Prepared for Applicant:
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1700 Kohlenberg Lane
P.O. Box 311657
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(830) 625-7894

PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN
ATTACHMENT 5

GROUNDWATER CHARACTERIZATION REPORT

MESQUITE CREEK LANDFILL
NEW BRAUNFELS,
COMAL AND GUADALUPE COUNTIES, TEXAS
MSW PERMIT NO. 66B

Prepared by:
Geosyntec consultants
~~GeoSyntec Consultants~~
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Technically Complete – 14 July 2006

Revised –~~,~~ 11 February 2010, 24 February 2021

1. INTRODUCTION

1.1 Scope

This Groundwater Characterization Report constitutes Part III, Attachment 5 of Permit Amendment Application No. MSW-2093B, as required by 30 TAC §330.56(e). Accordingly, this report presents the proposed facility groundwater monitoring network based on the hydrogeologic interpretations presented in Attachment 4 (Geology Report), results of ongoing detection groundwater quality monitoring taking place at the facility, and the proposed expansion layout design. Together with Attachment 4, this Attachment 5 satisfies 30 TAC §330.56(e)(5) which requires detailed plans and an engineering report describing the proposed groundwater monitoring program to meet requirements of 30 TAC §330.231 (Groundwater Monitoring Systems). The report considers the results of previous geologic, hydrogeologic, and geotechnical investigations of the currently permitted facility (i.e., Unit~~s~~ 1~~ and 3~~) as documented in the current permit [Metroplex Industries, Inc. (Metroplex) (2002)], along with the results of the recently-completed site hydrogeologic and geotechnical investigation completed by GeoSyntec Consultants for this proposed expansion (i.e., Unit 2).

1.2 Report Organization

The remainder of this attachment is organized as follows:

- an overview of the site hydrogeology is presented in Section 2;
- groundwater quality at the facility is discussed in Section 3;
- the proposed groundwater monitoring network is presented in Section 4; and
- references are listed in Section 5.

Water quality data is included in Appendix 5-A.

4. PROPOSED GROUNDWATER MONITORING SYSTEM

4.1 Overview of Proposed Groundwater Monitoring System

As discussed previously, historic and current site investigations have identified Stratum III as the uppermost water bearing zone beneath the site. The Stratum III potentiometric maps, presented as Drawings 4-13A to 4-13C in Attachment 4, show that groundwater and flow directions at the permitted facility and lateral expansion area are consistent with flow mainly toward the Mesquite Creek area. As Mesquite Creek is located between the existing and proposed waste footprints in the central area of the site, the proposed groundwater monitoring system for the facility is comprised of two physically separate groundwater monitoring systems (i.e., one for the existing area of Unit~~s~~ 1~~ and 3~~, and one for the expansion area, Unit 2). However, collectively they will comprise the groundwater monitoring system for the entire site required by 30 TAC §330.231. The certification of the proposed groundwater system design is included in Section 6.

The proposed groundwater monitoring system is shown on attached Drawing 5-1, which presents a site plan, along with existing topography, the landfill phase limits, the final limits of waste (waste management area), the permitted boundary, and the point of compliance boundary defined by 30 TAC §330.200(d) and meeting the requirements of 30 TAC §330.56(e)(3). The proposed groundwater monitoring system is also shown on Drawing 5-1A, which includes pre-landfill development topography.

Due to the nature of the groundwater flow direction, a relevant point of compliance has been established for each portion of the groundwater monitoring system (i.e., Unit 1~~ and 3~~, and Unit 2). Both segments of the point of compliance are located down-gradient of the corresponding MSWLF Unit~~(s)~~ and are capable of detecting a release from the protected area, should one occur. Collectively, these segments include monitor wells installed in the uppermost water bearing zone that allow the determination of the quality of groundwater passing the relevant point of compliance. Well spacing along both segments of the point of compliance has been established at 600 ft to comply with TCEQ guidelines. Location of the point of compliance is shown on Drawings 5-1 and 5-1A.

4.2 Monitoring Well Locations – Stratum III

The locations of the existing and proposed groundwater monitoring wells for the uppermost water-bearing zone, Stratum III, are presented on Drawing 5-1. Information on the existing and proposed monitoring wells (e.g., locations, depths, screened interval, etc.) is shown on Table 5-1.

Table 5-1 also includes the status of the well (existing or proposed), timing for well activation, and whether an existing piezometer will be converted to a monitor well. Selection of screened intervals of the proposed monitoring wells is discussed in Section 4.3.

4.2.1. Existing Facility Area (Unit~~s~~ 1~~ and 3~~)

~~Note that Unit 3 is already permitted (formerly known as Phase IV), but not yet constructed. The Unit 3 design, which included an approved alternate liner design using a geosynthetic clay liner instead of compacted clay, was previously part of Permit MSW-66. The Unit 3 design then continued with no changes to the alternate liner, horizontal extent, or base grades for Permit MSW-66A. No changes to the Unit 3 design layout are proposed for this permit amendment (MSW-66B). Unit 3 is proposed to have either the previously approved alternate liner, or a standard liner. It is also noted that a transfer station registration (Type V Facility, Registration No. 40200) is currently approved by TCEQ in the Unit 3 location. The registered transfer station is not in operation. The facility's preference is to construct Unit 3; however, if Permit Amendment Application MSW-66B is not approved, the facility may operate the transfer station in this area if marketplace demands are favorable. Unit 1 has been constructed and is active.~~

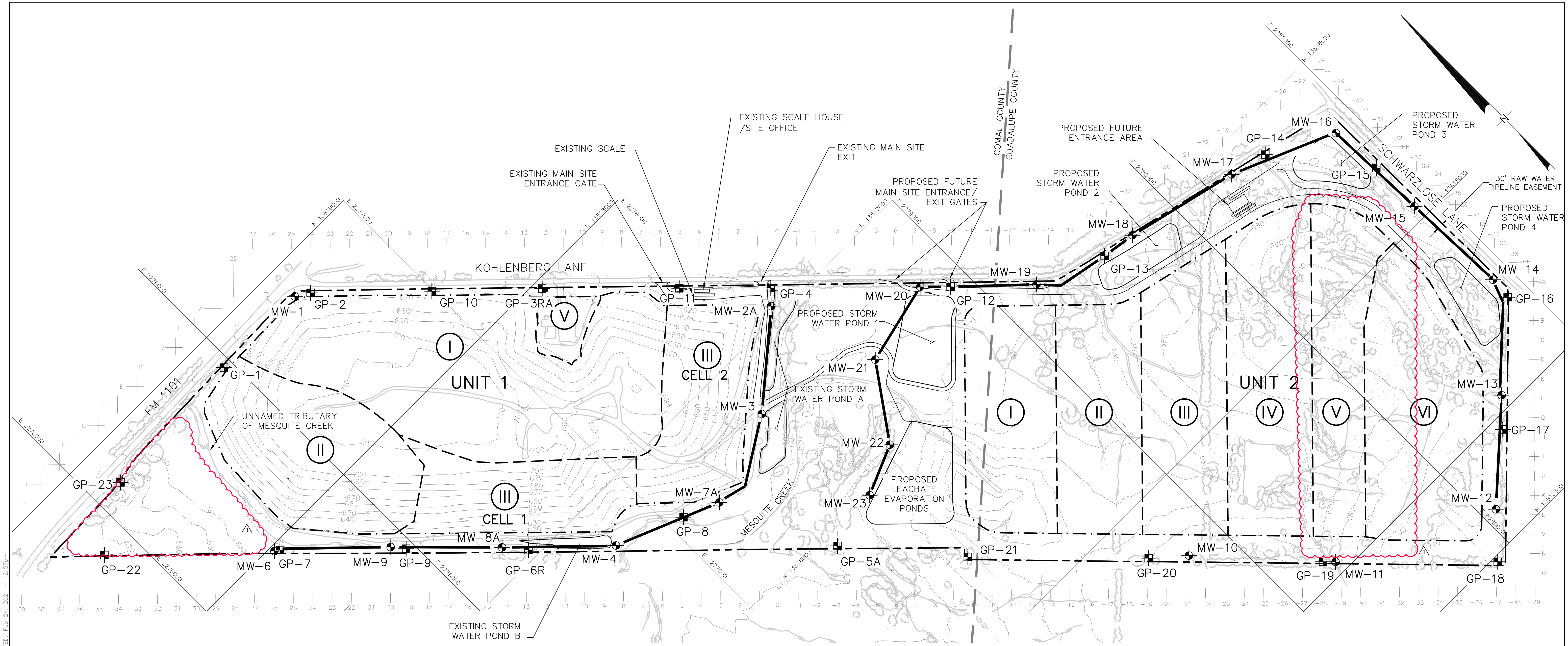
The existing facility (Unit 1) monitoring network is composed of seven monitoring wells; MW-1, MW-2, MW-3, MW-4, MW-6, MW-7, and MW-8. Currently permitted MW-7 and MW-8 are proposed to be plugged and abandoned for this permit amendment. Three new monitoring wells, MW-7A, MW-8A, and MW-9 are proposed in the southernmost area of the existing facility. Two of the new monitoring wells are located between MW-6 and MW-4, and one well, MW-7A, is located between MW-4 and MW-3. These new monitoring wells will enhance the current down-gradient monitoring well network and further delineate groundwater flow at the currently permitted facility. In addition, MW-2 will be moved approximately 500 ft to the southeast, and renamed MW-2A, where it is better positioned to detect a potential release from the facility since it was previously not down-gradient. As shown on Drawings 5-1 and 5-1A and presented in Table 5-1, the proposed monitoring well network for the existing facility (Unit~~s~~ 1~~ and 3~~) will then be comprised of eight monitoring wells (1 up-gradient and 7 down-gradient) to form the point-of-compliance boundary for the existing facility.

4.2.2. Expansion Area (Unit 2)

The proposed groundwater monitoring network for the expansion area (Unit 2) will be composed of two up-gradient and 12 down-gradient for a total of 14 groundwater monitoring

DRAWINGS

Drawing 5-1	Proposed Groundwater Monitoring Network
Drawing 5-1A	Proposed Groundwater Monitoring Network with Pre-Landfill Development Topography
Drawing 5-1B	Proposed Spacing of Point-of-Compliance Wells
Drawing 5-2	Groundwater Monitoring Well Construction Detail



LEGEND

650	EXISTING GROUND ELEVATION (FT, MSL)
	EXISTING WATER LINE
	EXISTING SITE FENCE
	EXISTING TREE LINE
	EXISTING ROAD
	EXISTING BUILDING
	PROPOSED LIMIT OF WASTE
	PHASE BOUNDARY
I	PHASE DESIGNATION
	PROPERTY BOUNDARY (NOTE 4)
N 13,674,000 E 2,080,000	STATE PLANE COORDINATES
A 20	SITE GRID
	SITE ACCESS ROAD
MW-7	GROUNDWATER MONITORING WELL (NOTE 5)
GP-1	GAS MONITORING PROBE
	POINT OF COMPLIANCE

NOTES:

1. THE EXISTING CONTOUR MAP SHOWN ON THIS DRAWING WAS COMPILED USING PHOTOGRAMMETRIC METHODS BASED ON AERIAL PHOTOGRAPHY PERFORMED ON 08 MARCH 2005 BY SURVEYING AND MAPPING, INC. OF AUSTIN, TEXAS.
2. ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL (FT, MSL) AS DEFINED BY THE USGS NATIONAL GEODETIC VERTICAL DATUM (NGVD) OF 1929. STATE PLANE COORDINATE GRID CORRESPONDS TO TEXAS COORDINATE SYSTEM, SOUTH CENTRAL ZONE, NORTH AMERICAN DATUM (NAD) 1983.
3. PROPERTY BOUNDARY AND EASEMENT INFORMATION PROVIDED BY SURVEYING AND MAPPING INC., AUSTIN, TEXAS, DATED 23 MAY 2005.
4. PERMIT BOUNDARY AND PROPERTY BOUNDARY COINCIDE.
5. SEE PART III, ATTACHMENT 5, TABLE 5-1 FOR MONITORING WELL COORDINATES, DEPTHS, SCREENED INTERVALS AND OTHER DATA, IDENTIFICATION OF WHICH WELLS EXIST, IDENTIFICATION OF WHICH WELLS ARE PROPOSED, AND THE SCHEDULE FOR INSTALLATION OR PLUGGING AND ABANDONING AS APPROPRIATE.

OVERVIEW OF GROUNDWATER MONITORING WELL NETWORK (SEE NOTE 5)

GROUNDWATER MONITORING WELL I.D.	STATUS (AT TIME OF PERMIT MODIFICATION REQUEST)
MW-1	ALREADY INSTALLED
MW-2A	ALREADY INSTALLED
MW-3	ALREADY INSTALLED
MW-4	ALREADY INSTALLED
MW-5	PLUGGED AND ABANDONED
MW-6	ALREADY INSTALLED
MW-7A	ALREADY INSTALLED
MW-8A	ALREADY INSTALLED
MW-9	ALREADY INSTALLED
MW-10	TO BE INSTALLED
MW-11	ALREADY INSTALLED
MW-12	ALREADY INSTALLED (USE EXISTING GB-21)
MW-13	TO BE INSTALLED
MW-14	TO BE INSTALLED
MW-15	TO BE INSTALLED
MW-16	ALREADY INSTALLED (USE EXISTING GB-15)
MW-17	TO BE INSTALLED
MW-18	ALREADY INSTALLED
MW-19	ALREADY INSTALLED
MW-20	ALREADY INSTALLED
MW-21	ALREADY INSTALLED
MW-22	ALREADY INSTALLED
MW-23	ALREADY INSTALLED

MARK	DATE	REVISION	BY	APPROVED
△1	02/24/2021	ELIMINATE UNIT 3	JJV	MW
–	07/14/2006	TECHNICALLY COMPLETE	SMG	JLRM
–	05/15/2006	RESPONSE TO NOD 2	SMG	JLRM
–	03/28/2006	RESPONSE TO NOD 1	SMG	JLRM
–	11/18/2005	INITIAL SUBMITTAL TO TCEQ	–	–

OWNER / SITE ADDRESS:

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WASTE MANAGEMENT OF TEXAS, INC.
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Geosyntec consultants
GEOSYNTEC CONSULTANTS, INC.
TEXAS PROF. GEOSCIENTISTS
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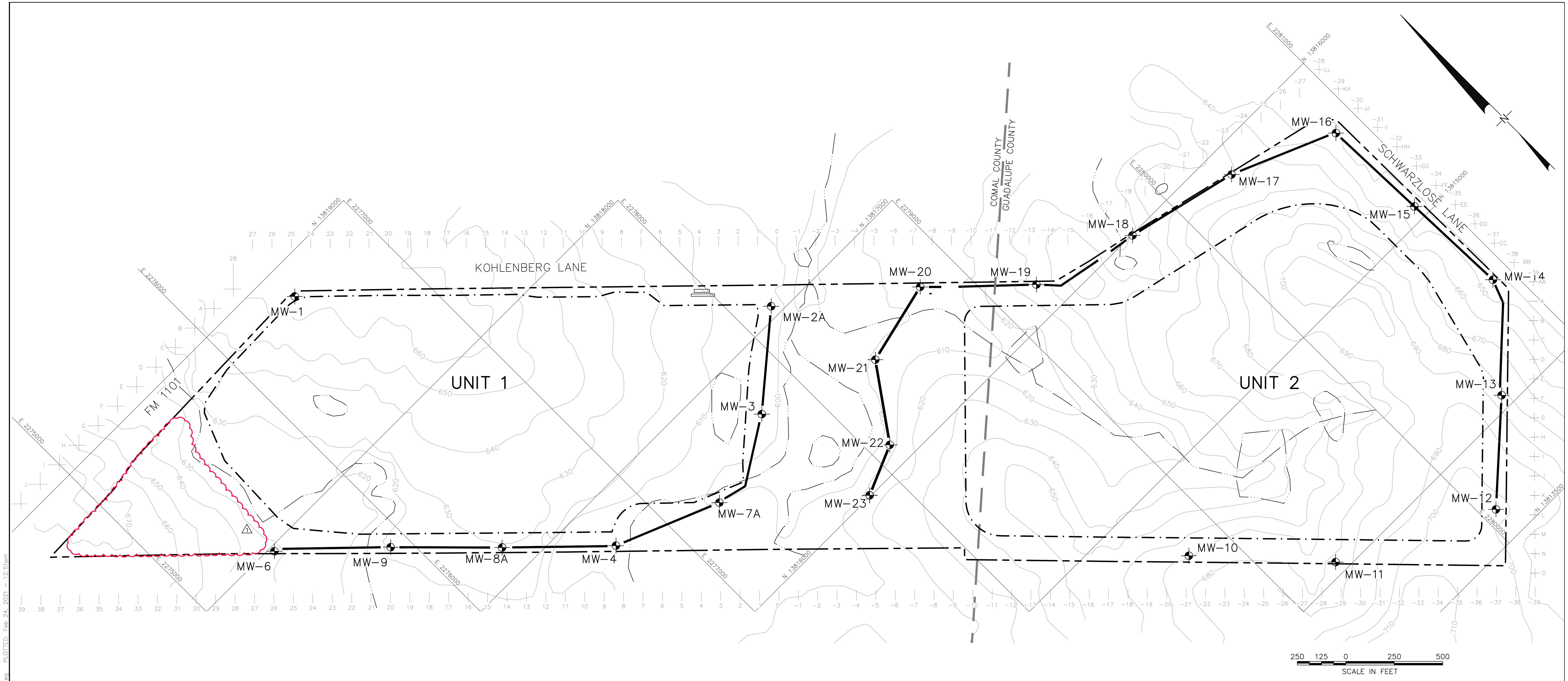
AUSTIN, TEXAS 78757
(512) 451-4003

PROJECT:
MESQUITE CREEK LANDFILL
PERMIT APPLICATION – PERMIT NO. MSW – 66 B

TITLE:
PROPOSED GROUNDWATER MONITORING NETWORK

PROJECT NO.: GT3435-03
FILE NO.: 3435-058
DRAWN BY: JJV
CHECKED BY: SMG
REVIEWED BY: BAG
APPROVED BY: JLRM
PART NO. III
FIGURE NO: 5-1

DRAWING: P:\CADD\Projects\M\Mesquite Creek Landfill\Permit\Mod Elim Unit 3 (GW7663)\DRAWINGS\3435-058.dwg PLOTTED: Feb 24, 2021 – 12:57pm



LEGEND

650	PRE–LANDFILL GROUND ELEVATION (FT, MSL)
	EXISTING WATERLINE
	PROPOSED LIMIT OF WASTE
	PROPERTY BOUNDARY (NOTE 4)
N 13,674,000 E 2,080,000	STATE PLANE COORDINATES
A 20	SITE GRID
MW–7	GROUNDWATER MONITORING WELL (NOTE 5)
	POINT OF COMPLIANCE

NOTES:

1. THE EXISTING CONTOUR MAP SHOWN ON THIS DRAWING REPRESENTS PRE–LANDFILL TOPOGRAPHY, AND WAS COMPILED USING PHOTOGRAMMETRIC METHODS BASED ON AERIAL PHOTOGRAPHY PERFORMED ON 08 MARCH 2005 BY SURVEYING AND MAPPING, INC. OF AUSTIN, TEXAS WITH THE EXCEPTION OF CONTOURS WITHIN UNIT 1 WHICH WERE TAKEN FROM THE USGS NEW BRAUNFELS EAST QUADRANGLE MAP.
2. ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL (FT, MSL) AS DEFINED BY THE USGS NATIONAL GEODETIC VERTICAL DATUM (NGVD) OF 1929. STATE PLANE COORDINATE GRID CORRESPONDS TO TEXAS COORDINATE SYSTEM, SOUTH CENTRAL ZONE, NORTH AMERICAN DATUM (NAD) 1983.
3. PROPERTY BOUNDARY AND EASEMENT INFORMATION PROVIDED BY SURVEYING AND MAPPING INC., AUSTIN, TEXAS, DATED 23 MAY 2005.
4. PERMIT BOUNDARY AND PROPERTY BOUNDARY COINCIDE.
5. SEE PART III, ATTACHMENT 5, TABLE 5–1 FOR MONITORING WELL COORDINATES, DEPTHS, SCREENED INTERVALS AND OTHER DATA, IDENTIFICATION OF WHICH WELLS EXIST, IDENTIFICATION OF WHICH WELLS ARE PROPOSED, AND THE SCHEDULE FOR INSTALLATION OR PLUGGING AND ABANDONING AS APPROPRIATE.

