Prepared for Applicant:
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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
Texas Board of Professional Geoscientists Firm Registration No. 50256
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Technically Complete – 14 July 2006
Revised – 11 February 2010, 24 February 2021

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02/24/2021

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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 1) 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 1, 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 Unit 2). Both segments of the point of compliance are located down-gradient of the corresponding MSWLF Unit 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 1)

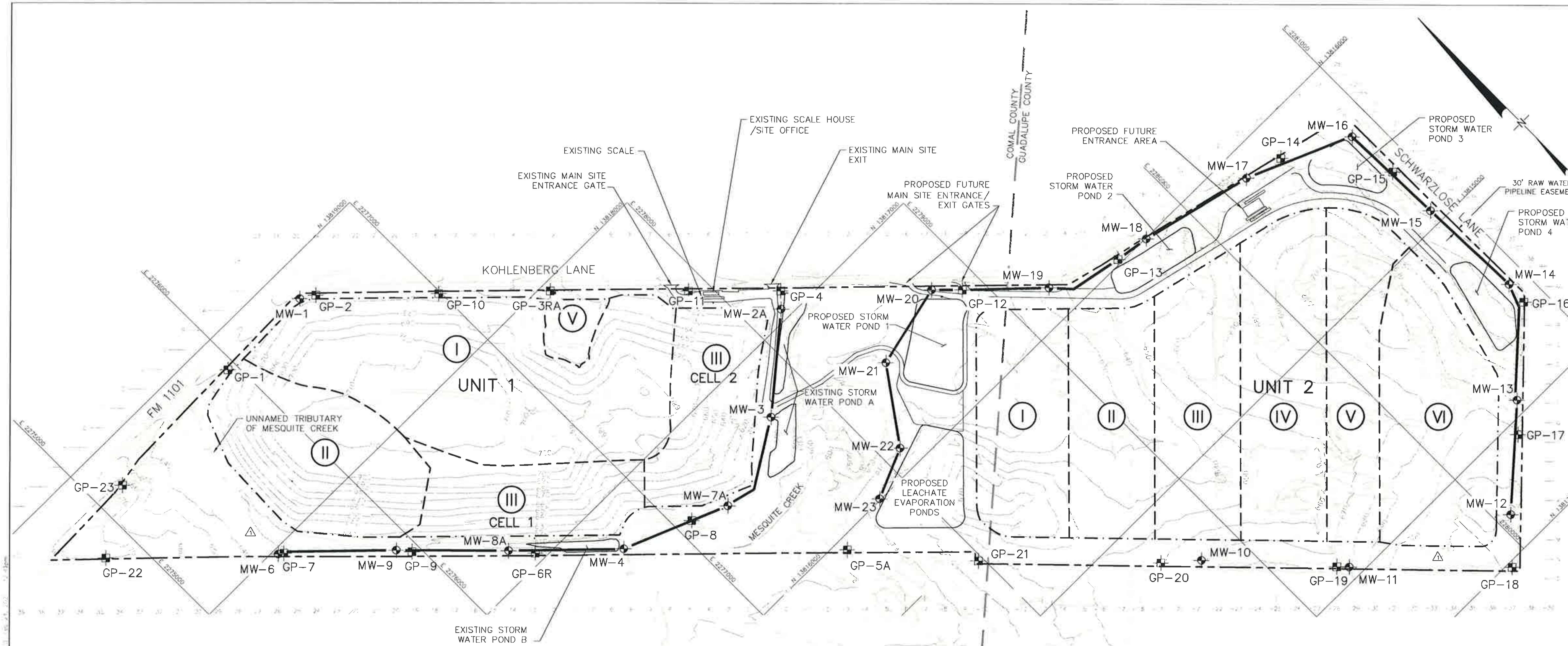
The existing facility (Unit 1) monitoring network is composed of seven monitoring wells; MW-1, MW-2, MW-3, MW-4, MW-6, MW-7, and MW-8. Currently permitted MW-7 and MW-8 are proposed to be plugged and abandoned for this permit amendment. Three new monitoring wells, MW-7A, MW-8A, and MW-9 are proposed 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 1) 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

- 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
- 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

STATE OF TEXAS
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02/24/2021

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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	-	-

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Geosyntec consultants
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AUSTIN, TEXAS 78757
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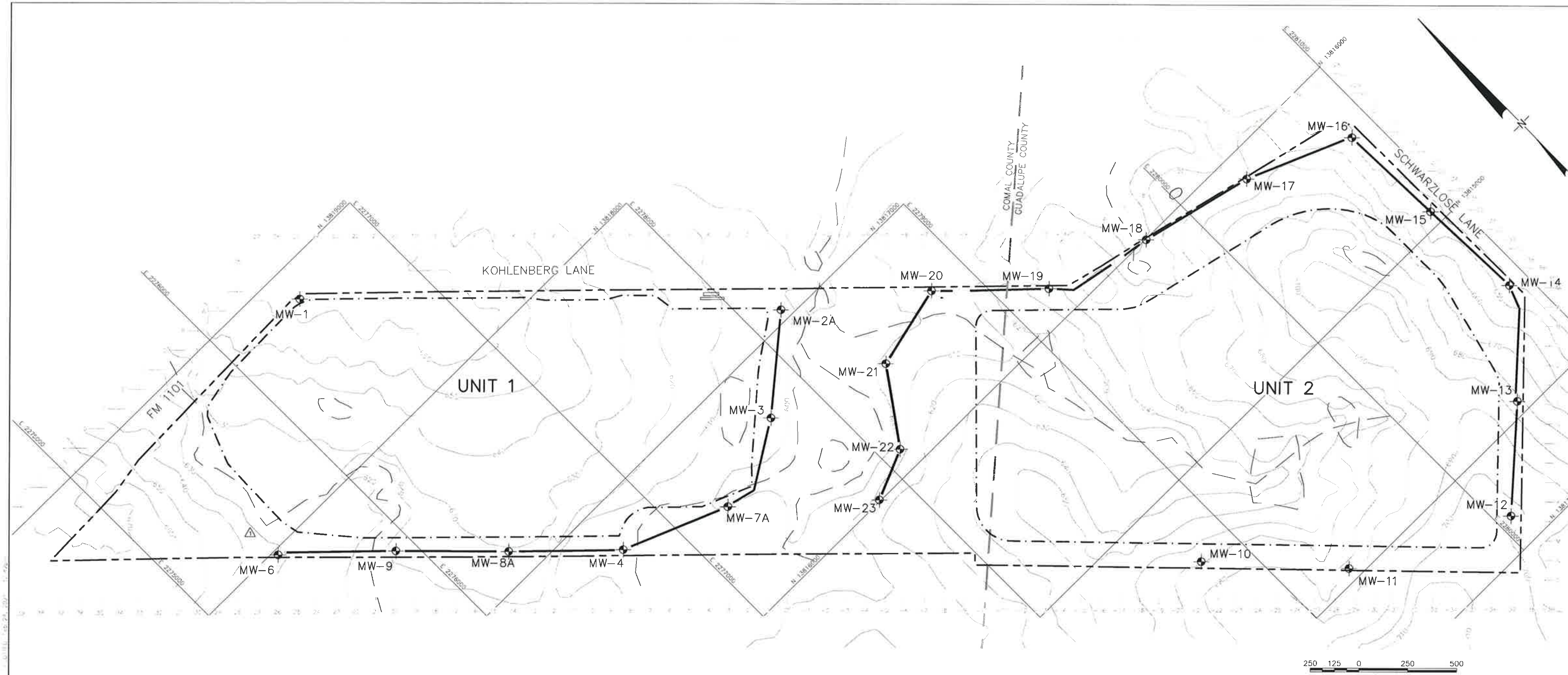
PROJECT: MESQUITE CREEK LANDFILL
PERMIT APPLICATION – PERMIT NO. MSW – 66 B

TITLE: **PROPOSED GROUNDWATER MONITORING NETWORK**

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



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02/24/2021

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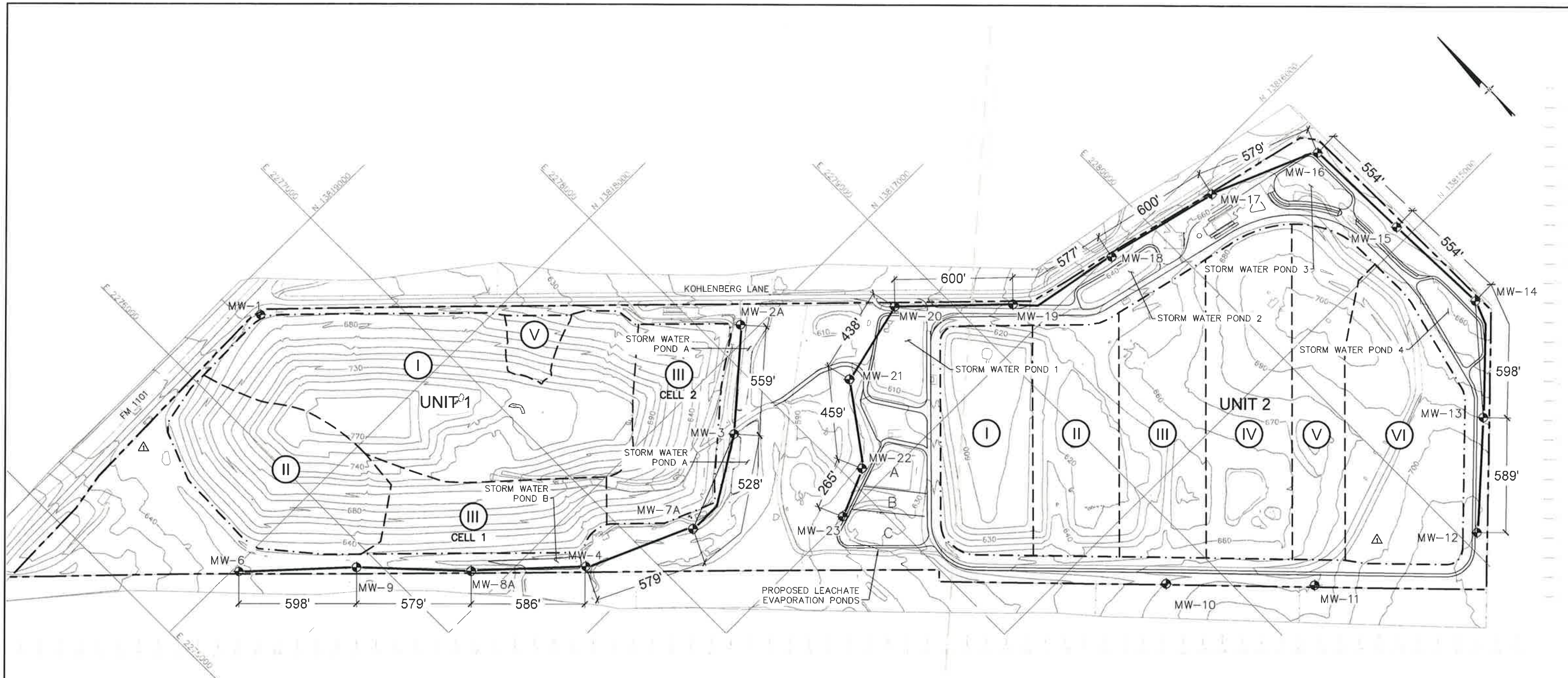
PROJECT: MESQUITE CREEK LANDFILL
PERMIT APPLICATION – PERMIT NO. MSW – 66 B

TITLE: PROPOSED GROUNDWATER MONITORING NETWORK WITH PRE-LANDFILL DEVELOPMENT TOPOGRAPHY

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



LEGEND

650	EXISTING GROUND ELEVATION (FT, MSL)
	EXISTING SITE FENCE
	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
	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

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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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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		

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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:
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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

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DRAWINGS

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2/24/2021

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GEOSYNTEC CONSULTANTS, INC.
Texas Board of Professional Engineers
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ATTACHMENTS

STATE OF TEXAS
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GEOSYNTEC CONSULTANTS, INC.
Texas Board of Professional Engineers
Firm Registration No. F-1182

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 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, storm-water 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.

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 the flow velocity of a 100-year/24-hour storm event, as shown in Attachment 6H of the Storm Water Plan.

Since neither the existing nor the proposed disposal areas are located in floodplains, the floodplain location restriction criterion (30 TAC §330.301) is satisfied, as presented in Parts I/II. Since none of the landfill perimeter roads or berms are located within the 100-year floodplain and since post-development discharge flow volumes and rates are designed to be less than pre-development conditions, the requirements of 30 TAC §330.55(b)(7)(C) are met because the flow and storage capacity of a 100-year frequency flood are not expected to be restricted. The storm water ponds partially within the flood pool allow backflow during a flood event, thereby not restricting the storage capacity within the flood pool area.

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 acres of the 244.12-acre facility, or about 64 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.

2.2 Surface Water Management System Components

Various surface water management system components collect and convey storm water from the cover system to discharge points from the site. Drainage benches built in to the sideslope will intercept surface water runoff (i.e., sheet flow) along the sideslope areas of the final cover and convey runoff to downchute channels. Drainage terraces in the form of compacted soil berms will be constructed on the top deck of the final cover. Top deck drainage terraces will convey runoff to channels along the top deck. Top deck channels consist of grass-lined trapezoidal shaped channels that consolidate surface water from top deck drainage terraces and convey it to the perimeter of the top deck areas. Trapezoidal shaped downchute channels will collect the runoff from the top deck and sideslopes and convey it to the toe of the cover system sideslopes. At the toe of the cover system sideslopes, runoff will be directed to a perimeter drainage channel, storm water pond, or a site discharge point. The perimeter drainage channels convey flow to a site discharge point or one of six storm water ponds. Surface water flow is conveyed from the perimeter drainage channels to the storm water ponds via pipe culverts. The perimeter berm, which incorporates an access road and the perimeter drainage channel, will serve to protect below grade areas from run-on, and collect clean runoff from above grade areas.

The storm water ponds (also known as sediment/detention basins) provide for sediment control while controlling surface water release from the site. The geometry and appurtenances of the storm water ponds will detain and release the surface water runoff at rates equal to or less than the predevelopment discharge rates from the site. Drawing 6-1 in this Storm Water Plan provides the layout of the surface water management system design, and Drawings 6-9 to 6-11 present details of the surface water management system components. Hydraulic calculations of the various surface water management system components, based on predicted required runoff discharges are presented in Attachments 6A through 6F of this Storm Water Plan.

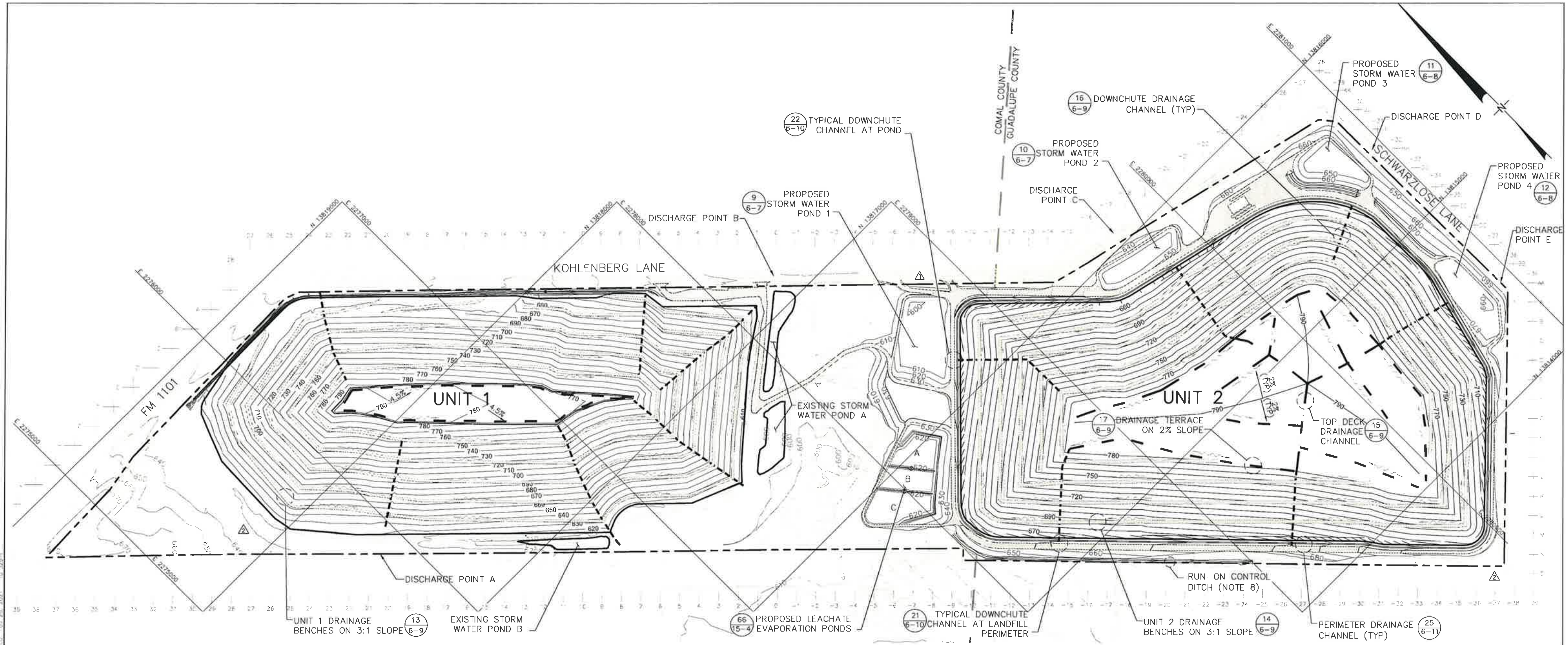
During the development phase prior to reaching final waste grades or final cover installation, the site will utilize temporary diversion berms and contaminated water holding areas to maintain the separation of clean runoff from contaminated water from active areas. Diversion berms will be placed in conjunction with the built-in drainage benches to intercept flow on the intermediate cover areas and route it around active areas to the clean surface water management system. Containment berms will be used to create the contaminated water holding areas. Details of the diversion and containment berms are included on Drawing 6-11 of this Storm Water Plan. The diversion and containment berms will be installed as required for site development. Calculations for sizing the temporary diversion berm and contaminated water holding area are presented in Attachment 6G of this Storm Water Plan.

In summary, surface water management system components used to collect, transport, store, and discharge clean runoff from the site include:

- temporary contaminated water diversion berms and containment berms;
- drainage terraces and benches (along the top deck and along the sideslopes);
- drainage channels on the top deck;
- downchute channels;
- perimeter drainage channels;
- perimeter access road/berm
- culverts; and
- storm water ponds and appurtenances.

DRAWINGS

- Drawing 6-1 Surface Water Management Plan
- Drawing 6-2 Pre-Development Plan with Drainage Patterns
- Drawing 6-3 Post-Development Plan with Drainage Patterns
- Drawing 6-4 Perimeter Drainage Channels Plan with Stationing
- Drawing 6-5 Unit 1 and 3 Perimeter Drainage Channel Profiles
- Drawing 6-6 Unit 2 Perimeter Drainage Channel Profiles
- Drawing 6-7 Storm Water Ponds 1 and 2 Plan Views
- Drawing 6-8 Storm Water Ponds 3 and 4 Plan Views
- Drawing 6-9 Surface Water Management System Details I
- Drawing 6-10 Surface Water Management System Details II
- Drawing 6-11 Surface Water Management System Details III
- Drawing 6-12 Storm Water Pond Typical Details
- Drawing 6-13 Leachate Collection System Details I
- Drawing 6-14 Leachate Collection System Details II
- Drawing 6-15 Liner System Details



250 125 0 250 500

SCALE IN FEET

LEGEND

812	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
	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.

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.

STATE OF TEXAS
SCOTT M. GRAVES
86557
LICENSED PROFESSIONAL ENGINEER

2/24/2021

FOR PERMIT PURPOSES ONLY

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:

WM WASTE MANAGEMENT

WASTE MANAGEMENT OF TEXAS, INC.
1000 KOHLENBERG LANE
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(830) 685-7894

ENGINEER:

Geosyntec consultants

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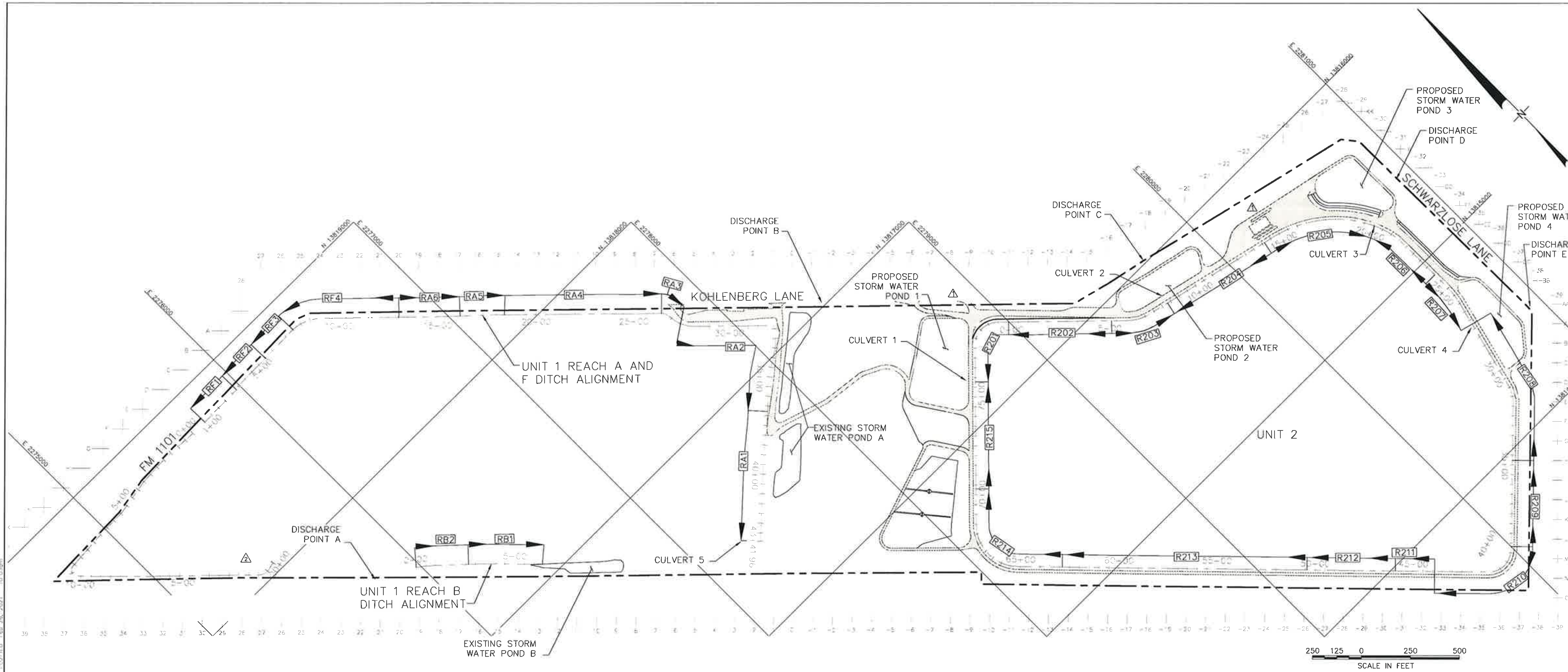
TEXAS ENG. FIRM REGISTRATION NO. 1182
8217 SHOAL CREEK BLVD., SUITE 200
AUSTIN, TEXAS 78757
(512) 451-4003

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. III	FIGURE NO: 6–1
FILE NO.: 3435-057	CHECKED BY: SMG	APPROVED BY: SMG		



2/24/2021

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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 22 — 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

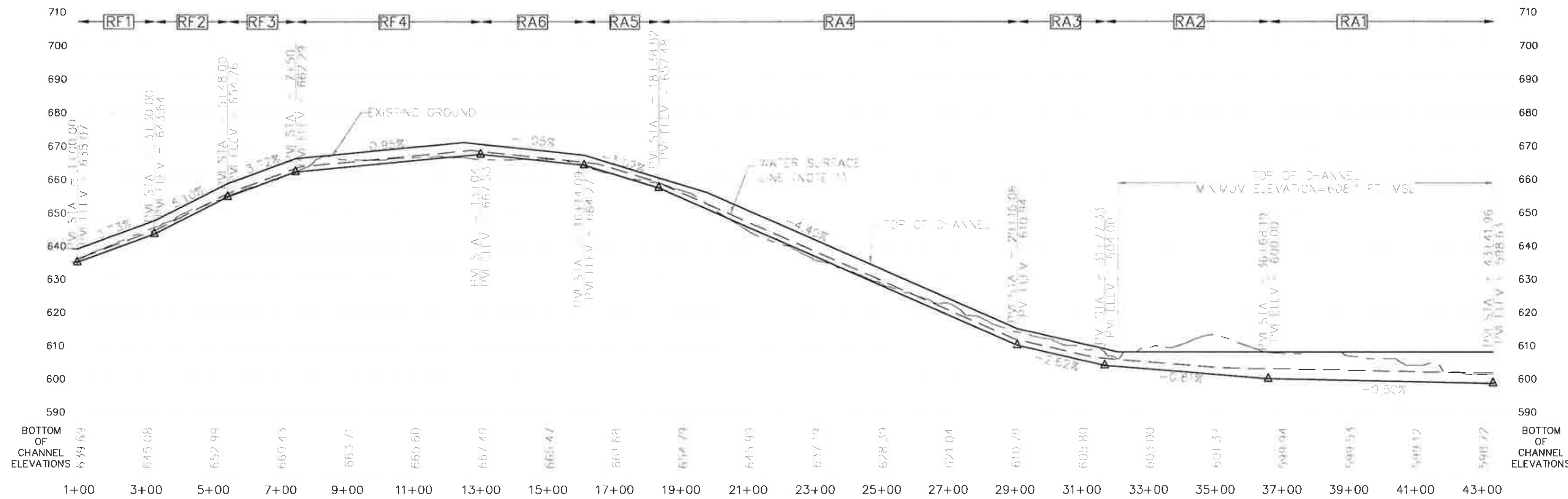
OWNER / SITE ADDRESS: WASTE MANAGEMENT OF TEXAS, INC. 1000 KOHLENBERG LANE P.O. BOX 311657 NEW BRAUNFELS, TEXAS 78130 (830) 685-7694

ENGINEER: Geosyntec consultants — GEOSYNTEC CONSULTANTS, INC. TEXAS ENG. FIRM REGISTRATION NO. 11182 8217 SHOAL CREEK BLVD., SUITE 200 AUSTIN, TEXAS 78757 (512) 451-4003

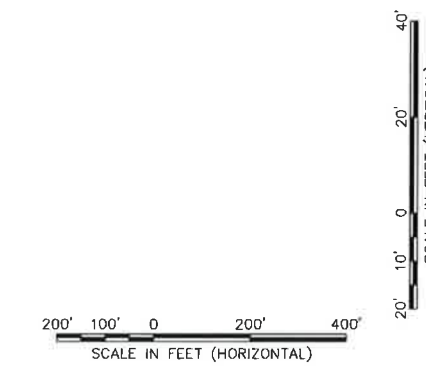
PROJECT: MESQUITE CREEK LANDFILL
PERMIT APPLICATION – PERMIT NO. MSW – 66 B

TITLE:
PERIMETER DRAINAGE CHANNELS PLAN WITH STATIONING

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



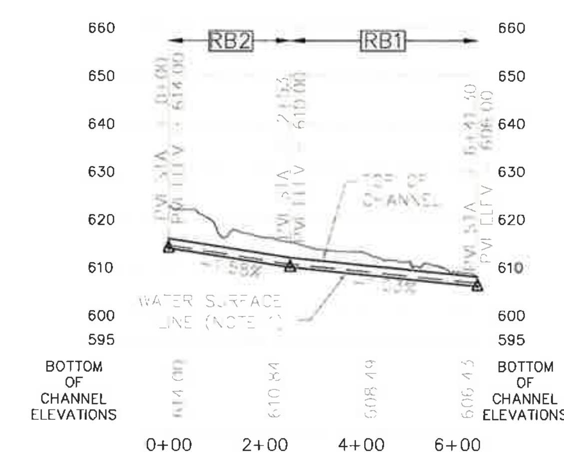
UNIT 1 REACH A AND F PERIMETER DRAINAGE
CHANNEL PROFILE STATION 1+00 TO STATION 43+41.96



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

STATE OF TEXAS
SCOTT M. GRAVES
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2/24/2021

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⚠	02/24/2021	ELIMINATE UNIT 3	JJV	SMG
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–	03/28/2006	RESPONSE TO NOD 1	SMG	SMG
–	11/18/2005	INITIAL SUBMITTAL TO TCEQ	SMG	SMG

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(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. III	FIGURE NO. 6-5
FILE NO.: 3435-028	CHECKED BY: MCC	APPROVED BY: SMG		

PERIMETER DRAINAGE CHANNEL SCHEDULE–UNIT 1

CHANNEL SEGMENT	CHANNEL SHAPE	CHANNEL SLOPE (%)	CHANNEL DIMENSIONS (MINIMUM) LENGTH (FT)	BOTTOM WIDTH (FT)	DEPTH (FT)	SIDE SLOPES	TOP WIDTH (FT)	25–YEAR PEAK FLOW (CFS)	25–YEAR PEAK DEPTH (FT)	25–YEAR 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

PERIMETER DRAINAGE CHANNEL SCHEDULE–UNIT 2

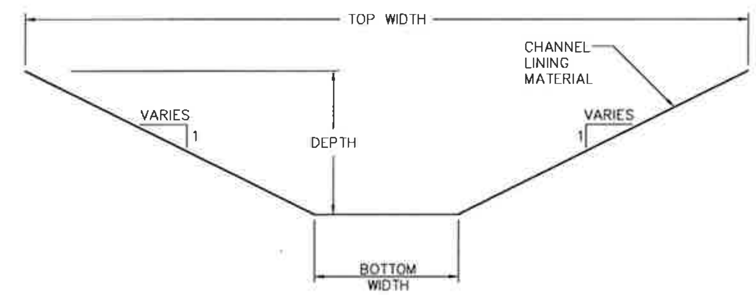
CHANNEL SEGMENT	CHANNEL SHAPE	CHANNEL SLOPE (%)	CHANNEL DIMENSIONS (MINIMUM) LENGTH (FT)	BOTTOM WIDTH (FT)	DEPTH (FT)	SIDE SLOPES	TOP WIDTH (FT)	25–YEAR PEAK FLOW (CFS)	25–YEAR PEAK DEPTH (FT)	25–YEAR PEAK VELOCITY (FT/S)	TRACTIVE STRESS (PSF)	LINING
R201	TRAPEZOIDAL	2.21	493.62	5	3	0.25	29	15.93	0.59	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

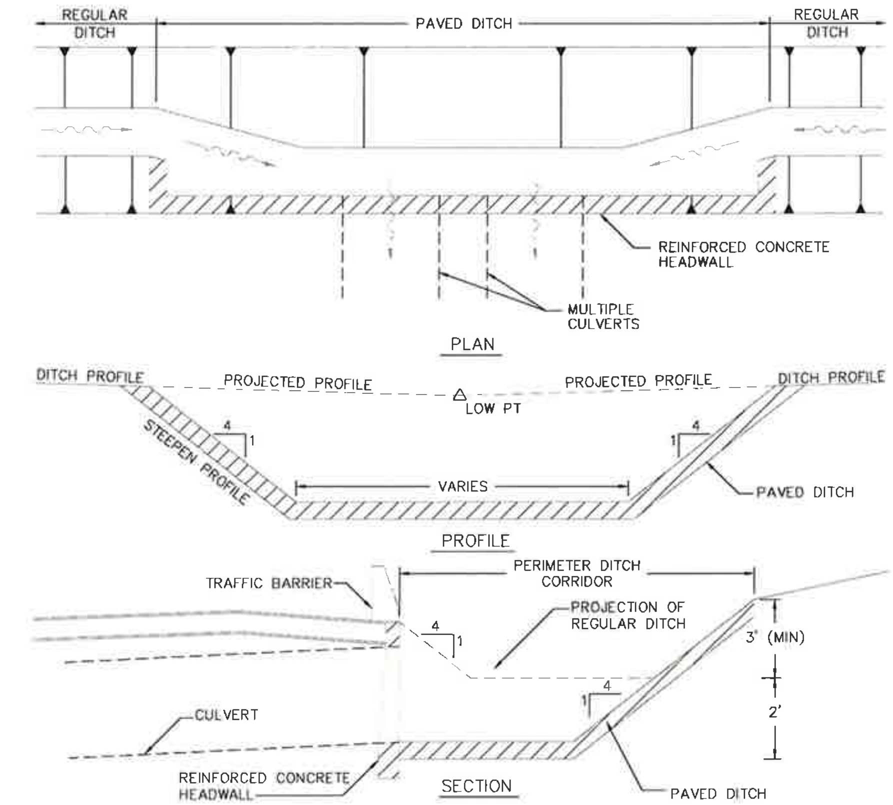
CULVERT	25–YR PEAK FLOW (CFS)	CONTRIBUTING REACHES	APPROX. LENGTH (FT)	SLOPE (%)	DESCRIPTION
1	282	R201, R215	40	1.5	2 – 42" PIPES
2	122	R203, R204	55	0.6	2 – 36" PIPES
3	70	R205, R206	100	0.8	2 – 30" PIPES
4	116	R207, R208	40	0.6	2 – 36" PIPES
5	270	J–A	100	0.5	3 – 42" PIPES WITH FLAPGATE

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

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1	02/24/2021	ELIMINATE UNIT 3	JJV	SMG
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–	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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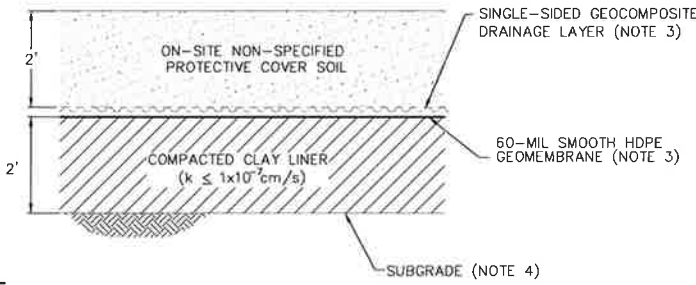
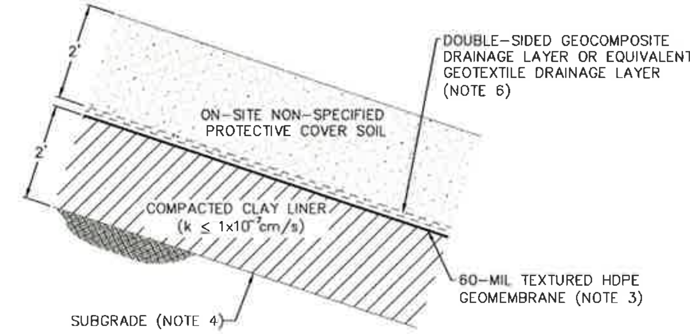
PROJECT: MESQUITE CREEK LANDFILL
PERMIT APPLICATION – PERMIT NO. MSW – 66 B

TITLE: SURFACE WATER MANAGEMENT SYSTEM DETAILS III

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



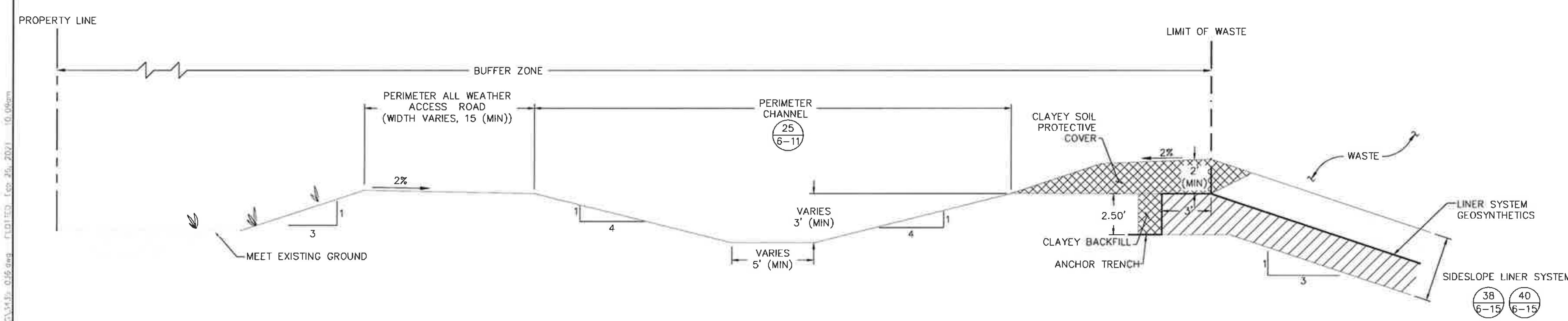
37 / 2-2 DETAIL
STANDARD FLOOR LINER SYSTEM (2% ≤ SLOPES < 6%)
XREF: 3435x119.DWG
0 2 4
SCALE IN FEET



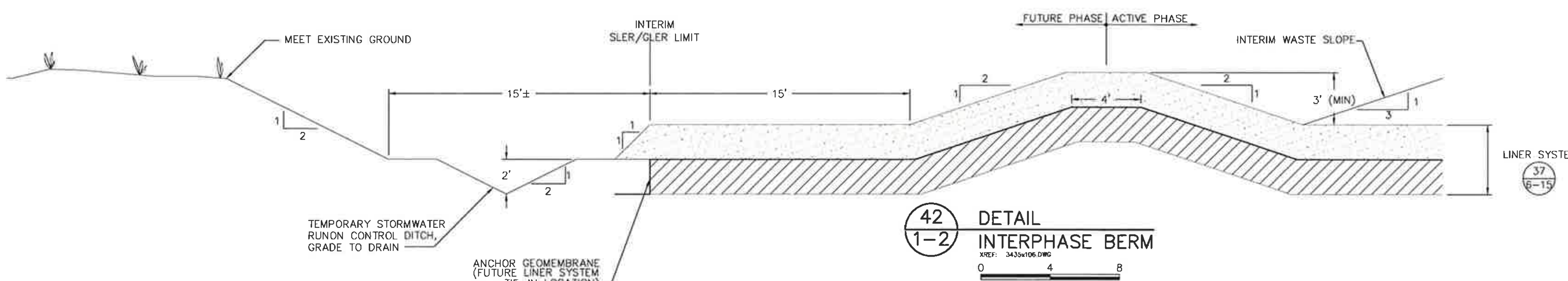
38 / 2-2 DETAIL
STANDARD SIDESLOPE LINER SYSTEM (6% ≤ SLOPES ≤ 33.3%)
XREF: 3435x119.DWG
0 2 4
SCALE IN FEET

39 / -- DETAIL
NOT USED

40 / -- DETAIL
NOT USED



41 / - DETAIL
TYPICAL LINER AT LANDFILL PERIMETER UNIT 2
XREF: 3435x106.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). ⚠
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/YD² (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.

