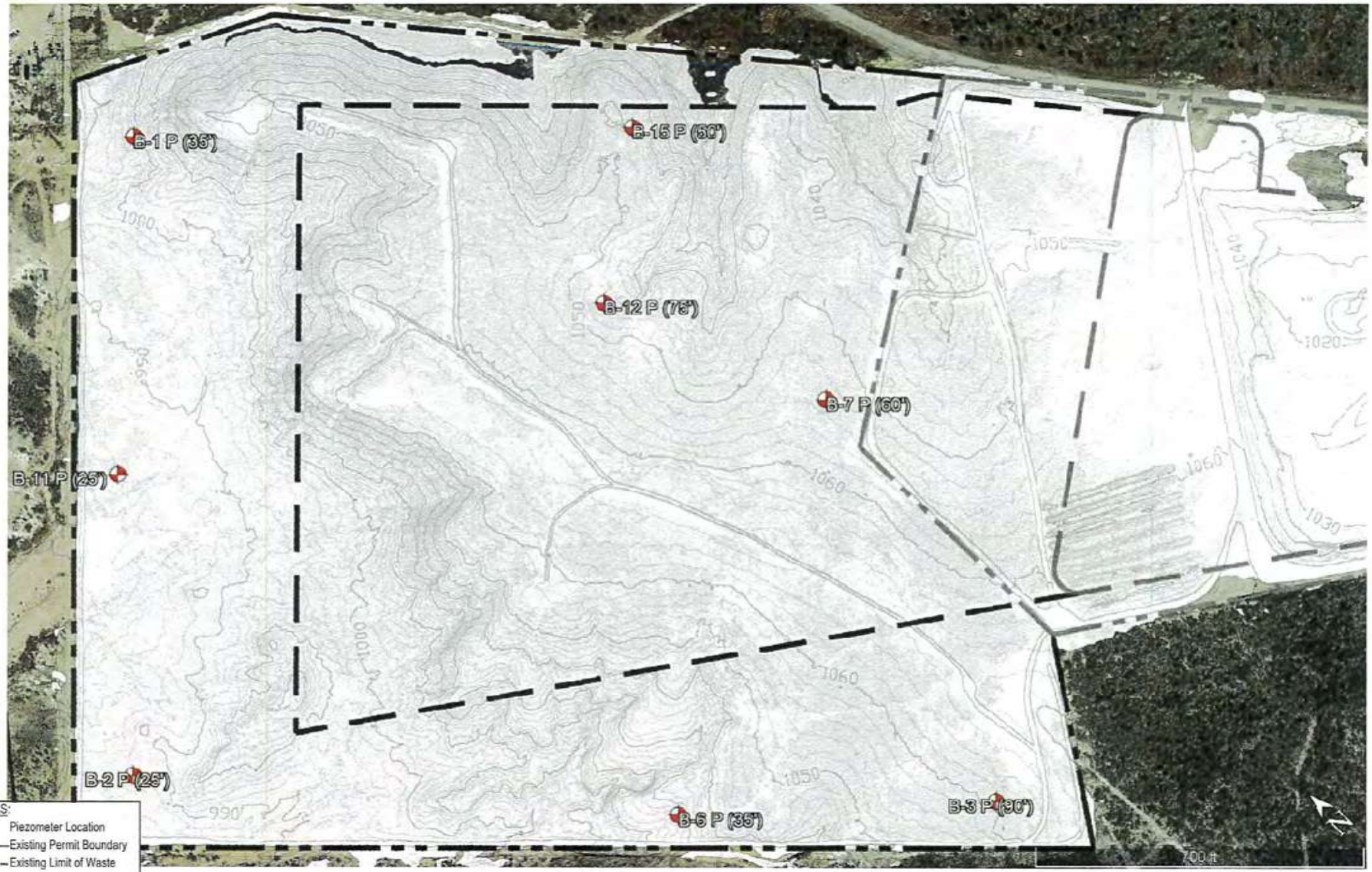
The sources of the groundwaters are likely precipitation and/or runoff that infiltrated through deep desiccation cracks in the clays of the site.

Attachments

Figure

Table 1

Eurofins TestAmerica Laboratory Analytical Reports



ARIAS GEOPROFESSIONALS
142 Chula Vista, San Antonio, Texas 78232
Phone: (210) 308-5884 - Fax: (210) 308-5886

Project Mngr:	GK
Drawn By:	AM
Checked By:	GK
Reviewed By:	GK
Project No.	2020-221
Scale:	NOT TO SCALE
Date:	09-25-2020

PIEZOMETER LOCATION PLAN

City of Del Rio Landfill Expansion Project

Del Rio, Val Verde County, Texas

Table 1 - Water Samples B-1, B-13, & B-15: Analytical Results with Edwards Plateau Aquifer Comparisons

Analytes	C/I PCLs		Sample IDs B-1		B-13		B-15		Comparison Well Values (by State ID)		
	Class 1	Class 3	1/6/2021	6/13/2021	1/6/2021	6/13/2021	1/6/2021	6/13/2021	70-42-102	70-42-106	70-42-101
VOCs											
Benzene	0.0050	0.50	< 0.000330	< 0.000330	< 0.000330	< 0.000330	0.000419 J	0.000412 J			
Chlorobenzene	0.10	10.00	< 0.000136	< 0.000136	< 0.000136	< 0.000136	< 0.000136	0.00354			
1,4-Dichlorobenzene	0.075	7.5	0.000391 J	< 0.000200	< 0.000200	< 0.000200	< 0.000200	0.000602 J			
1,1-Dichloroethane	15	1500	0.00203	0.00223	< 0.000168	< 0.000168	< 0.000168	< 0.000168			
cis-1,2-Dichloroethene	0.07	7	< 0.000121	0.000364 J	< 0.000121	< 0.000121	< 0.000121	0.00112			
Dichlorodifluoromethane	15	1500	< 0.000429	0.000599 J	< 0.000429	< 0.000429	< 0.000429	0.000876 J			
Ethylbenzene	0.70	70	< 0.000200	< 0.000200	< 0.000200	< 0.000200	0.000315 J	< 0.000200			
Toluene	1.0	100	< 0.000495	< 0.000495	< 0.000495	< 0.000495	0.000731 J	< 0.000495			
Xylenes (total)	10	1000	< 0.000200	< 0.000200	< 0.000200	< 0.000200	0.000734 J	< 0.000200			
m- & p-xylenes	10	1000	< 0.000260	< 0.000260	< 0.000260	< 0.000260	0.000323 J	< 0.000260			
o-xylene	10	1000	< 0.000200	< 0.000200	< 0.000200	< 0.000200	0.000412 J	< 0.000200	Metals and compounds analytical results were not reported in the Texas Water Development Board (TWDB) Well Information Reports for these wells.		
Metals											
Ag	0.37	37	< 0.00100	< 0.00100	< 0.00100	< 0.00100	< 0.00100	< 0.00100			
Sb	0.0060	0.60	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500			
As	0.010	1.0	0.00399 J	< 0.00350	0.00721 J	0.0208	0.00618 J	< 0.00350			
Ba	2.0	200	0.0264	0.00991 J	0.0321	0.0734	0.0447	0.0341			
Be	0.0040	0.40	< 0.000500	< 0.000500	< 0.000500	0.000710 J	< 0.000500	< 0.000500			
Cd	0.0050	0.50	0.00141 J	0.00260 J	0.00100 J	0.00126 J	0.00156 J	0.000920 J			
Cr	0.10	10	0.00316 J	< 0.00110	0.00384 J	0.0162	0.00245 J	0.112			
Pb	0.015	1.5	< 0.00330	< 0.00330	0.00391 J	0.0115 J	< 0.00330	< 0.00330			
Hg	0.0020	0.20	0.000170 J	0.000635 J	0.000194 J	0.000336 J	< 0.000130	0.00130 J			
Ni	1.5	150	0.0635	0.0717	0.0103	0.026	0.0346	0.0694			
Se	0.050	5.0	0.00697 J	< 0.00420	0.0186	0.0137	0.00566 J	0.00616 J			
Tl	0.0020	0.20	0.00441 J	< 0.00150	< 0.00150	< 0.00150	< 0.00150	< 0.00150			
V	0.13	13	0.00505	0.00783	0.0171	0.115	0.00531	0.00882			
Zn	22	2200	0.0124 J	0.0150 J	0.0225	0.0689	0.0181 J	0.0316			
Water Quality & Other Parameters (PCLs do not apply)											
Cl			2330	3630	967	752	3010	2700	59	54	51
SO_4	Secondary PCLs are available for only Cl (≤250 mg/L) and SO_4 (≤300 mg/L). TDS for class 1 groundwater is ≤10000 mg/L. TDS >10000 mg/L is class 3.		4450	6850	1340	897	4260	4670	114	24	32
Ca			529	517	331	274	453	497	103	103	85
Mg			1320	1420	215	141	872	875	52	20	34
Na			3160	3340 B	618	544 B	2660	2580 B	NA	16	17
K			77.8	82.3	29.0	18.4	58.1	52.3	NA	1	1.8
Specific conductance			18800	19600	5090	4210	16000	16800	948	795	707
pH			6.7	6.6	6.9	7	6.8	6.5	7.7	7.6	7.8
TDS			16900	16700	3650	3000	12600	11800	NA	409	409
Alkalinity, bicarbonate			1010	978	418	506	713	833	NA	334.37	342
Alkalinity, carbonate			< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	0	0	0

Notes: All results are reported in mg/L except pH (standard units) and conductivity (µmhos/cm)
Samples were collected on 1/6/21 and 6/13/21.
Well State Plane coordinates are: B-1 = N: 13684130.48, E: 1375589.86; B-13 = N: 13682239.04, E: 1376149.05; B-15 = N: 13683474.98, E: 1376491.54
Analytes not listed were below sample detection limits (SDLs) for all samples.
C/I PCLs: commercial/industrial (C/I) protective concentration limits (PCLs) for groundwater
J qualifier: Result is less than the method quantitation limit (MQL) but greater than or equal to the SDL and the concentration and is an estimated value.
B qualifier: Compound was found in the blank and sample.
Values preceded by "<" were below SDLs.
Values in Green are below both Class 1 and Class 3 C/I PCLs. Values in **Blue** are below Class 3 and above Class 2.
Camparison wells were the closest 3 wells in the TWDB Water Data Interactive Viewer.
Samples were collected on the following dates: #70-42-102, 8/8/1968; 70-42-106, 10/17/1984; 70-42-101, 8/8/1968. NA = not analyzed

Eurofins TestAmerica Laboratory Analytical Reports

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ANALYTICAL REPORT

Eurofins Xenco, Corpus Christi
1733 N. Padre Island Drive
Corpus Christi, TX 78408
Tel: (361)289-2471

Laboratory Job ID: 560-91853-1
Client Project/Site: 20051, 1/6/21

For:
Medina Consulting Company Inc
6391 DeZavala Rd
Suite 223D
San Antonio, Texas 78249

Attn: Dawne Butler

Authorized for release by:
1/22/2021 11:32:43 AM

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LINKS

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The test results in this report meet all 2003 NELAC, 2009 TNI, and 2016 TNI requirements for accredited parameters, exceptions are noted in this report. This report may not be reproduced except in full, and with written approval from the laboratory. For questions please contact the Project Manager at the e-mail address or telephone number listed on this page.

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

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IIIJ-G-15

Qualifiers

GC/MS VOA

Qualifier	Qualifier Description
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
U	Indicates the analyte was analyzed for but not detected.

Metals

Qualifier	Qualifier Description
^6+	Interference Check Standard (ICSA and/or ICSAB) is outside acceptance limits, high biased.
4	MS, MSD: The analyte present in the original sample is greater than 4 times the matrix spike concentration; therefore, control limits are not applicable.
E	Result exceeded calibration range.
F2	MS/MSD RPD exceeds control limits
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
U	Indicates the analyte was analyzed for but not detected.

General Chemistry

Qualifier	Qualifier Description
HF	Field parameter with a holding time of 15 minutes. Test performed by laboratory at client's request.
U	Indicates the analyte was analyzed for but not detected.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

Job ID: 560-91853-1

Laboratory: Eurofins Xenco, Corpus Christi

Narrative

Job Narrative
560-91853-1

Comments
No additional comments.

Receipt
The samples were received on 1/8/2021 10:00 AM; the samples arrived in good condition, and where required, properly preserved and on ice. The temperature of the cooler at receipt was -0.2° C.

GC/MS VOA
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Metals
Method 6010B: ICSA failed high TI. Graph checked. No spectral interference. Contamination suspected. Sample reported.

Method 6010B: Due to the high concentration of Zn, the matrix spike / matrix spike duplicate (MS/MSD) for preparation batch 560-181950 and 560-181987 and analytical batch 560-182122 could not be evaluated for accuracy and precision. The associated laboratory control sample (LCS) met acceptance criteria.

Method 6010: The following compound was detected in the leachate blank assoicated with batch 182072: Cadmium. The concentration of Cadmium was above the MDL, but below the RS, therefore, data are reported.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

General Chemistry
Methods 300.0, 9056: The following samples were diluted due to the nature of the sample matrix: B-13 (560-91853-1), B-1 (560-91853-2) and B-15 (560-91853-3). Elevated reporting limits (RLs) are provided.

Methods 9040C, SM 4500 H+ B: This analysis is normally performed in the field and has a method-defined holding time of 15 minutes. The following samples has been qualified with the "HF" flag to indicate analysis was performed in the laboratory outside the 15 minute timeframe: B-13 (560-91853-1), B-1 (560-91853-2), B-15 (560-91853-3) and (560-91648-D-1).

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Organic Prep
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Detection Summary

Client: Medina Consulting Company Inc
Project/Site: 20051, 1/6/21

Job ID: 560-91853-1

Client Sample ID: B-13

Lab Sample ID: 560-91853-1

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Arsenic	0.00721	J	0.0100	0.00350	mg/L	1		6010B	Total/NA
Barium	0.0321		0.0100	0.00200	mg/L	1		6010B	Total/NA
Cadmium	0.00100	J	0.00500	0.000340	mg/L	1		6010B	Total/NA
Calcium	331		0.200	0.101	mg/L	1		6010B	Total/NA
Chromium	0.00384	J	0.0100	0.00110	mg/L	1		6010B	Total/NA
Lead	0.00391	J	0.0100	0.00330	mg/L	1		6010B	Total/NA
Magnesium	215		0.200	0.0257	mg/L	1		6010B	Total/NA
Nickel	0.0103		0.0100	0.00200	mg/L	1		6010B	Total/NA
Potassium	29.0		0.500	0.375	mg/L	1		6010B	Total/NA
Selenium	0.0186		0.0100	0.00420	mg/L	1		6010B	Total/NA
Sodium	618		1.00	0.310	mg/L	1		6010B	Total/NA
Vanadium	0.0171		0.00500	0.000700	mg/L	1		6010B	Total/NA
Zinc	0.0225		0.0200	0.00570	mg/L	1		6010B	Total/NA
Mercury	0.000194	J	0.00200	0.000130	mg/L	1		7470A	Total/NA
Chloride	967		100	19.2	mg/L	100		9056	Total/NA
Sulfate	1340		100	37.7	mg/L	100		9056	Total/NA
Bicarbonate Alkalinity as CaCO3	418		5.00	5.00	mg/L	1		SM 2320B	Total/NA
Specific Conductance	5090		1.00	1.00	umho/cm	1		SM 2510B	Total/NA
Total Dissolved Solids	3650		66.7	66.7	mg/L	1		SM 2540C	Total/NA
pH	6.9	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA

Client Sample ID: B-1

Lab Sample ID: 560-91853-2

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
1,1-Dichloroethane	2.03		1.00	0.168	ug/L	1		8260B	Total/NA
1,4-Dichlorobenzene	0.391	J	1.00	0.200	ug/L	1		8260B	Total/NA
Arsenic	0.00399	J	0.0100	0.00350	mg/L	1		6010B	Total/NA
Barium	0.0264		0.0100	0.00200	mg/L	1		6010B	Total/NA
Cadmium	0.00141	J	0.00500	0.000340	mg/L	1		6010B	Total/NA
Calcium	529		0.200	0.101	mg/L	1		6010B	Total/NA
Chromium	0.00316	J	0.0100	0.00110	mg/L	1		6010B	Total/NA
Magnesium	1320		2.00	0.257	mg/L	10		6010B	Total/NA
Nickel	0.0635		0.0100	0.00200	mg/L	1		6010B	Total/NA
Potassium	77.8		0.500	0.375	mg/L	1		6010B	Total/NA
Selenium	0.00697	J	0.0100	0.00420	mg/L	1		6010B	Total/NA
Sodium	3160		10.0	3.10	mg/L	10		6010B	Total/NA
Thallium	0.00441	J	0.00500	0.00150	mg/L	1		6010B	Total/NA
Vanadium	0.00505		0.00500	0.000700	mg/L	1		6010B	Total/NA
Zinc	0.0124	J	0.0200	0.00570	mg/L	1		6010B	Total/NA
Mercury	0.000170	J	0.00200	0.000130	mg/L	1		7470A	Total/NA
Chloride	2330		500	96.0	mg/L	500		9056	Total/NA
Sulfate	4450		500	189	mg/L	500		9056	Total/NA
Bicarbonate Alkalinity as CaCO3	1010		5.00	5.00	mg/L	1		SM 2320B	Total/NA
Specific Conductance	18800		1.00	1.00	umho/cm	1		SM 2510B	Total/NA
Total Dissolved Solids	16900		250	250	mg/L	1		SM 2540C	Total/NA
pH	6.7	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA

Client Sample ID: B-15

Lab Sample ID: 560-91853-3

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Benzene	0.419	J	1.00	0.330	ug/L	1		8260B	Total/NA
Ethylbenzene	0.315	J	1.00	0.200	ug/L	1		8260B	Total/NA

This Detection Summary does not include radiochemical test results.

Client Sample ID: B-15 (Continued)

Lab Sample ID: 560-91853-3

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Toluene	0.731	J	1.00	0.495	ug/L	1		8260B	Total/NA
Xylenes, Total	0.734	J	2.00	0.200	ug/L	1		8260B	Total/NA
m-Xylene & p-Xylene	0.323	J	2.00	0.260	ug/L	1		8260B	Total/NA
o-Xylene	0.412	J	1.00	0.200	ug/L	1		8260B	Total/NA
Arsenic	0.00618	J	0.0100	0.00350	mg/L	1		6010B	Total/NA
Barium	0.0447		0.0100	0.00200	mg/L	1		6010B	Total/NA
Cadmium	0.00156	J	0.00500	0.000340	mg/L	1		6010B	Total/NA
Calcium	453		0.200	0.101	mg/L	1		6010B	Total/NA
Chromium	0.00245	J	0.0100	0.00110	mg/L	1		6010B	Total/NA
Magnesium	872		2.00	0.257	mg/L	10		6010B	Total/NA
Nickel	0.0346		0.0100	0.00200	mg/L	1		6010B	Total/NA
Potassium	58.1		0.500	0.375	mg/L	1		6010B	Total/NA
Selenium	0.00566	J	0.0100	0.00420	mg/L	1		6010B	Total/NA
Sodium	2660		10.0	3.10	mg/L	10		6010B	Total/NA
Vanadium	0.00531		0.00500	0.000700	mg/L	1		6010B	Total/NA
Zinc	0.0181	J	0.0200	0.00570	mg/L	1		6010B	Total/NA
Chloride	3010		500	96.0	mg/L	500		9056	Total/NA
Sulfate	4260		500	189	mg/L	500		9056	Total/NA
Bicarbonate Alkalinity as CaCO3	713		5.00	5.00	mg/L	1		SM 2320B	Total/NA
Specific Conductance	16000		1.00	1.00	umho/cm	1		SM 2510B	Total/NA
Total Dissolved Solids	12600		200	200	mg/L	1		SM 2540C	Total/NA
pH	6.8	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA

Client Sample ID: trip blank

Lab Sample ID: 560-91853-5

No Detections.

This Detection Summary does not include radiochemical test results.

Client Sample ID: B-13
Date Collected: 01/06/21 10:45
Date Received: 01/08/21 10:00

Lab Sample ID: 560-91853-1
Matrix: Water

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	5.00	U	10.0	5.00	ug/L			01/09/21 19:45	1
Benzene	0.330	U	1.00	0.330	ug/L			01/09/21 19:45	1
Chlorodibromomethane	0.223	U	2.00	0.223	ug/L			01/09/21 19:45	1
Bromoform	0.500	U	5.00	0.500	ug/L			01/09/21 19:45	1
Carbon disulfide	0.500	U	5.00	0.500	ug/L			01/09/21 19:45	1
Carbon tetrachloride	0.251	U	1.00	0.251	ug/L			01/09/21 19:45	1
Chlorobenzene	0.136	U	1.00	0.136	ug/L			01/09/21 19:45	1
Chloroethane	0.400	U	5.00	0.400	ug/L			01/09/21 19:45	1
Chloroform	0.173	U	1.00	0.173	ug/L			01/09/21 19:45	1
Chloromethane	0.390	U	5.00	0.390	ug/L			01/09/21 19:45	1
Dichlorobromomethane	0.175	U	1.00	0.175	ug/L			01/09/21 19:45	1
1,1-Dichloroethane	0.168	U	1.00	0.168	ug/L			01/09/21 19:45	1
1,2-Dichloroethane	0.172	U	1.00	0.172	ug/L			01/09/21 19:45	1
1,1-Dichloroethene	0.300	U	1.00	0.300	ug/L			01/09/21 19:45	1
trans-1,2-Dichloroethene	0.200	U	1.00	0.200	ug/L			01/09/21 19:45	1
cis-1,2-Dichloroethene	0.121	U	1.00	0.121	ug/L			01/09/21 19:45	1
1,2-Dichloropropane	0.173	U	1.00	0.173	ug/L			01/09/21 19:45	1
cis-1,3-Dichloropropene	0.146	U	1.00	0.146	ug/L			01/09/21 19:45	1
trans-1,3-Dichloropropene	0.200	U	5.00	0.200	ug/L			01/09/21 19:45	1
Ethylbenzene	0.200	U	1.00	0.200	ug/L			01/09/21 19:45	1
2-Hexanone	1.56	U	10.0	1.56	ug/L			01/09/21 19:45	1
Methylene Chloride	2.00	U	10.0	2.00	ug/L			01/09/21 19:45	1
2-Butanone (MEK)	1.00	U	10.0	1.00	ug/L			01/09/21 19:45	1
4-Methyl-2-pentanone (MIBK)	0.510	U	10.0	0.510	ug/L			01/09/21 19:45	1
Styrene	0.200	U	1.00	0.200	ug/L			01/09/21 19:45	1
Tetrachloroethene	0.189	U	1.00	0.189	ug/L			01/09/21 19:45	1
Toluene	0.495	U	1.00	0.495	ug/L			01/09/21 19:45	1
1,1,1-Trichloroethane	0.300	U	1.00	0.300	ug/L			01/09/21 19:45	1
1,1,2-Trichloroethane	0.173	U	1.00	0.173	ug/L			01/09/21 19:45	1
Trichloroethene	0.317	U	1.00	0.317	ug/L			01/09/21 19:45	1
Vinyl acetate	5.00	U	10.0	5.00	ug/L			01/09/21 19:45	1
Vinyl chloride	0.300	U	1.00	0.300	ug/L			01/09/21 19:45	1
Xylenes, Total	0.200	U	2.00	0.200	ug/L			01/09/21 19:45	1
1,1,2,2-Tetrachloroethane	0.190	U	1.00	0.190	ug/L			01/09/21 19:45	1
Bromomethane	0.392	U	5.00	0.392	ug/L			01/09/21 19:45	1
1,1,2-Trichloro-1,2,2-trifluoroethane	0.410	U	2.00	0.410	ug/L			01/09/21 19:45	1
1,2,4-Trichlorobenzene	0.168	U	5.00	0.168	ug/L			01/09/21 19:45	1
1,2-Dibromo-3-Chloropropane	0.349	U	5.00	0.349	ug/L			01/09/21 19:45	1
1,2-Dichlorobenzene	0.170	U	1.00	0.170	ug/L			01/09/21 19:45	1
1,3-Dichlorobenzene	0.128	U	1.00	0.128	ug/L			01/09/21 19:45	1
1,4-Dichlorobenzene	0.200	U	1.00	0.200	ug/L			01/09/21 19:45	1
Dichlorodifluoromethane	0.429	U	5.00	0.429	ug/L			01/09/21 19:45	1
Ethylene Dibromide	0.175	U	1.00	0.175	ug/L			01/09/21 19:45	1
Isopropylbenzene	0.500	U	5.00	0.500	ug/L			01/09/21 19:45	1
Methyl tert-butyl ether	0.200	U	1.00	0.200	ug/L			01/09/21 19:45	1
m-Xylene & p-Xylene	0.260	U	2.00	0.260	ug/L			01/09/21 19:45	1
o-Xylene	0.200	U	1.00	0.200	ug/L			01/09/21 19:45	1
Cyclohexane	1.00	U	2.00	1.00	ug/L			01/09/21 19:45	1
Bromochloromethane	0.228	U	1.00	0.228	ug/L			01/09/21 19:45	1

Client Sample ID: B-13

Lab Sample ID: 560-91853-1

Date Collected: 01/06/21 10:45
Date Received: 01/08/21 10:00

Matrix: Water

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
1,2-Dichloroethane-d4 (Surr)	*97*		*70 - 140*		*01/09/21 19:45*	*1*
4-Bromofluorobenzene (Surr)	*97*		*70 - 130*		*01/09/21 19:45*	*1*
Dibromofluoromethane (Surr)	*104*		*69 - 130*		*01/09/21 19:45*	*1*
Toluene-d8 (Surr)	*97*		*70 - 130*		*01/09/21 19:45*	*1*

Method: 6010B - Metals (ICP)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	0.00500	U	0.0100	0.00500	mg/L		01/12/21 11:00	01/15/21 14:55	1
Arsenic	**0.00721**	**J**	0.0100	0.00350	mg/L		01/12/21 11:00	01/15/21 14:55	1
Barium	**0.0321**		0.0100	0.00200	mg/L		01/12/21 11:00	01/15/21 14:55	1
Beryllium	0.000500	U	0.00400	0.000500	mg/L		01/12/21 11:00	01/15/21 14:55	1
Cadmium	**0.00100**	**J**	0.00500	0.000340	mg/L		01/12/21 11:00	01/15/21 14:55	1
Calcium	**331**		0.200	0.101	mg/L		01/12/21 11:00	01/15/21 14:55	1
Chromium	**0.00384**	**J**	0.0100	0.00110	mg/L		01/12/21 11:00	01/15/21 14:55	1
Lead	**0.00391**	**J**	0.0100	0.00330	mg/L		01/12/21 11:00	01/15/21 14:55	1
Magnesium	**215**		0.200	0.0257	mg/L		01/12/21 11:00	01/15/21 14:55	1
Nickel	**0.0103**		0.0100	0.00200	mg/L		01/12/21 11:00	01/15/21 14:55	1
Potassium	**29.0**		0.500	0.375	mg/L		01/12/21 11:00	01/15/21 14:55	1
Selenium	**0.0186**		0.0100	0.00420	mg/L		01/12/21 11:00	01/15/21 14:55	1
Silver	0.00100	U	0.00500	0.00100	mg/L		01/12/21 11:00	01/15/21 14:55	1
Sodium	**618**		1.00	0.310	mg/L		01/12/21 11:00	01/15/21 14:55	1
Thallium	0.00150	U	0.00500	0.00150	mg/L		01/12/21 11:00	01/15/21 14:55	1
Vanadium	**0.0171**		0.00500	0.000700	mg/L		01/12/21 11:00	01/15/21 14:55	1
Zinc	**0.0225**		0.0200	0.00570	mg/L		01/12/21 11:00	01/15/21 14:55	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	**0.000194**	**J**	0.00200	0.000130	mg/L		01/15/21 11:10	01/15/21 18:10	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**967**		100	19.2	mg/L			01/11/21 21:57	100
Sulfate	**1340**		100	37.7	mg/L			01/11/21 21:57	100
Bicarbonate Alkalinity as CaCO3	**418**		5.00	5.00	mg/L			01/20/21 13:30	1
Carbonate Alkalinity as CaCO3	5.00	U	5.00	5.00	mg/L			01/20/21 13:30	1
Specific Conductance	**5090**		1.00	1.00	umho/cm			01/20/21 10:00	1
Total Dissolved Solids	**3650**		66.7	66.7	mg/L			01/13/21 10:00	1
pH	**6.9**	**HF**	0.1	0.1	SU			01/15/21 12:10	1

Client Sample ID: B-1

Lab Sample ID: 560-91853-2

Date Collected: 01/06/21 12:33
Date Received: 01/08/21 10:00

Matrix: Water

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	5.00	U	10.0	5.00	ug/L			01/09/21 20:10	1
Benzene	0.330	U	1.00	0.330	ug/L			01/09/21 20:10	1
Chlorodibromomethane	0.223	U	2.00	0.223	ug/L			01/09/21 20:10	1
Bromoform	0.500	U	5.00	0.500	ug/L			01/09/21 20:10	1
Carbon disulfide	0.500	U	5.00	0.500	ug/L			01/09/21 20:10	1
Carbon tetrachloride	0.251	U	1.00	0.251	ug/L			01/09/21 20:10	1

Client Sample ID: B-1
Date Collected: 01/06/21 12:33
Date Received: 01/08/21 10:00

Lab Sample ID: 560-91853-2
Matrix: Water

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chlorobenzene	0.136	U	1.00	0.136	ug/L			01/09/21 20:10	1
Chloroethane	0.400	U	5.00	0.400	ug/L			01/09/21 20:10	1
Chloroform	0.173	U	1.00	0.173	ug/L			01/09/21 20:10	1
Chloromethane	0.390	U	5.00	0.390	ug/L			01/09/21 20:10	1
Dichlorobromomethane	0.175	U	1.00	0.175	ug/L			01/09/21 20:10	1
1,1-Dichloroethane	**2.03**		1.00	0.168	ug/L			01/09/21 20:10	1
1,2-Dichloroethane	0.172	U	1.00	0.172	ug/L			01/09/21 20:10	1
1,1-Dichloroethene	0.300	U	1.00	0.300	ug/L			01/09/21 20:10	1
trans-1,2-Dichloroethene	0.200	U	1.00	0.200	ug/L			01/09/21 20:10	1
cis-1,2-Dichloroethene	0.121	U	1.00	0.121	ug/L			01/09/21 20:10	1
1,2-Dichloropropane	0.173	U	1.00	0.173	ug/L			01/09/21 20:10	1
cis-1,3-Dichloropropene	0.146	U	1.00	0.146	ug/L			01/09/21 20:10	1
trans-1,3-Dichloropropene	0.200	U	5.00	0.200	ug/L			01/09/21 20:10	1
Ethylbenzene	0.200	U	1.00	0.200	ug/L			01/09/21 20:10	1
2-Hexanone	1.56	U	10.0	1.56	ug/L			01/09/21 20:10	1
Methylene Chloride	2.00	U	10.0	2.00	ug/L			01/09/21 20:10	1
2-Butanone (MEK)	1.00	U	10.0	1.00	ug/L			01/09/21 20:10	1
4-Methyl-2-pentanone (MIBK)	0.510	U	10.0	0.510	ug/L			01/09/21 20:10	1
Styrene	0.200	U	1.00	0.200	ug/L			01/09/21 20:10	1
Tetrachloroethene	0.189	U	1.00	0.189	ug/L			01/09/21 20:10	1
Toluene	0.495	U	1.00	0.495	ug/L			01/09/21 20:10	1
1,1,1-Trichloroethane	0.300	U	1.00	0.300	ug/L			01/09/21 20:10	1
1,1,2-Trichloroethane	0.173	U	1.00	0.173	ug/L			01/09/21 20:10	1
Trichloroethene	0.317	U	1.00	0.317	ug/L			01/09/21 20:10	1
Vinyl acetate	5.00	U	10.0	5.00	ug/L			01/09/21 20:10	1
Vinyl chloride	0.300	U	1.00	0.300	ug/L			01/09/21 20:10	1
Xylenes, Total	0.200	U	2.00	0.200	ug/L			01/09/21 20:10	1
1,1,2,2-Tetrachloroethane	0.190	U	1.00	0.190	ug/L			01/09/21 20:10	1
Bromomethane	0.392	U	5.00	0.392	ug/L			01/09/21 20:10	1
1,1,2-Trichloro-1,2,2-trifluoroethane	0.410	U	2.00	0.410	ug/L			01/09/21 20:10	1
1,2,4-Trichlorobenzene	0.168	U	5.00	0.168	ug/L			01/09/21 20:10	1
1,2-Dibromo-3-Chloropropane	0.349	U	5.00	0.349	ug/L			01/09/21 20:10	1
1,2-Dichlorobenzene	0.170	U	1.00	0.170	ug/L			01/09/21 20:10	1
1,3-Dichlorobenzene	0.128	U	1.00	0.128	ug/L			01/09/21 20:10	1
1,4-Dichlorobenzene	**0.391**	**J**	1.00	0.200	ug/L			01/09/21 20:10	1
Dichlorodifluoromethane	0.429	U	5.00	0.429	ug/L			01/09/21 20:10	1
Ethylene Dibromide	0.175	U	1.00	0.175	ug/L			01/09/21 20:10	1
Isopropylbenzene	0.500	U	5.00	0.500	ug/L			01/09/21 20:10	1
Methyl tert-butyl ether	0.200	U	1.00	0.200	ug/L			01/09/21 20:10	1
m-Xylene & p-Xylene	0.260	U	2.00	0.260	ug/L			01/09/21 20:10	1
o-Xylene	0.200	U	1.00	0.200	ug/L			01/09/21 20:10	1
Cyclohexane	1.00	U	2.00	1.00	ug/L			01/09/21 20:10	1
Bromochloromethane	0.228	U	1.00	0.228	ug/L			01/09/21 20:10	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
1,2-Dichloroethane-d4 (Surr)	*97*		*70 - 140*		*01/09/21 20:10*	*1*
4-Bromofluorobenzene (Surr)	*98*		*70 - 130*		*01/09/21 20:10*	*1*
Dibromofluoromethane (Surr)	*100*		*69 - 130*		*01/09/21 20:10*	*1*
Toluene-d8 (Surr)	*98*		*70 - 130*		*01/09/21 20:10*	*1*

Client Sample ID: B-1

Lab Sample ID: 560-91853-2
Matrix: Water

Date Collected: 01/06/21 12:33
Date Received: 01/08/21 10:00

Method: 6010B - Metals (ICP)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	0.00500	U	0.0100	0.00500	mg/L		01/12/21 11:00	01/15/21 14:59	1
Arsenic	**0.00399**	**J**	0.0100	0.00350	mg/L		01/12/21 11:00	01/15/21 14:59	1
Barium	**0.0264**		0.0100	0.00200	mg/L		01/12/21 11:00	01/15/21 14:59	1
Beryllium	0.000500	U	0.00400	0.000500	mg/L		01/12/21 11:00	01/15/21 14:59	1
Cadmium	**0.00141**	**J**	0.00500	0.000340	mg/L		01/12/21 11:00	01/15/21 14:59	1
Calcium	**529**		0.200	0.101	mg/L		01/12/21 11:00	01/15/21 14:59	1
Chromium	**0.00316**	**J**	0.0100	0.00110	mg/L		01/12/21 11:00	01/15/21 14:59	1
Lead	0.00330	U	0.0100	0.00330	mg/L		01/12/21 11:00	01/15/21 14:59	1
Magnesium	**1320**		2.00	0.257	mg/L		01/12/21 11:00	01/21/21 14:06	10
Nickel	**0.0635**		0.0100	0.00200	mg/L		01/12/21 11:00	01/15/21 14:59	1
Potassium	**77.8**		0.500	0.375	mg/L		01/12/21 11:00	01/15/21 14:59	1
Selenium	**0.00697**	**J**	0.0100	0.00420	mg/L		01/12/21 11:00	01/15/21 14:59	1
Silver	0.00100	U	0.00500	0.00100	mg/L		01/12/21 11:00	01/15/21 14:59	1
Sodium	**3160**		10.0	3.10	mg/L		01/12/21 11:00	01/21/21 14:06	10
Thallium	**0.00441**	**J**	0.00500	0.00150	mg/L		01/12/21 11:00	01/15/21 14:59	1
Vanadium	**0.00505**		0.00500	0.000700	mg/L		01/12/21 11:00	01/15/21 14:59	1
Zinc	**0.0124**	**J**	0.0200	0.00570	mg/L		01/12/21 11:00	01/15/21 14:59	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	**0.000170**	**J**	0.00200	0.000130	mg/L		01/15/21 11:10	01/15/21 18:12	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**2330**		500	96.0	mg/L			01/11/21 22:31	500
Sulfate	**4450**		500	189	mg/L			01/11/21 22:31	500
Bicarbonate Alkalinity as CaCO3	**1010**		5.00	5.00	mg/L			01/20/21 13:30	1
Carbonate Alkalinity as CaCO3	5.00	U	5.00	5.00	mg/L			01/20/21 13:30	1
Specific Conductance	**18800**		1.00	1.00	umho/cm			01/20/21 10:00	1
Total Dissolved Solids	**16900**		250	250	mg/L			01/13/21 10:00	1
pH	**6.7**	**HF**	0.1	0.1	SU			01/15/21 12:10	1

Client Sample ID: B-15

Lab Sample ID: 560-91853-3
Matrix: Water

Date Collected: 01/06/21 13:15
Date Received: 01/08/21 10:00

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	5.00	U	10.0	5.00	ug/L			01/09/21 19:37	1
Benzene	**0.419**	**J**	1.00	0.330	ug/L			01/09/21 19:37	1
Chlorodibromomethane	0.223	U	2.00	0.223	ug/L			01/09/21 19:37	1
Bromoform	0.500	U	5.00	0.500	ug/L			01/09/21 19:37	1
Carbon disulfide	0.500	U	5.00	0.500	ug/L			01/09/21 19:37	1
Carbon tetrachloride	0.251	U	1.00	0.251	ug/L			01/09/21 19:37	1
Chlorobenzene	0.136	U	1.00	0.136	ug/L			01/09/21 19:37	1
Chloroethane	0.400	U	5.00	0.400	ug/L			01/09/21 19:37	1
Chloroform	0.173	U	1.00	0.173	ug/L			01/09/21 19:37	1
Chloromethane	0.390	U	5.00	0.390	ug/L			01/09/21 19:37	1
Dichlorobromomethane	0.175	U	1.00	0.175	ug/L			01/09/21 19:37	1
1,1-Dichloroethane	0.168	U	1.00	0.168	ug/L			01/09/21 19:37	1

Client Sample ID: B-15
Date Collected: 01/06/21 13:15
Date Received: 01/08/21 10:00

Lab Sample ID: 560-91853-3
Matrix: Water

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
1,2-Dichloroethane	0.172	U	1.00	0.172	ug/L			01/09/21 19:37	1
1,1-Dichloroethene	0.300	U	1.00	0.300	ug/L			01/09/21 19:37	1
trans-1,2-Dichloroethene	0.200	U	1.00	0.200	ug/L			01/09/21 19:37	1
cis-1,2-Dichloroethene	0.121	U	1.00	0.121	ug/L			01/09/21 19:37	1
1,2-Dichloropropane	0.173	U	1.00	0.173	ug/L			01/09/21 19:37	1
cis-1,3-Dichloropropene	0.146	U	1.00	0.146	ug/L			01/09/21 19:37	1
trans-1,3-Dichloropropene	0.200	U	5.00	0.200	ug/L			01/09/21 19:37	1
Ethylbenzene	**0.315**	**J**	1.00	0.200	ug/L			01/09/21 19:37	1
2-Hexanone	1.56	U	10.0	1.56	ug/L			01/09/21 19:37	1
Methylene Chloride	2.00	U	10.0	2.00	ug/L			01/09/21 19:37	1
2-Butanone (MEK)	1.00	U	10.0	1.00	ug/L			01/09/21 19:37	1
4-Methyl-2-pentanone (MIBK)	0.510	U	10.0	0.510	ug/L			01/09/21 19:37	1
Styrene	0.200	U	1.00	0.200	ug/L			01/09/21 19:37	1
Tetrachloroethene	0.189	U	1.00	0.189	ug/L			01/09/21 19:37	1
Toluene	**0.731**	**J**	1.00	0.495	ug/L			01/09/21 19:37	1
1,1,1-Trichloroethane	0.300	U	1.00	0.300	ug/L			01/09/21 19:37	1
1,1,2-Trichloroethane	0.173	U	1.00	0.173	ug/L			01/09/21 19:37	1
Trichloroethene	0.317	U	1.00	0.317	ug/L			01/09/21 19:37	1
Vinyl acetate	5.00	U	10.0	5.00	ug/L			01/09/21 19:37	1
Vinyl chloride	0.300	U	1.00	0.300	ug/L			01/09/21 19:37	1
Xylenes, Total	**0.734**	**J**	2.00	0.200	ug/L			01/09/21 19:37	1
1,1,2,2-Tetrachloroethane	0.190	U	1.00	0.190	ug/L			01/09/21 19:37	1
Bromomethane	0.392	U	5.00	0.392	ug/L			01/09/21 19:37	1
1,1,2-Trichloro-1,2,2-trifluoroethane	0.410	U	2.00	0.410	ug/L			01/09/21 19:37	1
1,2,4-Trichlorobenzene	0.168	U	5.00	0.168	ug/L			01/09/21 19:37	1
1,2-Dibromo-3-Chloropropane	0.349	U	5.00	0.349	ug/L			01/09/21 19:37	1
1,2-Dichlorobenzene	0.170	U	1.00	0.170	ug/L			01/09/21 19:37	1
1,3-Dichlorobenzene	0.128	U	1.00	0.128	ug/L			01/09/21 19:37	1
1,4-Dichlorobenzene	0.200	U	1.00	0.200	ug/L			01/09/21 19:37	1
Dichlorodifluoromethane	0.429	U	5.00	0.429	ug/L			01/09/21 19:37	1
Ethylene Dibromide	0.175	U	1.00	0.175	ug/L			01/09/21 19:37	1
Isopropylbenzene	0.500	U	5.00	0.500	ug/L			01/09/21 19:37	1
Methyl tert-butyl ether	0.200	U	1.00	0.200	ug/L			01/09/21 19:37	1
m-Xylene & p-Xylene	**0.323**	**J**	2.00	0.260	ug/L			01/09/21 19:37	1
o-Xylene	**0.412**	**J**	1.00	0.200	ug/L			01/09/21 19:37	1
Cyclohexane	1.00	U	2.00	1.00	ug/L			01/09/21 19:37	1
Bromochloromethane	0.228	U	1.00	0.228	ug/L			01/09/21 19:37	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
1,2-Dichloroethane-d4 (Surr)	*101*		*70 - 140*		*01/09/21 19:37*	*1*
4-Bromofluorobenzene (Surr)	*90*		*70 - 130*		*01/09/21 19:37*	*1*
Dibromofluoromethane (Surr)	*106*		*69 - 130*		*01/09/21 19:37*	*1*
Toluene-d8 (Surr)	*105*		*70 - 130*		*01/09/21 19:37*	*1*

Method: 6010B - Metals (ICP)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	0.00500	U	0.0100	0.00500	mg/L		01/12/21 11:00	01/15/21 15:03	1
Arsenic	**0.00618**	**J**	0.0100	0.00350	mg/L		01/12/21 11:00	01/15/21 15:03	1
Barium	**0.0447**		0.0100	0.00200	mg/L		01/12/21 11:00	01/15/21 15:03	1
Beryllium	0.000500	U	0.00400	0.000500	mg/L		01/12/21 11:00	01/15/21 15:03	1

Client Sample ID: B-15

Lab Sample ID: 560-91853-3

Date Collected: 01/06/21 13:15

Matrix: Water

Date Received: 01/08/21 10:00

Method: 6010B - Metals (ICP) (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Cadmium	0.00156	J	0.00500	0.000340	mg/L		01/12/21 11:00	01/15/21 15:03	1
Calcium	453		0.200	0.101	mg/L		01/12/21 11:00	01/15/21 15:03	1
Chromium	0.00245	J	0.0100	0.00110	mg/L		01/12/21 11:00	01/15/21 15:03	1
Lead	0.00330	U	0.0100	0.00330	mg/L		01/12/21 11:00	01/15/21 15:03	1
Magnesium	872		2.00	0.257	mg/L		01/12/21 11:00	01/21/21 14:10	10
Nickel	0.0346		0.0100	0.00200	mg/L		01/12/21 11:00	01/15/21 15:03	1
Potassium	58.1		0.500	0.375	mg/L		01/12/21 11:00	01/15/21 15:03	1
Selenium	0.00566	J	0.0100	0.00420	mg/L		01/12/21 11:00	01/15/21 15:03	1
Silver	0.00100	U	0.00500	0.00100	mg/L		01/12/21 11:00	01/15/21 15:03	1
Sodium	2660		10.0	3.10	mg/L		01/12/21 11:00	01/21/21 14:10	10
Thallium	0.00150	U	0.00500	0.00150	mg/L		01/12/21 11:00	01/15/21 15:03	1
Vanadium	0.00531		0.00500	0.000700	mg/L		01/12/21 11:00	01/15/21 15:03	1
Zinc	0.0181	J	0.0200	0.00570	mg/L		01/12/21 11:00	01/15/21 15:03	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	0.000130	U	0.00200	0.000130	mg/L		01/15/21 11:10	01/15/21 18:14	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	3010		500	96.0	mg/L			01/11/21 23:05	500
Sulfate	4260		500	189	mg/L			01/11/21 23:05	500
Bicarbonate Alkalinity as CaCO3	713		5.00	5.00	mg/L			01/20/21 13:30	1
Carbonate Alkalinity as CaCO3	5.00	U	5.00	5.00	mg/L			01/20/21 13:30	1
Specific Conductance	16000		1.00	1.00	umho/cm			01/20/21 10:00	1
Total Dissolved Solids	12600		200	200	mg/L			01/13/21 10:00	1
pH	6.8	HF	0.1	0.1	SU			01/15/21 12:10	1

Client Sample ID: trip blank

Lab Sample ID: 560-91853-5

Date Collected: 01/06/21 00:00

Matrix: Water

Date Received: 01/08/21 10:00

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	5.00	U	10.0	5.00	ug/L			01/09/21 20:01	1
Benzene	0.330	U	1.00	0.330	ug/L			01/09/21 20:01	1
Chlorodibromomethane	0.223	U	2.00	0.223	ug/L			01/09/21 20:01	1
Bromoform	0.500	U	5.00	0.500	ug/L			01/09/21 20:01	1
Carbon disulfide	0.500	U	5.00	0.500	ug/L			01/09/21 20:01	1
Carbon tetrachloride	0.251	U	1.00	0.251	ug/L			01/09/21 20:01	1
Chlorobenzene	0.136	U	1.00	0.136	ug/L			01/09/21 20:01	1
Chloroethane	0.400	U	5.00	0.400	ug/L			01/09/21 20:01	1
Chloroform	0.173	U	1.00	0.173	ug/L			01/09/21 20:01	1
Chloromethane	0.390	U	5.00	0.390	ug/L			01/09/21 20:01	1
Dichlorobromomethane	0.175	U	1.00	0.175	ug/L			01/09/21 20:01	1
1,1-Dichloroethane	0.168	U	1.00	0.168	ug/L			01/09/21 20:01	1
1,2-Dichloroethane	0.172	U	1.00	0.172	ug/L			01/09/21 20:01	1
1,1-Dichloroethene	0.300	U	1.00	0.300	ug/L			01/09/21 20:01	1
trans-1,2-Dichloroethene	0.200	U	1.00	0.200	ug/L			01/09/21 20:01	1
cis-1,2-Dichloroethene	0.121	U	1.00	0.121	ug/L			01/09/21 20:01	1

Client Sample ID: trip blank
Date Collected: 01/06/21 00:00
Date Received: 01/08/21 10:00

Lab Sample ID: 560-91853-5
Matrix: Water

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
1,2-Dichloropropane	0.173	U	1.00	0.173	ug/L			01/09/21 20:01	1
cis-1,3-Dichloropropene	0.146	U	1.00	0.146	ug/L			01/09/21 20:01	1
trans-1,3-Dichloropropene	0.200	U	5.00	0.200	ug/L			01/09/21 20:01	1
Ethylbenzene	0.200	U	1.00	0.200	ug/L			01/09/21 20:01	1
2-Hexanone	1.56	U	10.0	1.56	ug/L			01/09/21 20:01	1
Methylene Chloride	2.00	U	10.0	2.00	ug/L			01/09/21 20:01	1
2-Butanone (MEK)	1.00	U	10.0	1.00	ug/L			01/09/21 20:01	1
4-Methyl-2-pentanone (MIBK)	0.510	U	10.0	0.510	ug/L			01/09/21 20:01	1
Styrene	0.200	U	1.00	0.200	ug/L			01/09/21 20:01	1
Tetrachloroethene	0.189	U	1.00	0.189	ug/L			01/09/21 20:01	1
Toluene	0.495	U	1.00	0.495	ug/L			01/09/21 20:01	1
1,1,1-Trichloroethane	0.300	U	1.00	0.300	ug/L			01/09/21 20:01	1
1,1,2-Trichloroethane	0.173	U	1.00	0.173	ug/L			01/09/21 20:01	1
Trichloroethene	0.317	U	1.00	0.317	ug/L			01/09/21 20:01	1
Vinyl acetate	5.00	U	10.0	5.00	ug/L			01/09/21 20:01	1
Vinyl chloride	0.300	U	1.00	0.300	ug/L			01/09/21 20:01	1
Xylenes, Total	0.200	U	2.00	0.200	ug/L			01/09/21 20:01	1
1,1,2,2-Tetrachloroethane	0.190	U	1.00	0.190	ug/L			01/09/21 20:01	1
Bromomethane	0.392	U	5.00	0.392	ug/L			01/09/21 20:01	1
1,1,2-Trichloro-1,2,2-trifluoroethane	0.410	U	2.00	0.410	ug/L			01/09/21 20:01	1
1,2,4-Trichlorobenzene	0.168	U	5.00	0.168	ug/L			01/09/21 20:01	1
1,2-Dibromo-3-Chloropropane	0.349	U	5.00	0.349	ug/L			01/09/21 20:01	1
1,2-Dichlorobenzene	0.170	U	1.00	0.170	ug/L			01/09/21 20:01	1
1,3-Dichlorobenzene	0.128	U	1.00	0.128	ug/L			01/09/21 20:01	1
1,4-Dichlorobenzene	0.200	U	1.00	0.200	ug/L			01/09/21 20:01	1
Dichlorodifluoromethane	0.429	U	5.00	0.429	ug/L			01/09/21 20:01	1
Ethylene Dibromide	0.175	U	1.00	0.175	ug/L			01/09/21 20:01	1
Isopropylbenzene	0.500	U	5.00	0.500	ug/L			01/09/21 20:01	1
Methyl tert-butyl ether	0.200	U	1.00	0.200	ug/L			01/09/21 20:01	1
m-Xylene & p-Xylene	0.260	U	2.00	0.260	ug/L			01/09/21 20:01	1
o-Xylene	0.200	U	1.00	0.200	ug/L			01/09/21 20:01	1
Cyclohexane	1.00	U	2.00	1.00	ug/L			01/09/21 20:01	1
Bromochloromethane	0.228	U	1.00	0.228	ug/L			01/09/21 20:01	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
1,2-Dichloroethane-d4 (Surr)	*104*		*70 - 140*		*01/09/21 20:01*	*1*
4-Bromofluorobenzene (Surr)	*89*		*70 - 130*		*01/09/21 20:01*	*1*
Dibromofluoromethane (Surr)	*108*		*69 - 130*		*01/09/21 20:01*	*1*
Toluene-d8 (Surr)	*103*		*70 - 130*		*01/09/21 20:01*	*1*

Surrogate Summary

Client: Medina Consulting Company Inc
Project/Site: 20051, 1/6/21

Job ID: 560-91853-1

Method: 8260B - Volatile Organic Compounds (GC/MS)

Matrix: Water

Prep Type: Total/NA

		Percent Surrogate Recovery (Acceptance Limits)			
Lab Sample ID	Client Sample ID	DCA (70-140)	BFB (70-130)	DBFM (69-130)	TOL (70-130)
560-91853-1	B-13	97	97	104	97
560-91853-2	B-1	97	98	100	98
560-91853-3	B-15	101	90	106	105
560-91853-5	trip blank	104	89	108	103
LCS 560-181921/3	Lab Control Sample	93	91	101	104
LCS 560-181922/3	Lab Control Sample	98	101	99	96
LCSD 560-181921/4	Lab Control Sample Dup	92	92	100	106
LCSD 560-181922/4	Lab Control Sample Dup	99	101	101	95
MB 560-181921/7	Method Blank	99	86	106	103
MB 560-181922/7	Method Blank	100	98	102	98

Surrogate Legend

DCA = 1,2-Dichloroethane-d4 (Surr)
BFB = 4-Bromofluorobenzene (Surr)
DBFM = Dibromofluoromethane (Surr)
TOL = Toluene-d8 (Surr)

Method: 8260B - Volatile Organic Compounds (GC/MS)

Lab Sample ID: MB 560-181921/7
Matrix: Water
Analysis Batch: 181921

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	5.00	U	10.0	5.00	ug/L			01/09/21 13:22	1
Benzene	0.330	U	1.00	0.330	ug/L			01/09/21 13:22	1
Chlorodibromomethane	0.223	U	2.00	0.223	ug/L			01/09/21 13:22	1
Bromoform	0.500	U	5.00	0.500	ug/L			01/09/21 13:22	1
Carbon disulfide	0.500	U	5.00	0.500	ug/L			01/09/21 13:22	1
Carbon tetrachloride	0.251	U	1.00	0.251	ug/L			01/09/21 13:22	1
Chlorobenzene	0.136	U	1.00	0.136	ug/L			01/09/21 13:22	1
Chloroethane	0.400	U	5.00	0.400	ug/L			01/09/21 13:22	1
Chloroform	0.173	U	1.00	0.173	ug/L			01/09/21 13:22	1
Chloromethane	0.390	U	5.00	0.390	ug/L			01/09/21 13:22	1
Dichlorobromomethane	0.175	U	1.00	0.175	ug/L			01/09/21 13:22	1
1,1-Dichloroethane	0.168	U	1.00	0.168	ug/L			01/09/21 13:22	1
1,2-Dichloroethane	0.172	U	1.00	0.172	ug/L			01/09/21 13:22	1
1,1-Dichloroethene	0.300	U	1.00	0.300	ug/L			01/09/21 13:22	1
trans-1,2-Dichloroethene	0.200	U	1.00	0.200	ug/L			01/09/21 13:22	1
cis-1,2-Dichloroethene	0.121	U	1.00	0.121	ug/L			01/09/21 13:22	1
1,2-Dichloropropane	0.173	U	1.00	0.173	ug/L			01/09/21 13:22	1
cis-1,3-Dichloropropene	0.146	U	1.00	0.146	ug/L			01/09/21 13:22	1
trans-1,3-Dichloropropene	0.200	U	5.00	0.200	ug/L			01/09/21 13:22	1
Ethylbenzene	0.200	U	1.00	0.200	ug/L			01/09/21 13:22	1
2-Hexanone	1.56	U	10.0	1.56	ug/L			01/09/21 13:22	1
Methylene Chloride	2.00	U	10.0	2.00	ug/L			01/09/21 13:22	1
2-Butanone (MEK)	1.00	U	10.0	1.00	ug/L			01/09/21 13:22	1
4-Methyl-2-pentanone (MIBK)	0.510	U	10.0	0.510	ug/L			01/09/21 13:22	1
Styrene	0.200	U	1.00	0.200	ug/L			01/09/21 13:22	1
Tetrachloroethene	0.189	U	1.00	0.189	ug/L			01/09/21 13:22	1
Toluene	0.495	U	1.00	0.495	ug/L			01/09/21 13:22	1
1,1,1-Trichloroethane	0.300	U	1.00	0.300	ug/L			01/09/21 13:22	1
1,1,2-Trichloroethane	0.173	U	1.00	0.173	ug/L			01/09/21 13:22	1
Trichloroethene	0.317	U	1.00	0.317	ug/L			01/09/21 13:22	1
Vinyl acetate	5.00	U	10.0	5.00	ug/L			01/09/21 13:22	1
Vinyl chloride	0.300	U	1.00	0.300	ug/L			01/09/21 13:22	1
Xylenes, Total	0.200	U	2.00	0.200	ug/L			01/09/21 13:22	1
1,1,2,2-Tetrachloroethane	0.190	U	1.00	0.190	ug/L			01/09/21 13:22	1
Bromomethane	0.392	U	5.00	0.392	ug/L			01/09/21 13:22	1
1,1,2-Trichloro-1,2,2-trifluoroethane	0.410	U	2.00	0.410	ug/L			01/09/21 13:22	1
1,2,4-Trichlorobenzene	0.168	U	5.00	0.168	ug/L			01/09/21 13:22	1
1,2-Dibromo-3-Chloropropane	0.349	U	5.00	0.349	ug/L			01/09/21 13:22	1
1,2-Dichlorobenzene	0.170	U	1.00	0.170	ug/L			01/09/21 13:22	1
1,3-Dichlorobenzene	0.128	U	1.00	0.128	ug/L			01/09/21 13:22	1
1,4-Dichlorobenzene	0.200	U	1.00	0.200	ug/L			01/09/21 13:22	1
Dichlorodifluoromethane	0.429	U	5.00	0.429	ug/L			01/09/21 13:22	1
Ethylene Dibromide	0.175	U	1.00	0.175	ug/L			01/09/21 13:22	1
Isopropylbenzene	0.500	U	5.00	0.500	ug/L			01/09/21 13:22	1
Methyl tert-butyl ether	0.200	U	1.00	0.200	ug/L			01/09/21 13:22	1
m-Xylene & p-Xylene	0.260	U	2.00	0.260	ug/L			01/09/21 13:22	1
o-Xylene	0.200	U	1.00	0.200	ug/L			01/09/21 13:22	1
Cyclohexane	1.00	U	2.00	1.00	ug/L			01/09/21 13:22	1

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: MB 560-181921/7
Matrix: Water
Analysis Batch: 181921

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Bromochloromethane	0.228	U	1.00	0.228	ug/L			01/09/21 13:22	1

Surrogate	*MB %Recovery*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
1,2-Dichloroethane-d4 (Surr)	*99*		*70 - 140*		*01/09/21 13:22*	*1*
4-Bromofluorobenzene (Surr)	*86*		*70 - 130*		*01/09/21 13:22*	*1*
Dibromofluoromethane (Surr)	*106*		*69 - 130*		*01/09/21 13:22*	*1*
Toluene-d8 (Surr)	*103*		*70 - 130*		*01/09/21 13:22*	*1*

Lab Sample ID: LCS 560-181921/3
Matrix: Water
Analysis Batch: 181921

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Acetone	125	95.31		ug/L		76	60 - 150
Benzene	25.0	25.97		ug/L		104	70 - 130
Chlorodibromomethane	25.0	27.74		ug/L		111	70 - 137
Bromoform	25.0	26.02		ug/L		104	63 - 145
Carbon disulfide	25.0	24.42		ug/L		98	52 - 156
Carbon tetrachloride	25.0	22.85		ug/L		91	70 - 138
Chlorobenzene	25.0	27.54		ug/L		110	70 - 130
Chloroethane	25.0	26.63		ug/L		107	54 - 141
Chloroform	25.0	26.70		ug/L		107	70 - 130
Chloromethane	25.0	30.59		ug/L		122	46 - 142
Dichlorobromomethane	25.0	25.79		ug/L		103	70 - 130
1,1-Dichloroethane	25.0	25.60		ug/L		102	70 - 130
1,2-Dichloroethane	25.0	24.76		ug/L		99	70 - 131
1,1-Dichloroethene	25.0	26.60		ug/L		106	70 - 139
trans-1,2-Dichloroethene	25.0	26.33		ug/L		105	70 - 134
cis-1,2-Dichloroethene	25.0	26.92		ug/L		108	70 - 130
1,2-Dichloropropane	25.0	27.57		ug/L		110	70 - 130
cis-1,3-Dichloropropene	25.0	24.76		ug/L		99	70 - 138
trans-1,3-Dichloropropene	25.0	22.73		ug/L		91	70 - 143
Ethylbenzene	25.0	26.81		ug/L		107	70 - 130
2-Hexanone	125	121.2		ug/L		97	70 - 138
Methylene Chloride	25.0	27.91		ug/L		112	70 - 130
2-Butanone (MEK)	125	104.0		ug/L		83	68 - 144
4-Methyl-2-pentanone (MIBK)	125	126.3		ug/L		101	70 - 138
Styrene	25.0	26.46		ug/L		106	70 - 130
Tetrachloroethene	25.0	26.79		ug/L		107	70 - 135
Toluene	25.0	26.92		ug/L		108	70 - 130
1,1,1-Trichloroethane	25.0	24.53		ug/L		98	65 - 130
1,1,2-Trichloroethane	25.0	27.68		ug/L		111	70 - 130
Trichloroethene	25.0	26.90		ug/L		108	70 - 130
Vinyl acetate	50.0	41.78		ug/L		84	18 - 200
Vinyl chloride	25.0	27.97		ug/L		112	49 - 140
Xylenes, Total	50.0	53.01		ug/L		106	70 - 130
1,1,2,2-Tetrachloroethane	25.0	25.87		ug/L		103	65 - 130
Bromomethane	25.0	27.94		ug/L		112	50 - 146

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: LCS 560-181921/3
Matrix: Water
Analysis Batch: 181921

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
1,1,2-Trichloro-1,2,2-trifluoroethane	25.0	26.48		ug/L		106	27 - 148
1,2,4-Trichlorobenzene	25.0	24.89		ug/L		100	70 - 157
1,2-Dibromo-3-Chloropropane	25.0	22.90		ug/L		92	70 - 149
1,2-Dichlorobenzene	25.0	25.55		ug/L		102	70 - 130
1,3-Dichlorobenzene	25.0	25.77		ug/L		103	70 - 130
1,4-Dichlorobenzene	25.0	26.69		ug/L		107	70 - 130
Dichlorodifluoromethane	25.0	37.44		ug/L		150	10 - 181
Ethylene Dibromide	25.0	27.60		ug/L		110	70 - 130
Isopropylbenzene	25.0	24.27		ug/L		97	70 - 131
Methyl tert-butyl ether	25.0	23.66		ug/L		95	70 - 131
m-Xylene & p-Xylene	25.0	26.54		ug/L		106	70 - 139
o-Xylene	25.0	26.46		ug/L		106	70 - 130
Cyclohexane	25.0	24.74		ug/L		99	40 - 141
Bromochloromethane	25.0	27.81		ug/L		111	70 - 130

Surrogate	*LCS %Recovery*	*LCS Qualifier*	*Limits*
1,2-Dichloroethane-d4 (Surr)	*93*		*70 - 140*
4-Bromofluorobenzene (Surr)	*91*		*70 - 130*
Dibromofluoromethane (Surr)	*101*		*69 - 130*
Toluene-d8 (Surr)	*104*		*70 - 130*

Lab Sample ID: LCSD 560-181921/4
Matrix: Water
Analysis Batch: 181921

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Acetone	125	93.38		ug/L		75	60 - 150	2	20
Benzene	25.0	26.56		ug/L		106	70 - 130	2	20
Chlorodibromomethane	25.0	28.38		ug/L		114	70 - 137	2	20
Bromoform	25.0	27.15		ug/L		109	63 - 145	4	20
Carbon disulfide	25.0	24.86		ug/L		99	52 - 156	2	20
Carbon tetrachloride	25.0	23.92		ug/L		96	70 - 138	5	20
Chlorobenzene	25.0	28.37		ug/L		113	70 - 130	3	20
Chloroethane	25.0	26.97		ug/L		108	54 - 141	1	20
Chloroform	25.0	26.48		ug/L		106	70 - 130	1	20
Chloromethane	25.0	29.46		ug/L		118	46 - 142	4	20
Dichlorobromomethane	25.0	26.58		ug/L		106	70 - 130	3	20
1,1-Dichloroethane	25.0	25.50		ug/L		102	70 - 130	0	20
1,2-Dichloroethane	25.0	25.12		ug/L		100	70 - 131	1	20
1,1-Dichloroethene	25.0	27.13		ug/L		109	70 - 139	2	20
trans-1,2-Dichloroethene	25.0	26.68		ug/L		107	70 - 134	1	20
cis-1,2-Dichloroethene	25.0	27.39		ug/L		110	70 - 130	2	20
1,2-Dichloropropane	25.0	27.85		ug/L		111	70 - 130	1	20
cis-1,3-Dichloropropene	25.0	25.63		ug/L		103	70 - 138	3	20
trans-1,3-Dichloropropene	25.0	23.65		ug/L		95	70 - 143	4	20
Ethylbenzene	25.0	27.52		ug/L		110	70 - 130	3	20
2-Hexanone	125	123.6		ug/L		99	70 - 138	2	20
Methylene Chloride	25.0	27.83		ug/L		111	70 - 130	0	20

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: LCSD 560-181921/4
Matrix: Water
Analysis Batch: 181921

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
2-Butanone (MEK)	125	105.7		ug/L		85	68 - 144	2	20
4-Methyl-2-pentanone (MIBK)	125	129.3		ug/L		103	70 - 138	2	20
Styrene	25.0	27.12		ug/L		108	70 - 130	2	20
Tetrachloroethene	25.0	27.80		ug/L		111	70 - 135	4	20
Toluene	25.0	27.62		ug/L		110	70 - 130	3	20
1,1,1-Trichloroethane	25.0	25.45		ug/L		102	65 - 130	4	20
1,1,2-Trichloroethane	25.0	28.22		ug/L		113	70 - 130	2	20
Trichloroethene	25.0	27.28		ug/L		109	70 - 130	1	20
Vinyl acetate	50.0	42.39		ug/L		85	18 - 200	1	20
Vinyl chloride	25.0	28.15		ug/L		113	49 - 140	1	20
Xylenes, Total	50.0	53.85		ug/L		108	70 - 130	2	20
1,1,2,2-Tetrachloroethane	25.0	26.40		ug/L		106	65 - 130	2	20
Bromomethane	25.0	27.34		ug/L		109	50 - 146	2	20
1,1,2-Trichloro-1,2,2-trifluoroethane	25.0	27.38		ug/L		110	27 - 148	3	20
1,2,4-Trichlorobenzene	25.0	26.42		ug/L		106	70 - 157	6	20
1,2-Dibromo-3-Chloropropane	25.0	23.37		ug/L		93	70 - 149	2	20
1,2-Dichlorobenzene	25.0	26.08		ug/L		104	70 - 130	2	20
1,3-Dichlorobenzene	25.0	26.68		ug/L		107	70 - 130	3	20
1,4-Dichlorobenzene	25.0	26.97		ug/L		108	70 - 130	1	20
Dichlorodifluoromethane	25.0	36.19		ug/L		145	10 - 181	3	30
Ethylene Dibromide	25.0	29.14		ug/L		117	70 - 130	5	20
Isopropylbenzene	25.0	25.06		ug/L		100	70 - 131	3	20
Methyl tert-butyl ether	25.0	23.75		ug/L		95	70 - 131	0	20
m-Xylene & p-Xylene	25.0	26.72		ug/L		107	70 - 139	1	20
o-Xylene	25.0	27.13		ug/L		109	70 - 130	2	20
Cyclohexane	25.0	25.65		ug/L		103	40 - 141	4	20
Bromochloromethane	25.0	27.94		ug/L		112	70 - 130	0	20

Surrogate	*LCSD %Recovery*	*LCSD Qualifier*	*Limits*
1,2-Dichloroethane-d4 (Surr)	*92*		*70 - 140*
4-Bromofluorobenzene (Surr)	*92*		*70 - 130*
Dibromofluoromethane (Surr)	*100*		*69 - 130*
Toluene-d8 (Surr)	*106*		*70 - 130*

Lab Sample ID: MB 560-181922/7
Matrix: Water
Analysis Batch: 181922

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	5.00	U	10.0	5.00	ug/L			01/09/21 13:25	1
Benzene	0.330	U	1.00	0.330	ug/L			01/09/21 13:25	1
Chlorodibromomethane	0.223	U	2.00	0.223	ug/L			01/09/21 13:25	1
Bromoform	0.500	U	5.00	0.500	ug/L			01/09/21 13:25	1
Carbon disulfide	0.500	U	5.00	0.500	ug/L			01/09/21 13:25	1
Carbon tetrachloride	0.251	U	1.00	0.251	ug/L			01/09/21 13:25	1
Chlorobenzene	0.136	U	1.00	0.136	ug/L			01/09/21 13:25	1
Chloroethane	0.400	U	5.00	0.400	ug/L			01/09/21 13:25	1
Chloroform	0.173	U	1.00	0.173	ug/L			01/09/21 13:25	1

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: MB 560-181922/7
Matrix: Water
Analysis Batch: 181922

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloromethane	0.390	U	5.00	0.390	ug/L			01/09/21 13:25	1
Dichlorobromomethane	0.175	U	1.00	0.175	ug/L			01/09/21 13:25	1
1,1-Dichloroethane	0.168	U	1.00	0.168	ug/L			01/09/21 13:25	1
1,2-Dichloroethane	0.172	U	1.00	0.172	ug/L			01/09/21 13:25	1
1,1-Dichloroethene	0.300	U	1.00	0.300	ug/L			01/09/21 13:25	1
trans-1,2-Dichloroethene	0.200	U	1.00	0.200	ug/L			01/09/21 13:25	1
cis-1,2-Dichloroethene	0.121	U	1.00	0.121	ug/L			01/09/21 13:25	1
1,2-Dichloropropane	0.173	U	1.00	0.173	ug/L			01/09/21 13:25	1
cis-1,3-Dichloropropene	0.146	U	1.00	0.146	ug/L			01/09/21 13:25	1
trans-1,3-Dichloropropene	0.200	U	5.00	0.200	ug/L			01/09/21 13:25	1
Ethylbenzene	0.200	U	1.00	0.200	ug/L			01/09/21 13:25	1
2-Hexanone	1.56	U	10.0	1.56	ug/L			01/09/21 13:25	1
Methylene Chloride	2.00	U	10.0	2.00	ug/L			01/09/21 13:25	1
2-Butanone (MEK)	1.00	U	10.0	1.00	ug/L			01/09/21 13:25	1
4-Methyl-2-pentanone (MIBK)	0.510	U	10.0	0.510	ug/L			01/09/21 13:25	1
Styrene	0.200	U	1.00	0.200	ug/L			01/09/21 13:25	1
Tetrachloroethene	0.189	U	1.00	0.189	ug/L			01/09/21 13:25	1
Toluene	0.495	U	1.00	0.495	ug/L			01/09/21 13:25	1
1,1,1-Trichloroethane	0.300	U	1.00	0.300	ug/L			01/09/21 13:25	1
1,1,2-Trichloroethane	0.173	U	1.00	0.173	ug/L			01/09/21 13:25	1
Trichloroethene	0.317	U	1.00	0.317	ug/L			01/09/21 13:25	1
Vinyl acetate	5.00	U	10.0	5.00	ug/L			01/09/21 13:25	1
Vinyl chloride	0.300	U	1.00	0.300	ug/L			01/09/21 13:25	1
Xylenes, Total	0.200	U	2.00	0.200	ug/L			01/09/21 13:25	1
1,1,2,2-Tetrachloroethane	0.190	U	1.00	0.190	ug/L			01/09/21 13:25	1
Bromomethane	0.392	U	5.00	0.392	ug/L			01/09/21 13:25	1
1,1,2-Trichloro-1,2,2-trifluoroethane	0.410	U	2.00	0.410	ug/L			01/09/21 13:25	1
1,2,4-Trichlorobenzene	0.168	U	5.00	0.168	ug/L			01/09/21 13:25	1
1,2-Dibromo-3-Chloropropane	0.349	U	5.00	0.349	ug/L			01/09/21 13:25	1
1,2-Dichlorobenzene	0.170	U	1.00	0.170	ug/L			01/09/21 13:25	1
1,3-Dichlorobenzene	0.128	U	1.00	0.128	ug/L			01/09/21 13:25	1
1,4-Dichlorobenzene	0.200	U	1.00	0.200	ug/L			01/09/21 13:25	1
Dichlorodifluoromethane	0.429	U	5.00	0.429	ug/L			01/09/21 13:25	1
Ethylene Dibromide	0.175	U	1.00	0.175	ug/L			01/09/21 13:25	1
Isopropylbenzene	0.500	U	5.00	0.500	ug/L			01/09/21 13:25	1
Methyl tert-butyl ether	0.200	U	1.00	0.200	ug/L			01/09/21 13:25	1
m-Xylene & p-Xylene	0.260	U	2.00	0.260	ug/L			01/09/21 13:25	1
o-Xylene	0.200	U	1.00	0.200	ug/L			01/09/21 13:25	1
Cyclohexane	1.00	U	2.00	1.00	ug/L			01/09/21 13:25	1
Bromochloromethane	0.228	U	1.00	0.228	ug/L			01/09/21 13:25	1