MARK	DATE	REVISION	BY	APPROVED
1	02/24/2021	ELIMINATE UNIT 3	JJV	MW
–	07/14/2006	TECHNICALLY COMPLETE	JLRM	JLRM
–	05/15/2006	RESPONSE TO NOD 2	JLRM	JLRM
–	03/28/2006	RESPONSE TO NOD 1	JLRM	JLRM

OWNER / SITE ADDRESS:

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SUITE 200
AUSTIN, TEXAS 78757
(512) 451–4003

PROJECT:

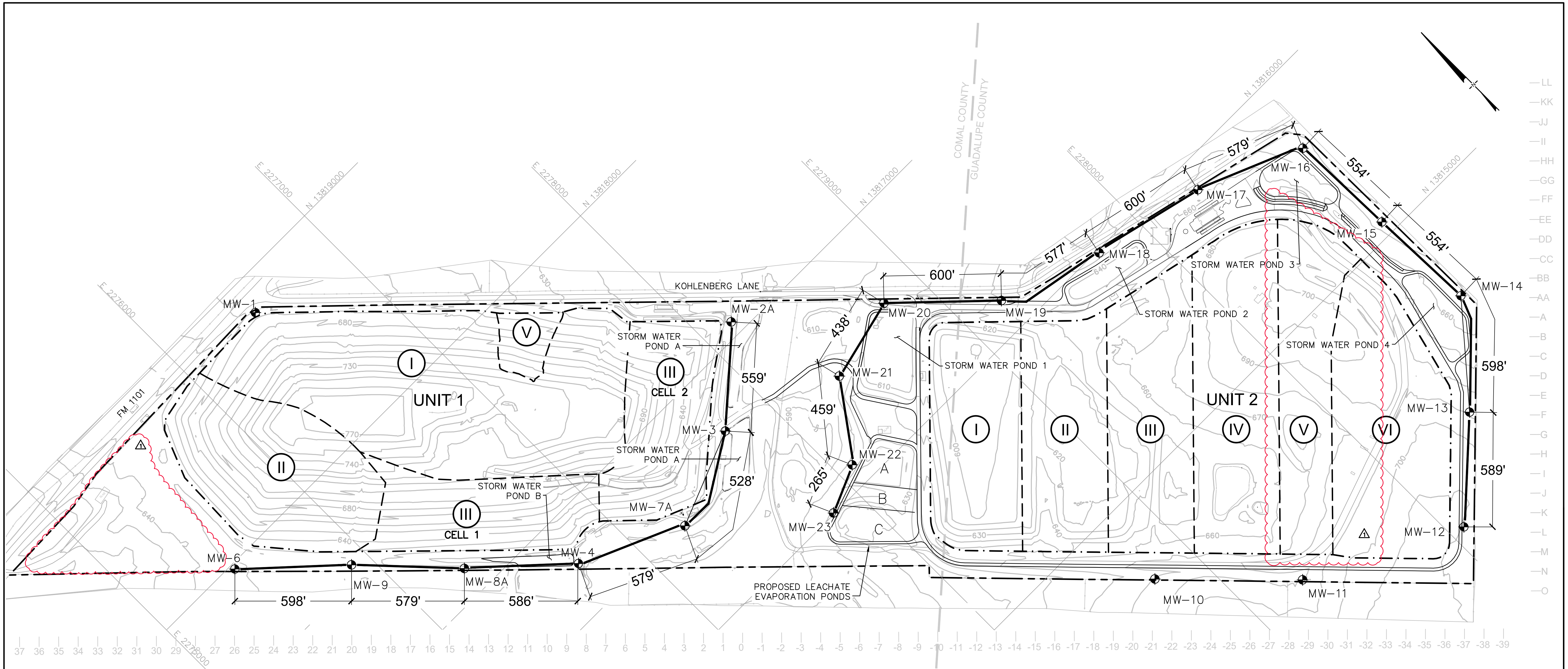
MESQUITE CREEK LANDFILL
PERMIT APPLICATION – PERMIT NO. MSW – 66 B

TITLE:

PROPOSED GROUNDWATER MONITORING NETWORK WITH PRE–LANDFILL DEVELOPMENT TOPOGRAPHY

PROJECT NO.: GT3534–03	DRAWN BY: JJV	REVIEWED BY: BAG	PART NO.	FIGURE NO:
FILE NO.: 3435–065	CHECKED BY: SMG	APPROVED BY: JLRM	III	5–1A

DRAWING: P:\CADD\Projects\M\Mesquite Creek Landfill\Permit\Mod Elim Unit 3 (GW7663)\DRAWINGS\3435–065.dwg PLOTTED: Feb 24, 2021 – 12:51pm



LEGEND

650	EXISTING GROUND ELEVATION (FT, MSL)
—x—x—x—	EXISTING SITE FENCE
═══	EXISTING ROAD
▭	EXISTING BUILDING
— · — · —	PROPOSED LIMIT OF WASTE
— — — —	PHASE BOUNDARY
Ⓘ	PHASE DESIGNATION
—— – – ——	PROPERTY BOUNDARY (NOTE 4)
N 13,674,000 E 2,080,000	STATE PLANE COORDINATES
A 20	SITE GRID
═══	SITE ACCESS ROAD
⊕MW-4	GROUNDWATER MONITORING WELL (NOTE 5)
━━━	POINT OF COMPLIANCE

NOTES:

1. THE EXISTING CONTOUR MAP SHOWN ON THIS DRAWING WAS COMPILED USING PHOTOGRAMMETRIC METHODS BASED ON AERIAL PHOTOGRAPHY PERFORMED ON 06 FEBRUARY 2009 BY SURVEYING AND MAPPING, INC. OF AUSTIN, TEXAS.
2. ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL (FT, MSL) AS DEFINED BY THE USGS NATIONAL GEODETIC VERTICAL DATUM (NGVD) OF 1929. STATE PLANE COORDINATE GRID CORRESPONDS TO TEXAS COORDINATE SYSTEM, SOUTH CENTRAL ZONE, NORTH AMERICAN DATUM (NAD) 1983.
3. PROPERTY BOUNDARY AND EASEMENT INFORMATION PROVIDED BY SURVEYING AND MAPPING INC., AUSTIN, TEXAS, DATED 23 MAY 2005.
4. PERMIT BOUNDARY AND PROPERTY BOUNDARY COINCIDE.
5. SEE PART III, ATTACHMENT 5, TABLE 5–1 FOR APPROXIMATE MONITORING WELL COORDINATES, DEPTHS, SCREENED INTERVALS AND OTHER DATA, IDENTIFICATION OF WHICH WELLS EXIST, IDENTIFICATION OF WHICH WELLS ARE PROPOSED, AND THE SCHEDULE FOR INSTALLATION OR PLUGGING AND ABANDONING AS APPROPRIATE.

0 250' 500'
SCALE IN FEET

REV	DATE	DESCRIPTION	DRN	APP
1	2/24/2021	ELIMINATE UNIT 3	JJV	MW
–	2/11/2010	ADDED DRAWING	JJV	EBD

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TEXAS PROF. GEOSCIENTISTS FIRM
REGISTRATION NO. 50256
8217 SHOAL CREEK BLVD., SUITE 200
AUSTIN, TEXAS 78757
PHONE: 512.451.4003

TITLE:
PROPOSED SPACING OF POINT–OF–COMPLIANCE WELLS

PROJECT:
MESQUITE CREEK LANDFILL
PERMIT APPLICATION – PERMIT NO. MSW – 66 B

PROJECT NO.: GW7663	DESIGN BY: SMG	REVIEWED BY: SMG	PART NO.: III	DRAWING NO.: 5–1B
FILE: 008702P01	DRAWN BY: JJV	APPROVED BY: EBD		

DRAWING: Austin P:\CADD\Projects\M\Mesquite Creek Landfill\Permit\Mod Elim Unit 3 (GW7663)\DRAWINGS\008702P01.dwg PLOTTED: Feb 24, 2021 – 12:50pm

Prepared for Applicant:
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PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN
ATTACHMENT 6

GROUNDWATER AND SURFACE WATER PROTECTION PLAN AND DRAINAGE PLAN

MESQUITE CREEK LANDFILL
NEW BRAUNFELS,
COMAL AND GUADALUPE COUNTIES, TEXAS
MSW PERMIT NO. 66B

Prepared by:
Geosyntec consultants

~~GeoSyntec Consultants~~
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Initial Application Submittal – 18 November 2005

Response to NOD 1 – 28 March 2006
Technically Complete – 14 July 2006
Revised – 11 February 2010, 24 February 2021

TABLE OF CONTENTS (CONTINUED)

ATTACHMENTS

The permitted acreage will be increased from 96.07 acres to 244.12 acres by incorporating approximately 148.05 acres of additional property located south of the currently permitted area. Approximately 84.9 acres will be designated for disposal in the expansion area, resulting in a total area of 157.2~~63.5~~ acres designated for waste disposal at the facility, with the remaining acreage to be used for buffer zones, perimeter access roads, scales, office buildings, leachate storage, stormwater management features, miscellaneous equipment/supplies storage areas, and soil stockpiles.

1.4 Natural Conditions Topography and Drainage Patterns

The facility is located at the southwest intersection of Farm-to-Market Road (FM) 1101 and Kohlenberg Lane, approximately 5 miles north of the intersection of State Highway 46 and FM 1101. The site is approximately two miles east of the I-35 Kohlenberg Road exit, north of the city of New Braunfels. Mesquite Creek flows east-northeast along the southern boundary of the current facility. The proposed expansion area is south of the current facility, therefore Mesquite Creek will flow across the middle of the proposed facility area. After leaving the site, Mesquite Creek flows approximately 0.3 mile before entering Freedom Lake, an impoundment located on adjacent land also owned by WMTX. After discharging from Freedom Lake, water in Mesquite Creek flows approximately 2.3 miles before entering York Creek. The York Creek watershed encompasses about 140 square miles and is a part of the 6,070-square mile Guadalupe River Basin.

The topography of the natural conditions of the site, herein defined as conditions of the land prior to any landfill development, generally is dominated by a broad valley trending southwest-northeast. The natural ground elevations of the site range from approximately 585 ft, MSL at the point where Mesquite Creek exits the site to 712 ft, MSL near the southern corner of the site. The surface slopes range from 0.039 ft/ft to 0.095 ft/ft in varying directions across the site. Per 30 TAC §330.56(c), Drawing 3-1 in Attachment 3 to the Site Development Plan (SDP) presents the natural conditions on a USGS topographic map that shows pre-landfill natural topography, with drainage areas delineated. As shown on Drawing 3-1, the entire site drains clean runoff to Mesquite Creek or tributaries of Mesquite Creek. A total of five locations, designated Points A through E, are utilized to represent discharge locations from the property. Hydrologic analysis of the natural conditions of the site is provided in Appendix 6A-5 of Attachment 6A to this Storm Water Plan.

1.5 Predevelopment Condition Topography and Drainage Patterns

The current permit for the facility (Permit No. MSW-66A) includes a surface water management system design which incorporates drainage terraces, benches, downchute channels, and perimeter channels to manage runoff from the final configuration of the landfill. As prescribed in the TCEQ Regulatory Guidance Document RG-417, "*Guidelines for Preparing a Surface Water Drainage Plan for a Municipal Solid Waste Facility*", the pre-development peak flows and volumes should be compared to the proposed post-development peak flows and volumes to show that development of the facility does not adversely alter natural drainage conditions.

~~Even though the landfill layout and grading plans for the currently permitted facility (Units 1 and 3) were not changed by this permit amendment, t~~The currently permitted surface water management system design was modeled to determine runoff volumes and discharge rates to each of the discharge locations, and confirm adequate function. The currently permitted surface water management system with drainage areas delineated is shown on Drawing 6-2 included with this Storm Water Plan. Hydrologic analysis of the predevelopment conditions of the site is provided in Appendix 6A-6 of Attachment 6A to this Storm Water Plan. Hydraulic analysis of the drainage benches and perimeter channels are provided in Attachments 6C and 6E, respectively.

1.6 Floodplain and Floodway Information

As described and documented in Parts I/II, Section 7 of this permit amendment application, the waste disposal limits of the facility are located outside the 100-yr floodplain (Figure I/II-13) based on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Community Panel Number 4854630130C (1986). The expansion site and the majority of the existing facility are located in an area of minimal flooding. The central portion of the site, where Mesquite Creek flows, is within the flood pool of the downstream Freedom Lake. According to information obtained from the York Creek Watershed Management District, Freedom Lake has a spillway elevation of 603.1 ft, MSL, and the flood pool elevation at the site is 605.1 ft, MSL. The existing landfill waste disposal limits do not extend into this flood pool. Neither the waste disposal areas, nor any perimeter roads/berm or leachate evaporation pond areas of the proposed expansion will extend into this flood pool. Two storm water ponds, one existing and one part of the proposed expansion area, are partially within the upper elevations of this flood pool; however, they are designed to allow backflow into the ponds during a flood event through their principal spillway pipes, thus not changing the flood storage capacity of Freedom Lake. The proposed storm water pond embankment is not expected to restrict the flow capacity or increase

2. SITE DEVELOPMENT

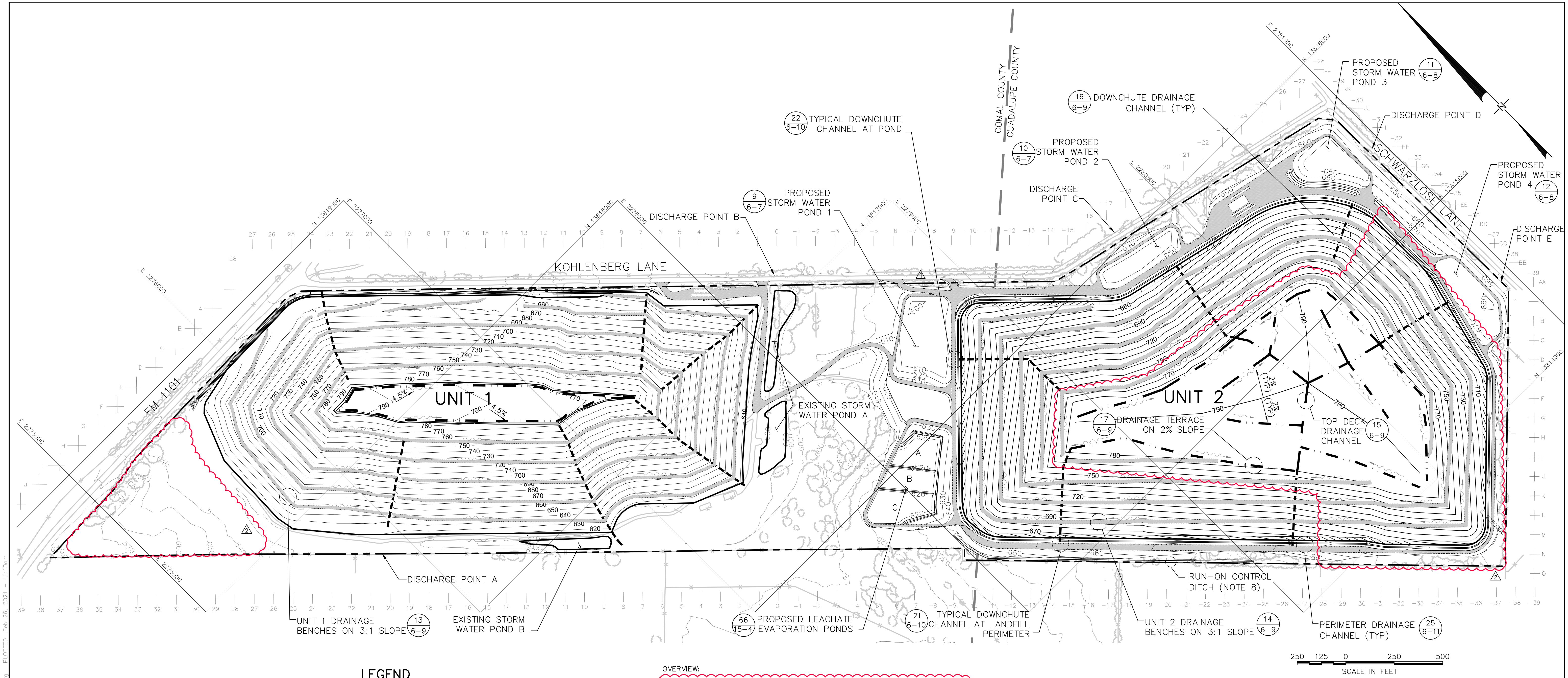
2.1 General

The facility is designed to operate as a modified area fill landfill, with above and below grade filling. The general sequence of anticipated landfill operation, base grades, and final cover grades are indicated on Drawings 1-1 through 1-3 in Attachment 1 to the SDP. As described below, certain permanent components of the surface water management system will be constructed during initial development of a cell, while other components will be installed as portions of the landfill reach final grade.

As shown on Drawing 6-1 in this Storm Water Plan, the final configuration of the landfill units will have 3 horizontal to 1 vertical (3H:1V) sideslopes between drainage benches. Drainage benches will be built in to the sideslopes at 30-ft (max.) vertical intervals, resulting in an average cover sideslope inclination of approximately 3.5H:1V. At the crest of the sideslopes, the final cover grades then continue up at a shallower top-deck grade of 4-5% up to a peak or ridgeline elevation. In this Storm Water Plan, final cover slope areas with grades of five percent or less are designated as top deck areas, and final cover slopes with grades of 3H:1V between drainage benches are designated as sideslope areas. The total post-development footprint of the landfill units occupies approximately 157.2~~63.5~~ acres of the 244.12-acre facility, or about 64~~7~~ percent of the total property area.

It is noted that the pre-development condition (Permit No. 66A, as shown on Drawing 6-2) contains Unit 3. At the time of the initial permit amendment (Permit No. 66B), Unit 3 was retained as a future permitted landfill unit and therefore part of the post-development condition, with no changes made (see Drawing 6-3). However, the facility no longer plans to construct Unit 3 (see Drawing 6-1) and it is proposed to be eliminated from the permit, along with making minor changes to the Unit 2 grades to compensate for the lost airspace through a permit modification that includes the February 2021 revisions being made to this document. The changes to the Unit 2 final cover grades are minor, and thus, do not materially change the post-development drainage patterns and stormwater management system design as explained, analyzed, and demonstrated in Attachment 6J. Therefore, the analyses and discussion presented in the remainder of this Storm Water Plan and in Attachments 6A through 6I have not been updated to reflect the very minor adjustments to the Unit 2 final cover grades, nor the removal of Unit 3. Instead, the newly added Attachment 6J serves as a stand-alone demonstration of the adequacy of the stormwater management system under the slightly revised conditions.

DRAWINGS



LEGEND

810	EXISTING GROUND ELEVATION (FT, MSL)
	EXISTING FENCE
	EXISTING ROAD
	EXISTING TREELINE
650	PROPOSED FINAL ELEVATION (FT, MSL)
	PROPOSED PERIMETER ACCESS ROAD
	PROPERTY BOUNDARY (NOTE 4)
	DRAINAGE DOWNCHUTES
	DRAINAGE BENCHES WITH FLOW DIRECTION
	TOP DECK DRAINAGE CHANNEL OR DRAINAGE TERRACE
	LIMIT OF FINAL COVER
N 13,674,000 E 2,080,000	STATE PLANE COORDINATES
A 20	SITE GRID

OVERVIEW:

UNIT 1 WASTE FILLING IS IN PROGRESS. NO CHANGES ARE PROPOSED TO THE PERMITTED UNIT 1 FINAL COVER GRADES OR THE SURFACE WATER MANAGEMENT DESIGN. UNIT 2 (LATERAL EXPANSION AREA) IS PROPOSED. 2

NOTES:

1. THE EXISTING CONTOUR MAP SHOWN ON THIS DRAWING WAS COMPILED USING PHOTOGRAMMETRIC METHODS BASED ON AERIAL PHOTOGRAPHY PERFORMED ON 08 MARCH 2005 BY SURVEYING AND MAPPING, INC. OF AUSTIN, TEXAS.
2. ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL (FT, MSL) AS DEFINED BY THE USGS NATIONAL GEODETIC VERTICAL DATUM (NGVD) OF 1929. STATE PLANE COORDINATE GRID CORRESPONDS TO TEXAS COORDINATE SYSTEM, SOUTH CENTRAL ZONE, NORTH AMERICAN DATUM (NAD) 1983.
3. PROPERTY BOUNDARY PROVIDED BY SURVEYING AND MAPPING INC., AUSTIN, TEXAS, DATED 23 MAY 2005.
4. PERMIT BOUNDARY AND PROPERTY BOUNDARY COINCIDE.
5. INFORMATION ON SEDIMENT BASIN APPURTENANCES IS PROVIDED IN TABLE ON DRAWING 6-12.
6. PERIMETER DRAINAGE CHANNEL PARAMETERS ARE PROVIDED IN TABLE ON DRAWING NO. 6-11.
7. STORM WATER POND CONSTRUCTION SCHEDULE:
    PONDS A AND B – ALREADY CONSTRUCTED.
    POND 1–CONSTRUCT WHEN UNIT 2, PHASE I FILLING IS ABOVE–GRADE.
    POND 2–CONSTRUCT WHEN UNIT 2, PHASE II FILLING IS ABOVE–GRADE.
    POND 3–CONSTRUCT WHEN UNIT 2, PHASE IV FILLING IS ABOVE–GRADE.
    POND 4–CONSTRUCT WHEN UNIT 2, PHASE VI FILLING IS ABOVE–GRADE.
8. RUN–ON CONTROL DITCH SHALL BE LOCATED AT TOE OF SLOPE PERIMETER BERM, WITHIN PROPERTY BOUNDARY AS NEEDED, AND GRADED TO DRAIN. DITCH SHALL BE V–DITCH, 2–FT (MIN) DEEP, VEGETATED.

MARK	DATE	REVISION	BY	APPROVED
2	02/24/2021	ELIMINATE UNIT 3	JJV	SMG
1	08/08/2008	REVISED SITE ENTRANCE	SMG	SMG
–	07/14/2006	TECHNICALLY COMPLETE	SMG	SMG
–	03/28/2006	RESPONSE TO NOD 1	SMG	SMG
–	11/18/2005	INITIAL SUBMITTAL TO TCEQ	SMG	SMG

OWNER / SITE ADDRESS:

WASTE MANAGEMENT OF TEXAS, INC.
1000 KOHLENBERG LANE
P.O. BOX 311657
NEW BRAUNFELS, TEXAS 78130
(830) 685–7894

ENGINEER:

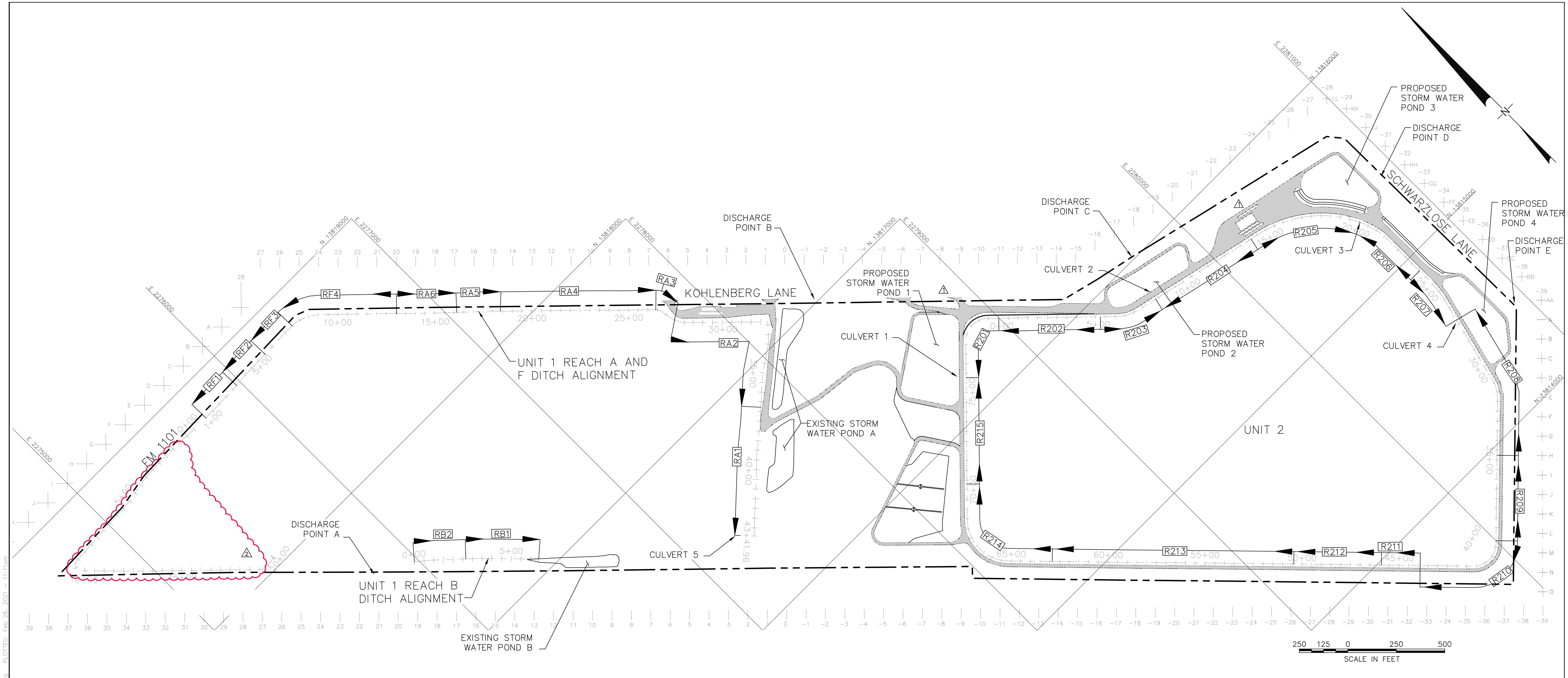
GEOSYNTEC CONSULTANTS, INC.
TEXAS ENG. FIRM REGISTRATION NO. 1182
8217 SHOAL CREEK BLVD., SUITE 200
AUSTIN, TEXAS 78757
(512) 451–4003

PROJECT:
MESQUITE CREEK LANDFILL
PERMIT APPLICATION – PERMIT NO. MSW – 66 B

TITLE:
SUFACE WATER MANAGEMENT PLAN

PROJECT NO.: GT3435–03	DRAWN BY: JJV	REVIEWED BY: BAG	PART NO.	FIGURE NO:
FILE NO.: 3435–057	CHECKED BY: SMG	APPROVED BY: SMG	III	6–1

DRAWING: P:\CADD\Projects\M\Mesquite Creek Landfill\Permit\Mod Elim Unit 3 (GW7663)\DRAWINGS\3435–057.dwg PLOTTED: Feb 26, 2021 – 11:10am



LEGEND

— — —	PROPERTY BOUNDARY (NOTE 2)
▬	PROPOSED PERIMETER ROAD/POND BERM
→ R1 →	CHANNEL REACH DESIGNATION AND FLOW DIRECTION
1+00	PERIMETER DRAINAGE CHANNEL CENTERLINE ALIGNMENT AND STATIONING
N 13,674,000 E 2,080,000	STATE PLANE COORDINATES
A 20	SITE GRID

NOTES:

1. PROPERTY BOUNDARY PROVIDED BY SURVEYING AND MAPPING INC., AUSTIN, TEXAS, DATED 23 MAY 2005.
2. PERMIT BOUNDARY AND PROPERTY BOUNDARY COINCIDE.
3. SEE DRAWING 1–2 FOR PROPOSED BASE GRADING PLAN.
4. SEE DRAWING 1–3 FOR PROPOSED FINAL COVER GRADING PLAN.
5. SEE ATTACHMENT 6E FOR PERIMETER DRAINAGE CHANNEL DESIGN, AND ATTACHMENT 6D FOR CULVERT DESIGN.