⚠

STATE OF TEXAS
SCOTT M. GRAVES
86557
LICENSED PROFESSIONAL ENGINEER
2/24/2021

FOR PERMIT PURPOSES ONLY

MARK	DATE	REVISION	BY	APPROVED
⚠	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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1000 KOHLENBERG LANE
P.O. BOX 311657
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(830) 685-7894

ENGINEER:
Geosyntec consultants
GEOSYNTEC CONSULTANTS, INC.
TEXAS ENG. FIRM REGISTRATION NO. 11182
8217 SHOAL CREEK BLVD., SUITE 200
AUSTIN, TEXAS 78757
(512) 451-4003

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

TITLE: LINER SYSTEM DETAILS

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

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PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN
ATTACHMENT 6J

SUPPLEMENTAL HYDROLOGY AND HYDRAULICS EVALUATION

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

Prepared by:

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2/24/2021

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24 February 2021

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STATE OF TEXAS
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2/24/2021

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GEOSYNTEC CONSULTANTS, INC.
Texas Board of Professional Engineers
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APPENDICES

SUPPLEMENTAL HYDROLOGY AND HYDRAULICS EVALUATION

PURPOSE

This Supplemental Hydrology and Hydraulics Evaluation (Supplemental Report) has been prepared to accompany a permit modification application dated February 2021 to request revisions to the landfill layout, thus necessitating an assessment of the potential effects on the facility drainage plan. More specifically, the permit modification proposes to eliminate Unit 3 (which has never been constructed) from the permit, and to compensate for this loss of airspace, make adjustments to the Unit 2 base and final cover grades. The changes to the Unit 2 final cover grades are minor, and by comparing the previously approved final cover grades to the new proposed grades (e.g., on Part III, Attachment 6 (Storm Water Plan), Drawing 6-1), it is evident that they are "*de minimis*" in terms of drainage patterns on the final cover and overall site surface water management. However, to check and affirm this, this Supplemental Report (i) evaluates the post-development drainage conditions under the proposed minor revisions; and (ii) verifies that no changes are necessary to the existing surface water management system design established in the Storm Water Plan. Specific objectives of this Supplemental Report are to:

- describe how the proposed changes may affect some of the hydrologic elements and drainage features of the currently permitted facility;
- conduct an updated post-development drainage hydrologic analysis;
- compare the updated post-development discharges to the post-development discharges under the current-permit conditions to demonstrate that the proposed minor changes will not adversely impact or otherwise change to any significant degree the discharges from the site; and
- analyze and demonstrate that the hydraulic sizing of affected surface water conveyances established in the Storm Water Plan of the current permit are still met as-designed.

Note that the post-development hydrologic modeling was performed using the latest available "Atlas 14" rainfall data (National Oceanic and Atmospheric Administration (NOAA), Atlas 14, 2018) and agency guidance. To compare "apples-to-apples", both the current-permitted post-development condition and the proposed revised post-development condition were re-modeled with the latest Atlas 14 rainfall data.

OVERVIEW OF PROPOSED MODIFICATIONS TO THE SURFACE WATER MANAGEMENT SYSTEM

Unit 3 is proposed to be removed from the permit, and as a result, surface water runoff from the Unit 3 area will continue to route to the same unnamed tributary of Mesquite Creek following drainage patterns consistent with natural conditions.

The Unit 2 area is proposed to be modified by (i) reducing the final cover top-deck slope from 5% to 2% (the peak landfill elevation of 690-ft MSL remains unchanged); and (ii) slightly extending the 3(horizontal):1(vertical) (3H:1V) side slopes to intersect the updated 2% top-deck surface, shifting the alignment of the crest formed by the final cover top-deck and side slopes inward. Side slope benches and downchute channels have been slightly extended to tie in with the adjusted top-deck.

The Unit 2 landfill footprint area is unchanged, and accordingly the total acreage associated with surface water runoff routing off the Unit 2 area is unchanged as well. Surface water will continue to be routed in the same manner as described in the Storm Water Plan.

The configuration of all features in the Unit 2 area that are downstream of the top-deck downchute channels (i.e., perimeter channels, culverts, and storm water detention ponds) are not be affected by the proposed final cover grading revisions.

SUPPLEMENTAL HYDROLOGY MODELING

This supplemental hydrology modeling evaluates the post-development drainage patterns at the site, comparing the results of the Base Case versus the Supplemental Case. The Base Case evaluates the post-development model presented in the Storm Water Plan, and the Supplemental Case incorporates the changes associated with the Permit Mod. The analyses presented herein both (Base Case and Supplemental Case) incorporate the latest available Atlas 14 rainfall data and agency guidance. This was done to generate results that would be compatible for comparison purposes (i.e., “apples-to-apples”).

Updated Hydrologic Parameters

The hydrologic methodology and parameter selection in this Supplemental Report are consistent with those described in the Storm Water Plan, except for the following updates to simplify the model to focus on the areas being changed.

- All nodes in the Unit 1 and Unit 3 areas not discharging to the comparison point of interest referred to herein as “Point A” (i.e., regions of the Unit 1 and Unit 3 area unimpacted by the removal of Unit 3) are removed from the simplified model. Point A is the uppermost node in the hydrology model that captures the removal of Unit 3 and is selected as a point of comparison between the Base Case and Supplemental Case.

- All nodes in the Unit 2 area downstream of the perimeter drainage system (i.e., all regions of the Unit 2 area that are not in contact with the modified Unit 2 final cover system) are removed from the simplified model. The four low points along the perimeter drainage system (junctions J-1 through J-4) are the uppermost nodes in the hydrology model that encapsulate all proposed modifications and are selected as points of comparison between the Base Case and Supplemental Case.
- The 24-hour, 2-year storm and 24-hour, 25-year storm are updated to 4.06 inches 8.90 inches, respectively. Rainfall values are based on region-specific data published by the NOAA (2018), as presented in Appendix 6J-1.
- Time of concentration calculations are performed on all subbasins according to the 24-hour, 2-year rainfall depth of 4.06 inches. Time of concentration calculations for all nodes are calculated with a maximum sheet flow length of 100 feet to reflect the latest Texas Department of Transportation guidance (TXDOT, 2019).
- The latest version of HEC-HMS (Version 4.7, 2020) is utilized. Kinematic Wave Routing is used for all reaches with index flows that are determined iteratively using guidance from the US Army Corps of Engineers (USACE, 2018) by setting the index flow for a given reach equal to half of the peak discharge from the 24-hour, 25-year event routing into the reach.

Hydrologic Parameter Considerations Specific to the Supplemental Case

The Supplemental Case is altered relative to the Base Case to account for the proposed changes, with the following considerations.

- Subbasins associated with Unit 3 (Subbasin-12 through Subbasin-16) were replaced with Subbasin-12-16, which routes directly into Point A and has an equivalent area to Subbasins-12 through Subbasin-16 combined. A curve number of 80 was selected, consistent with the current permit, to represent undeveloped conditions and a time of concentration was calculated according to the natural condition grades established in the Storm Water Plan .
- No reaches, subbasins, discharge points, or junctions were added.
- Acreages and times of concentration were recomputed for the slightly-adjusted subbasin layout associated with the Unit 2 final cover area to reflect the changes to the top-deck slope and crest alignment mentioned in the previous section.

- Combined acreages routing to each downchute are comparable to the Base Case. Slight variations in acreages are attributed to the side slope bench system being adjusted to tie into the modified Unit 2 crest alignment.

Results of the Supplemental Hydrology Analysis

Basin delineations for the Base Case are presented on Drawing 6-3 of the Storm Water Plan (i.e., the post-development plan, as currently permitted). Basin delineations at Unit 2 for the Supplemental Case are shown on a figure contained in Appendix 6J-2 of this document. Also, the combined exterior boundaries formed by Subbasin-12 and Subbasin-15 on Drawing 6-3 incorporates the boundary used to define Subbasin-12-16 for the Unit 3 area of the Supplemental Case. Other basin delineations for the Supplemental Case are shown in Appendix 6J-2.

Time of concentration calculations are included as Appendix 6J-3. Hydrographs for each of the five assessment points comparing the two supplemental cases are included as Appendix 6J-4. HEC-HMS results for the supplemental cases are included as Appendix 6J-5 and summarized in Table 6J-1.

TABLE 6J-1
HEC-HMS RESULTS FOR THE 24-HOUR, 25-YEAR DESIGN EVENT

Assessment Point of Interest	Location	BASE CASE			SUPPLEMENTAL CASE		
		Peak Discharge (CFS)	Time to Peak (Hours)	Runoff Volume (ACRE-FT)	Peak Discharge (CFS)	Time to Peak (Hours)	Runoff Volume (ACRE-FT)
J-1	Low Point at Unit 2 Perimeter Channel	331	12.2	29.5	315	12.2	29.5
J-2	Low Point at Unit 2 Perimeter Channel	140	12.1	11.9	136	12.1	12.1
J-3	Low Point at Unit 2 Perimeter Channel	65	12.1	5.4	65	12.1	5.4
J-4	Low Point at Unit 2 Perimeter Channel	131	12.1	11.2	124	12.1	11.1
A	Low Point at Unit 3	2565	12.6	452.9	2570	12.6	452.4

Calculated peak discharges, times to peak discharge, runoff volumes, and hydrographs at each assessment point of interest are comparable for the modified and currently-permitted configuration of the site, demonstrating that the proposed revisions do not affect post-development drainage conditions in any material way.

SUPPLEMENTAL HYDRAULIC ANALYSIS AND RESULTS

This supplemental hydraulic analysis evaluates the final cover surface water conveyances affected by the proposed revisions, comparing the results of the Base Case versus the Supplemental Case. The analysis was performed for affected final cover drainage terraces, benches, top-deck channels, and downchute channels (consistent with design methodology of Attachment 6C of the Storm Water Plan). Note that the perimeter channels for the Unit 2 area, designed in Attachment 6E of the Storm Water Plan, have no proposed modifications but were also included in this Supplemental Report because they are connected to features proposed to be revised. The purpose of this evaluation is to demonstrate that the revised features continue to meet the hydraulic design requirements established in the Storm Water Plan , which include:

- conveyance of the 24-hour, 25-year storm with adequate freeboard; and
- selection of channel lining materials with a permissible tractive stress greater than the calculated tractive stress.

Hydraulic Parameter Considerations Specific to the Supplemental Analysis

The Supplemental Case was updated relative to the Base Case with following considerations.

- For final cover drainage features, peak discharges are established in Attachment 6C of the Storm Water Plan using a linear regression plot of HEC-HMS subbasins associated with final cover landfill areas. This relationship was recalculated as 6.64 cfs/acre multiplied by the number of acres draining to a given component using data from the Supplemental Case, as shown in Appendix 6J-6.
- Subbasins developed for the Supplemental Case were further delineated to evaluate individual reaches of each final cover surface water feature and determine the critical cases for design as a function of acreage and flowline slope. The naming convention for these drainage areas was carried over from Attachment 6C of the Storm Water Plan. Drainage areas associated with the critical cases for the modified condition are shown on the figure in Appendix 6J-7.
- For perimeter channels, peak flow rates for subbasins developed for the HEC-HMS model of the Supplemental Case that correspond to the Unit 2 perimeter channel reaches (nodes R201 through R215) were used to evaluate each respective reach.

Results of the Supplemental Hydraulic Analysis

Results of the hydraulic analysis for the final cover drainage features are included as Appendix 6J-8 and summarized in Table 6J-2. Results of the hydraulic analysis for the perimeter channels are included as Appendix 6J-9 and summarized below in Table 6J-3. Calculated flow depths allow for conveyance of the 25-yr peak flow with 0.5 feet of freeboard or more using the currently permitted channel design. Calculated tractive stresses are below the maximum permissible tractive stresses for the channel lining materials selected in current permit. Bracketed values represent the results of this supplemental report and unbracketed values represent results from the current permit.

TABLE 6J-2
FINAL COVER HYDRAULIC ANALYSIS RESULTS

Channel Type	25-Yr Peak Flow Rate (ft^3/s)	25-Yr Peak Flow Depth (ft)	25-Yr Peak Flow Velocity (ft/s)	25-Yr Peak Tractive Stress (lb/ft^2)	Channel Lining Material
Top-deck Terrace, ≤2.0% Slope	23.5 [26.10]	0.80 [0.72]	3.25 [1.88]	1.00 [0.36]	Grass Lining
Top-deck Terrace, >2.0% Slope	17.4 [n/a]	0.69 [n/a]	3.27 [n/a]	1.07 [n/a]	Turf Reinforcement Mat
Side Slope Bench, ≤3.0% Slope	16.9 [18.2]	0.93 [0.95]	3.56 [3.65]	1.16 [1.19]	Turf Reinforcement Mat
Side Slope Bench, >3.0% Slope	15.8 [18.1]	0.76 [0.80]	4.94 [5.08]	2.37 [2.43]	Turf Reinforcement Mat
Top-deck Channel	50.1 [32.3]	0.68 [0.95]	6.30 [5.08]	1.91 [2.49]	Turf Reinforcement Mat
Downchute Channel	96.7 [113.7]	0.57 [0.62]	12.49 [13.17]	10.08 [10.91]	Reno Mattress

TABLE 6J-3
PERIMETER CHANNEL HYDRAULIC ANALYSIS RESULTS

Channel Segment Designation	25-Yr Peak Flow Rate (ft^3/s)	25-Yr Peak Flow Depth (ft)	25-Yr Peak Flow Velocity (ft/s)	25-Yr Peak Tractive Stress (lb/ft^2)	Proposed Channel Lining Material(1)
R201	15.9 [17.8]	0.59 [0.61]	3.66 [3.74]	0.81 [0.85]	Type 1
R202	16 [17.9]	0.46 [0.49]	5.05 [5.20]	1.59 [1.67]	Type 2
R203	8 [8.1]	0.43 [0.42]	2.77 [2.73]	0.48 [0.47]	Type 1
R204	105.2 [128.1]	1.35 [1.48]	7.49 [7.88]	3.13 [3.44]	Type 2

R205	21 [22.4]	1.00 [1.03]	2.33 [2.37]	0.31 [0.32]	Type 1
R206	8.0 [10.2]	0.43 [0.48]	2.78 [2.98]	0.49 [0.55]	Type 1
R207	8.0 [7.8]	0.50 [0.49]	2.27 [2.25]	0.32 [0.31]	Type 1
R208	23.9 [26.3]	0.59 [0.61]	5.51 [5.60]	1.84 [1.90]	Type 2
R209	24.0 [26.4]	0.73 [0.76]	4.18 [4.30]	1.04 [1.09]	Type 2
R210	20.0 [22.4]	0.79 [0.83]	3.09 [3.17]	0.56 [0.59]	Type 1
R211	19.9 [22.4]	0.56 [0.58]	4.94 [5.07]	1.49 [1.56]	Type 2
R212	19.9 [22.4]	0.53 [0.56]	5.21 [5.35]	1.67 [1.75]	Type 2
R213	99.4 [129.2]	1.61 [1.81]	5.41 [5.79]	1.61 [1.81]	Type 2
R214	174.6 [218.3]	1.87 [2.07]	7.5 [7.94]	3.03 [3.35]	Type 2
R215	174.3 [218]	1.61 [1.78]	9.5 [10.07]	4.96 [5.50]	Type 2

(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.

CONCLUSIONS

Based on the calculations presented herein, the following conclusions are drawn:

- Comparison of the HEC-HMS results for the Base Case and Supplemental Case post-development condition reveals that the proposed revisions will not adversely alter or change to any significant degree the currently permitted post-development drainage patterns of the site (as presented in the Storm Water Plan).
- The results of the supplemental hydraulic analysis demonstrate that under the proposed modifications, the sizing of final cover surface water conveyances remains adequate as-designed.

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USACE (2018). Hydraulic Modeling System HEC-HMS User's Manual, US Army Corps of Engineers, Hydrologic Engineering Center, CPD-74A, September 2018.

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USDA (1977) Engineering Division and Ecological Sciences and Technology Division. Procedure for Computing Sheet and Rill Erosion on Project Areas, TR-51. Rev. 2, September 1977.

APPENDIX 6J-1
RAINFALL INFORMATION
(NOAA, 2018)

NOAA Atlas 14, Volume 11, Version 2
Location name: New Braunfels, Texas, USA*
Latitude: 29.7317°, Longitude: -98.0195°
Elevation: 673.45 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.439 (0.333-0.580)	0.525 (0.399-0.681)	0.660 (0.502-0.865)	0.775 (0.582-1.03)	0.939 (0.684-1.29)	1.07 (0.758-1.51)	1.21 (0.831-1.75)	1.35 (0.905-2.00)	1.54 (1.00-2.38)	1.69 (1.07-2.68)
10-min	0.699 (0.529-0.923)	0.836 (0.635-1.09)	1.05 (0.800-1.38)	1.24 (0.930-1.65)	1.50 (1.10-2.07)	1.72 (1.22-2.43)	1.93 (1.33-2.80)	2.15 (1.44-3.20)	2.43 (1.58-3.75)	2.65 (1.68-4.18)
15-min	0.894 (0.677-1.18)	1.06 (0.806-1.38)	1.32 (1.01-1.74)	1.55 (1.16-2.06)	1.87 (1.36-2.57)	2.12 (1.51-3.00)	2.39 (1.65-3.46)	2.67 (1.79-3.97)	3.04 (1.98-4.69)	3.34 (2.11-5.28)
30-min	1.26 (0.955-1.67)	1.49 (1.13-1.94)	1.86 (1.41-2.44)	2.17 (1.63-2.89)	2.61 (1.89-3.57)	2.95 (2.09-4.16)	3.31 (2.28-4.80)	3.70 (2.49-5.51)	4.26 (2.77-6.57)	4.71 (2.98-7.44)
60-min	1.63 (1.23-2.15)	1.94 (1.48-2.52)	2.44 (1.86-3.20)	2.87 (2.15-3.82)	3.48 (2.52-4.76)	3.95 (2.79-5.57)	4.46 (3.08-6.47)	5.04 (3.39-7.50)	5.87 (3.81-9.05)	6.56 (4.15-10.4)
2-hr	1.94 (1.48-2.55)	2.39 (1.81-3.05)	3.07 (2.34-3.99)	3.69 (2.78-4.89)	4.60 (3.36-6.29)	5.36 (3.81-7.54)	6.20 (4.30-8.95)	7.17 (4.83-10.6)	8.59 (5.60-13.2)	9.78 (6.21-15.4)
3-hr	2.11 (1.61-2.76)	2.66 (1.99-3.34)	3.45 (2.64-4.47)	4.20 (3.18-5.56)	5.35 (3.93-7.31)	6.33 (4.53-8.90)	7.45 (5.17-10.7)	8.72 (5.89-12.9)	10.6 (6.93-16.3)	12.2 (7.78-19.2)
6-hr	2.40 (1.85-3.13)	3.12 (2.33-3.84)	4.11 (3.15-5.28)	5.09 (3.87-6.69)	6.60 (4.89-9.00)	7.94 (5.72-11.1)	9.50 (6.62-13.6)	11.3 (7.65-16.5)	14.0 (9.15-21.3)	16.3 (10.4-25.4)
12-hr	2.72 (2.09-3.52)	3.58 (2.67-4.36)	4.76 (3.66-6.07)	5.93 (4.53-7.75)	7.75 (5.76-10.5)	9.36 (6.77-13.1)	11.3 (7.89-16.0)	13.5 (9.18-19.7)	16.9 (11.1-25.6)	19.8 (12.7-30.8)
24-hr	3.07 (2.38-3.96)	4.06 (3.05-4.93)	5.44 (4.21-6.90)	6.79 (5.22-8.84)	8.90 (6.64-12.0)	10.8 (7.81-14.9)	12.9 (9.11-18.3)	15.5 (10.6-22.6)	19.6 (12.9-29.5)	23.0 (14.8-35.5)
2-day	3.51 (2.73-4.50)	4.63 (3.51-5.62)	6.21 (4.84-7.85)	7.75 (5.98-10.0)	10.1 (7.56-13.5)	12.1 (8.84-16.7)	14.5 (10.3-20.5)	17.4 (11.9-25.1)	21.8 (14.5-32.7)	25.6 (16.6-39.4)
3-day	3.82 (2.98-4.88)	5.02 (3.83-6.09)	6.73 (5.26-8.48)	8.36 (6.47-10.8)	10.8 (8.14-14.5)	13.0 (9.48-17.8)	15.5 (11.0-21.7)	18.4 (12.7-26.5)	22.9 (15.2-34.3)	26.8 (17.4-41.1)
4-day	4.07 (3.18-5.19)	5.32 (4.08-6.46)	7.11 (5.57-8.95)	8.81 (6.83-11.3)	11.4 (8.56-15.1)	13.6 (9.93-18.6)	16.1 (11.4-22.6)	19.1 (13.2-27.5)	23.6 (15.7-35.3)	27.5 (17.8-42.0)
7-day	4.64 (3.65-5.89)	5.98 (4.63-7.27)	7.93 (6.24-9.95)	9.75 (7.59-12.5)	12.5 (9.42-16.5)	14.8 (10.8-20.2)	17.4 (12.4-24.3)	20.4 (14.1-29.2)	24.8 (16.6-36.9)	28.6 (18.6-43.5)
10-day	5.12 (4.04-6.49)	6.53 (5.09-7.96)	8.60 (6.79-10.8)	10.5 (8.20-13.4)	13.3 (10.1-17.6)	15.7 (11.6-21.4)	18.4 (13.1-25.6)	21.3 (14.8-30.5)	25.7 (17.2-38.1)	29.3 (19.1-44.6)
20-day	6.63 (5.26-8.36)	8.18 (6.49-10.1)	10.6 (8.43-13.2)	12.7 (9.95-16.1)	15.7 (11.9-20.5)	18.1 (13.3-24.4)	20.7 (14.8-28.6)	23.6 (16.4-33.5)	27.8 (18.7-40.9)	31.2 (20.4-47.2)
30-day	7.89 (6.27-9.91)	9.54 (7.64-11.8)	12.2 (9.76-15.2)	14.5 (11.4-18.3)	17.6 (13.4-22.9)	20.0 (14.8-26.9)	22.6 (16.2-31.2)	25.4 (17.8-36.0)	29.5 (19.9-43.3)	32.8 (21.5-49.3)
45-day	9.65 (7.69-12.1)	11.5 (9.25-14.2)	14.5 (11.6-18.0)	17.0 (13.4-21.4)	20.4 (15.5-26.5)	23.0 (17.0-30.8)	25.6 (18.5-35.3)	28.4 (19.9-40.2)	32.3 (21.8-47.2)	35.2 (23.2-52.9)
60-day	11.2 (8.96-14.0)	13.2 (10.7-16.4)	16.5 (13.3-20.5)	19.2 (15.2-24.2)	22.9 (17.5-29.8)	25.7 (19.1-34.4)	28.5 (20.6-39.1)	31.3 (21.9-44.1)	34.9 (23.6-50.9)	37.6 (24.7-56.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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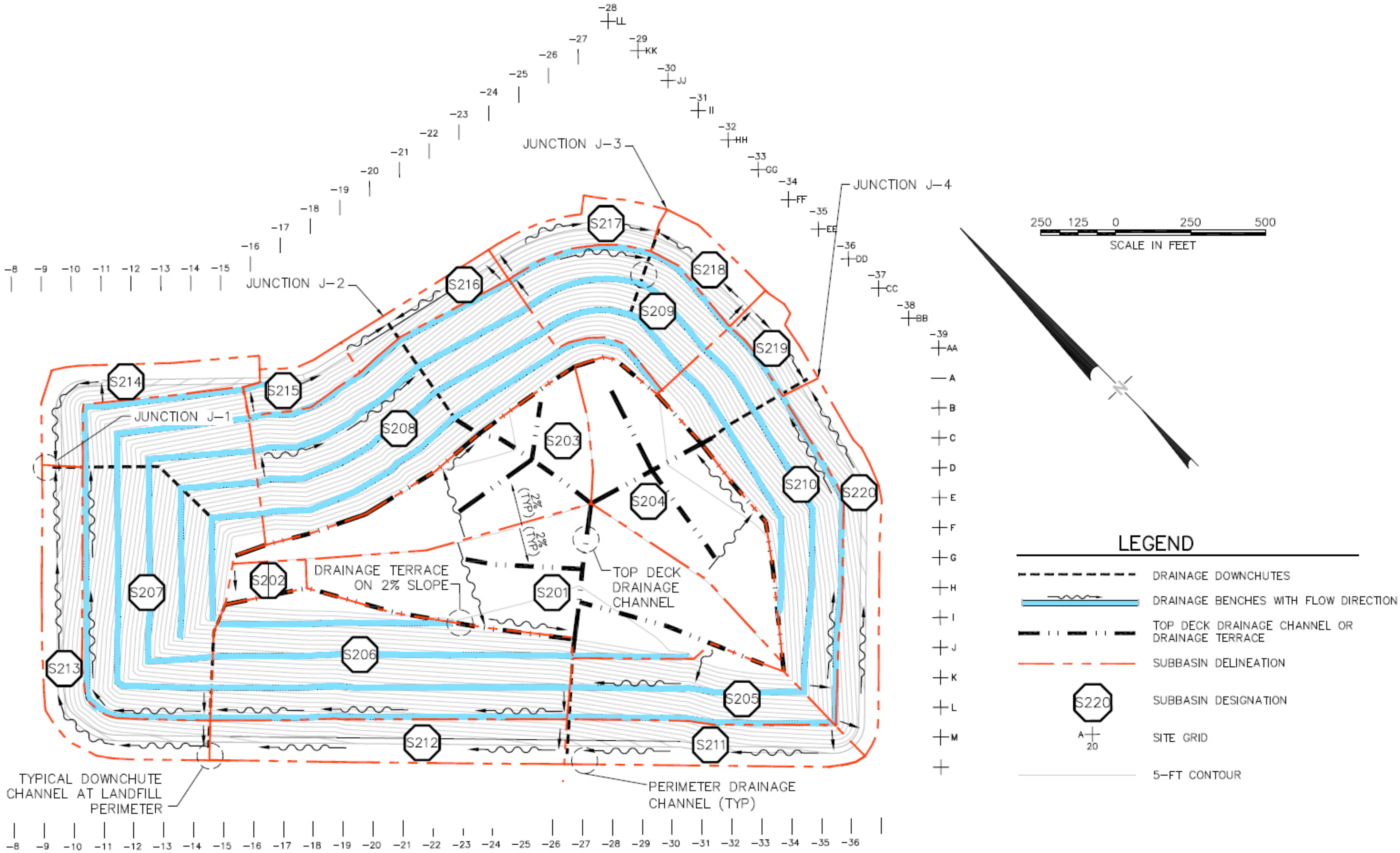
APPENDIX 6J-2

SUBBASIN MAP FOR MODIFIED UNIT 2 AREA


JUNCTION J-1
JUNCTION J-2
JUNCTION J-3
JUNCTION J-4
S201
S202
S203
S204
S205
S206
S207
S208
S209
S210
S211
S212
S213
S214
S215
S216
S217
S218
S219
S220
DRAINAGE TERRACE ON 2% SLOPE
TOP DECK DRAINAGE CHANNEL
2% (TYP)
TYPICAL DOWNCHUTE CHANNEL AT LANDFILL PERIMETER
PERIMETER DRAINAGE CHANNEL (TYP)
250 125 0 250 500
SCALE IN FEET
LEGEND
DRAINAGE DOWNCHUTES
DRAINAGE BENCHES WITH FLOW DIRECTION
TOP DECK DRAINAGE CHANNEL OR DRAINAGE TERRACE
SUBBASIN DELINEATION
SUBBASIN DESIGNATION
SITE GRID
5-FT CONTOUR

APPENDIX 6J-3

TIME OF CONCENTRATION CALCULATIONS

MESQUITE CREEK - BASE CASE
SURFACE WATER MANAGEMENT SYSTEM CALCULATIONS
TIME OF CONCENTRATION (Tc) AND LAG TIME (Tlag) CALCULATIONS FOR SUBBASINS

2-year, 24-hr Design Rainfall Depth, $P_{2\text{-}24}$ = 4.06 inches

SUBBASIN DESIGNATION		AREA (acres)	AREA (sq mi)	SHEET FLOW				SHALLOW CONCENTRATED FLOW				CHANNEL FLOW		Travel Times (Tt), Tc, and Tlag Calculation				
No.	Description			Length (ft)	Surf Desc	Manning n	Slope (ft/ft)	Length (ft)	Surf Desc	Slope (ft/ft)	Avg Vel (ft/s)	Length (ft)	Vel (ft/s)	Tt (Sheet) (min)	Tt (SH CON.) (min)	Tt (CH) (min)	Tc (min)	Tlag (min)
4	Unit 1 Side slope	8.57	0.013384	90	GRASS	0.240	0.333				0.00	1150	5	3.78	0.00	3.83	**7.6**	**4.6**
5	Unit 1 Side slope	5.11	0.007979	90	GRASS	0.240	0.333				0.00	730	5	3.78	0.00	2.43	**6.2**	**3.7**
12	Unit 3 Top Deck	8.64	0.013498	90	GRASS	0.240	0.333				0.00	1340	5	3.78	0.00	4.47	**8.2**	**4.9**
13	Unit 3 Top Deck	2.38	0.003715	100	GRASS	0.240	0.044	70	unpaved	0.044	3.38	600	5	9.24	0.34	2.00	**11.6**	**7.0**
14	Unit 3 Top Deck	0.77	0.001209	85	GRASS	0.240	0.044				0.00	0	5	8.12	0.00	0.00	**8.1**	**4.9**
15	Unit 3 Side slope	3.05	0.004772	90	GRASS	0.240	0.333				0.00	1400	5	3.78	0.00	4.67	**8.4**	**5.1**
16	Unit 3 Side slope	1.52	0.002371	90	GRASS	0.240	0.333				0.00	650	5	3.78	0.00	2.17	**6.0**	**3.6**
17	Unit 1 Perimeter	1.74	0.002716	90	GRASS	0.240	0.333				0.00	250	5	3.78	0.00	0.83	**6.0**	**3.6**
18	Unit 1 Perimeter	0.73	0.001140	60	GRASS	0.240	0.333				0.00	350	5	2.73	0.00	1.17	**6.0**	**3.6**
OS-1A	Offsite Runon	162.55	0.253991	100	GRASS	0.240	0.013	1324	unpaved	0.037	3.11	3307	5	15.16	7.09	11.02	**35.1**	**21.1**
								200	unpaved	0.013	1.82	0	5	0.00	1.83	0.00		
OS-1B	Offsite Runon	355.24	0.555060	100	GRASS	0.240	0.005	2769	unpaved	0.026	2.59	4538	5	21.64	17.80	15.13	**57.4**	**34.5**
								200	unpaved	0.005	1.17	0	5	0.00	2.85	0.00		
OS-1C	Offsite Runon	230.45	0.360081	100	GRASS	0.240	0.077	1995	unpaved	0.028	2.70	3847	5	7.39	12.30	12.82	**33.3**	**19.95**
								200	unpaved	0.077	4.48	0	5	0.00	0.74	0.00		
201	Unit 2 Top Deck	10.75	0.016794	100	GRASS	0.240	0.050	200	unpaved	0.050	3.61	382	5	8.78	0.92	1.27	**11.0**	**6.6**
202	Unit 2 Top Deck	0.87	0.001363	100	GRASS	0.240	0.050	62	unpaved	0.050	3.61	51	5	8.78	0.29	0.17	**9.2**	**5.5**
203	Unit 2 Top Deck	6.86	0.010719	100	GRASS	0.240	0.050	200	unpaved	0.050	3.61	111	5	8.78	0.92	0.37	**10.1**	**6.0**
204	Unit 2 Top Deck	7.64	0.011938	100	GRASS	0.240	0.050	200	unpaved	0.050	3.61	289	5	8.78	0.92	0.96	**10.7**	**6.4**

MESQUITE CREEK - BASE CASE
SURFACE WATER MANAGEMENT SYSTEM CALCULATIONS
TIME OF CONCENTRATION (Tc) AND LAG TIME (Tlag) CALCULATIONS FOR SUBBASINS (Continued)

2-year, 24-hr Design Rainfall Depth, P_{2-24} = 4.06 inches

SUBBASIN DESIGNATION		AREA (acres)	AREA (sq mi)	SHEET FLOW				SHALLOW CONCENTRATED FLOW				CHANNEL FLOW		Travel Times (Tt), Tc, and Tlag Calculation				
No.	Description			Length (ft)	Surf Desc	Manning n	Slope (ft/ft)	Length (ft)	Surf Desc	Slope (ft/ft)	Avg Vel (ft/s)	Length (ft)	Vel (ft/s)	Tt (Sheet) (min)	Tt (SH CON.) (min)	Tt (CH) (min)	Tc (min)	Tlag (min)
205	Unit 2 Sideslope	3.42	0.005344	90	GRASS	0.240	0.330					805	5	3.79	0.00	2.68	**6.5**	**3.9**
206	Unit 2 Sideslope	10.10	0.015781	100	GRASS	0.240	0.050	41	unpaved	0.050	3.61			8.78	0.19	0.00	**10.2**	**6.1**
								86	upaved	0.330	11.68	333	5	0.00	0.12	1.11		
207	Unit 2 Sideslope	12.68	0.019805	90	GRASS	0.240	0.330					1178	5	3.79	0.00	3.93	**7.7**	**4.6**
208	Unit 2 Sideslope	9.92	0.015500	90	GRASS	0.240	0.330					631	5	3.79	0.00	2.10	**6.0**	**3.6**
209	Unit 2 Sideslope	4.57	0.007141	90	GRASS	0.240	0.330					473	5	3.79	0.00	1.58	**6.0**	**3.6**
210	Unit 2 Sideslope	6.94	0.010844	90	GRASS	0.240	0.330					1023	5	3.79	0.00	3.41	**7.2**	**4.3**
211	Unit 2 Perimeter	2.94	0.004586	90	GRASS	0.240	0.330							3.79	0.00	0.00	**6.0**	**3.6**
212	Unit 2 Perimeter	3.50	0.005461	90	GRASS	0.240	0.330							3.79	0.00	0.00	**6.0**	**3.6**
213	Unit 2 Perimeter	4.01	0.006266	75	GRASS	0.240	0.330							3.28	0.00	0.00	**6.0**	**3.6**
214	Unit 2 Perimeter	2.55	0.003990	78	GRASS	0.240	0.330							3.38	0.00	0.00	**6.0**	**3.6**
215	Unit 2 Perimeter	1.14	0.001778	90	GRASS	0.240	0.330							3.79	0.00	0.00	**6.0**	**3.6**
216	Unit 2 Perimeter	1.40	0.002187	90	GRASS	0.240	0.330							3.79	0.00	0.00	**6.0**	**3.6**
217	Unit 2 Perimeter	1.71	0.002669	90	GRASS	0.240	0.330							3.79	0.00	0.00	**6.0**	**3.6**
218	Unit 2 Perimeter	1.44	0.002243	90	GRASS	0.240	0.330							3.79	0.00	0.00	**6.0**	**3.6**
219	Unit 2 Perimeter	1.10	0.001716	90	GRASS	0.240	0.330							3.79	0.00	0.00	**6.0**	**3.6**
220	Unit 2 Perimeter	3.63	0.005677	90	GRASS	0.240	0.330							3.79	0.00	0.00	**6.0**	**3.6**
221	Scales	0.96	0.001500	100	PAVED	0.011	0.020	118	unpaved	0.020	2.28			1.08	0.86	0.00	**6.0**	**3.6**
222	Scales	1.30	0.002031	100	PAVED	0.011	0.005	82	unpaved	0.005	1.14			1.87	1.20	0.00	**6.0**	**3.6**

MESQUITE CREEK - MODIFIED CASE
SURFACE WATER MANAGEMENT SYSTEM CALCULATIONS
TIME OF CONCENTRATION (Tc) AND LAG TIME (Tlag) CALCULATIONS FOR SUBBASINS

2-year, 24-hr Design Rainfall Depth, P_{2-24} = 4.06 inches

SUBBASIN DESIGNATION		**AREA (acres)**	**AREA (sq mi)**	**SHEET FLOW**				**SHALLOW CONCENTRATED FLOW**				**CHANNEL FLOW**		**Travel Times (Tt), Tc, and Tlag Calculation**				
No.	Description			Length (ft)	Surf Desc	Manning n	Slope (ft/ft)	Length (ft)	Surf Desc	Slope (ft/ft)	Avg Vel (ft/s)	Length (ft)	Vel (ft/s)	Tt (Sheet) (min)	Tt (SH CON.) (min)	Tt (CH) (min)	Tc (min)	Tlag (min)
4	Unit 1 Side slope	8.57	0.0133837	90	GRASS	0.240	0.333				0.00	1150	5	3.78	0.00	3.83	**7.6**	**4.57**
5	Unit 1 Side slope	5.11	0.0079793	90	GRASS	0.240	0.333				0.00	730	5	3.78	0.00	2.43	**6.2**	**3.73**
12-16	Unit 3 Area	16.36	0.0255640	100	GRASS	0.240	0.100	691	unpaved	0.055	3.78	1029	5	6.66	3.04	3.43	**13.1**	**7.88**
17	Unit 1 Perimeter	1.74	0.0027164	90	GRASS	0.240	0.333				0.00	250	5	3.78	0.00	0.83	**6.0**	**3.60**
18	Unit 1 Perimeter	0.73	0.0011400	60	GRASS	0.240	0.333				0.00	350	5	2.73	0.00	1.17	**6.0**	**3.60**
OS-1A	Offsite Runon	162.55	0.2539914	100	GRASS	0.240	0.013	1324	unpaved	0.037	3.11	3307	5	15.16	7.09	11.02	**35.1**	**21.06**
								200	unpaved	0.013	1.82	0	5	0.00	1.83	0.00		
OS-1B	Offsite Runon	355.24	0.5550597	100	GRASS	0.240	0.005	2769	unpaved	0.026	2.59	4538	5	21.64	17.80	15.13	**57.4**	**34.45**
								200	unpaved	0.005	1.17	0	5	0.00	2.85	0.00		
OS-1C	Offsite Runon	230.45	0.3600806	100	GRASS	0.240	0.077	1995	unpaved	0.028	2.70	3847	5	7.39	12.30	12.82	**33.3**	**19.95**
								200	unpaved	0.077	4.48	0	5	0.00	0.74	0.00		
201	Unit 2 Top Deck	10.06	0.0157248	100	GRASS	0.240	0.020	200	unpaved	0.020	2.28	382	5	12.67	1.46	1.27	**15.4**	**9.24**
202	Unit 2 Top Deck	0.68	0.0010623	100	GRASS	0.240	0.020	49	unpaved	0.020	2.28	41	5	12.67	0.36	0.14	**13.2**	**7.90**
203	Unit 2 Top Deck	6.42	0.0100269	100	GRASS	0.240	0.020	103	unpaved	0.020	2.28	170	5	12.67	0.75	0.57	**14.0**	**8.39**
204	Unit 2 Top Deck	6.77	0.0105838	100	GRASS	0.240	0.020	176	unpaved	0.020	2.28	276	5	12.67	1.29	0.92	**14.9**	**8.92**