Surrogate	*MB %Recovery*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
1,2-Dichloroethane-d4 (Surr)	*100*		*70 - 140*		*01/09/21 13:25*	*1*
4-Bromofluorobenzene (Surr)	*98*		*70 - 130*		*01/09/21 13:25*	*1*
Dibromofluoromethane (Surr)	*102*		*69 - 130*		*01/09/21 13:25*	*1*
Toluene-d8 (Surr)	*98*		*70 - 130*		*01/09/21 13:25*	*1*

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: LCS 560-181922/3
Matrix: Water
Analysis Batch: 181922

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Acetone	125	125.3		ug/L		100	60 - 150
Benzene	25.0	26.76		ug/L		107	70 - 130
Chlorodibromomethane	25.0	25.93		ug/L		104	70 - 137
Bromoform	25.0	24.07		ug/L		96	63 - 145
Carbon disulfide	25.0	23.65		ug/L		95	52 - 156
Carbon tetrachloride	25.0	23.46		ug/L		94	70 - 138
Chlorobenzene	25.0	24.95		ug/L		100	70 - 130
Chloroethane	25.0	25.30		ug/L		101	54 - 141
Chloroform	25.0	25.80		ug/L		103	70 - 130
Chloromethane	25.0	26.33		ug/L		105	46 - 142
Dichlorobromomethane	25.0	27.76		ug/L		111	70 - 130
1,1-Dichloroethane	25.0	24.86		ug/L		99	70 - 130
1,2-Dichloroethane	25.0	27.61		ug/L		110	70 - 131
1,1-Dichloroethene	25.0	26.05		ug/L		104	70 - 139
trans-1,2-Dichloroethene	25.0	25.58		ug/L		102	70 - 134
cis-1,2-Dichloroethene	25.0	26.38		ug/L		106	70 - 130
1,2-Dichloropropane	25.0	27.92		ug/L		112	70 - 130
cis-1,3-Dichloropropene	25.0	27.57		ug/L		110	70 - 138
trans-1,3-Dichloropropene	25.0	23.09		ug/L		92	70 - 143
Ethylbenzene	25.0	23.41		ug/L		94	70 - 130
2-Hexanone	125	140.1		ug/L		112	70 - 138
Methylene Chloride	25.0	26.56		ug/L		106	70 - 130
2-Butanone (MEK)	125	141.3		ug/L		113	68 - 144
4-Methyl-2-pentanone (MIBK)	125	128.5		ug/L		103	70 - 138
Styrene	25.0	24.20		ug/L		97	70 - 130
Tetrachloroethene	25.0	22.43		ug/L		90	70 - 135
Toluene	25.0	23.84		ug/L		95	70 - 130
1,1,1-Trichloroethane	25.0	24.98		ug/L		100	65 - 130
1,1,2-Trichloroethane	25.0	26.25		ug/L		105	70 - 130
Trichloroethene	25.0	26.17		ug/L		105	70 - 130
Vinyl acetate	50.0	47.19		ug/L		94	18 - 200
Vinyl chloride	25.0	23.26		ug/L		93	49 - 140
Xylenes, Total	50.0	46.04		ug/L		92	70 - 130
1,1,2,2-Tetrachloroethane	25.0	26.32		ug/L		105	65 - 130
Bromomethane	25.0	25.91		ug/L		104	50 - 146
1,1,2-Trichloro-1,2,2-trifluoroetha ne	25.0	25.01		ug/L		100	27 - 148
1,2,4-Trichlorobenzene	25.0	19.98		ug/L		80	70 - 157
1,2-Dibromo-3-Chloropropane	25.0	21.90		ug/L		88	70 - 149
1,2-Dichlorobenzene	25.0	22.95		ug/L		92	70 - 130
1,3-Dichlorobenzene	25.0	23.61		ug/L		94	70 - 130
1,4-Dichlorobenzene	25.0	23.42		ug/L		94	70 - 130
Dichlorodifluoromethane	25.0	23.34		ug/L		93	10 - 181
Ethylene Dibromide	25.0	26.91		ug/L		108	70 - 130
Isopropylbenzene	25.0	22.45		ug/L		90	70 - 131
Methyl tert-butyl ether	25.0	24.01		ug/L		96	70 - 131
m-Xylene & p-Xylene	25.0	23.15		ug/L		93	70 - 139
o-Xylene	25.0	22.88		ug/L		92	70 - 130
Cyclohexane	25.0	22.76		ug/L		91	40 - 141

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: LCS 560-181922/3
Matrix: Water
Analysis Batch: 181922

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Bromochloromethane	25.0	26.92		ug/L		108	70 - 130

Surrogate	*LCS %Recovery*	*LCS Qualifier*	*Limits*
1,2-Dichloroethane-d4 (Surr)	*98*		*70 - 140*
4-Bromofluorobenzene (Surr)	*101*		*70 - 130*
Dibromofluoromethane (Surr)	*99*		*69 - 130*
Toluene-d8 (Surr)	*96*		*70 - 130*

Lab Sample ID: LCSD 560-181922/4
Matrix: Water
Analysis Batch: 181922

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Acetone	125	117.9		ug/L		94	60 - 150	6	20
Benzene	25.0	25.34		ug/L		101	70 - 130	5	20
Chlorodibromomethane	25.0	24.67		ug/L		99	70 - 137	5	20
Bromoform	25.0	21.77		ug/L		87	63 - 145	10	20
Carbon disulfide	25.0	23.56		ug/L		94	52 - 156	0	20
Carbon tetrachloride	25.0	23.19		ug/L		93	70 - 138	1	20
Chlorobenzene	25.0	23.78		ug/L		95	70 - 130	5	20
Chloroethane	25.0	25.66		ug/L		103	54 - 141	1	20
Chloroform	25.0	25.27		ug/L		101	70 - 130	2	20
Chloromethane	25.0	26.15		ug/L		105	46 - 142	1	20
Dichlorobromomethane	25.0	26.87		ug/L		107	70 - 130	3	20
1,1-Dichloroethane	25.0	24.69		ug/L		99	70 - 130	1	20
1,2-Dichloroethane	25.0	26.48		ug/L		106	70 - 131	4	20
1,1-Dichloroethene	25.0	25.20		ug/L		101	70 - 139	3	20
trans-1,2-Dichloroethene	25.0	24.71		ug/L		99	70 - 134	3	20
cis-1,2-Dichloroethene	25.0	25.38		ug/L		102	70 - 130	4	20
1,2-Dichloropropane	25.0	26.76		ug/L		107	70 - 130	4	20
cis-1,3-Dichloropropene	25.0	26.44		ug/L		106	70 - 138	4	20
trans-1,3-Dichloropropene	25.0	21.79		ug/L		87	70 - 143	6	20
Ethylbenzene	25.0	22.61		ug/L		90	70 - 130	3	20
2-Hexanone	125	124.4		ug/L		100	70 - 138	12	20
Methylene Chloride	25.0	26.13		ug/L		105	70 - 130	2	20
2-Butanone (MEK)	125	129.6		ug/L		104	68 - 144	9	20
4-Methyl-2-pentanone (MIBK)	125	118.9		ug/L		95	70 - 138	8	20
Styrene	25.0	22.80		ug/L		91	70 - 130	6	20
Tetrachloroethene	25.0	21.97		ug/L		88	70 - 135	2	20
Toluene	25.0	22.82		ug/L		91	70 - 130	4	20
1,1,1-Trichloroethane	25.0	23.51		ug/L		94	65 - 130	6	20
1,1,2-Trichloroethane	25.0	24.93		ug/L		100	70 - 130	5	20
Trichloroethene	25.0	25.91		ug/L		104	70 - 130	1	20
Vinyl acetate	50.0	46.31		ug/L		93	18 - 200	2	20
Vinyl chloride	25.0	25.77		ug/L		103	49 - 140	10	20
Xylenes, Total	50.0	43.71		ug/L		87	70 - 130	5	20
1,1,2,2-Tetrachloroethane	25.0	25.52		ug/L		102	65 - 130	3	20
Bromomethane	25.0	26.51		ug/L		106	50 - 146	2	20

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: LCSD 560-181922/4
Matrix: Water
Analysis Batch: 181922

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
1,1,2-Trichloro-1,2,2-trifluoroethane	25.0	24.23		ug/L		97	27 - 148	3	20
1,2,4-Trichlorobenzene	25.0	20.63		ug/L		83	70 - 157	3	20
1,2-Dibromo-3-Chloropropane	25.0	21.36		ug/L		85	70 - 149	2	20
1,2-Dichlorobenzene	25.0	22.61		ug/L		90	70 - 130	2	20
1,3-Dichlorobenzene	25.0	23.21		ug/L		93	70 - 130	2	20
1,4-Dichlorobenzene	25.0	23.32		ug/L		93	70 - 130	0	20
Dichlorodifluoromethane	25.0	23.12		ug/L		92	10 - 181	1	30
Ethylene Dibromide	25.0	25.20		ug/L		101	70 - 130	7	20
Isopropylbenzene	25.0	22.68		ug/L		91	70 - 131	1	20
Methyl tert-butyl ether	25.0	23.79		ug/L		95	70 - 131	1	20
m-Xylene & p-Xylene	25.0	21.70		ug/L		87	70 - 139	6	20
o-Xylene	25.0	22.00		ug/L		88	70 - 130	4	20
Cyclohexane	25.0	22.18		ug/L		89	40 - 141	3	20
Bromochloromethane	25.0	25.50		ug/L		102	70 - 130	5	20

Surrogate	*LCSD %Recovery*	*LCSD Qualifier*	*Limits*
1,2-Dichloroethane-d4 (Surr)	*99*		*70 - 140*
4-Bromofluorobenzene (Surr)	*101*		*70 - 130*
Dibromofluoromethane (Surr)	*101*		*69 - 130*
Toluene-d8 (Surr)	*95*		*70 - 130*

Method: 6010B - Metals (ICP)

Lab Sample ID: MB 560-181987/1-A
Matrix: Water
Analysis Batch: 182072

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 181987

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	0.00500	U	0.0100	0.00500	mg/L		01/12/21 11:00	01/15/21 12:52	1
Arsenic	0.00350	U	0.0100	0.00350	mg/L		01/12/21 11:00	01/15/21 12:52	1
Barium	0.00200	U	0.0100	0.00200	mg/L		01/12/21 11:00	01/15/21 12:52	1
Beryllium	0.000500	U	0.00400	0.000500	mg/L		01/12/21 11:00	01/15/21 12:52	1
Cadmium	0.000340	U	0.00500	0.000340	mg/L		01/12/21 11:00	01/15/21 12:52	1
Calcium	0.101	U	0.200	0.101	mg/L		01/12/21 11:00	01/15/21 12:52	1
Chromium	0.00110	U	0.0100	0.00110	mg/L		01/12/21 11:00	01/15/21 12:52	1
Lead	0.00330	U	0.0100	0.00330	mg/L		01/12/21 11:00	01/15/21 12:52	1
Magnesium	0.0257	U	0.200	0.0257	mg/L		01/12/21 11:00	01/15/21 12:52	1
Nickel	0.00200	U	0.0100	0.00200	mg/L		01/12/21 11:00	01/15/21 12:52	1
Potassium	0.375	U	0.500	0.375	mg/L		01/12/21 11:00	01/15/21 12:52	1
Selenium	0.00420	U	0.0100	0.00420	mg/L		01/12/21 11:00	01/15/21 12:52	1
Silver	0.00100	U	0.00500	0.00100	mg/L		01/12/21 11:00	01/15/21 12:52	1
Sodium	0.310	U	1.00	0.310	mg/L		01/12/21 11:00	01/15/21 12:52	1
Thallium	0.00150	U	0.00500	0.00150	mg/L		01/12/21 11:00	01/15/21 12:52	1
Vanadium	0.000700	U	0.00500	0.000700	mg/L		01/12/21 11:00	01/15/21 12:52	1
Zinc	0.00570	U	0.0200	0.00570	mg/L		01/12/21 11:00	01/15/21 12:52	1

Method: 6010B - Metals (ICP) (Continued)

Lab Sample ID: LCS 560-181987/2-A
Matrix: Water
Analysis Batch: 182072

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 181987

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Antimony	0.250	0.2344		mg/L		94	80 - 120
Arsenic	0.250	0.2386		mg/L		95	80 - 120
Barium	0.250	0.2484		mg/L		99	80 - 120
Beryllium	0.250	0.2521		mg/L		101	80 - 120
Cadmium	0.250	0.2500		mg/L		100	80 - 120
Calcium	25.0	24.82		mg/L		99	80 - 120
Chromium	0.250	0.2482		mg/L		99	80 - 120
Lead	0.250	0.2375		mg/L		95	80 - 120
Magnesium	25.0	25.27		mg/L		101	80 - 120
Nickel	0.250	0.2564		mg/L		103	80 - 120
Potassium	25.0	25.06		mg/L		100	80 - 120
Selenium	0.250	0.2425		mg/L		97	80 - 120
Silver	0.250	0.2535		mg/L		101	80 - 120
Sodium	25.0	24.12		mg/L		96	80 - 120
Thallium	0.100	0.09664		mg/L		97	80 - 120
Vanadium	0.250	0.2356		mg/L		94	80 - 120
Zinc	0.250	0.2518		mg/L		101	80 - 120

Lab Sample ID: 560-91852-B-1-C MS
Matrix: Water
Analysis Batch: 182072

Client Sample ID: Matrix Spike
Prep Type: TCLP
Prep Batch: 181987

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Antimony	0.0413		0.250	0.2741		mg/L		93	75 - 125
Arsenic	0.00350	U	0.250	0.2499		mg/L		100	75 - 125
Barium	0.0943		0.250	0.3446		mg/L		100	75 - 125
Beryllium	0.000500	U	0.250	0.2496		mg/L		100	75 - 125
Cadmium	0.00173	J	0.250	0.2527		mg/L		100	75 - 125
Calcium	14.1	B	25.0	38.30		mg/L		97	75 - 125
Chromium	0.00110	U	0.250	0.2473		mg/L		99	75 - 125
Lead	0.00330	U	0.250	0.2327		mg/L		93	75 - 125
Magnesium	1.20		25.0	24.50		mg/L		93	75 - 125
Nickel	0.0350		0.250	0.2846		mg/L		100	75 - 125
Potassium	0.995		25.0	28.25		mg/L		109	75 - 125
Selenium	0.0143		0.250	0.2645		mg/L		100	75 - 125
Silver	0.00100	U	0.250	0.2634		mg/L		105	75 - 125
Vanadium	0.00102	J	0.250	0.2534		mg/L		101	75 - 125

Lab Sample ID: 560-91852-B-1-C MS
Matrix: Water
Analysis Batch: 182122

Client Sample ID: Matrix Spike
Prep Type: TCLP
Prep Batch: 181987

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Sodium	1270		25.0	1272	4	mg/L		22	75 - 125
Thallium	0.150	U F2 ^6+	0.100	0.1730	J ^6+	mg/L		NC	75 - 125
Zinc	759	B E	0.250	773.6	E 4	mg/L		5792	75 - 125

Method: 6010B - Metals (ICP) (Continued)

Lab Sample ID: 560-91852-B-1-D MSD
Matrix: Water
Analysis Batch: 182072

Client Sample ID: Matrix Spike Duplicate
Prep Type: TCLP
Prep Batch: 181987

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Antimony	0.0413		0.250	0.2679		mg/L		91	75 - 125	2	20
Arsenic	0.00350	U	0.250	0.2484		mg/L		99	75 - 125	1	20
Barium	0.0943		0.250	0.3362		mg/L		97	75 - 125	2	20
Beryllium	0.000500	U	0.250	0.2488		mg/L		100	75 - 125	0	20
Cadmium	0.00173	J	0.250	0.2484		mg/L		99	75 - 125	2	20
Calcium	14.1	B	25.0	37.91		mg/L		95	75 - 125	1	20
Chromium	0.00110	U	0.250	0.2433		mg/L		97	75 - 125	2	20
Lead	0.00330	U	0.250	0.2259		mg/L		90	75 - 125	3	20
Magnesium	1.20		25.0	24.11		mg/L		92	75 - 125	2	20
Nickel	0.0350		0.250	0.2821		mg/L		99	75 - 125	1	20
Potassium	0.995		25.0	28.43		mg/L		110	75 - 125	1	20
Selenium	0.0143		0.250	0.2590		mg/L		98	75 - 125	2	20
Silver	0.00100	U	0.250	0.2560		mg/L		102	75 - 125	3	20
Vanadium	0.00102	J	0.250	0.2495		mg/L		99	75 - 125	2	20

Lab Sample ID: 560-91852-B-1-D MSD
Matrix: Water
Analysis Batch: 182122

Client Sample ID: Matrix Spike Duplicate
Prep Type: TCLP
Prep Batch: 181987

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Sodium	1270		25.0	1287	4	mg/L		81	75 - 125	1	20
Thallium	0.150	U F2 ^6+	0.100	0.4670	J ^6+ F2	mg/L		NC	75 - 125	92	20
Zinc	759	B E	0.250	777.1	E 4	mg/L		7196	75 - 125	0	20

Method: 7470A - Mercury (CVAA)

Lab Sample ID: LB 560-181877/1-D
Matrix: Water
Analysis Batch: 182078

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 182075

Analyte	LB Result	LB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	0.000130	U	0.00200	0.000130	mg/L		01/15/21 11:10	01/15/21 17:48	1

Lab Sample ID: MB 560-182075/6-A
Matrix: Water
Analysis Batch: 182078

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 182075

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	0.000130	U	0.00200	0.000130	mg/L		01/15/21 11:10	01/15/21 17:28	1

Lab Sample ID: LCS 560-182075/7-A
Matrix: Water
Analysis Batch: 182078

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 182075

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Mercury	0.00500	0.004060		mg/L		81	80 - 120

Method: 7470A - Mercury (CVAA) (Continued)

Lab Sample ID: 560-91835-A-1-H MS
Matrix: Water
Analysis Batch: 182078

Client Sample ID: Matrix Spike
Prep Type: TCLP
Prep Batch: 182075

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Mercury	0.000130	U	0.00500	0.004380		mg/L		88	80 - 120

Lab Sample ID: 560-91835-A-1-I MSD
Matrix: Water
Analysis Batch: 182078

Client Sample ID: Matrix Spike Duplicate
Prep Type: TCLP
Prep Batch: 182075

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Mercury	0.000130	U	0.00500	0.004020		mg/L		80	80 - 120	9	20

Method: 9056 - Anions, Ion Chromatography

Lab Sample ID: MB 560-181983/3
Matrix: Water
Analysis Batch: 181983

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	0.192	U	1.00	0.192	mg/L			01/11/21 11:46	1
Sulfate	0.377	U	1.00	0.377	mg/L			01/11/21 11:46	1

Lab Sample ID: LCS 560-181983/4
Matrix: Water
Analysis Batch: 181983

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Chloride	10.0	10.08		mg/L		101	80 - 120
Sulfate	20.0	19.72		mg/L		99	80 - 120

Lab Sample ID: 560-91771-A-1 MS
Matrix: Water
Analysis Batch: 181983

Client Sample ID: Matrix Spike
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Chloride	0.192	U	10.0	9.994		mg/L		100	80 - 120
Sulfate	1.41		20.0	22.30		mg/L		104	80 - 120

Lab Sample ID: 560-91771-A-1 MSD
Matrix: Water
Analysis Batch: 181983

Client Sample ID: Matrix Spike Duplicate
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Chloride	0.192	U	10.0	9.938		mg/L		99	80 - 120	1	30
Sulfate	1.41		20.0	22.37		mg/L		105	80 - 120	0	30

Method: SM 2320B - Alkalinity

Lab Sample ID: MB 560-182166/1
Matrix: Water
Analysis Batch: 182166

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Bicarbonate Alkalinity as CaCO3	2.50	U	2.50	2.50	mg/L			01/20/21 13:30	1
Carbonate Alkalinity as CaCO3	2.50	U	2.50	2.50	mg/L			01/20/21 13:30	1

Lab Sample ID: 560-91798-A-3 DU
Matrix: Water
Analysis Batch: 182166

Client Sample ID: Duplicate
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Bicarbonate Alkalinity as CaCO3	367		371.2		mg/L		1	
Carbonate Alkalinity as CaCO3	5.00	U	5.00	U	mg/L		NC	

Method: SM 2510B - Conductivity, Specific Conductance

Lab Sample ID: MB 560-182146/3
Matrix: Water
Analysis Batch: 182146

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Specific Conductance	1.00	U	1.00	1.00	umho/cm			01/20/21 10:00	1

Lab Sample ID: LCS 560-182146/4
Matrix: Water
Analysis Batch: 182146

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Specific Conductance	999	960.0		umho/cm		96	90 - 110

Lab Sample ID: 560-91754-C-1 DU
Matrix: Water
Analysis Batch: 182146

Client Sample ID: Duplicate
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Specific Conductance	760		760.0		umho/cm		0	20

Method: SM 2540C - Solids, Total Dissolved (TDS)

Lab Sample ID: MB 560-182020/1
Matrix: Water
Analysis Batch: 182020

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	10.0	U	10.0	10.0	mg/L			01/13/21 10:00	1

Lab Sample ID: LCS 560-182020/2
Matrix: Water
Analysis Batch: 182020

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Total Dissolved Solids	2250	2104		mg/L		94	90 - 110

Method: SM 2540C - Solids, Total Dissolved (TDS) (Continued)

Lab Sample ID: 560-91844-A-2 DU
Matrix: Water
Analysis Batch: 182020

Client Sample ID: Duplicate
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Total Dissolved Solids	1610		1660		mg/L		3	20

Method: SM 4500 H+ B - pH

Lab Sample ID: LCS 560-182070/2
Matrix: Water
Analysis Batch: 182070

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
pH	5.00	5.0		SU		100	98 - 102

Lab Sample ID: 560-91648-D-1 DU
Matrix: Water
Analysis Batch: 182070

Client Sample ID: Duplicate
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
pH	6.6		6.7		SU		0.9	20

GC/MS VOA

Analysis Batch: 181921

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-91853-3	B-15	Total/NA	Water	8260B	
560-91853-5	trip blank	Total/NA	Water	8260B	
MB 560-181921/7	Method Blank	Total/NA	Water	8260B	
LCS 560-181921/3	Lab Control Sample	Total/NA	Water	8260B	
LCSD 560-181921/4	Lab Control Sample Dup	Total/NA	Water	8260B	

Analysis Batch: 181922

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-91853-1	B-13	Total/NA	Water	8260B	
560-91853-2	B-1	Total/NA	Water	8260B	
MB 560-181922/7	Method Blank	Total/NA	Water	8260B	
LCS 560-181922/3	Lab Control Sample	Total/NA	Water	8260B	
LCSD 560-181922/4	Lab Control Sample Dup	Total/NA	Water	8260B	

Metals

Leach Batch: 181877

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
LB 560-181877/1-D	Method Blank	Total/NA	Water	1311	
560-91835-A-1-H MS	Matrix Spike	TCLP	Water	1311	
560-91835-A-1-I MSD	Matrix Spike Duplicate	TCLP	Water	1311	

Leach Batch: 181950

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-91852-B-1-C MS	Matrix Spike	TCLP	Water	1311	
560-91852-B-1-D MSD	Matrix Spike Duplicate	TCLP	Water	1311	

Prep Batch: 181987

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-91853-1	B-13	Total/NA	Water	3010A	
560-91853-2	B-1	Total/NA	Water	3010A	
560-91853-3	B-15	Total/NA	Water	3010A	
MB 560-181987/1-A	Method Blank	Total/NA	Water	3010A	
LCS 560-181987/2-A	Lab Control Sample	Total/NA	Water	3010A	
560-91852-B-1-C MS	Matrix Spike	TCLP	Water	3010A	181950
560-91852-B-1-D MSD	Matrix Spike Duplicate	TCLP	Water	3010A	181950

Analysis Batch: 182072

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-91853-1	B-13	Total/NA	Water	6010B	181987
560-91853-2	B-1	Total/NA	Water	6010B	181987
560-91853-3	B-15	Total/NA	Water	6010B	181987
MB 560-181987/1-A	Method Blank	Total/NA	Water	6010B	181987
LCS 560-181987/2-A	Lab Control Sample	Total/NA	Water	6010B	181987
560-91852-B-1-C MS	Matrix Spike	TCLP	Water	6010B	181987
560-91852-B-1-D MSD	Matrix Spike Duplicate	TCLP	Water	6010B	181987

Prep Batch: 182075

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-91853-1	B-13	Total/NA	Water	7470A	
560-91853-2	B-1	Total/NA	Water	7470A	

Metals (Continued)

Prep Batch: 182075 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-91853-3	B-15	Total/NA	Water	7470A	
LB 560-181877/1-D	Method Blank	Total/NA	Water	7470A	181877
MB 560-182075/6-A	Method Blank	Total/NA	Water	7470A	
LCS 560-182075/7-A	Lab Control Sample	Total/NA	Water	7470A	
560-91835-A-1-H MS	Matrix Spike	TCLP	Water	7470A	181877
560-91835-A-1-I MSD	Matrix Spike Duplicate	TCLP	Water	7470A	181877

Analysis Batch: 182078

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-91853-1	B-13	Total/NA	Water	7470A	182075
560-91853-2	B-1	Total/NA	Water	7470A	182075
560-91853-3	B-15	Total/NA	Water	7470A	182075
LB 560-181877/1-D	Method Blank	Total/NA	Water	7470A	182075
MB 560-182075/6-A	Method Blank	Total/NA	Water	7470A	182075
LCS 560-182075/7-A	Lab Control Sample	Total/NA	Water	7470A	182075
560-91835-A-1-H MS	Matrix Spike	TCLP	Water	7470A	182075
560-91835-A-1-I MSD	Matrix Spike Duplicate	TCLP	Water	7470A	182075

Analysis Batch: 182122

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-91852-B-1-C MS	Matrix Spike	TCLP	Water	6010B	181987
560-91852-B-1-D MSD	Matrix Spike Duplicate	TCLP	Water	6010B	181987

Analysis Batch: 182208

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-91853-2	B-1	Total/NA	Water	6010B	181987
560-91853-3	B-15	Total/NA	Water	6010B	181987

General Chemistry

Analysis Batch: 181983

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-91853-1	B-13	Total/NA	Water	9056	
560-91853-2	B-1	Total/NA	Water	9056	
560-91853-3	B-15	Total/NA	Water	9056	
MB 560-181983/3	Method Blank	Total/NA	Water	9056	
LCS 560-181983/4	Lab Control Sample	Total/NA	Water	9056	
560-91771-A-1 MS	Matrix Spike	Total/NA	Water	9056	
560-91771-A-1 MSD	Matrix Spike Duplicate	Total/NA	Water	9056	

Analysis Batch: 182020

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-91853-1	B-13	Total/NA	Water	SM 2540C	
560-91853-2	B-1	Total/NA	Water	SM 2540C	
560-91853-3	B-15	Total/NA	Water	SM 2540C	
MB 560-182020/1	Method Blank	Total/NA	Water	SM 2540C	
LCS 560-182020/2	Lab Control Sample	Total/NA	Water	SM 2540C	
560-91844-A-2 DU	Duplicate	Total/NA	Water	SM 2540C	

General Chemistry

Analysis Batch: 182070

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-91853-1	B-13	Total/NA	Water	SM 4500 H+ B	
560-91853-2	B-1	Total/NA	Water	SM 4500 H+ B	
560-91853-3	B-15	Total/NA	Water	SM 4500 H+ B	
LCS 560-182070/2	Lab Control Sample	Total/NA	Water	SM 4500 H+ B	
560-91648-D-1 DU	Duplicate	Total/NA	Water	SM 4500 H+ B	

Analysis Batch: 182146

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-91853-1	B-13	Total/NA	Water	SM 2510B	
560-91853-2	B-1	Total/NA	Water	SM 2510B	
560-91853-3	B-15	Total/NA	Water	SM 2510B	
MB 560-182146/3	Method Blank	Total/NA	Water	SM 2510B	
LCS 560-182146/4	Lab Control Sample	Total/NA	Water	SM 2510B	
560-91754-C-1 DU	Duplicate	Total/NA	Water	SM 2510B	

Analysis Batch: 182166

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-91853-1	B-13	Total/NA	Water	SM 2320B	
560-91853-2	B-1	Total/NA	Water	SM 2320B	
560-91853-3	B-15	Total/NA	Water	SM 2320B	
MB 560-182166/1	Method Blank	Total/NA	Water	SM 2320B	
LCS 560-182166/2	Lab Control Sample	Total/NA	Water	SM 2320B	
560-91798-A-3 DU	Duplicate	Total/NA	Water	SM 2320B	

Client Sample ID: B-13

Lab Sample ID: 560-91853-1

Date Collected: 01/06/21 10:45

Matrix: Water

Date Received: 01/08/21 10:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260B		1	181922	01/09/21 19:45	A1S	TAL CC
Total/NA	Prep	3010A			181987	01/12/21 11:00	LR	TAL CC
Total/NA	Analysis	6010B		1	182072	01/15/21 14:55	AKM	TAL CC
Total/NA	Prep	7470A			182075	01/15/21 11:10	AKM	TAL CC
Total/NA	Analysis	7470A		1	182078	01/15/21 18:10	AKM	TAL CC
Total/NA	Analysis	9056		100	181983	01/11/21 21:57	JLC	TAL CC
Total/NA	Analysis	SM 2320B		1	182166	01/20/21 13:30	LDK	TAL CC
Total/NA	Analysis	SM 2510B		1	182146	01/20/21 10:00	LDK	TAL CC
Total/NA	Analysis	SM 2540C		1	182020	01/13/21 10:00	LDK	TAL CC
Total/NA	Analysis	SM 4500 H+ B		1	182070	01/15/21 12:10	LDK	TAL CC

Client Sample ID: B-1

Lab Sample ID: 560-91853-2

Date Collected: 01/06/21 12:33

Matrix: Water

Date Received: 01/08/21 10:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260B		1	181922	01/09/21 20:10	A1S	TAL CC
Total/NA	Prep	3010A			181987	01/12/21 11:00	LR	TAL CC
Total/NA	Analysis	6010B		1	182072	01/15/21 14:59	AKM	TAL CC
Total/NA	Prep	3010A			181987	01/12/21 11:00	LR	TAL CC
Total/NA	Analysis	6010B		10	182208	01/21/21 14:06	AKM	TAL CC
Total/NA	Prep	7470A			182075	01/15/21 11:10	AKM	TAL CC
Total/NA	Analysis	7470A		1	182078	01/15/21 18:12	AKM	TAL CC
Total/NA	Analysis	9056		500	181983	01/11/21 22:31	JLC	TAL CC
Total/NA	Analysis	SM 2320B		1	182166	01/20/21 13:30	LDK	TAL CC
Total/NA	Analysis	SM 2510B		1	182146	01/20/21 10:00	LDK	TAL CC
Total/NA	Analysis	SM 2540C		1	182020	01/13/21 10:00	LDK	TAL CC
Total/NA	Analysis	SM 4500 H+ B		1	182070	01/15/21 12:10	LDK	TAL CC

Client Sample ID: B-15

Lab Sample ID: 560-91853-3

Date Collected: 01/06/21 13:15

Matrix: Water

Date Received: 01/08/21 10:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260B		1	181921	01/09/21 19:37	PXS	TAL CC
Total/NA	Prep	3010A			181987	01/12/21 11:00	LR	TAL CC
Total/NA	Analysis	6010B		1	182072	01/15/21 15:03	AKM	TAL CC
Total/NA	Prep	3010A			181987	01/12/21 11:00	LR	TAL CC
Total/NA	Analysis	6010B		10	182208	01/21/21 14:10	AKM	TAL CC
Total/NA	Prep	7470A			182075	01/15/21 11:10	AKM	TAL CC
Total/NA	Analysis	7470A		1	182078	01/15/21 18:14	AKM	TAL CC
Total/NA	Analysis	9056		500	181983	01/11/21 23:05	JLC	TAL CC
Total/NA	Analysis	SM 2320B		1	182166	01/20/21 13:30	LDK	TAL CC

Lab Chronicle

Client: Medina Consulting Company Inc
Project/Site: 20051, 1/6/21

Job ID: 560-91853-1

Client Sample ID: B-15

Lab Sample ID: 560-91853-3

Date Collected: 01/06/21 13:15

Matrix: Water

Date Received: 01/08/21 10:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	SM 2510B		1	182146	01/20/21 10:00	LDK	TAL CC
Total/NA	Analysis	SM 2540C		1	182020	01/13/21 10:00	LDK	TAL CC
Total/NA	Analysis	SM 4500 H+ B		1	182070	01/15/21 12:10	LDK	TAL CC

Client Sample ID: trip blank

Lab Sample ID: 560-91853-5

Date Collected: 01/06/21 00:00

Matrix: Water

Date Received: 01/08/21 10:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260B		1	181921	01/09/21 20:01	PXS	TAL CC

Laboratory References:

TAL CC = Eurofins Xenco, Corpus Christi, 1733 N. Padre Island Drive, Corpus Christi, TX 78408, TEL (361)289-2471

Accreditation/Certification Summary

Client: Medina Consulting Company Inc
Project/Site: 20051, 1/6/21

Job ID: 560-91853-1

Laboratory: Eurofins Xenco, Corpus Christi

All accreditations/certifications held by this laboratory are listed. Not all accreditations/certifications are applicable to this report.

Authority	Program	Identification Number	Expiration Date
Louisiana	NELAP	05094	06-30-21
Oklahoma	State	2020-006	08-31-21
Texas	NELAP	T104704210-19-23	03-31-21
USDA	US Federal Programs	P330-18-00314	10-31-21

Method Summary

Client: Medina Consulting Company Inc
Project/Site: 20051, 1/6/21

Job ID: 560-91853-1

Method	Method Description	Protocol	Laboratory
8260B	Volatile Organic Compounds (GC/MS)	SW846	TAL CC
6010B	Metals (ICP)	SW846	TAL CC
7470A	Mercury (CVAA)	SW846	TAL CC
9056	Anions, Ion Chromatography	SW846	TAL CC
SM 2320B	Alkalinity	SM	TAL CC
SM 2510B	Conductivity, Specific Conductance	SM	TAL CC
SM 2540C	Solids, Total Dissolved (TDS)	SM	TAL CC
SM 4500 H+ B	pH	SM	TAL CC
3010A	Preparation, Total Metals	SW846	TAL CC
5030B	Purge and Trap	SW846	TAL CC
7470A	Preparation, Mercury	SW846	TAL CC

Protocol References:

SM = "Standard Methods For The Examination Of Water And Wastewater"

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL CC = Eurofins Xenco, Corpus Christi, 1733 N. Padre Island Drive, Corpus Christi, TX 78408, TEL (361)289-2471

Sample Summary

Client: Medina Consulting Company Inc
Project/Site: 20051, 1/6/21

Job ID: 560-91853-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received	Asset ID
560-91853-1	B-13	Water	01/06/21 10:45	01/08/21 10:00	
560-91853-2	B-1	Water	01/06/21 12:33	01/08/21 10:00	
560-91853-3	B-15	Water	01/06/21 13:15	01/08/21 10:00	
560-91853-5	trip blank	Water	01/06/21 00:00	01/08/21 10:00	

Eurofins TestAmerica, Corpus Christi
1733 N. Padre Island Drive
Corpus Christi, TX 78408
Phone: 361-289-2673 Fax: 361-289-2471

Chain of Custody Record

eurofins Environment Testing America

Client Information	Sampler: Dawne Butler / Jeff Nathery	Lab PM: Maingot, Lindy	Carrier Tracking No(s):	COC No: 560-34544-5997.1
Client Contact: Dawne Butler	Phone: 781-983-7292	E-Mail: Lindy.Maingot@Eurofinset.com	State of Origin:	Page: Page 1 of 1
Company: Medina Consulting Company Inc (MCC)	PWSID:			Job #: 683789
Address: 6391 DeZavala Rd Suite 223D	Due Date Requested:			
City: San Antonio	TAT Requested (days): standard			
State, Zip: TX, 78249	Compliance Project: \ Yes \ No			
Phone: 210-694-4545(Tel)	PO #: Purchase Order not required			
Email: dbutler@medinacci.com	WO #:			
Project Name: Groundwater Analysis	Project #: 56008598			
Site: 20051	SSOW#:			

Analysis Requested

Preservation Codes:
A - HCL, B - NaOH, C - Zn Acetate, D - Nitric Acid, E - NaHSO4, F - MeOH, G - Amchlor, H - Ascorbic Acid, I - Ice, J - DI Water, K - EDTA, L - EDA, M - Hexane, N - None, O - AsNaO2, P - Na2O4S, Q - Na2SO3, R - Na2S2O3, S - H2SO4, T - TSP Dodecahydrate, U - Acetone, V - MCAA, W - pH 4-5, Z - other (specify)
Other:

91853

Special Instructions/Note:
Loc: 560
91853

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	2320B, 9056, SM4500_H+	6010B, 7470A	8260B - TCL Volatiles TX - default	2510B, 2540C_Calcd	Total Number of containers
			Preservation Code:				N	D	A	N	
B-13	1/6/21	1045	G	Water			X	X	X	X	
B-1	1/6/21	1233	G	Water			X	X	X	X	
B-15	1/6/21	1315	G	Water			X	X	X	X	
trip blank				Water							

560-91853 Chain of Custody

Possible Hazard Identification
☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☒ Disposal By Lab ☐ Archive For _____ Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:

Relinquished by	Date/Time	Company	Received by	Date/Time	Company
Dawne Butler	1/7/21 1149	MCC	Lindsey Van	1/7/21 11:49	Xenco
Relinquished by: Lindsey Van	1/7/20	Xenco	Fed EX	01/07/20	
Relinquished by:	Date/Time:	Company	Received by: Deanna Cooper	1/8/21 1000	EX

Custody Seals Intact: \ Yes \ No | Custody Seal No.:

Cooler Temperature(s) °C and Other Remarks: 0.2 C/F 0.1 0.3 Hou223

-1.3 FR-10 -0.2 CF

Ver: 11.01.2020

eurofins

Sample SUB-Contract#: 76059

Date Printed: 01.07.2021 15:54

te/Time: 01.07.2021 15:54 Created by: Irene Vann

bcontractor: Test America - Corpus Christi

)#: 683789

:livery Priority:

r Bill No.:

voice To: apInvoices@xenco.com; subcontract@xenco.com; lindy.maingot@eurofinset.com

Send report to: Lindy Maingot

Address: 5309 Wurzbach Rd, Suite 119
San Antonio, TX 78238
Ph:(210) 509-3334

E-Mail: lindy.maingot@eurofinset.com

TAT: Standard

Sample Id	Client Sample Id	Cont #	Matrix	Sample Collection	Method	Method Name	Lab PM
683789-001	B-13	3969	W	01.06.21 10:45	SM2320B	Alkalinity by SM2320B	Lindy Maingot
683789-001	B-13	3969	W	01.06.21 10:45	SM2510B	Specific Conductance @25C by SM2510B	Lindy Maingot
683789-001	B-13	3969	W	01.06.21 10:45	SM2540C	TDS by SM2540C	Lindy Maingot
683789-001	B-13	3969	W	01.06.21 10:45	SM4500-H	pH by SM4500-H	Lindy Maingot
683789-001	B-13	3969	W	01.06.21 10:45	SW6010C_RCRA	RCRA Metals by SW846-6010C	Lindy Maingot
683789-001	B-13	3969	W	01.06.21 10:45	SW7470A	Mercury by EPA 7470A	Lindy Maingot
683789-001	B-13	3969	W	01.06.21 10:45	SW8260C	VOCs by SW-846 8260C	Lindy Maingot
683789-001	B-13	3969	W	01.06.21 10:45	SW8260C_TCLP	TCLP VOCs by SW-846 8260C	Lindy Maingot
683789-001	B-13	3969	W	01.06.21 10:45	SW9056A	Inorganic Anions by SW 9056	Lindy Maingot
683789-002	B-1	3970	W	01.06.21 12:33	SM2320B	Alkalinity by SM2320B	Lindy Maingot
683789-002	B-1	3970	W	01.06.21 12:33	SM2510B	Specific Conductance @25C by SM2510B	Lindy Maingot
683789-002	B-1	3970	W	01.06.21 12:33	SM2540C	TDS by SM2540C	Lindy Maingot
683789-002	B-1	3970	W	01.06.21 12:33	SM4500-H	pH by SM4500-H	Lindy Maingot
683789-002	B-1	3970	W	01.06.21 12:33	SW6010C_RCRA	RCRA Metals by SW846-6010C	Lindy Maingot
683789-002	B-1	3970	W	01.06.21 12:33	SW7470A	Mercury by EPA 7470A	Lindy Maingot
683789-002	B-1	3970	W	01.06.21 12:33	SW8260C	VOCs by SW-846 8260C	Lindy Maingot
683789-002	B-1	3970	W	01.06.21 12:33	SW8260C_TCLP	TCLP VOCs by SW-846 8260C	Lindy Maingot
683789-002	B-1	3970	W	01.06.21 12:33	SW9056A	Inorganic Anions by SW 9056	Lindy Maingot
683789-003	B-15	3971	W	01.06.21 13:15	SM2320B	Alkalinity by SM2320B	Lindy Maingot
683789-003	B-15	3971	W	01.06.21 13:15	SM2510B	Specific Conductance @25C by SM2510B	Lindy Maingot
683789-003	B-15	3971	W	01.06.21 13:15	SM2540C	TDS by SM2540C	Lindy Maingot
683789-003	B-15	3971	W	01.06.21 13:15	SM4500-H	pH by SM4500-H	Lindy Maingot
683789-003	B-15	3971	W	01.06.21 13:15	SW6010C_RCRA	RCRA Metals by SW846-6010C	Lindy Maingot
683789-003	B-15	3971	W	01.06.21 13:15	SW7470A	Mercury by EPA 7470A	Lindy Maingot
683789-003	B-15	3971	W	01.06.21 13:15	SW8260C	VOCs by SW-846 8260C	Lindy Maingot
683789-003	B-15	3971	W	01.06.21 13:15	SW8260C_TCLP	TCLP VOCs by SW-846 8260C	Lindy Maingot
683789-003	B-15	3971	W	01.06.21 13:15	SW9056A	Inorganic Anions by SW 9056	Lindy Maingot
683789-004	Trip Blank	3967	W	01.06.21 00:00	SW8260C	VOCs by SW-846 8260C	Lindy Maingot

IIIJ-G-50 1/22/2021

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Sample SUB-Contract#: 76059

Date Printed: 01.07.2021 15:54

Sample Id	Client Sample Id	Cont #	Matrix	Sample Collection	Method	Method Name	Lab PM

ıbcontractor: Analyze for method and samples specified on COC as requested. Any deviation, must be approved by a Xenco PM.

SUB-Contracting Comments:

Relinquished By: Irene Vann

Received By: Jenna Cooper

Date/ Time Relinquished: 01.07.2021

Date/ Time Received: 1/8/20 1000

Relinquished By:

Received By:

Date/ Time Relinquished:

Date/ Time Received:

Cooler Temperature: -1.3 IR-10 -0.2 cp

Login Sample Receipt Checklist

Client: Medina Consulting Company Inc

Job Number: 560-91853-1

Login Number: 91853
List Number: 1
Creator: Cooper, Jenna L

List Source: Eurofins TestAmerica, Corpus Christi

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	Check done at department level as required.

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ANALYTICAL REPORT

Eurofins Xenco, Corpus Christi
1733 N. Padre Island Drive
Corpus Christi, TX 78408
Tel: (361)289-2471

Laboratory Job ID: 560-95311-1
Client Project/Site: 20051, 06/13/2021

For:
Medina Consulting Company Inc
6391 DeZavala Rd
Suite 223D
San Antonio, Texas 78249

Attn: Dawne Butler

Authorized for release by:
6/29/2021 5:49:09 PM

Lindy Maingot, Project Manager I
(210)344-9751
Lindy.Maingot@Eurofinset.com

LINKS

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The test results in this report meet all 2003 NELAC, 2009 TNI, and 2016 TNI requirements for accredited parameters, exceptions are noted in this report. This report may not be reproduced except in full, and with written approval from the laboratory. For questions please contact the Project Manager at the e-mail address or telephone number listed on this page.

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

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IIIJ-G-54

Qualifiers

GC/MS VOA

Qualifier	Qualifier Description
4	MS, MSD: The analyte present in the original sample is greater than 4 times the matrix spike concentration; therefore, control limits are not applicable.
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
U	Indicates the analyte was analyzed for but not detected.

Metals

Qualifier	Qualifier Description
4	MS, MSD: The analyte present in the original sample is greater than 4 times the matrix spike concentration; therefore, control limits are not applicable.
B	Compound was found in the blank and sample.
F1	MS and/or MSD recovery exceeds control limits.
F2	MS/MSD RPD exceeds control limits
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
U	Indicates the analyte was analyzed for but not detected.

General Chemistry

Qualifier	Qualifier Description
HF	Field parameter with a holding time of 15 minutes. Test performed by laboratory at client's request.
U	Indicates the analyte was analyzed for but not detected.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Glossary (Continued)

Abbreviation	These commonly used abbreviations may or may not be present in this report.
TNTC	Too Numerous To Count

Matrix:	Water
Method:	2320B
Prep Method:	
Date Analyzed:	2/10/2021
Job #:	MDLV 560-182771/22
TALS Batch:	182771
Units:	mg/L

Analyte	Instrument #	MDL	DCS Spike	Measured Result	MQL
Alkalinity	NOEQUIP	5.000	3.000	3.600	5

DCS = Detection Check Standard
MQL = Method Quantitation Limit

Matrix:	Water
Method:	6010B
Prep Method:	3010A
Date Analyzed:	3/9/2021
Job #:	MDLV 560-183421/3
TALS Batch:	183464
Units:	mg/L

Analyte	Instrument #	MDL	DCS Spike	Measured Result	MQL
Ag	MTS6500	0.001	0.002	0.001	0.005
Al	MTS6500	0.068	0.020	0.018	0.1
As	MTS6500	0.004	0.001	0.001	0.01
B	MTS6500	0.007	0.010	0.007	0.05
Ba	MTS6500	0.002	0.001	0.000	0.01
Be	MTS6500	0.001	0.002	0.002	0.004
Bi	MTS6500	0.003	0.005	0.004	0.02
Ca	MTS6500	0.101	0.080	0.094	0.2
Cd	MTS6500	0.000	0.001	0.000	0.005
Co	MTS6500	0.001	0.001	0.000	0.005
Cr	MTS6500	0.001	0.001	0.000	0.01
Cu	MTS6500	0.005	0.002	0.002	0.01
Fe	MTS6500	0.050	0.020	0.013	0.2
K	MTS6500	0.375	0.100	0.147	0.5
Li	MTS6500	0.007	0.010	0.008	0.02
Mg	MTS6500	0.026	0.020	0.015	0.2
Mn	MTS6500	0.004	0.005	0.005	0.025
Mo	MTS6500	0.003	0.001	0.001	0.01
Na	MTS6500	0.310	0.500	0.261	1
Ni	MTS6500	0.002	0.002	0.002	0.01
P	MTS6500	0.010	0.010	0.011	0.5
Pb	MTS6500	0.003	0.005	0.006	0.01
Sb	MTS6500	0.005	0.002	0.003	0.01
Se	MTS6500	0.004	0.002	0.005	0.01
Si	MTS6500	0.071	0.200	0.120	0.5
Sn	MTS6500	0.010	0.002	0.001	0.04
Sr	MTS6500	0.001	0.001	0.000	0.005
Ti	MTS6500	0.001	0.001	0.001	0.005
Tl	MTS6500	0.002	0.002	0.002	0.005
V	MTS6500	0.001	0.002	0.001	0.005
Zn	MTS6500	0.006	0.002	0.002	0.02

DCS = Detection Check Standard
MQL = Method Quantitation Limit

Matrix:	Water
Method:	7470A
Prep Method:	7470A_Prep
Date Analyzed:	1/5/2021
Job #:	MDLV 560-181806/20
TALS Batch:	181824
Units:	mg/L

Analyte	Instrument #	MDL	DCS Spike	Measured Result	MQL
Hg	Mhg1	0.000	0.000	0.0002	0.002

DCS = Detection Check Standard
MQL = Method Quantitation Limit

Matrix:	Water
Method:	8260B
Prep Method:	5030B
Date Analyzed:	1/4/2021
Job #:	MDLV 560-181764/15
TALS Batch:	181764
Units:	ug/L

Analyte	Instrument #	MDL	DCS Spike	Measured Result	MQL
1,1,1,2-Tetrachloroethane	VGCMS#1	0.209	0.500	0.352	1
1,1,1-Trichloroethane	VGCMS#1	0.300	0.300	0.121	1
1,1,2,2-Tetrachloroethane	VGCMS#1	0.190	0.300	0.128	1
1,1,2-Trichloro-1,2,2-trifluoroethane	VGCMS#1	0.410	0.300	0.142	2
1,1,2-Trichloroethane	VGCMS#1	0.173	0.500	0.383	1
1,1-Dichloroethane	VGCMS#1	0.168	0.300	0.184	1
1,1-Dichloroethene	VGCMS#1	0.300	0.300	0.151	1
1,1-Dichloropropene	VGCMS#1	0.185	0.300	0.149	1
1,2,3-Trichlorobenzene	VGCMS#1	0.217	0.500	0.093	5
1,2,3-Trichloropropane	VGCMS#1	0.191	0.500	0.135	2
1,2,3-Trimethylbenzene	VGCMS#1	0.270	0.300	0.194	2
1,2,4-Trichlorobenzene	VGCMS#1	0.168	0.500	0.176	5
1,2,4-Trimethylbenzene	VGCMS#1	0.200	0.300	0.166	2
1,2-Dibromo-3-Chloropropane	VGCMS#1	0.349	1.000	0.065	5
1,2-Dichlorobenzene	VGCMS#1	0.170	0.300	0.220	1
1,2-Dichloroethane	VGCMS#1	0.172	0.300	0.258	1
1,2-Dichloropropane	VGCMS#1	0.173	0.300	0.183	1
1,3,5-Trichlorobenzene	VGCMS#1	0.203	0.300	0.165	5
1,3,5-Trimethylbenzene	VGCMS#1	0.200	0.300	0.173	2
1,3-Dichlorobenzene	VGCMS#1	0.128	0.300	0.230	1
1,3-Dichloropropane	VGCMS#1	0.146	0.300	0.231	1
1,4-Dichlorobenzene	VGCMS#1	0.200	0.300	0.300	1
1,4-Dioxane	VGCMS#1	15.900	40.000	8.089	100
1-Chlorohexane	VGCMS#1	0.500	0.300	0.247	5
1-Octene	VGCMS#1	0.440	0.500	0.252	5
2,2-Dichloropropane	VGCMS#1	0.335	0.500	0.166	1
2-Butanone (MEK)	VGCMS#1	1.000	2.500	0.779	10
2-Chloro-1,3-butadiene	VGCMS#1	1.000	0.200	0.548	1
2-Chloroethyl vinyl ether	VGCMS#1	0.691	0.500	0.110	2
2-Chlorotoluene	VGCMS#1	0.155	0.300	0.206	1
2-Hexanone	VGCMS#1	1.560	1.500	0.317	10
2-Methyl-2-propanol	VGCMS#1	25.000	5.000	0.801	50
2-Nitropropane	VGCMS#1	1.000	1.000	0.072	10
3-Chloro-1-propene	VGCMS#1	0.421	0.300	0.041	1
4-Chlorotoluene	VGCMS#1	0.242	0.300	0.223	1
4-Isopropyltoluene	VGCMS#1	0.150	0.300	0.177	1
4-Methyl-2-pentanone (MIBK)	VGCMS#1	0.510	2.500	0.822	10
Acetone	VGCMS#1	5.000	1.500	0.467	10
Acetonitrile	VGCMS#1	10.000	5.000	1.584	50
Acrolein	VGCMS#1	5.000	2.963	0.899	50
Acrylonitrile	VGCMS#1	1.930	3.000	0.923	10
Benzene	VGCMS#1	0.330	0.300	0.315	1
Benzyl chloride	VGCMS#1	0.278	1.000	0.168	5
Bromobenzene	VGCMS#1	0.128	0.300	0.238	1
Bromoform	VGCMS#1	0.500	0.500	0.186	5
Bromomethane	VGCMS#1	0.392	0.300	0.157	5
Butadiene	VGCMS#1	0.300	0.300	0.227	2
Carbon disulfide	VGCMS#1	0.500	0.300	0.219	5
Carbon tetrachloride	VGCMS#1	0.251	0.300	0.110	1

DCS = Detection Check Standard

MQL = Method Quantitation Limit

Matrix: Water
Method: 8260B
Prep Method: 5030B
Date Analyzed: 1/4/2021
Job #: MDLV 560-181764/15
TALS Batch: 181764
Units: ug/L

Analyte	Instrument #	MDL	DCS Spike	Measured Result	MQL
Chlorobenzene	VGCMS#1	0.136	0.300	0.309	1
Chlorobromomethane	VGCMS#1	0.228	0.500	0.272	1
Chlorodibromomethane	VGCMS#1	0.223	0.500	0.318	2
Chloroethane	VGCMS#1	0.400	0.300	0.239	5
Chloroform	VGCMS#1	0.173	0.300	0.212	1
Chloromethane	VGCMS#1	0.390	0.300	0.209	5
cis-1,2-Dichloroethene	VGCMS#1	0.121	0.300	0.141	1
cis-1,3-Dichloropropene	VGCMS#1	0.146	0.500	0.257	1
cis-1,4-Dichloro-2-butene	VGCMS#1	0.500	2.000	0.368	5
Cyclohexane	VGCMS#1	1.000	0.300	0.168	2
Cyclohexanone	VGCMS#1	5.000	25.000	9.601	50
Dibromomethane	VGCMS#1	0.165	0.300	0.144	1
Dichlorobromomethane	VGCMS#1	0.175	0.500	0.355	1
Dichlorodifluoromethane	VGCMS#1	0.429	0.300	0.286	5
Dichlorofluoromethane	VGCMS#1	0.200	0.300	0.236	1
Ethyl acetate	VGCMS#1	1.000	1.000	0.379	5
Ethyl acrylate	VGCMS#1	0.500	2.000	0.306	5
Ethyl ether	VGCMS#1	0.320	0.300	0.170	5
Ethyl methacrylate	VGCMS#1	0.500	0.500	0.110	5
Ethylbenzene	VGCMS#1	0.200	0.300	0.228	1
Ethylene Dibromide	VGCMS#1	0.175	0.300	0.114	1
Ethylene oxide	VGCMS#1	30.000	10.000	4.127	100
Hexachlorobutadiene	VGCMS#1	0.860	0.500	0.287	5
Hexane	VGCMS#1	2.000	2.000	0.944	5
Iodomethane	VGCMS#1	0.223	0.300	0.176	2
Isobutyl alcohol	VGCMS#1	5.000	25.000	8.231	50
Isooctane	VGCMS#1	0.500	0.300	0.142	5
Isopropyl ether	VGCMS#1	0.200	0.300	0.061	2
Isopropylbenzene	VGCMS#1	0.500	0.300	0.154	5
Methacrylonitrile	VGCMS#1	2.000	3.000	0.872	10
Methyl acetate	VGCMS#1	0.530	0.600	0.150	5
Methyl methacrylate	VGCMS#1	0.650	1.000	0.285	5
Methyl tert-butyl ether	VGCMS#1	0.200	0.300	0.146	1
Methylcyclohexane	VGCMS#1	0.200	0.300	0.179	1
Methylene Chloride	VGCMS#1	2.000	0.500	0.483	10
m-Xylene & p-Xylene	VGCMS#1	0.260	0.300	0.230	2
Naphthalene	VGCMS#1	0.200	0.300	0.030	5
n-Butyl acetate	VGCMS#1	0.500	0.500	0.155	5
n-Butylbenzene	VGCMS#1	0.200	0.300	0.149	2
n-Heptane	VGCMS#1	0.300	0.300	0.272	5
N-Propylbenzene	VGCMS#1	0.106	0.300	0.199	1
o-Xylene	VGCMS#1	0.200	0.300	0.180	1
Pentachloroethane	VGCMS#1	0.302	0.300	0.061	5
Propionitrile	VGCMS#1	2.690	5.000	1.310	20
sec-Butylbenzene	VGCMS#1	0.300	0.300	0.161	2
Styrene	VGCMS#1	0.200	0.300	0.133	1
Tert-amyl methyl ether	VGCMS#1	0.500	0.300	0.121	1
Tert-butyl ethyl ether	VGCMS#1	0.500	0.500	0.257	1
tert-Butylbenzene	VGCMS#1	0.200	0.300	0.148	2

DCS = Detection Check Standard
MQL = Method Quantitation Limit

Matrix:	Water
Method:	8260B
Prep Method:	5030B
Date Analyzed:	1/4/2021
Job #:	MDLV 560-181764/15
TALS Batch:	181764
Units:	ug/L

Analyte	Instrument #	MDL	DCS Spike	Measured Result	MQL
Tetrachloroethene	VGCMS#1	0.189	0.300	0.232	1
Tetrahydrofuran	VGCMS#1	1.200	1.000	0.079	5
Toluene	VGCMS#1	0.495	0.300	0.363	1
trans-1,2-Dichloroethene	VGCMS#1	0.200	0.300	0.187	1
trans-1,3-Dichloropropene	VGCMS#1	0.200	0.300	0.141	5
trans-1,4-Dichloro-2-butene	VGCMS#1	0.500	2.000	0.641	5
Trichloroethene	VGCMS#1	0.317	0.300	0.181	1
Trichlorofluoromethane	VGCMS#1	0.244	0.300	0.254	1
Vinyl acetate	VGCMS#1	5.000	4.000	1.853	10
Vinyl chloride	VGCMS#1	0.300	0.300	0.145	1
Xylenes, Total	VGCMS#1	0.200	0.600	0.411	2

DCS = Detection Check Standard
MQL = Method Quantitation Limit

Appendix A
Laboratory Data Package Cover Page - Page 1 of 4

This data package is for Eurofins Xenco, Corpus Christi job number 560-95311-1 and consists of:

- ☑ R1 - Field chain-of-custody documentation;
- ☑ R2 - Sample identification cross-reference;
- ☑ R3 - Test reports (analytical data sheets) for each environmental sample that includes:
  a. Items consistent with NELAC Chapter 5,
  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) and detectability check sample results for each analyte for each method and matrix.
- ☑ R10 - Other problems or anomalies.

The Exception Report for each "No" or "Not Reviewed (NR)" item in Laboratory Review Checklist and for each analyte, matrix, and method for which the laboratory does not hold NELAC accreditation under the Texas Laboratory Accreditation Program.

Release Statement: I am responsible for the release of this laboratory data package. This laboratory is NELAC accredited under the Texas Laboratory Accreditation Program for all the methods, analytes, and matrices reported in this data package except as noted in the Exception Reports. The data have been reviewed and are technically compliant with the requirements of the methods used, except where noted by the laboratory in the Exception Reports. By my signature below, I affirm to the best of my knowledge all problems/anomalies observed by the laboratory have been identified in the Laboratory Review Checklist, and no information affecting the quality of the data has been knowingly withheld.

Lindy Maingot		6/29/2021
Name (printed)	Signature	Date

Project Manager I
Official Title (printed)

Laboratory Review Checklist: Reportable Data - Page 2 of 4

Laboratory Name:	Eurofins Xenco, Corpus Christi	LRC Date:	6/29/2021
Project Name:	20051, 06/13/2021	Laboratory Job Number:	560-95311-1
Reviewer Name:	Lindy Maingot		

#[1]	A[2]	Description	Yes	No	NA[3]	NR[4]	ER#[5]
R1	OI	**Chain-of-custody (C-O-C)**					
		Did samples meet the laboratory's standard conditions of sample acceptability upon receipt?	X				
		Were all departures from standard conditions described in an exception report?	X				
R2	OI	**Sample and quality control (QC) identification**					
		Are all field sample ID numbers cross-referenced to the laboratory ID numbers?	X				
		Are all laboratory ID numbers cross-referenced to the corresponding QC data?	X				
R3	OI	**Test reports**					
		Were all samples prepared and analyzed within holding times?		X			R03A
		Other than those results < MQL, were all other raw values bracketed by calibration standards?	X				
		Were calculations checked by a peer or supervisor?	X				
		Were all analyte identifications checked by a peer or supervisor?	X				
		Were sample detection limits reported for all analytes not detected?	X				
		Were all results for soil and sediment samples reported on a dry weight basis?			X		
		Were % moisture (or solids) reported for all soil and sediment samples?			X		
		Were bulk soils/solids samples for volatile analysis extracted with methanol per SW846 Method 5035?			X		
		If required for the project, are TICs reported?			X		
R4	O	**Surrogate recovery data**					
		Were surrogates added prior to extraction?	X				
		Were surrogate percent recoveries in all samples within the laboratory QC limits?	X				
R5	OI	**Test reports/summary forms for blank samples**					
		Were appropriate type(s) of blanks analyzed?	X				
		Were blanks analyzed at the appropriate frequency?	X				
		Were method blanks taken through the entire analytical process, including preparation and, if applicable, cleanup procedures?	X				
		Were blank concentrations < MQL?	X				
R6	OI	**Laboratory control samples (LCS):**					
		Were all COCs included in the LCS?	X				
		Was each LCS taken through the entire analytical procedure, including prep and cleanup steps?	X				
		Were LCSs analyzed at the required frequency?	X				
		Were LCS (and LCSD, if applicable) %Rs within the laboratory QC limits?	X				
		Does the detectability check sample data document the laboratory's capability to detect the COCs at the MDL used to calculate the SDLs?	X				
		Was the LCSD RPD within QC limits?			X		
R7	OI	**Matrix spike (MS) and matrix spike duplicate (MSD) data**					
		Were the project/method specified analytes included in the MS and MSD?	X				
		Were MS/MSD analyzed at the appropriate frequency?	X				
		Were MS (and MSD, if applicable) %Rs within the laboratory QC limits?		X			R07C
		Were MS/MSD RPDs within laboratory QC limits?		X			R07D
R8	OI	**Analytical duplicate data**					
		Were appropriate analytical duplicates analyzed for each matrix?	X				
		Were analytical duplicates analyzed at the appropriate frequency?	X				
		Were RPDs or relative standard deviations within the laboratory QC limits?	X				
R9	OI	**Method quantitation limits (MQLs):**					
		Are the MQLs for each method analyte included in the laboratory data package?	X				
		Do the MQLs correspond to the concentration of the lowest non-zero calibration standard?	X				
		Are unadjusted MQLs and DCSs included in the laboratory data package?	X				
R10	OI	**Other problems/anomalies**					
		Are all known problems/anomalies/special conditions noted in this LRC and ER?	X				
		Was applicable and available technology used to lower the SDL to minimize the matrix interference effects on the sample results?		X			R10B
		Is the laboratory NELAC-accredited under the Texas Laboratory Accreditation Program for the analytes, matrices and methods associated with this laboratory data package?	X				

1. Items identified by the letter "R" must be included in the laboratory data package submitted in the TRRP-required report(s). Items identified by the letter "S" should be retained and made available upon request for the appropriate retention period.
2. O = organic analyses; I = inorganic analyses (and general chemistry, when applicable);
3. NA = Not applicable;
4. NR = Not reviewed;
5. ER# = Exception Report identification number (an Exception Report should be completed for an item if "NR" or "No" is checked).

Laboratory Review checklist: Supporting Data - Page 3 of 4

Laboratory Name:	Eurofins Xenco, Corpus Christi	LRC Date:	6/29/2021
Project Name:	20051, 06/13/2021	Laboratory Job Number:	560-95311-1
Reviewer Name:	Lindy Maingot		

#[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?	X				
		Were percent RSDs or correlation coefficient criteria met?	X				
		Was the number of standards recommended in the method used for all analytes?	X				
		Were all points generated between the lowest and highest standard used to calculate the curve?	X				
		Are ICAL data available for all instruments used?	X				
		Has the initial calibration curve been verified using an appropriate second source standard?	X				
S2	OI	**Initial and continuing calibration verification (ICV and CCV) and continuing calibration blank (CCB):**					
		Was the CCV analyzed at the method-required frequency?	X				
		Were percent differences for each analyte within the method-required QC limits?	X				
		Was the ICAL curve verified for each analyte?	X				
		Was the absolute value of the analyte concentration in the inorganic CCB < MDL?		X			S02D
S3	O	**Mass spectral tuning**					
		Was the appropriate compound for the method used for tuning?	X				
		Were ion abundance data within the method-required QC limits?	X				
S4	O	**Internal standards (IS)**					
		Were IS area counts and retention times within the method-required QC limits?	X				
S5	OI	**Raw data (NELAC Section 5.5.10)**					
		Were the raw data (for example, chromatograms, spectral data) reviewed by an analyst?	X				
		Were data associated with manual integrations flagged on the raw data?	X				
S6	O	**Dual column confirmation**					
		Did dual column confirmation results meet the method-required QC?			X		
S7	O	**Tentatively identified compounds (TICs)**					
		If TICs were requested, were the mass spectra and TIC data subject to appropriate checks?			X		
S8	I	**Interference Check Sample (ICS) results**					
		Were percent recoveries within method QC limits?	X				
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?	X				
S10	OI	**Method detection limit (MDL) studies**					
		Was a MDL study performed for each reported analyte?	X				
		Is the MDL either adjusted or supported by the analysis of DCSs?	X				
S11	OI	**Proficiency test reports**					
		Was the laboratory's performance acceptable on the applicable proficiency tests or evaluation studies?	X				
S12	OI	**Standards documentation**					
		Are all standards used in the analyses NIST-traceable or obtained from other appropriate sources?	X				
S13	OI	**Compound/analyte identification procedures**					
		Are the procedures for compound/analyte identification documented?	X				
S14	OI	**Demonstration of analyst competency (DOC)**					
		Was DOC conducted consistent with NELAC Chapter 5?	X				
		Is documentation of the analyst's competency up-to-date and on file?	X				
S15	OI	**Verification/validation documentation for methods (NELAC Chapter 5)**					
		Are all the methods used to generate the data documented, verified, and validated, where applicable?	X				
S16	OI	**Laboratory standard operating procedures (SOPs)**					
		Are laboratory SOPs current and on file for each method performed?	X				

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Laboratory Review Checklist: Exception Reports - Page 4 of 4

Laboratory Name:	Eurofins Xenco, Corpus Christi	LRC Date:	6/29/2021
Project Name:	20051, 06/13/2021	Laboratory Job Number:	560-95311-1
Reviewer Name:	Lindy Maingot		

ER #[1]	Description
R03A	Method SM 4500 H+ B: This analysis is normally performed in the field and has a method-defined holding time of 15 minutes. The following samples has been qualified with the "HF" flag to indicate analysis was performed in the laboratory outside the 15 minute timeframe: B-13 (560-95311-1), B-15 (560-95311-2) and B-1 (560-95311-3).
R07C	Method 6010B: The matrix spike / matrix spike duplicate (MS/MSD) recoveries for preparation batch 560-186461 and 560-186478 and analytical batch 560-186531 were outside control limits. Sample matrix interference and/or non-homogeneity are suspected because the associated laboratory control sample (LCS) recovery was within acceptance limits. Method 7470A: The matrix spike / matrix spike duplicate (MS/MSD) recoveries for preparation batch 560-186461 and 560-186475 and analytical batch 560-186491 were outside control limits. Sample matrix interference and/or non-homogeneity are suspected because the associated laboratory control sample (LCS) recovery was within acceptance limits.
R07D	Method 7470A: 560-95341-A-1-E MSD failed the RPD criteria for the following analyte(s): Mercury. Matrix interference is suspected.
R10B	Method 9056: The following samples were diluted due to the nature of the sample matrix: B-13 (560-95311-1), B-15 (560-95311-2) and B-1 (560-95311-3). Elevated reporting limits (RLs) are provided.
S02D	Method 6010B: The method blank (MB) for analytical batch 560-186502 contained Na above the reporting limit (RL). All reported samples associated with this MB were either ND for this analyte or contained this analyte at a concentration greater than 10X the value found in the MB; therefore, re-analysis of samples was not performed. Method 6010B: The method blank (MB) for analytical batch 560-186531 contained Na above the reporting limit (RL). All reported samples associated with this MB were either ND for this analyte or contained this analyte at a concentration greater than 10X the value found in the MB; therefore, re-analysis of samples was not performed.

1. Items identified by the letter "R" must be included in the laboratory data package submitted in the TRRP-required report(s). Items identified by the letter "S" should be retained and made available upon request for the appropriate retention period.
2. O = organic analyses; I = inorganic analyses (and general chemistry, when applicable);
3. NA = Not applicable;
4. NR = Not reviewed;
5. ER# = Exception Report identification number (an Exception Report should be completed for an item if "NR" or "No" is checked).

Job ID: 560-95311-1

Laboratory: Eurofins Xenco, Corpus Christi

Narrative

Job Narrative
560-95311-1

Receipt
The samples were received on 6/15/2021 10:45 AM. Unless otherwise noted below, the samples arrived in good condition, and, where required, properly preserved and on ice. The temperature of the cooler at receipt time was -0.3°C

All applicable analytical narratives can be found in the TRRP Checklist section of the report.

Detection Summary

Client: Medina Consulting Company Inc
Project/Site: 20051, 06/13/2021

Job ID: 560-95311-1

Client Sample ID: B-13

Lab Sample ID: 560-95311-1

Analyte	Result	Qualifier	MQL (Adj)	SDL	Unit	Dil Fac	D	Method	Prep Type
Arsenic	0.0208		0.0100	0.00350	mg/L	1		6010B	Total/NA
Barium	0.0734		0.0100	0.00200	mg/L	1		6010B	Total/NA
Beryllium	0.000710	J	0.00400	0.000500	mg/L	1		6010B	Total/NA
Cadmium	0.00126	J	0.00500	0.000340	mg/L	1		6010B	Total/NA
Calcium	274		0.200	0.101	mg/L	1		6010B	Total/NA
Chromium	0.0162		0.0100	0.00110	mg/L	1		6010B	Total/NA
Lead	0.0115		0.0100	0.00330	mg/L	1		6010B	Total/NA
Magnesium	141		0.200	0.0257	mg/L	1		6010B	Total/NA
Nickel	0.0260		0.0100	0.00200	mg/L	1		6010B	Total/NA
Potassium	18.4		0.500	0.375	mg/L	1		6010B	Total/NA
Selenium	0.0137		0.0100	0.00420	mg/L	1		6010B	Total/NA
Sodium	544	B	1.00	0.310	mg/L	1		6010B	Total/NA
Vanadium	0.115		0.00500	0.000700	mg/L	1		6010B	Total/NA
Zinc	0.0689		0.0200	0.00570	mg/L	1		6010B	Total/NA
Mercury	0.000366	J	0.00200	0.000130	mg/L	1		7470A	Total/NA
Chloride	752		50.0	9.60	mg/L	50		9056	Total/NA
Sulfate	897		50.0	18.9	mg/L	50		9056	Total/NA
Bicarbonate Alkalinity as CaCO3	506		5.00	5.00	mg/L	1		SM 2320B	Total/NA
Specific Conductance	4210		1.00	1.00	umho/cm	1		SM 2510B	Total/NA
Total Dissolved Solids	3000		40.0	40.0	mg/L	1		SM 2540C	Total/NA
pH	7.0	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA

Client Sample ID: B-15

Lab Sample ID: 560-95311-2

Analyte	Result	Qualifier	MQL (Adj)	SDL	Unit	Dil Fac	D	Method	Prep Type
Benzene	0.412	J	1.00	0.330	ug/L	1		8260B	Total/NA
Chlorobenzene	3.54		1.00	0.136	ug/L	1		8260B	Total/NA
cis-1,2-Dichloroethene	1.12		1.00	0.121	ug/L	1		8260B	Total/NA
1,4-Dichlorobenzene	0.602	J	1.00	0.200	ug/L	1		8260B	Total/NA
Dichlorodifluoromethane	0.876	J	5.00	0.429	ug/L	1		8260B	Total/NA
Barium	0.0341		0.0100	0.00200	mg/L	1		6010B	Total/NA
Cadmium	0.000920	J	0.00500	0.000340	mg/L	1		6010B	Total/NA
Calcium	497		0.200	0.101	mg/L	1		6010B	Total/NA
Chromium	0.112		0.0100	0.00110	mg/L	1		6010B	Total/NA
Magnesium	875		2.00	0.257	mg/L	10		6010B	Total/NA
Nickel	0.0694		0.0100	0.00200	mg/L	1		6010B	Total/NA
Potassium	52.3		5.00	3.75	mg/L	10		6010B	Total/NA
Selenium	0.00616	J	0.0100	0.00420	mg/L	1		6010B	Total/NA
Sodium	2580	B	10.0	3.10	mg/L	10		6010B	Total/NA
Vanadium	0.00882		0.00500	0.000700	mg/L	1		6010B	Total/NA
Zinc	0.0316		0.0200	0.00570	mg/L	1		6010B	Total/NA
Mercury	0.00130	J	0.00200	0.000130	mg/L	1		7470A	Total/NA
Chloride	2700		200	38.4	mg/L	200		9056	Total/NA
Sulfate	4670		200	75.4	mg/L	200		9056	Total/NA
Bicarbonate Alkalinity as CaCO3	833		5.00	5.00	mg/L	1		SM 2320B	Total/NA
Specific Conductance	16800		1.00	1.00	umho/cm	1		SM 2510B	Total/NA
Total Dissolved Solids	11800		200	200	mg/L	1		SM 2540C	Total/NA
pH	6.5	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA

This Detection Summary does not include radiochemical test results.