MARK	DATE	REVISION	BY	APPROVED
2	02/24/2021	ELIMINATE UNIT 3	JJV	SMG
1	08/08/2008	REVISED SITE ENTRANCE	SMG	SMG
–	07/14/2006	TECHNICALLY COMPLETE	SMG	SMG
–	03/28/2006	RESPONSE TO NOD 1	SMG	SMG
–	11/18/2005	INITIAL SUBMITTAL TO TCEQ	SMG	SMG

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AUSTIN, TEXAS 78757
(512) 451–4003

PROJECT:

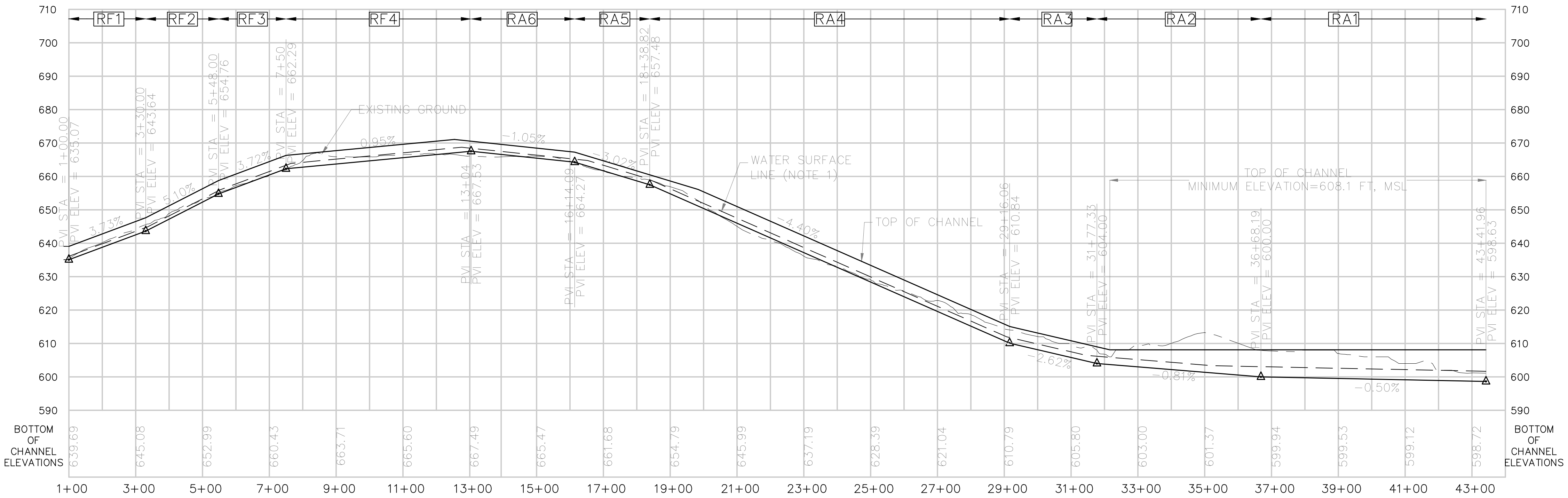
MESQUITE CREEK LANDFILL
PERMIT APPLICATION – PERMIT NO. MSW – 66 B

TITLE:

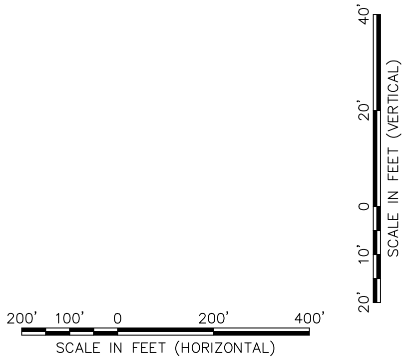
PERIMETER DRAINAGE CHANNELS PLAN WITH STATIONING

PROJECT NO.: GT3435–03	DRAWN BY: JJV	REVIEWED BY: BAG	PART NO. III	FIGURE NO: 6–4
FILE NO.: 3435–026	CHECKED BY: SMG	APPROVED BY: SMG		

DRAWING: P:\CADD\Projects\M\Mesquite Creek Landfill\Permit\Mod Elim Unit 3 (GW7663)\DRAWINGS\3435-026.dwg PLOTTED: Feb 26, 2021 – 11:11am



UNIT 1 REACH A AND F PERIMETER DRAINAGE
CHANNEL PROFILE STATION 1+00 TO STATION 43+41.96

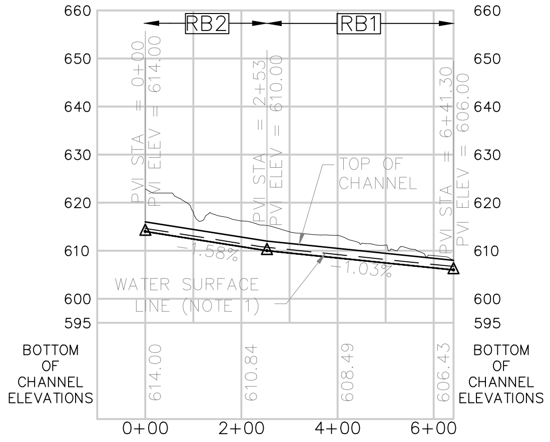


NOTES:

1. WATER LINES REPRESENT THE 25–YEAR, 24–HOUR NORMAL DEPTH OF FLOW.
2. SEE DRAWING 6–11 FOR TABLE OF PERIMETER DRAINAGE CHANNEL DESIGNATIONS, DIMENSIONS (WIDTH, DEPTH), AND CHANNEL LINING TYPE. SEE ATTACHMENT 6E FOR PERIMETER CHANNEL SIZING DESIGN.

NOTE: UNIT 3
ELIMINATED IN
2021

UNIT 3 PERIMETER DRAINAGE CHANNEL PROFILE
STATION 0+00 TO STATION 20+02.32



UNIT 1 REACH B PERIMETER DRAINAGE CHANNEL
PROFILE STATION 0+00 TO STATION 6+41.30

MARK	DATE	REVISION	BY	APPROVED
1	02/24/2021	ELIMINATE UNIT 3	JJV	SMG
–	07/14/2006	TECHNICALLY COMPLETE	SMG	SMG
–	03/28/2006	RESPONSE TO NOD 1	SMG	SMG
–	11/18/2005	INITIAL SUBMITTAL TO TCEQ	SMG	SMG

OWNER / SITE ADDRESS:

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ENGINEER:

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8217 SHOAL CREEK BLVD.,
SUITE 200
AUSTIN, TEXAS 78757
(512) 451–4003

PROJECT:
MESQUITE CREEK LANDFILL
PERMIT APPLICATION – PERMIT NO. MSW – 66 B

TITLE:
UNIT 1 AND UNIT 3 PERIMETER
DRAINAGE CHANNEL PROFILES

PROJECT NO.: GT3435–03	DRAWN BY: JJV	REVIEWED BY: BAG	PART NO.	FIGURE NO:
FILE NO.: 3435–028	CHECKED BY: MCC	APPROVED BY: SMG	III	6–5

DRAWING: P:\CADD\Projects\M\Mesquite Creek Landfill\Permit\Mod Elim Unit 3 (GW7663)\DRAWINGS\3435–028.dwg PLOTTED: Feb 26, 2021 – 11:11am

PERIMETER DRAINAGE CHANNEL SCHEDULE–UNIT 1

CHANNEL SEGMENT	CHANNEL SHAPE	CHANNEL SLOPE (%)	CHANNEL DIMENSIONS (MINIMUM)					25–YEAR	25–YEAR	25–YEAR		
			LENGTH (FT)	BOTTOM WIDTH (FT)	DEPTH (FT)	SIDE SLOPES	TOP WIDTH (FT)	PEAK FLOW (CFS)	PEAK DEPTH (FT)	PEAK VELOCITY (FT/S)	TRACTIVE STRESS (PSF)	LINING
RA1	TRAPEZOIDAL	0.5	673.77	8	4	0.33	32	243.84	3.05	4.65	0.95	TYPE 1
RA2	TRAPEZOIDAL	0.81	490.86	8	4	0.33	32	153.95	2.17	4.9	1.09	TYPE 2
RA3	TRAPEZOIDAL	2.62	261.27	4	3	0.33	22	112.02	1.71	7.15	2.8	TYPE 2
RA4	TRAPEZOIDAL	4.4	977.24	4	3	0.33	22	112.02	1.52	8.65	4.16	TYPE 2
RA5	TRAPEZOIDAL	3.02	224.73	4	3	0.33	22	112.02	1.66	7.53	3.12	TYPE 2
RA6	TRAPEZOIDAL	1.05	310.09	4	3	0.33	22	19.1	0.9	3.18	0.59	TYPE 1
RB1	TRAPEZOIDAL	1.04	383	8	2	0.10/0.25	36	26.9	0.73	2.81	0.47	TYPE 1
RB2	TRAPEZOIDAL	1.58	253	8	2	0.10/0.25	36	26.9	0.65	3.27	0.65	TYPE 1
RF1	TRAPEZOIDAL	3.73	230	4	4	0.33	28	48	1.04	6.48	2.42	TYPE 2
RF2	TRAPEZOIDAL	5.1	218	4	4	0.33	28	48	0.96	7.26	3.06	TYPE 2
RF3	TRAPEZOIDAL	3.72	202	4	4	0.33	28	48	1.04	6.48	2.42	TYPE 2
RF4	TRAPEZOIDAL	0.95	554	4	4	0.33	28	48	1.46	3.93	0.86	TYPE 1

LINING TYPE 1 IS NATIVE VEGETATION. LINING TYPE 2 IS TURF REINFORCEMENT MAT AND NATIVE VEGETATION HAVING AN ALLOWABLE TRACTIVE STRESS GREATER THAN THAT SHOWN. ALTERNATE LINING MATERIAL MAY BE SUBSTITUTED, GIVEN THAT IT HAS A MANNING'S COEFFICIENT LESS THAN OR EQUAL TO THAT ASSUMED IN THE CALCULATIONS AND HAS AN ALLOWABLE TRACTIVE STRESS GREATER THAN 1 PSF.

SEE DRAWING 6–4 FOR CHANNEL DESIGNATIONS

△1

PERIMETER DRAINAGE CHANNEL SCHEDULE–UNIT 2

CHANNEL SEGMENT	CHANNEL SHAPE	CHANNEL SLOPE (%)	CHANNEL DIMENSIONS (MINIMUM)					25–YEAR	25–YEAR	25–YEAR		
			LENGTH (FT)	BOTTOM WIDTH (FT)	DEPTH (FT)	SIDE SLOPES	TOP WIDTH (FT)	PEAK FLOW (CFS)	PEAK DEPTH (FT)	PEAK VELOCITY (FT/S)	TRACTIVE STRESS (PSF)	LINING
R201	TRAPEZOIDAL	2.21	493.62	5	3	0.25	29	15.93	0.59	3.66	0.81	TYPE 1
R202	TRAPEZOIDAL	5.5	523.65	5	3	0.25	29	15.99	0.46	5.05	1.59	TYPE 2
R203	TRAPEZOIDAL	1.8	316.35	5	3	0.25	29	7.99	0.43	2.77	0.48	TYPE 1
R204	TRAPEZOIDAL	3.72	581.2	5	3	0.25	29	105.15	1.35	7.49	3.13	TYPE 2
R205	TRAPEZOIDAL	0.5	578.8	5	3	0.25	29	20.98	1	2.33	0.31	TYPE 1
R206	TRAPEZOIDAL	1.83	393.36	5	3	0.25	29	7.98	0.43	2.78	0.49	TYPE 1
R207	TRAPEZOIDAL	1.02	315.15	5	3	0.25	29	7.98	0.5	2.27	0.32	TYPE 1
R208	TRAPEZOIDAL	5	746.3	5	3	0.25	29	23.9	0.59	5.51	1.84	TYPE 2
R209	TRAPEZOIDAL	2.3	440	5	3	0.25	29	23.96	0.73	4.18	1.04	TYPE 2
R210	TRAPEZOIDAL	1.14	450	5	3	0.25	29	19.95	0.79	3.09	0.56	TYPE 1
R211	TRAPEZOIDAL	4.29	200	5	3	0.25	29	19.92	0.56	4.94	1.49	TYPE 2
R212	TRAPEZOIDAL	5	452.01	5	3	0.25	29	19.87	0.53	5.21	1.67	TYPE 2
R213	TRAPEZOIDAL	1.6	1245.34	5	3	0.25	29	99.4	1.61	5.41	1.61	TYPE 2
R214	TRAPEZOIDAL	2.6	720.02	5	3	0.25	29	174.59	1.87	7.5	3.03	TYPE 2
R215	TRAPEZOIDAL	4.95	548.06	5	3	0.25	29	174.25	1.61	9.5	4.96	TYPE 2

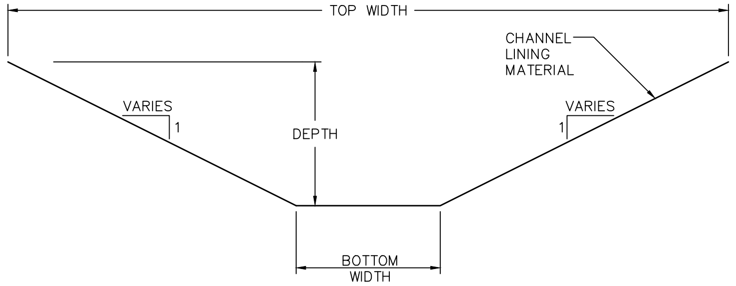
LINING TYPE 1 IS NATIVE VEGETATION. LINING TYPE 2 IS TURF REINFORCEMENT MAT AND NATIVE VEGETATION HAVING AN ALLOWABLE TRACTIVE STRESS GREATER THAN THAT SHOWN. ALTERNATE LINING MATERIAL MAY BE SUBSTITUTED, GIVEN THAT IT HAS A MANNING'S COEFFICIENT LESS THAN OR EQUAL TO THAT ASSUMED IN THE CALCULATIONS AND HAS AN ALLOWABLE TRACTIVE STRESS GREATER THAN 1 PSF.

SEE DRAWING 6–4 FOR CHANNEL DESIGNATIONS

SUMMARY OF CULVERT DESIGN PARAMETERS

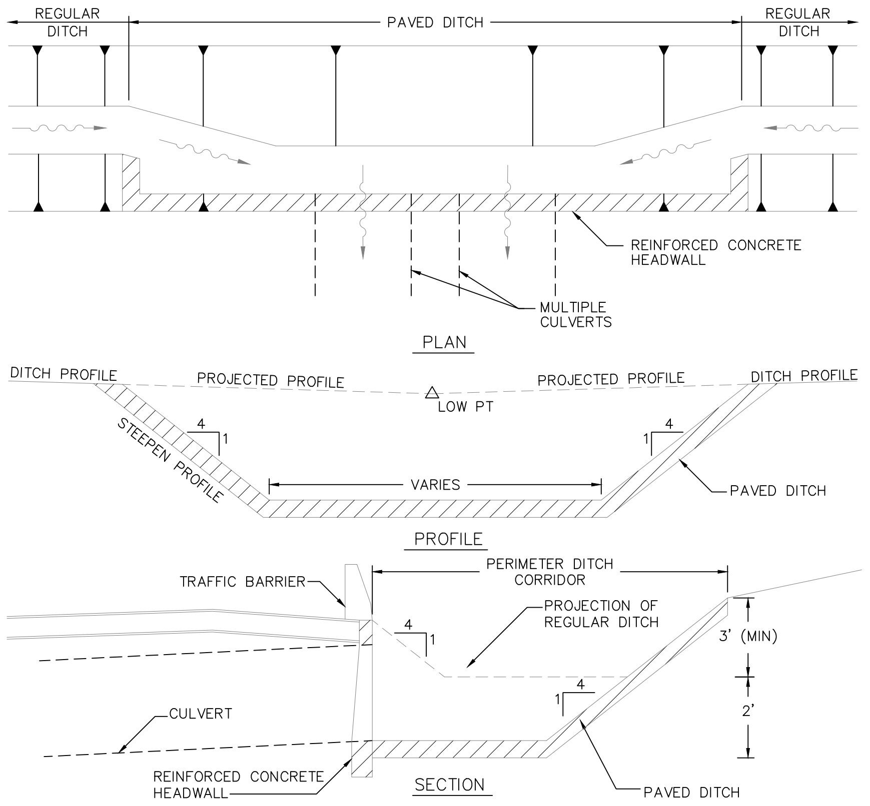
CULVERT	25–YR PEAK FLOW (CFS)	CONTRIBUTING REACHES	APPROX. LENGTH (FT)	SLOPE (%)	DESCRIPTION
1	282	R201, R215	40	1.5	2 – 42" PIPES
2	122	R203, R204	55	0.6	2 – 36" PIPES
3	70	R205, R206	100	0.8	2 – 30" PIPES
4	116	R207, R208	40	0.6	2 – 36" PIPES
5	270	J–A	100	0.5	3 – 42" PIPES WITH FLAPGATE

SEE DRAWING 6–4 FOR CULVERT DESIGNATIONS



25
2–5
DETAIL
PERIMETER CHANNEL
XREF: 3435x135
(SEE ATTACHED PERIMETER CHANNEL SCHEDULE)

0 2 4
SCALE IN FEET



26
6–7
DETAIL
DRAINAGE CULVERT INLET AT LANDFILL PERIMETER
SCALE: NTS
XREF: 3435x134

△1	02/24/2021	ELIMINATE UNIT 3	JJV	SMG
–	07/14/2006	TECHNICALLY COMPLETE	SMG	SMG
–	03/28/2006	RESPONSE TO NOD 1	SMG	SMG
–	11/18/2005	INITIAL SUBMITTAL TO TCEQ	SMG	SMG
MARK	DATE	REVISION	BY	APPROVED

OWNER / SITE ADDRESS:

WASTE MANAGEMENT

WASTE MANAGEMENT OF TEXAS, INC.
1000 KOHLENBERG LANE
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ENGINEER:

Geosyntec consultants

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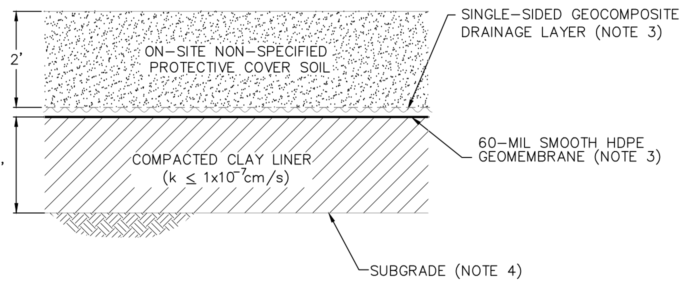
NO. 1182
8217 SHOAL CREEK BLVD.,
SUITE 200
AUSTIN, TEXAS 78757
(512) 451–4003

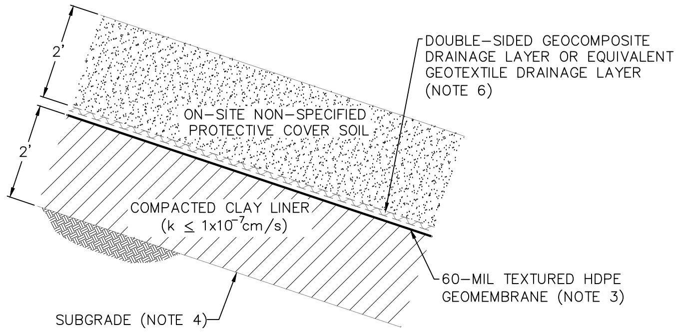
PROJECT:
MESQUITE CREEK LANDFILL
PERMIT APPLICATION – PERMIT NO. MSW – 66 B

TITLE:
SURFACE WATER MANAGEMENT SYSTEM
DETAILS III

PROJECT NO.: GT3435–03
FILE NO.: 3435–033
DRAWN BY: JJV
CHECKED BY: MCC
REVIEWED BY: BAG
APPROVED BY: SMG
PART NO. III
FIGURE NO: 6–11