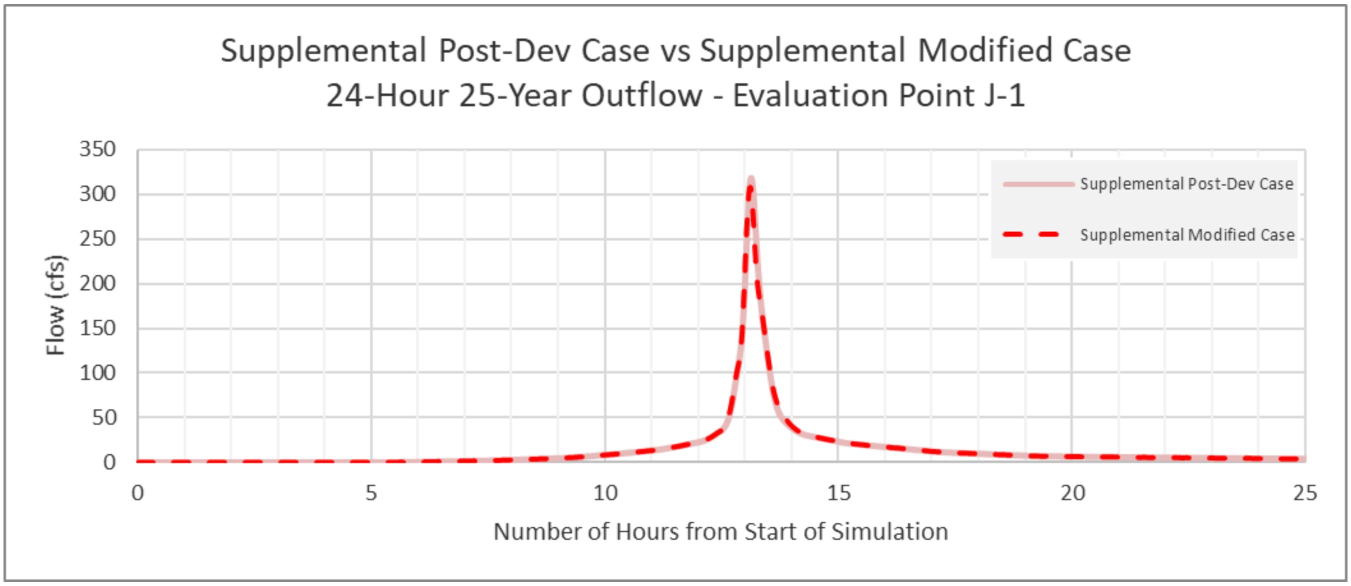
MESQUITE CREEK - MODIFIED CASE
SURFACE WATER MANAGEMENT SYSTEM CALCULATIONS
TIME OF CONCENTRATION (Tc) AND LAG TIME (Tlag) CALCULATIONS FOR SUBBASINS (Continued)

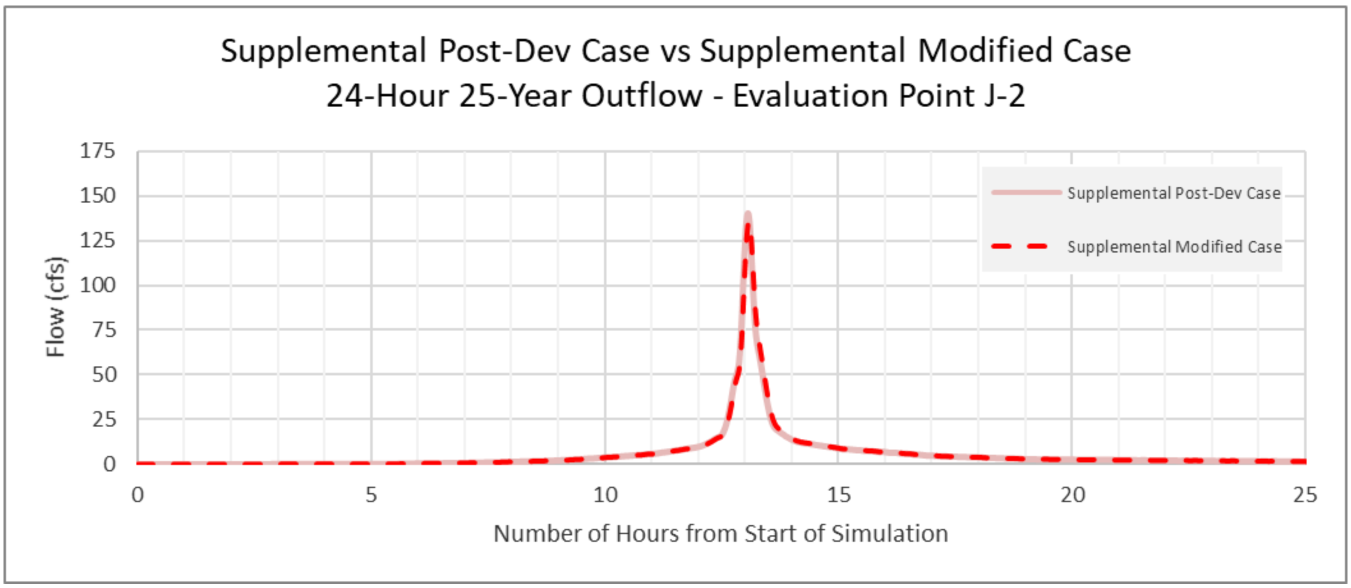
2-year, 24-hr Design Rainfall Depth, P_{2-24} = 4.06 inches

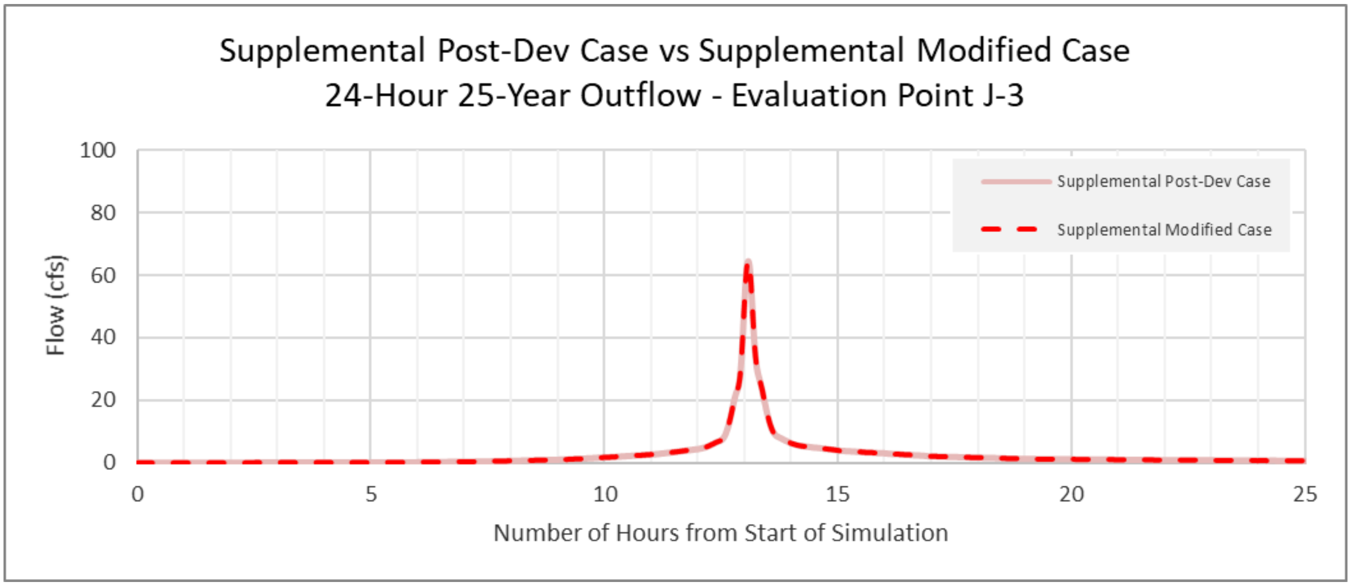
SUBBASIN DESIGNATION		AREA (acres)	AREA (sq mi)	SHEET FLOW				SHALLOW CONCENTRATED FLOW				CHANNEL FLOW		Travel Times (Tt), Tc, and Tlag Calculation				
No.	Description			Length (ft)	Surf Desc	Manning n	Slope (ft/ft)	Length (ft)	Surf Desc	Slope (ft/ft)	Avg Vel (ft/s)	Length (ft)	Vel (ft/s)	Tt (Sheet) (min)	Tt (SH CON.) (min)	Tt (CH) (min)	Tc (min)	Tlag (min)
205	Unit 2 Sideslope	3.88	0.006056	75	GRASS	0.240	0.020	59	unpaved	0.330	9.27	400	5	10.06	0.11	1.33	**12.9**	**7.72**
				25	GRASS	0.240	0.330							1.36	0.00	0.00		
206	Unit 2 Sideslope	9.81	0.015327	90	GRASS	0.240	0.330					1160	5	3.79	0.00	3.87	**7.7**	**4.60**
207	Unit 2 Sideslope	12.72	0.019868	90	GRASS	0.240	0.330					1178	5	3.79	0.00	3.93	**7.7**	**4.63**
208	Unit 2 Sideslope	10.64	0.016632	90	GRASS	0.240	0.330					631	5	3.79	0.00	2.10	**6.0**	**3.60**
209	Unit 2 Sideslope	4.57	0.007144	90	GRASS	0.240	0.330					473	5	3.79	0.00	1.58	**6.0**	**3.60**
210	Unit 2 Sideslope	7.52	0.011757	90	GRASS	0.240	0.330					1023	5	3.79	0.00	3.41	**7.2**	**4.32**
211	Unit 2 Perimeter	3.15	0.004928	90	GRASS	0.240	0.330							3.79	0.00	0.00	**6.0**	**3.60**
212	Unit 2 Perimeter	3.92	0.006118	90	GRASS	0.240	0.330							3.79	0.00	0.00	**6.0**	**3.60**
213	Unit 2 Perimeter	4.10	0.006411	75	GRASS	0.240	0.330							3.28	0.00	0.00	**6.0**	**3.60**
214	Unit 2 Perimeter	2.50	0.003910	78	GRASS	0.240	0.330							3.38	0.00	0.00	**6.0**	**3.60**
215	Unit 2 Perimeter	1.14	0.001778	90	GRASS	0.240	0.330							3.79	0.00	0.00	**6.0**	**3.60**
216	Unit 2 Perimeter	1.40	0.002187	90	GRASS	0.240	0.330							3.79	0.00	0.00	**6.0**	**3.60**
217	Unit 2 Perimeter	1.71	0.002669	90	GRASS	0.240	0.330							3.79	0.00	0.00	**6.0**	**3.60**
218	Unit 2 Perimeter	1.44	0.002243	90	GRASS	0.240	0.330							3.79	0.00	0.00	**6.0**	**3.60**
219	Unit 2 Perimeter	1.09	0.001704	90	GRASS	0.240	0.330							3.79	0.00	0.00	**6.0**	**3.60**
220	Unit 2 Perimeter	3.70	0.005788	90	GRASS	0.240	0.330							3.79	0.00	0.00	**6.0**	**3.60**
221	Scales	0.96	0.001500	100	PAVED	0.011	0.020	118	unpaved	0.020	2.28			1.08	0.86	0.00	**6.0**	**3.60**
222	Scales	1.30	0.002031	100	PAVED	0.011	0.005	82	unpaved	0.005	1.14			1.87	1.20	0.00	**6.0**	**3.60**

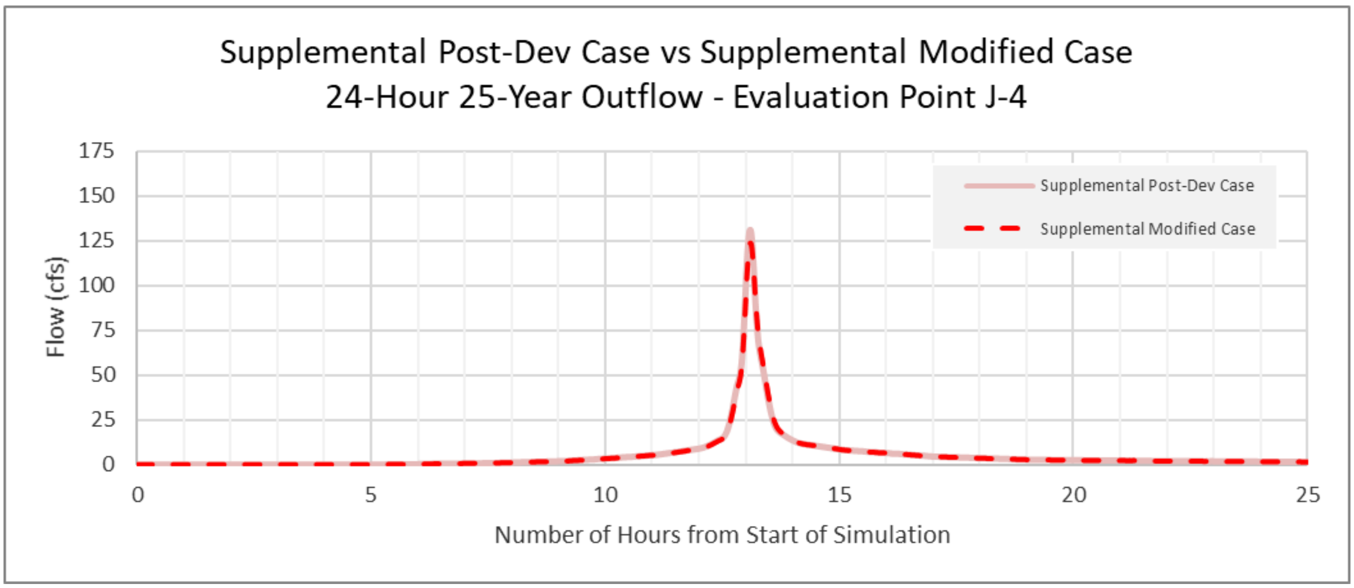
APPENDIX 6J-4

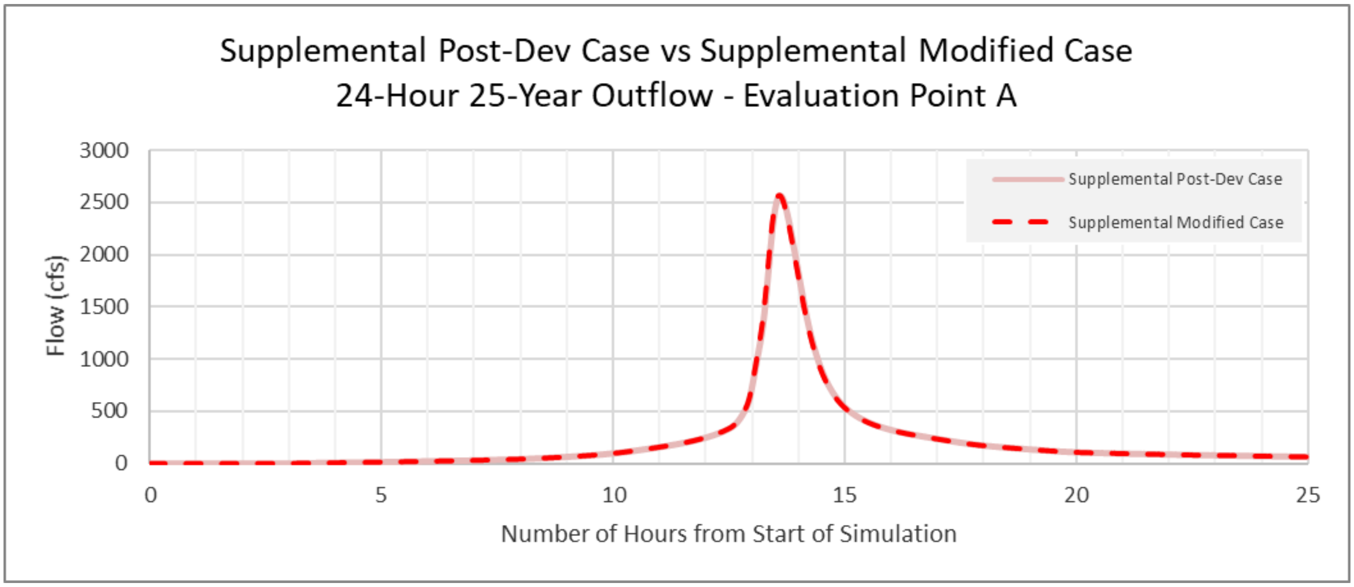
ASSESSMENT POINT HYDROGRAPHS


Supplemental Post-Dev Case vs Supplemental Modified Case
24-Hour 25-Year Outflow - Evaluation Point J-1
Flow (cfs)
350
300
250
200
150
100
50
0
0
5
10
15
20
25
Number of Hours from Start of Simulation
Supplemental Post-Dev Case
Supplemental Modified Case


Supplemental Post-Dev Case vs Supplemental Modified Case
24-Hour 25-Year Outflow - Evaluation Point J-2
Flow (cfs)
175
150
125
100
75
50
25
0
0
5
10
15
20
25
Number of Hours from Start of Simulation
Supplemental Post-Dev Case
Supplemental Modified Case


Supplemental Post-Dev Case vs Supplemental Modified Case
24-Hour 25-Year Outflow - Evaluation Point J-3
Flow (cfs)
100
80
60
40
20
0
0
5
10
15
20
25
Number of Hours from Start of Simulation
Supplemental Post-Dev Case
Supplemental Modified Case


Supplemental Post-Dev Case vs Supplemental Modified Case
24-Hour 25-Year Outflow - Evaluation Point J-4
Flow (cfs)
175
150
125
100
75
50
25
0
0
5
10
15
20
25
Number of Hours from Start of Simulation
Supplemental Post-Dev Case
Supplemental Modified Case


Supplemental Post-Dev Case vs Supplemental Modified Case
24-Hour 25-Year Outflow - Evaluation Point A
Flow (cfs)
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
Number of Hours from Start of Simulation
Supplemental Post-Dev Case
Supplemental Modified Case

APPENDIX 6J-5

HEC-HMS MODEL INPUT AND OUTPUT

• Figure 6J-5-1	Basin Model for the Base Case
• Figure 6J-5-2	Basin Model for the Modified Case
• Table 6J-5-1	HEC-HMS Output
• Sub Appendix 6J-5a	HEC-HMS Input (Base Case)
• Sub Appendix 6J-5b	HEC-HMS Input (Modified Case)

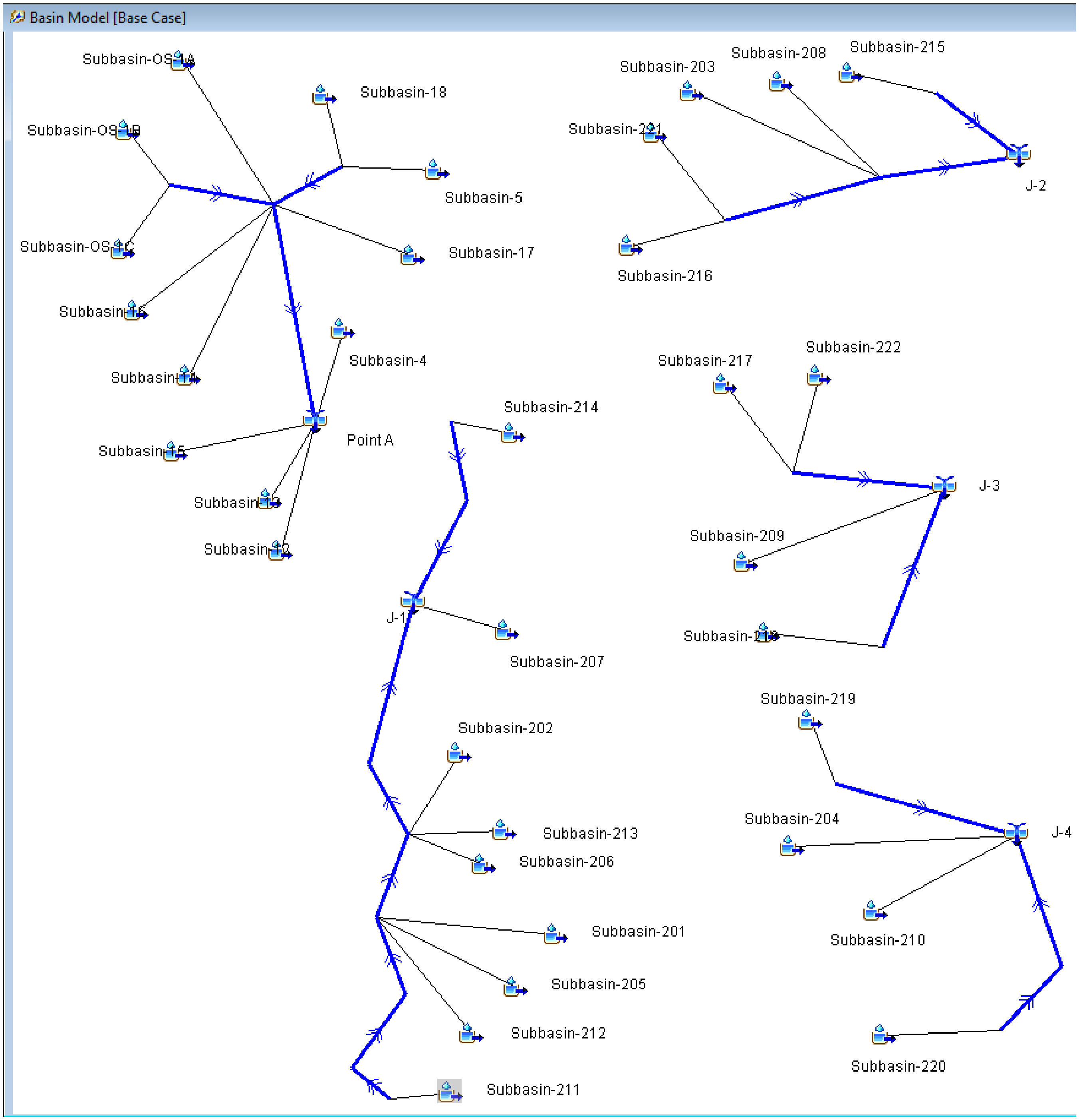


Figure 6J-5-1

Basin Model for the Base Case

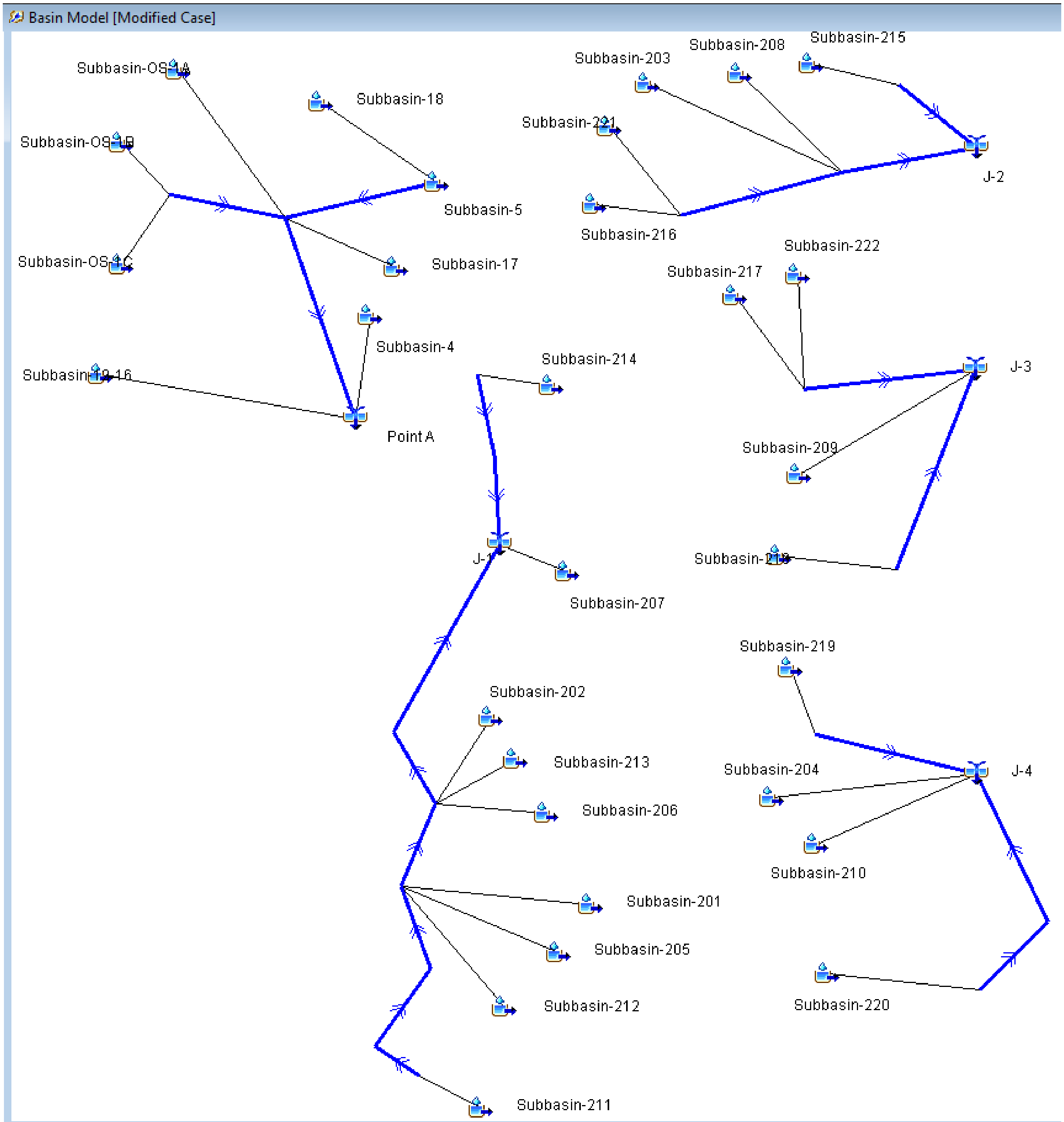


Figure 6J-5-2
Basin Model for the Modified Case

Table 6J-5-1
HEC-HMS Output

Global Summary Results for Run "25 yr Base"

Project: HEC-HMSJan2021 Simulation Run: 25 yr Base

Start of Run: 16May2005, 00:00 Basin Model: Base Case
End of Run: 20May2005, 00:00 Meteorologic Model: 25yrstorm
Compute Time:DATA CHANGED, RECOMPUTE Control Specifications:Base Control

Show Elements: All Elements Volum... IN ACRE Sorting: Alphabetic

Hydrologic Element	Drainage ... (MI2)	Peak Disc... (CFS)	Time of Peak	Volume (ACRE-FT)
J-1	0.0793891	330.75	16May2005, 12:09	29.4739
J-2	0.0316838	140.26	16May2005, 12:06	11.9011
J-3	0.0140835	64.46	16May2005, 12:06	5.4126
J-4	0.0301742	131.16	16May2005, 12:07	11.2040
Point A	1.2199000	2565.04	16May2005, 12:37	452.8801
Reach-11	0.0091193	41.93	16May2005, 12:07	3.5648
Reach-6	1.1845000	2539.01	16May2005, 12:38	439.0516
Reach-7	0.9151400	2009.42	16May2005, 12:39	338.9373
R-201	0.0039898	18.16	16May2005, 12:07	1.4814
R-202	0.0039898	18.23	16May2005, 12:06	1.4816
R-203	0.0017785	8.12	16May2005, 12:06	0.6604
R-204a	0.0299053	132.14	16May2005, 12:06	11.2407
R-204b	0.0036865	17.59	16May2005, 12:06	1.5048
R-205	0.0047002	22.42	16May2005, 12:07	1.9286
R-206	0.0022426	10.22	16May2005, 12:06	0.8326
R-207	0.0017163	7.82	16May2005, 12:06	0.6372
R-208	0.0056766	25.81	16May2005, 12:07	2.1075
R-209	0.0056766	25.92	16May2005, 12:06	2.1079
R-210	0.0045861	20.87	16May2005, 12:06	1.7026
R-211	0.0045861	20.86	16May2005, 12:07	1.7025
R-212	0.0045861	20.85	16May2005, 12:08	1.7026
R-213	0.0321851	137.16	16May2005, 12:09	11.9458
R-214	0.0555946	233.95	16May2005, 12:09	20.6405
R-215	0.0555946	233.32	16May2005, 12:10	20.6386
Subbasin-OS-1A	0.2539900	684.23	16May2005, 12:23	94.1224
Subbasin-OS-1B	0.5550600	1170.65	16May2005, 12:37	205.6902
Subbasin-OS-1C	0.3600800	994.08	16May2005, 12:22	133.4362
Subbasin-12	0.0134982	60.07	16May2005, 12:06	5.2776
Subbasin-13	0.0037147	15.51	16May2005, 12:08	1.4524
Subbasin-14	0.0012089	5.39	16May2005, 12:06	0.4727
Subbasin-15	0.0047716	21.14	16May2005, 12:06	1.8657
Subbasin-16	0.0023706	10.98	16May2005, 12:05	0.9269
Subbasin-17	0.0027164	12.58	16May2005, 12:05	1.0621
Subbasin-18	0.0011400	5.28	16May2005, 12:05	0.4457
Subbasin-201	0.0167943	70.03	16May2005, 12:08	6.2361
Subbasin-202	0.0013627	5.88	16May2005, 12:07	0.5060
Subbasin-203	0.0107188	45.43	16May2005, 12:07	3.9801
Subbasin-204	0.0119375	50.06	16May2005, 12:08	4.4327
Subbasin-205	0.0053438	24.23	16May2005, 12:05	1.9843
Subbasin-206	0.0157813	66.68	16May2005, 12:07	5.8600
Subbasin-207	0.0198047	87.86	16May2005, 12:06	7.3540
Subbasin-208	0.0155000	70.85	16May2005, 12:05	5.7555
Subbasin-209	0.0071406	32.64	16May2005, 12:05	2.6515
Subbasin-210	0.0108437	48.50	16May2005, 12:06	4.0266

Global Summary Results for Run "25 yr Modified"

Project: HEC-HMSJan2021 Simulation Run: 25 yr Modified

Start of Run: 16May2005, 00:00 Basin Model: Modified Case
End of Run: 20May2005, 00:00 Meteorologic Model: 25yrstorm
Compute Time:DATA CHANGED, RECOMPUTE Control Specifications:Base Control

Show Elements: All Elements Volu... IN ACF Sorting: Alphabetic

Hydrologic Element	Drainage ... (MI2)	Peak Disc... (CFS)	Time of Peak	Volume (ACRE-FT)
J-1	0.0794067	314.93	16May2005, 12:09	29.4812
J-2	0.0321243	136.23	16May2005, 12:06	12.0646
J-3	0.0140865	64.48	16May2005, 12:06	5.4137
J-4	0.0298329	123.87	16May2005, 12:07	11.0773
Point A	1.2199151	2569.59	16May2005, 12:37	452.3568
Reach-11	0.0091193	41.93	16May2005, 12:07	3.5648
Reach-6	1.1809674	2536.45	16May2005, 12:38	437.6506
Reach-7	0.9151403	2009.42	16May2005, 12:39	338.9359
R-201	0.0039098	17.79	16May2005, 12:07	1.4516
R-202	0.0039098	17.86	16May2005, 12:06	1.4519
R-203	0.0017785	8.12	16May2005, 12:06	0.6604
R-204a	0.0303458	128.12	16May2005, 12:06	11.4043
R-204b	0.0036865	17.59	16May2005, 12:06	1.5048
R-205	0.0047002	22.42	16May2005, 12:07	1.9285
R-206	0.0022426	10.22	16May2005, 12:06	0.8326
R-207	0.0017042	7.76	16May2005, 12:06	0.6327
R-208	0.0057878	26.32	16May2005, 12:07	2.1488
R-209	0.0057878	26.43	16May2005, 12:06	2.1492
R-210	0.0049285	22.44	16May2005, 12:06	1.8296
R-211	0.0049285	22.42	16May2005, 12:07	1.8296
R-212	0.0049285	22.40	16May2005, 12:08	1.8297
R-213	0.0328278	129.15	16May2005, 12:11	12.1855
R-214	0.0556289	218.31	16May2005, 12:09	20.6537
R-215	0.0556289	217.99	16May2005, 12:10	20.6521
Subbasin-OS-1A	0.2539914	684.23	16May2005, 12:23	94.1224
Subbasin-OS-1B	0.5550597	1170.65	16May2005, 12:37	205.6902
Subbasin-OS-1C	0.3600806	994.08	16May2005, 12:22	133.4362
Subbasin-12-16	0.0255640	99.00	16May2005, 12:09	9.4733
Subbasin-17	0.0027164	12.58	16May2005, 12:05	1.0621
Subbasin-18	0.0011400	5.28	16May2005, 12:05	0.4457
Subbasin-201	0.0157248	60.05	16May2005, 12:11	5.8390
Subbasin-202	0.0010623	4.24	16May2005, 12:09	0.3945
Subbasin-203	0.0100269	39.39	16May2005, 12:10	3.7232
Subbasin-204	0.0105838	40.87	16May2005, 12:10	3.9300
Subbasin-205	0.0060565	24.34	16May2005, 12:09	2.2489
Subbasin-206	0.0153275	68.07	16May2005, 12:06	5.6915
Subbasin-207	0.0198680	88.14	16May2005, 12:06	7.3775
Subbasin-208	0.0166324	76.02	16May2005, 12:05	6.1760
Subbasin-209	0.0071437	32.65	16May2005, 12:05	2.6526
Subbasin-210	0.0117571	52.58	16May2005, 12:06	4.3657
Subbasin-211	0.0049285	22.53	16May2005, 12:05	1.8301
Subbasin-212	0.0061180	27.96	16May2005, 12:05	2.2718
Subbasin-213	0.0064113	29.30	16May2005, 12:05	2.3807
Subbasin-214	0.0039098	17.87	16May2005, 12:05	1.4518

Table 6J-5-2
HEC-HMS Output (Continued)

Global Summary Results for Run "25 yr Base"

Project: HEC-HMSJan2021 Simulation Run: 25 yr Base

Start of Run: 16May2005, 00:00 Basin Model: Base Case
End of Run: 20May2005, 00:00 Meteorologic Model: 25yrstorm
Compute Time:DATA CHANGED, RECOMPUTE Control Specifications:Base Control

Show Elements: All Elements Volum... IN ACRE Sorting: Alphabetic

Hydrologic Element	Drainage ... (MI2)	Peak Disc... (CFS)	Time of Peak	Volume (ACRE-FT)
R-206	0.0022426	10.22	16May2005, 12:06	0.8326
R-207	0.0017163	7.82	16May2005, 12:06	0.6372
R-208	0.0056766	25.81	16May2005, 12:07	2.1075
R-209	0.0056766	25.92	16May2005, 12:06	2.1079
R-210	0.0045861	20.87	16May2005, 12:06	1.7026
R-211	0.0045861	20.86	16May2005, 12:07	1.7025
R-212	0.0045861	20.85	16May2005, 12:08	1.7026
R-213	0.0321851	137.16	16May2005, 12:09	11.9458
R-214	0.0555946	233.95	16May2005, 12:09	20.6405
R-215	0.0555946	233.32	16May2005, 12:10	20.6386
Subbasin-OS-1A	0.2539900	684.23	16May2005, 12:23	94.1224
Subbasin-OS-1B	0.5550600	1170.65	16May2005, 12:37	205.6902
Subbasin-OS-1C	0.3600800	994.08	16May2005, 12:22	133.4362
Subbasin-12	0.0134982	60.07	16May2005, 12:06	5.2776
Subbasin-13	0.0037147	15.51	16May2005, 12:08	1.4524
Subbasin-14	0.0012089	5.39	16May2005, 12:06	0.4727
Subbasin-15	0.0047716	21.14	16May2005, 12:06	1.8657
Subbasin-16	0.0023706	10.98	16May2005, 12:05	0.9269
Subbasin-17	0.0027164	12.58	16May2005, 12:05	1.0621
Subbasin-18	0.0011400	5.28	16May2005, 12:05	0.4457
Subbasin-201	0.0167943	70.03	16May2005, 12:08	6.2361
Subbasin-202	0.0013627	5.88	16May2005, 12:07	0.5060
Subbasin-203	0.0107188	45.43	16May2005, 12:07	3.9801
Subbasin-204	0.0119375	50.06	16May2005, 12:08	4.4327
Subbasin-205	0.0053438	24.23	16May2005, 12:05	1.9843
Subbasin-206	0.0157813	66.68	16May2005, 12:07	5.8600
Subbasin-207	0.0198047	87.86	16May2005, 12:06	7.3540
Subbasin-208	0.0155000	70.85	16May2005, 12:05	5.7555
Subbasin-209	0.0071406	32.64	16May2005, 12:05	2.6515
Subbasin-210	0.0108437	48.50	16May2005, 12:06	4.0266
Subbasin-211	0.0045861	20.96	16May2005, 12:05	1.7029
Subbasin-212	0.0054609	24.96	16May2005, 12:05	2.0278
Subbasin-213	0.0062656	28.64	16May2005, 12:05	2.3266
Subbasin-214	0.0039898	18.24	16May2005, 12:05	1.4815
Subbasin-215	0.0017785	8.13	16May2005, 12:05	0.6604
Subbasin-216	0.0021865	9.99	16May2005, 12:05	0.8119
Subbasin-217	0.0026690	12.20	16May2005, 12:05	0.9911
Subbasin-218	0.0022426	10.25	16May2005, 12:05	0.8327
Subbasin-219	0.0017163	7.84	16May2005, 12:05	0.6373
Subbasin-220	0.0056766	25.95	16May2005, 12:05	2.1079
Subbasin-221	0.0015000	7.61	16May2005, 12:05	0.6928
Subbasin-222	0.0020313	10.30	16May2005, 12:05	0.9381
Subbasin-4	0.0133837	60.27	16May2005, 12:06	5.2329
Subbasin-5	0.0079793	36.83	16May2005, 12:05	3.1198

Global Summary Results for Run "25 yr Modified"

Project: HEC-HMSJan2021 Simulation Run: 25 yr Modified

Start of Run: 16May2005, 00:00 Basin Model: Modified Case
End of Run: 20May2005, 00:00 Meteorologic Model: 25yrstorm
Compute Time:DATA CHANGED, RECOMPUTE Control Specifications:Base Control