Detection Summary

Client: Medina Consulting Company Inc
Project/Site: 20051, 06/13/2021

Job ID: 560-95311-1

Client Sample ID: B-1

Lab Sample ID: 560-95311-3

Analyte	Result	Qualifier	MQL (Adj)	SDL	Unit	Dil Fac	D	Method	Prep Type
1,1-Dichloroethane	2.23		1.00	0.168	ug/L	1		8260B	Total/NA
cis-1,2-Dichloroethene	0.364	J	1.00	0.121	ug/L	1		8260B	Total/NA
Dichlorodifluoromethane	0.599	J	5.00	0.429	ug/L	1		8260B	Total/NA
Barium	0.00991	J	0.0100	0.00200	mg/L	1		6010B	Total/NA
Cadmium	0.00260	J	0.00500	0.000340	mg/L	1		6010B	Total/NA
Calcium	517		0.200	0.101	mg/L	1		6010B	Total/NA
Magnesium	1420		2.00	0.257	mg/L	10		6010B	Total/NA
Nickel	0.0717		0.0100	0.00200	mg/L	1		6010B	Total/NA
Potassium	82.3		5.00	3.75	mg/L	10		6010B	Total/NA
Sodium	3340	B	10.0	3.10	mg/L	10		6010B	Total/NA
Vanadium	0.00783		0.00500	0.000700	mg/L	1		6010B	Total/NA
Zinc	0.0150	J	0.0200	0.00570	mg/L	1		6010B	Total/NA
Mercury	0.000635	J	0.00200	0.000130	mg/L	1		7470A	Total/NA
Chloride	3630		200	38.4	mg/L	200		9056	Total/NA
Sulfate	6850		200	75.4	mg/L	200		9056	Total/NA
Bicarbonate Alkalinity as CaCO3	978		5.00	5.00	mg/L	1		SM 2320B	Total/NA
Specific Conductance	19600		1.00	1.00	umho/cm	1		SM 2510B	Total/NA
Total Dissolved Solids	16700		200	200	mg/L	1		SM 2540C	Total/NA
pH	6.6	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA

Client Sample ID: Trip Blank

Lab Sample ID: 560-95311-4

No Detections.

This Detection Summary does not include radiochemical test results.

Client Sample ID: B-13
Date Collected: 06/13/21 09:01
Date Received: 06/15/21 10:45

Lab Sample ID: 560-95311-1
Matrix: Water

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	5.00	U	10.0	5.00	ug/L			06/15/21 17:58	1
Benzene	0.330	U	1.00	0.330	ug/L			06/15/21 17:58	1
Chlorodibromomethane	0.223	U	2.00	0.223	ug/L			06/15/21 17:58	1
Bromoform	0.500	U	5.00	0.500	ug/L			06/15/21 17:58	1
Carbon disulfide	0.500	U	5.00	0.500	ug/L			06/15/21 17:58	1
Carbon tetrachloride	0.251	U	1.00	0.251	ug/L			06/15/21 17:58	1
Chlorobenzene	0.136	U	1.00	0.136	ug/L			06/15/21 17:58	1
Chloroethane	0.400	U	5.00	0.400	ug/L			06/15/21 17:58	1
Chloroform	0.173	U	1.00	0.173	ug/L			06/15/21 17:58	1
Chloromethane	0.390	U	5.00	0.390	ug/L			06/15/21 17:58	1
Dichlorobromomethane	0.175	U	1.00	0.175	ug/L			06/15/21 17:58	1
1,1-Dichloroethane	0.168	U	1.00	0.168	ug/L			06/15/21 17:58	1
1,2-Dichloroethane	0.172	U	1.00	0.172	ug/L			06/15/21 17:58	1
1,1-Dichloroethene	0.300	U	1.00	0.300	ug/L			06/15/21 17:58	1
trans-1,2-Dichloroethene	0.200	U	1.00	0.200	ug/L			06/15/21 17:58	1
cis-1,2-Dichloroethene	0.121	U	1.00	0.121	ug/L			06/15/21 17:58	1
1,2-Dichloropropane	0.173	U	1.00	0.173	ug/L			06/15/21 17:58	1
cis-1,3-Dichloropropene	0.146	U	1.00	0.146	ug/L			06/15/21 17:58	1
trans-1,3-Dichloropropene	0.200	U	5.00	0.200	ug/L			06/15/21 17:58	1
Ethylbenzene	0.200	U	1.00	0.200	ug/L			06/15/21 17:58	1
2-Hexanone	1.56	U	10.0	1.56	ug/L			06/15/21 17:58	1
Methylene Chloride	2.00	U	10.0	2.00	ug/L			06/15/21 17:58	1
2-Butanone (MEK)	1.00	U	10.0	1.00	ug/L			06/15/21 17:58	1
4-Methyl-2-pentanone (MIBK)	0.510	U	10.0	0.510	ug/L			06/15/21 17:58	1
Styrene	0.200	U	1.00	0.200	ug/L			06/15/21 17:58	1
Tetrachloroethene	0.189	U	1.00	0.189	ug/L			06/15/21 17:58	1
Toluene	0.495	U	1.00	0.495	ug/L			06/15/21 17:58	1
1,1,1-Trichloroethane	0.300	U	1.00	0.300	ug/L			06/15/21 17:58	1
1,1,2-Trichloroethane	0.173	U	1.00	0.173	ug/L			06/15/21 17:58	1
Trichloroethene	0.317	U	1.00	0.317	ug/L			06/15/21 17:58	1
Vinyl acetate	5.00	U	10.0	5.00	ug/L			06/15/21 17:58	1
Vinyl chloride	0.300	U	1.00	0.300	ug/L			06/15/21 17:58	1
Xylenes, Total	0.200	U	2.00	0.200	ug/L			06/15/21 17:58	1
1,1,2,2-Tetrachloroethane	0.190	U	1.00	0.190	ug/L			06/15/21 17:58	1
Bromomethane	0.392	U	5.00	0.392	ug/L			06/15/21 17:58	1
1,1,2-Trichloro-1,2,2-trifluoroethane	0.410	U	2.00	0.410	ug/L			06/15/21 17:58	1
1,2,4-Trichlorobenzene	0.168	U	5.00	0.168	ug/L			06/15/21 17:58	1
1,2-Dibromo-3-Chloropropane	0.349	U	5.00	0.349	ug/L			06/15/21 17:58	1
1,2-Dichlorobenzene	0.170	U	1.00	0.170	ug/L			06/15/21 17:58	1
1,3-Dichlorobenzene	0.128	U	1.00	0.128	ug/L			06/15/21 17:58	1
1,4-Dichlorobenzene	0.200	U	1.00	0.200	ug/L			06/15/21 17:58	1
Dichlorodifluoromethane	0.429	U	5.00	0.429	ug/L			06/15/21 17:58	1
Ethylene Dibromide	0.175	U	1.00	0.175	ug/L			06/15/21 17:58	1
Isopropylbenzene	0.500	U	5.00	0.500	ug/L			06/15/21 17:58	1
Methyl tert-butyl ether	0.200	U	1.00	0.200	ug/L			06/15/21 17:58	1
m-Xylene & p-Xylene	0.260	U	2.00	0.260	ug/L			06/15/21 17:58	1
o-Xylene	0.200	U	1.00	0.200	ug/L			06/15/21 17:58	1
Cyclohexane	1.00	U	2.00	1.00	ug/L			06/15/21 17:58	1
Bromochloromethane	0.228	U	1.00	0.228	ug/L			06/15/21 17:58	1

Client Sample ID: B-13

Date Collected: 06/13/21 09:01
Date Received: 06/15/21 10:45

Lab Sample ID: 560-95311-1
Matrix: Water

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
1,2-Dichloroethane-d4 (Surr)	108		70 - 140		06/15/21 17:58	1
4-Bromofluorobenzene (Surr)	89		70 - 130		06/15/21 17:58	1
Dibromofluoromethane (Surr)	116		69 - 130		06/15/21 17:58	1
Toluene-d8 (Surr)	95		70 - 130		06/15/21 17:58	1

Method: 6010B - Metals (ICP)

Analyte	Result	Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	0.00500	U	0.0100	0.00500	mg/L		06/18/21 10:00	06/18/21 16:38	1
Arsenic	**0.0208**		0.0100	0.00350	mg/L		06/18/21 10:00	06/18/21 16:38	1
Barium	**0.0734**		0.0100	0.00200	mg/L		06/18/21 10:00	06/18/21 16:38	1
Beryllium	**0.000710**	**J**	0.00400	0.000500	mg/L		06/18/21 10:00	06/18/21 16:38	1
Cadmium	**0.00126**	**J**	0.00500	0.000340	mg/L		06/18/21 10:00	06/18/21 16:38	1
Calcium	**274**		0.200	0.101	mg/L		06/18/21 10:00	06/18/21 16:38	1
Chromium	**0.0162**		0.0100	0.00110	mg/L		06/18/21 10:00	06/18/21 16:38	1
Lead	**0.0115**		0.0100	0.00330	mg/L		06/18/21 10:00	06/18/21 16:38	1
Magnesium	**141**		0.200	0.0257	mg/L		06/18/21 10:00	06/18/21 16:38	1
Nickel	**0.0260**		0.0100	0.00200	mg/L		06/18/21 10:00	06/18/21 16:38	1
Potassium	**18.4**		0.500	0.375	mg/L		06/18/21 10:00	06/21/21 17:36	1
Selenium	**0.0137**		0.0100	0.00420	mg/L		06/18/21 10:00	06/18/21 16:38	1
Silver	0.00100	U	0.00500	0.00100	mg/L		06/18/21 10:00	06/18/21 16:38	1
Sodium	**544**	**B**	1.00	0.310	mg/L		06/18/21 10:00	06/18/21 16:38	1
Thallium	0.00150	U	0.00500	0.00150	mg/L		06/18/21 10:00	06/18/21 16:38	1
Vanadium	**0.115**		0.00500	0.000700	mg/L		06/18/21 10:00	06/18/21 16:38	1
Zinc	**0.0689**		0.0200	0.00570	mg/L		06/18/21 10:00	06/18/21 16:38	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	**0.000366**	**J**	0.00200	0.000130	mg/L		06/18/21 09:30	06/18/21 13:56	1

General Chemistry

Analyte	Result	Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**752**		50.0	9.60	mg/L			06/26/21 13:17	50
Sulfate	**897**		50.0	18.9	mg/L			06/26/21 13:17	50
Bicarbonate Alkalinity as CaCO3	**506**		5.00	5.00	mg/L			06/15/21 10:40	1
Carbonate Alkalinity as CaCO3	5.00	U	5.00	5.00	mg/L			06/15/21 10:40	1
Specific Conductance	**4210**		1.00	1.00	umho/cm			06/17/21 14:10	1
Total Dissolved Solids	**3000**		40.0	40.0	mg/L			06/16/21 14:40	1
pH	**7.0**	**HF**	0.1	0.1	SU			06/21/21 11:39	1

Client Sample ID: B-15

Date Collected: 06/13/21 10:41
Date Received: 06/15/21 10:45

Lab Sample ID: 560-95311-2
Matrix: Water

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	5.00	U	10.0	5.00	ug/L			06/15/21 18:23	1
Benzene	**0.412**	**J**	1.00	0.330	ug/L			06/15/21 18:23	1
Chlorodibromomethane	0.223	U	2.00	0.223	ug/L			06/15/21 18:23	1
Bromoform	0.500	U	5.00	0.500	ug/L			06/15/21 18:23	1
Carbon disulfide	0.500	U	5.00	0.500	ug/L			06/15/21 18:23	1
Carbon tetrachloride	0.251	U	1.00	0.251	ug/L			06/15/21 18:23	1

Client Sample ID: B-15
Date Collected: 06/13/21 10:41
Date Received: 06/15/21 10:45

Lab Sample ID: 560-95311-2
Matrix: Water

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Analyte	Result	Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
Chlorobenzene	**3.54**		1.00	0.136	ug/L			06/15/21 18:23	1
Chloroethane	0.400	U	5.00	0.400	ug/L			06/15/21 18:23	1
Chloroform	0.173	U	1.00	0.173	ug/L			06/15/21 18:23	1
Chloromethane	0.390	U	5.00	0.390	ug/L			06/15/21 18:23	1
Dichlorobromomethane	0.175	U	1.00	0.175	ug/L			06/15/21 18:23	1
1,1-Dichloroethane	0.168	U	1.00	0.168	ug/L			06/15/21 18:23	1
1,2-Dichloroethane	0.172	U	1.00	0.172	ug/L			06/15/21 18:23	1
1,1-Dichloroethene	0.300	U	1.00	0.300	ug/L			06/15/21 18:23	1
trans-1,2-Dichloroethene	0.200	U	1.00	0.200	ug/L			06/15/21 18:23	1
cis-1,2-Dichloroethene	**1.12**		1.00	0.121	ug/L			06/15/21 18:23	1
1,2-Dichloropropane	0.173	U	1.00	0.173	ug/L			06/15/21 18:23	1
cis-1,3-Dichloropropene	0.146	U	1.00	0.146	ug/L			06/15/21 18:23	1
trans-1,3-Dichloropropene	0.200	U	5.00	0.200	ug/L			06/15/21 18:23	1
Ethylbenzene	0.200	U	1.00	0.200	ug/L			06/15/21 18:23	1
2-Hexanone	1.56	U	10.0	1.56	ug/L			06/15/21 18:23	1
Methylene Chloride	2.00	U	10.0	2.00	ug/L			06/15/21 18:23	1
2-Butanone (MEK)	1.00	U	10.0	1.00	ug/L			06/15/21 18:23	1
4-Methyl-2-pentanone (MIBK)	0.510	U	10.0	0.510	ug/L			06/15/21 18:23	1
Styrene	0.200	U	1.00	0.200	ug/L			06/15/21 18:23	1
Tetrachloroethene	0.189	U	1.00	0.189	ug/L			06/15/21 18:23	1
Toluene	0.495	U	1.00	0.495	ug/L			06/15/21 18:23	1
1,1,1-Trichloroethane	0.300	U	1.00	0.300	ug/L			06/15/21 18:23	1
1,1,2-Trichloroethane	0.173	U	1.00	0.173	ug/L			06/15/21 18:23	1
Trichloroethene	0.317	U	1.00	0.317	ug/L			06/15/21 18:23	1
Vinyl acetate	5.00	U	10.0	5.00	ug/L			06/15/21 18:23	1
Vinyl chloride	0.300	U	1.00	0.300	ug/L			06/15/21 18:23	1
Xylenes, Total	0.200	U	2.00	0.200	ug/L			06/15/21 18:23	1
1,1,2,2-Tetrachloroethane	0.190	U	1.00	0.190	ug/L			06/15/21 18:23	1
Bromomethane	0.392	U	5.00	0.392	ug/L			06/15/21 18:23	1
1,1,2-Trichloro-1,2,2-trifluoroethane	0.410	U	2.00	0.410	ug/L			06/15/21 18:23	1
1,2,4-Trichlorobenzene	0.168	U	5.00	0.168	ug/L			06/15/21 18:23	1
1,2-Dibromo-3-Chloropropane	0.349	U	5.00	0.349	ug/L			06/15/21 18:23	1
1,2-Dichlorobenzene	0.170	U	1.00	0.170	ug/L			06/15/21 18:23	1
1,3-Dichlorobenzene	0.128	U	1.00	0.128	ug/L			06/15/21 18:23	1
1,4-Dichlorobenzene	**0.602**	**J**	1.00	0.200	ug/L			06/15/21 18:23	1
Dichlorodifluoromethane	**0.876**	**J**	5.00	0.429	ug/L			06/15/21 18:23	1
Ethylene Dibromide	0.175	U	1.00	0.175	ug/L			06/15/21 18:23	1
Isopropylbenzene	0.500	U	5.00	0.500	ug/L			06/15/21 18:23	1
Methyl tert-butyl ether	0.200	U	1.00	0.200	ug/L			06/15/21 18:23	1
m-Xylene & p-Xylene	0.260	U	2.00	0.260	ug/L			06/15/21 18:23	1
o-Xylene	0.200	U	1.00	0.200	ug/L			06/15/21 18:23	1
Cyclohexane	1.00	U	2.00	1.00	ug/L			06/15/21 18:23	1
Bromochloromethane	0.228	U	1.00	0.228	ug/L			06/15/21 18:23	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
1,2-Dichloroethane-d4 (Surr)	*104*		*70 - 140*		*06/15/21 18:23*	*1*
4-Bromofluorobenzene (Surr)	*91*		*70 - 130*		*06/15/21 18:23*	*1*
Dibromofluoromethane (Surr)	*114*		*69 - 130*		*06/15/21 18:23*	*1*
Toluene-d8 (Surr)	*97*		*70 - 130*		*06/15/21 18:23*	*1*

Client Sample ID: B-15

Date Collected: 06/13/21 10:41
Date Received: 06/15/21 10:45

Lab Sample ID: 560-95311-2
Matrix: Water

Method: 6010B - Metals (ICP)

Analyte	Result	Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	0.00500	U	0.0100	0.00500	mg/L		06/18/21 10:00	06/18/21 16:43	1
Arsenic	0.00350	U	0.0100	0.00350	mg/L		06/18/21 10:00	06/18/21 16:43	1
Barium	**0.0341**		0.0100	0.00200	mg/L		06/18/21 10:00	06/18/21 16:43	1
Beryllium	0.000500	U	0.00400	0.000500	mg/L		06/18/21 10:00	06/18/21 16:43	1
Cadmium	**0.000920**	**J**	0.00500	0.000340	mg/L		06/18/21 10:00	06/18/21 16:43	1
Calcium	**497**		0.200	0.101	mg/L		06/18/21 10:00	06/18/21 16:43	1
Chromium	**0.112**		0.0100	0.00110	mg/L		06/18/21 10:00	06/18/21 16:43	1
Lead	0.00330	U	0.0100	0.00330	mg/L		06/18/21 10:00	06/18/21 16:43	1
Magnesium	**875**		2.00	0.257	mg/L		06/18/21 10:00	06/21/21 17:40	10
Nickel	**0.0694**		0.0100	0.00200	mg/L		06/18/21 10:00	06/18/21 16:43	1
Potassium	**52.3**		5.00	3.75	mg/L		06/18/21 10:00	06/21/21 17:40	10
Selenium	**0.00616**	**J**	0.0100	0.00420	mg/L		06/18/21 10:00	06/18/21 16:43	1
Silver	0.00100	U	0.00500	0.00100	mg/L		06/18/21 10:00	06/18/21 16:43	1
Sodium	**2580**	**B**	10.0	3.10	mg/L		06/18/21 10:00	06/21/21 17:40	10
Thallium	0.00150	U	0.00500	0.00150	mg/L		06/18/21 10:00	06/18/21 16:43	1
Vanadium	**0.00882**		0.00500	0.000700	mg/L		06/18/21 10:00	06/18/21 16:43	1
Zinc	**0.0316**		0.0200	0.00570	mg/L		06/18/21 10:00	06/18/21 16:43	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	**0.00130**	**J**	0.00200	0.000130	mg/L		06/18/21 09:30	06/18/21 13:58	1

General Chemistry

Analyte	Result	Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**2700**		200	38.4	mg/L			06/26/21 13:51	200
Sulfate	**4670**		200	75.4	mg/L			06/26/21 13:51	200
Bicarbonate Alkalinity as CaCO3	**833**		5.00	5.00	mg/L			06/15/21 10:40	1
Carbonate Alkalinity as CaCO3	5.00	U	5.00	5.00	mg/L			06/15/21 10:40	1
Specific Conductance	**16800**		1.00	1.00	umho/cm			06/17/21 14:10	1
Total Dissolved Solids	**11800**		200	200	mg/L			06/16/21 14:40	1
pH	**6.5**	**HF**	0.1	0.1	SU			06/21/21 11:39	1

Client Sample ID: B-1

Date Collected: 06/13/21 11:39
Date Received: 06/15/21 10:45

Lab Sample ID: 560-95311-3
Matrix: Water

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	5.00	U	10.0	5.00	ug/L			06/15/21 18:48	1
Benzene	0.330	U	1.00	0.330	ug/L			06/15/21 18:48	1
Chlorodibromomethane	0.223	U	2.00	0.223	ug/L			06/15/21 18:48	1
Bromoform	0.500	U	5.00	0.500	ug/L			06/15/21 18:48	1
Carbon disulfide	0.500	U	5.00	0.500	ug/L			06/15/21 18:48	1
Carbon tetrachloride	0.251	U	1.00	0.251	ug/L			06/15/21 18:48	1
Chlorobenzene	0.136	U	1.00	0.136	ug/L			06/15/21 18:48	1
Chloroethane	0.400	U	5.00	0.400	ug/L			06/15/21 18:48	1
Chloroform	0.173	U	1.00	0.173	ug/L			06/15/21 18:48	1
Chloromethane	0.390	U	5.00	0.390	ug/L			06/15/21 18:48	1
Dichlorobromomethane	0.175	U	1.00	0.175	ug/L			06/15/21 18:48	1
1,1-Dichloroethane	**2.23**		1.00	0.168	ug/L			06/15/21 18:48	1

Client Sample ID: B-1
Date Collected: 06/13/21 11:39
Date Received: 06/15/21 10:45

Lab Sample ID: 560-95311-3
Matrix: Water

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Analyte	Result	Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
1,2-Dichloroethane	0.172	U	1.00	0.172	ug/L			06/15/21 18:48	1
1,1-Dichloroethene	0.300	U	1.00	0.300	ug/L			06/15/21 18:48	1
trans-1,2-Dichloroethene	0.200	U	1.00	0.200	ug/L			06/15/21 18:48	1
cis-1,2-Dichloroethene	**0.364**	**J**	1.00	0.121	ug/L			06/15/21 18:48	1
1,2-Dichloropropane	0.173	U	1.00	0.173	ug/L			06/15/21 18:48	1
cis-1,3-Dichloropropene	0.146	U	1.00	0.146	ug/L			06/15/21 18:48	1
trans-1,3-Dichloropropene	0.200	U	5.00	0.200	ug/L			06/15/21 18:48	1
Ethylbenzene	0.200	U	1.00	0.200	ug/L			06/15/21 18:48	1
2-Hexanone	1.56	U	10.0	1.56	ug/L			06/15/21 18:48	1
Methylene Chloride	2.00	U	10.0	2.00	ug/L			06/15/21 18:48	1
2-Butanone (MEK)	1.00	U	10.0	1.00	ug/L			06/15/21 18:48	1
4-Methyl-2-pentanone (MIBK)	0.510	U	10.0	0.510	ug/L			06/15/21 18:48	1
Styrene	0.200	U	1.00	0.200	ug/L			06/15/21 18:48	1
Tetrachloroethene	0.189	U	1.00	0.189	ug/L			06/15/21 18:48	1
Toluene	0.495	U	1.00	0.495	ug/L			06/15/21 18:48	1
1,1,1-Trichloroethane	0.300	U	1.00	0.300	ug/L			06/15/21 18:48	1
1,1,2-Trichloroethane	0.173	U	1.00	0.173	ug/L			06/15/21 18:48	1
Trichloroethene	0.317	U	1.00	0.317	ug/L			06/15/21 18:48	1
Vinyl acetate	5.00	U	10.0	5.00	ug/L			06/15/21 18:48	1
Vinyl chloride	0.300	U	1.00	0.300	ug/L			06/15/21 18:48	1
Xylenes, Total	0.200	U	2.00	0.200	ug/L			06/15/21 18:48	1
1,1,2,2-Tetrachloroethane	0.190	U	1.00	0.190	ug/L			06/15/21 18:48	1
Bromomethane	0.392	U	5.00	0.392	ug/L			06/15/21 18:48	1
1,1,2-Trichloro-1,2,2-trifluoroethane	0.410	U	2.00	0.410	ug/L			06/15/21 18:48	1
1,2,4-Trichlorobenzene	0.168	U	5.00	0.168	ug/L			06/15/21 18:48	1
1,2-Dibromo-3-Chloropropane	0.349	U	5.00	0.349	ug/L			06/15/21 18:48	1
1,2-Dichlorobenzene	0.170	U	1.00	0.170	ug/L			06/15/21 18:48	1
1,3-Dichlorobenzene	0.128	U	1.00	0.128	ug/L			06/15/21 18:48	1
1,4-Dichlorobenzene	0.200	U	1.00	0.200	ug/L			06/15/21 18:48	1
Dichlorodifluoromethane	**0.599**	**J**	5.00	0.429	ug/L			06/15/21 18:48	1
Ethylene Dibromide	0.175	U	1.00	0.175	ug/L			06/15/21 18:48	1
Isopropylbenzene	0.500	U	5.00	0.500	ug/L			06/15/21 18:48	1
Methyl tert-butyl ether	0.200	U	1.00	0.200	ug/L			06/15/21 18:48	1
m-Xylene & p-Xylene	0.260	U	2.00	0.260	ug/L			06/15/21 18:48	1
o-Xylene	0.200	U	1.00	0.200	ug/L			06/15/21 18:48	1
Cyclohexane	1.00	U	2.00	1.00	ug/L			06/15/21 18:48	1
Bromochloromethane	0.228	U	1.00	0.228	ug/L			06/15/21 18:48	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
1,2-Dichloroethane-d4 (Surr)	*106*		*70 - 140*		*06/15/21 18:48*	*1*
4-Bromofluorobenzene (Surr)	*87*		*70 - 130*		*06/15/21 18:48*	*1*
Dibromofluoromethane (Surr)	*119*		*69 - 130*		*06/15/21 18:48*	*1*
Toluene-d8 (Surr)	*97*		*70 - 130*		*06/15/21 18:48*	*1*

Method: 6010B - Metals (ICP)

Analyte	Result	Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	0.00500	U	0.0100	0.00500	mg/L		06/18/21 10:00	06/18/21 16:47	1
Arsenic	0.00350	U	0.0100	0.00350	mg/L		06/18/21 10:00	06/18/21 16:47	1
Barium	**0.00991**	**J**	0.0100	0.00200	mg/L		06/18/21 10:00	06/18/21 16:47	1
Beryllium	0.000500	U	0.00400	0.000500	mg/L		06/18/21 10:00	06/18/21 16:47	1

Client Sample ID: B-1

Date Collected: 06/13/21 11:39
Date Received: 06/15/21 10:45

Lab Sample ID: 560-95311-3
Matrix: Water

Method: 6010B - Metals (ICP) (Continued)

Analyte	Result	Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
Cadmium	**0.00260**	**J**	0.00500	0.000340	mg/L		06/18/21 10:00	06/18/21 16:47	1
Calcium	**517**		0.200	0.101	mg/L		06/18/21 10:00	06/18/21 16:47	1
Chromium	0.00110	U	0.0100	0.00110	mg/L		06/18/21 10:00	06/18/21 16:47	1
Lead	0.00330	U	0.0100	0.00330	mg/L		06/18/21 10:00	06/18/21 16:47	1
Magnesium	**1420**		2.00	0.257	mg/L		06/18/21 10:00	06/21/21 17:44	10
Nickel	**0.0717**		0.0100	0.00200	mg/L		06/18/21 10:00	06/18/21 16:47	1
Potassium	**82.3**		5.00	3.75	mg/L		06/18/21 10:00	06/21/21 17:44	10
Selenium	0.00420	U	0.0100	0.00420	mg/L		06/18/21 10:00	06/18/21 16:47	1
Silver	0.00100	U	0.00500	0.00100	mg/L		06/18/21 10:00	06/18/21 16:47	1
Sodium	**3340**	**B**	10.0	3.10	mg/L		06/18/21 10:00	06/21/21 17:44	10
Thallium	0.00150	U	0.00500	0.00150	mg/L		06/18/21 10:00	06/18/21 16:47	1
Vanadium	**0.00783**		0.00500	0.000700	mg/L		06/18/21 10:00	06/18/21 16:47	1
Zinc	**0.0150**	**J**	0.0200	0.00570	mg/L		06/18/21 10:00	06/18/21 16:47	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	**0.000635**	**J**	0.00200	0.000130	mg/L		06/18/21 09:30	06/18/21 14:00	1

General Chemistry

Analyte	Result	Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**3630**		200	38.4	mg/L			06/26/21 14:25	200
Sulfate	**6850**		200	75.4	mg/L			06/26/21 14:25	200
Bicarbonate Alkalinity as CaCO3	**978**		5.00	5.00	mg/L			06/15/21 10:40	1
Carbonate Alkalinity as CaCO3	5.00	U	5.00	5.00	mg/L			06/15/21 10:40	1
Specific Conductance	**19600**		1.00	1.00	umho/cm			06/17/21 14:10	1
Total Dissolved Solids	**16700**		200	200	mg/L			06/16/21 14:40	1
pH	**6.6**	**HF**	0.1	0.1	SU			06/21/21 11:39	1

Client Sample ID: Trip Blank

Date Collected: 06/13/21 00:00
Date Received: 06/15/21 10:45

Lab Sample ID: 560-95311-4
Matrix: Water

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	5.00	U	10.0	5.00	ug/L			06/15/21 19:13	1
Benzene	0.330	U	1.00	0.330	ug/L			06/15/21 19:13	1
Chlorodibromomethane	0.223	U	2.00	0.223	ug/L			06/15/21 19:13	1
Bromoform	0.500	U	5.00	0.500	ug/L			06/15/21 19:13	1
Carbon disulfide	0.500	U	5.00	0.500	ug/L			06/15/21 19:13	1
Carbon tetrachloride	0.251	U	1.00	0.251	ug/L			06/15/21 19:13	1
Chlorobenzene	0.136	U	1.00	0.136	ug/L			06/15/21 19:13	1
Chloroethane	0.400	U	5.00	0.400	ug/L			06/15/21 19:13	1
Chloroform	0.173	U	1.00	0.173	ug/L			06/15/21 19:13	1
Chloromethane	0.390	U	5.00	0.390	ug/L			06/15/21 19:13	1
Dichlorobromomethane	0.175	U	1.00	0.175	ug/L			06/15/21 19:13	1
1,1-Dichloroethane	0.168	U	1.00	0.168	ug/L			06/15/21 19:13	1
1,2-Dichloroethane	0.172	U	1.00	0.172	ug/L			06/15/21 19:13	1
1,1-Dichloroethene	0.300	U	1.00	0.300	ug/L			06/15/21 19:13	1
trans-1,2-Dichloroethene	0.200	U	1.00	0.200	ug/L			06/15/21 19:13	1
cis-1,2-Dichloroethene	0.121	U	1.00	0.121	ug/L			06/15/21 19:13	1

Client Sample ID: Trip Blank
Date Collected: 06/13/21 00:00
Date Received: 06/15/21 10:45

Lab Sample ID: 560-95311-4
Matrix: Water

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Analyte	Result	Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
1,2-Dichloropropane	0.173	U	1.00	0.173	ug/L			06/15/21 19:13	1
cis-1,3-Dichloropropene	0.146	U	1.00	0.146	ug/L			06/15/21 19:13	1
trans-1,3-Dichloropropene	0.200	U	5.00	0.200	ug/L			06/15/21 19:13	1
Ethylbenzene	0.200	U	1.00	0.200	ug/L			06/15/21 19:13	1
2-Hexanone	1.56	U	10.0	1.56	ug/L			06/15/21 19:13	1
Methylene Chloride	2.00	U	10.0	2.00	ug/L			06/15/21 19:13	1
2-Butanone (MEK)	1.00	U	10.0	1.00	ug/L			06/15/21 19:13	1
4-Methyl-2-pentanone (MIBK)	0.510	U	10.0	0.510	ug/L			06/15/21 19:13	1
Styrene	0.200	U	1.00	0.200	ug/L			06/15/21 19:13	1
Tetrachloroethene	0.189	U	1.00	0.189	ug/L			06/15/21 19:13	1
Toluene	0.495	U	1.00	0.495	ug/L			06/15/21 19:13	1
1,1,1-Trichloroethane	0.300	U	1.00	0.300	ug/L			06/15/21 19:13	1
1,1,2-Trichloroethane	0.173	U	1.00	0.173	ug/L			06/15/21 19:13	1
Trichloroethene	0.317	U	1.00	0.317	ug/L			06/15/21 19:13	1
Vinyl acetate	5.00	U	10.0	5.00	ug/L			06/15/21 19:13	1
Vinyl chloride	0.300	U	1.00	0.300	ug/L			06/15/21 19:13	1
Xylenes, Total	0.200	U	2.00	0.200	ug/L			06/15/21 19:13	1
1,1,2,2-Tetrachloroethane	0.190	U	1.00	0.190	ug/L			06/15/21 19:13	1
Bromomethane	0.392	U	5.00	0.392	ug/L			06/15/21 19:13	1
1,1,2-Trichloro-1,2,2-trifluoroethane	0.410	U	2.00	0.410	ug/L			06/15/21 19:13	1
1,2,4-Trichlorobenzene	0.168	U	5.00	0.168	ug/L			06/15/21 19:13	1
1,2-Dibromo-3-Chloropropane	0.349	U	5.00	0.349	ug/L			06/15/21 19:13	1
1,2-Dichlorobenzene	0.170	U	1.00	0.170	ug/L			06/15/21 19:13	1
1,3-Dichlorobenzene	0.128	U	1.00	0.128	ug/L			06/15/21 19:13	1
1,4-Dichlorobenzene	0.200	U	1.00	0.200	ug/L			06/15/21 19:13	1
Dichlorodifluoromethane	0.429	U	5.00	0.429	ug/L			06/15/21 19:13	1
Ethylene Dibromide	0.175	U	1.00	0.175	ug/L			06/15/21 19:13	1
Isopropylbenzene	0.500	U	5.00	0.500	ug/L			06/15/21 19:13	1
Methyl tert-butyl ether	0.200	U	1.00	0.200	ug/L			06/15/21 19:13	1
m-Xylene & p-Xylene	0.260	U	2.00	0.260	ug/L			06/15/21 19:13	1
o-Xylene	0.200	U	1.00	0.200	ug/L			06/15/21 19:13	1
Cyclohexane	1.00	U	2.00	1.00	ug/L			06/15/21 19:13	1
Bromochloromethane	0.228	U	1.00	0.228	ug/L			06/15/21 19:13	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
1,2-Dichloroethane-d4 (Surr)	*107*		*70 - 140*		*06/15/21 19:13*	*1*
4-Bromofluorobenzene (Surr)	*91*		*70 - 130*		*06/15/21 19:13*	*1*
Dibromofluoromethane (Surr)	*112*		*69 - 130*		*06/15/21 19:13*	*1*
Toluene-d8 (Surr)	*97*		*70 - 130*		*06/15/21 19:13*	*1*

Surrogate Summary

Client: Medina Consulting Company Inc
Project/Site: 20051, 06/13/2021

Job ID: 560-95311-1

Method: 8260B - Volatile Organic Compounds (GC/MS)

Matrix: Water

Prep Type: Total/NA

		Percent Surrogate Recovery (Acceptance Limits)			
Lab Sample ID	Client Sample ID	DCA (70-140)	BFB (70-130)	DBFM (69-130)	TOL (70-130)
560-95276-B-14 MS	Matrix Spike	94	97	100	101
560-95276-B-14 MSD	Matrix Spike Duplicate	92	96	101	103
560-95311-1	B-13	108	89	116	95
560-95311-2	B-15	104	91	114	97
560-95311-3	B-1	106	87	119	97
560-95311-4	Trip Blank	107	91	112	97
LCS 560-186356/3	Lab Control Sample	94	95	104	103
MB 560-186356/8	Method Blank	103	91	108	97

Surrogate Legend

DCA = 1,2-Dichloroethane-d4 (Surr)
BFB = 4-Bromofluorobenzene (Surr)
DBFM = Dibromofluoromethane (Surr)
TOL = Toluene-d8 (Surr)

Method: 8260B - Volatile Organic Compounds (GC/MS)

Lab Sample ID: MB 560-186356/8
Matrix: Water
Analysis Batch: 186356

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	5.00	U	10.0	5.00	ug/L			06/15/21 12:32	1
Benzene	0.330	U	1.00	0.330	ug/L			06/15/21 12:32	1
Chlorodibromomethane	0.223	U	2.00	0.223	ug/L			06/15/21 12:32	1
Bromoform	0.500	U	5.00	0.500	ug/L			06/15/21 12:32	1
Carbon disulfide	0.500	U	5.00	0.500	ug/L			06/15/21 12:32	1
Carbon tetrachloride	0.251	U	1.00	0.251	ug/L			06/15/21 12:32	1
Chlorobenzene	0.136	U	1.00	0.136	ug/L			06/15/21 12:32	1
Chloroethane	0.400	U	5.00	0.400	ug/L			06/15/21 12:32	1
Chloroform	0.173	U	1.00	0.173	ug/L			06/15/21 12:32	1
Chloromethane	0.390	U	5.00	0.390	ug/L			06/15/21 12:32	1
Dichlorobromomethane	0.175	U	1.00	0.175	ug/L			06/15/21 12:32	1
1,1-Dichloroethane	0.168	U	1.00	0.168	ug/L			06/15/21 12:32	1
1,2-Dichloroethane	0.172	U	1.00	0.172	ug/L			06/15/21 12:32	1
1,1-Dichloroethene	0.300	U	1.00	0.300	ug/L			06/15/21 12:32	1
trans-1,2-Dichloroethene	0.200	U	1.00	0.200	ug/L			06/15/21 12:32	1
cis-1,2-Dichloroethene	0.121	U	1.00	0.121	ug/L			06/15/21 12:32	1
1,2-Dichloropropane	0.173	U	1.00	0.173	ug/L			06/15/21 12:32	1
cis-1,3-Dichloropropene	0.146	U	1.00	0.146	ug/L			06/15/21 12:32	1
trans-1,3-Dichloropropene	0.200	U	5.00	0.200	ug/L			06/15/21 12:32	1
Ethylbenzene	0.200	U	1.00	0.200	ug/L			06/15/21 12:32	1
2-Hexanone	1.56	U	10.0	1.56	ug/L			06/15/21 12:32	1
Methylene Chloride	2.00	U	10.0	2.00	ug/L			06/15/21 12:32	1
2-Butanone (MEK)	1.00	U	10.0	1.00	ug/L			06/15/21 12:32	1
4-Methyl-2-pentanone (MIBK)	0.510	U	10.0	0.510	ug/L			06/15/21 12:32	1
Styrene	0.200	U	1.00	0.200	ug/L			06/15/21 12:32	1
Tetrachloroethene	0.189	U	1.00	0.189	ug/L			06/15/21 12:32	1
Toluene	0.495	U	1.00	0.495	ug/L			06/15/21 12:32	1
1,1,1-Trichloroethane	0.300	U	1.00	0.300	ug/L			06/15/21 12:32	1
1,1,2-Trichloroethane	0.173	U	1.00	0.173	ug/L			06/15/21 12:32	1
Trichloroethene	0.317	U	1.00	0.317	ug/L			06/15/21 12:32	1
Vinyl acetate	5.00	U	10.0	5.00	ug/L			06/15/21 12:32	1
Vinyl chloride	0.300	U	1.00	0.300	ug/L			06/15/21 12:32	1
Xylenes, Total	0.200	U	2.00	0.200	ug/L			06/15/21 12:32	1
1,1,2,2-Tetrachloroethane	0.190	U	1.00	0.190	ug/L			06/15/21 12:32	1
Bromomethane	0.392	U	5.00	0.392	ug/L			06/15/21 12:32	1
1,1,2-Trichloro-1,2,2-trifluoroethane	0.410	U	2.00	0.410	ug/L			06/15/21 12:32	1
1,2,4-Trichlorobenzene	0.168	U	5.00	0.168	ug/L			06/15/21 12:32	1
1,2-Dibromo-3-Chloropropane	0.349	U	5.00	0.349	ug/L			06/15/21 12:32	1
1,2-Dichlorobenzene	0.170	U	1.00	0.170	ug/L			06/15/21 12:32	1
1,3-Dichlorobenzene	0.128	U	1.00	0.128	ug/L			06/15/21 12:32	1
1,4-Dichlorobenzene	0.200	U	1.00	0.200	ug/L			06/15/21 12:32	1
Dichlorodifluoromethane	0.429	U	5.00	0.429	ug/L			06/15/21 12:32	1
Ethylene Dibromide	0.175	U	1.00	0.175	ug/L			06/15/21 12:32	1
Isopropylbenzene	0.500	U	5.00	0.500	ug/L			06/15/21 12:32	1
Methyl tert-butyl ether	0.200	U	1.00	0.200	ug/L			06/15/21 12:32	1
m-Xylene & p-Xylene	0.260	U	2.00	0.260	ug/L			06/15/21 12:32	1
o-Xylene	0.200	U	1.00	0.200	ug/L			06/15/21 12:32	1
Cyclohexane	1.00	U	2.00	1.00	ug/L			06/15/21 12:32	1

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: MB 560-186356/8
Matrix: Water
Analysis Batch: 186356

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
Bromochloromethane	0.228	U	1.00	0.228	ug/L			06/15/21 12:32	1

Surrogate	*MB %Recovery*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
1,2-Dichloroethane-d4 (Surr)	*103*		*70 - 140*		*06/15/21 12:32*	*1*
4-Bromofluorobenzene (Surr)	*91*		*70 - 130*		*06/15/21 12:32*	*1*
Dibromofluoromethane (Surr)	*108*		*69 - 130*		*06/15/21 12:32*	*1*
Toluene-d8 (Surr)	*97*		*70 - 130*		*06/15/21 12:32*	*1*

Lab Sample ID: LCS 560-186356/3
Matrix: Water
Analysis Batch: 186356

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Acetone	125	124.1		ug/L		99	60 - 150
Benzene	25.0	23.22		ug/L		93	70 - 130
Chlorodibromomethane	25.0	23.76		ug/L		95	70 - 137
Bromoform	25.0	21.62		ug/L		86	63 - 145
Carbon disulfide	25.0	24.89		ug/L		100	52 - 156
Carbon tetrachloride	25.0	23.37		ug/L		93	70 - 138
Chlorobenzene	25.0	22.87		ug/L		91	70 - 130
Chloroethane	25.0	25.18		ug/L		101	54 - 141
Chloroform	25.0	22.67		ug/L		91	70 - 130
Chloromethane	25.0	23.89		ug/L		96	46 - 142
Dichlorobromomethane	25.0	22.85		ug/L		91	70 - 130
1,1-Dichloroethane	25.0	23.36		ug/L		93	70 - 130
1,2-Dichloroethane	25.0	21.39		ug/L		86	70 - 131
1,1-Dichloroethene	25.0	24.54		ug/L		98	70 - 139
trans-1,2-Dichloroethene	25.0	24.08		ug/L		96	70 - 134
cis-1,2-Dichloroethene	25.0	25.54		ug/L		102	70 - 130
1,2-Dichloropropane	25.0	23.94		ug/L		96	70 - 130
cis-1,3-Dichloropropene	25.0	23.32		ug/L		93	70 - 138
trans-1,3-Dichloropropene	25.0	21.15		ug/L		85	70 - 143
Ethylbenzene	25.0	24.11		ug/L		96	70 - 130
2-Hexanone	125	117.1		ug/L		94	70 - 138
Methylene Chloride	25.0	24.89		ug/L		100	70 - 130
2-Butanone (MEK)	125	116.5		ug/L		93	68 - 144
4-Methyl-2-pentanone (MIBK)	125	117.6		ug/L		94	70 - 138
Styrene	25.0	23.06		ug/L		92	70 - 130
Tetrachloroethene	25.0	25.34		ug/L		101	70 - 135
Toluene	25.0	23.11		ug/L		92	70 - 130
1,1,1-Trichloroethane	25.0	22.82		ug/L		91	65 - 130
1,1,2-Trichloroethane	25.0	24.35		ug/L		97	70 - 130
Trichloroethene	25.0	24.27		ug/L		97	70 - 130
Vinyl acetate	50.0	42.23		ug/L		84	18 - 200
Vinyl chloride	25.0	22.29		ug/L		89	49 - 140
Xylenes, Total	50.0	47.13		ug/L		94	70 - 130
1,1,2,2-Tetrachloroethane	25.0	21.54		ug/L		86	65 - 130
Bromomethane	25.0	23.62		ug/L		94	50 - 146

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: LCS 560-186356/3
Matrix: Water
Analysis Batch: 186356

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
1,1,2-Trichloro-1,2,2-trifluoroethane	25.0	25.96		ug/L		104	27 - 148
1,2,4-Trichlorobenzene	25.0	22.32		ug/L		89	70 - 157
1,2-Dibromo-3-Chloropropane	25.0	21.44		ug/L		86	70 - 149
1,2-Dichlorobenzene	25.0	22.07		ug/L		88	70 - 130
1,3-Dichlorobenzene	25.0	22.33		ug/L		89	70 - 130
1,4-Dichlorobenzene	25.0	21.64		ug/L		87	70 - 130
Dichlorodifluoromethane	25.0	24.80		ug/L		99	10 - 181
Ethylene Dibromide	25.0	23.22		ug/L		93	70 - 130
Isopropylbenzene	25.0	20.72		ug/L		83	70 - 131
Methyl tert-butyl ether	25.0	25.85		ug/L		103	70 - 131
m-Xylene & p-Xylene	25.0	22.51		ug/L		90	70 - 139
o-Xylene	25.0	24.62		ug/L		98	70 - 130
Cyclohexane	25.0	25.13		ug/L		101	40 - 141
Bromochloromethane	25.0	24.24		ug/L		97	70 - 130

Surrogate	*LCS %Recovery*	*LCS Qualifier*	*Limits*
1,2-Dichloroethane-d4 (Surr)	*94*		*70 - 140*
4-Bromofluorobenzene (Surr)	*95*		*70 - 130*
Dibromofluoromethane (Surr)	*104*		*69 - 130*
Toluene-d8 (Surr)	*103*		*70 - 130*

Lab Sample ID: 560-95276-B-14 MS
Matrix: Water
Analysis Batch: 186356

Client Sample ID: Matrix Spike
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Acetone	206	J	3750	3962		ug/L		100	32 - 157
Benzene	450		750	1238		ug/L		105	70 - 130
Chlorodibromomethane	6.69	U	750	820.5		ug/L		109	62 - 145
Bromoform	15.0	U	750	743.7		ug/L		99	57 - 145
Carbon disulfide	15.0	U	750	819.4		ug/L		109	59 - 164
Carbon tetrachloride	7.53	U	750	765.9		ug/L		102	70 - 138
Chlorobenzene	4.08	U	750	781.1		ug/L		104	70 - 130
Chloroethane	12.0	U	750	803.3		ug/L		107	62 - 142
Chloroform	5.19	U	750	759.0		ug/L		101	70 - 130
Chloromethane	11.7	U	750	786.7		ug/L		105	57 - 148
Dichlorobromomethane	5.25	U	750	789.2		ug/L		105	70 - 130
1,1-Dichloroethane	5.04	U	750	771.9		ug/L		103	70 - 130
1,2-Dichloroethane	5.16	U	750	742.9		ug/L		99	65 - 130
1,1-Dichloroethene	9.00	U	750	796.0		ug/L		106	67 - 143
trans-1,2-Dichloroethene	6.00	U	750	794.3		ug/L		106	57 - 148
cis-1,2-Dichloroethene	3.63	U	750	856.0		ug/L		114	70 - 130
1,2-Dichloropropane	5.19	U	750	820.7		ug/L		109	70 - 130
cis-1,3-Dichloropropene	4.38	U	750	835.5		ug/L		111	46 - 136
trans-1,3-Dichloropropene	6.00	U	750	756.6		ug/L		101	44 - 139
Ethylbenzene	478		750	1376		ug/L		120	70 - 130
2-Hexanone	46.8	U	3750	4198		ug/L		112	56 - 130
Methylene Chloride	60.0	U	750	812.3		ug/L		108	70 - 130

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: 560-95276-B-14 MS
Matrix: Water
Analysis Batch: 186356

Client Sample ID: Matrix Spike
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
2-Butanone (MEK)	98.3	J	3750	4206		ug/L		110	42 - 142
4-Methyl-2-pentanone (MIBK)	15.3	U	3750	4039		ug/L		108	54 - 130
Styrene	6.00	U	750	917.1		ug/L		122	28 - 150
Tetrachloroethene	5.67	U	750	828.0		ug/L		110	69 - 130
Toluene	2700		750	3359		ug/L		88	70 - 130
1,1,1-Trichloroethane	9.00	U	750	767.8		ug/L		102	65 - 133
1,1,2-Trichloroethane	5.19	U	750	786.8		ug/L		105	70 - 130
Trichloroethene	9.51	U	750	834.2		ug/L		111	70 - 130
Vinyl acetate	150	U	1500	1515		ug/L		101	36 - 171
Vinyl chloride	9.00	U	750	731.6		ug/L		98	49 - 158
Xylenes, Total	5790		1500	7059		ug/L		85	70 - 130
1,1,2,2-Tetrachloroethane	5.70	U	750	723.6		ug/L		96	65 - 130
Bromomethane	11.8	U	750	772.4		ug/L		103	56 - 141
1,1,2-Trichloro-1,2,2-trifluoroethane	12.3	U	750	825.2		ug/L		110	47 - 152
1,2,4-Trichlorobenzene	5.04	U	750	867.8		ug/L		116	60 - 142
1,2-Dibromo-3-Chloropropane	10.5	U	750	790.4		ug/L		105	56 - 130
1,2-Dichlorobenzene	5.10	U	750	765.9		ug/L		102	70 - 130
1,3-Dichlorobenzene	3.84	U	750	770.5		ug/L		103	70 - 130
1,4-Dichlorobenzene	6.00	U	750	743.0		ug/L		99	70 - 130
Dichlorodifluoromethane	12.9	U	750	783.1		ug/L		104	14 - 198
Ethylene Dibromide	5.25	U	750	809.7		ug/L		108	70 - 130
Isopropylbenzene	91.5	J	750	760.6		ug/L		89	70 - 130
Methyl tert-butyl ether	32.2		750	882.0		ug/L		113	63 - 134
m-Xylene & p-Xylene	3440		750	4087	4	ug/L		86	67 - 130
o-Xylene	2340		750	2972		ug/L		84	70 - 130
Cyclohexane	30.0	U	750	836.9		ug/L		112	46 - 144
Bromochloromethane	6.84	U	750	799.9		ug/L		107	70 - 130

Surrogate	*MS %Recovery*	*MS Qualifier*	*Limits*
1,2-Dichloroethane-d4 (Surr)	*94*		*70 - 140*
4-Bromofluorobenzene (Surr)	*97*		*70 - 130*
Dibromofluoromethane (Surr)	*100*		*69 - 130*
Toluene-d8 (Surr)	*101*		*70 - 130*

Lab Sample ID: 560-95276-B-14 MSD
Matrix: Water
Analysis Batch: 186356

Client Sample ID: Matrix Spike Duplicate
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Acetone	206	J	3750	3674		ug/L		92	32 - 157	8	20
Benzene	450		750	1149		ug/L		93	70 - 130	7	20
Chlorodibromomethane	6.69	U	750	732.3		ug/L		98	62 - 145	11	20
Bromoform	15.0	U	750	662.0		ug/L		88	57 - 145	12	20
Carbon disulfide	15.0	U	750	723.0		ug/L		96	59 - 164	13	20
Carbon tetrachloride	7.53	U	750	693.4		ug/L		92	70 - 138	10	20
Chlorobenzene	4.08	U	750	707.2		ug/L		94	70 - 130	10	20
Chloroethane	12.0	U	750	736.6		ug/L		98	62 - 142	9	20
Chloroform	5.19	U	750	687.1		ug/L		92	70 - 130	10	20

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: 560-95276-B-14 MSD
Matrix: Water
Analysis Batch: 186356

Client Sample ID: Matrix Spike Duplicate
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Chloromethane	11.7	U	750	705.9		ug/L		94	57 - 148	11	20
Dichlorobromomethane	5.25	U	750	702.8		ug/L		94	70 - 130	12	20
1,1-Dichloroethane	5.04	U	750	704.9		ug/L		94	70 - 130	9	20
1,2-Dichloroethane	5.16	U	750	662.1		ug/L		88	65 - 130	12	20
1,1-Dichloroethene	9.00	U	750	733.0		ug/L		98	67 - 143	8	20
trans-1,2-Dichloroethene	6.00	U	750	735.5		ug/L		98	57 - 148	8	20
cis-1,2-Dichloroethene	3.63	U	750	783.1		ug/L		104	70 - 130	9	20
1,2-Dichloropropane	5.19	U	750	717.5		ug/L		96	70 - 130	13	20
cis-1,3-Dichloropropene	4.38	U	750	724.0		ug/L		97	46 - 136	14	20
trans-1,3-Dichloropropene	6.00	U	750	655.2		ug/L		87	44 - 139	14	20
Ethylbenzene	478		750	1327		ug/L		113	70 - 130	4	20
2-Hexanone	46.8	U	3750	3566		ug/L		95	56 - 130	16	20
Methylene Chloride	60.0	U	750	738.1		ug/L		98	70 - 130	10	20
2-Butanone (MEK)	98.3	J	3750	3609		ug/L		94	42 - 142	15	20
4-Methyl-2-pentanone (MIBK)	15.3	U	3750	3654		ug/L		97	54 - 130	10	20
Styrene	6.00	U	750	836.3		ug/L		112	28 - 150	9	20
Tetrachloroethene	5.67	U	750	749.5		ug/L		100	69 - 130	10	20
Toluene	2700		750	3419		ug/L		96	70 - 130	2	20
1,1,1-Trichloroethane	9.00	U	750	694.7		ug/L		93	65 - 133	10	20
1,1,2-Trichloroethane	5.19	U	750	714.2		ug/L		95	70 - 130	10	20
Trichloroethene	9.51	U	750	724.8		ug/L		97	70 - 130	14	20
Vinyl acetate	150	U	1500	1361		ug/L		91	36 - 171	11	20
Vinyl chloride	9.00	U	750	663.4		ug/L		88	49 - 158	10	20
Xylenes, Total	5790		1500	7210		ug/L		95	70 - 130	2	20
1,1,2,2-Tetrachloroethane	5.70	U	750	660.8		ug/L		88	65 - 130	9	20
Bromomethane	11.8	U	750	702.9		ug/L		94	56 - 141	9	20
1,1,2-Trichloro-1,2,2-trifluoroethane	12.3	U	750	747.8		ug/L		100	47 - 152	10	20
1,2,4-Trichlorobenzene	5.04	U	750	837.1		ug/L		112	60 - 142	4	20
1,2-Dibromo-3-Chloropropane	10.5	U	750	748.0		ug/L		100	56 - 130	6	20
1,2-Dichlorobenzene	5.10	U	750	705.1		ug/L		94	70 - 130	8	20
1,3-Dichlorobenzene	3.84	U	750	699.7		ug/L		93	70 - 130	10	20
1,4-Dichlorobenzene	6.00	U	750	670.0		ug/L		89	70 - 130	10	20
Dichlorodifluoromethane	12.9	U	750	703.6		ug/L		94	14 - 198	11	20
Ethylene Dibromide	5.25	U	750	689.5		ug/L		92	70 - 130	16	20
Isopropylbenzene	91.5	J	750	717.5		ug/L		83	70 - 130	6	20
Methyl tert-butyl ether	32.2		750	836.7		ug/L		107	63 - 134	5	20
m-Xylene & p-Xylene	3440		750	4171	4	ug/L		97	67 - 130	2	20
o-Xylene	2340		750	3039		ug/L		93	70 - 130	2	20
Cyclohexane	30.0	U	750	762.5		ug/L		102	46 - 144	9	20
Bromochloromethane	6.84	U	750	731.5		ug/L		98	70 - 130	9	20

Surrogate	*MSD %Recovery*	*MSD Qualifier*	*Limits*
1,2-Dichloroethane-d4 (Surr)	*92*		*70 - 140*
4-Bromofluorobenzene (Surr)	*96*		*70 - 130*
Dibromofluoromethane (Surr)	*101*		*69 - 130*
Toluene-d8 (Surr)	*103*		*70 - 130*

Method: 6010B - Metals (ICP)

Lab Sample ID: MB 560-186478/1-A
Matrix: Water
Analysis Batch: 186502

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 186478

Analyte	MB Result	MB Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	0.00500	U	0.0100	0.00500	mg/L		06/18/21 10:00	06/18/21 15:53	1
Arsenic	0.00350	U	0.0100	0.00350	mg/L		06/18/21 10:00	06/18/21 15:53	1
Barium	0.00200	U	0.0100	0.00200	mg/L		06/18/21 10:00	06/18/21 15:53	1
Beryllium	0.000500	U	0.00400	0.000500	mg/L		06/18/21 10:00	06/18/21 15:53	1
Cadmium	0.000340	U	0.00500	0.000340	mg/L		06/18/21 10:00	06/18/21 15:53	1
Calcium	0.101	U	0.200	0.101	mg/L		06/18/21 10:00	06/18/21 15:53	1
Chromium	0.00110	U	0.0100	0.00110	mg/L		06/18/21 10:00	06/18/21 15:53	1
Lead	0.00330	U	0.0100	0.00330	mg/L		06/18/21 10:00	06/18/21 15:53	1
Magnesium	0.0257	U	0.200	0.0257	mg/L		06/18/21 10:00	06/18/21 15:53	1
Nickel	0.00200	U	0.0100	0.00200	mg/L		06/18/21 10:00	06/18/21 15:53	1
Potassium	0.375	U	0.500	0.375	mg/L		06/18/21 10:00	06/18/21 15:53	1
Selenium	0.00420	U	0.0100	0.00420	mg/L		06/18/21 10:00	06/18/21 15:53	1
Silver	0.00100	U	0.00500	0.00100	mg/L		06/18/21 10:00	06/18/21 15:53	1
Sodium	2.917		1.00	0.310	mg/L		06/18/21 10:00	06/18/21 15:53	1
Thallium	0.00150	U	0.00500	0.00150	mg/L		06/18/21 10:00	06/18/21 15:53	1
Vanadium	0.000700	U	0.00500	0.000700	mg/L		06/18/21 10:00	06/18/21 15:53	1
Zinc	0.00570	U	0.0200	0.00570	mg/L		06/18/21 10:00	06/18/21 15:53	1

Lab Sample ID: LCS 560-186478/2-A
Matrix: Water
Analysis Batch: 186502

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 186478

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Antimony	0.250	0.2349		mg/L		94	80 - 120
Arsenic	0.250	0.2389		mg/L		96	80 - 120
Barium	0.250	0.2528		mg/L		101	80 - 120
Beryllium	0.250	0.2454		mg/L		98	80 - 120
Cadmium	0.250	0.2485		mg/L		99	80 - 120
Calcium	25.0	24.90		mg/L		100	80 - 120
Chromium	0.250	0.2516		mg/L		101	80 - 120
Lead	0.250	0.2413		mg/L		97	80 - 120
Magnesium	25.0	24.62		mg/L		98	80 - 120
Nickel	0.250	0.2543		mg/L		102	80 - 120
Potassium	25.0	25.47		mg/L		102	80 - 120
Selenium	0.250	0.2485		mg/L		99	80 - 120
Silver	0.250	0.2594		mg/L		104	80 - 120
Sodium	25.0	25.42		mg/L		102	80 - 120
Thallium	0.100	0.09807		mg/L		98	80 - 120
Vanadium	0.250	0.2548		mg/L		102	80 - 120
Zinc	0.250	0.2526		mg/L		101	80 - 120

Lab Sample ID: 560-95302-A-1-C MS
Matrix: Water
Analysis Batch: 186502

Client Sample ID: Matrix Spike
Prep Type: TCLP
Prep Batch: 186478

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Antimony	0.00702	J	0.250	0.2635		mg/L		103	75 - 125
Arsenic	0.00490	J	0.250	0.2819		mg/L		111	75 - 125
Barium	0.172		0.250	0.4322		mg/L		104	75 - 125

Method: 6010B - Metals (ICP) (Continued)

Lab Sample ID: 560-95302-A-1-C MS
Matrix: Water
Analysis Batch: 186502

Client Sample ID: Matrix Spike
Prep Type: TCLP
Prep Batch: 186478

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Beryllium	0.000500	U	0.250	0.2435		mg/L		97	75 - 125
Cadmium	0.000620	J	0.250	0.2691		mg/L		107	75 - 125
Chromium	0.00194	J	0.250	0.2536		mg/L		101	75 - 125
Lead	0.00330	U	0.250	0.2197		mg/L		88	75 - 125
Magnesium	0.117	J	25.0	21.54		mg/L		86	75 - 125
Nickel	0.0787		0.250	0.3190		mg/L		96	75 - 125
Selenium	0.0190		0.250	0.3115		mg/L		117	75 - 125
Silver	0.00100	U	0.250	0.2908		mg/L		116	75 - 125
Thallium	0.00150	U L	0.100	0.07757		mg/L		78	75 - 125
Vanadium	0.0356		0.250	0.2940		mg/L		103	75 - 125
Zinc	0.0228		0.250	0.2655		mg/L		97	75 - 125

Lab Sample ID: 560-95302-A-1-C MS
Matrix: Water
Analysis Batch: 186531

Client Sample ID: Matrix Spike
Prep Type: TCLP
Prep Batch: 186478

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Calcium	1420		25.0	2850	4	mg/L		5712	75 - 125
Potassium	4.76	J F1	25.0	64.79	F1	mg/L		240	75 - 125
Sodium	1490	B	25.0	3017	4	mg/L		6102	75 - 125

Lab Sample ID: 560-95302-A-1-D MSD
Matrix: Water
Analysis Batch: 186502

Client Sample ID: Matrix Spike Duplicate
Prep Type: TCLP
Prep Batch: 186478

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Antimony	0.00702	J	0.250	0.2631		mg/L		102	75 - 125	0	20
Arsenic	0.00490	J	0.250	0.2840		mg/L		112	75 - 125	1	20
Barium	0.172		0.250	0.4362		mg/L		106	75 - 125	1	20
Beryllium	0.000500	U	0.250	0.2447		mg/L		98	75 - 125	0	20
Cadmium	0.000620	J	0.250	0.2705		mg/L		108	75 - 125	1	20
Chromium	0.00194	J	0.250	0.2544		mg/L		101	75 - 125	0	20
Lead	0.00330	U	0.250	0.2202		mg/L		88	75 - 125	0	20
Magnesium	0.117	J	25.0	21.80		mg/L		87	75 - 125	1	20
Nickel	0.0787		0.250	0.3208		mg/L		97	75 - 125	1	20
Selenium	0.0190		0.250	0.3140		mg/L		118	75 - 125	1	20
Silver	0.00100	U	0.250	0.2937		mg/L		117	75 - 125	1	20
Thallium	0.00150	U L	0.100	0.07741		mg/L		77	75 - 125	0	20
Vanadium	0.0356		0.250	0.2957		mg/L		104	75 - 125	1	20
Zinc	0.0228		0.250	0.3005		mg/L		111	75 - 125	12	20

Lab Sample ID: 560-95302-A-1-D MSD
Matrix: Water
Analysis Batch: 186531

Client Sample ID: Matrix Spike Duplicate
Prep Type: TCLP
Prep Batch: 186478

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Calcium	1420		25.0	2815	4	mg/L		5570	75 - 125	1	20
Potassium	4.76	J F1	25.0	65.30	F1	mg/L		242	75 - 125	1	20
Sodium	1490	B	25.0	2985	4	mg/L		5973	75 - 125	1	20

Method: 7470A - Mercury (CVAA)

Lab Sample ID: MB 560-186475/6-A
Matrix: Water
Analysis Batch: 186491

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 186475

Analyte	MB Result	MB Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	0.000130	U	0.00200	0.000130	mg/L		06/18/21 09:30	06/18/21 13:35	1

Lab Sample ID: LCS 560-186475/7-A
Matrix: Water
Analysis Batch: 186491

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 186475

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Mercury	0.00500	0.004040		mg/L		81	80 - 120

Lab Sample ID: 560-95341-A-1-D MS
Matrix: Water
Analysis Batch: 186491

Client Sample ID: Matrix Spike
Prep Type: TCLP
Prep Batch: 186475

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Mercury	0.000278	J B F1 F2	0.00500	0.002270	F1	mg/L		40	80 - 120

Lab Sample ID: 560-95341-A-1-E MSD
Matrix: Water
Analysis Batch: 186491

Client Sample ID: Matrix Spike Duplicate
Prep Type: TCLP
Prep Batch: 186475

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Mercury	0.000278	J B F1 F2	0.00500	0.003620	F1 F2	mg/L		67	80 - 120	46	20

Method: 9056 - Anions, Ion Chromatography

Lab Sample ID: MB 560-186647/1-A
Matrix: Water
Analysis Batch: 186747

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	1.92	U	10.0	1.92	mg/L			06/25/21 23:43	1
Sulfate	3.77	U	10.0	3.77	mg/L			06/25/21 23:43	1

Lab Sample ID: LCS 560-186647/2-A
Matrix: Water
Analysis Batch: 186747

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Chloride	100	105.6		mg/L		106	80 - 120
Sulfate	200	210.4		mg/L		105	80 - 120

Lab Sample ID: 560-95317-A-6-B MS
Matrix: Water
Analysis Batch: 186747

Client Sample ID: Matrix Spike
Prep Type: Soluble

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Chloride	111	J	2000	1914		mg/L		90	80 - 120
Sulfate	199	J	4000	4270		mg/L		102	80 - 120

Method: 9056 - Anions, Ion Chromatography (Continued)

Lab Sample ID: 560-95317-A-6-C MSD
Matrix: Water
Analysis Batch: 186747

Client Sample ID: Matrix Spike Duplicate
Prep Type: Soluble

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Chloride	111	J	2000	1913		mg/L		90	80 - 120	0	30
Sulfate	199	J	4000	3895		mg/L		92	80 - 120	9	30

Method: SM 2320B - Alkalinity

Lab Sample ID: MB 560-186379/1
Matrix: Water
Analysis Batch: 186379

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
Bicarbonate Alkalinity as CaCO3	2.50	U	2.50	2.50	mg/L			06/15/21 10:40	1
Carbonate Alkalinity as CaCO3	2.50	U	2.50	2.50	mg/L			06/15/21 10:40	1

Lab Sample ID: 560-95110-B-3 DU
Matrix: Water
Analysis Batch: 186379

Client Sample ID: Duplicate
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Bicarbonate Alkalinity as CaCO3	266		262.4		mg/L		1	
Carbonate Alkalinity as CaCO3	5.00	U	5.00	U	mg/L		NC	

Method: SM 2510B - Conductivity, Specific Conductance

Lab Sample ID: MB 560-186448/3
Matrix: Water
Analysis Batch: 186448

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
Specific Conductance	1.00	U	1.00	1.00	umho/cm			06/17/21 14:10	1

Lab Sample ID: LCS 560-186448/4
Matrix: Water
Analysis Batch: 186448

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Specific Conductance	1000	910.0		umho/cm		91	90 - 110

Lab Sample ID: 560-95041-G-1 DU
Matrix: Water
Analysis Batch: 186448

Client Sample ID: Duplicate
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Specific Conductance	480		480.0		umho/cm		0	20

Method: SM 2540C - Solids, Total Dissolved (TDS)

Lab Sample ID: MB 560-186488/1
Matrix: Water
Analysis Batch: 186488

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	MQL (Adj)	SDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	10.0	U	10.0	10.0	mg/L			06/16/21 14:40	1

Lab Sample ID: LCS 560-186488/2
Matrix: Water
Analysis Batch: 186488

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Total Dissolved Solids			2250	2088		mg/L		93	90 - 110		

Lab Sample ID: 560-95345-A-1 DU
Matrix: Water
Analysis Batch: 186488

Client Sample ID: Duplicate
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier		DU Result	DU Qualifier	Unit	D			RPD	RPD Limit
Total Dissolved Solids	2090			2173		mg/L				4	20

Method: SM 4500 H+ B - pH

Lab Sample ID: LCS 560-186515/2
Matrix: Water
Analysis Batch: 186515

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
pH			5.00	5.0		SU		100	98 - 102		

Lab Sample ID: 840-290-B-1 DU
Matrix: Water
Analysis Batch: 186515

Client Sample ID: Duplicate
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier		DU Result	DU Qualifier	Unit	D			RPD	RPD Limit
pH	6.7			6.7		SU				0.1	20

GC/MS VOA

Analysis Batch: 186356

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-95311-1	B-13	Total/NA	Water	8260B	
560-95311-2	B-15	Total/NA	Water	8260B	
560-95311-3	B-1	Total/NA	Water	8260B	
560-95311-4	Trip Blank	Total/NA	Water	8260B	
MB 560-186356/8	Method Blank	Total/NA	Water	8260B	
LCS 560-186356/3	Lab Control Sample	Total/NA	Water	8260B	
560-95276-B-14 MS	Matrix Spike	Total/NA	Water	8260B	
560-95276-B-14 MSD	Matrix Spike Duplicate	Total/NA	Water	8260B	

Metals

Leach Batch: 186461

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-95302-A-1-C MS	Matrix Spike	TCLP	Water	1311	
560-95302-A-1-D MSD	Matrix Spike Duplicate	TCLP	Water	1311	
560-95341-A-1-D MS	Matrix Spike	TCLP	Water	1311	
560-95341-A-1-E MSD	Matrix Spike Duplicate	TCLP	Water	1311	

Prep Batch: 186475

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-95311-1	B-13	Total/NA	Water	7470A	
560-95311-2	B-15	Total/NA	Water	7470A	
560-95311-3	B-1	Total/NA	Water	7470A	
MB 560-186475/6-A	Method Blank	Total/NA	Water	7470A	
LCS 560-186475/7-A	Lab Control Sample	Total/NA	Water	7470A	
560-95341-A-1-D MS	Matrix Spike	TCLP	Water	7470A	186461
560-95341-A-1-E MSD	Matrix Spike Duplicate	TCLP	Water	7470A	186461

Prep Batch: 186478

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-95311-1	B-13	Total/NA	Water	3010A	
560-95311-2	B-15	Total/NA	Water	3010A	
560-95311-3	B-1	Total/NA	Water	3010A	
MB 560-186478/1-A	Method Blank	Total/NA	Water	3010A	
LCS 560-186478/2-A	Lab Control Sample	Total/NA	Water	3010A	
560-95302-A-1-C MS	Matrix Spike	TCLP	Water	3010A	186461
560-95302-A-1-D MSD	Matrix Spike Duplicate	TCLP	Water	3010A	186461

Analysis Batch: 186491

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-95311-1	B-13	Total/NA	Water	7470A	186475
560-95311-2	B-15	Total/NA	Water	7470A	186475
560-95311-3	B-1	Total/NA	Water	7470A	186475
MB 560-186475/6-A	Method Blank	Total/NA	Water	7470A	186475
LCS 560-186475/7-A	Lab Control Sample	Total/NA	Water	7470A	186475
560-95341-A-1-D MS	Matrix Spike	TCLP	Water	7470A	186475
560-95341-A-1-E MSD	Matrix Spike Duplicate	TCLP	Water	7470A	186475