37
2-2
DETAIL
STANDARD FLOOR LINER SYSTEM (2% ≤ SLOPES < 6%)
XREF: 3435x119.DWG
0 2 4
SCALE IN FEET

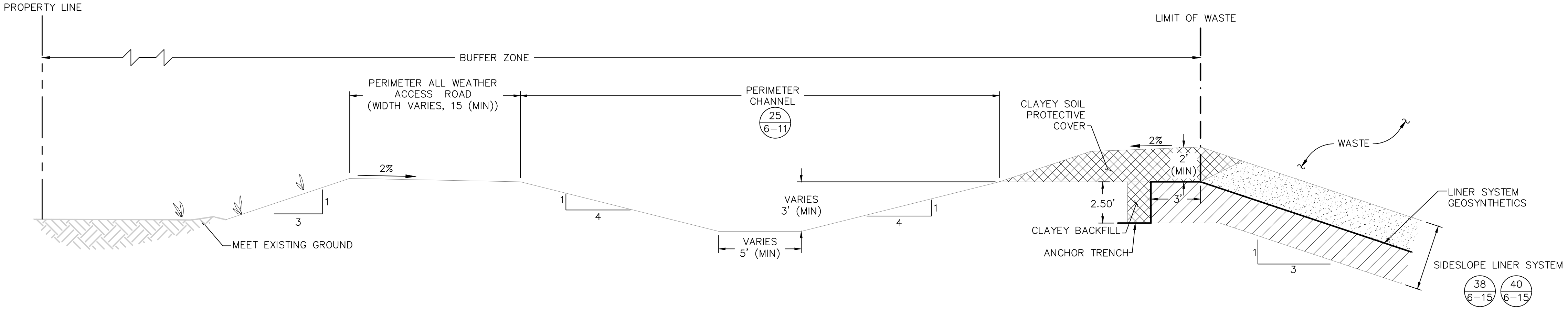


38
2-2
DETAIL
STANDARD SIDESLOPE LINER SYSTEM (6% ≤ SLOPES ≤ 33.3%)
XREF: 3435x119.DWG
0 2 4
SCALE IN FEET

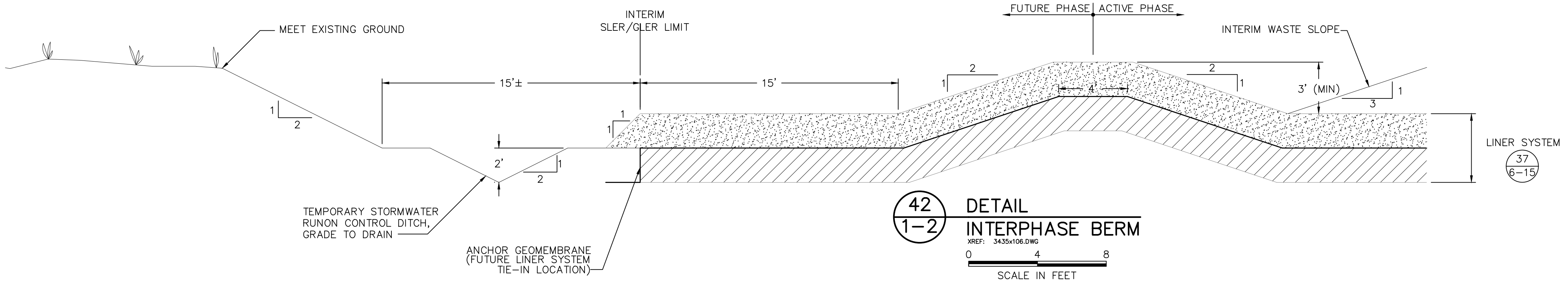
39
--
DETAIL
NOT USED

40
--
DETAIL
NOT USED

1



41
–
DETAIL
TYPICAL LINER AT LANDFILL PERIMETER UNIT 2
XREF: 3435x105.DWG
0 4 8
SCALE IN FEET



42
1-2
DETAIL
INTERPHASE BERM
XREF: 3435x106.DWG
0 4 8
SCALE IN FEET

NOTES:

1. DETAILS ARE SHOWN TO SCALE AS NOTED EXCEPT FOR GEOSYNTHETICS, WHICH ARE SHOWN AT AN EXAGGERATED SCALE FOR CLARITY. MATERIAL THICKNESS ARE MINIMUMS, AND TOLERANCES SHALL BE WITHIN THE LIMITS GIVEN IN THE SOILS AND LINER QUALITY CONTROL PLAN (SLQCP) (PART III, ATTACHMENT 10).
2. ALL LINED AREAS OF UNIT 1 ARE ALREADY CONSTRUCTED, AND WASTE FILLING IS IN PROGRESS. DETAILS SHOWN ARE APPLICABLE TO FUTURE LINER CONSTRUCTION (I.E., UNIT 2). 1
3. SMOOTH OR TEXTURED 60-mil THICK GEOMEMBRANE MAY BE USED ON SLOPES THAT ARE LESS THAN 6% (FLOOR). TEXTURED (BOTH SIDES) 60-mil THICK HDPE GEOMEMBRANE LINER SHALL BE USED ON SLOPES THAT ARE EQUAL TO OR GREATER THAN 6% (SIDESLOPES). IF TEXTURED GEOMEMBRANE IS USED ON FLOOR AREAS, DOUBLE-SIDED GEOCOMPOSITE DRAINAGE LAYER MEETING TRANSMISSIVITY REQUIREMENTS OF SINGLE-SIDED GEOCOMPOSITE SHALL BE USED.
4. IN-SITU SUBGRADE SHALL BE PREPARED AS DESCRIBED IN THE SLQCP (ATTACHMENT 10), INCLUDING CUT OR FILL AS APPROPRIATE TO ACHIEVE THE DESIGN BOTTOM OF SOIL LINER ELEVATIONS.
5. LINER SYSTEM AND LEACHATE COLLECTION DRAINAGE LAYER COMPONENT MATERIAL AND INSTALLATION SPECIFICATIONS AND CONSTRUCTION QUALITY ASSURANCE (CQA) REQUIREMENTS ARE PRESENTED IN THE SLQCP.
6. DOUBLE-SIDED GEOCOMPOSITE DRAINAGE LAYER ON SIDESLOPE LINER MAY BE REPLACED BY 16-oz/YD^2(MIN) NON-WOVEN GEOTEXTILE HAVING SUFFICIENT HYDRAULIC TRANSMISSIVITY AS SPECIFIED IN THE SLQCP.
7. A 1.5 FOOT THICK (DURING PLACEMENT) LAYER OF TIRE CHIPS MAY REPLACE THE TOP 1.0 FOOT OF SOIL PROTECTIVE COVER ON FLOOR AREAS ONLY (NOT ON SIDESLOPES). REFER TO SECTION 6 OF THE SLQCP FOR BOTH PROTECTIVE COVER SOIL AND TIRE CHIP MATERIAL REQUIREMENTS.

MARK	DATE	REVISION	BY	APPROVED
1	02/24/2021	ELIMINATE UNIT 3	JJV	SMG
–	07/14/2006	TECHNICALLY COMPLETE	SMG	SMG
–	11/18/2005	INITIAL SUBMITTAL TO TCEQ	SMG	SMG

OWNER / SITE ADDRESS:
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(512) 451-4003

PROJECT:
MESQUITE CREEK LANDFILL
PERMIT APPLICATION – PERMIT NO. MSW – 66 B

TITLE:
LINER SYSTEM DETAILS

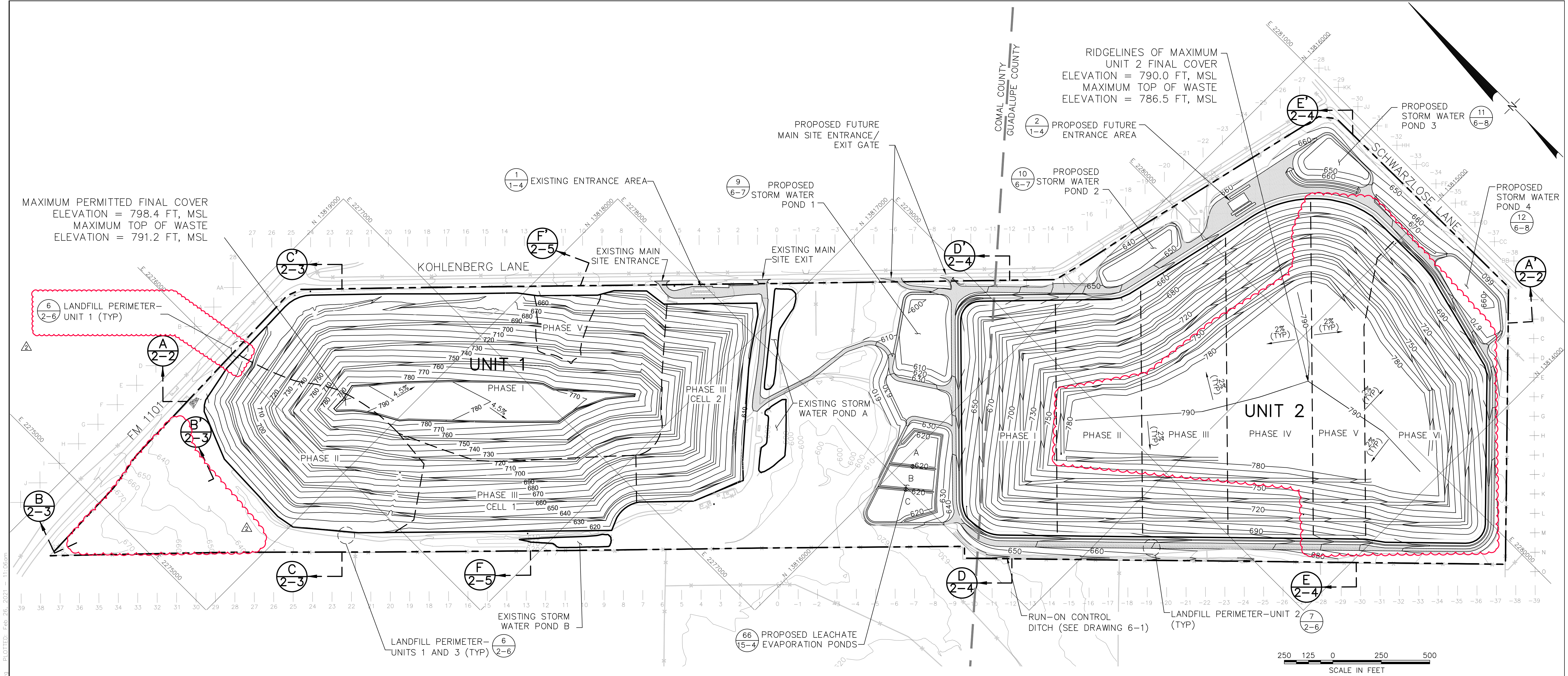
PROJECT NO.: GT3435-04
FILE NO.: 3435-036.dwg
DRAWN BY: JJV
CHECKED BY: SMG
REVIEWED BY: BAG
APPROVED BY: SMG
PART NO. III
FIGURE NO: 6-15

DRAWING: P:\CADD\Projects\M\Mesquite Creek Landfill\Permit\Mod Elim Unit 3 (GW7663)\DRAWINGS\3435-036.dwg PLOTTED: Feb 26, 2021 – 11:11am

ATTACHMENT 7

FINAL CONTOUR MAP

- Drawing 1-3 Overall Final Cover Grading Plan (drawing showing final contour map, re-copied from Part III, Attachment 1 of this PAA)
- Drawing 6-1 Surface Water Management Plan (drawing showing final contour map and cover drainage features, re-copied from Part III, Attachment 6 of this PAA)
- Drawing 7-1 Final Cover System Details



LEGEND

810	EXISTING GROUND ELEVATION (FT, MSL)
	EXISTING ROAD
	EXISTING BUILDING
	PROPERTY BOUNDARY (NOTE 4)
	LIMIT OF WASTE
	PHASE BOUNDARY
N 13,674,000 E 2,080,000	STATE PLANE COORDINATES
A 20	SITE GRID
▨	SITE ACCESS ROAD
650	PROPOSED TOP OF FINAL COVER SYSTEM (FT, MSL)
	PROPOSED LIMIT OF FINAL COVER
1 1-4	DETAIL OR SECTION NUMBER PART III DRAWING NUMBER ON WHICH ABOVE DETAIL NUMBER IS SHOWN

OVERVIEW:

UNIT 1 WASTE FILLING IS IN PROGRESS. NO CHANGES ARE PROPOSED TO THE PERMITTED UNIT 1 FINAL COVER GRADING PLAN DESIGN. UNIT 2 (LATERAL EXPANSION AREA) FINAL COVER GRADES ARE PROPOSED. △2

NOTES:

1. THE EXISTING CONTOUR MAP SHOWN ON THIS DRAWING WAS COMPILED USING PHOTOGRAMMETRIC METHODS BASED ON AERIAL PHOTOGRAPHY PERFORMED ON 08 MARCH 2005 BY SURVEYING AND MAPPING, INC. OF AUSTIN, TEXAS.
2. ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL (FT, MSL) AS DEFINED BY THE USGS NATIONAL GEODETIC VERTICAL DATUM (NGVD) OF 1929. STATE PLANE COORDINATE GRID CORRESPONDS TO TEXAS COORDINATE SYSTEM, SOUTH CENTRAL ZONE, NORTH AMERICAN DATUM (NAD) 1983.
3. PROPERTY BOUNDARY AND EASEMENT INFORMATION PROVIDED BY SURVEYING AND MAPPING INC., AUSTIN, TEXAS, DATED 23 MAY 2005.
4. PERMIT BOUNDARY AND PROPERTY BOUNDARY COINCIDE.
5. TOP OF FINAL COVER CONTOURS REFER TO PROPOSED FINISHED GRADE (TOP OF VEGETATIVE SOIL COMPONENT OF FINAL COVER SYSTEM). LIMIT OF FINAL COVER SYSTEM REFERS TO PERIMETER TOE OF SLOPE OF VEGETATIVE LAYER.
6. REFER TO ATTACHMENT 6, DRAWING 6-1 FOR SURFACE WATER MANAGEMENT SYSTEM FEATURES ON FINAL COVER (NOT SHOWN ON THIS DRAWING FOR CLARITY), AND FOR TIMING OF STORM WATER POND CONSTRUCTION.
7. REFER TO ATTACHMENT 14, DRAWING 14-4 FOR CONCEPTUAL LANDFILL GAS COLLECTION AND CONTROL SYSTEM DESIGN (NOT SHOWN ON THIS DRAWING FOR CLARITY).

MARK	DATE	REVISION	BY	APPROVED
△2	02/24/2021	ELIMINATE UNIT 3	JJV	SMG
△1	06/06/2006	REVISED SITE ENTRANCE	SMG	SMG
–	07/14/2006	TECHNICALLY COMPLETE	SMG	SMG
–	03/26/2006	RESPONSE TO NOD 1	SMG	SMG
–	11/18/2005	INITIAL SUBMITTAL TO TCEQ	SMG	SMG

OWNER / SITE ADDRESS:

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ENGINEER:

Geosyntec consultants
GEOSYNTEC CONSULTANTS, INC.
TEXAS ENG. FIRM REGISTRATION NO. 1182
8217 SHOAL CREEK BLVD., SUITE 200
AUSTIN, TEXAS 78757
(512) 451-4003

PROJECT:

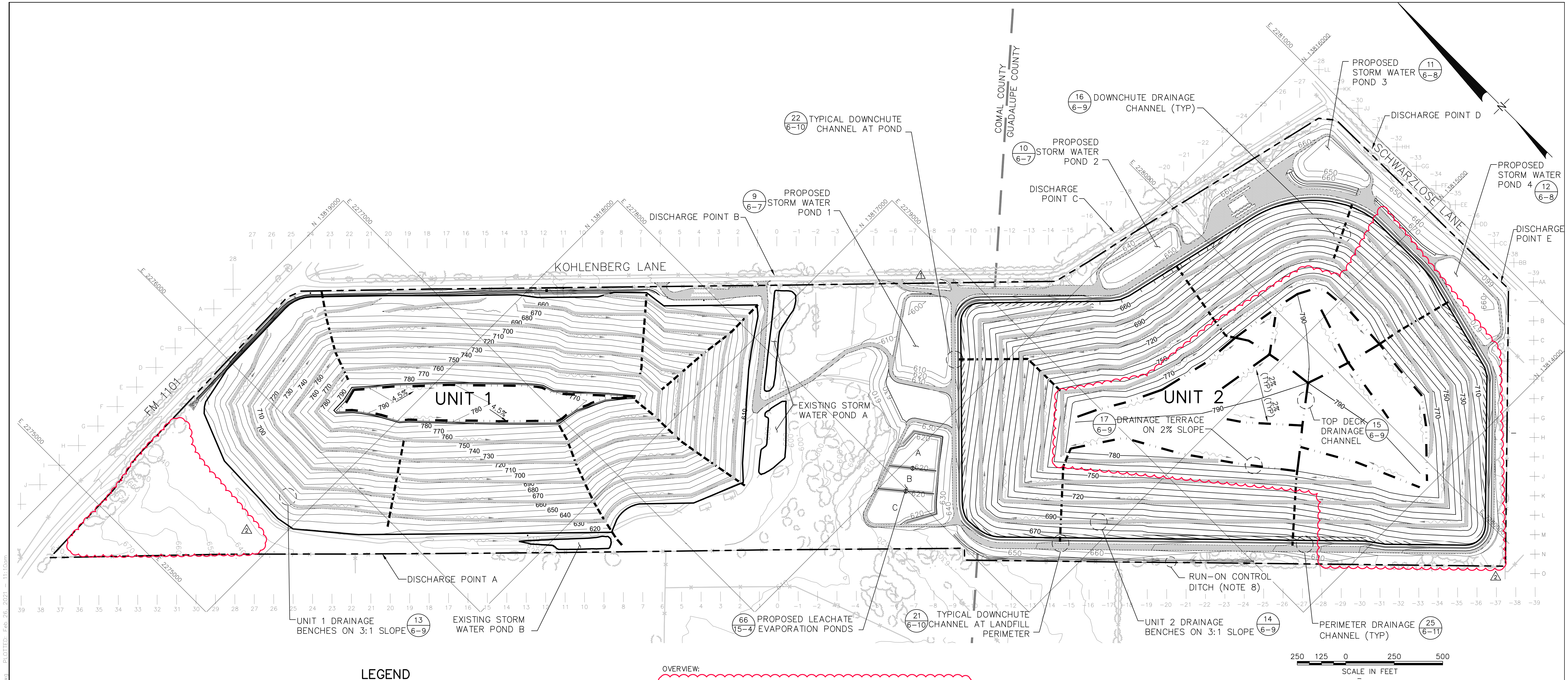
MESQUITE CREEK LANDFILL
PERMIT APPLICATION – PERMIT NO. MSW – 66 B

TITLE:

OVERALL FINAL COVER GRADING PLAN

PROJECT NO.: GT3435-03	DRAWN BY: JJV	REVIEWED BY: BAG	PART NO.	FIGURE NO:
FILE NO.: 3435-003	CHECKED BY: SMG	APPROVED BY: SMG	III	1-3

DRAWING: P:\CADD\Projects\M\Mesquite Creek Landfill\Permit\Mod Elim Unit 3 (GW7663)\DRAWINGS\3435-003.dwg PLOTTED: Feb 26, 2021 - 11:06am



OVERVIEW:

UNIT 1 WASTE FILLING IS IN PROGRESS. NO CHANGES ARE PROPOSED TO THE PERMITTED UNIT 1 FINAL COVER GRADES OR THE SURFACE WATER MANAGEMENT DESIGN. UNIT 2 (LATERAL EXPANSION AREA) IS PROPOSED. △2

LEGEND

— 810 —	EXISTING GROUND ELEVATION (FT, MSL)
—×—×—	EXISTING FENCE
═	EXISTING ROAD
～～～	EXISTING TREELINE
— 650 —	PROPOSED FINAL ELEVATION (FT, MSL)
▬	PROPOSED PERIMETER ACCESS ROAD
— — - —	PROPERTY BOUNDARY (NOTE 4)
- - - -	DRAINAGE DOWNCHUTES
▬	DRAINAGE BENCHES WITH FLOW DIRECTION
— · — · —	TOP DECK DRAINAGE CHANNEL OR DRAINAGE TERRACE
———	LIMIT OF FINAL COVER
N 13,674,000 E 2,080,000	STATE PLANE COORDINATES
A ┼ 20	SITE GRID

NOTES:

1. THE EXISTING CONTOUR MAP SHOWN ON THIS DRAWING WAS COMPILED USING PHOTOGRAMMETRIC METHODS BASED ON AERIAL PHOTOGRAPHY PERFORMED ON 08 MARCH 2005 BY SURVEYING AND MAPPING, INC. OF AUSTIN, TEXAS.
2. ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL (FT, MSL) AS DEFINED BY THE USGS NATIONAL GEODETIC VERTICAL DATUM (NGVD) OF 1929. STATE PLANE COORDINATE GRID CORRESPONDS TO TEXAS COORDINATE SYSTEM, SOUTH CENTRAL ZONE, NORTH AMERICAN DATUM (NAD) 1983.
3. PROPERTY BOUNDARY PROVIDED BY SURVEYING AND MAPPING INC., AUSTIN, TEXAS, DATED 23 MAY 2005.
4. PERMIT BOUNDARY AND PROPERTY BOUNDARY COINCIDE.
5. INFORMATION ON SEDIMENT BASIN APPURTENANCES IS PROVIDED IN TABLE ON DRAWING 6-12.
6. PERIMETER DRAINAGE CHANNEL PARAMETERS ARE PROVIDED IN TABLE ON DRAWING NO. 6-11.
7. STORM WATER POND CONSTRUCTION SCHEDULE:
    - PONDS A AND B – ALREADY CONSTRUCTED.
    - POND 1–CONSTRUCT WHEN UNIT 2, PHASE I FILLING IS ABOVE–GRADE.
    - POND 2–CONSTRUCT WHEN UNIT 2, PHASE II FILLING IS ABOVE–GRADE.
    - POND 3–CONSTRUCT WHEN UNIT 2, PHASE IV FILLING IS ABOVE–GRADE.
    - POND 4–CONSTRUCT WHEN UNIT 2, PHASE VI FILLING IS ABOVE–GRADE.
8. RUN–ON CONTROL DITCH SHALL BE LOCATED AT TOE OF SLOPE PERIMETER BERM, WITHIN PROPERTY BOUNDARY AS NEEDED, AND GRADED TO DRAIN. DITCH SHALL BE V–DITCH, 2–FT (MIN) DEEP, VEGETATED.