Show Elements: All Elements Volu... IN ACF Sorting: Alphabetic

Hydrologic Element	Drainage ... (MI2)	Peak Disc... (CFS)	Time of Peak	Volume (ACRE-FT)
R-203	0.0017785	8.12	16May2005, 12:06	0.6604
R-204a	0.0303458	128.12	16May2005, 12:06	11.4043
R-204b	0.0036865	17.59	16May2005, 12:06	1.5048
R-205	0.0047002	22.42	16May2005, 12:07	1.9285
R-206	0.0022426	10.22	16May2005, 12:06	0.8326
R-207	0.0017042	7.76	16May2005, 12:06	0.6327
R-208	0.0057878	26.32	16May2005, 12:07	2.1488
R-209	0.0057878	26.43	16May2005, 12:06	2.1492
R-210	0.0049285	22.44	16May2005, 12:06	1.8296
R-211	0.0049285	22.42	16May2005, 12:07	1.8296
R-212	0.0049285	22.40	16May2005, 12:08	1.8297
R-213	0.0328278	129.15	16May2005, 12:11	12.1855
R-214	0.0556289	218.31	16May2005, 12:09	20.6537
R-215	0.0556289	217.99	16May2005, 12:10	20.6521
Subbasin-OS-1A	0.2539914	684.23	16May2005, 12:23	94.1224
Subbasin-OS-1B	0.5550597	1170.65	16May2005, 12:37	205.6902
Subbasin-OS-1C	0.3600806	994.08	16May2005, 12:22	133.4362
Subbasin-12-16	0.0255640	99.00	16May2005, 12:09	9.4733
Subbasin-17	0.0027164	12.58	16May2005, 12:05	1.0621
Subbasin-18	0.0011400	5.28	16May2005, 12:05	0.4457
Subbasin-201	0.0157248	60.05	16May2005, 12:11	5.8390
Subbasin-202	0.0010623	4.24	16May2005, 12:09	0.3945
Subbasin-203	0.0100269	39.39	16May2005, 12:10	3.7232
Subbasin-204	0.0105838	40.87	16May2005, 12:10	3.9300
Subbasin-205	0.0060565	24.34	16May2005, 12:09	2.2489
Subbasin-206	0.0153275	68.07	16May2005, 12:06	5.6915
Subbasin-207	0.0198680	88.14	16May2005, 12:06	7.3775
Subbasin-208	0.0166324	76.02	16May2005, 12:05	6.1760
Subbasin-209	0.0071437	32.65	16May2005, 12:05	2.6526
Subbasin-210	0.0117571	52.58	16May2005, 12:06	4.3657
Subbasin-211	0.0049285	22.53	16May2005, 12:05	1.8301
Subbasin-212	0.0061180	27.96	16May2005, 12:05	2.2718
Subbasin-213	0.0064113	29.30	16May2005, 12:05	2.3807
Subbasin-214	0.0039098	17.87	16May2005, 12:05	1.4518
Subbasin-215	0.0017785	8.13	16May2005, 12:05	0.6604
Subbasin-216	0.0021865	9.99	16May2005, 12:05	0.8119
Subbasin-217	0.0026689	12.20	16May2005, 12:05	0.9910
Subbasin-218	0.0022426	10.25	16May2005, 12:05	0.8327
Subbasin-219	0.0017042	7.79	16May2005, 12:05	0.6328
Subbasin-220	0.0057878	26.45	16May2005, 12:05	2.1492
Subbasin-221	0.0015000	7.61	16May2005, 12:05	0.6928
Subbasin-222	0.0020313	10.30	16May2005, 12:05	0.9382
Subbasin-4	0.0133837	60.27	16May2005, 12:06	5.2329
Subbasin-5	0.0079793	36.83	16May2005, 12:05	3.1198

Sub Appendix 6-J-5a

HEC-HMS Model Input

(Base Case)

Basin: Base Case
Last Modified Date: 29 January 2021
Last Modified Time: 22:04:48
Version: 4.7
Filepath Separator: \
Unit System: English
Missing Flow To Zero: No
Enable Flow Ratio: No
Compute Local Flow At Junctions: No

Enable Sediment Routing: No

Enable Quality Routing: No
End:

Subbasin: Subbasin-OS-1B
Last Modified Date: 29 January 2021
Last Modified Time: 23:24:10
Canvas X: 2270247.3578770705
Canvas Y: 1.3824124020327084E7
Label X: -95.0
Label Y: -2.0
Area: 0.55506
Downstream: Reach-7

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 80
Initial Abstraction: 0

Transform: SCS
Lag: 34.453864
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-OS-1C
Last Modified Date: 29 January 2021
Last Modified Time: 23:24:10
Canvas X: 2270197.3038770705
Canvas Y: 1.3822839294327084E7
Label X: -97.0
Label Y: 0.0
Area: 0.36008
Downstream: Reach-7

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 80
Initial Abstraction: 0

Transform: SCS
Lag: 19.952436
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: Reach-7
Description: Tributary to Mesquite Creek through OS-1A
Last Modified Date: 29 January 2021
Last Modified Time: 23:24:10
Canvas X: 2271832.4098770707
Canvas Y: 1.3823329643663542E7
From Canvas X: 2270697.8468770706
From Canvas Y: 1.3823546545663541E7
Label X: -69.0
Label Y: 1.0
Downstream: Reach-6

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 3630
Energy Slope: 0.008
Mannings n: 0.05
Shape: Trapezoid
Number of Subreaches: 2
Width: 10
Side Slope: 30
Initial Variable: Combined Inflow

Index Parameter Type: Index Flow
Index Flow: 1006
Channel Loss: None
End:

Subbasin: Subbasin-OS-1A
Last Modified Date: 29 January 2021
Last Modified Time: 23:24:10
Canvas X: 2270847.664657421
Canvas Y: 1.3824884114472546E7
Label X: -95.0
Label Y: -1.0
Area: 0.25399
Downstream: Reach-6

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 80
Initial Abstraction: 0

Transform: SCS
Lag: 21.061273
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-5
Last Modified Date: 29 January 2021
Last Modified Time: 23:24:10
Canvas X: 2273600.9938770705
Canvas Y: 1.3823706901327083E7
Label X: -7.0
Label Y: -25.0
Area: 0.0079793
Downstream: Reach-11

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84
Initial Abstraction: 0

Transform: SCS
Lag: 3.728417
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-18
Last Modified Date: 29 January 2021
Last Modified Time: 23:24:10
Canvas X: 2272380.1612178786
Canvas Y: 1.3824514811117288E7
Label X: 16.0
Label Y: 0.0
Area: 0.0011400
Downstream: Reach-11

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84
Initial Abstraction: 0

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: Reach-11
Last Modified Date: 29 January 2021

Last Modified Time: 23:24:10
Canvas X: 2271832.4098770707
Canvas Y: 1.3823329643663542E7
From Canvas X: 2272566.5388770704
From Canvas Y: 1.3823746762663541E7
Label X: -26.0
Label Y: 12.0
Downstream: Reach-6

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 834
Energy Slope: 0.029
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 4
Side Slope: 3
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Subbasin: Subbasin-17
Last Modified Date: 29 January 2021
Last Modified Time: 23:24:10
Canvas X: 2273328.45585832
Canvas Y: 1.3822782292831771E7
Label X: 16.0
Label Y: 0.0
Area: 0.0027164
Downstream: Reach-6

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84
Initial Abstraction: 0

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-16
Last Modified Date: 29 January 2021
Last Modified Time: 23:24:10
Canvas X: 2270352.0785218617
Canvas Y: 1.382218164183177E7
Label X: -76.0
Label Y: -3.0
Area: 0.0023706
Downstream: Reach-6

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84
Initial Abstraction: 0

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-14
Last Modified Date: 29 January 2021
Last Modified Time: 23:24:10
Canvas X: 2270909.16685832
Canvas Y: 1.382148088283177E7
Label X: -77.0
Label Y: -4.0
Area: 0.0012089
Downstream: Reach-6

Discretization: None
File: Base_Case.sqlite

Canopy: None

Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84
Initial Abstraction: 0

Transform: SCS
Lag: 4.869233
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: Reach-6
Description: Tributary to Mesquite Creek
Last Modified Date: 29 January 2021
Last Modified Time: 23:24:10
Canvas X: 2272275.8595848866
Canvas Y: 1.3820980794990625E7
From Canvas X: 2271832.4098770707
From Canvas Y: 1.3823329643663542E7
Label X: 16.0
Label Y: 0.0
Downstream: Point A

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 1330
Energy Slope: 0.0069
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 15
Side Slope: 10
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 1270
Channel Loss: None
End:

Subbasin: Subbasin-12
Last Modified Date: 29 January 2021
Last Modified Time: 23:24:10
Canvas X: 2271903.754785067
Canvas Y: 1.3819588779994596E7
Label X: -76.0
Label Y: -1.0
Area: 0.0134982
Downstream: Point A

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84
Initial Abstraction: 0

Transform: SCS
Lag: 4.948417
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-4
Last Modified Date: 29 January 2021
Last Modified Time: 23:24:10
Canvas X: 2272580.0325553273
Canvas Y: 1.3821987279826554E7
Label X: -8.0
Label Y: -28.0
Area: 0.0133837
Downstream: Point A

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84
Initial Abstraction: 0

Transform: SCS

Lag: 4.568417
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-15
Last Modified Date: 29 January 2021
Last Modified Time: 23:24:10
Canvas X: 2270764.5858770707
Canvas Y: 1.3820660083663542E7
Label X: -76.0
Label Y: -2.0
Area: 0.0047716
Downstream: Point A

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84
Initial Abstraction: 0

Transform: SCS
Lag: 5.068417
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-13
Last Modified Date: 29 January 2021
Last Modified Time: 23:24:10
Canvas X: 2271782.2357645677
Canvas Y: 1.3820143311822396E7
Label X: -75.0
Label Y: -5.0
Area: 0.0037147
Downstream: Point A

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84
Initial Abstraction: 0

Transform: SCS
Lag: 6.952136
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: Point A
Last Modified Date: 29 January 2021
Last Modified Time: 23:24:10
Canvas X: 2272275.8595848866
Canvas Y: 1.3820980794990625E7
Label X: 13.0
Label Y: -17.0
End:

Subbasin: Subbasin-204
Last Modified Date: 29 January 2021
Last Modified Time: 23:24:31
Canvas X: 2277435.9862795626
Canvas Y: 1.3816411962999998E7
Label X: -52.0
Label Y: 20.0
Area: 0.0119375
Downstream: J-4

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 6.400559
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-210
Last Modified Date: 29 January 2021
Last Modified Time: 23:24:31
Canvas X: 2278330.5763839344
Canvas Y: 1.3815709926420873E7
Label X: -50.0
Label Y: -26.0
Area: 0.0108437
Downstream: J-4

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 4.322923
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-219
Last Modified Date: 29 January 2021
Last Modified Time: 23:24:31
Canvas X: 2277636.203279563
Canvas Y: 1.3817763427999998E7
Label X: -54.0
Label Y: 15.0
Area: 0.0017163
Downstream: R-207

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-220
Last Modified Date: 29 January 2021
Last Modified Time: 23:24:31
Canvas X: 2278430.6853839345
Canvas Y: 1.3814375146420874E7
Label X: -40.0
Label Y: -28.0
Area: 0.0056766
Downstream: R-209

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: R-208
Last Modified Date: 29 January 2021
Last Modified Time: 23:24:32

Canvas X: 2279849.0523948413
Canvas Y: 1.3816525877959145E7
From Canvas X: 2280337.8557004374
From Canvas Y: 1.3815110551999997E7
Label X: 2.0
Label Y: -21.0
Downstream: J-4

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 746
Energy Slope: 0.05
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Reach: R-209
Last Modified Date: 29 January 2021
Last Modified Time: 23:24:31
Canvas X: 2280337.8557004374
Canvas Y: 1.3815110551999997E7
From Canvas X: 2279682.0413839347
From Canvas Y: 1.3814425200420873E7
Label X: -3.0
Label Y: -16.0
Downstream: R-208

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 440
Energy Slope: 0.023
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Reach: R-207
Last Modified Date: 29 January 2021
Last Modified Time: 23:24:32
Canvas X: 2279849.0523948413
Canvas Y: 1.3816525877959145E7
From Canvas X: 2277901.8817004375
From Canvas Y: 1.3817079352999998E7
Label X: -14.0
Label Y: 10.0
Downstream: J-4

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 316
Energy Slope: 0.0102
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Junction: J-4
Last Modified Date: 29 January 2021
Last Modified Time: 23:24:32
Canvas X: 2279849.0523948413
Canvas Y: 1.3816525877959145E7
Label X: 16.0
Label Y: 0.0
End:

Subbasin: Subbasin-201
Last Modified Date: 29 January 2021
Last Modified Time: 22:06:51
Canvas X: 2274878.7944975025
Canvas Y: 1.3815458413617514E7
Label X: 16.0
Label Y: 0.0
Area: 0.0167943
Downstream: R-213

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 6.587379
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-212
Last Modified Date: 29 January 2021
Last Modified Time: 22:06:51
Canvas X: 2273970.3894614833
Canvas Y: 1.381438596170208E7
Label X: 19.0
Label Y: -2.0
Area: 0.0054609
Downstream: R-213

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-205
Last Modified Date: 29 January 2021
Last Modified Time: 22:06:51
Canvas X: 2274444.9914975027
Canvas Y: 1.3814891131617514E7
Label X: 16.0
Label Y: 0.0
Area: 0.0053438
Downstream: R-213

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.886603
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-211
Last Modified Date: 29 January 2021
Last Modified Time: 23:45:02
Canvas X: 2273744.3608922656
Canvas Y: 1.3813748890553076E7
Label X: 16.0
Label Y: 0.0
Area: 0.0045861
Downstream: R-210

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: R-210
Last Modified Date: 20 January 2021
Last Modified Time: 17:01:21
Canvas X: 2272668.9784614835
Canvas Y: 1.3814006839617515E7
From Canvas X: 2273086.0974614834
From Canvas Y: 1.3813679454485169E7
Label X: -35.0
Label Y: -13.0
Downstream: R-211

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 450
Energy Slope: 0.0114
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Reach: R-211
Last Modified Date: 20 January 2021
Last Modified Time: 17:01:21
Canvas X: 2273252.945461483
Canvas Y: 1.381480364135282E7
From Canvas X: 2272668.9784614835
From Canvas Y: 1.3814006839617515E7
Label X: -37.0
Label Y: -3.0
Downstream: R-212

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 200
Energy Slope: 0.0429
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Reach: R-212
Last Modified Date: 20 January 2021
Last Modified Time: 17:01:21
Canvas X: 2272935.9344614833
Canvas Y: 1.3815641945617514E7
From Canvas X: 2273252.945461483
From Canvas Y: 1.381480364135282E7
Label X: -38.0
Label Y: -12.0
Downstream: R-213

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 452
Energy Slope: 0.05
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Reach: R-213
Last Modified Date: 20 January 2021
Last Modified Time: 17:07:29
Canvas X: 2273284.486533522
Canvas Y: 1.381653885635282E7
From Canvas X: 2272935.9344614833
From Canvas Y: 1.3815641945617514E7
Label X: 5.0
Label Y: -9.0
Downstream: R-214

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 1245
Energy Slope: 0.016
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2

Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 69
Channel Loss: None
End:

Subbasin: Subbasin-206
Last Modified Date: 29 January 2021
Last Modified Time: 22:06:51
Canvas X: 2274103.011593035
Canvas Y: 1.3816207962473402E7
Label X: 16.0
Label Y: 0.0
Area: 0.0157813
Downstream: R-214

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 6.122171
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-213
Last Modified Date: 29 January 2021
Last Modified Time: 22:06:51
Canvas X: 2274320.769461483
Canvas Y: 1.3816576291617515E7
Label X: 18.0
Label Y: -5.0
Area: 0.0062656
Downstream: R-214

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-202
Last Modified Date: 29 January 2021
Last Modified Time: 22:06:51
Canvas X: 2273835.083533522
Canvas Y: 1.38174157193168E7
Label X: -14.0
Label Y: 18.0
Area: 0.0013627
Downstream: R-214

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 5.542733
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: R-214
Last Modified Date: 29 January 2021

Last Modified Time: 22:09:21
Canvas X: 2272852.5114614833
Canvas Y: 1.381728854905134E7
From Canvas X: 2273284.486533522
From Canvas Y: 1.381653885635282E7
Label X: -31.0
Label Y: -1.0
Downstream: R-215

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 720
Energy Slope: 0.026
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 117
Channel Loss: None
End:

Reach: R-215
Last Modified Date: 29 January 2021
Last Modified Time: 22:09:21
Canvas X: 2273328.2509412994
Canvas Y: 1.3819022352112522E7
From Canvas X: 2272852.5114614833
From Canvas Y: 1.381728854905134E7
Label X: -38.0
Label Y: -6.0
Downstream: J-1

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 548
Energy Slope: 0.0495
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 117
Channel Loss: None
End:

Subbasin: Subbasin-207
Last Modified Date: 29 January 2021
Last Modified Time: 22:06:51
Canvas X: 2274354.138461483
Canvas Y: 1.3818729746918993E7
Label X: -11.0
Label Y: -28.0
Area: 0.0198047
Downstream: J-1

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 4.632643
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-209
Last Modified Date: 29 January 2021
Last Modified Time: 23:27:11
Canvas X: 2276934.0934219686
Canvas Y: 1.3819476611689633E7
Label X: -59.0
Label Y: 19.0
Area: 0.0071406
Downstream: J-3

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-214
Last Modified Date: 29 January 2021
Last Modified Time: 22:06:51
Canvas X: 2274416.1621574676
Canvas Y: 1.3820859150264388E7
Label X: -21.0
Label Y: 19.0
Area: 0.0039898
Downstream: R-202

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-215
Last Modified Date: 29 January 2021
Last Modified Time: 22:06:51
Canvas X: 2278069.286
Canvas Y: 1.382475434E7
Label X: -14.0
Label Y: 19.0
Area: 0.0017785
Downstream: R-203

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-218
Last Modified Date: 29 January 2021
Last Modified Time: 23:27:11
Canvas X: 2277164.484831848
Canvas Y: 1.3818701767544484E7
Label X: -82.0
Label Y: -5.0
Area: 0.0022426
Downstream: R-206

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-208
Last Modified Date: 29 January 2021
Last Modified Time: 22:06:51
Canvas X: 2277318.472
Canvas Y: 1.3824654231E7
Label X: -54.0
Label Y: 21.0
Area: 0.0155000
Downstream: R-204a

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-203
Last Modified Date: 29 January 2021
Last Modified Time: 22:06:51
Canvas X: 2276350.756
Canvas Y: 1.3824554123E7
Label X: -72.0
Label Y: 18.0
Area: 0.0107188
Downstream: R-204a

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 6.045239
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-216
Last Modified Date: 29 January 2021
Last Modified Time: 22:06:51
Canvas X: 2275683.366
Canvas Y: 1.3822885648E7
Label X: -24.0
Label Y: -27.0
Area: 0.0021865
Downstream: R-204b

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: R-204a
Last Modified Date: 29 January 2021
Last Modified Time: 23:27:17
Canvas X: 2279885.438965554
Canvas Y: 1.3823852504783085E7
From Canvas X: 2278386.296
From Canvas Y: 1.3823619777E7
Label X: -20.0
Label Y: -23.0
Downstream: J-2

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 190
Energy Slope: 0.0372
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 66
Channel Loss: None
End:

Reach: R-204b
Last Modified Date: 20 January 2021
Last Modified Time: 17:01:21
Canvas X: 2278386.296
Canvas Y: 1.3823619777E7
From Canvas X: 2276701.136
From Canvas Y: 1.3823169288E7
Label X: 6.0
Label Y: -9.0
Downstream: R-204a

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 391
Energy Slope: 0.0372
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Subbasin: Subbasin-221
Last Modified Date: 29 January 2021
Last Modified Time: 22:06:51
Canvas X: 2275950.322
Canvas Y: 1.3824103635E7
Label X: -84.0
Label Y: 1.0
Area: 0.0015000
Downstream: R-204b

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-217
Last Modified Date: 29 January 2021
Last Modified Time: 23:27:11
Canvas X: 2276711.1219237563
Canvas Y: 1.3821391047327496E7
Label X: -68.0
Label Y: 17.0
Area: 0.0026690
Downstream: R-205

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None

End:

Subbasin: Subbasin-222
Last Modified Date: 29 January 2021
Last Modified Time: 23:27:11
Canvas X: 2277724.7394365384
Canvas Y: 1.3821489877748372E7
Label X: -24.0
Label Y: 21.0
Area: 0.0020313
Downstream: R-205

Discretization: None
File: Base_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: R-205
Last Modified Date: 29 January 2021
Last Modified Time: 23:27:11
Canvas X: 2279066.951053418
Canvas Y: 1.3820271000356043E7
From Canvas X: 2277430.1632527225
From Canvas Y: 1.3820437301294325E7
Label X: -1.0
Label Y: 6.0
Downstream: J-3

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 579
Energy Slope: 0.005
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Junction: J-1
Last Modified Date: 24 January 2021
Last Modified Time: 15:47:38
Canvas X: 2273328.2509412994
Canvas Y: 1.3819022352112522E7
Label X: -34.0
Label Y: -14.0
End:

Junction: J-2
Last Modified Date: 29 January 2021
Last Modified Time: 23:27:17
Canvas X: 2279885.438965554
Canvas Y: 1.3823852504783085E7
Label X: -7.0
Label Y: -26.0
End:

Junction: J-3
Last Modified Date: 29 January 2021
Last Modified Time: 23:27:11
Canvas X: 2279066.951053418
Canvas Y: 1.3820271000356043E7
Label X: 16.0
Label Y: 0.0
End:

Reach: R-201
Last Modified Date: 21 January 2021
Last Modified Time: 08:00:51
Canvas X: 2273328.2509412994
Canvas Y: 1.3819022352112522E7
From Canvas X: 2273920.3354614833
From Canvas Y: 1.3820130144617515E7
Label X: 16.0
Label Y: 0.0
Downstream: J-1

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 490
Energy Slope: 0.0221

Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Reach: R-202
Last Modified Date: 20 January 2021
Last Modified Time: 17:01:21
Canvas X: 2273920.3354614833
Canvas Y: 1.3820130144617515E7
From Canvas X: 2273742.1987912203
From Canvas Y: 1.3820991535925616E7
Label X: 16.0
Label Y: 0.0
Downstream: R-201

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 524
Energy Slope: 0.055
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Reach: R-203
Last Modified Date: 29 January 2021
Last Modified Time: 23:27:17
Canvas X: 2279885.438965554
Canvas Y: 1.3823852504783085E7
From Canvas X: 2278986.947
From Canvas Y: 1.3824537438E7
Label X: -43.0
Label Y: -9.0
Downstream: J-2

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 316
Energy Slope: 0.018
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Reach: R-206
Last Modified Date: 29 January 2021
Last Modified Time: 23:27:11
Canvas X: 2279066.951053418
Canvas Y: 1.3820271000356043E7
From Canvas X: 2278413.1267986763
From Canvas Y: 1.3818567171840278E7
Label X: 16.0
Label Y: 0.0
Downstream: J-3

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 393
Energy Slope: 0.0183
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Basin Layer Properties:
Element Layer:
Name: Icons
Layer shown: Yes
End Layer:
End:

Sub Appendix 6-J-5b

HEC-HMS Model Input

(Modified Case)

Basin: Modified Case
Last Modified Date: 29 January 2021
Last Modified Time: 22:04:41
Version: 4.7
Filepath Separator: \
Unit System: English
Missing Flow To Zero: No
Enable Flow Ratio: No
Compute Local Flow At Junctions: No

Enable Sediment Routing: No

Enable Quality Routing: No
End:

Subbasin: Subbasin-OS-1B
Last Modified Date: 29 January 2021
Last Modified Time: 23:30:43
Canvas X: 2270848.2398444363
Canvas Y: 1.3823933911422696E7
Label X: -95.0
Label Y: -2.0
Area: 0.5550597
Downstream: Reach-7

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 80
Initial Abstraction: 0

Transform: SCS
Lag: 34.453864
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-OS-1C
Last Modified Date: 29 January 2021
Last Modified Time: 23:30:43
Canvas X: 2270850.537392053
Canvas Y: 1.3822649185422696E7
Label X: -97.0
Label Y: 0.0
Area: 0.3600806
Downstream: Reach-7

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 80
Initial Abstraction: 0

Transform: SCS
Lag: 19.952436
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: Reach-7
Description: Tributary to Mesquite Creek through OS-1A
Last Modified Date: 29 January 2021
Last Modified Time: 23:30:43
Canvas X: 2272572.895971414
Canvas Y: 1.3823148961906822E7
From Canvas X: 2271351.080392053
From Canvas Y: 1.3823383314422695E7
Label X: -69.0
Label Y: 1.0
Downstream: Reach-6

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 3630
Energy Slope: 0.008
Mannings n: 0.05
Shape: Trapezoid
Number of Subreaches: 2
Width: 10
Side Slope: 30
Initial Variable: Combined Inflow

Index Parameter Type: Index Flow
Index Flow: 1006
Channel Loss: None
End:

Subbasin: Subbasin-OS-1A
Last Modified Date: 29 January 2021
Last Modified Time: 23:30:43
Canvas X: 2271448.5466247867
Canvas Y: 1.3824694005568158E7
Label X: -95.0
Label Y: -1.0
Area: 0.2539914
Downstream: Reach-6

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 80
Initial Abstraction: 0

Transform: SCS
Lag: 21.061273
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-5
Last Modified Date: 29 January 2021
Last Modified Time: 23:30:43
Canvas X: 2274158.044276542
Canvas Y: 1.3823516792422695E7
Label X: -7.0
Label Y: -25.0
Area: 0.0079793
Downstream: Reach-11

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84
Initial Abstraction: 0

Transform: SCS
Lag: 3.728417
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-18
Last Modified Date: 29 January 2021
Last Modified Time: 23:30:43
Canvas X: 2272937.21161735
Canvas Y: 1.3824351579876442E7
Label X: 16.0
Label Y: 0.0
Area: 0.0011400
Downstream: Reach-11

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84
Initial Abstraction: 0

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: Reach-11
Last Modified Date: 29 January 2021

Last Modified Time: 23:30:43
Canvas X: 2272572.895971414
Canvas Y: 1.3823148961906822E7
From Canvas X: 2274157.2413755218
From Canvas Y: 1.3823519409345685E7
Label X: -26.0
Label Y: 12.0
Downstream: Reach-6

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 834
Energy Slope: 0.029
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 4
Side Slope: 3
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Subbasin: Subbasin-17
Last Modified Date: 29 January 2021
Last Modified Time: 23:30:43
Canvas X: 2273724.240276542
Canvas Y: 1.3822632500422696E7
Label X: 16.0
Label Y: 0.0
Area: 0.0027164
Downstream: Reach-6

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84
Initial Abstraction: 0

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: Reach-6
Description: Tributary to Mesquite Creek
Last Modified Date: 29 January 2021
Last Modified Time: 23:30:44
Canvas X: 2273306.3690206646
Canvas Y: 1.3821048954709876E7
From Canvas X: 2272572.895971414
From Canvas Y: 1.3823148961906822E7
Label X: 16.0
Label Y: 0.0
Downstream: Point A

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 1330
Energy Slope: 0.0069
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 15
Side Slope: 10
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 1269
Channel Loss: None
End:

Subbasin: Subbasin-12-16
Last Modified Date: 29 January 2021
Last Modified Time: 23:30:43
Canvas X: 2270638.7585403486
Canvas Y: 1.3821511283446714E7
Label X: -76.0
Label Y: -3.0
Area: 0.0255640
Downstream: Point A

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 80
Initial Abstraction: 0

Transform: SCS
Lag: 7.877356
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-4
Last Modified Date: 29 January 2021
Last Modified Time: 23:32:11
Canvas X: 2273461.7605299666
Canvas Y: 1.3822128725664E7
Label X: -8.0
Label Y: -28.0
Area: 0.0133837
Downstream: Point A

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84
Initial Abstraction: 0

Transform: SCS
Lag: 4.568417
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: Point A
Last Modified Date: 29 January 2021
Last Modified Time: 23:30:44
Canvas X: 2273306.3690206646
Canvas Y: 1.3821048954709876E7
Label X: 13.0
Label Y: -17.0
End:

Subbasin: Subbasin-210
Last Modified Date: 29 January 2021
Last Modified Time: 23:29:02
Canvas X: 2278122.306601091
Canvas Y: 1.3816600371403135E7
Label X: -50.0
Label Y: -26.0
Area: 0.0117571
Downstream: J-4

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 4.322923
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-204
Last Modified Date: 29 January 2021
Last Modified Time: 23:29:02
Canvas X: 2277655.4061442423
Canvas Y: 1.3817084047041036E7
Label X: -52.0
Label Y: 20.0
Area: 0.0105838
Downstream: J-4

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 8.924750
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-219
Last Modified Date: 29 January 2021
Last Modified Time: 23:29:02
Canvas X: 2277855.6231442424
Canvas Y: 1.3818435512041036E7
Label X: -54.0
Label Y: 15.0
Area: 0.0017042
Downstream: R-207

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-220
Last Modified Date: 29 January 2021
Last Modified Time: 23:29:02
Canvas X: 2278237.026123722
Canvas Y: 1.3815250980880504E7
Label X: -40.0
Label Y: -28.0
Area: 0.0057878
Downstream: R-209

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: R-208
Last Modified Date: 29 January 2021
Last Modified Time: 23:29:03
Canvas X: 2279793.4410689264
Canvas Y: 1.3817337881961545E7
From Canvas X: 2280541.868144242
From Canvas Y: 1.3815782636041036E7
Label X: 2.0
Label Y: -21.0
Downstream: J-4

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 746
Energy Slope: 0.05
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Reach: R-209

Last Modified Date: 29 January 2021
Last Modified Time: 23:29:02
Canvas X: 2280541.868144242
Canvas Y: 1.3815782636041036E7
From Canvas X: 2279839.0346668735
From Canvas Y: 1.3815081877041036E7
Label X: -3.0
Label Y: -16.0
Downstream: R-208

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 440
Energy Slope: 0.023
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Reach: R-207
Last Modified Date: 29 January 2021
Last Modified Time: 23:29:03
Canvas X: 2279793.4410689264
Canvas Y: 1.3817337881961545E7
From Canvas X: 2278105.894144242
From Canvas Y: 1.3817751437041037E7
Label X: -14.0
Label Y: 10.0
Downstream: J-4

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 316
Energy Slope: 0.0102
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Subbasin: Subbasin-201
Last Modified Date: 29 January 2021
Last Modified Time: 23:07:28
Canvas X: 2275765.1622215016
Canvas Y: 1.3815971573878776E7
Label X: 16.0
Label Y: 0.0
Area: 0.0157248
Downstream: R-213

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 9.242072
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-212
Last Modified Date: 29 January 2021
Last Modified Time: 23:07:28
Canvas X: 2274856.7571854824
Canvas Y: 1.3814899121963343E7
Label X: 19.0
Label Y: -2.0
Area: 0.0061180
Downstream: R-213

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-205
Last Modified Date: 29 January 2021
Last Modified Time: 23:07:28
Canvas X: 2275424.661087186
Canvas Y: 1.3815466493122565E7
Label X: 16.0
Label Y: 0.0
Area: 0.0060565
Downstream: R-213

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 7.719415
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-211
Last Modified Date: 29 January 2021
Last Modified Time: 23:07:28
Canvas X: 2274613.914221502
Canvas Y: 1.3813835924878776E7
Label X: 16.0
Label Y: 0.0
Area: 0.0049285
Downstream: R-210

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: R-210
Last Modified Date: 29 January 2021
Last Modified Time: 23:07:28
Canvas X: 2273508.6952526406
Canvas Y: 1.381448889925688E7
From Canvas X: 2273972.4651854825
From Canvas Y: 1.381417706443548E7
Label X: -35.0
Label Y: -13.0
Downstream: R-211

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 450
Energy Slope: 0.0114
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Reach: R-211
Last Modified Date: 29 January 2021
Last Modified Time: 23:07:28

Canvas X: 2274092.66225264
Canvas Y: 1.3815301251303133E7
From Canvas X: 2273508.6952526406
From Canvas Y: 1.381448889925688E7
Label X: -37.0
Label Y: -3.0
Downstream: R-212

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 200
Energy Slope: 0.0429
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Reach: R-212
Last Modified Date: 29 January 2021
Last Modified Time: 23:07:28
Canvas X: 2273775.6512526395
Canvas Y: 1.3816155105878776E7
From Canvas X: 2274092.66225264
From Canvas Y: 1.3815301251303133E7
Label X: -38.0
Label Y: -12.0
Downstream: R-213

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 452
Energy Slope: 0.05
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Reach: R-213
Last Modified Date: 29 January 2021
Last Modified Time: 23:07:28
Canvas X: 2274139.7536356263
Canvas Y: 1.3817020915992184E7
From Canvas X: 2273775.6512526395
From Canvas Y: 1.3816155105878776E7
Label X: 5.0
Label Y: -9.0
Downstream: R-214

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 1245
Energy Slope: 0.016
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 65
Channel Loss: None
End:

Subbasin: Subbasin-206
Last Modified Date: 29 January 2021
Last Modified Time: 23:07:28
Canvas X: 2275300.385535982
Canvas Y: 1.3816923276776979E7
Label X: 16.0
Label Y: 0.0
Area: 0.0153275
Downstream: R-214

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 4.596643

Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-213
Last Modified Date: 29 January 2021
Last Modified Time: 23:30:11
Canvas X: 2274971.968600624
Canvas Y: 1.3817483987187857E7
Label X: 18.0
Label Y: -5.0
Area: 0.0064113
Downstream: R-214

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-202
Last Modified Date: 29 January 2021
Last Modified Time: 23:07:28
Canvas X: 2274721.4512575213
Canvas Y: 1.3817928879578061E7
Label X: -14.0
Label Y: 18.0
Area: 0.0010623
Downstream: R-214

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 7.898163
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: R-214
Last Modified Date: 29 January 2021
Last Modified Time: 23:07:28
Canvas X: 2273707.7785635875
Canvas Y: 1.3817770608690705E7
From Canvas X: 2274139.7536356263
From Canvas Y: 1.3817020915992184E7
Label X: -31.0
Label Y: -1.0
Downstream: R-215

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 720
Energy Slope: 0.026
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 109
Channel Loss: None
End:

Reach: R-215
Last Modified Date: 29 January 2021
Last Modified Time: 23:30:48
Canvas X: 2274811.25285168
Canvas Y: 1.3819734007673066E7
From Canvas X: 2273707.7785635875
From Canvas Y: 1.3817770608690705E7
Label X: -38.0
Label Y: -6.0

Downstream: J-1

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 548
Energy Slope: 0.0495
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 109
Channel Loss: None
End:

Subbasin: Subbasin-207
Last Modified Date: 29 January 2021
Last Modified Time: 23:07:28
Canvas X: 2275520.411782535
Canvas Y: 1.3819445061222572E7
Label X: -11.0
Label Y: -28.0
Area: 0.0198680
Downstream: J-1

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 4.632643
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-214
Last Modified Date: 29 January 2021
Last Modified Time: 23:07:28
Canvas X: 2275349.180814309
Canvas Y: 1.3821387860836597E7
Label X: -21.0
Label Y: 19.0
Area: 0.0039098
Downstream: R-202

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-1
Last Modified Date: 29 January 2021
Last Modified Time: 23:30:48
Canvas X: 2274811.25285168
Canvas Y: 1.3819734007673066E7
Label X: -34.0
Label Y: -14.0
End:

Reach: R-201
Description: R-201
Last Modified Date: 29 January 2021
Last Modified Time: 23:30:48
Canvas X: 2274811.25285168
Canvas Y: 1.3819734007673066E7
From Canvas X: 2274760.0522526396
From Canvas Y: 1.3820643304878777E7
Label X: 16.0
Label Y: 0.0
Downstream: J-1

Route: Kinematic Wave
Channel: Kinematic Wave

Length: 490
Energy Slope: 0.0221
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Reach: R-202
Last Modified Date: 29 January 2021
Last Modified Time: 23:07:28
Canvas X: 2274760.0522526396
Canvas Y: 1.3820643304878777E7
From Canvas X: 2274581.9155823765
From Canvas Y: 1.3821504696186878E7
Label X: 16.0
Label Y: 0.0
Downstream: R-201

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 524
Energy Slope: 0.055
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Subbasin: Subbasin-215
Last Modified Date: 24 January 2021
Last Modified Time: 20:56:31
Canvas X: 2278069.286
Canvas Y: 1.382475434E7
Label X: -14.0
Label Y: 19.0
Area: 0.0017785
Downstream: R-203

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-208
Last Modified Date: 29 January 2021
Last Modified Time: 22:07:15
Canvas X: 2277318.472
Canvas Y: 1.3824654231E7
Label X: -54.0
Label Y: 21.0
Area: 0.0166324
Downstream: R-204a

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-203

Last Modified Date: 29 January 2021
Last Modified Time: 22:07:15
Canvas X: 2276350.756
Canvas Y: 1.3824554123E7
Label X: -72.0
Label Y: 18.0
Area: 0.0100269
Downstream: R-204a

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 8.392822
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-216
Last Modified Date: 29 January 2021
Last Modified Time: 23:32:08
Canvas X: 2275805.2826873027
Canvas Y: 1.3823287467175126E7
Label X: -24.0
Label Y: -27.0
Area: 0.0021865
Downstream: R-204b

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: R-204a
Last Modified Date: 29 January 2021
Last Modified Time: 23:28:35
Canvas X: 2279793.441068927
Canvas Y: 1.3823883396100331E7
From Canvas X: 2278386.296
From Canvas Y: 1.3823619777E7
Label X: -20.0
Label Y: -23.0
Downstream: J-2

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 190
Energy Slope: 0.0372
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 64
Channel Loss: None
End:

Reach: R-204b
Last Modified Date: 20 January 2021
Last Modified Time: 17:01:38
Canvas X: 2278386.296
Canvas Y: 1.3823619777E7
From Canvas X: 2276701.136
From Canvas Y: 1.3823169288E7
Label X: 6.0
Label Y: -9.0
Downstream: R-204a

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 391
Energy Slope: 0.0372

Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Subbasin: Subbasin-221
Last Modified Date: 24 January 2021
Last Modified Time: 20:56:31
Canvas X: 2275950.322
Canvas Y: 1.3824103635E7
Label X: -84.0
Label Y: 1.0
Area: 0.0015000
Downstream: R-204b

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-2
Last Modified Date: 29 January 2021
Last Modified Time: 23:28:35
Canvas X: 2279793.441068927
Canvas Y: 1.3823883396100331E7
Label X: -7.0
Label Y: -26.0
End:

Reach: R-203
Last Modified Date: 29 January 2021
Last Modified Time: 23:28:35
Canvas X: 2279793.441068927
Canvas Y: 1.3823883396100331E7
From Canvas X: 2278986.947
From Canvas Y: 1.3824537438E7
Label X: -43.0
Label Y: -9.0
Downstream: J-2

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 316
Energy Slope: 0.018
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Junction: J-4
Last Modified Date: 29 January 2021
Last Modified Time: 23:29:03
Canvas X: 2279793.4410689264
Canvas Y: 1.3817337881961545E7
Label X: 16.0
Label Y: 0.0
End:

Subbasin: Subbasin-209
Last Modified Date: 29 January 2021
Last Modified Time: 23:28:48
Canvas X: 2277937.1550289695
Canvas Y: 1.38204667217242E7
Label X: -59.0
Label Y: 19.0
Area: 0.0071437
Downstream: J-3

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No

Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-218
Last Modified Date: 29 January 2021
Last Modified Time: 23:28:48
Canvas X: 2277736.9380289693
Canvas Y: 1.3819615799724199E7
Label X: -82.0
Label Y: -5.0
Area: 0.0022426
Downstream: R-206

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-217
Last Modified Date: 29 January 2021
Last Modified Time: 23:28:48
Canvas X: 2277267.6905516004
Canvas Y: 1.38223354147242E7
Label X: -68.0
Label Y: 17.0
Area: 0.0026689
Downstream: R-205

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 84

Transform: SCS
Lag: 3.600000
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-222
Last Modified Date: 29 January 2021
Last Modified Time: 23:28:48
Canvas X: 2277928.584576346
Canvas Y: 1.382255033242788E7
Label X: -24.0
Label Y: 21.0
Area: 0.0020313
Downstream: R-205

Discretization: None
File: Modified_Case.sqlite

Canopy: None
Allow Simultaneous Precip Et: No
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: SCS
Lag: 3.600000

Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: R-205
Last Modified Date: 29 January 2021
Last Modified Time: 23:28:48
Canvas X: 2279778.8305462953
Canvas Y: 1.3821560323001968E7
From Canvas X: 2277987.2090289695
From Canvas Y: 1.3821351013724199E7
Label X: -1.0
Label Y: 6.0
Downstream: J-3

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 579
Energy Slope: 0.005
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Junction: J-3
Last Modified Date: 29 January 2021
Last Modified Time: 23:28:48
Canvas X: 2279778.8305462953
Canvas Y: 1.3821560323001968E7
Label X: 16.0
Label Y: 0.0
End:

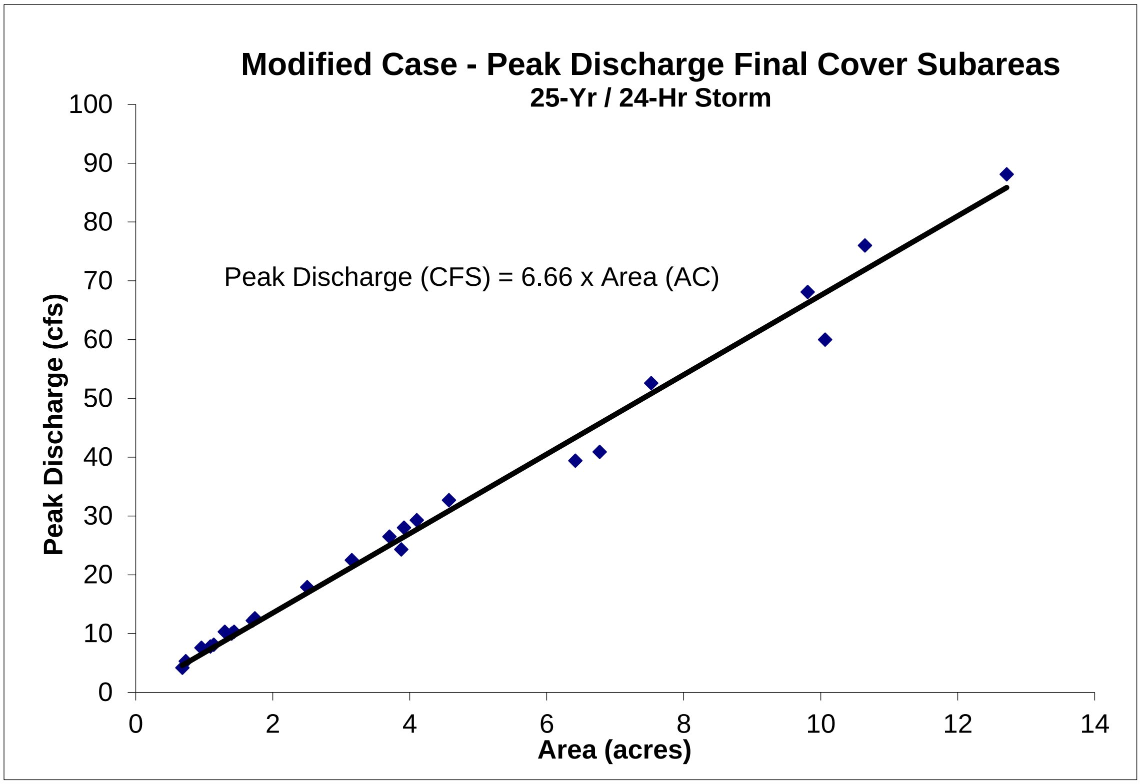
Reach: R-206
Last Modified Date: 29 January 2021
Last Modified Time: 23:28:48
Canvas X: 2279778.8305462953
Canvas Y: 1.3821560323001968E7
From Canvas X: 2278954.9250289695
From Canvas Y: 1.3819465636724198E7
Label X: 16.0
Label Y: 0.0
Downstream: J-3

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 393
Energy Slope: 0.0183
Mannings n: 0.03
Shape: Trapezoid
Number of Subreaches: 2
Width: 5
Side Slope: 4
Initial Variable: Combined Inflow
Index Parameter Type: Index Flow
Index Flow: 50
Channel Loss: None
End:

Basin Layer Properties:
Element Layer:
Name: Icons
Layer shown: Yes
End Layer:
End:

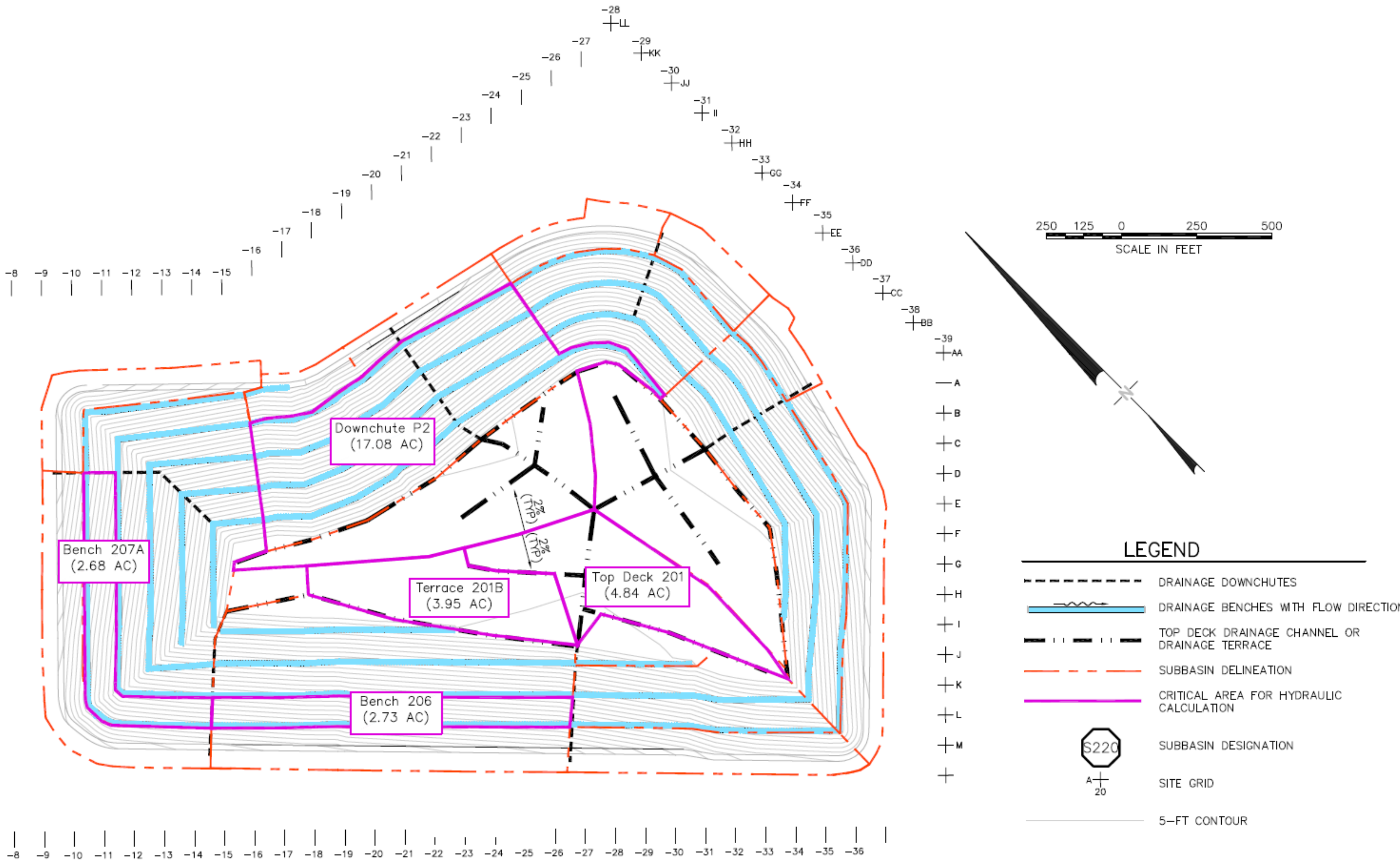
APPENDIX 6J-6

PEAK DISCHARGE VS ACREAGE RELATIONSHIP FOR THE 24-HOUR, 25-YEAR MODIFIED CASE


Modified Case - Peak Discharge Final Cover Subareas
25-Yr / 24-Hr Storm
Peak Discharge (CFS) = 6.66 x Area (AC)
Peak Discharge (cfs)
Area (acres)
0
10
20
30
40
50
60
70
80
90
100
0
2
4
6
8
10
12
14

APPENDIX 6J-7

SUBBASIN DELINEATION MAP
FOR CRITICAL HYDRAULIC CASES
(MODIFIED CASE)


250 125 0 250 500
SCALE IN FEET
Downchute P2
(17.08 AC)
Bench 207A
(2.68 AC)
Terrace 201B
(3.95 AC)
Top Deck 201
(4.84 AC)
Bench 206
(2.73 AC)
2% (TYP)
2% (TYP)
LEGEND
DRAINAGE DOWNCHUTES
DRAINAGE BENCHES WITH FLOW DIRECTION
TOP DECK DRAINAGE CHANNEL OR DRAINAGE TERRACE
SUBBASIN DELINEATION
CRITICAL AREA FOR HYDRAULIC CALCULATION
S220
SUBBASIN DESIGNATION
SITE GRID
5-FT CONTOUR

APPENDIX 6J-8

HYDRAULIC ANALYSIS
FOR FINAL COVER DRAINAGE FEATURES

Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

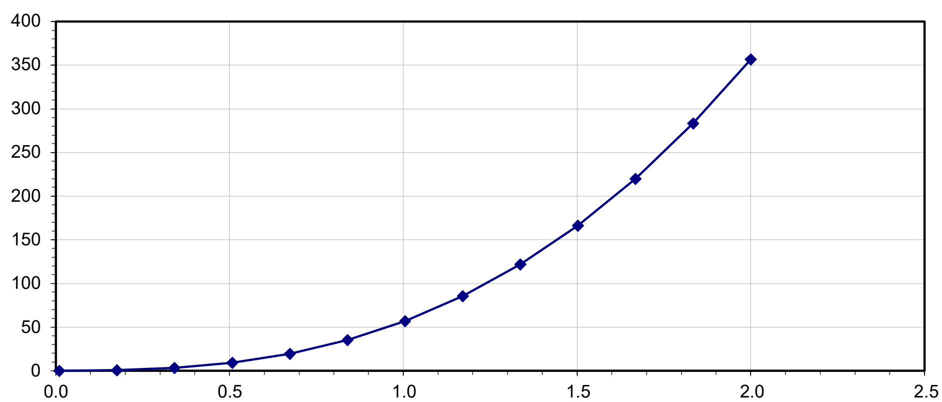
Project: Mesquite Creek LF

Ditch ID: **Terrace 201A, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	21.39	cfs
Bottom Width, B =	0.00	ft
Left Side Slope, Z_1 =	2.50	horizontal :1 vertical
Right Side Slope, Z_2 =	50.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0064	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.00	0.53	0.00	0.10	0.0	0.00	
0.18	0.81	9.27	0.09	0.67	0.5	0.07	
0.34	3.06	18.01	0.17	1.05	3.2	0.14	
0.51	6.76	26.75	0.25	1.36	9.2	0.20	
0.67	11.90	35.49	0.34	1.64	19.6	0.27	
0.84	18.49	44.23	0.42	1.90	35.2	0.34	
1.01	26.51	52.97	0.50	2.15	56.9	0.40	
1.17	35.98	61.71	0.58	2.38	85.5	0.47	
1.34	46.90	70.45	0.67	2.60	121.8	0.53	
1.50	59.26	79.19	0.75	2.81	166.3	0.60	
1.67	73.06	87.93	0.83	3.01	219.9	0.67	
1.83	88.31	96.67	0.91	3.21	283.2	0.73	
2.00	105.00	105.41	1.00	3.40	356.7	0.80	
0.69	12.60	36.51	0.35	1.67	21.10	0.28	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

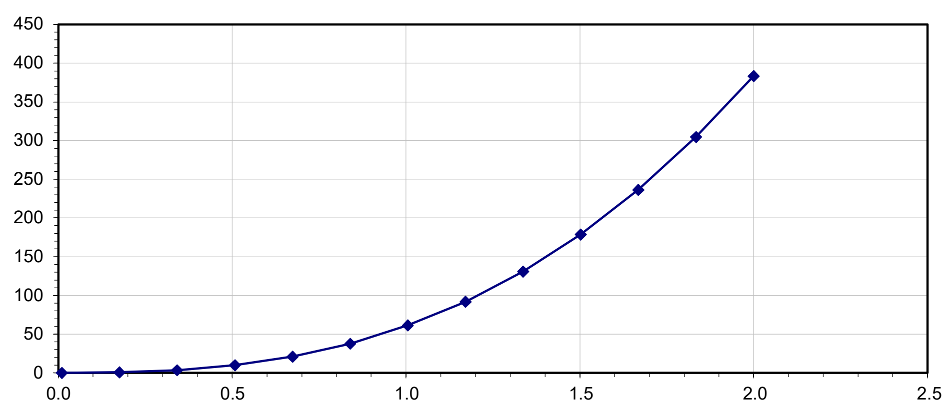
Project: Mesquite Creek LF

Ditch ID: **Terrace 201B, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	26.09	cfs
Bottom Width, B =	0.00	ft
Left Side Slope, Z_1 =	2.50	horizontal :1 vertical
Right Side Slope, Z_2 =	50.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0074	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.00	0.53	0.00	0.11	0.0	0.00	
0.18	0.81	9.27	0.09	0.72	0.6	0.08	
0.34	3.06	18.01	0.17	1.12	3.4	0.16	
0.51	6.76	26.75	0.25	1.46	9.9	0.23	
0.67	11.90	35.49	0.34	1.77	21.0	0.31	
0.84	18.49	44.23	0.42	2.05	37.8	0.39	
1.01	26.51	52.97	0.50	2.31	61.2	0.46	
1.17	35.98	61.71	0.58	2.56	92.0	0.54	
1.34	46.90	70.45	0.67	2.79	130.9	0.62	
1.50	59.26	79.19	0.75	3.02	178.9	0.69	
1.67	73.06	87.93	0.83	3.24	236.5	0.77	
1.83	88.31	96.67	0.91	3.45	304.5	0.85	
2.00	105.00	105.41	1.00	3.65	383.5	0.92	
0.72	13.73	38.12	0.36	1.85	25.46	0.33	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

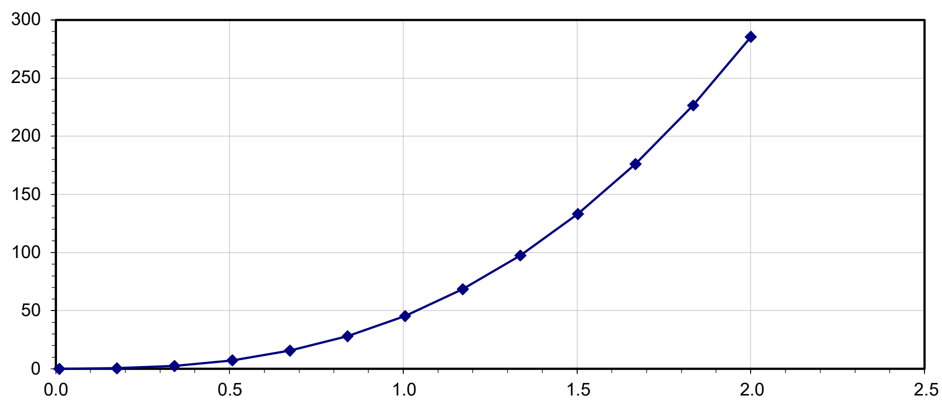
Project: Mesquite Creek LF

Ditch ID: **Terrace 202, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	4.51	cfs
Bottom Width, B =	0.00	ft
Left Side Slope, Z_1 =	2.50	horizontal :1 vertical
Right Side Slope, Z_2 =	50.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0041	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.00	0.53	0.00	0.08	0.0	0.00	
0.18	0.81	9.27	0.09	0.54	0.4	0.04	
0.34	3.06	18.01	0.17	0.84	2.6	0.09	
0.51	6.76	26.75	0.25	1.09	7.4	0.13	
0.67	11.90	35.49	0.34	1.32	15.7	0.17	
0.84	18.49	44.23	0.42	1.52	28.2	0.21	
1.01	26.51	52.97	0.50	1.72	45.6	0.26	
1.17	35.98	61.71	0.58	1.90	68.5	0.30	
1.34	46.90	70.45	0.67	2.08	97.5	0.34	
1.50	59.26	79.19	0.75	2.25	133.1	0.38	
1.67	73.06	87.93	0.83	2.41	176.0	0.43	
1.83	88.31	96.67	0.91	2.57	226.6	0.47	
2.00	105.00	105.41	1.00	2.72	285.5	0.51	
0.41	4.39	21.56	0.20	0.94	4.14	0.10	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

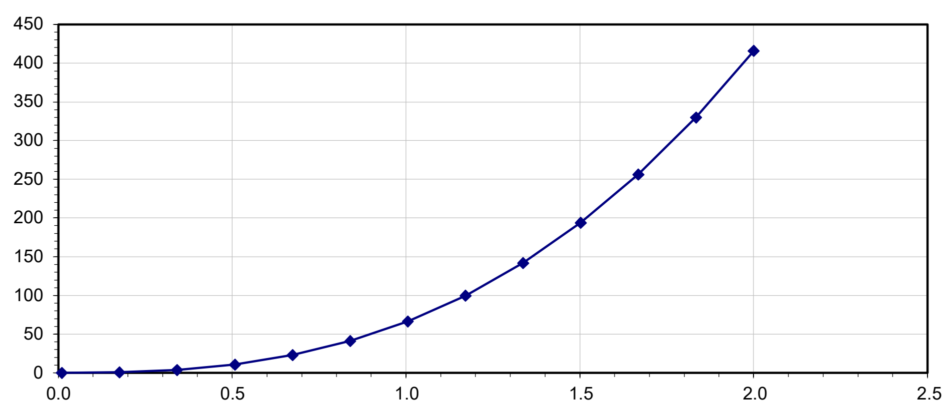
Project: Mesquite Creek LF

Ditch ID: **Terrace 203A, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	21.39	cfs
Bottom Width, B =	0.00	ft
Left Side Slope, Z_1 =	2.50	horizontal :1 vertical
Right Side Slope, Z_2 =	50.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0087	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.00	0.53	0.00	0.12	0.0	0.01	
0.18	0.81	9.27	0.09	0.78	0.6	0.10	
0.34	3.06	18.01	0.17	1.22	3.7	0.19	
0.51	6.76	26.75	0.25	1.59	10.7	0.28	
0.67	11.90	35.49	0.34	1.92	22.8	0.37	
0.84	18.49	44.23	0.42	2.22	41.0	0.46	
1.01	26.51	52.97	0.50	2.50	66.4	0.55	
1.17	35.98	61.71	0.58	2.77	99.7	0.64	
1.34	46.90	70.45	0.67	3.03	142.0	0.73	
1.50	59.26	79.19	0.75	3.27	193.9	0.82	
1.67	73.06	87.93	0.83	3.51	256.4	0.91	
1.83	88.31	96.67	0.91	3.74	330.1	1.00	
2.00	105.00	105.41	1.00	3.96	415.9	1.09	
0.65	11.23	34.46	0.33	1.88	21.09	0.36	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

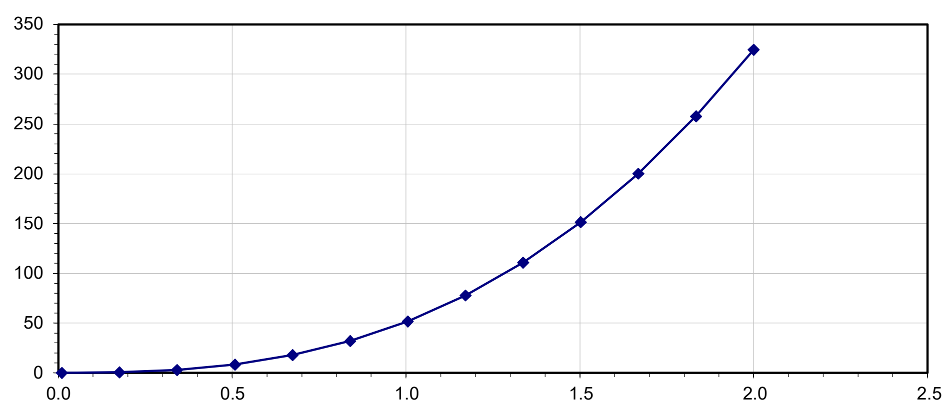
Project: Mesquite Creek LF

Ditch ID: **Terrace 203B, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	5.47	cfs
Bottom Width, B =	0.00	ft
Left Side Slope, Z_1 =	2.50	horizontal :1 vertical
Right Side Slope, Z_2 =	50.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0053	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.00	0.53	0.00	0.09	0.0	0.00	
0.18	0.81	9.27	0.09	0.61	0.5	0.06	
0.34	3.06	18.01	0.17	0.95	2.9	0.11	
0.51	6.76	26.75	0.25	1.24	8.4	0.17	
0.67	11.90	35.49	0.34	1.50	17.8	0.22	
0.84	18.49	44.23	0.42	1.73	32.0	0.28	
1.01	26.51	52.97	0.50	1.95	51.8	0.33	
1.17	35.98	61.71	0.58	2.16	77.8	0.39	
1.34	46.90	70.45	0.67	2.36	110.8	0.44	
1.50	59.26	79.19	0.75	2.55	151.4	0.50	
1.67	73.06	87.93	0.83	2.74	200.1	0.55	
1.83	88.31	96.67	0.91	2.92	257.7	0.61	
2.00	105.00	105.41	1.00	3.09	324.6	0.66	
0.42	4.61	22.09	0.21	1.09	5.03	0.14	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

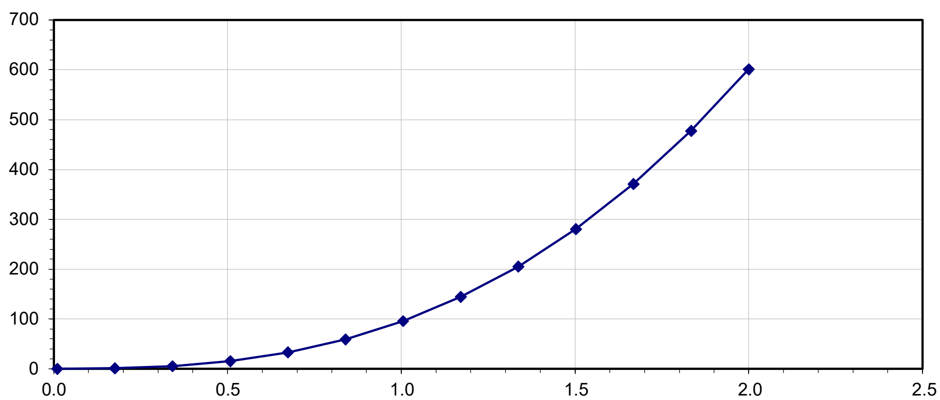
Project: Mesquite Creek LF

Ditch ID: **Terrace 203C, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	3.24	cfs
Bottom Width, B =	0.00	ft
Left Side Slope, Z_1 =	2.50	horizontal :1 vertical
Right Side Slope, Z_2 =	50.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0182	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.00	0.53	0.00	0.17	0.0	0.01	
0.18	0.81	9.27	0.09	1.13	0.9	0.20	
0.34	3.06	18.01	0.17	1.76	5.4	0.39	
0.51	6.76	26.75	0.25	2.29	15.5	0.58	
0.67	11.90	35.49	0.34	2.77	33.0	0.76	
0.84	18.49	44.23	0.42	3.21	59.3	0.95	
1.01	26.51	52.97	0.50	3.62	96.0	1.14	
1.17	35.98	61.71	0.58	4.01	144.2	1.33	
1.34	46.90	70.45	0.67	4.38	205.3	1.52	
1.50	59.26	79.19	0.75	4.73	280.5	1.71	
1.67	73.06	87.93	0.83	5.08	370.9	1.89	
1.83	88.31	96.67	0.91	5.41	477.5	2.08	
2.00	105.00	105.41	1.00	5.73	601.5	2.27	
0.26	1.80	13.80	0.13	1.48	2.66	0.30	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

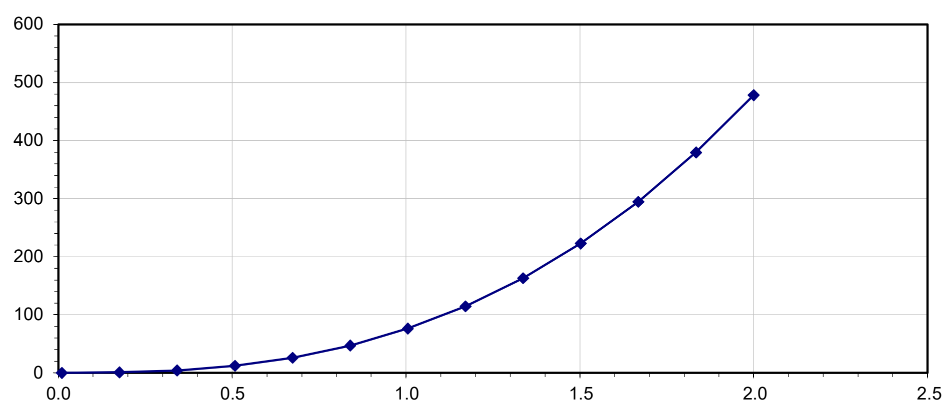
Project: Mesquite Creek LF

Ditch ID: **Terrace 204A, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	9.33	cfs
Bottom Width, B =	0.00	ft
Left Side Slope, Z_1 =	2.50	horizontal :1 vertical
Right Side Slope, Z_2 =	50.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0115	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.00	0.53	0.00	0.13	0.0	0.01	
0.18	0.81	9.27	0.09	0.90	0.7	0.13	
0.34	3.06	18.01	0.17	1.40	4.3	0.25	
0.51	6.76	26.75	0.25	1.82	12.3	0.36	
0.67	11.90	35.49	0.34	2.20	26.2	0.48	
0.84	18.49	44.23	0.42	2.55	47.2	0.60	
1.01	26.51	52.97	0.50	2.88	76.3	0.72	
1.17	35.98	61.71	0.58	3.19	114.6	0.84	
1.34	46.90	70.45	0.67	3.48	163.2	0.96	
1.50	59.26	79.19	0.75	3.76	223.0	1.08	
1.67	73.06	87.93	0.83	4.03	294.8	1.20	
1.83	88.31	96.67	0.91	4.30	379.6	1.32	
2.00	105.00	105.41	1.00	4.55	478.1	1.44	
0.45	5.21	23.48	0.22	1.67	8.71	0.32	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

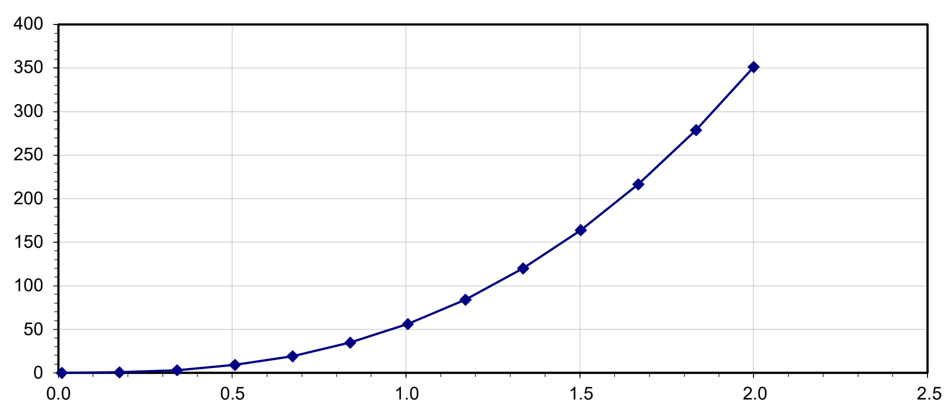
Project: Mesquite Creek LF

Ditch ID: **Terrace 204B, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	19.36	cfs
Bottom Width, B =	0.00	ft
Left Side Slope, Z_1 =	2.50	horizontal :1 vertical
Right Side Slope, Z_2 =	50.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0062	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.00	0.53	0.00	0.10	0.0	0.00	
0.18	0.81	9.27	0.09	0.66	0.5	0.07	
0.34	3.06	18.01	0.17	1.03	3.2	0.13	
0.51	6.76	26.75	0.25	1.34	9.1	0.20	
0.67	11.90	35.49	0.34	1.62	19.2	0.26	
0.84	18.49	44.23	0.42	1.87	34.6	0.32	
1.01	26.51	52.97	0.50	2.11	56.0	0.39	
1.17	35.98	61.71	0.58	2.34	84.2	0.45	
1.34	46.90	70.45	0.67	2.56	119.9	0.52	
1.50	59.26	79.19	0.75	2.76	163.7	0.58	
1.67	73.06	87.93	0.83	2.96	216.5	0.65	
1.83	88.31	96.67	0.91	3.16	278.7	0.71	
2.00	105.00	105.41	1.00	3.34	351.1	0.77	
0.67	11.94	35.55	0.34	1.62	19.34	0.26	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

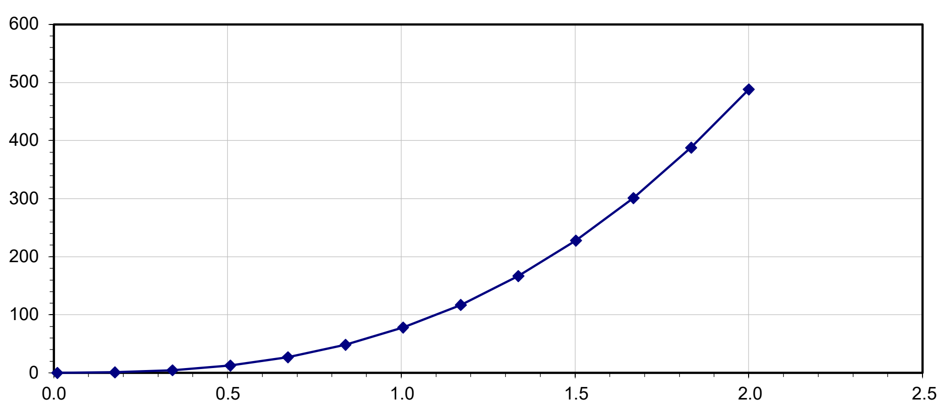
Project: Mesquite Creek LF

Ditch ID: **Terrace 204C, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	10.18	cfs
Bottom Width, B =	0.00	ft
Left Side Slope, Z_1 =	2.50	horizontal :1 vertical
Right Side Slope, Z_2 =	50.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0120	ft/ft

Depth of Flow Y ft	Area of Flow A ft²	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft³/s	Avg. Tractive Stress τ_o lb/ft²	Comments
0.01	0.00	0.53	0.00	0.14	0.0	0.01	
0.18	0.81	9.27	0.09	0.92	0.7	0.13	
0.34	3.06	18.01	0.17	1.43	4.4	0.26	
0.51	6.76	26.75	0.25	1.86	12.6	0.38	
0.67	11.90	35.49	0.34	2.25	26.8	0.50	
0.84	18.49	44.23	0.42	2.61	48.2	0.63	
1.01	26.51	52.97	0.50	2.94	77.9	0.75	
1.17	35.98	61.71	0.58	3.25	117.1	0.88	
1.34	46.90	70.45	0.67	3.56	166.7	1.00	
1.50	59.26	79.19	0.75	3.84	227.8	1.13	
1.67	73.06	87.93	0.83	4.12	301.1	1.25	
1.83	88.31	96.67	0.91	4.39	387.7	1.37	
2.00	105.00	105.41	1.00	4.65	488.4	1.50	
0.46	5.52	24.17	0.23	1.74	9.62	0.34	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

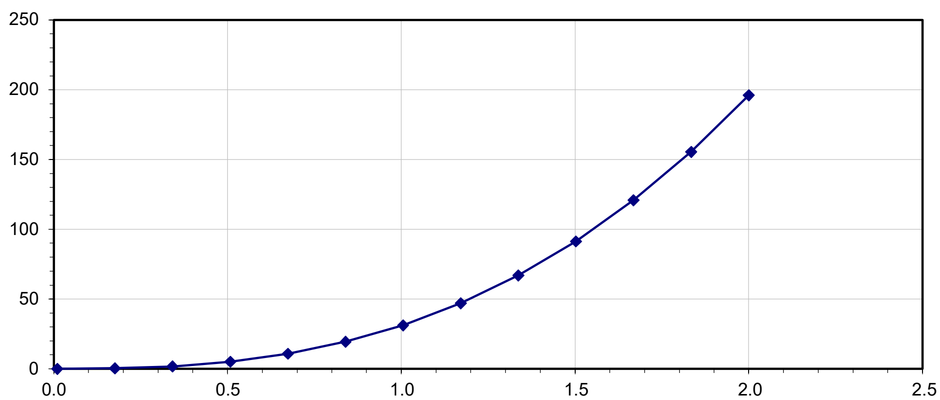
Project: Mesquite Creek LF

Ditch ID: **Bench 205, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	12.98	cfs
Bottom Width, B =	0.00	ft
Left Side Slope, Z_1 =	3.00	horizontal :1 vertical
Right Side Slope, Z_2 =	8.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0450	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.00	0.11	0.00	0.26	0.0	0.03	
0.18	0.17	1.97	0.09	1.76	0.3	0.49	
0.34	0.64	3.84	0.17	2.74	1.8	0.96	
0.51	1.42	5.70	0.25	3.57	5.1	1.43	
0.67	2.49	7.56	0.33	4.31	10.7	1.89	
0.84	3.87	9.42	0.41	4.99	19.3	2.36	
1.01	5.56	11.28	0.49	5.63	31.3	2.82	
1.17	7.54	13.14	0.57	6.23	47.0	3.29	
1.34	9.83	15.00	0.65	6.81	66.9	3.75	
1.50	12.42	16.86	0.74	7.36	91.4	4.22	
1.67	15.31	18.73	0.82	7.89	120.9	4.68	
1.83	18.50	20.59	0.90	8.41	155.6	5.15	
2.00	22.00	22.45	0.98	8.91	196.0	5.62	
0.72	2.82	8.04	0.35	4.49	12.68	2.01	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

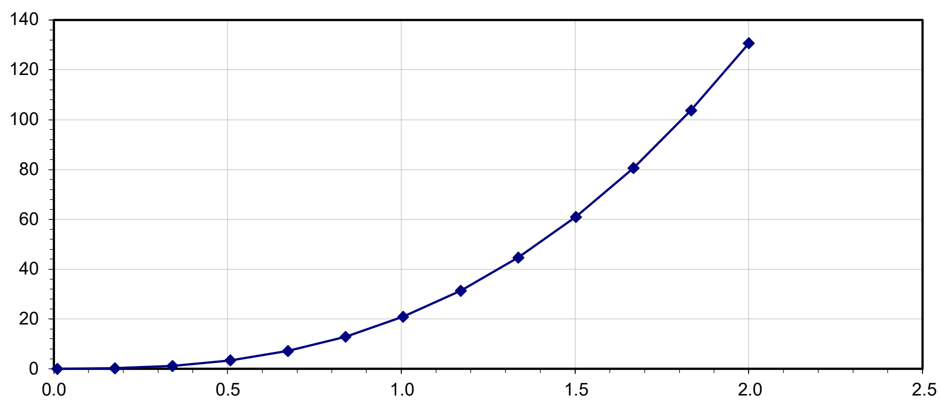
Project: Mesquite Creek LF

Ditch ID: **Bench 206, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	18.23	cfs
Bottom Width, B =	0.00	ft
Left Side Slope, Z_1 =	3.00	horizontal :1 vertical
Right Side Slope, Z_2 =	8.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0200	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.00	0.11	0.00	0.17	0.0	0.01	
0.18	0.17	1.97	0.09	1.17	0.2	0.22	
0.34	0.64	3.84	0.17	1.83	1.2	0.43	
0.51	1.42	5.70	0.25	2.38	3.4	0.63	
0.67	2.49	7.56	0.33	2.87	7.2	0.84	
0.84	3.87	9.42	0.41	3.33	12.9	1.05	
1.01	5.56	11.28	0.49	3.75	20.9	1.25	
1.17	7.54	13.14	0.57	4.16	31.3	1.46	
1.34	9.83	15.00	0.65	4.54	44.6	1.67	
1.50	12.42	16.86	0.74	4.91	60.9	1.88	
1.67	15.31	18.73	0.82	5.26	80.6	2.08	
1.83	18.50	20.59	0.90	5.61	103.7	2.29	
2.00	22.00	22.45	0.98	5.94	130.7	2.50	
0.95	4.97	10.67	0.47	3.62	17.96	1.19	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