Analysis Batch: 186502

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-95311-1	B-13	Total/NA	Water	6010B	186478

Metals (Continued)

Analysis Batch: 186502 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-95311-2	B-15	Total/NA	Water	6010B	186478
560-95311-3	B-1	Total/NA	Water	6010B	186478
MB 560-186478/1-A	Method Blank	Total/NA	Water	6010B	186478
LCS 560-186478/2-A	Lab Control Sample	Total/NA	Water	6010B	186478
560-95302-A-1-C MS	Matrix Spike	TCLP	Water	6010B	186478
560-95302-A-1-D MSD	Matrix Spike Duplicate	TCLP	Water	6010B	186478

Analysis Batch: 186531

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-95311-1	B-13	Total/NA	Water	6010B	186478
560-95311-2	B-15	Total/NA	Water	6010B	186478
560-95311-3	B-1	Total/NA	Water	6010B	186478
560-95302-A-1-C MS	Matrix Spike	TCLP	Water	6010B	186478
560-95302-A-1-D MSD	Matrix Spike Duplicate	TCLP	Water	6010B	186478

General Chemistry

Analysis Batch: 186379

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-95311-1	B-13	Total/NA	Water	SM 2320B	
560-95311-2	B-15	Total/NA	Water	SM 2320B	
560-95311-3	B-1	Total/NA	Water	SM 2320B	
MB 560-186379/1	Method Blank	Total/NA	Water	SM 2320B	
LCS 560-186379/2	Lab Control Sample	Total/NA	Water	SM 2320B	
560-95110-B-3 DU	Duplicate	Total/NA	Water	SM 2320B	

Analysis Batch: 186448

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-95311-1	B-13	Total/NA	Water	SM 2510B	
560-95311-2	B-15	Total/NA	Water	SM 2510B	
560-95311-3	B-1	Total/NA	Water	SM 2510B	
MB 560-186448/3	Method Blank	Total/NA	Water	SM 2510B	
LCS 560-186448/4	Lab Control Sample	Total/NA	Water	SM 2510B	
560-95041-G-1 DU	Duplicate	Total/NA	Water	SM 2510B	

Analysis Batch: 186488

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-95311-1	B-13	Total/NA	Water	SM 2540C	
560-95311-2	B-15	Total/NA	Water	SM 2540C	
560-95311-3	B-1	Total/NA	Water	SM 2540C	
MB 560-186488/1	Method Blank	Total/NA	Water	SM 2540C	
LCS 560-186488/2	Lab Control Sample	Total/NA	Water	SM 2540C	
560-95345-A-1 DU	Duplicate	Total/NA	Water	SM 2540C	

Analysis Batch: 186515

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-95311-1	B-13	Total/NA	Water	SM 4500 H+ B	
560-95311-2	B-15	Total/NA	Water	SM 4500 H+ B	
560-95311-3	B-1	Total/NA	Water	SM 4500 H+ B	
LCS 560-186515/2	Lab Control Sample	Total/NA	Water	SM 4500 H+ B	
840-290-B-1 DU	Duplicate	Total/NA	Water	SM 4500 H+ B	

General Chemistry

Leach Batch: 186647

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
MB 560-186647/1-A	Method Blank	Total/NA	Water	DI Leach	
LCS 560-186647/2-A	Lab Control Sample	Total/NA	Water	DI Leach	
560-95317-A-6-B MS	Matrix Spike	Soluble	Water	DI Leach	
560-95317-A-6-C MSD	Matrix Spike Duplicate	Soluble	Water	DI Leach	

Analysis Batch: 186747

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
560-95311-1	B-13	Total/NA	Water	9056	
560-95311-2	B-15	Total/NA	Water	9056	
560-95311-3	B-1	Total/NA	Water	9056	
MB 560-186647/1-A	Method Blank	Total/NA	Water	9056	186647
LCS 560-186647/2-A	Lab Control Sample	Total/NA	Water	9056	186647
560-95317-A-6-B MS	Matrix Spike	Soluble	Water	9056	186647
560-95317-A-6-C MSD	Matrix Spike Duplicate	Soluble	Water	9056	186647

Lab Chronicle

Client: Medina Consulting Company Inc
Project/Site: 20051, 06/13/2021

Job ID: 560-95311-1

Client Sample ID: B-13

Lab Sample ID: 560-95311-1

Date Collected: 06/13/21 09:01

Matrix: Water

Date Received: 06/15/21 10:45

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260B		1	186356	06/15/21 17:58	A1S	XEN CC
Total/NA	Prep	3010A			186478	06/18/21 10:00	LR	XEN CC
Total/NA	Analysis	6010B		1	186502	06/18/21 16:38	AKM	XEN CC
Total/NA	Prep	3010A			186478	06/18/21 10:00	LR	XEN CC
Total/NA	Analysis	6010B		1	186531	06/21/21 17:36	AKM	XEN CC
Total/NA	Prep	7470A			186475	06/18/21 09:30	AKM	XEN CC
Total/NA	Analysis	7470A		1	186491	06/18/21 13:56	AKM	XEN CC
Total/NA	Analysis	9056		50	186747	06/26/21 13:17	NCE	XEN CC
Total/NA	Analysis	SM 2320B		1	186379	06/15/21 10:40	LDK	XEN CC
Total/NA	Analysis	SM 2510B		1	186448	06/17/21 14:10	LDK	XEN CC
Total/NA	Analysis	SM 2540C		1	186488	06/16/21 14:40	LDK	XEN CC
Total/NA	Analysis	SM 4500 H+ B		1	186515	06/21/21 11:39	NCE	XEN CC

Client Sample ID: B-15

Lab Sample ID: 560-95311-2

Date Collected: 06/13/21 10:41

Matrix: Water

Date Received: 06/15/21 10:45

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260B		1	186356	06/15/21 18:23	A1S	XEN CC
Total/NA	Prep	3010A			186478	06/18/21 10:00	LR	XEN CC
Total/NA	Analysis	6010B		1	186502	06/18/21 16:43	AKM	XEN CC
Total/NA	Prep	3010A			186478	06/18/21 10:00	LR	XEN CC
Total/NA	Analysis	6010B		10	186531	06/21/21 17:40	AKM	XEN CC
Total/NA	Prep	7470A			186475	06/18/21 09:30	AKM	XEN CC
Total/NA	Analysis	7470A		1	186491	06/18/21 13:58	AKM	XEN CC
Total/NA	Analysis	9056		200	186747	06/26/21 13:51	NCE	XEN CC
Total/NA	Analysis	SM 2320B		1	186379	06/15/21 10:40	LDK	XEN CC
Total/NA	Analysis	SM 2510B		1	186448	06/17/21 14:10	LDK	XEN CC
Total/NA	Analysis	SM 2540C		1	186488	06/16/21 14:40	LDK	XEN CC
Total/NA	Analysis	SM 4500 H+ B		1	186515	06/21/21 11:39	NCE	XEN CC

Client Sample ID: B-1

Lab Sample ID: 560-95311-3

Date Collected: 06/13/21 11:39

Matrix: Water

Date Received: 06/15/21 10:45

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260B		1	186356	06/15/21 18:48	A1S	XEN CC
Total/NA	Prep	3010A			186478	06/18/21 10:00	LR	XEN CC
Total/NA	Analysis	6010B		1	186502	06/18/21 16:47	AKM	XEN CC
Total/NA	Prep	3010A			186478	06/18/21 10:00	LR	XEN CC
Total/NA	Analysis	6010B		10	186531	06/21/21 17:44	AKM	XEN CC
Total/NA	Prep	7470A			186475	06/18/21 09:30	AKM	XEN CC
Total/NA	Analysis	7470A		1	186491	06/18/21 14:00	AKM	XEN CC

Client Sample ID: B-1

Lab Sample ID: 560-95311-3

Date Collected: 06/13/21 11:39

Matrix: Water

Date Received: 06/15/21 10:45

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056		200	186747	06/26/21 14:25	NCE	XEN CC
Total/NA	Analysis	SM 2320B		1	186379	06/15/21 10:40	LDK	XEN CC
Total/NA	Analysis	SM 2510B		1	186448	06/17/21 14:10	LDK	XEN CC
Total/NA	Analysis	SM 2540C		1	186488	06/16/21 14:40	LDK	XEN CC
Total/NA	Analysis	SM 4500 H+ B		1	186515	06/21/21 11:39	NCE	XEN CC

Client Sample ID: Trip Blank

Lab Sample ID: 560-95311-4

Date Collected: 06/13/21 00:00

Matrix: Water

Date Received: 06/15/21 10:45

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260B		1	186356	06/15/21 19:13	A1S	XEN CC

Client Sample ID: Method Blank

Lab Sample ID: MB 560-186356/8

Date Collected: N/A

Matrix: Water

Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260B		1	186356	06/15/21 12:32	A1S	XEN CC

Client Sample ID: Method Blank

Lab Sample ID: MB 560-186379/1

Date Collected: N/A

Matrix: Water

Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	SM 2320B		1	186379	06/15/21 10:40	LDK	XEN CC

Client Sample ID: Method Blank

Lab Sample ID: MB 560-186448/3

Date Collected: N/A

Matrix: Water

Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	SM 2510B		1	186448	06/17/21 14:10	LDK	XEN CC

Client Sample ID: Method Blank

Lab Sample ID: MB 560-186475/6-A

Date Collected: N/A

Matrix: Water

Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	7470A			186475	06/18/21 09:30	AKM	XEN CC
Total/NA	Analysis	7470A		1	186491	06/18/21 13:35	AKM	XEN CC

Client Sample ID: Method Blank

Lab Sample ID: MB 560-186478/1-A

Date Collected: N/A
Date Received: N/A

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3010A			186478	06/18/21 10:00	LR	XEN CC
Total/NA	Analysis	6010B		1	186502	06/18/21 15:53	AKM	XEN CC

Client Sample ID: Method Blank

Lab Sample ID: MB 560-186488/1

Date Collected: N/A
Date Received: N/A

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	SM 2540C		1	186488	06/16/21 14:40	LDK	XEN CC

Client Sample ID: Method Blank

Lab Sample ID: MB 560-186647/1-A

Date Collected: N/A
Date Received: N/A

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Leach	DI Leach			186647	06/24/21 12:00	NCE	XEN CC
Total/NA	Analysis	9056		1	186747	06/25/21 23:43	NCE	XEN CC

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 560-186356/3

Date Collected: N/A
Date Received: N/A

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260B		1	186356	06/15/21 10:27	A1S	XEN CC

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 560-186379/2

Date Collected: N/A
Date Received: N/A

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	SM 2320B		1	186379	06/15/21 10:40	LDK	XEN CC

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 560-186448/4

Date Collected: N/A
Date Received: N/A

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	SM 2510B		1	186448	06/17/21 14:10	LDK	XEN CC

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 560-186475/7-A

Date Collected: N/A
Date Received: N/A

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	7470A			186475	06/18/21 09:30	AKM	XEN CC
Total/NA	Analysis	7470A		1	186491	06/18/21 13:37	AKM	XEN CC

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 560-186478/2-A

Date Collected: N/A
Matrix: Water
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3010A			186478	06/18/21 10:00	LR	XEN CC
Total/NA	Analysis	6010B		1	186502	06/18/21 15:57	AKM	XEN CC

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 560-186488/2

Date Collected: N/A
Matrix: Water
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	SM 2540C		1	186488	06/16/21 14:40	LDK	XEN CC

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 560-186515/2

Date Collected: N/A
Matrix: Water
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	SM 4500 H+ B		1	186515	06/21/21 11:39	NCE	XEN CC

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 560-186647/2-A

Date Collected: N/A
Matrix: Water
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Leach	DI Leach			186647	06/24/21 12:00	NCE	XEN CC
Total/NA	Analysis	9056		1	186747	06/26/21 00:17	NCE	XEN CC

Client Sample ID: Matrix Spike

Lab Sample ID: 560-95276-B-14 MS

Date Collected: N/A
Matrix: Water
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260B		30	186356	06/15/21 10:52	A1S	XEN CC

Client Sample ID: Matrix Spike Duplicate

Lab Sample ID: 560-95276-B-14 MSD

Date Collected: N/A
Matrix: Water
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260B		30	186356	06/15/21 11:17	A1S	XEN CC

Client Sample ID: Matrix Spike

Lab Sample ID: 560-95302-A-1-C MS

Date Collected: N/A
Date Received: N/A

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
TCLP	Leach	1311			186461	06/17/21 15:00	LR	XEN CC
TCLP	Prep	3010A			186478	06/18/21 10:00	LR	XEN CC
TCLP	Analysis	6010B		1	186502	06/18/21 16:05	AKM	XEN CC
TCLP	Leach	1311			186461	06/17/21 15:00	LR	XEN CC
TCLP	Prep	3010A			186478	06/18/21 10:00	LR	XEN CC
TCLP	Analysis	6010B		10	186531	06/21/21 17:06	AKM	XEN CC

Client Sample ID: Matrix Spike Duplicate

Lab Sample ID: 560-95302-A-1-D MSD

Date Collected: N/A
Date Received: N/A

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
TCLP	Leach	1311			186461	06/17/21 15:00	LR	XEN CC
TCLP	Prep	3010A			186478	06/18/21 10:00	LR	XEN CC
TCLP	Analysis	6010B		1	186502	06/18/21 16:17	AKM	XEN CC
TCLP	Leach	1311			186461	06/17/21 15:00	LR	XEN CC
TCLP	Prep	3010A			186478	06/18/21 10:00	LR	XEN CC
TCLP	Analysis	6010B		10	186531	06/21/21 17:10	AKM	XEN CC

Client Sample ID: Matrix Spike

Lab Sample ID: 560-95317-A-6-B MS

Date Collected: N/A
Date Received: N/A

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Soluble	Leach	DI Leach			186647	06/24/21 12:00	NCE	XEN CC
Soluble	Analysis	9056		20	186747	06/26/21 08:45	NCE	XEN CC

Client Sample ID: Matrix Spike Duplicate

Lab Sample ID: 560-95317-A-6-C MSD

Date Collected: N/A
Date Received: N/A

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Soluble	Leach	DI Leach			186647	06/24/21 12:00	NCE	XEN CC
Soluble	Analysis	9056		20	186747	06/26/21 09:19	NCE	XEN CC

Client Sample ID: Matrix Spike

Lab Sample ID: 560-95341-A-1-D MS

Date Collected: N/A
Date Received: N/A

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
TCLP	Leach	1311			186461	06/17/21 15:00	LR	XEN CC
TCLP	Prep	7470A			186475	06/18/21 09:30	AKM	XEN CC
TCLP	Analysis	7470A		1	186491	06/18/21 13:41	AKM	XEN CC

Client Sample ID: Matrix Spike Duplicate

Lab Sample ID: 560-95341-A-1-E MSD

Date Collected: N/A
Date Received: N/A

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
TCLP	Leach	1311			186461	06/17/21 15:00	LR	XEN CC
TCLP	Prep	7470A			186475	06/18/21 09:30	AKM	XEN CC
TCLP	Analysis	7470A		1	186491	06/18/21 13:43	AKM	XEN CC

Client Sample ID: Duplicate

Lab Sample ID: 560-95041-G-1 DU

Date Collected: N/A
Date Received: N/A

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	SM 2510B		1	186448	06/17/21 14:10	LDK	XEN CC

Client Sample ID: Duplicate

Lab Sample ID: 560-95110-B-3 DU

Date Collected: N/A
Date Received: N/A

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	SM 2320B		1	186379	06/15/21 10:40	LDK	XEN CC

Client Sample ID: Duplicate

Lab Sample ID: 560-95345-A-1 DU

Date Collected: N/A
Date Received: N/A

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	SM 2540C		1	186488	06/16/21 14:40	LDK	XEN CC

Client Sample ID: Duplicate

Lab Sample ID: 840-290-B-1 DU

Date Collected: N/A
Date Received: N/A

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	SM 4500 H+ B		1	186515	06/21/21 11:39	NCE	XEN CC

Laboratory References:

XEN CC = Eurofins Xenco, Corpus Christi, 1733 N. Padre Island Drive, Corpus Christi, TX 78408, TEL (361)289-2471

Accreditation/Certification Summary

Client: Medina Consulting Company Inc
Project/Site: 20051, 06/13/2021

Job ID: 560-95311-1

Laboratory: Eurofins Xenco, Corpus Christi

All accreditations/certifications held by this laboratory are listed. Not all accreditations/certifications are applicable to this report.

Authority	Program	Identification Number	Expiration Date
Louisiana	NELAP	05094	06-30-21
Oklahoma	State	2020-006	08-31-21
Texas	NELAP	T104704210-21-27	03-31-22
USDA	US Federal Programs	P330-18-00314	10-31-21

Method Summary

Client: Medina Consulting Company Inc
Project/Site: 20051, 06/13/2021

Job ID: 560-95311-1

Method	Method Description	Protocol	Laboratory
8260B	Volatile Organic Compounds (GC/MS)	SW846	XEN CC
6010B	Metals (ICP)	SW846	XEN CC
7470A	Mercury (CVAA)	SW846	XEN CC
9056	Anions, Ion Chromatography	SW846	XEN CC
SM 2320B	Alkalinity	SM	XEN CC
SM 2510B	Conductivity, Specific Conductance	SM	XEN CC
SM 2540C	Solids, Total Dissolved (TDS)	SM	XEN CC
SM 4500 H+ B	pH	SM	XEN CC
3010A	Preparation, Total Metals	SW846	XEN CC
5030B	Purge and Trap	SW846	XEN CC
7470A	Preparation, Mercury	SW846	XEN CC

Protocol References:

SM = "Standard Methods For The Examination Of Water And Wastewater"

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

XEN CC = Eurofins Xenco, Corpus Christi, 1733 N. Padre Island Drive, Corpus Christi, TX 78408, TEL (361)289-2471

Sample Summary

Client: Medina Consulting Company Inc
Project/Site: 20051, 06/13/2021

Job ID: 560-95311-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received	Asset ID
560-95311-1	B-13	Water	06/13/21 09:01	06/15/21 10:45	
560-95311-2	B-15	Water	06/13/21 10:41	06/15/21 10:45	
560-95311-3	B-1	Water	06/13/21 11:39	06/15/21 10:45	
560-95311-4	Trip Blank	Water	06/13/21 00:00	06/15/21 10:45	

Eurofins Xenco, Corpus Christi
1733 N Padre Island Drive
Corpus Christi, TX 78408
Phone (361) 289-2471 Phone (361) 289-2673

Chain of Custody Record

eurofins

Client Information	Sampler: Dawne Butler + David T Butler	Lab PM: Maingot, Lindy	Carrier Tracking No(s):	COC No: 560-36520-5997.1
Client Contact: Dawne Butler	Phone: 781.983.7292	E-Mail: Lindy.Maingot@Eurofinset.com	State of Origin:	Page: Page 1 of 1
Company: Medina Consulting Company Inc	PWSID:	Analysis Requested		Job #: 95311
Address: 6391 DeZavala Rd Suite 223D	Due Date Requested:			Preservation Codes:
City: San Antonio	TAT Requested (days): standard			A - HCL, B - NaOH, C - Zn Acetate, D - Nitric Acid, E - NaHSO4, F - MeOH, G - Amchlor, H - Ascorbic Acid, I - Ice, J - DI Water, K - EDTA, L - EDA, M - Hexane, N - None, O - AsNaO2, P - Na2O4S, Q - Na2SO3, R - Na2S2O3, S - H2SO4, T - TSP Dodecahydrate, U - Acetone, V - MCAA, W - pH 4-5, Z - other (specify)
State, Zip: TX, 78249	Compliance Project: Δ Yes Δ No			
Phone: 210-694-4545(Tel)	PO #: Purchase Order not required			Other:
Email: dbutler@medinacci.com KMcGookey@medinaeci.com	WO #:			
Project Name: Groundwater Analysis	Project #: 56008598			
Site: 20051	SSOW#:			

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	2320B Alkalinity, 9056 Chloride and Sulfate, SM4500_H+ pH	6010B, 7470A Metals	8260B - TCL Volatiles TX - default	2510B Conductivity, 2540C TDS	Total Number of containers	Special Instructions/Note:
			Preservation Code:				N	D	A	N		
B-13	6/13/21	901	G	Water			X	X	X	X		water was very silty
B-15		1041	G	Water			X	X	X	X		sample had a lot of dissolved gas or is high CO3
B-1		1139	G	Water			X	X	X	X		well required bailer use
trip blank				Water								

560-95311 Chain of Custody

Loc: 560
95311

Possible Hazard Identification	Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological	☐ Return To Client ☒ Disposal By Lab ☐ Archive For _____ Months
Deliverable Requested: I, II, III, IV, Other (specify)	Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:

	Relinquished by	Date/Time	Company	Received by	Date/Time	Company
1	Dawne Butler	6/14/21 0810	MCC		6/14 08:15	
2				Caitlyn Forrester	06/15/2021 1045	EX
3						

Custody Seal Intact: Δ Yes (No)	Custody Seal No.: N/A	Cooler Temperature(s) °C and Other Remarks: 1.4 IR-10 2 8b. / 1.5 corr.

Ver: 01/16/2019

-0.5 (0 IR-10 -0.3

Login Sample Receipt Checklist

Client: Medina Consulting Company Inc

Job Number: 560-95311-1

Login Number: 95311
List Number: 1
Creator: Forrester, Caitlyn D

List Source: Eurofins Xenco, Corpus Christi

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	Check done at department level as required.

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN

APPENDIX IIIK
WASTE CONTAINMENT POINT OF COMPLIANCE

Prepared for
City of Del Rio

September 2023



Prepared by
STV Inc
TPBE Registration No. F-1741
1820 Regal Row, Suite 200
Dallas, TX 75235
214-638-0500

This document is intended for permitting purposes only.

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4.0 SITE GEOLOGY IIIK-3
5.0 POINT OF COMPLIANCE DEMONSTRATION IIIK-3
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1.0 INTRODUCTION

The purpose of this appendix is to demonstrate that the containment system design for the pre-Subtitle D area with an overliner and the approved existing alternative liner for the Subtitle D area meets the point of compliance (POC) requirement set forth in Title 30 TAC §330.331(a), which is "*a design that ensures that the concentration values listed in Table 1 of this paragraph will not be exceeded in the uppermost aquifer at the point of compliance*."

A permit amendment was approved in November 2022 that included the point of compliance (POC) demonstration using the Hydrologic Evaluation of Landfill Performance (HELP) and Multimedia Exposure Assessment (Multimed) modeling. The following sections will demonstrate that the data and models submitted in the approved permit amendment are valid for this expansion. The approved Waste Contaminate POC is included in Appendix IIIK-A.

2.0 CONTAINMENT SYSTEM OVERVIEW

The existing Cells (1 through 6) have been constructed with the approved alternative liner. The alternative liner consists of 24 inches of compacted clay, overlain by a geocomposite leachate collection layer and 24 inches of protected cover. The TCEQ approval for the alternative liner is included in Appendix IIID-A. The liner system for the expansion area cells (7 through 10) will be the same as the existing cells.

In addition, an overliner will be constructed over the portion of the pre-Subtitle D area. The overliner system will be comprised of a reinforced geosynthetic clay liner (GCL) and a 40-mil linear low-density polyethylene (LLDPE) geomembrane (textured on both sides. This will be overlain by a geocomposite leachate collection layer and 24 inches of protective cover. The details of the liner system are shown in Appendix IIIA-A.

3.0 LEACHATE QUALITY

The site currently has a groundwater monitoring waiver and does not have any historical data on the groundwater chemical constituent levels at the site. The contaminant concentration levels of the site's leachate were tested to provide a base point for leachate quality at the City of Del Rio Landfill. Table 3-1 lists the maximum contaminant levels (MCLs) listed in §330.331(a)(1) and the site-specific leachate constituent levels. The leachate sampling was done in September 2021 and the results are included in Appendix IIIK-A as part of the approved POC demonstration.

Table 3-1 Chemical Constituent MCLs and City of Del Rio LF Leachate Quality

Constituent	MCL Listed in §330.331(a)(1) (mg/l)	City of Del Rio Landfill Leachate Quality Information (mg/l)[1]	Minimum Dilution Attenuation Factor
Arsenic	0.05	0.010	
Barium	1.0	0.047	
Benzene	0.005	0.001	
Cadmium	0.01	0.005	
Carbon tetrachloride	0.005	0.001	
Chromium (hexavalent)	0.05	0.003	
2,4-Dichlorophenoxy acetic acid	0.1		
1,4-Dichlorobenzene	0.075	0.001	
1,2-Dichloroethane	0.005	0.001	
1,1-Dichloroethylene	0.007	0.001	
Endrin	0.0002	0.00005	
Fluoride	4	2.44	
Lindane	0.004		
Lead	0.05	0.005	
Mercury	0.002	0.002	1.00
Methoxychlor	0.1	0.00005	
Nitrate	10	0.2	
Selenium	0.01	0.010	1.00
Silver	0.05	0.010	
Toxaphene	0.005	0.005	1.00
1,1,1-Trichloroethane	0.2	0.001	
Trichloroethylene	0.005	0.001	
2,4,5-Trichlorophenoxy acetic acid	0.01	0.002	
Vinyl Chloride	0.002	0.001	

1. Data was obtained from the leachate sampling was done in September 2021.

4.0 SITE GEOLOGY

Multiple site investigations have been conducted at the City of Del Rio Landfill facility to characterize the subsurface conditions at the site. The approved POC demonstration included geotechnical data from the proposed expansion area. A summary of the borings from the previous and current site investigation is included in Appendix IIIJ.

5.0 POINT OF COMPLIANCE DEMONSTRATION

The approved point of compliance (POC) demonstration used (1) the Hydrologic Evaluation of Landfill Performance (HELP) model to estimate leachate percolation through the liner in the pre-Subtitle D and Subtitle D areas and (2) Multimedia Exposure Assessment (Multimed) to perform pollutant fate and transport simulations between the landfill and the point of compliance. The following subsections discuss the POC demonstration methods using the HELP and Multimed models.

There were multiple runs that were conducted for the POC demonstration. The first model represented the base model, where conservative parameters were used based on site specific data. Then based on the base model, a sensitivity analysis was done increasing and decreasing specific parameters to determine how those parameters would affect the DAF calculations. The following sections describe the MULTIMED models that were generated in the approved POC demonstration.

5.1 Sensitivity Analysis

The in the approved POC demonstration, the conservative site-specific base model, was altered to test the sensitivity to the following parameters:

- Aquifer hydraulic conductivity (Aquifer Module)
- Aquifer thickness (Aquifer Module)
- Aquifer porosity (Aquifer Module)
- Hydraulic gradient (Aquifer Module)
- Receptor well distance/distance to POC (Aquifer Module)
- Infiltration rate (Source Module)
- Recharge rate (Source Module)

Table 5-1 shows the input parameters that were altered to test the model sensitivity. Two values were selected for each parameter shown in Table 5-1 to test the sensitivity of the model. One value being higher and one being lower than the number being used in the base model.

Table 5-1 Sensitivity of Parameters to DAF

Variable Name	Sensitivity Values	DAF*
Aquifer hydraulic conductivity	50 m/yr	147
	150 m/yr	434
Aquifer thickness	50 m	243
	125 m	289
Aquifer porosity	0.05	290
	0.506	290
Hydraulic gradient	0.024 ft/ft	630
	0.006 ft/ft	160
Receptor well distance	24.4 m	290
	36.6 m	291
Infiltration rate	1.3×10^{-4} m/yr	198
	3.0×10^{-5} m/yr	705
Recharge rate	0.01820 m/yr	290
	0.0382 m/yr	291

*The base model DAF is 290.

The base model was varied 14 times to evaluate the sensitivity to various model parameters shown in Table 5-1. Aquifer hydraulic conductivity, hydraulic gradient, and infiltration rate were the three parameters that impacted the DAF calculations the most. The hydraulic conductivity was varied by a magnitude of 50 meters to test the sensitivity of the model. The increase in hydraulic conductivity leads to a high DAF since most of dilution occurs beneath the landfill and the high hydraulic conductivity leads to higher Darcy flux. The change in the hydraulic gradient input also considerably varied the DAF calculations. The low hydraulic gradient means low water flow resulting in a low DAF. A fast-moving water flow (high hydraulic gradient) results in a high DAF, because the dilution beneath the landfill increases faster than dilution in the aquifer. The last parameter that impacted the DAF was the infiltration rate. As the infiltration rate increases the DAF decreased due to the increased amount of contaminates in the water. The aquifer thickness, aquifer porosity, receptor well distance, and rechange rate did not significantly impact the DAF calculations. The output files for the MULTIMED runs are included as part of the approved Waste Compliance POC.

Table 5-2 shows the base model input parameters before being altered to test the model sensitivity. The base model calculated DAF is 290.

Table 5-2 Base Model Parameters

Variable Name	Values
Aquifer hydraulic conductivity	100 m/yr
Aquifer thickness	91.4 m
Aquifer porosity	0.10
Hydraulic gradient	0.011 ft/ft
Receptor well distance	30 m
Infiltration rate	1.7×10^{-4} m/yr
Recharge rate	0.0282 m/yr

The aquifer hydraulic conductivity and hydraulic gradient are two parameters that are site specific that do not change for this expansion. The infiltration rate for the expansion area is 8.64×10^{-5}, which is less than the infiltration rate in the base model. Based on the model sensitivity analysis, a model that has an infiltration rate of 8.64×10^{-5} would result in a higher DAF than 290 due to the decrease amount of contaminates in the water. As mentioned above, the aquifer thickness, aquifer porosity, receptor well distance, and rechange rate do not significantly impact the DAF calculations.

6.0 RESULTS AND CONCLUSIONS

Table 5-1 shows the all the MULTIMED simulations that were run for this project with the different parameters. As shown in the Table 5-1, the DAF values from the different simulations range from 147 to 705. Two of the parameters that impacted the DAF calculations (aquifer hydraulic conductivity and hydraulic gradient) are site specific and are not being altered with this expansion. The infiltration rate, the third parameter that impacting the DAF calculation, for the expansion is less than the base model rate and therefore results in a higher DAF than 290 included in the approved POC demonstration. The predicted concentrations of the selected leachate chemical constituents do not exceed maximum contaminant levels in the perched groundwater zone at the point of compliance for the approved alternate liner.

Appendix IIIK-A. Approved Waste Containment Point of Compliance

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207B

MAJOR PERMIT AMENDMENT APPLICATION
PART III — SITE DEVELOPMENT PLAN

APPENDIX IIIK
WASTE CONTAINMENT POINT OF COMPLIANCE

Prepared for

City of Del Rio

Technically Complete November 16, 2022



Prepared by
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This document is intended for permitting purposes only.

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APPENDIX

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APPENDIX IIIK-B – Rainfall Recharge Model
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1 INTRODUCTION

The development of the Del Rio Landfill is a vertical expansion over a portion of the pre-Subtitle D area as well as the Subtitle D area of the landfill. The purpose of this appendix is to demonstrate that the containment system design for the pre-Subtitle D area with an overliner and the approved existing alternative liner for the Subtitle D area meets the point of compliance (POC) requirement set forth in Title 30 TAC §330.331(a), which is:

> *"a design that ensures that the concentration values listed in Table 1 of this paragraph will not be exceeded in the uppermost aquifer at the point of compliance."*

This is achieved by demonstrating that the predicted concentrations of selected leachate chemical constituents do not exceed maximum contaminant levels listed in Table 1 in §330.331(a)(1) in the uppermost aquifer at the POC.

2 CONTAINMENT SYSTEM AND DEMONSTRATION OVERVIEW

The following subsections describe the overliner and approved existing containment system (liner) at the City of Del Rio Landfill. The details of the liner system below are illustrated in Appendix IIIA-A figures.

2.1 Pre-Subtitle D Area Liner

The pre-Subtitle D area is located in the middle of the of the landfill as shown in the Figure 7.1 and is 12.3 acres. Consistent with MSW regulations at that time, the pre-Subtitle D liner is constructed with a 36-inch-thick compacted clay liner with a coefficient of permeability less than 1.0×10^{-7} cm/s and 24 inches of protective cover.

2.2 Subtitle D Alternative Liner

Cells 1 – 6 are Subtitle D areas. In December 1994, the site was approved for an alternative liner. The alternative liner consists of 24 inches of compacted clay, overlain by a geocomposite leachate collection layer and 24 inches of protected cover. The TCEQ approval for the alternative liner is included in Appendix IIID-A. Cells 1 through 5 have been constructed with the alternative liner. The details of the alternative liner are shown in Appendix IIIA-A. Cell 6 will be constructed with the previously approved alternative liner.

2.3 Overliner

The overliner will be constructed over the portion of the pre-Subtitle D area. The overliner system will comprised of a reinforced geosynthetic clay liner (GCL) and a 40-mil linear low-density polyethylene (LLDPE) geomembrane (textured on both sides. This will be overlain by a geocomposite leachate collection layer and 24 inches of protective cover. The overliner plan is included in Appendix IIIA-A.

2.4 POC Overview

The POC demonstration will show that the approved existing Subtitle D alternative liner area and the pre-Subtitle D liner with overliner will serve as a containment system and reduce the leachate infiltration into the groundwater. Once the Subtitle D final cover is in place, leachate generation rates will decrease even further. If the containment design systems described above reduce and/or eliminate leachate generation

into the ground, then current groundwater conditions at the site will be unaffected and will remain below the constituent parameters listed in Table 1 of §330.331(a)(1).

3 LEACHATE QUALITY

The site currently has a groundwater monitoring waiver and does not have any historical data on the groundwater chemical constituent levels at the site. Refer to Section 4.2 for discussion on the site's hydrogeology and groundwater characteristics. Although the site does not have any historical data on the chemical constituents in the groundwater a leachate quality analysis was conducted for this permit amendment application and are shown in Table 3-2.

The POC demonstration was conducted by showing that the containment system with highest leachate percolation will not allow the concentrations of the 24 EPA constituents shown in Table 3-1 to be exceeded at the relevant point of compliance. This is done by modeling a Dilution Attenuation Factor (DAF), defined as the initial input leachate concentration, Co, divided by the concentration at the POC, Cp:

$$DAF = \frac{\text{Co, Initial Constituent Concentration of Leachate within the Landfill}}{\text{Cp, Constituent Concentration at the POC}}$$

Two data inputs for the leachate concentrations were used to calculate the DAF. The first input of leachate concentrations are based on recommended input concentrations from USEPA's "Draft Background Summary of Data on Municipal Solid Waste Landfill Leachate Characteristics: July 1988", and the Toxicity Characteristic Leaching Procedure (TCLP) in 40 CFR 261.62. The greater of the two values for each constituent were used as the recommended input concentration. Table 3-1 lists these data. As noted in the above equation, the DAF represents the factor by which the constituent concentration is expected to decrease between the landfill and the POC. As shown in Table 3-1, the required DAFs range from less than 100 to 260. When the constituent's concentration in leachate is divided by the model predicted DAF, the resulting concentration must be less than the allowable maximum contaminant levels (MCLs) in groundwater for the chemical parameters listed in Table 1 included in Title 30 TAC §330.331(a)(1).

The highest listed DAF is 260, which indicates that if a trichloroethylene concentration of 1.3 mg/l exists within the landfill, then the concentration would have to be reduced by a factor of 260 prior to the constituent reaching the POC to meet the 0.005 mg/l MCL for this constituent.

$$DAF = \frac{1.3 \text{ mg/l}}{0.005 \text{ mg/l}} = 260$$

A DAF of 260 has been the historical standard used in POC demonstrations approved by the TCEQ and is the standard discussed in the original TCEQ guidance document for POC demonstrations (Texas Water Commission Alternate Liner Design Handbook, August 1993).

Table 3-1 – Typical Chemical Constituent Concentrations in Leachate

Constituent	MCL Listed in §330.331(a)(1) (mg/l)	Leachate Quality Information Historically Used for POC Demonstrations in Texas (mg/l)[1]	Minimum Dilution Attenuation Factor
Arsenic	0.05	5.0	100
Barium	1.0	100.0	100
Benzene	0.005	0.814	163
Cadmium	0.01	1.0	100
Carbon tetrachloride	0.005	0.5	100
Chromium (hexavalent)	0.05	5.0	100
2,4-Dichlorophenoxy acetic acid	0.1	10.0	100
1,4-Dichlorobenzene	0.075	7.5	100
1,2-Dichloroethane	0.005	0.5	100
1,1-Dichloroethylene	0.007	0.7	100
Endrin	0.0002	0.05	250
Fluoride	4		
Lindane	0.004	0.4	100
Lead	0.05	5.0	100
Mercury	0.002	0.2	100
Methoxychlor	0.1		
Nitrate	10		
Selenium	0.01	1.0	100
Silver	0.05	5.0	100
Toxaphene	0.005	0.5	100
1,1,1-Trichloroethane	0.2		
Trichloroethylene	0.005	1.3	260
2,4,5-Trichlorophenoxy acetic acid	0.01	1.0	100
Vinyl Chloride	0.002	0.2	100

1. Estimated leachate concentration values reported from the Texas Water Commission Alternative Liner Design Handbook, August 1993.

The second data used to calculate the DAF is the Del Rio Landfill leachate concentration. Table 3-2 lists the MCL's listed in 330.331(a)(1) and the site-specific leachate constituent levels. The leachate constituent's concentration for the Del Rio Landfill are at or below the MCL's set forth in 330.331(a)(1). The leachate sampling was done in 2021 and the results are included in Appendix IIIK-D.

The highest listed DAF based on the site's leachate quality is 1, which indicates that Mercery, Toxaphene, and Selenium concentration would have to be reduced by a factor of 1 prior to the

constituent reaching the POC to meet the MCL listed in the TAC. The calculated DAF for the other constituents in Table 3-2 is less than one.

Table 3-2 – Chemical Constituent MCLs and Del Rio LF Leachate Quality

Constituent	MCL Listed in §330.331(a)(1) (mg/l)	Del Rio Landfill Leachate Quality Information (mg/l)	Minimum Dilution Attenuation Factor
Arsenic	0.05	0.010	
Barium	1.0	0.047	
Benzene	0.005	0.001	
Cadmium	0.01	0.005	
Carbon tetrachloride	0.005	0.001	
Chromium (hexavalent)	0.05	0.003	
2,4-Dichlorophenoxy acetic acid	0.1		
1,4-Dichlorobenzene	0.075	0.001	
1,2-Dichloroethane	0.005	0.001	
1,1-Dichloroethylene	0.007	0.001	
Endrin	0.0002	0.00005	
Fluoride	4	2.44	
Lindane	0.004		
Lead	0.05	0.005	
Mercury	0.002	0.002	1.00
Methoxychlor	0.1	0.00005	
Nitrate	10	0.2	
Selenium	0.01	0.010	1.00
Silver	0.05	0.010	
Toxaphene	0.005	0.005	1.00
1,1,1-Trichloroethane	0.2	0.001	
Trichloroethylene	0.005	0.001	
2,4,5-Trichlorophenoxy acetic acid	0.01	0.002	
Vinyl Chloride	0.002	0.001	

4 SITE GEOLOGY

Multiple site investigations have been conducted at the Del Rio Landfill facility to characterize the subsurface conditions at the site. A summary of the borings from the previous and current site investigation is included in Table 2-2 of Appendix IIIJ. The subsurface investigations reveal that the subsurface materials at the site can be divided into three strata. The properties of these strata are described in the following sections.

4.1.1 Stratum I

Stratum I consists of silty clays with some sand and gravel. This layer is a "topsoil" zone and likely is a residual soil intermixed with erosional remnants of the overlaying Buda Limestone. This layer is very thin (1.5 to 4.5 feet) and absent in some areas of the site.

4.1.2 Stratum II

Stratum II consists of caliche and clay soils with some gravel content. Clay is the predominant constituent. The caliche is a cementitious material, primarily calcium carbonate, and is intermixed with the soil or as thin hard interbedded layers. This layer is also fairly thin (2.0 to 11.0 feet) and absent in some areas of the site.

4.1.3 Stratum III

Stratum III consists of clay and weathered shale, grading into unweathered shale, containing some limestones/siltstone seams, caliche, and gypsum. These soils comprise the Del Rio Clay formation.

5 HYDROGEOLOGY AND GROUNDWATER CHARACTERISTICS

5.1 Regional Aquifers

The Supplemental Geotechnical Information dated November 1994, recharge to the Edwards aquifer occurs north of the City of Del Rio where precipitation enters the Edwards aquifer through fracture networks, faults and/or karst features. Water that does not reach the subsurface runs off, evaporates and is lost to evapotranspiration.

The uppermost transmissive unit of the Edwards aquifer is the Salmon Peak formation, which represents the first perennial aquifer. Upper 80 feet characterized as granular with abundant caprinids (extinct bivalves) and other shell fragments, cross-bedded. The lower portion is described as consisting of low permeability mudstone with abundant masses of chert. Regionally, the hydraulic relationship between the Edwards and the Trinity aquifers is variable and complex. Throughout much of the Edwards Plateau, the Edwards Aquifer is hydraulically connected to the underlying Trinity Aquifer and is mapped as the Edwards-Trinity (Plateau) Aquifer by the Texas Water Development Board.

Regional groundwater flow is towards the south-southeast at a hydraulic gradient of about 0.011 feet/foot (61 feet/mile). Locally, groundwater flow is controlled by dissolution channels formed preferentially along bedding planes, joints, and fractures. Flow may also be influenced by localized pumping.

5.2 Site Hydrogeology

5.2.1 1986 and 1994 Groundwater Investigation

The uppermost (perennial) aquifer was evaluated during the 1986 Raba-Kistner geotechnical investigation by for the site. During this investigation a deep test boring was drilled to a total depth of 162 feet to evaluate the Salmon Peak limestone, the recognized upper transmissive unit of the Edwards Aquifer.

When deep boring B-3 was drilled during the 1986 Raba-Kistner investigation the portion of the unit that was drilled was not saturated, suggesting the upper porous and permeable part of the Salmon Peak is absent and only the lower, less permeable portion remains at this location. Deep boring B-3 penetrated the top of the Salmon Peak at a depth of 135 feet below grade (910 ft-msl). No groundwater was encountered or otherwise noted to be present in the formation at the time of drilling.

In March 1994, four piezometers were installed to monitor the groundwater activities around the site. All the piezometers were dry on drilling and remained dry over the observation period. In the Supplemental Geotechnical Information dated November 1994 prepared by Trinity Engineering Testing Corporation (included in Appendix IIIJ-C), calculations were made to estimate the top elevations of the Salmon Peak and the thickness of the Del Rio Clay at five locations within the landfill site. The calculated average thickness of the Del Rio Clay based on the five locations is 130.8 ft (refer to Table 3-1 in Appendix IIIJ). Based on the soil characterization of the Del Rio clay and the dry climate in the region the geotechnical report concluded that there is no groundwater at the site in the weathered-unweathered Del Rio Clay transition.

5.2.2 Groundwater Waiver

An Alternative Liner Demonstration permit modification was submitted for the site in 1994. A groundwater monitoring waiver was requested as part of alternative liner permit modification. As mentioned above the two site investigations (1986 and 1994) concluded that there was no shallow

groundwater system in the Del Rio Clay. The alternative liner and the groundwater waiver request were granted to the City in December 1994.

The City is currently requesting to extend the groundwater waiver as part of this Major Permit Amendment Application. Refer to Appendix IIIN for the No Migration Demonstration.

6 POINT OF COMPLIANCE DEMONSTRATION

This section describes the point of compliance (POC) demonstration using (1) the Hydrologic Evaluation of Landfill Performance (HELP) model to estimate leachate percolation through the liner in the pre-Subtitle D and Subtitle D areas and (2) Multimedia Exposure Assessment (Multimed) to perform pollutant fate and transport simulations between the landfill and the point of compliance. The following subsections discuss the POC demonstration methods using the HELP and Multimed models.

6.1 HELP Model Demonstration

6.1.1 HELP Model

The HELP Model, Version 4.0, is a quasi-two-dimensional hydrologic model of water movement across, into, through, and out of the landfill. The model uses climate, soil, and landfill design data to perform a solution technique that accounts for the effects of surface storage, run-off, infiltration, percolation, soil moisture storage, evapotranspiration, and lateral drainage. The HELP Model was used to estimate the rate of percolation through the various areas of the landfill. The percolation rate was determined for various landfill configurations as discussed in Section 6.1.2.

6.1.2 HELP Model Input

HELP Model simulations were performed to obtain percolation rates for each of the areas and conditions listed below. Table 6-1 summarizes the landfill configurations modeled using HELP.

Table 6-1 – Landfill Conditions Modeled in HELP

Area	Interim Condition 23-Year Timeframe	Closed Condition 30-Year Timeframe
Subtitle D Area	50 feet of waste with intermediate cover	80 feet of waste with final cover
Pre-Subtitle D with Overliner Area	60 feet of waste with intermediate cover	60 feet of waste with final cover

Additional HELP Model input information is provided in Appendix IIIK-A. The HELP Model Summary Sheets and output files are also provided in Appendix IIIK-A.

6.2 MULTIMED Model Demonstration

The Environmental Protection Agency's Multimedia Exposure Assessment Model (MULTIMED) for exposure assessment simulates the movement of contaminants leaching from a landfill. The model consists of a number of modules which predict concentrations at a receptor due to transport in the subsurface, surface water, or air. When applying MULTIMED to Subtitle D facilities, the landfill, surface water, and air modules in the model are not accessible by the user; only flow and transport through the unsaturated zone and transport in saturated zone can be considered. A steady-state, one-dimensional, semi-analytical module simulates flow in the unsaturated zone. The output from this module, water saturation as a function of depth, is used as input to the unsaturated zone transport module. The latter simulates transient, one-dimensional (vertical) transport in the unsaturated zone and includes the effects of longitudinal dispersion, linear adsorption, and first-order decay. The unsaturated zone transport module calculates steady-state or transient contaminant concentrations. Output from both unsaturated zone modules is used to couple the unsaturated zone transport module with the steady-state or transient,

semi-analytical saturated zone transport module. The latter includes one-dimensional uniform flow, three-dimensional dispersion, linear adsorption, first-order decay, and dilution due to direct infiltration into the groundwater plume.

The MULTIMED Model Version 2.00 was used to assess contaminant fate and transport between the landfill base and the POC. MULTIMED was developed by the Athens Environmental Research Laboratory for the EPA. MULTIMED estimates the capacity of the hydrogeologic system modeled to dilute and attenuate contaminant concentrations.

6.2.1 Description of Model Input

As mentioned above MULTIMED will be used to demonstrate that the predicted concentrations of selected leachate chemical constituents do not exceed maximum contaminant levels in the uppermost aquifer at the POC. Multiple MULTIMED model-runs were made to illustrate the sensitivity of the model to various input parameters. These sensitivity models were then compared to the base model to determine which input parameters have the biggest impact on the calculated DAF.

The general overall system inputs for all the MULTIMED models are as follows:

1. The “Subtitle D” option was selected for the application type.

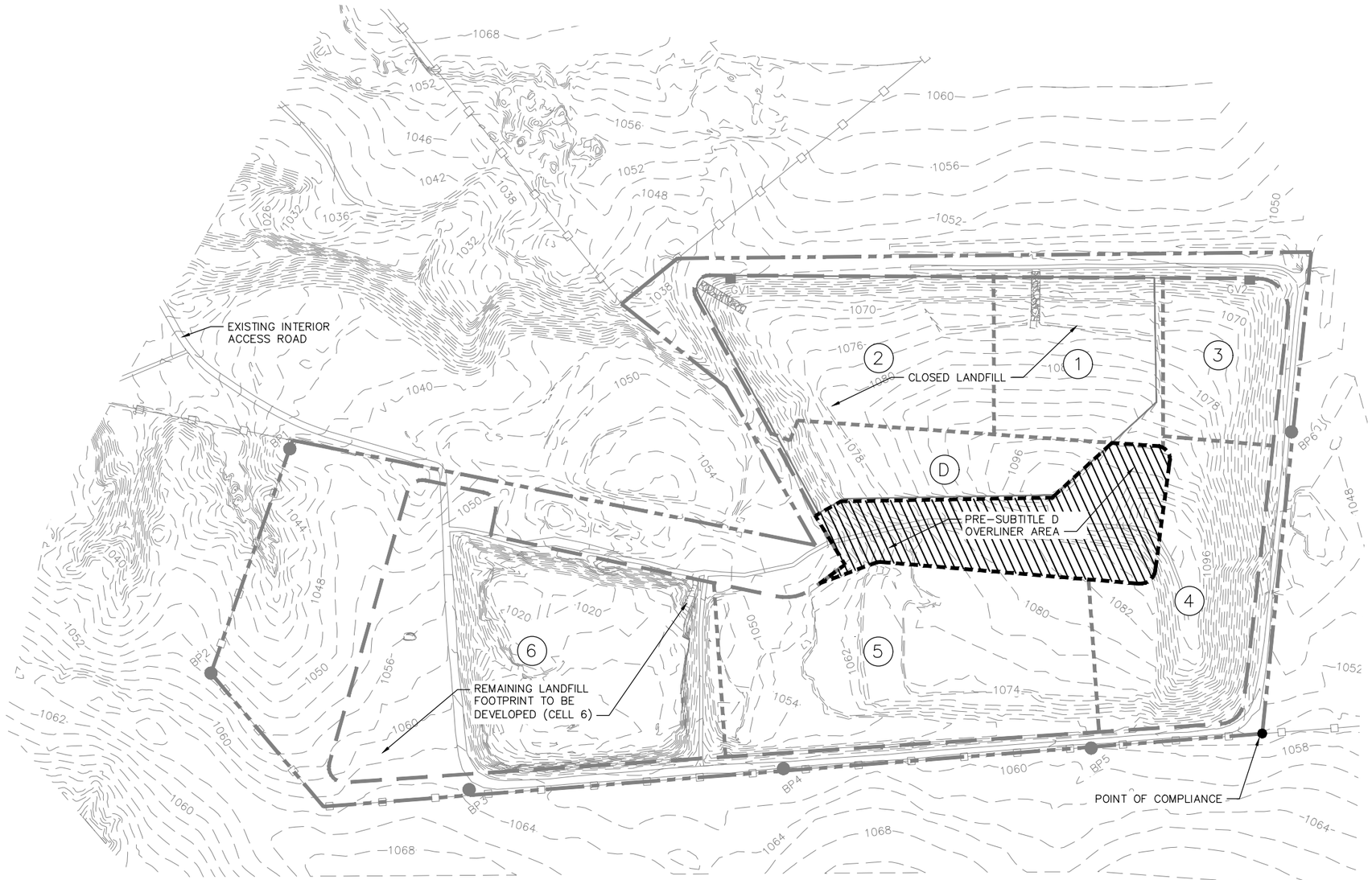
2. Saturated zone module was selected.

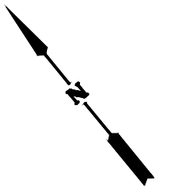
3. The model was run in deterministic mode because there is insufficient site data available to determine statistical distributions using the Monte Carlo simulation.

4. The model was run in steady state mode to satisfy the study objective.

Base Model

The base model inputs were based on site-specific data or were conservative. The MULTIMED base model input parameters are detailed in below. A normalized distribution of zero was used for the chemical input variable to simulate no chemical decay. By assuming the leachate does not undergo adsorption, biodegradation, and decay, a single MULTIMED simulation accounts for all 24 constituents identified by the EPA as required by the landfill design protection criteria. The distribution coefficient was derived by MULTIMED. The other chemical specific data were either not used or derived by the program as shown in Table 6-2.





LEGEND

- PERMIT BOUNDARY
- LIMIT OF WASTE
- CELL BOUNDARY
- CLOSED CELL BOUNDARY
- EXISTING SITE FENCE
- 1050 EXISTING CONTOURS
- (1) CELL DESIGNATION
- BP1 GAS PROBE
- EXISTING CHUTE

NOTES:

1. THIS MAP WAS DEVELOPED BY DALLAS AERIAL SERVICES, INC. BASED ON PHOTOGRAPHS TAKEN APRIL 13, 1994, AND ON SURVEYS MADE BY TIERRA SURVEYING SERVICES ON MAY 12, 2003. CELLS 1,2,3,4 & D TOP UPDATED AUGUST 2018 AND CELLS 6 AND 6 UPDATED JANUARY 2020 BY BAIN MEDINA BAIN SURVEYORS. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP STANDARDS. THE ELEVATIONS SHOWN ON THIS MAP ARE FOR THE CONTRACTORS GENERAL INFORMATION, ACTUAL ELEVATIONS VARY DUE TO ON-GOING LANDFILL ACTIVITIES.
2. PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY TIERRA SURVEYING SERVICES, 400 AVENUE 2, DEL RIO, TEXAS (830) 774-0796. DATED: 10-25-94.
3. CELLS 1, 2 AND A SECTION OF THE PRE-SUBTITLE D WERE APPROVED FOR CLOSURE 2013 BY TCEQ.

FOR PERMITTING PURPOSES ONLY

CP&Y, INC.
TEXAS REGISTERED ENGINEERING FIRM F-1741

CITY OF DEL RIO

4/16/2022

STATE OF TEXAS — TEMOBISTA METAFERIA — 123183 — LICENSED PROFESSIONAL ENGINEER

NO.	REVISION	BY	DATE
1.	1ST NOD – NEW DRAWING	TM	05/2021
2.	2ND NOD	TM	10/2021

VERIFY SCALE BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE
0 1"

CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

SITE PLAN
POINT OF COMPLIANCE

Date: MAY 2021
Designed: T. METAFERIA
Drawn: J. TORRES
Reviewed: B. HINDMAN, P.E.
CP&Y Proj. No: DELR1900546

FIGURE
7.1

REFERENCES: DELR1900546_ECBASE.dwg DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS.dwg DELR1900546_ECBASE_LF AREA COMPOSITE Oct 21, 2021 - 10:19am C:\pwworking\cpy\pw_cpy\tmetaferia\d0854221\DELR1900546 Figure 7.1.dwg LAYOUT: Layout1 USER:

Table 6-2 – Chemical Specific Data

Variable Name	Unit	Value	Comments
Solid phase decay coefficient	1/yr	0	Not used
Dissolved phase decay coefficient	1/yr	0	Not used
Chemical decay coefficient	1/yr	0	Not used
Acid catalyst hydrolysis constant	l/m-yr	0	Not used
Neutral hydrolysis rate constant	1/yr	0	Not used
Base catalyst hydrolysis constant	l/m-yr	0	Not used
Reference temperature	C	25	Not used
Normalized distribution coefficient	ml/g	0	Simulation is steady state, with no chemical decay
Distribution coefficient	ml/g		Derived by MULTIMED.
Biodegradation coefficient	1/yr	0	Biodegradation not allowed by TCEQ

Site specific data was used to determine the source specific variables in the model. Tabel 6-3 lists the source specific data used for the base model. The infiltration rate is the net amount of leachate that percolates into the aquifer system from the landfill.

As noted in Section 6.1, the HELP model was used to estimate the infiltration rate of the Del Rio Landfill. The HELP models for the infiltration rate are included in Appendix IIIK-A. The recharge rate is the net amount of water that percolates directly into the aquifer system outside of the land disposal facility. The recharge is assumed to have no contamination and hence dilutes the groundwater contaminate plume. The HELP model was also used to calculate the rainfall recharge rate for the Del Rio Clay. The HELP output is included in Appendix IIIK-B.

The limits of waste, which is approximately 79 acres, was used to set the area of disposal unit in the module. Since the area of the disposal unit was identified, the length and width of the scale of the facility were derived by MULTIMED. The initial concentration at landfill was set to one as is typical when calculating the DAF.

Table 6-3 – Source Specific Data

Variable Name	Unit	Value	Comments
Infiltration rate	m/yr	1.7×10^{-4}	Derived from HELP (Appendix IIIK-A)
Area of disposal unit	m^2	320,000	Limits of waste area
Spread of contaminant source	m	-	Derived by MULTIMED.
Recharge rate	m/yr	0.0282	Derived from HELP (Appendix IIIN-B)
Initial concentration at landfill	mg/l	1.0	Set at 1.0 to find DAF
Length scale of facility	m	-	Derived by MULTIMED.
Width scale of facility	m	-	Derived by MULTIMED.

The last module of inputs for the MULTIMED model is the aquifer specific parameters. The aquifer porosity, bulk density, and hydraulic conductivity are all obtained from Appendix E of the July 1994 TETCO Geotechnical Report. The particle diameter was obtained using Table 6-10 of the Manual for the Multimedia Exposure Assessment Model. Although the particle diameter is specified in the model it is not used for calculation since the aquifer porosity has been specified. The well distance is set to 100 feet at the POC. The other values in this module were derived by MULTIMED as shown in Table 6-4.

Table 6-4 – Aquifer Specific Data

Variable Name	Unit	Value	Comments
Particle diameter	cm	0.025	Obtained from Table 6-10 of the Manual for the Multimedia Exposure Assessment Model.
Aquifer porosity	unitless	0.10	Obtained from the TETCO Geotechnical Report
Bulk density	g/cc	2.40	Obtained from the TETCO Geotechnical Report
Aquifer thickness	m	91.4	Thickness of the Salmon Peak. Obtained from the TETCO Geotechnical Report. See Figure 3-1 in this appendix.
Mixing zone depth	m		Derived by MULTIMED.
Hydraulic conductivity	m/yr	100	Obtained from the TETCO Geotechnical Report (50 to 500 m/yr)
Hydraulic gradient	unitless	0.011	Section 4.1 of Appendix IIIN.
Groundwater seepage velocity	m/yr		Derived by MULTIMED.
Retardation coefficient	unitless	-	Derived by MULTIMED.
Longitudinal dispersity	m	-	Derived by MULTIMED.
Transversal dispersity	m	-	Derived by MULTIMED.
Vertical dispersity	m	-	Derived by MULTIMED.
Organic carbon content	%	0.003	Conservative assumption.
Receptor well distance	m	30	POC as shown in Figure 7.1

6.2.2 Sensitivity Analysis

The conservative base model, described in Section 6.2.1, was altered to test the sensitivity to the following parameters:

- Aquifer hydraulic conductivity (Aquifer Module)
- Aquifer thickness (Aquifer Module)
- Aquifer porosity (Aquifer Module)
- Hydraulic gradient (Aquifer Module)
- Receptor well distance/distance to POC (Aquifer Module)
- Infiltration rate (Source Module)
- Recharge rate (Source Module)

The base model calculated DAF is 290. Table 6-5 shows the input parameters that were altered to test the model sensitivity. Two values were selected for each parameter shown in Table 6-5 to test the sensitivity of the model. One value being higher and one being lower than the number being used in the base model.

Table 6- 5– Sensitivity of Parameters to DAF

Variable Name	Sensitivity Values	DAF*
Aquifer hydraulic conductivity	50 m/yr	147
	150 m/yr	434
Aquifer thickness	50 m	243
	125 m	289
Aquifer porosity	0.05	290
	0.506	290
Hydraulic gradient	0.024 ft/ft	630
	0.006 ft/ft	160
Receptor well distance	24.4 m	290
	36.6 m	291
Infiltration rate	2.5×10^{-4} m/yr	198
	7.0×10^{-5} m/yr	705
Recharge rate	0.01820 m/yr	290
	0.0382 m/yr	291

*The base model DAF is 290.

The base model was varied 15 times to evaluate the sensitivity to various model parameters shown in Table 6-5. Aquifer hydraulic conductivity, hydraulic gradient, and infiltration rate were the three parameters that impacted the DAF calculations the most. The hydraulic conductivity was varied by a magnitude of 50 meters to test the sensitivity of the model. The increase in hydraulic conductivity leads to a high DAF since most of dilution occurs beneath the landfill and the high hydraulic conductivity leads to higher Darcy flux. The change in the hydraulic gradient input also considerably varied the DAF calculations. The low hydraulic gradient means low water flow resulting in a low DAF. A fast-moving water flow (high hydraulic gradient) results in a high DAF, because the dilution beneath the landfill increases faster than dilution in the aquifer. The last parameter that impacted the DAF was the infiltration rate. As the infiltration rate increases the DAF decreased due to the increased amount of contaminates in the water. The aquifer thickness, aquifer porosity, receptor well distance, and recharge rate did not significantly impact the DAF. The output files for the MULTIMED runs are included in Appendix IIIK-C.

7 MODEL INPUT PARAMETERS

Appendices IIIK-A through IIIK-C present detailed information about the HELP and MULTIMED models and liner leakage calculations. Conservative assumptions were made in determining the recharge rate, percolation rate, and the dilution attenuation factor (DAF). The results of the leachate generation model utilizing the HELP Model are included in Appendix IIIK-A. The HELP model input parameters for determining the recharge rate through the Del Rio Clay and percolation is detailed in Appendix IIIK-B.

The MULTIMED model input parameters are detailed in Appendix IIIK-C. The POC for this demonstration is shown on Figure 7.1. The POC as defined by §330.3(108) is a vertical surface located no more than 500 feet from the hydraulically downgradient limit of the waste management unit boundary, extending down

through the uppermost aquifer underlying the regulated units, and located on land owned by the owner of the facility. The groundwater flow direction at the site is south-southeast. Therefore, the POC was selected to be down gradient of the existing limit of waste at the permit boundary.

8 RESULTS AND CONCLUSIONS

As shown in the HELP Model Summary Sheets included in Appendix IIIK-A (pages IIIK-A-4A and IIIK-A-4B) the approved alternative liner containment design has the highest leachate percolation compared to the overliner. The liner leakage rate estimated using the HELP model was used as an infiltration rate input in the MULTIMED model in conjunction with the recharge rate, calculated in Appendix IIIK-B, to evaluate the performance of the approved alternate liner system design by estimating constituent concentrations at the POC. The constituent concentrations at the base of the landfill liner and at the POC were used to calculate the DAF. The approved alternate liner must provide a DAF of 260 at the point of compliance.

The results of the alternate liner design base model demonstration are provided below:

- POC distance = 100 ft was used in the model as shown in Figure 7.1.
- Liner leakage rate from HELP model = 1.7×10^{-4} m/yr (this value was used as infiltration rate input into the MULTIMED models)
- DAF = 290

Table 6-5 shows the all the MULTIMED simulations that were run for this project with the different parameters. As shown in the Table 6-5 the simulations all demonstrate compliance with the minimum dilution factor required for an alternative liner demonstration. The DAF values from the different simulations range from 147 to 705. It should also be noted that the leachate quality at Del Rio Landfill, as shown in Table 3-2, is at or lower than the MCL values set in 330.331(a)(1). The predicted concentrations of the selected leachate chemical constituents do not exceed maximum contaminant levels in the perched groundwater zone at the point of compliance for either the approved alternate liner or the pre-Subtitle D overliner areas.

APPENDIX IIIK-A

LEACHATE GENERATION MODEL



LEACHATE GENERATION MODEL

HELP MODEL

The Hydrologic Evaluation of Landfill Performance (HELP) Model, Version 4.0 was used to estimate quantity of leachate that will be generated during the active life and post-closure period of the Del Rio Landfill. The HELP Model is a quasi-two-dimensional hydrologic model of water movement across, into, through, and out of the 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.

MODEL SETUP

The site was modeled as a 1-acre unit area for the following stages of landfill development in developed and undeveloped Subtitle D areas:

Table 1-1 – Landfill Conditions Modeled in HELP

Area	Interim Condition 23-Year Timeframe	Closed Condition 30-Year Timeframe
Subtitle D Area	50 feet of waste with intermediate cover	80 feet of waste with final cover
Pre-Subtitle D with Overliner Area	60 feet of waste with intermediate cover	60 feet of waste with final cover

The active stage was modeled for one year with intermediate or daily cover. The interim stages with intermediate cover were modeled for 23 years based on the approximate projected site life. The closed landfill condition was modeled for 30 years. The evaporative zone depth was selected to be 12 inches. The leaf area index was selected to be 2 for the interim cases and 4.5 for the closed case based on the selected ground area. The evaporative zone depth and leaf area index numbers were obtained from the Figures provided in Appendix F of EPA's Hydrologic Evaluation of landfill Performance: HELP 4.0 User Manual. The Soil Conservation Service (SCS) runoff curve numbers were calculated by HELP based on soil data and expected ground cover, surface slope, and slope length. The interim cases utilize the default curve number assigned by the HELP model which is 87.9 and corresponds to "fair" ground cover. The percent runoff area used varies between 80. This is representative of the intermediate cover, which will be 12 inches of compacted soil with 60 percent or more vegetation coverage as specified in Section 3 of Appendix IIIH-E (allows a soil loss up to 50 ton/acre-yr for intermediate cover which equates to 60 percent vegetation coverage). The final case models a curve number of 82 and percent runoff area of 100, which corresponds to "good" ground cover. This is representative of the final cover, which will have a minimum 90 percent vegetation coverage as specified in Section 2.2 of Appendix IIIE.

MOISTURE CONTENT AND FIELD CAPACITY

For a conservative analysis, HELP automatically sets the initial moisture content at field capacity. In addition, HELP automatically sets the initial moisture content for a compacted clay barrier layer at porosity (i.e., fully saturated). The initial moisture content for all profile layers was set to field capacity (HELP default) except the waste layer. The initial moisture content for the waste layer was selected to be 0.272. Typical data on the moisture content municipal solid waste components are shown in Tabel 1-2 and were obtained from *Solid Wastes Engineering Principles and Management Issues* written by George Tchobanoglous, Hilary Theisen, and Rolf Eliassen published in 1977. As shown in the Table, the typical value for municipal solid waste is 20% but can range between 15% to 40% depending on the composition of the wastes, the season of the year and the humidity and weather conditions. Due to the aird climate in the Del Rio region the moisture for the waste layer was modified from the field capacity value of 0.292 to 0.272. As shown in the table this is well above the typical value of moisture content for municipal solid waste.

Table 1-2 – Typical Data on Moisture Content of Municipal Solid Waste Components

Component	Moisture (%)	
	Range	Typical
Food waste	50 – 80	70
Paper	4 – 10	6
Cardboard	4 – 8	5
Plastics	1 – 4	2
Textiles	6 – 15	10
Rubber	1 – 4	2
Leather	8 – 12	10
Garden Trimmings	30 – 80	60
Wood	15 -40	20
Glass	1 – 4	2
Tin Cans	2 – 4	3
Nonferrous metals	2 – 4	2
Ferrous metals	2 – 6	3
Dirt, ashes, brick, etc.	6 – 12	8
Municipal solid waste	**15 -40**	**20**

Table was reproduced using Table 4-3 of the *Solid Wastes Engineering Principles and Management Issues* written by George Tchobanoglous, Hilary Theisen, and Rolf Eliassen published in 1977.

CLIMATE DATA INPUT

Precipitation data was synthetically simulated based on HELP V4 model program simulation using the latitude and longitude for Del Rio, Texas. The average annual precipitation over the modeled 30-year period was 18.19 inches. Temperature and solar radiation data were also synthetically generated by the HELP model using program defaults for Del Rio, Texas.

LANDFILL PROFILE

The landfill profiles for various stages of the landfill development are presented in the attached HELP Model summary sheets. The profile presented below includes a clay liner with a standard Subtitle D final cover system.

Liner Systems

The Subtitle D clay liner designed for developed and undeveloped cells consists of a 24-inch-thick compacted clay liner with a hydraulic conductivity of 1x10-7 cm/s. Default soil characteristics from the HELP model were selected for the compacted clay liner.

OverLiner Systems

The overliner system consists of a GCL and 40-mil LLDPE geomembrane. The geomembrane liner was modeled for a good quality installation quality, 4 construction defects per acre, and a production pinhole density of 1 hole/acre. Default soil characteristic from the HELP Model were selected for the LLDPE geomembrane hydraulic conductivity.

Leachate Collection System

Developed Subtitle D Cells 1 through 5 were constructed with an LCS that includes a 200-mil thick single-sided geocomposite (floor grades).

Waste Layers

A default wilting point was selected from HELP to represent municipal solid waste. The waste layer was modeled with a hydraulic conductivity of $1x10^{-3}$ cm/s, which is the default HELP number for MSW. The moisture content, field capacity, and porosity values were selected as discussed previously.

Intermediate Cover

The intermediate cover consists of a 12-inch-thick layer of soil placed over the waste. Default soil characteristics were selected from HELP to represent the available onsite soils with a hydraulic conductivity of $6.4x10^{-5}$ cm/s.

Final Cover

The final cover over the Subtitle D and pre-Subtitle D areas consists of a 12-inch erosion layer with the top 6 inches capable of sustaining growth of vegetation and an 18-inch infiltration layer. The infiltration layer consists of compacted soil with a hydraulic conductivity of $1x10^{-5}$ cm/s.