MARK	DATE	REVISION	BY	APPROVED
△2	02/24/2021	ELIMINATE UNIT 3	JJV	SMG
△1	08/08/2008	REVISED SITE ENTRANCE	SMG	SMG
–	07/14/2006	TECHNICALLY COMPLETE	SMG	SMG
–	03/28/2006	RESPONSE TO NOD 1	SMG	SMG
–	11/18/2005	INITIAL SUBMITTAL TO TCEQ	SMG	SMG

OWNER / SITE ADDRESS:

WASTE MANAGEMENT

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PROJECT:

MESQUITE CREEK LANDFILL
PERMIT APPLICATION – PERMIT NO. MSW – 66 B

TITLE:

SUFACE WATER MANAGEMENT PLAN

PROJECT NO.: GT3435–03	DRAWN BY: JJV	REVIEWED BY: BAG	PART NO.	FIGURE NO:
FILE NO.: 3435–057	CHECKED BY: SMG	APPROVED BY: SMG	III	6–1

DRAWING: P:\CADD\Projects\M\Mesquite Creek Landfill\Permit\Mod Elim Unit 3 (GW7663)\DRAWINGS\3435–057.dwg PLOTTED: Feb 26, 2021 – 11:10am

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PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN
ATTACHMENT 10

SOILS AND LINER QUALITY CONTROL PLAN (SLQCP)

MESQUITE CREEK LANDFILL
NEW BRAUNFELS,
COMAL AND GUADALUPE COUNTIES, TEXAS
MSW PERMIT NO. 66B

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Response to NOD 1 – 28 March 2006
Response to NOD 2 – 15 May 2006
Technically Complete – 14 July 2006
Revised – 24 February 2021

the proposed system are portrayed in Part III, Attachment 6, Drawing 6-15 (see Details 37 - 40). For Unit 2 (the expansion area), the proposed liner system is composed of (from bottom to top): a 2-ft thick (minimum) layer of compacted soil liner with a hydraulic conductivity of no more than 1 x 10^{-7} cm/s, overlain by a 60-mil high-density polyethylene (HDPE) geomembrane, a leachate drainage layer of either geocomposite (geonet bonded to geotextiles) or geotextile, and 2-ft thick (minimum) of protective soil. ~~Unit 3 is proposed to use either the same standard liner system described above, or an equivalent alternate that uses a geosynthetic clay liner (GCL) instead of the compacted soil liner. The alternate liner design demonstration for the existing facility, which includes Unit 3 (formerly known as Phase IV), is provided as Appendix III-B to the Site Development Plan.~~

Proposed Leachate Evaporation Pond Liner Design. Lined leachate evaporation ponds are proposed adjacent to Unit 2 as described and shown in Attachment 15 (Leachate and Contaminated Water Plan) of the Site Development Plan. The proposed liner system for the leachate evaporation ponds is composed of: (from bottom to top): a 60-mil HDPE geomembrane, overlain by a GCL, overlain by another 60-mil HDPE geomembrane. Refer to Part III, Attachment 15, Drawing 15-5, Detail 67) for an engineering detail of the proposed leachate evaporation pond liner system. Installation of this system shall be in accordance with this SLQCP.

- Summary of Liner System Installation Steps: An overview narrative of the general steps taken to construct and install the liner system components is provided below.
    - The liner system subgrade (bottom of liner system) is prepared by first excavating or filling, as appropriate to achieve the design grades. Most of the liner system is below natural grade, thus requiring excavation.
    - The subgrade will be fine-graded and prepared for compacted soil liner construction in accordance with the procedures set forth subsequently in Section 2.2.3 of this SLQCP.
    - The proposed source(s) of compacted soil will be pre-construction tested in accordance with the procedures set forth subsequently in Section 2.3.2 of this SLQCP.

TABLE 10-4 (Continued)
MATERIAL SPECIFICATIONS
60-mil HIGH-DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE - TEXTURED

PROPERTY	**QUALIFIER**	**UNITS**	**SPECIFIED VALUES**	**TEST METHOD**	**MQC TESTING FREQUENCY (Minimum)**
Oven Aging at 85 deg. C				ASTM D 5721	Per each formulation
1. Using Standard OIT or	Min. Avg.	% retained after 90 days	55	ASTM D 3895	
2. Using High Pressure OIT	Min. Avg.	Same as 1.	80	ASTM D 5885	
UV Resistance(7) (using High Pressure OIT)	Min. Avg.	Percent retained after 1600 hours	50	GM-11 ASTM D 5885	Per each formulation
Interface Shear Strength (textured geomembrane to soil liner material)	minimum	psf	Failure Envelope(8)	ASTM D 5321(8)	Note 8
Interface Shear Strength (textured geomembrane to geotextile (either the geotextile component of geocomposite drainage layer, or the geotextile drainage layer by itself if selected)	minimum	psf	Failure Envelope(8)	ASTM D 5321(8)	Note 8

Notes:

(7) Test using 20 hr. UV cycle at 75 deg. C, followed by 4 hr. condensation at 60 deg. C. UV resistance is based on percent retained value regardless of the original high pressure OIT value.

(8) Interface shear strength testing shall be performed prior to shipping as part of CQA program by a qualified, independent third-party geosynthetics testing laboratory. Geomembrane to geosynthetic and soil interfaces identified above shall have peak and large displacement effective-stress interface strength that meets or exceeds an envelope of:

Normal Stress (psf)	Shear Stress	
	Peak (psf)	Large-Displacement (psf)
500	195	~~145~~151
7,500	-	1,730
15,000	-	3,460

The above shear strength envelope applies to the sideslope liner system. If textured geomembrane is used on floor areas, see Table 10-5 for appropriate shear strength envelope that must be achieved. Also, see Attachment 4F (slope stability calculations) for other alternative allowable shear strength envelopes, which can be acceptable in conjunction with different required interim waste configurations (e.g., waste slope angle, height, benching set-back, etc.).

Interface shear tests shall be performed at the normal stresses indicated above, using fresh specimens for each normal stress increment, and using a maximum shear rate of 1 mm/minute for geosynthetic-to-soil interfaces, and 5 mm/minute for geosynthetic-to-geosynthetic interfaces. Soil liner material used for interface test shall be re-compacted in the lab to approximately 95% of the standard Proctor max. dry density and approximately 4 to 5% wet of the optimum moisture content.

Passing interface strength results for a particular interface are applicable from project-to-project at the site (e.g., for subsequent cell construction, next liner phases, etc.) and testing need not be repeated, provided that the geosynthetic type and soil source/properties proposed for use remains representative of those tested.

7. GEOSYNTHETIC CLAY LINERS (GCLs)

7.1 Introduction

This section addresses the specifications and CQA requirements for the geosynthetic clay liner (GCL). The GCL is proposed for use as~~: (i) a component of the alternate liner system for Unit 3; and (ii)~~ a component of the leachate evaporation ponds liner system. Engineering details showing the proposed alternate liner system using GCL are presented in Part III, Attachment 6, (in particular, see Drawing 6-15) of the Site Development Plan. The alternate liner design is presented in Part III, Appendix III-B of the Site Development Plan. Engineering details showing the proposed leachate evaporation ponds liner system are presented in Part III, Attachment 15, (in particular, see Drawing 15-6) of the Site Development Plan.

7.2 GCL Specifications

7.2.1 GCL Material Requirements

A. Material requirements for the GCL are presented in Table 10-12.

B. The GCL shall be composed of a bentonite core sandwiched between two geotextile layers.

7.2.2 Manufacturing Quality Control (MQC)

A. The GCL Manufacturer shall implement a quality control (MQC) program for materials related to GCL manufacturing, which shall include MQC sampling and testing to demonstrate the GCL quality and suitability for use.

B. The required MQC tests, methods, and frequencies are presented in Table 10-12.

C. Prior to shipping, the GCL Manufacturer shall provide CQA personnel with the required MQC information presented subsequently in Section 7.3.2 of this SLQCP, including results of the required MQC tests. Any sample that does not comply with the requirements shall result in rejection of the roll from which the sample was obtained.

7.2.3 Shipping, Delivery, and Storage

A. The GCL shall be shipped in rolls with weather-resistant opaque wrappings, and each roll shall be labeled with the manufacturer's name and product identification (e.g., batch and roll

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PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN
ATTACHMENT 12

FINAL CLOSURE PLAN

MESQUITE CREEK LANDFILL
NEW BRAUNFELS,
COMAL AND GUADALUPE COUNTIES, TEXAS
MSW PERMIT NO. 66B

Prepared by:

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2. GENERAL INFORMATION

2.1 Introduction

This section provides required information, pursuant to 30 TAC §330.253 (d)(2), (3), and (5) regarding the largest area requiring closure, maximum waste inventory, and final contour plan.

2.2 Largest Area Requiring Closure

Closure of the landfill (i.e., installation of the final cover system) will be performed incrementally as landfill areas reach final grade. The largest area of the landfill ever requiring a final cover at one time during the active life of the landfill, when the extent and method would be the most expensive, is approximately 54.3 acres, as shown on Drawing 12-1 of this Final Closure Plan.

2.3 Maximum Waste Inventory

The estimated maximum inventory of waste ever on the site over the active life of the landfill, using the calculated volume available for waste disposal, is 20,190~~7~~,09~~0~~0 yd^3.

Additional information on how this estimated waste volume was calculated is provided in the Site Development Plan narrative report at the beginning of Part III of this permit application.

2.4 Final Contour Plan

A final contour plan, showing the proposed final cover elevations, slopes, and drainage features was previously presented on Drawing 6-1 in Part III, Attachment 6 of this permit application. A copy of Drawing 6-1 is provided at the end of this Final Closure Plan. Inspection of Drawing 6-1 shows that the location of the 100-year floodplain will not encroach on the landfill footprint; therefore special provisions for protection from a 100-year flood is not applicable to this Final Closure Plan.

3. DESCRIPTION OF FINAL COVER SYSTEM

3.1 Introduction

The final cover system is designed to provide for encapsulation of the waste materials and to minimize leachate generation during the post-closure care period. This section describes the design and installation requirements for one proposed final cover system for pre-Subtitle D areas, and two proposed final cover system options for Subtitle D areas.

3.2 Final Cover System Design

3.2.1 Standard Final Cover System

3.2.1.1 Pre-subtitle D Area

Unit 1, Phases I and II of the existing landfill are pre-Subtitle D areas. Phase I has an in-situ liner. Phase II has a 36-in. thick compacted clay liner with a coefficient of permeability less than or equal to $1x10^{-7}$ cm/sec. Therefore, a standard final cover system meeting the requirements of 30 TAC §330.253(b)(2) and (3) is proposed for this area. The proposed pre-Subtitle D standard final cover system will consist of, from bottom to top:

- a 1.5-ft (min.) thick infiltration layer of compacted soil with a coefficient of permeability less than or equal to $1x10^{-7}$ cm/sec (which is less than or equal to the permeability of the constructed and in-situ bottom liners of these areas); and

- a 6-in. vegetation layer capable of sustaining native vegetation.

3.2.1.2 Subtitle D Area

The Subtitle D portions of the facility have a synthetic bottom composite-liner component as described previously in this permit application (see Site Development Plan narrative). Therefore, a standard final cover system meeting the requirements of 30 TAC §330.253(b)(1) and (3) is proposed as an allowable option for the Subtitle D portions of the facility (i.e., Unit 1, Phases III and V; and all of Unit 2~~, and all of Unit 3~~). At the facility's option, this Subtitle D final cover may also be placed over Unit 1, Phases I and II, since this cover is more stringent than the pre-Subtitle D cover described above. The proposed Subtitle D standard final cover system will consist of, from bottom to top:

- a 1.5-ft (min.) thick infiltration layer of compacted soil with a coefficient of permeability less than or equal to $1x10^{-5}$ cm/sec;

- a 40-mil low-density polyethylene (PE) geomembrane;

- a double-sided geocomposite drainage layer; and

- a 2-ft (min.) thick erosion layer of soil with the upper 6-inches capable of sustaining native vegetation.

An engineering detail of the standard final cover system was previously presented in Part III, Attachment 7, Drawing 7-1. An evaluation of the erosion potential of the erosion layer compared to typical permissible values was performed using the USDA Universal Soil Loss Equation (USLE) method and is presented in Part III, Attachment 6 (Sub-Attachment 6F) of this permit application. The material requirements and installation procedures, including specified properties of the standard final cover system components and quality assurance/quality control (QA/QC) requirements, are presented in the Final Cover Quality Control Plan (FCQCP) included as Appendix 12-A of this Final Closure Plan.

3.2.2 Alternate Final Cover System

As allowed by 30 TAC §330.253(c), an alternate final cover system that is equivalent to the requirements of 30 TAC §330.253(b)(1) and (3) is proposed as an acceptable option for Subtitle D portions of the facility (i.e., Unit 1, Phases III and V; and all of Unit 2~~, and all of Unit 3~~). At the facility's option, the alternate Subtitle D-equivalent final cover may also be placed over Unit 1, Phases I and II, since this cover is more stringent than the pre-Subtitle D cover described above. The proposed alternate final cover system for all areas not already having final cover installed will consist of, from bottom to top:

- a 1.5-ft (min.) thick infiltration layer of compacted soil with a hydraulic conductivity less than or equal to $1x10^{-5}$ cm/sec;

- a 2-ft (min.) thick erosion layer of soil that is capable of sustaining native or naturalized grassy vegetation; and

- a 0.5-ft (min.) thick vegetative soil layer that is capable of sustaining native or naturalized grassy vegetation.

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PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN
ATTACHMENT 14

LANDFILL GAS MANAGEMENT PLAN

MESQUITE CREEK LANDFILL
NEW BRAUNFELS,
COMAL AND GUADALUPE COUNTIES, TEXAS
MSW PERMIT NO. 66B

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Revised – 2 November 2011, 24 February 2021

2.7 Waste Stream

As described in Part I/II, Section 2.2 of this permit application, The facility currently accepts and is proposed to continue accepting municipal solid waste, industrial solid waste (Class 2 and 3), and special waste, as defined by 30 TAC §330.2. The facility has operated since 1975. It is anticipated that the principal source of waste will continue to be daily residential and commercial/industrial waste collection.

As discussed in Part I/II, Section 2.4 of this permit application, the current waste disposal rate at the facility is approximately 371,000 tons per year. Assuming the waste receipts increase proportional to the projected population growth, the existing landfill and proposed expansion combined together will have an estimated remaining site life of approximately 26.6 years. This growth scenario prediction leads to an estimated approximately 595,000 tons/year in the last year of operation.

2.9 Existing Landfill Design Overview

The basic design of the existing facility as currently permitted consists of an aerial fill method both above and below natural ground. The existing landfill waste footprint is permitted to occupy approximately 79 acres in two areas separated by an unnamed tributary of Mesquite Creek. Previously the existing landfill was designated as Phases I through V. For this permit amendment application, the existing landfill is being renamed as Unit 1 (comprised of Phases I through V, with no Phase IV)~~, and Unit 3 (formerly Phase IV)~~. Aside from the designation change, no other changes to the currently permitted Unit 1 ~~and Unit 3~~ design have been made for this permit amendment application. Bottom areas of Unit 1 have been constructed, and landfilling is in progress. The extent of the existing permitted landfill footprint is shown on attached Drawing 14-1. The base grade elevations (top of liner) generally range from approximately 564 ft to 640 ft above mean sea level (MSL). These base grades are up to approximately 60-ft below natural ground surface elevations. Unit 1, Phase I is a pre-Subtitle D area with an in-situ liner. Unit 1, Phase II is a pre-Subtitle D area with a 3-ft thick recompacted clay liner (k≤ 1 x 10^{-7} cm/s).

The remaining existing constructed phases of Unit 1~~, and the remaining permitted Unit 3 portions~~ are Subtitle D compliant and include a compacted soil liner (or previously approved geosynthetic clay liner (GCL) alternate) overlain by a 60-mil high-density polyethylene (HDPE) geomembrane. The Subtitle D composite liner system is overlain by a leachate collection system consisting of a geonet leachate collection drainage layer with a filter fabric and a 2-ft thick layer of protective cover. The above ground final cover system grades are sloped with sideslopes at 3 horizontal to 1 vertical (3H:1V) between drainage terraces, for an average slope of approximately 3.5H:1V from toe to crest. The flatter top-deck areas of the landfill are sloped at approximately five percent slopes. At the highest point at the facility, Unit 1 has a peak permitted elevation of 798 ft, MSL (no changes proposed). Unit~~s~~ 2 ~~and 3~~ will have a lower peak final cover elevation~~s~~ (elevation 790.0 ft, MSL~~ and 707.9 ft, MSL, respectively~~). The unit~~s~~ will be filled up to approximately 150-ft above natural ground surface elevations. Drawings showing the layout and liner system details of the existing permitted Unit 1 ~~and Unit 3~~ base liner grades are presented in Part III, Attachment 1 of this permit application.

2.10 Proposed Landfill Expansion Design Overview

Permit Amendment Application No. MSW-66B (this application) is proposed to modify existing Permit No. MSW-66A by increasing the permitted acreage from 96.07 acres to 244.12 acres by incorporating approximately 148.05-acres of additional property located south of the currently permitted area (see Drawing 14-1). The remaining acreage will be used for buffer zones, perimeter access roads, drainage and sedimentation facilities, miscellaneous equipment/supplies storage, and daily and final cover stockpiles. As mentioned, the maximum fill elevation for the entire facility is on Unit 1 and is at 798 ft, MSL (no changes proposed). Unit~~s~~ 2 ~~and 3~~ will have a lower peak final cover elevation~~s~~.

The aerial fill method above ground and below ground is proposed to continue for the expansion. Since all of the base areas of Unit 1 are already constructed and filling is in progress, no changes to the Unit 1 design are proposed.~~ Also, the Unit 3 design (formerly Phase IV) has not been changed.~~ Unit 2 (comprised of Unit 2, Phases I through VI) is the lateral expansion area proposed by this permit amendment application. The proposed layout of the Unit 2 landfill base liner grades and engineering details of the liner system are presented in Part III, Attachment 1 of this permit application. The units and phases will be developed in their numerical sequence. As shown on these drawings in Attachment 1, the proposed below-ground waste disposal will extend up to approximately ~~6~~100-ft below natural ground in the expansion phases.

The Unit~~s~~ 1 ~~and 3~~ liner system~~s~~ was~~ere~~ described above in Section 2.9, and no changes are proposed. Unit 2 (expansion area) will have a Subtitle D compliant liner system using a compacted soil liner overlain by a 60-mil HDPE geomembrane, in turn overlain by a leachate collection drainage layer and 2-ft of protective cover. Similar to the existing landfill, the Unit 2 above ground final cover system grades are sloped at 3H:1V between drainage benches (average slope of approximately 3.5H:1V) up to a flatter top-deck area at ~~five~~ two percent slopes up to a peak

TABLE 14-2
LANDFILL GAS MONITORING PROBE INFORMATION

GAS PROBE I.D.	COORD.(1)	GROUND SURFACE ELEV.	ADJACENT LOWEST TOP OF LINER ELEV.(4)	EXISTING/ANTICIPATED PROBE DETAILS(3)							STATUS
				GAS PROBE BOTTOM ELEV.	TOTAL GAS PROBE DEPTH	DEPTH OF SCREENED INTERVAL		SCREEN LENGTH	ELEV. OF SCREENED INTERVAL		
		(ft, MSL)	(ft, MSL)	(ft, MSL)	(ft, bgs)	(ft, bgs)		(ft)	(ft, MSL)		
						FROM	TO		FROM	TO	
GP-13	N 13,816,025 E 2,279,585	638	585	579	59	5	58	53	633	580	Install No Later Than Start of Unit 2, Phase I.
GP-14	N 13,815,800 E 2,280,540	657	610	604	53	5	52	47	652	605	Install No Later Than Start of Unit 2, Phase III.
GP-15	N 13,815,385 E 2,280,900	639	615	609	30	5	29	24	634	610	Install No Later Than Start of Unit 2, Phase IV.
GP-16	N 13,814,440 E 2,280,900	653	630	624	29	5	28	23	648	625	Install No Later Than Start of Unit 2, Phase V.
GP-17	N 13,813,960 E 2,280,390	703	630	624	79	5	78	73	698	625	Install No Later Than Start of Unit 2, Phase V.
GP-18	N 13,813,460 E 2,279,900	710	640	634	76	5	75	70	705	635	Install No Later Than Start of Unit 2, Phase V.
GP-19	N 13,814,105 E 2,279,265	684	630	624	60	5	59	54	679	625	Install No Later Than Start of Unit 2, Phase III.
GP-20	N 13,814,740 E 2,278,640	660	606	600	60	5	59	54	655	601	Install No Later Than Start of Unit 2, Phase I.
GP-21	N 13,815,430 E 2,277,985	638	596	590	48	5	47	42	633	591	Install No Later Than Start of Unit 2, Phase I.
GP-22	N 13,818,600 E 227,500	670	612	606	64	5	63	58	665	607	Install No Later Than Closure ~~Start~~ of Unit ~~3~~2, Phase VI.
GP-23	N 13,818,810 E 2,275,360	640	612	606	34	5	33	28	635	607	Install No Later Than Closure ~~Start~~ of Unit ~~3~~2, Phase VI.

Notes:

MSL = Mean Sea Level.   bgs = below ground surface

(1) Coordinates refer to state plane coordinates.

(2) Information for existing gas probes taken from construction logs.

(3) Information for proposed gas monitoring probes is approximate based on anticipated subsurface characterization and may be varied in the field as appropriate based on drill rig access conditions and actual subsurface findings.

(4) Lowest elevation of adjacent liner is within an approximately 1000-ft distance from each probe, taken from the base grading plan (Drawing 1-2). Pre-subtitle D elevations of Unit 1, Phase 1 are not available.

- Ten new gas monitoring probes are proposed to monitor for gas migration along the new lateral expansion area permit boundary adjacent to Unit 2. These proposed gas monitoring probes are designated GP-12 through GP-21 (see Drawing 14-2). The land use adjacent to the permit boundary around Unit 2 is similar to other areas of the facility, but in general is even more sparsely populated than towards the northern portion of the facility. Proposed gas monitoring probes GP-12 through GP-21 are spaced at no greater than 1000-ft interval along the facility permit boundary. There are several residences within 1000-ft of the permit boundary in the southwest corner of the facility, adjacent to Unit 2. Although subsurface conditions do not reveal materials likely to be highly air permeable, emphasis was given to make sure there is adequate gas monitoring probe coverage in the southwest portion of Unit 2.