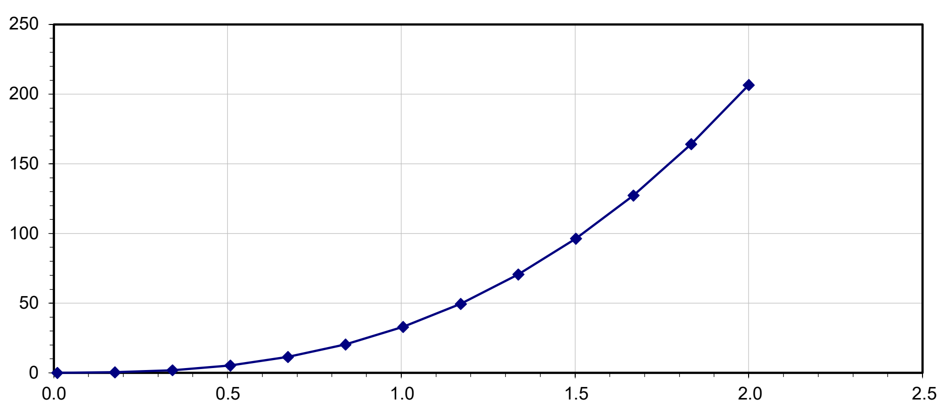
Project: Mesquite Creek LF

Ditch ID: **Bench 207A, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	18.07	cfs
Bottom Width, B =	0.00	ft
Left Side Slope, Z_1 =	3.00	horizontal :1 vertical
Right Side Slope, Z_2 =	8.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0500	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.00	0.11	0.00	0.27	0.0	0.03	
0.18	0.17	1.97	0.09	1.86	0.3	0.55	
0.34	0.64	3.84	0.17	2.89	1.9	1.07	
0.51	1.42	5.70	0.25	3.76	5.3	1.58	
0.67	2.49	7.56	0.33	4.54	11.3	2.10	
0.84	3.87	9.42	0.41	5.26	20.4	2.62	
1.01	5.56	11.28	0.49	5.93	33.0	3.14	
1.17	7.54	13.14	0.57	6.57	49.5	3.65	
1.34	9.83	15.00	0.65	7.18	70.5	4.17	
1.50	12.42	16.86	0.74	7.76	96.4	4.69	
1.67	15.31	18.73	0.82	8.32	127.4	5.21	
1.83	18.50	20.59	0.90	8.86	164.0	5.72	
2.00	22.00	22.45	0.98	9.39	206.6	6.24	
0.80	3.49	8.94	0.39	5.08	17.75	2.49	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

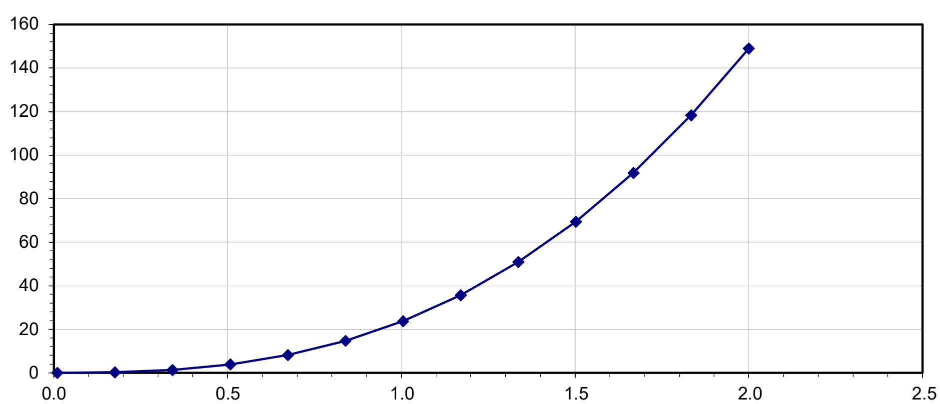
Project: Mesquite Creek LF

Ditch ID: **Bench 207B, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	9.26	cfs
Bottom Width, B =	0.00	ft
Left Side Slope, Z_1 =	3.00	horizontal :1 vertical
Right Side Slope, Z_2 =	8.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0260	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.00	0.11	0.00	0.20	0.0	0.02	
0.18	0.17	1.97	0.09	1.34	0.2	0.29	
0.34	0.64	3.84	0.17	2.08	1.3	0.55	
0.51	1.42	5.70	0.25	2.71	3.8	0.82	
0.67	2.49	7.56	0.33	3.28	8.2	1.09	
0.84	3.87	9.42	0.41	3.79	14.7	1.36	
1.01	5.56	11.28	0.49	4.28	23.8	1.63	
1.17	7.54	13.14	0.57	4.74	35.7	1.90	
1.34	9.83	15.00	0.65	5.18	50.9	2.17	
1.50	12.42	16.86	0.74	5.60	69.5	2.44	
1.67	15.31	18.73	0.82	6.00	91.9	2.71	
1.83	18.50	20.59	0.90	6.39	118.3	2.98	
2.00	22.00	22.45	0.98	6.77	149.0	3.24	
0.70	2.70	7.87	0.34	3.37	9.10	1.14	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

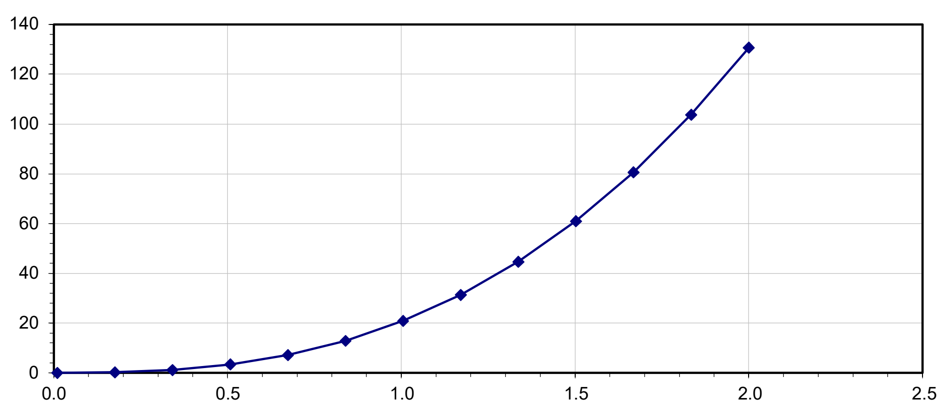
Project: Mesquite Creek LF

Ditch ID: **Bench 207C, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	10.02	cfs
Bottom Width, B =	0.00	ft
Left Side Slope, Z_1 =	3.00	horizontal :1 vertical
Right Side Slope, Z_2 =	8.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0200	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.00	0.11	0.00	0.17	0.0	0.01	
0.18	0.17	1.97	0.09	1.17	0.2	0.22	
0.34	0.64	3.84	0.17	1.83	1.2	0.43	
0.51	1.42	5.70	0.25	2.38	3.4	0.63	
0.67	2.49	7.56	0.33	2.87	7.2	0.84	
0.84	3.87	9.42	0.41	3.33	12.9	1.05	
1.01	5.56	11.28	0.49	3.75	20.9	1.25	
1.17	7.54	13.14	0.57	4.16	31.3	1.46	
1.34	9.83	15.00	0.65	4.54	44.6	1.67	
1.50	12.42	16.86	0.74	4.91	60.9	1.88	
1.67	15.31	18.73	0.82	5.26	80.6	2.08	
1.83	18.50	20.59	0.90	5.61	103.7	2.29	
2.00	22.00	22.45	0.98	5.94	130.7	2.50	
0.76	3.14	8.48	0.37	3.10	9.76	0.94	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

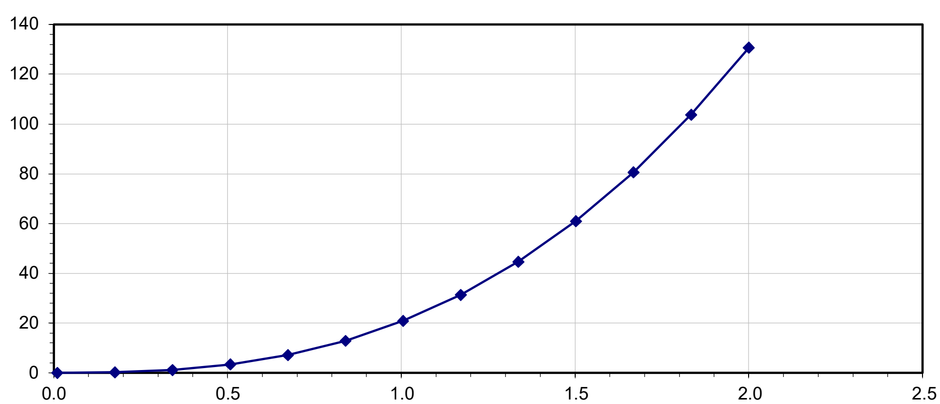
Project: Mesquite Creek LF

Ditch ID: **Bench 208A, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	9.86	cfs
Bottom Width, B =	0.00	ft
Left Side Slope, Z_1 =	3.00	horizontal :1 vertical
Right Side Slope, Z_2 =	8.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0200	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.00	0.11	0.00	0.17	0.0	0.01	
0.18	0.17	1.97	0.09	1.17	0.2	0.22	
0.34	0.64	3.84	0.17	1.83	1.2	0.43	
0.51	1.42	5.70	0.25	2.38	3.4	0.63	
0.67	2.49	7.56	0.33	2.87	7.2	0.84	
0.84	3.87	9.42	0.41	3.33	12.9	1.05	
1.01	5.56	11.28	0.49	3.75	20.9	1.25	
1.17	7.54	13.14	0.57	4.16	31.3	1.46	
1.34	9.83	15.00	0.65	4.54	44.6	1.67	
1.50	12.42	16.86	0.74	4.91	60.9	1.88	
1.67	15.31	18.73	0.82	5.26	80.6	2.08	
1.83	18.50	20.59	0.90	5.61	103.7	2.29	
2.00	22.00	22.45	0.98	5.94	130.7	2.50	
0.75	3.11	8.43	0.37	3.09	9.60	0.94	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

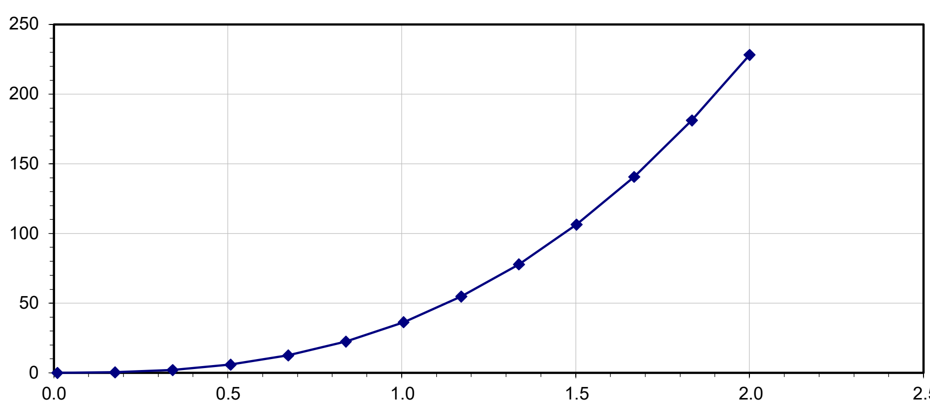
Project: Mesquite Creek LF

Ditch ID: **Bench 208B, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	6.73	cfs
Bottom Width, B =	0.00	ft
Left Side Slope, Z_1 =	3.00	horizontal :1 vertical
Right Side Slope, Z_2 =	8.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0610	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.00	0.11	0.00	0.30	0.0	0.04	
0.18	0.17	1.97	0.09	2.05	0.3	0.67	
0.34	0.64	3.84	0.17	3.19	2.0	1.30	
0.51	1.42	5.70	0.25	4.16	5.9	1.93	
0.67	2.49	7.56	0.33	5.02	12.5	2.56	
0.84	3.87	9.42	0.41	5.81	22.5	3.19	
1.01	5.56	11.28	0.49	6.56	36.4	3.83	
1.17	7.54	13.14	0.57	7.26	54.7	4.46	
1.34	9.83	15.00	0.65	7.93	77.9	5.09	
1.50	12.42	16.86	0.74	8.57	106.4	5.72	
1.67	15.31	18.73	0.82	9.19	140.7	6.35	
1.83	18.50	20.59	0.90	9.79	181.2	6.98	
2.00	22.00	22.45	0.98	10.37	228.2	7.61	
0.53	1.54	5.93	0.26	4.27	6.56	2.01	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

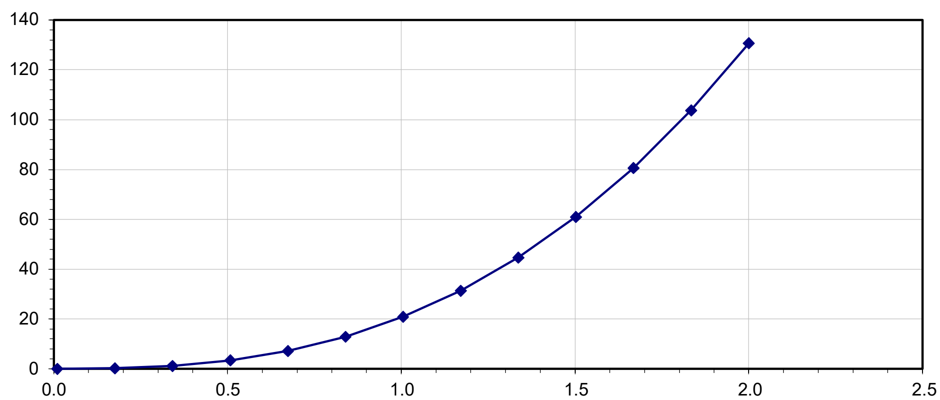
Project: Mesquite Creek LF

Ditch ID: **Bench 209A, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	7.26	cfs
Bottom Width, B =	0.00	ft
Left Side Slope, Z_1 =	3.00	horizontal :1 vertical
Right Side Slope, Z_2 =	8.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0200	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.00	0.11	0.00	0.17	0.0	0.01	
0.18	0.17	1.97	0.09	1.17	0.2	0.22	
0.34	0.64	3.84	0.17	1.83	1.2	0.43	
0.51	1.42	5.70	0.25	2.38	3.4	0.63	
0.67	2.49	7.56	0.33	2.87	7.2	0.84	
0.84	3.87	9.42	0.41	3.33	12.9	1.05	
1.01	5.56	11.28	0.49	3.75	20.9	1.25	
1.17	7.54	13.14	0.57	4.16	31.3	1.46	
1.34	9.83	15.00	0.65	4.54	44.6	1.67	
1.50	12.42	16.86	0.74	4.91	60.9	1.88	
1.67	15.31	18.73	0.82	5.26	80.6	2.08	
1.83	18.50	20.59	0.90	5.61	103.7	2.29	
2.00	22.00	22.45	0.98	5.94	130.7	2.50	
0.68	2.51	7.59	0.33	2.88	7.25	0.84	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

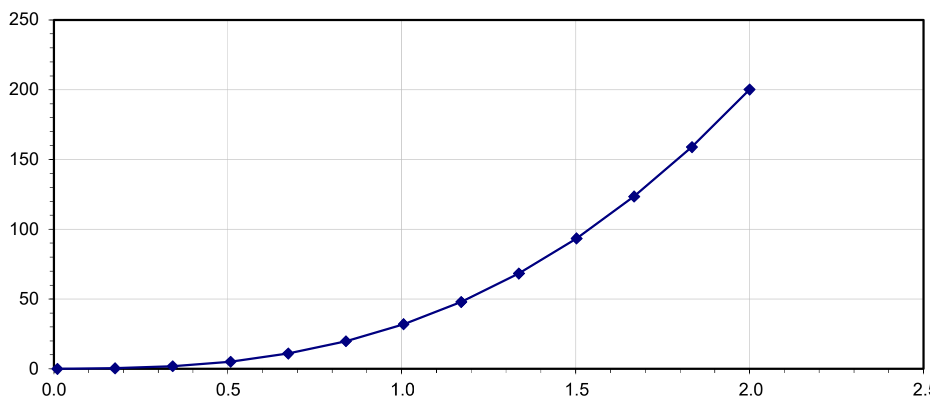
Project: Mesquite Creek LF

Ditch ID: **Bench 209B, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	5.62	cfs
Bottom Width, B =	0.00	ft
Left Side Slope, Z_1 =	3.00	horizontal :1 vertical
Right Side Slope, Z_2 =	8.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0470	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.00	0.11	0.00	0.27	0.0	0.03	
0.18	0.17	1.97	0.09	1.80	0.3	0.52	
0.34	0.64	3.84	0.17	2.80	1.8	1.00	
0.51	1.42	5.70	0.25	3.65	5.2	1.49	
0.67	2.49	7.56	0.33	4.41	11.0	1.97	
0.84	3.87	9.42	0.41	5.10	19.8	2.46	
1.01	5.56	11.28	0.49	5.75	32.0	2.95	
1.17	7.54	13.14	0.57	6.37	48.0	3.43	
1.34	9.83	15.00	0.65	6.96	68.4	3.92	
1.50	12.42	16.86	0.74	7.52	93.4	4.41	
1.67	15.31	18.73	0.82	8.07	123.5	4.89	
1.83	18.50	20.59	0.90	8.59	159.0	5.38	
2.00	22.00	22.45	0.98	9.11	200.3	5.87	
0.52	1.49	5.84	0.25	3.71	5.52	1.53	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

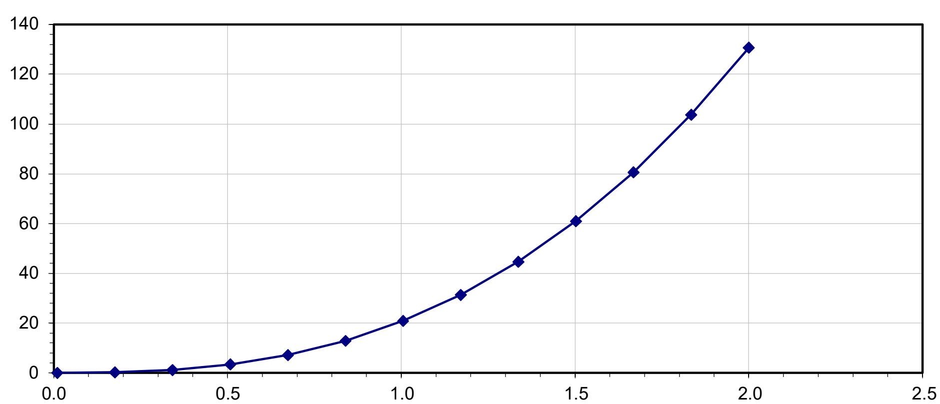
Project: Mesquite Creek LF

Ditch ID: **Bench 210A, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	4.45	cfs
Bottom Width, B =	0.00	ft
Left Side Slope, Z_1 =	3.00	horizontal :1 vertical
Right Side Slope, Z_2 =	8.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0200	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.00	0.11	0.00	0.17	0.0	0.01	
0.18	0.17	1.97	0.09	1.17	0.2	0.22	
0.34	0.64	3.84	0.17	1.83	1.2	0.43	
0.51	1.42	5.70	0.25	2.38	3.4	0.63	
0.67	2.49	7.56	0.33	2.87	7.2	0.84	
0.84	3.87	9.42	0.41	3.33	12.9	1.05	
1.01	5.56	11.28	0.49	3.75	20.9	1.25	
1.17	7.54	13.14	0.57	4.16	31.3	1.46	
1.34	9.83	15.00	0.65	4.54	44.6	1.67	
1.50	12.42	16.86	0.74	4.91	60.9	1.88	
1.67	15.31	18.73	0.82	5.26	80.6	2.08	
1.83	18.50	20.59	0.90	5.61	103.7	2.29	
2.00	22.00	22.45	0.98	5.94	130.7	2.50	
0.55	1.69	6.22	0.27	2.52	4.27	0.69	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

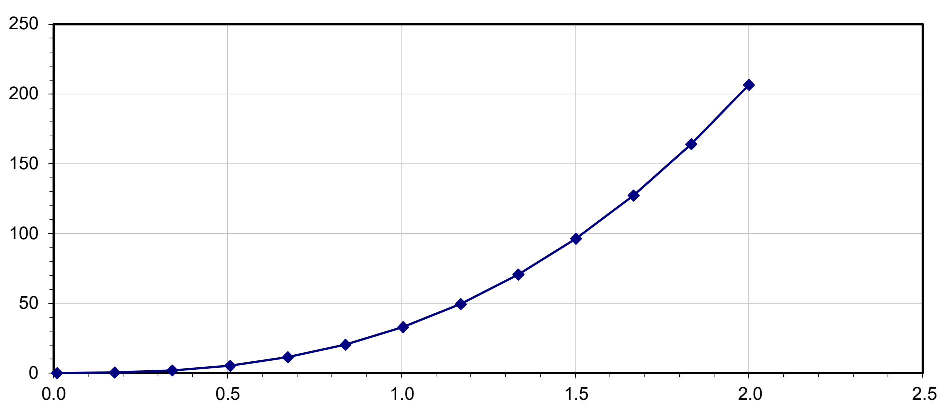
Project: Mesquite Creek LF

Ditch ID: **Bench 210B 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	17.00	cfs
Bottom Width, B =	0.00	ft
Left Side Slope, Z_1 =	3.00	horizontal :1 vertical
Right Side Slope, Z_2 =	8.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0500	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.00	0.11	0.00	0.27	0.0	0.03	
0.18	0.17	1.97	0.09	1.86	0.3	0.55	
0.34	0.64	3.84	0.17	2.89	1.9	1.07	
0.51	1.42	5.70	0.25	3.76	5.3	1.58	
0.67	2.49	7.56	0.33	4.54	11.3	2.10	
0.84	3.87	9.42	0.41	5.26	20.4	2.62	
1.01	5.56	11.28	0.49	5.93	33.0	3.14	
1.17	7.54	13.14	0.57	6.57	49.5	3.65	
1.34	9.83	15.00	0.65	7.18	70.5	4.17	
1.50	12.42	16.86	0.74	7.76	96.4	4.69	
1.67	15.31	18.73	0.82	8.32	127.4	5.21	
1.83	18.50	20.59	0.90	8.86	164.0	5.72	
2.00	22.00	22.45	0.98	9.39	206.6	6.24	
0.78	3.32	8.72	0.38	5.00	16.62	2.43	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

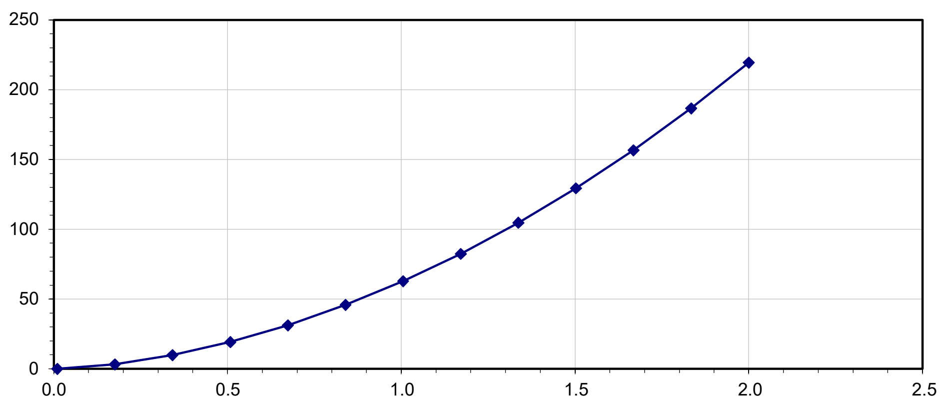
Project: Mesquite Creek LF

Ditch ID: **Top Deck Channel 201 25-YR 24-HR Storm, Post Dev.**

Peak Discharge, Q_{max}=	32.25	cfs
Bottom Width, B =	10.00	ft
Left Side Slope, Z_1 =	2.50	horizontal :1 vertical
Right Side Slope, Z_2 =	2.50	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0181	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.10	10.05	0.01	0.26	0.0	0.01	
0.18	1.84	10.95	0.17	1.74	3.2	0.20	
0.34	3.71	11.84	0.31	2.64	9.8	0.39	
0.51	5.72	12.73	0.45	3.36	19.2	0.57	
0.67	7.87	13.63	0.58	3.97	31.2	0.76	
0.84	10.15	14.52	0.70	4.51	45.8	0.95	
1.01	12.58	15.41	0.82	5.00	62.9	1.14	
1.17	15.14	16.31	0.93	5.45	82.5	1.32	
1.34	17.83	17.20	1.04	5.87	104.6	1.51	
1.50	20.67	18.09	1.14	6.26	129.4	1.70	
1.67	23.64	18.98	1.25	6.63	156.7	1.88	
1.83	26.75	19.88	1.35	6.98	186.8	2.07	
2.00	30.00	20.77	1.44	7.32	219.6	2.26	
0.68	8.02	13.69	0.59	4.01	32.16	0.77	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

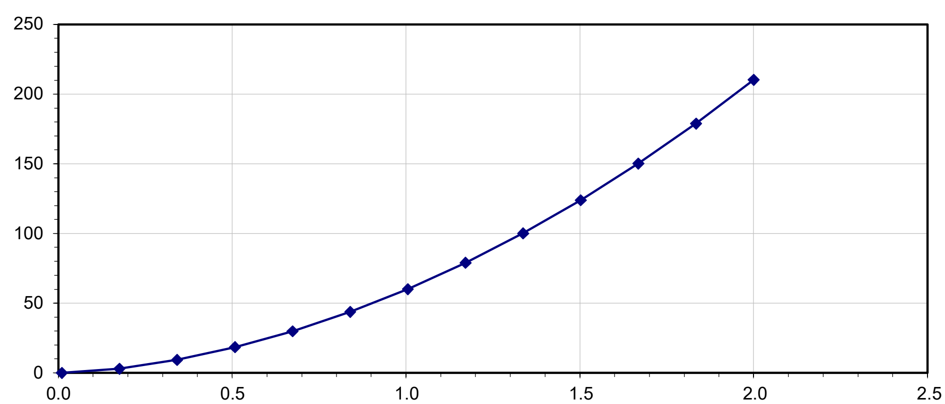
Project: Mesquite Creek LF

Ditch ID: **Top Deck Channel 203 25-YR 24-HR Storm, Post Dev.**

Peak Discharge, Q_{max}=	20.81	cfs
Bottom Width, B =	10.00	ft
Left Side Slope, Z_1 =	2.50	horizontal :1 vertical
Right Side Slope, Z_2 =	2.50	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0166	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.10	10.05	0.01	0.25	0.0	0.01	
0.18	1.84	10.95	0.17	1.67	3.1	0.18	
0.34	3.71	11.84	0.31	2.53	9.4	0.35	
0.51	5.72	12.73	0.45	3.22	18.4	0.53	
0.67	7.87	13.63	0.58	3.80	29.9	0.70	
0.84	10.15	14.52	0.70	4.32	43.9	0.87	
1.01	12.58	15.41	0.82	4.79	60.2	1.04	
1.17	15.14	16.31	0.93	5.22	79.0	1.21	
1.34	17.83	17.20	1.04	5.62	100.2	1.38	
1.50	20.67	18.09	1.14	5.99	123.9	1.56	
1.67	23.64	18.98	1.25	6.35	150.1	1.73	
1.83	26.75	19.88	1.35	6.69	178.9	1.90	
2.00	30.00	20.77	1.44	7.01	210.3	2.07	
0.54	6.16	12.92	0.48	3.35	20.61	0.56	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

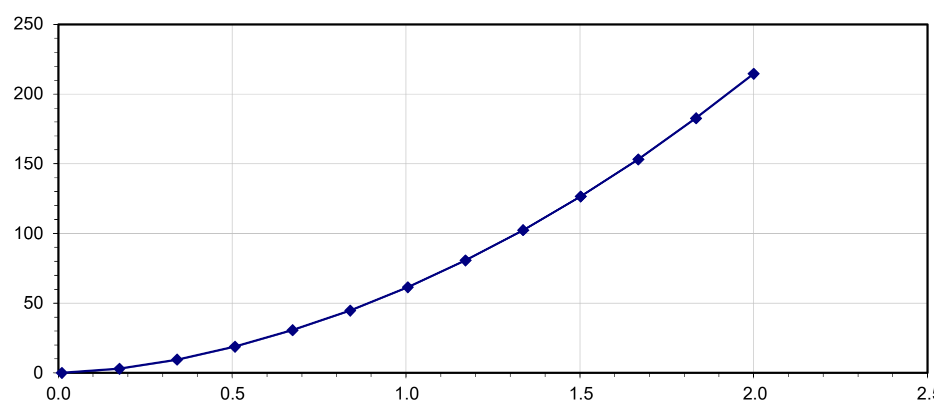
Project: Mesquite Creek LF

Ditch ID: **Downchute P1a 25-YR 24-HR Storm, Post Dev.**

Peak Discharge, Q_{max}=	17.81	cfs
Bottom Width, B =	10.00	ft
Left Side Slope, Z_1 =	2.50	horizontal :1 vertical
Right Side Slope, Z_2 =	2.50	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0173	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.10	10.05	0.01	0.26	0.0	0.01	
0.18	1.84	10.95	0.17	1.70	3.1	0.19	
0.34	3.71	11.84	0.31	2.58	9.6	0.37	
0.51	5.72	12.73	0.45	3.28	18.8	0.55	
0.67	7.87	13.63	0.58	3.88	30.6	0.73	
0.84	10.15	14.52	0.70	4.41	44.8	0.91	
1.01	12.58	15.41	0.82	4.89	61.5	1.09	
1.17	15.14	16.31	0.93	5.33	80.7	1.27	
1.34	17.83	17.20	1.04	5.74	102.4	1.44	
1.50	20.67	18.09	1.14	6.12	126.6	1.62	
1.67	23.64	18.98	1.25	6.49	153.3	1.80	
1.83	26.75	19.88	1.35	6.83	182.7	1.98	
2.00	30.00	20.77	1.44	7.16	214.8	2.16	
0.49	5.50	12.64	0.44	3.22	17.68	0.53	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

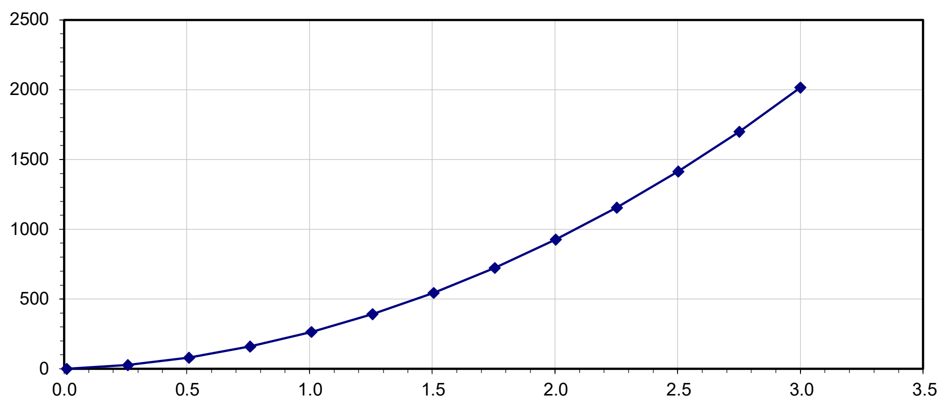
Project: Mesquite Creek LF

Ditch ID: **Downchute P2 25-YR 24-HR Storm, Post Dev.**

Peak Discharge, Q_{max}=	113.65	cfs
Bottom Width, B =	12.00	ft
Left Side Slope, Z_1 =	3.00	horizontal :1 vertical
Right Side Slope, Z_2 =	3.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.040	
Longitudinal Channel Slope, S_o =	0.2860	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.12	12.06	0.01	0.92	0.1	0.18	
0.26	3.31	13.64	0.24	7.75	25.7	4.63	
0.51	6.88	15.21	0.45	11.73	80.6	9.07	
0.76	10.81	16.79	0.64	14.85	160.6	13.52	
1.01	15.12	18.37	0.82	17.50	264.6	17.97	
1.26	19.80	19.94	0.99	19.83	392.6	22.41	
1.51	24.86	21.52	1.16	21.93	545.1	26.86	
1.75	30.28	23.09	1.31	23.87	722.7	31.31	
2.00	36.08	24.67	1.46	25.67	926.2	35.75	
2.25	42.25	26.25	1.61	27.37	1156.3	40.20	
2.50	48.80	27.82	1.75	28.98	1413.9	44.65	
2.75	55.71	29.40	1.90	30.51	1699.9	49.09	
3.00	63.00	30.97	2.03	31.99	2015.2	53.54	
0.61	8.46	15.87	0.53	13.09	110.71	10.91	DESIGN Q

Discharge versus Depth Relationship



APPENDIX 6J-9

HYDRAULIC ANALYSIS FOR PERIMETER CHANNELS

Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

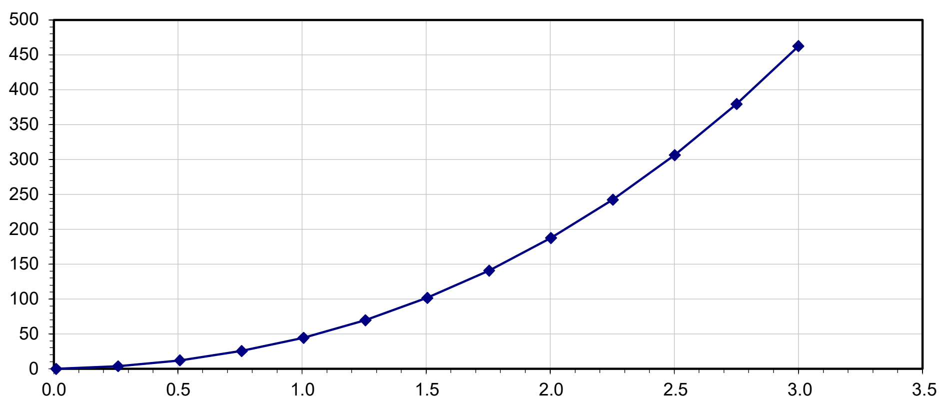
Project: Mesquite Creek LF

Ditch ID: **Reach R201, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	17.80	cfs
Bottom Width, B =	5.00	ft
Left Side Slope, Z_1 =	4.00	horizontal :1 vertical
Right Side Slope, Z_2 =	4.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0221	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.05	5.08	0.01	0.29	0.0	0.01	
0.26	1.56	7.14	0.22	2.30	3.6	0.36	
0.51	3.58	9.19	0.39	3.37	12.1	0.70	
0.76	6.08	11.25	0.54	4.20	25.5	1.04	
1.01	9.09	13.30	0.68	4.91	44.6	1.39	
1.26	12.59	15.36	0.82	5.54	69.8	1.73	
1.51	16.59	17.41	0.95	6.13	101.6	2.08	
1.75	21.08	19.47	1.08	6.67	140.7	2.42	
2.00	26.07	21.52	1.21	7.19	187.5	2.76	
2.25	31.56	23.57	1.34	7.69	242.6	3.11	
2.50	37.54	25.63	1.46	8.16	306.5	3.45	
2.75	44.02	27.68	1.59	8.62	379.6	3.79	
3.00	51.00	29.74	1.71	9.07	462.5	4.14	
0.61	4.58	10.07	0.46	3.74	17.16	0.85	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

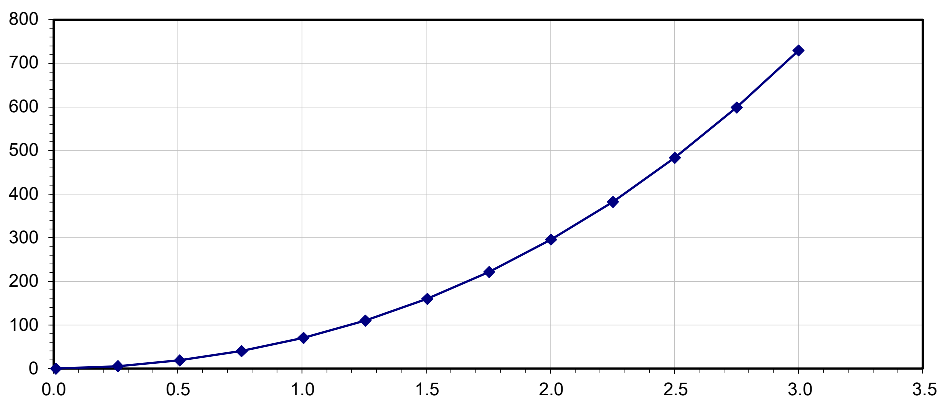
Project: Mesquite Creek LF

Ditch ID: **Reach R202, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	17.90	cfs
Bottom Width, B =	5.00	ft
Left Side Slope, Z_1 =	4.00	horizontal :1 vertical
Right Side Slope, Z_2 =	4.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0550	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.05	5.08	0.01	0.46	0.0	0.03	
0.26	1.56	7.14	0.22	3.63	5.7	0.89	
0.51	3.58	9.19	0.39	5.32	19.0	1.74	
0.76	6.08	11.25	0.54	6.63	40.3	2.60	
1.01	9.09	13.30	0.68	7.74	70.4	3.45	
1.26	12.59	15.36	0.82	8.74	110.1	4.31	
1.51	16.59	17.41	0.95	9.67	160.3	5.17	
1.75	21.08	19.47	1.08	10.53	221.9	6.02	
2.00	26.07	21.52	1.21	11.35	295.8	6.88	
2.25	31.56	23.57	1.34	12.13	382.7	7.73	
2.50	37.54	25.63	1.46	12.88	483.5	8.59	
2.75	44.02	27.68	1.59	13.60	598.9	9.44	
3.00	51.00	29.74	1.71	14.31	729.6	10.30	
0.49	3.39	9.02	0.38	5.20	17.61	1.67	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

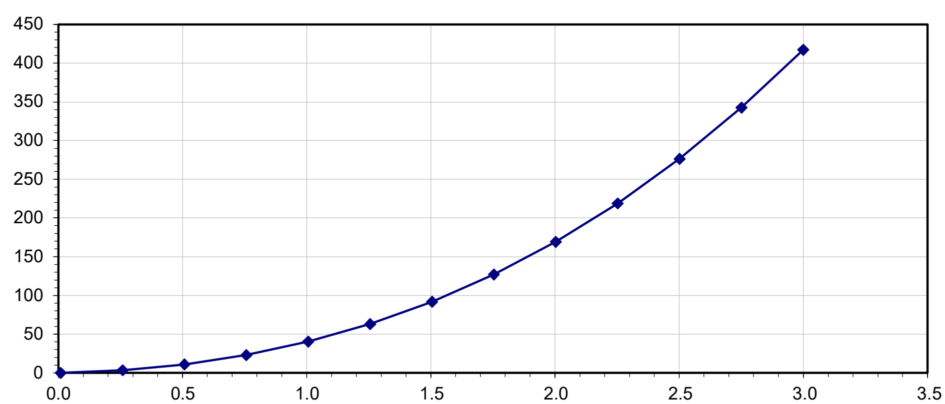
Project: Mesquite Creek LF

Ditch ID: **Reach R203, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	8.10	cfs
Bottom Width, B =	5.00	ft
Left Side Slope, Z_1 =	4.00	horizontal :1 vertical
Right Side Slope, Z_2 =	4.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0180	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.05	5.08	0.01	0.26	0.0	0.01	
0.26	1.56	7.14	0.22	2.08	3.2	0.29	
0.51	3.58	9.19	0.39	3.04	10.9	0.57	
0.76	6.08	11.25	0.54	3.79	23.1	0.85	
1.01	9.09	13.30	0.68	4.43	40.3	1.13	
1.26	12.59	15.36	0.82	5.00	63.0	1.41	
1.51	16.59	17.41	0.95	5.53	91.7	1.69	
1.75	21.08	19.47	1.08	6.02	127.0	1.97	
2.00	26.07	21.52	1.21	6.49	169.2	2.25	
2.25	31.56	23.57	1.34	6.94	218.9	2.53	
2.50	37.54	25.63	1.46	7.37	276.6	2.81	
2.75	44.02	27.68	1.59	7.78	342.6	3.09	
3.00	51.00	29.74	1.71	8.18	417.4	3.37	
0.42	2.79	8.44	0.33	2.73	7.59	0.47	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