HELP MODEL OUTPUT

HELP Model Summary Sheet - Pre-Subtitle D Area

Client: City of Del Rio
Project: Major Permit Amendment
Description: HELP Model Summary Sheet

Date: 1/31/2022
Job No: DELR1900546
By: T. Metaferia
Checked By: B. Hindman

		INTERIM (60 FT WASTE)	FINAL (60 FT WASTE)
GENERAL INFORMATION	Case No.	1	2
	No. of Years	23	30
	SCS Runoff Curve No.	87.9	82
	Model Area (acre)	1	1
	Runof Area (%)	80	100
	Maximum Leaf Area Index	2	4.5
	Evaporative Zone Depth (inch)	10	12
FINAL COVER	Thickness (in)		12
(TEXTURE = 10)	Porosity (vol/vol)		0.398
	Field Capacity (vol/vol)		0.244
	Wilting Point (vol/vol)		0.136
	Init. Moisture Content (vol/vol)		0.244
	Hyd. Conductivity (cm/s)		1.20E-04
DRAINAGE LAYER	Thickness (in)		18
(TEXTURE = 16)	Porosity (vol/vol)		0.427
	Field Capacity (vol/vol)		0.418
	Wilting Point (vol/vol)		0.367
	Init. Moisture Content (vol/vol)		0.427
	Hyd. Conductivity (cm/s)		1.00E-07
INTERMEDIATE COVER	Thickness (in)	12	12
(TEXTURE = 11)	Porosity (vol/vol)	0.464	0.464
	Field Capacity (vol/vol)	0.31	0.31
	Wilting Point (vol/vol)	0.187	0.187
	Init. Moisture Content (vol/vol)	0.31	0.31
	Hyd. Conductivity (cm/s)	6.40E-05	6.40E-05
WASTE	Thickness (in)	120	120
(TEXTURE =18)	Porosity (vol/vol)	0.671	0.671
	Field Capacity (vol/vol)	0.292	0.292
	Wilting Point (vol/vol)	0.077	0.077
	Init. Moisture Content (vol/vol)	0.272	0.272
	Hyd. Conductivity (cm/s)	1.00E-03	1.00E-03
PROTECTIVE COVER	Thickness (in)	24	24
(TEXTURE = 10)	Porosity (vol/vol)	0.398	0.398
	Field Capacity (vol/vol)	0.244	0.244
	Wilting Point (vol/vol)	0.136	0.136
	Init. Moisture Content (vol/vol)	0.244	0.244
	Hyd. Conductivity (cm/s)	1.20E-04	1.20E-04
LEACHATE COLLECTION LAYER	Thickness (in)	0.3	0.3
(TEXTURE = 44)	Porosity (vol/vol)	0.85	0.85
	Field Capacity (vol/vol)	0.01	0.01
	Wilting Point (vol/vol)	0.005	0.005
	Init. Moisture Content (vol/vol)	0.01	0.01
	Hyd. Conductivity (cm/s)	7.67	7.67
	Slope (%)	0.5	0.5
	Slope Length (ft)	500	500
FLEXIBLE MEMBRANE LINER	Thickness (in)	0.04	0.04
(TEXTURE = 35)	Hyd. Conductivity (cm/s)	4.00E-13	4.00E-13
	Pinhole Density (holes/acre)	1	1
	Install. Defects (holes/acre)	4	4
	Placement Quality	3	3
SUBGRADE SOIL LAYER	Thickness (in)	12	12
(TEXTURE = 11)	Porosity (vol/vol)	0.464	0.464
	Field Capacity (vol/vol)	0.31	0.31
	Wilting Point (vol/vol)	0.187	0.187
	Init. Moisture Content (vol/vol)	0.31	0.31
	Hyd. Conductivity (cm/s)	6.40E-05	6.40E-05
WASTE	Thickness (in)	600	600
(TEXTURE =18)	Porosity (vol/vol)	0.671	0.671
	Field Capacity (vol/vol)	0.292	0.292
	Wilting Point (vol/vol)	0.077	0.077
	Init. Moisture Content (vol/vol)	0.272	0.272
	Hyd. Conductivity (cm/s)	1.00E-03	1.00E-03
BARRIER SOIL LAYER	Thickness (in)	36	36
(TEXTURE = 29)	Porosity (vol/vol)	0.451	0.451
	Field Capacity (vol/vol)	0.419	0.419
	Wilting Point (vol/vol)	0.332	0.332
	Init. Moisture Content (vol/vol)	0.451	0.451
	Hyd. Conductivity (cm/s)	6.80E-07	6.80E-07
PRECIPITATION	Average Annual (in)	16.99	18.19
RUNOFF	Average Annual (in)	0.374	0.202
EVAPOTRANSPIRATION	Average Annual (in)	16.131	17.940
PRECOLATION	Average Annual (cf/yr)	0.000	0.000
THROUGH BOTTOM LINE	Average Annual (mm/yr)	0.000	0.000
HEAD OF LINER	Average Annual (in)	0.000	0.000
	Average Daily (in)	0.000	0.000

HELP Model Summary Sheet - Subtitle D

Client: City of Del Rio
Project: Major Permit Amendment
Description: HELP Model Summary Sheet

Date: 1/31/2022
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

		INTERIM (50 FT WASTE)	CLOSED (80 FT WASTE)
GENERAL INFORMATION	Case No.	1	2
	No. of Years	23	30
	SCS Runoff Curve No.	87.9	82
	Model Area (acre)	1	1
	Runof Area (%)	80	100
	Maximum Leaf Area Index	2	4.5
	Evaporative Zone Depth (inch)	10	12
TOPSOIL LAYER	Thickness (in)		12
(TEXTURE = 10)	Porosity (vol/vol)		0.398
	Field Capacity (vol/vol)		0.244
	Wilting Point (vol/vol)		0.136
	Init. Moisture Content (vol/vol)		0.244
	Hyd. Conductivity (cm/s)		1.20E-04
INFILTRATION LAYER	Thickness (in)		18
(TEXTURE = 0)	Porosity (vol/vol)		0.427
	Field Capacity (vol/vol)		0.418
	Wilting Point (vol/vol)		0.367
	Init. Moisture Content (vol/vol)		0.427
	Hyd. Conductivity (cm/s)		1.00E-07
INTERMEDIATE COVER	Thickness (in)	12	12
(TEXTURE = 11)	Porosity (vol/vol)	0.464	0.464
	Field Capacity (vol/vol)	0.31	0.31
	Wilting Point (vol/vol)	0.187	0.187
	Init. Moisture Content (vol/vol)	0.31	0.31
	Hyd. Conductivity (cm/s)	6.40E-05	6.40E-05
WASTE TOP[1]	Thickness (in)	600	960
(TEXTURE = 0)	Porosity (vol/vol)	0.671	0.671
	Field Capacity (vol/vol)	0.292	0.292
	Wilting Point (vol/vol)	0.077	0.077
	Init. Moisture Content (vol/vol)	0.272	0.272
	Hyd. Conductivity (cm/s)	1.00E-03	1.00E-03
PROTECTIVE COVER	Thickness (in)	24	24
(TEXTURE = 10)	Porosity (vol/vol)	0.398	0.398
	Field Capacity (vol/vol)	0.244	0.244
	Wilting Point (vol/vol)	0.136	0.136
	Init. Moisture Content (vol/vol)	0.244	0.244
	Hyd. Conductivity (cm/s)	1.20E-04	1.20E+04
LEACHATE COLLECTION LAYER	Thickness (in)	0.30	0.30
(TEXTURE = 0)	Porosity (vol/vol)	0.85	0.85
	Field Capacity (vol/vol)	0.01	0.01
	Wilting Point (vol/vol)	0.005	0.005
	Init. Moisture Content (vol/vol)	0.01	0.01
	Hyd. Conductivity (cm/s)	2.05	2.05
	Slope (%)	2	2
	Slope Length (ft)	200	200
CLAY LINER	Thickness (in)	24	24
(TEXTURE = 0)	Porosity (vol/vol)	0.427	0.427
	Field Capacity (vol/vol)	0.418	0.418
	Wilting Point (vol/vol)	0.367	0.367
	Init. Moisture Content (vol/vol)	0.427	0.427
	Hyd. Conductivity (cm/s)	1.00E-07	1.00E-07
PRECIPITATION	Average Annual (in)	16.99	18.19
RUNOFF	Average Annual (in)	0.374	0.202
EVAPOTRANSPIRATION	Average Annual (in)	16.130	17.940
PRECOLATION	Average Annual (cf/yr)	24.2	0.000
THROUGH BOTTOM LINE	Average Annual (mm/yr)	0.170	0.000
HEAD OF LINER	Average Annual (in)	0.000	0.000
	Peak Daily (in)	0.016	0.000

1. The field capacity and porosity values for the waste layer were obtained from: Zornberg, Jorge G. et. al, Retention of Free Liquids in Landfills Undergoing Vertical Expansion. Journal of Geotechincal and Geoenvironmental Engineering, July 1999, pp. 583-594.

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: Del Rio LF 60ft PreSub Interim **Simulated On:** 5/04/2022 16:22

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
CL - Clay Loam
Material Texture Number 11

Thickness	=	12	inches
Porosity	=	0.464	vol/vol
Field Capacity	=	0.31	vol/vol
Wilting Point	=	0.187	vol/vol
Initial Soil Water Content	=	0.31	vol/vol
Effective Sat. Hyd. Conductivity	=	6.40E-05	cm/sec

Layer 2

Type 1 - Vertical Percolation Layer (Waste)
Municipal Solid Waste (MSW) (900 pcy)
Material Texture Number 18

Thickness	=	120	inches
Porosity	=	0.671	vol/vol
Field Capacity	=	0.292	vol/vol
Wilting Point	=	0.077	vol/vol
Initial Soil Water Content	=	0.272	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-03	cm/sec

Layer 3

Type 1 - Vertical Percolation Layer
SCL - Sandy Clay Loam
Material Texture Number 10

Thickness	=	24	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.244	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 4

Type 2 - Lateral Drainage Layer
Lateral Drainage Layer

Material Texture Number 44

Thickness	=	0.3	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	7.67E+00	cm/sec
Slope	=	0.5	%
Drainage Length	=	500	ft

Layer 5

Type 4 - Flexible Membrane Liner

LDPE Membrane

Material Texture Number 36

Thickness	=	0.04	inches
Effective Sat. Hyd. Conductivity	=	4.00E-13	cm/sec
FML Pinhole Density	=	1	Holes/Acre
FML Installation Defects	=	4	Holes/Acre
FML Placement Quality	=	3	Good

Layer 6

Type 1 - Vertical Percolation Layer

CL - Clay Loam

Material Texture Number 11

Thickness	=	12	inches
Porosity	=	0.464	vol/vol
Field Capacity	=	0.31	vol/vol
Wilting Point	=	0.187	vol/vol
Initial Soil Water Content	=	0.31	vol/vol
Effective Sat. Hyd. Conductivity	=	6.40E-05	cm/sec

Layer 7

Type 1 - Vertical Percolation Layer (Waste)

Municipal Solid Waste (MSW) (900 pcy)

Material Texture Number 18

Thickness	=	600	inches
Porosity	=	0.671	vol/vol
Field Capacity	=	0.292	vol/vol
Wilting Point	=	0.077	vol/vol
Initial Soil Water Content	=	0.272	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-03	cm/sec

Layer 8

Type 3 - Barrier Soil Liner

C (Moderate)
Material Texture Number 29

Thickness	=	36	inches
Porosity	=	0.451	vol/vol
Field Capacity	=	0.419	vol/vol
Wilting Point	=	0.332	vol/vol
Initial Soil Water Content	=	0.451	vol/vol
Effective Sat. Hyd. Conductivity	=	6.80E-07	cm/sec

Note: Initial moisture content of the layers and snow water were specified by the user.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	87.9	
Fraction of Area Allowing Runoff	=	80	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	10	inches
Initial Water in Evaporative Zone	=	3.1	inches
Upper Limit of Evaporative Storage	=	4.64	inches
Lower Limit of Evaporative Storage	=	1.87	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	225.375	inches
Total Initial Water	=	225.375	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	29.73	Degrees
Maximum Leaf Area Index	=	2	
Start of Growing Season (Julian Date)	=	0	days
End of Growing Season (Julian Date)	=	367	days
Average Wind Speed	=	3.3	mph
Average 1st Quarter Relative Humidity	=	68	%
Average 2nd Quarter Relative Humidity	=	67	%
Average 3rd Quarter Relative Humidity	=	70	%
Average 4th Quarter Relative Humidity	=	49	%

Note: Evapotranspiration data was obtained for Del Rio, Texas

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
0.549708	0.841705	1.223631	1.049101	2.37765	2.193677
1.466374	1.825726	1.993245	1.884501	1.088813	0.493228

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
59	57.9	71.7	78.7	88.9	90.6
95.2	95.4	89.4	79	73.2	63.7

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Average Annual Totals Summary

Title: Del Rio LF 60ft PreSub Interim
Simulated on: 5/04/2022 16:23

	Average Annual Totals for Years 1 - 23*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	16.99	[3.08]	61,664.1	100.00
Runoff	0.374	[0.293]	1,357.2	2.20
Evapotranspiration	16.131	[2.974]	58,555.4	94.96
Subprofile1				
Lateral drainage collected from Layer 4	0.4312	[0.5647]	1,565.3	2.54
Percolation/leakage through Layer 5	0.000434	[0.000557]	1.5755	0.00
Average Head on Top of Layer 5	0.0027	[0.0036]	---	---
Subprofile2				
Percolation/leakage through Layer 8	0.000000	[0]	0.0000	0.00
Average Head on Top of Layer 8	0.0000	[0]	---	---
Water storage				
Change in water storage	0.0513	[0.3537]	186.2	0.30

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: Del Rio LF 60ft PreSub Interim
Simulated on: 5/04/2022 16:23

	Peak Values for Years 1 - 23*		
	(inches)		(cubic feet)
Precipitation	3.09		11,213.0
Runoff	1.031		3,743.0
Subprofile1			
Drainage collected from Layer 4	0.0923		334.9
Percolation/leakage through Layer 5	0.000078		0.2837
Average head on Layer 5	0.2122		---
Maximum head on Layer 5	0.4044		---
Location of maximum head in Layer 4	23.44	(feet from drain)	
Subprofile2			
Percolation/leakage through Layer 8	0.000000		0.0000
Average head on Layer 8	0.0000		
Other Parameters			
Snow water	0.7109		2,580.5
Maximum vegetation soil water	0.4167	(vol/vol)	
Minimum vegetation soil water	0.1870	(vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: Del Rio LF 60ft PreSub Interim
Simulated on: 5/04/2022 16:24
Simulation period: 23 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	2.4899	0.2075
2	35.0400	0.2920
3	5.8560	0.2440
4	0.0030	0.0100
5	0.0000	0.0000
6	3.6301	0.3025
7	163.2998	0.2722
8	16.2360	0.4510
Snow water	0.0000	---

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: Del Rio LF 60ft PreSub Final **Simulated On:** 5/04/2022 16:24

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
SCL - Sandy Clay Loam
Material Texture Number 10

Thickness	=	12	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.244	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 2

Type 3 - Barrier Soil Liner
Liner Soil (High)
Material Texture Number 16

Thickness	=	18	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Layer 3

Type 1 - Vertical Percolation Layer
CL - Clay Loam
Material Texture Number 11

Thickness	=	12	inches
Porosity	=	0.464	vol/vol
Field Capacity	=	0.31	vol/vol
Wilting Point	=	0.187	vol/vol
Initial Soil Water Content	=	0.31	vol/vol
Effective Sat. Hyd. Conductivity	=	6.40E-05	cm/sec

Layer 4

Type 1 - Vertical Percolation Layer (Waste)
Municipal Solid Waste (MSW) (900 pcy)

Material Texture Number 18

Thickness	=	120	inches
Porosity	=	0.671	vol/vol
Field Capacity	=	0.292	vol/vol
Wilting Point	=	0.077	vol/vol
Initial Soil Water Content	=	0.272	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-03	cm/sec

Layer 5

Type 1 - Vertical Percolation Layer

SCL - Sandy Clay Loam

Material Texture Number 10

Thickness	=	24	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.244	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 6

Type 2 - Lateral Drainage Layer

Lateral Drainage Layer

Material Texture Number 44

Thickness	=	0.3	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	7.67E+00	cm/sec
Slope	=	0.5	%
Drainage Length	=	500	ft

Layer 7

Type 4 - Flexible Membrane Liner

LDPE Membrane

Material Texture Number 36

Thickness	=	0.04	inches
Effective Sat. Hyd. Conductivity	=	4.00E-13	cm/sec
FML Pinhole Density	=	1	Holes/Acre
FML Installation Defects	=	4	Holes/Acre
FML Placement Quality	=	3	Good

Layer 8

Type 1 - Vertical Percolation Layer

CL - Clay Loam
Material Texture Number 11

Thickness	=	12	inches
Porosity	=	0.464	vol/vol
Field Capacity	=	0.31	vol/vol
Wilting Point	=	0.187	vol/vol
Initial Soil Water Content	=	0.31	vol/vol
Effective Sat. Hyd. Conductivity	=	6.40E-05	cm/sec

Layer 9
Type 1 - Vertical Percolation Layer (Waste)
Municipal Solid Waste (MSW) (900 pcy)
Material Texture Number 18

Thickness	=	600	inches
Porosity	=	0.671	vol/vol
Field Capacity	=	0.292	vol/vol
Wilting Point	=	0.077	vol/vol
Initial Soil Water Content	=	0.272	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-03	cm/sec

Layer 10
Type 3 - Barrier Soil Liner
C (Moderate)
Material Texture Number 29

Thickness	=	36	inches
Porosity	=	0.451	vol/vol
Field Capacity	=	0.419	vol/vol
Wilting Point	=	0.332	vol/vol
Initial Soil Water Content	=	0.451	vol/vol
Effective Sat. Hyd. Conductivity	=	6.80E-07	cm/sec

Note: Initial moisture content of the layers and snow water were specified by the user.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	82	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	12	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	inches

Initial Water in Layer Materials	=	235.989	inches
Total Initial Water	=	235.989	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	29.73	Degrees
Maximum Leaf Area Index	=	4.5	
Start of Growing Season (Julian Date)	=	0	days
End of Growing Season (Julian Date)	=	367	days
Average Wind Speed	=	3.3	mph
Average 1st Quarter Relative Humidity	=	68	%
Average 2nd Quarter Relative Humidity	=	67	%
Average 3rd Quarter Relative Humidity	=	70	%
Average 4th Quarter Relative Humidity	=	49	%

Note: Evapotranspiration data was obtained for Del Rio, Texas

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
0.433183	0.917002	0.962631	1.138112	3.0146	2.477437
1.656066	1.368296	2.878192	1.703864	1.14302	0.500851

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
64.2	62.4	71.3	76.3	89	92.5
95.6	95.2	89.8	78.3	72.2	62.3

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Average Annual Totals Summary

Title: Del Rio LF 60ft PreSub Final
Simulated on: 5/04/2022 16:26

	Average Annual Totals for Years 1 - 30*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	18.19	[3.03]	66,041.5	100.00
Runoff	0.202	[0.362]	733.3	1.11
Evapotranspiration	17.940	[2.921]	65,120.7	98.61
Subprofile1				
Percolation/leakage through Layer 2	0.080750	[0.064151]	293.1	0.44
Average Head on Top of Layer 2	0.1520	[0.1722]	---	---
Subprofile2				
Lateral drainage collected from Layer 6	0.0007	[0.0041]	2.7180	0.00
Percolation/leakage through Layer 7	0.000001	[0.000005]	0.0035	0.00
Average Head on Top of Layer 7	0.0000	[0]	---	---
Subprofile3				
Percolation/leakage through Layer 10	0.000000	[0]	0.0000	0.00
Average Head on Top of Layer 10	0.0000	[0]	---	---
Water storage				
Change in water storage	0.0509	[0.4215]	184.8	0.28

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: Del Rio LF 60ft PreSub Final
Simulated on: 5/04/2022 16:26

	Peak Values for Years 1 - 30*		
	(inches)		(cubic feet)
Precipitation	4.08		14,808.7
Runoff	0.990		3,593.3
Subprofile1			
Percolation/leakage through Layer 2	0.005627		20.4
Average head on Layer 2	11.7769		
Subprofile2			
Drainage collected from Layer 6	0.0041		15.0
Percolation/leakage through Layer 7	0.000005		0.0173
Average head on Layer 7	0.0095		---
Maximum head on Layer 7	0.0190		---
Location of maximum head in Layer 6	2.01	(feet from drain)	
Subprofile3			
Percolation/leakage through Layer 10	0.000000		0.0000
Average head on Layer 10	0.0000		
Other Parameters			
Snow water	1.0846		3,937.0
Maximum vegetation soil water	0.3980	(vol/vol)	
Minimum vegetation soil water	0.1360	(vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: Del Rio LF 60ft PreSub Final
Simulated on: 5/04/2022 16:26
Simulation period: 30 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	1.8717	0.1560
2	7.6859	0.4270
3	3.7200	0.3100
4	35.0400	0.2920
5	5.8560	0.2440
6	0.0030	0.0100
7	0.0000	0.0000
8	3.6301	0.3025
9	163.2900	0.2721
10	16.2360	0.4510
Snow water	0.1835	---

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: Del Rio LF 50ft Sub D Interim **Simulated On:** 5/04/2022 16:35

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
CL - Clay Loam
Material Texture Number 11

Thickness	=	12	inches
Porosity	=	0.464	vol/vol
Field Capacity	=	0.31	vol/vol
Wilting Point	=	0.187	vol/vol
Initial Soil Water Content	=	0.31	vol/vol
Effective Sat. Hyd. Conductivity	=	6.40E-05	cm/sec

Layer 2

Type 1 - Vertical Percolation Layer (Waste)
Municipal Solid Waste (MSW) (900 pcy)
Material Texture Number 18

Thickness	=	600	inches
Porosity	=	0.671	vol/vol
Field Capacity	=	0.292	vol/vol
Wilting Point	=	0.077	vol/vol
Initial Soil Water Content	=	0.272	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-03	cm/sec

Layer 3

Type 1 - Vertical Percolation Layer
SCL - Sandy Clay Loam
Material Texture Number 10

Thickness	=	24	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.244	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 4

Type 2 - Lateral Drainage Layer
Lateral Drainage Layer

Material Texture Number 44

Thickness	=	0.3	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	2.05E+00	cm/sec
Slope	=	2	%
Drainage Length	=	200	ft

Layer 5

Type 3 - Barrier Soil Liner

Liner Soil (High)

Material Texture Number 16

Thickness	=	24	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Note: Initial moisture content of the layers and snow water were specified by the user.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	87.9	
Fraction of Area Allowing Runoff	=	80	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	10	inches
Initial Water in Evaporative Zone	=	3.1	inches
Upper Limit of Evaporative Storage	=	4.64	inches
Lower Limit of Evaporative Storage	=	1.87	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	183.027	inches
Total Initial Water	=	183.027	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	29.73	Degrees
Maximum Leaf Area Index	=	2	

Start of Growing Season (Julian Date)	=	0	days
End of Growing Season (Julian Date)	=	367	days
Average Wind Speed	=	3.3	mph
Average 1st Quarter Relative Humidity	=	68	%
Average 2nd Quarter Relative Humidity	=	67	%
Average 3rd Quarter Relative Humidity	=	70	%
Average 4th Quarter Relative Humidity	=	49	%

Note: Evapotranspiration data was obtained for Del Rio, Texas

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
0.549708	0.841705	1.223631	1.049101	2.37765	2.193677
1.466374	1.825726	1.993245	1.884501	1.088813	0.493228

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
59	57.9	71.7	78.7	88.9	90.6
95.2	95.4	89.4	79	73.2	63.7

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Average Annual Totals Summary

Title: Del Rio LF 50ft Sub D Interim
Simulated on: 5/04/2022 16:36

	Average Annual Totals for Years 1 - 23*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	16.99	[3.08]	61,664.1	100.00
Runoff	0.374	[0.293]	1,357.5	2.20
Evapotranspiration	16.130	[2.974]	58,552.6	94.95
Subprofile1				
Lateral drainage collected from Layer 4	0.0083	[0.0376]	30.0	0.05
Percolation/leakage through Layer 5	0.006680	[0.027086]	24.2	0.04
Average Head on Top of Layer 5	0.0000	[0.0001]	---	---
Water storage				
Change in water storage	0.4683	[0.683]	1,699.8	2.76

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: Del Rio LF 50ft Sub D Interim
Simulated on: 5/04/2022 16:36

	Peak Values for Years 1 - 23*		
	(inches)		(cubic feet)
Precipitation	3.09		11,213.0
Runoff	1.031		3,743.1
Subprofile1			
Drainage collected from Layer 4	0.0093		33.9
Percolation/leakage through Layer 5	0.003403		12.4
Average head on Layer 5	0.0080		---
Maximum head on Layer 5	0.0160		---
Location of maximum head in Layer 4	0.39	(feet from drain)	
Other Parameters			
Snow water	0.7109		2,580.5
Maximum vegetation soil water	0.4167	(vol/vol)	
Minimum vegetation soil water	0.1870	(vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: Del Rio LF 50ft Sub D Interim
Simulated on: 5/04/2022 16:36
Simulation period: 23 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	2.4899	0.2075
2	175.2000	0.2920
3	5.8560	0.2440
4	0.0030	0.0100
5	10.2480	0.4270
Snow water	0.0000	---

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: Del Rio LF 80ft Sub D Final **Simulated On:** 5/04/2022 16:32

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
SCL - Sandy Clay Loam
Material Texture Number 10

Thickness	=	12	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.244	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 2

Type 3 - Barrier Soil Liner
Liner Soil (High)
Material Texture Number 16

Thickness	=	18	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Layer 3

Type 1 - Vertical Percolation Layer
CL - Clay Loam
Material Texture Number 11

Thickness	=	12	inches
Porosity	=	0.464	vol/vol
Field Capacity	=	0.31	vol/vol
Wilting Point	=	0.187	vol/vol
Initial Soil Water Content	=	0.31	vol/vol
Effective Sat. Hyd. Conductivity	=	6.40E-05	cm/sec

Layer 4

Type 1 - Vertical Percolation Layer (Waste)
Municipal Solid Waste (MSW) (900 pcy)

Material Texture Number 18

Thickness	=	960	inches
Porosity	=	0.671	vol/vol
Field Capacity	=	0.292	vol/vol
Wilting Point	=	0.077	vol/vol
Initial Soil Water Content	=	0.272	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-03	cm/sec

Layer 5

Type 1 - Vertical Percolation Layer

SCL - Sandy Clay Loam

Material Texture Number 10

Thickness	=	24	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.244	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 6

Type 2 - Lateral Drainage Layer

Lateral Drainage Layer

Material Texture Number 44

Thickness	=	0.3	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	2.05E+00	cm/sec
Slope	=	2	%
Drainage Length	=	200	ft

Layer 7

Type 3 - Barrier Soil Liner

Liner Soil (High)

Material Texture Number 16

Thickness	=	24	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Note: Initial moisture content of the layers and snow water

were specified by the user.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	82	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	12	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	inches
Initial Water in Layer Materials	=	291.561	inches
Total Initial Water	=	291.561	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	29.73	Degrees
Maximum Leaf Area Index	=	4.5	
Start of Growing Season (Julian Date)	=	0	days
End of Growing Season (Julian Date)	=	367	days
Average Wind Speed	=	3.3	mph
Average 1st Quarter Relative Humidity	=	68	%
Average 2nd Quarter Relative Humidity	=	67	%
Average 3rd Quarter Relative Humidity	=	70	%
Average 4th Quarter Relative Humidity	=	49	%

Note: Evapotranspiration data was obtained for Del Rio, Texas

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
0.433183	0.917002	0.962631	1.138112	3.0146	2.477437
1.656066	1.368296	2.878192	1.703864	1.14302	0.500851

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec

64.2	62.4	71.3	76.3	89	92.5
95.6	95.2	89.8	78.3	72.2	62.3

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Average Annual Totals Summary

Title: Del Rio LF 80ft Sub D Final
Simulated on: 5/04/2022 16:33

	Average Annual Totals for Years 1 - 30*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	18.19	[3.03]	66,041.5	100.00
Runoff	0.202	[0.362]	733.3	1.11
Evapotranspiration	17.940	[2.921]	65,120.7	98.61
Subprofile1				
Percolation/leakage through Layer 2	0.080750	[0.064151]	293.1	0.44
Average Head on Top of Layer 2	0.1520	[0.1722]	---	---
Subprofile2				
Lateral drainage collected from Layer 6	0.0000	[0]	0.0000	0.00
Percolation/leakage through Layer 7	0.000000	[0]	0.0000	0.00
Average Head on Top of Layer 7	0.0000	[0]	---	---
Water storage				
Change in water storage	0.0517	[0.4223]	187.5	0.28

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: Del Rio LF 80ft Sub D Final
Simulated on: 5/04/2022 16:33

	Peak Values for Years 1 - 30*		
	(inches)		(cubic feet)
Precipitation	4.08		14,808.7
Runoff	0.990		3,593.3
Subprofile1			
Percolation/leakage through Layer 2	0.005627		20.4
Average head on Layer 2	11.7769		
Subprofile2			
Drainage collected from Layer 6	0.0000		0.0000
Percolation/leakage through Layer 7	0.000000		0.0000
Average head on Layer 7	0.0000		---
Maximum head on Layer 7	0.0000		---
Location of maximum head in Layer 6	0.00	(feet from drain)	
Other Parameters			
Snow water	1.0846		3,937.0
Maximum vegetation soil water	0.3980	(vol/vol)	
Minimum vegetation soil water	0.1360	(vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: Del Rio LF 80ft Sub D Final
Simulated on: 5/04/2022 16:33
Simulation period: 30 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	1.8717	0.1560
2	7.6859	0.4270
3	3.6414	0.3035
4	263.6211	0.2746
5	5.8560	0.2440
6	0.0030	0.0100
7	10.2480	0.4270
Snow water	0.1835	---

APPENDIX IIIK-B

RAINFALL RECHARGE



11/16/2022

HELP MODEL RAINFALL RECHARGE CALCULATION

HELP MODEL

The Hydrologic Evaluation of Landfill Performance (HELP) Model, Version 4.0 was used to estimate the recharge rate for the Del Rio Clay. The HELP Model is a quasi-two-dimensional hydrologic model of water movement across, into, through, and out of soil. 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.

MODEL SETUP

The site was modeled as a 1-acre unit area for the existing in-situ soil layer (Del Rio Clay). The evaporative zone depth and leaf area index were suggested by the HELP model for Del Rio, Texas. The runoff potential was 90 percent since runoff outside the limits of the landfill will be allowed. The Soil Conservation Service (SCS) runoff curve number was determined based on soil data and expected ground cover for the existing in-situ soil layer from the United States Department of Agriculture, Soil Conservation Service, Soil Survey of Val Verde County, Texas.

CLIMATE DATA

Precipitation data was synthetically simulated based on HELP V4 model program simulation using the latitude and longitude for Del Rio, Texas. The average annual precipitation over the modeled 30-year period was 18.19 inches. Temperature and solar radiation data were also synthetically generated by the HELP model using program defaults for Del Rio, Texas.

SOIL PROFILE

Soil texture 10 was selected from the HELP Model default soil characteristics to represent the Del Rio Clay. Default values for soil texture 10 were selected for porosity, field capacity, wilting point, and saturated hydraulic conductivity. The moisture content of the subgrade soil was initialized by the HELP Model program. The thickness of the subgrade was assumed to be 100 feet, which represents the approximate thickness of the unsaturated zone.

HELP OUTPUT

The HELP input data and output files are presented on the following pages.

HELP MODEL OUTPUT

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: DelRio LF Vert Expan Recharge **Simulated On:** 4/30/2021 9:22

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
SCL - Sandy Clay Loam
Material Texture Number 10

Thickness	=	945	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.24	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Note: Initial moisture content of the layers and snow water were specified by the user.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	86.9	
Fraction of Area Allowing Runoff	=	90	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	10	inches
Initial Water in Evaporative Zone	=	2.4	inches
Upper Limit of Evaporative Storage	=	3.98	inches
Lower Limit of Evaporative Storage	=	1.36	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	226.8	inches
Total Initial Water	=	226.8	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	29.73	Degrees
Maximum Leaf Area Index	=	2	
Start of Growing Season (Julian Date)	=	0	days
End of Growing Season (Julian Date)	=	367	days

Average Wind Speed	=	3.3 mph
Average 1st Quarter Relative Humidity	=	68 %
Average 2nd Quarter Relative Humidity	=	67 %
Average 3rd Quarter Relative Humidity	=	70 %
Average 4th Quarter Relative Humidity	=	49 %

Note: Evapotranspiration data was obtained for Del Rio, Texas

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
0.433183	0.917002	0.962631	1.138112	3.0146	2.477437
1.656066	1.368296	2.878192	1.703864	1.14302	0.500851

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
64.2	62.4	71.3	76.3	89	92.5
95.6	95.2	89.8	78.3	72.2	62.3

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Average Annual Totals Summary

Title: DelRio LF Vert Expan Recharge
Simulated on: 5/10/2021 9:22

	Average Annual Totals for Years 1 - 30*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	18.19	[3.03]	66,041.5	100.00
Runoff	0.426	[0.409]	1,547.3	2.34
Evapotranspiration	16.543	[2.359]	60,049.7	90.93
Subprofile1				
Percolation/leakage through Layer 1	1.108307	[0.648699]	4,023.2	6.09
Water storage				
Change in water storage	0.1161	[0.975]	421.3	0.64

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: DelRio LF Vert Expan Recharge
Simulated on: 5/10/2021 9:22

	Peak Values for Years 1 - 30*		
	(inches)		(cubic feet)
Precipitation	4.08		14,808.7
Runoff	1.364		4,950.6
Subprofile1			
Percolation/leakage through Layer 1	0.012369		44.9
Other Parameters			
Snow water	1.0846		3,937.0
Maximum vegetation soil water	0.3841	(vol/vol)	
Minimum vegetation soil water	0.1360	(vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: DelRio LF Vert Expan Recharge
Simulated on: 5/10/2021 9:22
Simulation period: 30 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	230.0984	0.2435
Snow water	0.1835	---

APPENDIX IIIK-C

MULTIMED MODEL



11/16/2022

MULTIMED MODEL OUTPUT

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen Saturated zone model

Run was DETERMIN

Infiltration input by user

Run was steady-state

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.

Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

-

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.
Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

-

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.250E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990

Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	100.	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	30.0	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.3443E-02

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen Saturated zone model

Run was DETERMIN

Infiltration input by user

Run was steady-state

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.

Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.
Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.250E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990

Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	50.0	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	30.0	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.6819E-02

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen Saturated zone model

Run was DETERMIN

Infiltration input by user

Run was steady-state

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.

Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.
Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.250E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990

Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	150.	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	30.0	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.2303E-02

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen Saturated zone model

Run was DETERMIN

Infiltration input by user

Run was steady-state

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.

Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

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SOURCE SPECIFIC VARIABLES

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VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.
Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

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AQUIFER SPECIFIC VARIABLES

-

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.250E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990

Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	50.0	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	100.	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	30.0	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.4108E-02

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U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

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DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen Saturated zone model

Run was DETERMIN

Infiltration input by user

Run was steady-state

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

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CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.

Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

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SOURCE SPECIFIC VARIABLES

-

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.
Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

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AQUIFER SPECIFIC VARIABLES

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VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.250E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990

Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	125.	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	100.	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	30.0	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.3451E-02

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U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

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DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen Saturated zone model

Run was DETERMIN

Infiltration input by user

Run was steady-state

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

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CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.

Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

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SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.
Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

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AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.250E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.500E-01	-999.	0.100E-08	0.990

Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	100.	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	30.0	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.3443E-02

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U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

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DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen Saturated zone model

Run was DETERMIN

Infiltration input by user

Run was steady-state

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

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CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.

Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

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SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.
Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

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AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.250E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.506	-999.	0.100E-08	0.990

Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	100.	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	30.0	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.3443E-02

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U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

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DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen Saturated zone model

Run was DETERMIN

Infiltration input by user

Run was steady-state

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

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CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.

Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

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SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.
Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

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AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.250E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990

Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	100.	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.240E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	30.0	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.1587E-02

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U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

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DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen Saturated zone model

Run was DETERMIN

Infiltration input by user

Run was steady-state

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.

Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

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SOURCE SPECIFIC VARIABLES

-

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.
Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

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AQUIFER SPECIFIC VARIABLES

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VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.250E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990

Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	100.	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.600E-02	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	30.0	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.6261E-02

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

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DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen Saturated zone model

Run was DETERMIN

Infiltration input by user

Run was steady-state

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.

Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

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SOURCE SPECIFIC VARIABLES

-

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.
Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

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AQUIFER SPECIFIC VARIABLES

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VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.250E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990

Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	100.	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	24.4	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.3453E-02

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

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DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen Saturated zone model

Run was DETERMIN

Infiltration input by user

Run was steady-state

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

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CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.

Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

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SOURCE SPECIFIC VARIABLES

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VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.
Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

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AQUIFER SPECIFIC VARIABLES

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VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.250E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990

Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	100.	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	36.6	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.3432E-02

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U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

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DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen Saturated zone model

Run was DETERMIN

Infiltration input by user

Run was steady-state

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

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CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.

Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

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SOURCE SPECIFIC VARIABLES

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VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.250E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.
Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

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AQUIFER SPECIFIC VARIABLES

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VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.250E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990

Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	100.	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	30.0	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.5060E-02

1 U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1
Run options
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DEFAULT

DEL RIO LF VERTICAL EXPAN
Chemical simulated is DEFAULT CHEMICAL

Option Chosen Saturated zone model
Run was DETERMIN
Infiltration input by user
Run was steady-state
Reject runs if Y coordinate outside plume
Reject runs if Z coordinate outside plume
Gaussian source used in saturated zone model
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CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.

Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.700E-04	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.
Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.250E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00

Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	100.	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	30.0	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.1419E-02

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen Saturated zone model

Run was DETERMIN

Infiltration input by user

Run was steady-state

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.

Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

-

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.182E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.
Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

-

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.250E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990

Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	100.	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	30.0	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.3454E-02

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen Saturated zone model

Run was DETERMIN

Infiltration input by user

Run was steady-state

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.

Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.382E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.
Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.250E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990

Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	100.	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	30.0	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.3433E-02

APPENDIX IIIK-D

LEACHATE SAMPLING ANALYSIS

POLLUTION CONTROL SERVICES

Report of Sample Analysis

Client Information	Sample Information	Laboratory Information
Rene Maldonado **Del Rio, City of (Landfill)** **1897 Railway Ave** **Del Rio, TX 78840**	**Project Name: Landfill Leachate Quarterly** **Sample ID: Leachate** **Matrix: Non-Potable Water** **Date/Time Taken: 9/1/2021 1049**	**PCS Sample #: 648011 Page 1 of 2** **Date/Time Received: 9/1/2021 10:56** **Report Date: 9/21/2021** **Approved by:** Chuck Wallgren, President

Test Description	Result	Units	RL	Analysis Date/Time	Method	Analyst
Nitrate-N_IC	<0.2	mg/L	0.2	9/2/2021 12:17	EPA 300.0	JAS
Fluoride_IC	2.44	mg/L	0.20	9/2/2021 12:17	EPA 300.0	JAS
Arsenic/ICP (Total)	<0.010	mg/L	0.010	9/7/2021 13:34	EPA 200.7 / 6010 B	DJL
Barium/ICP (Total)	0.047	mg/L	0.010	9/7/2021 13:34	EPA 200.7 / 6010 B	DJL
Cadmium/ICP (Total)	<0.005	mg/L	0.005	9/7/2021 13:34	EPA 200.7 / 6010 B	DJL
Lead/ICP (Total)	<0.005	mg/L	0.005	9/7/2021 13:34	EPA 200.7 / 6010 B	DJL
Hexavalent Chrome	<0.003	mg/L	0.003	9/1/2021 16:30	SM 3500-Cr D	DJL
Silver/ICP (Total)	<0.010	mg/L	0.010	9/7/2021 13:34	EPA 200.7 / 6010 B	DJL

Quality Assurance Summary

Test Description	Precision	Limit	LCL	MS	MSD	UCL	LCS	LCS Limit
Nitrate-N_IC	<1	20	70	101	101	130	103	85 - 115
Fluoride_IC	<1	10	93	99	98	109	102	85 - 115
Arsenic/ICP (Total)	1	20	75	98	99	125	105	85 - 115
Barium/ICP (Total)	<1	20	75	87	87	125	105	85 - 115
Cadmium/ICP (Total)	<1	20	75	94	94	125	105	85 - 115
Lead/ICP (Total)	<1	20	75	84	84	125	105	85 - 115
Hexavalent Chrome	<1	20	75	92	92	125	102	85 - 115
Silver/ICP (Total)	<1	20	75	82	82	125	100	85 - 115

***Quality Statement:** All supporting quality data adhered to data quality objectives and test results meet the requirements of NELAC unless otherwise noted as flagged exceptions or in a case narrative attachment. Reports with full quality data deliverables are abailable on request.*

These analytical results relate only to the sample tested.
All data is reported on an 'As Is' basis unless designated as 'Dry Wt'.
RL = Reporting Limits

Web Site: www.pcslab.net
eMail: chuck@pcslab.net
Toll Free 800-880-4616
1532 Universal City Blvd. Suite 100
Universal City, TX 78148-3318
210-340-0343
FAX # 210-658-7903

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POLLUTION CONTROL SERVICES

Report of Sample Analysis

Client Information	Sample Information	Laboratory Information
Rene Maldonado **Del Rio, City of (Landfill)** **1897 Railway Ave** **Del Rio, TX 78840**	**Project Name: Landfill Leachate Quarterly** **Sample ID: Leachate** **Matrix: Non-Potable Water** **Date/Time Taken: 9/1/2021 1049**	**PCS Sample #: 648011 Page 2 of 2** **Date/Time Received: 9/1/2021 10:56** **Report Date: 9/21/2021**

Test Description	Flag	Result	Units	RL	Analysis Date/Time	Method	Analyst
Selenium/ICP (Total)		<0.010	mg/L	0.010	9/7/2021 13:34	EPA 200.7 / 6010 B	DJL
Mercury/CVAA (Total)	R	<0.002	mg/L	0.002	9/13/2021 12:40	EPA 245.1	EMV
VOC 8260			See Attached			Pace Analytical - TN	
Pesticides 8081			See Attached			Pace Analytical - TN	
Benzene			See Attached			Pace Analytical - TN	
Herbicides 8151			See Attached			Pace Analytical - TN	

Quality Assurance Summary

Test Description	Precision	Limit	LCL	MS	MSD	UCL	LCS	LCS Limit
Selenium/ICP (Total)	1	20	75	97	98	125	110	85 - 115
Mercury/CVAA (Total)	<1	20	75	*40	*40	125	103	85 - 115
VOC 8260	See Attached Report for Quality Assurance Information							
Pesticides 8081	See Attached Report for Quality Assurance Information							
Benzene	See Attached Report for Quality Assurance Information							
Herbicides 8151	See Attached Report for Quality Assurance Information							

***Quality Statement:** All supporting quality data adhered to data quality objectives and test results meet the requirements of NELAC unless otherwise noted as flagged exceptions or in a case narrative attachment. Reports with full quality data deliverables are available on request.*

*Approved for release per QA Plan, Exception to Limits - QAM Section 13-4
R Spike recovery outside control limits due to matrix effect - LCS within limits

These analytical results relate only to the sample tested.
All data is reported on an 'As Is' basis unless designated as 'Dry Wt'.
RL = Reporting Limits

Web Site: www.pcslab.net
eMail: chuck@pcslab.net
Toll Free 800-880-4616
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POLLUTION CONTROL SERVICES

1532 Universal City Blvd, Suite 100
Universal City, TX 78148-3318
Facsimilie 210.658.7903
210.340.0343

1057

CHAIN OF CUSTODY & SUBCONTRACT TRACKING SHEET

TO: Pace Analytical - TN
12065 Lebanon Rd

Mount Juliet, TN 37122

Relinquished by: Greg Felux
Date/Time: Sep 02, 2021 09:32
Received by:
Date/Time:

L1399307

PCS#	Date	Time	Analysis Requested	Pres	T. A. T.
648011	09/01/21	1049	VOC 8260, Herbicides 8151, Pesticides 8081	TCE	Std -01

Project: 648011

Sample Receipt Checklist

COC Seal Present/Intact:	Y N	If Applicable	
COC Signed/Accurate:	Y N	VOA Zero Headspace:	Y N
Bottles Arrive Intact:	Y N	Pres.Correct/Check:	Y N
Correct Bottles used:	Y N		
Sufficient volume sent:	Y N		
RAD Screen <0.5 mR/hr:	Y N		

Unless otherwise requested, send results and invoice to:

5300 4290 9119

Chuck Wallgren
Pollution Control Services
1532 Universal City Blvd, Suite 100
Universal City, TX 78148-3318

Authorized by: _____ Date: 09/02/2021

2.6+0=2.6
AGA

9/3/21 930

ANALYTICAL REPORT

September 15, 2021

Pollution Control Services - TX

Sample Delivery Group:	L1399307
Samples Received:	09/03/2021
Project Number:	648011
Description:	

Report To: Chuck Wallgren
1532 Universal City Blvd
Universal City, TX 78148

Entire Report Reviewed By:

Lori A Vahrenkamp
Project Manager

Results relate only to the items tested or calibrated and are reported as rounded values. This test report shall not be reproduced, except in full, without written approval of the laboratory. Where applicable, sampling conducted by Pace Analytical National is performed per guidance provided in laboratory standard operating procedures ENV-SOP-MTJL-0067 and ENV-SOP-MTJL-0068. Where sampling conducted by the customer, results relate to the accuracy of the information provided, and as the samples are received.

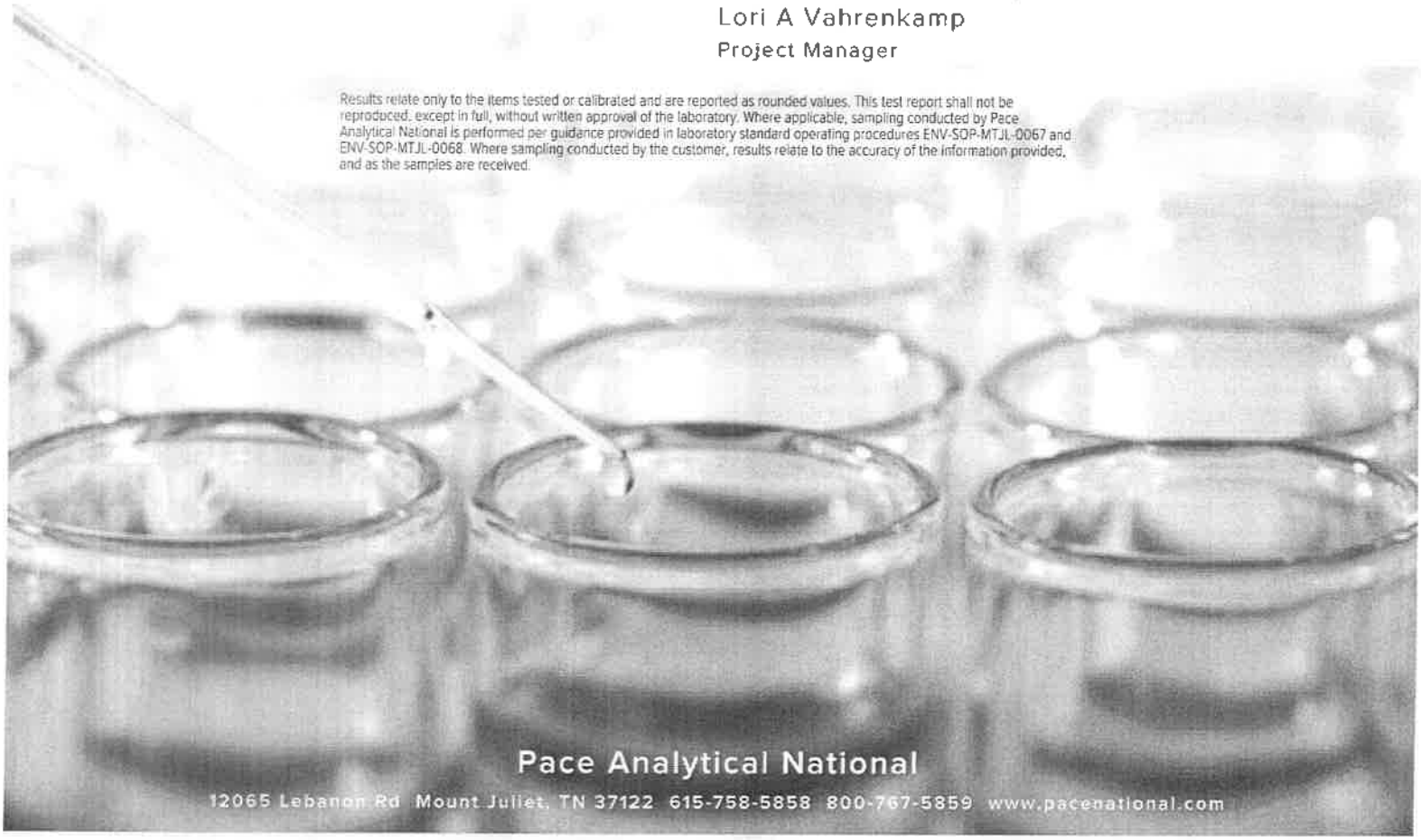


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SAMPLE SUMMARY

648011 L1399307-01 GW			Collected by	Collected date/time 09/01/21 10:49	Received date/time 09/03/21 09:30	
Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1735547	1	09/05/21 20:55	09/05/21 20:55	BMB	Mt. Juliet, TN
Chlorinated Acid Herbicides (GC) by Method 8151	WG1734817	1	09/06/21 07:52	09/08/21 04:08	AO	Mt. Juliet, TN
Pesticides (GC) by Method 8081	WG1735510	1	09/07/21 22:58	09/08/21 20:28	MTJ	Mt. Juliet, TN

CASE NARRATIVE

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times, unless qualified or notated within the report. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital 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, and no information or data have been knowingly withheld that would affect the quality of the data.

Lori A Vahrenkamp
Project Manager

Cp
Tc
Ss
Cn
Sr
Qc
Gl
Al
Sc

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result mg/l	Qualifier	RDL mg/l	Dilution	Analysis date / time	Batch
Acetone	<0.0500	J4	0.0500	1	09/05/2021 20:55	WG1735547
Acrolein	<0.0500		0.0500	1	09/05/2021 20:55	WG1735547
Acrylonitrile	<0.0100		0.0100	1	09/05/2021 20:55	WG1735547
Benzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Bromobenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Bromodichloromethane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Bromoform	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Bromomethane	<0.00500		0.00500	1	09/05/2021 20:55	WG1735547
n-Butylbenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
sec-Butylbenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
tert-Butylbenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Carbon tetrachloride	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Chlorobenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Chlorodibromomethane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Chloroethane	<0.00500		0.00500	1	09/05/2021 20:55	WG1735547
2-Chloroethyl vinyl ether	<0.0500		0.0500	1	09/05/2021 20:55	WG1735547
Chloroform	<0.00500		0.00500	1	09/05/2021 20:55	WG1735547
Chloromethane	<0.00250		0.00250	1	09/05/2021 20:55	WG1735547
2-Chlorotoluene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
4-Chlorotoluene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,2-Dibromo-3-Chloropropane	<0.00500		0.00500	1	09/05/2021 20:55	WG1735547
1,2-Dibromoethane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Dibromomethane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,2-Dichlorobenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,3-Dichlorobenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,4-Dichlorobenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Dichlorodifluoromethane	<0.00500		0.00500	1	09/05/2021 20:55	WG1735547
1,1-Dichloroethane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,2-Dichloroethane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,1-Dichloroethene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
cis-1,2-Dichloroethene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
trans-1,2-Dichloroethene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,2-Dichloropropane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,1-Dichloropropene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,3-Dichloropropane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
cis-1,3-Dichloropropene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
trans-1,3-Dichloropropene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
2,2-Dichloropropane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Di-isopropyl ether	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Ethylbenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Hexachloro-1,3-butadiene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Isopropylbenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
p-Isopropyltoluene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
2-Butanone (MEK)	<0.0100		0.0100	1	09/05/2021 20:55	WG1735547
Methylene Chloride	<0.00500		0.00500	1	09/05/2021 20:55	WG1735547
4-Methyl-2-pentanone (MIBK)	<0.0100		0.0100	1	09/05/2021 20:55	WG1735547
Methyl tert-butyl ether	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Naphthalene	<0.00500		0.00500	1	09/05/2021 20:55	WG1735547
n-Propylbenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Styrene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,1,1,2-Tetrachloroethane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,1,2,2-Tetrachloroethane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Tetrachloroethene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Toluene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,2,3-Trichlorobenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,2,4-Trichlorobenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result mg/l	Qualifier	RDL mg/l	Dilution	Analysis date / time	Batch
1,1,1-Trichloroethane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,1,2-Trichloroethane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Trichloroethene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Trichlorofluoromethane	<0.00500		0.00500	1	09/05/2021 20:55	WG1735547
1,2,3-Trichloropropane	<0.00250		0.00250	1	09/05/2021 20:55	WG1735547
1,2,4-Trimethylbenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,3,5-Trimethylbenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Vinyl chloride	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Xylenes, Total	<0.00300		0.00300	1	09/05/2021 20:55	WG1735547
(S) Toluene-d8	*103*		*80.0-120*		*09/05/2021 20:55*	WG1735547
(S) 4-Bromofluorobenzene	*105*		*77.0-126*		*09/05/2021 20:55*	WG1735547
(S) 1,2-Dichloroethane-d4	*87.8*		*70.0-130*		*09/05/2021 20:55*	WG1735547

Chlorinated Acid Herbicides (GC) by Method 8151

Analyte	Result mg/l	Qualifier	RDL mg/l	Dilution	Analysis date / time	Batch
2,4-D	<0.00200		0.00200	1	09/08/2021 04:08	WG1734817
Dalapon	<0.00200		0.00200	1	09/08/2021 04:08	WG1734817
2,4-DB	<0.00200		0.00200	1	09/08/2021 04:08	WG1734817
Dicamba	<0.00200		0.00200	1	09/08/2021 04:08	WG1734817
Dichloroprop	<0.00200		0.00200	1	09/08/2021 04:08	WG1734817
Dinoseb	<0.00200		0.00200	1	09/08/2021 04:08	WG1734817
MCPA	<0.100	J4	0.100	1	09/08/2021 04:08	WG1734817
MCPP	<0.100	J4	0.100	1	09/08/2021 04:08	WG1734817
2,4,5-T	<0.00200		0.00200	1	09/08/2021 04:08	WG1734817
2,4,5-TP (Silvex)	<0.00200		0.00200	1	09/08/2021 04:08	WG1734817
(S) 2,4-Dichlorophenyl Acetic Acid	*59.5*		*14.0-158*		*09/08/2021 04:08*	WG1734817

Pesticides (GC) by Method 8081

Analyte	Result mg/l	Qualifier	RDL mg/l	Dilution	Analysis date / time	Batch
Aldrin	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Alpha BHC	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Beta BHC	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Delta BHC	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Gamma BHC	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Chlordane	<0.00500		0.00500	1	09/08/2021 20:28	WG1735510
4,4-DDD	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
4,4-DDE	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
4,4-DDT	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Dieldrin	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Endosulfan I	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Endosulfan II	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Endosulfan sulfate	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Endrin	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Endrin aldehyde	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Endrin ketone	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Hexachlorobenzene	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Heptachlor	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Heptachlor epoxide	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Methoxychlor	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Toxaphene	<0.000500		0.000500	1	09/08/2021 20:28	WG1735510
(S) Decachlorobiphenyl	*89.3*		*10.0-128*		*09/08/2021 20:28*	WG1735510
(S) Tetrachloro-m-xylene	*95.8*		*10.0-127*		*09/08/2021 20:28*	WG1735510

Method Blank (MB)

(MB) R3701364-2 09/05/21 14:09

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Acetone	<0.0113		0.0113	0.0500
Acrolein	<0.00254		0.00254	0.0500
Acrylonitrile	<0.000671		0.000671	0.0100
Benzene	<0.0000941		0.0000941	0.00100
Bromobenzene	<0.000118		0.000118	0.00100
Bromodichloromethane	<0.000136		0.000136	0.00100
Bromoform	<0.000129		0.000129	0.00100
Bromomethane	<0.000605		0.000605	0.00500
n-Butylbenzene	<0.000157		0.000157	0.00100
sec-Butylbenzene	<0.000125		0.000125	0.00100
tert-Butylbenzene	<0.000127		0.000127	0.00100
Carbon tetrachloride	<0.000128		0.000128	0.00100
Chlorobenzene	<0.000116		0.000116	0.00100
Chlorodibromomethane	<0.000140		0.000140	0.00100
Chloroethane	<0.000192		0.000192	0.00500
2-Chloroethyl vinyl ether	<0.000575		0.000575	0.0500
Chloroform	<0.000111		0.000111	0.00500
Chloromethane	<0.000960		0.000960	0.00250
2-Chlorotoluene	<0.000106		0.000106	0.00100
4-Chlorotoluene	<0.000114		0.000114	0.00100
1,2-Dibromo-3-Chloropropane	<0.000276		0.000276	0.00500
1,2-Dibromoethane	<0.000126		0.000126	0.00100
Dibromomethane	<0.000122		0.000122	0.00100
1,2-Dichlorobenzene	<0.000107		0.000107	0.00100
1,3-Dichlorobenzene	<0.000110		0.000110	0.00100
1,4-Dichlorobenzene	<0.000120		0.000120	0.00100
Dichlorodifluoromethane	<0.000374		0.000374	0.00500
1,1-Dichloroethane	<0.000100		0.000100	0.00100
1,2-Dichloroethane	<0.0000819		0.0000819	0.00100
1,1-Dichloroethene	<0.000188		0.000188	0.00100
cis-1,2-Dichloroethene	<0.000126		0.000126	0.00100
trans-1,2-Dichloroethene	<0.000149		0.000149	0.00100
1,2-Dichloropropane	<0.000149		0.000149	0.00100
1,1-Dichloropropene	<0.000142		0.000142	0.00100
1,3-Dichloropropane	<0.000110		0.000110	0.00100
cis-1,3-Dichloropropene	<0.000111		0.000111	0.00100
trans-1,3-Dichloropropene	<0.000118		0.000118	0.00100
2,2-Dichloropropane	<0.000161		0.000161	0.00100
Di-isopropyl ether	<0.000105		0.000105	0.00100
Ethylbenzene	<0.000137		0.000137	0.00100

Method Blank (MB)

(MB) R3701364-2 09/05/21 14:09

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Hexachloro-1,3-buladiene	<0.000337		0.000337	0.00100
Isopropylbenzene	<0.000105		0.000105	0.00100
p-Isopropyltoluene	<0.000120		0.000120	0.00100
2-Butanone (MEK)	<0.00119		0.00119	0.0100
Methylene Chloride	<0.000430		0.000430	0.00500
4-Methyl-2-pentanone (MIBK)	<0.000478		0.000478	0.0100
Methyl tert-butyl ether	<0.000101		0.000101	0.00100
Naphthalene	<0.00100		0.00100	0.00500
n-Propylbenzene	<0.0000993		0.0000993	0.00100
Styrene	<0.000118		0.000118	0.00100
1,1,1,2-Tetrachloroethane	<0.000147		0.000147	0.00100
1,1,2,2-Tetrachloroethane	<0.000133		0.000133	0.00100
Tetrachloroethene	<0.000300		0.000300	0.00100
Toluene	<0.000278		0.000278	0.00100
1,2,3-Trichlorobenzene	<0.000230		0.000230	0.00100
1,2,4-Trichlorobenzene	<0.000481		0.000481	0.00100
1,1,1-Trichloroethane	<0.000149		0.000149	0.00100
1,1,2-Trichloroethane	<0.000158		0.000158	0.00100
Trichloroethene	<0.000190		0.000190	0.00100
Trichlorofluoromethane	<0.000160		0.000160	0.00500
1,2,3-Trichloropropane	<0.000237		0.000237	0.00250
1,2,4-Trimethylbenzene	<0.000322		0.000322	0.00100
1,3,5-Trimethylbenzene	<0.000104		0.000104	0.00100
Vinyl chloride	<0.000234		0.000234	0.00100
Xylenes, Total	<0.000174		0.000174	0.00300
(S) Toluene-d8	*102*			*80.0-120*
(S) 4-Bromofluorobenzene	*102*			*77.0-126*
(S) 1,2-Dichloroethane-d4	*90.4*			*70.0-130*

Laboratory Control Sample (LCS)

(LCS) R3701364-1 09/05/21 13:28

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Acetone	0.0250	0.0460	184	19.0-160	J4
Acrolein	0.0250	0.0293	117	10.0-160	
Acrylonitrile	0.0250	0.0312	125	55.0-149	
Benzene	0.00500	0.00471	94.2	70.0-123	
Bromobenzene	0.00500	0.00513	103	73.0-121	

Laboratory Control Sample (LCS)

(LCS) R3701364-1 09/05/21 13:28

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec %	Rec. Limits %	LCS Qualifier
Bromodichloromethane	0.00500	0.00434	86.8	75.0-120	
Bromoform	0.00500	0.00512	102	68.0-132	
Bromomethane	0.00500	0.00461	92.2	10.0-160	
n-Butylbenzene	0.00500	0.00465	93.0	73.0-125	
sec-Butylbenzene	0.00500	0.00485	97.0	75.0-125	
tert-Butylbenzene	0.00500	0.00540	108	76.0-124	
Carbon tetrachloride	0.00500	0.00435	87.0	68.0-126	
Chlorobenzene	0.00500	0.00530	106	80.0-121	
Chlorodibromomethane	0.00500	0.00492	98.4	77.0-125	
Chloroethane	0.00500	0.00439	87.8	47.0-150	
2-Chloroethyl vinyl ether	0.0250	0.0277	111	51.0-160	
Chloroform	0.00500	0.00439	87.8	73.0-120	
Chloromethane	0.00500	0.00442	88.4	41.0-142	
2-Chlorotoluene	0.00500	0.00518	104	76.0-123	
4-Chlorotoluene	0.00500	0.00512	102	75.0-122	
1,2-Dibromo-3-Chloropropane	0.00500	0.00614	123	58.0-134	
1,2-Dibromoethane	0.00500	0.00494	98.8	80.0-122	
Dibromomethane	0.00500	0.00534	107	80.0-120	
1,2-Dichlorobenzene	0.00500	0.00537	107	79.0-121	
1,3-Dichlorobenzene	0.00500	0.00556	111	79.0-120	
1,4-Dichlorobenzene	0.00500	0.00502	100	79.0-120	
Dichlorodifluoromethane	0.00500	0.00421	84.2	51.0-149	
1,1-Dichloroethane	0.00500	0.00456	91.2	70.0-126	
1,2-Dichloroethane	0.00500	0.00504	101	70.0-128	
1,1-Dichloroethene	0.00500	0.00473	94.6	71.0-124	
cis-1,2-Dichloroethene	0.00500	0.00446	89.2	73.0-120	
trans-1,2-Dichloroethene	0.00500	0.00455	91.0	73.0-120	
1,2-Dichloropropane	0.00500	0.00480	96.0	77.0-125	
1,1-Dichloropropene	0.00500	0.00452	90.4	74.0-126	
1,3-Dichloropropane	0.00500	0.00535	107	80.0-120	
cis-1,3-Dichloropropene	0.00500	0.00475	95.0	80.0-123	
trans-1,3-Dichloropropene	0.00500	0.00511	102	78.0-124	
2,2-Dichloropropane	0.00500	0.00366	73.2	58.0-130	
Di-isopropyl ether	0.00500	0.00460	92.0	58.0-138	
Ethylbenzene	0.00500	0.00469	93.8	79.0-123	
Hexachloro-1,3-butadiene	0.00500	0.00419	83.8	54.0-138	
Isopropylbenzene	0.00500	0.00508	102	76.0-127	
p-Isopropyltoluene	0.00500	0.00466	93.2	76.0-125	
2-Butanone (MEK)	0.0250	0.0327	131	44.0-160	
Methylene Chloride	0.00500	0.00481	96.2	67.0-120	

Laboratory Control Sample (LCS)

(LCS) R3701364-1 09/05/21 13:28

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
4-Methyl-2-pentanone (MIBK)	0.0250	0.0274	110	68.0-142	
Methyl tert-butyl ether	0.00500	0.00484	96.8	68.0-125	
Naphthalene	0.00500	0.00643	129	54.0-135	
n-Propylbenzene	0.00500	0.00496	99.2	77.0-124	
Styrene	0.00500	0.00530	106	73.0-130	
1,1,1,2-Tetrachloroethane	0.00500	0.00465	93.0	75.0-125	
1,1,2,2-Tetrachloroethane	0.00500	0.00504	101	65.0-130	
Tetrachloroethene	0.00500	0.00494	98.8	72.0-132	
Toluene	0.00500	0.00501	100	79.0-120	
1,2,3-Trichlorobenzene	0.00500	0.00498	99.6	50.0-138	
1,2,4-Trichlorobenzene	0.00500	0.00466	93.2	57.0-137	
1,1,1-Trichloroethane	0.00500	0.00417	83.4	73.0-124	
1,1,2-Trichloroethane	0.00500	0.00517	103	80.0-120	
Trichloroethene	0.00500	0.00512	102	78.0-124	
Trichlorofluoromethane	0.00500	0.00420	84.0	59.0-147	
1,2,3-Trichloropropane	0.00500	0.00525	105	73.0-130	
1,2,4-Trimethylbenzene	0.00500	0.00492	98.4	76.0-121	
1,3,5-Trimethylbenzene	0.00500	0.00468	93.6	76.0-122	
Vinyl chloride	0.00500	0.00440	88.0	67.0-131	
Xylenes, Total	0.0150	0.0161	107	79.0-123	
(S) Toluene-d8			*103*	*80.0-120*	
(S) 4-Bromofluorobenzene			*106*	*77.0-126*	
(S) 1,2-Dichloroethane-d4			*89.8*	*70.0-130*	

QUALITY CONTROL SUMMARY

L1399307-01

Method Blank (MB)

(MB) R3702851-1 09/07/21 16:48

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
2,4-D	<0.000547		0.000547	0.00200
Dalapon	<0.000344		0.000344	0.00200
2,4-DB	<0.000302		0.000302	0.00200
Dicamba	<0.000245		0.000245	0.00200
Dichloroprop	<0.00104		0.00104	0.00200
Dinoseb	<0.000250		0.000250	0.00200
MCPA	<0.0131		0.0131	0.100
MCPP	<0.0660		0.0660	0.100
2,4,5-T	<0.000258		0.000258	0.00200
2,4,5-TP (Silvex)	<0.000335		0.000335	0.00200
(S) 2,4-Dichlorophenyl Acetic Acid	*67.0*			*14.0-158*

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3702851-2 09/07/21 17:18 • (LCSD) R3702851-3 09/07/21 17:33

Analyte	Spike Amount mg/l	LCS Result mg/l	LCSD Result mg/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
2,4-D	0.00500	0.00424	0.00405	84.8	81.2	50.0-120			4.34	20
Dalapon	0.00500	0.00382	0.00362	76.4	72.4	32.0-120			5.38	20
2,4-DB	0.00500	0.00485	0.00473	97.0	94.6	53.0-140			2.51	20
Dicamba	0.00500	0.00427	0.00411	85.4	82.2	51.0-120			3.82	20
Dichloroprop	0.00500	0.00436	0.00423	87.2	84.6	55.0-127			3.03	20
Dinoseb	0.00500	0.00421	0.00399	84.2	79.8	36.0-134			5.37	20
MCPA	0.0500	0.637	0.647	1270	1290	10.0-160	E J4	E J4	1.56	40
MCPP	0.0500	0.561	0.479	1120	958	10.0-160	E J4	E J4	15.8	23
2,4,5-T	0.00500	0.00435	0.00414	87.0	82.8	54.0-120			4.95	20
2,4,5-TP (Silvex)	0.00500	0.00380	0.00431	76.0	86.2	50.0-125			12.6	20
(S) 2,4-Dichlorophenyl Acetic Acid				*86.4*	*80.2*	*14.0-158*				

Method Blank (MB)

(MB) R3702502-1 09/08/21 19:35

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Aldrin	<0.0000198		0.0000198	0.0000500
Alpha BHC	<0.0000172		0.0000172	0.0000500
Beta BHC	<0.0000208		0.0000208	0.0000500
Delta BHC	<0.0000150		0.0000150	0.0000500
Gamma BHC	<0.0000209		0.0000209	0.0000500
4,4-DDD	<0.0000177		0.0000177	0.0000500
4,4-DDE	<0.0000154		0.0000154	0.0000500
4,4-DDT	<0.0000198		0.0000198	0.0000500
Dieldrin	<0.0000162		0.0000162	0.0000500
Endosulfan I	<0.0000160		0.0000160	0.0000500
Endosulfan II	<0.0000164		0.0000164	0.0000500
Endosulfan sulfate	<0.0000217		0.0000217	0.0000500
Endrin	<0.0000161		0.0000161	0.0000500
Endrin aldehyde	<0.0000237		0.0000237	0.0000500
Endrin ketone	<0.0000219		0.0000219	0.0000500
Heptachlor	<0.0000148		0.0000148	0.0000500
Heptachlor epoxide	<0.0000183		0.0000183	0.0000500
Hexachlorobenzene	<0.0000176		0.0000176	0.0000500
Methoxychlor	<0.0000193		0.0000193	0.0000500
Chlordane	<0.0000198		0.0000198	0.00500
Toxaphene	<0.000168		0.000168	0.000500
(S) Decachlorobiphenyl	*87.3*			*10.0-128*
(S) Tetrachloro-m-xylene	*107*			*10.0-127*

Laboratory Control Sample (LCS)

(LCS) R3702502-2 09/08/21 19:44

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Aldrin	0.00100	0.00108	108	22.0-124	
Alpha BHC	0.00100	0.00119	119	54.0-130	
Beta BHC	0.00100	0.00119	119	53.0-136	
Delta BHC	0.00100	0.00119	119	54.0-133	
Gamma BHC	0.00100	0.00114	114	55.0-129	
4,4-DDD	0.00100	0.00103	103	56.0-140	
4,4-DDE	0.00100	0.00108	108	52.0-128	
4,4-DDT	0.00100	0.00111	111	50.0-141	
Dieldrin	0.00100	0.00121	121	59.0-133	
Endosulfan I	0.00100	0.00120	120	57.0-131	

Laboratory Control Sample (LCS)

(LCS) R3702502-2 09/08/21 19:44

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Endosulfan II	0.00100	0.00123	123	58.0-133	
Endosulfan sulfate	0.00100	0.00124	124	58.0-133	
Endrin	0.00100	0.000964	96.4	57.0-134	
Endrin aldehyde	0.00100	0.00109	109	53.0-129	
Endrin ketone	0.00100	0.00127	127	60.0-145	
Heptachlor	0.00100	0.00113	113	27.0-132	
Heptachlor epoxide	0.00100	0.00121	121	57.0-130	
Hexachlorobenzene	0.00100	0.00112	112	30.0-114	
Methoxychlor	0.00100	0.00128	128	54.0-155	
(S) Decachlorobiphenyl			*52.4*	*10.0-128*	
(S) Tetrachloro-m-xylene			*105*	*10.0-127*	

L1399309-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1399309-01 09/10/21 14:25 • (MS) R3703262-1 09/10/21 14:35 • (MSD) R3703262-2 09/10/21 14:44

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Aldrin	0.00100	<0.000500	0.000638	0.000696	63.8	69.6	10	10.0-141	P	P	8.70	40
Alpha BHC	0.00100	<0.000500	0.000714	0.000769	71.4	76.9	10	10.0-145	P		7.42	40
Beta BHC	0.00100	<0.000500	0.000844	0.000851	84.4	85.1	10	14.0-146	P	P	0.826	35
Delta BHC	0.00100	<0.000500	0.000949	0.000986	94.9	98.6	10	17.0-143			3.82	38
Gamma BHC	0.00100	<0.000500	<0.000500	<0.000500	45.3	46.0	10	14.0-141			1.53	40
4,4-DDD	0.00100	<0.000500	0.000550	0.000564	55.0	56.4	10	10.0-160			2.51	38
4,4-DDE	0.00100	<0.000500	<0.000500	<0.000500	0.000	0.000	10	10.0-159	J6	J6	0.000	35
4,4-DDT	0.00100	<0.000500	0.000951	0.000761	95.1	76.1	10	10.0-160		P	22.2	38
Dieldrin	0.00100	<0.000500	0.000635	0.000683	63.5	68.3	10	10.0-158			7.28	38
Endosulfan I	0.00100	<0.000500	0.00116	0.00129	116	129	10	10.0-153	P		10.6	36
Endosulfan II	0.00100	<0.000500	0.000524	0.000533	52.4	53.3	10	10.0-159	P	P	1.70	39
Endosulfan sulfate	0.00100	<0.000500	0.000521	0.000608	52.1	60.8	10	23.0-147	P	P	15.4	35
Endrin	0.00100	<0.000500	0.000736	0.000793	73.6	79.3	10	10.0-160	P		7.46	39
Endrin aldehyde	0.00100	<0.000500	<0.000500	<0.000500	0.000	0.000	10	10.0-148	J6	J6	0.000	38
Endrin ketone	0.00100	<0.000500	0.000522	0.000556	52.2	55.6	10	10.0-160	P		6.31	40
Heptachlor	0.00100	<0.000500	0.000883	0.000928	88.3	92.8	10	16.0-136			4.97	40
Heptachlor epoxide	0.00100	<0.000500	0.000821	0.000914	82.1	91.4	10	10.0-160	P		10.7	36
Hexachlorobenzene	0.00100	<0.000500	0.000785	0.000818	78.5	81.8	10	10.0-130	P	P	4.12	40
Methoxychlor	0.00100	<0.000500	0.000945	0.000593	94.5	59.3	10	10.0-160	P	J3 P	45.8	34
(S) Decachlorobiphenyl					*89.3*	*90.1*		*10.0-128*				
(S) Tetrachloro-m-xylene					*98.2*	*118*		*10.0-127*				

QUALITY CONTROL SUMMARY

L1399307-01

L1399309-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1399309-01 09/10/21 14:25 • (MS) R3703262-1 09/10/21 14:35 • (MSD) R3703262-2 09/10/21 14:44

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %

Sample Narrative:

OS: IS/SURR failed on lower dilution.

GLOSSARY OF TERMS

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Results Disclaimer - Information that may be provided by the customer, and contained within this report, include Permit Limits, Project Name, Sample ID, Sample Matrix, Sample Preservation, Field Blanks, Field Spikes, Field Duplicates, On-Site Data, Sampling Collection Dates/Times, and Sampling Location. Results relate to the accuracy of this information provided, and as the samples are received.

Abbreviations and Definitions

MDL	Method Detection Limit.
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
(S)	Surrogate (Surrogate Standard) - Analytes added to every blank, sample, Laboratory Control Sample/Duplicate and Matrix Spike/Duplicate; used to evaluate analytical efficiency by measuring recovery. Surrogates are not expected to be detected in all environmental media.
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, the sample preparation volume or weight values differ from the standard, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state "ND" (Not Detected) or "BDL" (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Uncertainty (Radiochemistry)	Confidence level of 2 sigma.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
E	The analyte concentration exceeds the upper limit of the calibration range of the instrument established by the initial calibration (ICAL).
J3	The associated batch QC was outside the established quality control range for precision.
J4	The associated batch QC was outside the established quality control range for accuracy.
J6	The sample matrix interfered with the ability to make any accurate determination; spike value is low.
P	RPD between the primary and confirmatory analysis exceeded 40%.