- Two gas monitoring probes (now designated as GP-22, and GP-23) along the northwest corner of the property boundary ~~adjacent to Unit 3~~ are currently permitted (formerly known as GP-8 and GP-9) but not yet installed~~ because waste filling has not progressed into this area~~. These gas monitoring probe locations have been changed slightly and their designation numbers have changed, but they are proposed at essentially the same locations as currently permitted, to provide gas monitoring coverage of the northwestern facility permit boundary~~ adjacent to future Unit 3~~.

The horizontal gas monitoring probe locations may be modified slightly during installation to allow for drill rig access and to avoid any nearby obstacles.

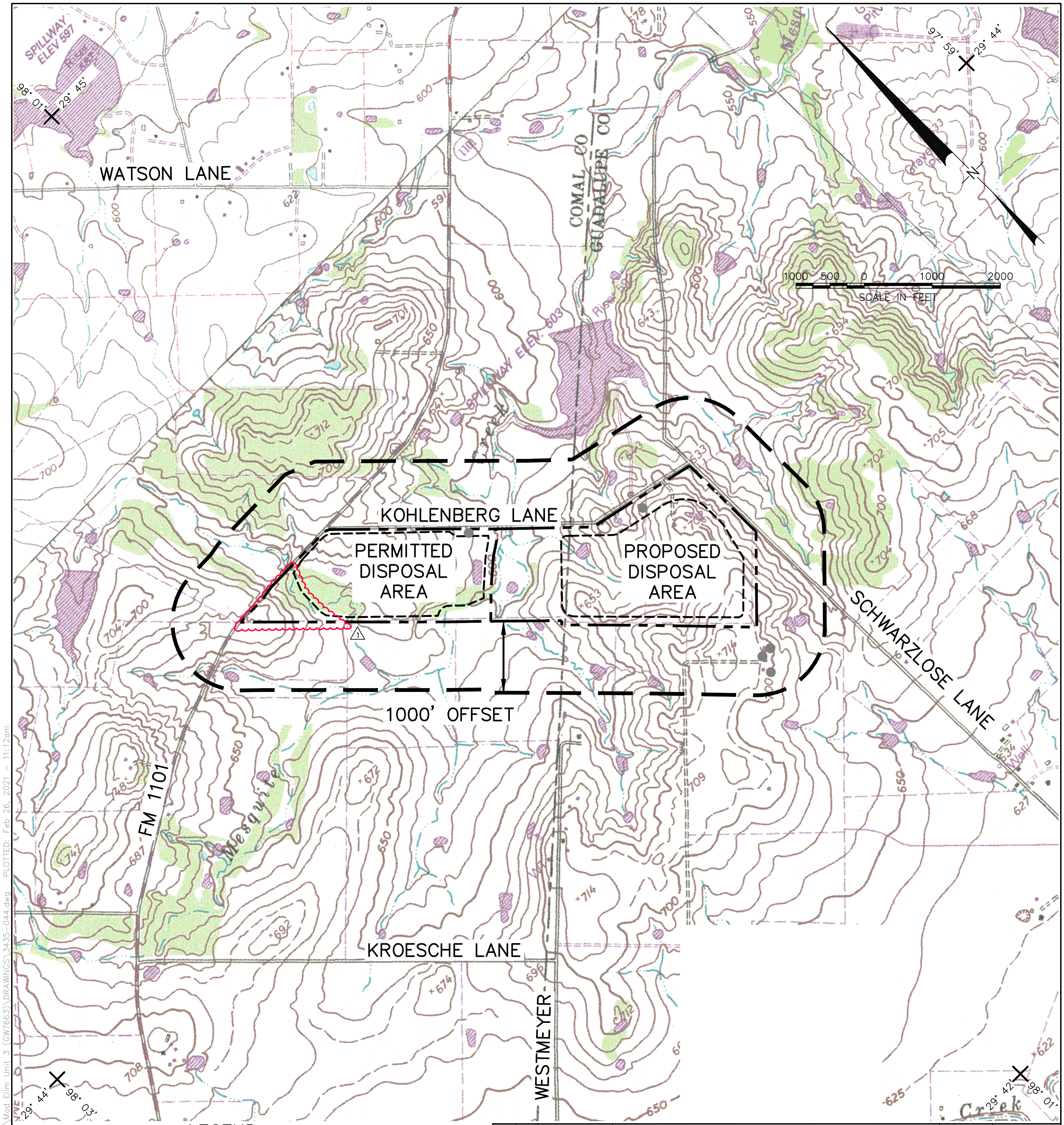
3.2.3 Basis for Gas Monitoring Probe Depths

The depths and screened intervals of the GPs were determined based on the proposed depth of the landfill and characterization of the subsurface soils and hydrogeologic conditions at the site and their potential for subsurface gas migration. The subsurface conditions and their potential to transmit landfill gas were described previously in Section 2.5 of this plan. In summary, Strata I, II, and IV were found to be aquitards with low hydraulic conductivity clays, and have low potential for landfill gas migration. Stratum III is also a clayey layer, but has secondary features that could potentially be conduits for landfill gas migration, particularly when groundwater levels are seasonally low.

Based on the above description of potential for landfill gas migration Stratum III is the zone of interest for subsurface landfill gas monitoring. A review of the existing gas monitoring probes shows that they are screened appropriately. The screened interval usually extends upwards into Strata I and II near the ground surface. Even though Strata I and II are low permeability clays and not expected to be likely paths for landfill gas migration, the presence of gas monitoring

DRAWINGS

LANDFILL GAS MANAGEMENT SYSTEM



LEGEND

— · —	PROPERTY BOUNDARY (PERMIT BOUNDARY)
- - - -	LIMIT OF WASTE
— —	1000-FT OFFSET
●	STRUCTURES AND INHABITABLE BUILDINGS

NOTES:

1. INFORMATION ON THIS MAP TAKEN FROM AERIAL PHOTOGRAPHY (MAY 2004), FIELD INSPECTION (JANUARY 2005) AND USGS QUADRANGLES.
2. MAP SOURCE: UNITED STATES DEPARTMENT OF THE INTERIOR, GEOLOGICAL SURVEY, 7 1/2 MINUTE SERIES QUADRANGLE (TOPOGRAPHIC) MAPS OF:
   NEW BRAUNFELS EAST, TEX. DATED 1958 REVISED 1994
   SAN MARCOS SOUTH, TEX. DATED 1964 REVISED 1994
   HUNTER, TEX. DATED 1964 REVISED 1994
   GERONIMO, TEX. DATED 1964 REVISED 1994
3. SEE PARTS I/II REPORT AND FIGURES FOR MORE DETAILED LAND USE MAPS AND DESCRIPTIONS.

MARK	DATE	REVISION	BY	APPROVED
1	02/24/2021	ELIMINATE UNIT 3	JJV	SMG
–	07/14/2006	TECHNICALLY COMPLETE	SMG	SMG
–	11/18/2005	INITIAL SUBMITTAL TO TCEQ	SMG	SMG

OWNER / SITE ADDRESS:

WASTE MANAGEMENT OF TEXAS, INC.
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P.O. BOX 311657
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(830) 685-7894

ENGINEER:

GEOSYNTEC CONSULTANTS, INC.
TEXAS ENG. FIRM REGISTRATION NO. 1182
8217 SHOAL CREEK BLVD.,
SUITE 200
AUSTIN, TEXAS 78757
(512) 451-4003

PROJECT:

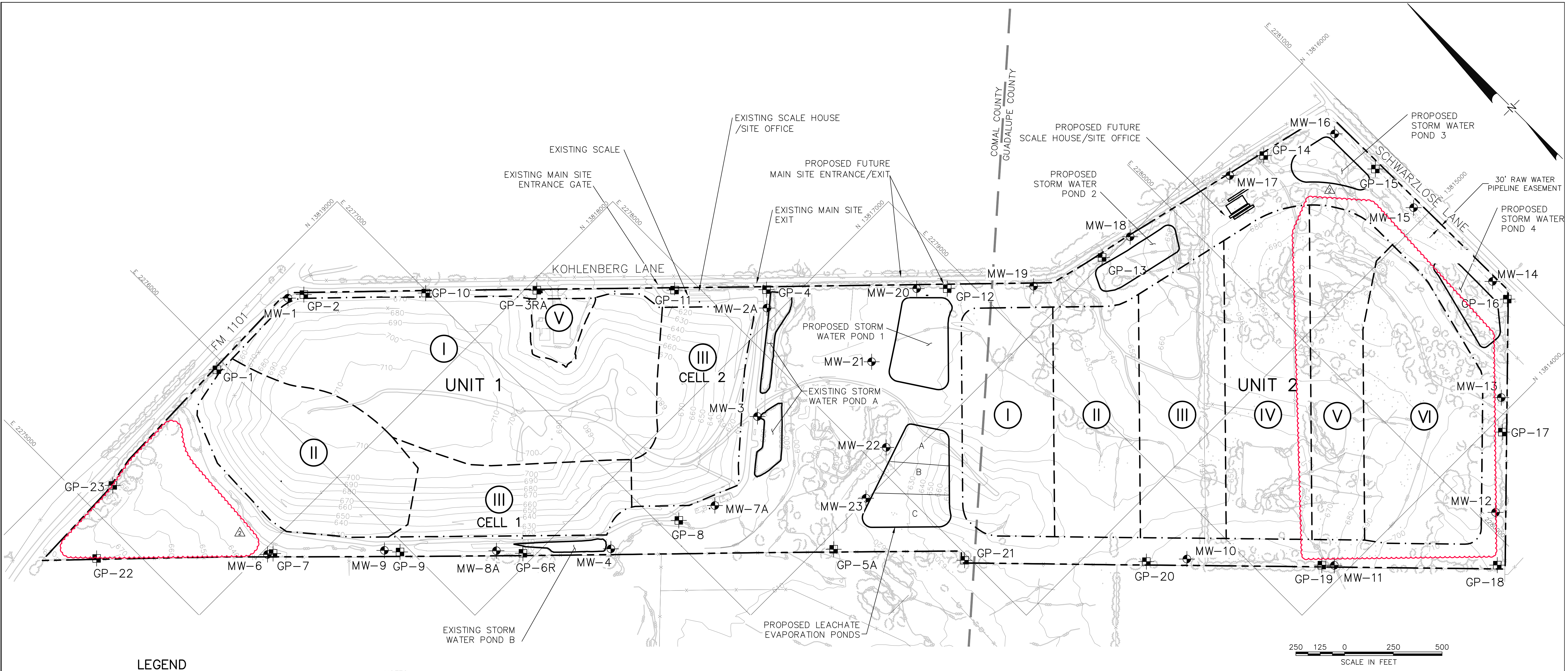
MESQUITE CREEK LANDFILL
PERMIT APPLICATION – PERMIT NO. MSW – 66 B

TITLE:

STRUCTURES AND INHABITABLE BUILDINGS WITHIN 1000 FEET OF SITE

PROJECT NO.: GT3435-03
FILE NO.: 3435-044
DRAWN BY: JJV
CHECKED BY: SMG
REVIEWED BY: BAG
APPROVED BY: SMG
PART NO. III
DRAWING NO: 14-1

DRAWING: P:\CADD\Projects\M\Mesquite Creek Landfill\Permit\Mod Elim Unit 3 (GW7663)\DRAWINGS\3435-044.dwg PLOTTED: Feb 26, 2021 – 11:12am



LEGEND

—— 650 ——	EXISTING GROUND ELEVATION (FT, MSL)
——•——•——	EXISTING WATER LINE
×——×——×	EXISTING SITE FENCE
∿∿∿∿∿∿	EXISTING TREE LINE
═══════	EXISTING ROAD
▭	EXISTING BUILDING
— · — · — · —	LIMIT OF WASTE
— — — — —	PHASE BOUNDARY
Ⓘ	PHASE DESIGNATION
—— – – ——	PROPERTY BOUNDARY (NOTE 4)
N 13,674,000 E 2,080,000	STATE PLANE COORDINATES
A ┼ 20	SITE GRID
MW-7	GROUNDWATER MONITORING WELL (NOTE 5)
GP-1	GAS MONITORING PROBE (NOTE 6)

NOTES:

1. THE EXISTING CONTOUR MAP SHOWN ON THIS DRAWING WAS COMPILED USING PHOTOGRAMMETRIC METHODS BASED ON AERIAL PHOTOGRAPHY PERFORMED ON 08 MARCH 2005 BY SURVEYING AND MAPPING, INC. OF AUSTIN, TEXAS.
2. ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL (FT, MSL) AS DEFINED BY THE USGS NATIONAL GEODETIC VERTICAL DATUM (NGVD) OF 1929. STATE PLANE COORDINATE GRID CORRESPONDS TO TEXAS COORDINATE SYSTEM, SOUTH CENTRAL ZONE, NORTH AMERICAN DATUM (NAD) 1983.
3. PROPERTY BOUNDARY AND EASEMENT INFORMATION PROVIDED BY SURVEYING AND MAPPING INC., AUSTIN, TEXAS, DATED 23 MAY 2005.
4. PERMIT BOUNDARY AND PROPERTY BOUNDARY COINCIDE.
5. SEE PART III, ATTACHMENT 5 FOR INFORMATION ON GROUNDWATER MONITORING WELLS, INCLUDING WHICH WELLS EXIST, WHICH WELLS ARE PROPOSED, AND THE INSTALLATION AND DECOMMISSIONING SCHEDULE.
6. SEE PART III, ATTACHMENT 14, TABLE 14–2 FOR GAS PROBE COORDINATES, DEPTHS, IDENTIFICATION OF WHICH PROBES CURRENTLY EXIST, WHICH PROBES ARE PROPOSED, AND THE INSTALLATION SCHEDULE.
7. UNIT 1, PHASES I AND II HAVE PRE–SUBTITLE D CLAY LINERS. THERE IS NO UNIT 1, PHASE IV. UNIT 1, PHASES III AND V, AND UNIT 2 HAVE/WILL HAVE SUBTITLE D STANDARD OR ALTERNATE LINER SYSTEM. △2

MARK	DATE	REVISION	BY	APPROVED
△2	02/24/2021	ELIMINATE UNIT 3	JJV	SMG
△1	08/08/2008	REVISED SITE ENTRANCE	SMG	SMG
–	07/14/2006	TECHNICALLY COMPLETE	SMG	SMG
–	05/15/2006	RESPONSE TO NOD 2	SMG	SMG
–	03/28/2006	RESPONSE TO NOD 1	SMG	SMG
–	11/18/2005	INITIAL SUBMITTAL TO TCEQ	SMG	SMG

OWNER / SITE ADDRESS:

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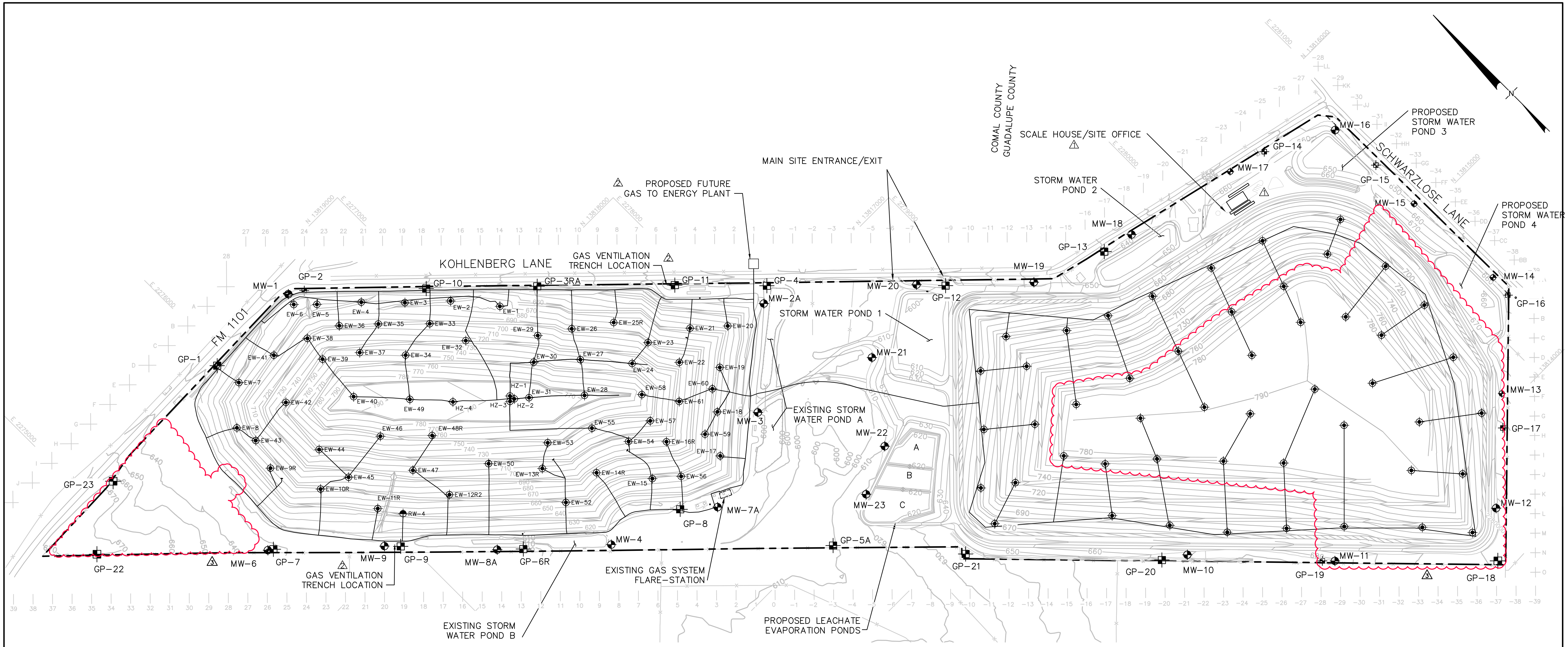
(512) 451–4003

PROJECT:
MESQUITE CREEK LANDFILL
PERMIT APPLICATION – PERMIT NO. MSW – 66 B

TITLE:
PROPOSED GAS MONITORING NETWORK

PROJECT NO.: GT3435–03	DRAWN BY: JJV	REVIEWED BY:	PART NO. III	FIGURE NO: 14–2
FILE NO.: 3435–045	CHECKED BY: SMG	APPROVED BY: SMG		

DRAWING: P:\CADD\Projects\M\Mesquite Creek Landfill\Permit\Mod Elim Unit 3 (GW7663)\DRAWINGS\3435–045.dwg PLOTTED: Feb 26, 2021 – 11:13am



LEGEND

650	EXISTING GROUND ELEVATION (FT, MSL)
×—×—×	EXISTING SITE FENCE
	EXISTING TREE LINE
═	EXISTING ROAD
▭	EXISTING BUILDING
— — —	PROPERTY BOUNDARY (NOTE 4)
N 13,674,000 E 2,080,000	STATE PLANE COORDINATES
A 20	SITE GRID
MW-6	GROUNDWATER MONITORING WELL
GP-7	GAS MONITORING PROBE
⊕	GAS EXTRACTION WELL (NOTE 7)
—	GAS COLLECTION LATERAL AND HEADER PIPING (NOTE 7)

NOTES:

1. THE EXISTING CONTOUR MAP SHOWN ON THIS DRAWING WAS COMPILED USING PHOTOGRAMMETRIC METHODS BASED ON AERIAL PHOTOGRAPHY PERFORMED ON 08 MARCH 2005 BY SURVEYING AND MAPPING, INC. OF AUSTIN, TEXAS.
2. ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL (FT, MSL) AS DEFINED BY THE USGS NATIONAL GEODETIC VERTICAL DATUM (NGVD) OF 1929. STATE PLANE COORDINATE GRID CORRESPONDS TO TEXAS COORDINATE SYSTEM, SOUTH CENTRAL ZONE, NORTH AMERICAN DATUM (NAD) 1983.
3. PROPERTY BOUNDARY AND EASEMENT INFORMATION PROVIDED BY SURVEYING AND MAPPING INC., AUSTIN, TEXAS, DATED 23 MAY 2005.
4. PERMIT BOUNDARY AND PROPERTY BOUNDARY COINCIDE.
5. TOP OF FINAL COVER CONTOURS REFER TO PROPOSED FINISHED GRADE (TOP OF VEGETATIVE SOIL COMPONENT OF FINAL COVER SYSTEM).
6. REFER TO ATTACHMENT 6, FOR SURFACE WATER MANAGEMENT SYSTEM FEATURES ON FINAL COVER (NOT SHOWN ON THIS DRAWING FOR CLARITY).
7. △2 THE PORTIONS OF THE UNIT 1 GAS COLLECTION AND CONTROL SYSTEM (GCCS) FEATURES WITH NUMERICAL DESIGNATIONS ARE EXISTING. THESE EXISTING WELL LOCATIONS AND EXISTING PIPING CONNECTING THE WELLS WERE PROVIDED BY GOLDER ASSOCIATES IN JANUARY 2010. GAS EXTRACTION WELLS WITHOUT NUMERICAL DESIGNATIONS ARE PROPOSED.
8. THE GAS COLLECTION AND CONTROL SYSTEM (GCCS) FEATURES SHOWN ON THIS DRAWING ARE CONCEPTUAL TO PRESENT AN OVERVIEW OF THE ANTICIPATED GAS MANAGEMENT SYSTEM FEATURES. IN ACCORDANCE WITH FEDERAL AND STATE AIR REGULATIONS, A DETAILED NSPS GCCS DESIGN PLAN WILL BE PREPARED AFTER APPROVAL OF THIS SOLID WASTE PERMIT AMENDMENT APPLICATION, AND SUBMITTED TO THE APPROPRIATE REGULATORY AGENCY.

0 250' 500'
SCALE IN FEET

REV	DATE	DESCRIPTION	DRN	APP
△3	02/24/21	ELIMINATE UNIT 3	JJV	SMG
△2	08/26/10	ADDED GCCS VENTILATION TRENCHES AND CURRENT UNIT 1 GCCS LAYOUT	JJV	SMG
△1	08/08/08	REVISED SITE ENTRANCE	JJV	SMG
–	07/14/06	TECHNICALLY COMPLETE	JJV	SMG

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AUSTIN, TEXAS 78757
PHONE: 512.451.4003

TITLE:
PROPOSED CONCEPTUAL GCCS LAYOUT

PROJECT:
MESQUITE CREEK LANDFILL
PERMIT APPLICATION – PERMIT NO. MSW – 66 B

PROJECT NO.: GW7663	DESIGN BY: SMG	REVIEWED BY: MCC	PART NO.:	DRAWING NO.:
FILE: 0144–01	DRAWN BY: JJV	APPROVED BY: SMG	III	14–4

DRAWING: Austin P:\CADD\Projects\M\Mesquite Creek Landfill\Permit\Mod Elim Unit 3 (GW7663)\DRAWINGS\0144–01.dwg PLOTTED: Feb 26, 2021 – 12:33pm

Prepared for Applicant:
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PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN
ATTACHMENT 15

LEACHATE AND CONTAMINATED WATER PLAN

MESQUITE CREEK LANDFILL
NEW BRAUNFELS,
COMAL AND GUADALUPE COUNTIES, TEXAS
MSW PERMIT NO. 66B

Prepared by:
Geosyntec consultants

~~GeoSyntec Consultants~~
Texas Board of Professional Engineers Firm Registration No. F-1182
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Initial Application Submittal – 18 November 2005
Response to NOD 1 – 28 March 2006
Response to NOD 2 – 15 May 2006

1. PURPOSE AND SCOPE

The purpose of this Leachate and Contaminated Water Plan is to describe how leachate and contaminated water will be managed at the Mesquite Creek Landfill (the facility). The plan provides information on the collection, transmission, storage, and disposal of leachate and contaminated water generated during the active, inactive (if occurs – not anticipated), and post-closure periods of the landfill. This plan also provides a description of the leachate recirculation system, information on off-site disposal of leachate and contaminated water, and operational procedures that will be followed to ensure long-term functionality of the leachate and contaminated water management system.