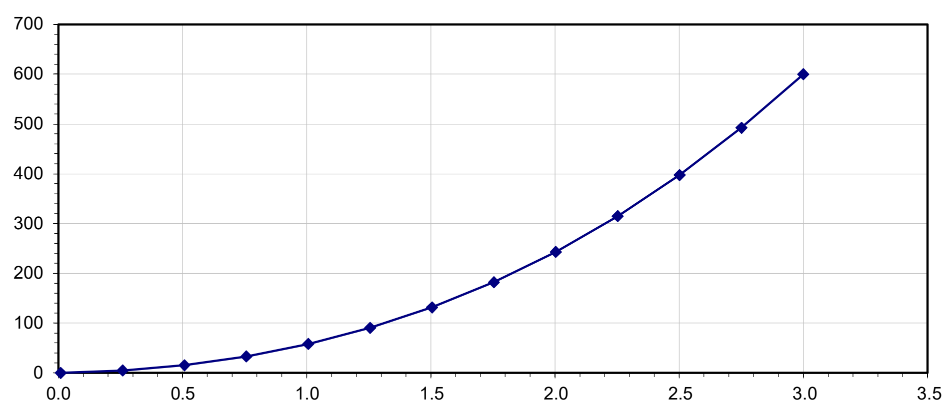
Project: Mesquite Creek LF

Ditch ID: **Reach R204, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	128.10	cfs
Bottom Width, B =	5.00	ft
Left Side Slope, Z_1 =	4.00	horizontal :1 vertical
Right Side Slope, Z_2 =	4.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0372	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.05	5.08	0.01	0.38	0.0	0.02	
0.26	1.56	7.14	0.22	2.98	4.7	0.60	
0.51	3.58	9.19	0.39	4.37	15.6	1.18	
0.76	6.08	11.25	0.54	5.45	33.1	1.76	
1.01	9.09	13.30	0.68	6.37	57.9	2.34	
1.26	12.59	15.36	0.82	7.19	90.5	2.92	
1.51	16.59	17.41	0.95	7.95	131.8	3.49	
1.75	21.08	19.47	1.08	8.66	182.5	4.07	
2.00	26.07	21.52	1.21	9.33	243.3	4.65	
2.25	31.56	23.57	1.34	9.97	314.8	5.23	
2.50	37.54	25.63	1.46	10.59	397.6	5.81	
2.75	44.02	27.68	1.59	11.19	492.5	6.39	
3.00	51.00	29.74	1.71	11.77	600.1	6.96	
1.48	16.20	17.22	0.94	7.88	127.72	3.44	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

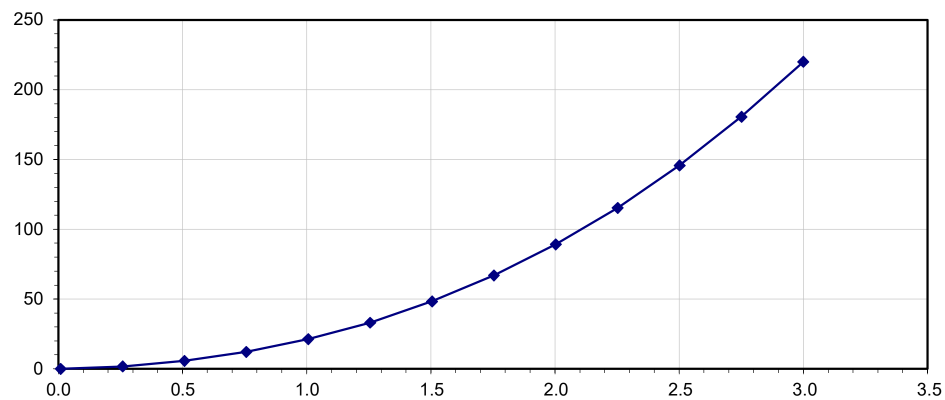
Project: Mesquite Creek LF

Ditch ID: **Reach R205, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	22.40	cfs
Bottom Width, B =	5.00	ft
Left Side Slope, Z_1 =	4.00	horizontal :1 vertical
Right Side Slope, Z_2 =	4.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0050	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.05	5.08	0.01	0.14	0.0	0.00	
0.26	1.56	7.14	0.22	1.09	1.7	0.08	
0.51	3.58	9.19	0.39	1.60	5.7	0.16	
0.76	6.08	11.25	0.54	2.00	12.2	0.24	
1.01	9.09	13.30	0.68	2.33	21.2	0.31	
1.26	12.59	15.36	0.82	2.64	33.2	0.39	
1.51	16.59	17.41	0.95	2.91	48.3	0.47	
1.75	21.08	19.47	1.08	3.17	66.9	0.55	
2.00	26.07	21.52	1.21	3.42	89.2	0.63	
2.25	31.56	23.57	1.34	3.66	115.4	0.70	
2.50	37.54	25.63	1.46	3.88	145.8	0.78	
2.75	44.02	27.68	1.59	4.10	180.6	0.86	
3.00	51.00	29.74	1.71	4.31	220.0	0.94	
1.03	9.41	13.50	0.70	2.37	22.27	0.32	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

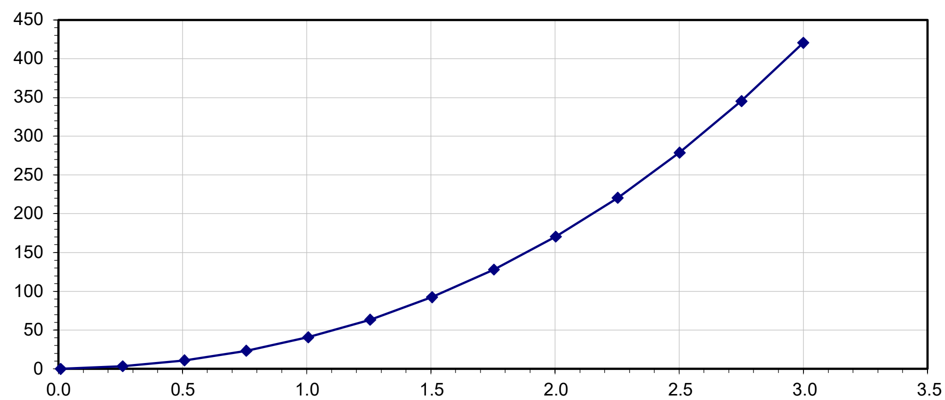
Project: Mesquite Creek LF

Ditch ID: **Reach R206, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	10.20	cfs
Bottom Width, B =	5.00	ft
Left Side Slope, Z_1 =	4.00	horizontal :1 vertical
Right Side Slope, Z_2 =	4.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0183	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.05	5.08	0.01	0.27	0.0	0.01	
0.26	1.56	7.14	0.22	2.09	3.3	0.30	
0.51	3.58	9.19	0.39	3.07	11.0	0.58	
0.76	6.08	11.25	0.54	3.82	23.2	0.87	
1.01	9.09	13.30	0.68	4.47	40.6	1.15	
1.26	12.59	15.36	0.82	5.04	63.5	1.43	
1.51	16.59	17.41	0.95	5.58	92.5	1.72	
1.75	21.08	19.47	1.08	6.07	128.0	2.00	
2.00	26.07	21.52	1.21	6.54	170.6	2.29	
2.25	31.56	23.57	1.34	7.00	220.8	2.57	
2.50	37.54	25.63	1.46	7.43	278.9	2.86	
2.75	44.02	27.68	1.59	7.85	345.4	3.14	
3.00	51.00	29.74	1.71	8.25	420.9	3.43	
0.48	3.35	8.99	0.37	2.98	10.00	0.55	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

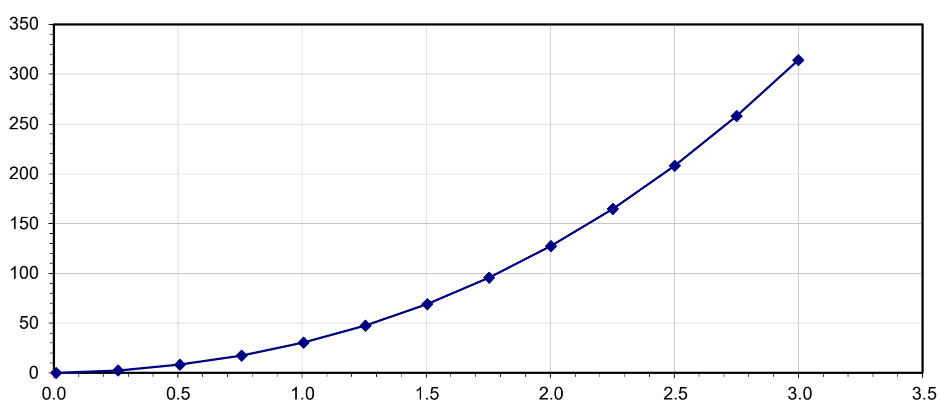
Project: Mesquite Creek LF

Ditch ID: **Reach R207, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	7.80	cfs
Bottom Width, B =	5.00	ft
Left Side Slope, Z_1 =	4.00	horizontal :1 vertical
Right Side Slope, Z_2 =	4.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0102	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.05	5.08	0.01	0.20	0.0	0.01	
0.26	1.56	7.14	0.22	1.56	2.4	0.16	
0.51	3.58	9.19	0.39	2.29	8.2	0.32	
0.76	6.08	11.25	0.54	2.85	17.4	0.48	
1.01	9.09	13.30	0.68	3.33	30.3	0.64	
1.26	12.59	15.36	0.82	3.77	47.4	0.80	
1.51	16.59	17.41	0.95	4.16	69.0	0.96	
1.75	21.08	19.47	1.08	4.53	95.6	1.12	
2.00	26.07	21.52	1.21	4.89	127.4	1.28	
2.25	31.56	23.57	1.34	5.22	164.8	1.43	
2.50	37.54	25.63	1.46	5.55	208.2	1.59	
2.75	44.02	27.68	1.59	5.86	257.9	1.75	
3.00	51.00	29.74	1.71	6.16	314.2	1.91	
0.49	3.42	9.05	0.38	2.25	7.70	0.31	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

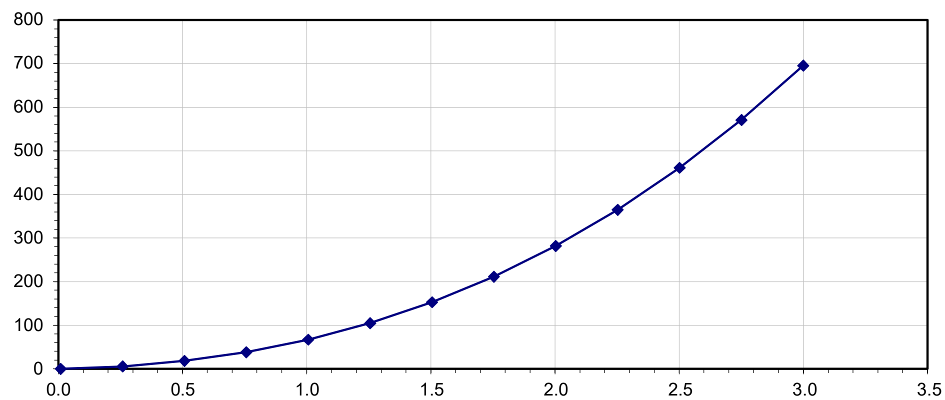
Project: Mesquite Creek LF

Ditch ID: **Reach R208, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	26.30	cfs
Bottom Width, B =	5.00	ft
Left Side Slope, Z_1 =	4.00	horizontal :1 vertical
Right Side Slope, Z_2 =	4.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0500	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.05	5.08	0.01	0.44	0.0	0.03	
0.26	1.56	7.14	0.22	3.46	5.4	0.81	
0.51	3.58	9.19	0.39	5.07	18.1	1.59	
0.76	6.08	11.25	0.54	6.32	38.4	2.36	
1.01	9.09	13.30	0.68	7.38	67.1	3.14	
1.26	12.59	15.36	0.82	8.34	104.9	3.92	
1.51	16.59	17.41	0.95	9.22	152.8	4.70	
1.75	21.08	19.47	1.08	10.04	211.6	5.47	
2.00	26.07	21.52	1.21	10.82	282.0	6.25	
2.25	31.56	23.57	1.34	11.56	364.9	7.03	
2.50	37.54	25.63	1.46	12.28	461.0	7.81	
2.75	44.02	27.68	1.59	12.97	571.0	8.58	
3.00	51.00	29.74	1.71	13.64	695.7	9.36	
0.61	4.52	10.02	0.45	5.60	25.35	1.90	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

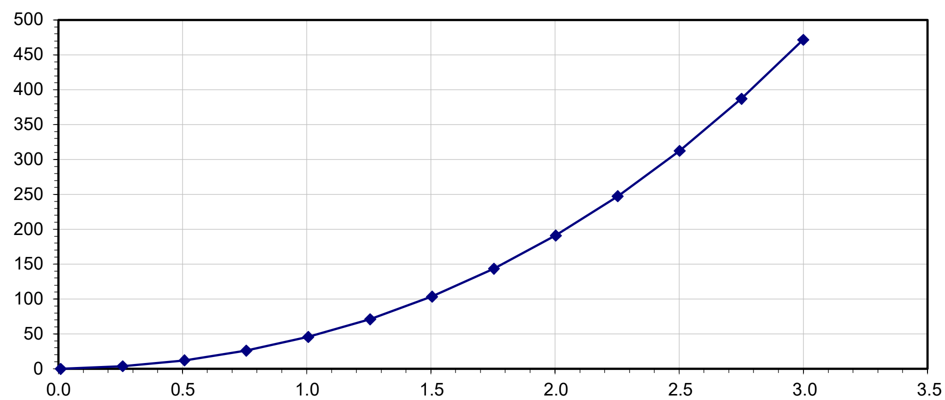
Project: Mesquite Creek LF

Ditch ID: **Reach R209, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	26.40	cfs
Bottom Width, B =	5.00	ft
Left Side Slope, Z_1 =	4.00	horizontal :1 vertical
Right Side Slope, Z_2 =	4.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0230	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.05	5.08	0.01	0.30	0.0	0.01	
0.26	1.56	7.14	0.22	2.35	3.7	0.37	
0.51	3.58	9.19	0.39	3.44	12.3	0.73	
0.76	6.08	11.25	0.54	4.28	26.1	1.09	
1.01	9.09	13.30	0.68	5.01	45.5	1.44	
1.26	12.59	15.36	0.82	5.65	71.2	1.80	
1.51	16.59	17.41	0.95	6.25	103.7	2.16	
1.75	21.08	19.47	1.08	6.81	143.5	2.52	
2.00	26.07	21.52	1.21	7.34	191.3	2.88	
2.25	31.56	23.57	1.34	7.84	247.5	3.23	
2.50	37.54	25.63	1.46	8.33	312.7	3.59	
2.75	44.02	27.68	1.59	8.80	387.3	3.95	
3.00	51.00	29.74	1.71	9.25	471.8	4.31	
0.76	6.13	11.28	0.54	4.30	26.35	1.09	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

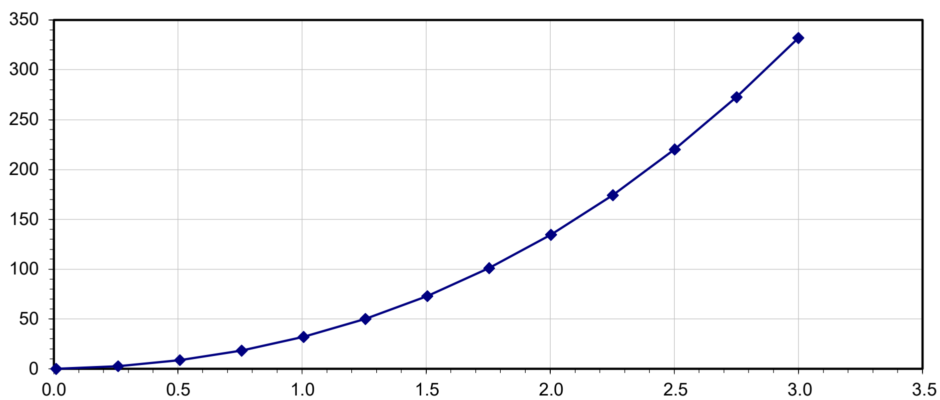
Project: Mesquite Creek LF

Ditch ID: **Reach R210, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	22.40	cfs
Bottom Width, B =	5.00	ft
Left Side Slope, Z_1 =	4.00	horizontal :1 vertical
Right Side Slope, Z_2 =	4.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0114	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.05	5.08	0.01	0.21	0.0	0.01	
0.26	1.56	7.14	0.22	1.65	2.6	0.18	
0.51	3.58	9.19	0.39	2.42	8.7	0.36	
0.76	6.08	11.25	0.54	3.02	18.3	0.54	
1.01	9.09	13.30	0.68	3.53	32.0	0.72	
1.26	12.59	15.36	0.82	3.98	50.1	0.89	
1.51	16.59	17.41	0.95	4.40	73.0	1.07	
1.75	21.08	19.47	1.08	4.79	101.0	1.25	
2.00	26.07	21.52	1.21	5.17	134.7	1.43	
2.25	31.56	23.57	1.34	5.52	174.2	1.60	
2.50	37.54	25.63	1.46	5.86	220.1	1.78	
2.75	44.02	27.68	1.59	6.19	272.7	1.96	
3.00	51.00	29.74	1.71	6.51	332.2	2.13	
0.83	6.92	11.85	0.58	3.17	21.97	0.59	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

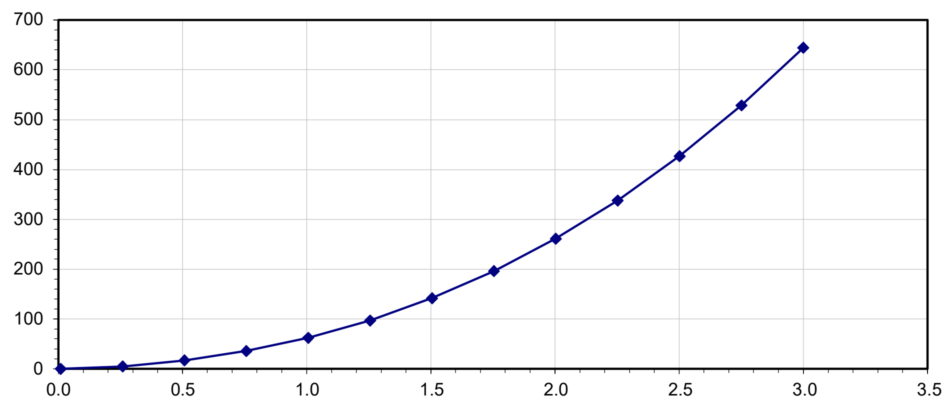
Project: Mesquite Creek LF

Ditch ID: **Reach R211, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	22.40	cfs
Bottom Width, B =	5.00	ft
Left Side Slope, Z_1 =	4.00	horizontal :1 vertical
Right Side Slope, Z_2 =	4.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0429	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.05	5.08	0.01	0.41	0.0	0.03	
0.26	1.56	7.14	0.22	3.20	5.0	0.69	
0.51	3.58	9.19	0.39	4.70	16.8	1.36	
0.76	6.08	11.25	0.54	5.85	35.6	2.03	
1.01	9.09	13.30	0.68	6.84	62.1	2.69	
1.26	12.59	15.36	0.82	7.72	97.2	3.36	
1.51	16.59	17.41	0.95	8.54	141.6	4.03	
1.75	21.08	19.47	1.08	9.30	196.0	4.70	
2.00	26.07	21.52	1.21	10.02	261.2	5.36	
2.25	31.56	23.57	1.34	10.71	338.0	6.03	
2.50	37.54	25.63	1.46	11.37	427.0	6.70	
2.75	44.02	27.68	1.59	12.01	528.9	7.36	
3.00	51.00	29.74	1.71	12.64	644.4	8.03	
0.58	4.27	9.80	0.44	5.07	21.64	1.56	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

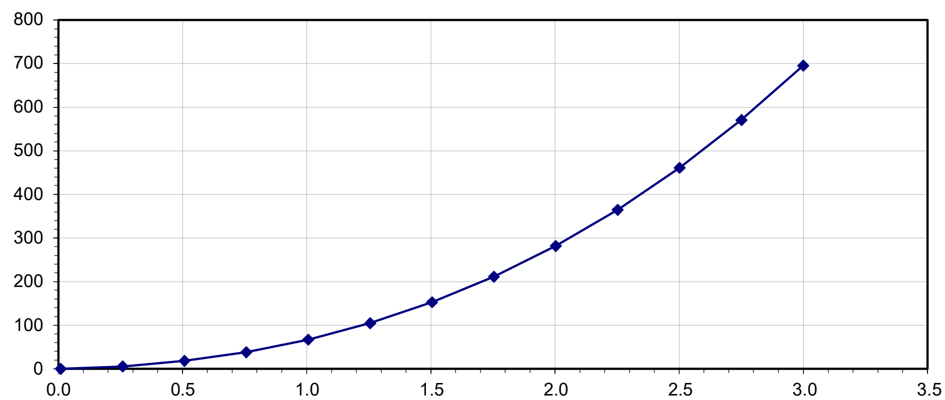
Project: Mesquite Creek LF

Ditch ID: **Reach R212, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	22.40	cfs
Bottom Width, B =	5.00	ft
Left Side Slope, Z_1 =	4.00	horizontal :1 vertical
Right Side Slope, Z_2 =	4.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0500	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.05	5.08	0.01	0.44	0.0	0.03	
0.26	1.56	7.14	0.22	3.46	5.4	0.81	
0.51	3.58	9.19	0.39	5.07	18.1	1.59	
0.76	6.08	11.25	0.54	6.32	38.4	2.36	
1.01	9.09	13.30	0.68	7.38	67.1	3.14	
1.26	12.59	15.36	0.82	8.34	104.9	3.92	
1.51	16.59	17.41	0.95	9.22	152.8	4.70	
1.75	21.08	19.47	1.08	10.04	211.6	5.47	
2.00	26.07	21.52	1.21	10.82	282.0	6.25	
2.25	31.56	23.57	1.34	11.56	364.9	7.03	
2.50	37.54	25.63	1.46	12.28	461.0	7.81	
2.75	44.02	27.68	1.59	12.97	571.0	8.58	
3.00	51.00	29.74	1.71	13.64	695.7	9.36	
0.56	4.06	9.62	0.42	5.35	21.75	1.75	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

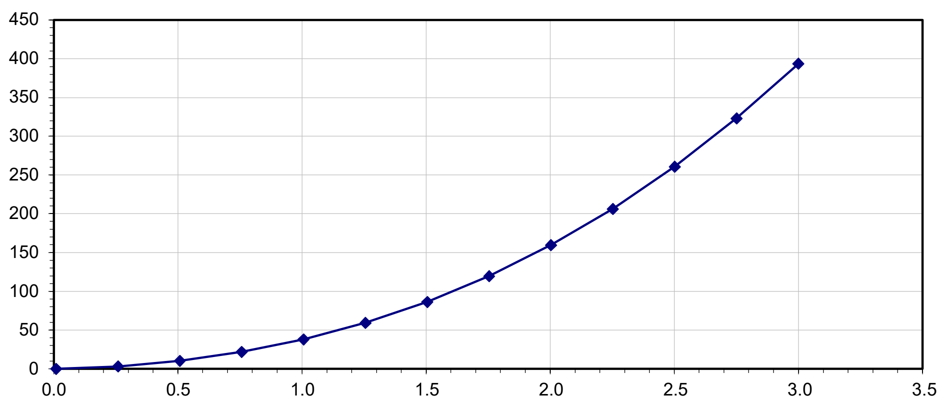
Project: Mesquite Creek LF

Ditch ID: **Reach R213, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	129.20	cfs
Bottom Width, B =	5.00	ft
Left Side Slope, Z_1 =	4.00	horizontal :1 vertical
Right Side Slope, Z_2 =	4.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0160	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.05	5.08	0.01	0.25	0.0	0.01	
0.26	1.56	7.14	0.22	1.96	3.1	0.26	
0.51	3.58	9.19	0.39	2.87	10.3	0.51	
0.76	6.08	11.25	0.54	3.57	21.7	0.76	
1.01	9.09	13.30	0.68	4.18	38.0	1.01	
1.26	12.59	15.36	0.82	4.72	59.4	1.25	
1.51	16.59	17.41	0.95	5.21	86.5	1.50	
1.75	21.08	19.47	1.08	5.68	119.7	1.75	
2.00	26.07	21.52	1.21	6.12	159.5	2.00	
2.25	31.56	23.57	1.34	6.54	206.4	2.25	
2.50	37.54	25.63	1.46	6.95	260.8	2.50	
2.75	44.02	27.68	1.59	7.34	323.0	2.75	
3.00	51.00	29.74	1.71	7.72	393.5	3.00	
1.81	22.22	19.95	1.11	5.79	128.58	1.81	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

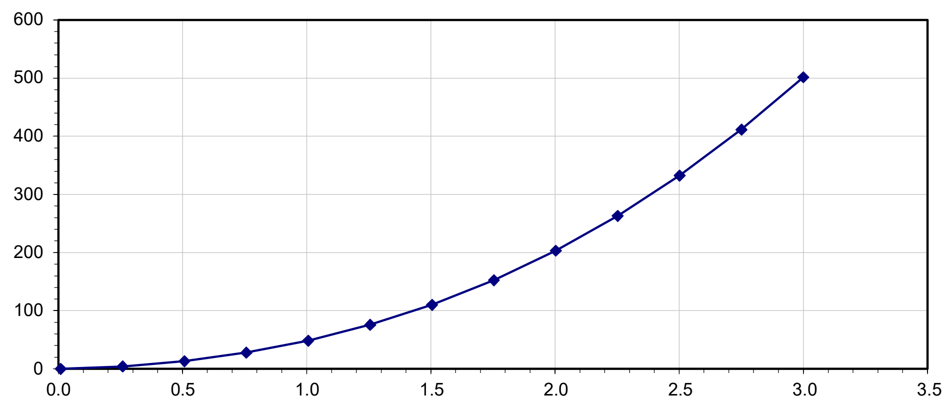
Project: Mesquite Creek LF

Ditch ID: **Reach R214, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	218.30	cfs
Bottom Width, B =	5.00	ft
Left Side Slope, Z_1 =	4.00	horizontal :1 vertical
Right Side Slope, Z_2 =	4.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0260	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.05	5.08	0.01	0.32	0.0	0.02	
0.26	1.56	7.14	0.22	2.49	3.9	0.42	
0.51	3.58	9.19	0.39	3.66	13.1	0.82	
0.76	6.08	11.25	0.54	4.56	27.7	1.23	
1.01	9.09	13.30	0.68	5.32	48.4	1.63	
1.26	12.59	15.36	0.82	6.01	75.7	2.04	
1.51	16.59	17.41	0.95	6.65	110.2	2.44	
1.75	21.08	19.47	1.08	7.24	152.6	2.85	
2.00	26.07	21.52	1.21	7.80	203.4	3.25	
2.25	31.56	23.57	1.34	8.34	263.1	3.65	
2.50	37.54	25.63	1.46	8.85	332.4	4.06	
2.75	44.02	27.68	1.59	9.35	411.8	4.46	
3.00	51.00	29.74	1.71	9.84	501.7	4.87	
2.07	27.39	22.03	1.24	7.94	217.44	3.35	DESIGN Q

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

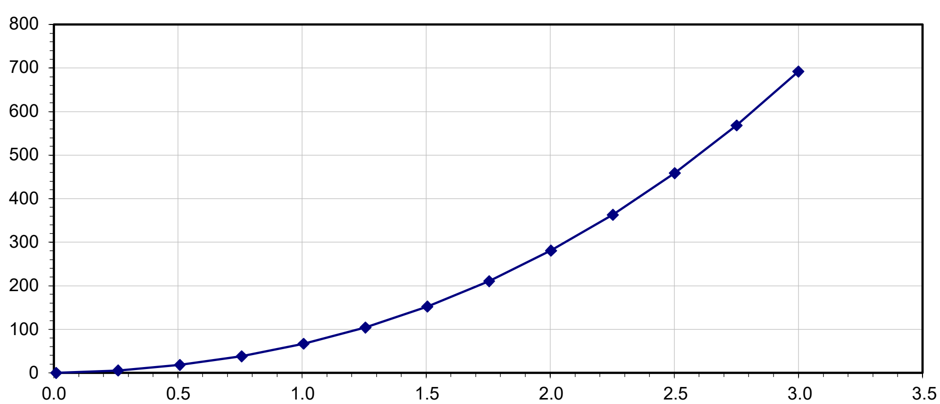
Project: Mesquite Creek LF

Ditch ID: **Reach R215, 25-YR 24-HR Storm, Post Development**

Peak Discharge, Q_{max}=	218.00	cfs
Bottom Width, B =	5.00	ft
Left Side Slope, Z_1 =	4.00	horizontal :1 vertical
Right Side Slope, Z_2 =	4.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.035	
Longitudinal Channel Slope, S_o =	0.0495	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_o lb/ft^2	Comments
0.01	0.05	5.08	0.01	0.44	0.0	0.03	
0.26	1.56	7.14	0.22	3.44	5.4	0.80	
0.51	3.58	9.19	0.39	5.05	18.0	1.57	
0.76	6.08	11.25	0.54	6.29	38.2	2.34	
1.01	9.09	13.30	0.68	7.35	66.8	3.11	
1.26	12.59	15.36	0.82	8.30	104.4	3.88	
1.51	16.59	17.41	0.95	9.17	152.1	4.65	
1.75	21.08	19.47	1.08	9.99	210.5	5.42	
2.00	26.07	21.52	1.21	10.76	280.6	6.19	
2.25	31.56	23.57	1.34	11.51	363.1	6.96	
2.50	37.54	25.63	1.46	12.22	458.7	7.73	
2.75	44.02	27.68	1.59	12.91	568.1	8.50	
3.00	51.00	29.74	1.71	13.57	692.2	9.27	
1.78	21.59	19.68	1.10	10.07	217.43	5.50	DESIGN Q

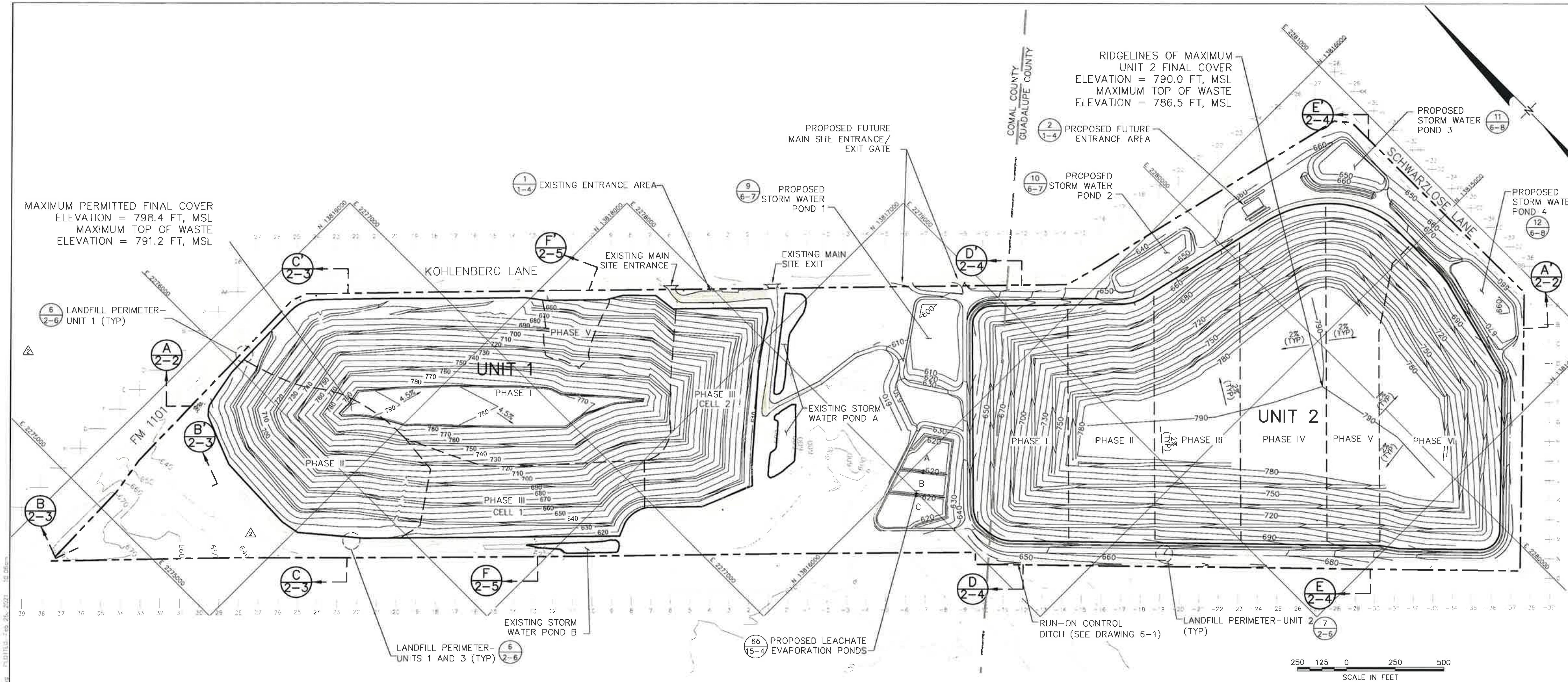
Discharge versus Depth Relationship



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



STATE OF TEXAS
SCOTT M. GRAVES
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2/24/2021

LEGEND

80	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
	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).

FOR PERMIT PURPOSES ONLY

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

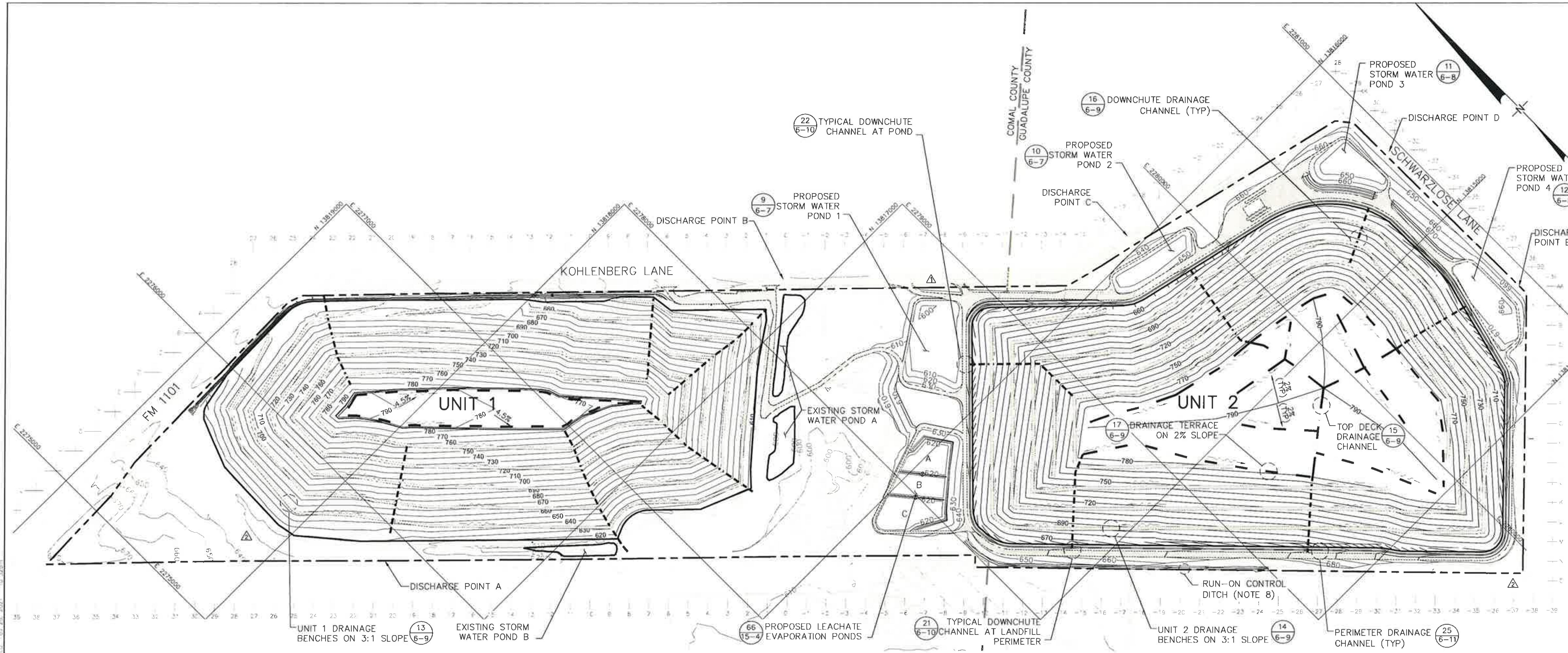
OWNER / SITE ADDRESS:
WASTE MANAGEMENT OF TEXAS, INC.
1000 KOHLENBERG LANE
P.O. BOX 311657
NEW BRAUNFELS, TEXAS 78130
(830) 685-7894

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. III	FIGURE NO: 1-3
FILE NO.: 3435-003	CHECKED BY: SMG	APPROVED BY: SMG		



LEGEND

- 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
- 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.

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.