ACCREDITATIONS & LOCATIONS

Pace Analytical National 12065 Lebanon Rd Mount Juliet, TN 37122

Alabama	40660	Nebraska	NE-OS-15-05
Alaska	17-026	Nevada	TN000032021-1
Arizona	AZ0612	New Hampshire	2975
Arkansas	88-0469	New Jersey–NELAP	TN002
California	2932	New Mexico [1]	TN00003
Colorado	TN00003	New York	11742
Connecticut	PH-0197	North Carolina	Env375
Florida	E87487	North Carolina [1]	DW21704
Georgia	NELAP	North Carolina [3]	41
Georgia [1]	923	North Dakota	R-140
Idaho	TN00003	Ohio–VAP	CL0069
Illinois	200008	Oklahoma	9915
Indiana	C-TN-01	Oregon	TN200002
Iowa	364	Pennsylvania	68-02979
Kansas	E-10277	Rhode Island	LA000356
Kentucky [1,6]	KY90010	South Carolina	84004002
Kentucky [2]	16	South Dakota	n/a
Louisiana	AI30792	Tennessee [1,4]	2006
Louisiana	LA018	Texas	T104704245-20-18
Maine	TN00003	Texas [5]	LAB0152
Maryland	324	Utah	TN000032021-11
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	110033
Minnesota	047-999-395	Washington	C847
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	998093910
Montana	CERT0086	Wyoming	A2LA
A2LA – ISO 17025	1461.01	AIHA-LAP,LLC EMLAP	100789
A2LA – ISO 17025 [5]	1461.02	DOD	1461.01
Canada	1461.01	USDA	P330-15-00234
EPA–Crypto	TN00003		

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [6] Wastewater n/a Accreditation not applicable

* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

* Accreditation is only applicable to the test methods specified on each scope of accreditation held by Pace Analytical

POLLUTION CONTROL SERVICES

Chain of Custody Number: 648011

MULTIPLE SAMPLE ANALYSIS REQUEST AND CHAIN OF CUSTODY FORM

Stamp 1st sample and COC as same number

CUSTOMER INFORMATION | **REPORT INFORMATION**

Name: Del Rio, City of (Landfill) | Attention: | Phone: | Fax: (000) 000-0000

SAMPLE INFORMATION | **Requested Analysis**

Project Information: Landfill Leachate Quality Testing

Report "Soils" ☐ As Is ☐ Dry Wt.

Collected By:

Client / Field Sample ID	Collected: Date	Collected: Time	Field Chlorine Residual mg/L	Composite or Grab	Matrix: DW-Drinking Water, NPW-Non-potable water, WW-Wastewater, LW-Liquid Waste	Container: Type	Container: Number	Container: Preservative	Metals(with Hex Cr)	NO3, F	VOC 8260	8081 Pest	8151 Herb			Instructions/Comments: PCS Sample Number
Leachate	Start: 9-1-21 End: 9-1-21	Start: 10:45 End: 10:49		☐C ☒G	☐ DW ☒ NPW ☐ WW ☐ Soil ☐ Sludge ☐ LW ☐ Other	☒P ☒G ☐O	8	☐ H_2SO_4 ☒ HNO_3 ☐ H_3PO_4 ☐ NaOH ☒ ICE ☐	★	★	★	★	★			648011 ☐S ☐B ☐N ☐HEM Other:
	Start: End:	Start: End:		☐C ☐G	☐ DW ☐ NPW ☐ WW ☐ Soil ☐ Sludge ☐ LW ☐ Other	☐P ☐G ☐O		☐ H_2SO_4 ☐ HNO_3 ☐ H_3PO_4 ☐ NaOH ☐ ICE ☐								☐S ☐B ☐N ☐HEM Other:
	Start: End:	Start: End:		☐C ☐G	☐ DW ☐ NPW ☐ WW ☐ Soil ☐ Sludge ☐ LW ☐ Other	☐P ☐G ☐O		☐ H_2SO_4 ☐ HNO_3 ☐ H_3PO_4 ☐ NaOH ☐ ICE ☐								☐S ☐B ☐N ☐HEM Other:
	Start: End:	Start: End:		☐C ☐G	☐ DW ☐ NPW ☐ WW ☐ Soil ☐ Sludge ☐ LW ☐ Other	☐P ☐G ☐O		☐ H_2SO_4 ☐ HNO_3 ☐ H_3PO_4 ☐ NaOH ☐ ICE ☐								☐S ☐B ☐N ☐HEM Other:
	Start: End:	Start: End:		☐C ☐G	☐ DW ☐ NPW ☐ WW ☐ Soil ☐ Sludge ☐ LW ☐ Other	☐P ☐G ☐O		☐ H_2SO_4 ☐ HNO_3 ☐ H_3PO_4 ☐ NaOH ☐ ICE ☐								☐S ☐B ☐N ☐HEM Other:
	Start: End:	Start: End:		☐C ☐G	☐ DW ☐ NPW ☐ WW ☐ Soil ☐ Sludge ☐ LW ☐ Other	☐P ☐G ☐O		☐ H_2SO_4 ☐ HNO_3 ☐ H_3PO_4 ☐ NaOH ☐ ICE ☐								☐S ☐B ☐N ☐HEM Other:
	Start: End:	Start: End:		☐C ☐G	☐ DW ☐ NPW ☐ WW ☐ Soil ☐ Sludge ☐ LW ☐ Other	☐P ☐G ☐O		☐ H_2SO_4 ☐ HNO_3 ☐ H_3PO_4 ☐ NaOH ☐ ICE ☐								☐S ☐B ☐N ☐HEM Other:
	Start: End:	Start: End:		☐C ☐G	☐ DW ☐ NPW ☐ WW ☐ Soil ☐ Sludge ☐ LW ☐ Other	☐P ☐G ☐O		☐ H_2SO_4 ☐ HNO_3 ☐ H_3PO_4 ☐ NaOH ☐ ICE ☐								☐S ☐B ☐N ☐HEM Other:
	Start: End:	Start: End:		☐C ☐G	☐ DW ☐ NPW ☐ WW ☐ Soil ☐ Sludge ☐ LW ☐ Other	☐P ☐G ☐O		☐ H_2SO_4 ☐ HNO_3 ☐ H_3PO_4 ☐ NaOH ☐ ICE ☐								☐S ☐B ☐N ☐HEM Other:

Required Turnaround: ☐ Routine (6-10 days) | ***EXPEDITE:*** (See Surcharge Schedule) ☐ < 8 Hrs. ☐ < 16 Hrs. ☐ < 24 Hrs. ☐ 5 days ☐ Other: _____ ***Rush Charges Authorized by:***

Sample Archive/Disposal: ☐ Laboratory Standard ☐ Hold for client pick up | **Container Type:** P = Plastic, G = Glass, O = Other | **Carrier ID:**

Relinquished By:		Date: 9-1-21	Time: 10:56 AM	Received By:		Date: 9-1-21	Time: 1:47pm
Relinquished By:		Date: 9-1-21	Time: 10:56AM	Received By:		Date: 9/1/21	Time: 1056

Rev. Multiple Sample COC 20180628

1532 Universal City Blvd., Ste. 100, Universal City, Texas 78148
P (210) 340-0343 or (800) 880-4616 - F (210) 658-7903

Login at www.pcslab.net

Pollution Control Services
Sample Log-In Checklist

PCS Sample No(s) 64801 **COC No.** 64801

Client/Company Name: Rel Rio **Checklist Completed by:**

Sample Delivery to Lab Via:
Client Drop Off ✓ Commercial Carrier: Bus ____ UPS ____ Lone Star ____ FedEx ____ USPS ____
PCS Field Services: Collection/Pick Up____ Other:____

Sample Kit/Coolers
Sample Kit/Cooler? Yes____ No✓ Sample Kit/Cooler: Intact? Yes✓ No___
Custody Seals on Sample Kit/Cooler: Not Present ✓ If Present, Intact ___ Broken ___
Sample Containers Intact; Unbroken and Not Leaking? Yes ✓ No ___
Custody Seals on Sample Bottles: Not Present ✓ If Present, Intact ___ Broken ___
COC Present with Shipment or Delivery or Completed at Drop Off? Yes ✓ No ___
Has COC sample date/time and other pertinent information been provided by client/sampler? Yes: ✓ No: ___
Has COC been properly Signed when Received/Relinquished? Yes ✓ No ___
Does COC agree with Sample Bottle Information, Bottle Types, Preservation, etc.? Yes ✓ No ___
All Samples Received before Hold Time Expiration? Yes ✓ No ___
Sufficient Sample Volumes for Analysis Requested? Yes ✓ No ___
Zero Headspace in VOA Vial if Present? Yes ___ No ✓

Sample Preservation:
* ***Cooling:*** **Not Required** ____ **or Required** ✓
If cooling required, record temperature of submitted samples Observed/Corrected 4 / 2 °C
Is Ice Present in Sample Kit/Cooler? ____ Yes ____ No Samples received same day as collected? ✓ Yes ____ No
Lab Thermometer Make and Serial Number: Vaughan 1807009583 Other: ____

Acid Preserved Sample - If present, is pH <2? **Yes** ____ **No** ____** ____H_2SO_4 ____HNO_3 ____H_3PO_4
Base Preserved Sample - If present, is pH >12? Yes ____ No ____ ____NaOH
Other Preservation:____ If Present, Meets Requirements? Yes____ No____
Sample Preservations Checked by:____ Date ____ Time ____
pH paper used to check sample preservation (PCS log #): ____ (HEM pH checked at analysis).

Samples Preserved/Adjusted by Lab:	Lab #	Parameters Preserved	Preservative Used	Log #

Adjusted by Tech/Analyst:____ Date :____Time:____

Client Notification/ Documentation for "No" Responses Above/ Discrepancies/ RevisionComments
Person Notified: ____ Contacted by:____
Notified Date: ____Time: ____
Method of Contact: At Drop Off:____ Phone ___ Left Voice Mail ___ E-Mail ____ Fax ____
Unable to Contact____ Authorized Laboratory to Proceed :____(Lab Director)
Regarding / Comments:____

Actions taken to correct problems/discrepancies:____

Receiving qualifier needed (*requires client notification above*) Temp. ___ Holding Time ___ Initails: ____
Receiving qualifier entered into LIMS at login Initial/Date: ____
Revision Comments: ____

** Samples submitted for Metals Analysis (except Hex Cr) or Drinking Water for Coliform Bacteria Only are not required to be iced. Samples collected prior day to receipt at the laboratory must meet method specific thermal cooling requirements, "or will be flagged accordingly". Samples delivered the same day as collected may not meet thermal criteria, but shall be considered acceptable if evidence that the chilling process has begun, such as arrival on ice (EPA 815-F-08-006, June 2008) ** Water samples for metals analysis that are not acid preserved prior to shipment may be acceptably preserved by the laboratory on receipt – however, the sample digestion procedure must be delayed for at least 24 hours after preservation by the laboratory.*

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT

APPENDIX IIIL
GEOTECHINCAL REPORT

Prepared for
City of Del Rio

September 2023



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This document is intended for permitting purposes only.

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APPENDICES

Appendix IIIL-A – Slope Stability Analysis

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1.0 INTRODUCTION

The purpose of this report is to present the geotechnical analysis and design for the proposed major permit amendment for the vertical expansion of the Del Rio Landfill. This report is based on the geotechnical testing information that has previously been compiled from the subsurface investigations at the site.

This report contains a compilation of geotechnical testing and design information, including:

- Slope stability analyses based on the geotechnical testing results and subsurface conditions including groundwater as well as landfill excavation and completion plans; and
- Settlement and heave analyses, which are also based on the landfill excavation and completion plans.

This report also provides geotechnical recommendations for construction of the landfill components, including bottom liner, and final cover systems with clay liner. The construction quality control and material and construction specifications for the groundwater protection components of the landfill are provided in Appendix IIID - Liner Quality Control Plan.

2.0 Laboratory Testing

2.1 Introduction

Previous geological investigations have been performed for the Del Rio Landfill, and includes the sampling and geotechnical testing of samples obtained during the investigations. A brief description of the geological/geotechnical characteristics of the site is provided in the next paragraphs. Additional geological and hydrogeological discussion is provided in Appendix IIIJ – Geology Report of this application.

Three distinct geologic subunits have been identified and described at the landfill. For consistency with the presentation from earlier geological investigations at the landfill, the geologic units are numbered from the surface downward as I through III.

- Stratum I consists of silty clays with some sand and gravel.
- Stratum II consists of caliche and clay soils with some gravel content. Clay is the predominant constituent.
- Stratum III consists of clay and weathered shale, grading into unweathered shale, containing some limestones/siltstone seams, caliche, and gypsum. These soils comprise the Del Rio Clay formation.

Additional description of the above geological units is provided in Section 3.

Laboratory tests were conducted on select samples recovered from the borings drilled to evaluate the physical and engineering properties of the different strata. Laboratory tests were performed in accordance with ASTM procedures. Available laboratory testing results from the previous (1989) investigations completed by Raba-Kistner Consultants, Inc. and (1994) Trinity Engineering Testing Corporation, are provided in Appendix IIIJ – Geology Report , and summarized in Table 3-1.

The laboratory testing meets the requirements of Title 30 TAC §330.63(e)(5)(A) regarding sampling each stratum. A summary of the laboratory tests performed is given in Table 2-1.

Table 2-1 Geotechnical Test Methods Performed

Test	Test Method
Sieve Analysis (Passing No. 200)	ASTM D 1140
Atterberg Limits (Liquid & Plastic Limit)	ASTM D 4318
Moisture Content	ASTM D 2216
Unconfined Compression	ASTM D 2166 & Pocket Penetrometer
Coefficient of Permeability (Hydraulic Conductivity)	Field Methods (vertical and horizontal permeability)
Consolidation	ASTM D 2435
Standard Proctor	ASTM D 698

2.2 Classification Tests

Classification tests consisting of Atterberg limits, percent passing the number 200 sieve, dry unit weight, and moisture content were performed on selected soil and shale samples recovered from boreholes. These test results are presented in Appendix IIIJ – Geology Report and are summarized in Table 3-1. Classification tests were used to classify the soils according to the Unified Soil Classification System (USCS) and to evaluate physical properties of the soils.

2.2.1 Material Strength Tests

Material strength tests were performed to provide general strength information and were used to evaluate the soils at the site. Unconfined compression tests were performed in the field using a hand penetrometer. Additional laboratory unconfined Compression tests (ASTM D 3080) were conducted for selected samples (as presented in Table 3-1). Shear strength correlations for each layer were developed from correlating the field and laboratory test results. Additionally, extensive field penetrometer testing was performed during investigations, as documented on boring logs included in Appendix IIIJ – Geology Report and summarized in Table 3-1. The results of field penetrometer testing were used to develop total and effective stress parameters required for stability analysis of the landfill and foundation strata.

2.2.2 Coefficient of Permeability Tests

Field slug and falling head tests were performed in the field to evaluate the hydrogeological properties of the soils and shale at the site, as well as laboratory tests that were performed of samples collected during investigations. These tests were performed to assist in evaluation of the hydrogeologic properties of the geological units at the site. The results of permeability testing performed in the field and laboratory are presented in Appendix IIIJ – Geology Report of this application and in Table 3-1.

2.2.3 Consolidation Tests

Consolidation testing was performed in the laboratory on representative soil samples obtained during field investigations. The results of the consolidation testing were utilized in settlement and heave analyses performed for this application.

2.2.4 Moisture-Density Relationships

Standard Proctor laboratory compaction tests were performed during previous liner construction activities at the site. The tests were performed to evaluate the moisture-density relationship of the

materials. Remolded samples for coefficient of permeability tests were compacted by static loading the sample to approximately 95 percent of the Standard Proctor maximum dry density at approximately the optimum moisture content determined from the Proctor test. The results to date demonstrate that the clays on site are suitable for liner construction, and able to achieve the 1x10-7 cm/sec permeability criteria. Sufficient soil quantities suitable for liner and final cover construction is available on-site, although alternatively clayey soils may be imported from off-site borrow areas.

2.3 Conclusion of Laboratory Testing

Classification testing along with unit weight, moisture content, and sieve analysis results were used to support field observations during subsurface explorations. Testing results were also used to support the subsurface characterization which includes the three formations that exist generally across the site. Additionally, soil strength parameters from both field and laboratory were conservatively generalized and selected for use in the geotechnical stability analysis. Finally, consolidation testing on representative samples obtained during field investigations were used to perform settlement and heave analyses for this application.

3.0 PROPERTIES OF SITE SOILS AND LANDFILL COMPONENTS

3.1 General

This section of the report includes the generalized stratigraphy for the site, typical properties of subsurface soils, potential uses of materials that may be excavated during construction, and soil material requirements for various components of the landfill. The results of the geotechnical testing performed on site soils are included in Appendix J – Geology Report.

The laboratory test results for soil samples obtained from the site are summarized in Table 3-1. Currently available laboratory testing information is presented in Appendix J – Geology Report.

3.2 Generalized Site Stratigraphy

The subsurface materials encountered at the site are discussed in detail in the Appendix J – Geology Report. In general, the subsurface at the site is characterized by three units. The principal geologic formation at the site is the Del Rio Clay Formation. It is overlain in some portions of the site by residual soils and remnants of the overlying Buda Limestone, and by secondary “caliche” soil and/or harder caliche layers. The specific soil stratigraphy can be divided into three generalized soil zones.

3.2.1 Stratum I

Stratum I consists of silty clays with some sand and gravel. This layer is a “topsoil” zone and likely is a residual soil intermixed with erosional remnants of the overlaying Buda Limestone. This layer is very thin (1.5 to 4.5 feet) and absent in some areas of the site.

3.2.2 Stratum II

Stratum II consists of caliche and clay soils with some gravel content. Clay is the predominant constituent. The caliche is a cementious material, primarily calcium carbonate, and is intermixed with the soil or as thin hard interbedded layers. This layer is also fairly thin (2.0 to 11.0 feet) and absent in some areas of the site.

3.2.3 Stratum III

Stratum III consists of clay and weathered shale, grading into unweathered shale, containing some limestones/siltstone seams, caliche, and gypsum. These soils comprise the Del Rio Clay formation.

3.3 Material Requirements for Landfill Components

Construction of the landfill will require clay or clayey soils which can be compacted to have an in-place hydraulic conductivity of 1x10-7 cm/s or less for the soil liner and an in-place hydraulic conductivity of 1x10-5 cm/s for the soil infiltration layer of the composite final cover system.

Soil will also be required for protective cover on the liner, operational cover (daily cover, intermediate cover) the infiltration and erosion layer components of the composite final cover, berm construction, and other miscellaneous general fill. Granular material (i.e., gravel) will be used for the leachate collection sumps, leachate collection chimney drains and may be used for groundwater dewatering collection trenches. Typical material requirements for various soil structures are summarized in Table 3-2.

Testing requirements and construction quality control and quality assurance for liner soils are detailed in Appendix IIID - Liner Quality Control Plan (LQCP). Testing requirements and construction quality control and quality assurance for final cover soils are detailed in Appendix IIIE - Closure Plan and in Appendix IIIE-A - Final Cover System Quality Control Plan (FCSQCP). Liner and final cover details are presented in Appendix IIIA-A - Liner and Final Cover System Details.

Table 3-1 Summary of Existing Geotechnical Data

Boring No.	Depth (ft-bgs)	LL	PI	Passing #200 sieve (%)	Moisture Content (%)	Dry Weight (pcf)	Horiz. Perm. (cm/sec)	Vertical Perm. (cm/sec)
Stratum I – Raba-Kisther Consultants, Inc. (1989)								
B-401	15.0	68.0	20.5	92.1	15.0	110.9	$5.2x10^{-9}$	N/A
B-402	1.5	49.0	20.5	95.3	17.0	109.0	N/A	N/A
B-403	6.0	72.0	20.5	91.7	20.5	105.9	N/A	N/A
B-404	N/A							
B-405	0.5	34.0	20.0	42.1	5.0	121.4	N/A	N/A
B-406	N/A							
B-407	6.0	55.0	19.5	82.0	19.5	106.7	N/A	N/A
B-408	N/A							
B-409	N/A							
B-410	N/A							
B-411	0.5	58.5	22.5	93.6	20.5	105.9	N/A	N/A
B-412	8.5	59.0	20.5	95.0	12.0	113.8	N/A	N/A
B-413	N/A							
B-414	N/A							
B-415	N/A							
B-416	1.0	39.5	21.0	93.1	11.0	114.9	N/A	N/A
B-417	N/A							
B-418	N/A							
B-419	N/A							
B-420	N/A							
B-3	4.5	39.5	18.5	85.0	8.0	118.1	N/A	N/A
Stratum I – Trinity Engineering Testing Corp (1994)								
B-1	5.0	54.0	38.0	95.0	11.0	118.0	N/A	$1.9x10^{-9}$
B-2	1.0	N/A	N/A	N/A	25.0	98.0	N/A	N/A
B-3	N/A							
B-4	N/A							
COMPUTATIONS – Stratum I								
Mean		52.9	22.2	86.5	15.0	111.1	$5.2x10^{-9}$	$1.9x10^{-9}$
Minimum		34.0	18.5	42.1	5.0	98.0	$5.2x10^{-9}$	$1.9x10^{-9}$
Maximum		72.0	38.0	95.3	25.0	121.4	$5.2x10^{-9}$	$1.9x10^{-9}$
Standard Deviation		12.5	5.7	16.2	6.1	6.9		
Number of Tests		10	10	10	11	11	1	1

Table 3-2 Summary of Existing Geotechnical Data

Boring No.	Depth (ft-bgs)	LL	PI	Passing #200 sieve (%)	Moisture Content (%)	Dry Weight (pcf)	Horiz. Perm. (cm/sec)	Vertical Perm. (cm/sec)
Stratum II – Raba-Kisther Consultants, Inc. (1989)								
B-401	N/A							
B-402	N/A							
B-403	N/A							
B-404	25.1	77.0	21.0	92.6	19.5	106.7	N/A	N/A
B-405	20.5	69.0	21.5	96.6	19.0	107.1	N/A	N/A
B-406	25.1	60.5	19.5	96.7	14.5	111.4	N/A	N/A
B-407	20.5	69.5	20.0	95.5	15.0	110.9	$2.1x10^{-9}$	N/A
B-408	N/A							
B-409	15.5	62.0	20.0	82.1	16.0	109.9	N/A	$1.6x10^{-9}$
B-410	20.5	69.5	21.5	93.4	16.5	109.4	N/A	N/A
B-411	10.5	75.5	22.5	97.5	22.5	104.1	$2.1x10^{-9}$	N/A
B-412	15.5	68.0	23.0	95.6	19.5	106.7	$4.0x10^{-8}$	N/A
B-413	N/A							
B-414	15.5	78.0	23.0	97.5	19.5	106.7	N/A	N/A
B-415	N/A							
B-416	N/A							
B-417	15.5	64.5	21.5	95.2	10.5	115.4	$3.5x10^{-9}$	N/A
B-418	10.5	51.5	19.5	78.2	12.5	113.3	N/A	N/A
B-419	N/A							
B-420	N/A							
B-3	9.5	51.5	19.0	86.0	12.5	113.3	N/A	N/A
Stratum II – Trinity Engineering Testing Corp (1994)								
B-1	10.0	57.0	40.0	95.0	15.0	116.0	$2.7x10^{-9}$	N/A
B-2	20.5	57.0	38.0	97.0	18.0	114.0	N/A	N/A
B-3	10.0	N/A	N/A	N/A	13.0	118.0	N/A	N/A
B-4	15.0	N/A	N/A	N/A	15.0	118.0	N/A	N/A
COMPUTATIONS – Stratum II								
Mean		65.0	23.6	92.8	16.2	111.3	$1.0x10^{-8}$	$1.6x10^{-9}$
Minimum		51.5	19.0	78.2	10.5	104.1	$2.1x10^{-9}$	$1.6x10^{-9}$
Maximum		78.0	40.0	97.5	22.5	118.0	$4.0x10^{-8}$	$1.6x10^{-9}$
Standard Deviation		8.8	6.7	6.1	3.3	4.3	$1.7x10^{-8}$	0.0
Number of Tests		14	14	14	16	16	5	1.0

Table 3-3 Summary of Existing Geotechnical Data

Boring No.	Depth (ft-bgs)	LL	PI	Passing #200 sieve (%)	Moisture Content (%)	Dry Weight (pcf)	Horiz. Perm. (cm/sec)	Vertical Perm. (cm/sec)
Stratum III – Raba-Kisther Consultants, Inc. (1989)								
B-401	42.5	N/A	N/A	95.4	18.5	107.6	N/A	$3.3x10^{-10}$
B-402	25.5	63.0	20.0	91.6	15.0	110.9	N/A	$5.6x10^{-10}$
B-403	23.5	62.0	20.0	89.6	18.5	107.6	N/A	N/A
B-404	N/A							
B-405	45.5	61.5	20.5	97.1	15.0	110.9	N/A	N/A
B-406	N/A							
B-407	N/A							
B-408	N/A							
B-409	26.0	69.0	20.5	90.0	18.5	107.6	N/A	$1.4x10^{-9}$
B-410	N/A							
B-411	49.5	65.0	22.0	98.2	18.5	107.6	N/A	N/A
B-412	N/A							
B-413	N/A							
B-414	35.5	40.5	20.0	89.8	10.5	115.4	N/A	$7.4x10^{-9}$
B-415	N/A							
B-416	N/A							
B-417	N/A							
B-418	N/A							
B-419	25.5	68.0	23.5	99.2	19.5	106.7	N/A	N/A
B-420	25.5	59.5	21.0	84.3	13.0	112.8	N/A	N/A
B-3	N/A							
Stratum III – Trinity Engineering Testing Corp (1994)								
B-1	15.0	N/A	N/A	N/A	18.0	117.0	$1.9x10^{-9}$	N/A
B-2	30.0	67.0	43.0	97.0	18.0	102.8	$2.7x10^{-9}$	N/A
B-3	29.5	75.0	52.0	98.0	17.0	109.0	$2.9x10^{-9}$	N/A
B-3A	49.5	68.0	44.0	96.0	15.0	116.4	$1.7x10^{-9}$	N/A
B-4	30.0	62.0	41.0	98.0	15.0	118.0	N/A	N/A
B-4A	55.0	57.0	37.0	97.0	14.0	116.0	$2.9x10^{-9}$	N/A
COMPUTATIONS – Stratum III								
Mean		62.9	29.6	94.4	16.3	111.1	$2.4x10^{-9}$	$2.4x10^{-9}$
Minimum		40.5	20.0	84.3	10.5	102.8	$1.7x10^{-9}$	$3.3x10^{-10}$
Maximum		75.0	52.0	99.2	19.5	118.0	$2.9x10^{-9}$	$7.4x10^{-9}$
Standard Deviation		8.2	11.8	4.5	2.6	4.6	$5.8x10^{-10}$	$3.4x10^{-9}$
Number of Tests		13	13	14	15	15	5	4

Table 3-4 Typical Soil Requirements for Landfill Construction

Landfill Component	Soil Description	Classification	Test Parameters				Material Source
			LL	PI	% - 200	Coefficient of Permeability CM/s	
Soil Liner	clayey sand, sandy clay, or clay	SC, CL, CH	30 min	15 min	30 min	$1x10^{-7}$ max	On site[1]
Final Cover infiltration Layer	clayey sand, sandy clay, or clay	SC, CL, CH	30 min	15 min	30 min	$1x10^{-5}$ max	On site
Liner Protective Cover	sand or sand with silt and clay	SP-SM, SP, SP-SC, SW, SME OR SM-SC				$1x10^{-4}$ max	On site[3]
Final Cover Erosion Layer	clayey sand, sandy clay, or clay	SC, CL, SM	Suitable to support plant growth				On site
Operational Cover (Daily Cover and Intermediate Cover)	sand, clayey sand, sandy clay, or clay	SP, SC, CL, CH	(2)	(2)	(2)	(2)	On site
Earth Fill Perimeter Berm and Subgrade Preparation	clayey sand, sandy clay, or clay	SC, CL, CH	--	--	--	--	On site

[1] If onsite materials meeting the required properties do not exist, an off-site material source can be used for liner soil.
[2] Refer to Section 4 for material requirements for the various final cover components.
[3] If onsite material does not meet the hydraulic conductivity criteria, leachate collection chimney drains will be extended through the protective cover at selected locations and will be exposed adequately for transmission of leachate to the collection system.

4.0 CONSTRUCTION CONSIDERATIONS

4.1 General

This section contains recommendations for excavation of the landfill, and soil liner, leachate collection layer, and final cover materials and construction. Additionally, operational cover soils, final cover construction, and perimeter embankment construction related recommendations are included in this section.

The landfill has a permitted footprint of 105.6 acres and a waste disposal footprint of approximately 79 acres. As shown on Figure I/II-3.3, Cells 3, 4 and 5 have been constructed, and will be expanded vertically to create the airspace proposed in this application.

4.2 Landfill Excavation

The landfill base grades for cells will be founded primarily in the Stratum III. The excavation for the liner construction will be performed in a manner that will achieve reasonable segregation of liner quality material from soils that are not suitable for a liner. Soil materials to be used for liner construction will be stockpiled separately, according to construction material properties outlined in Section 3 and visual observation during excavation.

Excavation of the soils encountered will be achieved with equipment such as excavators. Blasting of hard rock will not be required and will not be used at this site.

Excavation side slopes will be graded no steeper than 2 horizontal to 1 vertical. Excavation cut slopes around the perimeter of future cells may require erosion protection if an extended period of time occurs between excavation and liner construction. Interim erosion protection can be accomplished by diverting runoff away from the slopes. "Track walking" with a bulldozer up and down the slopes will create the effect of "mini-dikes" with the bulldozer tracks, which will reduce erosion.

Prior to beginning construction of the liner components, the subgrade area will be stripped to a depth sufficient to remove all loose surface soils or soft zones within the exposed excavation. The liner base grades will be proof-rolled with heavy, rubber-tired construction equipment or equivalent to detect soft areas. Soft areas will be undercut to firm material and backfilled with suitable compacted clay fill, as discussed in Section 2 of Appendix IIID – Liner Quality Control Plant (LQCP). Preparation of the liner base grades will result in a surface that is stable and that does not exhibit significant rutting from the construction traffic. The prepared liner base grades will be approved by a Professional of Record (POR), tested to verify that it meets the requirements outlined in Section 4.3, and surveyed to verify grades.

4.3 Clay Liner Construction

The bottom and sides of the landfill excavation consists of 2-foot-thick compacted clay liner. The clay liner will have a maximum hydraulic conductivity of 1x10-7 cm/s. Details for the liner system are provided in Appendix IIIA– Landfill Unit Design Information (Appendix IIIA-A). Adequate soil liner material will be available from proposed landfill excavations, onsite, or offsite borrow sources to provide material for the liner construction. Preconstruction laboratory tests may be performed to verify that a borrow source soil material is adequate to meet the compacted clay liner requirements listed in Title 30 TAC §330.339(c)(5) prior to using any soil borrow source as liner.

The soils used for liner construction will have the minimum soil property values listed in Table 4-1 that will be verified by preconstruction testing in a soils laboratory. The following soil liner properties are included in Appendix IIID - LQCP.

Table 4-1 Soil Liner Properties

Test	Specifications
Hydraulic Conductivity of Remolded Soils'	1.0×10^{-7} cm/s or less
Plasticity Index	15 minimum
Liquid Limit	30 minimum
Percent Passing No. 200 Mesh Sieve	30 minimum
Percent Passing 1-inch Sieve	100

[1] A hydraulic conductivity test will be performed on soil samples remolded per ASTM D 698 in accordance with Appendix IIID - LQCP.

Representative preliminary sampling will be performed on the materials that will be used for soil liner construction. Laboratory tests of samples recovered from soil borings indicate that some soils which will achieve a coefficient of permeability of less than 1x10-7 cm/s exist at the site. Prior to construction of each new liner area, conformance tests that include liquid limit, plastic limit, percent passing the No. 200 sieve, Standard Proctor (ASTM D 698) and remolded hydraulic conductivity tests will be performed for the soils used for liner. Additional conformance tests will be conducted if there are visual changes in the borrow material or the liquid limit or plasticity index vary by more than 10 points. The soil liner construction and testing procedures are outlined in Appendix IIID - LQCP.

4.4 Drainage Materials

The Leachate Collection System (LCS) drainage material will consist of a drainage geocomposite over the entire liner bottom and side slopes. Each sector will have a bottom slope toward an LCS trench (i.e., pipe enveloped in gravel and geotextile) that will collect leachate from the bottom and sideslopes. The leachate collection system details are illustrated in Appendix IIIA– Landfill Unit Design Information (Appendix IIIA-A). The material specifications and construction procedures for the LCS components are presented in Appendix IIID - LQCP. The LCS design and demonstrations are provided in Appendix IIIC - Leachate and Contaminated Water Management Plan.

4.5 Liner Protective Cover

The liner protective cover is required to be a minimum of 24 inches thick for the sideslopes and the floor area. The purpose of the protective cover is to protect the drainage geocomposite from solid waste placed over the liner system. To ensure passage of leachate into the leachate collection system, drainage passages (chimney drains) will be constructed through the protective cover. The chimney drains will be installed over the LCS collection pipes as shown in Appendix IIIA– Landfill Unit Design Information (Appendix IIIA-A). The protective cover will be placed with construction equipment in one lift such that it covers the leachate collection layer completely. The protective cover material will be free of solid waste and will not require compaction under the density-controlled construction procedures.

4.6 Operational Cover Soils

Operational cover soils include daily cover (placed over the waste each day) and intermediate cover (placed over waste in areas that will not receive additional fill for at least 6 months). All soils excavated at the site may be used for operational cover.

4.7 Final Cover Construction

4.7.1 Final Cover Infiltration Layer Construction

The infiltration layer of the final cover system will be constructed with clayey material and will be a minimum of 18 inches thick. As specified in Appendix IIIE ¬Closure Plan, the infiltration layer will consist of 18 inches of earthen material with a coefficient of permeability equal to or less than 1x10-5 cm/s. The purpose of this layer is to reduce infiltration of surface water into the fill. The final cover components material and construction requirements will be in accordance with Appendix IIIE-A - FCSQCP.

4.7.2 Final Cover Erosion Layer Construction

As shown in Appendix IIIA-A, the final cover system will include a 12-inch-thick erosion layer for the top slope and a 24-inch thick erosion layer for the sideslopes. The erosion layer will protect the infiltration layer and will support vegetative growth. The top 6 inches of the erosion layer will consist of (1) topsoil stockpiled during the excavation process, (2) other on-site excavated soils amended as necessary to be capable of sustaining vegetation, and/or (3) imported soil materials. Whether placed in a single lift or two lifts, the erosion layer (top of final cover) will be selected to sustain vegetative growth.

4.8 Perimeter Embankment Construction

Perimeter embankments (berms) will be constructed as needed to prevent surface water flow from entering the landfill excavation. The embankment will have side slopes no steeper than 3 horizontal to 1 vertical (3H:1V). A sufficient amount of soil is available from the landfill excavations to construct the perimeter embankment and other features that require stable soil fill material.

The embankments will be constructed of onsite soils free of organic or other objectionable materials. Prior to beginning embankment fill, the subgrade area will be stripped to a depth sufficient to remove all topsoil and vegetation. Topsoil will be stockpiled for later use. The subgrade area will be proof-rolled with heavy, rubber-tired construction equipment to detect soft areas. Soft areas will be undercut to firm material and backfilled with suitable compacted clay fill. The subgrade preparation will result in a subgrade surface that is stable and does not exhibit significant rutting from construction equipment traffic. As necessary, the outside slope of all embankment construction above ground level will be vegetated to minimize erosion and desiccation.

The general fill placed below the liner (e.g., over excavated areas within the liner construction area) will be spread in maximum 8-inch-thick, loose, horizontal lifts and compacted to a minimum of 95 percent of maximum Standard Proctor dry density within a range of moisture content provided at or above 95 percent compaction as determined by Standard Proctor. A minimum of one Standard Proctor test (ASTM D 698) will be performed on each representative soil used as clay fill material. Each lift will receive a minimum of four passes with a heavy tamping roller unless adequate compaction can be demonstrated with fewer passes. Moisture-density field-testing and full-time third party CQA monitoring during construction will be performed in accordance with Appendix IIID - LQCP.

5.0 SLOPE STABILITY ANALYSIS

5.1 General

This slope stability analysis has been developed to analyze excavation slope and landfill completion slopes using critical sections for each condition. Slide2 version 2018 was used to analyze the stability of excavation slopes and the final configuration of the site. Slide is an industry standard computer program developed by Rocscience Inc. and has been used widely in several slope stability application for dams, embankments, excavations, retaining walls and soil slopes.

The input file for the program includes:

- Slope surface geometry.
- Subsurface information to identify different types of soil materials in horizontal and vertical directions so that each subsurface segment is identified with corresponding soil strength parameters.
- Groundwater information. The program is capable of modeling multiple groundwater surfaces that may be applicable to various subsurface soil components identified in the second bullet.
- Material strength information. Each soil section (horizontal or vertical) identified in the second bullet is assigned with strength parameters including cohesion and friction angle.
- Model control and simulation user interface of the model that allows selection of the method of analysis (e.g., Simplified Bishop) and identifying simulation control parameters.

Automatic failure surface generation functions, that use either initiation/termination ranges of the failure surface or use search boxes to define failure surface location, are used to locate the critical failure surface. The two methods employed for this slope stability analysis are described below.

- Simplified Janbu Method - This method uses the method of slices to determine the stability of the mass above a failure surface.
- Simplified Bishop Method - This method uses the method of slices to discretize the soil mass for determining the factor of safety.

In general, the stability of various critical sections were analyzed under static condition for short-term (construction) and long-term (after construction) safety. The slope stability analyses are provided in Appendix IIIL-A.

The stability analysis has been developed using demonstrations showing that, for each analyzed section, the forces resisting movement of the slopes are higher than the forces that potentially create movement. Therefore, the ratio of forces resisting movement to the forces potentially creating movement is defined as the factor of safety (FS). When the FS is equal to or greater than 1.0, it means that the slope is stable. In the slope stability analysis, a factor of safety greater than 1.0 is desired. The FS value is increased for the increased uncertainty for the system analyzed. A factor of safety of 1.5 has been used for slopes that will stay in place long term, including interim and final cover configurations. A factor of safety of 1.3 is acceptable for total stress conditions that will be in place for a short period of time. A factor of safety of

1.0 is acceptable for analysis of residual stress (provided peak stress provides a factor of safety equal to or greater than 1.5).

5.2 Section Selected for Analysis

Slope stability analyses were performed on critical sections to evaluate the stability of the excavation and final cover configuration slopes. The geometries of the slopes analyzed were determined by reviewing the permitted excavation plan and the proposed final contour plan. The evaluation locations were selected to analyze critical slopes consisting of profiles that include the landfill configuration as well as natural materials at the toe and below the landfill excavation.

5.3 Configurations Analyzed

The excavation and final landfill configurations were modeled to represent critical slope conditions, and the analysis was performed using circular and block failure surfaces. The maximum final fill slopes will be 4 horizontal to 1 vertical (4H:1V), while excavation slopes will be as steep as 2H:1V. A copy of the top of liner plan and final completion plan showing the locations of the cross sections selected for analysis are included in Appendix IIIL-A. Additionally, the configurations analyzed are graphically illustrated in Appendix IIIL-A. It is assumed that the horizontal length of an interim slope will not be longer than the final cover condition. If the horizontal length of the actual interim slope is longer than the final cover is developed during site operations, an additional analysis will be completed at that time if deemed necessary by a registered engineer and maintained in the Site Operating Record.

5.4 Input Parameters

The cross sections for slope stability analysis were developed from the permitted excavation plan and the proposed landfill completion plan (see Drawings in Appendix IIIA-A). The soil parameters were selected based on a review of the boring logs and laboratory test results from the subsurface investigation studies at the site and upon engineering judgment and experience with similar materials. The groundwater surface is not indicated in the analysis is obtained from Appendix IIIJ – Geology Report and represents the highest measured groundwater levels. Table 5-1 summarizes the unit weights and strength parameters used for the stability analyses for the evaluated landfill slopes (excavation, interim and final cover slopes).

Table 5-1 Summary of Material Weight and Strenght Parameters Used in the Slope Stability Analysis

Strength Parameters			Comments
Liner System			For The liner system includes a 2-foot-thick compacted clay layer, drainage geocomposite (single-sided on floor grades and double-sided on 3H:IV sideslopes), and a 2-foot-thick protective cover soil layer. This system is modeled as two layers for the global stability analysis: the 2-foot-thick compacted clay liner and the soil protective cover. For the rotational global stability analysis, the liner system is modeled as two layers: the compacted clay liner and the soil protective cover layer. The drainage geocomposite layer is not included in the global analysis because it provides a negligible contribution to the forces that are resisting movement. The strength values selected for the liner system represent strength values typically used in the industry and these same strength values have been used in various permit applications approved by TCEQ. Duncan and Wright (2005) provides a comprehensive discussion regarding strength parameters for a liner system. In Chapter 5 - Shear Strengths of Soil and Municipal Solid Waste, a significant amount of data are presented and evaluated for compacted clay liners. The results indicate that the lowest cohesion value for compacted cohesive soils is 9 kPa (187 lb/ft2) and the lowest reported friction angle value is 19 degrees. Therefore, selected values of 100 lb/ft2 for cohesion and 16 degrees of friction angle conservatively represent the liner system. Soil properties used in the slope stability analysis are subject to verification at the time of each liner construction. Appendix IIID - LQCP includes the material strength tests required for soil used for liner construction. Protective cover and compacted clay liner soil unit weight values are based on experience with liner system construction. The global stability analysis is included in Appendices IIIE-A.
Soil Material Strength Parameters			
Cohesion (lb/ft^2)	**Friction Angle (degrees)**	**Unit Weight (lb/ft^3)**	
100	16	116	
Final Cover System			The The final cover system includes the erosion layer and compacted clay infiltration layer. For the rotational global stability analysis, the final cover system is modeled as a single layer and the strength parameters represent the compacted clay infiltration layer and the erosion layer. The strength values selected for the final cover system represent strength values typically used in the industry and these same strength values have been used in various permit applications approved by TCEQ. The global stability analysis for rotational failure analysis uses the soil material strength parameters (i.e., cohesion of 100 lb/ft^2 and a friction angle of 16 degrees). The global stability analysis is included in Appendix IIIL-A-2.
Soil Material Strength Parameters			
Cohesion (lb/ft^2)	**Friction Angle (degrees)**	**Unit Weight (lb/ft^3)**	
100	16	120	
Solid Waste			The strength parameters for solid waste were based on information contained in the following references: Pagotto and Rimoldi (1987), Landva and Clark (1990), and Richardson and Reynolds (1991). These sources list cohesion and friction angle values that range from 210 lb/ft^2 to 605 lb/ft^2 and 18° (for residual strength or large displacement for direct shear test which requires a factor of safety of 1) to 43°, respectively. The selected strength values (cohesion = 288 psf and friction angle = 23°) are conservatively selected to represent peak strength for MSW. The unit weight of waste was obtained from Appendix IIIB - Site Life Calculations.
Material Strength Parameters			
Cohesion (lb/ft^2)	**Friction Angle (degrees)**	**Unit Weight (lb/ft^3)**	
288	23	59	

5.5 Results of Stability Analysis

The results of the stability analyses using the computer program indicate that the permitted excavation and proposed final configuration slopes are stable under the conditions analyzed. Tables 5-2 and 5-3 summarize the results of the stability analyses for the landfill slopes and compares the calculated factor of safety to the recommended minimum factor of safety. The recommended minimum factors of safety for the conditions analyzed were determined using recommendations from the Corps of Engineers "Design and Construction of Levees" manual (EM 1110-2-1913) and the EPA's "Technical Guidance Manual for Design of Solid Waste Disposal Facilities," as 1.3 for short term slope stability (excavation slopes) and 1.5 for long term slope stability (interim and final cover slopes).

Table 5-2 Summary of Slope Stability Analysis for Excavation Slopes

Slope Designation	Method of Analysis	Factor of Safety Generated	Factor of Safety Generated for Total Stress
Excavation Slope A-1	Bishop-Circular	1.65	YES
Excavation Slope A-2	Janbu/Randkine	1.51	YES

Table 5-3 Summary of Slope Stability Analysis for the Final Landfill Configuration

Slope Designation	Method of Analysis	Factor of Safety Generated	Factor of Safety Generated for Total Stress
Final Cover B-1	Bishop-Circular	3.25	YES
Final Cover B-2	Janbu/Randkine	2.91	YES

Computer-generated slope stability analysis output is included in Appendix IIIL-A. As shown in Table 5-2 and 5-3, the minimum calculated factors of safety for excavation slopes is 1.51, with an acceptable minimum factor of safety of 1.50. As shown in Table 5-3, the minimum calculated factors of safety for final cover slopes is 2.91, with an acceptable minimum factor of safety of 1.5. The stability analysis output demonstrates that all conditions analyzed have an acceptable factor of safety.

6.0 SETTLEMENT, STRAIN, AND HEAVE ANALYSIS

6.1 General

The purpose of the settlement and heave analysis is to demonstrate that the liner system will not be adversely impacted by foundation settlement. The settlement analysis also addresses the settlement of

the final cover system to demonstrate that the proposed final cover is designed to withstand the potential strain induced by waste settlement.

Settlement of the liner system will occur due to consolidation of the foundation materials from the weight of the landfill components (i.e., protective cover, solid waste and daily cover, and final cover systems). Laboratory consolidation tests indicate that the foundation soils have low compressibility. Settlement of the final cover system will occur due to consolidation of foundation soils and consolidation within the solid waste. Total consolidation of final cover consists of primary and secondary consolidation of deposited waste. Appendix IIIL-B includes details for the foundation heave and settlement as well as final cover settlement analyses.

6.2 Foundation Heave

Potential heave (rebound) due to excavation of overburden above the excavation base was estimated using the standard consolidation theory for soils and the recompression index obtained from the rebound portion of the consolidation tests. In order to estimate potential for heave, the load is decreased, instead of increasing the load on the soils, to correspond with the projected weight of excavated soil. Using a maximum excavation depth of approximately 78 feet (existing ground elevation minus bottom of excavation at a given location), a heave of approximately 5.36 feet was calculated. The heave estimate presented in the calculation is assumed overly conservative as it assumes that the underlying shale will heave consistent with both the limited consolidation testing performed of the shale and the rebound curve represented in the consolidation test results. Actual heave likely will be significantly less and will be monitored during construction by surveying events performed of the excavation grades and protective cover grades. The depth of floor grade excavation for each individual sector (liner area draining to an LCS sump) is generally uniform (i.e., depth of soil to be removed from the floor grades does not change drastically within a given sector). Where the excavation depth is less, heave will also be less and therefore negligible. These calculations are included in Appendix IIIL-B-1. Heave will occur soon after excavation (before and during liner construction) and will not adversely affect the performance of the liner system.

6.3 Foundation Settlement and Strain

Foundation settlement potential has been assessed using the consolidation test results for the Stratum III. Consolidation test results for the shale demonstrated that the unit has characteristics of over-consolidation, which means that previous stresses on the unit were greater than stresses currently vertically distributed through the unit. Pre-consolidation pressure is generally assumed to represent the maximum vertical overburden stress that a particular soil layer has sustained in the past. For the analysis, the pre-consolidation stresses were incorporated into the settlement and strain analyses.

The results of the analyses are presented in Appendix IIIL-B. As demonstrated in Appendix IIIL-B, settlement in the foundation geological unit at the site is negligible and will not adversely affect the performance of the leachate collection system and will not result in detrimental strain on the liner system components.

6.4 Final Cover Settlement and Strain

Landfill final cover settlement occurs due to settlement of foundation soils and the settlement of waste materials. In general, foundation settlement is insignificant in comparison to the settlement of deposited waste. Waste settlement consists of primary and secondary settlement.

Settlement of solid waste generally begins rapidly as the waste load is placed and continues to occur for long periods of time after the initial placement. Initially, municipal solid waste will undergo primary settlement due to its own weight, final cover, equipment, etc. Primary settlement occurs quickly, generally within the first month after loading. Therefore, the weight of the final cover system is the only remaining factor that contributes to primary consolidation. By the time the construction of the final cover is complete, settlement of the waste due to the weight of the final cover will be complete.

Secondary settlement continues at substantial rates for periods of time well beyond primary settlement. It is a combination of mechanical secondary compression, physico-chemical reaction, and bio-chemical decay. Settlement analysis for the final cover system is presented in Appendix IIIL-B-3.

A strain analysis has been incorporated into the final cover settlement analysis presented in Appendix IIIL-B-3. The purpose of the settlement and strain analysis is to demonstrate that the final cover system will be stable as designed and maintain positive drainage. If it is considered that the waste settlement is uniform, then the sideslopes are expected to maintain positive drainage. Based on the estimates of settlement for the maximum waste thickness (where maximum waste settlement is expected to occur on the top deck of the landfill) and minimum waste thickness (where minimum settlement is expected to occur on the top deck of the landfill), the landfill final cover will be subject to a maximum strain of -0.008 percent. That is less than the allowable strain for the final cover soil infiltration layer. A strain demonstration in Appendix IIIL-B-3 shows that the top deck areas of the final cover will be stable and maintain positive drainage (minimum 2.29% slope) after settlement.

7.0 CONCLUSIONS NAD RECOMMENDATIONS

This geotechnical analysis has been developed using (1) geotechnical data obtained from testing performed on the soil samples recovered at the site; (2) general soil stratigraphy of the project area; and (3) known geotechnical characteristics of solid waste, and soils used for various components of landfills. It is concluded, based on this geotechnical analysis, that the proposed landfill and its components (e.g., leachate collection system) will be geotechnically stable and will function as designed. The following summarizes findings of the geotechnical analysis.

- All geotechnical engineering tests were performed in accordance with industry practice and recognized procedures (e.g., ASTM standards).
- Stability of the proposed landfill excavation slopes and the final cover are acceptable as designed (see Appendix IIIL-A).
- Foundation settlement after filling is expected to be negligible and within the strain limits of the liner system (refer to Appendix IIIL-B).
- Settlement of the final cover system will not adversely affect the final cover system, and the final cover system will function as designed (refer to Appendix IIIL-B).

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT

APPENDIX IIIL-A
SLOPE STABILITY ANALYSIS

Prepared for
City of Del Rio

September 2023



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Appendices

Appendix IIIL-A-1 – Excavation Configuration Stability Analysis

Appendix IIIL-A-2 – Final Configuration Stability Analysis



1.0 INTRODUCTION

This appendix includes the slope stability analysis for the landfill slopes during various phases of the site development and the final landfill configuration. General slope stability for the excavation and closed conditions were evaluated by using the Slide 2D 2018 computer program. The Simplified Bishop method was used for circular failure surfaces, and the Simplified Janbu method using Rankine Block was used for the translational slope stability analysis. Soil profiles analyzed for each configuration for the slope stability analysis are provided in the sub-appendices, along with the Slide computer output files as applicable. The stability analysis for the site is provided in the following appendices.

- Appendix IIIL-A-1 includes the slope stability analysis for the excavated landfill condition.
- Appendix IIIL-A-2 includes the slope stability analysis for the closed landfill condition.

APPENDIX IIIL-A-1
EXCAVATION CONFIGURATION
STABILITY ANALYSIS

APPENDIX IIIL-A-2
FINAL CONFIGURATION
STABILITY ANALYSIS

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT

APPENDIX IIIL-B
SETTLEMENT AND HEAVE ANALYSIS

Prepared for
City of Del Rio

September 2023



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1.0 INTRODUCTION 3

Appendices

Appendix IIIL-B-1 – Foundation Settlement and Heave Analysis

Appendix IIIL-B-2 – Final Cover System Settlement Analysis



1.0 INTRODUCTION

This appendix includes the settlement, strain and heave analyses for the foundation soils and the settlement and strain analyses for the final cover system. The following two appendices are developed for the foundation soils and final cover.

- Appendix IIIL-B-1 includes the settlement, heave and strain analysis for the foundation soils.
- Appendix IIIL-B-2 includes the settlement and strains analysis for the final cover system.

APPENDIX IIIL-B-1
FOUNDATION SETTLEMENT AND HEAVE ANALYSIS

APPENDIX IIIL-B-2
FINAL COVER SYSTEM SETTLEMENT ANALYSIS

CITY OF DEL RIO LANDFILL
VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW 207C

PERMIT AMENDMENT APPLICATION

PART III – FACILITY INVESTIGATION AND DESIGN
APPENDIX IIIM
LANDFILL GAS MANAGEMENT PLAN

Prepared for

City of Del Rio

September 2023



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Landfill Gas Monitoring Probe Plan

APPENDIX IIIM2
Reporting and Recording Forms

APPENDIX IIIM3
Landfill Gas Monitoring Probe Boring/Completion Logs



1 INTRODUCTION

30 TAC §§330.63(g), 330.371

1.1 Scope

This landfill gas (LFG) management plan has been developed for the City of Del Rio (City) as required by 30 TAC §330.63(g). This LFG management plan is consistent with the requirements set forth in §330.371 and provides a site-specific approach to implementing LFG monitoring. This plan describes the existing and proposed LFG monitoring network, the operation and monitoring of this network, notification procedures, and possible remediation activities, if required.

The City of Del Rio Landfill will comply with all applicable federal and state regulations. These include the Environmental Protection Agency's – Clean Air Act, Section 111(b), New Source Performance Standards for municipal solid waste landfills, and the applicable requirements of the TCEQ Office of Air Quality, including standard permit requirements and 30 TAC Chapter 330, Subchapter U.

1.2 Purpose

§330.371 requires landfills to implement a routine LFG monitoring program to verify that (1) the concentration of methane does not exceed 1.25 percent methane by volume in facility structures (excluding LFG collection and control system components), and that (2) the concentration of methane does not exceed 5 percent methane by volume in monitoring points, probes, subsurface soils, or other matrices at the permit boundary.

The purpose of this LFG management plan is to provide guidance for management of LFG at the site. These guidelines cover the evaluation of methane concentrations at the permit boundary and in structures on the permitted site.

1.3 General

Consistent with §330.371(d), the executive director may establish alternative schedules for demonstrating compliance with methane monitoring as required by §330.371(b), and with action plan activities as required by §330.371(c).

Consistent with §330.371(e), the landfill gas monitoring and control program will continue for a period of 30 years after certification of final closure of the facility, or until the City receives written authorization to reduce the program. Authorization to reduce gas monitoring and control shall be based on a demonstration by the owner or operator that there is no potential for gas migration beyond the permit boundary or into on-site structures. The demonstration will be supported by data collected and additional studies, as required.

Consistent with §330.371(f), gas monitoring and control systems will be revised as needed to maintain current and effective gas monitoring and control. Post closure land use of the facility will not interfere with the function of gas monitoring and control systems. Any underground utility trenches that cross the permit boundary will be vented and monitored regularly, contingent on approval from the utility easement owner.

2 SITE CHARACTERISTICS

30 TAC §330.371

2.1 Introduction

The proposed LFG monitoring network consists of a total of eighteen LFG monitoring probes, located near the permit boundary, to detect potential LFG migration. The proposed LFG monitoring probe locations are shown on Drawing IIIM1.1 in Appendix IIIM1.

2.2 Soil Conditions

The site geologic conditions present at the site are discussed in Appendix IIIJ.

2.3 Hydrogeologic Conditions

The hydrogeologic conditions present at the site are discussed in Appendix IIIJ.

2.4 Hydraulic Conditions

Hydraulic conditions at the site are discussed in Appendix IIIH.

2.5 Facility Structures Within the Permit Boundary

There are no enclosed structures within the permit boundary. Any future enclosed structures added within the permit boundary will be monitored using continuous monitors for the presence of LFG as described in Section 3.2.1 of this attachment.

2.6 Underground Utilities

There is a natural gas pipeline that enters and exits the northeastern portion of the permit boundary, as shown on Drawing IIIM1.1.

2.7 Offsite Structures

All known habitable structures located offsite within ¼ mile of the permit boundary are depicted on Drawing IIIM1.3.

3 MONITORING

30 TAC §330.371

3.1 Perimeter Monitoring

3.1.1 Perimeter Monitoring Network

The current LFG monitoring probe network at the landfill consists of six LFG monitoring probes. However, all of these are located outside of the proposed permit boundary. As a result, all of these probes will be plugged and abandoned. Eighteen probes will be added to provide a perimeter monitoring network around the perimeter of the proposed permit boundary. Proposed locations of the LFG monitoring probes are shown on Drawing IIIM1.1 in Appendix IIIM1.

The landfill gas monitoring probes will be installed in phases as the waste footprint develops. GP-1 through GP-12 will be installed within 120 days of final approval on the permit amendment. For the remainder of the proposed probes, prior to receiving waste in any new cell, all probes within 1,000 feet of that cell will be installed.

3.1.2 Landfill Gas Monitoring Probes

Future LFG monitoring probes will be installed in accordance with the detail shown on Drawing IIIM1.2. Once installation is completed, boring logs and completion logs will be submitted to TCEQ and added to Appendix IIIM3.

Each gas monitoring probe is designed to monitor the soil strata above the lowest planned future elevation of waste within 1,000 feet of the probe. The interprobe spacing for the gas monitoring probes will be a maximum of 1,000 feet, with tighter spacing in areas where habitable structures are currently located. The design depths and elevations for each of the proposed gas monitoring probes is shown on the table on Drawing IIIM1.1.

3.1.3 Utility Vents

There is a natural gas pipeline that enters and exits the northeastern portion of the permit boundary. Utility vents will be placed near these locations, as shown on Drawing IIIM1.1. A detail of the utility vents is shown on Drawing IIIM1.2.

3.1.4 Monitoring Procedures

Monitoring will be conducted by a qualified landfill representative or a qualified consultant. To avoid artificially impacting the probe static pressure during the induction of the gas sample into the instrument, the static pressure will be measured and recorded prior to measuring gas composition. Static gas pressure will be measured and recorded in inches of water column. The calibration and operation of the monitoring equipment will be as recommended by the instrument manufacturer.

During each monitoring event, the probes will be monitored for the following parameters:

- Methane concentration, as measured in percent by volume
- Oxygen concentration (optional), as measured in percent by volume
- Static pressure, as measured in inches of water column, gauge
- Depth to groundwater, as measured in feet

Monitoring for gas composition and gas pressure will be performed using a portable Landtec® GEM-2000, or equivalent instrument, capable of measuring the required parameters. The monitoring equipment will be calibrated and maintained in accordance with the manufacturer's recommended procedures. Manufacturer's maintenance and calibration requirements for the monitoring instruments will be maintained on site with the LFG monitoring records described in Section 3.3.

The monitoring device will have a suction sampling line equipped with a quick-disconnect fitting. This fitting will match up with a corresponding quick-disconnect fitting on the top of each probe to enable gas samples to be drawn directly into the monitoring instrument without diluting the sample. The indicator will give a direct reading of the methane concentration in one of two scales, percent of the LEL or percent by volume.

After these parameters are measured, the probe of a liquid level indicator will be lowered into the LFG probe through an opening located at the top of the LFG probe to measure water level (if any) inside the LFG probe. If no water is present, the level indicator will be used to verify and report total depth of the probe to assure that the probe is not obstructed.

3.1.5 Maintenance Procedures

Each time LFG monitoring is conducted, the sampler will inspect the integrity of the LFG monitoring probes. The sampler will record pertinent information on the Quarterly Landfill Gas Monitoring Report (see Appendix IIIM2) or similar forms. The Quarterly Landfill Gas Monitoring Report will be kept in the site operating record. The sampler will perform the following at each monitoring event:

- Verify that the LFG monitoring probe is clearly labeled on the outer casing or lid.
- Verify that the protective casing is intact and is not bent or excessively corroded.
- Verify that the concrete pad is intact (no evidence of cracking or heaving).
- Verify that the padlock is functional.
- Verify that the inner casing is intact.

If damage to the LFG monitoring probe is observed, it will be reported to the site manager. If it is not possible to repair the LFG monitoring probe and the damage can potentially affect the accuracy of future monitoring results, the LFG monitoring probe will be decommissioned and replaced with a new LFG monitoring probe in accordance with Sections 3.1.2 and 3.4 of this attachment.

3.2 Facility Structures Monitoring

3.2.1 Monitoring Procedures

Any future on-site buildings and structures designed for human occupation will be monitored with a continuous LFG monitor/alarm that will provide an audible alarm if methane concentrations exceed 1.25 percent methane by volume.

If allowable methane concentration limits are exceeded within structures, the building will be immediately evacuated and ventilated by opening doors and windows. Notification consistent with procedures in Section 4.2 of this attachment will be implemented immediately.

3.2.2 Maintenance Procedures

Continuous LFG monitors/alarms will be calibrated and maintained in accordance with the manufacturer's recommendations. Continuous LFG monitors/alarms will be tested following the manufacturer's testing specifications.

3.3 Recordkeeping/Reporting

Field monitoring data records will be maintained for the methane monitoring and kept in the site operating record. Field data will be recorded on the Quarterly Landfill Gas Monitoring Report form (or similar form) as shown in Appendix IIIM2.

Quarterly monitoring results will be placed in the site operating record. LFG monitoring points, probes, subsurface soils, or other matrices will be monitored quarterly. The LFG monitoring program will continue for a period of 30 years after the final closure of the facility or until the owner or operator receives written authorization from the TCEQ to revise or discontinue the program. Gas monitoring records will be maintained in the site operating record.

3.4 Backup Plan for Monitoring Probes and Continuous Monitors

The following is a back-up plan to be used if any installed LFG monitoring probes or continuous monitoring devices become unusable or inoperative.

Stationary Perimeter Probes

1. Damaged or inoperative perimeter probes will be repaired within 30 days of the date of damage or replaced within 60 days from the TCEQ approval date of the permit modification requesting replacement.

2. Upon completion of the replacement probe, an installation report including boring logs and construction details will be submitted to the TCEQ.

3. Should a monitoring event occur prior to replacement of a damaged probe, a bar-hole will be placed next to the damaged probe and a portable gas monitor used until the probe is replaced.

Stationary Combustible Gas Monitor

1. Damaged or inoperative stationary combustible gas monitors will be repaired within 30 days of the date of damage or replaced within 60 days.

2. A portable gas indicator will be used until the damaged or inoperative stationary unit is replaced.

3.5 Monitoring Frequency

LFG monitoring points, probes, subsurface soils, or other matrices will be monitored quarterly, at a minimum. Facility structures will be monitored using continuous LFG monitors. The facility will monitor more frequently those locations where monitoring results indicate that LFG migration is occurring or is accumulating in structures.

4 ACTION PLAN

30 TAC §330.371

4.1 Initial Response Measures

As required under 30 TAC §330.371, this action plan has been prepared for the protection of human health in the event concentrations of methane exceed allowable limits either within on-site buildings or at the permit boundary of the site. The appropriate emergency response is different for each situation; therefore, this plan addresses buildings and permit boundaries separately.

4.1.1 Emergency Action

The initial action in the event methane is detected at levels above regulatory limits is to protect human health. The specific response depends on the circumstances of the situation.

Buildings/Structures. If the monitoring device in a facility building/structure is triggered, or if gas monitoring equipment indicates that the methane concentration has exceeded the regulatory limit, the building/structure is to be evacuated of all personnel immediately and the site manager will be notified. Personnel (except for authorized monitoring personnel) will not be allowed to re-enter the affected building/structure until additional measures are taken. Notification consistent with procedures in Section 4.2 of this attachment will be conducted immediately.

Permit Boundary. If methane levels above the regulatory limit are detected at the permit boundary in the LFG monitoring points, probes, subsurface soils, or other matrices, the site manager will be notified. The immediate emergency response measure will be for the site manager to determine if any nearby buildings or structures (including off-site) are at risk and if evacuation of the buildings or structures should be requested.

Once immediate actions have been completed to protect human health, notification consistent with procedures in Section 4.2 of this attachment will be conducted immediately.

4.2 Notification Procedures

When methane concentrations above the regulatory limit have been detected in the monitoring points, probes, subsurface soils, or other matrices, or within any on-site structures, the monitoring personnel will notify the site manager, who in turn will immediately take steps to ensure the protection of human health. Notification will be made immediately in accordance with §330.371. Notification will be made to the executive director of the TCEQ; the TCEQ Region 16 office; appropriate city, county,

and local government and emergency officials; and any residents, tenants, and owners of property within 1/4 mile (1,320 feet) of the reading.

When methane levels above the regulatory limit have been detected (refer to Section 4.1.1 of this attachment), the site manager will place in the site operating record documentation of the methane gas levels detected and a description of the steps taken to ensure protection of human health within seven days of detection in accordance with §330.371. Written notification will also be sent to the TCEQ Region 16 Office within seven days outlining the steps taken.

5 REMEDIATION PLAN

30 TAC §330.371

5.1 Remediation Plan

If methane levels above regulatory limits are encountered in the buildings/structures or in one or more LFG monitoring points, probes, subsurface soils, or other matrices, remediation actions will be implemented within 60 days. The first 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
- Sampling and laboratory analysis of LFG monitoring probe samples to determine concentration of methane and trace compounds
- Additional LFG probe monitoring
- Installation of additional monitoring probes

Using accumulated data, an assessment will be made to determine an appropriate course of action to manage and control the migration of LFG. Such actions will vary with the specific incident. An incident-specific remediation plan, based on results of the investigation, will be submitted within 60 days of detection. Copies of the remediation plan will be placed in the site operating record and provided to the executive director of the TCEQ along with notification that the plan has been implemented. The executive director may establish an alternative schedule for demonstrating compliance.

CITY OF DEL RIO LANDFILL

APPENDIX IIIM1

LANDFILL GAS MONITORING PROBE PLAN



0 300 600
SCALE IN FEET

LEGEND

- PROPOSED PERMIT BOUNDARY
- WASTE BOUNDARY
- N 11000 — SITE COORDINATES
- EXISTING GROUND CONTOUR
- GP-1 — PROPOSED LANDFILL GAS MONITORING PROBE
- UV-1 — PROPOSED UTILITY VENT

GAS PROBE DESIGN INFORMATION

PROBE NAME	GROUND ELEVATION (FT-MSL)	BOTTOM ELEVATION (FT-MSL)	PROBE DEPTH (FT)
PROPOSED GAS MONITORING PROBES			
GP-1	1024	1007	17
GP-2	1048	1014	34
GP-3	1051	1020	31
GP-4	1046	1020	26
GP-5	1048	1020	28
GP-6	1046	1020	26
GP-7	1054	1020	34
GP-8	1058	1020	38
GP-9	1060	1020	40
GP-10	1061	1020	41
GP-11	1066	1014	52
GP-12	1041	1014	27
GP-13	995	978	17
GP-14	984	967	17
GP-15	982	965	17
GP-16	989	972	17
GP-17	995	978	17
GP-18	1006	989	17

* HIGHLIGHTED PROBES ARE NOT YET INSTALLED.

NOTES:

1. EXISTING CONTOURS WERE COMPILED BY DALLAS AERIAL SURVEYS, INC. FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020.

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PROFESSIONAL ENGINEER
09/22/2023

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GAS MONITORING PROBE PLAN

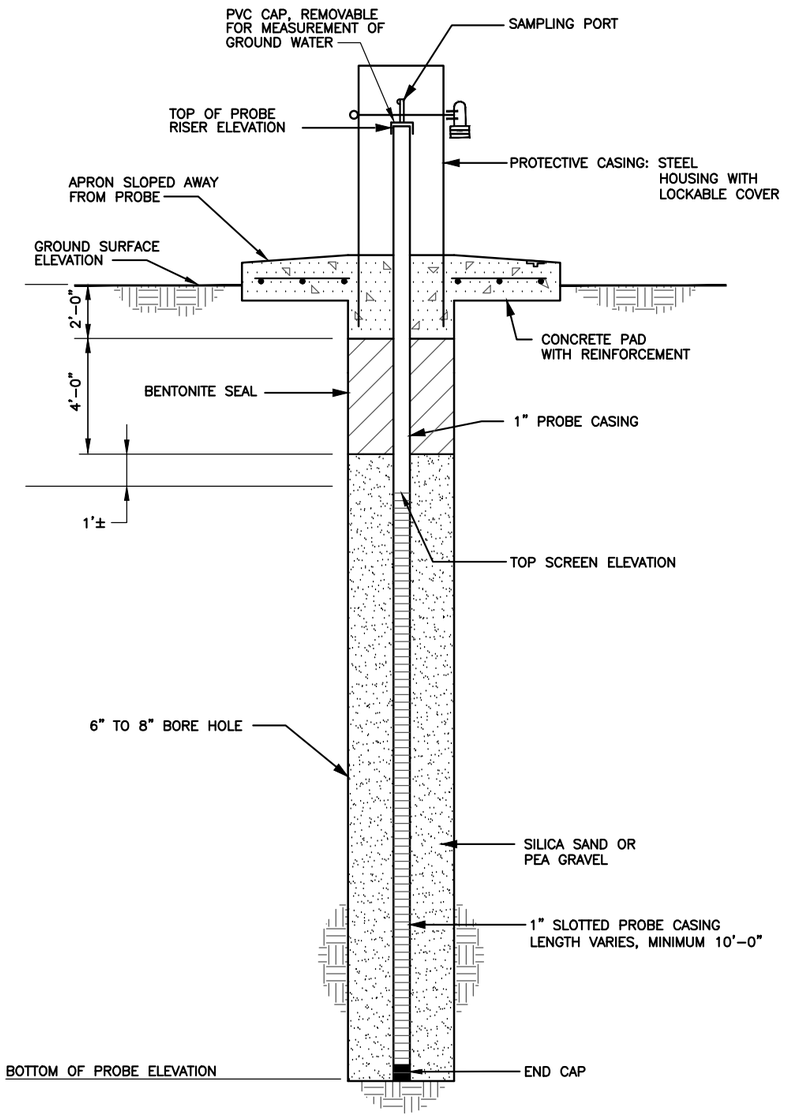
CITY OF DEL RIO
CITY OF DEL RIO LANDFILL
PERMIT AMENDMENT

BIGGS & MATHEWS ENVIRONMENTAL
1700 ROBERT ROAD, STE. 100
MANSFIELD, TEXAS 76063
817-563-1144

TBPE FIRM NO. F-256
TBPG FIRM NO. 50222

DRAWING
IIIM1.1

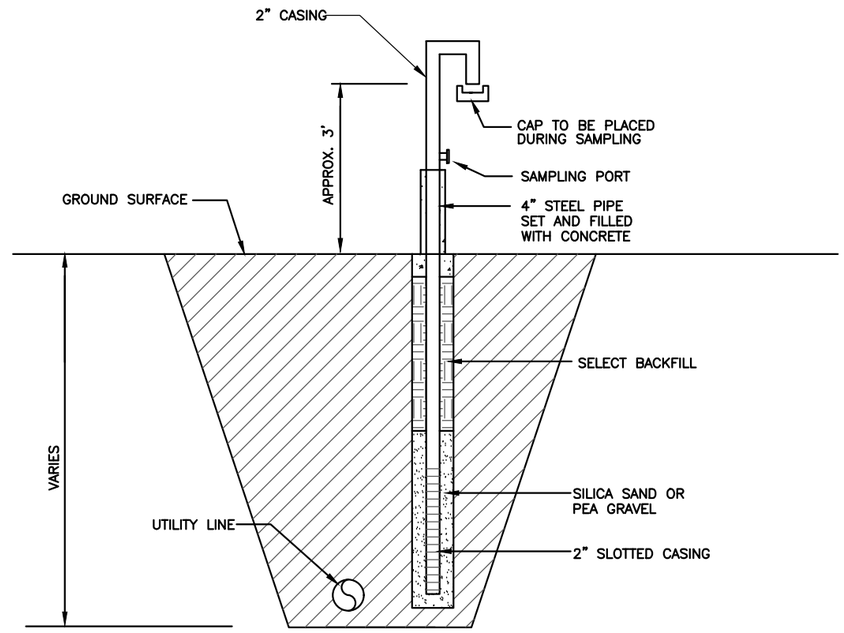
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MONITORING PROBE DETAILS (MP-1) NTS G1.2

NOTES

1. PROBES WILL BE INSTALLED TO MONITOR THE SOIL STRATA ABOVE THE LOWEST CURRENT OR PLANNED FUTURE ELEVATION OF WASTE WITHIN 1,000 FEET OF THE MONITORING PROBE.
2. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.



UTILITY VENT (MP-2) NTS G1.2

NOTE

1. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.