The design details for the liner and leachate collection system are shown in Drawings 6-13 to 6-15 of Part III, Attachment 6 - Groundwater and Surface Water Protection Plan and Drainage Plan. The base grading plan and final cover grading plan are shown in Drawings 1-2 and 1-3, respectively, in Part III, Attachment 1 - Site Layout Plans.

2. LEACHATE, GAS CONDENSATE, AND CONTAMINATED WATER GENERATION

2.1. Generation Process

Leachate is a liquid that has passed through or emerged from solid waste and is generated in the normal course of operations of a municipal solid waste disposal facility. The quantity of leachate produced depends on the climate, type of cover, site topography, construction and land filling procedures, and waste characteristics.

Gas condensate is liquid generated as water vapor condenses within a landfill gas collection system. Gas condensate is currently collected at low points in the gas system and conveyed to on-site leachate storage tanks. As the facility is developed, gas condensate piping will be connected to the proposed leachate management system forcemain from Unit~~s~~ 1 ~~and 3 ~~to the leachate storage tanks or connected to the proposed leachate forcemain from Unit 2 to the leachate evaporation ponds. Information on the layout and details of the landfill gas management system, including details showing condensate pump stations and drains, are presented in Part III, Attachment 14 (see drawings 14-4 through 14-8). At the facility, gas condensate is managed in the same manner as leachate. Therefore, discussions in Sections 5 to 7 on management of leachate by storage and evaporation, recirculation, and off-site disposal are also applicable to gas condensate.

Contaminated water is water that has come into contact with waste, leachate, or gas condensate. Contaminated water is generated, for example, when storm-water runoff comes into contact with solid waste at the active face of the landfill. Contaminated water at the facility is managed similarly to leachate and gas condensate, except that contaminated water must be disposed of at an authorized facility (rather than using the leachate evaporation ponds), and recirculation of contaminated water (including contaminated water mixed with leachate) is not permitted.

2.2. Leachate Generation Modeling

Modeling of leachate generation rates was performed using the Hydrologic Evaluation of Landfill Performance (HELP) computer model (Version 3.07) developed by the U.S. Environmental Protection Agency (USEPA) (Schroeder et al., 1994a, 1994b).

The HELP program is a quasi two-dimensional hydrologic model of water movement across, into, through, and out of landfills. The program accepts climatologic, soil, and design data, and uses a solution technique that accounts for the effects of surface storage, runoff, infiltration, evapotranspiration, soil moisture storage, and vertical and lateral drainage.

Leachate generation was evaluated using HELP for active (initial and intermediate) and closed landfill conditions. Operating conditions with and without leachate recirculation were considered. An explanation of the landfill scenarios that were analyzed, a description of the input parameters that were used, and printouts of HELP model output are included in Attachment 15A (HELP Model Calculations, see Tables 15A-1 and 15A-2).

3. LEACHATE COLLECTION SYSTEM

3.1. System Layout

The proposed layout of the leachate collection system for the facility is shown on Drawing 15-1. Unit 1, Phases I and II were constructed under pre-Subtitle D regulations. Both phases have a clay liner, but only Phase II has a leachate collection system. In Phase II, the clay liner was graded to a leachate collection pipe located on the west perimeter of the phase. Leachate can also be removed from Phase II via two leachate manholes located along the pipe. A leachate pipe was also installed on the east perimeter of Phase II, between Phases I and II.

The remainder of the landfill is being constructed with a liner system meeting Subtitle D regulations. The liner and leachate collection system for Unit 1, Phases III and V has been constructed and waste is currently being placed in these phases. The design of the leachate collection system for these phases is detailed in Metroplex (2002). As requested by TCEQ, a copy of the Metroplex (2002) approved permit MSW-66A leachate collection system design is included in Attachment 15I of this attachment for completeness. There is no Unit 1, Phase IV. Unit~~s~~ 2 ~~and 3~~ has~~ve~~ not yet been constructed at the time this permit amendment application was filed.

The design of the proposed leachate collection system for Unit~~s~~ 2 ~~and 3~~ is detailed in Attachments 15A to 15H. Consistent with §330.200(a)(2) and §330.201, the layout and materials of the leachate collection system for Unit~~s~~ 2 ~~and 3~~ were selected to maintain less than 30 cm (12 in.) of head on the liner.

3.2. Leachate Drainage Layer

The proposed liner system for Unit~~s~~ 2 ~~and 3~~ includes a drainage layer for leachate collection. Leachate percolating through the waste will be collected in the drainage layer above the liner and will flow by gravity to a leachate collection corridor or sideslope chimney drain. As shown in Drawing 15-1, the leachate collection system on the floor of Unit 1, Phases III and V ~~and Unit 3~~ slopes at two percent (minimum) towards a leachate collection corridor or sideslope chimney drain. The floor of the Unit 2 phases slopes at five percent (minimum) towards a leachate collection corridor. The maximum drainage length along the floor is approximately 400 ft in Unit 1, Phases III and V~~,~~ and 250 ft in Unit 2~~, and 100 ft in Unit 3~~. The sideslopes of the units are configured at 33 percent (3H:1V) minimum, with a maximum drainage length of approximately 210 ft along the 3H:1V sideslopes.

The proposed leachate drainage layer on the cell floor and sideslope consists of a geosynthetic. The leachate drainage layer on the floor consists of a single-sided or double-sided geocomposite, while the leachate drainage layer on the sideslope consists of either a double-sided geocomposite or geotextile. Details for the leachate collection system and drainage layer are shown on Drawings 6-13 and 6-14 of Attachment 6 - Groundwater and Surface Water Protection Plan and Drainage Plan.

The HELP model was used to obtain the design transmissivity of the geosynthetic drainage layer based on maintaining less than 30 cm (12 in.) of head on the liner, as described in Attachment 15A - HELP Model Calculations. A factor of safety and additional reduction factors accounting for creep, clogging, and intrusion were applied to the design transmissivity to obtain the minimum specified transmissivity, as described in Attachment 15C - Geosynthetic Drainage Layer Design. The minimum specified transmissivity of the geosynthetic drainage layer is shown in Table 15-1.

TABLE 15-1. LEACHATE DRAINAGE LAYER TRANSMISSIVITY

Location	Index Transmissivity (m^2/s)[1]	Applied Stress (psf)	Hydraulic Gradient
Cell Floor	2.9×10^{-4} m^2/s	13,000	0.05
Sideslope	6.0×10^{-5} m^2/s	8,800	0.32

Note:

1. Index transmissivity is determined with the geosynthetic drainage layer sandwiched between two steel plates under the specified applied stress at the specified hydraulic gradient. Note that the index specified index transmissivity was derived accounting for site-specific long-term conditions, and then applying appropriate reduction factors and factors of safety (as described subsequently). An alternate specification that uses the 100-hour transmissivity values is presented in Attachment 15C.

3.3. Leachate Collection Corridor and Sideslope Chimney Drain

The proposed leachate collection corridors collect leachate from the floor drainage layer and convey it to the leachate collection sumps. A leachate collection corridor is centrally located within each phase of Unit 2 ~~and within Unit 3~~ and slopes at 1% towards a sump (Drawing 15-1). Two options for the leachate collection corridor are proposed (Drawing 6-13 in Attachment 6– Groundwater and Surface Water Protection Plan and Drainage Plan). Option 1 consists of granular drainage media encased within a geotextile filter. The granular drainage media (i.e., coarse aggregate) must (i) have a maximum particle size less than or equal to 3 in., (ii) have a minimum D_5 of 3/8 in., and (iii) contain less than 15% calcium carbonate. Option 1 for the leachate collection corridor does not contain a perforated pipe because the granular drainage media is calculated to be adequately permeable to convey the anticipated maximum flow rate of leachate to the collection sump. The granular material extends vertically through the protective cover layer to create a chimney drain to allow leachate to more easily flow into the corridor.

Option 2 for the proposed leachate collection corridor consists of a perforated 6-in. diameter HDPE SDR-11 pipe embedded within a granular drainage media encased within a geotextile filter. The strength of the proposed leachate collection pipe is evaluated in Attachment 15G. The granular drainage media for the Option 2 detail must meet the same criteria specified for the Option 1 detail. Because flow is primarily conveyed in the pipe in Option 2, less granular drainage media is required for Option 2 than for Option 1. The pipe perforations are sized to be resistant to clogging based on their diameter compared to the surrounding granular material gradation. The granular material extends vertically through the protective cover layer to create a chimney drain to allow leachate to more easily flow into the corridor. As discussed subsequently in Section 4.1 of this plan, the leachate collection pipes will include cleanout access points around the perimeter (see Attachment 6, Drawing 6-14, Detail 34).

The proposed sideslope chimney drains collect leachate from the sideslope drainage layer and convey it to the leachate collection corridors or the leachate collection sumps. The sideslope chimney drains is located along the toe of slope of sideslopes around the perimeter of the waste footprint in Unit~~s~~ 2 ~~and 3~~ (Drawing 15-1). Like the proposed leachate collection corridors, the proposed sideslope chimney drains have a minimum slope of 1%, consist of the same granular drainage material encased within a geotextile filter, can be constructed with or without a perforated 6-in. diameter HDPE SDR-11 pipe, and extend vertically through the protective cover layer to create a chimney drain.

The leachate collection corridors and sideslope chimney drains are designed to convey the peak daily volumetric flow rates of leachate they are expected to collect. Attachment 15B – Leachate Volumetric Flow Rate Calculations presents the expected volumetric flow rates of leachate for each development phase. Calculations supporting the leachate collection corridor and sideslope chimney drain design and drainage media specifications are provided in Attachment 15D – Leachate switch on if the leachate depth in the sump reaches approximately 4 ft (corresponding to the depth of the sump). The recommended pumping rate for Unit~~s~~ 2 ~~and 3~~ will be between 10 gallons per minute (gpm) and 200 gpm and will be selected based on field conditions and expected/actual peak leachate flow rates. Expected leachate flow rates are presented in Attachment 15B – Leachate Volumetric Flow Rate Calculations.

4.2. Leachate Forcemain

An existing forcemain system serves Unit 1, Phase III, Cell 2 and Phase V and conveys leachate from the sumps in these phases to the existing leachate storage tanks (Drawing 15-1). The forcemain system consists of a 4-in. (nominal) diameter HDPE carrier pipe and an 8-in. (nominal) diameter HDPE secondary containment pipe. A leachate forcemain is proposed to connect the Unit 2 phases to the proposed leachate evaporation ponds (Drawing 15-1). A forcemain may also be extended from ~~Unit 3 and/or~~ Phase III, Cell 2 to the leachate storage tanks or from the leachate storage tanks to the leachate evaporation ponds to facilitate leachate management at the facility. The proposed forcemain layout is shown the conceptual leachate management system plan in Drawing 15-1. Details of the leachate transmission system are shown in Drawings 15-2 and 15-3.

All proposed forcemain components will be made from materials, such as HDPE, that are chemically resistant to leachate. The forcemain will consist of an HDPE carrier pipe with secondary containment. Secondary containment may consist of a larger diameter containment pipe or secondary containment may be achieved by installing the carrier pipe within the lined disposal area.

If the system head of the leachate transmission system increases in the future to levels that cause excess flow resistance, additional flow capacity may be added to the existing forcemain system by increasing the carrier pipe diameter to 6 in. or 8 in. (nominal), by spacing pump stations along the forcemain system, or by installing a parallel forcemain system. Manholes may be installed to provide adequate maintenance access for the system.

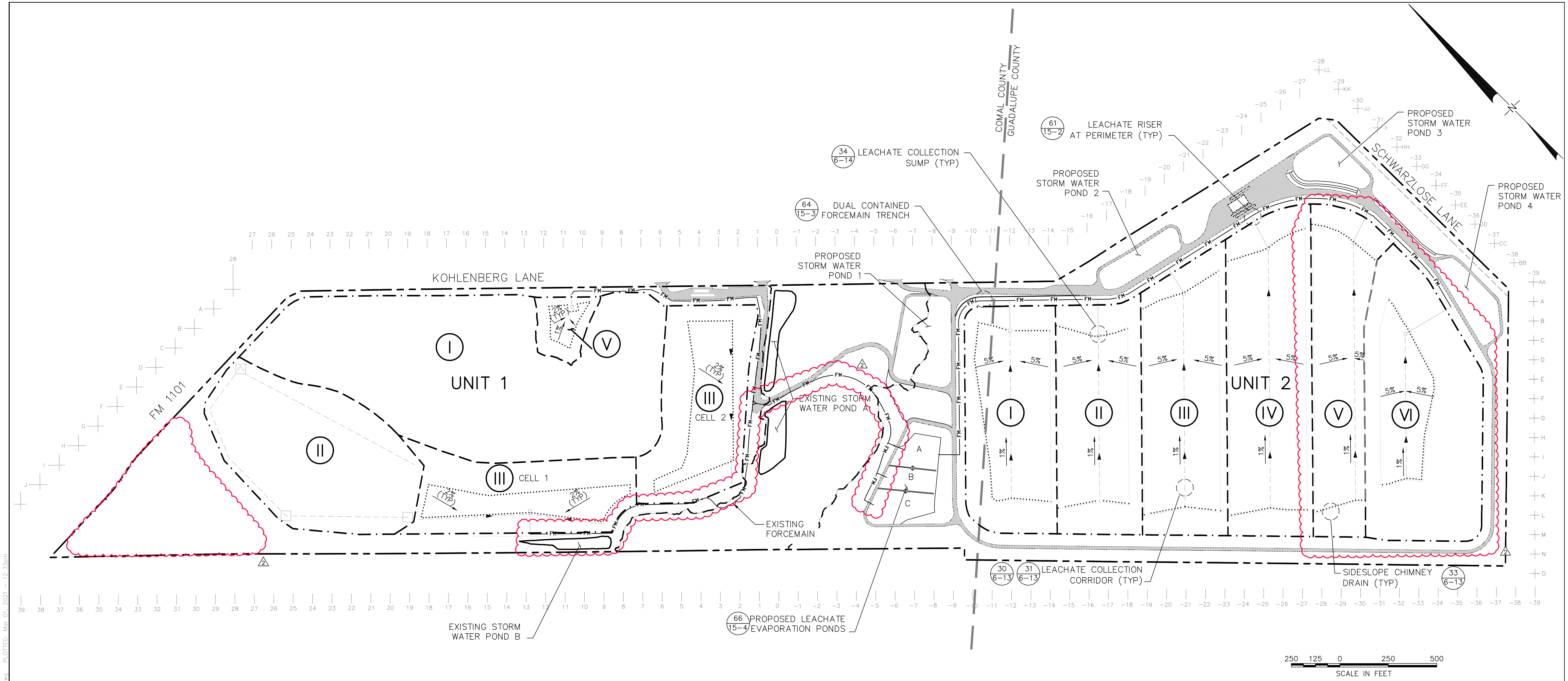
5. LEACHATE AND CONTAMINATED WATER STORAGE

Leachate and contaminated water generated at the facility is currently discharged into two 18,000-gallon leachate storage tanks located southwest of Unit 1, Phase III, Cell 2 (Drawing 15-1). These tanks will continue to be utilized for leachate and contaminated water storage for Unit 1~~ and for Unit 3, after it is constructed~~. Refer to Section 7 for leachate and contaminated water disposal requirements.

Leachate evaporation ponds A, B, and C are proposed to provide leachate storage and evaporation for Unit~~s~~ 1~~ to 3~~. Contaminated water shall not be placed in the leachate evaporation

DRAWINGS

- Drawing 15-1 Conceptual Leachate Management System Plan
- Drawing 15-2 Leachate Collection and Transmission System Details 1
- Drawing 15-3 Leachate Collection and Transmission System Details 2
- Drawing 15-4 Proposed Leachate Evaporation Pond Plan
- Drawing 15-5 Leachate Evaporation Pond Details



LEGEND

LIMIT OF WASTE
PROPOSED PERIMETER ACCESS ROAD
UNIT 1, PHASE II LEACHATE COLLECTION PIPE AND MANHOLE
UNIT 1, PHASE II LEACHATE RISER
LEACHATE COLLECTION SYSTEM CORRIDOR
LEACHATE COLLECTION SUMP AND RISER PIPE
LEACHATE FORCEMAIN
SIDESLOPE CHIMNEY DRAIN
PHASE BOUNDARY
PHASE DESIGNATION
PROPERTY BOUNDARY (NOTE 4)
SITE GRID
FREEDOM LAKE FLOOD POOL (NOTE 5)

OVERVIEW:

UNIT 1 HAS BEEN CONSTRUCTED. UNIT 1, PHASES I AND II HAVE PRE–SUBTITLE D CLAY LINERS WITHOUT LEACHATE COLLECTION SYSTEMS EXCEPT FOR THE PIPING AND MANHOLES SHOWN. THERE IS NO UNIT I, PHASE IV. ALL OTHER PHASES OF UNITS 1 AND 2 HAVE SUBTITLE D LINER SYSTEMS. △2

NOTES:

1. DUAL CONTAINMENT PIPING TO BE USED FOR ALL LEACHATE FORCEMAIN PIPELINES, UNLESS CARRIER PIPE IS PLACED WITHIN LINED FOOTPRINT.
2. UNIT 1 LEACHATE IS ROUTED INTO EXISTING LEACHATE EVAPORATION PONDS VIA FORCEMAIN PIPING OR DISPOSED OF AT AN AUTHORIZED FACILITY. △2
3. AIR RELEASE MANHOLES MAY BE PLACED PERIODICALLY AT HIGH POINTS ALONG THE FORCEMAIN ALIGNMENT. LEAK DETECTION SUMPS MAY BE PLACED PERIODICALLY AT LOW POINTS ALONG FORCEMAIN.
4. PERMIT BOUNDARY AND PROPERTY BOUNDARY COINCIDE.
5. THERE ARE NO FEMA–DESIGNATED 100–YEAR FLOODPLAIN AREAS WITHIN THE PERMITTED FACILITY AS DOCUMENTED IN PARTS I/II, FIGURE I/II–13. HOWEVER, THE DOWNSTREAM FREEDOM LAKE FLOOD POOL ELEVATION IS 605.1 FT, MSL ACCORDING TO THE YORK CREEK WATERSHED CONSERVATION DISTRICT. AS SHOWN, NEITHER THE EXISTING NOR THE PROPOSED LANDFILL ENCROACHES ON THE FREEDOM LAKE FLOOD POOL AREAS. STORM WATER PONDS IN THE FLOOD POOL AREA DO NOT ADVERSELY ALTER THE FLOOD POOL BECAUSE STORM WATER WILL BACKFLOW THROUGH THE PRINCIPAL SPILLWAY PIPES DURING A FLOOD EVENT.

MARK	DATE	REVISION	BY	APPROVED
△2	02/24/2021	ELIMINATE UNIT 3	JJV	SMG
△1	08/08/2008	REVISED SITE ENTRANCE	SMG	SMG
–	07/14/2006	TECHNICALLY COMPLETE	SMG	SMG
–	03/28/2006	RESPONSE TO NOD 1	SMG	SMG
–	11/18/2005	INITIAL SUBMITTAL TO TCEQ	SMG	SMG

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PROJECT:
MESQUITE CREEK LANDFILL
PERMIT APPLICATION – PERMIT NO. MSW – 66 B

TITLE:
CONCEPTUAL LEACHATE MANAGEMENT SYSTEM PLAN

PROJECT NO.: GT3435–03
FILE NO.: 3435–052
DRAWN BY: JJV
CHECKED BY: SMG
REVIEWED BY: BAG
APPROVED BY: SMG
PART NO. III
FIGURE NO: 15–1

ATTACHMENT 15G

LEACHATE COLLECTION PIPE AND RISER PIPE STRENGTH DESIGN

Written by: Partha Sharma/ Lorenzo Peve
Date: 05 /09 /-02 21 /01 /08 (YY MM DD)
Reviewed by: Beth Gross/ S. Graves
Date: 05 /-09 /-14 21 /02 /24 (YY MM DD)

Client: WMTX
Project: Mesquite Creek Landfill
Project/Proposal No.: GT3454
Task No: 4

LEACHATE COLLECTION PIPE AND RISER PIPE STRENGTH DESIGN

INTRODUCTION

The purpose of this analysis is to evaluate the ability of the leachate collection and riser pipes for Unit~~s~~ 2 ~~and 3~~ of Mesquite Creek Landfill (i.e., the units that have not yet been constructed) to resist applied loads with adequate factors of safety. The leachate collection pipes within these landfill phases will be 6” diameter standard dimension ratio (SDR) 11 (maximum) perforated high density polyethylene (HDPE). The riser pipes within these phases will be 18” diameter (minimum) SDR 17 (maximum) HDPE.

The function of leachate collection pipes is to convey leachate collected by the leachate drainage layer to the sump. The leachate collection pipes must have adequate structural resistance to withstand the loads applied on it. The locations for the proposed leachate collection pipes are shown on Drawing 15-1.

The riser pipes will extend from the sumps to the top of the perimeter sideslope. A pump will be placed inside the riser pipe in the sump to transfer the leachate from the sump to the leachate transmission system (LTS) forcemain. The riser pipe must have adequate structural resistance to withstand the loads applied on it. The locations for the proposed leachate riser pipes are shown on Drawing 15-1.

METHODS OF ANALYSES

Four potential strength failure mechanisms are for plastic pipes are: (i) wall crushing; (ii) wall buckling; (iii) excessive ring deflection; and (iv) excessive bending strain. These mechanisms are evaluated below using methods presented in the technical literature for flexible plastic pipes [Uni-Bell PVC Pipe Association (Unibell), 1991; Chevron Phillips Chemical Company (CPChem), 2002]. The design methods for flexible plastic pipe are applicable for both PVC and HDPE pipes (U.S. Army Corps of Engineers, 1997).