STATE OF TEXAS
SCOTT M. GRAVES
86557
LICENSED PROFESSIONAL ENGINEER

2/24/2021

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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:

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

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: SUFACE WATER MANAGEMENT PLAN

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

Prepared for Applicant:
Waste Management of Texas, Inc.
1000 Kohlenberg Lane
P.O. Box 311657
New Braunfels, Texas 78130
(830) 625-7894

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

Prepared by:
Geosyntec consultants
Texas Board of Professional Engineers Firm Registration No. F-1182
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STATE OF TEXAS
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2/24/2021

FOR PERMIT PURPOSES ONLY

Initial Application Submittal – 18 November 2005
Response to NOD 1 – 28 March 2006
Response to NOD 2 – 15 May 2006
Technically Complete – 14 July 2006
Revised – 24 February 2021

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Texas Board of Professional Engineers
Firm Registration No. F-1182

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Firm Registration No. F-1182

APPENDICES

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. 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	Shear Stress	
	Peak	Large-Displacement
(psf)	(psf)	(psf)
500	195	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 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

WASTE MANAGEMENT

Prepared for Applicant:
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(830) 625-7894

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:
Geosyntec consultants
Texas Board of Professional Engineers Firm Registration No. F-1182
8217 Shoal Creek Blvd, Suite 200
Austin, Texas 78757
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STATE OF TEXAS
SCOTT M. GRAVES
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LICENSED PROFESSIONAL ENGINEER
2/24/2021

FOR PERMIT PURPOSES ONLY

Initial Application Submittal – 18 November 2005
Technically Complete – 14 July 2006
Revised – 24 February 2021

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86557
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2/24/2021

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Texas Board of Professional Engineers
Firm Registration No. F-1182

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SCOTT M. GRAVES
86557
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PROFESSIONAL ENGINEER
2/24/2021

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Texas Board of Professional Engineers
Firm Registration No. F-1182

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 20,190,090 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). 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). 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.

Prepared for Applicant:
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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

Prepared by:
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STATE OF TEXAS
SCOTT M. GRAVES
86557
LICENSED PROFESSIONAL ENGINEER
2/24/2021

FOR PERMIT PURPOSES ONLY

Initial Application Submittal – 18 November 2005
Response to NOD 1 – 28 March 2006
Response to NOD 2 – 15 May 2006
Technically Complete – 14 July 2006
Revised – 2 November 2011, 24 February 2021

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STATE OF TEXAS
SCOTT M. GRAVES
86557
LICENSED PROFESSIONAL ENGINEER
2/24/2021

FOR PERMIT PURPOSES ONLY

GEOSYNTEC CONSULTANTS, INC.
Texas Board of Professional Engineers
Firm Registration No. F-1182

TABLE OF CONTENTS (CONTINUED)

FOR PERMIT PURPOSES ONLY

GEOSYNTEC CONSULTANTS, INC.
Texas Board of Professional Engineers
Firm Registration No. F-1182

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). Aside from the designation change, no other changes to the currently permitted Unit 1 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 ($k \leq 1 \times 10^{-7}$ cm/s).

The remaining existing constructed phases of Unit 1 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 2 will have a lower peak final cover elevation (elevation 790.0 ft, MSL). The unit 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 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 2 will have a lower peak final cover elevation.

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. 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 100-ft below natural ground in the expansion phases.

The Unit 1 liner system was 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 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	
EXISTING GAS PROBES[2]												
GP-1	N E	13,818,826.17 2,275,954.17	641.9	Note 4	617.9	24.0	4.0	24.0	20.0	637.9	617.9	No Changes Proposed.
GP-2	N E	13,818,782.92 2,276,542.22	662.8	Note 4	627.8	35.0	5.0	35.0	30.0	657.8	627.8	No Changes Proposed.
GP-3RA	N E	13,817,930.77 2,277,412.96	641.0	Note 4	619.0	22.0	2.0	22.0	20.0	639.0	619.0	No Changes Proposed.
GP-4	N E	13,817,122.67 2,278,237.64	602.8	568	566.8	36.0	4.5	34.5	30.0	598.3	568.3	No Changes Proposed.
GP-5	N E	13,816,548.79 2,277,564.47	602.5	564	565.5	37.0	6.0	36.0	30.0	596.5	566.5	Discontinue Gas Monitoring Upon Approval of Permit 66B. Plug and Abandon.
GP-6R	N E	13,817,051.01 2,276,398.00	623.45	584	580.20	43.25	5.0	42.0	37.0	618.5	581.5	No Changes Proposed.
GP-7	N E	13,817,956.20 2,275,490.16	631.8	612	610.00	21.80	5.0	21.0	16.0	626.8	610.8	No Changes Proposed.
PROPOSED GAS PROBES[3]												
GP-5A	N E	13,815,940 2,277,535	609	564	558	51	5	50	45	604	559	Install No Later Than Start of Unit 2, Phase I to Replace GP-5.
GP-8	N E	13,816,604 2,277,083	603	562	556	47	5	46	41	598	557	Install Upon Approval of Permit 66B.
GP-9	N E	13,817,501 2,275,958	624	584	578	46	5	45	40	619	579	Install Upon Approval of Permit 66B.
GP-10	N E	13,818,347 2,276,989	663	623	617	46	5	45	40	658	618	Install Upon Approval of Permit 66B.
GP-11	N E	13,817,455 2,277,903	615	566	560	55	5	54	49	610	561	Install Upon Approval of Permit 66B.
GP-12	N E	13,816,470 2,278,910	608	585	579	29	5	28	23	603	580	Install No Later Than Start of Unit 2, Phase I.

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] GAS PROBE BOTTOM ELEV.	TOTAL GAS PROBE DEPTH	DEPTH OF SCREENED INTERVAL		SCREEN LENGTH	ELEV. OF SCREENED INTERVAL		STATUS
			(ft, MSL)	(ft, MSL)	(ft, MSL)	(ft, bgs)	(ft, bgs) FROM	TO	(ft)	(ft, MSL) FROM	TO	
GP-13	N E	13,816,025 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 E	13,815,800 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 E	13,815,385 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 E	13,814,440 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 E	13,813,960 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 E	13,813,460 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 E	13,814,105 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 E	13,814,740 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 E	13,815,430 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 E	13,818,600 227,500	670	612	606	64	5	63	58	665	607	Install No Later Than Closure of Unit 2, Phase VI.
GP-23	N E	13,818,810 2,275,360	640	612	606	34	5	33	28	635	607	Install No Later Than Closure of Unit 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 are currently permitted (formerly known as GP-8 and GP-9) but not yet installed. 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.

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

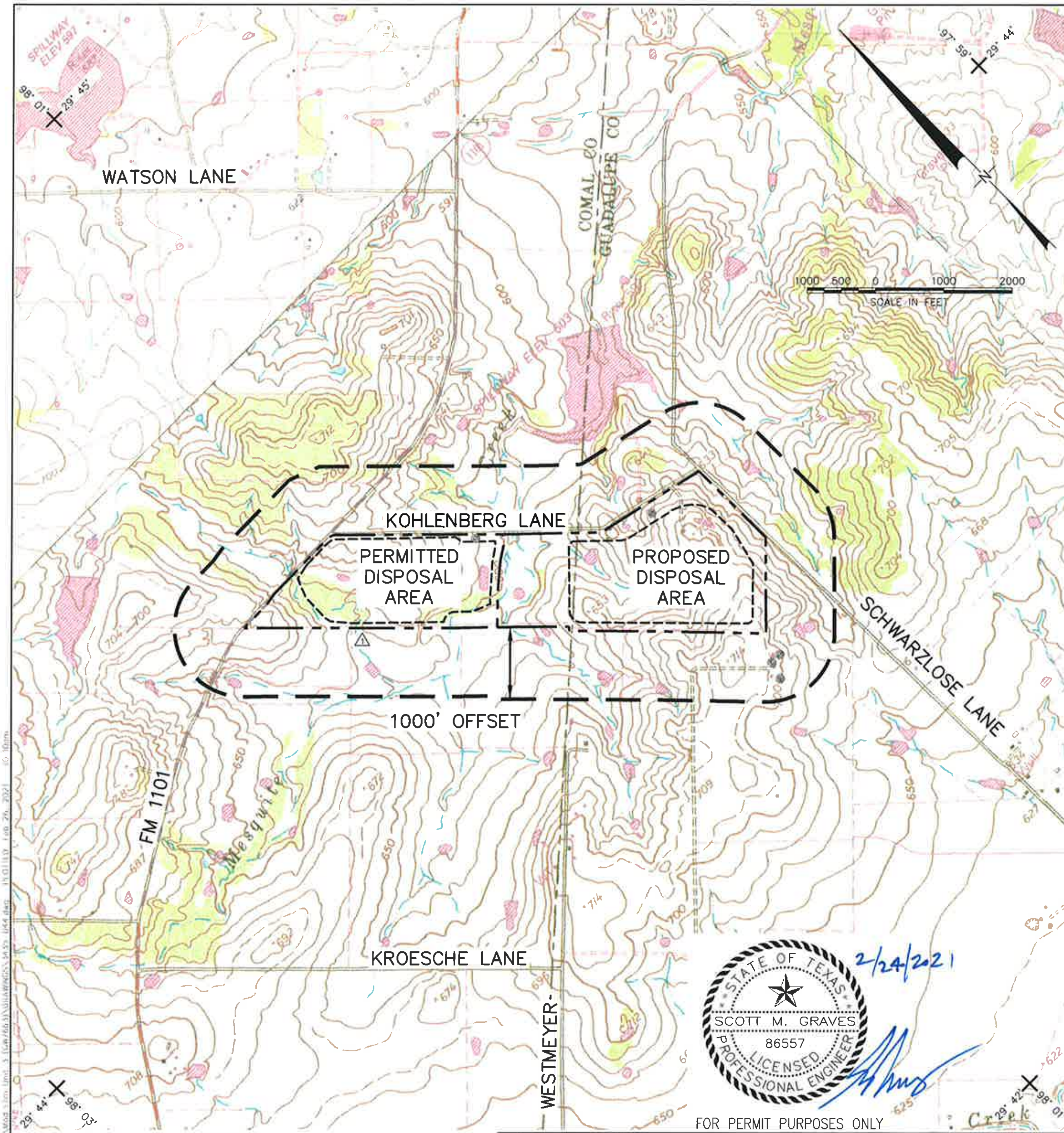
The depths and screened intervals of the GPs were determined based on the proposed depth of the landfill and characterization of the subsurface soils and hydrogeologic conditions at the site and their potential for subsurface gas migration. The subsurface conditions and their potential to transmit landfill 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

- Drawing 14-1 Site Vicinity Map and Structures Within 1000 Ft
- Drawing 14-2 Proposed Gas Monitoring Network
- Drawing 14-3 Landfill Gas Monitoring Probe
- Drawing 14-4 Proposed Conceptual GCCS Layout Plan
- Drawing 14-5 Typical Landfill Gas Management System Details I
- Drawing 14-6 Typical Landfill Gas Management System Details II
- Drawing 14-7 Typical Landfill Gas Management System Details III
- Drawing 14-8 Typical Landfill Gas Management System Details IV
- Drawing 14-9 GCCS Ventilation Trench Details



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:

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1000 KOHLENBERG LANE
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(830) 685–7894

ENGINEER:

Geosyntec consultants

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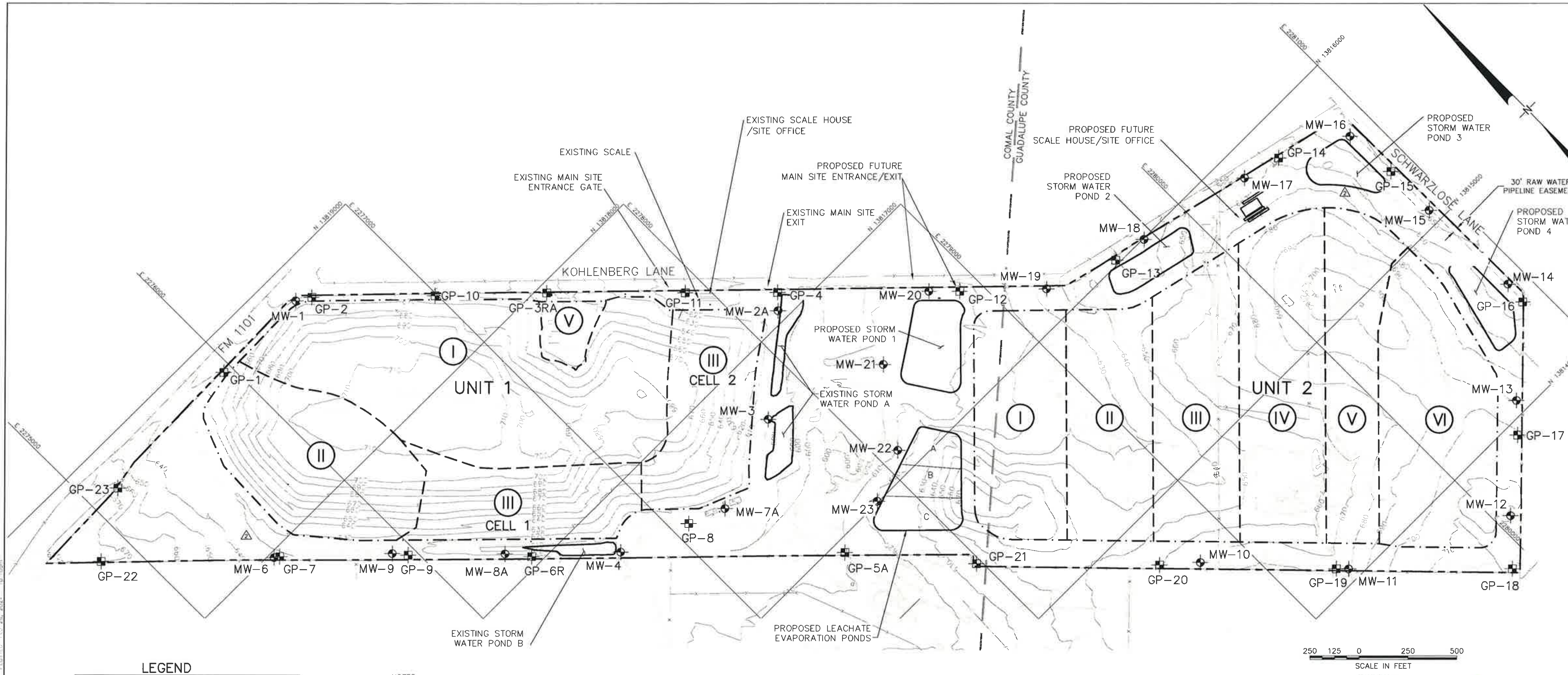
8217 SHOAL CREEK BLVD., SUITE 200
AUSTIN, TEXAS 78757
(512) 451–4003

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

TITLE: **STRUCTURES AND INHABITABLE BUILDINGS WITHIN 1000 FEET OF SITE**

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



LEGEND

---650---	EXISTING GROUND ELEVATION (FT, MSL)
	EXISTING WATER LINE
---x---x---	EXISTING SITE FENCE
	EXISTING TREE LINE
	EXISTING ROAD
	EXISTING BUILDING
—·—·—	LIMIT OF WASTE
— — —	PHASE BOUNDARY
(I)	PHASE DESIGNATION
—— — —	PROPERTY BOUNDARY (NOTE 4)
N 13,674,000 E 2,080,000	STATE PLANE COORDINATES
	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)

STATE OF TEXAS
SCOTT M. GRAVES
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PROFESSIONAL ENGINEER
2/24/2021

FOR PERMIT PURPOSES ONLY

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

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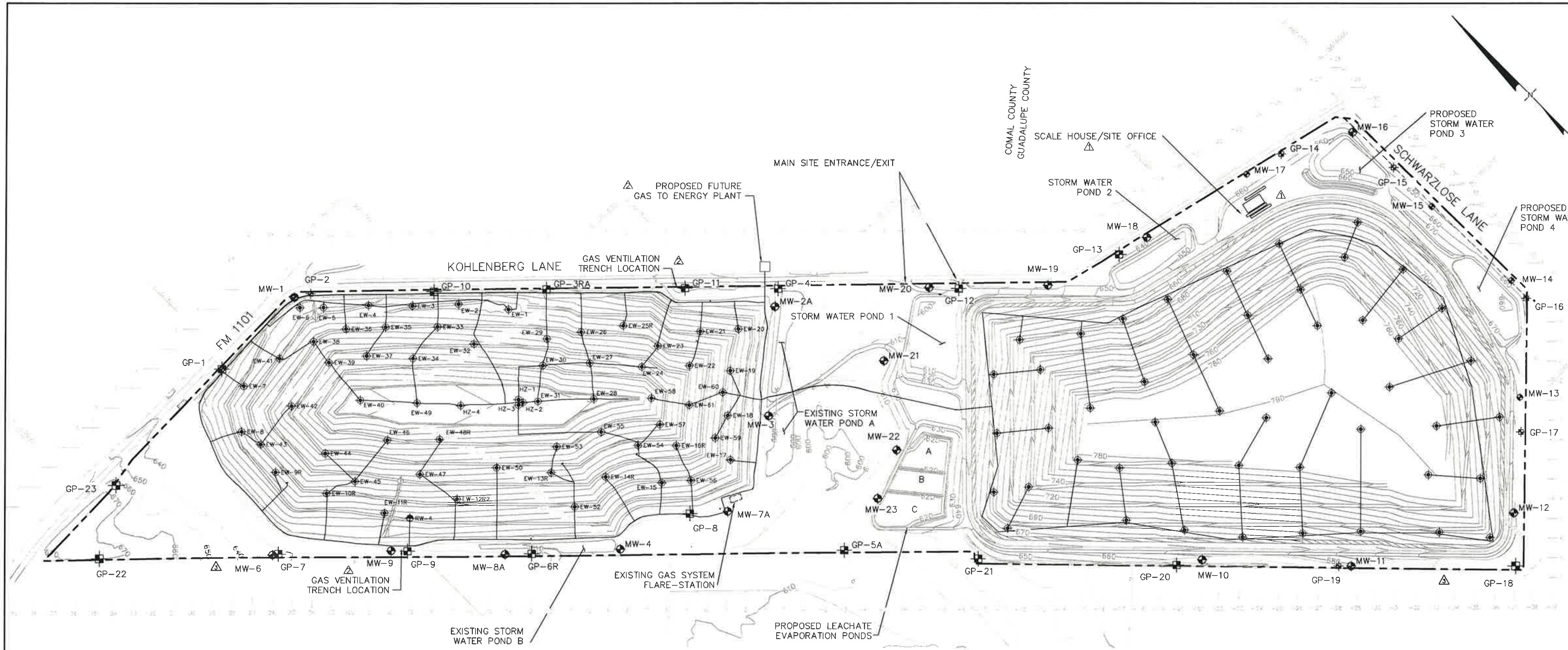
PROJECT: MESQUITE CREEK LANDFILL
PERMIT APPLICATION – PERMIT NO. MSW – 66 B

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		



LEGEND

850	EXISTING GROUND ELEVATION (FT, MSL)
	EXISTING SITE FENCE
	EXISTING TREE LINE
	EXISTING ROAD
	EXISTING BUILDING
	PROPERTY BOUNDARY (NOTE 4)
	STATE PLANE COORDINATES
	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.

2/24/2021

STATE OF TEXAS
SCOTT M. GRAVES
86557
LICENSED PROFESSIONAL ENGINEER

FOR PERMIT PURPOSES ONLY

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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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.: III	DRAWING NO.: 14-4
FILE: 0144-01	DRAWN BY: JJV	APPROVED BY: SMG		

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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:
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FOR PERMIT PURPOSES ONLY

Initial Application Submittal – 18 November 2005
Response to NOD 1 – 28 March 2006
Response to NOD 2 – 15 May 2006
Technically Complete – 14 July 2006
Revised – 20 October 2006, 20 July 2009, 24 February 2021

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TABLES

2/24/2021

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FOR PERMIT PURPOSES ONLY

GEOSYNTEC CONSULTANTS, INC.
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Firm Registration No. F-1182

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. <u>Generation Process</u>

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 1 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 2 has not yet been constructed at the time this permit amendment application was filed.

The design of the proposed leachate collection system for Unit 2 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 2 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 2 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 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. 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 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 2 (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 2 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 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.

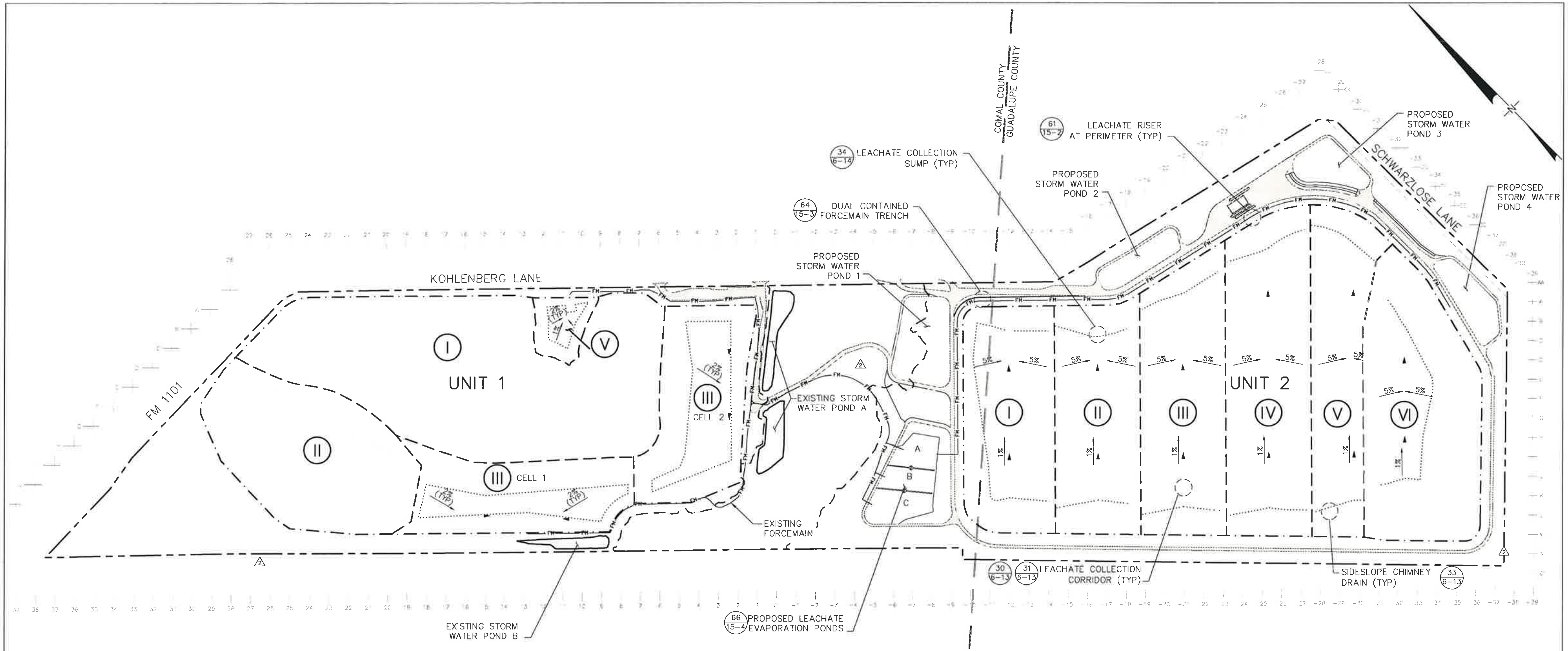
5. LEACHATE AND CONTAMINATED WATER STORAGE

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. 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 1. 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
- FM — FM LEACHATE FORCEMAIN
- SIDESLOPE CHIMNEY DRAIN
- PHASE BOUNDARY
- (I) 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.

STATE OF TEXAS
SCOTT M. GRAVES
86557
LICENSED
PROFESSIONAL ENGINEER

2/24/2021

FOR PERMIT PURPOSES ONLY

MARK	DATE	REVISION	BY	APPROVED
2	02/24/2021	ELIMINATE UNIT 3	JJV	SMG
1	08/08/2006	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:

WM WASTE MANAGEMENT

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

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: CONCEPTUAL LEACHATE MANAGEMENT SYSTEM PLAN

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

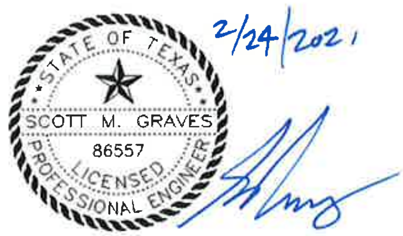
ATTACHMENT 15G

LEACHATE COLLECTION PIPE AND RISER PIPE STRENGTH DESIGN

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

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

LEACHATE COLLECTION PIPE AND RISER PIPE STRENGTH DESIGN



FOR PERMIT PURPOSES ONLY.
SEALED FOR CALCULATION PAGES 15G-1 THROUGH 15G-18.

INTRODUCTION

The purpose of this analysis is to evaluate the ability of the leachate collection and riser pipes for Unit 2 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 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:

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

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.

Wall Buckling

Wall buckling (a longitudinal wrinkling in the pipe wall) can occur when the external vertical pressure exceeds the critical buckling pressure of the pipe/bedding aggregate system. The factor of safety against pipe wall buckling may be calculated using the following equation:

$$FS_{wb} = \frac{1.2}{\sigma_{max}}\left[\frac{E'E}{(SDR)^3}\right]^{1/2} \qquad \text{(Eqn. 3)}$$

where:

FS_{wb} = factor of safety against pipe wall buckling;
σ_{max} = maximum stress applied to the pipe, psi;
E' = f (E_s, ν, k) = modulus of soil reaction for pipe bedding material, psi;
E = modulus of elasticity of the pipe material, psi; and
SDR = standard dimension ratio of the pipe.

The modulus of soil reaction, E′, for pipe bedding is a representative parameter of soil stiffness, which is related to the overburden stress. The modulus of soil reaction is calculated using the Young's modulus of the pipe bedding material (E_s), Poisson's ratio of the pipe bedding material (ν), and an empirical factor (k) based on test data.

The following equation was used to calculate the constrained modulus of the bedding material:

$$M_s = \frac{E_s(1-\nu)}{(1+\nu)(1-2\nu)} \qquad \text{(Eqn. 4)}$$

where:

M_s = constrained modulus, psi;
E_s = Young's modulus, psi; and
ν = Poisson's ratio.

The Young's modulus and Poisson's ratio were taken from data presented by Selig (1990) for soils at various overburden stress levels. For the leachate collection pipe analysis, the Young's modulus and Poisson's ratio values are based on a gravel bedding material (i.e., having a classification of GW or GP as defined by the Unified Soil Classification System (USCS)) compacted to 85 percent ASTM D698 at a stress level of 60 psi, the highest stress considered in the Selig (1990) table (Table 1). It is assumed that this material will be an AASHTO No. 57 stone or similar material. The calculations for the riser pipe assume two options for the bedding material: (1) a well-graded sand or gravel (having a USCS classification of SP, SW, GP, or GW) compacted to 85 percent ASTM D698 at a stress level of 60 psi; or (2) a clayey soil (having a USCS classification of CL) compacted to 85 percent ASTM D698 at a stress level of 60 psi. It is noted that the maximum applied stress on the pipes are higher than 60 psi, as shown in the calculations below. It is therefore anticipated that the constrained modulus will be even higher than the values calculated for a stress level of 60 psi.

The modulus of soil reaction can then be calculated based on the constrained modulus of the bedding material (M_s) and an empirically derived factor (k).

$$E' = k \times M_s \qquad \text{(Eqn. 5)}$$

where:

E' = modulus of soil reaction for pipe bedding material, psi;
k = empirically derived factor; and
M_s = constrained modulus, psi.

The value of k may vary form 0.7 to 2.3 (Selig, 1990). For the analysis herein, an average value of k = 1.5 is used.

Ring Deflection

Excessive ring deflection is a horizontal over-deflection of the pipe causing a reversal of curvature of the pipe wall. This can occur if large external vertical pressures are applied to the pipe/bedding aggregate system. Excessive ring deflection can also lead to substantial loss in flow capacity. Ring deflection is calculated using the Modified Iowa Equation (Mosher, 1990):

$$\Delta X = \frac{D_L K W_c}{\left(EI / r^3\right) + \left(0.061E'\right)} \qquad \text{(Eqn. 6)}$$

where:

ΔX = horizontal deflection or change in diameter, in.;
D_L = deflection lag factor;
K = bedding constant;
W_c = Marston's prism load per unit length of pipe, psi;
E = short-term modulus of elasticity of the pipe, psi;
E' = modulus of soil reaction for bedding material, psi;
I = moment of inertia of the pipe wall per unit length, in.^{4}/in.; and
r = mean radius of the pipe $\left[\frac{D_{od} - t}{2}\right]$, in.

For PVC pipe, Uni-Bell (1997) recommends a value of 7.5 percent as the allowable ring deflection. For non-pressure heavy wall HDPE pipe, CPChem (2002) does not recommend a specific "allowable deflection", but instead recommends the bending strain at the predicted deflection be calculated and compared to the allowable strain.

Bending Strain

When a pipe deflects under load, bending strains are induced in the pipe wall. Bending strain occurs in the pipe wall as external pressures are applied to the pipe/bedding aggregate system. Bending strain is calculated using the following equation (Mosher, 1990):

$$\varepsilon_b = f_d \times \frac{t \cdot \Delta y}{D^2} \qquad \text{(Eqn. 7)}$$

where:

ε_b = bending strain, percent;
f_d = deformation shape factor (CPChem, 2002) recommends a value of 6 for elliptical cross-sections);
t = minimum wall thickness, in.;
Δy = vertical deflection, in.; and
D = mean pipe diameter, in.

The following are recommendations for allowable bending strain from the literature and manufacturers:

- an allowable bending strain of 5 percent is recommended in Wilson-Fahmy and Koerner (1994), based on ASSHTO guidelines for long term use of smooth polyethylene pipes;
- an allowable bending strain of 4.2 percent is recommended as conservative in CPChem (2002) [it is noted that strains up to 8 percent are reported in literature as acceptable for a design period of 50 years]; and
- an allowable bending strain of 3.5 percent is recommended for PVC pipe in US Army Corps of Engineers (1997).

Based on the above information, an allowable strain of 5 percent is selected for HDPE pipe.

CALCULATIONS

6"ϕ SDR 11 HDPE Leachate Collection Pipe

σ_y = compressive yield strength of the pipe = 216,000 psf (Phillips 66, 1991)
B_c = nominal outer diameter = 6.625 in. (CPChem, 2002)
t = minimum wall thickness = 0.602 in. (CPChem, 2002)
B_i = average inner diameter = 5.349 in. (CPChem, 2002)

Post-Closure Stress Condition:

γ_p = 68 pcf (average unit weight of overburden material and waste, based on Appendix 15C-I in Attachment 15C)

D_p = 190 ft (depth of overburden material)

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

σ_{max} = 68 pcf * 190 ft

σ_{max} = 12,920 psf = 90 psi

Wall Crushing:

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

σ_{max} = 12,920 psf

SDR = standard dimension ratio of the pipe = 11

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

FS_{wc} = 2 * 216,000 psf / (11 – 1) / 12,920 psf

$\mathbf{FS_{wc} = 3.3}$

Wall Buckling:

σ_{max} = 12,920 psf = 90 psi

From Table 1, for gravel 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' = 9,013 psi

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

$S_A = (SDR - 1)\ \sigma_{max} /2$

S_A = (11 – 1) 12,920 psf /2

S_A = 64,600 psf = 448.6 psi

From Fig. 1, at S_A = 449 psi, E = modulus of elasticity of the pipe material = 20,000 psi at 50 years.

SDR = standard dimension ratio of the pipe = 11

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

FS_{WB} = 1.2/90 psi [9,013 psi * 20,000 psi / $(11)^3]^{0.5}$

$\mathbf{FS_{WB} = 4.9}$

Ring Deflection:

Written by:	Partha Sharma/ Lorenzo Peve	Date:	05 21 /09 /01 02 /08 (YY MM DD)	Reviewed by:	Beth Gross/ S. Graves	Date:	05 21 /09 /02 /14 /24 (YY MM DD)
Client:	WMTX	Project:	Mesquite Creek Landfill	Project/Proposal No.:	GT3454	Task No:	4

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

Input parameters:

D_L	1.25	
K	0.11	
W_c	594	lb/in.
γ_{avg}	68	pcf
d_c	190	ft
E	20,000	psi
E'	9013	psi
Pipe/HDPE:		
SDR	11	
D_{od}	6.625	in.
I	0.01818	$in.^4/in.$
t_{min}	0.602	in.
r_{mean}	3.01	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 (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; Table 2], 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.
$\Delta X\%$ = the ring deflection, %.
= $100(\Delta X/D_{od})$

Change in diameter, ΔX = 0.145 in.

Ring deflection, $\Delta X\%$ = 2.19 %

Allowable ring deflection, $\Delta X\%$: 3.0% - [CPChem, 2002]

Bending Strain:

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

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

t	0.602	in.
Δy	0.145	in.
D	6.02	in.

Bending strain, ε_b = 1.45 %

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

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 = 63.4 pcf (average unit weight of overburden material and waste based on Appendix 15C-I in Attachment 15C)
D_p = 147 ft
$\sigma_{max} = \gamma_p * D_p$
$\sigma_{max} =$ 63.4 pcf * 147 ft
$\sigma_{max} =$ 9,320 psf = 65 psi

Wall Crushing:

σ_y = compressive yield strength of the pipe = 216,000 psf [Phillips 66, 1991]
σ_{max} = 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) / 9,320 psf
FS_{wc} = 2.9

Wall Buckling (Granular Bedding Material Option):

$\sigma_{max} =$ 9,320 psf = 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) 9,320 psf /2
S_A = 74,560 psf = 518 psi
From Fig. 1, at S_A = 518 psi, E = modulus of elasticity of the pipe material = 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} = 1.2/65 psi [9,013 psi * 18,850 psi / $(17)^3]^{0.5}$
FS_{WB} = 3.4

Wall Buckling (Clayey Bedding Material Option):

σ_{max} = 9,320 psf = 65 psi
From Table 1, for clayey soil at 85% D698 at 60 psi stress level:
E_s = 800 psi
ν = 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) 9,320 psf /2
S_A = 46,600 psf = 324 psi
From Fig. 1, at S_A = 324 psi, E = modulus of elasticity of the pipe material = 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} = 1.2/65 psi [2571 psi * 23,850 psi / $(11)^3]^{0.5}$
FS_{WB} = 4.0

Ring Deflection, Granular Bedding Material:

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

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

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.
$\Delta X\%$ = the ring deflection, %.
= $100(\Delta X/D_{od})$

Change in diameter, ΔX = 0.29 in.

Ring deflection, $\Delta X\%$ = 1.61 %

Allowable ring deflection, $\Delta X\%$: 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	0.290	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:

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

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

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

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.
$\Delta X\%$ = the ring deflection, %.
= 100($\Delta X/D_{od}$)

Change in diameter, ΔX = 0.93 in.

Ring deflection, $\Delta X\%$ = 5.15 %

Allowable ring deflection, $\Delta X\%$: 7.5% - [CPChem, 2002]

Bending Strain, Clayey 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	1.636	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]

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

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

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

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

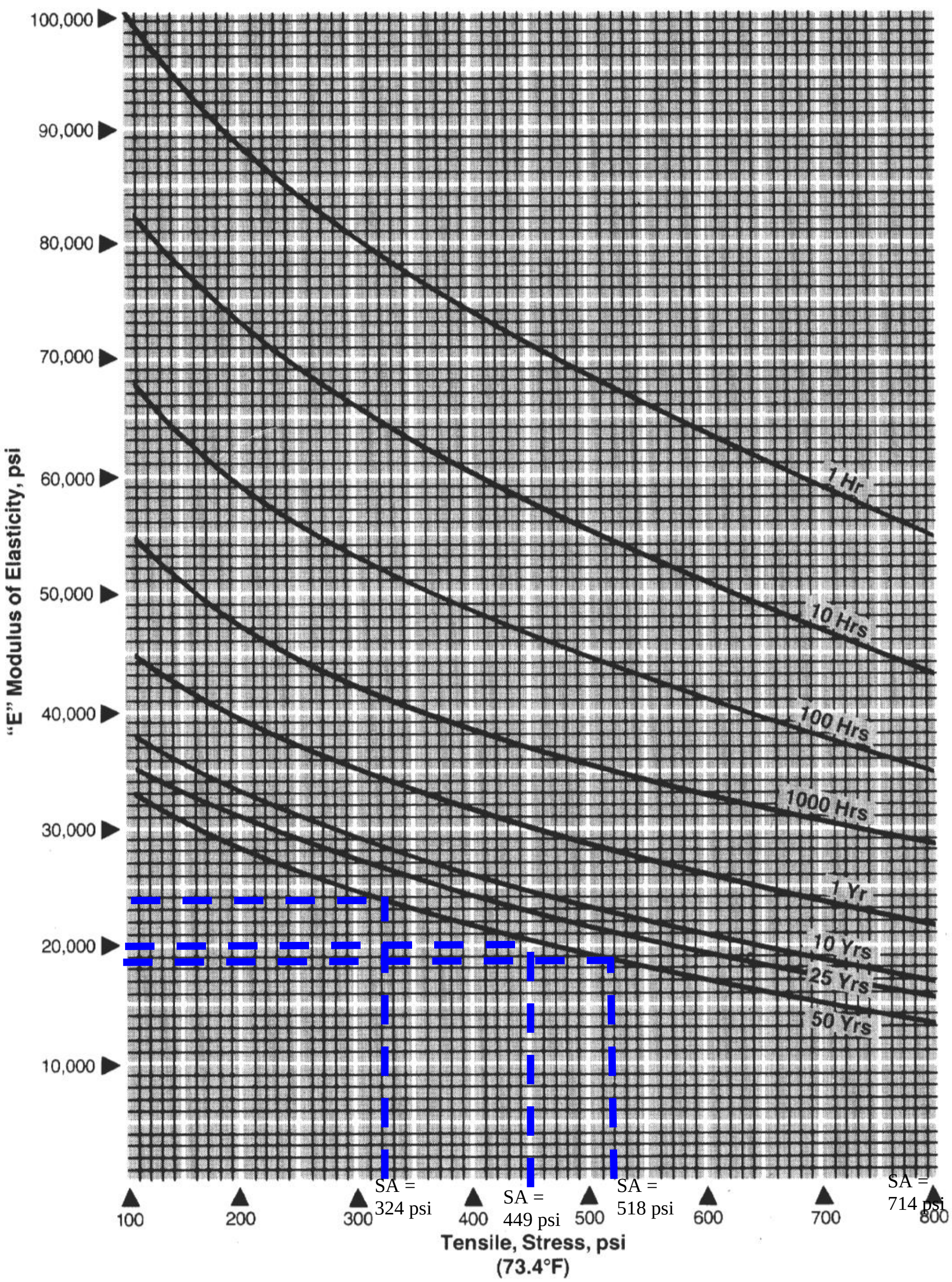


Figure 1. Time Dependent Modulus of Elasticity for Polyethylene Pipe (from Phillips 66, 1991)

ATTACHMENT 5

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