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MONITORING PROBE/VENT DETAILS

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TBPE FIRM NO. F-256
TBPG FIRM NO. 50222

DRAWING
IIIM1.2

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0 500 1000
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LANDFILL FOOTPRINT
- 1/4 MILE RADIUS
- HABITABLE STRUCTURE

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09/22/2023

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STRUCTURES WITHIN 1/4 MILE OF PERMIT BOUNDARY

CITY OF DEL RIO
CITY OF DEL RIO LANDFILL
PERMIT AMENDMENT

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817-563-1144

TBPE FIRM NO. F-256
TBPG FIRM NO. 50222

DRAWING
IIIM1.3

D:\Projects\City of Del Rio\LFG\2023 LGMP\Drawings\IIIM1.3 Adjacent Structures.dwg Layout: Layout1 User: HParker

CITY OF DEL RIO LANDFILL

APPENDIX IIIM2

REPORTING AND RECORDING FORMS

CITY OF DEL RIO LANDFILL
QUARTERLY LANDFILL GAS MONITORING REPORT

Sampled by:_____ Date:_____
Time Start: _____ Time Finish: _____ Temperature: _____
Weather: _____ Bar. Pressure (Optional): _____
Monitoring Equipment: _____ Date of Calibration: _____
Field Calibration:
Date: _____ Time: _____ CH4:_____ CO2:_____ O2:_____ Balance:_____

GAS MONITORING PROBES

Probe Name	Ground Surface Elevation (ft-MSL)	Bottom of Probe Elevation (ft-MSL)	% Methane	% LEL	% O_2 (Optional)	Static Pressure (in-W.C)	Depth to Water (ft)	Probe Integrity Verified (Yes/No)

ON-SITE STRUCTURES

Structure	Verify if Continuous LFG Alarm is Operational (Circle One)		Continuous LFG Alarm Activated (LEL > 25%) Since Last Monitoring Event (Circle One)	
	Yes	No	Yes	No
	Yes	No	Yes	No

GENERAL COMMENTS:

_____

_____

_____

CITY OF DEL RIO LANDFILL

APPENDIX IIIM3

LANDFILL GAS MONITORING
PROBE BORING/COMPLETION LOGS

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207B

MAJOR PERMIT AMENDMENT APPLICATION
PART III — SITE DEVELOPMENT PLAN

APPENDIX IIIN
NO MIGRATION DEMONSTRATION

Prepared for

City of Del Rio



October 2021

Revision 1 January 2022
Revision 2 March 2022
Revisions 3 May 2022
Revision 4 June 2022

Prepared by

CP&Y Inc
TPBE Registration No. F-1741
1820 Regal Row, Suite 200
Dallas, TX 75235
214-638-0500

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APPENDIX

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1 INTRODUCTION

The Del Rio Landfill expansion includes a vertical expansion over a portion of the pre-Subtitle D area as well as the Subtitle D area of the landfill. The purpose of this appendix is to comply with §330.401(d) by demonstrating that there is no potential for migration of hazardous constituents from the solid waste management unit to the uppermost aquifer as defined in §330.3 of this title during the active life and the closure and post-closure care period of the unit. This is achieved by demonstrating that the time that leachate reaches the uppermost aquifer will exceed the site life of the landfill including the post-closure period. The uppermost aquifer as defined by Title 30 TAC §330.3 is the geologic formation nearest the natural ground surface that is an aquifer; includes lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary.

2 CONTAINMENT SYSTEM

The following subsections describe the proposed and approved existing containment system (liner) at the City of Del Rio Landfill. The details of the liner system below are illustrated in Appendix IIIA-A figures.

2.1 Pre-Subtitle D Area Liner

The pre-Subtitle D area is located in the middle of the of the landfill as shown in the Figure 2.1 and is 12.3 acres. Consistent with MSW regulations at that time, the pre-Subtitle D liner was constructed with a 36-inch-thick compacted clay liner with a coefficient of permeability less than 1.0×10^{-7} cm/s and 24 inches of protective cover.

2.2 Subtitle D Alternative Liner

Cells 1 – 6 are Subtitle D areas. In December 1994, the site was approved for an alternative liner. The alternative liner consists of 24 inches of compacted clay, overlain by a geocomposite leachate collection layer and 24 inches of protected cover. The TCEQ approval for the alternative liner is included in Appendix IIID-A. Cells 1 through 5 have been constructed with the alternative liner.

2.3 Overliner

The overliner will be constructed over the portion of the pre-Subtitle D area. The overliner system will be comprised of a reinforced geosynthetic clay liner (GCL) and a 40-mil linear low-density polyethylene (LLDPE) geomembrane (textured on both sides). This will be overlain by a geocomposite leachate collection layer and 24 inches of protective cover. The overliner plan is included in Appendix IIIA-A.

3 SITE GEOLOGY

Multiple site investigations have been conducted across the Del Rio Landfill facility since 1986 to characterize subsurface conditions at the site, with the most recent work being performed within the extension area located at the west end of the current landfill permit boundary.

3.1 Landfill Stratigraphy

Based on observations made from boreholes drilled across the landfill since 1986, landfill stratigraphy has been subdivided into three “soil zones” or “stratums” identified from shallowest to deepest as Stratum 1, Stratum 2, and Stratum 3. The relationship of each of these intervals (site specific stratigraphy) to the geology of southeastern Val Verde County is shown in Table 3-1.

- **Stratum I – Uvalde Gravel:** Consists of 1.5 - 4.5 feet of silty clay, sand & gravel. The layer is a "topsoil" zone with residual soils sometimes consisting of erosional remnants of Buda limestone. This layer looks to be equivalent to the Uvalde Gravel which is described as consisting of caliche-cemented gravels with occasional boulders. Gravels and cobbles are comprised of a mix of chert, quartz, limestone, and igneous rock fragments.
- **Stratum II – Uvalde Gravel/Del Rio Clay:** Consists of 2.0 feet to 11.0 feet of caliche and clay soils with some gravel content. Clay is the predominant constituent. The caliche is a cemented material, primarily calcium carbonate intermixed with the soil or as thin hard interbedded layers. This stratum or zone is not present everywhere across the landfill. Gravels can include remnants of Buda limestone as well as fragments of chert, quartz, and igneous rock fragments. In some areas the lower part of this zone includes uppermost portions of the Del Rio Clay.
- **Stratum III – Del Rio Clay:** This zone underlies Stratum I and Stratum II and consists mostly of clay and weathered shale, grading into un-weathered shale, containing some limestones/siltstone seams, caliche, and gypsum. One deep boring drilled in 1986 by Raba-Kistner Consultants and identified as deep boring B-3 penetrated a total of 135 feet of Del Rio Clay at the east end of the landfill. The purpose of deep boring B-3 was to identify and determine the depth to the uppermost aquifer in accordance with rule 330.63(e)(4)(B). Deep boring B-3 penetrated 27 feet into the Salmon Peak Formation which is recognized as the upper unit of the Edwards Hydrologic Unit. The Edwards Hydrologic Unit is the uppermost aquifer in the area. Locally, a few drillers have referred to the uppermost unit as the "Georgetown", which appears to be a name adopted from the petroleum industry. No groundwater was encountered in deep boring B-3 at the time the boring was drilled, and no information was provided at the time to indicate how long the boring may have monitored for groundwater before being plugged.
- **Salmon Peak Limestone:** Deep boring B-3, drilled by Raba-Kistner in November 1986, penetrated 27 feet of the Salmon Peak limestone. No groundwater was encountered at the time the boring was drilled but moisture was noted, indicating the top of the saturated layer was below the total depth of the borehole. The location of the deep Raba-Kistner borehole is shown on Figure 4.2.

Table 3-1 Stratigraphic Chart

ERA	SYSTEM	GROUP	FORMATION Maverick Basin & Rio Grande Embayment	HYDROLOGIC UNIT	LANDFILL LITHOLOGY	COMMENTS
Cenozoic	Quaternary		Alluvium		Not Present	
	Tertiary		Uvalde Gravel		Stratum I	Stratum I consists of 1.5 - 4.5 feet of silty clay, sand & gravel. The layer is a "topsoil" zone with residual soils sometimes consisting of erosional remnants of Buda LS.
Mesozoic	Cretaceous	Washita Group	Buda Limestone	Confining Bed	Stratum II	Stratum II predominantly consists of 2.0 feet to 11.0 feet of caliche and clay soils with some gravel content. Clay is the predominant constituent. The caliche is a cementitious material, primarily calcium carbonate, and is intermixed with the soil or as thin hard interbedded layers. Not present everywhere across the landfill. This interval can include remnants of Buda LS and includes upper portions of the Del Rio Clay. The Buda is not present across most of the landfill but is present along and near the southern boundary.
			Del Rio Clay	Confining Bed	Stratum III	Stratum III consists mostly of clay and weathered shale, grading into un-weathered shale, containing some limestones/siltstone seams, caliche, and gypsum. This layer can consist of upper, middle and deeper portions of the Del Rio Clay across the landfill.
			Salmon Peak (aka Georgetown)	Edwards Hydrologic Unit	Salmon Peak	Penetrated 27 feet of Salmon Peak. Deep boring B-3 drilled 11/6/1986 by Raba-Kistner Consultants, Inc. Total depth 162 feet (Elevation 883 msl).
		Fredricksburg Group	McKnight Fm		Not Penetrated in the Landfill	
			West Nueces Fm			
		Trinity Group	Glen Rose Fm	Trinity		

Source:

1. Source: Condon, S.M., and Dyman, T.S., 2006, Chapter 2: 2003 Geologic Assessment of Undiscovered Conventional Oil and Gas Resources in the Upper Cretaceous Navarro and Taylor Groups, Western Gulf Province, Texas, in Symposium and Geologic Assessment of Undiscovered Oil and Gas, Navarro and Taylor Groups, Western Gulf Province, Texas ISBN: 1411309987.
2. Geologic and hydrogeologic units of Val Verde County, Texas: adapted from Overview of Groundwater Conditions in Val Verde County, Texas, prepared by the Texas Water Development Board with cooperation of the Texas Commission on Environmental Quality and Texas Parks and Wildlife Department, December 2018.

Figure 3.1 illustrates a cross section prepared by Raba-Kistner and presented in the 1994 TETCO geotechnical report also shows local geology underlying the landfill. The precise location of the cross section transect has not been shown in geotechnical reports.

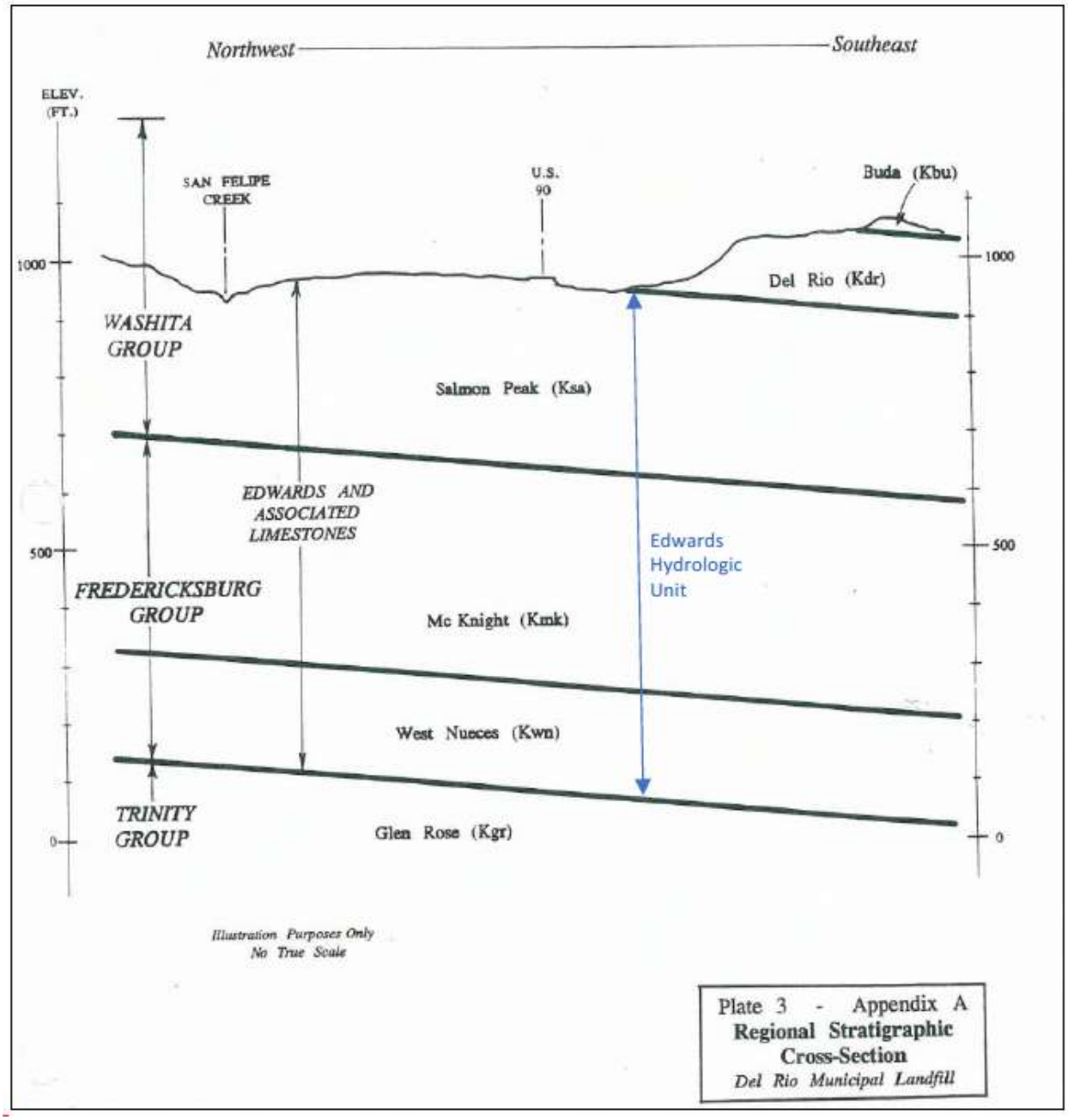


Figure 3.1: Landfill Cross Section (1994 TETCO)

4 HYDROGEOLOGY AND GROUNDWATER CHARACTERISTICS

4.1 Regional Aquifers

Figure 4.1 is a topographic map developed to show the location of wells located within 1.0 mile of the landfill, the transect of Geologic Cross Section A – A', the up-dip limits of the Buda Limestone and elevation contours on the top of the Edwards Limestone (undifferentiated). Elevation contours show the direction of dip and direction of groundwater flow in the Edwards is to the south.

Three borings (B-3, B-13, and B-16) drilled by Arias at the northwest end of the landfill in 2020 encountered the Buda limestone. The trace of the Buda is shown to aid in visualizing the geologic relationships referenced in the literature and geotechnical reports, as well as to show the source of Buda rock fragments noted in the Uvalde Gravel.

Figure 4.2 shows Cross Section A – A' as a north to south cross section prepared to illustrate how geology of the landfill ties into the local geology of southeastern Val Verde County, Texas. The cross section transect is roughly parallel to geologic dip of the Edwards Limestone (undifferentiated) and includes wells located within 1.0 mile of the landfill. Comments made on driller's logs are shown adjacent to wells. Cross Section A – A' shows the south-dipping Del Rio Clay (Del Rio confining unit) ranges from 58 feet in total thickness about 1.0 mile north of the land fill to 135 feet below the landfill. Underlying the Del Rio is the Edwards Hydrologic Unit (Edwards Aquifer), which is the first perennial aquifer underlying the landfill.

The Edwards Aquifer, shown as the Edwards Hydrologic Unit on Cross Section A – A' (Figure 4.2), is the first perennial aquifer underlying the landfill and is the principal source of fresh groundwater to wells in the Del Rio area. The Del Rio Clay, or Del Rio Confining Unit overlies the Edwards and acts as a barrier to precipitation and the vertical movement of water. Recharge to the Edwards aquifer occurs where the Edwards is exposed at the surface and precipitation enters the aquifer through dissolution channels, fracture networks, faulting and/or karst features.

In 1986 Raba-Kistner Consultants reported the uppermost transmissive unit of the Edwards Hydrologic unit as the Salmon Peak formation. Lithology descriptions provided by Raba-Kistner indicated the upper part of the Salmon Peak is granular with abundant fossil fragments and cross-bedded. The lower portion is described as consisting of low permeability mudstone with abundant masses of chert.

Elevation contours over the Edwards aquifer shown on Figure 4.1, indicate the formation dips about 61 feet/mile (0.011 ft/ft) to the south. This is consistent with the estimated gradient of 55 feet/mile discussed on pages 1 and 2 of the Supplemental Geotechnical Information report prepared by TETCO in November 1994 (see pages IIIJ-C-78 and IIIJ-C-79 of Appendix J). In the supplemental report, TETCO provided estimated elevations at the top of the Salmon Peak limestone (Edwards Hydrologic Unit) that were computed at the locations of the landfill sumps, identified as A, B, C, D, and E in the following Table 4.1. The locations A, B, C, and D and associated elevations on the top of the Salmon Peak limestone are also shown on Figure 4.1.

Table 4-1 – Del Rio Clay Thickness and Salmon Peak Aquifer Elevations

Point No.	Ground Elev (ft-msl)	Bottom of Waste Elev (ft-msl)	Top Salmon Peak Elev (ft-msl)	Total Thickness (ft)	Thickness Below Bottom of Liner (ft)
A	1,048	1,021	931	117	89
B	1,049	1,021	924	125	95
C	1,051	1,021	913	138	106
D	1,058	1,021	917	141	102
E	1,060	1,021	927	133	92
Averages				**130.8**	**96.8**

Underlying the Edwards Hydrologic Unit is the Trinity Aquifer system. Regionally, hydraulic communication between the Edwards and the Trinity aquifers is variable and complex. Consequently, the Edwards and Trinity Aquifers are recognized by the Texas Water Development Board as a single hydrologic unit referred to as the Edwards-Trinity (Plateau) Aquifer. None of the wells located within 1.0 mile of the landfill were drilled deep enough to have penetrated the Edwards-Trinity.

4.2 Site Hydrogeology

4.2.1 1986 and 1994 Groundwater Investigation

In accordance with rule §330.63(e)(4)(B) if no aquifers exist within 50 feet of the elevation of the deepest excavation, at least one test hole shall be drilled to the top of the first perennial aquifer beneath the site, if sufficient data does not exist to accurately locate it. The §330.63(e)(4)(B) allows the executive director to accept data equivalent to a deep boring on the site to determine information for aquifers more than 50 feet below the site. The uppermost (perennial) aquifer was penetrated in deep boring B-3 drilled in November 1986 as part of the Raba-Kistner geotechnical investigation for the site. Deep boring B-3, shown on Figure 4.2, was drilled to a total depth of 162 feet which penetrated the upper 27 feet of the Salmon Peak limestone, the recognized upper transmissive unit of the Edwards Hydrologic Unit. The top of the Salmon Peak was penetrated in deep boring B-3 at 135 feet below grade (subsurface elevation 910 feet) but did not encounter groundwater at the time the hole was drilled. The reason groundwater was not encountered at the time is because the boring was simply not drilled deep enough to have penetrated the saturated portion of the aquifer. The estimated top of the saturated part of the Salmon Peak is shown on Cross Section A – A' (Figure 4.2) as a black dashed line shown just below the top of the Edwards Hydrologic Unit. Placement and gradient of the dashed line on Cross Section A – A' is shown based on the reported depths of the "first perforation" on the following two driller's logs which are both shown on Figures 4.1 and 4.2 above:

- Domestic Water Well No. YR-70-42-101 drilled in 1965, total depth 134 ft. The first perforation noted on the driller's log of this well is at a depth of 80 feet (elevation of 945 feet).

- Domestic Water Well No. YR-70-42-103 (owner J. Leach), drilled in 1969, total depth 200 ft. The first perforation noted on the driller's log of this well is at a depth of 100 feet (elevation 975 feet).

Also shown on Cross Section A – A' (Figure 4.2) is a blue dashed line that is shown parallel to the top of the saturated layer line (black dashed line) to indicate the location of the static water level (SWL) in the aquifer. The level shown is based on a 1970 reported static water level in a domestic well located north of the landfill and identified as Domestic Water Well YR-70-42-101 which is also shown on Figures 4.1 and 4.2. While the static water level has undoubtedly changed since 1970, the line is shown to indicate the relative position of the static water level to the top of the saturated layer. The gradient of the SWL is shown to be the same as the gradient of the top of the saturated layer which is roughly parallel to the top of the Edwards Hydrologic Unit. The location of the SWL will fluctuate up and down in response to changes in groundwater storage in the aquifer.

In the November 1994 Supplemental Geotechnical Information prepared by Trinity Engineering Testing Corporation (report included in Appendix IIIJ-C), calculations were made to estimate the top elevations of the Salmon Peak and the thickness of the Del Rio Clay at five locations within the landfill site. The calculated average thickness of the Del Rio Clay based on the five locations is 130.8 ft (refer to Table 4-1). Based on the soil characterization of the Del Rio clay and the dry climate in the region, the geotechnical report concluded that there is no groundwater at the site in the weathered-unweathered Del Rio Clay transition.

4.2.2 Groundwater Investigation 2020

Arias Geoprofessionals , Inc. (Arias) installed seventeen (17) boring of which ten (10) were converted to piezometers in November 2020 on a 75-ac tract of land located adjacent to the landfill. The location of the piezometers is shown in Figure 4.3. During installation, water was encountered at three of the 10 piezometer locations as follows:

- B-1
- B-15
- B-13

No water has been observed in the other seven (7) piezometers over the past eleven (11) months. Based on the analysis of the boring logs prepared by Arias, and taking the local topography into account, shallow groundwater encountered during the boring and sampling operations in borings B-1, B-15 and B-13 occurs in three distinct, vertically separated perched groundwater systems within the Del Rio Clay. As shown in Cross Section B-B' shown on Figure 4.4, approximately 110 feet of the upper Del Rio Clay can be subdivided into three general layers based on local lithology:

- Layer 1 – Fat clays with gravel and limestone fragments
- Layer 2 – Clay-shale, weathered, hard
- Layer 3 – Clay-shale, hard, with facies transition to marl

Two of the shallow groundwater systems occur in middle Layer 2 and were encountered in borings B-15 and B-13. The third perched groundwater system was encountered in lower Layer 2 in Boring B-1. Note that in all three cases these groundwater systems "daylight" to the southwest in the drainage of Calaveras Creek. .

Generally speaking, the upper 80 feet of the subsurface tends to be fractured. This can be due to a combination of conditions such as shrinking and swelling of clay-rich formations, formation of desiccation cracks, and/or elastic behavior caused by erosion and removal overburden pressure over time. Fracturing provides a flow pathway for seepage from the surface to migrate downward into perched groundwater zones. The recharge to these perched groundwater systems occurs as the result of precipitation events and vertical seepage from the surface downward.

Groundwater flow in shallow groundwater systems closely mimics surface topography. Consequently, flow in each of the perched groundwater systems encountered at the site will generally be to the southwest where flow exits to the surface in Calaveras Creek. All three of the perched systems occur at elevations that are above the elevation of Calaveras Creek which is at an elevation of approximately 960 feet above mean sea level. Perched groundwater is found in porous saturated zones at an elevation that is higher than the local or regional groundwater table. The three perched zones identified for this project all occur within the Del Rio Confining Unit at elevations that are higher than the regional potentiometric surface of the Edwards Hydrologic Unit. All three zones daylight into the creek which supports the interpretation that these zones are perched.

Well #[2]	State Well No.	Total Depth	Aquifer	Use
1	7042101	134	Edwards Limestone	Withdrawal of Water
2	7042104	200	Edwards Limestone	Withdrawal of Water
3	7042102	125	Edwards Limestone	Withdrawal of Water
4	7042106	145	Edwards Limestone	Withdrawal of Water
5	TX238701	120	Edwards Limestone	Withdrawal of Water
6	TX238702	200	Edwards Limestone	Withdrawal of Water

2 Wells
North well #70-42-1C
South Well #YR-70.42-103

Well #70-42-1A
This well "projected"
into cross section

SITE LOCATION

Rabe-Kistner
Deep Boring B-3

New B-3

DEL RIO

Val Verde Park Colonia

Val Verde Park

Eagle Pass Hill

BUDA LS

LEGEND

Elevation contours top Edwards Hydrologic Unit (Salmon Peak) and Direction of Edwards Groundwater Flow

Transect Cross Section A - A'

Well Control

Borehole

Limits Buda Limestone

0 2000 4000
SCALE IN FEET

MAP USAGE:
24K QUAD - DEL RIO, SE, TX, COA
24K QUAD - DEL RIO NE, TX, COA
24K QUAD - DEL RIO NW, TX, COA
24) QUAD - DEL RIO SW, TX, COA

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TEXAS ENGINEERING FIRM F-1741

CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

TOP OF EDWARDS ELEVATION & LIMITS OF BUDA LIMESTONE

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2.	4TH NOD	TM	01/2022
1.	3RD NOD – NEW DRAWING	TM	10/2021

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Drawn: J. TORRES
Reviewed: J. ROBERTS, P.G.
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FIGURE
4.1

REFERENCES: DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS.dwg _Std ENVIRO SEALS
Feb 01, 2022 - 3:18pm C:\pwworking\cpy\pw_cpy\metaferia\d0870496\DELR1900546 Figure 4.1.dwg LAYOUT: Layout1 USER:

A'

A

Elevation

1100

1050

1000

950

900

850

NEW BORING B-3
(Projected Location)
Arias
Drilled 11/6/2020
Surface Elev. 1060.67
TD 90 Ft. (Elev 970)

DEEP BORING B-3
Raba-Kistner
Consultants, Inc.
Drilled 11/1986
Surface Elev. 1045
TD 162 Ft. (Elev 883)

#1
DOMESTIC WATER
WELL
Well No. YR-70-42-101
Drilled 9/1965
Surface Elev. 1025 est.
TD 134' (Elev 891)

#2
DOMESTIC WATER
WELL
Well No. YR-70-42-106
Drilled 9/1935
Surface Elev. 1042 est.
TD 145' (Elev 897)

James E Crell
DOMESTIC WATER
WELL
(Location Projected)
Well No. 70-42-1A
Drilled 9/1/1967
Surface Elev. 1055 est.
TD 145' (Elev 910)

J Leach
DOMESTIC WATER
WELL
Well No. YR-70-42-103
Drilled 8/20/1969
Surface Elev. 1075 est.
TD 200' (Elev 875)

Bob Edgerton
DOMESTIC WATER
WELL
Well No. 70-42-1C
Drilled 11/4/1968
Surface Elev. 1075 est.
TD 200' (Elev 875)

BUDA LS

LANDFILL

DEL RIO CONFINING UNIT

EDWARDS HYDROLOGIC UNIT

Includes Salmon Peak (Georgetown)

TD
Elev 970

SWL
Elev +/-977
(est)

Top Salmon Peak
Elev 910

TD
Elev 883

Estimated Top
Saturated Layer

SWL
Elev 974.33
(1970)

First perf at
Elev 945'

TD
Elev 891

1024'

Driller noted
caliche 0'- 31'

Driller noted
Georgetown
at 54'
(Elev 971)

First perf at Elev 975'

TD
Elev 910

TD
Elev 897

1047'

Driller noted Del
Rio Clay
28'-58'

Driller noted
Georgetown
at 58'
(Elev 1017)

TD
Elev 875

TD
Elev 875

CROSS–SECTION A–A'

0 400 800
HORIZ. SCALE IN FEET

0 40 80
VERT. SCALE IN FEET

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REFERENCES: DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS.dwg _Std ENVIRO SEALS
Feb 01, 2022 - 11:53am C:\pwworking\cpy\pw_cpy\tmetaferia\d0870496\DELR1900546 Figure 4.2.dwg LAYOUT: Layout1 USER:

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STATE OF TEXAS JAMES W. ROBERTS 12639 LICENSED PROFESSIONAL GEOLOGIST 1/31/2022

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CITY OF DEL RIO
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MUNICIPAL SOLID WASTE LANDFILL NO. 207B
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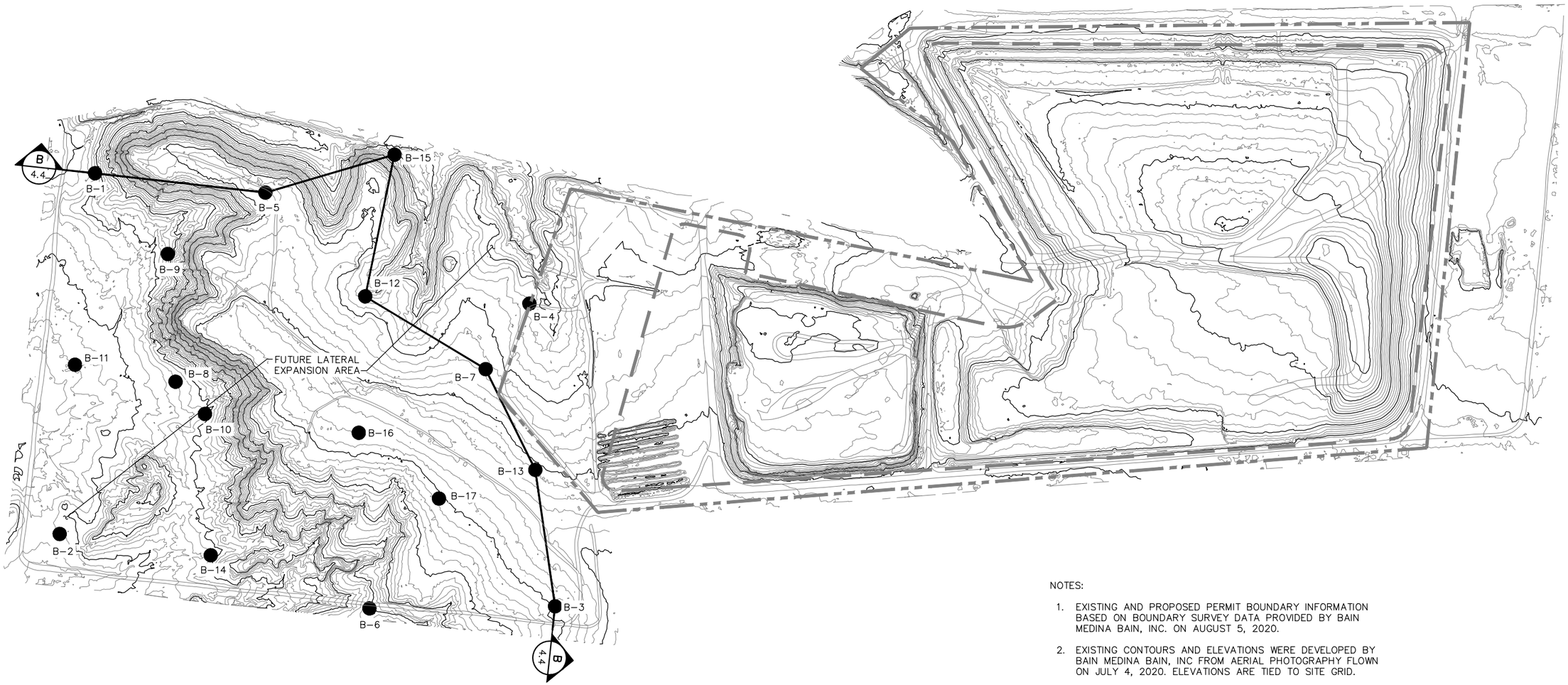
CROSS SECTION A–A'

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Reviewed: J. ROBERTS, P.G.
CP&Y Proj. No. DELR1900546

FIGURE

4.2

PIEZOMETER MONITORING		
PIZOMETER NO.	PERCHED GROUNDWATER ELEV.	DATE
B–1	969.42 MSL	12/8/2020
B–13	1031.9 MSL	12/8/2020
B–15	1002.37 MSL	12/8/2020



NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. ELEVATIONS ARE TIED TO SITE GRID.

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MUNICIPAL SOLID WASTE LANDFILL NO. 207B
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ARIAS BORING AND PIEZOMETER LOCATION

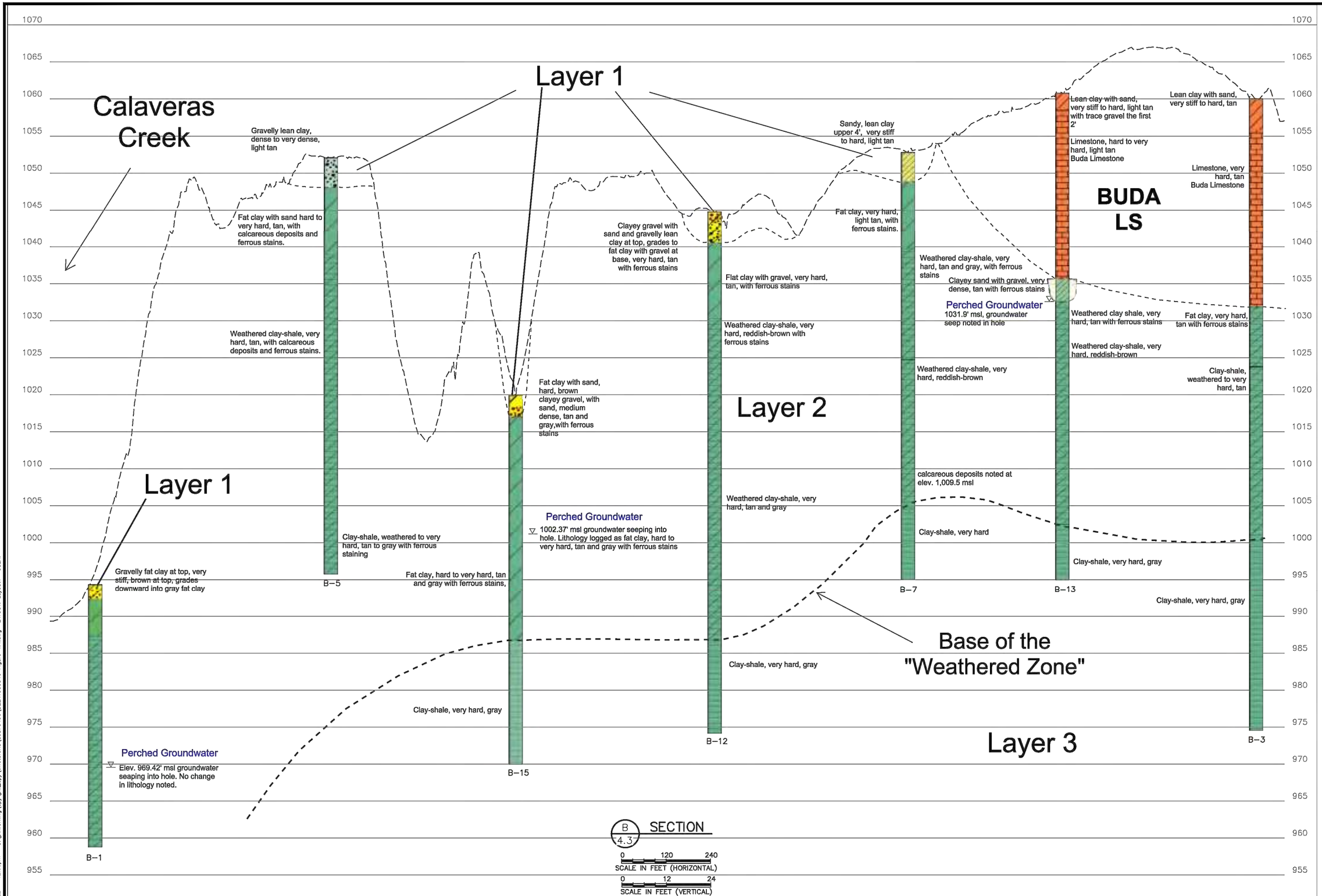
NO.	REVISION	BY	DATE
2.	4TH NOD	TM	01/2022
1.	3RD NOD – NEW DRAWING	TM	10/2021

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0 1"

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FIGURE
4.3

REFERENCES: DELR2000302 Figure Border.dwg DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS.dwg _Std ENVIRO SEALS
Feb 01, 2022 – 12:07pm C:\pwworking\cpy\pw_cpy\tmetaferia\d0870496\DELR1900546 Figure 4.3.dwg LAYOUT: Layout1 USER:



B 4.3 SECTION

0 120 240
SCALE IN FEET (HORIZONTAL)

0 12 24
SCALE IN FEET (VERTICAL)

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REFERENCES: DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS.dwg _Std ENVIRO SEALS
Feb 01, 2022 - 12:00pm C:\pwworking\cpy\cw_cpy\metaferia\d0870496\DELR1900546 Figure 4.4.dwg LAYOUT: Layout1 USER:

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CITY OF Del Rio TEXAS

STATE OF TEXAS JAMES W. ROBERTS 126.56 LICENSED PROFESSIONAL GEOLOGIST 01/31/2022

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0 1"

CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

CROSS SECTION B–B'

Date: OCTOBER 2021
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FIGURE
4.4

5 GROUNDWATER MONITORING WAIVER

5.1 1994 Groundwater Waiver

A groundwater monitoring waiver was requested as part of alternative liner permit modification submitted to TCEQ in 1994. As mentioned above, the two site investigations (1986 and 1994) concluded that there was no shallow groundwater system in the Del Rio Clay. The alternative liner and the groundwater waiver requests were granted to the City in December 1994. The approval letter is included in Appendix IIID-A.

5.2 2020 Waiver Request

The City is currently requesting to extend the groundwater waiver as part of this Major Permit Amendment Application. As previously discussed with the TCEQ staff, the City has installed piezometers on the 75-ac tract of land located adjacent to the landfill to provide recent site-specific groundwater data for the site. The goal is to use the data obtained from the new piezometers along with previous data as part of the groundwater monitoring waiver request.

6 NO MIGRATION DEMONSTRATION

This section describes the no migration demonstration using:

1. the Hydrologic Evaluation of Landfill Performance (HELP) model to estimate leachate percolation through the liner in the pre-Subtitle D and Subtitle D areas,

2. Multimedia Exposure Assessment (MULTIMED) to perform pollutant fate and transport simulations between the landfill and uppermost aquifer, and

3. Darcy's equation to calculate the time of travel for potential migration from the landfill to the Calaveras Creek.

The following subsections discuss the no migration demonstration methods using the HELP and MULTIMED models.

6.1 HELP Model Demonstration

6.1.1 HELP Model

The HELP Model, Version 4.0, is a quasi-two-dimensional hydrologic model that was used to model water movement across, into, through, and out of the landfill. The model uses climate, soil, and landfill design data to perform a solution technique that accounts for the effects of surface storage, run-off, infiltration, percolation, soil moisture storage, evapotranspiration, and lateral drainage. The HELP Model was used to estimate the rate of percolation through the various areas of the landfill, as discussed in Section 6.1.2.

6.1.2 HELP Model Input

HELP Model simulations were performed to estimate percolation rates for each of the areas and conditions listed in Table 6-1. The HELP output models are in Appendix IIIK-A.

Table 6-1 – Landfill Conditions Modeled in HELP

Area	Active Condition 1-Year Timeframe	Interim Condition 23-Year Timeframe	Closed Condition 30-Year Timeframe
Subtitle D Area	50 feet of waste with intermediate cover	50 feet of waste with intermediate cover	80 feet of waste with final cover
Pre-Subtitle D with Overliner	60 feet of waste with intermediate cover	60 feet of waste with intermediate cover	60 feet of waste with final cover

The active stage of the landfill was modeled for one year with intermediate or daily cover. A waste height of 50 feet is used for the active and interim conditions based on a bottom of waste grade elevation of 1021 ft-msl and an average top of waste grade elevation of 1070 ft-msl for the Subtitle-D area. A waste height of 60 feet was used for the pre-Subtitle-D area based on an assumed bottom of waste elevation at 1040 ft-msl and an average top of waste at 1100 ft-msl. The interim stages with intermediate cover were modeled for 23 years based on the projected site life. The site life calculations are included in Appendix IIIB. The closed landfill condition was modeled for 30 years based on TCEQ's post-closure period.

The evaporative zone depth was selected to be 10 inches for the active and interim cases and 12 inches for the closed case. The leaf area index was selected 2 for the interim cases and 4.5 for the closed case based on the selected ground area. The Soil Conservation Service (SCS) runoff curve numbers were calculated by HELP based on soil data and expected ground cover, surface slope, and slope length.. The interim cases utilize the default curve number assigned by the HELP model which is 87.9 and corresponds to "fair" ground cover. The percent runoff area used varies between 80. This is representative of the intermediate cover, which will be 12 inches of compacted soil with 60 percent or more vegetation coverage as specified in Section 3 of Appendix IIIH-E (allows a soil loss up to 50 ton/acre-yr for intermediate cover which equates to 60 percent vegetation coverage). The final case models a curve number of 82 and percent runoff area of 100, which corresponds to "good" ground cover. This is representative of the final cover, which will have a minimum 90 percent vegetation coverage as specified in Section 2.2 of Appendix IIIE.

6.1.2.1 MOISTURE CONTENT AND FIELD CAPACITY

The initial moisture content was set at field capacity for all profile layers except the compacted clay barrier layer and the waste layer. HELP automatically sets the initial moisture content for a compacted clay barrier layer at porosity that is fully saturated. Refer to Appendix IIIK-A for additional information.

6.1.2.2 CLIMATE DATA INPUT

Precipitation data was synthetically simulated based on HELP V4 model program simulation using the latitude and longitude for Del Rio, Texas. The average annual precipitation over the modeled 30-year period was 18.19 inches. Temperature and solar radiation data were also synthetically generated by the HELP model using program defaults for Del Rio, Texas.

6.1.2.3 LANDFILL PROFILE

The profile presented below includes a clay liner with a standard Subtitle D final cover system. For additional information on the Liner Quality Control Plan refer to Appendix IIID.

- **Liner System** – The Subtitle D clay liner designed for developed and undeveloped cells consists of a 24-inch-thick compacted clay liner with a hydraulic conductivity of $1x10^{-7}$ cm/s. Default soil characteristics from the HELP model were selected for the compacted clay liner.

- **Overliner System** – The overliner system consists of a GCL and 40-mil LLDPE geomembrane. The geomembrane liner was modeled for a good quality installation with four (4) construction defects per acre, and a production pinhole density of 1 hole/acre. Default soil characteristic from the HELP Model were selected for the LLDPE geomembrane hydraulic conductivity.

- **Leachate Collection System** – Developed Subtitle D Cells 1 through 5 were constructed with an LCS that includes a 200-mil thick single-sided geocomposite material (floor grades).

- **Waste Layers** – Various waste thicknesses were modeled to represent the various stages of landfill development in the Subtitle D and pre-subtitle D areas. A default wilting point was selected from HELP to represent municipal solid waste. The moisture content, field capacity, and porosity values were selected as discussed previously.

- **Intermediate Cover** – The intermediate cover consists of a 12-inch-thick layer of soil placed over the waste. Default soil characteristics were selected from HELP to represent the available onsite soils with a hydraulic conductivity of 6.4×10^{-5} cm/s.

- **Final Cover** – The final cover over the Subtitle D and pre-Subtitle D areas consists of a 12-inch erosion layer with the top 6 inches capable of sustaining growth of vegetation and an 18-inch infiltration layer. The infiltration layer consists of compacted soil with a hydraulic conductivity of 1×10^{-5} cm/s.

6.2 MULTIMED Model Demonstration

The MULTIMED Model Version 2.00 was used to assess contaminant fate and transport between the landfill and the uppermost aquifer. MULTIMED was developed by the Athens Environmental Research Laboratory for the Environmental Protection Agency. MULTIMED estimates the capacity of the hydrogeologic system modeled to dilute and attenuate contaminant concentrations. The model can be used to simulate the fate and transport processes in both the unsaturated and the saturated subsurface environments.

The unsaturated-zone flow module is used to simulate steady state one dimensional (vertical) flow in the unsaturated zone using a "semi analytical" method. The output from the unsaturated-zone flow is then used as an input in the unsaturated-zone transport module. The transport module then simulates a steady-state or transient, one-dimensional (vertical) transport in the unsaturated one and includes the effects of longitudinal dispersion, liner absorption, and first-order decay. Output from the unsaturated-zone transport module, contaminant concentrations at the water table (either steady state or time series), is used to join the unsaturated-zone transport module with the steady-state or transient, semi analytical saturated-zone transport module.

The saturated-zone transport module simulates one-dimensional (horizontal) uniform flow three-dimensional dispersion, linear adsorption, first order decay, and dilution resulting from direct infiltration into the ground-water plume. MULTIMED doesn't simulate processes such as flow in fractures and chemical reactions between contaminants. The model transport modules assume piston flow, continuous, spatially distributed diffuse recharge through the entire unsaturated zone.

6.2.1 Description of Model Input

To demonstrate no-migration of constituents to the upper most aquifer during the site life and post-closure period of the Del Rio Landfill, multiple MULTIMED model-runs were made to illustrate the sensitivity of the MULTIMED model to various input parameters. These sensitivity models were then compared to the base model to determine which input parameters have the biggest impact on the time of travel.

The general overall system inputs for all the MULTIMED models are as follows:

1. The "generic" option was selected for the application types because the "Subtitle D" doesn't allow the transient-mode option.

2. Saturated and unsaturated zone modules were selected.

3. The model was run in deterministic mode because there is insufficient site data available to determine statistical distributions using the Monte Carlo simulation.

4. The model was run in transient mode to satisfy the study objective.

5. The analytical solution used for the unsaturated-zone model.

Base Model

The base model inputs were based on site-specific data or were conservative. The MULTIMED base model input parameters are detailed in below. A normalized distribution of zero was used for the chemical input variable to simulate no chemical decay. By assuming the leachate does not undergo adsorption, biodegradation, and decay, a single MULTIMED simulation accounts for all 24 constituents identified by the EPA as required by the landfill design protection criteria. The distribution coefficient was derived by MULTIMED. The other chemical specific data were either not used or derived by the program as shown in Table 6-2.

Table 6-2 – Chemical Specific Data

Variable Name	Unit	Value	Comments
Solid phase decay coefficient	1/yr	0	Not used
Dissolved phase decay coefficient	1/yr	0	Not used
Chemical decay coefficient	1/yr	0	Not used
Acid catalyst hydrolysis constant	l/m-yr	0	Not used
Neutral hydrolysis rate constant	1/yr	0	Not used
Base catalyst hydrolysis constant	l/m-yr	0	Not used
Reference temperature	C	25	Not used
Normalized distribution coefficient	ml/g	0	Simulation is steady state, with no chemical decay
Distribution coefficient	ml/g		Derived by MULTIMED.
Biodegradation coefficient	1/yr	0	Biodegradation not allowed by TCEQ

Site specific data was used to determine the source specific variables in the model. Tabel 6-3 lists the source specific data used for the base model. The infiltration rate is the net amount of leachate that percolates into the aquifer system from the landfill.

As noted in Section 6.1, the HELP model was used to estimate the infiltration rate of the Del Rio Landfill. The HELP models for the infiltration rate are included in Appendix IIIK-A. The recharge rate is the net amount of water that percolates directly into the aquifer system outside of the land disposal facility. The recharge is assumed to have no contamination and hence dilutes the groundwater contaminate plume.

The HELP model was also used to calculate the rainfall recharge rate for the Del Rio Clay. The HELP output is included in Appendix IIIN-B.

The limits of waste, which is approximately 79 acres, was used to set the area of disposal unit in the module. Since the area of the disposal unit was identified, the length and width of the scale of the facility were derived by MULTIMED. The duration of pulse was set to 10,000 years. The initial concentration at landfill was set to one as is typical when calculating the dilution-attenuation factor (DAF).

Table 6-3 – Source Specific Data

Variable Name	Unit	Value	Comments
Infiltration rate	m/yr	1.7×10^{-4}	Derived from HELP (Appendix IIIK-A, page IIIK-A-4B)
Area of disposal unit	m^2	320,000	Limits of waste area
Spread of contaminant source	m	-	Derived by MULTIMED.
Recharge rate	m/yr	0.0282	Derived from HELP (Appendix IIIN-B)
Initial concentration at landfill	mg/l	1.0	Set at 1.0 to find DAF
Duration of pulse	yr	10,000	Assumed
Length scale of facility	m	-	Derived by MULTIMED.
Width scale of facility	m	-	Derived by MULTIMED.

The two modules that MULTIMED uses to model the unsaturated zone are transport and flow modules. Input parameters for the unsaturated flow module are described below. The unsaturated zone is between the bottom of the landfill liner and the top of the Salmon Peak. Based on the bedrock contours on the top of the Edwards hydrologic unit shown on Figure 4.1, the Edwards (Salmon Peak) elevation contour (940 ft-msl) was selected to represent the uppermost aquifer underlying the landfill. For this demonstration, the uppermost aquifer is located 78 feet (in the vertical direction) from the bottom of liner elevation. The hydraulic conductivity for the Del Rio Clay used in the model is 2.0×10^{-7} cm/sec. This value is obtained from the November 1994 TETCO geotechnical evaluation report included in Appendix IIIJ-C, page IIIJ-C-91. The hydraulic conductivity was calculated based on the soil parameters for the top 60 feet of the Del Rio Clay. The Del Rio Clay below 60 feet is more compact and less permeable, as the materials are not weathered, contain little to no moisture, and any existing secondary structures would be tightly closed from overburden. Since the 78 feet of Del Rio Clay between the bottom of liner and the top of the Salmon Peak was modeled as one layer this hydraulic conductivity value is considered conservative. The unsaturated zone porosity requires the effective porosity, which is part of the total porosity which is effective at transmitting water. Unsaturated zone porosity is 0.02 for clay and is dimensionless. The residual water content is the amount of the total water content which can't be removed from the soil, even under large suction pressure because it adheres to the soil grains. This value was obtained using Table 6-4 of the Manual for the Multimedia Exposure Assessment Model for clay. The ALPHA van Genuchten and BETA Van Genuchten coefficients were also obtained using Tabel 6-5 of the Manual for the Multimedia Exposure Assessment Model for clays. The Van Genuchten coefficients are used to describe (1) the pressure head versus water saturation relationships and (2) the relationship between relative permeability and water saturation. Tabel 6-4 lists the parameters used for the unsaturated flow module.

Variable Name	Unit	Value	Comments
Saturated hydraulic conductivity	cm/hr	7.2×10^{-4}	Obtained from the TETCO Geotechnical Report
Unsaturated zone porosity	-	0.02	Assumed based on typical values for clay
Depth of the unsaturated zone	m	23.8	From bottom of the landfill liner and the top of the Salmon Peak
Residual water content	-	0.068	Obtained from Tabel 6-4 of the Manual for the Multimedia Exposure Assessment Model
ALFA van Genuchten coefficient	-	0.008	Obtained from Tabel 6-5 of the Manual for the Multimedia Exposure Assessment Model
BETA Van Genuchten coefficient	-	1.09	Obtained from Tabel 6-5 of the Manual for the Multimedia Exposure Assessment Model

The percent organic matter and the bulk density of the soil are the two parameters that needed to be identified in the unsaturated transport module. The values for both parameters were obtained using the Manual for the Multimedia Exposure Assessment Model. Table 6-5 lists inputs for the unsaturated transport module.

Table 6-5 – Unsaturated Transport Model Data

Variable Name	Unit	Value	Comments
Longitudinal dispersivity of material	m		Derived by MULTIMED.
Percent organic matter	-	1.34	Obtained from Tabel 6-7 of the Manual for the Multimedia Exposure Assessment Model
Bulk density of soil for material	g/cc	1.30	Obtained from Section 6.4.5 of the Manual for the Multimedia Exposure Assessment Model

The last module of inputs for the MULTIMED model is the aquifer specific parameters. The aquifer porosity, bulk density, and hydraulic conductivity are all obtained from Appendix E of the July 1994 TETCO Geotechnical Report. The particle diameter was obtained using Table 6-10 of the Manual for the Multimedia Exposure Assessment Model. Although the particle diameter is specified in the model it is not used for calculation since the aquifer porosity has been specified. The well distance is set to one, which is the smallest value that can pe input for this parameter. Although the MULTIMED model requires that the saturated-zone module be used in combination with the unsaturated-zone module, in this implementation the distance from the landfill to the upper most aquifer (Salmon Peak) was set to a small value to reduce the effect of the saturated-zone module. The other values in this module were derived by MULTIMED as shown in Table 6-6.

Table 6-6 – Aquifer Specific Data

Variable Name	Unit	Value	Comments
Particle diameter	cm	0.025	Obtained from Table 6-10 of the Manual for the Multimedia Exposure Assessment Model.
Aquifer porosity	unitless	0.10	Obtained from the TETCO Geotechnical Report
Bulk density	g/cc	2.40	Obtained from the TETCO Geotechnical Report
Aquifer thickness	m	91.4	Thickness of the Salmon Peak. Obtained from the TETCO Geotechnical Report. See Figure 3-1 in this appendix.
Mixing zone depth	m		Derived by MULTIMED.
Hydraulic conductivity	m/yr	50	Obtained from the TETCO Geotechnical Report (50 to 500 m/yr)
Hydraulic gradient	unitless	0.011	Section 4.1 of this appendix.
Groundwater seepage velocity	m/yr		Derived by MULTIMED.
Retardation coefficient	unitless		Derived by MULTIMED.
Longitudinal dispersity	m		Derived by MULTIMED.
Transversal dispersity	m		Derived by MULTIMED.
Vertical dispersity	m		Derived by MULTIMED.
Organic carbon content	%	0.003	Conservative assumption.
Receptor well distance	m	1	Conservative assumption.

6.2.2 Sensitivity Analysis

According to the EPA's "Preparing No-Migration Demonstration for Municipal Solid Waste Disposal Facilities: Screening Tool" the five variables that significantly influence the time of travel of leachate from the landfill to the uppermost aquifer are (1) depth of groundwater, (2) permeability of the soil, (3) the precipitation rate, (4) the evapotranspiration potential, and (5) the net infiltration rate. When conducting the sensitivity analyses, the recharge rate and net infiltration rates were altered to account for the precipitation rate and evapotranspiration potential since the HELP model utilizes these parameters in the net infiltration and rechange rate calculations. In addition to parameters mentioned above, the parameters below were also altered to test the sensitivity to time of travel.

- Aquifer hydraulic conductivity (Aquifer Module)
- Aquifer thickness (Aquifer Module)
- Aquifer porosity (Aquifer Module)
- Hydraulic gradient (Aquifer Module)
- Saturated hydraulic conductivity (Unsaturated Flow Module)
- Unsaturated Zone porosity (Unsaturated Flow Module)

The base model calculated time of travel to be 6000 years. The output files for the MULTIMED runs are included in Appendix IIIN-A. Table 6-7 shows the input parameters that were used to test the model sensitivity to calculate the time of travel. Two values were selected for each parameter shown in Table 6-7 to test the sensitivity of the model. One value being higher and one being lower than the number being used in the base model. As shown in the table below, the four parameters impacting the time of travel are (1) the saturated hydraulic conductivity, (2) unsaturated zone porosity, (3) depth of the unsaturated zone, and (4) infiltration rate.

Table 6- 7– Sensitivity of Time of Travel to Input Parameters

Variable Name	Sensitivity Values	Time of Travel with Sensitivity Values (yrs)*
Aquifer hydraulic conductivity	25 m/yr	1850
	75 m/yr	1850
Aquifer thickness	45.7 m	1850
	183 m	1850
Aquifer porosity	0.05	1850
	0.606	1850
Hydraulic gradient	0.0015	1850
	0.150	1850
Saturated hydraulic conductivity	0.000072 cm/hr	1650
	0.0072 cm/hr	2100
Unsaturated zone porosity	0.0020	450
	0.20	More than 10,000
Depth of the unsaturated zone	15 m	750
	5 m	200
Infiltration rate	0.00007 m/yr	4000
	0.00025 m/yr	1200
Recharge rate	0.282 m/yr	1850
	0.00282 m/yr	1850

*The base model time of travel is 1850 yrs.

As shown in Tabel 6-7, unsaturated zone porosity, infiltration rate and the depth of the unsaturated zone input parameters impact the time of travel. The unsaturated zone porosity input in MULTIMED is the effective porosity. The effective porosity is that part of the total porosity which is effective at transmitting water. A low unsaturated zone porosity results in a shorter time of travel. Infiltration rate is the second input that varies the time of travel. High infiltration rate increases the speed of contaminate entering the soil resulting in a low time of travel. A decrease in the infiltration rate will slow down the time of travel as shown in the table above. The change in the depth of unsaturated zone also varied the time of travel. Decreasing the depth of the unsaturated zone had the most impact on the time of travel. Using a depth of 5 meters for the unsaturated zone, which assumes that the Salmon Peak is 5 meters below the bottom of the liner, the time of travel to the upper most aquifer is 250 years. Site life of the Del Rio Landfill is approximately 21 years. So that makes the Del Rio Landfill overall site life 51 years, including the post closure period. The MULTIMED model demonstrates that the time required for the leachate to migrate from the bottom of the landfill down to the uppermost aquifer, exceeds the total site life of the landfill, including the post-closure period. As a consequence, the site meets the requirements of §330.401(d).

6.3 Travel Time to Calaveras Creek

The landfill site lies primarily within the Calaveras Creek drainage basin which has its head waters about 2.8 miles east of the landfill along U.S. 90. From the head water area flow is directed to the west for approximately 1.5 miles where the channel then makes an abrupt turn toward the southwest. From this point the channel flows southwesterly around the nortwestern and western extent of the landfill for a distance of about 2.5 miles where Calevaras then enters San Felipe Creek.A small drainage channel which begins in the landfill area and crosses the old landfill site directs surface water to the north and west towards Calaveras Creek. Calaveras Creek may be classified as an ephemeral stream consisting of a single, sinuous, shale and alluvial-bottomed channel which carries a mixed sediment load with particle and clast sizes that range from clay- to gravel-sized.

Calaveras Creek appears is a natural channel with dense vegetation occurring along the banks. The creek is generally about 15 to 30 feet wide and about 5 to 10 feet deep. The meandering creek channel is characterized by an alternating pool/riffle sequence (i.e. deep and shallow sections). During our field investigations of March 1994, the creek channel was walked from the landfill area downstream to Highway 277. The bed and bank consist of alternating alluvium and weathered shale materials. The alluvium can be generally described as brown silty clays with thin gravel and sand layers. The weathered shales, the Del Rio formation and-thin limestone or siltstone beds.

Based on previous site observations and results of the geotechnical studies, that Calaveras Creek in the landfill area is neither a losing or gaining stream. A "gaining stream", by definition, intersects the water table while a losing stream lies above the water table implying that surface water recharges the underlying aquifer. There was no obvious bank seepage recharge to the creek during our field inspections nor apparent base flow to support a "gaining stream" classification. In addition, the creek has a minimal vertical dissection located above the saturated zone. Ponded water in the creek channel is believed to be surface water related to ephemeral flow and the impervious nature of the channel soils.

A "losing stream" indicates that the surface water is recharging an aquifer. There is no evidence to support this classification because the stream only flows during precipitation events as the result of surface runoff and is incised into the Del Rio confining unit above the Edwards hydrologic unit. The only possible recharge would be localized bank recharge in the ponded areas and during high flows where the creek flow enters localized granular alluvium depositions. During subsequent low flows, the bank recharge may re-enter the creek, although in the March 1994 site observation following above-normal rainfall did not find evidence of seepage to the creek channel.

The most probable leachate flow and transport mechanism is discussed in the following paragraphs. For purposes of this discussion, it is first assumed that there is sufficient precipitation available to enter the waste layer and create leachate, and that some portion of this leachate which is not absorbed by the waste eventually drains to the bottom of the waste zone. The leachate then reaches the leachate collection medium where it then flows under gravity to the leachate collection sumps where it is subsequently removed. Some portion of the leachate will be absorbed, assuming a partially saturated initial liner condition, into the recompacted clay liner as it flows through the gravel collection system.

The first barrier which the leachate must breach is the recompacted clay liner. This clay liner provides not only a hydraulic barrier restricting flow, but also provides containment of leachate during the period of time required for the clay liner to reach full saturation (field capacity).

After the leachate has fully saturated the clay liner, leachate will be drawn into the unsaturated weathered clay-shale by soil suction gradients. Soil suction is defined as the state of the soil when it is under reduced pressure. It is measured in terms of the height of the water column (h) suspended in the soil. The Del Rio Clays at this site are desiccated with moisture contents below the plastic limit indicating their high affinity for moisture absorption. Thus, the leachate will be absorbed by the weathered clay-shales until their soil suction gradients have been reduced sufficiently to release moisture to lower levels. This process continues depending on the availability of leachate (moisture) and thus will be time dependent reflecting the leachate generation rate.

The absorptive potential of the Del Rio Clays is substantial. A conservative estimate of the flux rate of leachate through the compacted clay liner of 0.0002 inches per day (0.073 inches per year) was used in calculations to illustrate the absorptive potential. The clay liner is assumed to be fully saturated. This flux rate will be absorbed by the underlying Del Rio clays through its soil suction gradient until this suction gradient is satisfied. This moisture increase will be accompanied by swelling of the clay matrix. For each 1% increase in moisture, 0.225 inches of water are required per square foot per foot of thickness. The moisture contents from four laboratory permeability tests (TETCO 1994) on undisturbed samples of the Del Rio Clay increased from their initial to final moistures on an average of 6.8% and ranged from 5.4% to 8.2%.

It is assumed that the landfill site produces a large enough supply of leachate sufficient to saturate the clay liner and to overcome all absorptive affinity of the unsaturated weathered clay-shales. Leachate would then be released as free liquid and would eventually flow under gravity forces through a tortuous path of fractures, bedding planes and other secondary structures in contact with the unweathered Del Rio shales. Here the leachate would be further restricted in downward flow and would take the path of least resistance which would be to flow laterally. Portions of the leachate may be trapped in low areas of the weathered-unweathered transition or along discontinuous fracture planes. The remaining leachate would flow down-gradient following the path indicated by the contours of the weathered-unweathered transitional contact and eventually towards Calaveras Creek and to a minor extent towards Zorro Creek to the south. The most probable discharge point, although unlikely based on the conservative assumptions, would be along Calaveras Creek exhibiting itself as seepage into the creek.

The existing water wells north and northeast of the landfill are topographically and hydraulically upgradient and would not be affected by leachate flow from the landfill. Additionally, there are no water wells immediately south and southwest of the landfill due to the poor quality of the Salmon Peak water in the downdip zone, nor are there any water wells west between the landfill and Calaveras Creek.

An estimate of the travel time for fluid flow from the landfill tract to Calaveras Creek has been made using the Darcy flow equation.

$$v = \left(\frac{k}{n_e}\right) i$$

Where v= linear velocity
k = hydraulic conductivity
i = hydraulic gradient
n_e = effective porosity

Substituting a (a) hydraulic gradient (i) of 0.0125 calculated from the slope of a hypothetical water table corresponding to the slope of the weathered-unweathered Del Rio transitional contact; (b.) a hydraulic conductivity of 1 X 10^{-5} cm/sec (10.346 ft/yr); and (c.) an effective porosity of 0.05 for the weathered clay-shale stratum results in a velocity of 2.587 ft. per year. Since Calaveras Creek is about 2500 feet to the nearest point of the landfill site, the estimated travel time is 966 years. This demonstrates that it is highly unlikely that flow could occur from the landfill to Calaveras Creek, particularly considering that this calculation did not consider the absorptive potential of the unsaturated zone along the 2500-foot route and considering the conservative assumption concerning the presence of a driving hydraulic head.

7 RESULTS AND CONCLUSIONS

The travel time calculations in Sections 6.2 and 6.3 demonstrate the time that leachate reaches the uppermost aquifer and Calaveras Creek will exceed the site life of the landfill including the post-closure period. The site is in compliance with §330.401(d) in that there is no potential for migration of hazardous constituents from that solid waste management unit to the uppermost aquifer as defined in §330.3 of this title during the active life and the closure and post-closure care period of the unit.

APPENDIX IIIN-A

MULTIMED MODEL



1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

UNSATURATED ZONE FLOW MODEL PARAMETERS

(input parameter description and value)

NP	- Total number of nodal points	240
NMAT	- Number of different porous materials	1
KPROP	- Van Genuchten or Brooks and Corey	1
IMSHGN	- Spatial discretization option	1
NVFLAYR	- Number of layers in flow model	1

OPTIONS CHOSEN

------- ------

Van Genuchten functional coefficients

User defined coordinate system

1

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	23.80	1

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.720E-03	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.200E-01	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.000	-999.	0.000	-999.
Depth of the unsaturated zone	m	CONSTANT	23.8	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.680E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000	-999.	0.000	10.0
ALFA coefficient	1/cm	CONSTANT	0.800E-02	-999.	0.000	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.09	-999.	1.00	5.00

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

Currently Not Used in Multimed Version 2.0 1

```
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      2
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --            0.0
 WTFUN  - Weighting factor                --            1.2
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying pulse source
 Computer generated times for computing concentrations
1
```

DATA FOR MATERIAL 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.34	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.30	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	0.100E+05	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.

Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.25E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	50.0	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.20	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	1.00	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

1

TIME	CONCENTRATION
0.100E+02	0.00000E+00
0.200E+02	0.00000E+00
0.300E+02	0.00000E+00
0.400E+02	0.00000E+00
0.500E+02	0.00000E+00
0.600E+02	0.00000E+00
0.700E+02	0.00000E+00
0.800E+02	0.00000E+00
0.900E+02	0.00000E+00

0.100E+03 0.00000E+00
0.150E+03 0.00000E+00
0.200E+03 0.00000E+00
0.250E+03 0.00000E+00
0.300E+03 0.00000E+00
0.350E+03 0.00000E+00
0.400E+03 0.00000E+00
0.450E+03 0.00000E+00
0.500E+03 0.00000E+00
0.550E+03 0.00000E+00
0.600E+03 0.00000E+00
0.650E+03 0.00000E+00
0.700E+03 0.00000E+00
0.750E+03 0.00000E+00
0.800E+03 0.00000E+00
0.850E+03 0.00000E+00
0.900E+03 0.00000E+00
0.950E+03 0.00000E+00
0.100E+04 0.00000E+00
0.105E+04 0.00000E+00
0.110E+04 0.00000E+00
0.115E+04 0.00000E+00
0.120E+04 0.00000E+00
0.125E+04 0.00000E+00
0.130E+04 0.00000E+00
0.135E+04 0.00000E+00
0.140E+04 0.00000E+00
0.145E+04 0.00000E+00
0.150E+04 0.00000E+00
0.155E+04 0.00000E+00
0.160E+04 0.00000E+00
0.165E+04 0.00000E+00
0.170E+04 0.00000E+00
0.175E+04 0.00000E+00
0.180E+04 0.00000E+00
0.185E+04 0.00000E+00
0.190E+04 0.42573E-04
0.195E+04 0.11836E-03
0.200E+04 0.19414E-03
0.205E+04 0.26993E-03
0.210E+04 0.34571E-03
0.215E+04 0.42150E-03
0.220E+04 0.49728E-03
0.225E+04 0.57306E-03
0.230E+04 0.64885E-03

0.235E+04 0.72463E-03
0.240E+04 0.82969E-03
0.245E+04 0.10095E-02
0.250E+04 0.11892E-02
0.255E+04 0.13690E-02
0.260E+04 0.15487E-02
0.265E+04 0.17285E-02
0.270E+04 0.19083E-02
0.275E+04 0.20880E-02
0.280E+04 0.22678E-02
0.285E+04 0.24623E-02
0.290E+04 0.26629E-02
0.295E+04 0.28635E-02
0.300E+04 0.30642E-02
0.305E+04 0.32648E-02
0.310E+04 0.34654E-02
0.315E+04 0.36660E-02
0.320E+04 0.38261E-02
0.325E+04 0.39551E-02
0.400E+04 0.58906E-02
0.500E+04 0.68450E-02
0.600E+04 0.69634E-02
0.700E+04 0.69353E-02
0.800E+04 0.69230E-02
0.900E+04 0.69287E-02
0.100E+05 0.69384E-02

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

UNSATURATED ZONE FLOW MODEL PARAMETERS

(input parameter description and value)

NP	- Total number of nodal points	240
NMAT	- Number of different porous materials	1
KPROP	- Van Genuchten or Brooks and Corey	1
IMSHGN	- Spatial discretization option	1
NVFLAYR	- Number of layers in flow model	1

OPTIONS CHOSEN

------- ------

Van Genuchten functional coefficients

User defined coordinate system

1

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	23.80	1

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.720E-03	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.200E-01	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.000	-999.	0.000	-999.
Depth of the unsaturated zone	m	CONSTANT	23.8	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.680E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000	-999.	0.000	10.0
ALFA coefficient	1/cm	CONSTANT	0.800E-02	-999.	0.000	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.09	-999.	1.00	5.00

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

Currently Not Used in Multimed Version 2.0 1

```
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      2
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --            0.0
 WTFUN  - Weighting factor                --            1.2
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying pulse source
 Computer generated times for computing concentrations
1
```

DATA FOR MATERIAL 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.34	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.30	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	0.100E+05	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.

Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.25E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	25.0	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.20	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	1.00	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

1

TIME	CONCENTRATION
0.100E+02	0.00000E+00
0.200E+02	0.00000E+00
0.300E+02	0.00000E+00
0.400E+02	0.00000E+00
0.500E+02	0.00000E+00
0.600E+02	0.00000E+00
0.700E+02	0.00000E+00
0.800E+02	0.00000E+00
0.900E+02	0.00000E+00

0.100E+03 0.00000E+00
0.150E+03 0.00000E+00
0.200E+03 0.00000E+00
0.250E+03 0.00000E+00
0.300E+03 0.00000E+00
0.350E+03 0.00000E+00
0.400E+03 0.00000E+00
0.450E+03 0.00000E+00
0.500E+03 0.00000E+00
0.550E+03 0.00000E+00
0.600E+03 0.00000E+00
0.650E+03 0.00000E+00
0.700E+03 0.00000E+00
0.750E+03 0.00000E+00
0.800E+03 0.00000E+00
0.850E+03 0.00000E+00
0.900E+03 0.00000E+00
0.950E+03 0.00000E+00
0.100E+04 0.00000E+00
0.105E+04 0.00000E+00
0.110E+04 0.00000E+00
0.115E+04 0.00000E+00
0.120E+04 0.00000E+00
0.125E+04 0.00000E+00
0.130E+04 0.00000E+00
0.135E+04 0.00000E+00
0.140E+04 0.00000E+00
0.145E+04 0.00000E+00
0.150E+04 0.00000E+00
0.155E+04 0.00000E+00
0.160E+04 0.00000E+00
0.165E+04 0.00000E+00
0.170E+04 0.00000E+00
0.175E+04 0.00000E+00
0.180E+04 0.00000E+00
0.185E+04 0.00000E+00
0.190E+04 0.62326E-04
0.195E+04 0.17327E-03
0.200E+04 0.28422E-03
0.205E+04 0.39517E-03
0.210E+04 0.50612E-03
0.215E+04 0.61706E-03
0.220E+04 0.72801E-03
0.225E+04 0.83896E-03
0.230E+04 0.94991E-03

0.235E+04 0.10609E-02
0.240E+04 0.12147E-02
0.245E+04 0.14778E-02
0.250E+04 0.17410E-02
0.255E+04 0.20042E-02
0.260E+04 0.22673E-02
0.265E+04 0.25305E-02
0.270E+04 0.27937E-02
0.275E+04 0.30569E-02
0.280E+04 0.33200E-02
0.285E+04 0.36048E-02
0.290E+04 0.38985E-02
0.295E+04 0.41922E-02
0.300E+04 0.44859E-02
0.305E+04 0.47796E-02
0.310E+04 0.50732E-02
0.315E+04 0.53669E-02
0.320E+04 0.56014E-02
0.325E+04 0.57903E-02
0.400E+04 0.86237E-02
0.500E+04 0.10021E-01
0.600E+04 0.10194E-01
0.700E+04 0.10153E-01
0.800E+04 0.10135E-01
0.900E+04 0.10144E-01
0.100E+05 0.10158E-01

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

UNSATURATED ZONE FLOW MODEL PARAMETERS

(input parameter description and value)

NP	- Total number of nodal points	240
NMAT	- Number of different porous materials	1
KPROP	- Van Genuchten or Brooks and Corey	1
IMSHGN	- Spatial discretization option	1
NVFLAYR	- Number of layers in flow model	1

OPTIONS CHOSEN

------- ------

Van Genuchten functional coefficients

User defined coordinate system

1

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	23.80	1

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.720E-03	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.200E-01	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.000	-999.	0.000	-999.
Depth of the unsaturated zone	m	CONSTANT	23.8	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.680E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000	-999.	0.000	10.0
ALFA coefficient	1/cm	CONSTANT	0.800E-02	-999.	0.000	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.09	-999.	1.00	5.00

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

Currently Not Used in Multimed Version 2.0 1

```
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      2
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --            0.0
 WTFUN  - Weighting factor                --            1.2
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying pulse source
 Computer generated times for computing concentrations
1
```

DATA FOR MATERIAL 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.34	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.30	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	0.100E+05	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.

Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.25E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	75.0	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.20	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	1.00	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

1

TIME	CONCENTRATION
0.100E+02	0.00000E+00
0.200E+02	0.00000E+00
0.300E+02	0.00000E+00
0.400E+02	0.00000E+00
0.500E+02	0.00000E+00
0.600E+02	0.00000E+00
0.700E+02	0.00000E+00
0.800E+02	0.00000E+00
0.900E+02	0.00000E+00

0.100E+03 0.00000E+00
0.150E+03 0.00000E+00
0.200E+03 0.00000E+00
0.250E+03 0.00000E+00
0.300E+03 0.00000E+00
0.350E+03 0.00000E+00
0.400E+03 0.00000E+00
0.450E+03 0.00000E+00
0.500E+03 0.00000E+00
0.550E+03 0.00000E+00
0.600E+03 0.00000E+00
0.650E+03 0.00000E+00
0.700E+03 0.00000E+00
0.750E+03 0.00000E+00
0.800E+03 0.00000E+00
0.850E+03 0.00000E+00
0.900E+03 0.00000E+00
0.950E+03 0.00000E+00
0.100E+04 0.00000E+00
0.105E+04 0.00000E+00
0.110E+04 0.00000E+00
0.115E+04 0.00000E+00
0.120E+04 0.00000E+00
0.125E+04 0.00000E+00
0.130E+04 0.00000E+00
0.135E+04 0.00000E+00
0.140E+04 0.00000E+00
0.145E+04 0.00000E+00
0.150E+04 0.00000E+00
0.155E+04 0.00000E+00
0.160E+04 0.00000E+00
0.165E+04 0.00000E+00
0.170E+04 0.00000E+00
0.175E+04 0.00000E+00
0.180E+04 0.00000E+00
0.185E+04 0.00000E+00
0.190E+04 0.28418E-04
0.195E+04 0.79004E-04
0.200E+04 0.12959E-03
0.205E+04 0.18018E-03
0.210E+04 0.23076E-03
0.215E+04 0.28135E-03
0.220E+04 0.33194E-03
0.225E+04 0.38252E-03
0.230E+04 0.43311E-03

0.235E+04 0.48369E-03
0.240E+04 0.55382E-03
0.245E+04 0.67382E-03
0.250E+04 0.79381E-03
0.255E+04 0.91380E-03
0.260E+04 0.10338E-02
0.265E+04 0.11538E-02
0.270E+04 0.12738E-02
0.275E+04 0.13938E-02
0.280E+04 0.15138E-02
0.285E+04 0.16436E-02
0.290E+04 0.17775E-02
0.295E+04 0.19114E-02
0.300E+04 0.20453E-02
0.305E+04 0.21792E-02
0.310E+04 0.23131E-02
0.315E+04 0.24470E-02
0.320E+04 0.25539E-02
0.325E+04 0.26401E-02
0.400E+04 0.39320E-02
0.500E+04 0.45690E-02
0.600E+04 0.46481E-02
0.700E+04 0.46293E-02
0.800E+04 0.46211E-02
0.900E+04 0.46249E-02
0.100E+05 0.46314E-02

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

UNSATURATED ZONE FLOW MODEL PARAMETERS

(input parameter description and value)

NP	- Total number of nodal points	240
NMAT	- Number of different porous materials	1
KPROP	- Van Genuchten or Brooks and Corey	1
IMSHGN	- Spatial discretization option	1
NVFLAYR	- Number of layers in flow model	1

OPTIONS CHOSEN

------- ------

Van Genuchten functional coefficients

User defined coordinate system

1

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	23.80	1

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.720E-03	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.200E-01	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.000	-999.	0.000	-999.
Depth of the unsaturated zone	m	CONSTANT	23.8	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.680E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000	-999.	0.000	10.0
ALFA coefficient	1/cm	CONSTANT	0.800E-02	-999.	0.000	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.09	-999.	1.00	5.00

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

Currently Not Used in Multimed Version 2.0 1

```
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      2
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --            0.0
 WTFUN  - Weighting factor                --            1.2
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying pulse source
 Computer generated times for computing concentrations
1
```

DATA FOR MATERIAL 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.34	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.30	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	0.100E+05	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.

Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.25E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	45.7	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	50.0	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.20	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	1.00	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

1

TIME	CONCENTRATION
0.100E+02	0.00000E+00
0.200E+02	0.00000E+00
0.300E+02	0.00000E+00
0.400E+02	0.00000E+00
0.500E+02	0.00000E+00
0.600E+02	0.00000E+00
0.700E+02	0.00000E+00
0.800E+02	0.00000E+00
0.900E+02	0.00000E+00

0.100E+03 0.00000E+00
0.150E+03 0.00000E+00
0.200E+03 0.00000E+00
0.250E+03 0.00000E+00
0.300E+03 0.00000E+00
0.350E+03 0.00000E+00
0.400E+03 0.00000E+00
0.450E+03 0.00000E+00
0.500E+03 0.00000E+00
0.550E+03 0.00000E+00
0.600E+03 0.00000E+00
0.650E+03 0.00000E+00
0.700E+03 0.00000E+00
0.750E+03 0.00000E+00
0.800E+03 0.00000E+00
0.850E+03 0.00000E+00
0.900E+03 0.00000E+00
0.950E+03 0.00000E+00
0.100E+04 0.00000E+00
0.105E+04 0.00000E+00
0.110E+04 0.00000E+00
0.115E+04 0.00000E+00
0.120E+04 0.00000E+00
0.125E+04 0.00000E+00
0.130E+04 0.00000E+00
0.135E+04 0.00000E+00
0.140E+04 0.00000E+00
0.145E+04 0.00000E+00
0.150E+04 0.00000E+00
0.155E+04 0.00000E+00
0.160E+04 0.00000E+00
0.165E+04 0.00000E+00
0.170E+04 0.00000E+00
0.175E+04 0.00000E+00
0.180E+04 0.00000E+00
0.185E+04 0.00000E+00
0.190E+04 0.55997E-04
0.195E+04 0.15568E-03
0.200E+04 0.25536E-03
0.205E+04 0.35504E-03
0.210E+04 0.45472E-03
0.215E+04 0.55440E-03
0.220E+04 0.65408E-03
0.225E+04 0.75376E-03
0.230E+04 0.85344E-03

0.235E+04 0.95312E-03
0.240E+04 0.10913E-02
0.245E+04 0.13278E-02
0.250E+04 0.15642E-02
0.255E+04 0.18006E-02
0.260E+04 0.20371E-02
0.265E+04 0.22735E-02
0.270E+04 0.25100E-02
0.275E+04 0.27464E-02
0.280E+04 0.29829E-02
0.285E+04 0.32388E-02
0.290E+04 0.35026E-02
0.295E+04 0.37665E-02
0.300E+04 0.40303E-02
0.305E+04 0.42942E-02
0.310E+04 0.45581E-02
0.315E+04 0.48219E-02
0.320E+04 0.50325E-02
0.325E+04 0.52023E-02
0.400E+04 0.77479E-02
0.500E+04 0.90033E-02
0.600E+04 0.91591E-02
0.700E+04 0.91221E-02
0.800E+04 0.91059E-02
0.900E+04 0.91135E-02
0.100E+05 0.91261E-02

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

UNSATURATED ZONE FLOW MODEL PARAMETERS

(input parameter description and value)

NP	- Total number of nodal points	240
NMAT	- Number of different porous materials	1
KPROP	- Van Genuchten or Brooks and Corey	1
IMSHGN	- Spatial discretization option	1
NVFLAYR	- Number of layers in flow model	1

OPTIONS CHOSEN

------- ------

Van Genuchten functional coefficients

User defined coordinate system

1

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	23.80	1

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.720E-03	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.200E-01	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.000	-999.	0.000	-999.
Depth of the unsaturated zone	m	CONSTANT	23.8	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.680E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000	-999.	0.000	10.0
ALFA coefficient	1/cm	CONSTANT	0.800E-02	-999.	0.000	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.09	-999.	1.00	5.00

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

Currently Not Used in Multimed Version 2.0 1

```
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      2
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --            0.0
 WTFUN  - Weighting factor                --            1.2
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying pulse source
 Computer generated times for computing concentrations
1
```

DATA FOR MATERIAL 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.34	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.30	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	0.100E+05	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.

Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.25E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	183.	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	50.0	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.20	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	1.00	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

1

TIME	CONCENTRATION
0.100E+02	0.00000E+00
0.200E+02	0.00000E+00
0.300E+02	0.00000E+00
0.400E+02	0.00000E+00
0.500E+02	0.00000E+00
0.600E+02	0.00000E+00
0.700E+02	0.00000E+00
0.800E+02	0.00000E+00
0.900E+02	0.00000E+00

0.100E+03 0.00000E+00
0.150E+03 0.00000E+00
0.200E+03 0.00000E+00
0.250E+03 0.00000E+00
0.300E+03 0.00000E+00
0.350E+03 0.00000E+00
0.400E+03 0.00000E+00
0.450E+03 0.00000E+00
0.500E+03 0.00000E+00
0.550E+03 0.00000E+00
0.600E+03 0.00000E+00
0.650E+03 0.00000E+00
0.700E+03 0.00000E+00
0.750E+03 0.00000E+00
0.800E+03 0.00000E+00
0.850E+03 0.00000E+00
0.900E+03 0.00000E+00
0.950E+03 0.00000E+00
0.100E+04 0.00000E+00
0.105E+04 0.00000E+00
0.110E+04 0.00000E+00
0.115E+04 0.00000E+00
0.120E+04 0.00000E+00
0.125E+04 0.00000E+00
0.130E+04 0.00000E+00
0.135E+04 0.00000E+00
0.140E+04 0.00000E+00
0.145E+04 0.00000E+00
0.150E+04 0.00000E+00
0.155E+04 0.00000E+00
0.160E+04 0.00000E+00
0.165E+04 0.00000E+00
0.170E+04 0.00000E+00
0.175E+04 0.00000E+00
0.180E+04 0.00000E+00
0.185E+04 0.00000E+00
0.190E+04 0.42582E-04
0.195E+04 0.11838E-03
0.200E+04 0.19418E-03
0.205E+04 0.26998E-03
0.210E+04 0.34578E-03
0.215E+04 0.42159E-03
0.220E+04 0.49739E-03
0.225E+04 0.57319E-03
0.230E+04 0.64899E-03

0.235E+04 0.72479E-03
0.240E+04 0.82987E-03
0.245E+04 0.10097E-02
0.250E+04 0.11895E-02
0.255E+04 0.13693E-02
0.260E+04 0.15491E-02
0.265E+04 0.17289E-02
0.270E+04 0.19087E-02
0.275E+04 0.20885E-02
0.280E+04 0.22683E-02
0.285E+04 0.24629E-02
0.290E+04 0.26635E-02
0.295E+04 0.28642E-02
0.300E+04 0.30648E-02
0.305E+04 0.32655E-02
0.310E+04 0.34661E-02
0.315E+04 0.36668E-02
0.320E+04 0.38269E-02
0.325E+04 0.39560E-02
0.400E+04 0.58918E-02
0.500E+04 0.68465E-02
0.600E+04 0.69649E-02
0.700E+04 0.69367E-02
0.800E+04 0.69244E-02
0.900E+04 0.69302E-02
0.100E+05 0.69398E-02

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

UNSATURATED ZONE FLOW MODEL PARAMETERS

(input parameter description and value)

NP	- Total number of nodal points	240
NMAT	- Number of different porous materials	1
KPROP	- Van Genuchten or Brooks and Corey	1
IMSHGN	- Spatial discretization option	1
NVFLAYR	- Number of layers in flow model	1

OPTIONS CHOSEN

------- ------

Van Genuchten functional coefficients

User defined coordinate system

1

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	23.80	1

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.720E-03	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.200E-01	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.000	-999.	0.000	-999.
Depth of the unsaturated zone	m	CONSTANT	23.8	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.680E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000	-999.	0.000	10.0
ALFA coefficient	1/cm	CONSTANT	0.800E-02	-999.	0.000	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.09	-999.	1.00	5.00

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

Currently Not Used in Multimed Version 2.0 1

```
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      2
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --            0.0
 WTFUN  - Weighting factor                --            1.2
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying pulse source
 Computer generated times for computing concentrations
1
```

DATA FOR MATERIAL 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.34	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.30	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	0.100E+05	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.

Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.25E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.500E-01	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	50.0	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.20	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	1.00	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

1

TIME	CONCENTRATION
0.100E+02	0.00000E+00
0.200E+02	0.00000E+00
0.300E+02	0.00000E+00
0.400E+02	0.00000E+00
0.500E+02	0.00000E+00
0.600E+02	0.00000E+00
0.700E+02	0.00000E+00
0.800E+02	0.00000E+00
0.900E+02	0.00000E+00

0.100E+03 0.00000E+00
0.150E+03 0.00000E+00
0.200E+03 0.00000E+00
0.250E+03 0.00000E+00
0.300E+03 0.00000E+00
0.350E+03 0.00000E+00
0.400E+03 0.00000E+00
0.450E+03 0.00000E+00
0.500E+03 0.00000E+00
0.550E+03 0.00000E+00
0.600E+03 0.00000E+00
0.650E+03 0.00000E+00
0.700E+03 0.00000E+00
0.750E+03 0.00000E+00
0.800E+03 0.00000E+00
0.850E+03 0.00000E+00
0.900E+03 0.00000E+00
0.950E+03 0.00000E+00
0.100E+04 0.00000E+00
0.105E+04 0.00000E+00
0.110E+04 0.00000E+00
0.115E+04 0.00000E+00
0.120E+04 0.00000E+00
0.125E+04 0.00000E+00
0.130E+04 0.00000E+00
0.135E+04 0.00000E+00
0.140E+04 0.00000E+00
0.145E+04 0.00000E+00
0.150E+04 0.00000E+00
0.155E+04 0.00000E+00
0.160E+04 0.00000E+00
0.165E+04 0.00000E+00
0.170E+04 0.00000E+00
0.175E+04 0.00000E+00
0.180E+04 0.00000E+00
0.185E+04 0.00000E+00
0.190E+04 0.42573E-04
0.195E+04 0.11836E-03
0.200E+04 0.19414E-03
0.205E+04 0.26993E-03
0.210E+04 0.34571E-03
0.215E+04 0.42150E-03
0.220E+04 0.49728E-03
0.225E+04 0.57307E-03
0.230E+04 0.64885E-03

0.235E+04 0.72464E-03
0.240E+04 0.82970E-03
0.245E+04 0.10095E-02
0.250E+04 0.11892E-02
0.255E+04 0.13690E-02
0.260E+04 0.15488E-02
0.265E+04 0.17285E-02
0.270E+04 0.19083E-02
0.275E+04 0.20880E-02
0.280E+04 0.22678E-02
0.285E+04 0.24624E-02
0.290E+04 0.26630E-02
0.295E+04 0.28636E-02
0.300E+04 0.30642E-02
0.305E+04 0.32648E-02
0.310E+04 0.34654E-02
0.315E+04 0.36660E-02
0.320E+04 0.38261E-02
0.325E+04 0.39552E-02
0.400E+04 0.58906E-02
0.500E+04 0.68450E-02
0.600E+04 0.69634E-02
0.700E+04 0.69353E-02
0.800E+04 0.69230E-02
0.900E+04 0.69288E-02
0.100E+05 0.69384E-02

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

UNSATURATED ZONE FLOW MODEL PARAMETERS

(input parameter description and value)

NP	- Total number of nodal points	240
NMAT	- Number of different porous materials	1
KPROP	- Van Genuchten or Brooks and Corey	1
IMSHGN	- Spatial discretization option	1
NVFLAYR	- Number of layers in flow model	1

OPTIONS CHOSEN

------- ------

Van Genuchten functional coefficients

User defined coordinate system

1

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	23.80	1

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.720E-03	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.200E-01	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.000	-999.	0.000	-999.
Depth of the unsaturated zone	m	CONSTANT	23.8	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.680E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000	-999.	0.000	10.0
ALFA coefficient	1/cm	CONSTANT	0.800E-02	-999.	0.000	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.09	-999.	1.00	5.00

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

Currently Not Used in Multimed Version 2.0 1

```
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      2
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --            0.0
 WTFUN  - Weighting factor                --            1.2
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying pulse source
 Computer generated times for computing concentrations
1
```

DATA FOR MATERIAL 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.34	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.30	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	0.100E+05	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.

Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.25E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.606	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	50.0	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.20	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	1.00	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

1

TIME	CONCENTRATION
0.100E+02	0.00000E+00
0.200E+02	0.00000E+00
0.300E+02	0.00000E+00
0.400E+02	0.00000E+00
0.500E+02	0.00000E+00
0.600E+02	0.00000E+00
0.700E+02	0.00000E+00
0.800E+02	0.00000E+00
0.900E+02	0.00000E+00

0.100E+03 0.00000E+00
0.150E+03 0.00000E+00
0.200E+03 0.00000E+00
0.250E+03 0.00000E+00
0.300E+03 0.00000E+00
0.350E+03 0.00000E+00
0.400E+03 0.00000E+00
0.450E+03 0.00000E+00
0.500E+03 0.00000E+00
0.550E+03 0.00000E+00
0.600E+03 0.00000E+00
0.650E+03 0.00000E+00
0.700E+03 0.00000E+00
0.750E+03 0.00000E+00
0.800E+03 0.00000E+00
0.850E+03 0.00000E+00
0.900E+03 0.00000E+00
0.950E+03 0.00000E+00
0.100E+04 0.00000E+00
0.105E+04 0.00000E+00
0.110E+04 0.00000E+00
0.115E+04 0.00000E+00
0.120E+04 0.00000E+00
0.125E+04 0.00000E+00
0.130E+04 0.00000E+00
0.135E+04 0.00000E+00
0.140E+04 0.00000E+00
0.145E+04 0.00000E+00
0.150E+04 0.00000E+00
0.155E+04 0.00000E+00
0.160E+04 0.00000E+00
0.165E+04 0.00000E+00
0.170E+04 0.00000E+00
0.175E+04 0.00000E+00
0.180E+04 0.00000E+00
0.185E+04 0.00000E+00
0.190E+04 0.42573E-04
0.195E+04 0.11836E-03
0.200E+04 0.19414E-03
0.205E+04 0.26993E-03
0.210E+04 0.34571E-03
0.215E+04 0.42150E-03
0.220E+04 0.49728E-03
0.225E+04 0.57306E-03
0.230E+04 0.64885E-03

0.235E+04 0.72463E-03
0.240E+04 0.82969E-03
0.245E+04 0.10095E-02
0.250E+04 0.11892E-02
0.255E+04 0.13690E-02
0.260E+04 0.15487E-02
0.265E+04 0.17285E-02
0.270E+04 0.19083E-02
0.275E+04 0.20880E-02
0.280E+04 0.22678E-02
0.285E+04 0.24623E-02
0.290E+04 0.26629E-02
0.295E+04 0.28635E-02
0.300E+04 0.30642E-02
0.305E+04 0.32648E-02
0.310E+04 0.34654E-02
0.315E+04 0.36660E-02
0.320E+04 0.38261E-02
0.325E+04 0.39551E-02
0.400E+04 0.58906E-02
0.500E+04 0.68450E-02
0.600E+04 0.69634E-02
0.700E+04 0.69353E-02
0.800E+04 0.69230E-02
0.900E+04 0.69287E-02
0.100E+05 0.69384E-02

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

UNSATURATED ZONE FLOW MODEL PARAMETERS

(input parameter description and value)

NP	- Total number of nodal points	240
NMAT	- Number of different porous materials	1
KPROP	- Van Genuchten or Brooks and Corey	1
IMSHGN	- Spatial discretization option	1
NVFLAYR	- Number of layers in flow model	1

OPTIONS CHOSEN

------- ------

Van Genuchten functional coefficients

User defined coordinate system

1

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	23.80	1

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.720E-03	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.200E-01	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.000	-999.	0.000	-999.
Depth of the unsaturated zone	m	CONSTANT	23.8	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.680E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000	-999.	0.000	10.0
ALFA coefficient	1/cm	CONSTANT	0.800E-02	-999.	0.000	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.09	-999.	1.00	5.00

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

Currently Not Used in Multimed Version 2.0 1

```
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      2
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --            0.0
 WTFUN  - Weighting factor                --            1.2
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying pulse source
 Computer generated times for computing concentrations
1
```

DATA FOR MATERIAL 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.34	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.30	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	0.100E+05	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.

Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.25E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	50.0	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.150E-02	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.20	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	1.00	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

1

TIME	CONCENTRATION
0.100E+02	0.00000E+00
0.200E+02	0.00000E+00
0.300E+02	0.00000E+00
0.400E+02	0.00000E+00
0.500E+02	0.00000E+00
0.600E+02	0.00000E+00
0.700E+02	0.00000E+00
0.800E+02	0.00000E+00
0.900E+02	0.00000E+00

0.100E+03 0.00000E+00
0.150E+03 0.00000E+00
0.200E+03 0.00000E+00
0.250E+03 0.00000E+00
0.300E+03 0.00000E+00
0.350E+03 0.00000E+00
0.400E+03 0.00000E+00
0.450E+03 0.00000E+00
0.500E+03 0.00000E+00
0.550E+03 0.00000E+00
0.600E+03 0.00000E+00
0.650E+03 0.00000E+00
0.700E+03 0.00000E+00
0.750E+03 0.00000E+00
0.800E+03 0.00000E+00
0.850E+03 0.00000E+00
0.900E+03 0.00000E+00
0.950E+03 0.00000E+00
0.100E+04 0.00000E+00
0.105E+04 0.00000E+00
0.110E+04 0.00000E+00
0.115E+04 0.00000E+00
0.120E+04 0.00000E+00
0.125E+04 0.00000E+00
0.130E+04 0.00000E+00
0.135E+04 0.00000E+00
0.140E+04 0.00000E+00
0.145E+04 0.00000E+00
0.150E+04 0.00000E+00
0.155E+04 0.00000E+00
0.160E+04 0.00000E+00
0.165E+04 0.00000E+00
0.170E+04 0.00000E+00
0.175E+04 0.00000E+00
0.180E+04 0.00000E+00
0.185E+04 0.00000E+00
0.190E+04 0.30551E-03
0.195E+04 0.84936E-03
0.200E+04 0.13932E-02
0.205E+04 0.19370E-02
0.210E+04 0.24809E-02
0.215E+04 0.30247E-02
0.220E+04 0.35686E-02
0.225E+04 0.41124E-02
0.230E+04 0.46563E-02

0.235E+04 0.52001E-02
0.240E+04 0.59541E-02
0.245E+04 0.72441E-02
0.250E+04 0.85341E-02
0.255E+04 0.98241E-02
0.260E+04 0.11114E-01
0.265E+04 0.12404E-01
0.270E+04 0.13694E-01
0.275E+04 0.14984E-01
0.280E+04 0.16274E-01
0.285E+04 0.17670E-01
0.290E+04 0.19110E-01
0.295E+04 0.20549E-01
0.300E+04 0.21989E-01
0.305E+04 0.23429E-01
0.310E+04 0.24868E-01
0.315E+04 0.26308E-01
0.320E+04 0.27457E-01
0.325E+04 0.28383E-01
0.400E+04 0.42272E-01
0.500E+04 0.49121E-01
0.600E+04 0.49971E-01
0.700E+04 0.49769E-01
0.800E+04 0.49681E-01
0.900E+04 0.49722E-01
0.100E+05 0.49791E-01

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

UNSATURATED ZONE FLOW MODEL PARAMETERS

(input parameter description and value)

NP	- Total number of nodal points	240
NMAT	- Number of different porous materials	1
KPROP	- Van Genuchten or Brooks and Corey	1
IMSHGN	- Spatial discretization option	1
NVFLAYR	- Number of layers in flow model	1

OPTIONS CHOSEN

------- ------

Van Genuchten functional coefficients

User defined coordinate system

1

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	23.80	1

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.720E-03	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.200E-01	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.000	-999.	0.000	-999.
Depth of the unsaturated zone	m	CONSTANT	23.8	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.680E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000	-999.	0.000	10.0
ALFA coefficient	1/cm	CONSTANT	0.800E-02	-999.	0.000	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.09	-999.	1.00	5.00

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

Currently Not Used in Multimed Version 2.0 1

```
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      2
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --            0.0
 WTFUN  - Weighting factor                --            1.2
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying pulse source
 Computer generated times for computing concentrations
1
```

DATA FOR MATERIAL 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.34	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.30	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	0.100E+05	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.

Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.25E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	50.0	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.150	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.20	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	1.00	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

1

TIME	CONCENTRATION
0.100E+02	0.00000E+00
0.200E+02	0.00000E+00
0.300E+02	0.00000E+00
0.400E+02	0.00000E+00
0.500E+02	0.00000E+00
0.600E+02	0.00000E+00
0.700E+02	0.00000E+00
0.800E+02	0.00000E+00
0.900E+02	0.00000E+00

0.100E+03 0.00000E+00
0.150E+03 0.00000E+00
0.200E+03 0.00000E+00
0.250E+03 0.00000E+00
0.300E+03 0.00000E+00
0.350E+03 0.00000E+00
0.400E+03 0.00000E+00
0.450E+03 0.00000E+00
0.500E+03 0.00000E+00
0.550E+03 0.00000E+00
0.600E+03 0.00000E+00
0.650E+03 0.00000E+00
0.700E+03 0.00000E+00
0.750E+03 0.00000E+00
0.800E+03 0.00000E+00
0.850E+03 0.00000E+00
0.900E+03 0.00000E+00
0.950E+03 0.00000E+00
0.100E+04 0.00000E+00
0.105E+04 0.00000E+00
0.110E+04 0.00000E+00
0.115E+04 0.00000E+00
0.120E+04 0.00000E+00
0.125E+04 0.00000E+00
0.130E+04 0.00000E+00
0.135E+04 0.00000E+00
0.140E+04 0.00000E+00
0.145E+04 0.00000E+00
0.150E+04 0.00000E+00
0.155E+04 0.00000E+00
0.160E+04 0.00000E+00
0.165E+04 0.00000E+00
0.170E+04 0.00000E+00
0.175E+04 0.00000E+00
0.180E+04 0.00000E+00
0.185E+04 0.00000E+00
0.190E+04 0.31318E-05
0.195E+04 0.87068E-05
0.200E+04 0.14282E-04
0.205E+04 0.19857E-04
0.210E+04 0.25432E-04
0.215E+04 0.31007E-04
0.220E+04 0.36582E-04
0.225E+04 0.42157E-04
0.230E+04 0.47731E-04

0.235E+04 0.53306E-04
0.240E+04 0.61035E-04
0.245E+04 0.74259E-04
0.250E+04 0.87483E-04
0.255E+04 0.10071E-03
0.260E+04 0.11393E-03
0.265E+04 0.12715E-03
0.270E+04 0.14038E-03
0.275E+04 0.15360E-03
0.280E+04 0.16683E-03
0.285E+04 0.18114E-03
0.290E+04 0.19590E-03
0.295E+04 0.21065E-03
0.300E+04 0.22541E-03
0.305E+04 0.24017E-03
0.310E+04 0.25492E-03
0.315E+04 0.26968E-03
0.320E+04 0.28146E-03
0.325E+04 0.29095E-03
0.400E+04 0.43333E-03
0.500E+04 0.50354E-03
0.600E+04 0.51225E-03
0.700E+04 0.51018E-03
0.800E+04 0.50928E-03
0.900E+04 0.50970E-03
0.100E+05 0.51041E-03

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

UNSATURATED ZONE FLOW MODEL PARAMETERS

(input parameter description and value)

NP	- Total number of nodal points	240
NMAT	- Number of different porous materials	1
KPROP	- Van Genuchten or Brooks and Corey	1
IMSHGN	- Spatial discretization option	1
NVFLAYR	- Number of layers in flow model	1

OPTIONS CHOSEN

------- ------

Van Genuchten functional coefficients

User defined coordinate system

1

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	23.80	1

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.720E-04	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.200E-01	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.000	-999.	0.000	-999.
Depth of the unsaturated zone	m	CONSTANT	23.8	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.680E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000	-999.	0.000	10.0
ALFA coefficient	1/cm	CONSTANT	0.800E-02	-999.	0.000	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.09	-999.	1.00	5.00

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

Currently Not Used in Multimed Version 2.0 1

```
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      2
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --            0.0
 WTFUN  - Weighting factor                --            1.2
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying pulse source
 Computer generated times for computing concentrations
1
```

DATA FOR MATERIAL 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.34	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.30	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	0.100E+05	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.

Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.25E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	50.0	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.20	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	1.00	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

1

TIME	CONCENTRATION
0.100E+02	0.00000E+00
0.200E+02	0.00000E+00
0.300E+02	0.00000E+00
0.400E+02	0.00000E+00
0.500E+02	0.00000E+00
0.600E+02	0.00000E+00
0.700E+02	0.00000E+00
0.800E+02	0.00000E+00
0.900E+02	0.00000E+00

0.100E+03 0.00000E+00
0.150E+03 0.00000E+00
0.200E+03 0.00000E+00
0.250E+03 0.00000E+00
0.300E+03 0.00000E+00
0.350E+03 0.00000E+00
0.400E+03 0.00000E+00
0.450E+03 0.00000E+00
0.500E+03 0.00000E+00
0.550E+03 0.00000E+00
0.600E+03 0.00000E+00
0.650E+03 0.00000E+00
0.700E+03 0.00000E+00
0.750E+03 0.00000E+00
0.800E+03 0.00000E+00
0.850E+03 0.00000E+00
0.900E+03 0.00000E+00
0.950E+03 0.00000E+00
0.100E+04 0.00000E+00
0.105E+04 0.00000E+00
0.110E+04 0.00000E+00
0.115E+04 0.00000E+00
0.120E+04 0.00000E+00
0.125E+04 0.00000E+00
0.130E+04 0.00000E+00
0.135E+04 0.00000E+00
0.140E+04 0.00000E+00
0.145E+04 0.00000E+00
0.150E+04 0.00000E+00
0.155E+04 0.00000E+00
0.160E+04 0.00000E+00
0.165E+04 0.00000E+00
0.170E+04 0.15911E-04
0.175E+04 0.99827E-04
0.180E+04 0.18374E-03
0.185E+04 0.26766E-03
0.190E+04 0.35157E-03
0.195E+04 0.43549E-03
0.200E+04 0.51941E-03
0.205E+04 0.60332E-03
0.210E+04 0.68724E-03
0.215E+04 0.77115E-03
0.220E+04 0.95933E-03
0.225E+04 0.11584E-02
0.230E+04 0.13574E-02

0.235E+04 0.15565E-02
0.240E+04 0.17555E-02
0.245E+04 0.19546E-02
0.250E+04 0.21536E-02
0.255E+04 0.23565E-02
0.260E+04 0.25786E-02
0.265E+04 0.28007E-02
0.270E+04 0.30229E-02
0.275E+04 0.32450E-02
0.280E+04 0.34671E-02
0.285E+04 0.36893E-02
0.290E+04 0.38498E-02
0.295E+04 0.39855E-02
0.300E+04 0.41211E-02
0.305E+04 0.42568E-02
0.310E+04 0.43924E-02
0.315E+04 0.45281E-02
0.320E+04 0.46638E-02
0.325E+04 0.47994E-02
0.400E+04 0.65352E-02
0.500E+04 0.69707E-02
0.600E+04 0.69476E-02
0.700E+04 0.69230E-02
0.800E+04 0.69270E-02
0.900E+04 0.69380E-02
0.100E+05 0.69465E-02

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

UNSATURATED ZONE FLOW MODEL PARAMETERS

(input parameter description and value)

NP	- Total number of nodal points	240
NMAT	- Number of different porous materials	1
KPROP	- Van Genuchten or Brooks and Corey	1
IMSHGN	- Spatial discretization option	1
NVFLAYR	- Number of layers in flow model	1

OPTIONS CHOSEN

------- ------

Van Genuchten functional coefficients

User defined coordinate system

1

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	23.80	1

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.720E-02	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.200E-01	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.000	-999.	0.000	-999.
Depth of the unsaturated zone	m	CONSTANT	23.8	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.680E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000	-999.	0.000	10.0
ALFA coefficient	1/cm	CONSTANT	0.800E-02	-999.	0.000	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.09	-999.	1.00	5.00

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

Currently Not Used in Multimed Version 2.0 1

```
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      2
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --            0.0
 WTFUN  - Weighting factor                --            1.2
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying pulse source
 Computer generated times for computing concentrations
1
```

DATA FOR MATERIAL 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.34	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.30	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	0.100E+05	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.

Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.25E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	50.0	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.20	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	1.00	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

1

TIME	CONCENTRATION
0.100E+02	0.00000E+00
0.200E+02	0.00000E+00
0.300E+02	0.00000E+00
0.400E+02	0.00000E+00
0.500E+02	0.00000E+00
0.600E+02	0.00000E+00
0.700E+02	0.00000E+00
0.800E+02	0.00000E+00
0.900E+02	0.00000E+00

0.100E+03 0.00000E+00
0.150E+03 0.00000E+00
0.200E+03 0.00000E+00
0.250E+03 0.00000E+00
0.300E+03 0.00000E+00
0.350E+03 0.00000E+00
0.400E+03 0.00000E+00
0.450E+03 0.00000E+00
0.500E+03 0.00000E+00
0.550E+03 0.00000E+00
0.600E+03 0.00000E+00
0.650E+03 0.00000E+00
0.700E+03 0.00000E+00
0.750E+03 0.00000E+00
0.800E+03 0.00000E+00
0.850E+03 0.00000E+00
0.900E+03 0.00000E+00
0.950E+03 0.00000E+00
0.100E+04 0.00000E+00
0.105E+04 0.00000E+00
0.110E+04 0.00000E+00
0.115E+04 0.00000E+00
0.120E+04 0.00000E+00
0.125E+04 0.00000E+00
0.130E+04 0.00000E+00
0.135E+04 0.00000E+00
0.140E+04 0.00000E+00
0.145E+04 0.00000E+00
0.150E+04 0.00000E+00
0.155E+04 0.00000E+00
0.160E+04 0.00000E+00
0.165E+04 0.00000E+00
0.170E+04 0.00000E+00
0.175E+04 0.00000E+00
0.180E+04 0.00000E+00
0.185E+04 0.00000E+00
0.190E+04 0.00000E+00
0.195E+04 0.00000E+00
0.200E+04 0.00000E+00
0.205E+04 0.00000E+00
0.210E+04 0.00000E+00
0.215E+04 0.59306E-04
0.220E+04 0.12667E-03
0.225E+04 0.19403E-03
0.230E+04 0.26139E-03

0.235E+04 0.32875E-03
0.240E+04 0.39611E-03
0.245E+04 0.46347E-03
0.250E+04 0.53084E-03
0.255E+04 0.59820E-03
0.260E+04 0.66556E-03
0.265E+04 0.73292E-03
0.270E+04 0.82937E-03
0.275E+04 0.98916E-03
0.280E+04 0.11489E-02
0.285E+04 0.13087E-02
0.290E+04 0.14685E-02
0.295E+04 0.16283E-02
0.300E+04 0.17881E-02
0.305E+04 0.19479E-02
0.310E+04 0.21076E-02
0.315E+04 0.22674E-02
0.320E+04 0.24396E-02
0.325E+04 0.26179E-02
0.400E+04 0.47970E-02
0.500E+04 0.64870E-02
0.600E+04 0.69353E-02
0.700E+04 0.69627E-02
0.800E+04 0.69336E-02
0.900E+04 0.69230E-02
0.100E+05 0.69276E-02

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

UNSATURATED ZONE FLOW MODEL PARAMETERS

(input parameter description and value)

NP	- Total number of nodal points	240
NMAT	- Number of different porous materials	1
KPROP	- Van Genuchten or Brooks and Corey	1
IMSHGN	- Spatial discretization option	1
NVFLAYR	- Number of layers in flow model	1

OPTIONS CHOSEN

------- ------

Van Genuchten functional coefficients

User defined coordinate system

1

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	23.80	1

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.720E-03	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.200E-02	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.000	-999.	0.000	-999.
Depth of the unsaturated zone	m	CONSTANT	23.8	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.680E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000	-999.	0.000	10.0
ALFA coefficient	1/cm	CONSTANT	0.800E-02	-999.	0.000	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.09	-999.	1.00	5.00

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

Currently Not Used in Multimed Version 2.0 1

```
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      2
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --            0.0
 WTFUN  - Weighting factor                --            1.2
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying pulse source
 Computer generated times for computing concentrations
1
```

DATA FOR MATERIAL 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.34	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.30	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	0.100E+05	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.

Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.25E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	50.0	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.20	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	1.00	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

1

TIME	CONCENTRATION
0.100E+02	0.00000E+00
0.200E+02	0.00000E+00
0.300E+02	0.00000E+00
0.400E+02	0.00000E+00
0.500E+02	0.00000E+00
0.600E+02	0.00000E+00
0.700E+02	0.00000E+00
0.800E+02	0.00000E+00
0.900E+02	0.00000E+00

0.100E+03 0.00000E+00
0.150E+03 0.00000E+00
0.200E+03 0.00000E+00
0.250E+03 0.00000E+00
0.300E+03 0.00000E+00
0.350E+03 0.00000E+00
0.400E+03 0.00000E+00
0.450E+03 0.00000E+00
0.500E+03 0.20104E-03
0.550E+03 0.50487E-03
0.600E+03 0.84933E-03
0.650E+03 0.15700E-02
0.700E+03 0.22907E-02
0.750E+03 0.30915E-02
0.800E+03 0.37813E-02
0.850E+03 0.39401E-02
0.900E+03 0.40989E-02
0.950E+03 0.42576E-02
0.100E+04 0.44164E-02
0.105E+04 0.45752E-02
0.110E+04 0.47340E-02
0.115E+04 0.48928E-02
0.120E+04 0.50515E-02
0.125E+04 0.52103E-02
0.130E+04 0.53691E-02
0.135E+04 0.55279E-02
0.140E+04 0.56866E-02
0.145E+04 0.58454E-02
0.150E+04 0.60042E-02
0.155E+04 0.61630E-02
0.160E+04 0.63217E-02
0.165E+04 0.64805E-02
0.170E+04 0.66393E-02
0.175E+04 0.67981E-02
0.180E+04 0.69289E-02
0.185E+04 0.69298E-02
0.190E+04 0.69307E-02
0.195E+04 0.69316E-02
0.200E+04 0.69325E-02
0.205E+04 0.69334E-02
0.210E+04 0.69343E-02
0.215E+04 0.69352E-02
0.220E+04 0.69361E-02
0.225E+04 0.69370E-02
0.230E+04 0.69379E-02

0.235E+04 0.69388E-02
0.240E+04 0.69397E-02
0.245E+04 0.69406E-02
0.250E+04 0.69415E-02
0.255E+04 0.69424E-02
0.260E+04 0.69433E-02
0.265E+04 0.69442E-02
0.270E+04 0.69451E-02
0.275E+04 0.69460E-02
0.280E+04 0.69467E-02
0.285E+04 0.69468E-02
0.290E+04 0.69469E-02
0.295E+04 0.69470E-02
0.300E+04 0.69471E-02
0.305E+04 0.69472E-02
0.310E+04 0.69473E-02
0.315E+04 0.69474E-02
0.320E+04 0.69475E-02
0.325E+04 0.69476E-02
0.400E+04 0.69478E-02
0.500E+04 0.69446E-02
0.600E+04 0.69439E-02
0.700E+04 0.69440E-02
0.800E+04 0.69440E-02
0.900E+04 0.69440E-02
0.100E+05 0.61581E-02

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options
--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN
Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN

Infiltration input by user
Run was transient
Reject runs if Y coordinate outside plume
Reject runs if Z coordinate outside plume
Gaussian source used in saturated zone model
1
1

UNSATURATED ZONE FLOW MODEL PARAMETERS
(input parameter description and value)

NP	- Total number of nodal points	240
NMAT	- Number of different porous materials	1
KPROP	- Van Genuchten or Brooks and Corey	1
IMSHGN	- Spatial discretization option	1
NVFLAYR	- Number of layers in flow model	1

OPTIONS CHOSEN
------- ------
Van Genuchten functional coefficients
User defined coordinate system
1

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	23.80	1

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.720E-03	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.200	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.000	-999.	0.000	-999.
Depth of the unsaturated zone	m	CONSTANT	23.8	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.680E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000	-999.	0.000	10.0
ALFA coefficient	1/cm	CONSTANT	0.800E-02	-999.	0.000	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.09	-999.	1.00	5.00

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

Currently Not Used in Multimed Version 2.0 1

```
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      2
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --            0.0
 WTFUN  - Weighting factor                --            1.2
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying pulse source
 Computer generated times for computing concentrations
1
```

DATA FOR MATERIAL 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.34	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.30	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	0.100E+05	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.

Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.25E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	50.0	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.20	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	1.00	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

1

TIME	CONCENTRATION
0.100E+02	0.00000E+00
0.200E+02	0.00000E+00
0.300E+02	0.00000E+00
0.400E+02	0.00000E+00
0.500E+02	0.00000E+00
0.600E+02	0.00000E+00
0.700E+02	0.00000E+00
0.800E+02	0.00000E+00
0.900E+02	0.00000E+00

0.100E+03 0.00000E+00
0.150E+03 0.00000E+00
0.200E+03 0.00000E+00
0.250E+03 0.00000E+00
0.300E+03 0.00000E+00
0.350E+03 0.00000E+00
0.400E+03 0.00000E+00
0.450E+03 0.00000E+00
0.500E+03 0.00000E+00
0.550E+03 0.00000E+00
0.600E+03 0.00000E+00
0.650E+03 0.00000E+00
0.700E+03 0.00000E+00
0.750E+03 0.00000E+00
0.800E+03 0.00000E+00
0.850E+03 0.00000E+00
0.900E+03 0.00000E+00
0.950E+03 0.00000E+00
0.100E+04 0.00000E+00
0.105E+04 0.00000E+00
0.110E+04 0.00000E+00
0.115E+04 0.00000E+00
0.120E+04 0.00000E+00
0.125E+04 0.00000E+00
0.130E+04 0.00000E+00
0.135E+04 0.00000E+00
0.140E+04 0.00000E+00
0.145E+04 0.00000E+00
0.150E+04 0.00000E+00
0.155E+04 0.00000E+00
0.160E+04 0.00000E+00
0.165E+04 0.00000E+00
0.170E+04 0.00000E+00
0.175E+04 0.00000E+00
0.180E+04 0.00000E+00
0.185E+04 0.00000E+00
0.190E+04 0.00000E+00
0.195E+04 0.00000E+00
0.200E+04 0.00000E+00
0.205E+04 0.00000E+00
0.210E+04 0.00000E+00
0.215E+04 0.00000E+00
0.220E+04 0.00000E+00
0.225E+04 0.00000E+00
0.230E+04 0.00000E+00

0.235E+04 0.00000E+00
0.240E+04 0.00000E+00
0.245E+04 0.00000E+00
0.250E+04 0.00000E+00
0.255E+04 0.00000E+00
0.260E+04 0.00000E+00
0.265E+04 0.00000E+00
0.270E+04 0.00000E+00
0.275E+04 0.00000E+00
0.280E+04 0.00000E+00
0.285E+04 0.00000E+00
0.290E+04 0.00000E+00
0.295E+04 0.00000E+00
0.300E+04 0.00000E+00
0.305E+04 0.00000E+00
0.310E+04 0.00000E+00
0.315E+04 0.00000E+00
0.320E+04 0.00000E+00
0.325E+04 0.00000E+00
0.400E+04 0.00000E+00
0.500E+04 0.00000E+00
0.600E+04 0.00000E+00
0.700E+04 0.00000E+00
0.800E+04 0.00000E+00
0.900E+04 0.00000E+00
0.100E+05 0.00000E+00

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

UNSATURATED ZONE FLOW MODEL PARAMETERS

(input parameter description and value)

NP	- Total number of nodal points	240
NMAT	- Number of different porous materials	1
KPROP	- Van Genuchten or Brooks and Corey	1
IMSHGN	- Spatial discretization option	1
NVFLAYR	- Number of layers in flow model	1

OPTIONS CHOSEN

------- ------

Van Genuchten functional coefficients

User defined coordinate system

1

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	15.00	1

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.720E-03	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.200E-01	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.000	-999.	0.000	-999.
Depth of the unsaturated zone	m	CONSTANT	15.0	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.680E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000	-999.	0.000	10.0
ALFA coefficient	1/cm	CONSTANT	0.800E-02	-999.	0.000	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.09	-999.	1.00	5.00

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

Currently Not Used in Multimed Version 2.0 1

```
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      2
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --            0.0
 WTFUN  - Weighting factor                --            1.2
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying pulse source
 Computer generated times for computing concentrations
1
```

DATA FOR MATERIAL 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.34	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.30	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	0.100E+05	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.

Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.25E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	50.0	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.20	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	1.00	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

1

TIME	CONCENTRATION
0.100E+02	0.00000E+00
0.200E+02	0.00000E+00
0.300E+02	0.00000E+00
0.400E+02	0.00000E+00
0.500E+02	0.00000E+00
0.600E+02	0.00000E+00
0.700E+02	0.00000E+00
0.800E+02	0.00000E+00
0.900E+02	0.00000E+00

0.100E+03 0.00000E+00
0.150E+03 0.00000E+00
0.200E+03 0.00000E+00
0.250E+03 0.00000E+00
0.300E+03 0.00000E+00
0.350E+03 0.00000E+00
0.400E+03 0.00000E+00
0.450E+03 0.00000E+00
0.500E+03 0.00000E+00
0.550E+03 0.00000E+00
0.600E+03 0.00000E+00
0.650E+03 0.00000E+00
0.700E+03 0.00000E+00
0.750E+03 0.00000E+00
0.800E+03 0.19454E-06
0.850E+03 0.58882E-06
0.900E+03 0.98310E-06
0.950E+03 0.13774E-05
0.100E+04 0.17717E-05
0.105E+04 0.21660E-05
0.110E+04 0.25602E-05
0.115E+04 0.29545E-05
0.120E+04 0.80333E-04
0.125E+04 0.19868E-03
0.130E+04 0.31703E-03
0.135E+04 0.43538E-03
0.140E+04 0.55373E-03
0.145E+04 0.67208E-03
0.150E+04 0.81004E-03
0.155E+04 0.10936E-02
0.160E+04 0.13771E-02
0.165E+04 0.16607E-02
0.170E+04 0.19442E-02
0.175E+04 0.22278E-02
0.180E+04 0.25337E-02
0.185E+04 0.28506E-02
0.190E+04 0.31674E-02
0.195E+04 0.34843E-02
0.200E+04 0.37789E-02
0.205E+04 0.39323E-02
0.210E+04 0.40858E-02
0.215E+04 0.42392E-02
0.220E+04 0.43927E-02
0.225E+04 0.45462E-02
0.230E+04 0.46996E-02

0.235E+04 0.48531E-02
0.240E+04 0.50065E-02
0.245E+04 0.51600E-02
0.250E+04 0.53134E-02
0.255E+04 0.54669E-02
0.260E+04 0.56204E-02
0.265E+04 0.57738E-02
0.270E+04 0.59273E-02
0.275E+04 0.60807E-02
0.280E+04 0.62342E-02
0.285E+04 0.63877E-02
0.290E+04 0.65411E-02
0.295E+04 0.66946E-02
0.300E+04 0.68280E-02
0.305E+04 0.68346E-02
0.310E+04 0.68413E-02
0.315E+04 0.68479E-02
0.320E+04 0.68545E-02
0.325E+04 0.68611E-02
0.400E+04 0.69593E-02
0.500E+04 0.69239E-02
0.600E+04 0.69361E-02
0.700E+04 0.69482E-02
0.800E+04 0.69520E-02
0.900E+04 0.69514E-02
0.100E+05 0.69496E-02

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

UNSATURATED ZONE FLOW MODEL PARAMETERS

(input parameter description and value)

NP	- Total number of nodal points	240
NMAT	- Number of different porous materials	1
KPROP	- Van Genuchten or Brooks and Corey	1
IMSHGN	- Spatial discretization option	1
NVFLAYR	- Number of layers in flow model	1

OPTIONS CHOSEN

------- ------

Van Genuchten functional coefficients

User defined coordinate system

1

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	5.00	1

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.720E-03	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.200E-01	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.000	-999.	0.000	-999.
Depth of the unsaturated zone	m	CONSTANT	5.00	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.680E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000	-999.	0.000	10.0
ALFA coefficient	1/cm	CONSTANT	0.800E-02	-999.	0.000	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.09	-999.	1.00	5.00

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

Currently Not Used in Multimed Version 2.0 1

```
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      2
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --            0.0
 WTFUN  - Weighting factor                --            1.2
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying pulse source
 Computer generated times for computing concentrations
1
```

DATA FOR MATERIAL 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.34	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.30	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	0.100E+05	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.

Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.25E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	50.0	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.20	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	1.00	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

1

TIME	CONCENTRATION
0.100E+02	0.00000E+00
0.200E+02	0.00000E+00
0.300E+02	0.00000E+00
0.400E+02	0.00000E+00
0.500E+02	0.00000E+00
0.600E+02	0.00000E+00
0.700E+02	0.00000E+00
0.800E+02	0.00000E+00
0.900E+02	0.00000E+00

0.100E+03 0.00000E+00
0.150E+03 0.00000E+00
0.200E+03 0.00000E+00
0.250E+03 0.23220E-05
0.300E+03 0.88334E-05
0.350E+03 0.15345E-04
0.400E+03 0.22855E-03
0.450E+03 0.55749E-03
0.500E+03 0.10745E-02
0.550E+03 0.19010E-02
0.600E+03 0.27780E-02
0.650E+03 0.37071E-02
0.700E+03 0.39259E-02
0.750E+03 0.40836E-02
0.800E+03 0.42413E-02
0.850E+03 0.43989E-02
0.900E+03 0.45566E-02
0.950E+03 0.47143E-02
0.100E+04 0.48720E-02
0.105E+04 0.50296E-02
0.110E+04 0.51873E-02
0.115E+04 0.53450E-02
0.120E+04 0.55026E-02
0.125E+04 0.56603E-02
0.130E+04 0.58180E-02
0.135E+04 0.59757E-02
0.140E+04 0.61333E-02
0.145E+04 0.62910E-02
0.150E+04 0.64487E-02
0.155E+04 0.66064E-02
0.160E+04 0.67640E-02
0.165E+04 0.69217E-02
0.170E+04 0.69353E-02
0.175E+04 0.69366E-02
0.180E+04 0.69378E-02
0.185E+04 0.69391E-02
0.190E+04 0.69403E-02
0.195E+04 0.69415E-02
0.200E+04 0.69428E-02
0.205E+04 0.69440E-02
0.210E+04 0.69452E-02
0.215E+04 0.69465E-02
0.220E+04 0.69477E-02
0.225E+04 0.69490E-02
0.230E+04 0.69502E-02

0.235E+04 0.69514E-02
0.240E+04 0.69527E-02
0.245E+04 0.69539E-02
0.250E+04 0.69551E-02
0.255E+04 0.69564E-02
0.260E+04 0.69576E-02
0.265E+04 0.69589E-02
0.270E+04 0.69588E-02
0.275E+04 0.69586E-02
0.280E+04 0.69584E-02
0.285E+04 0.69583E-02
0.290E+04 0.69581E-02
0.295E+04 0.69579E-02
0.300E+04 0.69577E-02
0.305E+04 0.69575E-02
0.310E+04 0.69574E-02
0.315E+04 0.69572E-02
0.320E+04 0.69570E-02
0.325E+04 0.69568E-02
0.400E+04 0.69547E-02
0.500E+04 0.69535E-02
0.600E+04 0.69536E-02
0.700E+04 0.69536E-02
0.800E+04 0.69536E-02
0.900E+04 0.69536E-02
0.100E+05 0.56451E-02

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

UNSATURATED ZONE FLOW MODEL PARAMETERS

(input parameter description and value)

NP	- Total number of nodal points	240
NMAT	- Number of different porous materials	1
KPROP	- Van Genuchten or Brooks and Corey	1
IMSHGN	- Spatial discretization option	1
NVFLAYR	- Number of layers in flow model	1

OPTIONS CHOSEN

------- ------

Van Genuchten functional coefficients

User defined coordinate system

1

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	23.80	1

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.720E-03	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.200E-01	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.000	-999.	0.000	-999.
Depth of the unsaturated zone	m	CONSTANT	23.8	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.680E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000	-999.	0.000	10.0
ALFA coefficient	1/cm	CONSTANT	0.800E-02	-999.	0.000	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.09	-999.	1.00	5.00

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

Currently Not Used in Multimed Version 2.0 1

```
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      2
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --            0.0
 WTFUN  - Weighting factor                --            1.2
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying pulse source
 Computer generated times for computing concentrations
1
```

DATA FOR MATERIAL 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.34	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.30	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.700E-04	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	0.100E+05	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.

Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.25E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	50.0	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.20	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	1.00	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

1

TIME	CONCENTRATION
0.100E+02	0.00000E+00
0.200E+02	0.00000E+00
0.300E+02	0.00000E+00
0.400E+02	0.00000E+00
0.500E+02	0.00000E+00
0.600E+02	0.00000E+00
0.700E+02	0.00000E+00
0.800E+02	0.00000E+00
0.900E+02	0.00000E+00

0.100E+03 0.00000E+00
0.150E+03 0.00000E+00
0.200E+03 0.00000E+00
0.250E+03 0.00000E+00
0.300E+03 0.00000E+00
0.350E+03 0.00000E+00
0.400E+03 0.00000E+00
0.450E+03 0.00000E+00
0.500E+03 0.00000E+00
0.550E+03 0.00000E+00
0.600E+03 0.00000E+00
0.650E+03 0.00000E+00
0.700E+03 0.00000E+00
0.750E+03 0.00000E+00
0.800E+03 0.00000E+00
0.850E+03 0.00000E+00
0.900E+03 0.00000E+00
0.950E+03 0.00000E+00
0.100E+04 0.00000E+00
0.105E+04 0.00000E+00
0.110E+04 0.00000E+00
0.115E+04 0.00000E+00
0.120E+04 0.00000E+00
0.125E+04 0.00000E+00
0.130E+04 0.00000E+00
0.135E+04 0.00000E+00
0.140E+04 0.00000E+00
0.145E+04 0.00000E+00
0.150E+04 0.00000E+00
0.155E+04 0.00000E+00
0.160E+04 0.00000E+00
0.165E+04 0.00000E+00
0.170E+04 0.00000E+00
0.175E+04 0.00000E+00
0.180E+04 0.00000E+00
0.185E+04 0.00000E+00
0.190E+04 0.00000E+00
0.195E+04 0.00000E+00
0.200E+04 0.00000E+00
0.205E+04 0.00000E+00
0.210E+04 0.00000E+00
0.215E+04 0.00000E+00
0.220E+04 0.00000E+00
0.225E+04 0.00000E+00
0.230E+04 0.00000E+00

0.235E+04 0.00000E+00
0.240E+04 0.00000E+00
0.245E+04 0.00000E+00
0.250E+04 0.00000E+00
0.255E+04 0.00000E+00
0.260E+04 0.00000E+00
0.265E+04 0.00000E+00
0.270E+04 0.00000E+00
0.275E+04 0.00000E+00
0.280E+04 0.00000E+00
0.285E+04 0.00000E+00
0.290E+04 0.00000E+00
0.295E+04 0.00000E+00
0.300E+04 0.00000E+00
0.305E+04 0.00000E+00
0.310E+04 0.00000E+00
0.315E+04 0.00000E+00
0.320E+04 0.00000E+00
0.325E+04 0.00000E+00
0.400E+04 0.00000E+00
0.500E+04 0.56928E-04
0.600E+04 0.30238E-03
0.700E+04 0.85857E-03
0.800E+04 0.14969E-02
0.900E+04 0.20513E-02
0.100E+05 0.24430E-02

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options
--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN
Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN

Infiltration input by user
Run was transient
Reject runs if Y coordinate outside plume
Reject runs if Z coordinate outside plume
Gaussian source used in saturated zone model
1
1

UNSATURATED ZONE FLOW MODEL PARAMETERS
(input parameter description and value)

NP	- Total number of nodal points	240
NMAT	- Number of different porous materials	1
KPROP	- Van Genuchten or Brooks and Corey	1
IMSHGN	- Spatial discretization option	1
NVFLAYR	- Number of layers in flow model	1

OPTIONS CHOSEN
------- ------
Van Genuchten functional coefficients
User defined coordinate system
1

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	23.80	1

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.720E-03	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.200E-01	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.000	-999.	0.000	-999.
Depth of the unsaturated zone	m	CONSTANT	23.8	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.680E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000	-999.	0.000	10.0
ALFA coefficient	1/cm	CONSTANT	0.800E-02	-999.	0.000	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.09	-999.	1.00	5.00

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

Currently Not Used in Multimed Version 2.0 1

```
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      2
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --            0.0
 WTFUN  - Weighting factor                --            1.2
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying pulse source
 Computer generated times for computing concentrations
1
```

DATA FOR MATERIAL 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.34	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.30	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.250E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	0.100E+05	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.

Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.25E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	50.0	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.20	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	1.00	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

1

TIME	CONCENTRATION
0.100E+02	0.00000E+00
0.200E+02	0.00000E+00
0.300E+02	0.00000E+00
0.400E+02	0.00000E+00
0.500E+02	0.00000E+00
0.600E+02	0.00000E+00
0.700E+02	0.00000E+00
0.800E+02	0.00000E+00
0.900E+02	0.00000E+00

0.100E+03 0.00000E+00
0.150E+03 0.00000E+00
0.200E+03 0.00000E+00
0.250E+03 0.00000E+00
0.300E+03 0.00000E+00
0.350E+03 0.00000E+00
0.400E+03 0.00000E+00
0.450E+03 0.00000E+00
0.500E+03 0.00000E+00
0.550E+03 0.00000E+00
0.600E+03 0.00000E+00
0.650E+03 0.00000E+00
0.700E+03 0.00000E+00
0.750E+03 0.00000E+00
0.800E+03 0.00000E+00
0.850E+03 0.00000E+00
0.900E+03 0.00000E+00
0.950E+03 0.00000E+00
0.100E+04 0.00000E+00
0.105E+04 0.00000E+00
0.110E+04 0.00000E+00
0.115E+04 0.00000E+00
0.120E+04 0.00000E+00
0.125E+04 0.95423E-05
0.130E+04 0.17656E-03
0.135E+04 0.34357E-03
0.140E+04 0.51059E-03
0.145E+04 0.67760E-03
0.150E+04 0.84461E-03
0.155E+04 0.10116E-02
0.160E+04 0.12263E-02
0.165E+04 0.16225E-02
0.170E+04 0.20186E-02
0.175E+04 0.24148E-02
0.180E+04 0.28110E-02
0.185E+04 0.32071E-02
0.190E+04 0.36261E-02
0.195E+04 0.40682E-02
0.200E+04 0.45103E-02
0.205E+04 0.49524E-02
0.210E+04 0.53945E-02
0.215E+04 0.56749E-02
0.220E+04 0.58978E-02
0.225E+04 0.61206E-02
0.230E+04 0.63435E-02

0.235E+04 0.65663E-02
0.240E+04 0.67892E-02
0.245E+04 0.70120E-02
0.250E+04 0.72349E-02
0.255E+04 0.74577E-02
0.260E+04 0.76805E-02
0.265E+04 0.79034E-02
0.270E+04 0.81262E-02
0.275E+04 0.83491E-02
0.280E+04 0.85719E-02
0.285E+04 0.87948E-02
0.290E+04 0.90176E-02
0.295E+04 0.92405E-02
0.300E+04 0.94633E-02
0.305E+04 0.96862E-02
0.310E+04 0.99090E-02
0.315E+04 0.99771E-02
0.320E+04 0.99901E-02
0.325E+04 0.10003E-01
0.400E+04 0.10198E-01
0.500E+04 0.10171E-01
0.600E+04 0.10174E-01
0.700E+04 0.10193E-01
0.800E+04 0.10203E-01
0.900E+04 0.10205E-01
0.100E+05 0.10203E-01

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options
--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN
Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN

Infiltration input by user
Run was transient
Reject runs if Y coordinate outside plume
Reject runs if Z coordinate outside plume
Gaussian source used in saturated zone model
1
1

UNSATURATED ZONE FLOW MODEL PARAMETERS
(input parameter description and value)

NP	- Total number of nodal points	240
NMAT	- Number of different porous materials	1
KPROP	- Van Genuchten or Brooks and Corey	1
IMSHGN	- Spatial discretization option	1
NVFLAYR	- Number of layers in flow model	1

OPTIONS CHOSEN
------- ------
Van Genuchten functional coefficients
User defined coordinate system
1

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	23.80	1

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.720E-03	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.200E-01	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.000	-999.	0.000	-999.
Depth of the unsaturated zone	m	CONSTANT	23.8	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.680E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000	-999.	0.000	10.0
ALFA coefficient	1/cm	CONSTANT	0.800E-02	-999.	0.000	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.09	-999.	1.00	5.00

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

Currently Not Used in Multimed Version 2.0 1

```
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      2
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --            0.0
 WTFUN  - Weighting factor                --            1.2
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying pulse source
 Computer generated times for computing concentrations
1
```

DATA FOR MATERIAL 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.34	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.30	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	0.100E+05	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.

Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.25E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	50.0	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.20	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	1.00	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

1

TIME	CONCENTRATION
0.100E+02	0.00000E+00
0.200E+02	0.00000E+00
0.300E+02	0.00000E+00
0.400E+02	0.00000E+00
0.500E+02	0.00000E+00
0.600E+02	0.00000E+00
0.700E+02	0.00000E+00
0.800E+02	0.00000E+00
0.900E+02	0.00000E+00

0.100E+03 0.00000E+00
0.150E+03 0.00000E+00
0.200E+03 0.00000E+00
0.250E+03 0.00000E+00
0.300E+03 0.00000E+00
0.350E+03 0.00000E+00
0.400E+03 0.00000E+00
0.450E+03 0.00000E+00
0.500E+03 0.00000E+00
0.550E+03 0.00000E+00
0.600E+03 0.00000E+00
0.650E+03 0.00000E+00
0.700E+03 0.00000E+00
0.750E+03 0.00000E+00
0.800E+03 0.00000E+00
0.850E+03 0.00000E+00
0.900E+03 0.00000E+00
0.950E+03 0.00000E+00
0.100E+04 0.00000E+00
0.105E+04 0.00000E+00
0.110E+04 0.00000E+00
0.115E+04 0.00000E+00
0.120E+04 0.00000E+00
0.125E+04 0.00000E+00
0.130E+04 0.00000E+00
0.135E+04 0.00000E+00
0.140E+04 0.00000E+00
0.145E+04 0.00000E+00
0.150E+04 0.00000E+00
0.155E+04 0.00000E+00
0.160E+04 0.00000E+00
0.165E+04 0.00000E+00
0.170E+04 0.00000E+00
0.175E+04 0.00000E+00
0.180E+04 0.00000E+00
0.185E+04 0.00000E+00
0.190E+04 0.42359E-04
0.195E+04 0.11776E-03
0.200E+04 0.19316E-03
0.205E+04 0.26857E-03
0.210E+04 0.34397E-03
0.215E+04 0.41937E-03
0.220E+04 0.49478E-03
0.225E+04 0.57018E-03
0.230E+04 0.64558E-03

0.235E+04 0.72099E-03
0.240E+04 0.82552E-03
0.245E+04 0.10044E-02
0.250E+04 0.11832E-02
0.255E+04 0.13621E-02
0.260E+04 0.15410E-02
0.265E+04 0.17198E-02
0.270E+04 0.18987E-02
0.275E+04 0.20775E-02
0.280E+04 0.22564E-02
0.285E+04 0.24499E-02
0.290E+04 0.26495E-02
0.295E+04 0.28491E-02
0.300E+04 0.30487E-02
0.305E+04 0.32483E-02
0.310E+04 0.34479E-02
0.315E+04 0.36475E-02
0.320E+04 0.38068E-02
0.325E+04 0.39352E-02
0.400E+04 0.58609E-02
0.500E+04 0.68105E-02
0.600E+04 0.69283E-02
0.700E+04 0.69004E-02
0.800E+04 0.68881E-02
0.900E+04 0.68938E-02
0.100E+05 0.69034E-02

1

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

1

Run options

--- -------

DEFAULT

DEL RIO LF VERTICAL EXPAN

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

UNSATURATED ZONE FLOW MODEL PARAMETERS

(input parameter description and value)

NP	- Total number of nodal points	240
NMAT	- Number of different porous materials	1
KPROP	- Van Genuchten or Brooks and Corey	1
IMSHGN	- Spatial discretization option	1
NVFLAYR	- Number of layers in flow model	1

OPTIONS CHOSEN

------- ------

Van Genuchten functional coefficients

User defined coordinate system

1

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	23.80	1

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.720E-03	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.200E-01	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.000	-999.	0.000	-999.
Depth of the unsaturated zone	m	CONSTANT	23.8	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.680E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000	-999.	0.000	10.0
ALFA coefficient	1/cm	CONSTANT	0.800E-02	-999.	0.000	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.09	-999.	1.00	5.00

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

Currently Not Used in Multimed Version 2.0 1

```
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      2
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --            0.0
 WTFUN  - Weighting factor                --            1.2
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying pulse source
 Computer generated times for computing concentrations
1
```

DATA FOR MATERIAL 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.34	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.30	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.170E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	0.100E+05	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-02	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.

Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.25E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.100	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	91.4	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	50.0	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.110E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.20	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	1.00	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

1

TIME	CONCENTRATION
0.100E+02	0.00000E+00
0.200E+02	0.00000E+00
0.300E+02	0.00000E+00
0.400E+02	0.00000E+00
0.500E+02	0.00000E+00
0.600E+02	0.00000E+00
0.700E+02	0.00000E+00
0.800E+02	0.00000E+00
0.900E+02	0.00000E+00

0.100E+03 0.00000E+00
0.150E+03 0.00000E+00
0.200E+03 0.00000E+00
0.250E+03 0.00000E+00
0.300E+03 0.00000E+00
0.350E+03 0.00000E+00
0.400E+03 0.00000E+00
0.450E+03 0.00000E+00
0.500E+03 0.00000E+00
0.550E+03 0.00000E+00
0.600E+03 0.00000E+00
0.650E+03 0.00000E+00
0.700E+03 0.00000E+00
0.750E+03 0.00000E+00
0.800E+03 0.00000E+00
0.850E+03 0.00000E+00
0.900E+03 0.00000E+00
0.950E+03 0.00000E+00
0.100E+04 0.00000E+00
0.105E+04 0.00000E+00
0.110E+04 0.00000E+00
0.115E+04 0.00000E+00
0.120E+04 0.00000E+00
0.125E+04 0.00000E+00
0.130E+04 0.00000E+00
0.135E+04 0.00000E+00
0.140E+04 0.00000E+00
0.145E+04 0.00000E+00
0.150E+04 0.00000E+00
0.155E+04 0.00000E+00
0.160E+04 0.00000E+00
0.165E+04 0.00000E+00
0.170E+04 0.00000E+00
0.175E+04 0.00000E+00
0.180E+04 0.00000E+00
0.185E+04 0.00000E+00
0.190E+04 0.42595E-04
0.195E+04 0.11842E-03
0.200E+04 0.19424E-03
0.205E+04 0.27006E-03
0.210E+04 0.34589E-03
0.215E+04 0.42171E-03
0.220E+04 0.49753E-03
0.225E+04 0.57335E-03
0.230E+04 0.64918E-03

0.235E+04 0.72500E-03
0.240E+04 0.83011E-03
0.245E+04 0.10100E-02
0.250E+04 0.11898E-02
0.255E+04 0.13697E-02
0.260E+04 0.15495E-02
0.265E+04 0.17294E-02
0.270E+04 0.19092E-02
0.275E+04 0.20891E-02
0.280E+04 0.22689E-02
0.285E+04 0.24636E-02
0.290E+04 0.26643E-02
0.295E+04 0.28650E-02
0.300E+04 0.30657E-02
0.305E+04 0.32664E-02
0.310E+04 0.34671E-02
0.315E+04 0.36678E-02
0.320E+04 0.38280E-02
0.325E+04 0.39571E-02
0.400E+04 0.58935E-02
0.500E+04 0.68484E-02
0.600E+04 0.69669E-02
0.700E+04 0.69388E-02
0.800E+04 0.69265E-02
0.900E+04 0.69322E-02
0.100E+05 0.69419E-02

APPENDIX IIIN-B

RAINFALL RECHARGE



01/31/2022

HELP MODEL RAINFALL RECHARGE CALCULATION

HELP MODEL

The Hydrologic Evaluation of Landfill Performance (HELP) Model, Version 4.0 was used to estimate the recharge rate for the Del Rio Clay. The HELP Model is a quasi-two-dimensional hydrologic model of water movement across, into, through, and out of soil. 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.

MODEL SETUP

The site was modeled as a 1-acre unit area for the existing in-situ soil layer (Del Rio Clay). The evaporative zone depth and leaf area index were suggested by the HELP model for Del Rio, Texas. The runoff potential was 90 percent since runoff outside the limits of the landfill will be allowed. The Soil Conservation Service (SCS) runoff curve number was determined based on soil data and expected ground cover for the existing in-situ soil layer from the United States Department of Agriculture, Soil Conservation Service, Soil Survey of Val Verde County, Texas.

CLIMATE DATA

Precipitation data was synthetically simulated based on HELP V4 model program simulation using the latitude and longitude for Del Rio, Texas. The average annual precipitation over the modeled 30-year period was 18.19 inches. Temperature and solar radiation data were also synthetically generated by the HELP model using program defaults for Del Rio, Texas.

SOIL PROFILE

Soil texture 10 was selected from the HELP Model default soil characteristics to represent the Del Rio Clay. Default values for soil texture 10 were selected for porosity, field capacity, wilting point, and saturated hydraulic conductivity. The moisture content of the subgrade soil was initialized by the HELP Model program. The thickness of the subgrade was assumed to be 100 feet, which represents the approximate thickness of the unsaturated zone.

HELP OUTPUT

The HELP input data and output files are presented on the following pages.

HELP MODEL OUTPUT

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: DelRio LF Vert Expan Recharge **Simulated On:** 4/30/2021 9:22

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
SCL - Sandy Clay Loam
Material Texture Number 10

Thickness	=	945	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.24	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Note: Initial moisture content of the layers and snow water were specified by the user.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	86.9	
Fraction of Area Allowing Runoff	=	90	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	10	inches
Initial Water in Evaporative Zone	=	2.4	inches
Upper Limit of Evaporative Storage	=	3.98	inches
Lower Limit of Evaporative Storage	=	1.36	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	226.8	inches
Total Initial Water	=	226.8	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	29.73	Degrees
Maximum Leaf Area Index	=	2	
Start of Growing Season (Julian Date)	=	0	days
End of Growing Season (Julian Date)	=	367	days

Average Wind Speed	=	3.3 mph
Average 1st Quarter Relative Humidity	=	68 %
Average 2nd Quarter Relative Humidity	=	67 %
Average 3rd Quarter Relative Humidity	=	70 %
Average 4th Quarter Relative Humidity	=	49 %

Note: Evapotranspiration data was obtained for Del Rio, Texas

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
0.433183	0.917002	0.962631	1.138112	3.0146	2.477437
1.656066	1.368296	2.878192	1.703864	1.14302	0.500851

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
64.2	62.4	71.3	76.3	89	92.5
95.6	95.2	89.8	78.3	72.2	62.3

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 29.73/-100.88

Average Annual Totals Summary

Title: DelRio LF Vert Expan Recharge
Simulated on: 5/10/2021 9:22

	Average Annual Totals for Years 1 - 30*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	18.19	[3.03]	66,041.5	100.00
Runoff	0.426	[0.409]	1,547.3	2.34
Evapotranspiration	16.543	[2.359]	60,049.7	90.93
Subprofile1				
Percolation/leakage through Layer 1	1.108307	[0.648699]	4,023.2	6.09
Water storage				
Change in water storage	0.1161	[0.975]	421.3	0.64

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: DelRio LF Vert Expan Recharge
Simulated on: 5/10/2021 9:22

	Peak Values for Years 1 - 30*		
	(inches)		(cubic feet)
Precipitation	4.08		14,808.7
Runoff	1.364		4,950.6
Subprofile1			
Percolation/leakage through Layer 1	0.012369		44.9
Other Parameters			
Snow water	1.0846		3,937.0
Maximum vegetation soil water	0.3841	(vol/vol)	
Minimum vegetation soil water	0.1360	(vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: DelRio LF Vert Expan Recharge
Simulated on: 5/10/2021 9:22
Simulation period: 30 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	230.0984	0.2435
Snow water	0.1835	---