Stress on Leachate Collection Pipe and Riser Pipe

Stresses applied to the pipes are estimated for the post-closure condition. Stresses during construction are expected to be significantly lower than the post-closure stresses. During the post-closure condition, the stress applied to the pipe is due to the overburden materials above the pipe (i.e., waste material and daily, intermediate, and final cover soils). This stress is calculated as follows:

$$\sigma_{\max} = \gamma_p D_p \qquad \text{(Eqn. 1)}$$

where:

σ_{max} = stress on the pipe, psf;
γ_p = average unit weight of the overburden materials, pcf; and
D_p = thickness of the overburden materials, ft.

The influence of holes on the pipe stress is not normally accounted for in the design process (Bonaparte et al., 2002) and is not done so here. Instead, perforation locations that have been demonstrated to be less critical in terms of stress concentrations (Brachman and Krushelnitzky, 2002) have been specified (i.e., perforations are located at the pipe shoulders and haunches).

The structural resistance of the 6" diameter leachate collection pipe is evaluated under loading from 190 ft of waste (the greatest waste thickness) and liner system and cover system materials.

The structural resistance of the 18" diameter leachate riser pipe is evaluated under loading from ~~140~~ 147 ft of waste (the greatest waste thickness at sump) and liner system and cover system materials.

Wall Crushing

Wall crushing can occur when the stress in the pipe wall, due to external vertical pressure, exceeds the compressive strength of the pipe material. The factor of safety against pipe wall crushing may be calculated using the following equation:

$$\mathrm{FS_{wc}} = \frac{2\sigma_y}{(\mathrm{SDR}-1)\sigma_{\max}} \qquad \text{(Eqn. 2)}$$

where:

FS_{wc} = factor of safety against pipe wall crushing;
σ_y = compressive yield strength of the pipe, psf;
SDR = standard dimension ratio of the pipe; and
σ_{max} = maximum stress applied to the pipe, psf.

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18”ϕ SDR 17 HDPE Riser Pipe

σ_y = compressive yield strength of the pipe = 216,000 psf (Phillips 66, 1991)

B_c = nominal outer diameter = 18.0 in. (CPChem, 2002)

t = minimum wall thickness = 1.059 in. (CPChem, 2002)

B_i = average inner diameter = 15.755 in. (CPChem, 2002)

Post-Closure Stress Condition:

γ_p = ~~63~~ 63.4 pcf (average unit weight of overburden material and waste based on Appendix 15C-I in Attachment 15C)

D_p = ~~140~~147 ft

$\sigma_{max} = \gamma_p * D_p$

σ_{max} = ~~63 pcf * 140 ft~~63.4 pcf * 147 ft

σ_{max} = ~~8,820~~9,320 psf = ~~61~~ 65 psi

Wall Crushing:

σ_y = compressive yield strength of the pipe = 216,000 psf [Phillips 66, 1991]

σ_{max} = ~~8,820~~9,320 psf

SDR = standard dimension ratio of the pipe = 17

$FS_{wc} = 2 * \sigma_y / (SDR - 1) / \sigma_{max}$

FS_{wc} = 2 * 216,000 psf / (17 – 1) / ~~8,820~~9,320 psf

FS_{wc} = ~~3.0~~2.9

Wall Buckling (Granular Bedding Material Option):

σ_{max} = ~~8,820~~9,320 psf = ~~61~~ 65 psi

From Table 1, for SW/GW bedding material at 85% D698 at 60 psi stress level:

E_s = 4700 psi

ν = 0.28

$M_s = E_s(1 - \nu)/(1 + \nu)/(1 - 2\nu)$

M_s = 4700 psi (1 - 0.28)/(1 + 0.28)/(1 - 2*0.28)

M_s = 6009 psi

$E' = k * M_s$

E’ = 1.5 * 6009 psi

E’ = 9013 psi

Determine E from Figure 1 based on tensile stress, S_A:

$S_A = (SDR – 1)\ \sigma_{max} /2$

S_A = (17 – 1) ~~8,820~~9,320 psf /2

S_A = ~~70,560~~74,560 psf = ~~490 psi~~518 psi

From Fig. 1, at S_A = ~~490 psi~~518 psi, E = modulus of elasticity of the pipe material = ~~19,000~~18,850 psi at 50 years.

SDR = standard dimension ratio of the pipe = 17

$FS_{WB} = 1.2 / \sigma_{max}\ [E'E / (SDR)^3]^{0.5}$

FS_{WB} = 1.2/~~61~~ 65 psi [9,013 psi * ~~19,000~~18,850 psi / $(17)^3]^{0.5}$

FS_{WB} = ~~3.7~~3.4

Wall Buckling (Clayey Bedding Material Option):

σ_{max} = ~~8,820~~9,320 psf = ~~61~~ 65 psi

From Table 1, for clayey soil at 85% D698 at 60 psi stress level:

$E_s = 800$ psi

$\nu = 0.40$

$M_s = E_s(1 - \nu)/(1 + \nu)/(1 - 2\nu)$

M_s = 800 psi (1 - 0.40)/(1 + 0.40)/(1 - 2*0.40)

M_s = 1714 psi

E’ = k * M_s

E’ = 1.5 * 1714 psi

E’ = 2571 psi

Determine E from Figure 1 based on tensile stress, S_A:

$S_A = (SDR – 1)\sigma_{max}/2$

S_A = (11 – 1) ~~8,820~~9,320 psf /2

S_A = ~~44,100~~46,600 psf = ~~306~~ 324 psi

From Fig. 1, at S_A = ~~306~~ 324 psi, E = modulus of elasticity of the pipe material = ~~24,000~~23,850 psi

SDR = standard dimension ratio of the pipe = 11 (max for clayey bedding material option)

$FS_{WB} = 1.2 / \sigma_{max}\ [E'E / (SDR)^3]^{0.5}$

FS_{WB} = 1.2/~~61~~ 65 psi [2571 psi * ~~24,000~~23,850 psi / $(11)^3]^{0.5}$

FS_{WB} = ~~4.2~~4.0

Ring Deflection, Granular Bedding Material:

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$$\Delta X = \frac{D_L K W_c}{\left(EI/r^3\right) + \left(0.061E'\right)}$$

Input parameters:

D_L	1.25	
K	0.11	
W_c	1,096	lb/in.
γ_{avg}	63	pcf
d_c	140	ft
E	19,000	psi
E'	9013	psi
Pipe/HDPE:		
SDR	17	
D_{od}	17.9	in.
I	0.09897	$in.^4/in.$
t_{min}	1.059	in.
r_{mean}	8.42	in.

Change in diameter, ΔX = 0.27 in.

Ring deflection, ΔX% = 1.52 %

ΔX = maximum horizontal deflection or change in diameter, in;
D_L = deflection lag factor (assume 1.25) [Wilson-Fahmy and Koerner, 1994];
K = bedding constant (0º => 0.110) [Wilson-Fahmy and Koerner, 1994; Figure 2]
W_c = Marston's prism load per unit length of pipe, lb/in. [Wilson -Fahmy and Koerner, 1994]
= $(\gamma_{avg})(d_c)(D_{od})$;
γ_{avg} = average unit weight of overlying materials (waste, liner and cover), pcf;
d_c = Maximum thickness of overlying materials, ft;
E = Long-term modulus of elasticity of the pipe material [Phillips 66, 1991], psi;
E' = the modulus of soil reaction for pipe bedding material [Selig, 1990], psi;
D_{od} = outer diameter of pipe, in [CPChem, 2002];
I = the moment of inertia of the pipe wall per unit length ($t_{min}^3/12$), $in.^4/in.$;
t_{min} = minimum thickness, in. [CPChem, 2002]
r_{mean} = mean radius = $(D_{od} - t_{min})/2$, in.
ΔX% = the ring deflection, %.
= $100(\Delta X/D_{od})$

Allowable ring deflection, ΔX%: 5.0% - [CPChem, 2002]

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$$\Delta X = \frac{D_L K W_c}{\left(EI / r^3\right) + \left(0.061E'\right)}$$

Input parameters:

D_L	1.25	
K	0.11	
W_c	1,165	lb/in.
γ_{avg}	63.4	pcf
d_c	147	ft
E	18,850	psi
E'	9013	psi
Pipe/HDPE:		
SDR	17	
D_{od}	18	in.
I	0.09897	in.^{4}/in.
t_{min}	1.059	in.
r_{mean}	8.47	in.

ΔX = maximum horizontal deflection or change in diameter, in;
D_L = deflection lag factor (assume 1.25) [Wilson-Fahmy and Koerner, 1994];
K = bedding constant (0° => 0.110) [Wilson-Fahmy and Koerner, 1994; Figure 2]
W_c = Marston's prism load per unit length of pipe, lb/in. [Wilson-Fahmy and Koerner, 1994]
= (γ_{avg}) (d_c) (D_{od});
γ_{avg} = average unit weight of overlying materials (waste, liner and cover), pcf;
d_c = Maximum thickness of overlying materials, ft;
E = Long-term modulus of elasticity of the pipe material [Phillips 66, 1991], psi;
E' = the modulus of soil reaction for pipe bedding material [Selig, 1990], psi;
D_{od} = outer diameter of pipe, in [CPChem, 2002];
I = the moment of inertia of the pipe wall per unit length (t_{min}^3/12), in.^{4}/in.;
t_{min} = minimum thickness, in. [CPChem, 2002]
r_{mean} = mean radius = (D_{od} - t_{min})/2 , in.
ΔX% = the ring deflection, %.
= 100(ΔX/D_{od})

Change in diameter, ΔX = 0.29 in.

Ring deflection, ΔX% = 1.61 %

Allowable ring deflection, ΔX%: 7.5% - [CPChem, 2002]

Bending Strain, Granular Bedding Material:

$$\varepsilon_b = 6 \cdot \frac{t \cdot \Delta y}{D^2}$$

ε_b = Bending strain, %;
t = wall thickness, in.;
Δy =Vertical deflection, in.
= ΔX
D = diameter;
= Mean diameter (D_{od}-t_{min}), in.

t	1.059	in.
Δy	0.273	in.
D	16.84	in.

Bending strain, ε_b = 0.61 %

Allowable wall ring bending strain: from 4.2 to 8% (8% for 50 year design life) - [CPChem, 2002]

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$$\boxed{\varepsilon_b = 6 \cdot \frac{t \cdot \Delta y}{D^2}}$$

ε_b = Bending strain, %;
t = wall thickness, in.;
Δy =Vertical deflection, in.
= ΔX
D = diameter;
= Mean diameter (D_{od}-t_{min}), in.

t	1.059	in.
Δy	0.290	in.
D	16.94	in.

Bending strain, ε_b = 0.64 %

Allowable wall ring bending strain: from 4.2 to 8% (8% for 50 year design life) - [CPChem, 2002]

Ring Deflection, Clayey Bedding Material:

$$\boxed{\Delta X = \frac{D_L K W_c}{\left(EI / r^3\right) + \left(0.061E'\right)}}$$

Input parameters:

D_L	1.25	
K	0.11	
W_c	1,103	lb/in.
γ_{avg}	63	pcf
d_c	140	ft
E	24,000	psi
E'	2571	psi
Pipe/HDPE:		
SDR	11	
D_{od}	18	in.
I	0.36490	in.^{4}/in.
t_{min}	1.636	in.
r_{mean}	8.18	in.

ΔX = maximum horizontal deflection or change in diameter, in;
D_L = deflection lag factor (assume 1.25) [Wilson-Fahmy and Koerner, 1994];
K = bedding constant (0° => 0.110) [Wilson-Fahmy and Koerner, 1994; Figure 2]
W_c = Marston's prism load per unit length of pipe, lb/in. [Wilson -Fahmy and Koerner, 1994]
= (γ_{avg}) (d_c) (D_{od});
γ_{avg} = average unit weight of overlying materials (waste, liner and cover), pcf;
d_c = Maximum thickness of overlying materials, ft;
E = Long-term modulus of elasticity of the pipe material [Phillips 66, 1991], psi;
E' = the modulus of soil reaction for pipe bedding material [Selig, 1990], psi;
D_{od} = outer diameter of pipe, in [CPChem, 2002];
I = the moment of inertia of the pipe wall per unit length (t_{min}^3/12), in.^{4}/in.;
t_{min} = minimum thickness, in. [CPChem, 2002]
r_{mean} = mean radius = (D_{od} - t_{min})/2 , in.
ΔX% = the ring deflection, %.
= 100(ΔX/D_{od})

Change in diameter, ΔX = 0.88 in.

Ring deflection, ΔX% = 4.87 %

Allowable ring deflection, ΔX%: 5.0% - [CPChem, 2002]

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$$\Delta X = \frac{D_L K W_c}{\left(EI/r^3\right) + \left(0.061E'\right)}$$

Input parameters:

D_L	1.25	
K	0.11	
W_c	1,165	lb/in.
γ_{avg}	63.4	pcf
d_c	147	ft
E	23,850	psi
E'	2571	psi
Pipe/HDPE:		
SDR	11	
D_{od}	18	in.
I	0.36490	in.^{4}/in.
t_{min}	1.636	in.
r_{mean}	8.18	in.

ΔX = maximum horizontal deflection or change in diameter, in;
D_L = deflection lag factor (assume 1.25) [Wilson-Fahmy and Koerner, 1994];
K = bedding constant (0° => 0.110) [Wilson-Fahmy and Koerner, 1994; Figure 2]
W_c = Marston's prism load per unit length of pipe, lb/in. [Wilson-Fahmy and Koerner, 1994]
= (γ_{avg}) (d_c) (D_{od});
γ_{avg} = average unit weight of overlying materials (waste, liner and cover), pcf;
d_c = Maximum thickness of overlying materials, ft;
E = Long-term modulus of elasticity of the pipe material [Phillips 66, 1991], psi;
E' = the modulus of soil reaction for pipe bedding material [Selig, 1990], psi;
D_{od} = outer diameter of pipe, in [CPChem, 2002];
I = the moment of inertia of the pipe wall per unit length (t_{min}^3/12), in.^{4}/in.;
t_{min} = minimum thickness, in. [CPChem, 2002]
r_{mean} = mean radius = (D_{od} - t_{min})/2 , in.
ΔX% = the ring deflection, %.
= 100(ΔX/D_{od})

Change in diameter, ΔX = 0.93 in.

Ring deflection, ΔX% = 5.15 %

Allowable ring deflection, ΔX%: 7.5% - [CPChem, 2002]

Bending Strain, Clayey Bedding Material:

Calculate the pipe wall bending strain, ε_b.

$$\varepsilon_b = 6 \cdot \frac{t \cdot \Delta y}{D^2}$$

ε_b = Bending strain, %;
t = wall thickness, in.;
Δy =Vertical deflection, in.
= ΔX
D = diameter;
= Mean diameter (D_{od}-t_{min}), in.

t	1.636	in.
Δy	0.877	in.
D	16.36	in.

Bending strain, ε_b = 3.22 %

Allowable wall ring bending strain: from 4.2 to 8% (8% for 50 year design life) - [CPChem, 2002]

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$$\varepsilon_b = 6 \cdot \frac{t \cdot \Delta y}{D^2}$$

ε_b = Bending strain, %;
t = wall thickness, in.;
Δy = Vertical deflection, in.
= ΔX
D = diameter;
= Mean diameter (D_{od}-t_{min}), in.

t	1.636	in.
Δy	0.927	in.
D	16.36	in.

Bending strain, ε_b = 3.40 %

Allowable wall ring bending strain: from 4.2 to 8% (8% for 50 year design life) - [CPChem, 2002]

SUMMARY AND CONCLUSIONS

6”ϕ SDR 11 HDPE Leachate Collection Pipe

- Factor of safety against pipe wall crushing, FS_{wc} = 3.3 (OK)
- Factor of safety against pipe wall buckling, FS_{wb} = 4.9 (OK)
- Ring deflection = 2.2 percent (OK)
- Bending strain = 1.5 percent (OK)

18”ϕ SDR 17 HDPE Leachate Riser Pipe (granular bedding)

- Factor of safety against pipe wall crushing, FS_{wc} = ~~3.0~~2.9 (OK)
- Factor of safety against pipe wall buckling, FS_{wb} = ~~3.7~~3.4 (OK)
- Ring deflection = ~~1.5~~1.6 percent (OK)
- Bending strain = 0.6 percent (OK)

18”ϕ SDR 11 HDPE Leachate Riser Pipe (clayey bedding)

- Factor of safety against pipe wall crushing, FS_{wc} > ~~3.0~~2.9 (OK)
- Factor of safety against pipe wall buckling FS_{wb} = ~~4.2~~4.0 (OK)
- Ring deflection = ~~4.9~~5.2 percent (OK)
- Bending strain = ~~3.2~~3.4 percent (OK)

Based on the above results, the specified pipes are anticipated to perform as designed.

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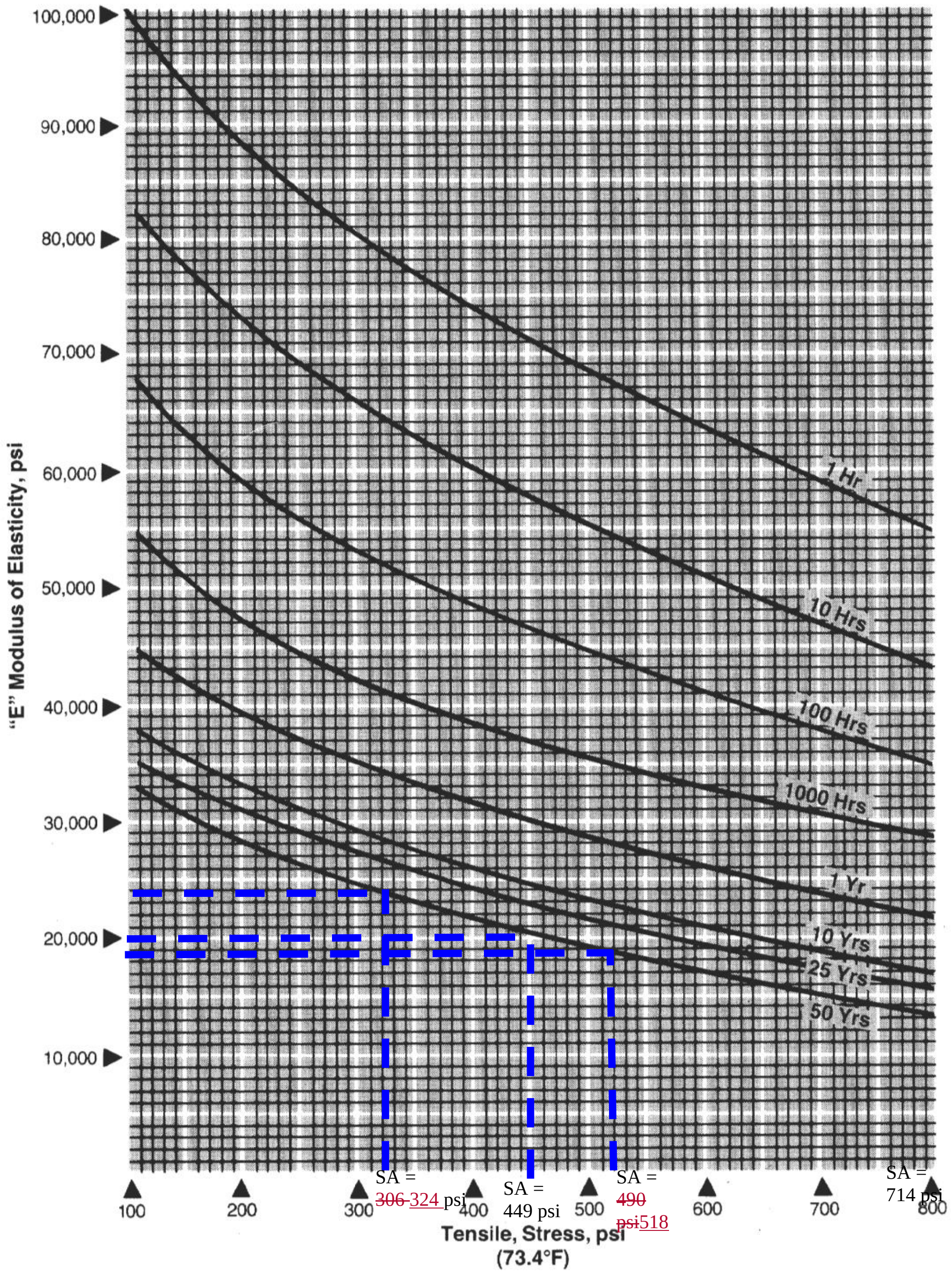

Figure 1. Time Dependent Modulus of Elasticity for Polyethylene Pipe (from Phillips 66, 1991)

ATTACHMENT 4

UNMARKED REVISED (and ADDED) PAGES

(REPLACEMENT PAGES)

The items that follow are to completely replace the previous versions (along with new additions, as noted below).

Application Item	**Replacement/Added Pages**
Part I/II, Report	Cover, Table of Contents (TOC), 3
Part I/II, Figures	Cover, Figure I/II-3, 5, 6, 11, 13
Part III, Site Development Plan	Cover, TOC, 1, 3, 4, 6, 7, 9, 15, Appendix III-A (Full Replacement), Appendix III-B (Cover)
Part III, Attachment 1, Drawings	Cover, Drawing 1-1 – 1-3
Part III, Attachment 2, Drawings	Cover, Drawing 2-1 – 2-6
Part III, Attachment 4 Geology Report	Cover, TOC, 28 – 31
Part III, Attachment 4, Appendix 4-F Stability	Full Replacement except Appendix 4F-3
Part III, Attachment 5 Groundwater Characterization Report	Cover, TOC, 1, 10, 11
Part III, Attachment 5, Drawings	Cover, Drawing 5-1, 5-1A, 5-1B
Part III, Attachment 6, Surface Water Report	Cover, TOC, 3 – 7
Part III, Attachment 6, Drawings	Cover, Drawing 6-1, 4, 5, 11, 15
Part III, Attachment 6, Attachment 6J	Attachment Added
Part III, Attachment 7, Drawings	Cover, Drawing 1-3, 6-1
Part III, Attachment 10, SLQCP	Cover, TOC, 4, 40, 60
Part III, Attachment 12 Closure Plan	Cover, TOC, 2 – 4
Part III, Attachment 14 Landfill Gas Management Plan	Cover, TOC, 7, 8, 12, 13, 15
Part III, Attachment 14, Drawings	Cover, Drawing 14-1, 2, 4
Part III, Attachment 15 Leachate and Contaminated Water Plan	Cover, TOC, 1 – 4, 6
Part III, Attachment 15, Drawings	Cover, Drawing 15-1
Part III, Attachment 15, Appendix 15G	Cover, 1 – 12, 17